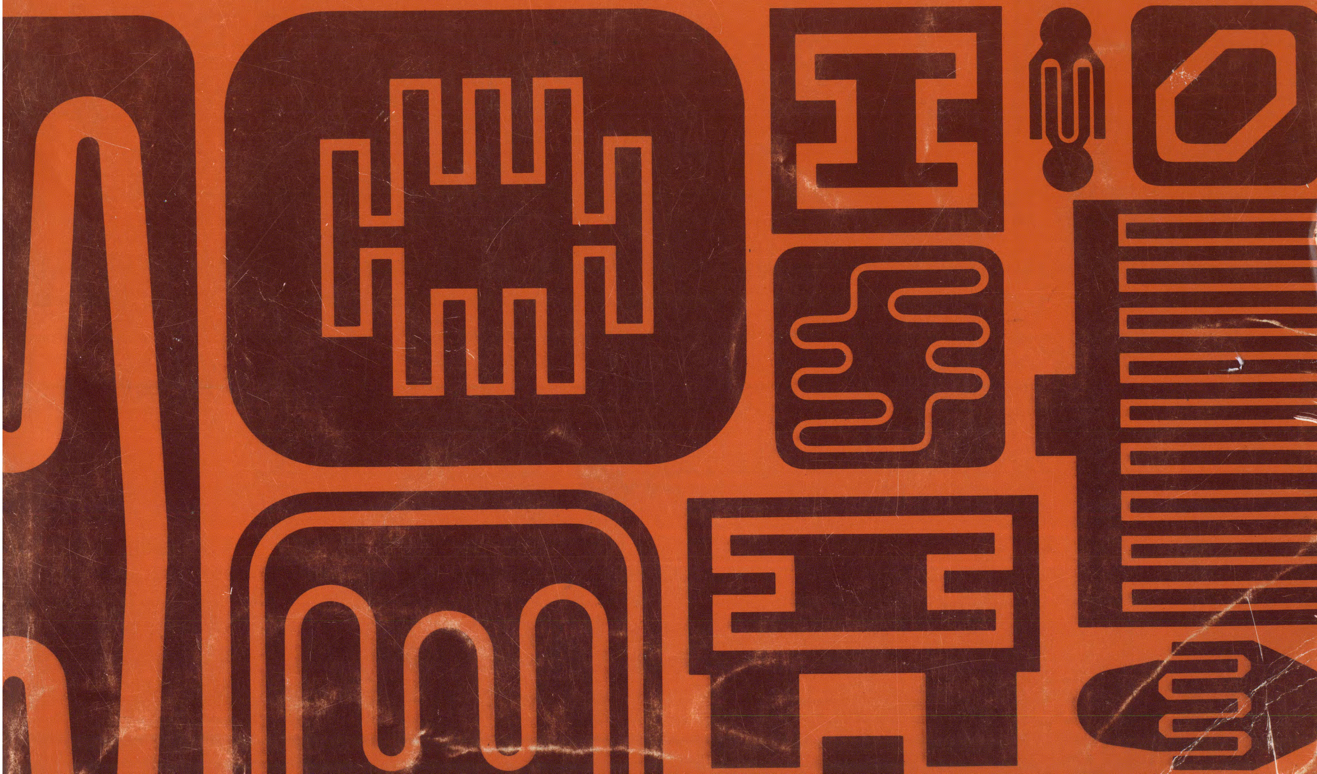
TRANSISTORS

SMALL SIGNAL
FIELD EFFECT
POWER

National



Introduction

This is National Semiconductor's latest handbook on discrete semiconductor devices. You will notice that the company has added more than 350 transistor part numbers and three product families since publication of the last handbook in 1971. Many of these new products already have been widely acclaimed by users.

So, in addition to small signal and bipolar field effect transistors that have been the mainstay of our catalog, you will now find sections for multiple bipolar and multiple field effect transistors and the latest family – power transistors. More part numbers will be added as market needs expand.

To keep current on all new National transistors please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

How to Use This Catalog

Find the basic transistor type number in the Standard Parts Listing which begins on page v. This will reference a page number for the particular Specification sheet.

The Process Number for the device will be found in the extreme right-hand column of the Specification sheet. Process Characteristic sheets are arranged in numerical order and that section begins on page 77.

Refer to the Package Outlines beginning on page 216 for complete physical dimensions of all packages. Note that the numbers in parenthesis behind the case style numbers refer to NS internal package codes.

Process Characteristic sheets contain complete design/application data and limit information. Critical package parameters will be indicated in the "Notes" column of the Process Characteristic sheets.

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Transistor Standard Parts List

*Also See Page 49

*Also See Page 50

*Also See Page 48

*Also See Page 54

MIL-STD Qualifications

MIL-STD-19500 qualifications

Type	Detail Spec.	Qualification JAN	TX	TXV	File or Approval No.	Date of Approval	Approving Agency	Part Included on MIL-STD-701
2N706		X						
2N760A	218	X			19500-1069-68	3/4/69	DESC	X
2N918	301	X	X	X	19500-1162-67	2/21/68	DESC	X
2N929	253	X	X	X	6724	4/9/65	DESC	
2N930	253	X	X	X	6725	4/9/65	DESC	X
2N2218	251	X	X	X	6935	10/6/67	DESC	X
2N2218A	251	X	X	X	6921	10/6/67	DESC	X
2N2219	251	X	X	X	6936	10/6/67	DESC	X
2N2219A	251	X	X	X	6922	10/6/67	DESC	X
2N2221	255	X	X	X	6937	10/9/67	DESC	X
2N2221A	255	X	X	X	6923	10/9/67	DESC	X
2N2222	255	X	X	X	6938	10/9/67	DESC	X
2N2222A	255	X	X	X	6924	10/9/67	DESC	X
2N2369A	317	X	X	X	19500-161-68	4/25/68	DESC	X
2N2604	354	X			7066	10/27/66	AMSES	X
2N2605	354	X			7067	10/27/66	AMSES	X
2N2904	290	X	X	X	6939	10/17/67	DESC	X
2N2904A	290	X	X	X	6940	10/17/67	DESC	X
2N2905	290	X	X	X	6941	10/17/67	DESC	X
2N2905A	290	X	X	X	6942	10/17/67	DESC	X
2N2906	291	X	X	X	6943	10/17/67	DESC	X
2N2906A	291	X	X	X	6944	10/17/67	DESC	X
2N2907	291	X	X	X	6945	10/17/67	DESC	X
2N2907A	291	X	X	X	2946	10/17/67	DESC	X
2N2920	355	X	X	X	7124	1/5/67	DESC	X
2N3019	391	X	X	X	19500-356-68	5/19/69	DESC	X
2N3250A	323A	X	X	X	19500-1204-69	6/19/70	DESC	
2N3251A	323A	X	X	X	19500-1204-69	6/19/70	DESC	
2N3810	366	X	X	X	19500-1065-68	5/28/69	DESC	X
2N3811	366	X	X	X	19500-1065-68	5/28/69	DESC	X

JAN TX, TXV, NX and NXV processing

The 100% reliability pre-conditioning on JAN TX parts (vs. no pre-conditioning of JAN parts) has resulted in a significant improvement in field reported failure rates.

National Semiconductor also offers JAN TXV types (JAN TX with 100% preseal visual inspection per MIL-STD-750 Method 2072) per the above list.

All hermetically sealed transistors in this catalog (where JAN TX or JAN TXV specifications do not exist) are available with TX and TXV type 100% processing as NX and NXV types respectively; e.g., NX2N4033 is 2N4033 processed per the flow plans on this page.

Production Process

- Raw Material
- Factory Processing
Visual Inspection per GWS 1000*
- Inspection Lot Formed at Final Assembly Operation

100% Process Conditioning

- Preseal Visual MIL-STD-750, Method 2072 (Note 1)
- High Temp. Storage
24 Hr. 200°C
- Temp. Cycling
10 Cycles −65°C to 200°C
Min. of 15 min. in each Extreme
- Reverse Bias Burn-In
VCB per Spec (PNP only)
12 hr. 175°C (Note 2)
- Acceleration
Y_1 orientation
20,000 G min.
- Fine + Gross Hermetic Seal Tests per spec

100% Burn-In (Note 3)

- Measurement of specified parameters per spec.
- 168 hr. Operating Life at Max. rated conditions
- Measurement of Parameters to determine delta per spec

Inspection Test to Verify LTPD

- Group A – Electrical Test per Spec
- Group B
  1. Environmental Testing
  2. High Temp. Life
  3. Steady State Operation Life
- Group C per Spec

*Patterned after Visual Criteria of MIL-STD-883.

Note 1: JAN TXV types only.

Note 2: Reverse Bias Burn-in restricted to PNP devices only on current JAN TX specs.

Note 3: JAN TX and JAN TXV types only.

JFET Application Guide

National Semiconductor manufactures a broad line of silicon Junction Field Effect Transistors (JFETs). National's JFETs provide excellent performance in many areas such as RF amplifiers, analog switching, low input current amplifiers, low noise high impedance amplifiers and outstanding matched duals for operational amplifiers input applications.

The following chart is a guide to enable the user to determine what parameters are important in each application.

APPLICATIONS AND THEIR PARAMETERS
LISTED IN APPROXIMATE ORDER OF IMPORTANCE

LOW FREQUENCY AMPLIFIER	LOW NOISE AMPLIFIER	HIGH FREQUENCY AMPLIFIER	DIFFERENTIAL AMPLIFIER	ANALOG SWITCHING	DIGITAL SWITCHING
Y_{fs}	e_n and i_n	$Re(Y_{fs})$	$\lvert V_{GS1} - V_{GS2} \rvert$	$R_{DS(ON)}$	$R_{DS(ON)}$
I_{DSS}	NF	$Re(Y_{is})$	$\frac{\Delta \lvert V_{GS1} - V_{GS2} \rvert}{\Delta T}$	$I_{D(OFF)}$	$V_{GS(OFF)}$
$V_{GS(OFF)}$	Y_{fs}	NF	$\lvert I_{G1} - I_{G2} \rvert$	C_{iss}	$t_{on} + t_{off}$
C_{iss}	I_{DSS}	C_{rss}	I_G	C_{rss}	C_{iss}
C_{rss}	$V_{GS(OFF)}$	$Re(Y_{os})$	Y_{fs}	$V_{GS(OFF)}$	C_{rss}
		I_{DSS}	Y_{fs1}/Y_{fs2}		
		$V_{GS(OFF)}$	$\lvert Y_{os1} - Y_{os2} \rvert$		

For any particular JFET product type, $V_{GS(OFF)}$, $Y_{fs(o)}$ and I_{DSS} can be used to calculate circuit bias conditions and gain within reasonable accuracy. For instance, if $V_{GS(OFF)}$ and I_{DSS} are known, $Y_{fs(o)}$ (Y_{fs} at zero gate source voltage) can be calculated. The actual devices will deviate slightly from the theoretical formulae listed below.

FORMULAE USED TO ENABLE CALCULATION OF PARAMETERS
FORM DATA SHEET INFORMATION

$$I_D = I_{DSS}\left(1 - \frac{V_G}{V_{GS(OFF)}}\right)^2$$
– Variation of drain current with gate bias.

$$Y_{fs} = Y_{fs(o)}\left(1 - \frac{V_G}{V_{GS(OFF)}}\right)$$
– Variation of g_m with gate bias.

$$Y_{fs}^2 = \frac{Y_{fs}^2}{I_{DSS}} I_D$$
– Variation of g_m with drain current.

$$V_{GS(OFF)} = \frac{2\,I_{DSS}}{Y_{fs(o)}}$$
– Pinch-off voltage in terms of I_{DSS} and g_{mo}.

$$V_{GS(OFF)} = 1.46V_G \text{ @ } I_D = 0.1\,I_{DSS}$$
– Pinch-off voltage in terms of V_G at a drain current of $\frac{1}{10}I_{DSS}$.

$$I_D = V_{DS}^2 \frac{I_{DSS}}{V_{GS(OFF)}^2}$$
– Focus of point where the triode (VVR) region ends and linear region starts.

$$R_{DS} \cong \frac{K\,V_{GS(OFF)}^2}{I_{DSS}(V_{GS(OFF)} - V_G)}$$
– Variation of drain resistance in the triode region in terms of I_{DSS} and Vp with gate bias.

$K = 0.5 - 0.9$

Bipolar Transistor and FET Dice

DICE

Standard types from National's transistor families are available in unencapsulated die form for use in hybrid circuits.

FEATURES

- 100% probed and guaranteed to 10% LTPD for key 2N parameters.
  a. BV_{CBO}, BV_{CEO}, BV_{EBO} and h_{FE} for bipolar transistors.
  b. BV_{GSS}, I_{DSS}, I_{GSS}*, R_{ON}*, Y_{fs}, $V_{GS(off)}$ for FET's.
- Minimum 60% yield to all unprobed 2N parameters.
- 100% visual inspection guaranteed to 10% LTPD for criteria equivalent to MIL-STD-883 Method 2010.
- Gold backing on all types.
- Shipment in waffle carriers.
- Die geometries shown in process section of catalog. Base Pad is identified by adjacent metalized circle on all interdigitated geometries. (e.g. see Process 21)

STANDARD TYPES (see index for page listing specification)

BIPOLAR TRANSISTOR DICE		FETs	
2N915	2N3250A	2N3684	2N4340
2N918	2N3251	2N3685	2N4341
2N929	2N3251A	2N3686	2N4391
2N930	2N3467	2N3687	2N4392
2N2219, 2222	2N3468	2N3821	2N4393
2N2219A, 2222A	2N3564	2N3822	2N4416
2N2218, 2221	2N3565	2N3823	2N4416A
2N2218A, 2221A	2N3568	2N3824	2N4856
2N2369A	2N3569	2N3921	2N4857
2N2484	2N3638A	2N3954	2N4858
2N2605	2N3640	2N4091	2N4859
2N2880	2N3646	2N4092	2N4860
2N2890	2N3694	2N4093	2N4861
2N2891	2N3724	2N4117	2N5163
2N2894	2N3725	2N4118	2N5196
2N2894A	2N3903	2N4119	2N5432
2N2904, 2906	2N3904	2N4338	2N5433
2N2904A, 2906A	2N3905	2N4339	2N5434
2N2905, 2N2907	2N3906		
2N2905A, 2907A	2N4030		
2N3014	2N4033		
2N3019	2N4208		
2N3020	2N4209		
2N3250			

Information on alternative specifications and packaging methods available on request.

***FET NOTE:**

Leakages (I_{GSS})	≤100PA	10% AQL
$RDS_{(ON)}$	≤10Ω	10% AQL

NPN Transistors

SATURATED SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N706	TO-18	25	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10	75		9	21
JAN2N706	TO-18	25	15	5	100	15	30	120	10	1	0.5	0.7	0.9	10	6	200	700	10	75		9	21
							20		1	1												
							10		.1	1												
2N708	TO-52	40	15	5	25	20	30	120	10	1	0.4	0.72	0.8	10	6	300		10				22
2N744	TO-18	20	12	5	1.0 μA	20	20		1.0	0.25		0.65	0.85	10	5	282		10	24			21
							40	120	10	0.35			1.5	100								
							20		100	1												
2N753	TO-18	25	15	5			40	120	10	1	0.6		0.9	10	5	200		10				21
2N834	TO-18	40		5	500	20	25		10	1	0.25		0.9	10	4	350		10	75			21
2N2369	TO-18	40	15	4.5	400	20	40	120	10	1	0.25	0.7	0.85	10	4	500		10	18		1	21
							20		100	2												
2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.2	0.7	0.85	10	4	500		10	18		1	21
							20		100	1	0.5		1.6	100								
JAN2N2369A	TO-18	40	15	4.5	30	20	40	120	10	0.35	0.2	0.7	0.85	10	4	500		10	18		1	21
							30	120	30	0.4	0.25		1.15	30								
							40	120	10	1	0.5		1.6	100								
							20	120	100	1												
JANTX2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.30	0.7	0.85	10	4	500		10	18		1	21
							40	120	10	1	0.25		1.15	30								
							30	120	30	0.4	0.50		1.6	100								
							20	120	100	1												
JANTXV2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.30	0.7	0.85	10	4	500		10	18		1	21
							40	120	10	1	0.25		1.15	30								
							30	120	30	0.4	0.50		1.6	100								
							20	120	100	1												
2N3009	TO-52	40	15	4	500 I_{CES}	20	30	120	30	0.4	0.18	0.75	0.95	30	5	350		30	25		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
2N3011	TO-18	30	12	5			30	120	10	0.35	0.2	0.72	0.87	10	4	400		20	20		5	21
							12		100	1	0.5		1.6	100								
2N3013	TO-52	40	15	4	300 I_{CES}	20	30	120	30	0.4	0.18	0.75	0.95	30	5	350		30	25		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								

Test Conditions:

1. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1.5 mA
2. I_C = 300 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 30 mA
3. I_C = 500 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 50 mA
4. I_C = 500 mA, V_{CC} = 30V, I_{B1} = I_{B2} = 50 mA
5. V_{CC} = 10V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
6. I_C = 1A, V_{CC} = 30V, I_{B1} = I_{B2} = 100 mA
7. V_{CC} = 3V, I_C = 10 mA, I_{B1} = I_{B2} = 3.3 mA
8. I_C = 10 mA, V_{CC} = 3V, I_{B1} = 3 mA, I_{B2} = 1.5 mA
9. V_{CC} = 3V, I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
10. V_{CC} = 2V, I_C = 30 mA, I_{B1} = 3 mA, I_{B2} = 3 mA
11. V_{CC} = 30V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
12. V_{CC} = 30V, I_C = 1A, I_{B1} = I_{B2} = 100 mA

($t = t_s + t_f$)

NPN Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3014	TO-52	40	20	5	300	20	30	120	30	0.4	0.18		0.8	10	5	350		30	25		10	28
					I_{CES}		25		10	0.4	0.18		0.95	30								
							25		100	1	0.35		1.2	100								
2N3015	TO-5 (Lo-Profile)	60	30	5	200	30	30	120	150	10	0.4		1.2	150	8	250		50	60		2	25
					I_{CES}		10		300	0.7	1.0		1.6	500								
2N3252	TO-5 (Lo-Profile)	60	30	5	500	40	30		150	1	0.3		1.0	150	12	200		10	70†		4	25
							30	90	500	1	0.5	0.7	1.3	500								
							25		1A	5	1.0		1.8	100								
2N3253	TO-5 (Lo-Profile)	75	40	5	500	60	25		150	1	0.35		1.0	150	12	175		50	70†		4	25
							25	75	375	1	0.6		0.7	500								
							20		750	5	1.2		1.8	1A								
2N3444	TO-5 (Lo-Profile)	80	50	5	500	60	20		150	1	0.35		1.0	150	12	150		50	70†		4	25
							20	60	500	1	0.6	0.7	1.3	500								
							15		1A	5	1.2		1.8	1A								
2N3605	TO-92(74)		14		500	18	30		10	1.0	0.25		0.85	10	6	300		10	45		9	21
2N3606	TO-92(74)		14		500	18	30		10	1.0	0.25		0.85	10	6	300		10	60		9	21
2N3607	TO-92(74)		14		500	18	30		10	1.0	0.25		0.85	10	6	300		10	70		9	21
2N3646	TO-106	40	15	5	500	20	30	120	30	0.4	0.2	0.75	0.95	30	5	350		30	28		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
2N3722	TO-5 (Lo-Profile)	80	60	6	500	40	25		10	1	0.25		0.75	10	10	300		50	100		4	24
					I_{CES}		40	150	100	1	0.22		0.85	100								
							20		300	2	0.37		1.1	300								
							15		500	2	0.5	0.86	1.2	500								
							12		800	5	2		1.5	800								
2N3723	TO-5 (Lo-Profile)	100	80	6	500	50	25		10	1	0.25		0.75	10	9	300		50	130		4	24
					I_{CES}		40	150	100	1	0.28		0.85	100								
							15		300	2	0.44		1.1	300								
							15		500	3	0.75	0.86	1.2	500								
							12		800	5												
2N3724	TO-5 (Lo-Profile)	50	30	6	1.7 μA	40	60	150	100	1	0.2		0.86	100	12	300		50	60		4	25
							40		300	1	0.25		0.76	10								
							30		1A	5	0.32		1.1	300								
							30		10	1	0.42	0.9	1.2	500								
							25		800	2	0.65		1.5	800								
											0.75		1.7	1A								
2N3724A	TO-5 (Lo-Profile)	50	30	6	500	40	30		10	1	0.25		0.76	10	12	300		50	60		4	25
							60	150	100	1	0.2		0.86	100					50		6	
							40		300	1	0.32		1.1	300								
							35		500	1	0.42	0.9	1.2	500								
							30		800	2	0.65		1.3	800								
							30		1A	5	0.75	0.9	1.4	1A								
							25		1.5A	5												
2N3725	TO-5 (Lo-Profile)	80	50	6	1.7 μA	60	60	150	100	1	0.25		0.76	10	10	300		50	60		4	25
							40		300	1	0.4		1.1	300								
							35		500	1	0.52	0.9	1.2	500								
							30		10	1	0.8		1.5	800								
							20		800	2	0.95		1.7	1A								
							25		1A	5												

2N3725A	TO-5 (Lo-Profile)	80	50	6	500	60	30		10	1	0.25		0.76	10	10	300	50	60		4	25
							60	150	100	1	0.26		0.86	100				50		6	
							40		300	1	0.4		1.1	300							
							35		500	1	0.52	0.9	1.2	500							
							25		800	2	0.8		1.3	800							
							25		1A	5	0.9	0.9	1.4	1A							
							20		1.5A	5											
2N3734	TO-5 (Lo-Profile)	50	30	5			35		10	1	0.2		0.8	10	9	300	50	60		6	01
							40		150	1	0.3		1.0	150							
							35		500	1	0.5		1.2	500							
							30	120	1A	1.5	0.9	0.9	1.4	1A							
							30		1.5A	5											
2N4013	TO-18 (Solid)	50	30	6	1.7 μA	40	30		10	1	0.25		0.76	10	12	300	50	60		4	25
							60	150	100	1	0.2		0.86	100							
							40		300	1	0.32		1.1	300							
							35		500	1	0.42	0.9	1.2	500							
							25		800	2	0.65		1.5	800							
							30		1A	5	0.75		1.7	1A							
2N4014	TO-18 (Solid)	80	50	6	1.7 μA	60	30		10	1	0.25		0.76	10	10	300	50	60		4	25
							60	150	100	1	0.26		0.86	100							
							40		300	1	0.4		1.1	300							
							35		500	1	0.52	0.9	1.2	500							
							20		800	2	0.8		1.5	800							
							25		1A	5	0.95		1.7	1A							
2N4274	TO-106	30	12	4.5			35	120	10	1	0.2	0.72	0.85	10	4	400	10	12		7	21
							18		100	1	0.5		1.6	100							
2N4275	TO-106	40	15	4.5			30	120	10	1	0.2	0.72	0.85	10	4	400	10	12		7	21
							18		100	1	0.5		1.6	100							
2N5134	TO-106	20	10	3.5	400	15	20	150	10	1	0.25	0.7	0.9	10	4	250	10	18		7	21
							15		30	0.4											
2N5224	TO-92(72)	25	12	5	500	15	40	400	10	1.0	0.35		0.90	10	4	250	10	60†		8	21
							15		100	1.0											
2N6375	TO-18 (Solid)	75	40	6	200	40	60		10	1	0.25		0.8	100	10	300	50	20-40		11	01
							60		100	1	0.35	0.8	0.9	300				20-40		4	
							50		300	1	0.4	0.85	1	500				15-35		12	
							30	90	500	1	0.55	0.95	1.2	1A							
							20		1A	1											
2N6376	TO-5 (Lo-Profile)	75	40	6	200	40	60		10	1	0.25		0.8	100	10	300	50	20-40		11	01
							60		100	1	0.35	0.8	0.9	300				20-40		4	
							50		300	1	0.4	0.85	1	500				15-35		12	
							30	90	500	1	0.55	0.95	1.2	1A							
							20		1A	1											
EN706	TO-106	25	15	3	500	15	20		10	1	0.6		0.9	10	6	200	10				21
EN708	TO-106	40	15	5	50	20	30	120	10	1	0.4	0.72	0.85	10	6	300	10	75		9	22
							15		0.5	1											
EN744	TO-106	20	12	5	1.0 μA	20	20			0.25		0.65	0.85	10		290	10	24		8	21
							40	120		0.35			1.5	100							
							20			1											

Test Conditions:

1. $I_C = 10$ mA, $I_{B1} = 3$ mA, $I_{B2} = 1.5$ mA
2. $I_C = 300$ mA, $V_{CE} = 25V$, $I_{B1} = I_{B2} = 30$ mA
3. $I_C = 500$ mA, $V_{CE} = 25V$, $I_{B1} = I_{B2} = 50$ mA
4. $I_C = 500$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 50$ mA
5. $V_{CC} = 10V$, $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA
6. $I_C = 1A$, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 100$ mA
7. $V_{CC} = 3V$, $I_C = 10$ mA, $I_{B1} = I_{B2} = 3.3$ mA
8. $I_C = 10$ mA, $V_{CC} = 3V$, $I_{B1} = 3$ mA, $I_{B2} = 1.5$ mA
9. $V_{CC} = 3V$, $I_C = 10$ mA, $I_{B1} = 3$ mA, $I_{B2} = 1$ mA
10. $V_{CC} = 2V$, $I_C = 30$ mA, $I_{B1} = 3$ mA, $I_{B2} = 3$ mA
11. $V_{CC} = 30V$, $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA
12. $V_{CC} = 30V$, $I_C = 1A$, $I_{B1} = I_{B2} = 100$ mA

(† = $t_s + t_f$)

NPN Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
EN2369A	TO-106	40	15	4.5	400	20	40		10	0.35	0.2	0.7	0.85	10	4	500		10	18		8	21
					I_{CES}		30		30	0.4	0.25		1.15	30								
							20		100	1	0.5		1.6	100								
MPS706	TO-92(72)	15	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10	75		8	21
MPS834	TO-92(72)	40		5	500	20	25		10	1	0.25		0.9	10	4	350		10	30		9	21
											0.4			50								
MPS2369	TO-92(72)	40	15	4.5	400	20	40	120	10	1	0.25	0.7	0.85	10	4	500		10	18		8	21
							20		100	2												
MPS2713	TO-92(72)	18	15	5	500	18	30	90	2	4.5	0.3		1.3	50								21
MPS2714	TO-92(72)				500	18	75	225	2	4.5	0.3	0.6	1.3	50								21
MPS3646	TO-92(72)	40	15	5			30	120	30	0.4	0.2	0.75	0.95	30	5	350		30	28		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								

Test Conditions:

1. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1.5 mA
2. I_C = 300 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 30 mA
3. I_C = 500 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 50 mA
4. I_C = 500 mA, V_{CC} = 30V, I_{B1} = I_{B2} = 50 mA
5. V_{CC} = 10V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
6. I_C = 1A, V_{CC} = 30V, I_{B1} = I_{B2} = 100 mA
7. V_{CC} = 3V, I_C = 10 mA, I_{B1} = I_{B2} = 3.3 mA
8. I_C = 10 mA, V_{CC} = 3V, I_{B1} = 3 mA, I_{B2} = 1.5 mA
9. V_{CC} = 3V, I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
10. V_{CC} = 2V, I_C = 30 mA, I_{B1} = 3 mA, I_{B2} = 3 mA
11. V_{CC} = 30V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
12. V_{CC} = 30V, I_C = 1A, I_{B1} = I_{B2} = 100 mA

($t = t_s + t_f$)

NPN Transistors

RF-IF AMPS AND OSCILLATORS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{cb}/C_{re} (pF) Min	C_{cb}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
2N917	TO-72	30	15	3	1 μA	15	20		3	1	0.5		0.87	3		1.7¶	500		4	6	60	43
JAN2N918	TO-72	30	15	3	10	15	20		10	10	0.4		1	10		1.7¶	600		4	6	60	43
							10		0.5	10												
							20	200	3	1												
JANTX2N918	TO-72	30	15	3	10	15	10		0.5	10	0.4		1	10		1.7¶	600		4	6	60	43
							20		10	10												
JANTXV2N918	TO-72	30	15	3	10	15	10		0.5	10	0.4		1	10		1.7¶	500		4	6	60	43
							20		10	10												
2N3478	TO-72	30	15	2	20	1	25	150	2	8						1.0	750	1600	5	4.5	200	42
2N3563	TO-106	30	12	2	50	15	20	200	8	10						1.7¶	600	1500	8			43
2N3564	TO-106	30	15	4	50	15	20	500	15	10	0.3		0.97	20		3.5¶	400	1200	15			43
2N3600	TO-72	30	15	3	10	15	20	150	3	1						1.0	850	1500	2	4.5	200	42
																				3.0	60	
2N3693	TO-106	45	45	4	50	30	40	160	10	10						6¶	200		10			27
2N3694	TO-106	45	45	4	50	30	100	400	10	10						6¶	200		10			27
2N3932	TO-72	30	20	2.5	10	15	40	150	2	8						0.55	750	1600	2	4.5	200	42
2N3933	TO-72	40	30	2.5	10	15	60	200	2	8						0.55	750	1600	2	4	200	42
2N4134	TO-72	30	30	3	50	10	25	200	4	10	3.0		.92	10		.5¶	350	800	4	5.0	60	44
2N4135	TO-72	30	30	3	50	10	25	200	4	10	3.0		.92	10		.5¶	425	800	4			44
2N4259	TO-72	40	30	2.5	10	15	60	250	2	8						0.55	750	1600	1.5	5	450	42
2N4934	TO-72(28)	40	30	3	10	15	40	170	2	8						0.25§	700	1600	2	3.5	200	47
2N4935	TO-72(28)	50	40	3	10	15	60	200	2	8						0.25§	700	1600	2	3.6	200	47
2N4936	TO-72(28)	50	40	3	10	15	60	250	2	8						0.25§	700	1600	2	4.5	450	47
2N5130	TO-106	30	12	1	50	10	15	250	8	10	0.6		1	10		1.7¶	450		8			43
2N5132	TO-106	20	20	3	50	10	30	400	10	10	0.2		0.9	10		3.5¶	200		10			27
2N5179	TO-72	20	12	2.5	20	15	25	250	3	1	0.4		1	10		1.0	900	2000	5	4.5	200	42
2N5180	TO-72	30	15	2	500	8	20	200	2	8						1.0	650	1700	2			42
2N5181	TO-72(28)				20	1	27		1	6						0.32	400	1200	3			47
2N5182	TO-72(28)				30	1	27		1	6						0.34	400	1200	3			47
2N5222	TO-92(71)	20	15	2	100	10	20	1500	4	10	1		1.2	4		1.3	450		4			49
2N5770	TO-92	30	15	3	10	15	20		3	1	0.4		1	10		1.7	900		8	6	60	43
2SC313	TO-72	30	19	2	500	10	35	120	10	10	1			20		2¶	600					42
2SC454	TO-92(74)	30	30	5	500	18	60	320	2	12	1.1			10						25	1 KHz	46
													0.75	2		3.5¶						
2SC458	TO-92(74)	30	30	5	500	18	60	500	2	12	1.0			10						10	1 KHz	46
													0.75	2		3.5¶						
2SC460	TO-92(74)	30	30	5	500	18	35	200	2	12	1.1			10		3.5¶				6.5	1	46
													0.75	2								

¶ C_{ob} § Typical

NPN Transistors

RF-IF AMPS AND OSCILLATORS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{cb}/C_{re} (pF) Min	C_{cb}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
2SC461	TO-92(74)	30	30	5	500	18	35	200	2	12	1.1		 0.75	10 2		3.5¶						46
2SC463	TO-72	35	35	4	100	10	30	150	2	10						0.6	400		2	4	200	44
2SC464	TO-72	30	19	2	500	10	20 (1 KHz)		1	6	1			20		2.0¶	600		10			42
2SC466	TO-72	30	19	2	500	10	20 (1 KHz)		1	6	1			20		2.0¶	600		10			42
2SC535	TO-92(74)	30	20	4	500	10	35	200	1	6						1.2¶	450		1	5.5	100	42
2SC562	TO-72(28)	40	30	4			40		4	10						0.22						45
2SC563	TO-72(28)	40	25	4			38		7	10						0.23						47
2SC682	TO-72	20	20	3	100	10	20	200	2	10						0.6¶	400		2			44
2SC683	TO-72	20	20	3	100	10	20	200	2	10						0.6¶	400		2	4	200	44
2SC684	TO-92(74)	30	19	2	500	10	40		10	10	1			20		2.0¶	900		10			42
2SC717	TO-92(74)	30	19	2	500	10	40		1	6	1			20		2.0¶	600		10			42
40235	TO-72	45		4.5	20 1 µA	1 35	40	170	1	6						0.65				3.3§	216	42
40236	TO-72	45		4.5	20 1 µA	1 35	40	275	1	6						0.65						42
40237	TO-72	45		4.5	20 1 µA	1 35	27	275	1	6												42
40238	TO-72	45		4.5	20 1 µA	1 35	40	170	1	6												42
40239	TO-72	45		4.5	20 1 µA	1 35	27	100	1	6												42
40240	TO-72	45		4.5	20 1 µA	1 35	27	275	1	6												42
40242	TO-72	45	45	4.5	20	1	40	170	1	6						0.65¶				2.5§	100	42
40243	TO-72	45	45	4.5	20	1	40	170	1	6						0.65¶						42
40244	TO-72	45	45	4.5	20	1	27	170	1	6						0.8¶						42
40245	TO-72	45	45	4.5	20	1	70	275	1	6						0.65¶						42
40246	TO-72	45	45	4.5	20	1	27	90	1	6						0.65¶						42
40472	TO-72(28)	45		3	20 1 µA	1 45	40	170	1	6						0.19§				3.3§	200	47
40473	TO-72(28)	45		3	20 1 µA	1 45	40	275	1	6						0.19§						47
40474	TO-72(28)	45		3	20 1 µA	1 45	27	275	1	6												47
40475	TO-72(28)	45		3	20 1 µA	1 45	40	170	1	6						0.18§						47

40476	TO-72(28)	45		3	20 1 μA	1 45	27	100	1	6					0.18§						47
40477	TO-72(28)	45		3	20 1 μA	1 45	27	275	1	6					0.18§						47
40478	TO-72(28)	45	45	3	20	1	40	170	1	6					0.2§				2.5§	100	47
40479	TO-72(28)	45	45	3	20	1	40	170	1	6					0.2§						47
40480	TO-72(28)	45	45	3	20	1	27	275	1	6					0.2§						47
40481	TO-72(28)	45	45	3	20	1	70	275	1	6					0.2§						47
40482	TO-72(28)	45	45	3	20	1	27	90	1	6					0.2§						47
BF167	TO-72(28)	40	30	4			27		4	10					0.15§				3§	35	45
BF173	TO-72(28)	40	25	4			38		7	10			0.9	7							47
BF194	TO-92	30	20	5			66	210	1	10		0.65	0.74	1	0.95§				4§ 1.2§ 1.5§	100 1 0.2	46
BF195	TO-92	30	20	5			35	125	1	10		0.65	0.74	1	0.95§				3.5§ 4§	1 100	46
BF196	TO-92(71)	40	30	4			27		4	10			0.84	4					3§	35	45
BF197	TO-92(71)	40	25	4			38		7	10			0.9	7							47
BF198	TO-92(71)	40	30	4			27		4	10			0.85	4					3§	35	45
BF199	TO-92(71)	40	25	4			38		7	10			0.925	7					1.5§ 1.2§	0.2 1	47
BF233	TO-92(71)	30	20	5			35	120	1	10					0.85§				2.5§	1	49
CS9010	TO-105		20	3	50	18	16	200	1	5	0.7		1	20							46
CS9011	TO-106		18	3	50	18	29	280	1	5											27
CS9016	TO-106		20	3	50	18	29	146	1	5	3		1	10							44
CS9017	TO-106		18	3	50	18	40	198	1	5	2		0.9	10							27
CS9018	TO-106		12	2	50	15	29	198	1	5	0.6			10							43
CS9019	TO-72		20	3	50	18	16	280	1	5	3	1	1	10							44
EN918	TO-106	30	15	3	50	15	20		3	1	0.4		1	10	3¶	600		4	6	60	43
MPS918	TO-92	30	15	3	10	15	20		3	1	0.4		1	10	1.7¶ 3¶	600		4	6	60	43
MPS3563	TO-92	30	15	2	50	15	20	200	8	10					1.7¶	600	1500	8			43
MPS3693	TO-92	45	45	4	50	35	40	160	10	10					3.5¶	200		10	4	1	27
MPS3694	TO-92	45	45	4	50	35	100	400	10	10					3.5¶	200		10	4	1	27
MPS6507	TO-92	30 (V_{CES})	20		50	15	25		2	10					2.5¶	700		10			43
MPS6511	TO-92	30 (V_{CES})	20		50	15	25		2	10					2.5¶						43
MPS6540	TO-92(71)	30	30	4	100	25	25		2	10	0.5		0.95	10	0.65	350		2			49
MPS6542	TO-92(71)	30 (V_{CES})	20		50	15	25		2	10					1.5¶	700		10			47
MPS6543	TO-92(71)	35	25	3	100	25	25		4	10	0.35		0.95	10	1.0¶	750		4			47
MPS6544	TO-92(71)	60	45	4	500	35	20		30	10	0.5			30	0.65						49
MPS6546	TO-92(71)	35	25	3	1 μA	25	20		2	10	0.35			10	0.45	600		2			47
MPS6567	TO-92(71)		40	5	500	35	25		10	5	0.5		0.8	10	0.7						49
MPS6568A	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10	0.65	375	800	4	3.3	200	44
MPS6569	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10	0.5	300	800	10	6	45	44
MPS6570	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10	0.5	300	800	10	6	45	44

¶ C_{ob} § Typical

RF-IF AMPS AND OSCILLATORS (Cont.)

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	I_C (mA)	C_{cb}/C_{re} (pF) Min	C_{cb}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
MPSH10	TO-92(71)	30	25	3	100	25	60		4	10	0.5		0.95	4		0.7	650		4			42
MPSH11	TO-92(71)	30	25	3	100	25	60		4	10	0.5		0.95	4		0.7	650		4			47
MPSH19	TO-92(71)	30	25	3	100	15	46		4	10						0.65	300		4			47
MPSH20	TO-92(71)	40	30	4	50	15	25		4	10						0.65	400		4			49
MPSH30	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.65	300	800	4	6	45	44
MPSH31	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.65	300	800	4	6	45	44
MPSH32	TO-92(71)	40	30	4	50	10	27	200	4	5	3		1.2	10		0.22	300		4			45
MPSH37	TO-92(71)		40	5	500	35	25		5	10	0.5		 0.9	10 5		0.7	300		5			49
SE1001	TO-106	45	45	4	500	30	40	160	10	10						3.5¶	200		10			26
SE1002	TO-106	45	45	4	500	30	100	400	10	10						3.5¶	200		10			26
SE3001	TO-106	30	12	2	500	15	20		8	10	0.6			10		1.7¶	600		8	4	60	43
SE3002	TO-106	30	12	2	500	15	20		8	10	0.6			10		1.7¶	600		8	4	60	43
SE5020	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	375	800	4	3.3	200	44
SE5021	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	375	800	4	4.0	200	44
SE5022	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	300	800	4			44
SE5023	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	300	800	4	6.0	45	44
SE5024	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	300	800	4	6.0	45	44
SE5035	TO-72(28)	40	30	4	50	30	40	180	5	10						.30	600		5			47
SE5050	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	300		4	4	100	44
SE5051	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5	300		4	3.0†	100	44
SE5052	TO-72	20	20	3	50	10					3.0			10			375		4	4.0	200	44
SE5055	TO-72(28)	20	20	3	50	20	20	220	2	10	2.0			10		.22	300		2	5.0	200	45
ST3100	TO-92	30	30	3	200	30	30	225	5	10						0.85	500		5			47
ST5025	TO-92	30	30	3	50	30	20	100	10	10	.6			20	.6	1.1	300	700	10			46
ST5029	TO-92	30	30	3	200	30	30	225	5	10			0.85	5		0.4	500		5	6	45	47
ST5030	TO-92(71)	45	40	4.5	100	30	45	150	7	15	3.0		 .92	20 10	.25	.40	600		7			47
ST5031	TO-92	40	30	4	100	30	30	180	5	10	1			10		0.4	500		5	4.5	200	47
ST5055	TO-92(71)	20	20	3	50	20	20	220	2	10	2.0			10		.3	300		2	5.0	45	45

¶ = C_{ob} § = Typical

NPN Transistors

LOW LEVEL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} (1kc)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N760	TO-18	45	45	8	200	30	76	333*	1	5	1	0.6	1.1	10	8	50		1				07
2N760A	TO-18	60	60	8	100	30	76	333*	1	5	1	0.9	1.1	10	8	50		1				07
JAN2N760A	TO-18	75	60	8	10	30	76	333*	1	5	1	0.6	1.1	10	6	60		1		24	1	07
2N929	TO-18	45	45	4	10	45	40	120	0.01 μA	5	1	0.6	1.1	10	8	30		0.5		4	5	07
							60		0.5 μA	5												
								350	10	5												
JAN2N929	TO-18	60	45	6	10	45	40	120	0.01 μA	5	1	0.6	1.1	10	8	45	180	0.5		5	3	07
							60		0.5 μA	5										3	4	
								350	10	5										3	2	
JANTX2N929	TO-18	65	45	6	10	45	40	120	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							60		0.5	5										3	4	
								350	10	5										3	2	
JANTXV2N929	TO-18	65	45	6	10	45	40	120	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							60		0.05	5										3	4	
								350	10	5										3	2	
2N929A	TO-18	60	45	6	2	45	25		0.001	5	0.5	0.7	0.9	10	6	45		0.5		4	2	07
							40	120	0.01	5												
							60		0.5	5												
								350	10	5												
2N930	TO-18	45	45	5	10	45	100	300	0.01	5	1	0.6	1	10	8	30		0.5		3	5	07
							150		0.5	5												
								600	10	5												
JAN2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
JANTX2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
JANTXV2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
2N930A	TO-18	60	45	6	2	45	60		0.001	5	0.5	0.7	0.9	10	6	45		0.5		3	2	07
							100	300	0.01	5												
							150		0.5	5												
								600	10	5												
2N981	TO-18	80	80	8	1.0 μA	30	36	100*	1	5	3			10	5							07

Test Conditions:

1. $I_C = 1.0$ mA, $V_{CB} = 5V$, $R_G = 500\Omega$, f = 1 kHz
2. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, f = 10 kHz
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, f = 100 Hz
4. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, f = 1 kHz
5. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 15.7 kHz
6. $I_C = 5\ \mu A$, $V_{CE} = 5V$, $R_G = 50\ k\Omega$, f = 1 kHz
7. $I_C = 5\mu A$, $V_{CE} = 5V$, $R_G = 50\ k\Omega$, f = 10 kHz
8. $V_{CE} = 5V$, $I_C = 100\mu A$, $R_G = 10k\Omega$, W.B.
9. $V_{CE} = 5V$, $I_C = 30\mu A$, $R_G = 100k\Omega$, f = 1kHz
10. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_S = 22\ K\Omega$, W.B.
11. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_S = 10\ K\Omega$, f = 1 kHz
12. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 5\ K\Omega$, W.B.
13. $I_C = 100\ \mu A$, $V_{CE} = 4.5V$, $R_G = 5\ K\Omega$, W.B.

NPN Transistors

LOW LEVEL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2483	TO-18	60	60	6	10	45	40	120	0.01	5	0.35	0.5	0.7	1	6	60		0.5		4	4	07
							75		0.1	5										3	2	
							175		1	5										4	5	
2N2484	TO-18	60	60	6	10	45	100	500	0.01	5	0.35	0.5	0.7	1	6	60		0.5		3	4	07
							175		0.1	5										2	2	
							250		1	5										3	5	
2N2509	TO-18	125	80	7	5	100	25		0.01	5	1		0.9	5	6	45		5		7	4	07
							40		10	5												
2N2510	TO-18	100	65	7	5	80	75		0.01	5	1		0.9	5	6	45		5		4	4	07
							150	500	10	5												
2N2511	TO-18	80	50	7	5	60	80		0.001	5	1		0.9	5	6	45		5		4	4	07
							120		0.01	5												
							240	750	10	5												
2N2586	TO-18	60	45	6	2	45	80		0.001	5	0.5	0.7	0.9	10	7	45		0.5		3	4	07
							120	360	0.01	5										2	2	
							150		0.5	5												
								600	10	5												
2N3117	TO-18	60	60	6	10	45	250	500	0.01	5	0.35		0.7	1	8	60		0.5		1	6	07
							300		0.1	5										1	7	
							400		1	5												
2N3565	TO-106	30	25	6	50	25	150	600	1	10					4	40	240	1				07
2N3691	TO-106	35	20	4	50	15	40	160	10	1	0.7		0.9	10	3.5	200		10				23
2N3692	TO-106	35	20	4	50	15	100	400	10	1	0.7		0.9	10	3.5	200		10				23
2N3709	TO-92(74)		30		100	20	45	165	1	5	1			10								07
2N3877	TO-92(74)	70	70	4	500	70	20	250	2	4.5		0.5	0.9	10								07
2N3877A	TO-92(74)	85	85	4	500	70	20	250	2	4.5		0.5	0.9	10								07
2N3900A	TO-92(74)	18	18	5	100	18	250	500	2	4.5					12					5	13	07
2N4384	TO-18	40	30	5	10	30	60		0.001	5	0.2	0.65	0.8	10	8	30	120	0.5		2	5	07
							100	500	0.01	5												
							120		1	5												
							150		10	5												
2N4386	TO-18	40	30	5	10	30	40	500	0.01	5	0.2	0.65	0.8	10	8	30	120	0.5		3	5	07
							100		1	5												
							120		10	5												
2N4409	TO-92(72)	80	50	5	10	60	60		1	1	0.2		0.8	1.0	12	60	300	10				07
							60	400	10	1												
2N4410	TO-92(72)	120	80	5	10	100	60		1	1	0.2		0.8	1.0	12	60	300	10				07
							60	400	10	1												
2N4966	TO-106	50	40	6	25	25	40	200	0.01	5	0.4				6	40		1		6	4	07
							50		10	5												
2N4967	TO-106	50	40	6	25	25	100	600	0.01	5	0.4				6	40		1		6	4	07
							120		10	5												

2N4968	TO-106	30	25	6	50	25	40	200	0.01	5	0.4				6	40		1		6	4	07
							50		10	5												
2N5088	TO-92(72)	35	30		50	20	300	900	0.1	5	0.5			10	4					3	8	07
							350		1	5												
							300		10	5												
2N5089	TO-92(72)	35	30		50	15	400	120	0.1	5	0.5			10	4					3	8	07
							450		1	5												
							400		10	5												
2N5127	TO-106	20	12	3	50	10	15	300	2	10	0.3				3.5	150		2				07
2N5131	TO-106	20	15	3	50	10	30	500	10	10	1				6	100		10				27
2N5133	TO-106	20	18	3	50	15	60	1000	1	1	0.4				5	40	200	1				07
2N5209	TO-92(72)	50	50		50	35	100	300	0.1	5	0.7			10	4	30		0.5		3	10	07
							150		1	5										4	11	
							150		10	5												
2N5210	TO-92(72)	50	50		50	35	200	600	0.1	5	0.7			10	4	30		0.5		2	10	07
							250		1	5										3	11	
							250		10	5												
2N5232	TO-92(74)		50		30	50	250	500	2	5	0.125			10	4							07
2N5232A	TO-92(74)		50		30	50	250	500	2	5	0.125			10	4					5	12	07
EN930	TO-106	45	45	5	50	45	100	300	0.01	5	1.0	0.6	1	10	8	30		0.5		3	5	07
							150		0.5	5												
								600	10	5												
EN2484	TO-106	60	60	6	50	45	30		0.001	5	0.35	0.5	0.7	1	6	60		0.5		3	5	07
							100	500	0.01	5										3	4	
							175		0.1	5										2	2	
							200		0.5	5												
							250		1	5												
								800	10	5												
MPSA09	TO-92(72)	50	50		100	25	100	600	0.1	5	0.9			10		30		0.5				07
MPS3707	TO-92(74)	30	30	6	100	20	100	400	0.1	5	1			10						5	12	07
MPS3708	TO-92(74)	30	30	6	100	20	45	660	1	5	1			10								07
MPS3709	TO-92(74)	30	30	6	100	20	45	165	1	5	1			10								07
MPS3710	TO-92(74)	30	30	6	100	20	90	330	1	5	1			10								07
MPS3711	TO-92(74)	30	30	6	100	20	180	660	1	5	1			10								07
MPS6571	TO-92(74)	25	20	3	50	20	250	1000	0.1	5	0.5			10	4.5	50		0.5				07
SE4001	TO-106	30	25	6	200	5.0	60	300	1	10	0.35			1	4	40		1				07
SE4002	TO-106	30	25	6	200	5.0	200	1000	1	10	0.35			1	4	60		1				07
SE4010	TO-106	30	25	6	200	5.0	200	1000	1	10	0.35			1	4	20		0.05		3	9	07
																60		1				

Test Conditions:

1. I_C = 1.0 mA, V_{CB} = 5V, R_G = 500Ω, f = 1 kHz
2. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 10 kHz
3. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz
4. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz
5. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
6. I_C = 5 μA, V_{CE} = 5V, R_G = 50 kΩ, f = 1 kHz
7. I_C = 5μA, V_{CE} = 5V, R_G = 50 kΩ, f = 10 kHz
8. V_{CE} = 5V, I_C = 100μA, R_G = 10kΩ, W.B.
9. V_{CE} = 5V, I_C = 30μA, R_G = 100kΩ, f = 1kHz
10. I_C = 20 μA, V_{CE} = 5V, R_S = 22 KΩ, W.B.
11. I_C = 20 μA, V_{CE} = 5V, R_S = 10 KΩ, f = 1 kHz
12. I_C = 100 μA, V_{CE} = 5V, R_G = 5 KΩ, W.B.
13. I_C = 100 μA, V_{CE} = 4.5V, R_G = 5 KΩ, W.B.

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N697	TO-5	60	40	5	100	30	40	120	150	10	1.5		1.3	150	35	50		50				20
2N699	TO-39	120		5	2	60	40	120	150	10	5		1.3	150	20	50		50				12
2N718	TO-18	60	40	5	100	30	40	120	150	10	1.5		1.3	150	35	50		15				20
2N915	TO-18	70	50	5	10	60	50	20	10	5	1		0.9	10	3.5	250		10				27
2N956	TO-18	75		7	10	60	20		0.01	10	1.5		1.3	150	25	70		50				20
							75		10	10												
							100	300	150	10												
							40		500	10												
2N1420	TO-5	60		5	1.0 μA	30	100	300	150	10	1.5		1.3	150	35	50		50				20
2N1613	TO-5	75	50	7	10	60	20		0.1	10	1.5		1.3	150	25	60		50		12	5	20
							35		10	10												
							40	120	150	10												
							20		500	10												
2N1711	TO-5	75		7	100	60	20		0.01	10	1.5		1.3	150	25	70		50				20
							75		10	10												
							100	300	150	10												
							40		500	10												
2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4		1.3	150	8	250		20				20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
JAN2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							25		1	10	1.6		2.6	500								
							35		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
JANTXV2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
2N2218A	TO-5	75	40	6	10	60	20		0.1	10	0.3	0.6	1.2	150	8	250		20	285†		1	20
							35		10	10	1		2	500								
							40	120	150	10												
							20		150	1												
							25		500	10												
JAN2N2218A	TO-5	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							35		1	10	1		2	500								
							40		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2218A	TO-5	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							40		10	10	1		2	500								
							40	120	150	10												
							20		500	10												

JANTXV2N2218A	TO-5	75	50	6	10	60	30 40 40 20	 120	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250	20	300		1	20
2N2219	TO-5	60	30	5	10	50	35 75 100 30	 300	0.1 10 150 500	10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	250	20			1	20
JAN2N2219	TO-5	60	30	5	10	50	35 50 75 100 30	 300	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250	20	250		1	20
JANTX2N2219	TO-5	60	30	5	10	50	35 75 100 30	 300	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250	20	250		1	20
JANTXV2N2219	TO-5	60	30	5	10	50	35 75 100 30	 300	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250	20	250		1	20
2N2219A	TO-5	75	40	6	10	60	35 75 100 50 40	 300	0.1 10 150 150 500	10 10 10 1 10	0.3 1	0.6	1.2 2	150 500	8	300	20	285†		1	20
JAN2N2219A	TO-5	75	50	6	10	60	50 75 100 100 30	 300	0.1 1 10 150 500	10 10 10 10 10	1 0.3	 0.6	2 1.2	500 150	8	250	20	300		1	20
JANTX2N2219A	TO-5	75	50	6	10	60	50 100 100 30	 300	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250	20	300		1	20
JANTXV2N2219A	TO-5	75	50	6	10	60	50 100 100 30	 300	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250	20	300		1	20
2N2221	TO-18	60	30	5	10	50	20 35 40 20	 120	0.1 10 150 500	10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	250	20				20
JAN2N2221	TO-18	60	30	5	10	50	20 25 35 40 20	 120	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250	20	250		1	20
JANTX2N2221	TO-18	60	30	5	10	50	20 35 40 20	 120	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250	20	250		1	20

Test Condition:

1. I_C = 150 mA, V_{CC} = 30V, I_{B1} = I_{B2} = 15 mA
2. I_C = 100 μA, V_{CE} = 5V, R_G = 1 kΩ, BW = 15.7 kHz
3. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, WB
4. V_{CC} = 3V, I_C = 10 mA, I_{B1} = I_{B2} = 1 mA
5. I_C = 300 μA, V_{CE} = 10V, R_G = 510Ω, f = 1 kHz

*$V_{BE(ON)}$

(† = ts + tf)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
JANTXV2N2221	TO-18	60	30	6	10	50	20 35 40 20	 120 	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250		20	250		1	20
2N2221A	TO-18	75	40	6	10	60	30 35 40 20 25	 120 	0.1 10 150 150 500	10 10 10 1 10	0.3 1	0.6	1.2 2	150 500	8	250		20	285†		1	20
JAN2N2221A	TO-18	75	50	6	10	60	30 35 40 40 20	 120 	0.1 1 10 150 500	10 10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20
JANTX2N2221A	TO-18	75	50	6	10	60	30 40 40 20	 120 	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20
JANTXV2N2221A	TO-18	75	50	6	10	60	30 40 40 20	 120 	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20
2N2222	TO-18	60	30	5	10	50	35 75 100 30	 300 	0.1 10 150 500	10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	250		20				20
JAN2N2222	TO-18	60	30	5	10	50	35 50 75 100 30	 300 	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250		20	250		1	20
JANTX2N2222	TO-18	60	30	5	10	50	35 75 100 30	 300 	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250		20	250		1	20
JANTXV2N2222	TO-18	60	30	6	10	50	35 75 100 30	 300 	0.1 10 150 500	10 10 10 10	0.4 1.6	0.6	1.3 2.6	150 500	8	250		20	250		1	20
2N2222A	TO-18	75	40	6	10	60	35 75 100 50 40	 300 	0.1 10 150 150 500	10 10 10 1.0 10	0.3 1	0.6	1.2 2	150 500	8	300		20	285†		1	20
JAN2N2222A	TO-18	75	50	6	10	60	50 75 100 100 30	 300 	0.1 1 10 150 500	10 10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20

JANTX2N2222A	TO-18	75	50	6	10	60	50 100 100 30	 300	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20
JANTXV2N2222A	TO-18	75	50	6	10	60	50 100 100 30	 300	0.1 10 150 500	10 10 10 10	0.3 1	0.6	1.2 2	150 500	8	250		20	300		1	20
2N3299	TO-5	60	30	5			20 35 40 20	 120	0.1 10 150 500	10 10 10 10	0.22 0.6 0.45		1.1 1.5 1.3	150 500 300	8	250		50	300		1	20
2N3300	TO-5	60	30	5			35 75 100 50	 300	0.1 10 150 500	10 10 10 10	0.22 0.6 0.45		1.1 1.5 1.3	150 500 300	8	250		50				20
2N3301	TO-18	60	30	5			20 35 40 20	 120	0.1 10 150 500	10 10 10 10	0.22 0.6 0.45		1.1 1.5 1.3	150 500 300	8	250		50				20
2N3302	TO-18	60	30	5			35 75 100 50	 300	0.1 10 150 500	10 10 10 10	0.22 0.6 0.45		1.1 1.5 1.3	150 500 300	8	250		50				20
2N3566	TO-105	40	30	5	50	20	80 150	 600	2 10	10 10	1			100	25	40	200	30				20
2N3641	TO-105	60	30	5	50	50	40 15	120	150 500	10 10	0.22			150	8	250		50				20
2N3642	TO-105	60	45	5	50	50	40 15	120	150 500	10 10	0.22			150	8	250		50				20
2N3643	TO-105	60	30	5	50	50	100 20	300	150 500	10 10	0.22			150	8	250		50				20
2N3704	TO-92(74)	50	30	5	100	20	100	300	50	2.0	0.6			100	12	100		50				13
2N3705	TO-92(74)	50	30	5	100	20	50	150	50	2.0	0.8			100	12	100		50				13
2N3706	TO-92(74)	40	20	5	100	20	30	600	50	2	1			100	12	100		50				13
2N3793	TO-92(74)	40	20	5	500	15	10 20 20	 120	.1 10 100	10 10 10	0.4		1.5	10	10	100		10				13
2N3794	TO-92(74)	40	20	5	500	15	35 100 100	 600	.1 10 100	10 10 10	0.4		1.5	10	10	100	600	10				13
2N3858	TO-92(74)	30	30	4	500	18	60	120	2	4.5					4	90		2				27
2N3858A	TO-92(74)	60	60	6	500	18	45 60	 120	1 10	1 1					4	90		2				27
2N3859	TO-92(74)	30	30	4	500	18	100	200	2	4.5					4	90		2				27
2N3859A	TO-92(74)	60	60	6	500	18	75 100	 200	1 10	1 1					4	90		2				27
2N3860	TO-92(74)	30	30	4	500	18	150	300	2	4.5					4	90		2				27

Test Condition:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100 μA, V_{CE} = 5V, R_G = 1 kΩ, BW = 15.7 kHz
3. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, WB
4. V_{CC} = 3V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1 mA
5. I_C = 300 μA, V_{CE} = 10V, R_G = 510Ω, f = 1 kHz

*$V_{BE(ON)}$

(t = ts + tf)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3903	TO-92(72)	60	40	6	50	30	20		0.1	1	0.2	0.65	0.85	10	4	250		10		6	2	23
					I_{CEX}		35		1	1	0.3		0.95	50					225†		4	
							50	150	10	1												
							30		10	1												
							15		100	1												
2N3904	TO-92(72)	60	40	6	50	30	40		0.1	1	0.2	0.65	0.85	10	4	300		10		5	2	23
					I_{CEX}		70		1	1	0.3		0.95	50					250†		4	
							100	300	10	1												
							60		50	1												
							30		100	1												
2N3946	TO-18	60	40	6	10	40	30		0.1	1	0.2	0.6	0.9	10	4	250		10		5	2	23
					I_{CEX}		45		1	1	0.3		1	50					375†		4	
							20		50	1												
2N3947	TO-18	60	40	6	10	40	60		0.1	1	0.2	0.6	0.9	10	4	300		10		5	2	23
					I_{CEX}		90		1	1	0.3		1	50					450†		4	
							100		10	1												
							40		50	1												
2N4123	TO-92(72)	40	30	5	50	20	50	150	2	1	0.3		0.95	50	4	250		10		6	2	23
							25		50	1												
2N4124	TO-92(72)	30	25	5	50	20	120	360	2	1	0.3		0.95	50	4	300		10		5	2	23
							60		50	1												
2N4140	TO-106	60	30	5	50	40	20		0.1	10	0.4		1.3	150	8	250		20				20
							25		1	10												
							35		10	10												
							20		150	1												
							40	120	150	10												
							20		500	10												
2N4141	TO-106	60	30	5	50	40	35		0.1	10	0.4		1.3	150	8	250		20				20
							50		1	10												
							75		10	10												
							50		150	1												
							100	300	150	10												
							30		500	10												
2N4227	TO-106	60	30	5	50	40	25		0.1	10	0.4		1.3	150	8	250		20				20
							35		1	10												
							50		10	10												
							30		150	1												
							75	150	150	10												
							20		500	10												
2N4400	TO-92(72)	60	40	6			20		1	1	0.4	0.75	0.95	150		200		20	255†		1	13
							40		10	1	0.75		1.2	500								
							50	150	150	1												
							20		500	2												
2N4401	TO-92(72)	60	40	6			20		0.1	1						250		20	255†		1	13
							40		1	1												
							80		10	1												
							100	300	150	1												
							40		500	2												

2N4951	TO-92(74)	60	30	5	50	40	20		1	10	0.3		1.3	150	8	250		20	400		1	13
							40		10	10												
							60	200	150	10												
2N4952	TO-92(74)	60	30	5	50	40	50		1	10	0.3		1.3	150	8	250		20	400		1	13
							75		10	10												
							100	300	150	10												
2N4953	TO-92(74)	60	30	5	50	40	75		1	10	0.3		1.3	150	8	250		20	400		1	13
							150		10	10												
							200	600	150	10												
2N4954	TO-92(74)	40	30	5	50	40	20		1	10	0.3		1.3	150	8	250		20	400		1	13
							40		10	10												
							60	600	150	10												
2N4969	TO-106	50	30	5	50	30	30		10	10	0.4	0.6	1.2	150	8	200		20				20
							40	120	150	10												
							20		150	1												
2N4970	TO-106	50	30	5	50	30	70		10	10	0.4	0.6	1.2	150	8	200		20				20
							100	350	150	10												
							50		150	1												
2N5128	TO-105	15	12	3	50	10	20		10	10	0.25		1.1	150	10	200	800	50				20
							35	350	50	10												
2N5129	TO-106	15	12	3	50	10	20		10	10	0.25		1.1	150	10	200	800	50				20
							35	350	50	10												
2N5135	TO-105	30	25	4	300	15	15		2	10	1		1	100	25	40	300	30				20
							50	600	10	10												
2N5136	TO-105	30	20	3	100	20	20		30	1	0.25		1.1	150	35	40	400	50				20
							20	400	150	1												
2N5137	TO-106	30	20	3	100	20	20		30	1	0.25		1.1	150	35	40	400	50				20
							20	400	150	1												
2N5219	TO-92(72)	20	15	3	100	10	35	500	2	10	0.4		1.0	10	4	150		10				27
2N5220	TO-92(72)	15	15	3	100	10	25		10	10	0.5		1.1	150	10	100		20				13
							30	600	50	10												
2N5223	TO-92(72)	25	20	3	100	10	50	800	2	10	0.7		1.2	10	4	150		10				27
2N5225	TO-92(72)	25	25	4	300	15	25		10	10	0.8		1.0	100	20	50		20				13
							30	600	50	10												
EN697	TO-105	60	30	5	1000	30	40	120	150	10	1.5		1.3	150	35	50		30				20
EN916	TO-106	45	25	5	50	30	50	200	10	1	0.5		0.9	10	6	300		10				27
EN956	TO-106	75	40	7	50	60	20		0.01	10	1.5		1.3	150	25	70		30		8	5	20
							75		10	10												
							100	300	150	10												
							40		500	10												
EN1711	TO-106	75	40	7	50	60	20		0.01	10	1.5		1.3	150	25	70		30		8	5	20
							35		0.1	10												
							75		10	10												
							100	300	150	10												
							40		500	10												
EN2219	TO-105	60	30	5	50	50	35		0.1	10	0.4		1.3	150	8.0	250		20				20
							75		10	10	1.6		2.6	500								
							100	300	150	10												
							30		500	10												

Test Condition:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100 μA, V_{CE} = 5V, R_G = 1 kΩ, BW = 15.7 kHz
3. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, WB
4. V_{CC} = 3V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1 mA
5. I_C = 300 μA, V_{CE} = 10V, R_G = 510Ω, f = 1 kHz

*$V_{BE(ON)}$
(† = ts + tf)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
EN2222	TO-106	60	30	5	50	50	35 75 100 30	 300 	0.1 10 150 500	10 10 10 10	0.4 1.6		1.3 2.6	150 50	8	250		20				20
MPSA10	TO-92(72)		40	4	100	30	40	400	5	10					4	50		5				27
MPSA20	TO-92(72)		40	4	100	30	40	400	5	10	0.25			10	4	125		5				27
MPS2711	TO-92(72)	18	18	5	500	18	30	90	2	4.5					4							23
MPS2712	TO-92(72)	18	18	5	500	18	75	225	2	4.5					4							23
MPS2716	TO-92(72)				500	18	75	225	2	4.5					3.5							23
MPS2923	TO-92(72)	25	25	5	500	25	90	180	2	10					12							23
MPS2924	TO-92(72)	25	25	5	500	25	150	300	2	10					12							23
MPS2925	TO-92(72)	25	25	5	500	25	235	470	2	10					12							23
MPS2926	TO-92(72)	18	18	5	500	18	35	470	2	10					3.5							23
MPS3392	TO-92(72)	25	25	5	100	18	150	300	2	4.5					3.5							07
MPS3393	TO-92(72)	25	25	5	100	18	90	180	2	4.5					3.5							23
MPS3394	TO-92(72)	25	25	5	100	18	55	110	2	4.5					3.5							23
MPS3395	TO-92(72)	25	25	5	100	18	150	500	2	4.5					3.5							23
MPS3396	TO-92(72)	25	25	5	100	18	90	500	2	4.5					3.5							23
MPS3397	TO-92(72)	25	25	5	100	18	55	500	2	4.5					3.5							23
MPS3398	TO-92(72)	25	25	5	100	18	55	800	2	4.5					3.5							23
MPS3642	TO-92(72)	60	45	5	50 (I_{CES})	50	40 15	120 	150 500	10 10	0.22			150	8	250		50				20
MPS3704	TO-92(72)	50	30	5	100	20	100	300	50	2	0.6			100	12	100		50				13
MPS3705	TO-92(72)	50	30	5	100	20	50	150	50	2	0.8			100	12	100		50				13
MPS3706	TO-92(72)	40	20	5	100	20	30	600	50	2	1			100	12	100		50				13
MPS3721	TO-92(72)	25	25	5	500	18	60	660	2	10					3.5							23
MPS3826	TO-92(72)	60	45	4	100	30	40	160	10	10					3.5	200	800	10				23
MPS3827	TO-92(72)	60	45	4	100	30	100	400	10	10					3.5	200	800	10				23
MPS5172	TO-92(72)	25	25	5	100	25	100	500	10	10	0.25			10	10							27
MPS6512	TO-92(72)	40	30	4	50	30	50 30	100 	2 100	10 10	0.5			50	3.5							27
MPS6513	TO-92(72)	40	30	4	50	30	90 60	180 	2 100	10 10	0.5			50	3.5							27
MPS6514	TO-92(72)	40	25	4	50	30	150 90	300 	2 100	10 10	0.5			50	3.5							27
MPS6515	TO-92(72)	40	25	4	50	30	250 150	500 	2 100	10 10	0.5			50	3.5							27
MPS6520	TO-92(72)	40	25	4	50	30	100 200	 300	0.1 2	10 10	0.5			50	3.5					3	1	27
MPS6521	TO-92(72)	40	25	4	50	30	150 300	 600	0.1 2	10 10	0.5			50	3.5					3	1	27

MPS6530	TO-92(72)	60	40	5	50	40	30 40 25	 120 	10 100 500	1 1 10	0.5		1	100	5						13
MPS6531	TO-92(72)	60	40	5	50	40	60 90 50	 270 	10 100 500	1 1 10	0.3		1	100	5						13
MPS6532	TO-92(72)	50	30	5	100	30	30		100	1	0.5		1.2	100	5						13
MPS6564	TO-92(72)		45	5	500	40	25		10	5	0.5			10	4						27
MPS6565	TO-92(72)	60	45	4	100	30	40	160	10	10	0.4			10	3.5	200	10				27
MPS6566	TO-92(72)	60	45	4	100	30	100	400	10	10	0.4			10	3.5	200	10				27
NS3903	TO-18	60	40	6	50	30 (I_{CEX})	20 35 50 30 15	 150 	0.1 1 10 50 100	1 1 1 1 1	0.2 0.3	0.65	0.85 0.95	10 50	4	250	10	225†	6	4 2	23
NS3904	TO-18	60	40	6	50	30 (I_{CEX})	40 70 100 60 30	 300 	0.1 1 10 50 100	1 1 1 1 1	0.2 0.3	0.65	0.85 0.95	10 50	4	300	10	250†	5	4 2	23
SE2001	TO-106	35	20	4	500	15	40	160	10	1	0.7		0.9	10	6	200	10				27
SE6001	TO-105	40	30	5	500	20	50	200	10	10	1		0.9*	100	25	40	30				20
SE6002	TO-105	40	30	5	500	20	150	600	10	10	1		0.9*	100	25	40	30				20

Test Condition:

1. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA
2. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, BW = 15.7 kHz
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, WB
4. $V_{CC} = 3V$, $I_C = 10$ mA, $I_{B1} = I_{B2} = 1$ mA
5. $I_C = 300\ \mu A$, $V_{CE} = 10V$, $R_G = 510\Omega$, f = 1 kHz

*$V_{BE(ON)}$

(† = ts + tf)

NPN Transistors

POWER

Type No.	Case Style	$V_{CEX(SUS)}$ (V) Min	$V_{CEO(SUS)}$ (V) Min	V_{EBO} (V) Min	I_{CEX} (mA) Max	@ V_{CE} (V)	h_{FE} Min	h_{FE} Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (A)	f_T (MHz) Min	f_T (MHz) Max	@ I_C (A)	Process No.
2N3054	TO-66	90	55	7	1.0	90	25 5		0.5 3	4 4	1 6		1.7	0.5 3	.8		.2	1A
2N3055	TO-3	90	60	7	5.0	10C	20 5	70	4 10	4 4	1.1 8		1.8	4 10	.8		1.0	1B
2N3442	TO-3	160	140	7	5.0	140	20	70	3	4	1 5		1.7 5.7	3 10				1C
2N3771	TO-3	50	40	5	2	50	15 5	60	15 30	4 4	2 4		2.7	15 30	.2		1.0	1D
2N3772	TO-3	80	60	7	2.0	100	15 5	60	10 20	4 4	1.4 4		2.2	10 20	.2		1.0	1D
2N3773	TO-3	160	140	7	5.0	140	15 5	60	8 16	4 4	1.4 4		2.2	8 16	.2		1.0	1E
2N4347	TO-3	140	120	7	2.0	125	15	60	2 5	4 4	1 2		2 3	2 5				1C
2N4348	TO-3	140	120	7	2.0	120	15 10	60	5 10	4 4	1 2		2 3	5 10	.2		1.0	1E
2N6253	TO-3	55	45	5	2.0	55	20 3	70	3 15	4 4	1 4		1.7	3 15	.8		1.0	1B

NPN Transistors

MEDIUM POWER AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max @	I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2017	TO-39	60	60	8	10 μA	30	35		10	10	2			200								12
							50	200	200	10												
							20		1A	15												
2N2102	TO-39	120	65	7	2	60	10		0.01	10	0.5		1.1	150	10	60		50				12
							20		0.1	10												
							35		10	10												
							40	120	150	10												
							25		500	10												
							10		1A	10												
2N2192	TO-39	60	40	5	10	30	75		10	10	0.35		1.3	150	20	50		50				12
							100	300	150	10												
							15		1A	10												
2N2192A	TO-39	60	40	5	10	30	75		10	10	0.25		1.3	150	20	50		50				12
							100	300	150	10												
							15		1A	10												
2N2193	TO-39	80	50	8	10	60	15		0.1	10	0.35		1.3	150	20	50		50				12
							40	120	150	10												
							15		1A	10												
2N2193A	TO-39	80	50	8	10	60	15		0.1	10	0.25		1.3	150	20	50		50				12
							40	120	150	10												
							15		1A	10												
2N2195	TO-39	45	25	5	100	30	20		150	10	0.35		1.3	150	20	50		50				12
2N2195A	TO-39	45	25	5	100	30	20		150	10	0.25		1.3	150	20	50		50				12
2N2243	TO-39	120	80	7	10	60	15		0.1	10	0.35		1.3	150	15	50		50				12
							40	120	150	10												
							15		500	10												
2N2243A	TO-39	120	80	7	10	60	15		0.1	10	0.25		1.3	150	15	50		50				12
							40	120	150	10												
							15		500	10												
2N2270	TO-39	60	45	7	50	60	30		1	10	0.9		1.2	150	15	100		50				12
							50	200	150	10												
2N2657	TO-39	80	60	8	100	60	40	120	1A	2	0.5		1.5	1A	150	20		200	1500		1	34
							15		5A	6	3.0		2.5	5A								
2N2658	TO-39	100	80	8	100	60	40	120	1A	2	0.5		1.5	1A	150	20		200	1500		1	34
							15		5A	6	3.0		2.5	5A								
2N2890	TO-39	100	80	5			20		100	2	0.5		1.2	1A	70	30		200	1500		1	34
							30	90	1A	2	0.75		1.3	2A								
							25		2A	5												
2N2891	TO-39	100	80	5			35		100	2	0.5		1.2	1A	70	30		200	1500		1	34
							50	150	1A	2	0.75		1.3	2A								
							40		2A	5												
2N3019	TO-39	140	80	7	10	90	50		0.1	10	0.2		1.1	150	12	100		50				12
							100	300	150	10	0.5			500								
							15		1A	10												
							90		10	10												

JAN2N3019	TO-39	140	80	7	10	90	15		1A	10	0.2	1.1	150	12	100	400	50				12
							50	200	0.1	10	0.5		500								
							90		10	10											
							100	300	150	10											
							50	200	500	10											
JANTX2N3019	TO-39	140	80	7	10	90	50	200	0.1	10	0.20	1.1	150	12	100	400	50				12
							90		10	10	0.50		500								
							100	300	150	10											
							50	200	500	10											
							15		1A	10											
JANTXV2N3019	TO-39	140	80	7	10	90	50	200	0.1	10	0.2	1.1	150	12	100	400	50				12
							90		10	10	0.5		500								
							100	300	150	10											
							50	200	500	10											
							15		1A	10											
2N3020	TO-39	140	80	7	10	90	30	100	0.1	10	0.2	1.1	150	12	100		50				12
							40	120	150	10	0.5		500								
							15		1A	10											
							40	120	10	10											
2N3053	TO-39	60	40	5			25		150	2.5	1.4	1.7	150	15	100		50				12
							50	250	150	10											
2N3107	TO-39	100	60	7			100	300	150	1	1	2	1A	20	350		50				12
							35		0.1	10	0.25	1.1	150								
							40		500	10											
2N3108	TO-39	100	60	7	10	60	20		0.1	10	0.25	1.1	150	20	60		50				12
							40	120	150	10	1	2	1A								
							25		500	10											
2N3109	TO-39	80	40	7	10	60	35		0.1	10	0.25	1.1	150	25	70		50				12
							100	300	150	1	1	2	1A								
							40		500	10											
2N3110	TO-39	80	40	7	10	60	20		0.1	10	0.25	1.1	150	25	60		50				12
							40		150	1	1	2	1A								
							25		500	10											
2N3567	TO-105	80	40	5	50	40	40		30	1	0.25		150	20	60	200	50				14
							40	120	150	1											
2N3568	TO-105	80	60	5	50	40	40		30	1	0.25		150	20	60	200	50				14
							40	120	150	1											
2N3569	TO-105	80	40	5	50	40	100		30	1	0.25		150	20	60	200	50				14
							100	300	150	1											
2N3665	TO-39	120	80	10	50	60	30		10	10	0.5	1.2	150	12	60		50				12
							40	120	150	10	1.2	1.8	500								
							25		500	10											
2N3666	TO-39	120	80	10	50	60	70		10	10	0.5	1.2	150	12	60		50				12
							100	300	150	10	1.2	1.8	500								
							50		500	10											
2N3700	TO-18	140	80	7	10	90	50		0.1	10	0.2	1.1	150	12	100	200	50		4	2	12
							90		10	10	0.5		500								
							100	300	150	10											
							50		500	10											
							15		1A	10											
2N3742	TO-39	300	300	7	200	200	10		3	10	1	1	10	6	30		10				48
							15		10	10	5	1.2	30								
							20	200	30	10											
							20		50	20											

Test Conditions:

1. $V_{CC} = 20V$, $I_C = 1A$, $I_{B1} = I_{B2} = 100$ mA
2. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 1\ k\Omega$, f = 1 kHz
3. $I_C = 2A$, $V_{CC} = 40V$, $I_{B1} = I_{B2} = 200$ mA

NPN Transistors

MEDIUM POWER AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3743	TO-39	300	300	5	300	200	20		0.1	10	5		1	10	15	30		10				48
							25		1	10	8		1.2	30								
							25		10	10												
							25	250	30	10												
							25		50	20												
2N3945	TO-39	70	50	8			25		10	10	0.5		1.2	150	12	60		50				12
							40	250	150	10	1.8		1.8	500								
							20		500	10												
2N4237	TO-39		40		100μA	50	30	150	250	1	0.3			500	100	1		100				14
							30		500	4	0.6		1.5	1A								
							15		1A	1			1	250								
2N4238	TO-39		60		100μA	80	30	150	250	1	0.3			500	100	1		100				14
							30		500	4	0.6		1.5	1A								
							15		1A	1			1	250								
2N4924	TO-39	100	100	5	100	50	25		1	10	0.25			10	10	100	500	20				12
							35		10	10	0.4		0.95	50								
							40	200	150	10												
2N4926	TO-39	200	200	7	100	100	10		3	10					6	30	300	10				48
							15		10	10					C_{cb}							
							20	200	30	10												
							20		50	20												
2N4927	TO-39	250	250	7	100	150	10		3	10					6	30	300	10				48
							15		10	10					C_{cb}							
							20	200	30	10												
							20		50	20												
2N4930	TO-39	200	200	4	1 μA	150	20		1	10	5		1	10	20	20	200	20				48
							20	200	10	10					C_{cb}							
							20		30	10												
2N4931	TO-39	250	250	4	1 μA	150	20		1	10	5		1	10	20	10	100	20				48
							20	200	10	10					C_{cb}							
							20		30	10												
2N4943	TO-39	120	80	7	10	60	60		10	10	0.25		0.95	150	12	150	1000	50				12
							100	300	150	10												
							10		500	10												
2N5148	TO-39		80				5		3A	5	5		3	3A	70	50		200				34
							15		2A	5	0.85		1.5	2A	C_{cb}							
							30	90	1A	5	0.46		1.2	1A								
							20		50	5			1.5	2A								
2N5150	TO-39		80				15		3A	5	5		3	3A	70	60		200				34
							30		2A	5	0.85		1.5	2A	C_{cb}							
							70	200	1A	5	0.46		1.2	1A								
							50		50	5			1.5	2A								
2N5334	TO-39		60		5μA	60	30	150	1A	2	0.7		1.5	2A	75	40		100	1050		1	34
							15		2A	2												
2N5335	TO-39		80		5μA	80	30	150	1A	2	0.7		1.5	2A	75	40		100	1050		1	34
							15		2A	2												

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ Min	$V_{BE(sat)}$ Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5336	TO-39		80		10μA	80	30		500	2	0.7		1.2	2A		30		500	2200		3	34
							30	120	2A	2	1.2		1.8	5A								
							20		5A	2												
2N5337	TO-39		80		10 μA	80	60		500	2	0.7		1.2	2A		30		500	2200		3	34
							60	240	2A	2	1.2		1.8	5A								
							40		5A	2												
2N5338	TO-39		100		10 μA	100	30		500	2	0.7		1.2	2A		30		500	2200		3	34
							30	120	2A	2	1.2		1.8	5A								
							20		5A	2												
2N5339	TO-39		100		10 μA	100	60		500	2	0.7		1.2	2A		30		500	2200		3	34
							60	240	2A	2	1.2		1.8	5A								
							40		5A	2												
CS9013	TO-105		25	3			64	202	50	1	1.0			250								09
MPSA05	TO-92 (72)		60	4	100	60	50		10	1	0.25			100		50		100				14
							50		100	1												
MPSA06	TO-92 (72)		80	4	100	80	50		10	1	0.25			100		50		100				12
							50		100	1												
MPS6560	TO-92 (72)		25	5	100	20	35		10	1	0.50			500	30	60		10				14
							50		100	1												
							50	200	500	1												
MPS6561	TO-92 (72)		20	5	100	20	35		10	1	0.50			350	30	60		10				14
							50		100	1												
							50	200	350	1												

Test Conditions:

1. V_{CC} = 20V, I_C = 1A, $I_{B1} = I_{B2}$ = 100 mA
2. V_{CE} = 10V, I_C = 100 μA, R_G = 1 kΩ, f = 1 kHz
3. I_C = 2A, V_{CC} = 40V, $I_{B1} = I_{B2}$ = 200 mA

NPN Transistors

DARLINGTON AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ Min	$V_{BE(sat)}$ Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5305	TO-92 (74)				100	25	2,000	20,000	2	5	1.4			200	10	60		2				05
2N5306	TO-92 (74)				100	25	7,000	70,000	2	5	1.4			200	10	60		2				05
2N5307	TO-92 (74)				100	40	2,000	20,000	2	5	1.4			200	10	60		2				05
2N5308	TO-92 (74)				100	40	7,000	70,000	2	5	1.4			200	10	60		2				05
MPSA12	TO-92 (72)	20 (V_{CES})			100 (I_{CES})	15	20,000				1.0			10								05
MPSA13	TO-92 (72)	30 (V_{CES})			100	30	5,000		10	5	1.5			100		125		10				05
							10,000		100	5												
MPSA14	TO-92 (72)	30 (V_{CES})			100	30	10,000		10	5	1.5			100		125		10				05
							20,000		100	5												

NPN Transistors

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	$\frac{h_{FE1}}{h_{FE2}}$ (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\frac{\Delta V_{BE1}-V_{BE2}}{\Delta T}$ (μV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2453	TO-78	60	30	7	5	50	80 150	600	0.01 1	10	3 5	10	8	60		7	1	07
2N2453A	TO-78	80	50	7	5	60	80 150	600	0.01 1	10	3 5	5	4	60		4	1	07
2N2639	TO-78	45	45	5	10	45	50 55 65	300	0.01 0.1 1	10	5	10	8	80		4	2	07
2N2640	TO-78	45	45	5	10	45	50 55 65	300	0.01 0.1 1	20	10	20	8	80		4	2	07
2N2641	TO-78	45	45	5	10	45	50 55 65	300	0.01 0.1 1				8	80		4	2	07
2N2642	TO-78	45	45	5	10	45	100 110 130	300	0.01 0.1 1	10	5	10	8	80		4	2	07
2N2643	TO-78	45	45	5	10	45	100 110 130	300	0.01 0.1 1	20	10	20	8	80		4	2	07
2N2644	TO-78	45	45	5	10	45	100 110 130	300	0.01 0.1 1				8	80		4	2	07
2N2722	TO-78	45	45	5	1	30	50 100 125	250	0.001 0.01 0.1	10	5	10	6	100		4	2	07
2N2903	TO-78	60	30	7	10	50	60 125	625	0.01 1	20	10	20	8	60		7	1	07
2N2903A	TO-78	60	30	7	10	50	60 125	625	0.01 1	10	5	10	8	60		7	1	07
2N2913	TO-78	45	45	6	10	45	60 100 150	240	0.01 0.1 1				6	60		4 4	2 3	07
2N2914	TO-78	45	45	6	10	45	150 225 300	600	0.01 0.1 1				6	60		3 3	2 3	07
2N2915	TO-78	45	45	6	10	45	60 100 150	240	0.01 0.1 1	10	5 3 5	10	6	60		4 4	2 3	07
2N2915A	TO-78	45	45	6	10	45	60 100 150	240	0.01 0.1 1	10 *15	2 1.5 2	5	6	60	160	4 4	2 3	07
2N2916	TO-78	45	45	6	10	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60		3 3	2 3	07

2N2916A	TO-78	45	45	6	10	45	150 225 300	600	0.01 0.1 1	10 *15	2 1.5 2	5	6	60	160	3 3	2 3	07
2N2917	TO-78	45	45	6	10	45	60 100 150	240	0.01 0.1 1	20	10 5 10	20	6	60		4 4	2 3	07
2N2918	TO-78	45	45	6	10	45	150 225 300	600	0.01 0.1 1	20	10 5 10	20	6	60		3 3	3 2	07
2N2919	TO-78	60	60	6	2	45	60 100 150	240	0.01 0.1 1	10	5 3 5	10	6	60		4 4	3 2	07
2N2919A	TO-78	60	60	6	2	45	60 100 150	240	0.01 0.1 1	10 †15	2 1.5 2	5	6	60	160	4 4	3 2	07
2N2920	TO-78	60	60	6	2	45	150 225 300	600 – –	0.01 0.1 1	10 –	5 3 5	10	6	60		3 3	3 2	07
JAN2N2920	TO-78	70	60	6	2	45	150 225 300	600 – –	0.01 0.1 1	– 10 –	5 3 5	10	6	60	400	3 3 5	3 2 4	07
JANTX2N2920	TO-78	70	60	6	2	45	175 235 300	600 – –	0.01 0.1 1	– 10 –	5 3 5	10	5	60	400	3 3 5	3 2 4	07
JANTXV2N2920	TO-78	70	60	6	2	45	175 235 300	600	0.01 0.1 1	10	5 3 5	10	5	60	400	3 3 5	3 2 4	07
2N2920A	TO-78	60	60	6	2	45	150 225 300	600	0.01 0.1 1	10 †15	2 1.5 2	5	6	60	160	3 3	5 2	07
2N2972	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1				6	60		4 4	3 2	07
2N2973	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1				6	60		3 3	3 2	07
2N2974	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1	10	5 3 5	10	6	60		4 4	3 2	07
2N2975	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60		3 3	3 2	07
2N2976	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1	20	10 5 10	20	6	60		4 4	3 2	07
2N2977	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1	20	10 5 10	20	6	60		3 3	3 2	07

Test Conditions:

1. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz
2. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
3. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz BW = 200 Hz
4. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz
5. I_C = 100 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz

*This parameter measured at frequency = 1 kHz.
†T_A = –55°C to +125°C.

NPN Transistors

DUAL DIFFERENTIAL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	h_{FE1}/h_{FE2} (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\Delta(V_{BE1}-V_{BE2})/\Delta T$ ($\mu V/^\circ C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2978	TO-71	60	60	6	2	45	60	240	0.01		5		6	60		4	3	07
							100		0.1	10	3	10				4	2	
							150		1		5							
2N2979	TO-71	60	60	6	2	45	150	600	0.01		5		6	60		3	3	07
							225		0.1	10	3	10				3	2	
							300		1		5							
2N3587	TO-78	60	45	5	10	40	50		0.1				8	80	200	10	3	07
							80	500	1	‡20	20	20						
2N3680	TO-78	60	50	6	10	45	150	600	0.01	10	3	5	6	60	180	3	2	07
							225		0.1									
							300		1									
2N3907	TO-78	60	45	6	10	45	60	300	0.01		2		6	60	240	4	3	07
							70	500	0.1	10	1	5						
							120		1		2.5							
2N3908	TO-78	60	60	6	2	45	100	500	0.01		2		6	60	240	3	3	07
							125	800	0.1	10	1	5						
							200		1		2.5							
ND5700	TO-78	45	45	6	0.2	50	200	1500	0.01	5	0.5	2	3			3	5	570
							200	2000	1									
							200	2000	5									
ND5701	TO-78	45	45	6	0.2	50	200	1500	0.01	10	1	5	3			3	5	570
							200	2000	1									
							200	2000	5									
ND5702	TO-78	45	45	6	0.2	50	200	1500	0.01	10	2	10	3			3	5	570
							200	2000	1									
							200	2000	5									

Test Conditions:

1. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $f = 1\ kHz$
2. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $BW = 15.7\ kHz$
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $f = 1\ kHz$, $BW = 200\ Hz$
4. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $f = 100\ Hz$
5. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $BW = 15.7\ kHz$

*This parameter measured at frequency = 1 kHz.

†$T_A = -55^\circ C$ to $+125^\circ C$.

PNP Transistors

SATURATED SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N869	TO-52	25		5	10	15	20		10	5			1	10		100		10	18			64
													1	10								
2N869A	TO-52	25	18	5	10	15	40	120	30	0.5	0.15	0.78	0.98	10	6	400		10	80		8	64
					(I_{CES})		40	120	10	5	0.2	0.85	1.2	30								
							30		10	0.3	0.5		1.7	100								
							25		100	1												
2N995	TO-52	20	15	4	50	15	35	140	20	1	0.2		0.95	20	10	100		10				64
2N995A	TO-52	20	15	4	5	15	25		1	1	0.2		0.95	20	6	100		10	90		2	64
							35	140	20	1	0.5		1.7	100		400		30				
							25		50	1												
							25		100	1												
2N2894	TO-52	12	12	4	80	6	40	150	30	0.5	0.15	0.78	0.98	10	6	400		30	90		2	64
					I_{CES}		30		10	0.3	0.2	0.85	1.2	30								
							25		100	1	0.5		1.7	100								
2N2894A	TO-52	12	12	4.5	50	10	20		10	0.5	0.13	0.78	0.92	10	4.5	800		30	25		3	64
					I_{CES}																	
							30		10	0.3	0.19	0.85	1.15	30					35		2	
							40	120	30	0.5	0.45	1.0	1.5	100								
							30		100	1												
2N3012	TO-52	12	12	4	80	6	30	120	30	0.5	0.15	0.78	0.98	10	6	400		30	75		2	64
					I_{CES}		25		10	0.3	0.2	0.85	1.2	30								
							20		100	1	0.5		1.7	100								
2N3209	TO-52	20	20	4	80	10	30	120	30	0.5	0.15	0.78	0.98	10	5	400		30	90		2	64
					I_{CES}		25		10	0.3	0.2	0.85	1.2	30								
							15		100	1	0.6		1.7	100								
2N3244	TO-5 (Lo-Profile)	40	40	5	50	30	60		150	1	0.3		1.1	150	25	175		50	195		9	70
							50	150	500	1	0.5	0.75	1.5	500								
							25		750	5	1		2	750								
2N3245	TO-5 (Lo-Profile)	50	50	5	50	50	35		150	1	0.35		1.1	150	25	150		50	165		9	70
							30	90	500	1	0.6	0.75	1.5	500								
							20		1A	5	1.2		2	1A								
2N3248	TO-52	15	12	5	50	10	50	150	0.1	1	0.12	0.6	0.9	10	8	250		20	100		1	64
					I_{CEX}		50		1	1	0.25	0.7	1.1	50								
							50		10	1	0.40		1.3	100								
							35		50	1												
							25		100	1												
2N3249	TO-52	15	12	5	50	10	100	300	0.1	1	0.125	0.6	0.9	10	8	250		20	100		1	64
					I_{CEX}		100		1	1	0.25	0.7	1.1	50								
							100		10	1	0.45		1.3	100								
							75		50	1												
							35		100	1												

Test Conditions:

1. I_C = 100 mA, $I_{B1} = I_{B2}$ = 10 mA
2. I_C = 30 mA, $I_{B1} = I_{B2}$ = 1.5 mA
3. I_C = 30 mA, $I_{B1} = I_{B2}$ = 3 mA
4. I_C = 100 µA, V_{CE} = 5V, R_G = 1 kΩ, f = 100 Hz
5. I_C = 10 mA, $I_{B1} = I_{B2}$ = 0.5 mA
6. I_C = 50 mA, $I_{B1} = I_{B2}$ = 5 mA
7. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1 mA
8. I_C = 30 mA, I_{B1} = 3 mA, I_{B2} = 1.5 mA
9. I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA
10. I_C = 1·A, $I_{B1} = I_{B2}$ = 100 mA

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3250	TO-18	50	40	5			40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
							45		1	1	0.5		1.2	50						6	4	
							50	150	10	1												
							15		50	1												
2N3250A	TO-18	60	60	5			40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
							45		1	1	0.5		1.2	50						6	4	
							50	150	10	1												
							15		50	1												
JAN2N3250A	TO-18	60	60	5			40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
							45		1	1	0.5		1.2	50						6	4	
							50	150	10	1												
							15		50	1												
JANTXV2N3250A	TO-18	60	60	5			40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
							45		1	1	0.5		1.2	50						6	4	
							50	150	10	1												
							15		50	1												
2N3251	TO-18	50	40	5			80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
							90		1	1	0.5		1.2	50						6	4	
							100	300	10	1												
							30		50	1												
2N3251A	TO-18	60	60	5			80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
							90		1	1	0.5		1.2	50						6	4	
							100	300	10	1												
							30		50	1												
JAN2N3251A	TO-18	60	60	5			80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
							90		1	1	0.5		1.2	50						6	4	
							100	300	10	1												
							30		50	1												
JANTX2N3251A	TO-18	60	60	5			80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
							90		1	1	0.5		1.2	50						6	4	
							100	300	10	1												
							30		50	1												
JANTXV2N3251A	TO-18	60	60	5			80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
							90		1	1	0.5		1.2	50						6	4	
							100	300	10	1												
							30		50	1												
2N3304	TO-52	6	6	4			30	120	10	0.3	0.15	0.7	0.8	1	3.5	500		10	60		5	65
							20		50	1	0.16	0.8	1	10								
							15		1	0.5	0.5		1.5	50								
2N3451	TO-52	6	6	4.0	10	3	30	120	10	0.3	0.16	0.8	1	10	5.5	500		10	25		6	65
					I_{CES}																	
							20		50	1	0.25	0.75	0.95	10/5					60		5	
											0.5		1.5	50/5								
2N3467	TO-5 (Lo-Profile)	40	40	5	100	30	40		150	1	0.3		1	150	25	175		50	90		9	70
							40	120	500	1	0.5	0.8	1.2	500								
							40		1A	5	1		1.6	1A								

2N3468	TO-5 (Lo-Profile)	50	50	5	100	30	25 25 20	75	150 500 1A	1 1 5	0.35 0.6 1.2	0.8	1 1.2 1.6	150 500 1A	25	150	50	90		9	70
2N3545	TO-52	20	20	5	10	10	30 40 35 30	120	1 10 50 100	1 1 1 1	0.2 0.3 0.5	0.65	0.85 1.1 1.3	10 50 100	8	250	10	90		7	64
2N3546	TO-52	15	12	4.5	10	10	20 30 25	120	1 10 50	1 1 1	0.15 0.25 0.5	0.7 0.8	0.9 1.3 1.6	10 50 100	6	700	10	30		6	64
2N3576	TO-52	20	15	5	10 I_{CES}	15	40 10	120	10 100	0.5 1	0.15 0.5	0.75	0.95 1.1	10 100	4.5	400	10	50		7	64
2N3639	TO-106	6	6	4	10 I_{CES}	3	30 20	120	10 50	0.3 1	0.16 0.5 0.25	0.75 0.8	1.5 0.95 1	10/5 50 10/.5 10/1	3.5	500 300	10 10	60		5	65
2N3640	TO-106	12	12	4	10 I_{CES}	6	30 20	120	10 50	0.3 1	0.2 0.6 0.3	0.8 0.75	1 1.5 0.95	10/1 50 10/.5	3.5	500 300	10 10	35		6	65
2N4208	TO-52	12	12	4.5	10 I_{CES}	6	30 30 15	120	50 10 1	1 0.3 0.5	0.13 0.15 0.5	0.8	0.8 0.95 1.5	1 10 50	3	700	10	20		7	65
2N4209	TO-52	15	15	4.5	10 I_{CES}	8	40 50 35	120	50 10 1	1 0.3 0.5	0.15 0.18 0.6	0.8	0.8 0.95 1.5	1 10 50	3	850	10	20		7	65
2N4258	TO-106	12	12	4.5	10 I_{CES}	6	30 30 15	120	50 10 1	1 0.3 0.5	0.5 0.15		1.5 0.95	50 10	3	700	10	20		7	65
2N4313	TO-106	12	12	4.5	50 I_{CES}	10	18 30 30 25		1 10 30 100	0.5 1 0.5 1	0.13 0.19 0.45	0.95	0.92 1.15 1.5	10 30 100	4	700	30	25		3	64
2N4423	TO-106	12	12	4	80 I_{CES}	6	30 40 20	150	10 30 100	0.3 0.5 1	0.15 0.2 0.5			10 30 100	6	400	30	50		3	64
2N5022	TO-5 (Lo-Profile)	50	50	5	100 I_{CES}	30	15 25 25	100	100 500 1A	1 1 5	0.2 0.4 0.8	0.8	1 1.4 1.75	100 500 1A	25	170	50	90		9	70
2N5023	TO-5 (Lo-Profile)	30	30	5	100 I_{CES}	20	30 40 40	100	100 500 1A	1 1 5	0.17 0.35 0.7	0.8	1 1.4 1.75	100 500 1A	25	200	50	90		9	70
2N5055	TO-106	12	12	4.5	50 I_{CES}	10	12 20 30 20	100	1 10 30 100	0.5 1 0.5 1	0.13 0.19 0.45	0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	550	20	25		3	64
2N5056	TO-52	15	15	4.5	50 I_{CES}	10	12 20 30 20	100	1 10 30 100	0.5 0.3 0.5 1	0.13 0.19 0.45	0.72 0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	600	30	35		3	64
2N5057	TO-52	15	15	4.5	50 I_{CES}	10	20 30 40 30	100	1 10 30 100	0.5 0.3 0.5 1	0.13 0.19 0.45	0.72 0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	800	30	35		3	64

Test Conditions:

1. I_C = 100 mA, $I_{B1} = I_{B2}$ = 10 mA
2. I_C = 30 mA, $I_{B1} = I_{B2}$ = 1.5 mA
3. I_C = 30 mA, $I_{B1} = I_{B2}$ = 3 mA
4. I_C = 100 μA, V_{CE} = 5V, R_G = 1 kΩ, f = 100 Hz
5. I_C = 10 mA, $I_{B1} = I_{B2}$ = 0.5 mA
6. I_C = 50 mA, $I_{B1} = I_{B2}$ = 5 mA
7. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1 mA
8. I_C = 30 mA, I_{B1} = 3 mA, I_{B2} = 1.5 mA
9. I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA
10. I_C = 1·A, $I_{B1} = I_{B2}$ = 100 mA

PNP Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5140	TO-106	5	5	4	50	3	70		50	1	0.75			50	5	400		10	20		7	65
					I_{CES}		30		1	0.5	0.2		1.2	10								
							20	140	10	1												
2N5141	TO-106	6	6	6	100	4	15		1	2	0.2		1.1	10	7	300		20	150		3	64
					I_{CES}		25		10	2	0.25	0.8	1.25	30								
							30		30	2	0.6		2.0	100								
							15		100	5												
2N5910	TO-106	20	20	4.5	10	20	30	120	10	0.3	0.5			50	3	700		10	20		7	65
MPS3639	TO-92(70)	6	6	4			30	120	10	0.3		0.75	0.95	10	3.5	500		10	25		6	65
							20		50	1	0.16	0.8	1	10		300		10	60		5	
											0.5		1.5	50								
MPS3640	TO-92(70)	12	12	4	10	6	30	120	10	0.3	0.2	0.8	1	10	3.5	500		10	35		6	65
					I_{CES}		20		50	1	0.6		1.5	50					75		5	
NS3762	TO-5	40	40	5	100	20	35		10	1	0.15		0.8	10	18	180		50	115		10	70
	(Lo-Profile)				I_{CEX}		40		150	1	0.22		1	150								
							35		500	1	0.5		1.2	500								
							30	120	1A	1.5	0.9		1.4	1A								
							30		1.5A	5												
NS3763	TO-5	60	60	5	100	20	35		10	1	0.15		0.8	10	18	180		50	115		10	70
	(Lo-Profile)				I_{CEX}		40		150	1	0.22		1	150								
							35		500	1	0.5		1.2	500								
							20		1A	1.5	0.9		1.4	1A								
							20		1.5A	5												

Test Conditions:

1. $I_C = 100$ mA, $I_{B1} = I_{B2} = 10$ mA
2. $I_C = 30$ mA, $I_{B1} = I_{B2} = 1.5$ mA
3. $I_C = 30$ mA, $I_{B1} = I_{B2} = 3$ mA
4. $I_C = 100\ \mu$A, $V_{CE} = 5$V, $R_G = 1\ k\Omega$, f = 100 Hz
5. $I_C = 10$ mA, $I_{B1} = I_{B2} = 0.5$ mA
6. $I_C = 50$ mA, $I_{B1} = I_{B2} = 5$ mA
7. $I_C = 10$ mA, $I_{B1} = I_{B2} = 1$ mA
8. $I_C = 30$ mA, $I_{B1} = 3$ mA, $I_{B2} = 1.5$ mA
9. $I_C = 500$ mA, $I_{B1} = I_{B2} = 50$ mA
10. $I_C = 1$·A, $I_{B1} = I_{B2} = 100$ mA

PNP Transistors

LOW LEVEL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2604	TO-46	60	45	6	10	45	40	120	0.01	5	0.5	0.7	0.9	10	6	30		0.5		4	1	62
							60		0.5	5												
								350	10	5												
JAN2N2604	TO-46	80	60	6	10	50	40	120	0.01	5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
							60		0.5	5												
								350	10	5												

2N2605	TO-46	60	45	6	10	45	100 150 	300 600	0.01 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30		0.5		3	1	62
JAN2N2605	TO-46	70	60	6	10	50	100 150 	300 600	0.010 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
2N3547	TO-18	60	60	6	25	45	60 100 75	 500 	0.01 1 10	5 5 5	1		1	10	8	45	150	1		5	1	62
2N3548	TO-18	60	45	6	10	45	100 150 	300 600	0.01 0.1 10	5 5 5	1		1	10	8	60	150	1		4	1	62
2N3549	TO-18	60	60	6	10	45	100 150 200	500 	0.010 0.100 1	5 5 5	1		1	10	8	60	150	1		4	1	62
2N3550	TO-18	60	45	8	1.0	45	125 200 300	 600 	0.001 0.010 1	5 5 5	0.5	0.7	0.9	5	8	60	150	1		4	1	62
2N3799	TO-18	60	60	5	10	50	75 225 300 300 300	 900 	0.001 0.01 0.1 0.5 1	5 5 5 5 5	0.2 0.25		0.7 0.8	0.01 1	4	30		0.5		1.5 1.5 4 2.5	9 10 11 12	62
2N3962	TO-18	60	60	6	10	50	100 100	300 450	0.010 1.0	5 5	 0.25		 0.9	 10	6	40	160	0.5		3 3 3 10	2 3 4 5	62
2N3963	TO-18	80	80	6	10	70	100 100	300 450	0.010 1.0	5 5	0.25		0.9	10	6	40	160	0.5		3 3 3 10	2 3 4 5	62
2N3964	TO-18	45	45	6	10	40	250 250	500 600	0.010 1	5 5	0.25		0.9	10	6	40	160	0.5		2 2 2 4	2 3 4 5	62
2N3965	TO-18	60	60	6	10	50	250 250	500 600	0.010 1	5 5	0.25		0.9	10	6	40	160	0.5		2 2 2 4	2 3 4 5	62
2N4248	TO-106	40	40	5	10	40	50		0.1	5	0.25			10	6							62
2N4249	TO-106	60	60	5	10	40	100	300	0.1	5	0.25			10	6					3 3 3	2 4 6	62

Test Conditions:

1. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 15.7 kHz
2. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 15.7 kHz
3. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 1.5 kHz, f = 10 kHz
4. $I_C = 20\ \mu A$, $V_{CE} = 5V$, f = 1 kHz, BW = 150 Hz, $R_G = 10\ k\Omega$
5. $I_C = 20\ \mu A$, $V_{CE} = 5V$, f = 100 Hz, BW = 15 Hz, $R_G = 10\ k\Omega$
6. $I_C = 250\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, f = 1 kHz, BW = 150 Hz
7. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, f = 1 kHz, BW = 200
8. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_S = 3K$, f = 1 kHz
9. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$, f = 1 kHz, BW = 200 Hz
10. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$, f = 10 kHz, BW = 2 kHz
11. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$, f = 100 Hz, BW = 20 Hz
12. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$, BW = 15.7 Hz

LOW LEVEL AMPS (Cont.)

PNP Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4250	TO-106	40	40	5	10	40	250	700	0.1	5	0.25			10	6					2 2 2	2 4 6	62
2N4250A	TO-106	60	60	5	10	50	250	700	0.1	5	0.25			10	6					2 2 2	2 4 6	62
2N4964	TO-106	50	40	5	25	20	30 40	120	0.01 10	5 5	0.4			10	8	60		1		6	7	62
2N4965	TO-106	50	40	5	25	20	80 100	400	0.01 10	5 5	0.4			10	8	60		1		6	7	62
2N5086	TO-92(72)	50	50		50	35	150 150 150	500	0.1 1 10	5 5 5	0.3			10	4	40		0.5		3 3	8 2	62
2N5087	TO-92(72)	50	50		50	35	250 250 250	800	0.1 1 10	5 5 5	0.3			10	4	40		0.5		2 2	8 2	62
2N5227	TO-92(72)	30	30	3	100	10	30 50	 700	0.1 2	10 10	0.4		1	10	5	100		10				62
MPSA70	TO-92(72)		40	4	100	30	40	400	5	10	0.25			10	4	125		5				62

Test Conditions:

1. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 15.7 kHz
2. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 15.7 kHz
3. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, BW = 1.5 kHz, f = 10 kHz
4. $I_C = 20\ \mu A$, $V_{CE} = 5V$, f = 1 kHz, BW = 150 Hz, $R_G = 10\ k\Omega$
5. $I_C = 20\ \mu A$, $V_{CE} = 5V$, f = 100 Hz, BW = 15 Hz, $R_G = 10\ k\Omega$
6. $I_C = 250\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, f = 1 kHz, BW = 150 Hz
7. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, f = 1 kHz BW = 200
8. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_S = 3K$, f = 1 kHz
9. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$ f = 1 kHz, BW = 200 Hz
10. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$ f = 10 kHz, BW = 2 kHz
11. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$ f = 100 Hz, BW = 20 Hz
12. $V_{CE} = 10V$, $I_C = 100\ \mu A$, $R_G = 3\ k\Omega$ BW = 15.7 Hz

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N722	TO-18	50	35	5	1.0 μA	30	30	90	150	10	1.5		1.3	150	45	60		50				63
							25		5	10												
2N1132	TO-5	50	35	5	1.0 μA	30	25	100	1	5	1.5		1.3	150	45	60		50				63
							25*		5	10												
2N2904	TO-5	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JAN2N2904	TO-5	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							25		1	10	1.6		2.6	500								
							35		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2904	TO-5	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JANTXV2N2904	TO-5	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
2N2904A	TO-5	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JAN2N2904A	TO-5	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40		1	10	1.6		2.6	500								
							40		10	10												
							40	120	150	10												
							40		500	10												
JANTX2N2904A	TO-5	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JANTXV2N2904A	TO-5	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
2N2905	TO-5	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50				63
							100	300	150	10	1.6		2.6	500								
							30		500	10												
JAN2N2905	TO-5	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							50		1	10	1.6		2.6	500								
							75		10	10												
							100	300	150	10												
							30		500	10												
JANTX2N2905	TO-5	60	40	5	20	50	50		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												

Test Conditions:

1. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{cb} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
JANTXV2N2905	TO-5	60	40	5	20	50	50		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												
2N2905A	TO-5	60	60	5	10	50	75		0.1	10	0.4		1.3	150	8	200		50				63
							100	300	150	10	1.6		2.6	500								
							50		500	10												
JAN2N2905A	TO-5	60	60	5	10	50	75		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100		1	10	1.6		2.6	500								
							100		10	10												
							100	300	150	10												
							50		500	10												
JANTX2N2905A	TO-5	60	60	5	10	50	75		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							50		500	10												
JANTXV2N2905A	**TO-5**	**60**	**60**	**5**	**10**	**50**	**75**		**0.1**	**10**	**0.4**		**1.3**	**150**	**8**	**200**		**50**	**200**		**1**	**63**
							100	**300**	**150**	**10**	**1.6**		**2.6**	**500**								
							50		**500**	**10**												
2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JAN2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							25		1	10	1.6		2.6	500								
							35		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JANTXV2N2906	**TO-18**	**60**	**40**	**5**	**20**	**50**	**20**		**0.1**	**10**	**0.4**		**1.3**	**150**	**8**	**200**		**50**	**175**		**1**	**63**
							20	**140**	**150**	**10**	**1.6**		**2.6**	**500**								
							20		**500**	**10**												
2N2906A	TO-18	60	60	5	20	50	40		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JAN2N2906A	TO-18	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40		1	10	1.6		2.6	500								
							40		10	10												
							40	120	150	10												
							40		500	10												
JANTX2N2906A	TO-18	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JANTXV2N2906A	**TO-18**	**60**	**60**	**5**	**10**	**50**	**40**		**0.1**	**10**	**0.4**		**1.3**	**150**	**8**	**200**		**50**	**175**		**1**	**63**
							40	**120**	**150**	**10**	**1.6**		**2.6**	**500**								
							40		**500**	**10**												
2N2907	TO-18	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50			1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												

JAN2N2907	TO-18	60	40	5	20	50	35 50 75 100 30	 300	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	1.3 2.6	150 500	8	200	50	200		1	63
JANTX2N2907	TO-18	60	40	5	20	50	35 100 30	 300	0.1 150 500	10 10 10	0.4 1.6	1.3 2.6	150 500	8	200	50	**200**		1	63
JANTXV2N2907	**TO-18**	**60**	**40**	**5**	**20**	**50**	**35 100 30**	 **300**	**0.1 150 500**	**10 10 10**	**0.4 1.6**	**1.3 2.6**	**150 500**	**8**	**200**	**50**	**200**		1	63
2N2907A	TO-18	60	60	5	20	50	75 100 50	 300	1.0 150 500	10 10 10	0.4 1.6	1.3 2.6	150 500	8	200	50				63
JAN2N2907A	TO-18	60	60	5	10	50	75 100 100 100 50	 300	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	1.3 2.6	150 500	8	200	50	200		1	63
JANTX2N2907A	TO-18	60	60	5	10	50	75 100 50	 300	1 150 500	10 10 10	0.4 1.6	1.3 2.6	150 500	8	200	50	200		1	63
JANTXV2N2907A	**TO-18**	**60**	**60**	**5**	**10**	**50**	**75 100 50**	 **300**	**1 150 500**	**10 10 10**	**0.4 1.6**	**1.3 2.6**	**150 500**	**8**	**200**	**50**	200		1	63
2N3072	TO-5	60	60	4			30 15	130	50 300	1 2	0.25 1.0	1.2 2.0	50 300	10	130	50	100		10	63
2N3073	TO-18	60	60	4			30 15	130	50 300	1 2	0.25 1.0	1.2 2.0	50 300	10	130	50	100		10	63
2N3120	TO-5	45	45	4			30 15	130	50 300	1 2	0.25 0.5 1.0	1.2 2.0	50 500	10	130	50	100		10	63
2N3121	TO-18	45	45	4			30 15	130	50 300	1 2	0.25 0.5 1.0	1.2 2.0	50 500	10	130	50	100		10	63
2N3133	TO-5	50	35	4	50	30	10 25 40	 120	150 1 150	1.0 10 10	0.6	1.5	150	10	200	50				63
2N3134	TO-5	50	35	4	50	30	25 50 100	 300	150 1 150	1.0 10 10	0.6	1.5	150	10	200	50				63
2N3135	TO-18	50	35	4	50	30	10 25 40	 120	150 1 150	1.0 10 10	0.6	1.5	150	10	200	50				63
2N3136	TO-18	50	35	4	50	30	25 50 100	 300	150 1 150	1.0 10 10	0.6	1.5	150	10	200	50				63

Test Conditions:

1. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA
2. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, BW = 15.7 kHz
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, WB
4. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 10V$
5. $I_C = 30\ \mu A$, $V_{CE} = 15V$, $R_S = 10\ k\Omega$, f = 1 kHz
6. $I_C = 150$ mA, $I_{B1} = I_{B2} = 15$ mA
7. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 30V$
8. $I_C = 10$ mA, $I_{B1} = I_{B2} = 1$ mA
9. $I_C = 50$ mA, $V_{CC} = 10V$ $I_{B1} = I_{B2} = 5$ mA
10. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 15V$

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3502	TO-5	45	45	5	10	30	80		0.01	10	0.25		1.0	50	8	200		50	100		7	63
					ICES		120		0.1	10	0.4		1.3	150						4	5	
							135		1	10	1.0		2.0	300								
							140		10	10	1.6		20	500								
							100	300	150	10												
							50		500	10												
							115	300	50	1												
2N3503	TO-5	60	60	5	10	50	80		0.01	10	0.25		1.0	50	8	200		50	100		7	63
					ICES		120		0.1	10	0.4		1.3	150						4	5	
							135		1	10	1.0		2.0	300								
							140		10	10	1.6		20	500								
							100	300	150	10												
							50		500	10												
							115	300	50	1												
2N3504	TO-18	45	45	5	10	30	80		0.01	10	0.25		1.0	50	8	200		50	100		7	63
					ICES		120		0.1	10	0.4		1.3	150						4	5	
							135		1	10	1.0		2.0	300								
							140		10	10	1.6		20	500								
							100	300	150	10												
							50		500	10												
							115	300	50	1												
2N3505	TO-18	60	60	5	10	50	80		0.01	10	0.25		1.0	50	8	200		50	100		7	63
					ICES		120		0.1	10	0.4		1.3	150						4	5	
							135		1	10	1.0		2.0	300								
							140		10	10	1.6		20	500								
							100	300	150	10												
							50		500	10												
							115	300	50	1												
2N3638	TO-105	25	25	4	35	15	30		50	2	1.0	0.8	2.0	300	20	100		50	170		4	63
							20		300	1	0.25		1.1	50								
2N3638A	TO-105	25	25	4	35	15	80		1	2	1.0	0.8	2.0	300	10	150		50	170		4	63
							100		10	1	0.15		1.1	50								
							100		50	10												
							20		300	10												
2N3644	TO-105	45	45	5	35	30	40		0.1	10	1.0	0.8	2.0	300	8	200		20	100		7	63
							80		1	10												
							100		10	10												
							115	300	50	10												
							100	300	150	2												
							20		300	1												
2N3645	TO-105	60	60	5	35	50	40		0.1	10	1.0	0.8	2.0	300	8	200		20	100		7	63
							80		1	10	0.25		1.0	50								
							100		10	10												
							115	300	50	10												
							100	300	150	2												
							20		300	1												
2N3905	TO-92(72)	40	40	5			30		0.1	1	0.25	0.65	0.65	10	4.5	200		10		5	2	66
							40		1	1	0.4		0.95	50								
							50	150	10	1												
							30		50	1												
							15		100	1												

2N3906	TO-92(72)	40	40	5			60		0.1	1	0.25	0.65	0.85	10	4.5	250	10		4	2	66
							80		1	1	0.4		0.95	50							
							100	300	10	1											
							60		50	1											
							30		100	1											
2N4121	TO-106	40	40	5			40		0.1	1	0.13		0.75	1.0	4.5	400	10		4	2	66
							60		1	1	0.14	0.7	0.9	10							
							70	200	10	1	0.3		1.1	50							
							15		50	1											
2N4122	TO-106	40	40	5			100		0.1	1	0.13		0.75	1.0	4.5	450	10		4	2	66
							150		1	1	0.14	0.7	0.9	10							
							150	300	10	1	0.3		1.1	50							
							30		50	1	0.4			50							
2N4125	TO-92(72)	30	30	4	50	20	50	150	2	1	0.4		0.95	50	4.5	200	10		5	2	66
							25		50	1											
2N4126	TO-92(72)	25	25	4	50	20	120	360	2	1	0.4		0.95	50	4.5	250	10		4	2	66
							60		50	1											
2N4142	TO-106	60	40	5	50	30	20		0.1	10	0.4		1.3	150	8	200	50				63
							25		1	10											
							35		10	10											
							20		150	1											
							40	120	150	10											
							20		500	1											
2N4143	TO-106	60	40	5	50	30	35		0.1	10	0.4		1.3	150	8	200	50				63
							50		1	10											
							75		10	10											
							50		150	1											
							100	300	150	10											
							30		500	1											
2N4228	TO-106	60	40	5	50	30	25		0.1	10	0.4		1.3	150	8	200	50				63
							50		10	10											
							30		150	1											
							75	150	150	10											
							20		500	1											
2N4402	TO-92(72)	40	40	5.0			30		1	1	0.4	0.75	.95	150		150	20	255		1	63
							50		10	1	0.75		1.3	500							
							50	150	150	1											
							20		500	2											
2N4403	TO-92(72)	40	40	5.0			30		0.1	1	0.4	0.75	.95	150		200	20	255		1	63
							60		1	1	0.75		1.2	500							
							100		10	1											
							100	300	150	1											
							20		500	2											
2N4916	TO-106	30	30	5			40		0.1	1	0.13		0.75	1	4.5	400	10		4	2	66
							60		1	1	0.14	0.7	0.9	10							
							70	200	10	1	0.3	0.75	1.1	50							
							15		50	1											
2N4917	TO-106	30	30	5			100		0.1	1	0.13		0.75	1	4.5	450	10	150		9	66
							150		1	1	0.14	0.7	0.9	10							
							150	300	10	1	0.3	0.75	1.1	50							
							30		50	1											
2N4971	TO-106	50	40	5	25	30	30		10	10	0.15		1.3	150	8	200	50	150		9	63
							20		150	1									4	2	
							40	120	150	10											

Test Conditions:

1. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA
2. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, BW = 15.7 kHz
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, WB
4. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 10V$
5. $I_C = 30\ \mu A$, $V_{CE} = 15V$, $R_S = 10\ k\Omega$, f = 1 kHz
6. $I_C = 150$ mA, $I_{B1} = I_{B2} = 15$ mA
7. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 30V$
8. $I_C = 10$ mA, $I_{B1} = I_{B2} = 1$ mA
9. $I_C = 50$ mA, $V_{CC} = 10V$ $I_{B1} = I_{B2} = 5$ mA
10. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA $V_{CC} = 15V$

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4972	TO-106	50	40	5	25	30	70		10	10	0.4		1.3	150	8	200		50				63
							50		150	1												
							100	300	150	10												
2N5138	TO-106	30	30	5	50	20	50	800	0.1	10	0.3		1.0	10	7	30		5				66
							50		1	10												
							50		10	10												
2N5139	TO-106	20	20	5	50	15	30		0.1	10	0.5	0.7	1.0	50	5	300		10				66
							40		1	10												
							40		10	1												
2N5142	TO-105	20	20	4	50	12	30		50	1	2	0.8	2.5	300	10	100		50	200		4	63
							15		300	10	0.5		1.5	50								
2N5143	TO-106	20	20	4	50	12	30		50	1	2	0.8	2.5	300	10	100		50	200		4	63
							15		300	10	0.5		1.5	50								
2N5221	TO-92(72)	15	15	3	100	10	25		10	10	0.5		1.1	150	15	100		20				63
							30	600	50	10												
2N5226	TO-92(72)	25	25	4	300	15	25		10	10	0.8		1	100	20	50		20				63
							30	600	50	10												
2N5356	TO-92(74)		25		100	25	250	500	50	1	0.25			50								63
EN722	TO-106	50	35		1000	30	25		5.0	10	1.5		1.3	150	45	60		50				63
							30	90	150	10												
EN1132	TO-105	50	35		1000	30	25		5.0	10	1.5		1.3	150	45	60		50				63
							30	90	150	10												
EN2905	TO-105	60	40		50	50	35		0.1	10	0.4		1.3	150	8	150		50	110		6	63
							100	300	150	10	1		2	300								
							30		500	10												
EN2907	TO-106	60	40	5	50	50	35		0.1	10	0.4		1.3	150	8	150		50	110		6	63
							100	300	150	10	1		2	300								
							30		500	10												
EN3250	TO-106	50	40	5	50	40	40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		8	66
					I_{CEX}		45		1	1	0.5		1.2	50								
							50	150	10	1												
							15		50	1												
EN3502	TO-105	45	45	5	10	30	80		0.01	10	0.25		1	50	8	150		50	100		7	63
					I_{CES}		120		0.1	10	0.4		1.3	150						4	5	
							135		1	10	1		2	300								
							140		10	10												
							115	300	50	1												
							100	300	150	10												
							30		500	10												
EN3504	TO-106	45	45	5	10	30	80		0.01	10						150		50	100		7	63
					I_{CES}		120		0.1	10										4	5	
							135		1	10												
							140		10	10												
							115	300	50	1												
							100	300	150	10												
							30		500	10												

MPS3638	TO-92	25	25	4			20		10	10	0.25		1.1	50	20	100	50	170		4	63
	(72)						30		50	1											
							20		300	2											
MPS3638A	TO-92	25	25	4			80		1	10	0.25		1.1	50	10	150	50	170		4	63
	(72)						100		10	10	1	0.8	2	300							
							100		50	1											
							20		300	2											
MPS3644	TO-92	45	45	5	35	30	40		0.1	10	0.25		1	50	8	200	20	100		7	63
	(72)				I_{CES}		80		1	10	0.4		1.3	150							
							100		10	10	1	0.8	2	300							
							100	300	150	10											
							20		300	2											
							115	300	50	1											
MPS3645	TO-92	60	60	5	35	50	40		0.1	10	0.25		1	50	8	200	20	100		7	63
	(72)				I_{CES}		80		1	10	0.4		1.3	150							
							100		10	10	1	0.8	2	300							
							100	300	150	10											
							20		300	2											
							80	240	50	1											
MPS3702	TO-92(72)	40	25	5	100	20	60	300	50	5	0.25			50	12	100	50				63
MPS3703	TO-92(72)	50	30	5	100	20	30	150	50	5	0.25			50	12	100	50				63
MPS6516	TO-92(72)	40	40	4	50	30	50	100	2	10	0.5			50	4						66
							30		100	10											
MPS6517	TO-92(72)	40	40	4	50	30	90	180	2	10	0.5			50	4						66
							60		100	10											
MPS6518	TO-92(72)	40	40	4	500	30	150	300	2	10	0.5			50	4						66
							90		100	10											
MPS6522	TO-92(72)	25	25	4	50	20	100		0.1	10	0.5			50	4				3	3	66
							200	400	2	10											
MPS6533	TO-92(72)	40	40	4	50	30	30		10	1	0.5		1	100	6						63
							40	120	100	1											
							25		500	10											
MPS6534	TO-92(72)	40	40	4	50	30	60		10	1	0.3		1	100	6						63
							90	270	100	1											
							50		500	10											
MPS6535	TO-92(72)	30	30	4	100	20	30		100	1	0.5		1.2	100	6						63
NS3905	TO-18	40	40	5	50	30	30		0.1	1	0.25	0.65	0.85	10	4.5	200	10	260		8	66
					(I_{CEX})		40		1	1	0.4		0.95	50					5	2	
							50	150	10	1											
							30		50	1											
							15		100	1											
NS3906	TO-18	40	40	5	50	30	60		0.1	1	0.25	0.65	0.85	10	4.5	250	10	300		8	66
					(I_{CEX})		80		1	1	0.4		0.95	50					4	2	
							100	300	10	1											
							60		50	1											
							30		100	1											

Test Conditions:

1. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA
2. $I_C = 100\ \mu A$, $V_{CE} = 5V$, $R_G = 1\ k\Omega$, BW = 15.7 kHz
3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, WB
4. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA, $V_{CC} = 10V$
5. $I_C = 30\ \mu A$, $V_{CE} = 15V$, $R_S = 10\ k\Omega$, f = 1 kHz
6. $I_C = 150$ mA, $I_{B1} = I_{B2} = 15$ mA
7. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA, $V_{CC} = 30V$
8. $I_C = 10$ mA, $I_{B1} = I_{B2} = 1$ mA
9. $I_C = 50$ mA, $V_{CC} = 10V$, $I_{B1} = I_{B2} = 5$ mA
10. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA, $V_{CC} = 15V$

MEDIUM POWER AMPS

PNP Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4030	TO-39	60	60	5	50	50	30		0.10	5	0.15		0.9	150	20	100		50	400*		2	67
							40	120	100	5	0.5		1.1	500		400						
							15		1A	5	1.0		1.2	1000								
2N4031	TO-39	80	80	5	50	60	30		0.1	5	0.15		0.9	150	20	100		50	400*		2	67
							40	120	100	5	0.5		1.1	500		400						
							10		1A	5												
2N4032	TO-39	60	60	5	50	50	75		0.1	5	0.15		0.9	150	20	150		50	400*		2	67
							100	300	100	5	0.5		1.1	500		500						
							40		1A	5	1.0		1.2	1000								
2N4033	TO-39	80	80	5	50	60	75		0.1	5	0.15		0.9	150	20	150		50	400*		2	67
							100	300	100	5	0.5		1.1	500		500						
							25		1A	5												
2N4036	TO-39	90	65	7	100	90	20	200	150	2	0.65		1.4	150		60		50	700		3	67
							20		0.1	10												
							40	140	150	10												
							20		500	10												
2N4037	TO-39	60	40	7	250	60	15		1	10	1.4				30	60		200	50			67
							50	250	150	10												
2N4234	TO-39	40	40	7	100 μA	40	10		1A	1	0.6		1.5	1A	100	3		100				67
							30	150	250	1			1*	250								
							40		100	1												
							20		500	1												
2N4235	TO-39	60	60	7	100 μA	60	10			1	0.6		1.5	1A	100	3		100				67
							30	150	1A	1			1*	250								
							40		250	1												
							20		100	1												
									500													
2N4236	TO-39	80	80	7	100 μA	80	10		1A	1	0.6		1.5	1A	100	3		100				67
							30	150	250	1			1*	250								
							40		100	1												
							20		500	1												
2N4314	TO-39	90	65		250	60	50	250	150	10	1.4		1.5*	150	30	60	200	50				67
							15		1	10												
2N4354	TO-105	60	60	5	50	50	25		0.1	10	0.15		0.9	150	30	100	500	50		3	1	67
							40		1	1												
							50	500	10	10												
							40		100	10												
							30		500	10												
2N4355	TO-105	60	60	5	50	50	60		0.1	10	0.15		0.9	150	30	100	500	50		3	1	67
							75		1	10												
							100	400	10	10												
							75		100	10												
							75		500	10												

2N4356	TO-105	80	80	5	50	59	25		0.1	10	0.15	0.9	150	30	100	500	50		3	1	67
							40		1	10											
							50	250	10	10											
							40		100	10											
							30		500	10											
CS9012	TO-105		25	3			64	202	50	1	1.0		250								60
MPSA55	TO-92(72)		60	4	100	60	50		10	1	0.25		100		50		100				67
							50		100	1											
MPSA56	TO-92(72)		80	4	100	80	50		10	1	0.25		100		50		100				67
							50		100	1											
MPS4354	TO-92(72)	60	60	5	50	50	25		0.1	10	0.15	0.9	150	30	100	500	50	400		2	67
							40		1	10	0.5	1.1	500						3	1	
							50	500	10	10											
							40		100	10											
							30		500	10											
MPS4355	TO-92(72)	60	60	5	50	50	60		0.1	10	0.15	0.9	150	30	100	500	50	400		2	67
							75		1	10	0.5	1.1	500						3	1	
							100	400	10	10											
							75		100	10											
							75		500	10											
MPS4356	TO-92(72)	80	80	5	50	50	25		0.1	10	0.15	0.9	150	30	100	500	50	400		2	67
							40		1	10	0.5	1.1	500						3	1	
							50	250	10	10											
							40		100	10											
							30		500	10											
MPS6562	TO-92(72)			5	100	20	35		10	1	0.5		500	30	60		10				67
							50		100	1											
							50	200	500	1											
MPS6563	TO-92(72)			5	100	20	35		10	1	0.5		350	30	60		10				67
							50		100	1											
							50	200	350	1											

Test Conditions:

1. $I_C = 100\ \mu A$, $V_{CE} = 10V$, $R_G = 1\ k\Omega$, BW = 1 Hz, f = 1.0 KHz
2. $V_{CC} = 30V$, $I_C = 500$ mA, $I_{B1} = I_{B2} = 50$ mA,
3. $I_C = 150$ mA, $V_{CC} = 30V$, $I_{B1} = I_{B2} = 15$ mA

(*ts + tf)

PNP Transistors

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	$\frac{h_{FE1}}{h_{FE2}}$ (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\frac{\Delta V_{BE1}-V_{BE2}}{\Delta T}$ ($\mu V/°C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N3347	TO-78	60	45	6	10	45	40 60	300	0.01 1	10	5	10	6	60	240	4	1	62
2N3348	TO-78	60	45	6	10	45	40 60	300	0.01 1	20	10	20	6	60	240	4	1	62
2N3349	TO-78	60	45	6	10	45	40 60	300	0.01 1	40	20	40	6	60	240	4	1	62
2N3350	TO-78	60	45	6	10	45	100 150	300	0.01 1	10	5	10	6	60	240	4	1	62
2N3351	TO-78	60	45	6	10	45	100 150	300	0.01 1	20	10	20	6	60	240	4	1	62
2N3352	TO-78	60	45	6	10	45	100 150	300	0.01 1	40	20	40	6	60	240	4	1	62
2N3806	TO-78	60	60	5	10	50	100 150 150	450 450	0.01 0.1 1				4	100	500	7 3 2.5 3.5	2 3 4 5	62
2N3807	TO-78	60	60	5	10	50	225 300 300	900 900	0.01 0.1 1				4	100	500	4 1.5 1.5 2.5	2 3 4 5	62
2N3808	TO-78	60	60	5	10	50	100 150 150	450 450	0.01 0.1 1	20	8 5 8	20	4	100	500	7 3 2.5 3.5	6 3 4 5	62
2N3809	TO-78	60	60	5	10	50	225 300 300	900 900	0.01 0.1 1	20	8 5 8	20	4	100	500	4 1.5 1.5 2.5	6 3 4 5	62
2N3810	TO-78	60	60	5	10	50	100 150 150	450 450	0.01 0.1 1	10	5 3 5	10	4	100	500	7 3 2.5 3.5	6 3 4 5	62
JAN2N3810	TO-78	60	60	5	10	50	100 150 150 150 125	450 450 450	0.01 0.1 0.5 1 10	10	5 3	10	5	100	500	7 3 2.5 3.5	6 3 4 5	62
JANTX2N3810	TO-78	60	60	5	10	50	100 150 150 150 125	450 450 450	0.01 0.1 0.5 1 10	10	5 3 5	10	5	100	500	7 3 2.5 3.5	6 3 4 5	62
JANTXV2N3810	TO-78	60	60	5	10	50	100 150 150 150 125	450 450 450	0.01 0.1 0.5 1 10	10	5 3 5	10	5	100	500	7 3 2.5 3.5	6 3 4 5	62

2N3810A	TO-78	60	60	5	10	50	100 150 150	450 450	0.01 0.1 1	5	5 1.5 5	5	4	100	500	7 3 2.5 3.5	2 3 4 5	62
2N3811	TO-78	60	60	5	10	50	225 300 300	900 900	0.01 0.1 1	10	5 3 5	10	4	100	500	4 1.5 1.5 2.5	2 3 4 5	62
JAN2N3811	TO-78	60	60	5	10	50	75 225 300 300 300 250	900 900 900	0.001 0.01 0.1 0.5 1 10	10	5 3	10	5	100	500	4 1.5 1.5 2.5	6 3 4 5	62
JANTX2N3811	TO-78	60	60	5	10	50	75 225 300 300 300 250	900 900 900	0.001 0.01 0.1 0.5 1 10	10	5 3 5	10	5	100	500	4 1.5 1.5 2.5	6 3 4 5	62
JANTXV2N3811	TO-78	60	60	5	10	50	75 225 300 300 300 250	900 900 900	0.001 0.01 0.1 0.5 1 10	10	5 3 5	10	5	100	500	4 1.5 1.5 2.5	6 3 4 5	62
2N3811A	TO-78	60	60	5	10	50	225 300 300	900 900	0.01 0.1 1	5	5 1.5 5	5	4	100	500	4 1.5 1.5 2.5	2 3 4 5	62
2N4015	TO-78	60	60	5	10	50	80 120 135 120	350	0.01 0.1 1 50	10 10	5 5	20 20	8	200	600	4	8	62
2N4016	TO-78	60	60	5	10	50	80 120 135 120	350	0.01 0.1 1 50	10 10	2 2	10 10	8	200	600	4	9	62
2N4017	TO-78	80	80	6	10	70	100 100 90	350	0.01 0.1 50				6	40	160	3 10	10 11	62
2N4018	TO-78	60	60	6	10	50	100 100 90	500	0.01 0.1 50				6	40	160	3 10	10 11	62
2N4019	TO-78	45	45	6	10	30	250 250 180	500	0.01 0.1 50				6	50	160	2 4	10 11	62

Test Conditions:

1. I_E = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 100 μA, V_{CE} = 5V R_G = 3 kΩ, f = 100 Hz, BW = 20 Hz
3. I_C 100 μA, V_{CE} = 10V, R_G = 3 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 100 μA, V_{CE} = 10V, R_G = 3 kΩ, f = 10 kHz, BW = 2 kHz
5. I_C = 100 μA, V_{CE} = 10V, R_G = 3 kΩ, BW = 15.7 kHz
6. I_C = 100 μA, V_{CE} = 10V R_G = 3 kΩ, f = 100 Hz, BW = 20 Hz
7. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 2 kHz, BW = 200 Hz
8. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW - 150 Hz
10. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz
11. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz

PNP Transistors

DUAL DIFFERENTIAL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	$\frac{h_{FE1}}{h_{FE2}}$ (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\frac{\Delta V_{BE1}-V_{BE2}}{\Delta T}$ (μV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N4020	TO-78	45	45	6	10	30	250	500	0.01				6	50	160	4	10	62
							250	550	0.1	20	5	20				2	11	
							250	600	1	20	10							
							180		50									
2N4021	TO-78	60	60	6	10	50	100	350	0.01				6	40	160	10	10	62
							100	400	0.1	20	5	20				3	11	
							100	500	1	20	10							
							90		50									
2N4023	TO-78	45	45	6	10	30	250	500	0.01				6	50	160	4	11	62
							250	550	0.1	10	3	10				2	10	
							250	600	1	10	5							
							180		50									
2N4024	TO-78	60	60	6	10	50	100	350	0.01				6	40	160	10	11	62
							100	400	0.1	10	3	10				3	10	
							100	500	1	10	5							
							90		50									

Test Conditions:

1. I_E = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 100 μA, V_{CE} = 5V R_G = 3 kΩ, f = 100 Hz, BW = 20 Hz
3. I_C 100 μA, V_{CE} = 10V, R_G = 3 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 100 μA, V_{CE} = 10V, R_G = 3 kΩ, f = 10 kHz, BW = 2 kHz
5. I_C = 100 μA, V_{CE} = 10V, R_G = 3 kΩ, BW = 15.7 kHz
6. I_C = 100 μA, V_{CE} = 10V R_G = 3 kΩ, f = 100 Hz, BW = 20 Hz
7. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 2 kHz, BW = 200 Hz
8. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW · 150 Hz
10. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz
11. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz

N-Channel FETs

SWITCHES

Type No.	Case Style	BV_{GSS} $^*BV_{GDO}$ (V) Min	@ I_G (μA)	I_{GSS} $^*I_{DGO}$ (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N3824	TO-72	50	1	0.1	30	0.1	15	-8		8	15	.1				250		6	15	0	3	0	-8			55
2N3966	TO-72	30	1	0.1	20	1	10	-7	4	6	10	10	2		20	220		6	20	0	1.5	0	-7			50
2N3970	TO-18	40	1	0.25*	20	0.25	20	-12	4	10	20	1	50	150	20	30	1	25	20	0	6	0	-12	20	30	51
2N3971	TO-18	40	1	0.25*	20	0.25	20	12	2	5	20	1	25	75	20	60	1	25	20	0	6	0	-12	30	60	51
2N3972	TO-18	40	1	0.25*	20	0.25	20	-12	0.5	3	20	1	5	30	20	100	1	25	20	0	6	0	-12	80	100	51
2N4091	TO-18	40	1	0.2*	20	0.2	20	-12	5	10	20	1	30		20	30	1	16	20	0	5	0	-20	25	40	51
2N4092	TO-18	40	1	0.2*	20	0.2	20	-8	2	7	20	1	15		20	50	1	16	20	0	5	0	-20	35	60	51
2N4093	TO-18	40	1	0.2*	20	0.2	20	-6	1	5	20	1	8		20	80	1	16	20	0	5	0	-20	60	80	51
2N4391	TO-18	40	1	0.1	20	0.1	20	-12	4	10	20	1	50		20	30	1	14	20	0	3.5	0	-12	20	35	51
2N4392	TO-18	40	1	0.1	20	0.1	20	-7	2	5	20	1	25		20	60	1	14	20	0	3.5	0	-7	20	55	51
2N4393	TO-18	40	1	0.1	20	0.1	20	-5	0.5	3	20	1	5		20	100	1	14	20	0	3.5	0	-5	20	80	51
2N4856	TO-18	40	1	0.25	20	0.25	15	-10	4	10	15	.5	50		15	25		18	0	-10	8	0	-10	9	25	51
2N4856A	TO-18	40	1	0.25	20	0.25	15	-10	4	10	15	.5	50		15	25		10	0	-10	4	0	-10	8	20	51
2N4857	TO-18	40	1	0.25	20	0.25	15	-10	2	6	15	.5	20		15	40		18	0	-10	8	0	-10	10	50	51
2N4857A	TO-18	40	1	0.25	20	0.25	15	-10	2	6	15	.5	20		15	40		10	0	-10	3.5	0	-10	10	40	51
2N4858	TO-18	40	1	0.25	20	0.25	15	-10	0.8	4	15	.5	8		15	60		18	0	-10	8	0	-10	20	100	51
2N4858A	TO-18	40	1	0.25	20	0.25	15	-10	0.8	4	15	.5	8		15	60		10	0	-10	3.5	0	-10	16	80	51
2N4859	TO-18	30	1	0.25	15	0.25	15	-10	4	10	15	.5	50		15	25		18	0	-10	8	0	-10	9	25	51
2N4859A	TO-18	30	1	0.25	15	0.25	15	-10	4	10	15	.5	50		15	25		10	0	-10	4	0	-10	8	20	51
2N4860	TO-18	30	1	0.25	15	0.25	15	-10	2	6	15	.5	20		15	40		18	0	-10	8	0	-10	10	50	51
2N4860A	TO-18	30	1	0.25	15	0.25	15	-10	2	6	15	.5	20		15	40		10	0	-10	3.5	0	-10	10	40	51
2N4861	TO-18	30	1	0.25	15	0.25	15	-10	0.8	4	15	.5	8		15	60		18	0	-10	8	0	-10	20	100	51
2N4861A	TO-18	30	1	0.25	15	0.25	15	-10	0.8	4	15	.5	8		15	60		10	0	-10	3.5	0	-10	16	80	51
2N5432	TO-52	25	1	0.2	15	0.2	5	-10	4	10	5	3	150		15	5	10	30	0	-10	15	0	-10	5	36	58
2N5433	TO-52	25	1	0.2	15	0.2	5	-10	3	9	5	3	100		15	7	10	30	0	-10	15	0	-10	5	36	58
2N5434	TO-52	25	1	0.2	15	0.2	5	-10	1	4	5	3	30		15	10	10	30	0	-10	15	0	-10	5	36	58
2N5555	TO-92	25	10	1	15	10	12	-10					15		15	150		5	15	0	1.2	0	-10	10	25	50
2N5638	TO-92	30	10	1	15	1	15	-12					50		20	30	1	10	0	-12	4	0	-12			51
2N5639	TO-92	30	10	1	15	1	15	-8					25		20	60	1	10	0	-12	4	0	-8			51
2N5640	TO-92	30	10	1	15	1	15	-6					5		20	100	1	10	0	-12	4	0	-6			51
2N5653	TO-92	30	10	1	15	1	15	-12					40		20	50	1	10	0	-12	3.5	0	-12	9	15	51
2N5654	TO-92	25	10	1	15	10	15	-8					15		20	100	1	10	0	-12	3.5	0	-8	14	30	51
E109	TO-106	25	1	3	15	3	5	-10	2	6	5	1μ	40		15	12		85	0	0	15	0	-10			58
KE4091	TO-106	40	1	1*	20	1	20	-12	5	10	20	1	30		20	30		16	20	0	5	20	0	25	40	51
KE4092	TO-106	40	1	1*	20	1	20	-8	2	7	20	1	15		20	50		16	20	0	5	20	0	35	60	51
KE4093	TO-106	40	1	1*	20	1	20	-6	1	5	20	1	8		20	80		16	20	0	5	20	0	60	80	51

N-Channel FETs

SWITCHES (Cont.)

Type No.	Case Style	BV_{GSS} $^*BV_{GDO}$ (V) Min	@ I_G (μA)	I_{GSS} $^*I_{DGO}$ (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	V_p (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
KE4391	TO-106	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	3.5	0	−12	20	35	51
KE4392	TO-106	40	1	1	20	1	20	−7	2	5	20	1	25	75	20	60		14	20	0	3.5	0	−7	40	80	51
KE4393	TO-106	40	1	1	20	1	20	−5	0.5	3	20	1	5	30	20	100		14	20	0	3.5	0	−5	55	130	51
KE4856	TO-106	40	1	1	20	1	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
KE4857	TO-106	40	1	1	20	1	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
KE4858	TO-106	40	1	1	20	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
KE4859	TO-106	30	1	1	15	1	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
KE4860	TO-106	30	1	1	15	1	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
KE4861	TO-106	30	1	1	15	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
NF510	TO-18	30	1	10	15				0.5	10	20	10	5		10	100		18	0	−10	6	0	−10			51
NF580	TO-52	25	1	1	15	1	5	−12	4	12	5	3				5	10	25	0	−15	13	0	−15	5	25	58
NF581	TO-52	25	1	1	15	1	5	−10	4	10	5	3				6	10	25	0	−15	13	0	−15	5	25	58
NF582	TO-52	25	1	1	15	1	5	−10	2	6	5	3				10	10	25	0	−15	13	0	−15	5	25	58
NF583	TO-52	25	1	1	15	1	5	−10	0.5	4	5	3				20	10	25	0	−15	13	0	−15	10	25	58
NF584	TO-52	15	1	50	15	50	5	−10		10	5	3				10	10	25	0	−15	13	0	−15			58
NF585	TO-52	15	1	50	15	50	5	−10		6	5	3				20	10	25	0	−15	13	0	−15			58
NF4445	TO-52	25	1	3*	15	3	5	−10	2	10	5	3	150		2	5	10	50	0	−10	25	0	−10			58
NF4446	TO-52	25	1	3*	15	3	5	−10	2	10	5	3	100		2	10	10	50	0	−10	25	0	−10			58
NF4447	TO-52	20	1	3*	15	3	5	−10	2	10	5	3	150		2	6	10	50	0	−10	25	0	−10			58
NF4448	TO-52	20	1	3*	15	3	5	−10	2	10	5	3	100		2	12	10	50	0	−10	25	0	−10			58
NF5555	TO-72	25	10	1	15	1	12	−10					15		15	150		5	15	0	1.2	0	−10	10	25	50
NF5638	TO-18	30	10	1	15	1	15	−12					50		20	30	1	10	0	−12	4	0	−12			51
NF5639	TO-18	30	10	1	15	1	15	−8					25		20	60	1	10	0	−12	4	0	−8			51
NF5640	TO-18	30	10	1	15	1	15	−6					5		20	100	1	10	0	−12	4	0	−6			51
NF5653	TO-18	30	10	1	15	1	15	−12					40		20	50	1	10	0	−12	3.5	0	−12	9	15	51
NF5654	TO-18	30	10	1	15	1	15	−8					15		20	100	1	10	0	−12	3.5	0	−8	14	30	51
TIS73	TO-106	30	1	2	15	2	15	−10	4	10	15	4	50		15	25		18	0	−10	8	0	−10	9	25	51
TIS74	TO-106	30	1	2	15	2	15	−10	2	6	15	4	20	100	15	40		18	0	−10	8	0	−10	10	50	51
TIS75	TO-106	30	1	2	15	2	15	−10	0.8	4	15	4	8	80	15	60		18	0	−10	8	0	−10	20	100	51
U1897E	TO-106	40	1	0.2*	20				5	10	20	1	30		20	30	1	16	20	0	5	0	−20	25	40	51
U1898E	TO-106	40	1	0.2*	20				2	7	20	1	15		20	50	1	16	20	0	5	0	−20	35	60	51
U1899E	TO-106	40	1	0.2*	20				1	5	20	1	8		20	80	1	16	20	0	5	0	−20	60	80	51
UC250	TO-18	30	1	1	20				5	10	20	1	50	150	20	30		25	20	0	7	10	0			51
UC251	TO-18	30	1	1	20				1	6	20	1	7.5	75	20	75		25	20	0	7	10	0			51

N-Channel FETs

RF AMPS

Type No.	Case Style	BV_{GSS} $*BV_{GDO}$ (V) Min	@ I_G (μA)	I_{GSS} $*I_{DGO}$ (nA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	$R_e Y_{fs}$ (mMho) Min	@ Freq (MHz)	$R_e(Y_{os})$ (μMho) Max	@ f (MHz)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	NF (dB) Max	@ R_G = 1k Freq (MHz)	Process No.
2N3819	TO-106	25	1	2	15		8	15	2	2	20	15	1.6	100			8	15	0	4	15	0			50
2N3823	TO-72	30	1	0.5	20		8	15	.5	4	20	15	3.2	200	200	200	6	15	0	2	15	0	2.5	100	50
2N4223	TO-72	30	10	0.25	20	0.1	8	15	.25	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50
2N4224	TO-72	30	10	0.5	20	0.1	8	15	.5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50
2N4416	TO-72	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
2N4416A	TO-72	30	1	0.1	20	2.5	6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
2N5078	TO-72	30	1	0.25	20	0.5	8	15	1000	4	25	15	4	200	150	200	6	15	0	2	15	0	3	200	50
2N5245	TO-106	30	1	1	20	1	6	15	10	5	15	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
2N5246	TO-106	30	1	1	20	0.5	4	15	10	1.5	7	15	2.5	400	100	400	4.5	15	0	1	15	0			50
2N5247	TO-106	30	1	1	20	1.5	8	15	10	8	24	15	4	400	150	400	4.5	15	0	1	15	0			50
2N5248	TO-92	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	6	15	0	2	15	0			50
2N5484	TO-92	25	1	.1	20	0.3	3	15	10	1	5	15	2.5	100	75	100	5	15	0	1	15	0	3	100	50
2N5485	TO-92	25	1	1	20	1	4	15	10	4	10	15	3	400	100	400	5	15	0	1	15	0	4	400	50
2N5486	TO-92	25	1	1	20	2	6	15	10	8	20	15	3.5	400	100	400	5	15	0	1	15	0	4	400	50
2N5668	TO-92	25	10	2	15	0.2	4	15	10	1	5	15	1	100	50	100	7	15	0	3	15	0	2.5	100	50
2N5669	TO-92	25	10	2	15	1	6	15	10	4	8	15	1.6	100	100	100	7	15	0	3	15	0	2.5	100	50
2N5670	TO-92	25	10	2	15	2	8	15	10	8	20	15	2.5	100	150	100	7	15	0	3	15	0	2.5	100	50
BF256A	TO-106	30	1	5	20	0.5	7.5	15	1000	3	7	15	4.5	1			1.2	15	0	0.7	20	−1	7.0	800	50
BF256B	TO-106	30	1	5	20	0.5	7.5	15	1000	6	13	15	4.5	1			1.2	15	0	0.7	20	−1	7.0	800	50
BF256C	TO-106	30	1	5	20	0.5	7.5	15	1000	11	18	15	4.5	1			1.2	15	0	0.7	20	−1	7.0	800	50
KE4223	TO-106	30	1	1	20	0.1	8	15	1	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50
KE4224	TO-106	30	1	1	20	0.1	8	15	.5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50
KE4416	TO-106	30	1	1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
MPF102	TO-92	25	1	2	15		8	15	2	2	20	15	1.6	100	100	200	7	15	0	3	15	0			50
MPF106	TO-92	25	1	1	20	0.5	4	15	.5	4	10	15	2.5	0.001			5	15	0	2	15	0	4	400	50
MPF107	TO-92	25	1	1	20	2	6	15	.5	8	20	15	4	0.001			5	15	0	1.2	15	0	4	400	50
MPF108	TO-92	25	10	1	15	0.5	8	15	10μ	1.5	24	15	1.6	100	200	100	6.5	15	0	2.5	15	0	3	100	50
NF500	TO-72	25	10	10	20		8	15	10	1	30	15													50
NF501	TO-72	15	10	50	10		8	10	1000	1	30	10													50
NF506	TO-72	25	1	1	20	0.5	5	15	5000	4	15	15	2.5	0.001			4	15	0	1	15	0	2	100	50
NF5485	TO-72	25	1	1	20	1	4	15	10	4	10	15	3	400	100	400	5	15	−10	1	15	−10	4	400	50
NF5486	TO-72	25	1	1	20	2	6	15	10	8	20	15	3.5	400	100	400	5	15	0	1	15	0	4	400	50
TIS34	TO-106	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	6	15	0	2	15	0			50
TIS88	TO-106	30	1	1	20	1	6	15	10	5	15	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
UC734	TO-72	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	4	15	0	0.8	15	0			50
UC734E	TO-106	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	4.5	15	0	1	15	0			50

N-Channel FETs

LOW NOISE AMPS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mMho) Min	G_{fs} (mMho) Max	@ V_{DS} (V)	G_{oss} (μMho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N3089	TO-18	15	1	1	10	1	5	15	100	0.5	2	10	0.3	2	15	50	15	6	15	0	2	15	0	125 avg	10-15 k	52
2N3089A	TO-18	15	1	1	10	1	5	15	100	0.5	2	10	0.3	2	15	50	15	6	15	0	2	15	0	45 avg	10-15 k	52
2N3459	TO-18	50*	1	0.25	30		3.4	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	-6	5	30	0	155	20	52
2N3460	TO-18	50*	1	0.25	30		1.8	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	-4	5	30	0	155	20	52
2N4338	TO-18	50	1	0.1	30	0.3	1	15	.1	0.2	0.6	15	0.6	1.8	15	5	15	7	15	0	3	15	0	70	1000	52
2N4339	TO-18	50	1	0.1	30	0.6	1.8	15	.1	0.5	1.5	15	0.8	2.4	15	15	15	7	15	0	3	15	0	70	1000	52
2N4340	TO-18	50	1	0.1	30	1	3	15	.1	1.2	3.6	15	1.3	3	15	30	15	7	15	0	3	15	0	70	1000	52
2N4341	TO-18	50	1	0.1	30	2	6	15	.1	3	9	15	2	4	15	60	15	7	15	0	3	15	0	70	1000	52
2N4867	TO-72	40	1	0.25	30	0.7	2	20	1000	0.4	1.2	20	0.7	2	20	1.5	20	25	20	0	5	20	0	20	10	57
2N4867A	TO-72	40	1	0.25	30	0.7	2	20	1000	0.4	1.2	20	0.7	2	20	1.5	20	25	20	0	5	20	0	10	10	57
2N4868	TO-72	40	1	0.25	30	1	3	20	1000	1	3	20	1	3	20	4	20	25	20	0	5	20	0	20	10	57
2N4868A	TO-72	40	1	0.25	30	1	3	20	1000	1	3	20	1	3	20	4	20	25	20	0	5	20	0	10	10	57
2N4869	TO-72	40	1	0.25	30	1.8	5	20	1000	2.5	7.5	20	1.3	4	20	10	20	25	20	0	5	20	0	20	10	57
2N4869A	TO-72	40	1	0.25	30	1.8	5	20	1000	2.5	7.5	20	1.3	4	20	10	20	25	20	0	5	20	0	10	10	57
KE3684	TO-106	50	1	1	35	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	20	52
KE3685	TO-106	50	1	1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	20	52
KE3686	TO-106	50	1	1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	20	52
KE3687	TO-106	50	1	1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	20	52

N-Channel FETs

ULTRA-LOW INPUT CURRENT AMPS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (pA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (μA) Min	I_{DSS} (μA) Max	@ V_{DS} (V)	G_{fs} (μMho) Min	G_{fs} (μMho) Max	@ V_{DS} (V)	G_{oss} (μMho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ f (Hz)	Process No.
2N4117	TO-72	40	1	10	20	0.6	1.8	10	1	30	90	10	20	210	10	3	10	3	10	0	1.5	10	0			53
2N4117A	TO-72	40	1	1	20	0.6	1.8	10	1	30	90	10	70	210	10	3	10	3	10	0	1.5	10	0			53
2N4118	TO-72	40	1	10	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53
2N4118A	TO-72	40	1	1	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53
2N4119	TO-72	40	1	10	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53
2N4119A	TO-72	40	1	1	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53

N-Channel FETs

GENERAL PURPOSE AMPS

Transistor Type	Case Style	BV_{GSS} $*BV_{GDO}$ (V) Min	@ I_G (μA)	I_{GSS} $*I_{DGO}$ (nA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mMho) Min	G_{fs} (mMho) Max	@ V_{DS} (V)	G_{oss} (μMho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N3069	TO-18	*50	1	1	30		9.5	30	1000	2	10	30	1	2.5	30	80	30	15	0	−12	1.5	30	0	125	1000	52
2N3070	TO-18	*50	1	1	30		4.5	30	1000	0.5	2.5	30	0.75	2.5	30	30	30	15	0	−8	1.5	30	0	125	1000	52
2N3071	TO-18	*50	1	1	30		2.2	30	1000	0.5	2.5	30	0.75	2.5	30	30	30	15	0	−8	1.5	30	0	125	1000	52
2N3365	TO-18	*40	1	5	30		11.5	20	1000	0.8	4	30	0.4	2	30	50	30	15	8	0	2.5	30	0			52
2N3367	TO-18	*40	1	5	30		2.2	20	1000	0.05	0.25	30	0.1	1	30	10	30	15	8	0	2.5	30	0			53
2N3368	TO-18	*40	1	5	30		11.5	20	1000	2	12	30	1	4	30	80	30	20	8	0	3	30	0			52
2N3369	TO-18	*40	1	5	30		6.5	20	1000	0.5	2.5	30	0.6	2.5	30	30	30	20	8	0	3	30	0			52
2N3370	TO-18	*40	1	5	30		3.2	20	1000	0.1	0.6	30	0.3	2.5	30	15	30	20	8	0	3	30	0			52
2N3436	TO-18	*50	1	0.5	30		9.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	6	30	0	100	1000	55
2N3437	TO-18	*50	1	0.5	30		4.8	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	6	30	0	100	1000	55
2N3438	TO-18	*50	1	0.5	30		2.3	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	6	30	0	100	1000	55
2N3452	TO-72	*50	1	0.1	30		9.8	20	1000	0.8	4	30	0.2	1.2	30	15	30	6	0	−12	1.5	30	0	100	100	53
2N3453	TO-72	*50	1	0.1	30		4.8	20	1000	0.2	1	30	0.15	0.9	30	5	30	6	0	−8	1.5	30	0	100	100	53
2N3454	TO-72	*50	1	0.1	30		2.3	20	1000	0.05	0.25	30	0.1	0.6	30	3	30	6	0	−4	1.5	30	0	100	100	53
2N3455	TO-72	*50	1	0.4	30		9.8	20	1000	0.8	4	30	0.3	9	30	5	30	5	0	−12	1.5	30	0	155	20	53
2N3456	TO-72	*50	1	0.4	30		4.8	20	1000	0.2	1	30	0.15	0.6	30	3	30	5	0	−8	1.5	30	0	155	20	53
2N3457	TO-72	*50	1	0.4	30		2.3	20	1000	0.05	0.25	30	0.15	0.6	30	3	30	5	0	−4	1.5	30	0	155	20	53
2N3458	TO-18	*50	1	0.25	30		7.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	5	30	0	225	20	55
2N3459	TO-18	*50	1	0.25	30		3.4	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	5	30	0	155	20	55
2N3460	TO-18	*50	1	0.25	30		1.8	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	5	30	0	155	20	52
2N3684	TO-72	50	1	0.1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	100	52
2N3685	TO-72	50	1	0.1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	100	52
2N3686	TO-72	50	1	0.1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	100	52
2N3687	TO-72	50	1	0.1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	100	52
2N3821	TO-72	50	1	0.1	30		4	15	.5	0.5	2.5	15	1.5	4.5	15	10	15	6	15	0	3	15	0	200	10	55
2N3822	TO-72	50	1	0.1	30		6	15	.5	2	10	15	3	6.5	15	20	15	6	15	0	3	15	0	200	10	55
2N3967	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5	2.5	20	35	20¶	5	20	¶	1.3	20	•	84	100	50
2N3967A	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5	2.5	20	35	20¶	5	20	¶	1.3	20	•	160	10	50
2N3968	TO-72	30	1	0.1	20		3	20	1	1	5	20	2	2	20	15	20**	5	20	**	1.3	20	†	84	100	50
2N3968A	TO-72	30	1	0.1	20		3	20	1	1	5	20	2	2	20	15	20**	5	20	**	1.3	20	†	160	10	50
2N3969	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3	1.3	20	5	20††	5	20	††	1.3	20	¶	84	100	50
2N3969A	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3	1.3	20	5	20††	5	20	††	1.3	20	¶	160	10	50
2N4139	TO-18	50	1	1	30	2	8	20	1	8	11	20	3.5	7	20	35	20	18	20	0	5	20	0	100	1000	55
2N4220	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			52

•I_D = 1 mA   †I_D = 500μA   ¶I_D = 250μA   §I_D = 200μA   **I_D = 100μA   ††I_D = 40μA

N-Channel FETs

GENERAL PURPOSE AMPS (Cont.)

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mMho) Min	G_{fs} (mMho) Max	@ V_{DS} (V)	G_{oss} (μMho) Max	V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N4220A	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0	115	100	52
2N4221	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55
2N4221A	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0	115	100	55
2N4222	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55
2N4222A	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55
2N4302	TO-106	30	1	1	10		4	20	10	0.5	5	20	1	1	20	50	20	6	20	0	3	20	0	100	1000	52
2N4303	TO-106	30	1	1	10		6	20	10	4	10	20	2	2	20	50	20	6	20	0	3	20	0	100	1000	52
2N4304	TO-106	30	1	1	10		10	20	10	0.5	15	20	1	1	20	50	20	6	20	0	3	20	0	125	1000	52
2N4338	TO-18	50	1	0.1	30	0.3	1	15	100	0.2	0.6	15	0.6	1.8	15	5	15	7	15	0	3	15	0	68	1000	52
2N4339	TO-18	50	1	0.1	30	0.6	1.8	15	100	0.5	1.5	15	0.8	2.4	15	15	15	7	15	0	3	15	0	68	1000	52
2N4340	TO-18	50	1	0.1	30	1	3	15	100	1.2	3.6	15	1.3	3	15	30	15	7	15	0	3	15	0	68	1000	52
2N4341	TO-18	50	1	0.1	30	2	6	15	100	3	9	15	2	4	15	60	15	7	15	0	3	15	0	68	1000	52
2N5103	TO-72	25	10	0.1	15	0.5	4	15	1	1	8	15	2	8	15	100	15	5	15	0	1	15	0	100	10	50
2N5104	TO-72	25	1	0.1	15	0.5	4	15	1	2	6	15	3.5	7.5	15	100	15	5	15	0	1	15	0	50	10	50
2N5163	TO-106	25	1	10	15	0.4	8	15	1000	1	40	15	2	9	15	200	15	12	15	0	3	15	0	50	1000	50
2N5358	TO-72	40	1	0.1	20	0.5	3	15	100	0.5	1	15	1	3	15	10	15	6	15	0	2	15	0	115	100	52
2N5359	TO-72	40	1	0.1	20	0.8	4	15	100	0.6	1.6	15	1.2	3.6	15	10	15	6	15	0	2	15	0	115	100	52
2N5360	TO-72	40	1	0.1	20	0.8	4	15	100	0.5	2.5	15	1.4	4.2	15	20	15	6	15	0	2	15	0	115	100	52
2N5361	TO-72	40	1	0.1	20	1	6	15	100	2.5	5	15	1.5	4.5	15	20	15	6	15	0	2	15	0	115	100	55
2N5362	TO-72	40	1	0.1	20	2	7	15	100	4	8	15	2	5.5	15	40	15	6	15	0	2	15	0	115	100	55
2N5363	TO-72	40	1	0.1	20	2.5	8	15	100	7	14	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55
2N5364	TO-72	40	1	0.1	20	2.5	8	15	100	9	18	15	2.7	6.5	15	60	15	6	15	0	2	15	0	115	100	55
2N5457	TO-92	25	1	1	15	0.5	6	15	10	1	5	15	2	5	15	50	15	7	15	0	3	15	0			55
2N5458	TO-92	25	1	1	15	1	7	15	10	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55
2N5459	TO-92	25	1	1	15	2	8	15	10	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55
2N5556	TO-72	30	1	0.1	15	0.2	4	15	1	0.5	2.5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5557	TO-72	30	1	0.1	15	0.2	4	15	1	0.5	2.5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5558	TO-72	30	1	0.1	15	0.8	5	15	1	2	5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5716	TO-92	40	10	1	20	0.2	3	15	1	0.05	0.25	15	0.2	1	15	25	15	5	15	0	1.5	15	0			52(72)
2N5717	TO-92	40	10	1	20	0.5	5	15	1	0.2	1	15	0.4	1.6	15	25	15	5	15	0	1.5	15	0			52
2N5718	TO-92	40	10	1	20	1	8	15	1	0.8	4	15	0.5	2	15	25	15	5	15	0	1.5	15	0			52
E100	TO-106	30	1	0.5	20	0.3	10	20	10	0.2	20	20	0.5	0.5	20			8	20	0	3	20	0			52
E101	TO-106	30	1	0.5	20	0.3	1.5	20	10	0.2	1	20	0.5	0.5	20			8	20	0	3	20	0			52
E102	TO-106	30	1	0.5	20	0.8	4	20	10	0.9	4.5	20	1	1	20			8	20	0	3	20	0			52
E103	TO-106	30	1	0.5	20	2	10	20	10	4	20	20	1.5	1.5	20			8	20	0	3	20	0			52
KE3684	TO-106	50	1	1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	20	52

KE3685	TO-106	50	1	1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	20	52
KE3686	TO-106	50	1	1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	20	52
KE3687	TO-106	50	1	1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	20	52
KE4220	TO-106	30	10	1	15		4	15	1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			55
KE4221	TO-106	30	10	1	15		6	15	1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55
KE4222	TO-106	30	10	1	15		8	15	1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55
MPF103	TO-92	25	1	1	15		6	15	1	1	5	15	1	5	15	50	15	7	15	0	3	15	0			55
MPF104	TO-92	25	1	1	15		7	15	1	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55
MPF105	TO-92	25	1	1	15		8	15	1	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55
MPF109	TO-92	25	10	1	15	0.2	8	15	10	0.5	24	15	0.8	6	15	75	15	7	15	0	3	15	0	115	1000	55
MPF110	TO-92	20	10	100	10	0.5	10	10	1000	0.5	20	10	0.5	7.5	10											50
MPF111	TO-92	20	10	100	10	0.5	10	10	1000	0.5	20	10	0.5	0.5	10	200	10									50
MPF112	TO-92	25	10	100	10	0.5	10	10	1000	1	25	10	1	7.5	10											55
NF520	TO-72	30	10	1	15		8	15	10	1	10	15	0.5	0.5	15			4	0	−15	1.2	0	−15	65	1000	52
NF521	TO-72	30	10	1	15		8	15	10	0.1	2	15	0.4	0.4	15			4	0	−15	1.2	0	−15	65	1000	52
NF530	TO-18	30	10	1	15		8	15	10	1	10	15	0.5	0.5	15			4	0	−15	1.2	0	−15	65	1000	52
NF531	TO-18	30	10	1	15		8	15	10	0.1	2	15	0.4	0.4	15			4	0	−15	1.2	0	−15	65	1000	52
NF4302	TO-18	30	1	1	10		4	20	10	0.5	5	20	1	1	20	50	20	6	20	0	3	20	0	100	1000	52
NF4303	TO-18	30	1	1	10		6	20	10	4	10	20	2	2	20	50	20	6	20	0	3	20	0	100	1000	52
NF4304	TO-18	30	1	1	10		10	20	10	0.5	15	20	1	1	20	50	20	6	20	0	3	20	0	125	1000	52
NF5163	TO-72	25	1	10	15	0.4	8	15	1000	1	40	15	2	9	15	200	15	12	15	0	3	15	0	50	1000	50
NF5457	TO-18	25	1	1	15	0.5	6	15	10	1	5	15	1	5	15	50	15	7	15	0	3	15	0			55
NF5458	TO-18	25	1	1	15	1	7	15	10	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55
NF5459	TO-18	25	1	1	15	2	8	15	10	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55
TIS58	TO-92	25	1	4	15	0.5	5	15	20	2.5	8	15	1.3	4	15			6	15	2 mA	3	15	2 mA			50
UC714	TO-18	30	1	1	20		8	20	1	2	20	20	2	6.5	20			8	20	0	4	20	0	100	100	52

N-Channel FETs

MONOLITHIC DUALS

Type No.	Case Style	*BV_{DGO} BV_{GSS} (V) Min	I_{GSS} *I_{DGO} (pA) @ V_{GS} Max	(V)	V_p (V) Min	Max	I_{DSS} (mA) Min	Max	G_{fs} (mMho) Min	Max	G_{oss} (μMho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	Oper. Cond. V_{DG} (V)	I_D (μA)	I_G (pA) Max	V_{GS} (V) Min	Max	V_{OS} (mV) Max	DRIFT (μV/°C) Max	I_{G1}-I_{G2} @ 125°C (nA) Max	G_{oss} (μMho) Max	G_{fs} (mMho) Min	Process No.
2N3921	TO-71	*50	1000	30		3	1	10	1.5	7.5	35	18	6	10	700	250			5	10		20	1.5	83
2N3922	TO-71	*50	1000	30		3	1	10	1.5	7.5	35	18	6	10	700	250			5	25		20	1.5	83
2N3954	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.5	20	200	50	0.5	4	5	10	10			83
2N3954A	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.5	20	200	50	0.5	4	5	5	10			83
2N3955	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.5	20	200	50	0.5	4	10	25	10			83

N-Channel FETs

MONOLITHIC DUALS (Cont.)

Type No.	Case Style	*BV_{DGO} BV_{GSS} (V) Min	I_{GSS} *I_{DGO} (pA) Max	@ V_{GS} (V)	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (mMho) Min	G_{fs} (mMho) Max	G_{oss} (μMho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	Oper. Cond. V_{DG} (V)	Oper. Cond. I_D (μA)	I_G (pA) Max	V_{GS} (V) Min	V_{GS} (V) Max	V_{OS} (mV) Max	DRIFT (μV/°C) Max	I_{G1}-I_{G2} @ 125°C (nA) Max	G_{oss} (μMho) Max	G_{fs} (mMho) Min	Process No.
2N3955A	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.5	20	200	50	0.5	4	5	15	10			83
2N3956	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	15	50	10			83
2N3957	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	20	75	10			83
2N3958	TO-71	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	25	100	10			83
2N4084	TO-71	*50	1000	30		3	1	10	1.5	7.5	35	18	6	10	700	250			15	10		20	1.5	83
2N4085	TO-71	*50	1000	30		3	1	10	1.5	7.5	35	18	6	10	700	250			15	25		20	1.5	83
2N5045	TO-71	50	250	30	0.5	4.5	0.5	8	1.5	6	25	8	4	15	200				5	10	10			83
2N5046	TO-71	50	250	30	0.5	4.5	0.5	8	1.5	6	25	8	4	15	200				10	20	10			83
2N5047	TO-71	50	250	30	0.5	4.5	0.5	8	1.5	6	25	8	4	15	200				15	50	10			83
2N5196	TO-71	50	25	30	0.7	4	0.7	7	1	4	50	6	2	20	200	15	0.2	3.8	5	5	5	4	0.7	83
2N5197	TO-71	50	25	30	0.7	4	0.7	7	1	4	50	6	2	20	200	15	0.2	3.8	5	10	5	4	0.7	83
2N5198	TO-71	50	25	30	0.7	4	0.7	7	1	4	50	6	2	20	200	15	0.2	3.8	10	20	5	4	0.7	83
2N5199	TO-71	50	25	30	0.7	4	0.7	7	1	4	50	6	2	20	200	15	0.2	3.8	15	40	5	4	0.7	83
2N5545	TO-71	50	100	30	0.5	4.5	0.5	8	1.5	6	25	6	2	15	200	50			5	10	5			83
2N5546	TO-71	50	100	30	0.5	4.5	0.5	8	1.5	6	25	6	2	15	200	50			10	20	5			83
2N5547	TO-71	50	100	30	0.5	4.5	0.5	8	1.5	6	25	6	2	15	200	50			15	40	5			83
FM1100	TO-99	35	100	20	0.5	3	0.1	1.2	0.5	3	35	5	0.6	15	100	50			2	5	10			59
FM1101	TO-99	35	100	20	0.5	3	0.1	1.2	0.5	3	35	5	0.6	15	100	50			5	5	10			59
FM1102	TO-99	35	100	20	0.5	3	0.1	1.2	0.5	3	35	5	0.6	15	100	50			10	5	10			59
FM1103	TO-99	35	100	20	0.5	3	0.1	1.2	0.5	3	35	5	0.6	15	100	50			10	20	10			59
FM1104	TO-99	35	100	20	0.5	3	0.1	1.2	0.5	3	35	5	0.6	15	100	50			25	50	10			59
FM1105	TO-99	35	100	20	1	6	1	10	1	6	35	5	0.6	15	100	50			2	5	10			59
FM1106	TO-99	35	100	20	1	6	1	10	1	6	35	5	0.6	15	100	50			5	5	10			59
FM1107	TO-99	35	100	20	1	6	1	10	1	6	35	5	0.6	15	100	50			10	5	10			59
FM1108	TO-99	35	100	20	1	6	1	10	1	6	35	5	0.6	15	100	50			10	20	10			59
FM1109	TO-99	35	100	20	1	6	1	10	1	6	35	5	0.6	15	100	50			25	50	10			59
FM1110	TO-99	25	1000	20	0.5	10	0.1	10	0.5	6		5	0.6	15	100	500			10	20	50			59
FM1111	TO-99	25	1000	20	0.5	10	0.1	10	0.5	6		5	0.6	15	100	500			50	100	50			59
FM1100A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			2	5	0.04			82
FM1101A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			5	5	0.04			82
FM1102A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			10	5	0.04			82
FM1103A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			10	20	0.04			82
FM1104A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			25	50	0.04			82
FM1105A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			2	5	0.04			82
FM1106A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			5	5	0.04			82
FM1107A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			10	5	0.04			82

FM1108A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			10	20	0.04			82
FM1109A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			25	50	0.04			82
FM1110A	TO-78	*35			0.5	10	0.1	10	0.5	6		5	0.6	15	100	5¶			10	20				82
FM1111A	TO-78	*35			0.5	10	0.1	10	0.5	6		5	0.6	15	100	5¶			50	100				82
FM1200	TO-99	35	200	20	0.5	2	0.2	2.5	0.8	4.5	35	8	1	15	200	100			2	5	10			54
FM1201	TO-99	35	200	20	0.5	2	0.2	2.5	0.8	4.5	35	8	1	15	200	100			5	5	10			54
FM1202	TO-99	35	200	20	0.5	2	0.2	2.5	0.8	4.5	35	8	1	15	200	100			10	5	10			54
FM1203	TO-99	35	200	20	0.5	2	0.2	2.5	0.8	4.5	35	8	1	15	200	100			10	20	10			54
FM1204	TO-99	35	200	20	0.5	2	0.2	2.5	0.8	4.5	35	8	1	15	200	100			25	50	10			54
FM1205	TO-99	35	200	20	1	7	2	20	3	10	50	8	1	15	200	100			2	5	10			54
FM1206	TO-99	35	200	20	1	7	2	20	3	10	50	8	1	15	200	100			5	5	10			54
FM1207	TO-99	35	200	20	1	7	2	20	3	10	50	8	1	15	200	100			10	5	10			54
FM1208	TO-99	35	200	20	1	7	2	20	3	10	50	8	1	15	200	100			10	20	10			54
FM1209	TO-99	35	200	20	1	7	2	20	3	10	50	8	1	15	200	100			25	50	10			54
FM1210	TO-99	25	1000	20	0.5	7	0.2	20	0.8	10		8	1	15	200	500			10	20	50			54
FM1211	TO-99	25	1000	20	0.5	7	0.2	20	0.8	10		8	1	15	200	500			50	100	50			54
FM1300	TO-71	40	100	20	0.5	3	0.2	2	0.5	2	10	4	1.2	20	200	50			5	5		10		83
FM1301	TO-71	40	100	20	0.5	3	0.2	2	0.5	2	10	4	1.2	20	200	50			5	10		10		83
FM1302	TO-71	40	100	20	0.5	3	0.2	2	0.5	2	10	4	1.2	20	200	50			10	10		10		83
FM1303	TO-71	40	100	20	0.5	3	0.2	2	0.5	2	10	4	1.2	20	200	50			10	25		10		83
FM1304	TO-71	40	100	20	0.5	3	0.2	2	0.5	2	10	4	1.2	20	200	50			25	50		10		83
FM1305	TO-71	40	100	20	1	6	1.5	10	1	3	10	4	1.2	20	200	50†			5	5		10		83
FM1306	TO-71	40	100	20	1	6	1.5	10	1	3	10	4	1.2	20	200	50†			5	10		10		83
FM1307	TO-71	40	100	20	1	6	1.5	10	1	3	10	4	1.2	20	200	50†			10	10		10		83
FM1308	TO-71	40	100	20	1	6	1.5	10	1	3	10	4	1.2	20	200	50†			10	25		10		83
FM1309	TO-71	40	100	20	1	6	1.5	10	1	3	10	4	1.2	20	200	50†			25	50		10		83
FM1310	TO-71	30	1000	20	0.5	10	0.1	10	0.5	3		4	1.2	20	200	100†			10	25				83
FM1311	TO-71	30	1000	20	0.5	10	0.1	10	0.5	3		4	1.2	20	200	100†			25	100				83
FM3954	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	5	10	10			59
FM3954A	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	5	5	10			59
FM3955	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	10	25	10			59
FM3955A	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	5	15	10			59
FM3956	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	15	50	10			59
FM3957	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	20	75	10			59
FM3958	TO-99	50	100	30	1	4.5	0.5	5	1	3	35	4	1.2	20	200	50	0.5	4	25	100	10			59
U231	TO-71	50	100	30	0.5	4.5	0.5	5	1	3	35	6	2	20	200	50	0.3	4	5	10	10	10	600	83
U232	TO-71	50	100	30	0.5	4.5	0.5	5	1	3	35	6	2	20	200	50	0.3	4	10	25	10	10	600	83
U233	TO-71	50	100	30	0.5	4.5	0.5	5	1	3	35	6	2	20	200	50	0.3	4	15	50	10	10	600	83
U234	TO-71	50	100	30	0.5	4.5	0.5	5	1	3	35	6	2	20	200	50	0.3	4	20	75	10	10	600	83
U235	TO-71	50	100	30	0.5	4.5	0.5	5	1	3	35	6	2	20	200	50	0.3	4	25	100	10	10	600	83

¶ V_{DG} = 25V   † V_{DG} = 35V

P-Channel FETs

SWITCHES

Transistor Type	Case Style	BVGSS *BVGDO (V) Min	@ I_G (μA)	IGSS *IDGO (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	r_{ds} (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N3382	TO-72	30	1	15	30	2	–5	6	1	5	–5	1	3	30	10	300										88
2N3384	TO-72	30	1	15	30	2	–5	6	4	5	–5	1	15	30	10	180										88
2N3386	TO-72	30	1	15	30	2.5	–5	10	4	9.5	–5	1	15	50	10	150										88
2N3993	TO-72	25	1	1.2*	15	1.2	–10	10	4	9.5	–10	1	10	10	10	150		16	–10	0	4.5	0	10			88
2N3993A	TO-72	25	1	1.2*	15	1.2	–10	10	4	9.5	–10	1	10	10	10	150		12	–10	0	3	0	10			88
2N3994	TO-72	25	1	1.2*	15	1.2	–10	6	1	5.5	–10	1	2	2	10	300		16	–10	0	4.5	0	10			88
2N3994A	TO-72	25	1	1.2*	15	1.2	–10	6	1	5.5	–10	1	2	2	10	300		12	–10	0	3	0	10			88
2N5018	TO-18	30	1	2	15	10	–15	12		10	–15	1	10	10	20	75		45	–15	0	10	0	12	35	65	88
2N5019	TO-18	30	1	2	15	10	–15	7		5	–15	1	5	5	20	150		45	–15	0	10	0	7	90	125	88
2N5114	TO-18	30	1	0.5	20	0.5	–15	12	5	10	–15	.001	30	90	18	75	1	25	–15	0	7	0	12	16	21	88
2N5115	TO-18	30	1	0.5	20	0.5	–15	7	3	6	–15	.001	15	60	15	100	1	25	–15	0	7	0	7	30	38	88
2N5116	TO-18	30	1	0.5	20	0.5	–15	5	1	4	–15	.001	5	25	15	150	1	25	–15	0	7	0	5	42	60	88
P1086E	TO-106	30	1	2	20	10	–15	10		10	–15	.01	10	10	15	75	1	45	–15	0	10	15	0	35	50	88
P1087E	TO-106	30	1	2	20	10	–15	5		5	–15	.01	5	5	15	150		45	–15	0	10	15	0	40	75	88
PF510	TO-18	30	1	10	15				0.5	10	–15	.01	5	5	10	200	0.5	15	–10	0	4	0	12			88
UC451	TO-18	25	1	0.25	20					6	–20	.001	3.75	37.5	20	150		25	–20	0	7	10				88

P-Channel FETs

AMPLIFIERS

Transistor Type	Case Style	BVGSS *BVGDO (V) Min	@ I_G (μA)	IGSS *IDGO (nA) Max	@ V_{DG} (V)	V_P (V) Min	V_P (V) Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	I_{DSS} (mA) Max	@ V_{DS} (V)	G_{fs} (mMho) Min	G_{fs} (mMho) Max	@ V_{DS} (V)	G_{oss} (μMho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N2608	TO-18	30	1	10	30	1	4	–5	1	0.9	4.5	5	1	1	5			17	–5	1				125	1000	89
2N2609	TO-18	30	1	30	30	1	4	–5	1	2	10	5	2.5	2.5	5			30	–5	1				125	1000	88
2N3329	TO-72	20	10	10	10		5	–15	10	1	3	10	1	2	10/1mA	20	10	20	–10	1				125	1000	89
2N3330	TO-72	20	10	10	10		6	–15	10	2	6	10	1.5	3	10/2mA	40	10	20	–10	1				125	1000	89
2N3331	TO-72	20	10	10	10		8	–15	10	5	15	10	2	4	10/5mA	100	10	20	–10	1				155	1000	89
2N3332	TO-72	20	10	10	10		6	–15	10	1	6	10	1	2.2	10/1mA	20	10	20	–10	1				65	1000	89
2N3820	TO-106	20	10	20	10		8	–10	10	0.3	15	10	0.8	5	10	200	10	32	–10	0	16	–10	0			89
2N4342	TO-106	25	10	10	15		5.5	–10	1	4	12	10	2	6	10	75	10	20	–10	0	5	–10	0	80	100	89
2N4343	TO-106	25	10	10	15		10	–10	1	10	30	10	4	8	10	100	10	20	–10	0	5	–10	0	80	100	88

2N4360	TO-106	20	10	10	15	0.7	10	−10	1	3	30	10	2	8	10	100	10	20	−10	0	5	−10	0	190	100	89
2N4381	TO-18	25	1	1	15	1	5	−15	1	3	12	15	2	6	15	75	15	20	−15	0	5	−15	0	20	1000	89
2N4382	TO-18	25	1	1	15	2.5	9	−15	1	10	30	15	4	8	15	100	15	20	−15	0	5	−15	0	20	1000	88
2N5020	TO-18	25	1	1	15	0.3	1.5	−15	1	0.3	1.2	15	1	3.5	15	20	15	25	−15	0	7	−15	0	30	1000	89
2N5021	TO-18	25	1	1	15	0.5	2.5	−15	1	1	3.5	15	1.5	5	15	20	15	25	−15	0	7	−15	0	30	1000	89
2N5033	TO-106	20	10	10	15	0.3	2.5	−10	1	0.3	3.5	10	1	5	10	20	10	25	−10	0	7	−10	0	100	1000	89
2N5460	TO-92	40	10	5	20	0.75	6	−15	1	1	5	15	1	4	15	50	15	7	−15	0	2	−15	0	115	100	89
2N5461	TO-92	40	10	5	20	1	7.5	−15	1	2	9	15	1.5	5	15	50	15	7	−15	0	2	−15	0	115	100	89
2N5462	TO-92	40	10	5	20	1.8	9	−15	1	4	16	15	2	6	15	50	15	7	−15	0	2	−15	0	115	100	89
UC450	TO-18	25	1	0.25	20	5	10	−20	.001	25	75	20	10	10	20			25	−20	0	7	0	10			88
UC451	TO-18	25	1	0.25	20	1	6	−20	.001	3.75	37.5	20	6	6	20			25	−20	0	7	0	10			88

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} / h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ / $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition See Note	Process No.
BC107	TO-18	50	45	6	15	50 I_{CES}	125	900*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC107A	TO-18	50	45	6	15	50 I_{CES}	125	260*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC107B	TO-18	50	45	6	15	50 I_{CES}	240	500*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC108	TO-18	30	20	5	15	30 I_{CES}	125	900*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC108A	TO-18	30	20	5	15	30 I_{CES}	125	260*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC108B	TO-18	30	20	5	15	30 I_{CES}	240	500*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC108C	TO-18	30	20	5	15	30 I_{CES}	450	900*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		10	1	04
BC109	TO-18	30	20	5	15	30 I_{CES}	240	900*	2	5	0.2 0.6	 0.55	 0.7*	10 100 2	4.5	150		10		4 4	1 2	04

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5 mA

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe}(1kHz)* Min	h_{FE} h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC109B	TO-18	30	20	5	15 I_{CES}	30	240	500*	2	5	0.2 0.6	0.55	.07*	10 100 2	4.5	150		10		4 4	1 2	04
BC109C	TO-18	30	20	5	15 I_{CES}	30	450	900*	2	5	0.2 0.6	0.55	.07*	10 100 2	4.5	150		10		4 4	1 2	04
BC113	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4							07
BC114	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4	60		0.05		3	3	07
BC115	TO-105	40	30	5	100	20	50 100 50	 400	1 10 100	10 10 10	1		0.9	100	25							20
BC116	TO-105	60	40	5	100	20	20 35 40	 120	0.1 10 150	10 10 10	0.4 1.6		 1	150 500 50	8	200		30				63
BC118	TO-106	45	45	4	500	30	40	160	10	10					3.5	200		10				23
BC125B	TO-105	60	30	6	50	40	45 40	 120	10 150	1 1	0.25 0.8		1 1.3	150 500	8	200		50				20
BC126	TO-105	35		5	50	20	30 30 25 30	 120	50 150 1 10	1 1 10 10	0.5 0.25		1.3 1.0	150 50 50								63
BC126A	TO-105	40	40	5	50	10	50 50	 150	10 50	10 1	0.5		1.3 1*	150 50								63
BC132	TO-106	30	25	6	50	5	60	300	1	10	0.35			1	4	40		1				04
BC136	TO-105	60		5	50	30	30		10	10	1.5		 1.2	500 150	25							20
BC137	TO-105	40	40	4	50	30	25 30		50 10	4 10	2		 1.3	500 150	10							63
BC140	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	40	250	100	1	1		1.8*	1A	25	50		50	850		19	14
BC140-6	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	40	100	100	1	1		1.8*	1A	25	50		50	850		19	14
BC140-10	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	63	160	100	1	1		1.8*	1A	25	50		50	850		19	14
BC140-16	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	100	250	100	1	1		1.8*	1A	25	50		50	850		19	14
BC141	TO-39	100 BV_{CES}	60	7	100 I_{CES}	60	40	250	100	1	1		1.8*	1A	25	50		50	850		19	14
BC141-6	TO-39	100 BV_{CES}	60	7	100 I_{CES}	60	40	100	100	1	1		1.8*	1A	25	50		50	850		19	14
BC141-10	TO-39	100 BV_{CES}	60	7	100 I_{CES}	60	63	160	100	1	1		1.8*	1A	25	50		50	850		19	14
BC143	TO-5	60	60	5	50	40	20		200	2	1.5		 1.5	500 200		60		50				63

BC153	TO-106	40	40	5	20	40	50 50		0.1 1	5 5	0.25			10					3	4	62
BC154	TO-106	40	40	5	10	40	160 160		0.1 1	5 5	0.25			10					2.5	4	62
BC160	TO-39	40	40	5	100 I_{CES}	40	40	250	100	1	1		1.7*	1A	30	50	50	650		19	67
BC160-6	TO-39	40	40	5	100 I_{CES}	40	40	100	100	1	1		1.7*	1A	30	50	50	650		19	67
BC160-10	TO-39	40	40	5	100 I_{CES}	40	63	160	100	1	1		1.7*	1A	30	50	50	650		19	67
BC160-16	TO-39	40	40	5	100 I_{CES}	40	100	250	100	1	1		1.7*	1A	30	50	50	650		19	67
BC161	TO-39	60	60	5	100 I_{CES}	60	40	250	100	1	1		1.7*	1A	30	50	50	650		19	67
BC161-6	TO-39	60	60	5	100 I_{CES}	60	40	100	100	1	1		1.7*	1A	30	50	50	650		19	67
BC161-10	TO-39	60	60	5	100 I_{CES}	60	63	160	100	1	1		1.7*	1A	30	50	50	650		19	67
BC161-16	TO-39	60	60	5	100 I_{CES}	60	100	250	100	1	1		1.7*	1A	30	50	50	650		19	67
BC167A	TO-92 (74)		45	6	15 I_{CES}	50	125	260*	2	5	0.2 0.6			10 100	4.5	150	10		10	1	04
BC167B	TO-92 (74)		45	6	15 I_{CES}	50	240	500*	2	5	0.2 0.6			10 100	4.5	150	10		10	1	04
BC168A	TO-92 (74)		20	5	15 I_{CES}	30	125	260*	2	5	0.2 0.6			10 100	4.5	150	10		10	1	04
BC168B	TO-92 (74)		20	5	15 I_{CES}	30	240	500*	2	5	0.2 0.6			10 100	4.5	150	10		10	1	04
BC168C	TO-92 (74)		20	5	15 I_{CES}	30	450	900*	2	5	0.2 0.6			10 100	4.5	150	10		10	1	04
BC169B	TO-92 (74)		20	5	15 I_{CES}	30	240	500*	2	5	0.2 0.6			10 100	4.5	150	10		4 4	1 2	04
BC169C	TO-92 (74)		20	5	15 I_{CES}	30	450	900*	2	5	0.2 0.6			10 100	4.5	150	10		4 4	1 2	04
BC170A	TO-106	20	20	5	100	15	35 30	100	1 30	1 1	0.25 0.4		0.7	1 30							04
BC170B	TO-106	20	20	5	100	15	80 60	250	1 30	1 1	0.25 0.4		0.7	1 30							04
BC170C	TO-106	20	20	5	100	15	200 150	600	1 30	1 1	0.25 0.4		0.7	1 30							04
BC171	TO-106		45	5	15	45	125	500*	2	5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC171A	TO-106		45	5	15	45	40 125	260*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04

Test Conditions:

1. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
2. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, WB
3. $I_C = 30\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
4. $I_C = 20\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 150 Hz
5. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_G = 2\,k\Omega$, f = 20 Hz to 15 kHz
6. $I_C = 100\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, f = 10 Hz to 10 kHz
7. $I_C = 50\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, BW = 10 Hz to 15 kHz
8. $I_C = 50\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
9. $I_C = 200\,\mu A$, $V_{CE} = 2V$, $R_S = 2\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
10. $I_C = 10\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, WB
11. $I_C = 150\,mA$, $V_{CE} = 10V$, $I_{B1} = I_{B2} = 15\,mA$
12. $I_C = 150\,mA$, $I_{B1} = I_{B2} = \pm 7.5\,mA$
13. $I_C = 10\,mA$, $I_{B1} = 3\,mA$, $I_{B2} = 1\,mA$
14. $I_C = 100\,mA$, $I_{B1} = 40\,mA$, $I_{B2} = 20\,mA$
15. $V_{CC} = 10V$, $I_C = 100\,mA$, $I_{B1} = I_{B2} = 10\,mA$
16. $I_C = 150\,mA$, $V_{CE} = 6V$, $I_{B1} = I_{B2} = 15\,mA$
17. $I_C = 10\,mA$, $I_{B1} = 1\,mA$, $I_{B2} = -1\,mA$
18. $I_C = 300\,mA$, $I_{B1} = I_{B2} = 30\,mA$, $V_{CC} = 25V$
19. $V_{CC} = 20V$, $I_C = 100\,mA$, $I_{B1} = I_{B2} = 5\,mA$

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} / h_{fe}(1kHz)* Min	h_{FE} / h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max &	$V_{BE(sat)}$ / $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ / $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC171B	TO-106		45	5	15	45	40 240	 500*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		6	1	04
BC172	TO-106		20	5	15	20	125	900*	2	5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		6	1	04
BC172A	TO-106		20	5	15	20	40 125	 260*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		6	1	04
BC172B	TO-106		20	5	15	20	40 240	 500*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		6	1	04
BC172C	TO-106		20	5	15	20	100 450	 900*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		6	1	04
BC173	TO-106		20	5	15	20	40 240	 900*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		4	2	04
BC173A	TO-106		20	5	15	20	40 125	 260*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		4 4	2 1	04
BC173B	TO-106		20	5	15	20	40 240	 500*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		4	2	04
BC173C	TO-106		20	5	15	20	100 450	 900*	0.01 2	5 5	0.25 0.6	 0.55	 0.7*	10 100 2		150		10		4	2	04
BC177	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	75	260*	2	5	(V_{CEK}) 0.6	0.6	0.75*	2 10	6					10	1	71
BC177A	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	125	260*	2	5	(V_{CEK}) 0.6	0.6	0.75*	2 10	6					10	1	71
BC177-VI	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	75	150*	2	5	(V_{CEK}) 0.6	0.6	0.75*	2 10	6					10	1	71
BC178	TO-18	30	25 BV_{CES} 30	5	100 I_{CES}	20	75	500*	2	5	(V_{CEK}) 0.6	0.6	0.75*	2 10	6					10	1	71
BC178A	TO-18	30	25 BV_{CES} 30	5	100 I_{CES}	20					(V_{CEK}) 0.6	0.6	0.75*	2	6					10	1	71
BC178B	TO-18	30	25 BV_{CES} 30	5	100 I_{CES}	20					(V_{CEK}) 0.6	0.6	0.75*	2	6					10	1	71

BC179	TO-18	25	20 BV_{CES} 25	5	100 I_{CES}	20					(V_{CEK}) 0.6	0.6	0.75*	2	6				4 4	1 5	71
BC179A	TO-18	25	20 BV_{CES} 30	5	100 I_{CES}	20					(V_{CEK}) 0.6	0.6	0.75*	2	6				4 4	1 5	71
BC179B	TO-18	25	20	5	100 I_{CES}	20					(V_{CEK}) 0.6	0.6	0.75*	2	6				4 4	1 5	71
BC182K	TO-106	60	50	5	15	50	40 100 80	480	0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC182KA	TO-106	60	50	5	15	50	40 100 80		0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC182KB	TO-106	60	50	5	15	50	40 100 80		0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC182L	TO-92 (74)	60	50	5	15	50	40 80 125	500*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC182LA	TO-92 (74)	60	50	5	15	50	40 80 125	260*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2		150	10		10	1	04
BC182LB	TO-92 (74)	60	50	5	15	50	40 80 240	500*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183K	TO-106	45	30	5	15	30	40 100 80	850	0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183KA	TO-106	45	30	5	15	30	40 100 80	850	0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183KB	TO-106	45	30	5	15	30	40 100 80	850	0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183KC	TO-106	45	30	5	15	30	40 100 80	850	0.01 2 100	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183L	TO-92 (74)	45	30	5	15	30	40 80 125	900*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183LA	TO-92 (74)	45	30	5	15	30	40 80 125	260*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04
BC183LB	TO-92 (74)	45	30	5	15	30	40 80 240	500*	0.01 100 2	5 5 5	0.25 0.6	0.55	1.2 0.7*	10 100 2	5	150	10		10	1	04

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA, I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA, I_{B1} = I_{B2} = 5 mA

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe}(1kHz)* Min	h_{FE} h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC183LC	TO-92 (74)	45	30	5	15	30	40 80 450	 900*	0.01 100 2	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		10	1	04
BC184K	TO-106	45	30	5	15	30	100 250 130		0.01 2 100	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC184KB	TO-106	45	30	5	15	30	100 250 130		0.01 2 100	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC184KC	TO-106	45	30	5	15	30	100 250 130		0.01 2 100	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC184L	TO-92 (74)	45	30	5	15	30	100 130 240	 900*	0.01 100 2	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC184LB	TO-92 (74)	45	30	5	15	30	100 130 240	 500*	0.01 100 2	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC184LC	TO-92 (74)	45	30	5	15	30	100 130 450	 900*	0.01 100 2	5 5 5	0.25 0.6	 0.55	 1.2 0.7*	10 100 2	5	150		10		4	2	04
BC204	TO-106	50	45	5	50	45	50	450	2	5	0.3	 0.55	 0.75*	10 2						10	1	71
BC204A	TO-106	50	45	5	50	45	110	220	2	5	0.3	 0.55	 0.75*	10 2						10	1	71
BC204B	TO-106	50	45	5	50	45	200	450	2	5	0.3	 0.55	 0.75*	10 2						10	1	62
BC204VI	TO-106	50	45	5	50	45	50	120	2	5	0.3	 0.55	 0.75*	10 2						10	1	71
BC205	TO-106	25	20	5	50	20	110	450	2	5	0.3	 0.55	 0.75*	10 2						10	1	71
BC205A	TO-106	25	20	5	50	20	110	220	2	5	0.3	 0.55	 0.75*	10 2						10	1	71
BC205B	TO-106	25	20	5	50	20	200	450	2	5	0.3	 0.55	 0.75*	10 2						10	1	62
BC206	TO-106	25	25	5	50	20	200		2	5	0.3	 0.55	 0.75*	10 2						4	1	62
BC206B	TO-106	25	25	5	50	20	200	450	2	5	0.3	 0.55	 0.75*	10 2						4	1	62
BC207	TO-106	50	45	5	15	40	110	450	2	5	0.25 0.6			10 100	6					10	1	04
BC207A	TO-106	50	45	5	15	40	110	220	2	5	0.25 0.6			10 100	6					10	1	04
BC207B	TO-106	50	45	5	15	40	200 40	450	2 0.10	5 5	0.25 0.6			10 100	6					10	1	04

BC208	TO-106	25	20	5	15	20	110	800	2	5	0.25 0.6			10 100	6				10	1	04
BC208A	TO-106	25	20	5	15	20	110	220	2	5	0.25 0.6			10 100	6				10	1	04
BC208B	TO-106	25	20	5	15	20	200 40	450	2 0.10	5 5	0.25 0.6			10 100	6				10	1	04
BC208C	TO-106	25	20	5	15	20	420 100	800	2 0.10	5 5	0.25 0.6			10 100	6				10	1	04
BC209	TO-106	25	20	5	15	20	200 70	800 0.10	2 0.10	5 5	0.25 0.6			10 100	6				4	2	04
BC209B	TO-106	25	20	5	15	20	200 40	450	2 0.10	5 5	0.25 0.6			10 100	6				4	2	04
BC209C	TO-106	25	20	5	15	20	420 100	800	2 0.10	5 5	0.25 0.6			10 100	6				4	2	04
BC212K	TO-106	60	50	5	15	30	40 60 60	 300 *	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 1.1	2 10 100	10	200	10		10	1	63
BC212KA	TO-106	60	50	5	15	30	40 60 100 	 300 300' 	0.01 2 2 	5 5 5 	 0.25 0.6	 0.6 	 0.72* 1.1	 2 10 100	10	200	10		10	1	63
BC212KB	TO-106	60	50	5	15	30	40 60 200	 300 400*	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 	2 10 100	10	200	10		10	1	63
BC213K	TO-106	45	30	5	15	30	40 80 80	 400 *	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 1.1	2 10 100	10	200	10		10	1	63
BC213KA	TO-106	45	30	5	15	30	40 80 100	 300*	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 1.1	2 10 100	10	200	10		10	1	63
BC213KB	TO-106	45	30	5	15	30	40 80 200	 400*	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 1.1	2 10 100	10	200	10		10	1	63
BC213KC	TO-106	45	30	5	15	30	40 80 350	 600*	0.01 2 2	5 5 5	 0.25 0.6	0.6 	0.72* 1.1	2 10 100	10	200	10		10	1	63
BC213L	TO-92 (74)	45	30	5	15	30	40 80	 400	0.01 2	5 5	0.25 0.6 	 0.6	 1.1 0.72*	10 100 2	10	200	10		10	1	63
BC213LA	TO-92 (74)	45	30	5	15	30	40 100	 300*	0.01 2	5 5	0.25 0.6 	 0.6	 1.1 0.72*	10 100 2	10	200	10		10	1	63
BC213LB	TO-92 (74)	45	30	5	15	30	40 200	 400*	0.01 2	5 5	0.25 0.6 	 0.6	 1.1 0.72*	10 100 2	10	200	10		10	1	63
BC213LC	TO-92 (74)	45	30	5	15	30	350	600*	2	5	0.25 0.6 	 0.6	 1.1 0.72*	10 100 2	10	200	10		10	1	63

Test Conditions:

1. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
2. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, WB
3. $I_C = 30\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
4. $I_C = 20\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 150 Hz
5. $I_C = 200\,\mu A$, $V_{CE} = 5V$, $R_G = 2\,k\Omega$, f = 20 Hz to 15 kHz
6. $I_C = 100\,\mu A$, $V_{CE} = 5V$, $R_S = 2\,k\Omega$, f = 10 Hz to 10 kHz
7. $I_C = 50\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, BW = 10 Hz to 15 kHz
8. $I_C = 50\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
9. $I_C = 200\,\mu A$, $V_{CE} = 2V$, $R_S = 2\,k\Omega$, $f = 1\,kHz$, BW = 200 Hz
10. $I_C = 10\,\mu A$, $V_{CE} = 5V$, $R_S = 10\,k\Omega$, WB
11. $I_C = 150\,mA$, $V_{CE} = 10V$, $I_{B1} = I_{B2} = 15\,mA$
12. $I_C = 150\,mA$, $I_{B1} = I_{B2} = \pm 7.5\,mA$
13. $I_C = 10\,mA$, $I_{B1} = 3\,mA$, $I_{B2} = 1\,mA$
14. $I_C = 100\,mA$, $I_{B1} = 40\,mA$, $I_{B2} = 20\,mA$
15. $V_{CC} = 10V$, $I_C = 100\,mA$ $I_{B1} = I_{B2} = 10\,mA$
16. $I_C = 150\,mA$, $V_{CE} = 6V$, $I_{B1} = I_{B2} = 15\,mA$
17. $I_C = 10\,mA$, $I_{B1} = 1\,mA$, $I_{B2} = -1\,mA$
18. $I_C = 300\,mA$, $I_{B1} = I_{B2} = 30\,mA$, $V_{CC} = 25V$
19. $V_{CC} = 20V$, $I_C = 100\,mA$ $I_{B1} = I_{B2} = 5\,mA$

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} / h_{fe} (1kHz)* Min	h_{FE} / h_{fe} (1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ / $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ / $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC214K	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200		10		2	2	63
							140	400	2	5	0.25			10								
							120		100	5	0.6		1.1	100								
BC214KA	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200		10		2	2	63
							140	400	2	5	0.25			10								
							120		100	5	0.6		1.1	100								
							100	300*	2	5												
BC214KB	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200		10		2	2	63
							200	400*	2	5	0.25			10								
							120		100	5	0.6		1.1	100								
BC214KC	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200		10		2	2	63
							350	600*	2	5	0.25			10								
							120		100	5	0.6		1.1	100								
BC214L	TO-92 (74)	45	30	5	15	30	100		0.01	5	0.25			10	10	200		10		2	2	63
							140	400	2	5	0.6		1.1	100								
							120		100	5		0.6	0.72*	2								
BC214LB	TO-92 (74)	45	30	5	15	30	200	400*	2	5	0.25			10	10	200		10		2	2	63
											0.6		1.1	100								
												0.6	0.72*	2								
BC214LC	TO-92 (74)	45	30	5	15	30	350	600*	2	5	0.25			10	10	200		10		2	2	63
											0.6		1.1	100								
												0.6	0.72*	2								
BC237	TO-106	50	45	6	50	20	125	500*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC237A	TO-106	50	45	6	50	20	125	260*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC237B	TO-106	50	45	6	50	20	240	500*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC238	TO-106	30	20	5	50	20	125	900*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC238A	TO-106	30	20	5	50	20	125	260*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC238B	TO-106	30	20	5	50	20	240	500*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC238C	TO-106	30	20	5	50	20	450	900*	2	5	0.25		0.77*	10	4.5					10	1	04
											0.6			100								
BC239	TO-106	30	20	5	50	20	240	900*	2	5	0.25			10	4.5					4	1	04
													0.7*	2						4	2	
BC239B	TO-106	30	20	5	50	20	240	500*	2	5	0.25			10	4.5					4	1	04
													0.7*	2						4	2	
BC239C	TO-106	30	20	5	50	20	450	900*	2	5	0.25			10	4.5					4	1	27
													0.7*	2						4	2	
BC251A	TO-106		45	5	50	45	125	260*	2	5	0.25		0.9	10						6	1	71
											0.6			100								

BC251B	TO-106		45	5	50	45	240	500*	2	5	0.25 0.6		0.9	10 100				6	1	71
BC251CA	TO-106		45	5	50	45	450	900*	2	5	0.25		0.9	10				6	1	62
BC252A	TO-106		20	5	50	20	125	260*	2	5	0.25 0.6		0.9	10 100				6	1	71
BC252B	TO-106		20	5	50	20	240	500*	2	5	0.25 0.6		0.9	10 100				6	1	71
BC252CA	TO-106		20	5	50	20	450	900*	2	5	0.25		0.9	10				6	1	62
BC253A	TO-106		20	5	50	20	40 125	 260*	0.01 2	5 5	0.25 0.6		0.9 0.9	10 100				2.5	2	71
BC253B	TO-106		20	5	50	20	40 240	 500*	0.01 2	5 5	0.25 0.6		0.9	10 100				2.5	2	71
BC253CA	TO-106		20	5	50	20	100 450	 900*	0.01 2	5 5	0.25		0.9	10				2.5	2	62
BC261A	TO-18		45		50	45	125	260*	2	5	0.25 0.6		0.9	10 100				6	9	71
BC261B	TO-18		45		50	45	240	500*	2	5	0.25 0.6		0.9	10 100				6	9	71
BC262A	TO-18		20	5	50	20	125	260*	2	5	0.25 0.6		0.9	10 100				6	9	71
BC262B	TO-18		20	5	50	20	240	500*	2	5	0.25 0.6		0.9	10 100				6	9	71
BC263A	TO-18		20	5	50	20	40 125	 260*	0.01 2	5 5	0.25 0.6		0.9	10 100				2.5	2	71
BC263B	TO-18		20	5	50	20	40 240	 500*	0.01 2	5 5	0.25 0.6		0.9	10 100				2.5	2	71
BC307	TO-106	50	45	5	100 I_{CES}	20	75	50*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC307A	TO-106	50	45	5	100 I_{CES}	20	125	160*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC307B	TO-106	50	45	5	100 I_{CES}	20	240	500*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC307VI	TO-106	50	45	5	100 I_{CES}	20	75	150*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC308	TO-106	30	25	5	50	20	125	500*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC308A	TO-106	30	25	5	50	20	125	260*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC308B	TO-106	30	25	5	50	20	240	500*	2	5	0.6 (V_{CEK})	 0.6	 0.75*	10 2	6			10	1	71
BC407	TO-106	50	45	6	50	20	125	500*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5			10	1	04
BC407A	TO-106	50	45	6	50	20	125	260*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5			10	1	04

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA, I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA, I_{B1} = I_{B2} = 5 mA

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe}(1kHz)* Min	h_{FE} h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC407B	TO-106	50	45	6	50	20	240	500*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					10	1	04
BC408	TO-106	30	20	5	50	20	125	900*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					10	1	04
BC408A	TO-106	30	20	5	50	20	125	260*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					10	1	04
BC408B	TO-106	30	20	5	50	20	240	500*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					10	1	04
BC408C	TO-106	30	20	5	50	20	450	900*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					10	1	04
BC409	TO-106	30	20	5	50	20	240	900*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					4 4	1 2	04
BC409B	TO-106	30	20	5	50	20	240	500*	2	5	0.25 0.6	 0.55	 0.7*	10 100 2	4.5					4 4	1 2	04
BC409C	TO-106	30	20	5	50	20	450	900*	2	5	0.25 0.6	 0.55	0.77* 0.7*	10 100 2	4.5					4 4	1 2	04
BC413	TO-106	45	30	5	15	30	200	800	2	5	0.25 0.6	 0.55	 0.7*	10 100 2						3	2	04
BC413B	TO-106	45	30	5	15	30	200	450	2	5	0.25 0.6	 0.55	 0.7*	10 100 2						3	2	04
BC413C	TO-106	45	30	5	15	30	420	800	2	5	0.25 0.6	 0.55	 0.7*	10 100 2						3	2	04
BCY58	TO-18	32	32	7	10 I_{CES}	32	120 80 40	630 1000	2 10 100	5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800 800	 6	17 15 1	04
BCY58-7	TO-18	32	32	7	10 I_{CES}	32	120 80 40	220	2 10 100	5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800 800	 6	17 15 1	04
BCY58-8	TO-18	32	32	7	10 I_{CES}	32	20 180 120 45	 310 400	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125		10	800 800	 6	17 15 1	04

BCY58-9	TO-18	32	32	7	10 ICES	32	40 250 160 60	 460 630	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY58-10	TO-18	32	32	7	10 ICES	32	100 380 240 60	 630 1000	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY59	TO-18	45	45	7	10 ICES	45	120 80 40	630 1000	2 10 100	5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY59-7	TO-18	45	45	7	10 ICES	45	120 80 40	220	2 10 100	5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY59-8	TO-18	45	45	7	10 ICES	45	20 180 120 45	 310 400	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY59-9	TO-18	45	45	7	10 59 ICES	45	40 250 160 60	 460 630	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY59-10	TO-18	45	45	7	10 ICES	45	100 380 240 60	 630 1000	0.01 2 10 100	5 5 1 1	0.35 0.7	0.6 0.75 0.55	0.85 1.2 0.7*	10 100 2	6	125	10	800 800	6	17 15 1	04
BCY70	TO-18	50	40	5	10	50	40 45 50 15		0.1 1 10 50	1 1 1 1	0.25 0.5	0.6	0.9 1.2	10 50	6	250	10	 420	6	6 17	71
BCY71	TO-18	45	45	5	500 50	45 40	40 80 90 100 100	 600 400*	0.01 0.1- 1 . 10 1	1 1 1 1 10	0.25 0.5	0.6	0.9 1.2	10 50	6	200 166	20 0.1		2	6	71
BCY71A	TO-18	45	45		50	40	40 80 90 100 100	 600 400*	0.01 0.1 1 10 1	1 1 1 1 10	0.25 0.5	0.6	0.9 1.2	10 50	6	300 15	10 1		2	6	71
BCY72	TO-18	25	25	5	50 500	20 25	40 50		1 10	1 1	0.25 0.5		 1.2	10 50	6	200	10	 420	6	175 6 17	71
BF153	TO-106	30	12	2	100	15	20		3	6	0.5			10	(CRE) 1.2	300	3		GT 40 dB Min		43
BF160	TO106	30	12	2	500	15	20		3	10	0.5			10	1.7	400	10				43

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5 mA

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} / h_{fe}(1kHz)* Min	h_{FE} / h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ / $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ / $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BF167	TO-72(28)	40	30	4			27		4	10												45
BF173	TO-72(28)	40	25	4			38		7	10			0.9	7								47
BF194	T092	30	20	5			66	210	1	10		0.65	0.74	1								46
BF195	TO-92	30	20	5			35	125	1	10		0.65	0.74	1								46
BF196	TO-092(71)	40	30	4			27		4	10			0.84	4								45
BF197	TO-92(71)	40	25	4			38		7	10			0.9	7								47
BF198	TO-92(71)	40	30	4			27		4	10			0.85	4								45
BF199	TO-92(71)	40	25	4			38		7	10			0.925	7								47
BF233	TO-92(71)	30	20	5			35	120	1	10												49
BF257	TO-39	160	160	5	50	100	25		30	10	—			30	5.5	90		10			20	15
BF258	TO-39	250	250	5	50	100	25		30	10	—			30	5.5	90		10			20	15
BF259	TO-39	300	300	5	50	100	25		30	10	—			30	5.5	90		10			20	15
BFX29	TO-5	60	60		50	50	20		0.1	10	0.4		1.3	150	12	100		50	150		16	63
							40		1	10			0.9	30								
							50		10	10												
							50		50	10												
							100	400*	1	10												
							40		150	10												
BFX65	TO-18	45	45	6	10	40	100		0.1	5	0.25		0.9	10	6.5					3	4	62
					I_{CES}		100		1	5												
							100		10	5												
							120		1	5												
BFX84	TO-39	100	60	5	500	100	20		10	10	0.15		1.2	10	12	50		50	360		11	14
					50	80	30		150	10	0.35		1.3	150								
							20		500	10	1.0		1.5	500								
							15		1A	10	1.6		2.0	1A								
BFX85	TO-39	100	60	5	50	80	50		10	10	0.15		1.2	10	12	50		50	360		11	14
					500	100	70		150	10	0.35		1.3	150								
							30		500	10	1.0		1.5	500								
							15		1A	10	1.6		2.0	1A								
BFX86	TO-39	40	35	5	50	30	50		10	10	0.15		1.2	10	12	50		50	360		16	14
					500	40	70		150	10	0.35		1.3	150								
							30		500	10	1.0		1.5	500								
							15		1A	10	1.6		2.0	1A								
BFX87	TO-5	50	50	4	500	50	40		1	10	0.4		1.3	150	12	100		50	150		16	63
					50	40	40		10	10			0.9	30								
							40		150	10												
							25		500	10												
BFX88	TO-5	40	40	4	50	30	40		1	10	0.4		1.3	150	12	100		50	150		16	63
							40		150	10			0.9	30								
							40		10	10												
							25		500	10												
BFY39	TO-18	45	25	5	50	30	35	400*	10	10	1.0		1.0	10	5	150		10				23
BFY39-1	TO-18	45	25	5	50	30	35	110	10	10	1.0		1.0	10	5	150		10				23
							120	*	1	5												
BFY39-2	TO-18	45	25	5	50	30	100	200	10	10	1.0		1.0	10	5	150		10				23
BFY39-3	TO-18	45	25	5	50	30	180	400	10	10	1.0		1.0	10	5	150		10				23
							120	*	1	5												

BFY50	TO-39	80	35	6	50 500	60 80	20 30 20 15		10 150 500 1A	10 10 10 10	0.7 0.1 0.2 1.0		1.5 1.2 1.3 2.0	500 10 150 1A	12	60	50	360		11	14
BFY51	TO-39	60	30	6	50 500	40 60	30 40 25 15		10 150 500 1A	10 10 10 10	1.0 0.15 0.35 1.6		1.5 1.2 1.3 2.0	500 10 150 1A	12	50	50	360		11	14
BFY52	TO-39	40	20	6	50 500	30 40	30 60 30 15		10 150 500 1A	10 10 10 10	1.0 0.15 0.35 1.6		1.5 1.2 1.3 2.0	500 10 150 1A	12	50	50	360		11	14
BFY56	TO-39	80	45	5	50	50	15 20 30	 150	0.1 500 150	10 10 1	0.3 2.3		1.5 1.2	150 100	25	40	50	625		12	14
BFY72	TO-5	50	28	5	0.02 I_{CES}	40	15 20 30 40 15	 150	0.1 1 10 150 500	100 10 10 10 10	0.25 0.7		1.2 1.6	150 500	8	50	50	170		18	20
BFY76	TO-18	45		6	20	30	80 30 80 140	550* 200	1 0.01 0.5 1	5 5 5 5	 0.35	0.5	0.75	0.1 1	6 6	2.4 2	0.05 0.5		4	10	07
BSX21	TO-18	120	80	5	500 0.04	50 120	20		4	3			0.9	4		60	4				07
BSX45-6	TO-39	BV_{CES} 80	40	7	10 I_{CES}	60	40	100	100	1	1.0		 2.0	500 1000	20	60	50	650		12	14
BSX45-10	TO-39	BV_{CES} 80	40	7	10 I_{CES}	60	63	160	100	1	1.0		 2.0	500 1A	20	60	50	650		12	14
BSX45-16	TO-39	BV_{CES} 80	40	7	10	60	100	250	100	1	1.0		 2.0	500 1A	20	60	50	650		12	14
BSX46-6	TO-39	BV_{CES} 100	60	7	10	60	40	100	100	1	1.0		 2.0	500 1A	25	60	50	650		12	14
BSX46-10	TO-39	BV_{CES} 100	60	7	10	60	63	160	100	1	1.0		 2.0	500 1A	25	60	50	650		12	14
BSX46-16	TO-39	BV_{CES} 100	60	7	10	60	100	250	100	1	1.0		 2.0	500 1A	25	60	50	650		12	14
BSX88	TO-18	40	15	5	25	20	15 30	 120	0.5 10	1 1	0.4	0.72	0.8	10	6	300	10	75		13	21
BSY38	TO-18	20	12	5	100	20	30 15	60 45	10 100	0.35 1	0.25 0.6	0.7	0.85 1.5	10 100	5	200	10	45		14	21
BSY39	TO-18	20	12	5	100	20	40 20	120 70	10 100	0.35 1	0.25 0.6	0.7	0.85 1.5	10 100	5	200	10	45		14	21
BSY51	TO-5	60	25	5	100	30	40	120	150	10	1.0		1.3	150	9	130	50				20
BSY52	TO-5	60	25	5	100	30	100	300	150	10	1.0		1.3	150	9	130	50				20

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5 mA

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Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe}(1kHz)* Min	h_{FE} h_{fe}(1kHz)* Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BSY53	TO-5	75	30	7	10	60	20		0.1	10	0.6		1.3	150	9	150		50				20
							35		10	10	2.0			500								
							40	120	150	10												
							20		500	10												
BSY54	TO-5	75	30	7	10	60	35		0.1	10	0.6		1.3	150	9	150		50				20
							75		10	10	2.0			500								
							100	300	150	10												
							40		500	10												
BSY95A	TO-18	20	15	5	50	16	30		1	0.35	0.35	0.67	0.87	10	6	200		10				21
							50	200	10	0.35												

Test Conditions:

1. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
2. I_C = 200 μA, V_{CE} = 5V, R_S = 2 kΩ, WB
3. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100 μA, V_{CE} = 5V, R_S = 2 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 200 Hz
9. I_C = 200 μA, V_{CE} = 2V, R_S = 2 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 10 μA V_{CE} = 5V, R_S = 10 kΩ, WB
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA
18. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5 mA

NPN Transistors

HIGH VOLTAGE

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3498	TO-30	100	100	6	50	50	20		0.1	10	0.2		0.8	10	10	150		20				08
							25		1	10	0.25		0.9	50								
							35		10	10	0.6		1.4	300								
							40	120	150	10												
							15		500	10												
2N3499	TO-39	100	100	6	50	50	35		0.1	10	0.2		0.8	10	10	150		20				08
							50		1	10	0.25		0.9	50								
							75		10	10	0.6		1.4	300								
							100	300	150	10												
							20		500	10												
2N3500	TO-39	150	150	6	50	75	20		0.1	10	0.2		0.8	10	8	150		20				08
							25		1	10	0.25		0.9	50								
							35		10	10	0.4		1.2	150								
							40	120	150	10												
							15		300	10												
2N3501	TO-39	150	150	6	50	75	35		0.1	10	0.2		0.8	10	8	150		20				08
							50		1	10	0.25		0.9	50								
							75		10	10	0.4		1.2	150								
							100	300	150	10												
							20		300	10												
2N5550	TO-92	160	140	6	100	100	60		1	5	0.15		1	10	6	100	300	10		10	1	16
							60	250	10	5	0.25		1.2	50								
							20		50	5												
2N5551	TO-92	180	160	6	50	120	80		1	5	0.15		1	10	6	100	300	10		8	1	16
							80	250	10	5	0.2		1	50								
							30		50	5												
MPSA42	TO-92	300	300	8	100	200	25		1	10	0.5		0.9	20	3	50		10				48
							40		10	10												
							40		30	10												
MPSA43	TO-92	200	200	6	100	160	25		1	10	0.4		0.9	20	4	50		10				48
							40		10	10												
							50	200	30	10												
MPSL01	TO-92	140	120	5	1μA	75	50	300	10	5	0.2		1.2	10	8	60		10				15
											0.3		1.4	50								
SE7056	TO-39	300	300	7	100	200	20		1	20	1		0.85	20	3	50		15				48
							40		10	20												
							40		30	20												
SP7056	X51D(35)	300	300	7	100	200	20		1	20	1		0.85	20	3	50		15				48
							40		10	20												
							40		30	20												

1. V_{CE} = 5V, I_C = 250 mA
R_S = 1 kΩ, WB

PNP Transistors

HIGH VOLTAGE

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3634	TO-39	140	140	5	100	100	40		0.1	10	0.3		0.8	10	10	150		30	600		1	73
							45		1	10	0.5	0.65	0.9	50								
							50		10	10												
							50	150	50	10												
							25		150	10												
2N3635	TO-39	140	140	5	100	100	80		0.1	10	0.3		0.8	10	10	200		30	600		1	73
							90		1	10	0.5	0.65	0.9	50								
							100		10	10												
							100	300	50	10												
							50		150	10												
2N3636	TO-39	175	175	5	100	100	40		0.1	10	0.3		0.8	10	10	150		30	600		1	73
							45		1	10	0.5	0.65	50									
							50		10	10												
							50	150	50	10												
							25		150	10												
2N3637	TO-39	175	175	5	100	100	80		0.1	10	0.3		0.8	10	10	200		30	600		1	73
							90		1	10	0.5	0.65	0.9	50								
							100		10	10												
							100	300	50	10												
							50		150	10												
2N5400	TO-92	130	120	5	100	100	30		1	5	0.2		1	10	6	100	400	10		8	2	74
							40	180	10	5	0.5		1	50								
							40		50	5												
2N5401	TO-92	160	150	5	50	120	50		1	5	0.2		1	10	6	100	300	10		8	2	74
							60	240	10	5	0.5		1	50								
							50		50	5												
MPSL5	TO-92	100	100	4	1μA	50	40	250	50	5	0.25		1.2	10	8	60						74
											0.3		1.2	50								

1. $V_{CC} = 100V$
   $I_C = 50$ mA
   $I_{B1} = I_{B2} = 5$ mA

2. $V_{CE} = 5V$, $I_C = 250$ mA
   $R_S = 1$ kΩ, WB

DH3467C Quad PNP Core Driver

DESCRIPTION

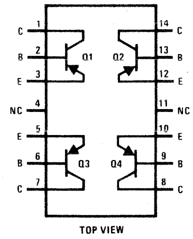
The DH3467C consists of four 2N3467 type PNP transistors mounted in a 14-pin molded dual-in-line package. The device is primarily intended for core memory application requiring operating currents in the ampere range, high stand-off voltage, and fast turn-on and turn-off times.

TYPICAL CHARACTERISTICS

Turn-ON Time	18 ns
Turn-OFF Time	45 ns
Collector Current	1A
Collector-Base Breakdown Voltage	120V typ.
Collector Saturation Voltage at I_C = 1A	0.55V
Collector Saturation Voltage at I_C = 0.5A	0.31V

CONNECTION DIAGRAM

Dual-In-Line Package
Order Number: DH3467CN



SWITCHING TIME TEST CIRCUITS

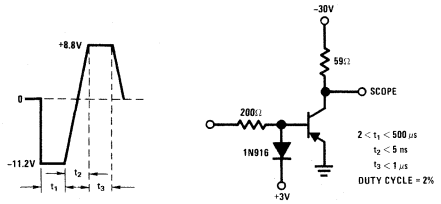


FIGURE 1. t_{on} Equivalent Test Circuit

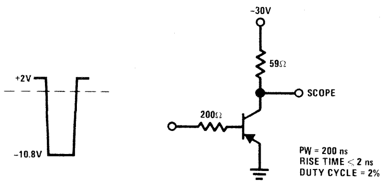


FIGURE 2. t_{off} Equivalent Test Circuit

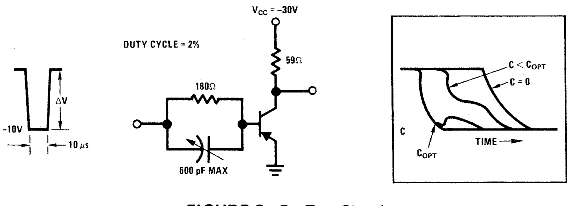


FIGURE 3. Q_T Test Circuit

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	40V
Collector to Emitter Voltage	40V
Collector to Emitter Voltage (Note)	40V
Emitter to Base Voltage	5V
Collector Current – Continuous	1.0A
Power Dissipation (T_A = 25°C) (each device)	0.85W
Power Dissipation (T_A = 25°C) (total package)	2.5W
Operating Junction Temperature	150°C Max
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Note 1: Pulsed test, PW = 300µs, duty cycle = 1%

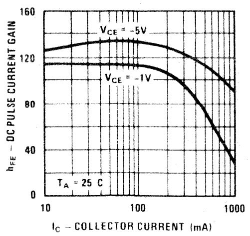
DH3467C

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

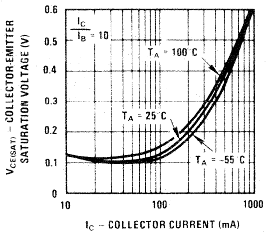
PARAMETER	CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
Collector to Base Breakdown Voltage (BV_{CBO})	I_C = 10 µA I_E = 0	-40		V
Emitter to Base Breakdown Voltage (BV_{EBO})	I_E = 10 µA I_C = 0	-5.0		V
Collector to Emitter Breakdown Voltage (Note 1) (BV_{CEO})	I_C = 10 mA I_B = 0	-40		V
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 150 mA V_{CE} = −1.0V	40		
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 500 mA V_{CE} = −1.0V	40	120	
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 1.0A V_{CE} = −5.0V	40		
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 150 mA I_B = 15 mA		−0.30	V
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 500 mA I_B = 50 mA		−0.50	V
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 1.0A I_B = 100 mA		−1.0	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 150 mA I_B = 15 mA		−1.0	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 500 mA I_B = 50 mA	−0.8	−1.2	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 1.0A I_B = 100 mA		−1.6	V
Collector Cutoff Current (I_{CBO})	V_{CB} = −30V I_B = 0		100	nA
Collector Cutoff Current ($I_{CBO(100°C)}$)	V_{CB} = −30V I_B = 0		15	µA
Collector Cutoff Current (I_{CEX})	V_{CB} = −30V V_{EB} = −3.0V		100	nA
Base Cutoff Current (I_{BL})	V_{CB} = −30V V_{EB} = −3.0V		120	nA
Total Control Charge (Figure 3) (Q_T)	I_C = 500 mA I_B = 50 mA		6.0	nC
Turn On Delay Time (Figure 1) (t_d)	I_C = 500 mA I_{B1} = 50 mA		10	ns
Rise Time (Figure 1) (t_r)	I_C = 500 mA I_{B1} = 50 mA		30	ns
Storage Time (Figure 2) (t_s)	I_C = 500 mA I_{B1} = I_{B2} = 50 mA		60	ns
Fall Time (Figure 2) (t_f)	I_C = 500 mA I_{B1} = I_{B2} = 50 mA		30	ns
Output Capacitance (f = 100 kHz) (C_{ob})	I_E = 0 V_{CB} = −10V		25	pF
Input Capacitance (f = 100 kHz) (C_{ib})	I_C = 0 V_{CB} = −0.5V		100	pF
High Frequency Current Gain (f = 100 MHz) (h_{fe})	I_C = 50 mA V_{CE} = 10V	1.75		

Note 1: Pulsed test, PW = 300µs, duty cycle = 1%

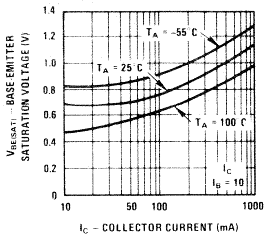
DC Pulse Current Gain vs Collector Current



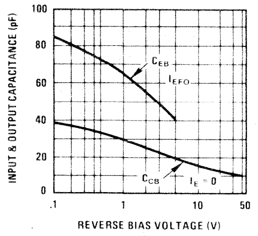
Collector-Emitter Saturation Voltage vs Collector Current



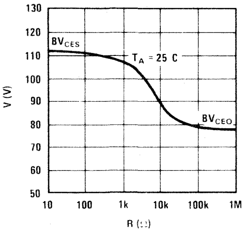
Base-Emitter Saturation Voltage vs Collector Current



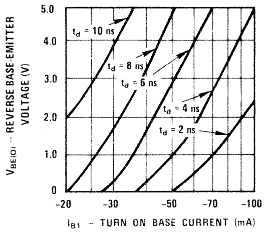
Input & Output Capacitance vs Reverse Bias Voltage



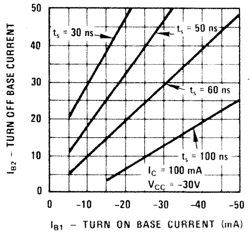
BV_{CER} vs R_{BE} I_C = 10 mA



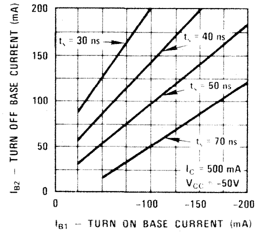
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



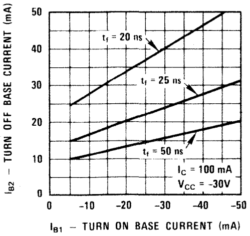
Storage Time vs Turn On and Turn Off Base Currents



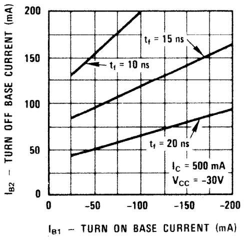
Storage Time vs Turn On and Turn Off Base Currents



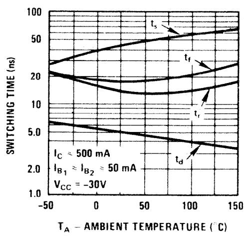
Fall Time vs Turn On and Turn Off Base Currents



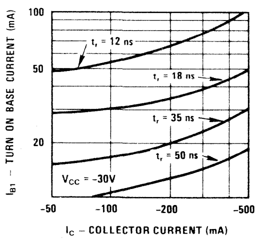
Fall Time vs Turn On and Turn Off Base Currents



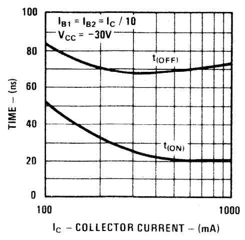
Switching Times vs Ambient Temperature



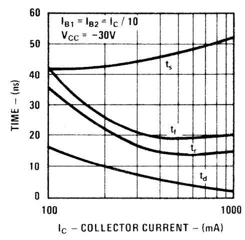
Rise Time vs Collector Current and Turn On Base Current



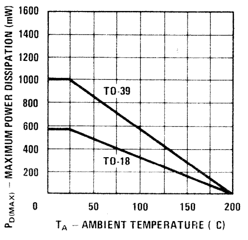
Turn On and Turn Off Times vs Collector Current



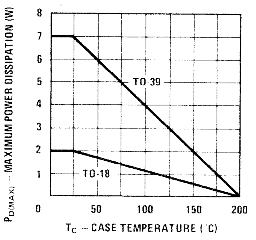
Switching Times vs Collector Current



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



DH3725C Quad NPN Core Driver

DESCRIPTION

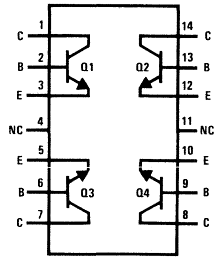
The DH3725C consists of four 2N3725 type NPN transistors mounted in a 14-pin molded dual-in-line package. The device is primarily intended for core memory application requiring operating currents in the ampere range, high stand-off voltage, and fast turn-on and turn-off times.

TYPICAL CHARACTERISTICS

Turn-ON Time	18 ns
Turn-OFF Time	45 ns
Collector Current	1A
Collector-Base Breakdown Voltage	120V typ.
Collector Saturation Voltage at I_C = 1A	0.55V
Collector Saturation Voltage at I_C = 0.5A	0.31V

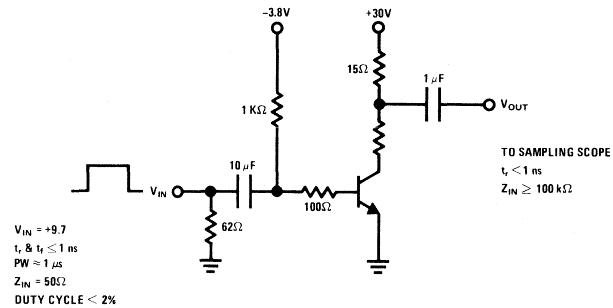
CONNECTION DIAGRAM

Dual-In-Line Package
Order Number: DH3725CN



TOP VIEW

SWITCHING TIME TEST CIRCUIT



$I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	80V
Collector to Emitter Voltage	80V
Collector to Emitter Voltage (Note)	50V
Emitter to Base Voltage	6V
Collector Current — Continuous	1.0A
Power Dissipation (T_A = 25°C)	0.6W
Power Dissipation (T_C = 25°C)	1.5W
Operating Junction Temperature	150°C Max
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Note: Ratings refer to a high-current point where collector-to-emitter voltage is lowest.

ELECTRICAL CHARACTERISTICS

Each transistor ($T_A = 25^\circ C$, unless otherwise specified)

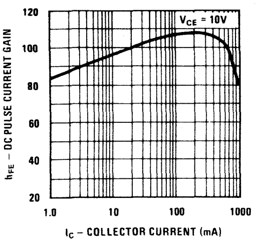
DH3725C

PARAMETER	CONDITIONS	LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS
Collector to Emitter Sustaining Voltage (V_{CEO} (sust)	$I_C = 10$ mA, $I_B = 0$	50			V
Collector to Emitter Breakdown Voltage (BV_{CES})	$I_C = 10\ \mu A$, $V_{BE} = 0$	80			V
Collector to Base Breakdown Voltage (BV_{CBO})	$I_C = 10\ \mu A$, $I_E = 0$	80			V
Emitter to Base Breakdown Voltage (BV_{EBO})	$I_C = 0$, $I_E = 10\ \mu A$	6.0			V
Collector Saturation Voltage ($V_{CE\ (Sat)}$) (Note 1)	$I_C = 1A$, $I_B = 100$ mA $I_C = 0.5A$, $I_B = 50$ mA $I_C = 0.1A$, $I_B = 10$ mA		0.55 0.31 0.19	0.95 0.52 0.26	V V V
DC Pulse Current Gain (h_{FE}) (Note 1)	$I_C = 1A$, $V_{CE} = 5V$ $I_C = 0.5A$, $V_{CE} = 1V$ $I_C = 0.1A$, $V_{CE} = 1V$	25 35 60	65 45 90	 150	
Base Saturation Voltage (V_{BE} (Sat) (Note 1)	$I_C = 1A$, $I_B = 100$ mA $I_C = 0.5A$, $I_B = 50$ mA $I_C = 0.1A$, $I_B = 10$ mA		1.10 0.95 0.75	1.70 1.20 0.86	V V V
Collector Cutoff Current (I_{CBO})	$I_E = 0$, $V_{CB} = 60V$		0.33	1.70	μA
Turn-ON Time	$I_C = 0.5A$, $I_{B1} = 50$ mA (See test circuit)		18	30	ns
Turn-OFF Time	$I_C = 0.5A$, $I_{B1} = 50$ mA $I_{B2} = 50$ mA (See test circuit)		45	60	ns
High Frequency Current Gain	f = 100 MHz, $I_C = 50$ mA, $V_{CE} = 10V$	2.5	4.5		
Common Base, Open Circuit, Output Capacitance	$I_E = 0$, $V_{CB} = 10V$		4.8	10	pF
Common Base, Open Circuit, Input Capacitance	$I_C = 0$, $V_{BE} = 0.5V$		40	55	pF

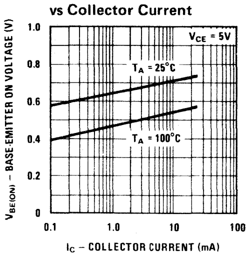
Note 1: Pulse conditions: Length = 300μs, duty cycle = 1%.

TYPICAL PERFORMANCE CURVES (each transistor)

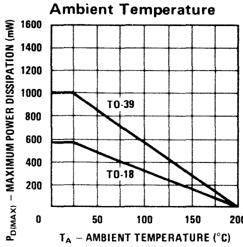
DC Pulse Current Gain vs Collector Current



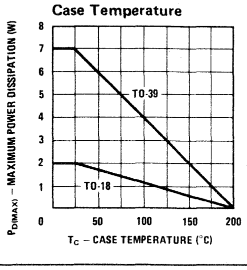
Base-Emitter On Voltage vs Collector Current



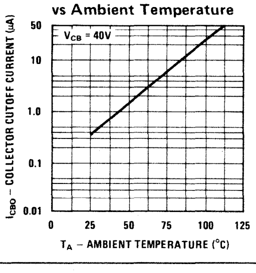
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



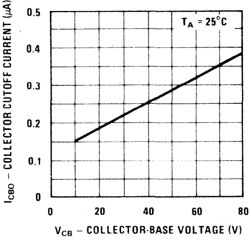
Collector Cutoff Current vs Ambient Temperature



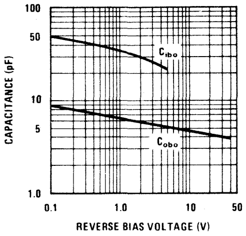
TYPICAL PERFORMANCE CURVES (each transistor)

DH3725C

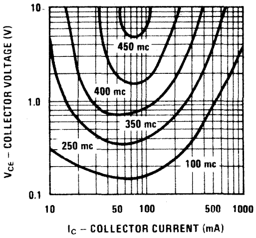
Collector Cutoff Current vs Reverse Bias Voltage



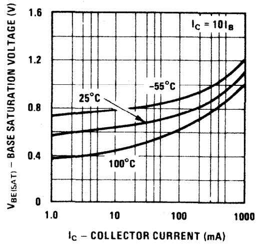
Input and Output Capacitance vs Reverse Bias



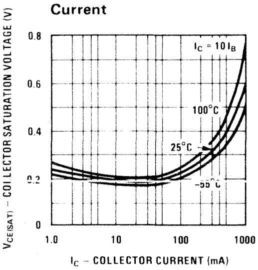
Contours of Constant Bandwidth Product (f_T)



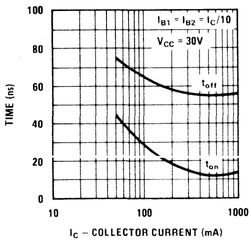
Base Saturation Voltage vs Collector Current



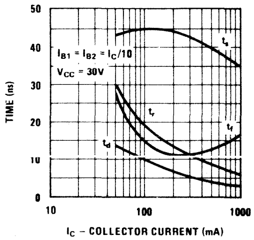
Collector Saturation Voltage vs Collector Current



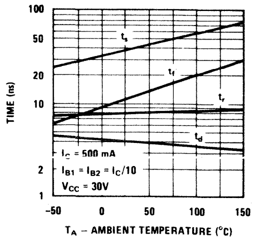
Turn On and Turn Off Times vs Collector Current



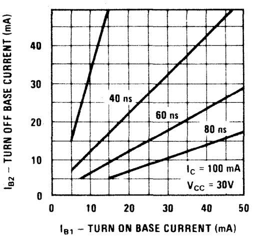
Switching Times vs Collector Current



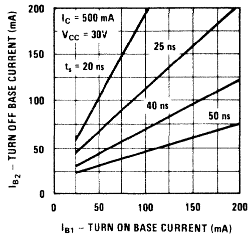
Switching Times vs Ambient Temperature



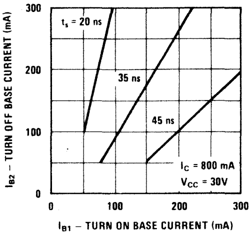
Storage Time vs Turn On and Turn Off Base Currents



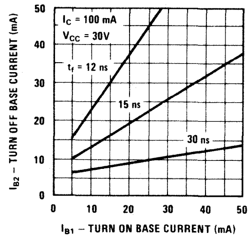
Storage Time vs Turn On and Turn Off Base Currents



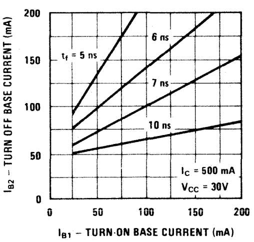
Storage Time vs Turn On and Turn Off Base Currents



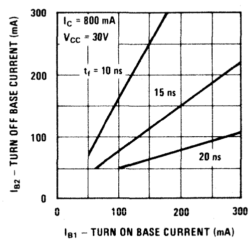
Fall Time vs Turn On and Turn Off Base Currents



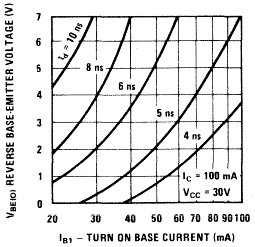
Fall Time vs Turn On and Turn Off Base Currents



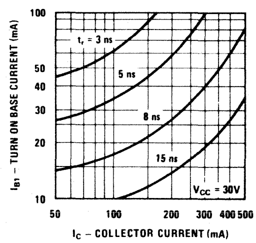
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



Rise Time vs Collector and Turn On Base Currents



Process 1A NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3054

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNITS
h_{FE}	I_C = 0.5 A, V_{CE} = 4.0V	25	50		
h_{FE}	I_C = 3.0 A, V_{CE} = 4.0V	5	12		
$V_{BE(ON)}$	I_C = 1.5 A, V_{CE} = 4.0V		1.5	2.2	V
$V_{CE(SAT)}$	I_C = 0.5 A, I_B = .05 A		.5	1.0	V
$V_{CE(SAT)}$	I_C = 1.5 A, I_B = .15 A		1.0	1.5	V
I_{CEO}	V_{CE} = 30V		.1	1.0	mA
I_{CEX}	V_{CE} = 90V, V_{EB} = 1.5V		.1	1.0	mA
I_{EBO}	V_{EB} = 7.0V		.02	1.0	mA
$V_{CEO(SUS)}$	I_C = 100 mA	40	60		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	50	95		V
V_{EBO}	I_B = −1.0 mA	7			V
POWER TEST	t = 1 sec	25			W
f_T	I_C = 200 mA, V_{CE} = 4.0V		.8		MHz

Process 1B NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3055, 2N6253

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 4.0 A, V_{CE} = 4.0V	15	33		
h_{FE}	I_C = 100 mA, V_{CE} = 4.0V		56		
$V_{BE(ON)}$	I_C = 4.0 A, V_{CE} = 4.0V			1.8	V
$V_{CE(SAT)}$	I_C = 4.0 A, I_B = 0.4 A		.5	1.1	V
$V_{CE(SAT)}$	I_C = 15.0 A, I_B = 5.0 A			4	V
I_{CEO}	V_{CE} = 30V			1.8	mA
I_{CEX}	V_{CE} = 55V, V_{EB} = 1.5V		.1	2.0	mA
I_{EBO}	V_{EB} = 7.0V		.02	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	45	80		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	55	100		V
V_{EBO}	I_B = –5.0 mA	7			V
POWER TEST	t = 1 sec, V_{CE} = 45V	117			W
f_T	I_C = 1.0 A, V_{CE} = 4V		.8		MHz

Process 1C NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3442, 2N4347

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 3 A, V_{CE} = 4.0V	13	25		
h_{FE}	I_C = 100 mA, V_{CE} = 4.0V		70		
$V_{BE(ON)}$	I_C = 3.0 A, V_{CE} = 4.0V		1	2	V
$V_{CE(SAT)}$	I_C = 3.0 A, I_B = .3 A		.6	1	V
$V_{CE(SAT)}$					
I_{CEO}	V_{CE} = 100V			200	mA
I_{CEX}	V_{CE} = 125V, V_{EB} = 1.5V		.1	2.0	mA
I_{EBO}	V_{EB} = 7.0V		.02	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	120	150		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	140	165		V
V_{EBO}	I_B = –5.0 mA	7			V
POWER TEST	t = 1 sec., I_C = 1.5A	100	117		W

Process 1D NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3771, 2N3772

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 20 A, V_{CE} = 4V	5	10		
h_{FE}	I_C = 10 A, V_{CE} = 4V	15	25		
$V_{BE(ON)}$	I_C = 10 A, V_{CE} = 4V		1.5	2.2	V
$V_{CE(SAT)}$	I_C = 10 A, I_B = 1.0 A		.7	1.4	V
$V_{CE(SAT)}$	I_C = 20 A, I_B = 4.0 A		1.5	4.0	V
I_{CEO}	V_{CE} = 30V			10	mA
I_{CEX}	V_{CE} = 50V, V_{EB} = 1.5V		.1	2.0	mA
I_{EBO}	V_{EB} = 7V		.02	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	40	70		V
$V_{CEX(SUS)}$	I_C = 200 mA, V_{EB} = 1.5V	50	90		V
V_{EBO}	I_B = –5.0 mA	7.0			V
POWER TEST	t = 1 sec., V_{CE} = 40V	150			W
f_T	I_C = 1.0 A, V_{CE} = 4.0V		.8		MHz

Process 1E NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

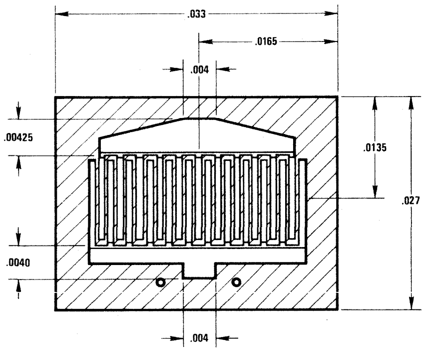
This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3773, 2N4348

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 10 A, V_{CE} = 4.0V	10	15		
h_{FE}	I_C = 5 A, V_{CE} = 4.0V	15	30		
$V_{BE(ON)}$	I_C = 5 A, V_{CE} = 4.0V		1.0	2.0	V
$V_{CE(SAT)}$	I_C = 10 A, I_B = 1.25 A		.7	2.0	V
$V_{CE(SAT)}$	I_C = 5 A, I_B = 0.5 A		.35	1.0	V
I_{CEO}	V_{CE} = 100V			200	mA
I_{CEX}	V_{CE} = 120V, V_{EB} = 1.5V		.2	2.0	mA
I_{EBO}	V_{EB} = 7V		.1	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	120	150		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	140	165		V
V_{EBO}	I_B = 5.0 mA	7			V
POWER TEST	t = 1 sec., I = 1.5 A	120	150		W

Process 01 NPN High Speed Switch



DESCRIPTION

Process 01 is an overlay double diffused, gold doped epitaxial device.

APPLICATION

This device was designed for ultra high speed core driver applications where predictable switching speed is a prime consideration.

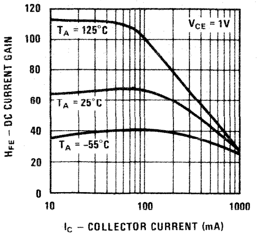
PRINCIPAL DEVICE TYPES

TO-18 2N6375
TO-39 (PKG 17) 2N6376

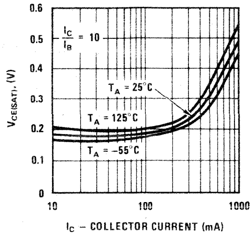
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	V_{CE} = 30V, I_C = 300 mA, I_{B_1} = 30 mA	10	14	20	ns	
t_{off}	V_{CE} = 30V, I_C = 300 mA, I_{B_1} = $-I_{B_2}$ = 30 mA	20	27	40	ns	
t_{on}	V_{CE} = 30V, I_C = 500 mA, I_{B_1} = 50 mA	8	10	16	ns	
t_{off}	V_{CE} = 30V, I_C = 500 mA, I_{B_1} = $-I_{B_2}$ = 50 mA	20	28	40	ns	
t_{on}	V_{CE} = 30V, I_C = 1 Amp, I_{B_1} = 100 mA	10	14	25	ns	
t_{off}	V_{CE} = 30V, I_C = 1 Amp, I_{B_1} = $-I_{B_2}$ = 100 mA	15	25	35	ns	
h_{FE}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	3.0	4.2			
C_{CB}	V_{CB} = 10V		6.5	10	pF	
C_{EB}	V_{EB} = 0.5V		55	65	pF	
H_{FE}	V_{CE} = 1V, I_C = 10 mA	60				
H_{FE}	V_{CE} = 1V, I_C = 100 mA	60				
H_{FE}	V_{CE} = 1V, I_C = 300 mA	50				
H_{FE}	V_{CE} = 1V, I_C = 500 mA	30		90		
H_{FE}	V_{CE} = 1V, I_C = 1 Amp	20				
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.17	.25	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.22	.35	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.30	.40	V	
$V_{CE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		0.49	.55	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.77	0.8	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA	0.8	0.86	0.9	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	0.85	0.94	1.0	V	
$V_{BE(SAT)}$	I_C = 1 Amp, I_B = 100 mA	0.95	1.08	1.2	V	
I_{CBO}	V_{CB} = 40V			0.2	μA	
I_{EBO}	V_{EB} = 4V			0.2	μA	
BV_{CBO}	I_C = 10 μA	75	116		V	
BV_{EBO}	I_E = 10 μA	6.0	7.6		V	
BV_{CEO}	I_C = 10 mA	30	40		V	

Process 01

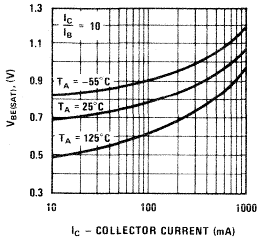
DC Current Gain vs Collector Current



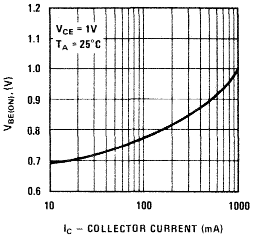
$V_{CE(SAT)}$, Collector Saturation Voltage



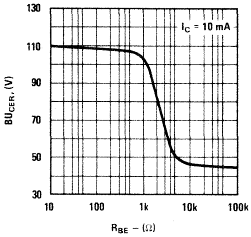
$V_{BE(SAT)}$, Base Saturation Voltage



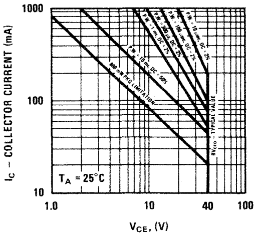
$V_{BE(ON)}$, Base Emitter On Voltage



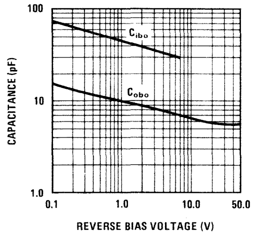
BV_{CER} vs R_{BE}



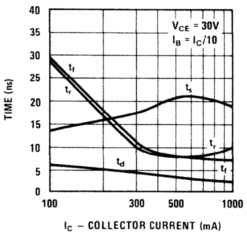
Safe Operating Area



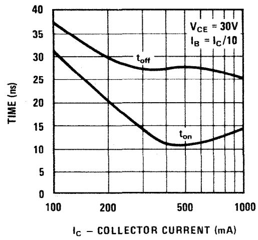
Capacitance vs Reverse Bias Voltage



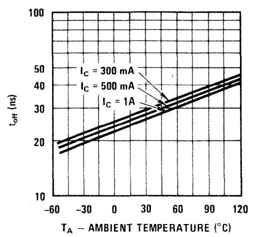
Switching Times vs Collector Current



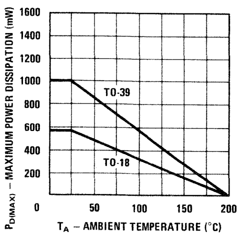
Turn On and Turn Off Times vs Collector Current



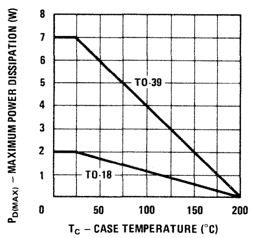
t_{off} vs Ambient Temperature



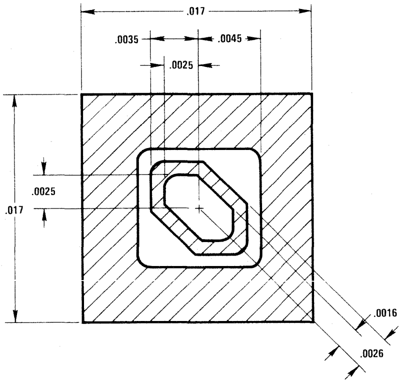
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



Process 04 NPN Small Signal



DESCRIPTION

Process 04 is a non-overlay double-diffused silicon epitaxial device. Complement to Process 71.

APPLICATION

This device was designed for low noise, high gain, general purpose amplifier application. From 1 μA to 100 mA collector current.

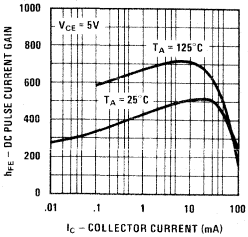
PRINCIPAL DEVICE TYPES:

TO-18 BC107 Series

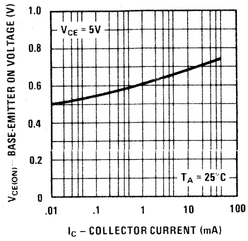
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V f = 1 kHz, R_S = 2k		1.0	3.0	dB	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		7.0	8.0	pF	TO-18
f_t	V_{CE} = 5V, I_C = 10 mA	150	250		MHz	
h_{FE}	V_{CE} = 5V, I_C = 100 μA	50	250	500		
h_{FE}	V_{CE} = 5V, I_C = 2 mA	100	400	750		
h_{FE}	V_{CE} = 5V, I_C = 100 mA	75	250	300		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	30	100	150		
$V_{CE(sat)}$	I_C = 10 mA, I_B = 1 mA		.040	.080	V	
$V_{CE(sat)}$	I_C = 100 mA, I_B = 5 mA		.150	.200	V	
$V_{BE(sat)}$	I_C = 10 mA, I_B = 1 mA		.75	.85	V	
BV_{CBO}	I_C = 10 μA	115	125		V	
BV_{CEO}	I_C = 10 mA	45	50		V	
BV_{EBO}	I_E = 10 μA	8.0	9.0		V	
I_{CBO}	V_{CB} = 40V			10	NA	
I_{EBO}	V_{EB} = 4V			10	NA	

Process 04

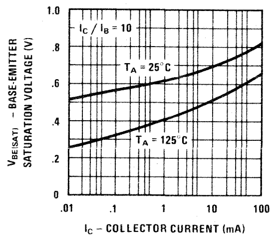
Pulsed DC Current Gain vs Collector Current



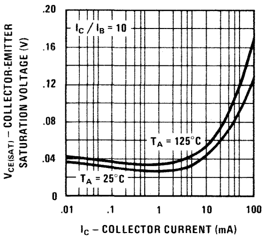
Base-Emitter On Voltage vs Collector Current



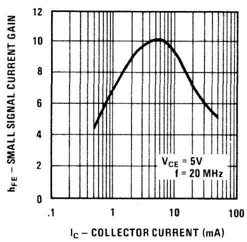
Base-Emitter Saturation Voltage vs Collector Current



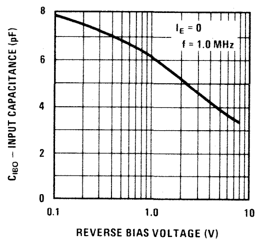
Collector-Emitter Saturation Voltage vs Collector Current



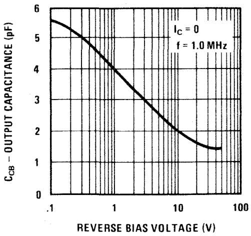
Small Signal Current Gain @ 20 MHz vs Collector Current



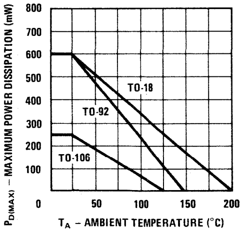
Input Capacitance vs Reverse Bias Voltage



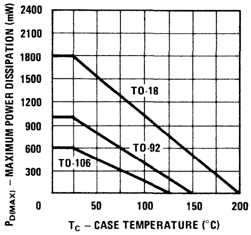
Output Capacitance vs Reverse Bias Voltage



Maximum Power Dissipation vs Ambient Temperature

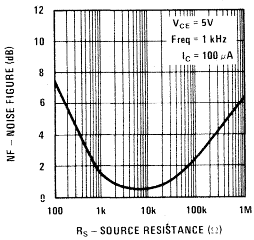


Maximum Power Dissipation vs Case Temperature

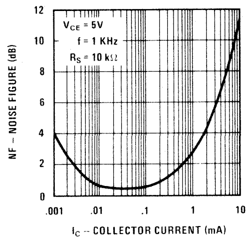


Process 04

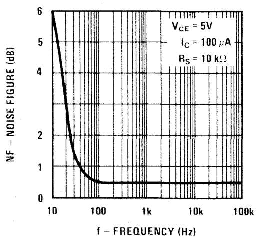
Noise Figure vs Source Resistance



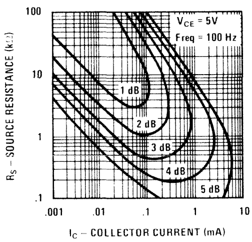
Noise Figure vs Collector Current



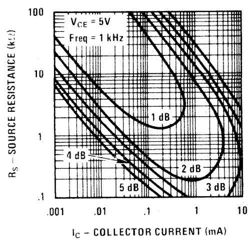
Noise Figure vs Frequency



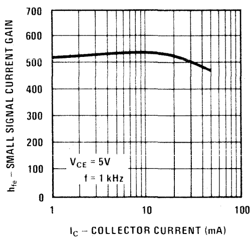
Contours of Constant Narrow Band Noise Figure



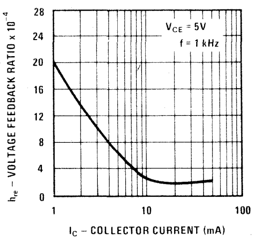
Contours of Constant Narrow Band Noise Figure



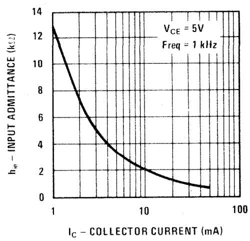
Small Signal Current Gain



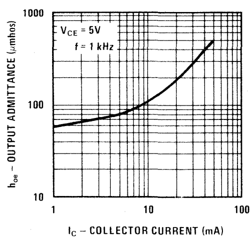
Voltage Feedback Ratio



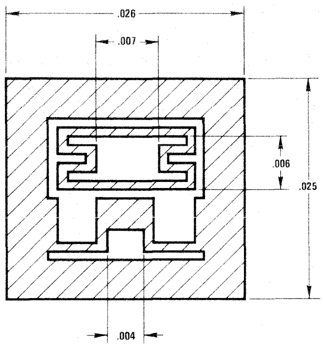
Input Admittance



Output Admittance



Process 05 NPN Darlington



DESCRIPTION

Process 05 is a monolithic double diffused, silicon epitaxial Darlington.

APPLICATION

This device is designed for applications requiring extremely high current gain at collector currents to 1 Amp.

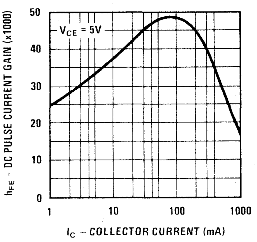
PRINCIPAL DEVICE TYPES:

TO-92, MPS-A12 (EBC), 2N5306 (ECB)

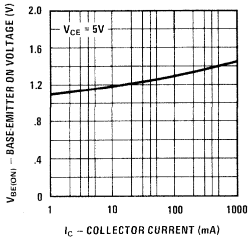
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	I_C = 1 mA, V_{CE} = 5V, R_S = 100 k, f = 1 kHz		2		dB	
C_{cb}	V_{CB} = 10V, I_E = 0, f = 1 MHz		4	8	pF	
h_{FE}	I_C = 10 mA, V_{CE} = 5V I_C = 100 mA, V_{CE} = 5V	20,000 5,000	80,000 100,000	200,000 250,000		
$V_{CE(SAT)}$	10 mA, .01 mA 100 mA, .1 mA			1.0 1.5	V	
$V_{BE(ON)}$	10 mA, 5V 100 mA, 5V		1.2 1.25	1.4 2.0	V	
h_{FE}	I_C = 10 mA, V_{CE} = 5.0V, f = 1 kHz		80,000			
BV_{CES}	I_C = 100 μA	20	45		V	
I_{CES}	V_{CE} = 15V, V_{BE} = 0			100	nA	
I_{CBO}	V_{CB} = 15V, I_E = 0			100	nA	
I_{EBO}	V_{EB} = 10V, I_C = 0			100	nA	

Process 05

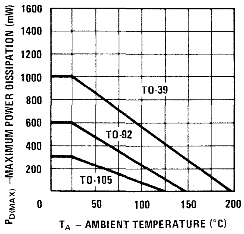
DC Pulse Current Gain vs Collector Current



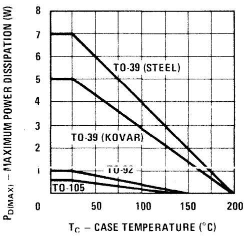
Base-Emitter On Voltage vs Collector Current



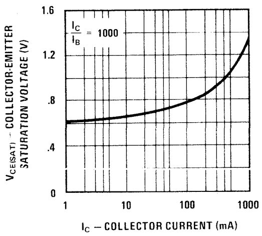
Maximum Power Dissipation vs Ambient Temperature



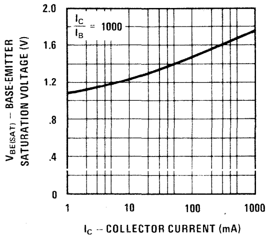
Maximum Power Dissipation vs Case Temperature



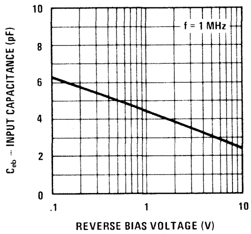
Collector-Emitter Saturation Voltage vs Collector Current



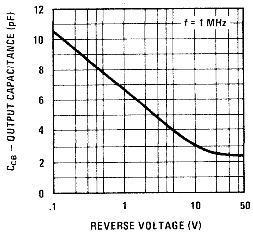
Base-Emitter Saturation Voltage vs Collector Current



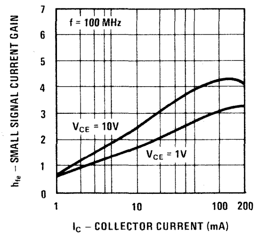
Input Capacitance vs Reverse Bias Voltage



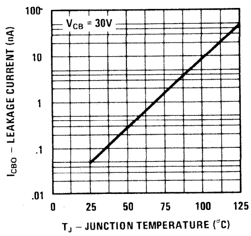
Output Capacitance vs Reverse Bias Voltage



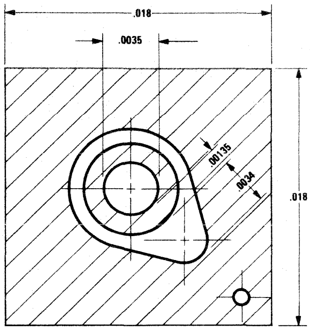
Small Signal Current Gain vs Collector Current



Collector-Base Diode Reverse Current vs Temperature



Process 07 NPN Small Signal



DESCRIPTION

Process 07 a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 62.

APPLICATION

This device was designed for low noise, high gain general purpose amplifier applications. From 1 μA to 25 mA collector current.

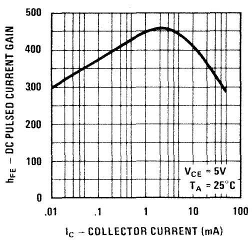
PRINCIPAL DEVICE TYPES:

TO-18	2N930
TO-71	2N2979
TO-78	2N2920
TO-92	2N5088 (EBC), 2N3392 (ECB)
TO-106	2N3565

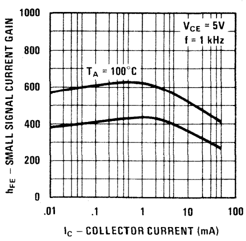
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 100 Hz, P_{BW} = 20 Hz		3	10	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 1 kHz P_{BW} = 200 Hz		1	3	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 10 kHz, P_{BW} = 2 kHz		1	3	dB	
NF (wide band)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, P_{BW} = 15.7 kHz		1	3	dB	
h_{fe}	I_C = 500 μA, V_{CE} = 5V, f = 20 MHz	5	7			
C_{cb}	V_{CB} = 5V		1.7	2.5	pF	TO-18
C_{eb}	V_{EB} = 0.50V		4.5	6.0	pF	TO-18
h_{FE}	I_C = 1 μA, V_{CE} = 5V	20	200	200		
h_{FE}	I_C = 10 μA, V_{CE} = 5V	20	300	600		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	20	350	800		
h_{FE}	I_C = 500 μA, V_{CE} = 5V	20	425	1000		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	20	450	1000		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	20	425	1000		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.06	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.15	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.1 mA		0.65	0.75	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.85	V	
BV_{CEO}	I_C = 10 mA	60			V	
BV_{CBO}	I_C = 1000 μA	60			V	
BV_{EBO}	I_C = 10 μA	6			V	
I_{CBO}	V_{CB} = 45V			10	nA	
I_{EBO}	V_{EB} = 4V			10	nA	

Process 07

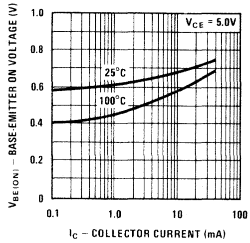
Pulsed DC Current Gain vs Collector Current



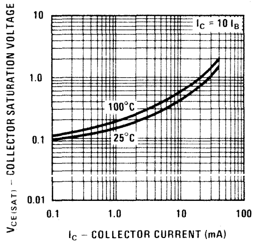
Small Signal Current Gain vs Collector Current



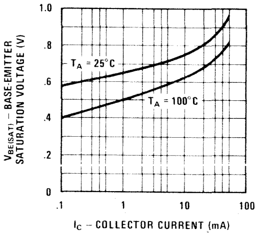
Base-Emitter On Voltage vs Collector Current



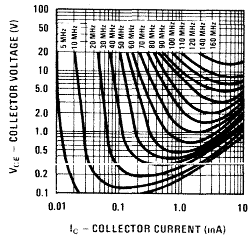
Collector Saturation Voltage vs Collector Current



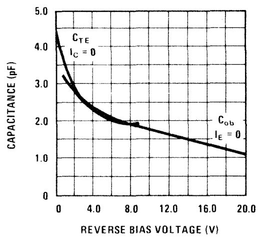
Base-Emitter Saturation Voltage vs Collector Current



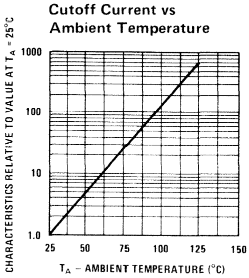
Contours of Constant Gain Bandwidth Product (f_T)



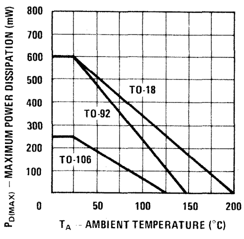
Input and Output Capacitance vs Reverse Bias Voltage



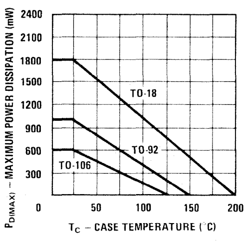
Normalized Collector Cutoff Current vs Ambient Temperature



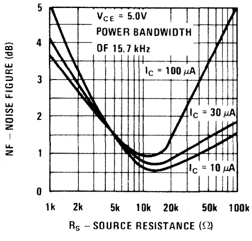
Maximum Power Dissipation vs Ambient Temperature



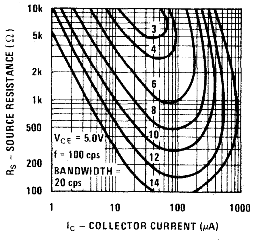
Maximum Power Dissipation vs Case Temperature



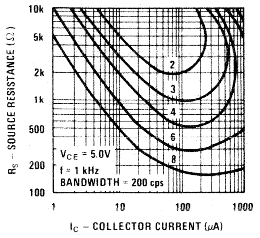
Wide Band Noise Figure vs Source Resistance



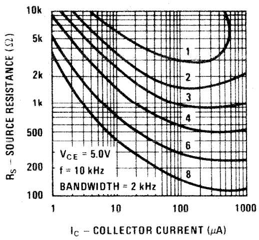
Contours of Constant Narrow Band Noise Figure



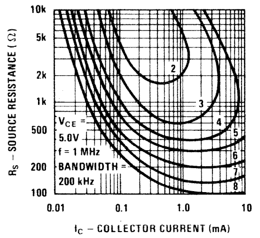
Contours of Constant Narrow Band Noise Figure



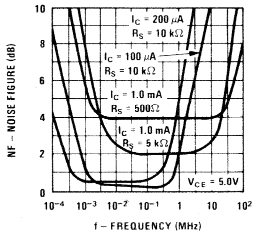
Contours of Constant Narrow Band Noise Figure



Contours of Constant Narrow Band Noise Figure



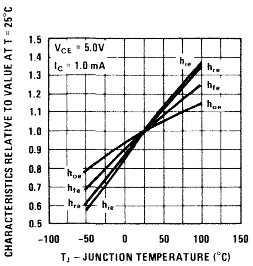
Noise Figure vs Frequency

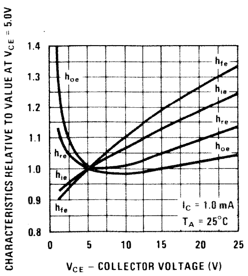


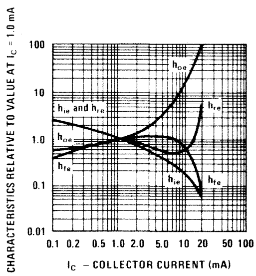
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	15	kΩ	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{oe}	Output Conductance	15	μmho	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{re}	Voltage Feedback Ratio	425	$\times 10^{-6}$	$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{fe}	Small Signal Current Gain	400		$I_C = 1.0$ mA $V_{CE} = 5.0$V
h_{ib}	Input Resistance	27	ohms	$I_C = 1.0$ mA $V_{CB} = 5.0$V

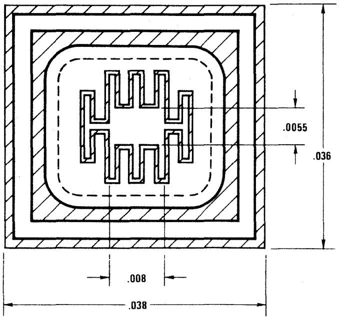
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 08 NPN High Voltage



DESCRIPTION

Complements Process 73.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

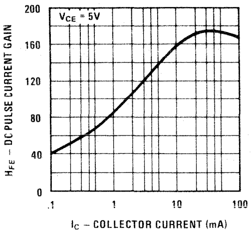
PRINCIPAL DEVICE TYPES:

TO-39 2N3501

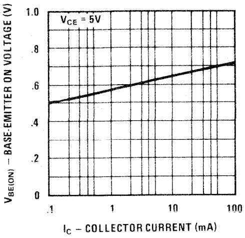
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 10 mA	100	160		V	
BV_{CBO}	I_C at 10 μA	100	200		V	
BV_{EBO}	I_E at 10 μA	6	7.5		V	
I_{CBO}	V_{CB} at 50V			50	nA	
I_{EBO}	V_{EB} at 4V			25	nA	
H_{FE}	I_C at 0.1 mA, V_{CE} at 10V	20	40			
H_{FE}	I_C at 1 mA, V_{CE} at 10V	25	70			
H_{FE}	I_C at 10 mA, V_{CE} at 10V	35	95			
H_{FE}	I_C at 150 mA, V_{CE} at 10V	40	100	300		
H_{FE}	I_C at 300 mA, V_{CE} at 10V	15	40			
$V_{CE(SAT)}$	I_C at 150 mA, I_B at 15 mA		0.25	0.4	V	
$V_{BE(SAT)}$	I_C at 150 mA, I_B at 15 mA		0.9	1.2	V	
C_{OB}	V_{CB} at 10V		7.5	10	pF	
C_{IB}	V_{EB} at 0.5V		65	80	pF	
FT	I_C at 20 mA, V_{CE} at 20V, f at 100 MHz	150	200		MHz	

Process 08

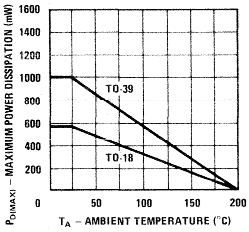
DC Pulse Current Gain vs Collector Current



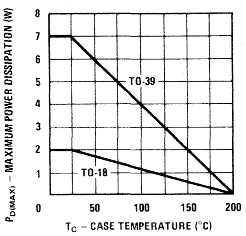
Base-Emitter On Voltage vs Collector Current



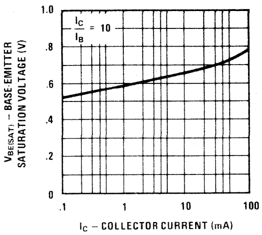
Maximum Power Dissipation vs Ambient Temperature



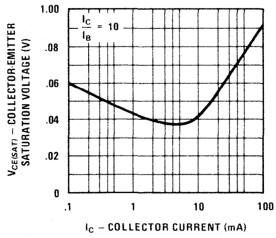
Maximum Power Dissipation vs Case Temperature



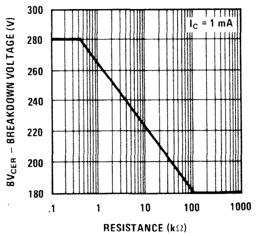
Base-Emitter Saturation Voltage vs Collector Current



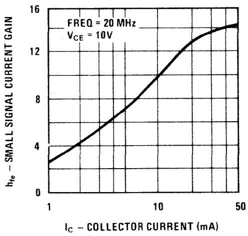
Collector-Emitter Saturation Voltage vs Collector Current



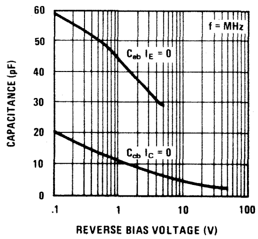
Collector-Emitter Breakdown Voltage With Resistance Between Emitter and Base



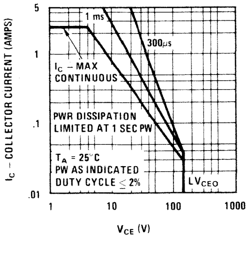
Small Signal Current Gain vs Collector Current



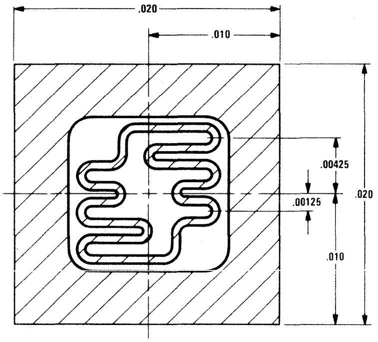
Input and Output Capacitance vs Reverse Bias Voltage



Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



Process 09 NPN Medium Power



DESCRIPTION

Process 09 is a nonoverlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to one Amp.

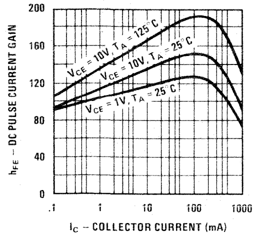
PRINCIPAL DEVICE TYPES:

TO-105 CS9013

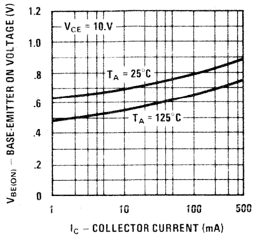
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	V_{CB} = 10V		5	10	pF	
C_{IB}	V_{EB} = .5V		25	35	pF	
NF	V_{CE} = 10V, I_C = 1 mA R_S = 1k, f = 1 kHz		1.0		dB	
f_T	V_{CE} = 10V, I_C = 100 mA		400		MHz	
h_{FE}	V_{CE} = 1.0V, I_C = 1 mA	25	120	250		
h_{FE}	V_{CE} = 1.0V, I_C = 50 mA	40	130	350		
h_{FE}	V_{CE} = 1.0V, I_C = 500 mA	25	100	150		
h_{FE}	V_{CE} = 1.0V, I_C = 1A	15	80	100		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		.09		V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		.24		V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		.86		V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0		V	
BV_{CBO}	I_C = 1 mA		100			
BV_{CEO}	I_C = 10 mA	25	30			
BV_{EBO}	I_E = 1 μA		7.5			
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 4.0V			50	nA	

Process 09

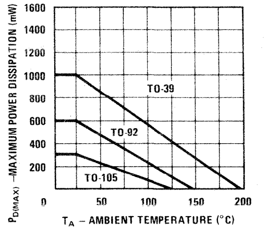
DC Pulse Current Gain vs Collector Current



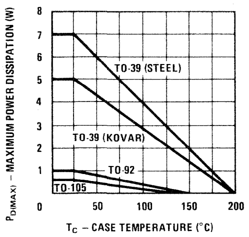
Base-Emitter On Voltage vs Collector Current



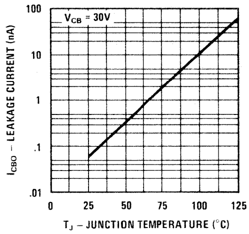
Maximum Power Dissipation vs Ambient Temperature



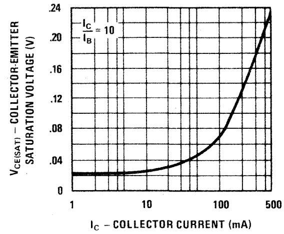
Maximum Power Dissipation vs Case Temperature



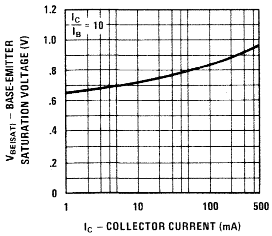
Collector-Base Diode Reverse Current vs Temperature



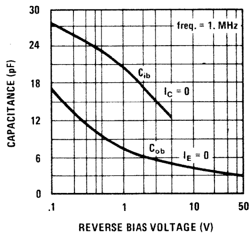
Collector-Emitter Saturation Voltage vs Collector Current



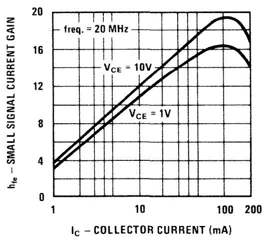
Base-Emitter Saturation Voltage vs Collector Current



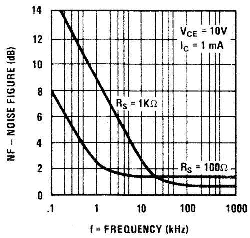
Capacitance vs Reverse Bias Voltage



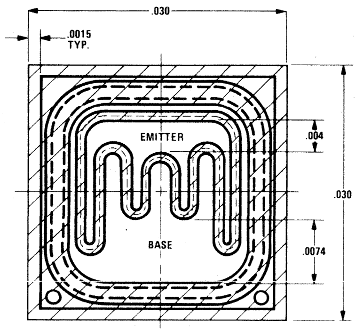
Small Signal Current Gain vs Collector Current



Noise Figure vs Frequency



Process 12 NPN Medium Power



DESCRIPTION

Process 12 is a nonoverlay, double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose medium power amplifiers and switches requiring collector currents up to 1 amp and collector voltages between 80 and 140 volts.

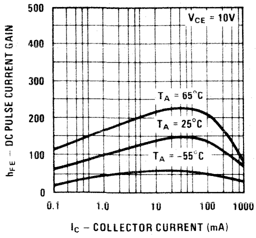
PRINCIPAL DEVICE TYPES:

TO-18	2N3700
TO-39	2N3019
TO-105	2N3568

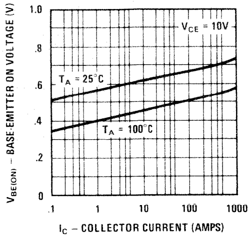
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		50	60	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		400	500	ns	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	4.0	6.5			
C_{cb}	V_{CB} = 10V		6.5	10	pF	TO-39
C_{eb}	V_{EB} = 0.5		50	60	pF	
NF	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	130			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	140			
h_{FE}	I_C = 100 mA, V_{CE} = 10V	20	160	400		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	20	130			
h_{FE}	I_C = 1A, V_{CE} = 10V	20	40			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	0.5	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.82	0.90	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.20	V	
BV_{CEO}	I_C = 10 mA	80			V	
BV_{CBO}	I_C = 100 μA	140			V	
BV_{EBO}	I_C = 10 μA	7			V	
I_{CBO}	V_{CB} = 90V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 12

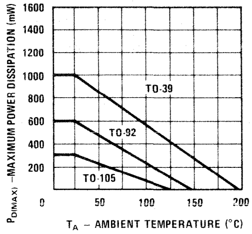
Pulsed DC Current Gain vs Collector Current



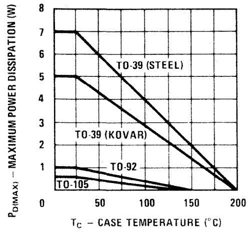
Base-Emitter On Voltage vs Collector Current



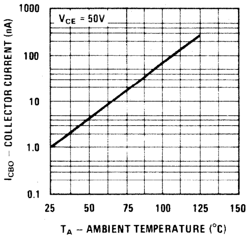
Maximum Power Dissipation vs Ambient Temperature



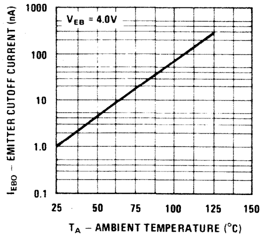
Maximum Power Dissipation vs Case Temperature



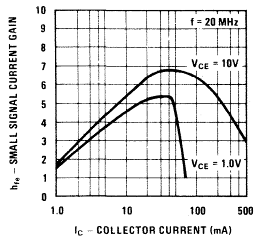
Collector Reverse Current vs Ambient Temperature



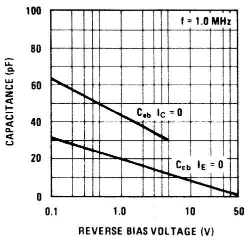
Emitter Cutoff Current vs Ambient Temperature



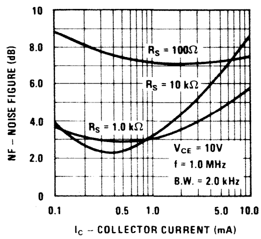
Small Signal Current Gain at 20 MHz



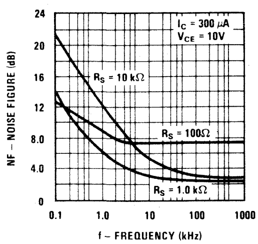
Collector-Base and Emitter Base Capacitance vs Reverse Bias Voltage



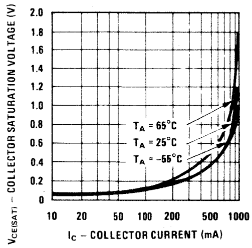
Noise Figure vs Collector Current



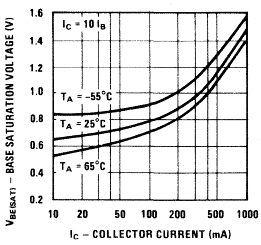
Noise Figure vs Frequency



Collector Saturation Voltage vs Collector Current

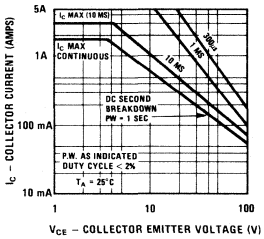


Base Saturation Voltage vs Collector Current

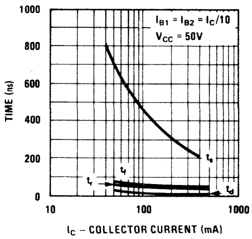


Process 12

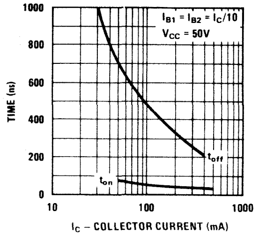
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink

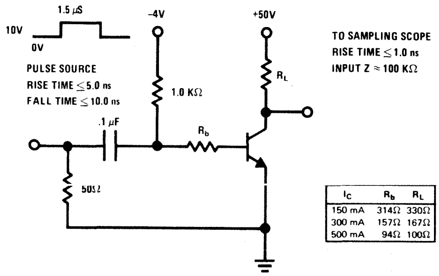


Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current





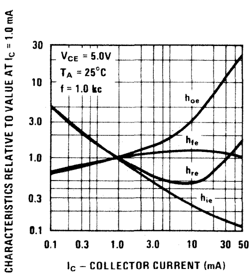
I_C	R_b	R_L
150 mA	314Ω	330Ω
300 mA	157Ω	167Ω
500 mA	94Ω	100Ω

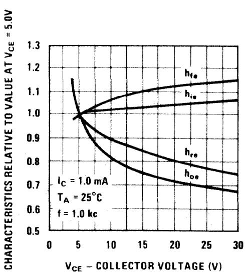
FIGURE 1. t_{on}, t_{off} Test Circuit

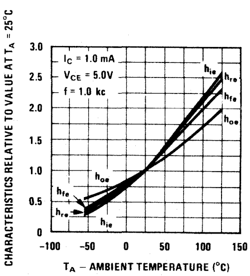
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	3000	ohms	I_C = 1.0 mA	V_{CE} = 5.0V
h_{oe}	Output Conductance	8.0	μmhos	I_C = 1.0 mA	V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	2.1	$x10^{-4}$	I_C = 1.0 mA	V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	100		I_C = 1.0 mA	V_{CE} = 5.0V

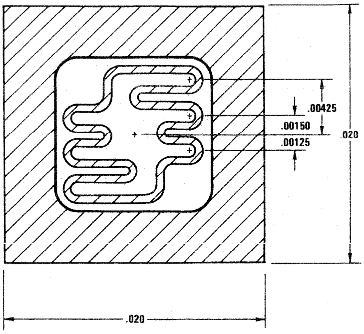
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 13 NPN Medium Power



DESCRIPTION

Process 13 is a nonoverlay. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of .1 mA to one Amp.

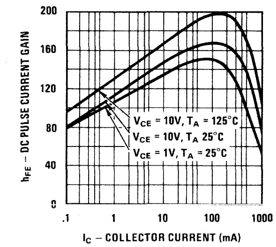
PRINCIPAL DEVICE TYPES:

TO-92 2N4401 (EBC), 2N3704 (ECB)

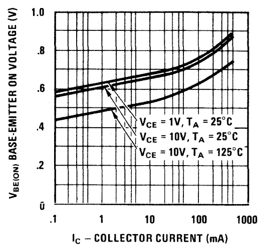
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
C_{ob}	V_{CB} = 10 V		4.5		pF	
C_{ib}	V_{EB} = .5V		22		pF	
h_{FE}	V_{CE} = 1.0V, I_C = 100 μA	15	80	125		
h_{FE}	V_{CE} = 1.0V, I_C = 1.0 mA	25	110	200		
h_{FE}	V_{CE} = 1.0V, I_C = 10 mA	35	135	280		
h_{FE}	V_{CE} = 1.0V, I_C = 150 mA	40	140	300		
h_{FE}	V_{CE} = 1.0V, I_C = 500 mA	25	100	150		
h_{FE}	V_{CE} = 5.0V, I_C = 1A	15	45	60		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.26	.36	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.87	.97	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.2	V	
BV_{CBO}	I_C = 1.0 μA		110		V	
BV_{CEO}	I_C = 10 mA	35	45	50	V	
BV_{EBO}	I_E = 1.0 μA		7.5		V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 13

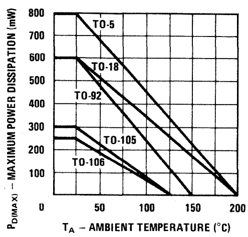
DC Pulse Current Gain vs Collector Current



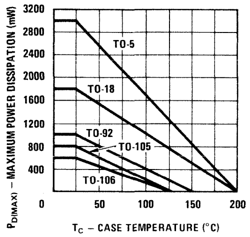
Base-Emitter On Voltage vs Collector Current



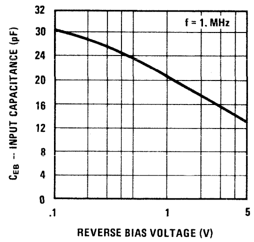
Maximum Power Dissipation vs Ambient Temperature



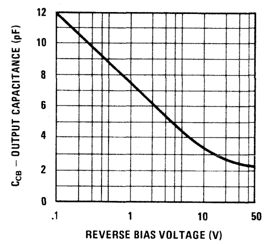
Maximum Power Dissipation vs Case Temperature



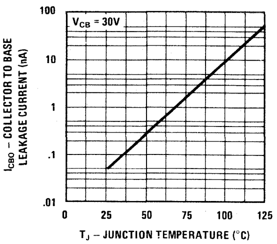
Input Capacitance vs Reverse Bias Voltage



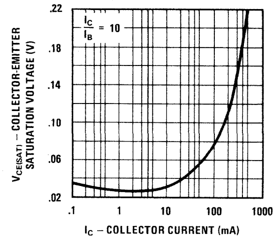
Output Capacitance vs Reverse Bias Voltage



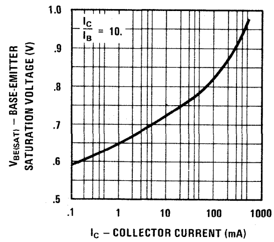
Collector to Base Diode Reverse Current vs Temperature



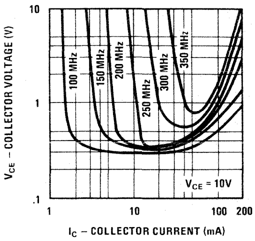
Collector-Emitter Saturation Voltage vs Collector Current



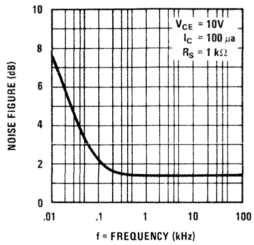
Base-Emitter Saturation Voltage vs Collector Current



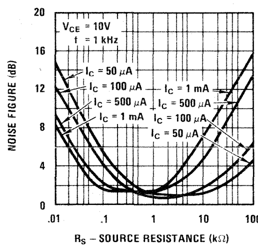
Contours of Constant Gain Bandwidth Product (f_t)



Noise Figure vs Frequency



Noise Figure vs Source Resistance

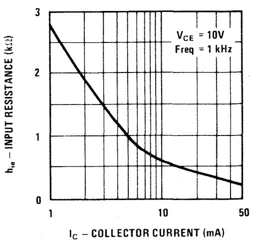


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

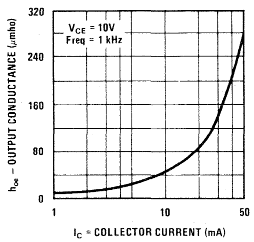
SYMBOL	CHARACTERISTIC	TYP	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	600	ohms	I_C = 10 mA, V_{CE} = 10V
h_{oe}	Output Conductance	50	μmhos	I_C = 10 mA, V_{CE} = 10V
h_{fe}	Small Signal Current Gain	170		I_C = 10 mA, V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	120	$\times 10^{-6}$	I_C = 10 mA, V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

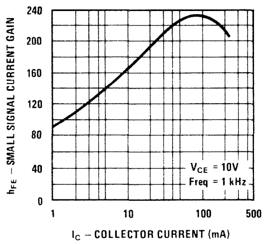
Small Signal Input Resistance vs Collector Current



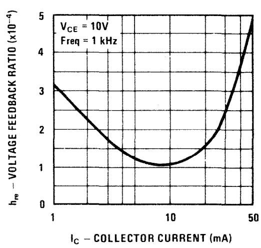
Small Signal Output Conductance vs Collector Current



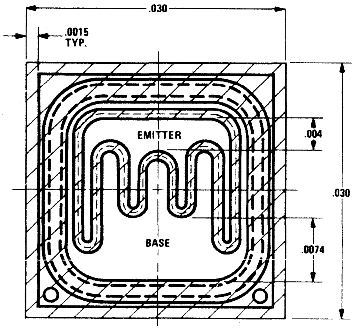
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 14 NPN Medium Power



DESCRIPTION

Process 14 is a nonoverlay double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to 500 mA.

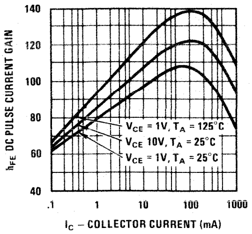
PRINCIPAL DEVICE TYPES:

TO-39	BFY50
TO-92	MPS6560
TO-105	2N3569

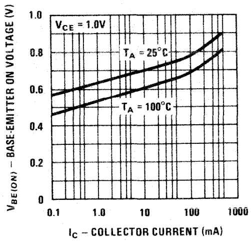
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{ob}	V_{CB} = 10V		8	10	pF	
C_{ib}	V_{EB} = 0.5V		55	65	pF	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	5	10			
h_{FE}	I_C = 0.1 mA, V_{CE} = 1V	20	60			
h_{FE}	I_C = 1 mA	20	80			
h_{FE}	I_C = 10 mA	20	100	400		
h_{FE}	I_C = 100 mA	20	110			
h_{FE}	I_C = 500 mA	20	70			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.04	0.10	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.07	0.12	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.90	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.80	1.0	V	
BV_{CEO}	I_C = 1 mA	40			V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5			V	
I_{CBO}	V_{CB} = 30			50	nA	
I_{EBO}	V_{EB} = 3			50	nA	

Process 14

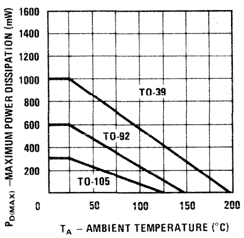
DC Pulse Current Gain vs Collector Current



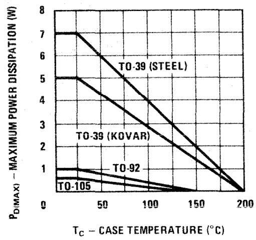
Base-Emitter On Voltage vs Collector Current



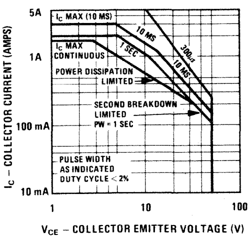
Maximum Power Dissipation vs Ambient Temperature



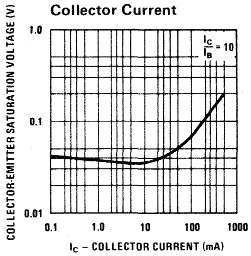
Maximum Power Dissipation vs Case Temperature



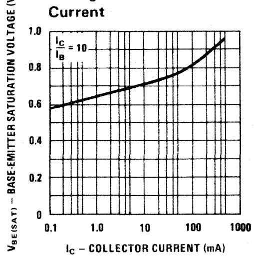
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



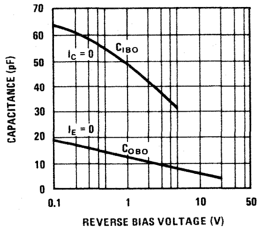
Collector-Emitter Saturation Voltage vs Collector Current



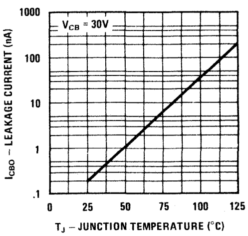
Base-Emitter Saturation Voltage vs Collector Current



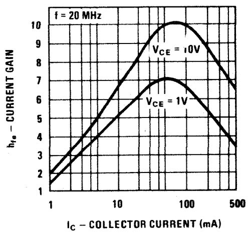
Capacitance vs Reverse Bias Voltage



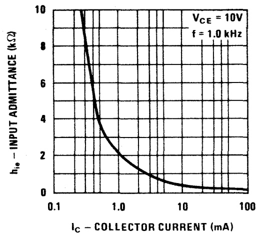
Collector-Base Diode Reverse Current vs Temperature



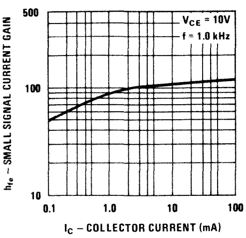
Small Signal Current Gain At 20 MHz vs Collector Current



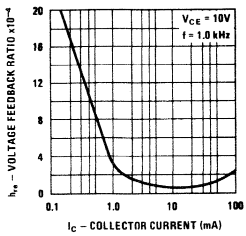
Input Admittance



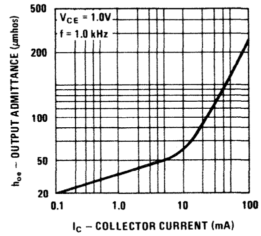
Small Signal Current Gain



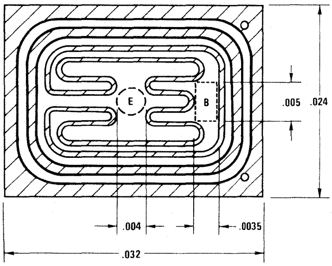
Voltage Feedback Ratio



Output Admittance



Process 15 NPN High Voltage



DESCRIPTION

Process 15 is a nonoverlay, double diffused, epitaxial silicon device.

APPLICATION

This device was designed for general purpose high voltage amplifiers and switches.

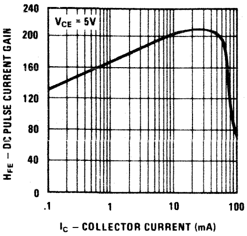
PRINCIPAL DEVICE TYPES:

TO-92	2N5832
TO-39	BF258

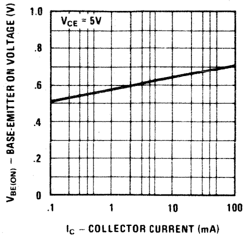
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C = 1 mA	140	250		V	
BV_{CBO}	I_C = 100 μA	160	300		V	
BV_{EBO}	I_E = 10 μA	5	7.2		V	
I_{CBO}	V_{CB} = 120V		0.5	50	nA	
I_{EBO}	V_{EB} = 4V		0.3	50	nA	
h_{FE}	I_C = 1 mA, V_{CE} = 5V	50	161			
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	200	500		
h_{FE}	I_C = 50 mA, V_{CE} = 5V	20	216			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.068	0.15	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.107	0.25	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.698	1.0	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 10 mA		0.778	1.2	V	
f_T	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	100	172	500	MHz	
C_{ob}	V_{CB} = 10V		4.97	6	pF	
C_{cb}	V_{CB} = 10V		2.43	4	pF	
C_{ib}	V_{EB} = 0.5V		51	60	pF	

Process 15

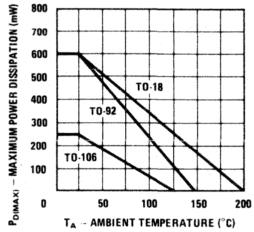
DC Pulse Current Gain vs Collector Current



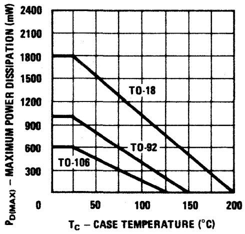
Base-Emitter on Voltage vs Collector Current



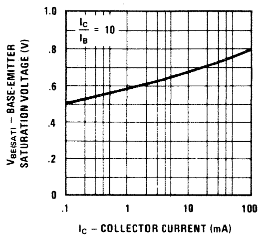
Maximum Power Dissipation vs Ambient Temperature



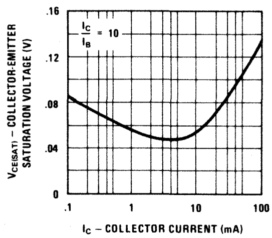
Maximum Power Dissipation vs Case Temperature



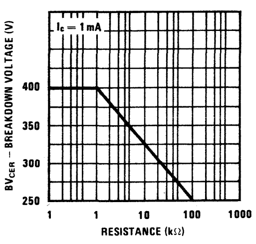
Base-Emitter Saturation Voltage vs Collector Current



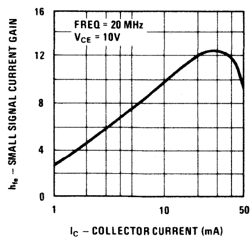
Collector-Emitter Saturation Voltage vs Collector Current



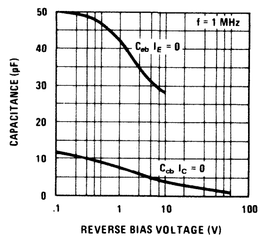
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



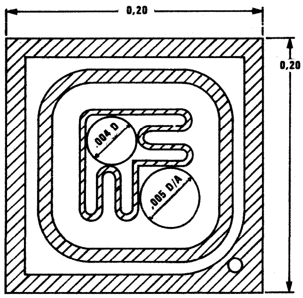
Small Signal Current Gain vs Collector Current



Input and Output Capacitance vs Reverse Bias Voltage



Process 16 NPN High Voltage



DESCRIPTION

Process 15 is a double diffused, epitaxial, planar, NPN Transistor.

APPLICATION

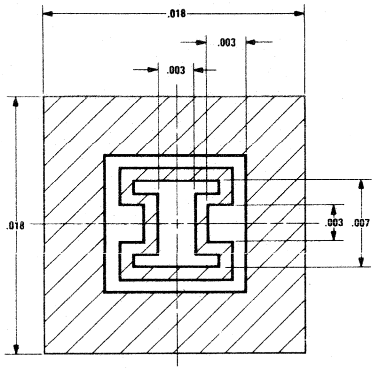
General purpose, high voltage amplifier applications. Gas discharge display driver.

PRINCIPAL DEVICE TYPES:

TO-92 2N5551

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	$I_C = 1$ mA	100	170		V
BV_{CBO}	$I_C = 100\ \mu A$	120	275		V
BV_{EBO}	$I_E = 10\ \mu A$	5	7.2		V
I_{CBO}	$V_{CB} = 120V$		0.5	50	nA
I_{EBO}	$V_{EB} = 4V$		0.3	50	nA
h_{FE}	$I_C = 1$ mA, $V_{CE} = 5V$	50	110		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 5V$	50	132	300	
h_{FE}	$I_C = 50$ mA, $V_{CE} = 5V$	20	60		
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.064	0.15	V
$V_{CE(SAT)}$	$I_C = 50$ mA, $I_B = 5$ mA		0.115	0.25	V
$V_{BE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.743	1.0	V
$V_{BE(SAT)}$	$I_C = 50$ mA, $I_B = 10$ mA		0.825	1.2	V
f_T	$I_C = 10$ mA, $V_{CE} = 10V$, f = 100 MHz	100	220	300	MHz
C_{ob}	$V_{CB} = 10V$		2.67	6	pF
C_{cb}	$V_{CB} = 10V$		2.53	4	pF
C_{ib}	$V_{EB} = 0.5V$		1.5	30	pF

Process 20 NPN Medium Power



DESCRIPTION

Process 20 is nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of 0.1 to 500 mA.

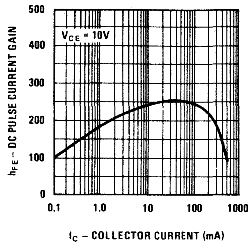
PRINCIPAL DEVICE TYPES:

TO-15	2N2219A
TO-18	2N2222A
TO-92	MPS3642
TO-105	2N3643
TO-106	2N4141

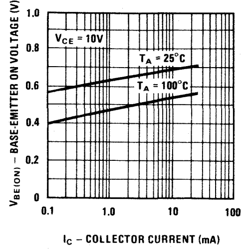
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{cb}	V_{EB} = 0.5V		18	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	195			
h_{FE}	I_C = 10 mA	20	240	500		
h_{FE}	I_C = 100 mA	20	250	500		
h_{FE}	I_C = 500 mA	20	90			
h_{FE}	I_C = 1A	15	30			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.12	0.50	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.00	1.5	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	70			V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 20

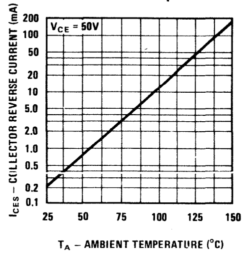
DC Pulse Current Gain vs Collector Current



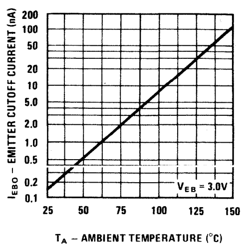
Base-Emitter On Voltage vs Collector Current



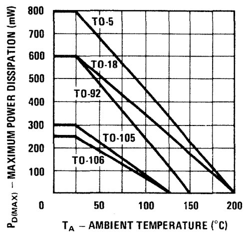
Collector Reverse Current vs Ambient Temperature



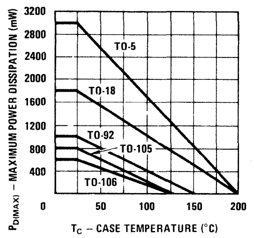
Emitter Cutoff Current vs Ambient Temperature



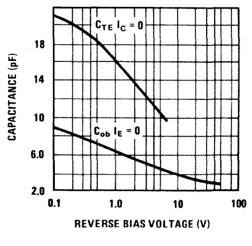
Maximum Power Dissipation vs Ambient Temperature



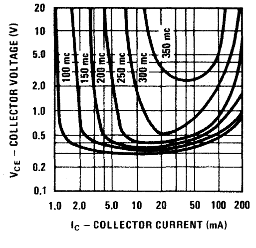
Maximum Power Dissipation vs Case Temperature



Emitter Transition and Output Capacitance vs Reverse Bias Voltage

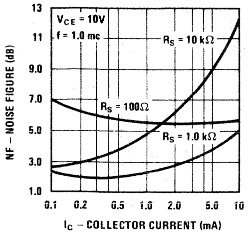


Contours of Constant Gain Bandwidth Product (f_T)

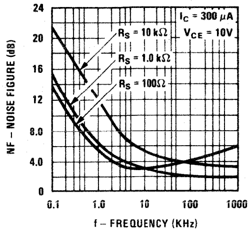


Process 20

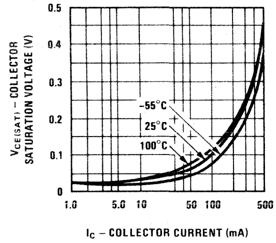
Noise Figure vs Collector Current



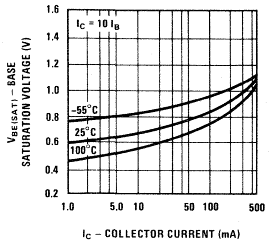
Noise Figure vs Frequency



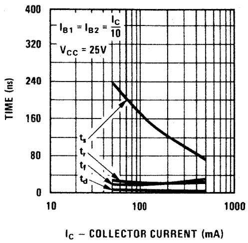
Collector Saturation Voltage vs Collector Current



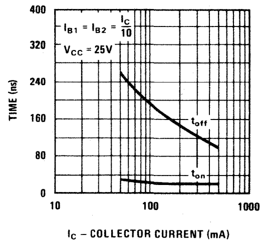
Base Saturation Voltage vs Collector Current



Switching Times vs Collector Current



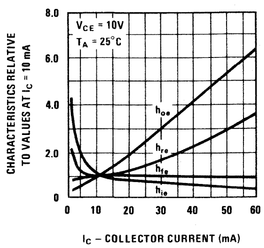
Turn On and Turn Off Times vs Collector Current

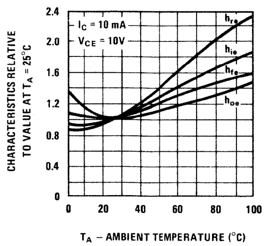


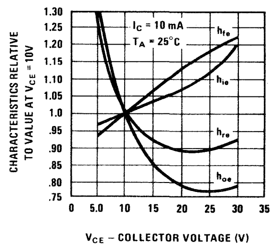
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	700	ohms	I_C = 10 mA V_{CE} = 10V
h_{oe}	Output Conductance	120	μmhos	I_C = 10 mA V_{CE} = 10V
h_{fe}	Small Signal Current Gain	240		I_C = 10 mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	460	$x10^{-6}$	I_C = 10 mA V_{CE} = 10V

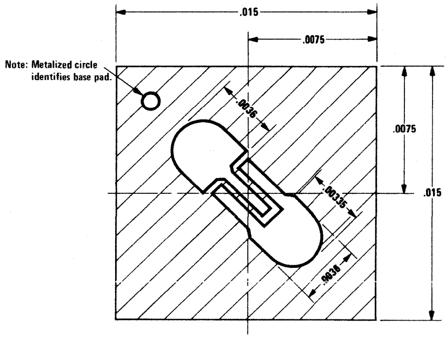
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 21 NPN High Speed Switch



DESCRIPTION

Process 21 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 65.

APPLICATION

This device was designed for high speed saturated switching at collector currents of 10 to 100 mA.

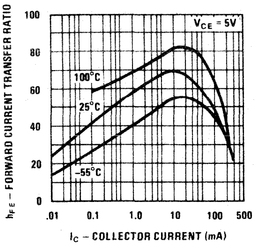
PRINCIPAL DEVICE TYPES:

TO-18	2N2369A
TO-92	MPS2369 (EBC), 2N5030 (ECB)
TO-106	2N4275

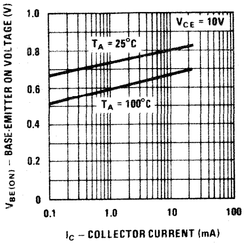
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	$I_{B1} = I_{B2} = I_C = 10$ mA		7	13	ns	Fig. 1
t_{on}	$I_C = 10$ mA, $I_{B1} = 3$ mA		9	12	ns	Fig. 2
t_{off}	$I_C = 10$ mA, $I_{B2} = 1.50$ mA		10	18	ns	Fig. 2
h_{fe}	$I_C = 10$ mA, $V_{CE} = 10V$, f = 100 MHz	5.0	7.0			
C_{cb}	$V_{CB} = 5V$		2.0	4.0	pF	TO-18
C_{EB}	$V_{EB} = 0.5V$		4.0	5.0	pF	TO-18
h_{FE}	$I_C = 1$ mA, $V_{CE} = 1V$	40	70	200		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1V$	40	70	200		
h_{FE}	$I_C = 50$ mA, $V_{CE} = 1V$	40	60	200		
h_{FE}	$I_C = 100$ mA, $V_{CE} = 1V$	40	50	200		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 0.35V$	40	65	200		
h_{FE}	$I_C = 30$ mA, $V_{CE} = 0.4V$	40	60	200		
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.14	0.2	V	
$V_{CE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		0.20	0.5	V	
$V_{BE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.80	0.85	V	
$V_{BE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		1.0	1.5	V	
BV_{CEO}	$I_C = 10$ mA	15	17		V	
BV_{CBO}	$I_C = 10\ \mu A$	40	60		V	
BV_{EBO}	$I_E = 10\ \mu A$	4.5	5.5		V	
I_{CBO}	$V_{CB} = 25V$			50	nA	
I_{EBO}	$V_{EB} = 3V$			50	nA	

Process 21

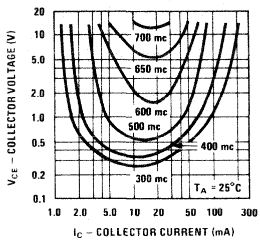
Pulse DC Current Gain vs Collector Current



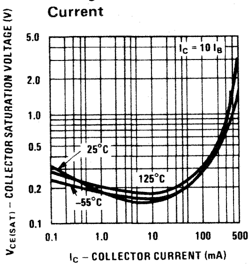
Base-Emitter On Voltage vs Collector Current



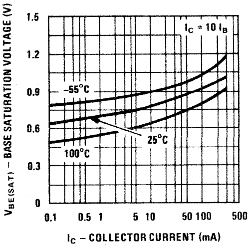
Contours of Constant Gain Bandwidth Product (f_T)



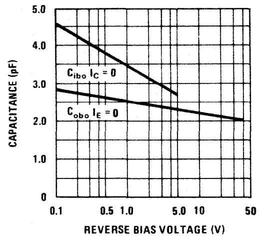
Collector Saturation Voltage vs Collector Current



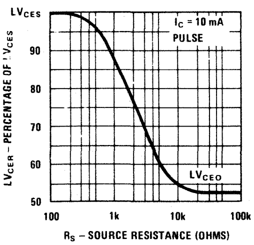
Base Saturation Voltage vs Collector Current



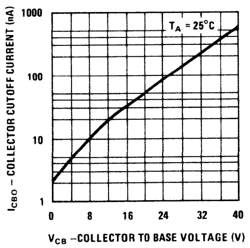
Emitter Transition and Output Capacitances vs Reverse Bias Voltage



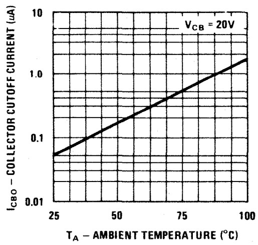
Lower Limiting Voltage vs Source Resistance



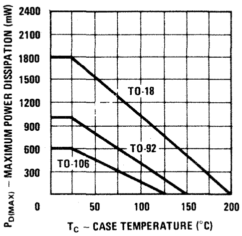
Collector Cutoff Current vs Reverse Bias Voltage



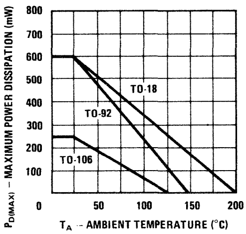
Collector Cutoff Current vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature

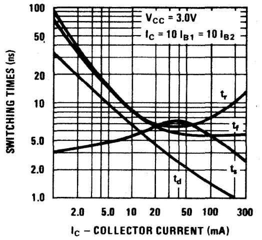


Maximum Power Dissipation vs Ambient Temperature

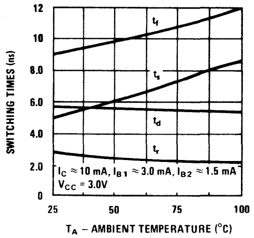


Process 21

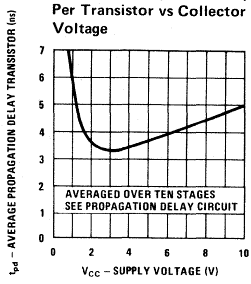
Switching Times vs Collector Current



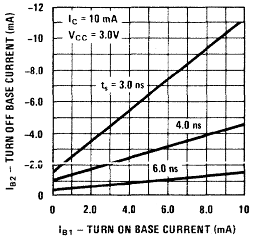
Switching Times vs Ambient Temperature



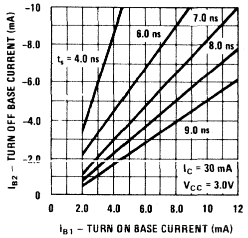
Average Propagation Delay Per Transistor vs Collector Voltage



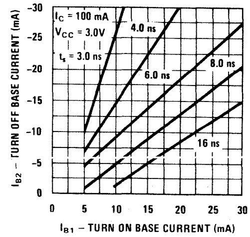
Storage Time vs Turn On and Turn Off Base Currents



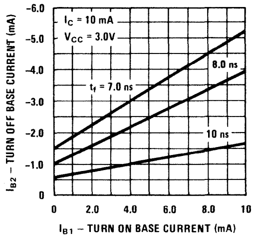
Storage Time vs Turn On and Turn Off Base Currents



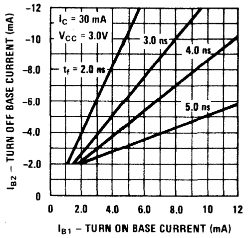
Storage Time vs Turn On and Turn Off Base Currents



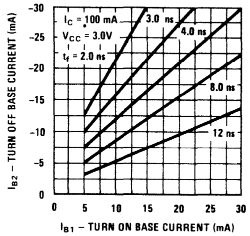
Fall Time vs Turn On and Turn Off Base Current



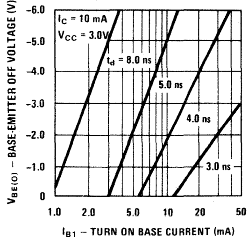
Fall Time vs Turn On and Turn Off Base Currents



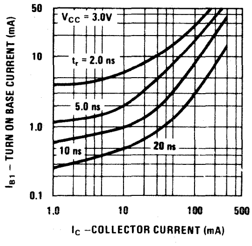
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base Emitter Off Voltage and Turn On Base Current



Rise Time vs Turn On Base Current and Collector Current



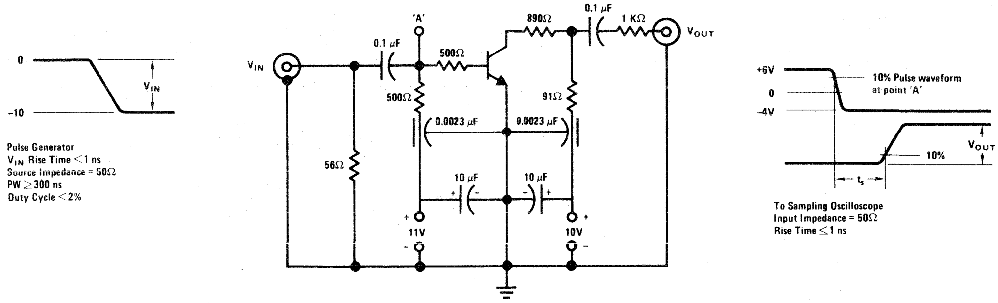


FIGURE 1. Charge Storage Time Measurement Circuit

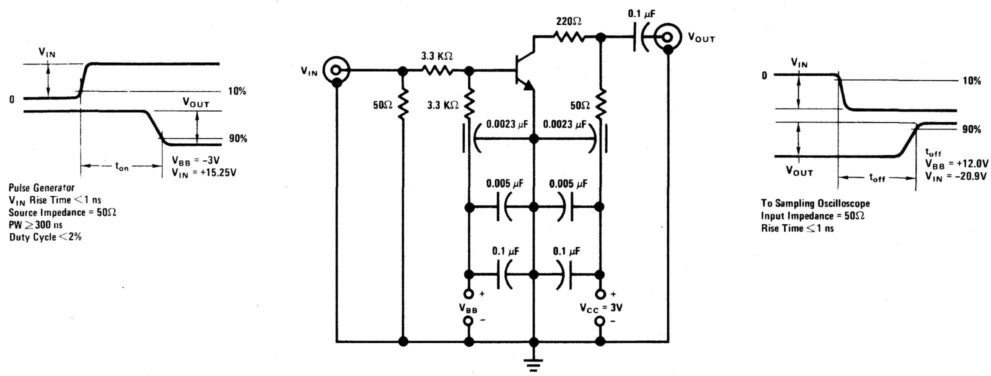
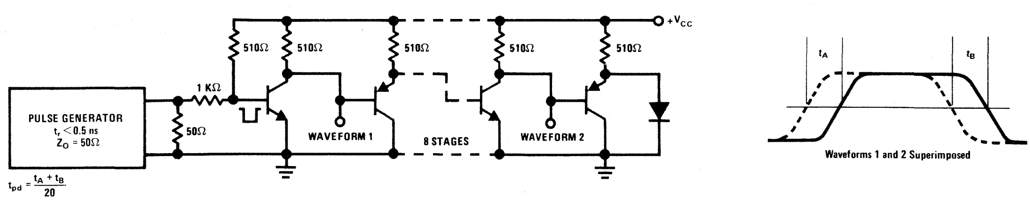


FIGURE 2. t_{on}, t_{off} Measurement Circuit

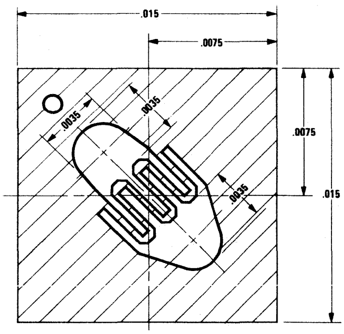


$t_{pd} = \frac{t_A + t_B}{20}$

t_{pd} = Average Propagation per Transistor

FIGURE 3. Circuit For Measurement of Propagation Delay

Process 22 NPN Small Signal



DESCRIPTION

Process 22 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 64.

APPLICATION

This device was designed for high speed logic and core driver applications to 300 mA.

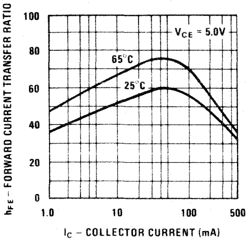
PRINCIPAL DEVICE TYPES:

TO-52	2N3013
TO-92	MPS3646
TO-106	2N3646

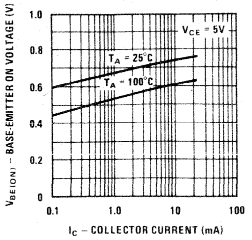
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	I_C = 10 mA, I_{B1} = I_{B2} = 10 mA		12	18	ns	Fig. 1
t_{on}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		10	18	ns	Fig. 2
t_{off}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		18	30	ns	
C_{ob}	V_{CB} = 5V		3.2	5.0	pF	TO-18
C_{ob}	V_{EB} = 0.5V		6.2	8.0	pF	TO-18
h_{fe}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	7.0	10		
h_{FE}	V_{CE} = 1V, 10 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	20	48	150		
h_{FE}	V_{CE} = 1V, I_C = 300 mA	15	30	120		
h_{FE}	V_{CE} = 0.4V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 0.5V, I_C = 100 mA	20	50	150		
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.14	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.20	0.28	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.40	0.50	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.80	0.95	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.92	1.2	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		1.1	1.7	V	
BV_{CBO}	I_C = 100 μA	40	50		V	
BV_{CEO}	I_C = 10 mA	15	18		V	
BV_{EBO}	I_E = 100 μA	5.0	5.7		V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 22

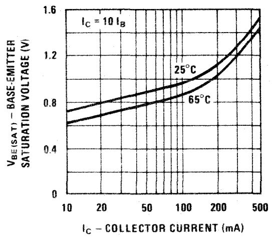
DC Pulse Current Gain vs Collector Current



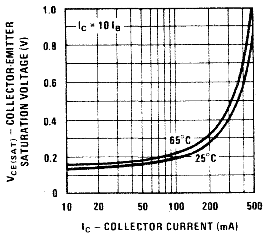
Base-Emitter On Voltage vs Collector Current



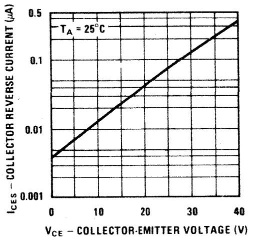
Base Saturation Voltage vs Collector Current



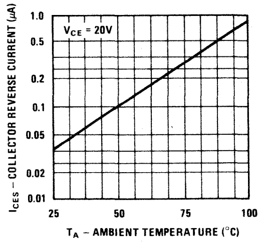
Collector Saturation Voltage vs Collector Current



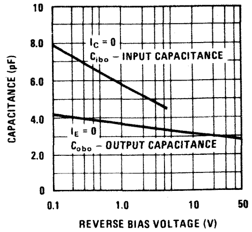
Collector Reverse Current vs Reverse Bias Voltage



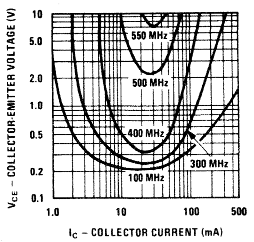
Collector Reverse Current vs Ambient Temperature



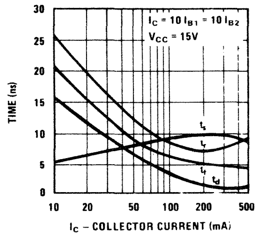
Input and Output Capacitance vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

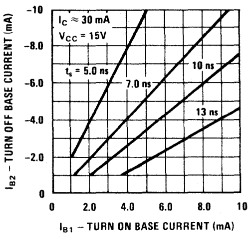


Switching Times vs Collector Current

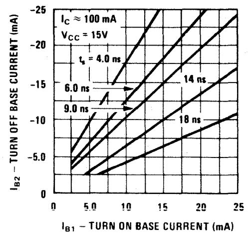


Process 22

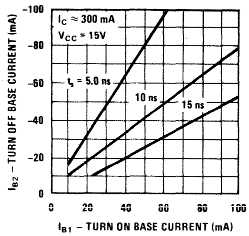
Storage Time vs Turn On and Turn Off Base Currents



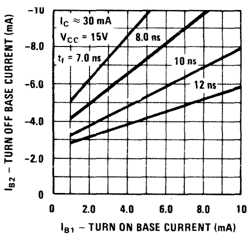
Storage Time vs Turn On and Turn Off Base Currents



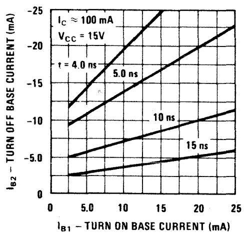
Storage Time vs Turn On and Turn Off Base Currents



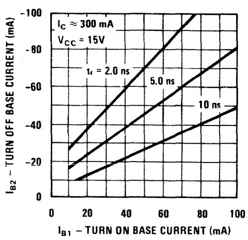
Fall Time vs Turn On and Turn Off Base Currents



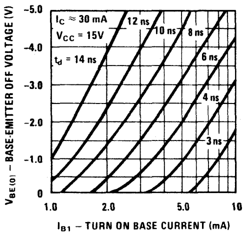
Fall Time vs Turn On and Turn Off Base Currents



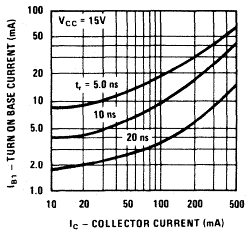
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base Emitter Off Voltage and Turn On Base Current

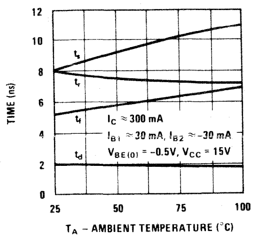


Rise Time vs Collector and Turn On Base Currents

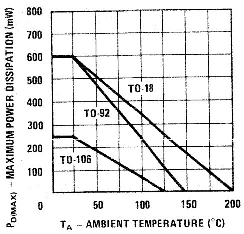


Process 22

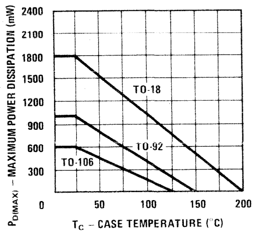
Switching Times vs Ambient Temperature



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



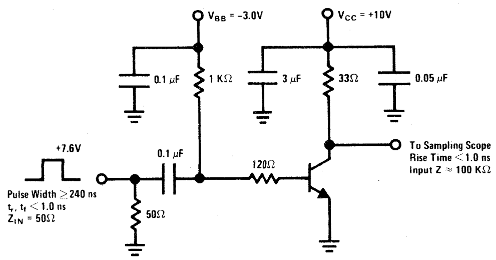


FIGURE 1. t_{on}, t_{off} Test Circuit

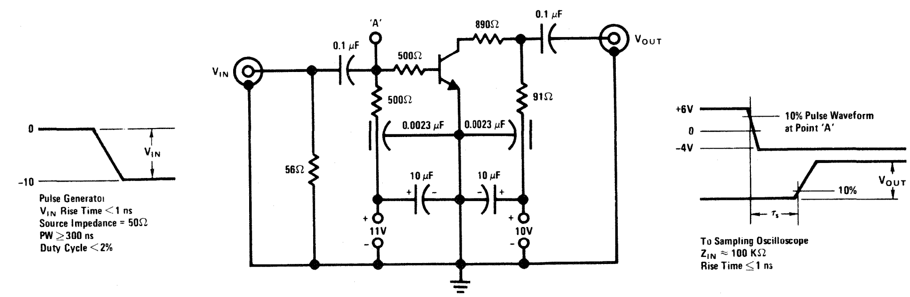
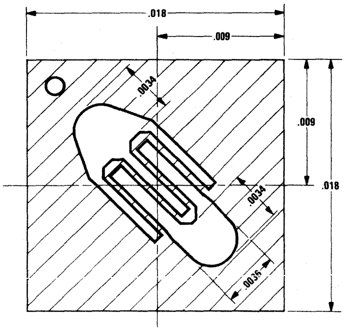


FIGURE 2. Charge Storage Time Measurement Circuit

Process 23 NPN Small Signal



DESCRIPTION

Process 23 is an overlay, double diffused gold doped silicon epitaxial device. Complement to Process 66.

APPLICATION

This device is designed as general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

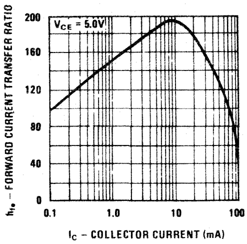
PRINCIPAL DEVICE TYPES:

TO-18 NS3904
TO-92 2N3904
TO-106 SM3904

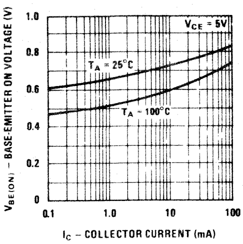
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	Fig. 1
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		70	200	ns	Fig. 2
C_{ob}	V_{CB} = 5V, f = 1 MHz		2.0	4.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		4.0	8.0	pF	TO-18
NF	V_{CE} = 5V, I_C = 100 μA, R_S = 1 kΩ, P_{BW} = 15.7 kHz		2.0	5.0	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 20V, f = 100 MHz	2.0	5.0	7.0		
H_{FE}	I_C = 100 μA, V_{CE} = 5V	40	100	300		
H_{FE}	I_C = 1 mA, V_{CE} = 5V	70	150	300		
H_{FE}	I_C = 10 mA, V_{CE} = 5V	60	200	350		
H_{FE}	I_C = 50 mA, V_{CE} = 5V	30	120	200		
H_{FE}	I_C = 100 mA, V_{CE} = 5V	20	50	100		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.1	0.15	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.80	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.12	0.2	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.75	0.85	V	
BV_{CBO}	I_C = 10 μA	60	90	120	V	
BV_{CEO}	I_C = 1 mA	40	60	80	V	
BV_{EBO}	I_C = 10 μA	6.0		8.0	V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 23

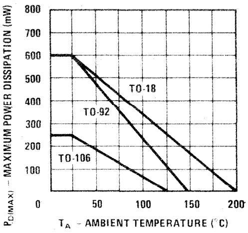
Pulsed DC Current Gain vs Collector Current



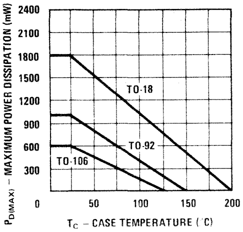
Base-Emitter On Voltage vs Collector Current



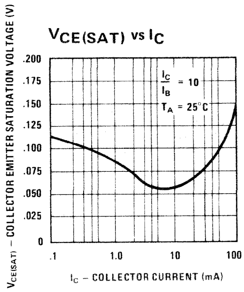
Maximum Power Dissipation vs Ambient Temperature



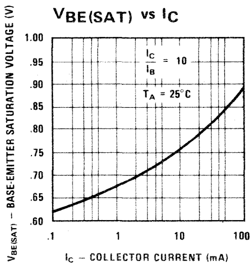
Maximum Power Dissipation vs Case Temperature



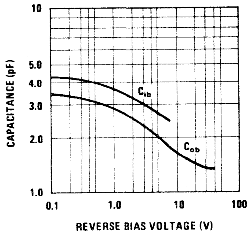
$V_{CE(SAT)}$ vs I_C



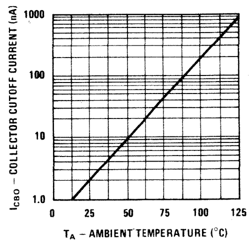
$V_{BE(SAT)}$ vs I_C



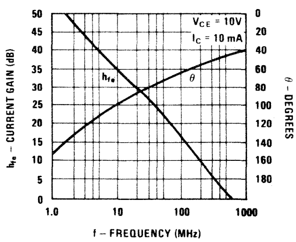
Capacitance vs Reverse Bias Voltage



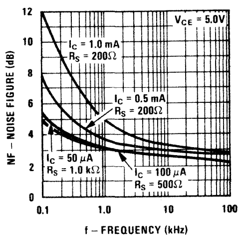
Collector Cutoff Current vs Ambient Temperature



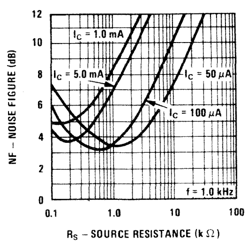
Current Gain and Phase Angle vs Frequency



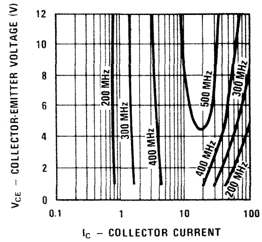
Noise Figure vs Frequency



Noise Figure vs Source Resistance



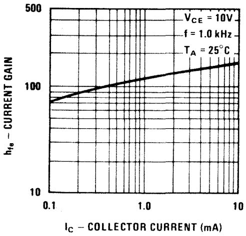
Contours of Constant Gain Bandwidth Product (f_T)



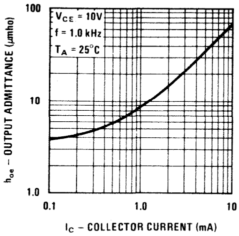
Process 23

h PARAMETERS (V_{CE} = 10 V_{DC}, f = 1.0 kHz, T_A = 25°C)

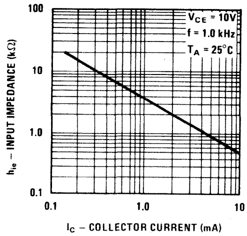
Current Gain



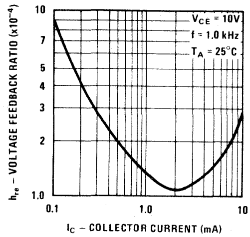
Output Admittance



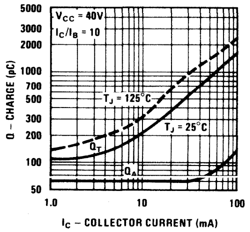
Input Impedance



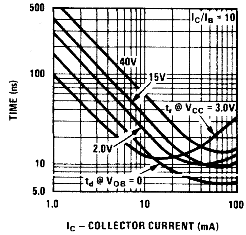
Voltage Feedback Ratio



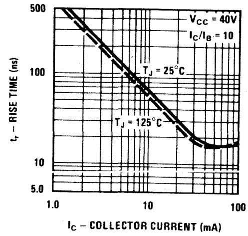
Charge Data



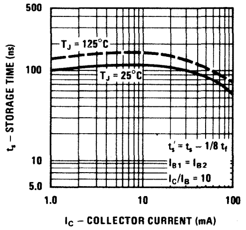
Turn On Time



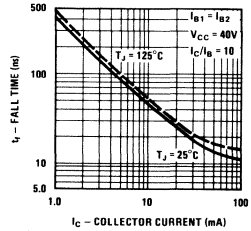
Rise Time



Storage Time



Fall Time



TRANSIENT CHARACTERISTICS (–T_J = 25°C --- T_J = 125°C)

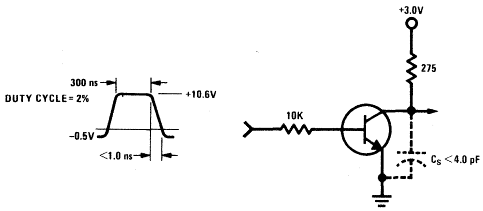


FIGURE 1. Delay and Rise Time Equivalent Test Circuit

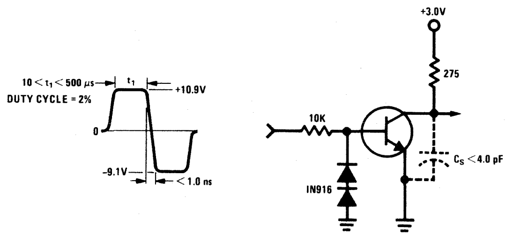
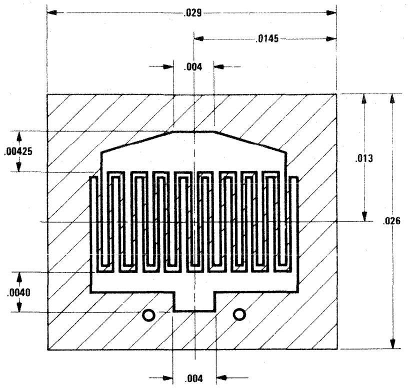


FIGURE 2. Storage and Fall Time Equivalent Test Circuit

Process 24 NPN High Speed High Voltage Switch



DESCRIPTION

Process 24 is an overlay double diffused gold doped epitaxial device.

APPLICATION

This device was designed for High Voltage, High Current core driver applications.

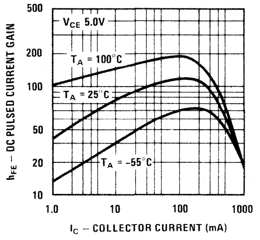
PRINCIPAL DEVICE TYPES:

TO-39 (pkg. 17) 2N3723

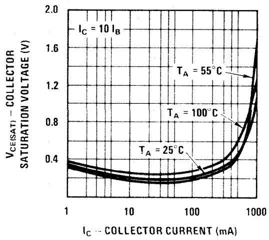
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	V_{CE} = 30V, I_C = 500 mA, I_B = 50 mA		25	70	ns	Fig. 1
t_{off}	V_{CE} = 30V, I_C = 500 mA, I_{B1} = $-I_{B2}$ = 50 mA		70	130	ns	Fig. 1
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	3	4			
C_{ob}	V_{CB} = 10V		6	10	pF	
C_{ib}	V_{EB} = 0.5V		50	65	pF	
h_{fe}	V_{CE} = 1V, I_C = 10 mA	25	45			
h_{fe}	V_{CE} = 1V, I_C = 100 mA	40	70	150		
h_{fe}	V_{CE} = 2V, I_C = 300 mA	15	35			
h_{fe}	V_{CE} = 2V, I_C = 500 mA	15	30			
h_{fe}	V_{CE} = 3V, I_C = 500 mA	15	25			
h_{fe}	V_{CE} = 3V, I_C = 800 mA	12	30			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.16	0.25	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.22	0.28	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.4	0.44	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.3	0.75	V	
$V_{CE(SAT)}$	I_C = 800 mA, I_B = 80 mA		0.6	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.75	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA			0.85	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA			1.1	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	.86		1.2	V	
$V_{BE(SAT)}$	I_C = 800 mA, I_B = 80 mA			1.5	V	
I_{CES}	V_{CE} = 50V			0.5	μA	
BV_{CBO}	I_C = 100 μA	80			V	
BV_{EBO}	I_E = 100 μA	6			V	
BV_{CEO}	I_C = 10 mA	60	80		V	

Process 24

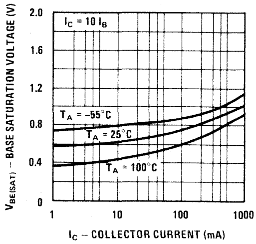
DC Pulsed Current Gain vs Collector Current



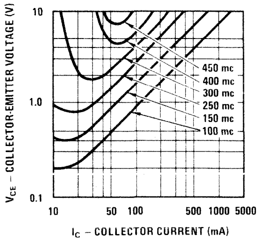
Collector Saturation Voltage vs Collector Current



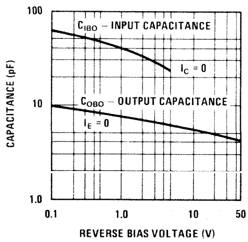
Base Saturation Voltage vs Collector Current



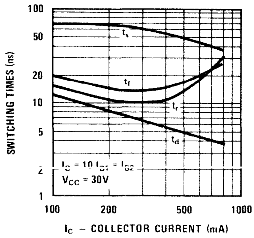
Contours of Constant Gain Bandwidth Product (f_T)



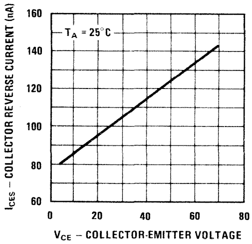
Input and Output Capacitance vs Reverse Bias Voltage



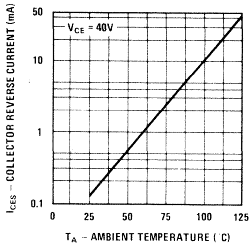
Switching Times vs Collector Current



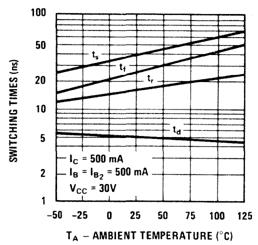
Collector Cutoff Current vs Reverse Bias Voltage



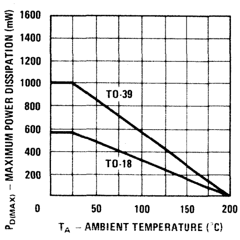
Collector Cutoff Current vs Ambient Temperature



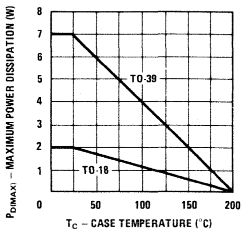
Switching Times vs Ambient Temperature



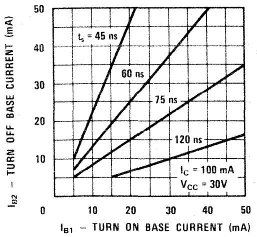
Maximum Power Dissipation vs Ambient Temperature



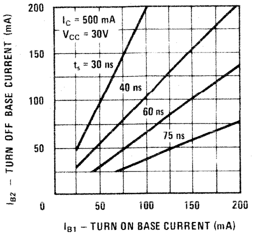
Maximum Power Dissipation vs Case Temperature



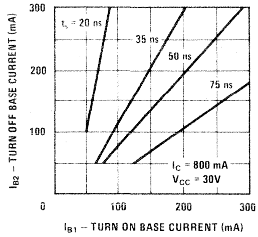
Storage Time vs Turn On and Turn Off Base Current



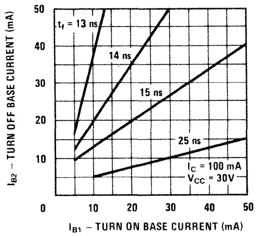
Storage Time vs Turn On and Turn Off Base Current



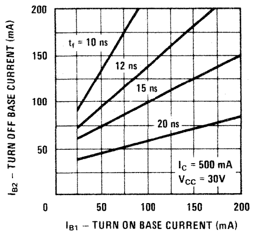
Storage Time vs Turn On and Turn Off Base Current



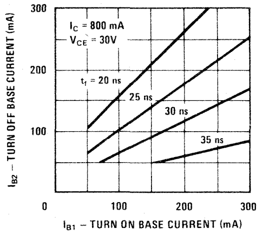
Fall Time vs Turn On and Turn Off Base Currents



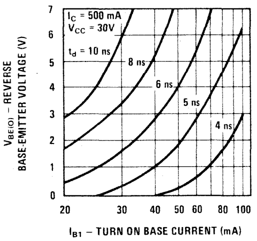
Fall Time vs Turn On and Turn Off Base Current



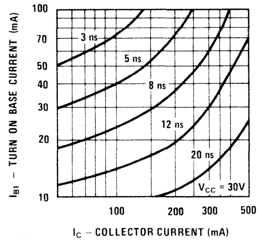
Fall Time vs Turn On and Turn Off Base Current



Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



Rise Time vs Collector and Turn On Base Current



SWITCHING TIME TEST CIRCUIT

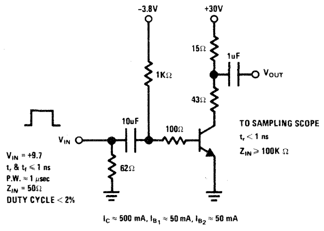
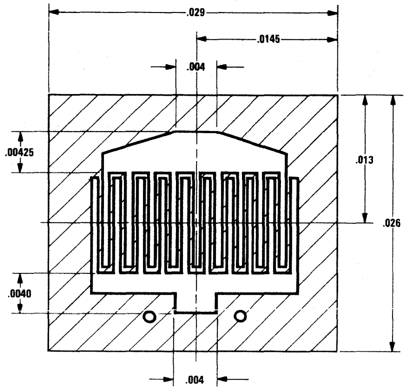


FIGURE 1.

Process 25 NPN Small Signal



DESCRIPTION

Process 25 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 70.

APPLICATION

This device was designed for high speed core driver applications.

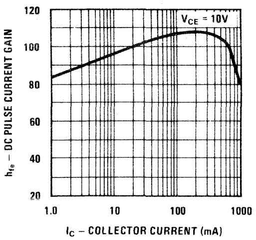
PRINCIPAL DEVICE TYPES:

TO-18 2N4014
TO-39 (pkg. 17) 2N3725

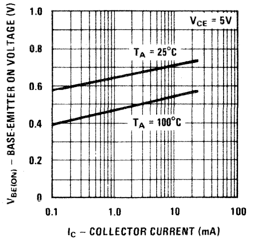
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA		12	35	ns	Fig. 1
t_{off}	I_C = 500 mA, I_{B2} = 50 mA		50	60	ns	Fig. 1
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 100 MHz	2.5	4.25			
C_{cb}	V_{CB} = 10V		5	10	pF	
C_{eb}	V_{EB} = 0.5V		45	55	pF	
h_{fe}	I_C = 10 mA, V_{CE} = 1V	40	60	120		
h_{fe}	I_C = 100 mA, V_{CE} = 1V	60	90	150		
h_{fe}	I_C = 300 mA, V_{CE} = 1V	35	65	120		
h_{fe}	I_C = 500 mA, V_{CE} = 1V	25	50	100		
h_{fe}	I_C = 800 mA, V_{CE} = 1V	20	28	40		
h_{fe}	I_C = 1A, V_{CE} = 1V	15	25	35		
h_{fe}	I_C = 800 mA, V_{CE} = 2V	25	38	60		
h_{fe}	I_C = 1A, V_{CE} = 5V	25	40	60		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.240	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.350	0.50	V	
$V_{CE(SAT)}$	I_C = 800 mA, 80 mA		0.50	0.80	V	
$V_{CE(SAT)}$	I_C = 1A, I_B = 100 mA		0.70	1.20	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.66	0.70	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.77	0.85	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.88	1.20	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.20		
$V_{BE(SAT)}$	I_C = 800 mA, I_B = 80 mA		1.10	1.50	V	
$V_{BE(SAT)}$	I_C = 1A, I_B = 100 mA		1.18	1.70	V	
BV_{CEO}	I_C = 10 mA	30	50	60	V	
BV_{CBO}	I_C = 100 μA	50	100	140	V	
BV_{EBO}	I_C = 10 μA	5.5	6.5	7.0	V	
I_{CBO}	V_{CB} = 40V			1.0	μA	
I_{EBO}	V_{EB} = 4V			1.0	μA	

Process 25

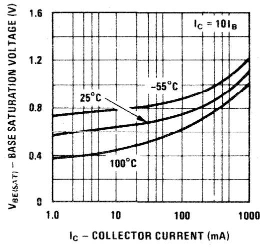
DC Pulse Current Gain vs Collector Current



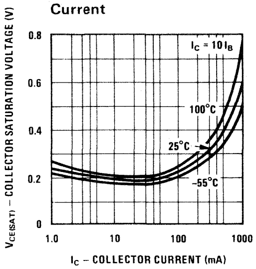
Base-Emitter On Voltage vs Collector Current



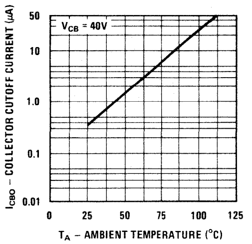
Base Saturation Voltage vs Collector Current



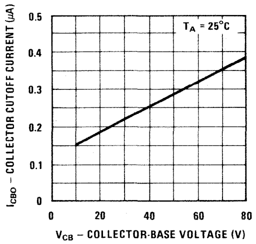
Collector Saturation Voltage vs Collector Current



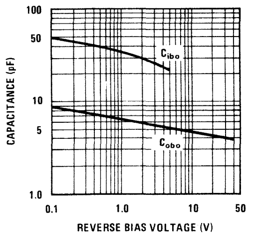
Collector Cutoff Current vs Ambient Temperature



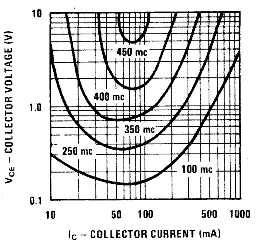
Collector Cutoff Current vs Reverse Bias Voltage



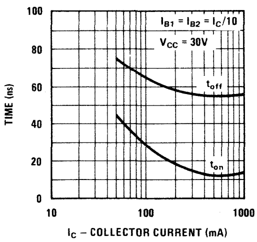
Input and Output Capacitance vs Reverse Bias



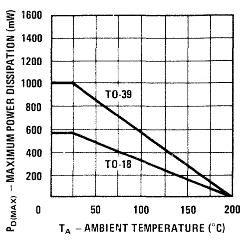
Contours of Constant Bandwidth Product (f_T)



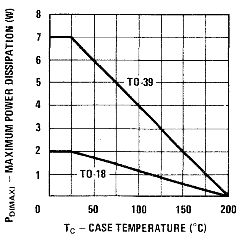
Turn On and Turn Off Times vs Collector Current



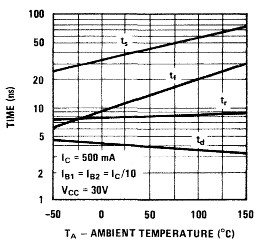
Maximum Power Dissipation vs Ambient Temperature



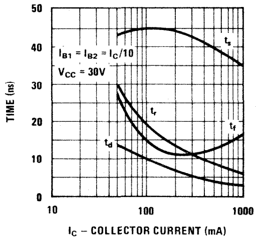
Maximum Power Dissipation vs Case Temperature



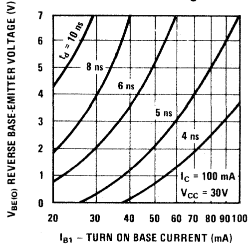
Switching Times vs Ambient Temperature



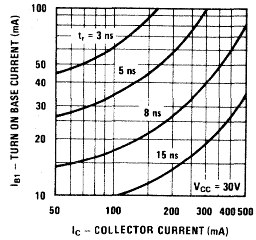
Switching Times vs Collector Current



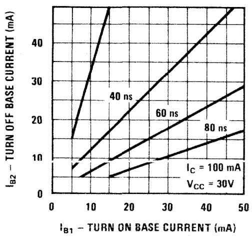
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



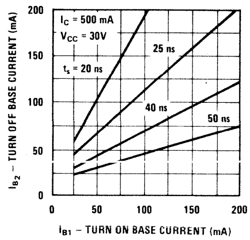
Rise Time vs Collector and Turn On Base Currents



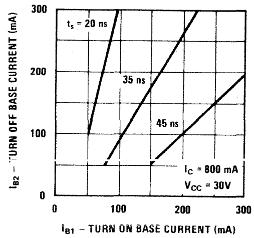
Storage Time vs Turn On and Turn Off Base Currents



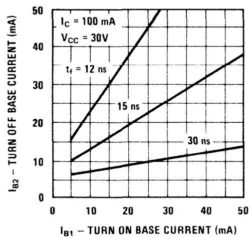
Storage Time vs Turn On and Turn Off Base Currents



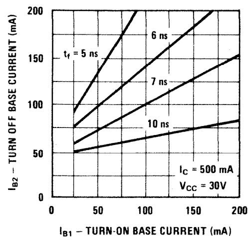
Storage Time vs Turn On and Turn Off Base Currents



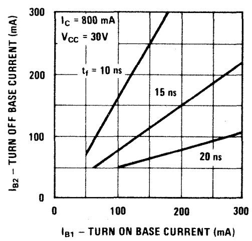
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



SWITCHING TIME TEST CIRCUIT

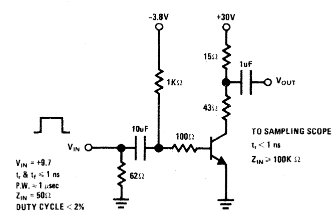
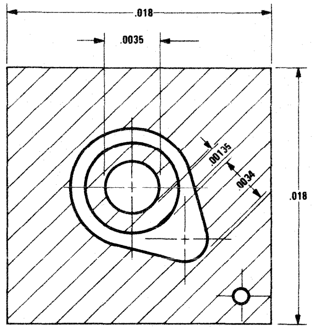


FIGURE 1. $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

Process 26 NPN Small Signal



DESCRIPTION

Process 26 is a nonoverlay double diffused, silicon device.

APPLICATION

This device was designed for use as a general purpose amplifier useful to 100 MHz.

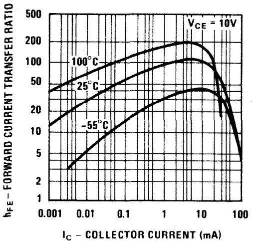
PRINCIPLE DEVICE TYPES:

TO-106 SE1001

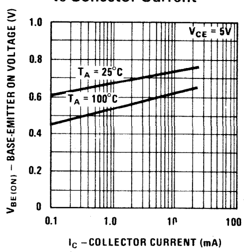
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V R_S = 2k, f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 10V f = 100 MHz	2	4			
C_{cb}	V_{CB} = 10V		2.0	3.5	pF	TO-92
C_{eb}	V_{EB} = .5V		7.0	10	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 10V	20	50			
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	80			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	120	400		
h_{FE}	I_C = 50 mA, V_{CE} = 10V	10	130			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.2	1	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.45	2	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.65	0.80	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.8	1.0	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5			V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 26

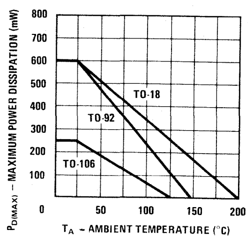
Pulsed DC Current Gain vs Collector Current



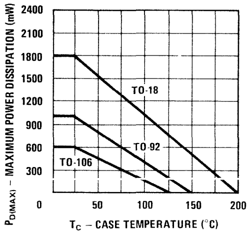
Base-Emitter On Voltage vs Collector Current



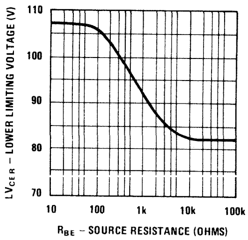
Maximum Power Dissipation vs Ambient Temperature



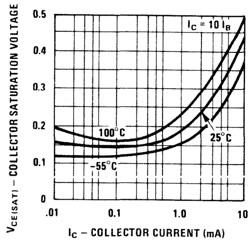
Maximum Power Dissipation vs Case Temperature



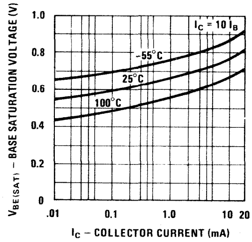
Lower Limiting Voltage vs Source Resistance



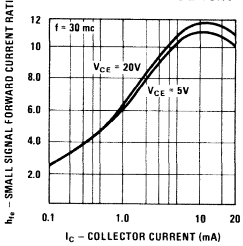
Collector Saturation Voltage vs Collector Current



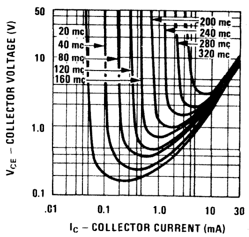
Base Saturation Voltage vs Collector Current



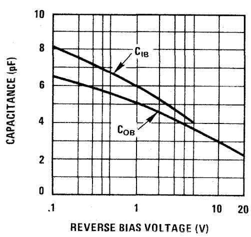
High Frequency Current Gain vs Collector Current



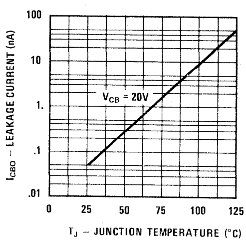
Contours of Constant Gain Bandwidth Product (f_T)



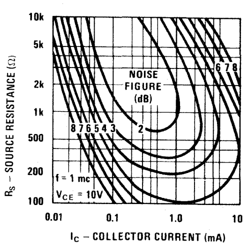
Capacitance vs Reverse Bias Voltage



Collector-Base Diode Reverse Current vs Temperature

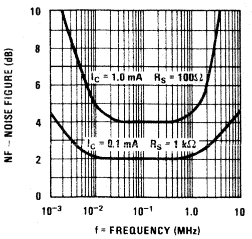


Contours of Spot Noise Figure

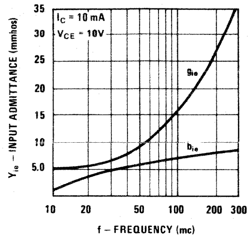


Process 26

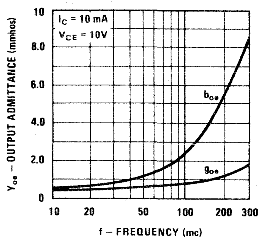
Noise Figure vs Frequency



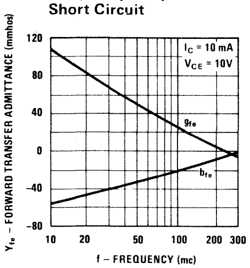
Input Admittance vs Frequency-Output Short Circuit



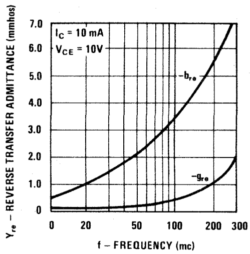
Output Admittance vs Frequency-Input Short Circuit



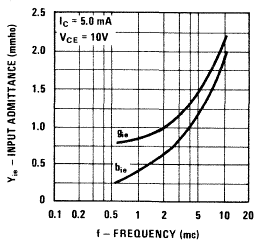
Forward Transfer Admittance vs Frequency-Output Short Circuit



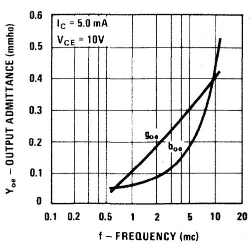
Reverse Transfer Admittance vs Frequency-Input Short Circuit



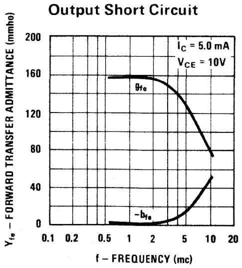
Input Admittance vs Frequency-Output Short Circuit



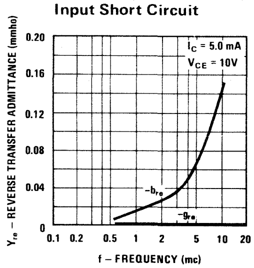
Output Admittance vs Frequency-Input Short Circuit



Forward Transfer Admittance vs Frequency-Output Short Circuit

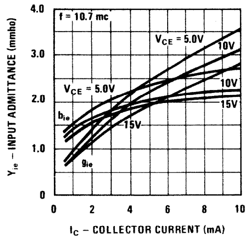


Reverse Transfer Admittance vs Frequency-Input Short Circuit

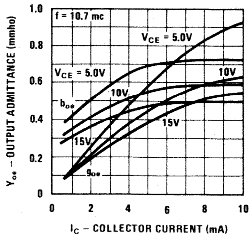


Process 26

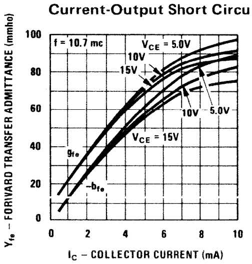
Input Admittance vs Collector Current-Output Short Circuit



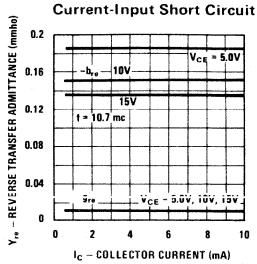
Output Admittance vs Collector Current-Input Short Circuit



Forward Transfer Admittance vs Collector Current-Output Short Circuit



Reverse Transfer Admittance vs Collector Current-Input Short Circuit

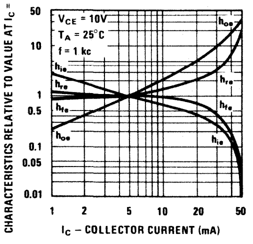


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

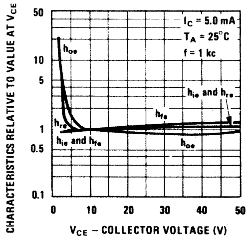
SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	1130	Ohms	I_C = 5.0 mA V_{CE} = 10V
h_{oe}	Output Conductance	35	μmho	I_C = 5.0 mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	1.25	$x10^{-4}$	I_C = 5.0 mA V_{CE} = 10V
h_{fe}	Small Signal Current Gain	145		I_C = 5.0 mA V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

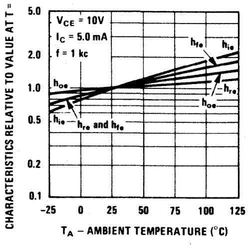
Small Signal Characteristics



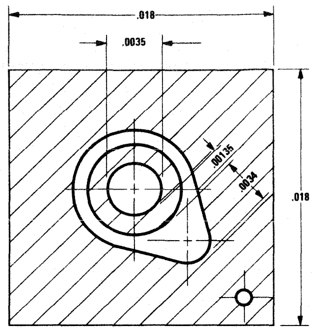
Small Signal Characteristics



Small Signal Characteristics



Process 27 NPN Small Signal



DESCRIPTION

Process 27 is a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 69.

APPLICATION

This device is designed for general purpose amplifier and switch useful from audio to RF frequencies.

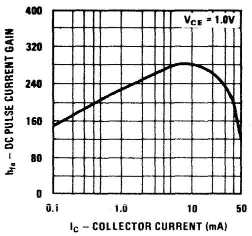
PRINCIPAL DEVICE TYPES:

TO-18	2N915
TO-92	MPSA20 (EBC), 2N2925 (ECB)
TO-106	2N3694

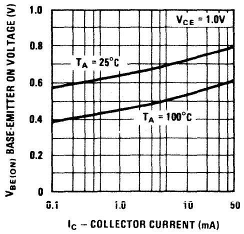
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (wide band)	V_{CE} = 5, I_C = 100 μA, f_{BW} = 15.7 kHz		1.5		dB	
NF (spot)	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1k		1.5	3.0	dB	
C_{cb}	V_{CB} = 10V, f = 1 MHz		2.0	2.5	pF	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 0.50V, f = 1 MHz		5.5	7.0	pF	TO-18
f_T	V_{CE} = 10V, I_C = 10 mA	100	500		MHz	
t_{on}	V_{CE} = 10V, I_C = 10 mA, I_{B1} = 1 mA	30	40	50	ns	
t_{off}	V_{CE} = 10V, I_C = 10 mA, I_{B2} = 1 mA	400	600	700	ns	
h_{FE}	V_{CE} = 10V, I_C = 100 μA	50	200	500		
h_{FE}	V_{CE} = 10V, I_C = 1 mA	50	220	500		
h_{FE}	V_{CE} = 10V, I_C = 10 mA	50	250	500		
h_{FE}	V_{CE} = 10V, I_C = 50 mA	50	240	500		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.10	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.770	1.0	V	
BV_{CBO}	I_C = 100 μA	50	70		V	
BV_{CEO}	I_C = 10 mA	30	50		V	
BV_{EBO}	I_E = 10 μA	5.0	6.5		V	
I_{CBO}	V_{CB} = 40			50	nA	
I_{EBO}	V_{EB} = 4.0			50	nA	

Process 27

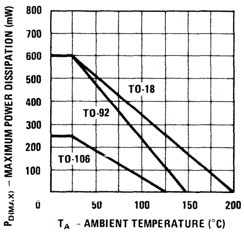
DC Pulse Current Gain vs Collector Current



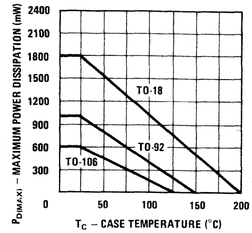
Base-Emitter On Voltage vs Collector Current



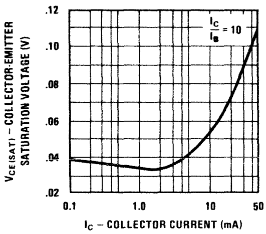
Maximum Power Dissipation vs Ambient Temperature



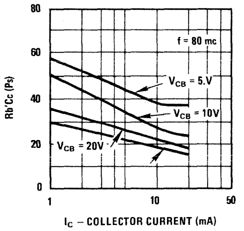
Maximum Power Dissipation vs Case Temperature



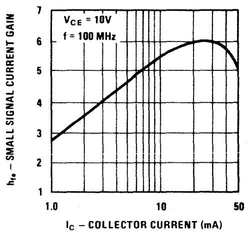
Collector-Emitter Saturation Voltage vs Collector Current



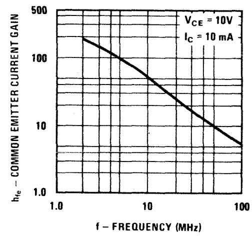
Rb'Cc vs Collector Current



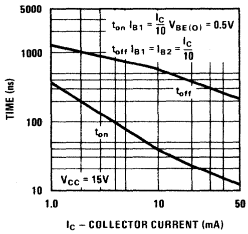
Small Signal Current Gain vs Collector Current



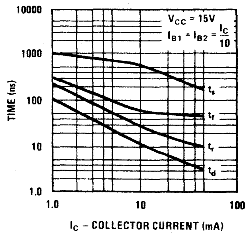
Small Signal Current Gain vs Frequency



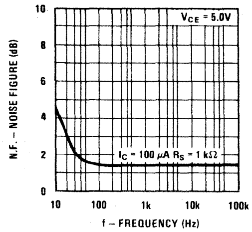
t_{on} And t_{off} vs Collector Current



Switching Times vs Collector Current

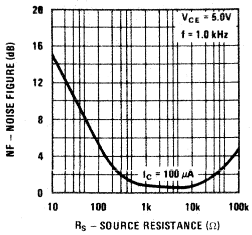


Noise Figure vs Frequency

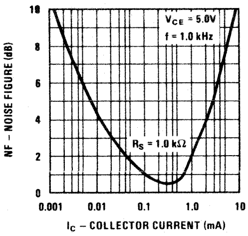


Process 27

Noise Figure vs Source Resistance

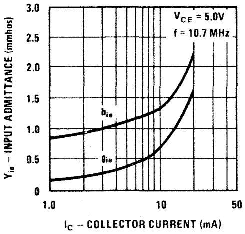


Noise Figure vs Collector Current

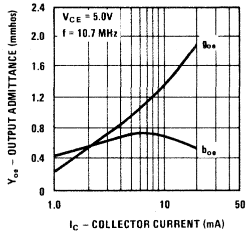


COMMON EMITTER Y PARAMETERS

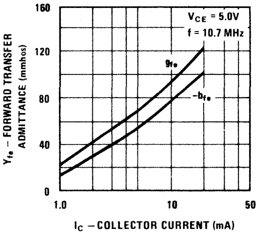
Input Admittance vs Collector Current



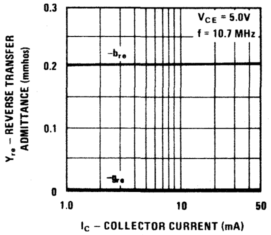
Output Admittance vs Collector Current



Forward Transfer Admittance vs Collector Current

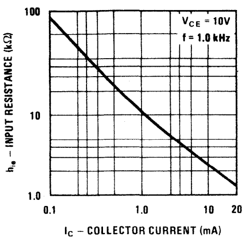


Reverse Transfer Admittance vs Collector Current

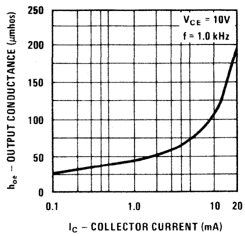


COMMON EMITTER H PARAMETERS

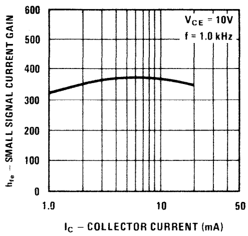
Small Signal Input Resistance vs Collector Current



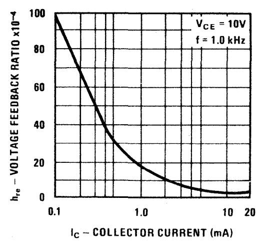
Small Signal Output Conductance vs Collector Current



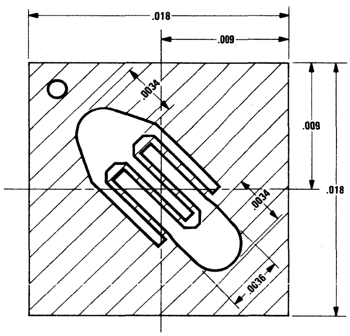
Small Signal Current Gain vs Collector Current



Small Singal Voltage Feedback Ratio vs Collector Current



Process 28 NPN High Speed Switch



DESCRIPTION

Process 28 is a double diffused, gold doped, silicon epitaxial device. Complement to Process 64.

APPLICATION

This device was designed for high speed medium voltage logic applications.

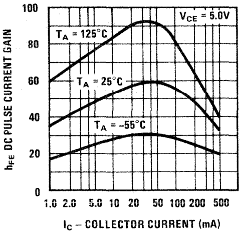
PRINCIPAL DEVICE TYPES:

TO-52 2N3014

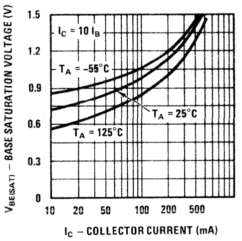
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA, V_{CE} 2V		11	16	ns	Fig. 1
t_{off}	I_C = 30 mA, I_{B1} = $-I_{B2}$ = 3 mA, V_{CE} = 2V		16	25	ns	Fig. 1
t_s	I_C = I_{B1} = $-I_{B2}$ = 10 mA, V_{CE} = 10V		8	18	ns	Fig. 2
h_{FE}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	5.5			
C_{ob}	V_{CB} = 5V			5	pF	
C_{ib}	V_{EB} = 0.5V			8	pF	
H_{FE}	I_C = 10 mA, V_{CE} = 0.4V	25				
H_{FE}	I_C = 30 mA, V_{CE} = 0.4V	30		120		
H_{FE}	I_C = 100 mA, V_{CE} = 1V	25				
H_{FE}	I_C = 30 mA, V_{CE} = 0.4V, T_A = $-55°C$	12				
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.18	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA			0.18	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA			0.35	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.8	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA			0.95	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA			1.2	V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{CEO}	I_C = 10 mA	20			V	
BV_{CES}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 100 μA	5.0			V	
I_{CES}	V_{CE} = 20V			0.3	μA	
I_{CES}	V_{CE} = 20V, T_A = 125°C			40	μA	

Process 28

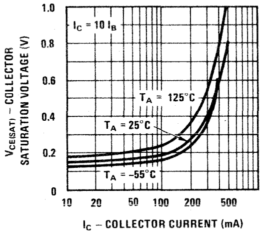
DC Pulse Current Gain vs Collector Current



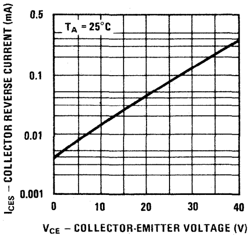
Base Saturation Voltage vs Collector Current



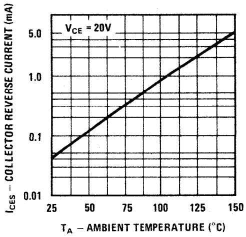
Collector Saturation Voltage vs Collector Current



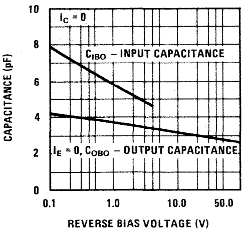
Collector Reverse Current vs Reverse Bias Voltage



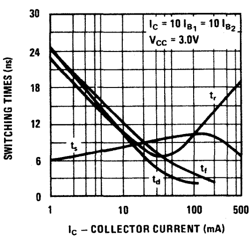
Collector Reverse Current vs Ambient Temperature



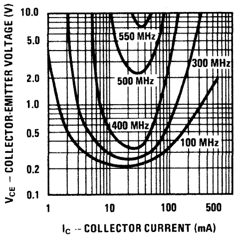
Input and Output Capacitance vs Reverse Bias Voltage



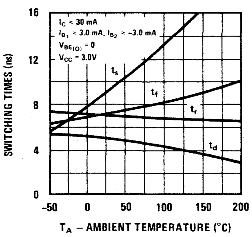
Switching Times vs Collector Current



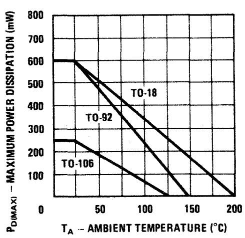
Contours of Constant Gain Bandwidth Product (f_T)



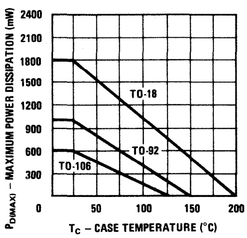
Switching Times vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature

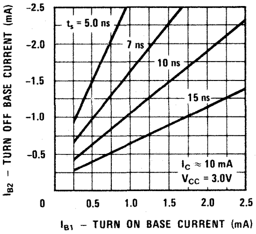


Maximum Power Dissipation vs Ambient Temperature

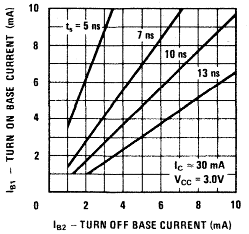


Process 28

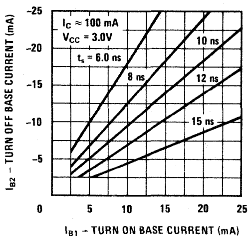
Storage Time vs Turn On and Turn Off Base Currents



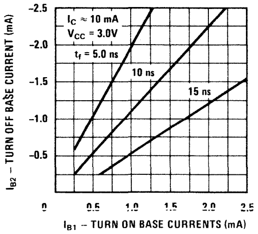
Storage Time vs Turn On and Turn Off Base Currents



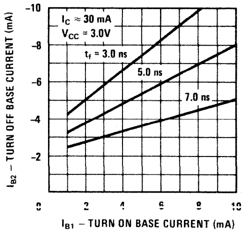
Storage Time vs Turn On and Turn Off Base Currents



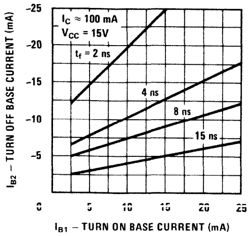
Fall Time vs Turn On and Turn Off Base Currents



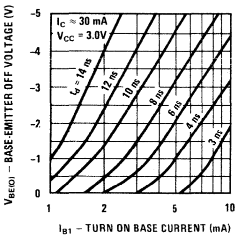
Fall Time vs Turn On and Turn Off Base Currents



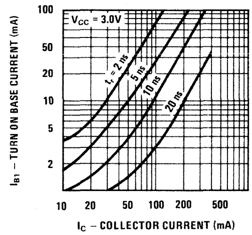
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base-Emitter Off Voltage and Turn On Base Current



Rise Time vs Collector and Turn On Base Current



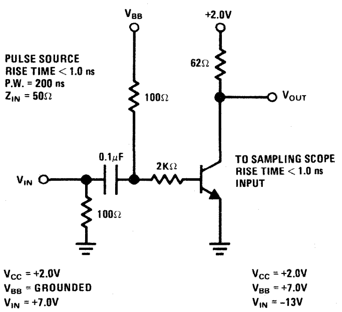


FIGURE 1. t_{on} **and** t_{off} **Test Circuit**

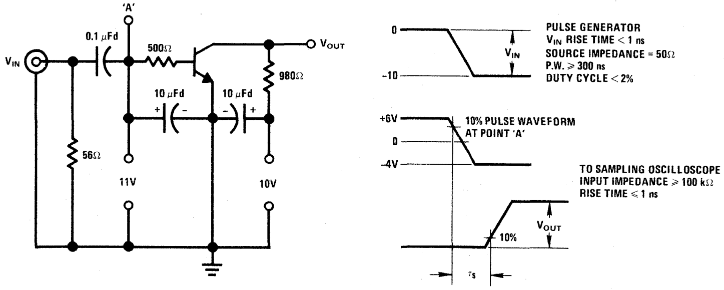
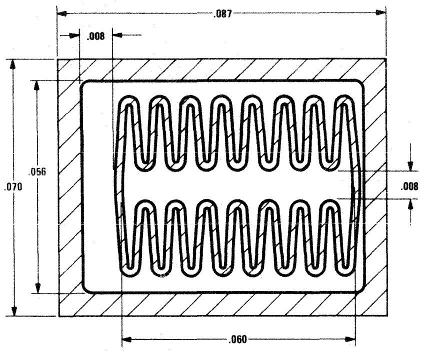


FIGURE 2. Charge Storage Time Measurement Circuit

Process 34 NPN Power Signal



DESCRIPTION

This device is nonoverlay double diffused, silicon epitaxial transistor.

APPLICATION

This device was designed for general purpose amplifier application utilizing collector currents to 5 amps.

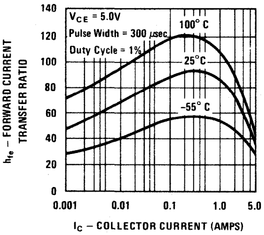
PRINCIPAL DEVICE TYPES:

TO-39 2N2891

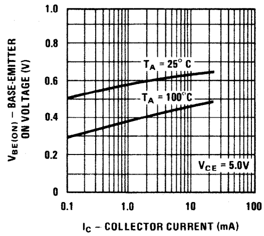
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 1A, I_{B1} = 0.1A		90	120	ns	
t_{off}	I_C = 1A, I_{B2} = 0.1A		200	260	ns	
C_{ob}	V_{CB} = 10V		60	70	pF	
C_{ib}	V_{EB} = 0.5V		425	500	pF	
h_{fe}	I_C = 200 mA, V_{CE} = 10V, f = 20 MHz	4.0	5.0			
h_{FE}	I_C = 1 mA, V_{CE} = 5V	40	50	100		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	40	70	100		
h_{FE}	I_C = 100 mA, V_{CE} = 5V	40	90	120		
h_{FE}	I_C = 500 mA, V_{CE} = 5V	40	95	150		
h_{FE}	I_C = 1A, V_{CE} = 5V	20	30	100		
h_{FE}	I_C = 5A, V_{CE} = 5V	15	20			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.05	0.10	V	
$V_{CE(SAT)}$	I_C = 1A, I_B = 100 mA		0.20	0.25	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.70	0.85	V	
$V_{BE(SAT)}$	I_C = 1A, I_B = 100 mA		0.90	1.10	V	
BV_{CEO}	I_C = 10 mA	80	100			
BV_{CBO}	I_C = 100 μA	100	150			
BV_{EBO}	I_E = 10 μA	8	10			
I_{CBO}	V_{CB} = 60V			100	nA	
I_{EBO}	V_{EB} = 6V			100	nA	

Process 34

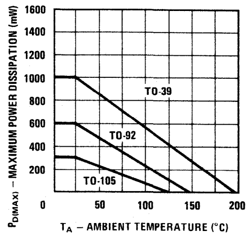
Pulsed DC Current Gain vs Collector Current



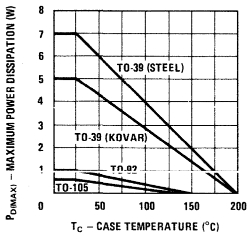
Base-Emitter On Voltage vs Collector Current



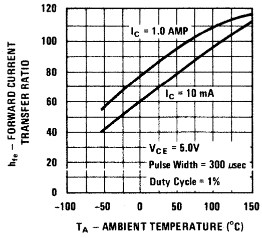
Maximum Power Dissipation vs Ambient Temperature



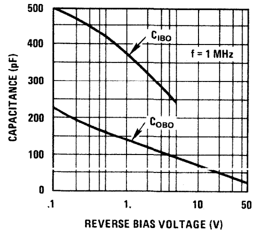
Maximum Power Dissipation vs Case Temperature



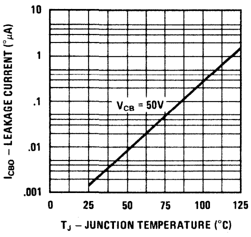
Pulsed DC Current Gain vs Ambient Temperature



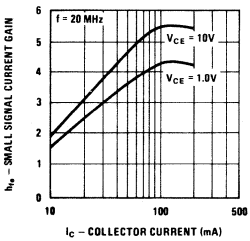
Capacitance vs Reverse Bias Votlage



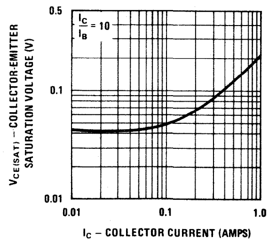
Collector-Base Diode Reverse Current vs Temperature



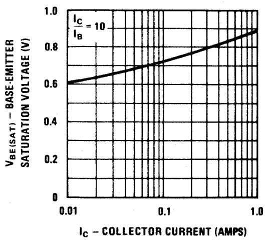
Small Signal Current Gain vs Collector Current



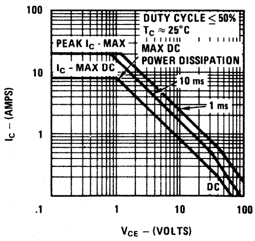
Collector-Emitter Saturation Voltage vs Collector Current



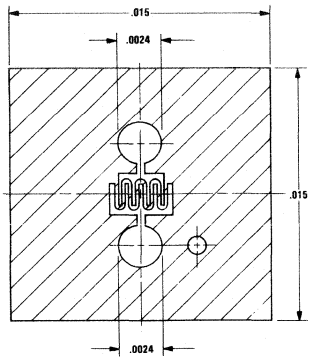
Base-Emitter Saturation Voltage vs Collector Current



Safe Region of Operation



Process 42 NPN RF Amplifier



DESCRIPTION

Process 42 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for use in low noise UHF/VHF amplifiers with collector current in the 100 μA to 10 mA range in common emitter or common base mode of operation.

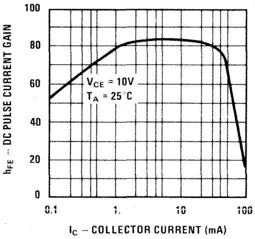
PRINCIPAL DEVICE TYPES:

TO-72 2N5179
TO-92 2SC535 (ECB), MPS-H10 (BEC)

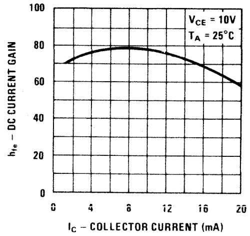
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	f = 450 MHz, V_{CE} = 10V, I_C = 2 mA	10	14		dB	Fig. 1
NF	f = 450 MHz, V_{CE} = 10V, I_C = 2 mA R_g = 50Ω			5.0	dB	Fig. 1
PG	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA	22	27		dB	Fig. 2
NF	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA R_S = 120Ω		2.0	3.5	dB	Fig. 2
h_{fe}	f = 100 MHz, V_{CE} = 10V, I_C = 5 mA	7.0	10	15		
rb'Cc	f = 79.8 MHz, V_{CE} = 10V, I_C = 5 mA		3.5	10	ps	TO-72
C_{cb}	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.4	0.5	pF	TO-72
C_{ce}	f = 1.0 MHz, V_{CE} = 10V, I_B = 0		0.2	0.3	pF	TO-72
C_{eb}	f = 1.0 MHz, V_{EB} = 0.5V, I_C = 0		0.8	1.5	pF	TO-72
h_{FE}	V_{CE} = 10V, I_C = 5 mA	30	80	250		
h_{FE}	V_{CE} = 6V, I_C = 1 mA	20	65			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.07	0.3	V	
BV_{CEO}	I_C = 1 mA	30	45		V	
BV_{CBO}	I_C = 100 μA	35	50		V	
BV_{EBO}	I_E = 10 μA	3.0	5.5		V	
I_{CBO}	V_{CB} = 30V			100	nA	
I_{EBO}	V_{EB} = 2.0			50	nA	

Process 42

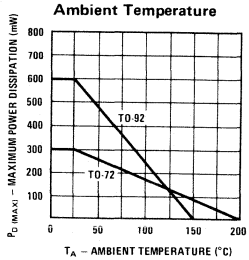
DC Pulse Current Gain vs Collector Current



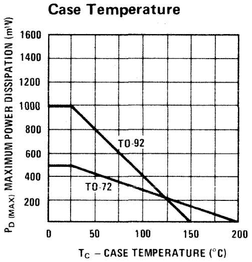
DC Current Gain vs Collector Current



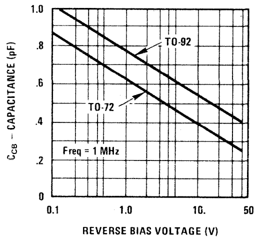
Maximum Power Dissipation vs Ambient Temperature



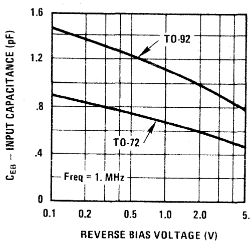
Maximum Power Dissipation vs Case Temperature



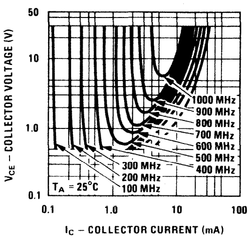
Reverse Transfer Capacitance vs Reverse Bias Voltage



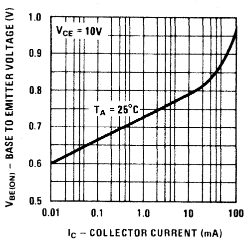
Input Capacitance vs Reverse Bias Voltage



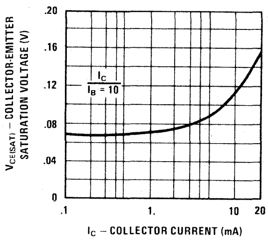
Contours Of Constant Gain Bandwidth Product (f_T)



Base Emitter On Voltage vs Collector Current

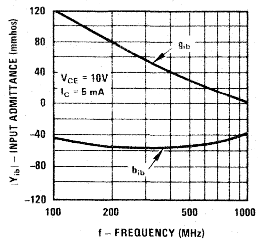


Collector-Emitter Saturation Voltage vs Collector Current

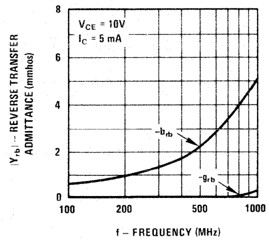


COMMON BASE Y PARAMETERS VS FREQUENCY

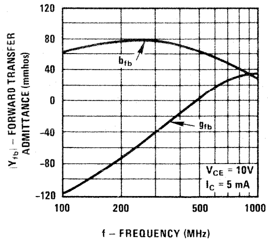
Input Admittance vs Frequency



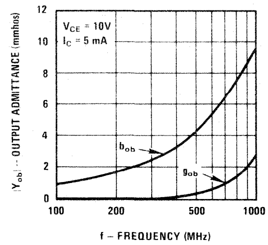
Reverse Transfer Admittance vs Frequency



Forward Transfer Admittance vs Frequency

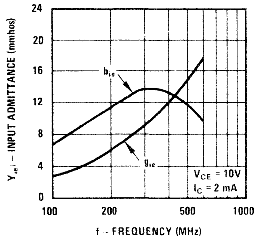


Output Admittance vs Frequency

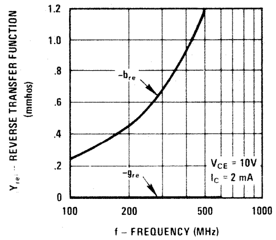


COMMON EMITTER Y PARAMETERS VS FREQUENCY

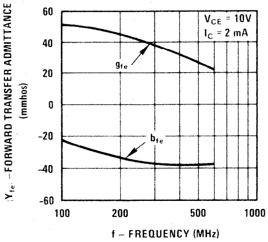
Input Admittance vs Frequency



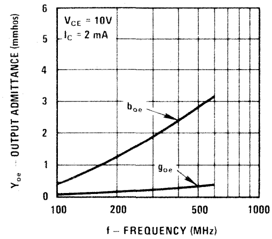
Reverse Transfer Admittance vs Frequency

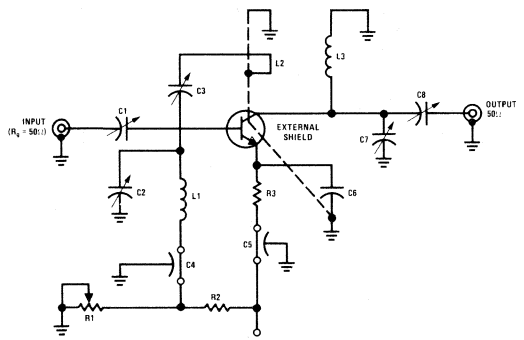


Forward Transfer Admittance vs Frequency



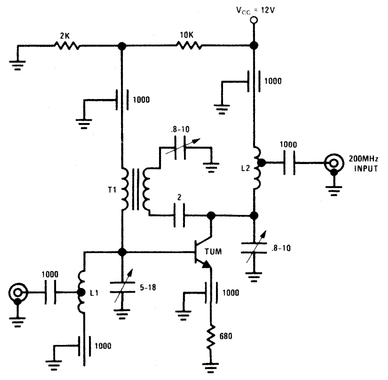
Output Admittance vs Frequency





C1, C2, C3, C7, C8 – 0.8-10 pF VARIABLE CAPACITOR
C3 – PLASTIC TUBULAR TRIMMER CAPACITOR (ADJUSTED AND FIXED FOR A TRANSISTOR HAVING A TYPICAL VALUE OF C_{cb} (0.35 pF))
C4 – 200 pF BUTTON-TYPE FEEDTHROUGH CAPACITOR
C5 – 1000 pF FEEDTHROUGH CAPACITOR
C6 – 470 pF LEADLESS CERAMIC DISC CAPACITOR
L1, L3 – 1" LENGTH OF 1/4" DIAMETER COPPER BAR STOCK
L2 – 1/2 LOOP No. 14 AWG ENAMELED WIRE PARALLEL TO AND APPROXIMATELY 1/4" FROM L3
R1 – 5 kΩ POTENTIOMETER
R2 – 1.2 kΩ
R3 – 2 kΩ

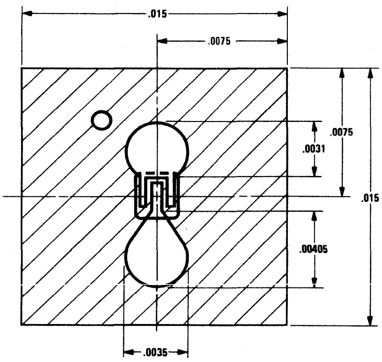
FIGURE 1. Neutralized 450-MHz Gain and Noise Figure Circuit



L1 – 3T #16 WIRE, 1/2"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
L2 – 6T #14 WIRE, 1"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
T1 – PRI. 1T #16 WIRE; SEC. 1T #18 WIRE; CORE IS INDIANA GENERAL P/N F-684-Q3
ALL CAPACITANCE IN pF, ALL RESISTANCE IN OHMS.

FIGURE 2. Neutralized 200-MHz PF & NF Circuit

Process 43 NPN UHF Oscillator



DESCRIPTION

Process 43 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for use as RF amplifiers and UHF oscillators with collector current in the 1 mA to 20 mA range.

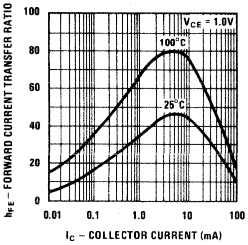
PRINCIPAL DEVICE TYPES:

TO-72	2N918
TO-92	MPS3563 (EBC), 2N3663 (ECB)
TO-106	2N3563, SE3002

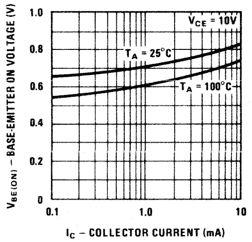
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{PE}	f = 200 MHz, I_C = 5 mA, V_{CE} = 10V	15	18		dB	Neutralized
NF	f = 60 MHz, I_C = 1 mA, V_{CE} = 10V R_S = 200Ω		3	5	dB	
PO	f = 500 MHz, I_C = 8 mA, V_{CE} = 15V	30	35		mW	
PO	f = 900 MHz, I_C = 8 mA, V_{CE} = 15V	3	7		mW	
h_{fe}	I_C = 5 mA, V_{CE} = 10V, f = 100 MHz	6	9			
C_{cb}	V_{CB} = 10V		1.5	2.5	pF	
C_{eb}	V_{EB} = .5V		1.4	2.0	pF	
h_{FE}	I_C = 100 μA, V_{CE} = 1V	10	20			
h_{FE}	I_C = 1 mA, V_{CE} = 1V	20	35			
h_{FE}	I_C = 10 mA, V_{CE} = 1V	20	45	150		
h_{FE}	I_C = 5 mA, V_{CE} = 10V	20	100	200		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.20	0.30	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.25	0.40	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.75	0.85	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.85	0.95	V	
BV_{CEO}	I_C = 3 mA	15	22		V	
BV_{CBO}	I_C = 100 μA	30	45		V	
BV_{EBO}	I_E = 10 μA	3	5.2		V	
I_{CBO}	V_{CB} = 15V			50	nA	
I_{EBO}	V_{CB} = 3V			50	nA	

Process 43

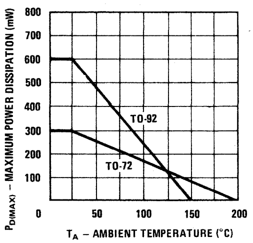
Pulsed DC Current Gain
vs Collector Current



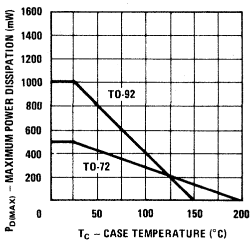
Base-Emitter On Voltage
vs Collector Current



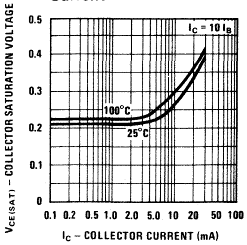
Maximum Power
Dissipation vs Ambient
Temperature



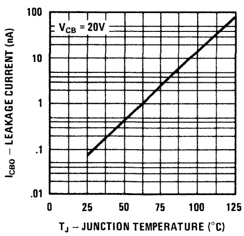
Maximum Power
Dissipation vs Case
Temperature



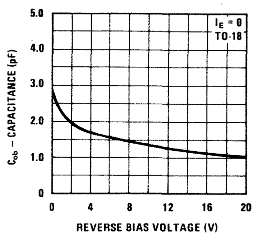
Collector Saturation
Voltage vs Collector
Current



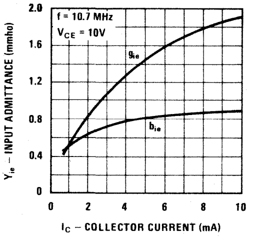
Collector-Base Diode
Reverse Current vs
Temperature



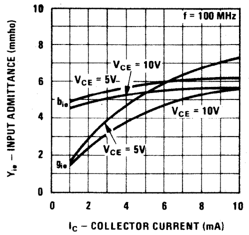
Output Capacitance vs
Reverse Bias Voltage



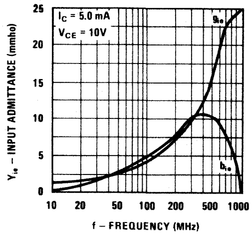
Input Admittance vs Collector Current-Output Short Circuit



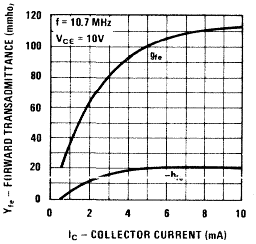
Input Admittance vs Collector Current-Output Short Circuit



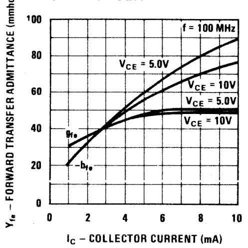
Input Admittance vs Frequency-Output Short Circuit



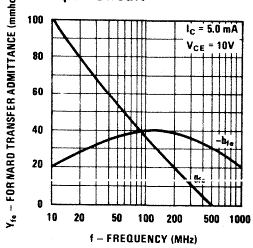
Forward Transfer Admittance vs Collector Current-Output Short Circuit



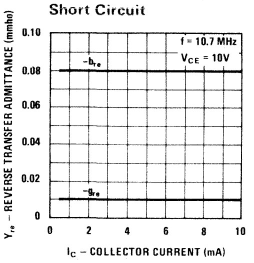
Forward Transfer Admittance vs Collector Current-Output Short Circuit



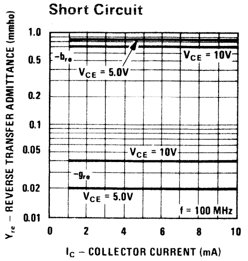
Forward Transfer Admittance vs Frequency-Output Open Circuit



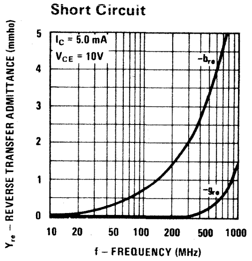
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



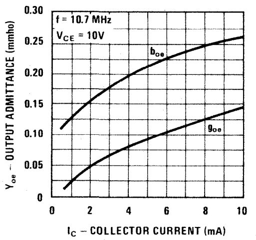
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



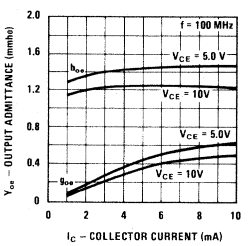
Reverse Transfer Admittance vs Frequency-Input Short Circuit



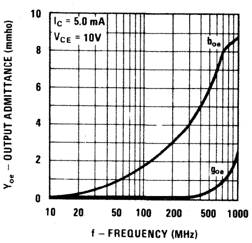
Output Admittance vs Collector Current-Input Short Circuit



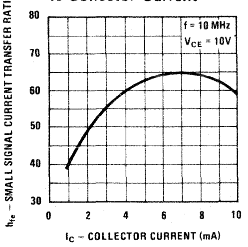
Output Admittance vs Collector Current-Input Short Circuit



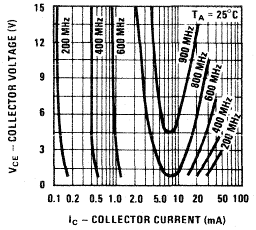
Output Admittance vs Frequency-Input Short Circuit



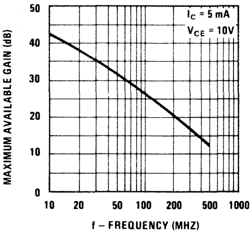
Small Signal Current Gain vs Collector Current



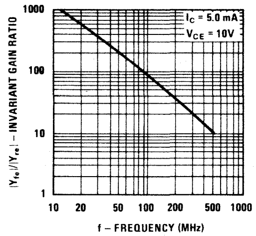
Contours of Constant Gain Bandwidth Product (f_T)



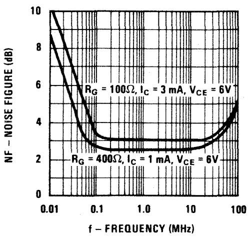
Maximum Available Gain vs Frequency



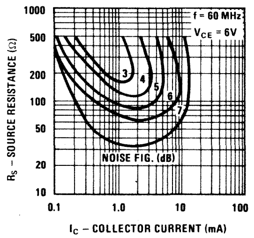
Invariant Maximum Stable Power Gain vs Frequency



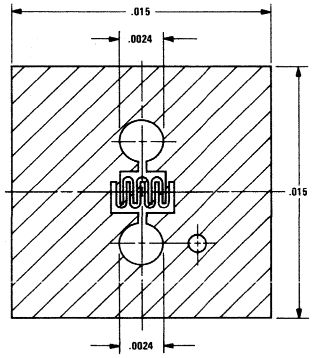
Noise Figure vs Frequency



Contours of Constant Noise Figure



Process 44 NPN AGC-RF Amplifier



DESCRIPTION

Process 44 is an overlay double diffused, silicon device.

APPLICATION

This device was designed for use as a low noise VHF amplifier with forward AGC capability.

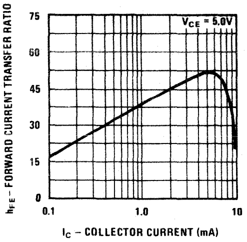
PRINCIPLE DEVICE TYPES:

TO-72 SE5020
TO-92 MPS-H30 (BEC)

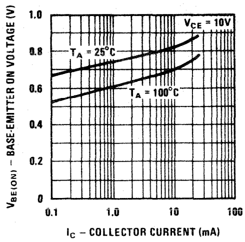
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω		2.5	3.3	dB	Fig. 1
P_G	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω	20	24	27	dB	Fig. 1
NF	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω		3.0	5.0	dB	Fig. 2
P_G	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω	23	26	30	dB	Fig. 2
AGC	f = 200 MHz, V_{AGC} at 30 dB Down	4.0	4.5	5.0	V	Fig. 1
AGC	f = 45 MHz, V_{AGC} at 30 dB Down	4.5	5.0	5.5	V	Fig. 2
C_{cb}	V_{CB} = 10V		0.35	0.50	pF	TO-72
h_{fe}	V_{CE} = 10V, I_C = 4 mA, I_C = 100 MHz	3.75	5.0	8.0		
h_{FE}	I_C = 4 mA, V_{CE} = 10V	20	60	200		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		2.0	3.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.92	V	
BV_{CEO}	I_C = 1 mA	20			V	
BV_{CBO}	I_C = 100 μA	20			V	
BV_{EBO}	I_E = 10 μA	3				
I_{CBO}	V_{CB} = 15V			10	nA	
I_{EBO}	V_{EB} = 2V			10	nA	

Process 44

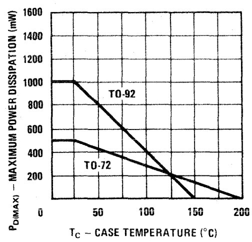
Pulsed DC Current Gain vs Collector Current



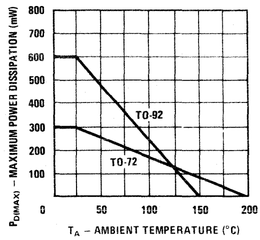
Base-Emitter On Voltage vs Collector Current



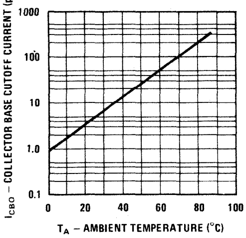
Maximum Power Dissipation vs Case Temperature



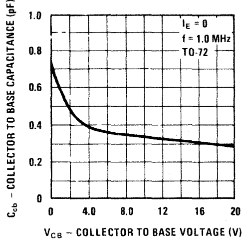
Maximum Power Dissipation vs Ambient Temperature



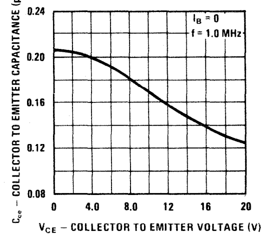
Collector Cutoff Current vs Ambient Temperature



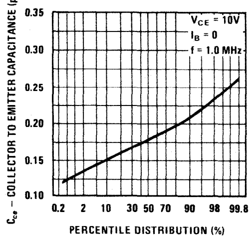
Collector to Base Capacitance vs Collector to Base Voltage



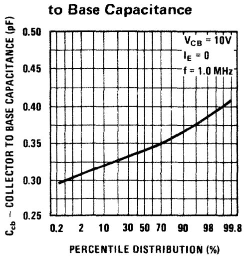
Collector to Emitter Capacitance vs Collector to Emitter Voltage



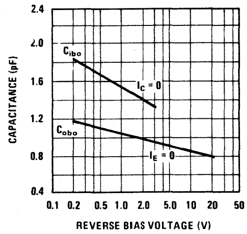
Distribution of Collector to Emitter Capacitance



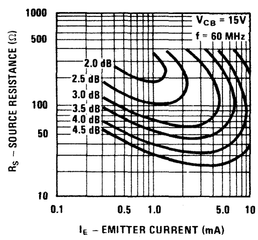
Distribution of Collector to Base Capacitance



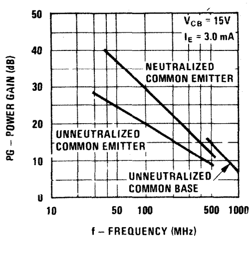
Input and Output Capacitance vs Reverse Bias Voltage



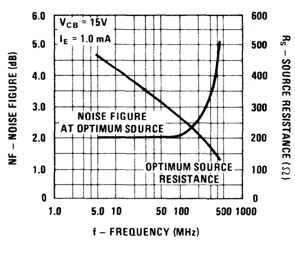
Noise Figure vs Source Resistance and Collector Current



Power Gain vs Frequency

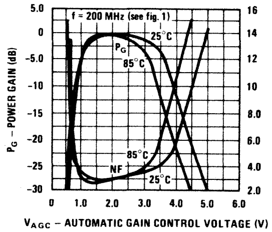


Noise Figure and Source Resistance vs Frequency

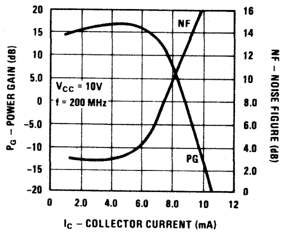


COMMON EMITTER PERFORMANCE

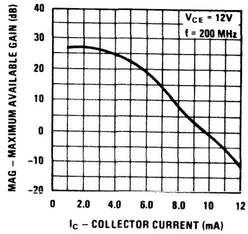
Power Gain and Noise Figure vs Automatic Gain Control Voltage



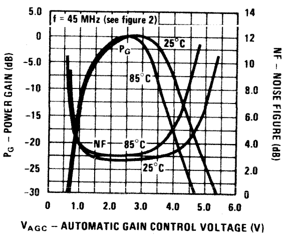
Power Gain and Noise Figure vs Collector Current



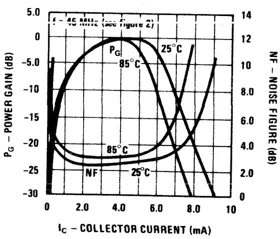
Maximum Available Gain vs Collector Current



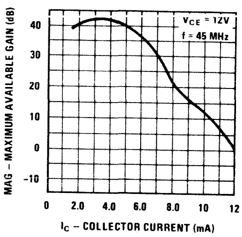
Power Gain and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Maximum Available Gain vs Collector Current



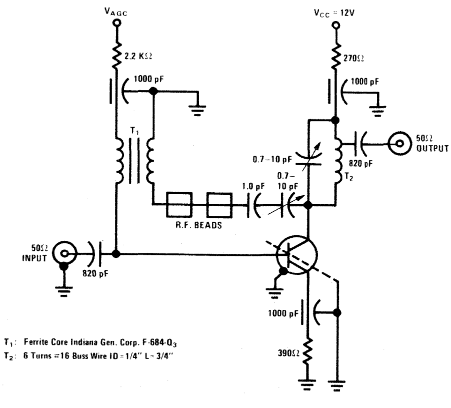


FIGURE 1. 200 MHz, AGC, Power Gain and Noise Figure Test Jig

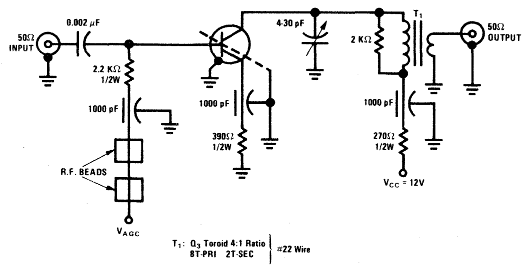
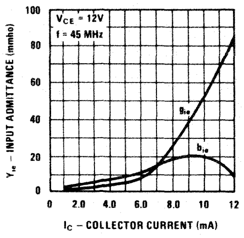


FIGURE 2. 45 MHz, AGC, Power Gain and Noise Figure Test Jig

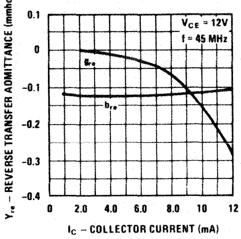
COMMON EMITTER Y PARAMETERS VS FREQUENCY

Process 44

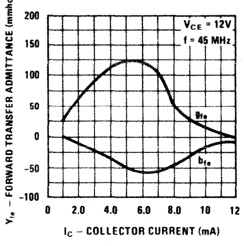
Input Admittance vs Collector Current-Output Short Circuit



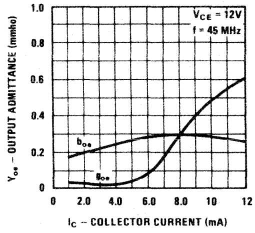
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



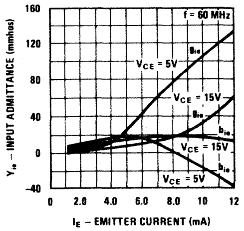
Forward Transfer Admittance vs Collector Current-Output Short Circuit



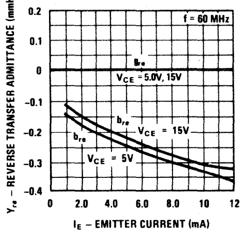
Output Admittance vs Collector Current-Input Short Circuit



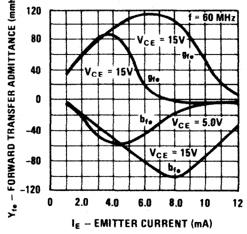
Input Admittance vs Emitter Current-Output Short Circuit



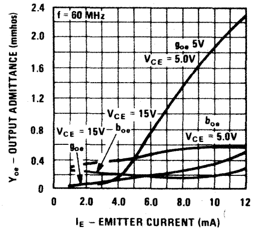
Reverse Transfer Admittance vs Emitter Current-Input Short Circuit



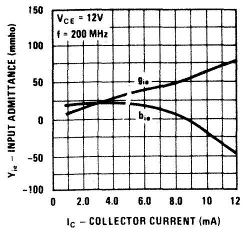
Forward Transfer Admittance vs Emitter Current-Output Short Circuit



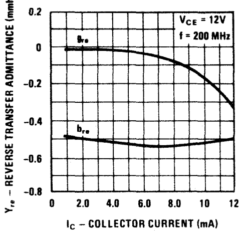
Output Admittance vs Emitter Current - Input Short Circuit



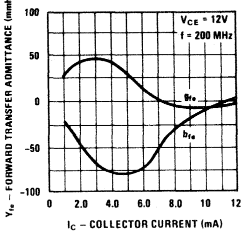
Input Admittance vs Collector Current-Output Short Circuit



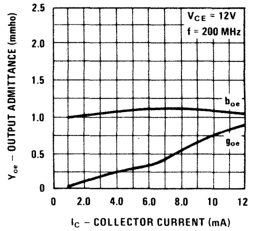
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



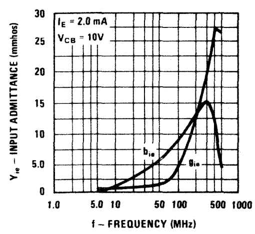
Forward Transfer Admittance vs Collector Current-Output Short Circuit



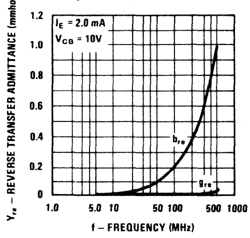
Output Admittance vs Collector Current - Input Short Circuit



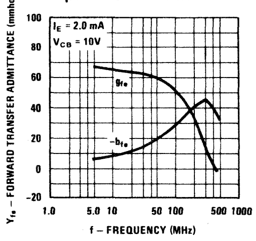
Input Admittance vs Frequency - Output Short Circuit



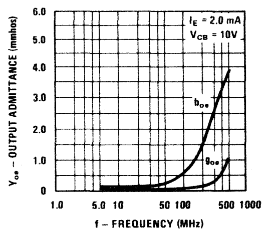
Reverse Transfer Admittance vs Frequency Output Short Circuit



Forward Transfer Admittance vs Frequency Input Short Circuit



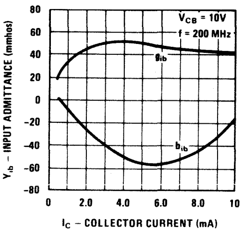
Output Admittance vs Frequency - Input Short Circuit



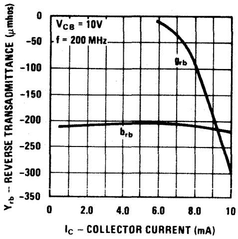
Process 44

COMMON BASE Y PARAMETERS VS FREQUENCY

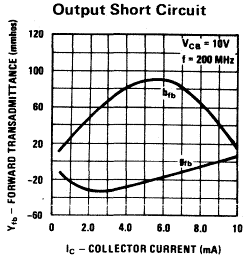
Input Admittance vs Collector Current-Output Short Circuit



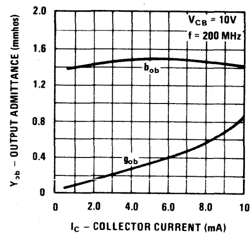
Reverse Transadmittance vs Collector Current-Input Short Circuit



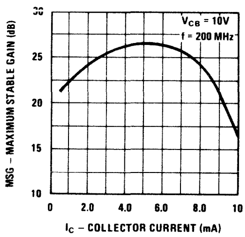
Forward Transadmittance vs Collector Current-Output Short Circuit



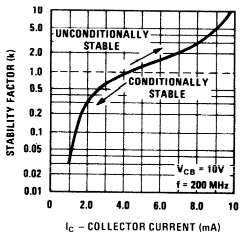
Output Admittance vs Collector Current-Input Short Circuit



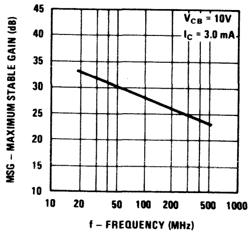
Maximum Stable Gain vs Collector Current Common Base Configuration



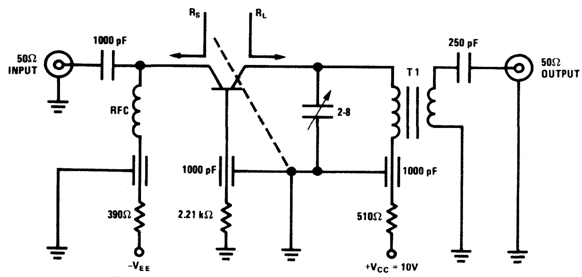
Common Base Configuration Stability Factor-k vs Collector Current



Maximum Stable Gain vs Frequency Common Base Configuration



Rollett stability factor "k" is defined as: $R = \frac{2g_ig_o - R_e(Y_f Y_r)}{|Y_f Y_r|}$



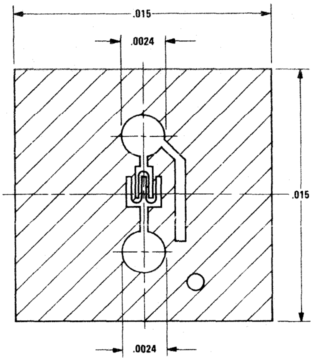
T_1–3:1 Ratio No. 22 Bifilar on Micrometals Toroid, P/N T30-12

R_S = 50Ω, R_L = 2.5 kΩ

f_{bw} = 8.0 MHz

FIGURE 3. 200 MHz Common Base Power Gain, Noise Figure, Automatic Gain Control Test Circuit.

Process 45 NPN AGC-IF Amplifier



DESCRIPTION

Process 45 is an overlay double diffused silicon device.

APPLICATION

This device was designed for use as a forward AGC amplifier in IF amplifiers without neutralization.

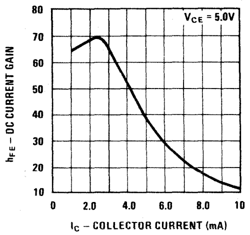
PRINCIPAL DEVICE TYPES:

TO-72 (pkg 28) SE5055
TO-92 MPS-H32 (BEC)

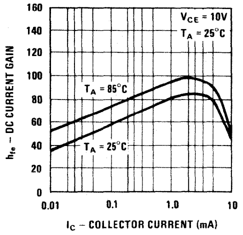
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω	27	29		dB	Fig. 1
NF	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω		2.8	5.0	dB	Fig. 1
C_{re}	V_{CB} = 10V		0.13	0.22	pF	TO-72
V_{AGC}	f = 45 MHz, V_{CC} = 12V 30 dB Gain Reduction	 3.5	0.22 4.3	0.30 5.0	pF V	Fig. 1
V_{AGC}	f = 45 MHz, V_{CC} = 12V 50 dB Gain Reduction		6.50	8.0	V	Fig. 1
h_{fe}	V_{CE} = 10V, I_C = 2 mA, f = 100 MHz	3	5			
h_{FE}	V_{CE} = 10V, I_C = 2 mA	20	80	250		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		1.0	2.75	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.92	1.0	V	
BV_{CEO}	I_C = 1 mA	30			V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_E = 10 μA	3			V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 2V			50	nA	

Process 45

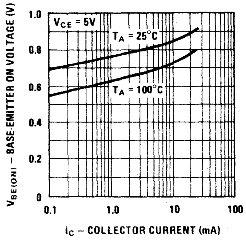
DC Current Gain vs Collector Current



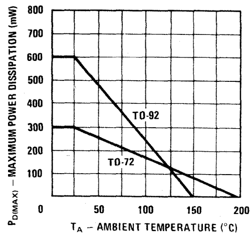
DC Pulse Current Gain vs Collector Current



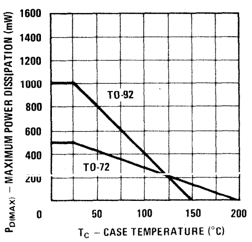
Base-Emitter On Voltage vs Collector Current



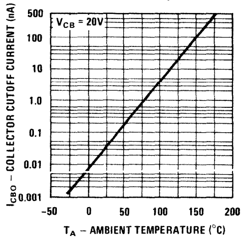
Maximum Power Dissipation vs Ambient Temperature



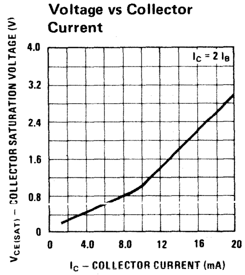
Maximum Power Dissipation vs Case Temperature



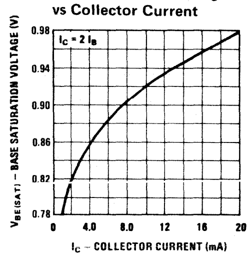
Collector Cutoff Current vs Ambient Temperature



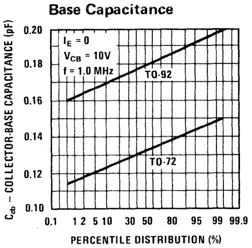
Collector Saturation Voltage vs Collector Current



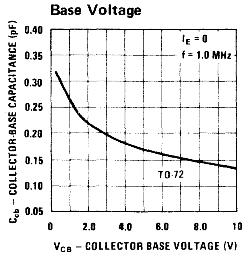
Base Saturation Voltage vs Collector Current



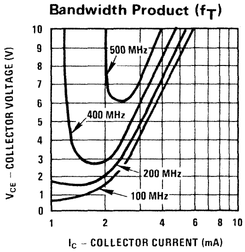
Distribution of Collector-Base Capacitance



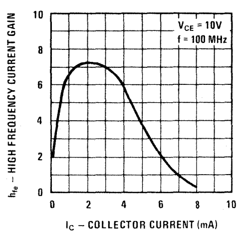
Collector-Base Capacitance vs Collector-Base Voltage



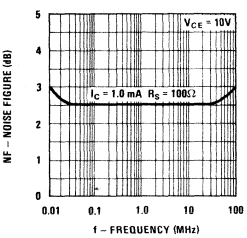
Contours of Constant Gain Bandwidth Product (f_T)



High Frequency Current Gain vs Collector Current



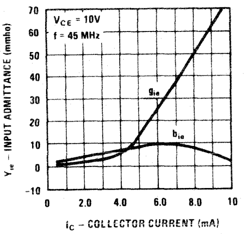
Noise Figure vs Frequency



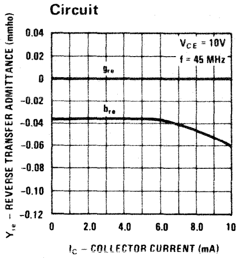
COMMON EMITTER Y PARAMETERS VS FREQUENCY

Process 45

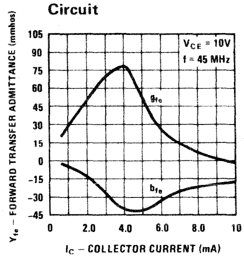
Input Admittance vs Collector Current-Output Short Circuit



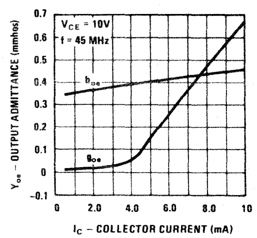
Reverse Transfer Admittance vs Collector Current—Input Short Circuit



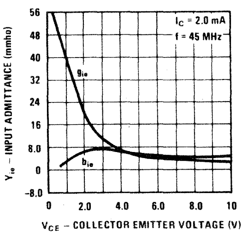
Forward Transfer Admittance vs Collector Current - Output Short Circuit



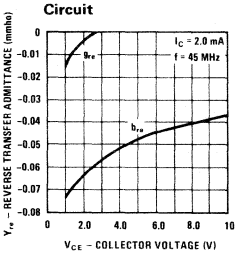
Output Admittance vs Collector Current-Input Short Circuit



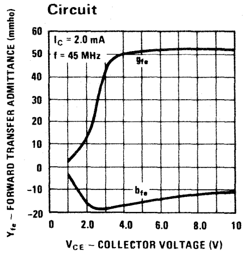
Input Admittance vs Collector Voltage-Output Short Circuit



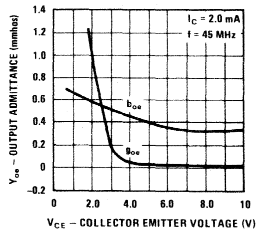
Reverse Transfer Admittance vs Collector Voltage - Input Short Circuit



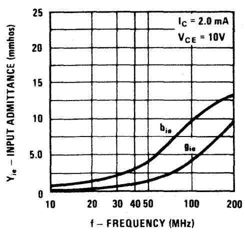
Forward Transfer Admittance vs Collector Voltage—Output Short Circuit



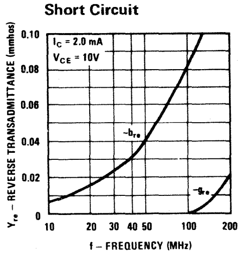
Output Admittance vs Collector Voltage-Input Short Circuit



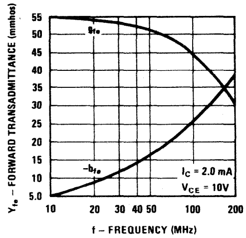
Input Admittance vs Frequency - Output Short Circuit



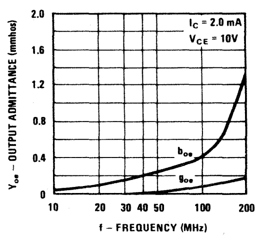
Reverse Transadmittance vs Frequency - Input Short Circuit



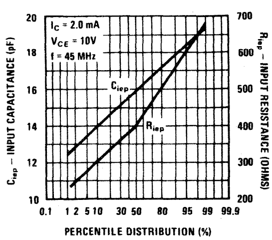
Forward Transadmittance vs Frequency - Output Short Circuit



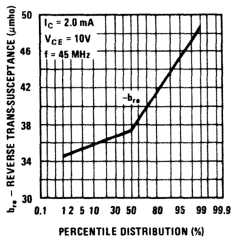
Output Admittance vs Frequency - Input Short Circuit



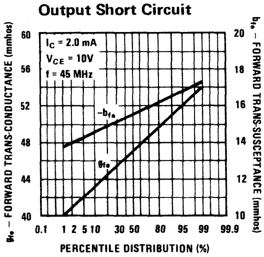
Distribution of Input Capacitance and Input Resistance—Output Short Circuit



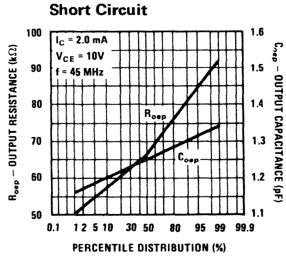
Distribution of Reverse Transadmittance—Input Short Circuit



Distribution of Forward Transfer Admittance Output Short Circuit



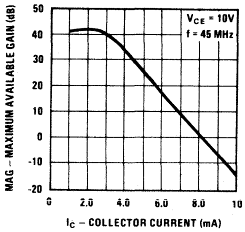
Distribution of Output Capacitance and Output Resistance - Input Short Circuit



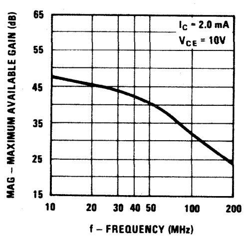
Process 45

COMMON EMITTER PERFORMANCE

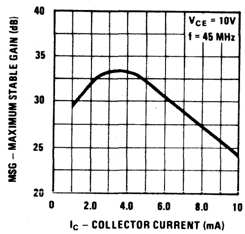
Maximum Available Gain vs Collector Current



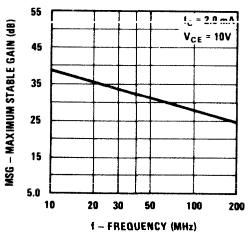
Maximum Available Gain vs Frequency



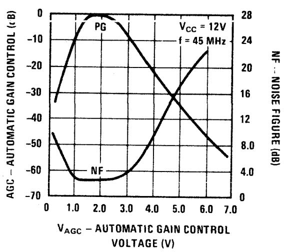
Maximum Stable Gain vs Collector Current



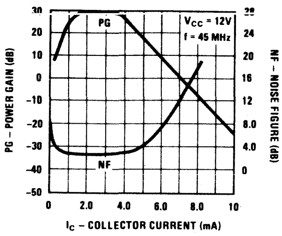
Maximum Stable Gain vs Frequency



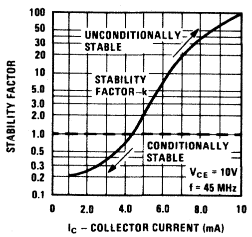
Automatic Gain Control and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Stability Factor* vs Collector Current



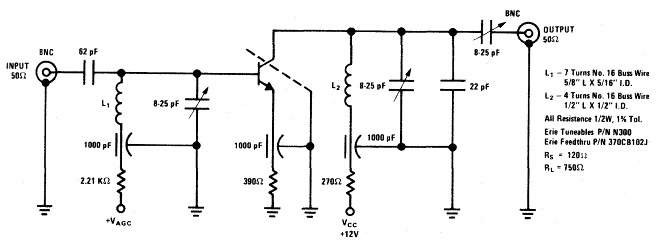
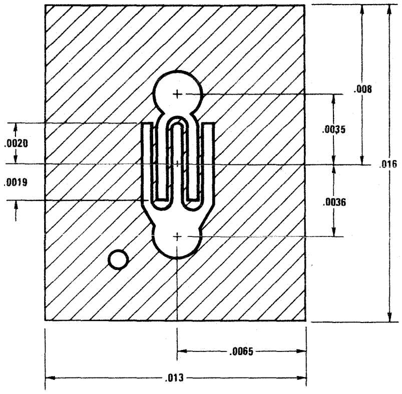


FIGURE 1. SE5055 45 MHz Gain, Noise Figure, AGC Circuit

* Rollett stability factor "k" is defined as: $R = \frac{2g_{ig}g_o - R_e(Y_f Y_r)}{|Y_f Y_r|}$

Process 46 NPN RF-IF Amplifier



DESCRIPTION

Process 46 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for linear amplifier applications at audio through RF frequencies.

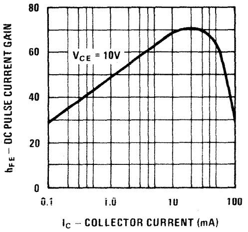
PRINCIPAL DEVICE TYPES:

TO-92 ST5025

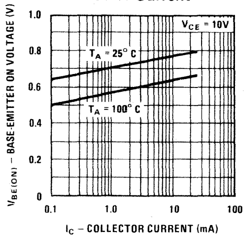
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{pe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	28		dB	
C_{cb}	V_{CB} = 10V		0.9	1.1	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			200	μmho	
h_{fe}	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	3.0	4.50			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	50	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.2	0.6	V	
BV_{CEO}	I_C = 1 mA	30	60		V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_C = 10 μA	3.0			V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 2V			50	nA	

Process 46

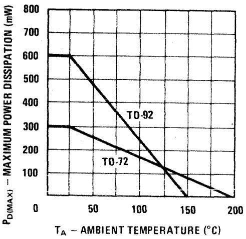
DC Pulse Current Gain vs Collector Current



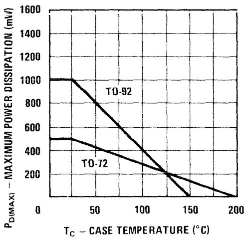
Base-Emitter On Voltage vs Collector Current



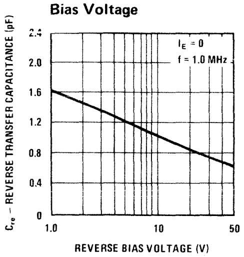
Maximum Power Dissipation vs Ambient Temperature



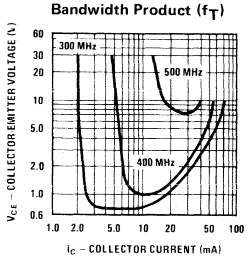
Maximum Power Dissipation vs Case Temperature



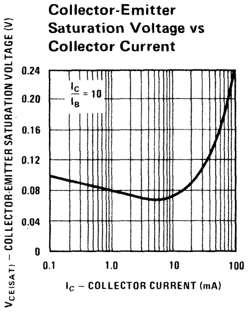
Reverse Transfer Capacitance vs Reverse Bias Voltage



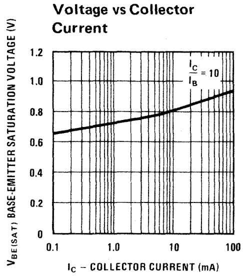
Contours of Constant Gain Bandwidth Product (f_T)



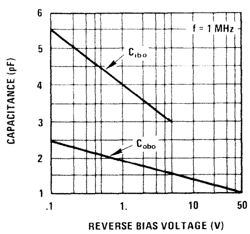
Collector-Emitter Saturation Voltage vs Collector Current



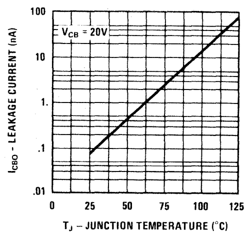
Base-Emitter Saturation Voltage vs Collector Current



Capacitance vs Reverse Bias Voltage

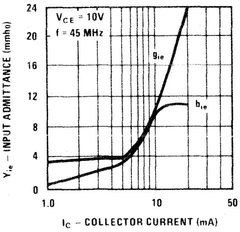


Collector-Base Diode Reverse Current vs Temperature

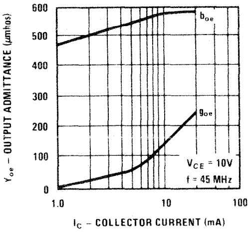


Process 46

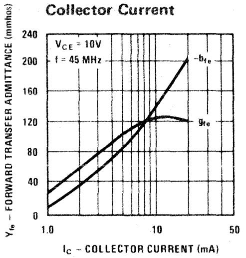
Input Admittance vs Collector Current



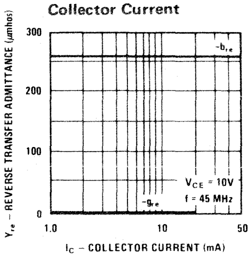
Output Admittance vs Collector Current



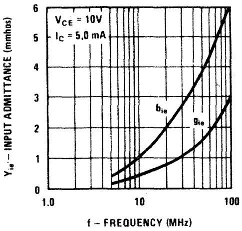
Forward Transfer Admittance vs Collector Current



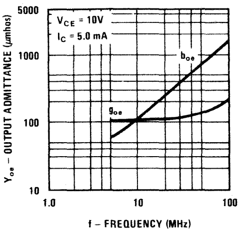
Reverse Transfer Admittance vs Collector Current



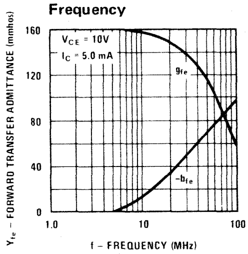
Input Admittance vs Frequency



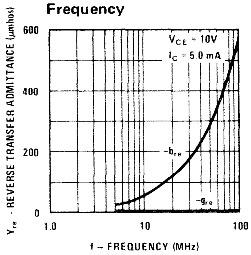
Output Admittance vs Frequency



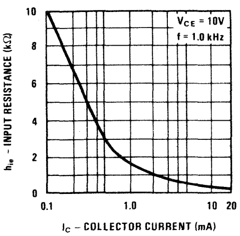
Forward Transfer Admittance vs Frequency



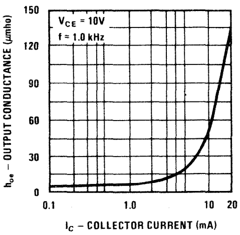
Reverse Transfer Admittance vs Frequency



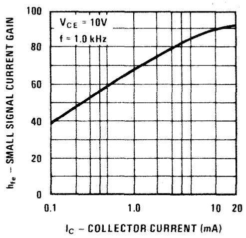
Small Signal Input Resistance vs Collector Current



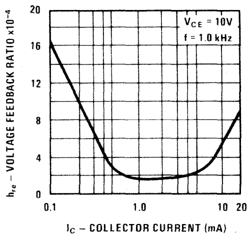
Small Signal Output Conductance vs Collector Current



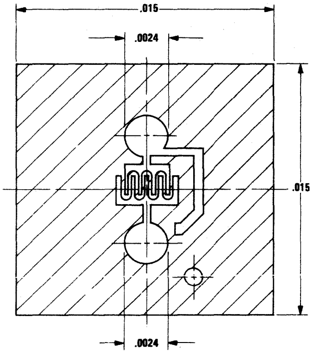
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 47 NPN RF-IF Amplifier



DESCRIPTION

Process 47 is an overlay double diffused, silicon epitaxial device, with a Faraday shield diffusion.

APPLICATION

This device was designed for application as an RF-IF amplifier for use to 300 MHz. Its primary application is as a third video IF in T.V.

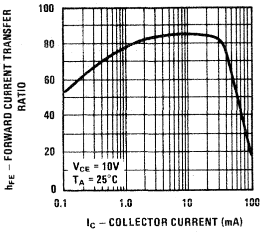
PRINCIPAL DEVICE TYPES:

TO-72	SE5035
TO-92	ST5030B

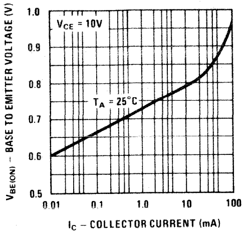
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	f = 200 MHz, V_{CE} = 10V, I_C = 4 mA	22	25		dB	Fig. 2
NF	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA, R_S = 50Ω		2.0	4.0	dB	Fig. 3
G_{ve}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA	38	42	46	dB	Fig. 4
G_{pe}	f = 200 MHz, V_{CC} = 12V, I_C = 2 mA	17	20		dB	Fig. 3
C_{ib}	V_{EB} = 0.5V		2.0	3.0	pF	TO-92
C_{cb}	V_{CB} = 15V	0.25	0.33	0.40	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA			125	μmho	
h_{fe}	f = 100 MHz, V_{CE} = 15V, I_C = 7 mA	6	10			
h_{FE}	V_{CE} = 15V, I_C = 7 mA	40	80	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.3	1.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.92	V	
BV_{CEO}	I_C = 10 mA	30	45		V	
BV_{CBO}	I_C = 100 μA	40	60		V	
BV_{EBO}	I_E = 10 μA	4.0	5.5			
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 47

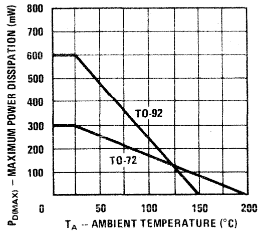
DC Pulse Current Gain vs Collector Current



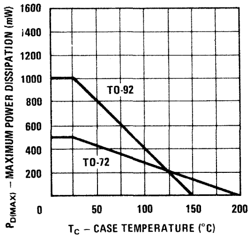
Base-Emitter On Voltage vs Collector Current



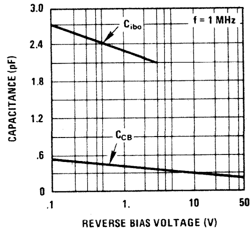
Maximum Power Dissipation vs Ambient Temperature



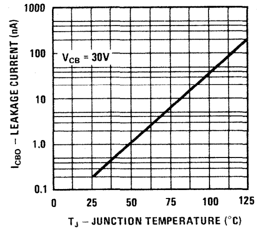
Maximum Power Dissipation vs Case Temperature



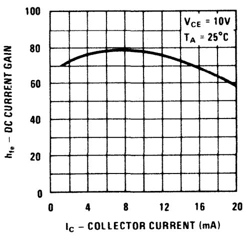
Capacitance vs Reverse Bias Voltage



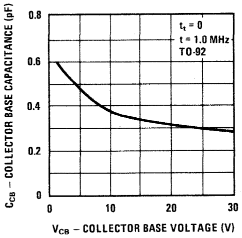
Collector-Base Diode Reverse Current vs Temperature



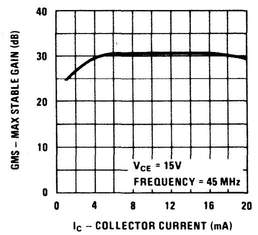
DC Current Gain vs Collector Current



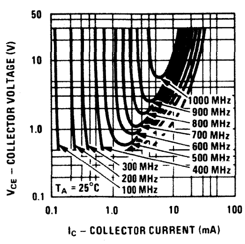
Collector-Base Capacitance vs Collector-Base Voltage



Max Stable Gain vs Collector Current



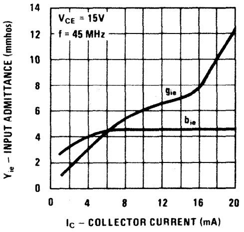
Contours of Constant Gain Bandwidth Product (f_T)



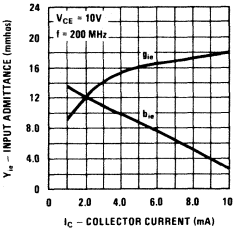
COMMON EMITTER VS FREQUENCY Y PARAMETERS

Process 47

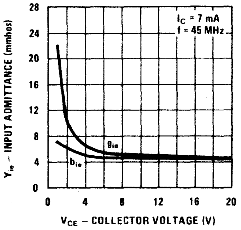
Input Admittance vs Collector Current



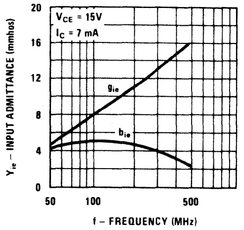
Input Admittance vs Collector Current



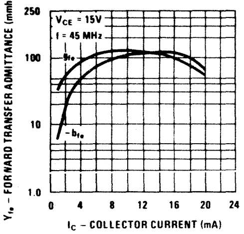
Input Admittance vs Collector Voltage



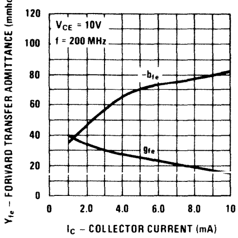
Input Admittance vs Frequency



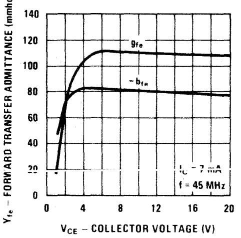
Forward Transfer Admittance vs Collector Current



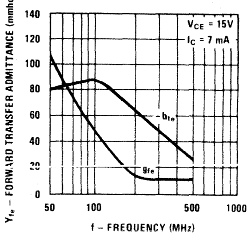
Forward Transfer Admittance vs Collector Current



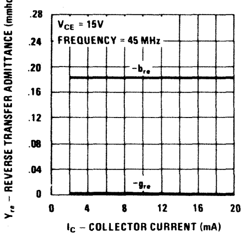
Forward Transfer Admittance vs Collector Voltage



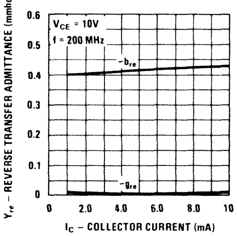
Forward Transfer Admittance vs Frequency



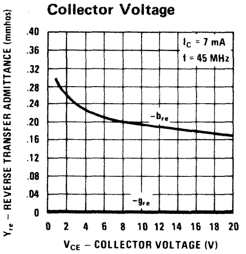
Reverse Transfer Admittance vs Collector Current



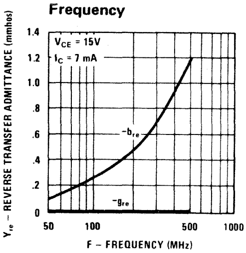
Reverse Transfer Admittance vs Collector Current



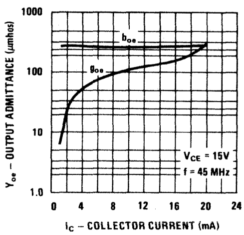
Reverse Transfer Admittance vs Collector Voltage



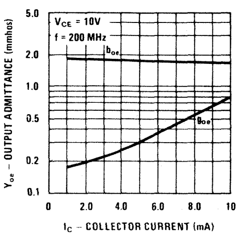
Reverse Transfer Admittance vs Frequency



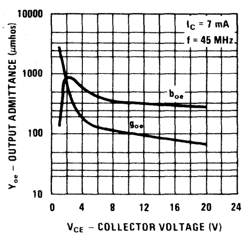
Output Admittance vs Collector Current



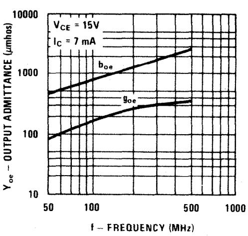
Output Admittance vs Collector Current



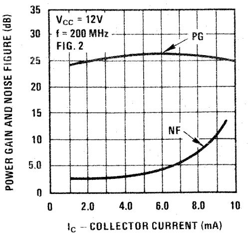
Output Admittance vs Collector Voltage



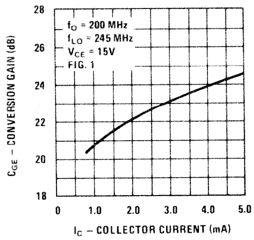
Output Admittance vs Frequency

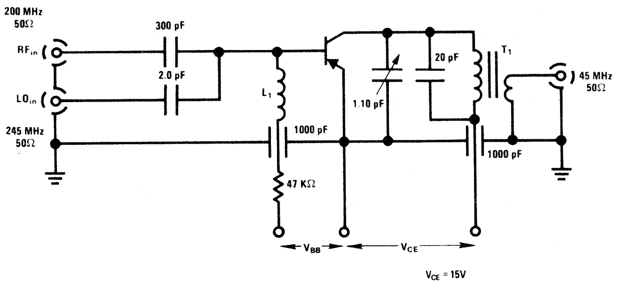


Power Gain and Noise Figure vs Collector Current



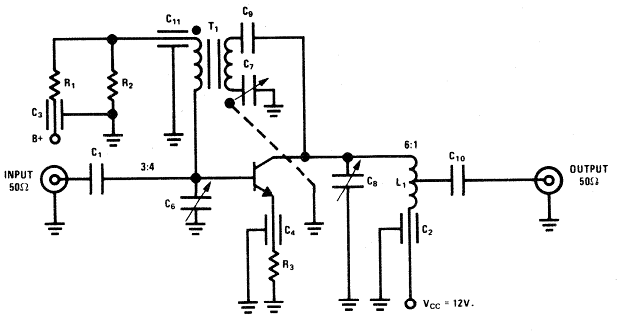
Conversion Gain vs Collector Current





L1 – Ohmite RFC Z235
T1 – Primary 5 turns #34 wire ¼" dia.
Secondary 2 turns #34 wire close wound over a Q100 core (10.7 MHz)
When terminated on secondary side with 50Ω, primary measures 1.5k, –25 pF.

FIGURE 1. 200 MHz Conversion Gain Test Circuit

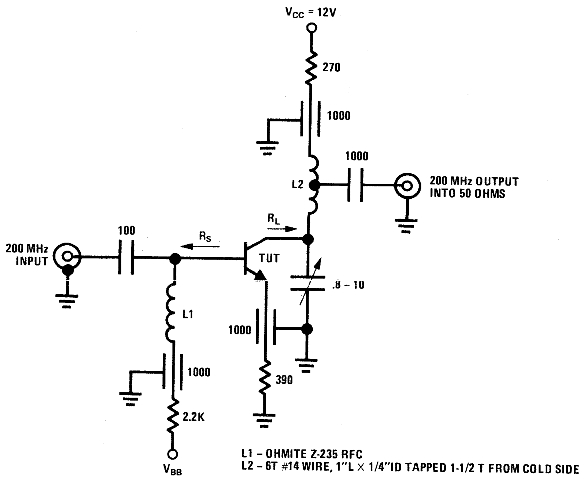


C_1, C_{10} = 1000 pF Duramica
C_2, C_3, C_4, C_5, C_{11} = 1000 pF feed thru
C_6 = 8 - 25 pF
C_7, C_8 = 0.7 - 10 pF
C_9 = 2 pF Duramica

R_1 = 10 kΩ
R_2 = 2 kΩ
R_3 = 270Ω
L_1 = 5 turns #14 wire, 5/16" I.D. x 1" long

T_1 = 1 turn #14 wire–primary
1 turn #16 wire enamel, secondary.
Wound on Balun form Ferrite core Indiana Gen. Corp. F-684-Q3

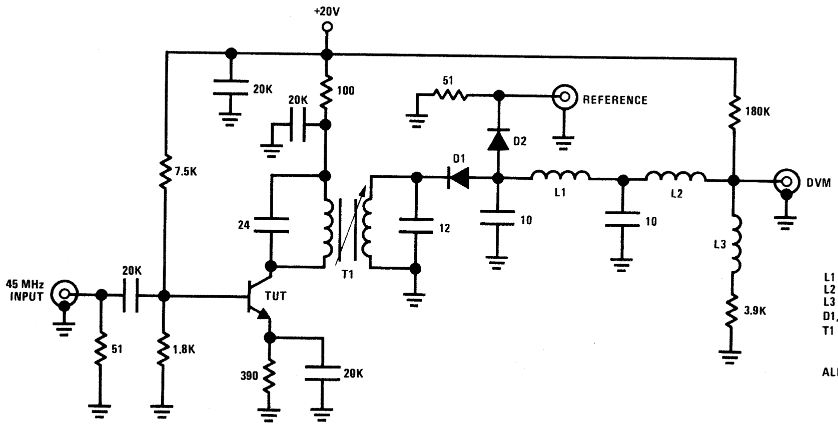
FIGURE 2. 200 MHz Power Gain Test Circuit



L1 - OHMITE Z-235 RFC
L2 - 6T #14 WIRE, 1"L × 1/4"ID TAPPED 1-1/2 T FROM COLD SIDE

ALL CAPACITANCE IN pF, ALL RESISTANCE IN OHMS.

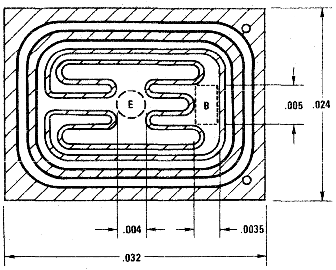
FIGURE 3. Unneutralized 200 MHz PG NF Test Circuit



L1 - 15µh COILCRAFT RFC
L2 - 5µh COILCRAFT RFC
L3 - 180µh COILCRAFT RFC
D1, D2 - FH110
T1 - PRI. 6T #32 WIRE
SEC. 9T #32 WIRE
CORE IS MILLER P/N 4500-2
ALL CAP IN pF, ALL RESISTANCE IN Ω

FIGURE 4. 45 MHz Voltage Gain (Gve) Circuit

Process 48 NPN High Voltage Video Output



DESCRIPTION

Process 48 is a nonoverlay triple diffused, silicon device with a field plate.

APPLICATION

This device was designed for application as a video output to drive color CRT.

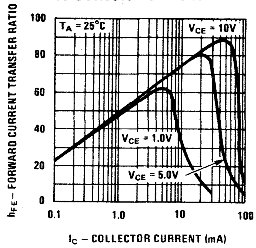
PRINCIPAL DEVICE TYPES:

TO-39	SE7056
X51	SP7056

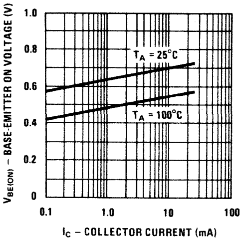
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{cb}	V_{CB} = 20V		2.5	3.5	pF	TO-39
h_{fe}	f = 20 MHz, V_{CE} = 100V I_C = 15 mA	2.5	4.0			
h_{FE}	I_C = 1 mA, V_{CE} = 20V	15	50			
h_{FE}	I_C = 10 mA, V_{CE} = 20V	30	100			
h_{FE}	I_C = 30 mA, V_{CE} = 20V	30	100			
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.74	0.85	V	
C_{eb}	V_{EB} = 0.5V		45	70	pF	
BV_{CEO}	I_C = 5 mA	220	320	500	V	
BV_{CBO}	I_C = 100 μA	220	320	500	V	
BV_{EBO}	I_E = 100 μA	7.0			V	
I_{CBO}	V_{CB} = 150V			100	nA	
I_{EBO}	V_{EB} = 6V			100	nA	

Process 48

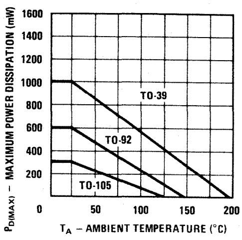
DC Pulse Current Gain vs Collector Current



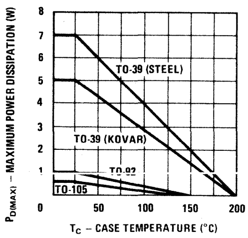
Base-Emitter On Voltage vs Collector Current



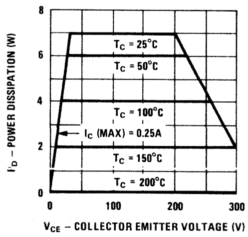
Maximum Power Dissipation vs Ambient Temperature



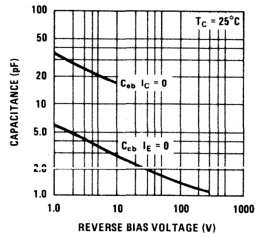
Maximum Power Dissipation vs Case Temperature



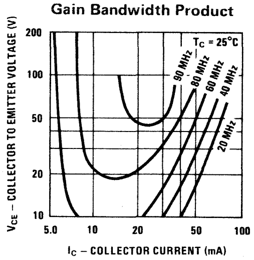
Guaranteed Maximum DC Power Dissipation vs Collector-Emitter Voltage



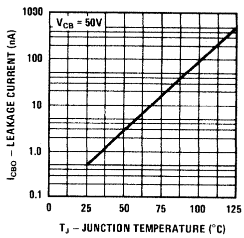
Collector to Base and Emitter to Base Capacitance vs Reverse Bias Voltage



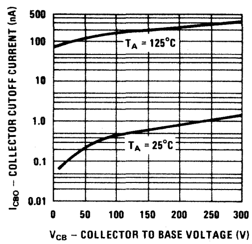
Contours of Constant Gain Bandwidth Product



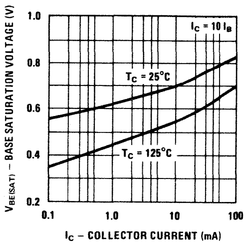
Collector-Base Diode Reverse Current vs Temperature



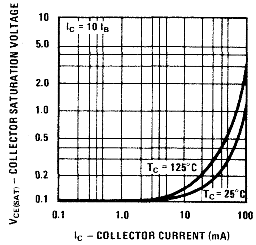
Collector Cutoff Current vs Collector Voltage



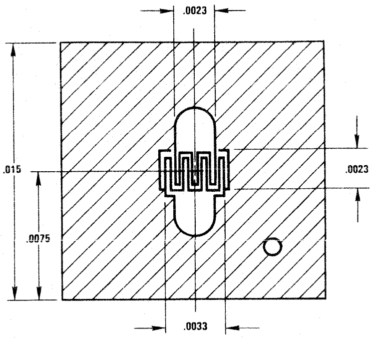
Base Saturation Voltage vs Collector Current



Collector Saturation Voltage vs Collector Current



Process 49 NPN RF Amplifier



DESCRIPTION

Process 49 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general RF amplifier applications to 250 MHz.

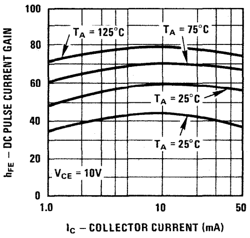
PRINCIPAL DEVICE TYPES:

TO-92 (BEC) MPS6544, MPSH20

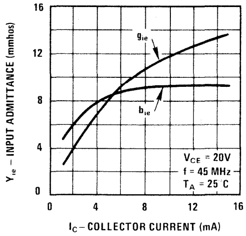
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	30		dB	
f_t	V_{CE} = 10V, I_C = 10 mA	400	700		MHz	
rb'Cc	f = 31.9 MHz, V_{CE} = 10V, I_C = 8 mA		6.5	20.0	ps	TO-92
Ccb	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.55	0.65	pF	TO-92
h_{FE}	V_{CE} = 10V, I_C = 30 mA	25	75			
h_{FE}	V_{CE} = 10V, I_C = 4 mA	25				
$V_{BE(ON)}$	V_{CE} = 10V, I_C = 10 mA		0.80	0.95	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_C = 3 mA		0.15	0.50	V	
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			100	µmhos	
roep	f = 4.5 MHz, V_{CE} = 10V, I_C = 2 mA	80k			Ω	
BV_{CEO}	I_C = 1 mA	40	55		V	
BV_{CBO}	I_C = 100 µA	45	75		V	
BV_{EBO}	I_E = 10 µA	4.0	5.5		V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3.0V			50	nA	

Process 49

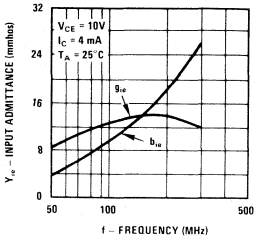
DC Pulse Current Gain vs Collector Current



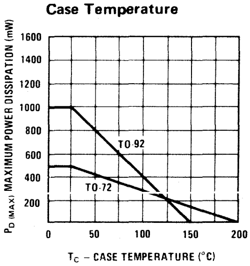
Input Admittance vs Collector Current



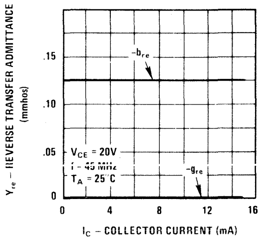
Input Admittance vs Frequency



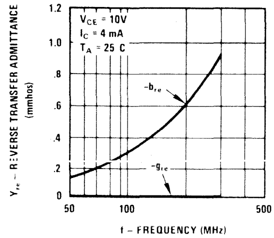
Maximum Power Dissipation vs Case Temperature



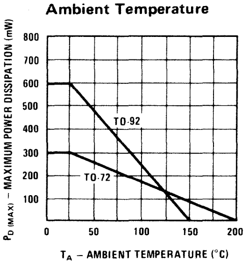
Reverse Transfer Admittance vs Collector Current



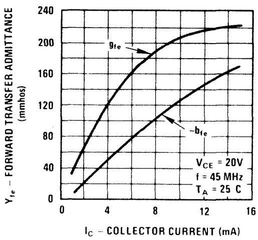
Reverse Transfer Admittance vs Frequency



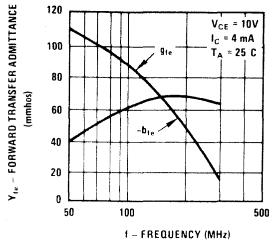
Maximum Power Dissipation vs Ambient Temperature



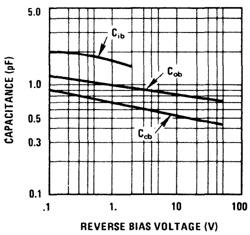
Forward Transfer Admittance vs Collector Current



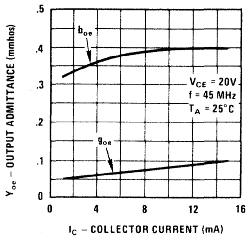
Forward Transfer Admittance vs Frequency



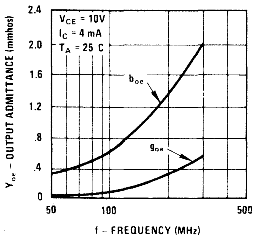
Capacitance vs Reverse Bias Voltage



Output Admittance vs Collector Current

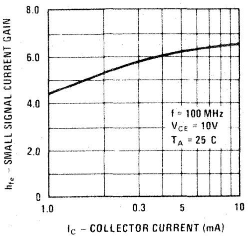


Output Admittance vs Frequency

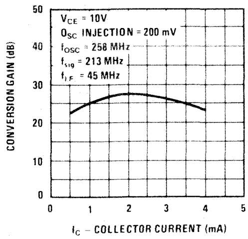


Process 49

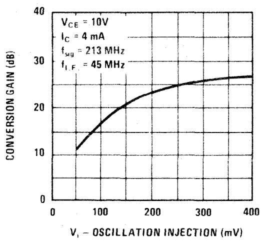
Small Signal Current Gain vs Collector Current



Conversion Gain vs Collector Current



Conversion Gain vs Oscillator Injection Level



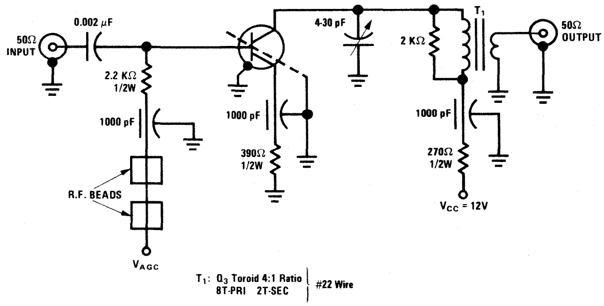


FIGURE 1. 45 MHz Power Gain Circuit

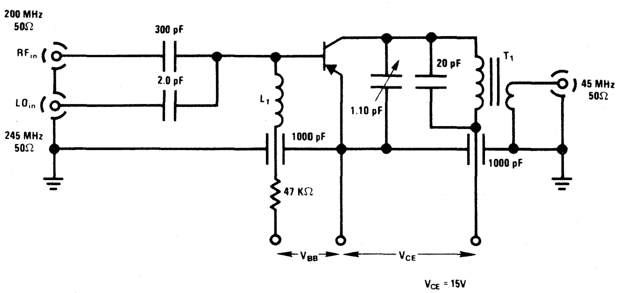
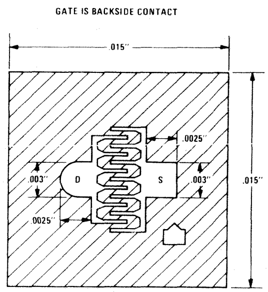


FIGURE 2. 200 MHz Conversion Gain Test Circuit

Process 50 N-Channel Junction FET



PACKAGES:

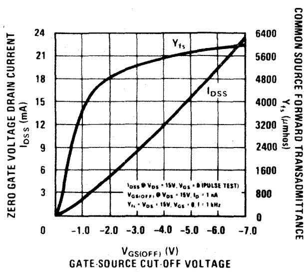
TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

2N4416
2N5485
KE4416

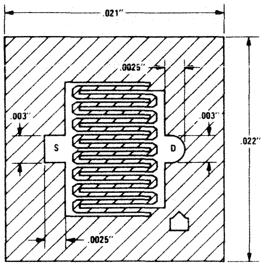
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0, I_G = 1\ \mu A$	20	40	50	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V, V_{GS} = 0V$	1	10	25	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 15V, V_{GS} = 0$	3	5.0	7	mmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 20V, V_{DS} = 0$		0.02	10	nA
On Resistance	$R_{DS(ON)}$	$V_{DS} = 0, V_{GS} = 0$	100	175	500	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15, I_D = 1$ nA	0.7	3.5	9	V
Feedback Capacitance	C_{rss}	$V_{DG} = 15V, I_S = 0$	0.6	0.7	1.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V, V_{GS} = 0$	3	3.5	5.0	pF

Process 50 is designed primarily for RF amplifier and mixer applications. It will operate up to 450 MHz with low noise figure and good power gain. These devices offer outstanding performance at VHF aircraft and communications frequencies. Their major advantage is low crossmodulation and intermodulation, low noise figure and good power gain. The device is also a good choice for analog switching where low capacitance is very important.



Process 51 N-Channel Junction FET

GATE IS BACKSIDE CONTACT



PACKAGES:

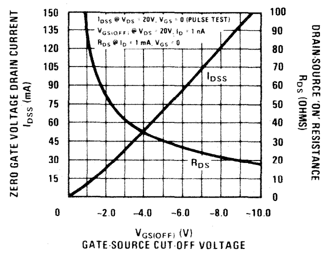
TO-18, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

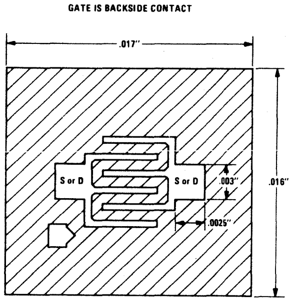
2N4091-93
2N4391-93
2N4856-61
2N5638, 39, 40
KE 4391, 92, 93

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = 1\ \mu A$	30	60	80	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20V$, $V_{GS} = 0$ Pulse Test	5	65	170	mA
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 20V$, $V_{DS} = 0$		0.05	10	nA
"ON" Resistance	$R_{DS(ON)}$	$V_{DS} = 0$, $V_{GS} = 0$	20	35	100	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 20$, $I_D = 1$ nA	0.5	4.5	10.0	V
Drain "OFF" Current	$I_{D(OFF)}$	$V_{DS} = 20$, $V_{GS} = -10V$		0.05	100	nA
Feedback Capacitance	C_{rss}	$V_{DG} = 15V$, $I_S = 0$, f = 1 MHz	3.0	3.5	4.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V$, $I_D = 2$ mA, f = 1 MHz	12	14	18	pF

Process 51 is designed primarily for electronic switching applications such as low ON resistance analog switching. It features excellent C_{iss} $R_{DS(ON)}$ time constant. The inherent zero offset voltage and low leakage current make these devices excellent for chopper stabilized amplifiers, sample and hold circuits, and reset switches. Low feedthrough capacitance also allows them to handle video signals to 100 MHz.



Process 52 N-Channel Junction FET



PACKAGES:

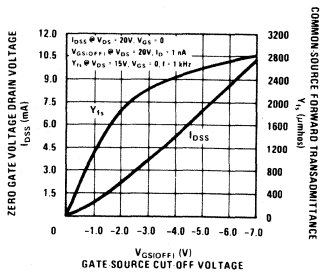
TO-18, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

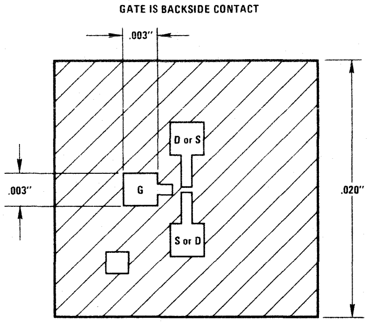
2N4338, 39, 40, 41
2N3684, 85, 86, 87
2N4302-04
2N5716-18

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	40	100	150	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.1	3.0	10.0	mA
Forward Trans-conductance	Y_{fs}	V_{DS} = 20V, V_{GS} = 0	0.5	1.8	3.0	mmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = 30V, V_{DS} = 0		0.01	2	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0, V_{GS} = 0	300	500	2000	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	0.5	3.0	8.0	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1 MHz	0.8	1.2	1.5	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz	3.0	4.0	5.0	pF

Process 52 is designed primarily for low level audio and general purpose applications. These devices provide excellent performance as input stages for piezo electric transducers or other high impedance signal sources. Their high output impedance and high voltage breakdown lend them to high gain audio and video amplifier applications. Source and drain are interchangeable.



Process 53 N-Channel Junction FET



PACKAGES:

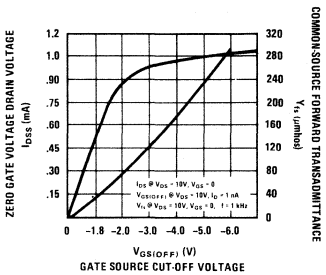
TO-18, TO-72

PRINCIPAL DEVICE TYPES:

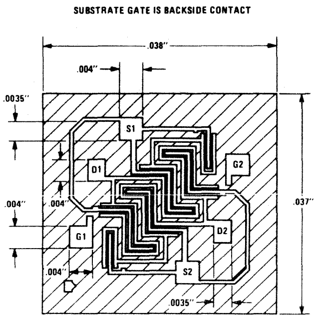
2N3089
2N3452-54
2N4117-19
2N4117A-19A

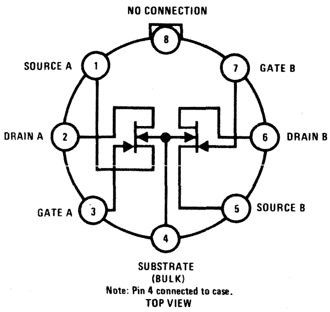
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G 1 μA	40	60	80	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0	0.02	0.25	1	mA
Forward Trans-conductance	Y_{fs}	V_{DS} = 10V, V_{GS} = 0	80	250	350	μmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.1	10	pA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	0.5	2.2	6	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1 MHz	0.7	0.85	1.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz	1.7	2	2.5	pF

Process 53 is designed primarily for low current DC and audio applications. These devices provide excellent performance as input stages for sub pico-amp instrumentation or any high impedance signal sources.



Process 54 N-Channel Junction FET





PACKAGES:

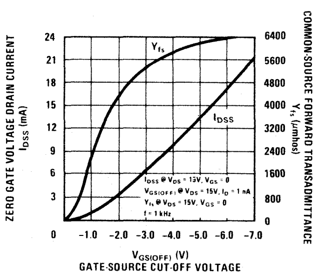
TO-99

PRINCIPAL DEVICE TYPES:

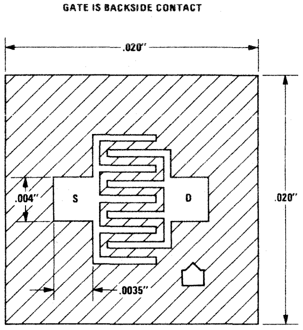
FM1200 SERIES

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = 1\ \mu A$	20	35		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V$, $V_{GS} = 0$	0.2	5.0	20	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 15V$, $V_{GS} = 0$	0.8	3.5	10	mmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 20V$, $V_{DS} = 0$		0.10	10	nA
"ON" Resistance	$r_{DS(ON)}$	$V_{DS} = 0$, $V_{GS} = 0$	125	300	1200	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15V$, $I_D = 1$ nA	0.5	3.0	7.0	V
Gate Current	I_G	$V_{DG} = 15V$, $I_D = 0.20$ mA		40	100	pA
Feedback Capacitance	C_{rss}	$V_{DG} = 15V$, $I_S = 0$, f = 1 MHz		0.7	1.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V$, $V_{GS} = 0$, f = 1 MHz		5.0	8.0	pF

Process 54 is a monolithic matched JFET dual. It features high Y_{fs} and low offset voltage and temperature drift. This device can be used for low radio frequency balanced mixer applications, low level differential analog switching and as an input buffer for operational amplifiers. Typical offset voltage $|V_{GS1} - V_{GS2}|$ is about 5 mV with a temperature coefficient of 10 $\mu V/°$ C.



Process 55 N-Channel Junction FET



PACKAGES:

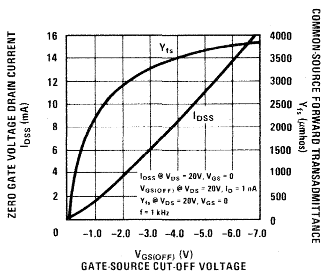
TO-18, TO-72, TO-92

PRINCIPAL DEVICE TYPES:

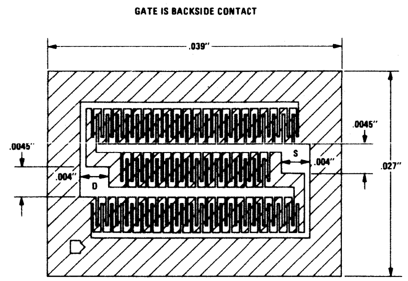
2N4221-22
2N5457, 58, 59
2N5361-64

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V, I_G = 1\ \mu A$	50	100	150	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20V, V_{GS} = 0$	0.5	5.0	17	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 20V, V_{GS} = 0$	0.8	3.5	5.0	mmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 30V, V_{DS} = 0$		0.02	3	nA
"ON" Resistance	$r_{DS(ON)}$	$V_{DS} = 0, V_{GS} = 0$	150	350	800	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 20V, I_D = 1\ nA$	0.5	3.0	8.0	V
Feedback Capacitance	C_{rss}	$V_{DG} = 15V, I_S = 0, f = 1\ MHz$	1.0	1.5	2.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V, I_D = 2\ mA, f = 1\ MHz$	4.0	5.5	7.0	pF

Process 55 is a general purpose low level audio amplifier and switching transistor. Wafer processing is similar to process 52 but process 55 uses a larger geometry. This results in higher Y_{fs}, I_{DSS}, and capacitance and lower $R_{DS(ON)}$. It is useful for audio and video frequency amplifiers and RF amplifiers under 50 MHz. It may also be used for analog switching applications.



Process 58 N-Channel Junction FET



PACKAGES:

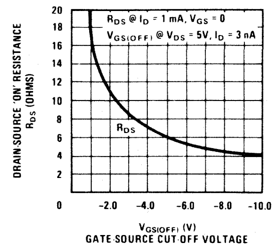
TO-52

PRINCIPAL DEVICE TYPES:

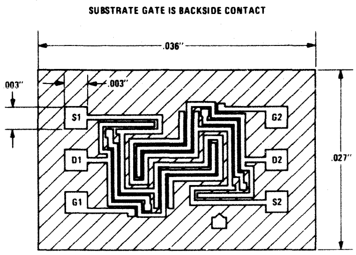
2N5432, 33, 34
NF 580 SERIES

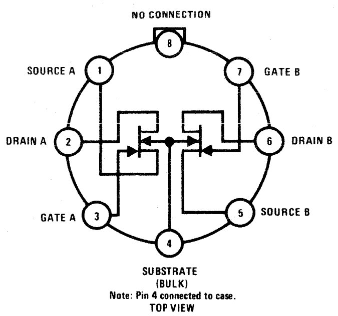
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	15	30	45	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 5V, V_{GS} = 0 Pulse Test	100	400	1000	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = 15V, V_{DS} = 0		0.10	20	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0 , V_{GS} = 0	5.0	7.0	20	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 5V, I_D = 3 nA	0.5	5.0	12	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 5V, V_{GS} = −10V		0.10	20	nA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1 MHz		12	25	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 2 mA, f = 1 MHz		25	50	pF

Process 58 was developed for analog or digital switching applications where very low $R_{DS(ON)}$ is mandatory. Switching times are very fast and $R_{DS(ON)}$ C_{iss} time constant is low. The 7Ω typical on resistance is very useful in precision multiplex systems where switch resistance must be held to an absolute minimum.



Process 59 N-Channel Junction FET





PACKAGES:

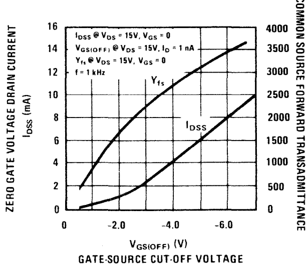
TO-99

PRINCIPAL DEVICE TYPES:

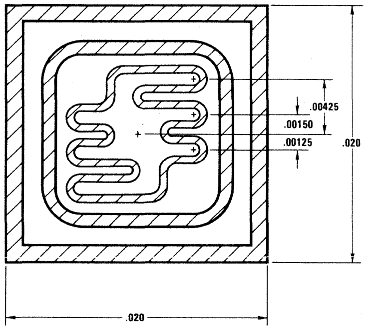
FM3954 SERIES
FM1100 SERIES

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	30	60	80	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.1	2.0	10.0	mA
Forward Trans-conductance	Y_{fs}	V_{DS} = 15V, V_{GS} = 0	0.5	2.5	6.0	mmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.05	2.0	nA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	0.5	3.0	6.0	V
Gate Current	I_G	V_{DG} = 15V, I_D = 0.10 mA		20	50	pA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1 MHz		0.3	0.6	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 2 mA, f = 1 MHz		3.5	5.0	pF

Process 59 is a monolithic dual JFET. It is intended primarily for use as a buffer for Operational Amplifier applications. Process 59 used as a buffer for an LM101 or LM741 results in an excellent Op Amp for sample and hold circuits, integrators, charge amplifiers or other applications which cannot stand the excessive bias and offset current of bipolar Op Amps. Typical offset voltage $|V_{GS1} - V_{GS2}|$ is about 6 mV and temperature drift is 12 μV/°C.



Process 60 PNP Medium Power



DESCRIPTION

Complements Process 13.

APPLICATION

These devices are designed for general purpose amplifier applications at collector currents to 500 mA.

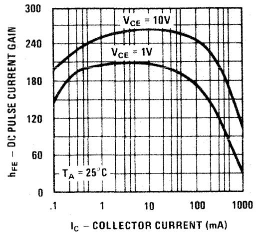
PRINCIPAL DEVICE TYPES:

TO-105 CS9012

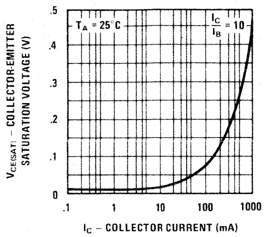
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	V_{CB} = 10V		8	12	pF	
C_{IB}	V_{EB} = 1V		22	26	pF	
NF	V_{CE} = 10V, I_C = 1 mA R_S = 1k, f = 1 kHz		.5		dB	
f_T	V_{CE} = 10V, I_C = 100 mA		400		MHz	
h_{FE}	V_{CE} = 1V, I_C = 1 mA	50	200	300		
h_{FE}	V_{CE} = 1V, I_C = 50 mA	50	190	300		
h_{FE}	V_{CE} = 1V, I_C = 150 mA	50	165	300		
h_{FE}	V_{CE} = 1V, I_C = 500 mA	30	80	200		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		.1	.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		.3	.5	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		.8	.96	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		.98	1.2	V	
I_{CES}	V_{CE} = 20V			100	nA	
I_{CEO}	V_{CE} = 20V			100	nA	
BV_{CBO}	I_C = 10 mA	40	68		V	
BV_{EBO}	I_E = 10 mA	7	8		V	
BV_{CEO}	I_C = 10 mA	25	40		V	

Process 60

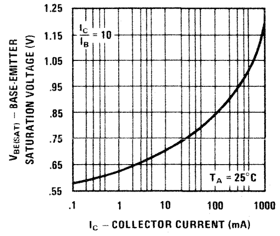
DC Pulse Current Gain vs Collector Current



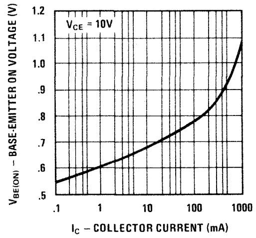
Collector-Emitter Saturation Voltage vs Collector Current



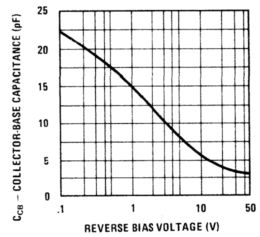
Base-Emitter Saturation Voltage vs Collector Current



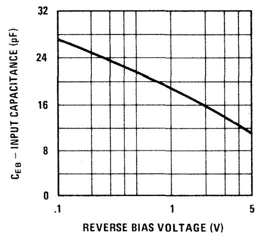
Base-Emitter On Voltage vs Collector Current



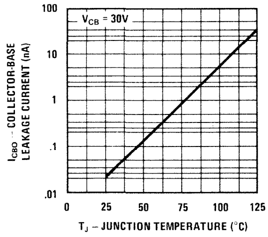
Collector-Base Capacitance vs Reverse Bias Voltage



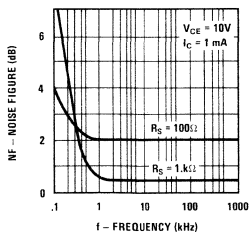
Input Capacitance vs Reverse Bias Voltage



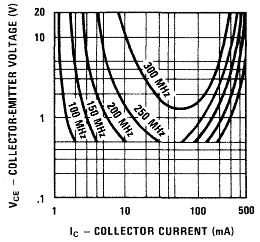
Collector-Base Diode Reverse Current vs Temperature



Noise Figure vs Frequency

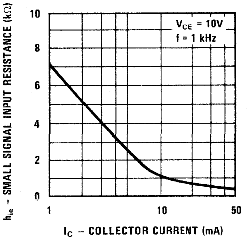


Contours of Constant Gain Bandwidth Product (f_T)

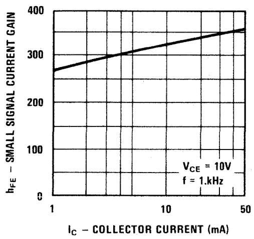


Process 60

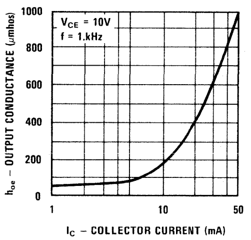
Small Signal Input Resistance vs Collector Current



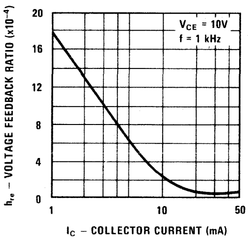
Small Signal Current Gain vs Collector Current



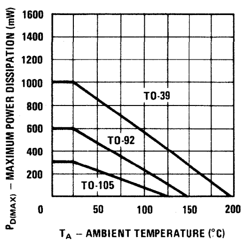
Small Signal Output Conductance vs Collector Current



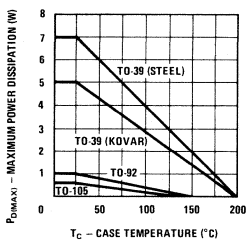
Small Signal Voltage Feedback Ratio vs Collector Current



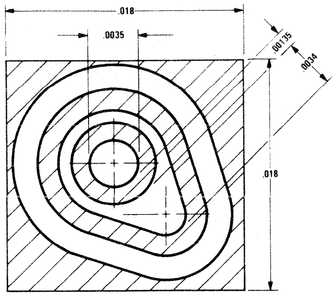
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



Process 62 PNP Small Signal



DESCRIPTION

Process 62 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 07.

APPLICATION

These devices are designed for low level, high gain, low noise general purpose amplifier applications.

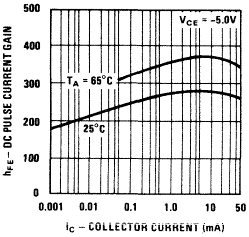
PRINCIPAL DEVICE TYPES:

TO-18	2N3962
TO-46	2N2605
TO-92	2N5086 (EBC), 2N4058 (ECB)
TO-106	2N4250

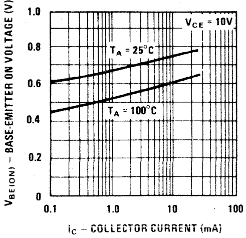
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	V_{CE} = 5V, I_C = 10 μA, R_S = 10 kΩ, P_{BW} = 15.70 kHz		1.20	3	dB	
h_{fe}	V_{CE} = 5V, I_C = 500 μA, f = 20 MHz	5	6			
C_{eb}	V_{EB} = 0.5V		6	7	pF	
C_{cb}	V_{CB} = 5V		3	5	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 5V	50	200	400		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	50	250	500		
h_{FE}	I_C = 500 μA, V_{CE} = 5V	50	260	500		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	50	270	500		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	270	500		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.1mA		0.05	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.11	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.1 mA		0.60	0.70	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.90	V	
BV_{CEO}	I_C = 1 mA	60	80		V	
BV_{CBO}	I_C = 100 μA	80	90		V	
BV_{EBO}	I_E = 10 μA	6	7.50		V	
I_{CBO}	V_{CB} = 45V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 62

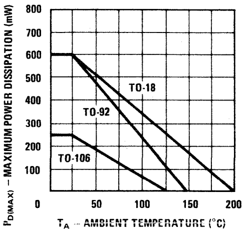
DC Pulse Current Gain
vs Collector Current



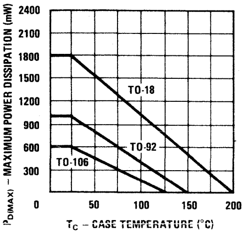
Base-Emitter On Voltage
vs Collector Current



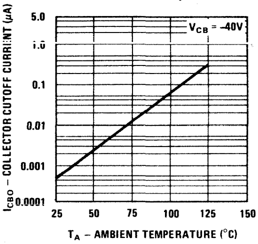
Maximum Power
Dissipation vs
Ambient Temperature



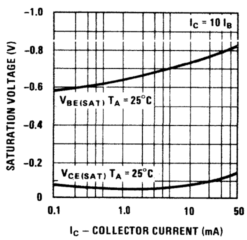
Maximum Power
Dissipation vs
Case Temperature



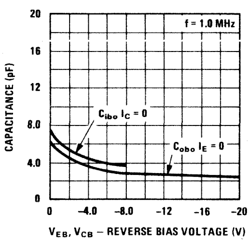
Collector Cutoff Current
vs Ambient Temperature



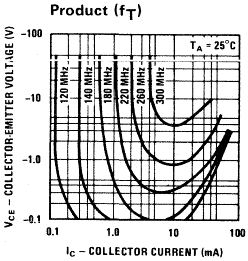
Collector and Base
Saturation Voltage vs
Collector Current



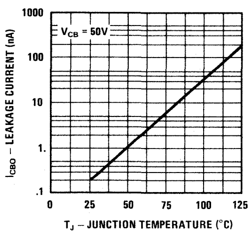
Input and Output
Capacitances vs Reverse
Bias Voltage



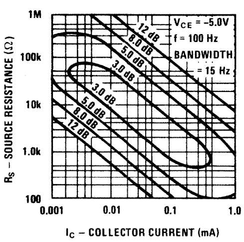
Contours of Constant
Gain Bandwidth
Product (f_T)



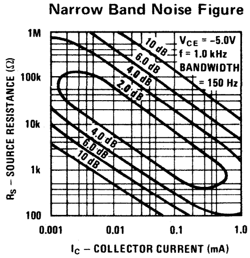
Collector-Base Diode
Current vs Temperature



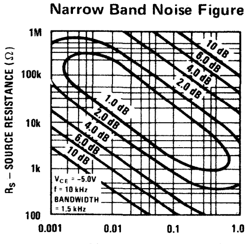
Contours of Constant
Narrow Band Noise Figure



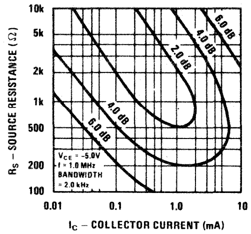
Contours of Constant
Narrow Band Noise Figure



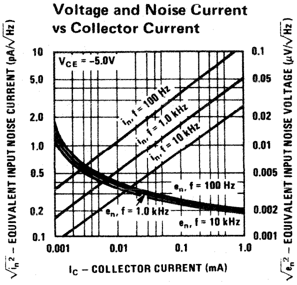
Contours of Constant
Narrow Band Noise Figure



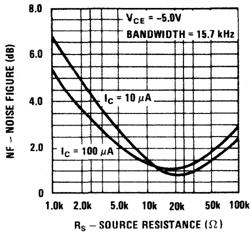
Contours of Constant Narrow Band Noise Figure



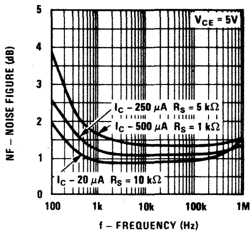
Equivalent Input Noise Voltage and Noise Current vs Collector Current



Wide Band Noise Figure vs Source Resistance



Noise Figure vs Frequency

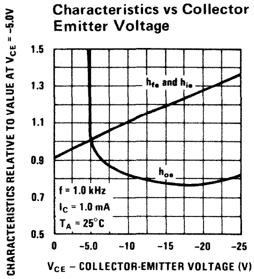


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

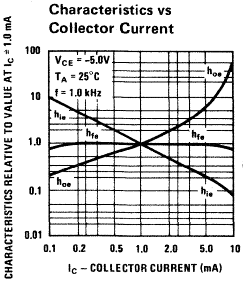
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	2.5	8.0	20	kΩ	I_C = 1.0 mA V_{CE} = –5.0V
h_{oe}	Output Conductance	5.0	19	50	µmho	I_C = 1.0 mA V_{CE} = –5.0V
h_{re}	Voltage Feedback Ratio			10	$\times 10^{-4}$	I_C = 1.0 mA V_{CE} = –5.0V
h_{fe}	Small Signal Current Gain	100	250	800		I_C = 1.0 mA V_{CE} = –5.0V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

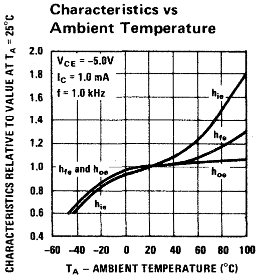
Common Emitter Characteristics vs Collector Emitter Voltage



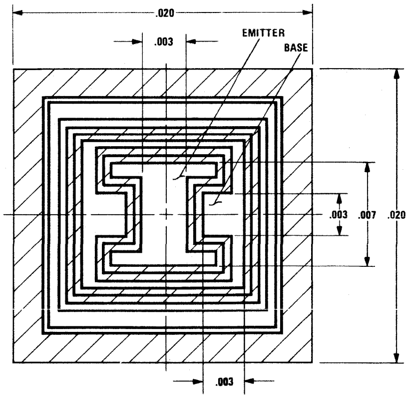
Common Emitter Characteristics vs Collector Current



Common Emitter Characteristics vs Ambient Temperature



Process 63 PNP Medium Power



DESCRIPTION

Process 63 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 20.

APPLICATION

This device was designed for use as general purpose amplifiers and switches requiring collector currents to 500 mA.

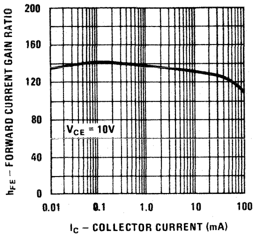
PRINCIPAL DEVICE TYPES:

TO-5	2N2905A
TO-18	2N2907A
TO-92	2N4403 (EBC), 2N3702 (ECB)
TO-105	2N3645
TO-106	2N4143

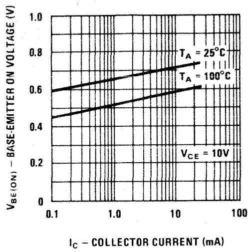
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		30	45	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		220	200	ns	Fig. 2
C_{cb}	V_{CB} = 10V		6	8	pF	TO-18
C_{eb}	V_{EB} = 0.50V		15	18	pF	TO-18
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2	3.00			
NF (spot)	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz		1.5	3	dB	
h_{FE}	I_C = 1 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 100 mA, V_{CE} = 10V	50	95	400		
h_{FE}	I_C = 150 mA, V_{CE} = 10V	50	80	400		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	40	50	200		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.25	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.40	1.00	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		1.00	1.3	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.2	2.0	V	
BV_{CEO}	I_C = 10 mA	40	70		V	
BV_{CBO}	I_C = 100 μA	60	70		V	
BV_{EBO}	I_E = 10 μA	5	7		V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 63

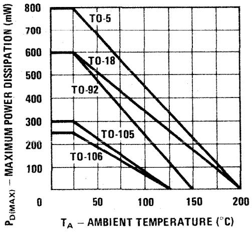
DC Pulse Current Gain vs Collector Current



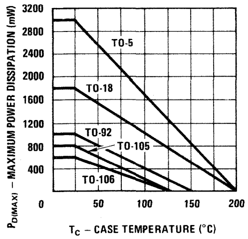
Base-Emitter On Voltage vs Collector Current



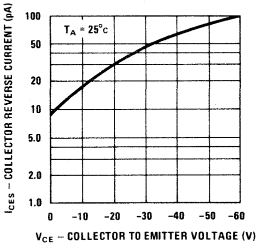
Maximum Power Dissipation vs Ambient Temperature



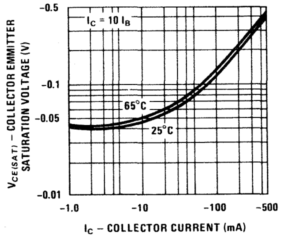
Maximum Power Dissipation vs Case Temperature



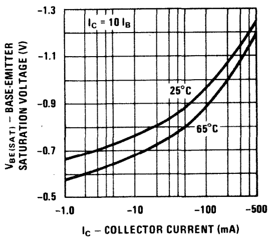
Collector Reverse Current vs Reverse Bias Voltage



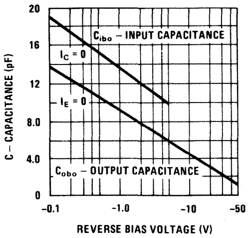
Pulsed Collector Saturation Voltage vs Collector Current



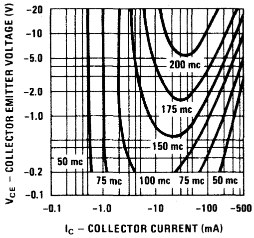
Pulsed Base Saturation Voltage vs Collector Current



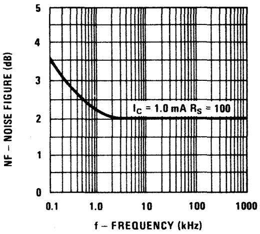
Input and Output Capacitances vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

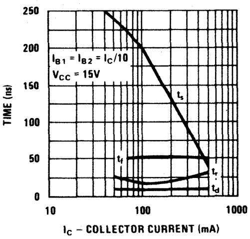


Noise Figure vs Frequency

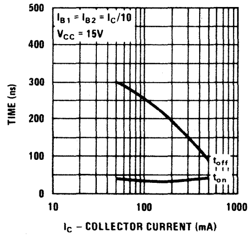


Process 63

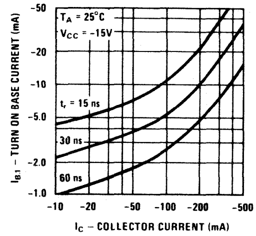
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



Rise Time vs Collector and Turn On Base Currents



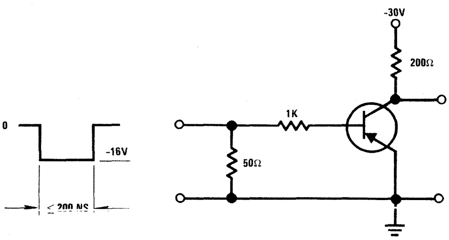


FIGURE 1. Saturated Turn-On Switching Time Test Circuit

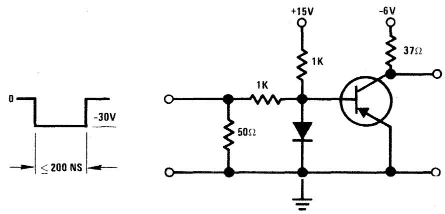
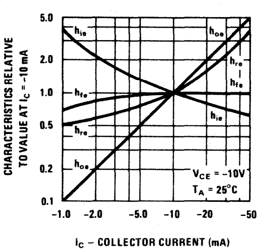


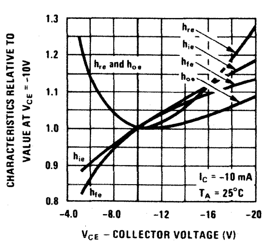
FIGURE 2. Saturated Turn-Off Switching Time Test Circuit

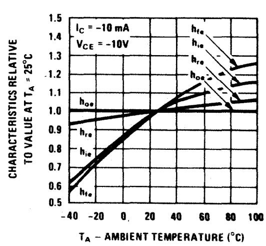
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance		480	2000	ohms	I_C = 10 mA	V_{CE} = −10V
h_{oe}	Output Conductance		80	1200	μmhos	I_C = 10 mA	V_{CE} = −10V
h_{re}	Voltage Feedback Ratio		162	1500	$x10^{-6}$	I_C = 10 mA	V_{CE} = −10V
h_{fe}	Small Signal Current Gain	100				I_C = 10 mA	V_{CE} = −10V

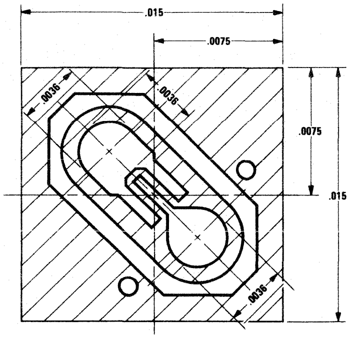
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 64 PNP High Speed Switch



DESCRIPTION

Process 64 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 22.

APPLICATION

This device was designed for high speed saturated switching applications at collector currents to 200 mA.

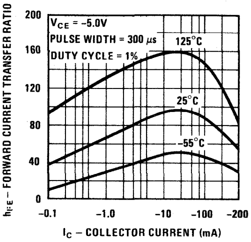
PRINCIPAL DEVICE TYPES:

TO-52 2N2894A
TO-106 2N4313

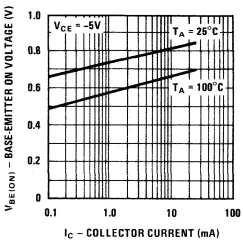
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA		10	20	ns	Fig. 1
t_{off}	I_C = 30 mA, I_{B2} = 3 mA		15	25	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CE} = 5V		3.0	4.5	pF	TO-18
C_{ib}	V_{EB} = 0.5V		5.0	6.0	pF	TO-18
h_{fe}	f = 100 MHz, I_C = 30 mA, V_{CE} = 10V	8	12			
h_{FE}	I_C = 1 mA	20	65			
h_{FE}	I_C = 10 mA	30	95			
h_{FE}	I_C = 30 mA	40	95			
h_{FE}	I_C = 100 mA	30	85			
$V_{CE(SAT)}$	I_C = 10 mA		0.07	0.13	V	
$V_{CE(SAT)}$	I_C = 30 mA		0.11	0.19	V	
$V_{CE(SAT)}$	I_C = 100 mA		0.28	0.45	V	
$V_{BE(SAT)}$	I_C = 10 mA		0.80	0.92	V	
$V_{BE(SAT)}$	I_C = 30 mA		0.90	1.15	V	
$V_{BE(SAT)}$	I_C = 100 mA		1.10	1.50	V	
BV_{CEO}	I_C = 10 mA	12			V	
BV_{CBO}	I_C = 100 μA	12			V	
BV_{EBO}	I_E = 10 μA	4.50			V	
I_{CES}	V_{CE} = 10V			50	nA	

Process 64

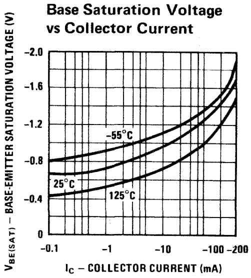
Pulsed DC Current Gain vs Collector Current



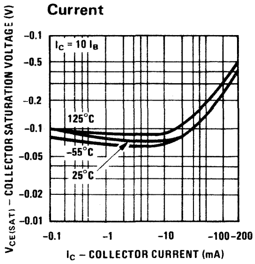
Base-Emitter On Voltage vs Collector Current



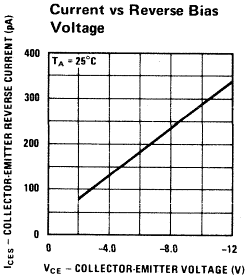
Base Saturation Voltage vs Collector Current



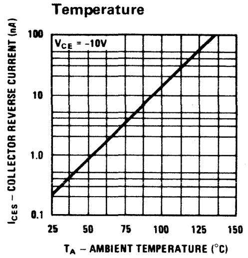
Collector Saturation Voltage vs Collector Current



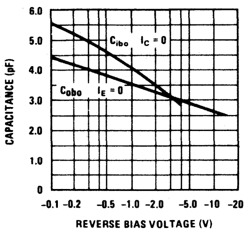
Collector-Base Reverse Current vs Reverse Bias Voltage



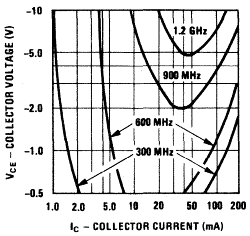
Collector-Base Diode Reverse Current vs Temperature



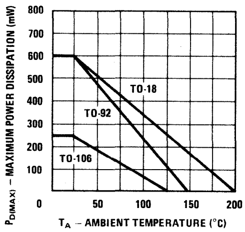
Input and Output Capacitance vs Reverse Bias Voltage



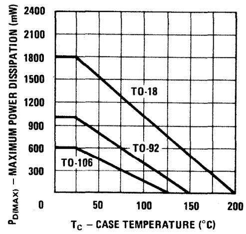
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature

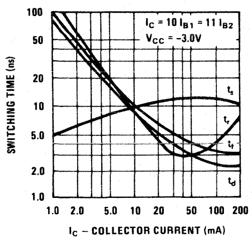


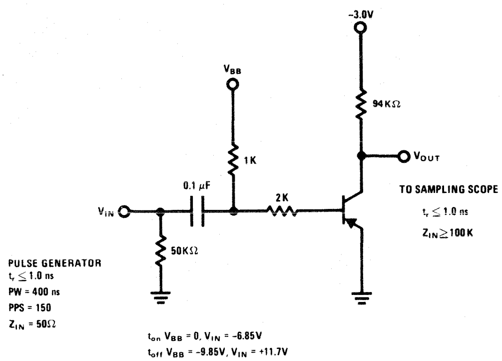
Maximum Power Dissipation vs Case Temperature



Process 64

Switching Times vs Collector Current





Switching Times vs Temperature

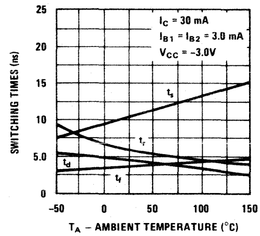
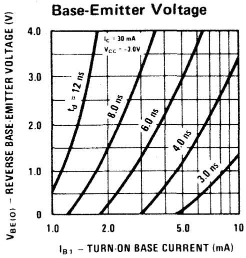
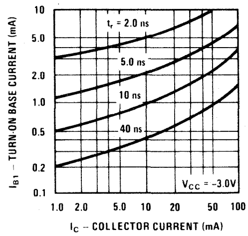


FIGURE 1. Switching Time Test Circuit

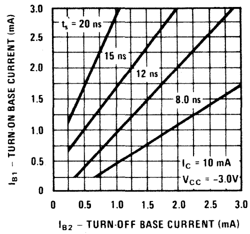
Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage



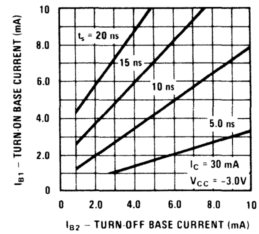
Rise Time vs Collector and Turn On Base Currents



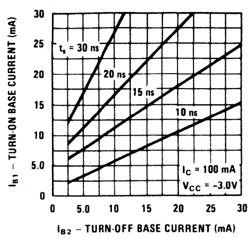
Storage Time vs Turn On and Turn Off Base Currents



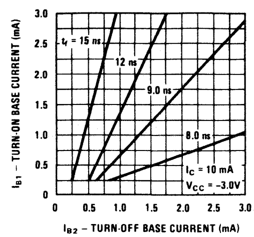
Storage Time vs Turn On and Turn Off Base Currents



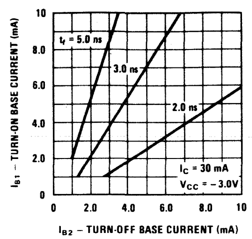
Storage Time vs Turn On and Turn Off Base Currents



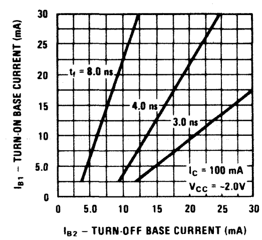
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



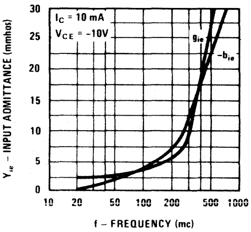
Fall Times vs Turn On and Turn Off Base Currents



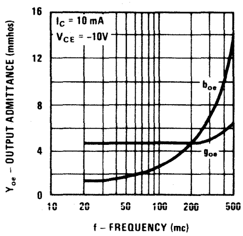
Process 64

COMMON EMITTER VS FREQUENCY Y PARAMETERS

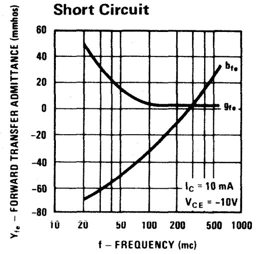
Input Admittance vs Frequency-Output Short Circuit



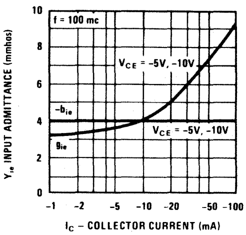
Output Admittance vs Frequency-Input Short Circuit



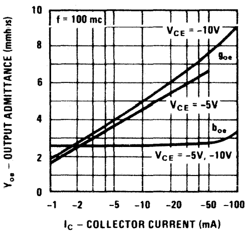
Forward Transfer Admittance vs Frequency-Output Short Circuit



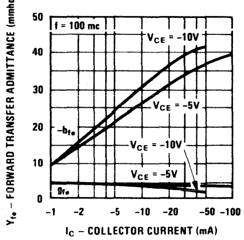
Input Admittance vs Collector Current and Voltage-Output Short Circuit



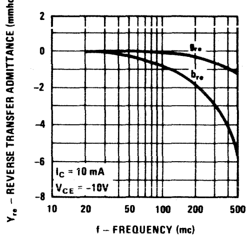
Output Admittance vs Collector Current and Voltage-Input Short Circuit



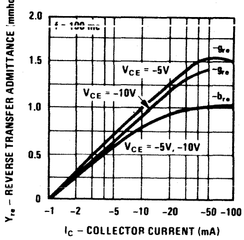
Forward Transfer Admittance vs Collector Current and Voltage-Output Short Circuit



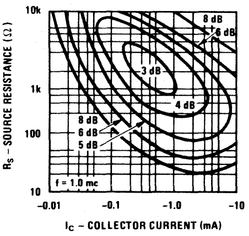
Reverse Transfer Admittance vs Frequency-Input Short Circuit



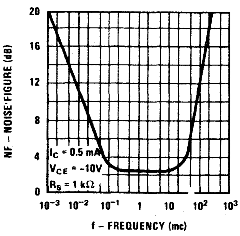
Reverse Transfer Admittance vs Collector Current and Voltage-Input Short Circuit



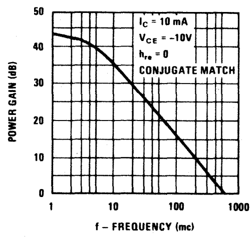
Noise Figure vs Source Resistance and Collector Current



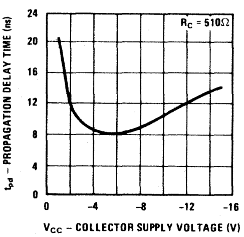
Noise Figure vs Frequency



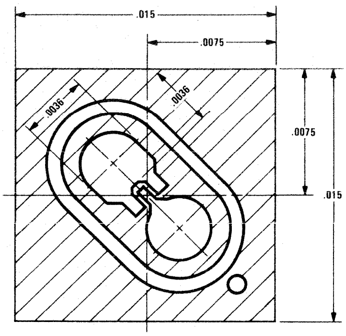
M.A.G. vs Frequency



Propagation Delay Time vs Collector Supply Voltage



Process 65 PNP High Speed Switch



DESCRIPTION

Process 65 is an overlay double diffused, gold doped, silicon epitaxial device.

APPLICATION

This device was designed for very high speed saturate switching at collector currents to 50 mA.

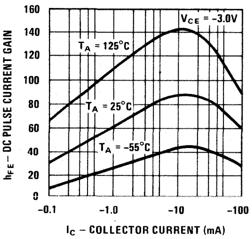
PRINCIPAL DEVICE TYPES:

TO-18	2N4208
TO-92	MPS3640
TO-106	2N4258

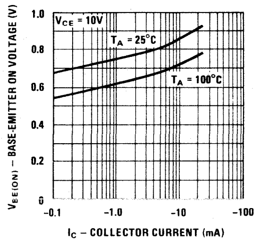
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		15	20	ns	Fig. 1
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		11	15	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CB} = 5V		2	3	pF	TO-18
C_{ib}	V_{EB} = .5V		2.5	3.5	pF	
h_{fe}	V_{CE} = 10V, I_C = 10 mA, f = 100 MHz	6.5	13			
h_{FE}	I_C = 1 mA, V_{CE} = 3V	20	60			
h_{FE}	I_C = 10 mA, V_{CE} = 3V	20	85			
h_{FE}	I_C = 50 mA, V_{CE} = 3V	20	75			
h_{FE}	I_C = 100 mA, V_{CE} = 3V	20	60			
h_{FE}	I_C = 1 mA, V_{CE} = .5V	20	60			
h_{FE}	I_C = 10 mA, V_{CE} = .3V	20	67	150		
h_{FE}	I_C = 50 mA, V_{CE} = 1.0V	20	60			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.07	0.13	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.15	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.25	0.50	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.73	0.8	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.88	0.95	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		1.15	1.5	V	
BV_{CEO}	I_C = 3 mA	6	13		V	
BV_{CBO}	I_C = 100 μA	6	13		V	
BV_{EBO}	I_C = 10 μA	4.5			V	
I_{CBO}	V_{CB} = 3V			50	nA	

Process 65

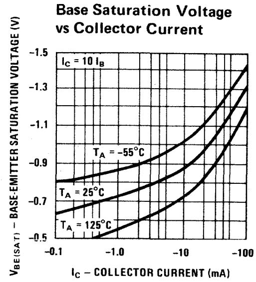
DC Pulse Current Gain vs Collector Current



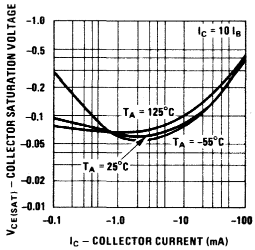
Base-Emitter On Voltage vs Collector Current



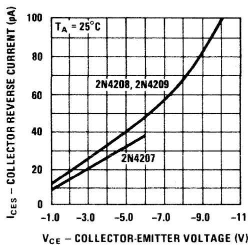
Base Saturation Voltage vs Collector Current



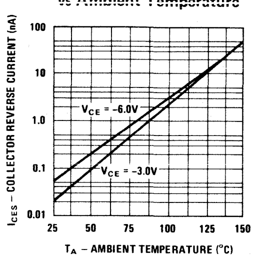
Collector Saturation Voltage vs Collector Current



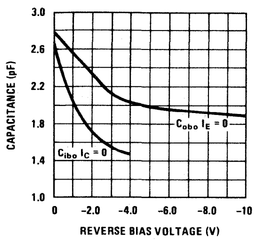
Collector Reverse Current vs Collector-Emitter Voltage



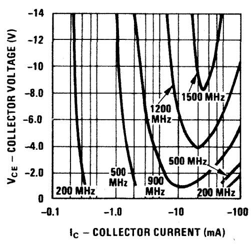
Collector Reverse Current vs Ambient Temperature



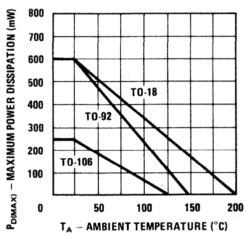
Input and Output Capacitance vs Reverse Bias Voltage



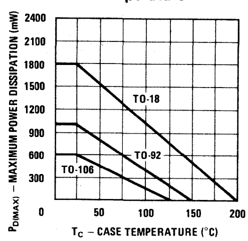
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature

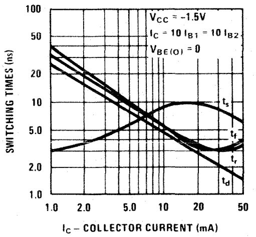


Maximum Power Dissipation vs Case Temperature

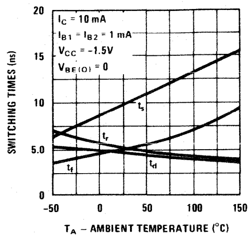


Process 65

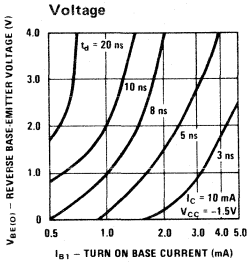
Switching Times vs Collector Current



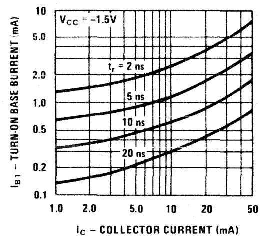
Switching Times vs Ambient Temperature



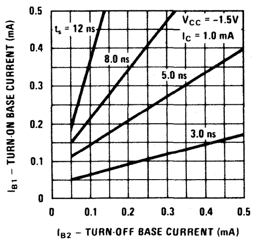
Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage



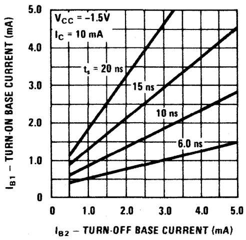
Rise Time vs Collector and Turn On Base Currents



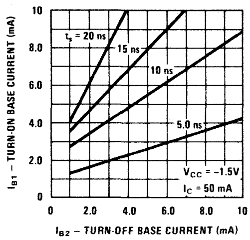
Storage Time vs Turn On and Turn Off Base Currents



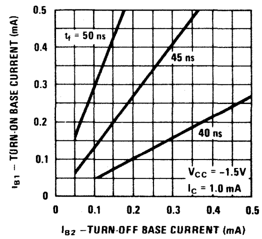
Storage Time vs Turn On and Turn Off Base Currents



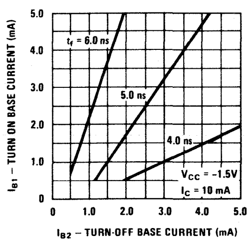
Storage Time vs Turn On and Turn Off Base Currents



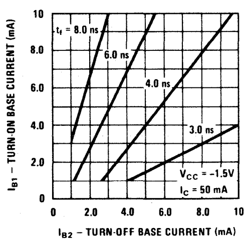
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



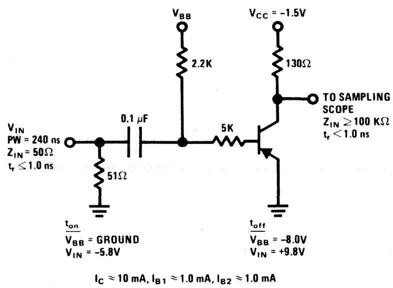
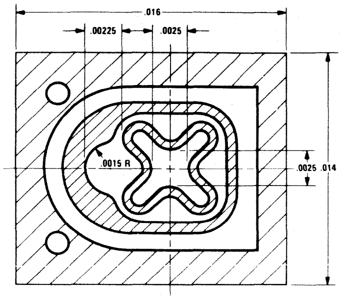


FIGURE 1. t_{on} and t_{off} Test Circuit

Process 66 PNP Small Signal



DESCRIPTION

Process 66 is a nonoverlay double diffused, gold doped, silicon epitaxial device.

APPLICATION

This device was designed for general purpose amplifier and switching applications at collector currents of 10 μA to 100 mA.

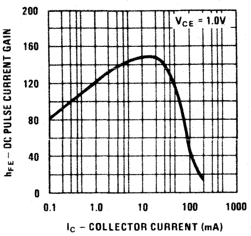
PRINCIPAL DEVICE TYPES:

TO-18	NS3906
TO-92	2N3906
TO-106	SM3906

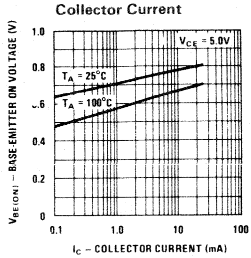
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		125	300	ns	
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	
C_{ob}	V_{CB} = 5V		3.0	4.5	pF	TO-92
C_{ib}	V_{EB} = 0.5V		6.0	10.0	pF	TO-92
h_{fe}	f = 100 MHz, V_{CE} = 20V, I_C = 10 mA	2.5	6.0			
NF (wide band)	I_C = 100 μA, V_{CE} = 5V, R_S = 1 kΩ		2.0	4.0	dB	
h_{FE}	I_C = 0.1 mA, V_{CE} = 1V	40	80			
h_{FE}	I_C = 1 mA, V_{CE} = 1V	40	120			
h_{FE}	I_C = 10 mA, V_{CE} = 1V	40	150	500		
h_{FE}	I_C = 50 mA, V_{CE} = 1V	40	110			
h_{FE}	I_C = 100 mA, V_{CE} = 1V	20	40			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.05	0.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.12	0.40	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.75	0.85	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.85	0.95	V	
BV_{CEO}	I_C = 1 mA	40	50		V	
BV_{CBO}	I_C = 100 μA	40	60		V	
BV_{EBO}	I_C = 10 μA	5.0			V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 66

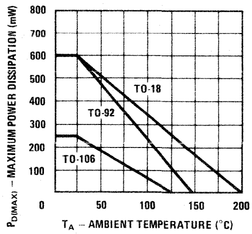
DC Pulse Current Gain vs Collector Current



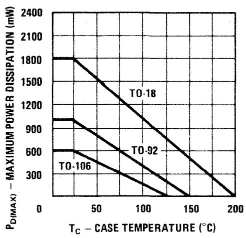
Base-Emitter On Voltage vs Collector Current



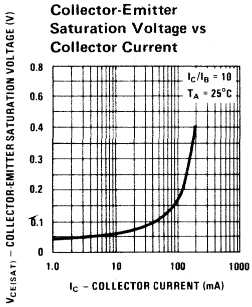
Maximum Power Dissipation vs Ambient Temperature



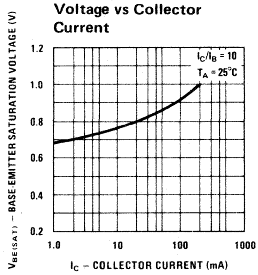
Maximum Power Dissipation vs Case Temperature



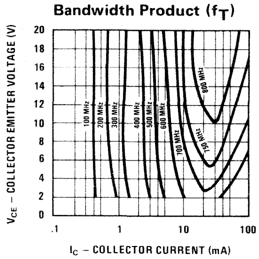
Collector-Emitter Saturation Voltage vs Collector Current



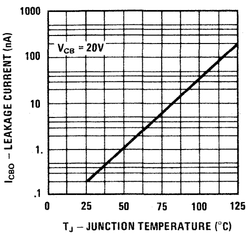
Base-Emitter Saturation Voltage vs Collector Current



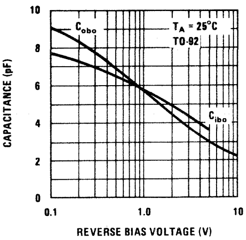
Contours of Constant Gain Bandwidth Product (f_T)



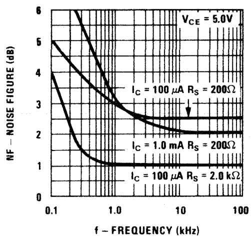
Collector-Base Diode Reverse Current vs Temperature



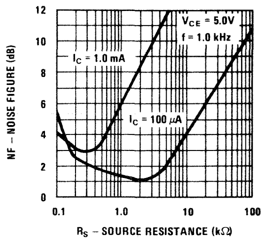
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



Noise Figure vs Frequency

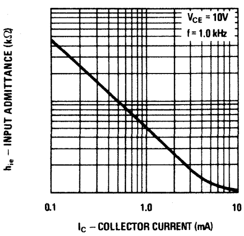


Noise Figure vs Source Resistance

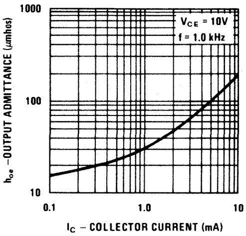


Process 66

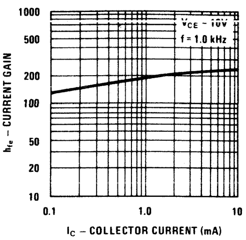
Input Admittance



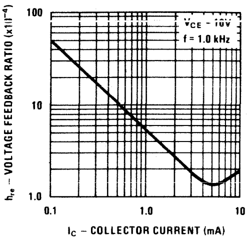
Output Admittance



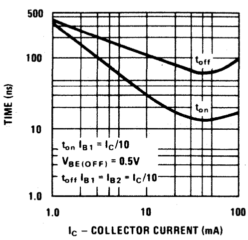
Current Gain



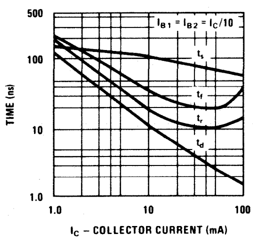
Voltage Feedback Ratio



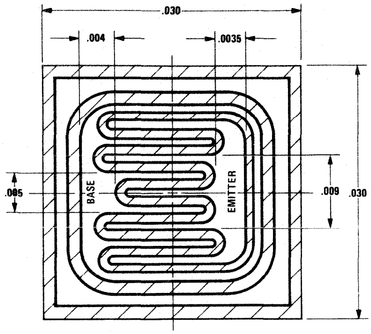
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



Process 67 PNP Medium Power



DESCRIPTION

Process 67 is a nonoverlay double diffused silicon device. Complement to Process 12.

APPLICATION

This device is designed for general purpose amplifier and switching applications at currents to one amp.

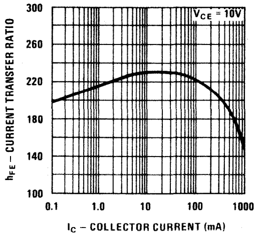
PRINCIPAL DEVICE TYPES:

TO-39	2N4033
TO-92	MPS4356
TO-106	2N4356

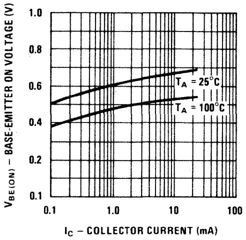
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA	20	25	60	ns	
t_{off}	I_C = 500 mA, I_{B2} = 50 mA	200	250	400	ns	
C_{ob}	V_{CB} = 10V		14	18	pF	TO-39
C_{ib}	V_{EB} = 0.50V		80	100	pF	TO-39
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	1.5	2			
NF (spot)	I_C = 100 μA, R_S = 1k, V_{CE} = 10V, f = 1 kHz		0.5	4	dB	
h_{FE}	I_C = 0.10 mA	50	200			
h_{FE}	I_C = 1.0 mA	50	220			
h_{FE}	I_C = 10 mA	50	230	350		
h_{FE}	I_C = 100 mA	50	220			
h_{FE}	I_C = 500 mA	50	170			
h_{FE}	I_C = 1A	25	150			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.25	0.4	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.8	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.2	V	
BV_{CEO}	I_C = 10 mA	60	80		V	
BV_{CBO}	I_C = 100 μA	80	120		V	
BV_{EBO}	I_E = 10 μA	5.0	7.00		V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 67

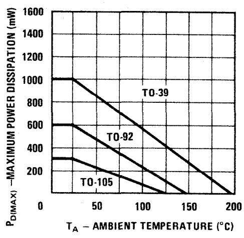
DC Pulse Current Gain vs Collector Current



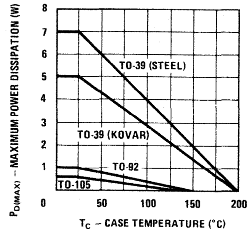
Base-Emitter On Voltage vs Collector Current



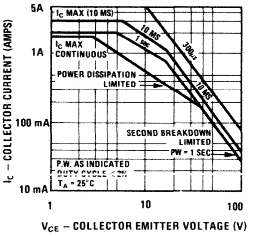
Maximum Power Dissipation vs Ambient Temperature



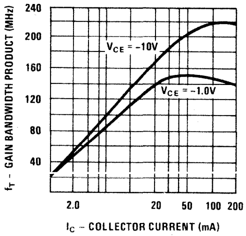
Maximum Power Dissipation vs Case Temperature



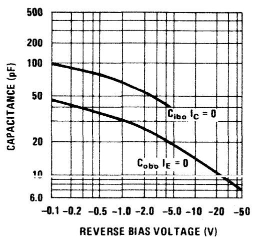
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



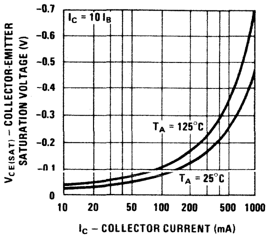
Gain Bandwidth Product vs Collector Current



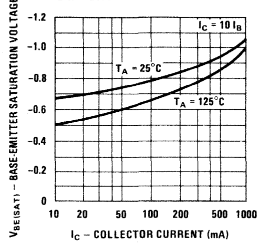
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



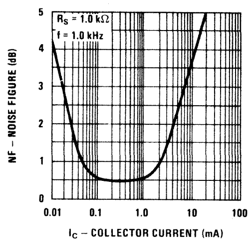
Collector-Emitter Saturation Voltage vs Collector Current



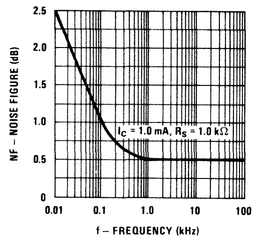
Base-Emittter Saturation Voltage vs Collector Current



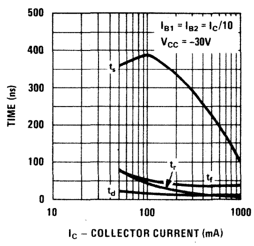
Noise Figure vs Collector Current



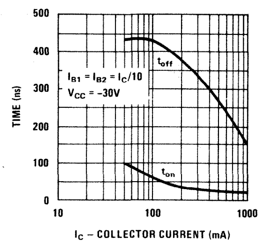
Noise Figure vs Frequency



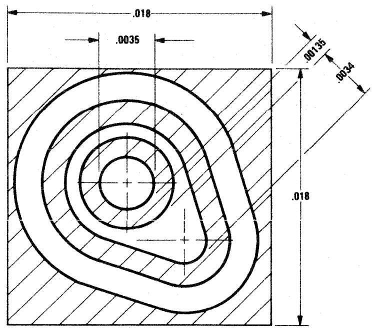
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



Process 69 PNP Small Signal



DESCRIPTION

Process 69 is a nonoverlay double diffused, silicon epitaxial device. Complements Process 27.

APPLICATION

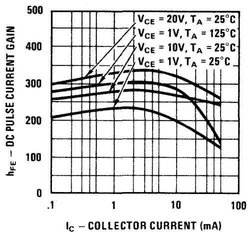
This device was designed for general purpose amplifier and switching applications to collector currents of 100 mA.

PRINCIPAL DEVICE TYPES:

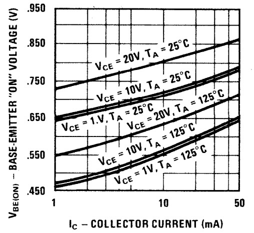
TO-18 2N3251A

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
T_{ON}	I_C = 10 mA, I_B = 1 mA		50	70	nS	
T_{OFF}	I_C = 10 mA, I_B = 1 mA		125	225	nS	
NF	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1 kΩ		1.7	4.5	dB	
C_{OB}	V_{CE} = 5V		4	5.0	pF	
C_{IB}	V_{EB} = 1V		6.5	8.0	pF	
f_T	V_{CE} = 20V, I_C = 10 mA	250	450		MHz	
H_{FE}	1V, 100 μA	40	150	300		
H_{FE}	1V, 1 mA	45	160	325		
H_{FE}	V_{CE} = 1V, I_C = 10 mA	50	150	350		
H_{FE}	V_{CE} = 1V, I_C = 50 mA	15	65	110		
H_{FE}	V_{CG} = 1V, I_C = 100 mA		18	35		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		.15	.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		.25	.50	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		.74	.90	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		.85	1.20	V	
I_{CBO}	V_{CB} = 30V		1.5	50	nA	
I_{EBO}	V_{EB} = 4V		.05	50	nA	
BV_{CBO}	I_C = 10 μA	50	90			
BV_{EBO}	I_C = 10 μA	5.0	7.0			
BV_{CEO}	I_C = 1 mA	40	70			
BV_{CES}	I_C = 10 μA		90			

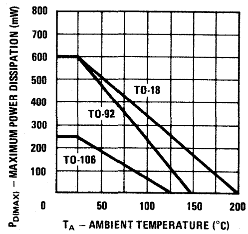
DC Pulse Current Gain vs Collector Current



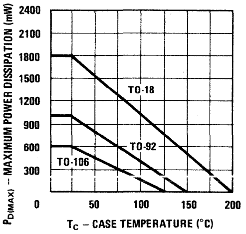
Base-Emitter On Voltage vs Collector Current



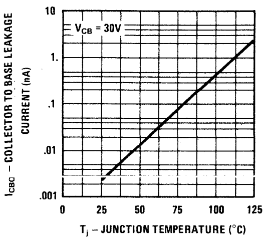
Maximum Power Dissipation vs Ambient Temperature



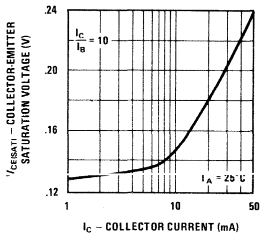
Maximum Power Dissipation vs Case Temperature



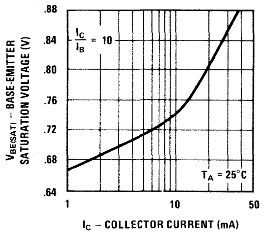
Collector-Base Diode Reverse Current vs Temperature



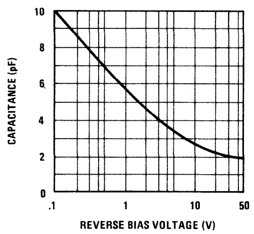
Collector-Emitter Saturation Voltage vs Collector Current



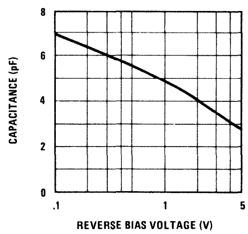
Base-Emitter On Voltage vs Collector Current



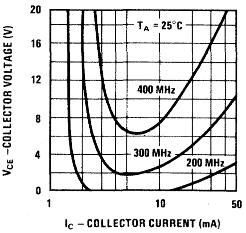
Output Capacitance vs Reverse Bias Voltage



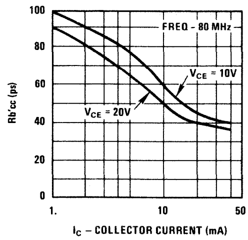
Input Capacitance vs Reverse Bias Voltage



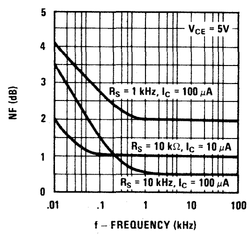
Contours of Constant Gain Bandwidth Product (f_T)



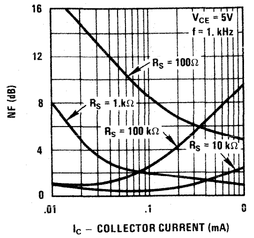
Rb'cc vs Collector Current



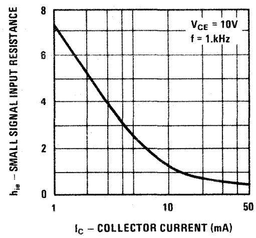
Noise Figure vs Frequency



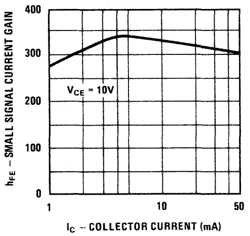
Noise Figure vs Collector Current



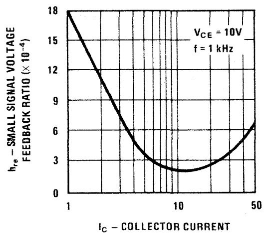
Small Signal Input Resistance vs Collector Current



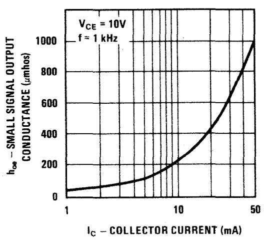
Small Signal Current Gain vs Collector Current



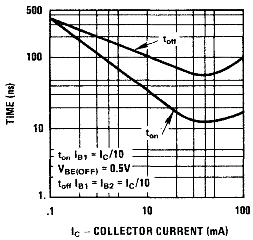
Small Signal Voltage Feedback Ratio vs Collector Current



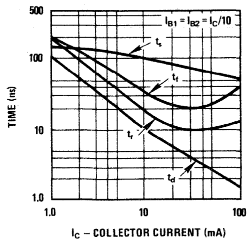
Small Signal Output Conductance vs Collector Current



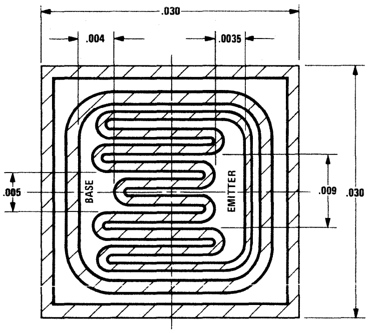
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



Process 70 PNP Core Driver



DESCRIPTION

Process 70 is a nonoverlay double diffused, gold doped, silicon epitaxial device compliment to process 25.

APPLICATION

This device was designed primarily for high speed saturated switching applications.

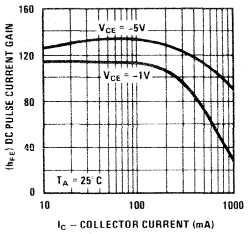
PRINCIPAL DEVICE TYPES:

TO-39 (pkg. 17) 2N3467

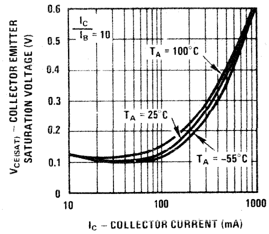
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{ON}	I_C = 500 mA, I_{B1} = 50 mA		20	40	ns	Fig. 1
t_{OFF}	I_C = 500 mA, I_{B2} = 50 mA		64	90	ns	Fig. 2
h_{fe}	I_C = 50 mA, V_{CE} = –10V, f = 100 MHz	1.75	2.9			
C_{ob}	V_{CB} = –10V		14	25	pF	
C_{ib}	V_{eb} = –0.5V		72	100	pF	
h_{FE}	I_C = 150 mA, V_{CE} = –1V	40	120			
h_{FE}	I_C = 500 mA, V_{CE} = –1V	40	75	120		
h_{FE}	I_C = 1 Amp, V_{CE} = –5V	40	85			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.165	0.3	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.30	0.5	V	
$V_{CE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		0.50	1.0	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.80	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	0.8	0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		1.1	1.6	V	
BV_{CEO}	I_C = 10 mA	40	66		V	
BV_{CBO}	I_C = 10 μA	40	98		V	
BV_{EBO}	I_E = 10 μA	5	8.0		V	
I_{CBO}	V_{CB} = 30V		10	100	nA	
I_{CEX}	V_{CE} = –30V, $V_{BE(OFF)}$ = –3V		10	100	nA	
I_{bL}	V_{CE} = –30V, $V_{BE(OFF)}$ = –3V		10	120	nA	

Process 70

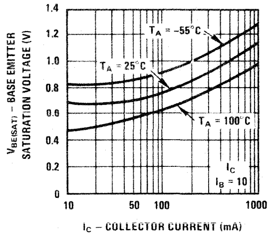
DC Pulse Current Gain vs Collector Current



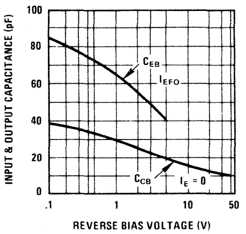
Collector-Emitter Saturation Voltage vs Collector Current



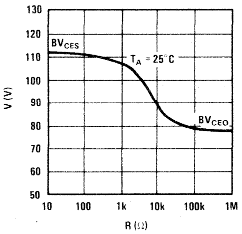
Base-Emitter Saturation Voltage vs Collector Current



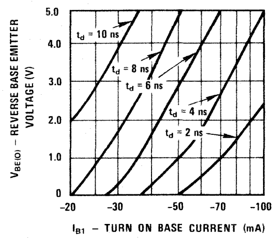
Input & Output Capacitance vs Reverse Bias Voltage



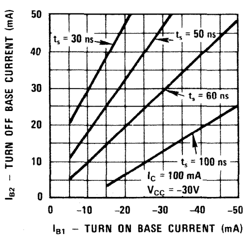
BV_{CER} vs R_{BE}
I_C = 10 mA



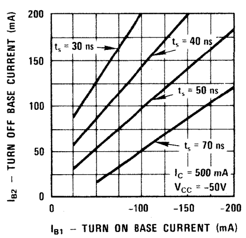
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



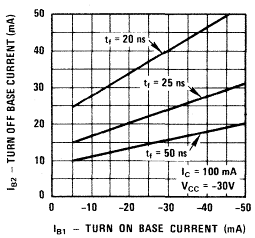
Storage Time vs Turn On and Turn Off Base Currents



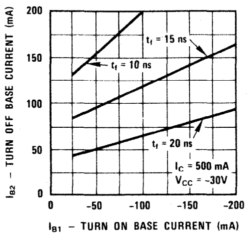
Storage Time vs Turn On and Turn Off Base Currents



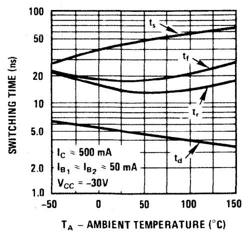
Fall Time vs Turn On and Turn Off Base Currents



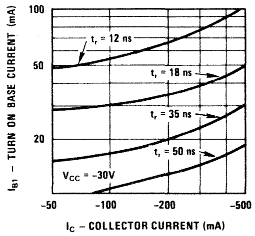
Fall Time vs Turn On and Turn Off Base Currents



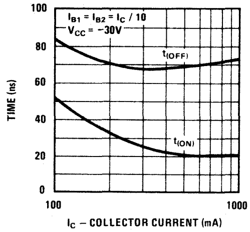
Switching Times vs Ambient Temperature



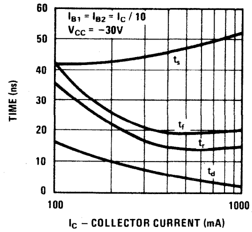
Rise Time vs Collector Current and Turn On Base Current



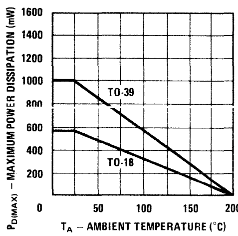
Turn On and Turn Off Times vs Collector Current



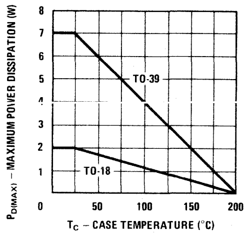
Switching Times vs Collector Current



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



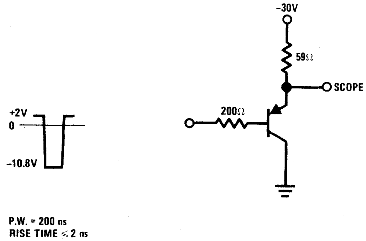


FIGURE 1. t_{on} **Equivalent Test Circuit**

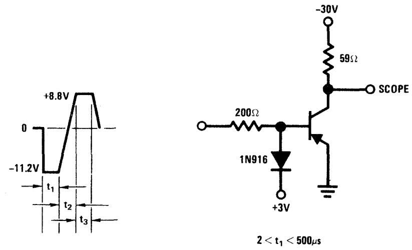
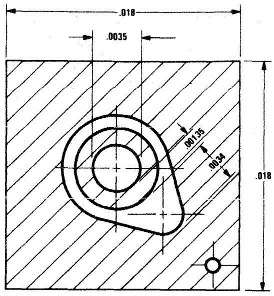


FIGURE 2. t_{off} **Equivalent Test Circuit**

Process 71 PNP Small Signal



DESCRIPTION

Process 71 is a nonoverlay, double diffused, silicon device. Complement to Process 04.

APPLICATION

This device was designed for general purpose amplifier applications at collector currents to 20 mA.

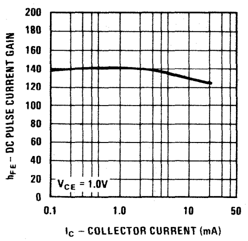
PRINCIPAL DEVICE TYPES:

TO-18	BC177 Series
TO-106	BC251 Series

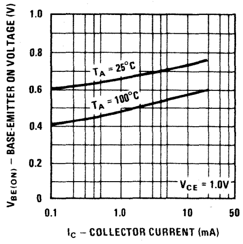
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_C = 5V, R_S = 2k, f = 1 kHz		0.5	2.50	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 5V, f = 100 MHz	3	5			
C_{ob}	V_{CB} = 10V		4	6	pF	TO-18
C_{ib}	V_{EB} = 0.50V		8	12	pF	TO-18
h_{FE}	I_C = 100 μA, V_{CE} = 1V	40	140	400		
h_{FE}	I_C = 1 mA, V_{CE} = 1V	40	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 1V	40	130			
h_{FE}	I_C = 20 mA, V_{CE} = 1V	40	125			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.04	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.11	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.8	0.95	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.9	1.0	V	
BV_{CEO}	I_C = 1 mA	40	50		V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5	6		V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 71

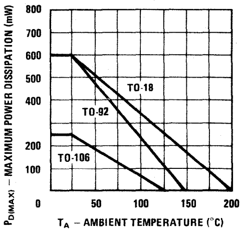
DC Pulse Current Gain vs Collector Current



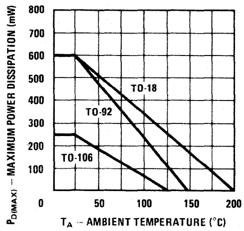
Base-Emitter On Voltage vs Collector Current



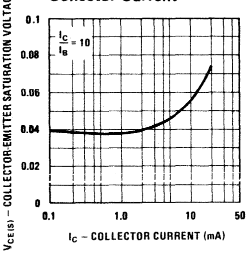
Maximum Power Dissipation vs Ambient Temperature



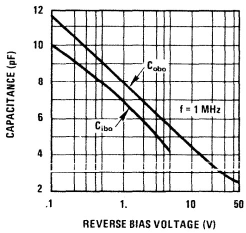
Maximum Power Dissipation vs Case Temperature



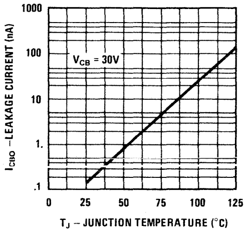
Collector-Emitter Saturation Voltage vs Collector Current



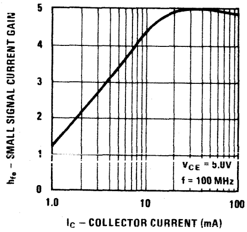
Capacitance vs Reverse Bias Voltage



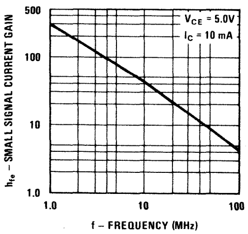
Collector-Base Diode Reverse Current vs Temperature



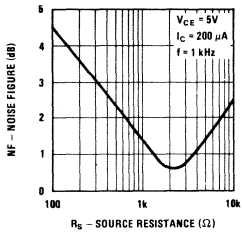
Small Signal Current Gain vs Collector Current



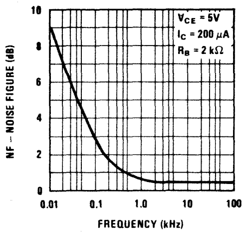
Capacitance vs Reverse Bias Voltage



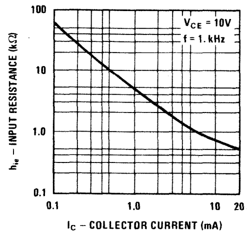
Noise Figure vs Source Resistance



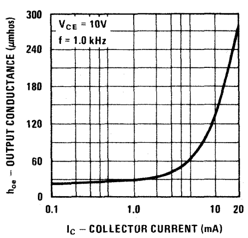
Noise Figure vs Frequency



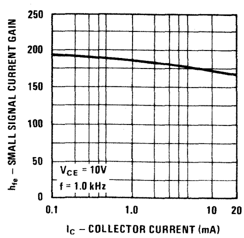
Small Signal Input Resistance vs Collector Current



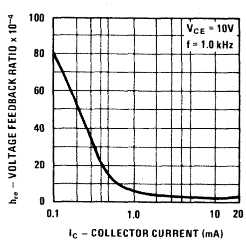
Small Signal Output Conductance vs Collector Current



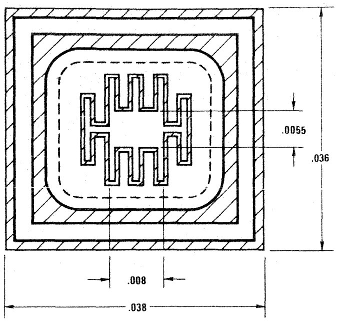
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 73 PNP High Voltage



DESCRIPTION

Process 73 is nonoverlay doubled diffused, silicon epitaxial device. Complement to Process 08.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

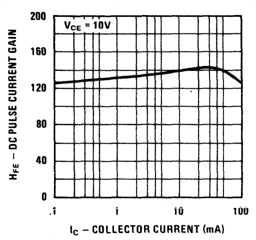
PRINCIPAL DEVICE TYPES:

TO-39 2N3634

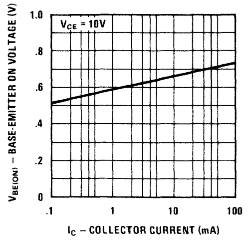
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 10 mA	140	180		V	
BV_{CBO}	I_C at 100 μA	140	240		V	
BV_{EBO}	I_E at 10 μA	5	7		V	
I_{CBO}	V_{CB} at 100V			100	nA	
I_{EBO}	V_{EB} at 3V			50	nA	
H_{FE}	I_C at 0.1 mA, V_{CE} at 10V	40	80			
H_{FE}	I_C at 1 mA, V_{CE} at 10V	45	90			
H_{FE}	I_C at 10 mA, V_{CE} at 10V	50	100			
H_{FE}	I_C at 50 mA, V_{CE} at 10V	25	50			
$V_{CE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.25	0.5	V	
$V_{BE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.65	0.9		
C_{OB}	V_{CB} at 20V		8	10	pF	
C_{IB}	V_{EB} at 1.0V		50	75	pF	
F_T	I_C at 30 mA, V_{CE} at 30V, F at 100 MHz	150	225		MHz	

Process 73

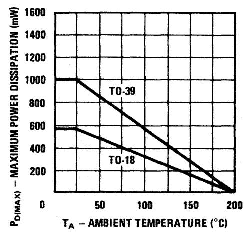
DC Pulse Current Gain vs Collector Current



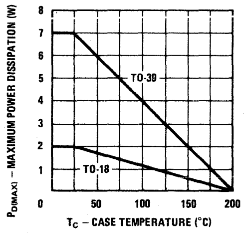
Base-Emitter On Voltage vs Collector Current



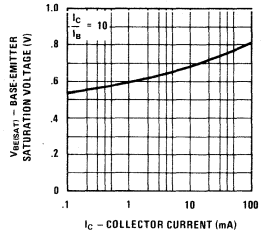
Maximum Power Dissipation vs Ambient Temperature



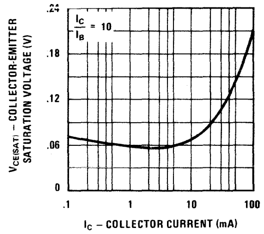
Maximum Power Dissipation vs Case Temperature



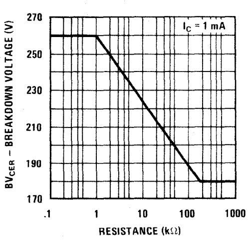
Base-Emitter Saturation Voltage vs Collector Current



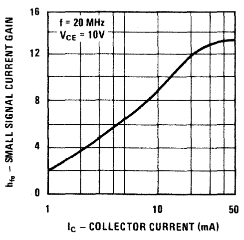
Collector-Emitter Saturation Voltage vs Collector Current



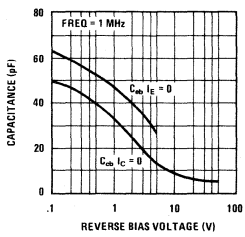
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



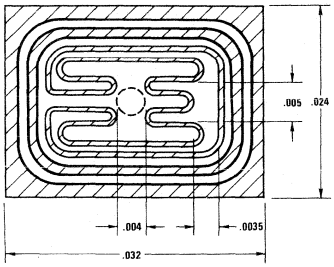
Small Signal Current Gain vs Collector Current



Input and Output Capacitance vs Reverse Bias Voltage



Process 74 PNP High Voltage



DESCRIPTION

Process 74 is nonoverlay doubled diffused, silicon epitaxial device. Complement to Process 15.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages

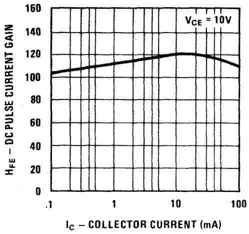
PRINCIPAL DEVICE TYPES:

TO-92 2N5401

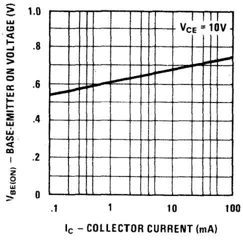
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 1 mA	120	170		V	
BV_{CBO}	I_C at 100 μA	130	220		V	
BV_{EBO}	I_E at 10 μA	5	6.5			
I_{CBO}	V_{CB} at 100V			100	nA	
I_{EBO}	V_{EB} at 3V			50	nA	
H_{FE}	I_C at 1 mA, V_{CE} at 5V	30	60			
H_{FE}	I_C at 10 mA, V_{CE} at 5V	40	100	240		
H_{FE}	I_C at 50 mA, V_{CE} at 5V	40	60			
$V_{CE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.18	0.25		
$V_{BE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.75	1.0		
C_{OB}	V_{CB} at 10V		5	6.0	pF	
F_T	I_C at 10 mA, V_{CE} at 10V, F at 100 MHz	100	200	400	MHz	

Process 74

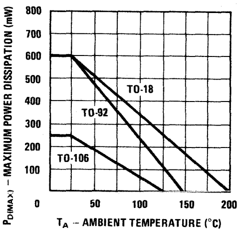
DC Pulse Current Gain vs Collector Current



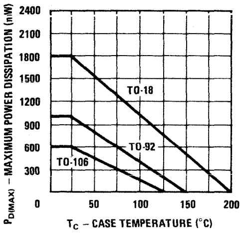
Base-Emitter On Voltage vs Collector Current



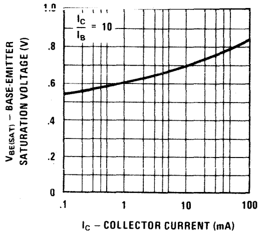
Maximum Power Dissipation vs Ambient Temperature



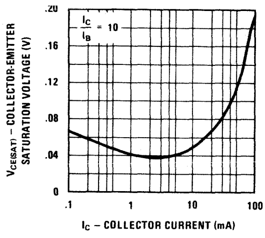
Maximum Power Dissipation vs Case Temperature



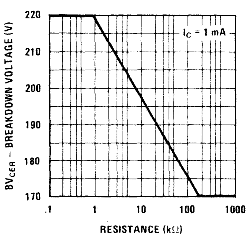
Base-Emitter Saturation Voltage vs Collector Current



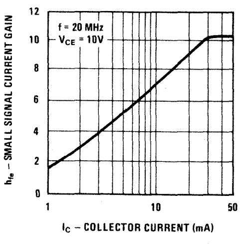
Collector-Emitter Saturation Voltage vs Collector Current



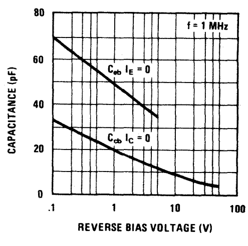
Collector-Emitter Break-down Voltage With Resistance Between Base-Emitter



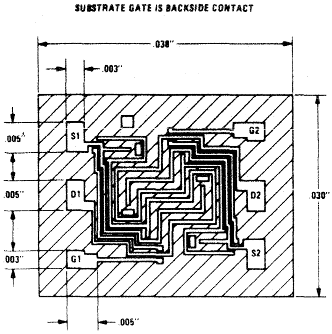
Small Signal Current Gain vs Collector Current

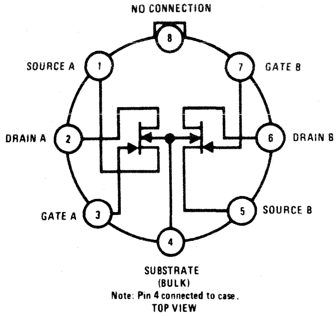


Input and Output Capacitance vs Reverse Bias Voltage



Process 82 N-Channel Junction FET





PACKAGES:

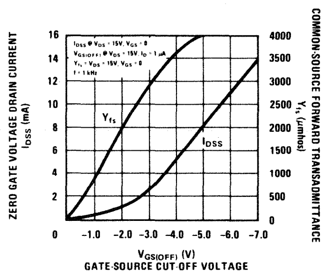
TO-99

PRINCIPAL DEVICE TYPES:

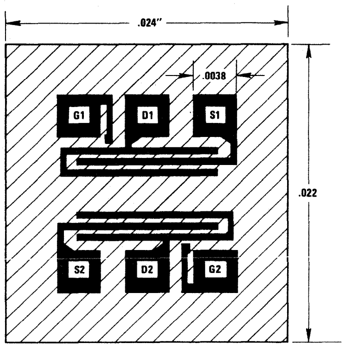
FM1100A SERIES

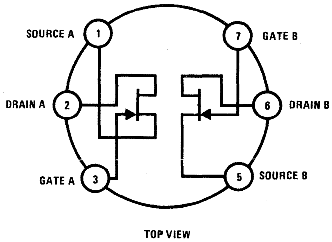
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V, I_G = 1\ \mu A$	20	35		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V, V_{GS} = 0$	0.1	3.0	10	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 15V, V_{GS} = 0$	0.5	3.0	6.0	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15V, I_D = 1\ \mu A$	0.5	3.0	6.0	V
Gate Current	I_G	$V_{DG} = 35V, I_D = 0.10$ mA	0.1	0.4	10	pA
Feedback Capacitance	C_{rss}	$V_{DG} = 15V, I_S = 0$, f = 1 MHz		0.3	0.6	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V, I_D = 2$ mA, f = 1 MHz		3.5	5.0	pF

Process 82 is a monolithic dual JFET. It is strictly intended for operational amplifier input buffer applications. Special processing results in extremely low input bias current and virtually unmeasureable offset current. It is important to note that the sub-pico ampere bias current is measured at 35 volts. Typical CMRR is 115 dB. Performance superior to electrometer tubes can be readily achieved with low offset voltage and almost zero long term drift.



Process 83 N-Channel Junction FET





PACKAGES:

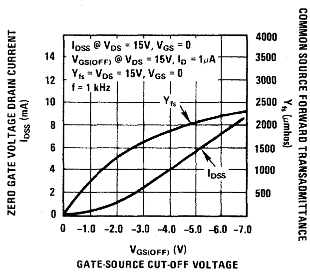
TO-71

PRINCIPAL DEVICE TYPES:

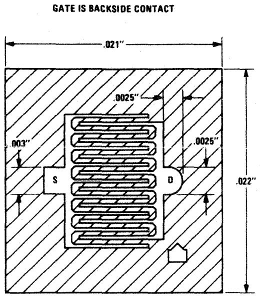
2N5196-99
FM1300 Series
2N3954-58
2N5045-47
2N5545-47
U231-235
2N3921-22
2N4084-85

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V, I_G = 1\ \mu A$	30	70	100	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V, V_{GS} = 0$	0.2	3.0	10	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 15V, V_{GS} = 0$	0.5	1.5	3	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	$V_{DS} = 15V, I_D = 1\ \mu A$	0.5	3.0	8	V
Gate Current	I_G	$V_{DG} = 20V, I_D = 0.10$ mA	1	10	100	pA
Feedback Capacitance	C_{rss}	$V_{DG} = 15V, I_S = 0$, f = 1 MHz				pF
Input Capacitance	C_{iss}	$V_{DS} = 15V, I_D = 2$ mA, f = 1 MHz				pF

Process 83 is a monolithic dual JFET with a diode isolated substrate. It is intended for operational amplifier input buffer applications. Processing results in low input bias current and virtually unmeasureable offset current.



Process 88 P-Channel Junction FET



PACKAGES:

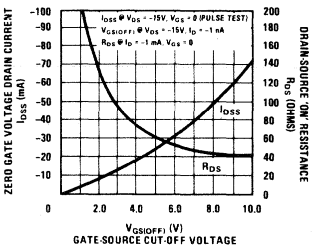
TO-18P, TO-72, TO-106

PRINCIPAL DEVICE TYPES:

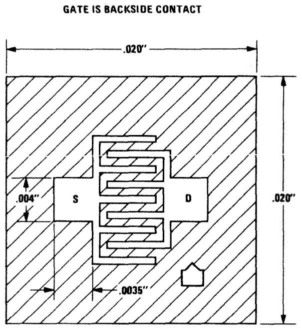
2N3382-86
3N5114-16
P1086E
2N3993-94
2N5018-21

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	30	40	50	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	5.0	30	90	mA
Forward Trans-conductance	Y_{fs}	V_{DS} = 15V, V_{GS} = 0	4.0	12.0	16.0	mmho
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.05	10	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0, V_{GS} = 0	60	100	200	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	0.5	5.0	10	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 15V, V_{GS} = −10V		0.05	10	nA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1MHz	3.0	4.0	5.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 2 mA, f = 1 MHz	12	14	15	pF

Process 88 is designed primarily for electronic switching applications where a P channel device is desirable. Inherent zero offset voltage, low leakage and low $R_{DS(ON)}$ C_{iss} time constant make this device excellent for low level analog switching, sample and hold circuits and chopper stabilized amplifiers. This device is the compliment to process 51.



Process 89 P-Channel Junction FET



PACKAGES:

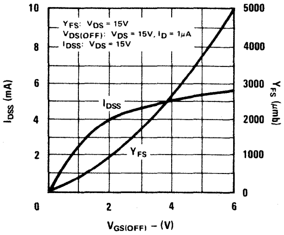
TO-18P, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

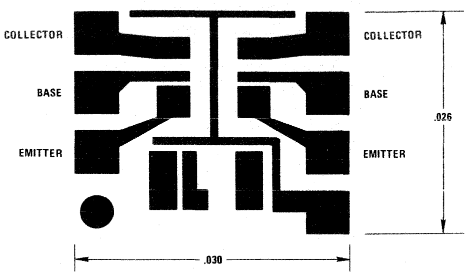
2N2608
2N4381
2N5460-62
2N3329-32

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	30		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.3	3	20	mA
Forward Trans-conductance	Y_{fs}	V_{DS} = 15V, V_{GS} = 0	1	2.5	4	mmho
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.1	10	nA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	0.5	3	9	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1 MHz		2	2.5	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 2 mA, f = 1 MHz		7	8.5	pF

Process 89 is designed primarily for low level amplifier applications. This device is the complement to Process 55.



Process 570 NPN Monolithic Dual



NPN TRANISTOR PAIR

DESCRIPTION

Monolithic junction isolated NPN Transistor Pair.

APPLICATION

This device is designed for applications requiring extremely close matching.

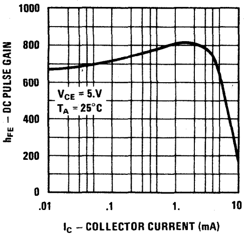
PRINCIPAL DEVICE TYPES:

ND5700
ND5701
ND5702

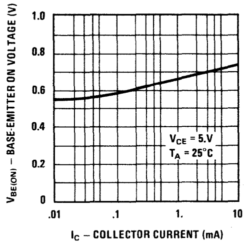
PARAMETER	TEST CONDITIONS	ND5700		ND5701		ND5702		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	
h_{FE1}/h_{FE2}	I_C = 10 μA, V_{CE} = 5.0V		5.0		10		10	%
$\|V_{BE1}-V_{BE2}\|$	I_C = 10 μA to 5.0 mA, V_{CE} = 5.0V		0.5		1.0		2.0	mV
$\|\Delta(V_{BE1}-V_{BE2})\|$	I_C = 10 μA, V_{CE} = 5.0V, T_A = –55°C to +125°C		2.0		5.0		10	μV/°C
C_{ob}	I_E = 0, V_{CB} = 5.0V		3.0		3.0		3.0	pF
C_{ib}	I_C = 0, V_{EB} = 0.5V		3.0		3.0		3.0	pF
h_{fe}	I_C = 1.0 mA, V_{CE} = 5.0V, f = 1 kHz	220	2200	220	2200	220	2200	
h_{FE}	I_C = 10 μA, V_{CE} = 5.0V	200	1500	200	1500	200	1500	
h_{FE}	I_C = 1.0 mA, V_{CE} = 5.0V	200	2000	200	2000	200	2000	
h_{FE}	I_C = 5.0 mA, V_{CE} = 5.0V	200	2000	200	2000	200	2000	
$V_{CE(SAT)}$	I_C = 1.0 mA, I_B = 0.1 mA		.3		.3		.3	V
$V_{CE(SAT)}$	I_C = 5.0 mA, I_B = 0.5 mA		1.1		1.1		1.1	V
$V_{BE(SAT)}$	I_C = 1.0 mA, I_B = 0.1 mA		.8		.8		.8	V
$V_{BE(SAT)}$	I_C = 5.0 mA, I_B = 0.5 mA		.9		.9		.9	V
$V_{BE(ON)}$	I_C = 10 μA, V_{CE} = 5.0V		0.7		0.7		0.7	V
BV_{CBO}	I_C = 10 μA	45		45		45		V
BV_{CEO}	I_C = 5 mA	45		45		45		V
BV_{EBO}	I_E = 10 μA	6.0		6.0		6.0		V
I_{CBO}	V_{CB} = 50V		0.2		0.2		0.2	nA
I_{EBO}	V_{EB} = 4.5V		0.2		0.2		0.2	nA

Process 570

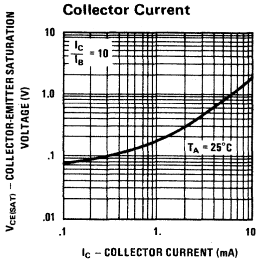
DC Pulse Current Gain vs Collector Current



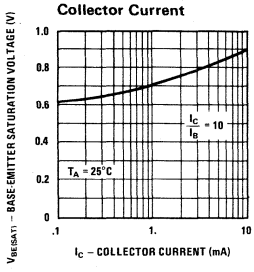
Base-Emitter On Voltage vs Collector Current



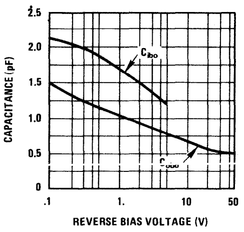
Collector-Emitter Saturation Voltage vs Collector Current



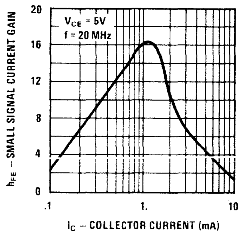
Base-Emitter Saturation Voltage vs Collector Current



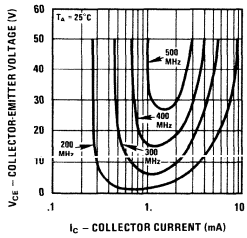
Input and Output Capacitance vs Reverse Bias Voltage



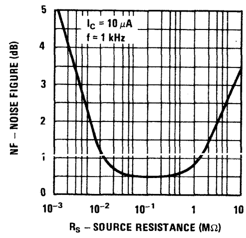
Small Signal Current Gain vs Collector Current



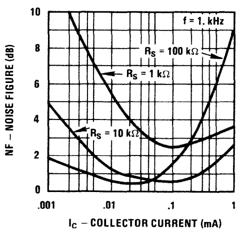
Contours of Constant Gain Bandwidth Product



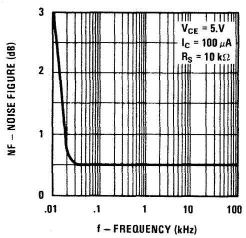
Noise Figure vs Source Resistance



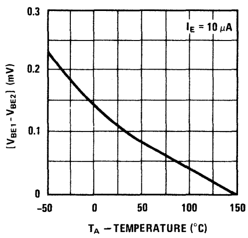
Noise Figure vs Collector Current



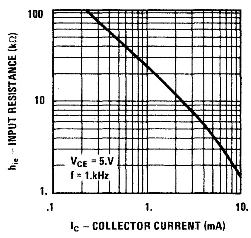
Noise Figure vs Frequency



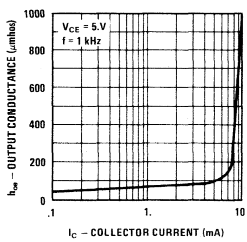
[V_{BE1} - V_{BE2}] vs Temperature



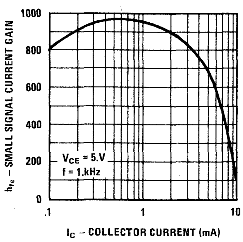
Small Signal Input Resistance vs Collector Current



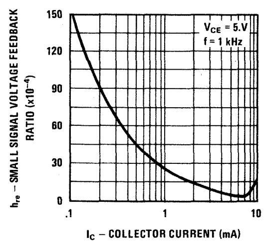
Small Signal Output Conductance vs Collector Current



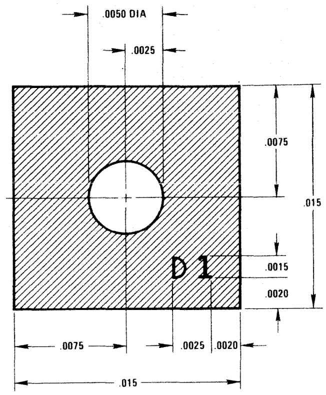
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process D1 High Speed Diode



DESCRIPTION

Process D1 is a gold doped epitaxial silicon diode. (cathode back contact)

APPLICATION

This device was designed in die form for hybrid circuit applications requiring a high speed diode having controlled forward characteristics.

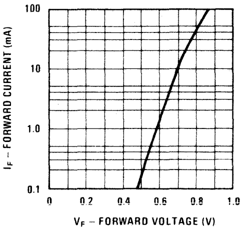
PRINCIPAL DEVICE TYPE:

1N914 (Available in dice or wafer form only)

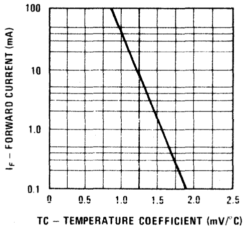
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV	10 μA	60	80	100	V	
I_R	50V		30	100	nA	
V_F	100 μA	0.46	0.48	0.49	V	
V_F	1.0 mA	0.56	0.58	0.62	V	
V_F	10 mA	0.66	0.70	0.74	V	
V_F	100 mA	0.82	0.90	0.93	V	
V_F	500 mA		1.2	1.4	V	
C_o	0V		1.1	1.8	pF	
t_{rr}	$I_F = I_R$ = 1.0 mA to 10 mA		2.5	4.0	ns	
t_{rr}	$I_F = I_R$ = 10 mA to 100 mA		3.0	4.0	ns	
t_{rr}	$I_F = I_R$ = 20 mA to 200 mA		4.0	6.0	ns	

Process D1

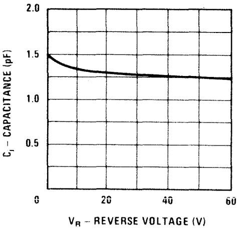
Forward Voltage vs Forward Current



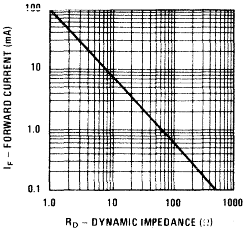
Forward Current vs Temperature Coefficient



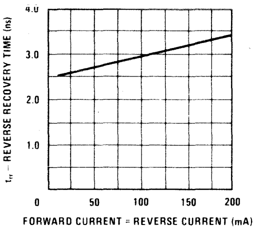
Capacitance vs Reverse Voltage



Dynamic Impedance vs Forward Current



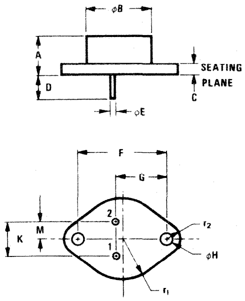
Reverse Recovery Time vs Forward Current ($I_F = I_R$)



Package Outlines

NOTE: Numbers in parentheses are NS internal package codes.

TO-3 (98)

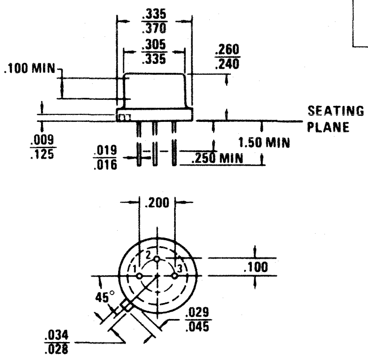


Terminal Connections
Pin 1– Ground
Pin 2– Output
Case – Input

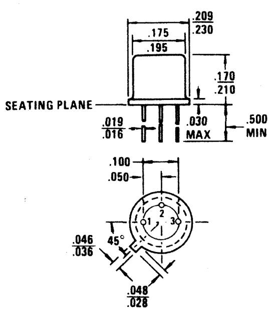
SYMBOL	INCHES	
	MIN	MAX
A	.250	.450
φE	.038	.043
φB		.875
K	.420	.440
M	.205	.225
C		.135
D	.312	
φH	.151	.161
F	1.177	1.197
r1		.525
r2		.188
G	.655	.675

TO-5 (03)

PIN	T
1	E
2	B
3	C



TO-18 (02, 11, 19*)



*(19 IS SOLID BASE)

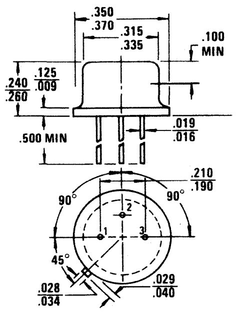
PIN	T (02), (19)
1	E
2	B
3	C

PIN	FET N (02)
1	S
2	D
3	G

PIN	FET P (11)
1	S
2	G
3	D

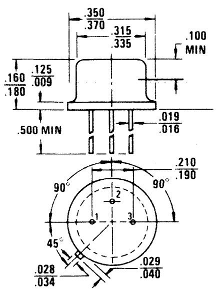
TO-39 (10, 16)

PIN	T
1	E
2	B
3	C



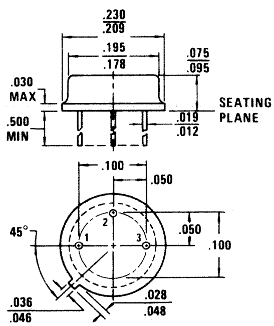
TO-39 (17) LO-PROFILE

PIN	T
1	E
2	B
3	C



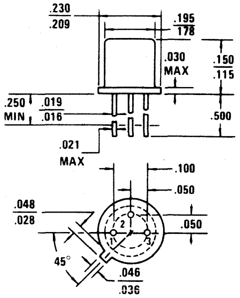
TO-46 (06)

PIN	T
1	E
2	B
3	C

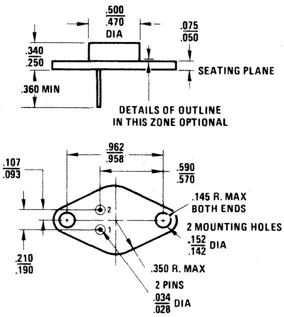


TO-52 (07, 18)

PIN	T (18)	FET (07)
1	E	S
2	B	D
3	C	G



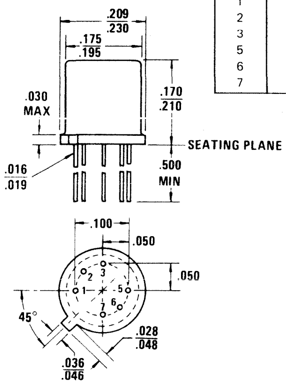
TO-66 (99)



PIN 1 – BASE
PIN 2 – EMITTER
CASE – COLLECTOR
MOUNTING FLANGE – COLLECTOR

TO-71 (08, 12)

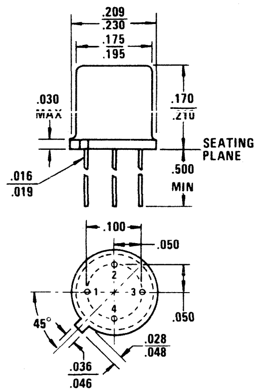
PIN	T (08)	FET (12)
1	E	S1
2	B	D1
3	C	G1
5	E	S2
6	B	D2
7	C	G2



TO-72 (23, 25, 28)

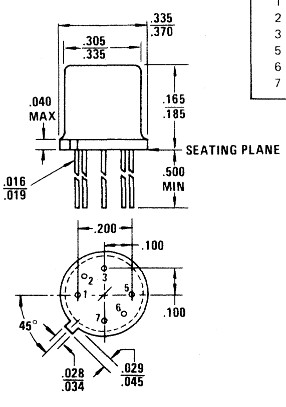
PIN	T (25)	FET N (25)
1	E	S
2	B	D
3	C	G
4	GND	CASE

PIN	T (28)	FET P (23)
1	B	S
2	E	G
3	C	D
4	GND	CASE

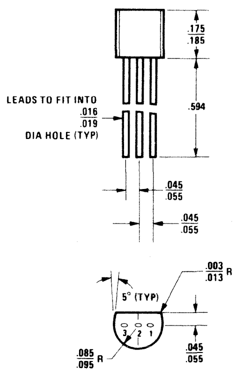


TO-78 (24, 27)

PIN	T (27)	FET (24)
1	C	S1
2	B	D1
3	E	G1
5	E	S2
6	B	D2
7	C	G2



TO-92 (71, 72, 74)



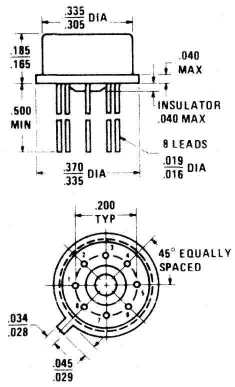
PIN	71	
	T	FET
1	C	G
2	E	D
3	B	S

PIN	72	
	T	FET
1	C	G
2	B	S
3	E	D

PIN	74	
	T	FET
1	B	S
2	C	G
3	E	D

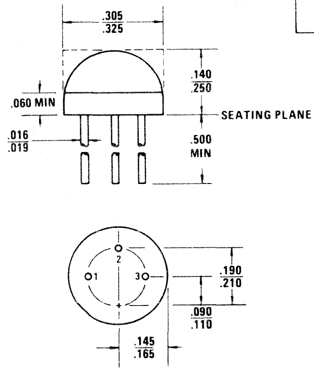
TO-99 (22)

PIN	FET
1	S
2	D
3	G
4	SUB
5	S
6	D
7	G
8	NC



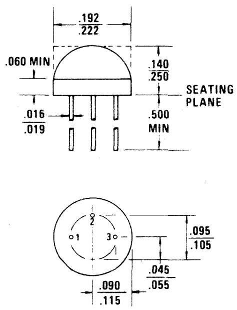
TO-105 (42)

PIN	T
1	E
2	B
3	C

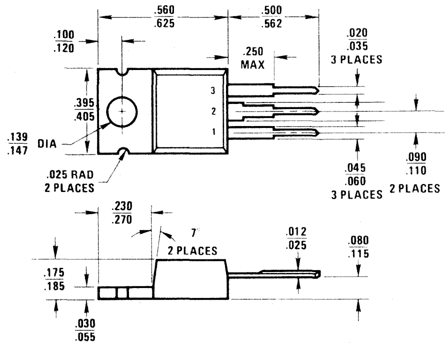


TO-106 (41)

PIN	FET	T
1	S	E
2	D	B
3	G	C

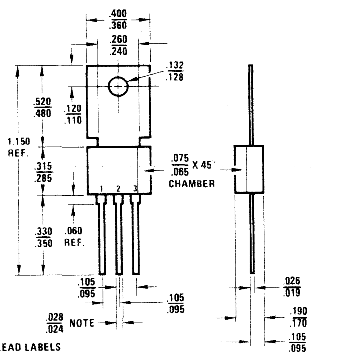


TO-220 (37)



PIN 1 – BASE
PIN 2 – COLLECTOR
PIN 3 – EMITTER

X51d (35)

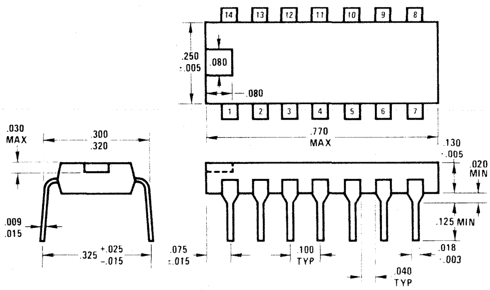


LEAD LABELS

PIN 1 – EMITTER
PIN 2 – BASE
PIN 3 – COLLECTOR

NOTE:
.043-.057 LEAD WIDTH WITHIN .100 OF BODY.

MOLDED DUAL-IN-LINE PACKAGE (N)



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