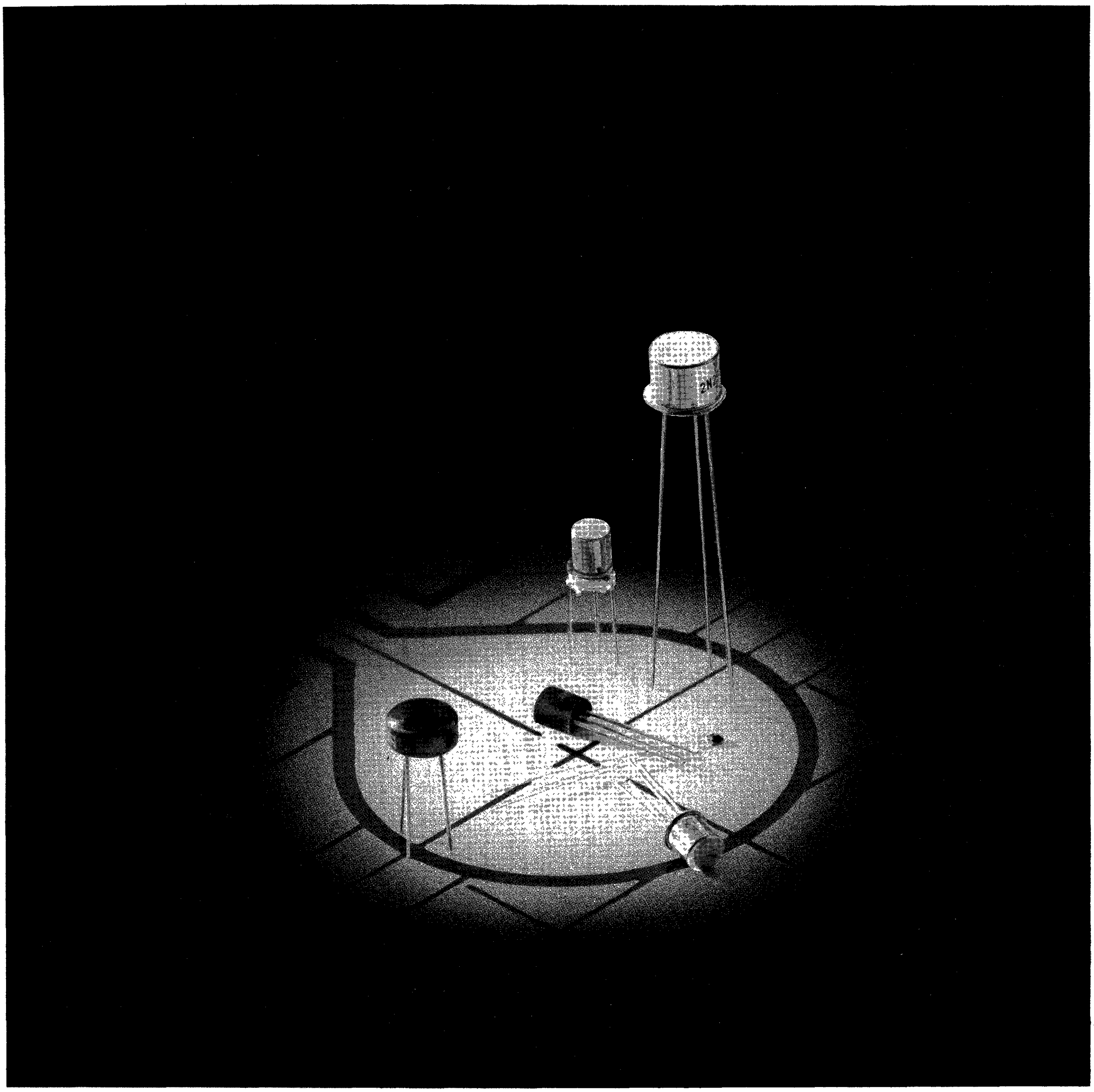
National Semiconductor Corporation

NATIONAL TRANSISTORS



Introduction

Here is National's latest handbook on transistor products; it gives pertinent data on our complete line of small signal and bipolar field-effect transistors. The selection guides and device characteristics for each product category will aid you in determining the exact National devices needed to fulfill your requirements.

To keep current on National transistors, contact a sales office, representative or distributor and ask to be placed on our mailing list.

How to Use This Catalog

Find the basic transistor type number in the Standard Parts Listing which begins on Page iv. This will reference a page number for the applicable Standard Specification.

The Process Number for each device may be found in the extreme right-hand column of the Standard Specification sheets. The Process Characteristics sheets are arranged in "Process No." order and the section begins on Page 35 of the catalog.

The Process Characteristic sheets contain complete design/application data and limit information. Critical package parameters will be indicated in the 'NOTES' column of the Process Characteristics sheets.

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Transistor Standard Parts List

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JAN2N930	5	2N2894A	15	2N3248	15	2N3692	5
JANTX2N930	5	2N2903	13	2N3249	15	2N3693	3
2N930A	5	2N2903A	13	2N3250	15	2N3694	3
2N956	7	2N2904	19	2N3250A	15	2N3724	1
2N981	5	JAN2N2904	19	JAN2N3250A	15	2N3724A	1
2N995	15	JANTX2N2904	19	JANTX2N3250A	15	2N3725	1
2N1132	19	2N2904A	19	2N3251	15	2N3725A	1
2N1420	7	JAN2N2904A	19	2N3251A	15	2N3734	1
2N1711	7	JANTX2N2904A	19	JAN2N3251A	15	2N3735	1
2N2017	11	2N2905	19	JANTX2N3251A	15	2N3806	25
2N2102	11	JAN2N2905	19	2N3252	1	2N3807	25
2N2192	11	JANTX2N2905	19	2N3253	1	2N3808	25
2N2192A	11	2N2905A	19	2N3299	8	2N3809	25
2N2193	11	JAN2N2905A	19	2N3300	8	2N3810	25
2N2193A	11	JANTX2N2905A	19	2N3301	8	JAN2N3810	25
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JANTX2N2218	7	JAN2N2906A	19	2N3349	25	2N3819	29
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JAN2N2218A	7	2N2907	19	2N3351	25	2N3822	28
JANTX2N2218A	7	JAN2N2907	19	2N3352	25	2N3823	28
2N2219	7	JANTX2N2907	19	2N3365	29	2N3824	27
JAN2N2219	7	2N2907A	19	2N3366	29	2N3903	8
JANTX2N2219	7	JAN2N2907A	20	2N3367	29	2N3904	8
2N2219A	7	JANTX2N2907A	20	2N3368	29	2N3905	20
JAN2N2219A	7	2N2913	13	2N3369	29	2N3906	20
JANTX2N2219A	7	2N2914	13	2N3370	29	2N3907	14
2N2221	7	2N2915	13	2N3436	29	2N3908	14
JAN2N2221	7	2N2915A	13	2N3437	29	2N3945	11
JANTX2N2221	7	2N2916	13	2N3438	29	2N3946	8
2N2221A	7	2N2916A	13	2N3444	1	2N3947	8
JAN2N2221A	8	2N2917	13	2N3451	15	2N3962	17
JANTX2N2221A	8	2N2918	13	2N3458	28	2N3963	17
2N2222	8	2N2919	13	2N3459	28	2N3964	17
JAN2N2222	8	2N2919A	13	2N3460	28	2N3965	17
JANTX2N2222	8	2N2920	13	2N3502	20	2N3966	14, 27
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JAN2N2222A	8	JANTX2N2920	13	2N3504	20	2N3967A	29
JANTX2N2222A	8	2N2920A	13	2N3505	20	2N3968	29
2N2243	11	2N2972	13	2N3545	15	2N3968A	29
2N2243A	11	2N2973	13	2N3546	15	2N3969	29
2N2270	11	2N2974	13	2N3547	17	2N3969A	29
2N2369	1	2N2975	14	2N3548	17	2N3970	27
2N2369A	1	2N2976	14	2N3549	17	2N3971	27
JAN2N2369A	1	2N2977	14	2N3550	17	2N3972	27
JANTX2N2369A	1	2N2978	14	2N3563	3	2N4015	25
2N2411	15	2N2979	14	2N3564	3	2N4016	25
2N2412	15	2N3011	1	2N3565	5	2N4017	25
2N2453	13	2N3012	15	2N3566	8	2N4018	25

Metal Can/Epoxy Cross Reference

METAL CAN	EPOXY
2N918	2N3563
2N918	2N3564
2N930	2N3565
2N2219	2N3566
2N2218	2N3567
2N3053	2N3568
2N3109	2N3569
2N2905	2N3638
2N2905	2N3638A
2N4247	2N3639
2N4208	2N3640
2N2218	2N3641
2N2218A	2N3642
2N2219	2N3643
2N2905	2N3644
2N2905A	2N3645
2N3013	2N3646
2N929	2N3691
2N930	2N3692
2N929	2N3693
2N930	2N3694
2N3946	2N3903
2N3947	2N3904
2N3250	2N3905
2N3251	2N3906
2N3250	2N4121
2N3251	2N4122
2N3946	2N4123

METAL CAN	EPOXY
2N4207	2N4257
2N4207	2N4257A
2N2894A	2N4313
2N2894	2N4423
2N3947	2N4124
2N3250	2N4125
2N3251	2N4126
2N2221	2N4140
2N2222	2N4141
2N2906	2N4142
2N2907	2N4143
2N2221	2N4227
2N2906	2N4228
2N3547	2N4248
2N3549	2N4249
2N3549	2N4250
2N2369	2N4274
2N2369	2N4275
2N4030	2N4354
2N4032	2N4355
2N4031	2N4356
2N3013	2N4421
2N3013	2N4422
2N3250	2N4916
2N3251	2N4917
2N3547	2N4964
2N3548	2N4965
2N929	2N4966

METAL CAN	EPOXY
2N930	2N4967
2N929	2N4968
2N2221	2N4969
2N2222	2N4970
2N2906	2N4971
2N2907	2N4972
2N3013	2N5029
2N3013	2N5030
2N5056	2N5055
2N929	2N5127
2N2218	2N5128
2N2221	2N5129
2N918	2N5130
2N930	2N5131
2N930	2N5132
2N930	2N5133
2N2369	2N5134
2N2219	2N5135
2N2219	2N5136
2N2222	2N5137
2N3251	2N5138
2N3251	2N5139
2N4207	2N5140
2N2894	2N5141
2N2905	2N5142
2N2907	2N5143
2N4209	2N5910

MIL-STD Qualif/TX Processing

MIL-S-19500 qualifications

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

TX 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 TX type reliability processing on all device types per above flow plan.

For further information concerning TX type processing, contact your National Field Representative.

Production Process

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

100% Process Condition

- 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**
- Acceleration
Y_1 orientation
20,000 G min.
- Fine + Gross Hermetic Seal Tests per spec

100% Burn-In

- 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.

**Reverse Bias Burn-in is restricted to PNP devices only on current JAN-TX specs.

Field Effect Transistor 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	$Re(Y_{is})$	$\dfrac{\Delta \lvert V_{GS1} - V_{GS2} \rvert}{\Delta T}$	$I_{D(OFF)}$	$V_{GS(OFF)}$
$V_{GS(OFF)}$	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 FROM 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}.

$$V_{GS(OFF)} = 1.46 V_G \ @ \ I_D = 0.1\, I_{DSS}$$ – 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.

$K = 0.5 - 0.9$

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	–			21
2N708	TO-18	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												
2N3011	TO-18	30	12	5	–	–	30	120	10	0.35	0.2	0.72	0.87	10	4	400		20	20			21
							12	–	100	1	0.5	–	1.6	100								
2N3015	TO-5 (Lo-Profile)	60	30	5	200 I_{CES}	30	30	120	150	10	0.4	–	1.2	150	8	250	–	50	60		2	25
							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	30		3	25
							30	90	500	1	0.5	0.7	1.3	500								
							25	–	1000	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	30		3	25
							25	75	375	1	0.6	–	0.7	500								
							20	–	750	5	1.2	–	1.8	1000								
2N3444	TO-5 (Lo-Profile)	80	50	5	500	60	20	–	150	1	0.35	–	1.0	150	12	150	–	50	30		4	25
							20	60	500	1	0.6	0.7	1.3	500								
							15	–	1000	5	1.2	–	1.8	1000								
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								
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		3	25
							40	–	300	1	0.25	–	0.76	10								
							30	–	1000	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	1000								
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	–	1000	5	0.75	0.9	1.4	1000								
							25	–	1500	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		3	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	1000								
							25	–	1000	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		1000	5	0.9	0.9	1.4	1000								
							20		1500	5												
2N3734	TO-5 (Lo-Profile)	50	30	5			35	–	10	1	0.2	–	0.8	10	9	300	–	50	60		6	25
							40	–	150	1	0.3	–	1.0	150								
							35	–	500	1	0.5	–	1.2	500								
							30	120	1000	1.5	0.9	0.9	1.4	1000								
							30	–	1500	5												
2N3735	TO-5 (Lo-Profile)	75	50	5	200 I_{CEX}	40	35	–	10	1	0.2	–	0.8	10	9	250	–	50	60		6	25
							40	–	150	1	0.3	–	1.0	150								
							35	–	500	1	0.5	–	1.2	500								
							20	80	1000	1.5	0.9	0.9	1.4	1000								
							20		1500	5												
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												
MPS706	TO-92	15	15	3	500	15	20	–	10	1	0.6	–	0.9	10	6	200	–	10	75		8	21
MPS834	TO-92	40		5	500	20	25	–	10	1	0.25	–	0.9	10	4	350	–	10	30		9	21
											0.4			50								
MPS2369	TO-92	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												
MPS2714	TO-92				500	18	75	225	2	4.5	0.3	0.6	1.3	50								22

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. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
6. I_C = 1000 mA, V_{CC} = 12V, I_{B1} = I_{B2} = 100 mA
7. 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. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA

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_{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.
MPS3639	TO-92	6	6	4			30	120	10	0.3	–	0.75	0.95	10	3.5	500	–	10	25		11	65
							20	–	50	1	0.16	0.8	1	10		300	–	10	60		12	
											0.5	–	1.5	50								
MPS3640	TO-92	12	12	4			30	120	10	0.3	0.2	0.8	1	10	3.5	500	–	10	35		11	65
							20	–	50	1	0.6	–	1.5	50		300	–	10	75		12	
												0.75	0.95	10								
MPS3646	TO-92	40	15	5			30	120	30	0.4	0.2	0.75	0.95	30	5	350	–	30	28		10	22
							25	–	100	0.5	0.28	–	1.2	100								
							15	–	300	1	0.5	–	1.7	300								

Test Conditions:

10. $I_C = 300$ mA, $I_{B1} = I_{B2} = 30$ mA

11. $I_C = 50$ mA, $V_{OB} = 1.9$V, $I_{B1} = I_{B2} = 5$ mA

12. $I_C = 10$ mA, $I_{B1} = I_{B2} = 0.5$ mA

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_{ob} (pF) Min	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	Test Condition	Process No.
2N917	TO-72	30	15	3	1 μA	15	20	–	3	1	0.5	–	0.87	3		1.7	500	–	4	6	1	43
2N918	TO-72	30	15	3	10	15	20	–	3	1	0.4	–	1	10		1.7	600	–	4	6	1	43
JAN2N918	TO-72	30	15	3	10	15	20 10 20	– – 200	10 0.5 3	10 10 1	0.4	–	1	10		1.7	600	–	4	6	1	43
JANTX2N918	TO-72	30	15	3	10	15	10 20	– –	0.5 10	10 10	0.4	–	1	10		1.7	600	–	4	6	1	43
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
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
2N4134	TO-72	30	30	3	50	10	25	200	4	10	3.0		.92	10		45	350	800	4	5.0	7	44
2N4135	TO-72	30	30	3	50	10	25	200	4	10	3.0		.92	10		45	425	800	4			44
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
EN918	TO-106	30	15	3	50	15	20	–	3	1	0.4	–	1	10		3	600		4	6	1	43
MPS918	TO-92	30	15	3	10	15	20	–	3	1	0.4	–	1	10		1.7 3	600	–	4	6	1	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	2	27
MPS3694	TO-92	45	45	4	50	35	100	400	10	10						3.5	200	–	10	4	2	27
SE1001	TO-106	45	45	4.0	500	30	40	160	10	10	–	–	–	–		3.5	200		10	–	–	26
SE1002	TO-106	45	45	4.0	500	30	100	400	10	10	–	–	–	–		3.5	200		10	–	–	26
SE3001	TO-106	30	12	2.0	500	15	20	–	8	10	0.6	–	–	10		1.7	600		8	4	1	
SE3002	TO-106	30	12	2.0	500	15	20	–	8	10	.0.6	–	–	10		1.7	600		8	4	1	
SE5020	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5*	375	800	4	3.3	3	44
SE5021	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5*	375	800	4	4.0	3	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	4	44
SE5024	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5*	300	800	4	6.0	4	44
SE5035	TO-72 †	40	30	4	50	30	40	180	5	10						.30***	600		5			47
SE5036	TO-72 †	35	30	3	50	30	30	225	5	10						.3***	500		5			47
SE5037	TO-72 †	45	40	4	50	30	40	180	10	10	1.0			20	.6	1.0*	600		10			47
SE5050	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5*	300		4		5	44
SE5051	TO-72	20	20	3	50	10	20	200	4	5	3.0		.96	10	.25	.5*	300		4	3.0**	5	44
SE5052	TO-72	20	20	3	50	10					3.0			10			375		4	4.0	6	44
SE5055	TO-72 †	20	20	3	50	20	20	220	2	10	2.75			10		.22***	300		2	5.0		
ST5025	TO-92 †	30	30	3	50	30	20	100	10	10	.6			20	.6	1.0*	300	700	10			46
ST5030	TO-92 †	45	40	4.5	100	30	45	150	7	15	3.0		 .92	20 10	.25	.40***	600		7			47
ST5056	TO-92 †	20	20	3	50	20	20	220	2	10	2.75			10		.3***	300		2	5.0	8	45

Test Conditions:

1. I_C = 1 mA, V_{CE} = 6V, R_G = 400Ω, f = 60 MHz
2. I_C = 3 mA, V_{CE} = 10V, R_S = 300Ω, f = 1 MHz
3. V_{AGC} = 1.4V, R_S = 75Ω, f = 200 MHz, Neutralized
4. V_{AGC} = 2.75V, f = 45 MHz, R_S = 50Ω, Unneutralized
5. V_{AGC} = 2.0V, R_G = 75Ω, f = 100 MHz
6. V_{CC} = 10V, I_C = 3.0 mA, f = 200 MHz, R_S = 50Ω
7. I_E = 1.0 mA, V_{CB} = 15V, R_S = 130Ω, f = 450 MHz
8. V_{BE} = 2.0V, f = 45 MHz

* C_{re}
** Typical
*** C_{cb}
† E-B leads reversed.

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} 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		–		
2N760A	TO-18	60	60	8	100	30	76	333*	1	5	1	0.9	1.1	10	8	50	–	1		–		
JAN2N760A	TO-18	75	60	8	10	30	76	333	1	5	1	0.6	1.1	10	6	60	–	1		24	1	
2N929	TO-18	45	45	4	10	45	40 60 –	120 – 350	0.01 µA 0.5 µA 10	5 5 5	1	0.6	1.1	10	8	30	–	0.5		4	12	07
JAN2N929	TO-18	60	45	6	10	45	40 60 –	120 – 350	0.01 µA 0.5 µA 10	5 5 5	1	0.6	1.1	10	8	45	180	0.5		5 3 3	3 4 2	07
JANTX2N929	TO-18	65	45	6	10	45	40 60 –	120 – 350	0.01 0.5 10	5 5 5	1	0.6	1	10	8	45	180	0.5		3 5 3	7 5 6	07
2N929A	TO-18	60	45	6	2	45	25 40 60 –	– 120 – 350	0.001 0.01 0.5 10	5 5 5 5	0.5	0.7	0.9	10	6	45	–	0.5		4	12	07
2N930	TO-18	45	45	5	10	45	100 150 –	300 – 600	0.01 0.5 10	5 5 5	1	0.6	1	10	8	30	–	0.5		3	12	07
JAN2N930	TO-18	60	45	6	10	45	100 150 –	300 – 600	0.01 0.5 10	5 5 5	1	0.6	1	10	8	45	180	0.5		5 3 3	5 6 7	07
JANTX2N930	TO-18	60	45	6	10	45	100 150 –	300 – 600	0.01 0.5 10	5 5 5	1	0.6	1	10	8	45	180	0.5		5 3 3	3 4 2	07
2N930A	TO-18	60	45	6	2	45	60 100 150 –	– 300 – 600	0.001 0.01 0.5 10	5 5 5 5	0.5	0.7	0.9	10	6	45	–	0.5		3	12	07
2N981	TO-18	80	80	8	1.0 µA	30					3			10	5							
2N2483	TO-18	60	60	6	10	45	40 75 175	120 – –	0.01 0.1 1	5 5 5	0.35	0.5	0.7	1	6	60	–	0.5		4 3 4	4 2 8	07
2N2484	TO-18	60	60	6	10	45	100 175 250	500 – –	0.01 0.1 1	5 5 5	0.35	0.5	0.7	1	6	60	–	0.5		3 2 3	4 2 8	07
2N2509	TO-18	125	80	7	5	100	25 – 40	– – –	0.01 – 10	5 – 5	1	–	0.9	5	6	45	–	5		7	4	07
2N2510	TO-18	100	65	7	5	80	75 – 150	– – 500	0.01 – 10	5 – 5	1	–	0.9	5	6	45	–	5		4	4	07
2N2511	TO-18	80	50	7	5	60	80 120 240	– – 750	0.001 0.01 10	5 5 5	1	–	0.9	5	6	45	–	5		4	4	07
2N2586	TO-18	60	45	6	2	45	80 120 150 –	– 360 – 600	0.001 0.01 0.5 10	5 5 5 5	0.5	0.7	0.9	10	7	45	–	0.5		3 2	4 2	07
2N3117	TO-18	60	60	6	10	45	250 300 400	500 – –	0.01 0.1 1	5 5 5	0.35	–	0.7	1	8	60	–	0.5		1 1	9 10	07
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
2N4966	TO-106	50	40	6	25	25	40 50	200 –	0.01 10	5 5	0.4	–	–	–	6	40		1		6	4	07
2N4967	TO-106	50	40	6	25	25	100 120	600 –	0.01 10	5 5	0.4	–	–	–	6	40		1		6	4	07
2N4968	TO-106	30	25	6	50	25	40 50	200 –	0.01 10	5 5	0.4	–	–	–	6	40		1		6	4	07
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		–	–	07
2N5133	TO-106	20	18	3	50	15	60	1000	1	1	0.4	–	–	–	5	40	200	1		–	–	07
EN930	TO-106	45	45	5	50	45	100 150 	300 600	0.01 0.5 10	5 5 5	1.0	0.6	1	10	8	30		0.5	–	3	11	07
EN2484	TO-106	60	60	6	50	45	30 100 175 200 250 	 500 800	0.001 0.01 0.1 0.5 1 10	5 5 5 5 5 5	0.35	0.5	0.7	1	6	60		0.5	–	3 3 2	11 12 13	07

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 = 10Ω, f = 100 Hz
6. I_C = 10 µA, V_{CE} = 5V, R_G = 10Ω, f = 1 kHz
7. I_C = 10 µA, V_{CE} = 5V, R_G = 10Ω, f = 10 kHz
8. I_C = 10 µA, V_{CE} = 5V, R_G = 10 kΩ, BW = 1.57 kHz
9. I_C = 5 µA, V_{CE} = 5V, R_G = 5 kΩ, f = 1 kHz
10. I_C = 5 µA, V_{CE} = 5V, R_G = 50 kΩ, f = 10 kHz
11. I_C = 10 µA, V_{CE} = 5V, R_S = 10 kΩ, BW 15.7 kHz
12. I_C = 10 µA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz
13. I_C = 10 µA, V_{CE} = 5V, R_S = 10 kΩ, f = 10 kHz

low level amps (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_{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.
MPS3707	TO-92		30		100	20	100	400	0.1	5	1	–	–	10						5	14	07
MPS3708	TO-92		30		100	20	45	660	1	5	1	–	–	10								07
MPS3709	TO-92		30		100	20	45	165	1	5	1	–	–	10								07
MPS3710	TO-92		30		100	20	90	330	1	5	1	–	–	10								07
MPS3711	TO-92		30		100	20	180	660	1	5	1	–	–	10								07
MPS6571	TO-92	25	20	3	50	20	250	1000	0.1	5	0.5	–	–	10	4.5	50	–	0.5				07
SE4001	TO-10€	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 60		0.05 1	–	3	15	07

Test Conditions:

14. I_C = 100 μA, V_{CE} = 5V, R_G = 10 kΩ, WB

15. I_C = 30 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz

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-5	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
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	50	10	50	20	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20				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				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				20
							40	–	10	10	–	–	2	500								
							40	120	150	10												
							20	–	500	10												
2N2219	TO-5	60	30	5	10	50	35	–	0.1	10	0.4	–	1.3	150	8	250	–	20				20
							75	–	10	10	1.6	–	2.6	500								
							100	300	150	10												
							30	–	500	10												
JAN2N2219	TO-5	60	30	5	10	50	35	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20	250		1	20
							50	–	1	10												
							75	–	10	10												
							100	300	150	10												
							30	–	500	10												
JANTX2N2219	TO-5	60	30	5	10	50	35	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20				20
							75	–	10	10	1.6	–	2.6	500								
							100	300	150	10												
							30	–	500	10												
2N2219A	TO-5	75	40	6	10	60	35	–	0.1	10	0.3	0.6	1.2	150	8	300	–	20				20
							75	–	10	10	1	–	2	500								
							100	300	150	10												
							50	–	150	1												
							40	–	500	10												
JAN2N2219A	TO-5	75	50	6	10	60	50	–	0.1	10	1	–	2	500	8	250	–	20	300		1	20
							75	–	1	10	0.3	0.6	1.2	150								
							100	–	10	10												
							100	300	150	10												
							30	–	500	10												
JANTX2N2219A	TO-5	75	50	6	10	60	50	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20				20
							100	–	10	10	1	–	2	500								
							100	300	150	10												
							30	–	500	10												
2N2221	TO-18	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												
JAN2N2221	TO-18	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												
JANTX2N2221	TO-18	60	30	5	10	50	20	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20				20
							35	–	10	10	1.6	–	2.6	500								
							40	120	150	10												
							20	–	500	10												
2N2221A	TO-18	75	40	6	10	60	30	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20				20
							35	–	10	10	1	–	2	500								
							40	120	150	10												
							20	–	150	1												
							25	–	500	10												

Test Condition:

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

general purpose amps and switches (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_{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.
JAN2N2221A	TO-18	75	50	6	10	60	30	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20	250		1	20
							35	–	1	10	1	–	2	500								
							40	–	10	10												
							40	120	150	10												
							20	–	500	10												
JANTX2N2221A	TO-18	75	50	6	10	60	30	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20				20
							40	–	10	10	1	–	2	500								
							40	120	150	10												
							20	–	500	10												
2N2222	TO-18	60	30	5	10	50	35	–	0.1	10	0.4	–	1.3	150	8	250	–	20				20
							75	–	10	10	1.6	–	2.6	500								
							100	300	150	10												
							30	–	500	10												
JAN2N2222	TO-18	60	30	5	10	50	35	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20	250		1	20
							50	–	1	10	1.6	–	2.6	500								
							75	–	10	10												
							100	300	150	10												
							30	–	500	10												
JANTX2N2222	TO-18	60	30	5	10	50	35	–	0.1	10	0.4	0.6	1.3	150	8	250	–	20				20
							75	–	10	10	1.6	–	2.6	500								
							100	300	150	10												
							30	–	500	10												
2N2222A	TO-18	75	40	6	10	60	35	–	0.1	10	0.3	0.6	1.2	150	8	300	–	20				20
							75	–	10	10	1	–	2	500								
							100	300	150	10												
							50	–	150	1.0												
							40	–	500	10												
JAN2N2222A	TO-18	75	50	6	10	60	50	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20	300		1	20
							75	–	1	10	1	–	2	500								
							100	–	10	10												
							100	300	150	10												
							30	–	500	10												
JANTX2N2222A	TO-18	75	50	6	10	60	50	–	0.1	10	0.3	0.6	1.2	150	8	250	–	20				20
							100	–	10	10	1	–	2	500								
							100	300	150	10												
							30	–	500	10												
2N3299	TO-5	60	30	5	–	–	20	–	0.1	10	0.22	–	1.1	150	8	250	–	50				20
							35	–	10	10	0.6	–	1.5	500								
							40	120	150	10	0.45	–	1.3	300								
							20	–	500	10												
2N3300	TO-5	60	30	5	–	–	35	–	0.1	10	0.22	–	1.1	150	8	250	–	50				20
							75	–	10	10	0.6	–	1.5	500								
							100	300	150	10	0.45	–	1.3	300								
							50	–	500	10												
2N3301	TO-18	60	30	5	–	–	20	–	0.1	10	0.22	–	1.1	150	8	250	–	50				20
							35	–	10	10	0.6	–	1.5	500								
							40	120	150	10	0.45	–	1.3	300								
							20	–	500	10												
2N3302	TO-18	60	30	5	–	–	35	–	0.1	10	0.22	–	1.1	150	8	250	–	50				20
							75	–	10	10	0.6	–	1.5	500								
							100	300	150	10	0.45	–	1.3	300								
							50	–	500	10												
2N3566	TO-105	40	30	5	50	20	80	–	2	10	1	–	–	100	25	40	200	30		–		20
							150	600	10	10												
2N3567	TO-105	80	40	5	50	40	40	–	30	1	0.25	–	–	150	20	60	200	50		–		20
							40	120	150	1												
2N3641	TO-105	60	30	5	50	50	40	120	150	10	0.22	–	–	150	8	250	–	50		–		20
							15	–	500	10												
2N3642	TO-105	60	45	5	50	50	40	120	150	10	0.22	–	–	150	8	250	–	50		–		20
							15	–	500	10												
2N3643	TO-105	60	30	5	50	50	100	300	150	10	0.22	–	–	150	8	250	–	50		–		20
							20	–	500	10												
2N3903	TO-92	60	40	6	50 I_{CEX}	30	20	–	0.1	1	0.2	0.65	0.85	10	4	250		10	225	6	2	23
							35	–	1	1	0.3	–	0.95	50								
							50	150	10	1												
							30	–	10	1												
							15	–	100	1												
2N3904	TO-92	60	40	6	50 I_{CEX}	30	40	–	0.1	1	0.2	0.65	0.85	10	4	300		10	250	5	2	23
							70	–	1	1	0.3	–	0.95	50								
							100	300	10	1												
							60	–	50	1												
							30	–	100	1												
2N3946	TO-18	60	40	6	10 I_{CEX}	40	30	–	0.1	1	0.2	0.6	0.9	10	4	250		10	375	5	2	27
							45	–	1	1	0.3		1	50								
							20	–	50	1												
2N3947	TO-18	60	40	6	10 I_{CEX}	40	60	–	0.1	1	0.2	0.6	0.9	10	4	300		10	450	5	2	27
							90	–	1	1	0.3		1	50								
							100	–	10	1												
							40	–	50	1												
2N4123	TO-92	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	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												

Test Conditions:

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

general purpose amps and switches (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_{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.
2N4227	TO-106	60	30	5	50	40	25 35 50 30 75 20	– – – – 150 –	0.1 1 10 150 150 500	10 10 10 1 10 10	0.4	–	1.3	150	8	250	–	20		–		20
2N4400	TO-92	60	40	6.0	–	–	20 40 50 20	– – 150 –	1 10 150 500	1 1 1 2	0.4 0.75	0.75 –	0.95 1.2	150 500	–	200		20	255	–	3	20
2N4401	TO-92	60	40	6.0	–	–	20 40 80 100 40	– – – 300 –	0.1 1 10 150 500	1 1 1 1 2	–	–	–	–	–	250		20	255	–	3	20
2N4969	TO-106	50	30	5	50	30	30 40 20	– 120 –	10 150 150	10 10 1	0.4	0.6	1.2	150	8	200	–	20		–		20
2N4970	TO-106	50	30	5	50	30	70 100 50	– 350 –	10 150 150	10 10 1	0.4	0.6	1.2	150	8	200	–	20		–		20
2N5128	TO-105	15	12	3	50	10	20 35	– 350	10 50	10 10	0.25	–	1.1	150	10	200	800	50		–		20
2N5129	TO-106	15	12	3	50	10	20 35	– 350	10 50	10 10	0.25	–	1.1	150	10	200	800	50		–		20
2N5135	TO-105	30	25	4	300	15	15 50	– 600	2 10	10 10	1	–	1	100	25	40	300	30		–		20
2N5136	TO-105	30	20	3	100	20	20 20	– 400	30 150	1 1	0.25	–	1.1	150	35	40	400	50		–		20
2N5137	TO-106	30	20	3	100	20	20 20	– 400	30 150	1 1	0.25	–	1.1	150	35	40	400	50		–		20
EN697	TO-105	60	30	5.0	1000	30	40	120	150	10	1.5	–	1.3	150	35	50		30				20
EN956	TO-106	75	40	7.0	50	60	20 75 100 40	– – 300 –	0.01 10 150 500	10 10 10 10	1.5	–	1.3	150	25	70		30		8	5	20
EN2219	TO-105	60	30	5.0	50	50	35 75 100 30	– – 300 –	0.1 10 150 500	10 10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8.0	250		20				20
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
MPS2711	TO-92				500	18	30	90	2	4.5					4							23
MPS2712	TO-92				500	18	75	225	2	4.5					4							23
MPS2716	TO-92				500	18	75	225	2	4.5					3.5							23
MPS2923	TO-92				500	25									12							23
MPS2924	TO-92				500	25									12							23
MPS2925	TO-92				500	25									12							23
MPS2926	TO-92				500	18									3.5							23
MPS3392	TO-92		25		100	18	150	300	2	4.5					3.5							23
MPS3393	TO-92		25		100	18	90	180	2	4.5					3.5							23
MPS3394	TO-92		25		100	18	55	110	2	4.5					3.5							23
MPS3395	TO-92		25		100	18	150	500	2	4.5					3.5							23
MPS3396	TO-92		25		100	18	90	500	2	4.5					3.5							23
MPS3397	TO-92		25		100	18	55	500	2	4.5					3.5							23
MPS3398	TO-92		25		100	18	55	800	2	4.5					3.5							23
MPS3704	TO-92	50	30	5	100	20	100	300	50	2	0.6	–	–	100	12	100	–	50				20
MPS3705	TO-92	50	30	5	100	20	50	150	50	2	0.8	–	–	100	12	100	–	50				20
MPS3706	TO-92	40	20	5	100	20	30	600	50	2	1	–	–	100	12	100	–	50				20
MPS3721	TO-92				500	18									3.5							23
MPS3826	TO-92	60	45	4	100	30	40	160	10	10					3.5	200	800	10				23
MPS3827	TO-92	60	45	4	100	30	100	400	10	10					3.5	200	800	10				23
MPS6512	TO-92	40	30	4	50	30	50 30	100 –	2 100	10 10	0.5	–	–	50	3.5							27
MPS6513	TO-92	40	30	4	50	30	90 60	180 –	2 100	10 10	0.5	–	–	50	3.5							27
MPS6514	TO-92	40	25	4	50	30	150 90	300 –	2 100	10 10	0.5	–	–	50	3.5							27
MPS6515	TO-92	40	25	4	50	30	250 150	500 –	2 100	10 10	0.5	–	–	50	3.5							27
MPS6520	TO-92	40	25	4	50	30	100 200	– 300	0.1 2	10 10	0.5	–	–	50	3.5					3	4	27
MPS6521	TO-92	40	25	4	50	30	150 300	– 600	0.1 2	10 10	0.5	–	–	50	3.5					3	4	27
MPS6530	TO-92	60	40	5	50	40	30 40 25	– 120 –	10 100 500	1 1 10	0.5	–	1	100	5							20
MPS6531	TO-92	60	40	5	50	40	60 90 50	– 270 –	10 100 500	1 1 10	0.3	–	1	100	5							20
MPS6532	TO-92	50	30	5	100	30	30	–	100	1	0.5	–	1.2	100	5							20
MPS6564	TO-92		45	5	500	40	25	–	10	5	0.5	–	–	10	4							23
MPS6565	TO-92	60	45	4	100	30	40	160	10	10	0.4	–	–	10	3.5	200	–	10				27
MPS6566	TO-92	60	45	4	100	30	100	400	10	10	0.4	–	–	10	3.5	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 Conditions:

3. $I_C = 10\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, WB

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

5. $I_C = 300\ \mu A$, $V_{CE} = 10V$, $R_G = 510\Omega$, f = 1 kHz

*$V_{BE(ON)}$

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 50 20	– 200 –	10 200 1A	10 10 15	2	–	–	200	–	–	–	–				12
2N2102	TO-39	120	65	7	2	60	10 20 35 40 25 10	– – – 120 – –	0.01 0.1 10 150 500 1A	10 10 10 10 10 10	0.5	–	1.1	150	10	60	–	50				12
2N2192	TO-39	60	40	5	10	30	75 100 15	– 300 –	10 150 1A	10 10 10	0.35	–	1.3	150	20	50	–	50				12
2N2192A	TO-39	60	40	5	10	30	75 100 15	– 300 –	10 150 1A	10 10 10	0.25	–	1.3	150	20	50	–	50				12
2N2193	TO-39	80	50	8	10	60	15 40 15	– 120 –	0.1 150 1A	10 10 10	0.35	–	1.3	150	20	50	–	50				12
2N2193A	TO-39	80	50	8	10	60	15 40 15	– 120 –	0.1 150 1A	10 10 10	0.25	–	1.3	150	20	50	–	50				12
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-5	120	80	7	10	60	15 40 15	– 120 –	0.1 150 500	10 10 10	0.35	–	1.3	150	15	50	–	50				12
2N2243A	TO-39	120	80	7	10	60	15 40 15	– 120 –	0.1 150 500	10 10 10	0.25	–	1.3	150	15	50	–	50				12
2N2270	TO-5 (solid)	60	45	7	50	60	30 50	– 200	1 150	10 10	0.9	–	1.2	150	15	100	–	50				12
2N2657	TO-39	80	60	8	100	60	40 15	120 –	1A 5A	2 6	0.5 3.0	– –	1.5 2.5	1A 5A	150	20		200	1500			34
2N2658	TO-39	100	80	8	100	60	40 15	120 –	1A 5A	2 6	0.5 3.0	– –	1.5 2.5	1A 5A	150	20		200	1500			34
2N2890	TO-39	100	80	5	–	–	20 30 25	– 90 –	100 1A 2A	2 2 5	0.5 0.75	– –	1.2 1.3	1A 2A	70	30		200	1500			34
2N2891	TO-39	100	80	5	–	–	35 50 40	– 150 –	100 1A 2A	2 2 5	0.5 0.75	– –	1.2 1.3	1A 2A	70	30		200	1500			34
2N3019	TO-5 (solid)	140	80	7	10	90	50 100 15 90	– 300 – –	0.1 150 1A 10	10 10 10 10	0.2 0.5	–	1.1	150 500	12	100	–	50				12
JAN2N3019	TO-5 (solid)	140	80	7	10	90	15 50 90 100 50	– 200 – 300 200	1A 0.1 10 150 500	10 10 10 10 10	0.2 0.5	–	1.1	150 500	12	100	400	50				12
JANTX2N3019	TO-5 (solid)	140	80	7	10	90	50 90 100 50 15	200 – 300 200 –	0.1 10 150 500 1A	10 10 10 10 10	0.20 0.50	–	1.1	150 500	12	100	400	50				12
2N3020	TO-39	140	80	7	10	90	30 40 15 40	100 120 – 120	0.1 150 1A 10	10 10 10 10	0.2 0.5	–	1.1	150 500	12	100	–	50				12
2N3053	TO-39	60	40	5	–	–	25 50	– 250	150 150	2.5 10	1.4	–	1.7	150	15	100		50				12
2N3107	TO-39	100	60	7			100 35 40	300 – –	150 0.1 500	1 10 10	1 0.25	– –	2 1.1	1000 150	20	350	–	50				12
2N3108	TO-39	100	60	7	10	60	20 40 25	– 120 –	0.1 150 500	10 10 10	0.25 1	– –	1.1 2	150 1A	20	60	–	50				12
2N3109	TO-39	80	40	7	10	60	35 100 40	– 300 –	0.1 150 500	10 1 10	0.25 1	– –	1.1 2	150 1A	25	70	–	50				12
2N3110	TO-39	80	40	7	10	60	20 40 25	– –	0.1 150 500	10 1 10	0.25 1	– –	1.1 2	150 1A	25	60	–	50				12
2N3568	TO-105	80	60	5	50	40	40 40	– 120	30 150	1 1	0.25	–	–	150	20	60	200	50				12
2N3569	TO-105	80	40	5	50	40	100 100	– 300	30 150	1 1	0.25	–	–	150	20	60	200	50				12
2N3665	TO-39	120	80	10	50	60	30 40 25	– 120 –	10 150 500	10 10 10	0.5 1.2	– –	1.2 1.8	150 500	12	60	–	50				12
2N3666	TO-39	120	80	10	50	60	70 100 50	– 300 –	10 150 500	10 10 10	0.5 1.2	– –	1.2 1.8	150 500	12	60	–	50				12
2N3945	TO-39	70	50	8	–	–	25 40 20	– 250 –	10 150 500	10 10 10	0.5 1.8	– –	1.2 1.8	150 500	12	60	–	50				12
2N4943	TO-39	120	80	7	10	60	60 100 15	– 300 –	10 150 500	10 10 10	0.25	–	0.95	150	12	150	1000	50				12

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	$\frac{\Delta V_{BE1}-V_{BE2}}{\Delta T}$ ($\mu V/^\circ C$) 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	1	07
2N2640	TO-78	45	45	5	10	45	50 55 65	300 – –	0.01 0.1 1	20 – –	10 – –	20 – –	8	80	–	4	1	07
2N2641	TO-78	45	45	5	10	45	50 55 65	300 – –	0.01 0.1 1	– – –	– – –	– – –	8	80	–	4	1	07
2N2642	TO-78	45	45	5	10	45	100 110 130	300 – –	0.01 0.1 1	10 – –	5 – –	10 – –	8	80	–	4	1	07
2N2643	TO-78	45	45	5	10	45	100 110 130	300 – –	0.01 0.1 1	20 – –	10 – –	20 – –	8	80	–	4	1	07
2N2644	TO-78	45	45	5	10	45	100 110 130	300 – –	0.01 0.1 1	– – –	– – –	– – –	8	80	–	4	1	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 1	07
2N2914	TO-78	45	45	6	10	45	150 225 300	600 – –	0.01 0.1 1	– – –	– – –	– – –	6	60	–	3 3	2 1	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 1	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 1	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 1	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 1	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 1	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	150 225 300	600 – –	0.01 0.1 1	– 10 –	5 3 5	– 10 –	6	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 4	07

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°C to +125°C.

dual differential amps (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)	$\frac{h_{FE1}}{h_{FE2}}$ (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\frac{\Delta V_{BE1}-V_{BE2}}{\Delta T}$ ($\mu V/^\circ C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
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
2N2978	TO-71	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
2N2979	TO-71	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
2N3587	TO-78	60	45	5	10	40	50 80	– 500	0.1 1	– ‡20	– 20	– 20	8	80	200	10	3	07
2N3680	TO-78	60	50	6	10	45	150 225 300	600 – –	0.01 0.1 1	10 – –	3 – –	5 – –	6	60	180	3	3	07
2N3907	TO-78	60	45	6	10	45	60 70 120	300 500 –	0.01 0.1 1	– 10 –	2 1 2.5	– 5 –	6	60	240	4	3	07
2N3908	TO-78	60	60	6	2	45	100 125 200	500 800 –	0.01 0.1 1	– 10 –	2 1 2.5	– 5 –	6	60	240	3	2	07

Test Conditions:

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

‡$T_A = 0^\circ C$ to $+85^\circ C$.

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-18	25		5	10	15	20	–	10	5	–	–	1	10		100	–	10	18			64
											–	–	1	10								
2N995	TO-18	20	15	4	50	15	35	140	20	1	0.2	–	0.95	20	10	100	–	10				64
2N2411	TO-18	25	20	5	10	25	10		0.05	0.5	0.2	0.7	0.9	10	5	140		10	100		1	64
							20	60	10	0.5												
							10		50	1												
2N2412	TO-18	25	20	5	10	25	20		0.05	0	0.2	0.7	0.9	10	5	140		10	100		1	64
							40	120	10	0												
							20		50	1												
2N2894	TO-18	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-18	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-18	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-18	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								
2N3248	TO-18	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-18	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												
2N3250	TO-18	50	40	5			40	–	0.1	1	0.25	0.6	0.9	10	6	250	–	10	225	6	4	66
							45	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							45	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							45	–	1	1	0.5	–	1.2	50								
							50	150	10	1												
							15	–	50	1												
JANTX2N3250A	TO-18	60	60	5			40	–	0.1	1	0.25	0.6	0.9	10	6	250	–	10	225	6	4	66
							45	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							90	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							90	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							90	–	1	1	0.5	–	1.2	50								
							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	6	4	66
							90	–	1	1	0.5	–	1.2	50								
							100	300	10	1												
							30	–	50	1												
2N3304	TO-18	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-18	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								
2N3545	TO-18	20	20	5	10	10	30		1	1	0.2	0.65	0.85	10	8	250		10	90		7	64
							40	120	10	1	0.3		1.1	50								
							35		50	1	0.5		1.3	100								
							30		100	1												
2N3546	TO-18	15	12	4.5	10	10	20		1	1	0.15	0.7	0.9	10	6	700		10	30		6	64
							30	120	10	1	0.25	0.8	1.3	50								
							25		50	1	0.5		1.6	100								
2N3576	TO-18	20	15	5	10	15	40	120	10	0.5	0.15	0.75	0.95	10	4.5	400		10	50		7	64
					I_{CES}		10		100	1	0.5		1.1	100								
2N3639	TO-106	6	6	4	10	3	30	120	10	0.3	0.16			10/5	3.5	500	–	10	60		5	65
					I_{CES}		20	–	50	1	0.5	–	1.5	50		300	–	10				
											0.25	0.75	0.95	10/.5								
												0.8	1	10/1								

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

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.
2N3640	TO-106	12	12	4	10	6	30	120	10	0.3	0.2	0.8	1	10/1	3.5	500	–	10	35		6	65
					I_{CES}		20	–	50	1	0.6	–	1.5	50		300	–	10				
											0.3	0.75	0.95	10/.5								
2N4207	TO-18	6	6	4.5	10	3	40	–	50	1	0.13	0.8	–	1	3	650	–	10	15		7	65
					I_{CES}		50	120	10	0.3	0.15	0.8	0.95	10								
							35	–	1	0.5	0.5	–	1.5	50								
2N4208	TO-18	12	12	4.5	10	6	30	–	50	1	0.13	–	0.8	1	3	700	–	10	20		7	65
					I_{CES}		30	120	10	0.3	0.15	0.8	0.95	10								
							15	–	1	0.5	0.5	–	1.5	50								
2N4209	TO-18	15	15	4.5	10	8	40	–	50	1	0.15	–	0.8	1	3	850	–	10	20		7	65
					I_{CES}		50	120	10	0.3	0.18	0.8	0.95	10								
							35	–	1	0.5	0.6	–	1.5	50								
2N4257	TO-106	6	6	4.5	10	3	30	–	50	1	0.5	–	1.5	50	3	500	–	10	15		7	65
					I_{CES}		30	120	10	0.3	0.15	0.8	0.95	10								
							15	–	1	0.5												
2N4257A	TO-106	6	6	4.5	10	3	30	–	50	1	0.5	–	1.5	50	3	500	–	10	15		7	65
					I_{CES}		30	120	10	0.3	0.15	0.8	0.95	10								
							15	–	1	0.5												
2N4258	TO-106	12	12	4.5	10	6	30	–	50	1	0.5	–	1.5	50	3	700	–	10	20		7	65
					I_{CES}		30	120	10	0.3	0.15	–	0.95	10								
							15	–	1	0.5												
2N4258A	TO-106	12	12	4.5	10	6	30	–	50	1	0.5	–	1.5	50	3	700	–	10	18		8	65
					I_{CES}		30	120	10	0.3	0.15	0.8	0.95	10								
							15	–	1	0.5												
2N4313	TO-106	12	12	4.5	50	10	18	–	1	0.5	0.13	–	0.92	10	4	700	–	30	25		3	64
					I_{CES}		30	–	10	1	0.19	–	1.15	30								
							30	–	30	0.5	0.45	0.95	1.5	100								
							25	–	100	1												
2N4423	TO-106	12	12	4.0	80	6	30		10	0.3	0.15			10	6	400		30	50		3	64
					I_{CES}		40	150	30	0.5	0.2			30								
							20		100	1	0.5			100								
2N5055	TO-106	12	12	4.5	50	10	12	–	1	0.5	0.13	–	0.92	10	4.5	550	–	20	25		3	64
					I_{CES}		20	–	10	1	0.19	0.8	1.15	30								
							30	100	30	0.5	0.45	0.95	1.5	100								
							20	–	100	1												
2N5056	TO-18	15	15	4.5	50	10	12	–	1	0.5	0.13	0.72	0.92	10	4.5	600	–	30	35		3	64
					I_{CES}		20	–	10	0.3	0.19	0.8	1.15	30								
							30	100	30	0.5	0.45	0.95	1.5	100								
							20	–	100	1												
2N5057	TO-18	15	15	4.5	50	10	20	–	1	0.5	0.13	0.72	0.92	10	4.5	800	–	30	35		3	64
					I_{CES}		30	–	10	0.3	0.19	0.8	1.15	30								
							40	100	30	0.5	0.45	0.95	1.5	100								
							30	–	100	1												
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

Test Conditions:

3. I_C = 30 mA, I_{B1} = I_{B2} = 3 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 = 10 mA, I_{B1} = 0.5 mA, I_{B2} = −1 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 60 –	120 – 350	0.01 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30	–	0.5		4	1	62
JAN2N2604	TO-46	80	60	6	10	50	40 60 – –	120 – – 350	0.01 0.5 – 10	5 5 – 5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
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
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	100	0.25	–	–	10	6	–		–		–		62
2N4249	TO-106	60	60	5	10	40	100	300	0.1	100	0.25	–	–	10	6	–		–		3 3 3	6 7 8	62
2N4250	TO-106	40	40	5	10	40	250	700	0.1	5	0.25	–	–	10	6	–		–		2 2 2	6 7 8	62
2N4964	TO-106	50	40	5	25	20	30 40	120 –	0.01 10	5 5	0.4	–	–	10	8	60		1		6	9	62
2N4965	TO-106	50	40	5	25	20	80 100	400 –	0.01 10	5 5	0.4	–	–	10	8	60		1		6	9	62

Test Conditions:

1. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15.7 kHz
3. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, BW = 15 kHz
4. I_C = 20 μA, V_{CE} = 5V, f = 1 kHz, BW = 150 Hz, R_G = 10 kΩ
5. I_C = 20 μA, V_{CE} = 5V, f = 100 Hz, BW = 15 Hz, R_G = 10 kΩ
6. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz
7. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW = 150 Hz
8. I_C = 250 μA, V_{CE} = 5V, R_G = 1 kΩ, f = 1 kHz, BW = 150 Hz
9. I_C = 10 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz

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 25	90 –	150 5	10 10	1.5	–	1.3	150	45	60		50				63
2N1132	TO-5	50	35	5	1.0 µA	30	25* 30*	100 –	1 5	5 10	1.5	–	1.3	150	45	60		50				63
2N2904	TO-5	60	40	5	20	50	20 40 20	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
JAN2N2904	TO-5	60	40	5	20	50	20 25 35 40 20	– – – 120 –	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50	175		1	63
JANTX2N2904	TO-5	60	40	5	20	50	20 40 20	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2904A	TO-5	60	60	5	10	50	40 40 40	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
JAN2N2904A	TO-5	60	60	5	10	50	40 40 40 40 40	– – – 120 –	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200	–	50	175		1	63
JANTX2N2904A	TO-5	60	60	5	10	50	40 40 40	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2905	TO-5	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				63
JAN2N2905	TO-5	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
JANTX2N2905	TO-5	60	40	5	20	50	50 100 30	– 300 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2905A	TO-5	60	60	5	10	50	75 100 50	– 300 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
JAN2N2905A	TO-5	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
JANTX2N2905A	TO-5	60	60	5	10	50	75 100 50	– 300 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2906	TO-18	60	40	5	20	50	20 40 20	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
JAN2N2906	TO-18	60	40	5	20	50	20 25 35 40 20	– – – 120 –	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200	–	50	175		1	63
JANTX2N2906	TO-18	60	40	5	20	50	20 40 20	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2906A	TO-18	60	60	5	20	50	40 40 40	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
JAN2N2906A	TO-18	60	60	5	10	50	40 40 40 40 40	– – – 120 –	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200	–	50	175		1	63
JANTX2N2906A	TO-18	60	60	5	10	50	40 40 40	– 120 –	0.1 150 500	10 10 10	0.4 1.6	– –	1.3 2.6	150 500	8	200		50				63
2N2907	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				63
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				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

Test Condition:

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

general purpose amps and switches (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.
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				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				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				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				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				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
2N3502	TO-5	45	45	5	10 μA	30	80 120 135 140 100 50 115	– – – – 300 – 300	0.01 0.1 1 10 150 500 50	10 10 10 10 10 10 1	0.25 0.4 1.0 1.6	– – – –	1.0 1.3 2.0 20	50 150 300 500	8	200		50				63
2N3503	TO-5	60	60	5	10 μA	50	80 120 135 140 100 50 115	– – – – 300 – 300	0.01 0.1 1 10 150 500 50	10 10 10 10 10 10 1	0.25 0.4 1.0 1.6	– – – –	1.0 1.3 2.0 20	50 150 300 500	8	200		50				63
2N3504	TO-18	45	45	5	10 μA	30	80 120 135 140 100 50 115	– – – – 300 – 300	0.01 0.1 1 10 150 500 50	10 10 10 10 10 10 1	0.25 0.4 1.0 1.6	– – – –	1.0 1.3 2.0 20	50 150 300 500	8	200		50				63
2N3505	TO-18	60	60	5	10 μA	50	80 120 135 140 100 50 115	– – – – 300 – 300	0.01 0.1 1 10 150 500 50	10 10 10 10 10 10 1	0.25 0.4 1.0 1.6	– – – –	1.0 1.3 2.0 20	50 150 300 500	8	200		50				63
2N3638	TO-105	25	25	4	35	15	30 20	– –	50 300	2 1	1.0 0.25	0.8 –	2.0 1.1	300 50	20	100		50				63
2N3638A	TO-105	25	25	4	35	15	80 100 100 20	– – – –	1 10 50 300	2 1 10 10	1.0 0.15	0.8	2.0 1.1	300 50	10	150		50				63
2N3644	TO-105	45	45	5	35	30	40 80 100 115 100 20	– – – 300 300 –	0.1 1 10 50 150 300	10 10 10 10 2 1	1.0	0.8	2.0	300	8	200		20				63
2N3645	TO-105	60	60	5	35	50	40 80 100 115 100 20	– – – 300 300 –	0.1 1 10 50 150 300	10 10 10 10 2 1	1.0 0.25	0.8 –	2.0 1.0	300 50	8	200		20				63
2N3905	TO-92	40	40	5	–	–	30 40 50 30 15	– – 150 – –	0.1 1 10 50 100	1 1 1 1 1	0.25 0.4	0.65 –	0.65 0.95	10 50	4.5	200		10		5		66
2N3906	TO-92	40	40	5	–	–	60 80 100 60 30	– – 300 – –	0.1 1 10 50 100	1 1 1 1 1	0.25 0.4	0.65 –	0.85 0.95	10 50	4.5	250		10		4	2	66

Test Conditions:

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

general purpose amps and switches (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.
2N4121	TO-106	40	40	5	–	–	40 60 70 15	– – 200 –	0.1 1 10 50	1 1 1 1	0.13 0.14 0.3	– 0.7 –	0.75 0.9 1.1	1.0 10 50	4.5	400		10		4	2	66
2N4122	TO-106	40	40	5	–	–	100 150 150 30	– – 300 –	0.1 1 10 50	1 1 1 1	0.13 0.14 0.3 0.4	– 0.7 –	0.75 0.9 1.1	1.0 10 50 50	4.5	450		10		4	2	66
2N4125	TO-92	30	30	4	50	20	50 25	150 –	2 50	1 1	0.4	–	0.95	50	4.5	200		10		5	2	66
2N4126	TO-92	25	25	4	50	20	120 60	360 –	2 50	1 1	0.4	–	0.95	50	4.5	250		10		4	2	66
2N4142	TO-106	60	40	5	50	30	20 25 35 20 40 20	– – – – 120 –	0.1 1 10 150 150 500	10 10 10 1 10 1	0.4	–	1.3	150	8	200		50				63
2N4143	TO-106	60	40	5	50	30	35 50 75 50 100 30	– – – – 300 –	0.1 1 10 150 150 500	10 10 10 1 10 1	0.4	–	1.3	150	8	200		50		–		63
2N4228	TO-106	60	40	5	50	30	25 50 30 75 20	– – – 150 –	0.1 10 150 150 500	10 10 1 10 1	0.4	–	1.3	150	8	200		50		–		63
2N4402	TO-92	40	40	5.0	–	–	30 50 50 20	– – 150 –	1 10 150 500	1 1 1 2	0.4 0.75	0.75	.95 1.3	150 500	–	150		20	255	–	1	63
2N4403	TO-92	40	40	5.0	–	–	30 60 100 100 20	– – – 300 –	0.1 1 10 150 500	1 1 1 1 2	0.4 0.75	0.75	.95 1.2	150 500	–	200		20	255	–	1	63
2N4916	TO-106	30	30	5	–	–	40 60 70 15	– – 200 –	0.1 1 10 50	1 1 1 1	0.13 0.14 0.3	– 0.7 0.75	0.75 0.9 1.1	1 10 50	4.5	400		10		4	2	66
2N4917	TO-106	30	30	5	–	–	100 150 150 30	– – 300 –	0.1 1 10 50	1 1 1 1	0.13 0.14 0.3	– 0.7 0.75	0.75 0.9 1.1	1 10 50	4.5	450		10		–		66
2N4971	TO-106	50	40	5	25	30	30 20 40	– – 120	10 150 150	10 1 10	0.15	–	1.3	150	8	200		50		–		63
2N4972	TO-106	50	40	5	25	30	70 50 100	– – 300	10 150 150	10 1 10	0.4	–	1.3	150	8	200		50		–		63
2N5138	TO-106	30	30	5	50	20	50 50 50	800 – –	0.1 1 10	10 10 10	0.3	–	1.0	10	7	30		5		–	–	66
2N5139	TO-106	20	20	5	50	15	30 40 40	– – –	0.1 1 10	10 10 1	0.5	0.7	1.0	50	5	300		10		–	–	66
2N5142	TO-105	20	20	4	50	12	30 15	– –	50 300	1 10	2 0.5	0.8 –	2.5 1.5	300 50	10	100		50		–		66
2N5143	TO-106	20	20	4	50	12	30 15	– –	50 300	1 10	2 0.5	0.8 –	2.5 1.5	300 50	10	100		50		–		66
EN722	TO-106	50	35		1000	30	25 30	– 90	5.0 150	10 10	1.5	–	1.3	150	45	60		50	–	–		
EN1132	TO-105	50	35		1000	30	25 30	– 90	5.0 150	10 10	1.5	–	1.3	150	45	60		50	–	–		63
EN2905	TO-105	60	40		50	50	35 100 30	– 300 –	0.1 150 500	10 10 10	0.4 1	– –	1.3 2	150 300	8	150		50	–	–	6	63
EN2907	TO-106	60	40	5	50	50	35 100 30	– 300 –	0.1 150 500	10 10 10	0.4 1	– –	1.3 2	150 300	8	150		50	110	–	6	63
EN3502	TO-105	45	45	5	10 I_{CES}	30	80 120 135 140 115 100 30	– – – – 300 300 –	0.01 0.1 1 10 50 150 500	10 10 10 10 1 10 10	0.25 0.4 1	– – –	1 1.3 2	50 150 300	8	150		50	100	4	7 5	63
EN3504	TO-106	45	45	5	10 I_{CES}	30	80 120 135 140 115 100 30	– – – – 300 300 –	0.01 0.1 1 10 50 150 500	10 10 10 10 1 10 10	–	–	–	–	–	150		50	100	4	7 5	63
MPS3638	TO-92	25	25	4			20 30 20	– – –	10 50 300	10 1 2	0.25	–	1.1	50	20	100	–	50	170		4	63
MPS3638A	TO-92	25	25	4			80 100 100 20	– – – –	1 10 50 300	10 10 1 2	0.25 1	– 0.8	1.1 2	50 300	10	150	–	50	170		4	63
MPS3702	TO-92	25	40	5	100	20	60	300	50	5	0.25	–	–	50	12	100	–	50				63
MPS3703	TO-92	30	50	5	100	20	30	150	50	5	0.25	–	–	50	12	100	–	50				63
MPS6516	TO-92	40	40	4	50	30	50 30	100 –	2 100	10 10	0.5	–	–	50	4							66
MPS6517	TO-92	40	40	4	50	30	90 60	180 –	2 100	10 10	0.5	–	–	50	4							66
MPS6518	TO-92	40	40	4	500	30	150 90	300 –	2 100	10 10	0.5	–	–	50	4							66
MPS6522	TO-92	25	25	4	50	20	100 200	– 400	0.1 2	10 10	0.5	–	–	50	4					3	3	66

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.
MPS6533	TO-92	40	40	4	50	30	30	–	10	1	0.5	–	1	100	6							63
							40	120	100	1												
							25	–	500	10												
MPS6534	TO-92	40	40	4	50	30	60	–	10	1	0.3	–	1	100	6							63
							90	270	100	1												
							50	–	500	10												
MPS6535	TO-92	30	30	4	100	20	30	–	100	1	0.5	–	1.2	100	6							63

Test Conditions:

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. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA
5. I_C = 30 μA, V_{CE} = 15V, R_S = 10 kΩ, 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

PNP 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.
2N4030	TO-39	60	60	5	50	50	30	–	0.10	5	0.15	–	0.9	150	20	100		50				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				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				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				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				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												
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												

Test Conditions:

1. $I_C = 100\ \mu A$, $V_{CE} = 10V$,
   $R_G = 1\ k\Omega$, $BW = 1\ Hz$

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)	h_{FE1}/h_{FE2} (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\Delta V_{BE1}-V_{BE2}$/ΔT (μV/°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	6 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	7 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	6 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	6 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		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	6 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
2N4020	TO-78	45	45	6	10	30	250 250 250 180	500 550 600	0.01 0.1 1 50	– 20 20 –	– 5 10 –	– 20 – –	6	50	160	4 2	10 11	62
2N4021	TO-78	60	60	6	10	50	100 100 100 90	350 400 500	0.01 0.1 1 50	– 20 20 –	– 5 10 –	– 20 – –	6	40	160	10 3	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 kHz, 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} = 5V, R_G = 3 kΩ, f = 100 Hz, BW = 20 Hz
7. I_C = 100 μA, V_{CE} = 5V, R_G = 3 kΩ, f = 1 kHz, BW = 20 Hz
8. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 2 kHz, BW = 200 Hz
9. I_C = 30 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW = 200 Hz
10. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 1 kHz, BW · 150 Hz
11. I_C = 20 μA, V_{CE} = 5V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz

dual differential 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)	h_{FE1}/h_{FE2} (%) Max	$V_{BE_1}-V_{BE_2}$ (mV) Max	$\Delta V_{BE1}-V_{BE2}/\Delta T$ ($\mu V/°C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N4022	TO-78	60	60	6	10	50	250	500	0.01	–	–	–	6	50	160	4	11	62
							250	550	0.1	20	5	20				2	10	
							250	600	1	20	10	–						
							180		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	–	–	–						
2N4025	TO-78	60	60	6	10	50	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	–	–	–						

Test Conditions:

10. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $f = 1\ kHz$, $BW = 150\ Hz$

11. $I_C = 20\ \mu A$, $V_{CE} = 5V$, $R_G = 10\ k\Omega$, $f = 100\ Hz$, $BW = 15\ Hz$

N-Channel FETs

switches

Type No.	Case Style	BV_{GSS} *BV_{DGO} (V) Min	I_{GSS} (nA) Max	I_{DSS} (mA) Min	Max	$I_{D(off)}$ (nA) Max	$V_{p(off)}$ (V) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$r_{ds(on)}$ (ohms) Max	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N3824	TO-72	50	0.1			0.1	8	6	3	250			55
2N3966	TO-72	30	0.1	2		0.1	6	6	1.5	220	100		50
2N3970	TO-18	40	0.25	50	150	0.25	10	25	6	30	20	30	51
2N3971	TO-18	40	0.25	25	75	0.25	5	25	6	60	30	60	51
2N3972	TO-18	40	0.25	5	30	0.25	3	25	6	100	80	100	51
2N4091	TO-18	40	0.2	30		0.2	10	16	5	30	25	40	51
2N4092	TO-18	40	0.2	15		0.2	7	16	5	50	35	60	51
2N4093	TO-18	40	0.2	8		0.2	5	16	5	80	60	80	51
2N4391	TO-18	40	0.1	50	150	0.1	10	14	3.5	30	20	35	51
2N4392	TO-18	40	0.1	25	75	0.1	5	14	3.5	60	20	55	51
2N4393	TO-18	40	0.1	5	30	0.1	3	14	3.5	100	20	80	51
2N4856	TO-18	40	0.25	50		0.25	10	18	8	25	9	25	51
2N4856A	TO-18	40	0.25	50		0.25	10	10	4	25	8	20	51
2N4857	TO-18	40	0.25	20	100	0.25	6	18	8	40	10	50	51
2N4857A	TO-18	40	0.25	20	100	0.25	6	10	3.5	40	10	40	51
2N4858	TO-18	40	0.25	8	80	0.25	4	18	8	60	20	100	51
2N4858A	TO-18	40	0.25	8	80	0.25	4	10	3.5	60	16	80	51
2N4859	TO-18	30	0.25	50		0.25	10	18	8	25	9	25	51
2N4859A	TO-18	30	0.25	50		0.25	10	10	4	25	8	20	51
2N4860	TO-18	30	0.25	20	100	0.25	6	18	8	40	10	50	51
2N4860A	TO-18	30	0.25	20	100	0.25	6	10	3.5	40	10	40	51
2N4861	TO-18	30	0.25	8	80	0.25	4	18	8	60	20	100	51
2N4861A	TO-18	30	0.25	8	80	0.25	4	10	3.5	60	16	80	51
2N5432	TO-52	25	0.2	150		0.2	10	30	15	5	5	36	58
2N5433	TO-52	25	0.2	100		0.2	9	30	15	7	5	36	58
2N5434	TO-52	25	0.2	30		0.2	4	30	15	10	5	36	58
2N5555	TO-92 EPOXY	25	1	15		10	10	5	1.2	150	10	25	50
2N5638	TO-92 EPOXY	30	1	50		1	12	10	4	30	9	15	51
2N5639	TO-92 EPOXY	30	1	25		1	8	10	4	60	14	30	51
2N5640	TO-92 EPOXY	30	1	5		1	6	10	4	100	18	45	51
2N5653	TO-92 EPOXY	30	1	40		1	12	10	3.5	50	9	15	51
2N5654	TO-92 EPOXY	30	1	15		1	8	10	3.5	100	14	30	51
KE4091	TO-106 EPOXY	40	1	30		1	10	16	5	30	25	40	51
KE4092	TO-106 EPOXY	40	1	15		1	7	16	5	50	35	60	51
KE4093	TO-106 EPOXY	40	1	8		1	5	16	5	80	60	80	51
KE4391	TO-106 EPOXY	40	1	50	150	1	10	14	3.5	30	20	35	51
KE4392	TO-106 EPOXY	40	1	25	75	1	5	14	3.5	60	20	35	51
KE4393	TO-106 EPOXY	40	1	5	30	1	3	14	3.5	100	20	80	51
KE4856	TO-106 EPOXY	40	1	50		1	10	18	8	25	9	25	51
KE4857	TO-106 EPOXY	40	1	20	100	1	6	18	8	40	10	50	51
KE4858	TO-106 EPOXY	40	1	8	80	1	4	18	8	60	20	100	51
KE4859	TO-106 EPOXY	30	1	50		1	10	18	8	25	9	25	51
KE4860	TO-106 EPOXY	30	1	20	100	1	6	18	8	40	10	50	51
KE4861	TO-106 EPOXY	30	1	8	80	1	4	18	8	60	20	100	51
NF510	TO-18	30	10	5			10			100			51
NF511	TO-18	20	100	5			10			100			51
NF580	TO-52	25	1			1	12	25	13	5	5	25	58
NF581	TO-52	25	1			1	10	25	13	6	5	25	58
NF582	TO-52	25	1			1	6	25	13	10	5	25	58
NF583	TO-52	25	1			1	4	25	13	20	10	25	58
NF584	TO-52	15	50			50	10	25	13	10			58
NF585	TO-52	15	50			50	6	25	13	20			58
NF4445	TO-52	25	3	150		3	10	50	25	5	35	35	58
NF4446	TO-52	25	3	100		3	10	50	25	10	35	35	58
NF4447	TO-52	20	3	150		3	10	50	25	6	35	35	58
NF4448	TO-52	20	3	100		3	10	50	25	12	35	35	58
NF5555	TO-72	25	1	15		10	10	5	1.2	150	10	25	50
NF5638	TO-18	30	1	50		1	12	10	4	30	9	15	51
NF5639	TO-18	30	1	25		1	8	10	4	60	14	30	51
NF5640	TO-18	30	1	5		1	6	10	4	100	18	45	51
NF5653	TO-18	30	1	40		1	12	10	3.5	50	9	15	51
NF5654	TO-18	30	1	15		1	8	10	3.5	100	14	30	51
TIXS41	TO-18	30	0.2	50		0.5	10	18	8	25			51
TIS73	TO-106 EPOXY†	30	2	50		2	10	18	8	25	9	25	51
TIS74	TO-106 EPOXY†	30	2	20	100	2	6	18	8	40	10	50	51
TIS75	TO-106 EPOXY†	30	2	8	80	2	4	18	8	60	20	100	51
U1897E	TO-106 EPOXY	*40	1	30			10	16		30	25	40	51
U1898E	TO-106 EPOXY	*40	1	15			7	16		50	35	60	51
U1899E	TO-106 EPOXY	*40	1	8			5	16		80	60	80	51
UC250	TO-18	30	1	50	150		10	25		30			51
UC251	TO-18	30	1	7.5	75		6	25		75			51

† Denotes pin configuration modified from original manufacturer.

N-Channel FETs

RF amps

Type No.	Case Style	BV_{GSS} $*BV_{DGO}$ (V) Min	I_{GSS} (nA) Max	I_{DSS} (mA) Min	Max	Y_{fs} (μmho) Min	@ f (MHz)	$V_{p(off)}$ (V) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	G_p (dB) Min	@ f (MHz)	NF (dB) Max	@ f (MHz)	@ R_{gen} (kΩ)	Process No.
2N3821	TO-72	50	0.1	0.5	2.5	1500	100	4	6	3						55
2N3822	TO-72	50	0.1	4	20	3000	100	6	6	3						55
2N3823	TO-72	30	0.5	4	20	3200	200	8	6	2			2.5	100	1	50
2N4223	TO-72	30	0.25	3	18	2700	200	8	6	2	10	200				50
2N4224	TO-72	30	0.5	2	20	1700	200	8	6	2						50
2N4416	TO-72	30	0.1	5	15	4000	400	6	4	0.8	10	400	4	400	1	50
2N4416A	TO-72	35	0.1	5	15	4000	400	6	4	0.8	10	400	4	400	1	50
2N5078	TO-72	*30	0.25	4	25	4000	200	8	6	2	12	400	4	400	1	50
2N5103	TO-72	25	0.1	1	8	1500	100	4	5	1						50
2N5104	TO-72	25	0.1	2	6	2000	100	4	5	1						50
2N5105	TO-72	25	0.1	5	15	3500	100	4	5	1						50
2N5245	TO-106 EPOXY†	30	1	5	15	4000	400	6	4.5	1	10	400	4	400	1	50
2N5246	TO-106 EPOXY†	30	1	1.5	7	2500	400	4	4.5	1						50
2N5247	TO-106 EPOXY†	30	1	8	24	4000	400	8	4.5	1						50
2N5248	TO-92 EPOXY†	30	5	4	20	3000	200	8	6	2						50
2N5484	TO-92 EPOXY	25	1	1	5	2500	100	3	5	1	16	100	3	100	1	50
2N5485	TO-92 EPOXY	25	1	4	10	3000	400	4	5	1	10	400	4	400	1	50
2N5486	TO-92 EPOXY	25	1	8	20	3500	400	6	5	1	10	400	4	400	1	50
2N5668	TO-92 EPOXY	25	2	1	5	1000	100	4	7	3	16	100	2.5	100	1	50
2N5669	TO-92 EPOXY	25	2	4	10	1600	100	6	7	3	16	100	2.5	100	1	50
2N5670	TO-92 EPOXY	25	2	8	20	2500	100	8	7	3	16	100	2.5	100	1	50
KE4416	TO-106 EPOXY	30	1	5	15	4000	400	6	4	1	10	400	4	400	1	50
MPF102	TO-92 EPOXY	25	2	2	20	1600	100	8	7	3						50
MPF106	TO-92 EPOXY	25	1	4	10			4	5	2	10	400	2	100	1	50
MPF107	TO-92 EPOXY	25	1	8	20			6	5	2	10	400	2	100	1	50
MPF108	TO-92 EPOXY	25	1	1.5	24	1600	100	8	6.5	2.5			3	100	1	50
MPF112	TO-92 EPOXY†	20	100	1	25	1000		10								50
NF500	TO-72	25	10	1	30			8								50
NF501	TO-72	15	50	1	30			8								50
NF506	TO-72	25	1	4	15			5	4	1	18	100	2	100	1	50
NF5485	TO-72	25	1	4	10	3000	400	4	5	1	10	400	4	400	1	50
NF5486	TO-72	25	1	8	20	3500	400	6	5	1	10	400	4	400	1	50
TIS34	TO-106 EPOXY†	30	5	4	20	3000	200	8	6	2						50
TIS88	TO-106 EPOXY†	30	1	5	15	4000	400	6	4.5	1	10	400	4	400	1	50
U1837E	TO-106 EPOXY	30	1	4	25	4000	200	8	6	2						50
U1994E	TO-106 EPOXY	30	1	5	15	4000	400	6	4	1	10	400	4	400	1	50
UC734	TO-72	30	5	4	20	3000	200	8	4	0.8						50
UC734E	TO-106 EPOXY	30	5	4	20	3000	200	8	4	1						50

† Denotes pin configuration modified from original manufacturer.

low noise amps

Type No.	Case Style	BV_{GSS} $*BV_{DGO}$ (V) Min	I_{GSS} (nA) Max	I_{DSS} (mA) Min	Max	Y_{fs} (μmho) Min	Max	$V_{p(off)}$ (V) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) (*e_n in nV/$\sqrt{Hz}$) Max	@ f (kHz)	@ R_{gen} (MΩ)	Process No.
2N3458	TO-18	*50	0.25	3	15	2500	10000	8	18		1	1	1	52
2N3459	TO-18	*50	0.25	0.8	4	1500	6000	4	18		1	1	1	52
2N3460	TO-18	*50	0.25	0.2	1	800	4500	2	18		1	1	1	52
2N3684	TO-72	50	0.1	2.5	7.5	2000	3000	5	4	1.2	0.5	0.1	10	52
2N3685	TO-72	50	0.1	1	3	1500	2500	3.5	4	1.2	0.5	0.1	10	52
2N3686	TO-72	50	0.1	0.4	1.2	1000	2000	2	4	1.2	0.5	0.1	10	52
2N3687	TO-72	50	0.1	0.1	0.5	500	1500	1.2	4	1.2	0.5	0.1	10	52
2N4338	TO-18	50	0.1	0.2	0.6	600	1800	1	6	2	1	1	1	52
2N4339	TO-18	50	0.1	0.5	1.5	800	2400	1.8	6	2	1	1	1	52
2N4340	TO-18	50	0.1	1.2	3.6	1300	3000	3	6	2	1	1	1	52
2N4341	TO-18	50	0.1	3	9	2000	4000	6	6	2	1	1	1	52
KE3684	TO-106 EPOXY	50	1	2.5	7.5	2000	3000	5	4	1.2	0.5	0.1	10	52
KE3685	TO-106 EPOXY	50	1	1	3	1500	2500	3.5	4	1.2	0.5	0.1	10	52
KE3686	TO-106 EPOXY	50	1	0.4	1.2	1000	2000	2	4	1.2	0.5	0.1	10	52
KE3687	TO-106 EPOXY	50	1	0.1	0.5	500	1500	1.2	4	1.2	0.5	0.1	10	52

N-Channel FETs

general purpose amps

Type No.	Case Style	BV_{GSS} $^*BV_{DGO}$ (V) Min	I_{GSS} (nA) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	Y_{fs} (μmhos) Min	Y_{fs} (μmhos) Max	$V_{p(off)}$ (V) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) (*e_n in $nV/\sqrt{Hz}$) Max	Process No.
2N3069	TO-18	*50	1	2	10	1000	2500	10	15		4	52
2N3070	TO-18	*50	1	0.5	2.5	750	2500	5	15		4	52
2N3071	TO-18	*50	1	0.1	0.6	500	2500	2.5	15		4	52
2N3365	TO-18	*40	5	0.8	4	400	2000	12	15			52
2N3366	TO-18	*40	5	0.2	1	250	1000	7	15			52
2N3367	TO-18	*40	5		0.25	100	1000	2.5	15			52
2N3368	TO-18	*40	5	2	12	1000	4000	12	20			52
2N3369	TO-18	*40	5	0.5	2.5	600	2500	7	20			52
2N3370	TO-18	*40	5	0.1	0.6	300	2500	3.5	20			52
2N3436	TO-18	*50	0.5	3	15	2500	10000	10	18		2	52
2N3437	TO-18	*50	0.5	0.8	4	1500	6000	5	18		2	52
2N3438	TO-18	*50	0.5	0.2	1	800	4500	2.5	18		2	52
2N3819	TO-106 EPOXY†	25	2	2	20	2000	6500	8	8	4		50
2N3967	TO-72	30	0.1	2.5	10	1600	2400	5	5	1.3	1.5	50
2N3967A	TO-72	30	0.1	2.5	10	1600	2400	5	5	1.3	1.5	50
2N3968	TO-72	30	0.1	1	5	1400	2000	3	5	1.3	1.5	50
2N3968A	TO-72	30	0.1	1	5	1400	2000	3	5	1.3	1.5	50
2N3969	TO-72	30	0.1	0.4	2	950	1450	1.7	5	1.3	1.5	50
2N3969A	TO-72	30	0.1	0.4	2	950	1450	1.7	5	1.3	1.5	50
2N4220	TO-72	30	0.1	0.5	3	1000	4000	4	6	2		55
2N4220A	TO-72	30	0.1	0.5	3	1000	4000	4	6	2	2.5	55
2N4221	TO-72	30	0.1	2	6	2000	5000	6	6	2		55
2N4221A	TO-72	30	0.1	2	6	2000	5000	6	6	2	2.5	55
2N4222	TO-72	30	0.1	5	15	2500	6000	8	6	2		55
2N4222A	TO-72	30	0.1	5	15	2500	6000	8	6	2	2.5	55
2N4302	TO-106 EPOXY	*30	1	0.5	5	1000		4	6	3	2	55
2N4303	TO-106 EPOXY	*30	1	4	10	2000		6	6	3	2	55
2N4304	TO-106 EPOXY	*30	1	0.5	15	1000		10	6	3	3	55
2N5163	TO-106 EPOXY	25	10	1	40	2000	9000	8	20	5		50
2N5358	TO-72	40	0.1	0.5	1	1000	3000	3	6	2	*115	55
2N5359	TO-72	40	0.1	0.8	1.6	1200	3600	4	6	2	*115	55
2N5360	TO-72	40	0.1	1.5	3	1400	4200	4	6	2	*115	55
2N5361	TO-72	40	0.1	2.5	5	1500	4500	6	6	2	*115	55
2N5362	TO-72	40	0.1	4	8	2000	5500	7	6	2	*115	55
2N5363	TO-72	40	0.1	7	14	2500	6000	8	6	2	*115	55
2N5364	TO-72	40	0.1	9	18	2700	6500	8	6	2	*115	55
2N5457	TO-92 EPOXY	25	1	1	5	1000	5000	6	7	3		55
2N5458	TO-92 EPOXY	25	1	2	9	1500	5500	7	7	3		55
2N5459	TO-92 EPOXY	25	1	4	16	2000	6000	8	7	3		55
E100	TO-106 EPOXY	30	0.5	0.2	20	500		10	8	3		55
E101	TO-106 EPOXY	30	0.5	0.2	1	500		1.5	8	3		55
E102	TO-106 EPOXY	30	0.5	0.9	4.5	1000		4	8	3		55
E103	TO-106 EPOXY	30	0.5	4	20	1500		10	8	3		55
MPF103	TO-92 EPOXY	25	1	1	5	1000	5000	6	7	3		55
MPF104	TO-92 EPOXY	25	1	2	9	1500	5500	7	7	3		55
MPF105	TO-92 EPOXY	25	1	4	16	2000	6000	8	7	3		55
MPF109	TO-92 EPOXY	25	1	0.5	24	800	6000	8	7	3	2.5	55
MPF110	TO-92 EPOXY†	20	100	0.5	20							55
MPF111	TO-92 EPOXY†	20	10	0.5	20	500		10				55
NF520	TO-72	30	1	1	10	500		8				52
NF521	TO-72	30	1	0.1	2	500		8				52
NF522	TO-72	20	10	1	10	500		8				52
NF523	TO-72	20	10	0.1	2	500		8				52
NF530	TO-18	30	1	1	10	500		8				52
NF531	TO-18	30	1	0.1	2	500		8				52
NF532	TO-18	20	10	1	10	500		8				52
NF533	TO-18	20	10	0.1	2	500		8				52
NF5457	TO-18	25	1	1	5	1000	5000	6	7	3		55
NF5458	TO-18	25	1	2	9	1500	5500	7	7	3		55
NF5459	TO-18	25	1	4	16	2000	6000	8	7	3		55
KE4220	TO-106 EPOXY	30	1	0.5	3	1000	4000	4	6	2		55
KE4221	TO-106 EPOXY	30	1	2	6	2000	5000	6	6	2		55
KE4222	TO-106 EPOXY	30	1	5	15	2500	6000	8	6	2		55
TIS58	TO-92 EPOXY†	25	4	2.5	8	1300	4000	5	6	3		50
UC714	TO-18	30	1	2	20	2000	6500	8	8	4	2	55

† Denotes pin configuration modified from original manufacturer.

N-Channel FETs

monolithic duals

Type No.	Case Style	BV_{GSS} (V) Min	I_{GSS} (nA) Max	I_G (pA) Max	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	Y_{fs} (μmhos) Min	Y_{fs} (μmhos) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	Y_{os} (μmhos) Max	$V_{GS1}-V_{GS2}$ (mV) Max	$\Delta V_{GS}/\Delta T$ (μV/°C) Max	$I_{G1}-I_{G2}$ @125°C (nA) Max	I_{DSS1}/I_{DSS2} Min	Process No.
FM1100	TO-99	35	0.1	50	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	35	2	5	10	0.99	59
FM1100A	TO-99	35	–	1.0	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	3.5	2	5	.04	0.99	82
FM1101	TO-99	35	0.1	50	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	35	5	5	10	0.99	59
FM1101A	TO-99	35	–	1.0	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	3.5	5	5	.04	0.99	82
FM1102	TO-99	35	0.1	50	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	35	10	5	10	0.98	59
FM1102A	TO-99	35	–	1.0	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	3.5	10	5	.04	0.98	82
FM1103	TO-99	35	0.1	50	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	35	10	20	10	0.98	59
FM1103A	TO-99	35	–	1.0	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	3.5	10	20	.04	0.98	82
FM1104	TO-99	35	0.1	50	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	35	25	50	10	0.95	59
FM1104A	TO-99	35	–	1.0	0.5	3.0	0.1	1.2	500	3000	5.0	0.6	3.5	25	50	.04	0.95	82
FM1105	TO-99	35	0.1	50	1.0	6.0	1.0	10.0	1000	6000	5.0	0.6	50	2	5	10	0.99	59
FM1105A	TO-99	35	–	1.0	1.0	6.0	1.0	10	1000	6000	5.0	0.6	5.0	2	5	.04	0.99	82
FM1106	TO-99	35	0.1	50	1.0	6.0	1.0	10.0	1000	6000	5.0	0.6	50	5	5	10	0.99	59
FM1106A	TO-99	35	–	1.0	1.0	6.0	1.0	10	1000	6000	5.0	0.6	5.0	5	5	.04	0.99	82
FM1107	TO-99	35	0.1	50	1.0	6.0	1.0	10.0	1000	6000	5.0	0.6	50	10	5	10	0.98	59
FM1107A	TO-99	35	–	1.0	1.0	6.0	1.0	10	1000	6000	5.0	0.6	5.0	10	5	.04	0.98	82
FM1108	TO-99	35	0.1	50	1.0	6.0	1.0	10.0	1000	6000	5.0	0.6	50	10	20	10	0.98	59
FM1108A	TO-99	35	–	1.0	1.0	6.0	1.0	10	1000	6000	5.0	0.6	5.0	10	20	.04	0.98	82
FM1109	TO-99	35	0.1	50	1.0	6.0	1.0	10.0	1000	6000	5.0	0.6	50	25	50	10	0.95	59
FM1109A	TO-99	35	–	1.0	1.0	6.0	1.0	10	1000	6000	5.0	0.6	5.0	25	50	.04	0.95	82
FM1110	TO-99	25	1	500	0.5	10	0.1	10.0	500	6000	5.0	0.6	50	10	20	50	0.95	59
FM1110A	TO-99	25	–	5.0	0.5	10	0.1	10	500	6000	5.0	0.6	5.0	10	20	.20	0.95	82
FM1111	TO-99	25	1	500	0.5	10	0.1	10.0	500	6000	5.0	0.6	50	50	100	50	0.90	59
FM1111A	TO-99	25	–	5.0	0.5	1.0	0.1	10	500	6000	5.0	0.6	5.0	50	100	.20	0.90	82
FM1200	TO-99	35	0.2	100	0.5	2.0	0.2	2.5	800	4500	8.0	1.0	35	2	5	10	0.99	54
FM1201	TO-99	35	0.2	100	0.5	2.0	0.2	2.5	800	4500	8.0	1.0	35	5	5	10	0.99	54
FM1202	TO-99	35	0.2	100	0.5	2.0	0.2	2.5	800	4500	8.0	1.0	35	10	5	10	0.98	54
FM1203	TO-99	35	0.2	100	0.5	2.0	0.2	2.5	800	4500	8.0	1.0	35	10	20	10	0.98	54
FM1204	TO-99	35	0.2	100	0.5	2.0	0.2	2.5	800	4500	8.0	1.0	35	25	50	10	0.95	54
FM1205	TO-99	35	0.2	100	1.0	7.0	2.0	20	3000	10000	8.0	1.0	50	2	5	10	0.99	54
FM1206	TO-99	35	0.2	100	1.0	7.0	2.0	20	3000	10000	8.0	1.0	50	5	5	10	0.99	54
FM1207	TO-99	35	0.2	100	1.0	7.0	2.0	20	3000	10000	8.0	1.0	50	10	5	10	0.98	54
FM1208	TO-99	35	0.2	100	1.0	7.0	2.0	20	3000	10000	8.0	1.0	50	10	20	10	0.98	54
FM1209	TO-99	35	0.2	100	1.0	7.0	2.0	20	3000	10000	8.0	1.0	50	25	50	10	0.95	54
FM1210	TO-99	25	1	500	0.5	7.0	0.2	20	800	10000	8.0	1.0	50	10	20	50	0.90	54
FM1211	TO-99	25	1	500	0.5	7.0	0.2	20	800	10000	8.0	1.0	50	50	100	50	0.85	54
FM3954A	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	5	5	10	0.95	59
FM3954	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	5	10	10	0.95	59
FM3955A	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	5	15	10	0.95	59
FM3955	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	10	25	10	0.95	59
FM3956	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	15	50	10	0.95	59
FM3957	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	20	75	10	0.90	59
FM3958	TO-99	50	0.1	50	1.0	4.5	0.5	5.0	1000	4000	4.0	1.2	35	25	100	10	0.85	59

P-Channel FETs

switches

Type No.	Case Style	BV_{GSS} *BV_{DGO} (V) Min	I_{GSS} (nA) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	$I_{D(off)}$ (nV) Max	$V_{p(off)}$ (V) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$r_{ds(on)}$ (ohms) Max	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N5018	TO-18P	30	2	10		10	10	45	10	75	20	30	88
2N5019	TO-18P	30	2	5		10	5	45	10	150	75	40	88
2N5114	TO-18P	30	0.5	30	90	0.5	10	25	7	75	16	21	88
2N5115	TO-18P	30	0.5	15	60	0.5	6	25	7	100	32	42	88
2N5116	TO-18P	30	0.5	5	25	0.5	4	25	7	150	45	75	88
P1086E	TO-106 EPOXY	30	2	10		10	10	45	10	75	20	30	88
P1087E	TO-106 EPOXY	30	2	5		10	5	45	10	150	75	40	88
PF510	TO-18P	30	10	5			10			200			88
PF511	TO-18P	20	100	5			10			200			88
UC450	TO-18P	25	.25	25	75		10	25		60			88
UC451	TO-18P	25	.25	3.75	37.5		6	25		150			88

Pro-electron Series

Type No.	Case Style	BV_{CBO} (V) Min	BV_{CEO} BV_{CES}* (V) Min	BV_{EBO} (V) Min	I_{CBO} I_{CES}* (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 I_{CES}	50	125*	900	2	5	0.2 0.6 –	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC107A	TO-18	50	45	6	15 I_{CES}	50	125*	260	2	5	0.2 0.6 –	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC107B	TO-18	50	45	6	15 I_{CES}	50	240*	500	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC108	TO-18	30	20	5	15 I_{CES}	30	125*	900	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC108A	TO-18	30	20	5	15 I_{CES}	30	125*	260	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC108B	TO-18	30	20	5	15 I_{CES}	30	240*	500	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC108C	TO-18	30	20	5	15 I_{CES}	30	450*	900	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	10	1	27
BC109	TO-18	30	20	5	15 I_{CES}	30	240*	900	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	4 4	1 2	27
BC109B	TO-18	30	20	5	15 I_{CES}	30	240*	500	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	4 4	1 2	27
BC109C	TO-18	30	20	5	15 I_{CES}	30	450*	900	2	5	0.2 0.6	– 0.55	– 0.7	10 100 2	4.5	150		10	–	4 4	1 2	27
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	–	–		27
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
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
BC170A	TO-106	20	20	5	100	15	35 30	100 –	1 30	1 1	0.25 0.4	–	0.7	1 30								27
BC170B	TO-106	20	20	5	100	15	80 60	250 –	1 30	1 1	0.25 0.4		0.7	1 30								27
BC170C	TO-106	20	20	5	100	15	200 150	600	1 30	1 1	0.25 0.4		0.7	1 30								27
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	27
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	27
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	27
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	27
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	27

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

Pro-electron Series

Type No.	Case Style	BV_{CBO} (V) Min	BV_{CEO} BV_{CES}* (V) Min	BV_{EBO} (V) Min	I_{CBO} I_{CES}* (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.
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	27
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	(5 typ) 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	(5 typ) 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	(5 typ) 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	(5 typ) 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	(5 typ) 10	200		10	–	10	1	63
BC213KB	TO-106	45	30	5	15	30	40 80	– –	0.01 2	5 5	– 0.25 0.6	0.6	0.72 1.1	2 10 100	(5 typ) 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	(5 typ) 10	200		10	–	10	1	63
BC214K	TO-106	45	30	5	15	30	100 140 120	– 400 –	0.01 2 100	5 5 5	– 0.25 0.6	0.6	0.72 1.1	2 10 100	(5 typ) 10	200		10	–	2	2	63
BC214KA	TO-106	45	30	5	15	30	100 140 120 100*	– 400 – 300	0.01 2 100 2	5 5 5 5	– 0.25 0.6	0.6	0.72 1.1	2 10 100	(5 typ) 10	200		10	–	2	2	63

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
5. I_C = 200 μA, V_{CE} = 5V, R_G = 2 kΩ, f = 20 Hz to 15 kHz

Pro-electron Series

Type No.	Case Style	BV_{CBO} (V) Min	BV_{CEO} BV_{CES}* (V) Min	BV_{EBO} (V) Min	I_{CBO} I_{CES}* (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.
BC214KB	TO-106	45	30	5	15	30	100 140 120	– 400 –	0.01 2 100	5 5 5	– 0.25 0.6	0.6	0.72 1.1	2 10 100	(5 typ) 10	200		10	–	2	2	63
BC214KC	TO-106	45	30	5	15	30	100 140 120	– 400 –	0.01 2 100	5 5 5	– 0.25 0.6	0.6	0.72 1.1	2 10 100	(5 typ) 10 –	200 –		0 –	– –	2	2	63
BC251A	TO-106	–	45	5	50	45	125*	260	2	5	0.25 0.6	– –	0.9 –	10 100	– –	– –		– –	– –	6	1	71
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
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 H	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	6 H	71
BCY87	TO-78	45	40	5	1	20	80 100 10%	– 450 match	0.005 0.05 0.1	–	– –	V_{BE1}–V_{BE2} –	 0.003	0.1	3.5 –	10 50		0.05 0.5	– –	3 4	7 8	07
BCY88	TO-78	45	40	5	1	20	100 120 20%	450 600 match	0.05 0.5 0.1	10 10 10	– –	V_{BE1}–V_{BE2} –	 0.006	0.1	3.5 –	10 50		0.05 0.5	– –	4 5	7 8	07
BCY89	TO-78	45	40	5	10	20	100 100 30%	450 600 match	0.05 10 0.1	10 10 10	– –	V_{BE1}–V_{BE2} –	 0.01	0.1	3.5 –	10 50		0.05 0.5	– –	4 5	7 8	07
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
BFX29	TO-5	60	60	–	50	50	20 40 50 50 100* 40	– – – – 400 –	0.1 1 10 50 1 150	10 10 10 10 10 10	0.4 –	– –	1.3 0.9	150 30	12 –	100		50 –	150 –	–	F	63
BFX65	TO-18	45	45	6	10 I_{CES}	40	100 100 100 120	– – – –	0.1 1 10 1	5 5 5 5	0.25	–	0.9	10	6.5	–		–	–	3	4	62
BFX84	TO-39	100	60	5	500 50	100 80	20 30 20 15 10* 15*	– – – – – –	10 150 500 1000 1 10	10 10 10 10 5 5	0.15 0.35 1.0 1.6	– – – –	1.2 1.3 1.5 2.0	10 150 500 1000	12 – – –	50 – – –		50 – – –	360 – – –	– – – –	E	14
BFX85	TO-39	100	60	5	50 500	80 100	50 70 30 15 30* 45*	– – – – – –	10 150 500 1000 1 10	10 10 10 10 5 5	0.15 0.35 1.0 1.6	– – – –	1.2 1.3 1.5 2.0	10 150 500 1000	12 – – –	50 – – –		50 – – –	360 – – –	– – – –	E	14
BFX86	TO-39	40	35	5	50 500	30 40	50 70 30 15 30* 45*	– – – – – –	10 150 500 1000 1 10	10 10 10 10 5 5	0.15 0.35 1.0 1.6	– – – –	1.2 1.3 1.5 2.0	10 150 500 1000	12 – – –	50 – – –		50 – – –	360 – – –	– – – –	E	14

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
4. I_C = 20 μA, V_{CE} = 5V, R_S = 10 kΩ, f = 1 kHz, BW = 150 Hz
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

E. I_C = 150 mA, V_{EE} = 10V, $I_{B(on)}$ = $-I_{B(off)}$ = 15 mA, $V_{BE(off)}$ = 2V

F. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA

H. I_C = 10 mA, I_{B1} = 1 mA, I_{B2} = −1 mA

Pro-electron Series

Type No.	Case Style	BV_{CBO} (V) Min	BV_{CEO} BV_{CES}* (V) Min	BV_{EBO} (V) Min	I_{CBO} I_{CES}* (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.
BFX87	TO-5	50	50	4	500 50	50 40	40 40 40 25	– – – –	1 10 150 500	10 10 10 10	0.4	–	1.3 0.9	150 30	12	100		50	150	–	F	63
BFX88	TO-5	40	40	4	50	30	40 40 40 25	– – – –	1 150 10 500	10 10 10 10	0.4	–	1.3 0.9	150 30	12	100		50	150	–	F	63
BFY39	TO-18	45	25	5	50	30	35*	400	10	10	1.0	–	1.0	10	5	150		10	–	–		27
BFY39-1	TO-18	45	25	5	50	30	35 120*	110 –	10 1	10 5	1.0	–	1.0	10	5	150		10	–	–		27
BFY39-2	TO-18	45	25	5	50	30	100	200	10	10	1.0	–	1.0	10	5	150		10	–	–		27
BFY39-3	TO-18	45	25	5	50	30	180 120*	400 –	10 1	10 5	1.0	–	1.0	10	5	150		10	–	–		27
BFY50	TO-39	80	35	6	50 500	60 80	20 30 20 15 10* 120*	– – – – – –	10 150 500 1000 1 1	10 10 10 10 5 5	0.7 0.1 0.2 1.0	–	1.5 1.2 1.3 2.0	500 10 150 1000	12	60		50	360	–	A	14
BFY51	TO-39	60	30	6	50 500	40 60	30 40 25 15 30* 45*	– – – – – –	10 150 500 1000 1 10	10 10 10 10 5 5	1.0 0.15 0.35 1.6	–	1.5 1.2 1.3 2.0	500 10 150 1000	12	50		50	360	–	A	14
BFY52	TO-39	40	20	6	50 500	30 40	30 60 30 15 30* 45*	– – – – – –	10 150 500 1000 1 10	10 10 10 10 5 5	1.0 0.15 0.35 1.6	–	1.5 1.2 1.3 2.0	500 10 150 1000	12	50		50	360	–	A	14
BFY56	TO-39	80	45	5	50	50	15 20 30 2*	– – 150 –	0.1 500 150 50	10 10 1 10	0.3 2.3	–	1.5 1.2	150 100	25	–		–	625	–	B	14
BFY72	TO-5	50	28	5	0.02 I_{CES}	40	15 20 30 40 15 2.5*	– – – 150 – –	0.1 1 10 150 500 50	100 10 10 10 10 10	0.25 0.7	–	1.2 1.6	150 500	8	–		–	170	–	J	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	–	B	14
BSX45-10	TO-39	(BV_{CES}) 80	40	7	10 I_{CES}	60	63	160	100	1	1.0	–	– 2.0	500 1000	20	60		50	650	–	B	14
BSX45-16	TO-39	(BV_{CES}) 80	40	7	10	60	100	250	100	1	1.0	–	– 2.0	500 1000	20	60		50	650	–	B	14
BSX46-6	TO-39	(BV_{CES}) 100	60	7	10	60	40	100	100	1	1.0	–	– 2.0	500 1000	25	60		50	650	–	B	14
BSX46-10	TO-39	(BV_{CES}) 100	60	7	10	60	63	160	100	1	1.0	–	– 2.0	500 1000	25	60		50	650	–	B	14
BSX46-16	TO-39	(BV_{CES}) 100	60	7	10	60	100	250	100	1	1.0	–	– 2.0	500 1000	25	60		50	650	–	B	14
BSX88	TO-18	40	15	5	25	20	15 30 3*	– 120 –	0.5 10 10	1 1 10	0.4	0.72	0.8	10	6	–		–	75	–	C	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	–	D	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	–	D	21
BSY51	TO-5	60	25	5	100	30	40 6.5*	120 –	150 50	10 10	1.0	–	1.3	150	9	–		–	–	–		20
BSY52	TO-5	60	25	5	100	30	100 6.5*	300 –	150 50	10 10	1.0	–	1.3	150	9	–		–	–	–		20
BSY53	TO-5	75	30	7	10	60	20 35 40 20 7.5*	– – 120 – –	0.1 10 150 500 50	10 10 10 10 10	0.6 2.0	–	1.3	150 500	9	–		–	–	–		20
BSY54	TO-5	75	30	7	10	60	35 75 100 40 7.5*	– – 300 – –	0.1 10 150 500 50	10 10 10 10 10	0.6 2.0	–	1.3	150 500	9	–		–	–	–		20
BSY95A	TO-18	20	15	5	50	16	30 50	– 200	1 10	0.35 0.35	0.35	0.67	0.87	10	6	200		10	–	–		21

Test Conditions:

10. I_C = 10 μA, V_{CE} = 5V, R_S = 10 kΩ, WB

A. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA

B. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA

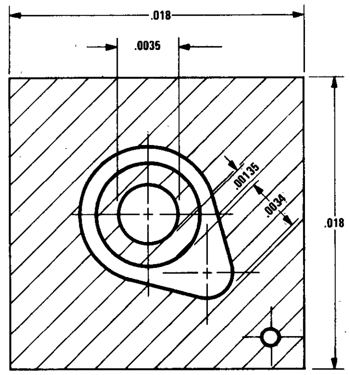
C. I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA

D. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA

F. I_C = 150 mA, V_{CE} = 6V, I_{B1} = I_{B2} = 15 mA

J. I_C = 300 mA, I_{B1} = I_{B2} = 30 mA, V_{CC} = 25V

Process 07 NPN Small Signal



description

Process 07 a nonoverlay, double diffused, silicon epitaxial device.

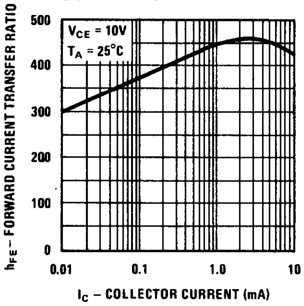
application

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

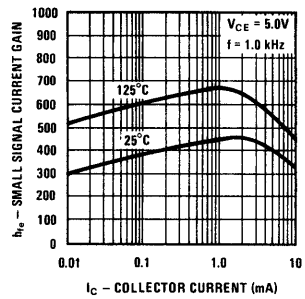
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 100 Hz, P_{BW} = 20 Hz		3	10	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 1 kHz P_{BW} = 200 Hz		1	3	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 10 kHz, P_{BW} = 2 kHz		1	3	dB	
NF (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

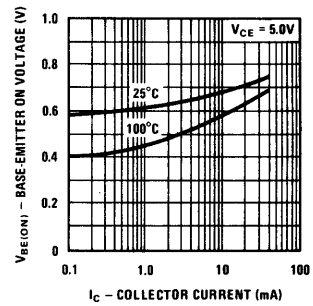
Pulsed DC Current Gain Collector Current



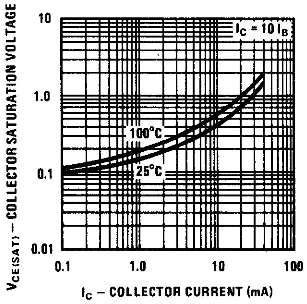
Small Signal Current Gain vs Collector Current



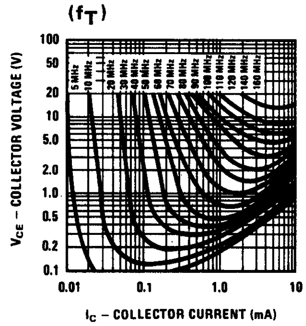
Base-Emitter On Voltage vs Collector Current



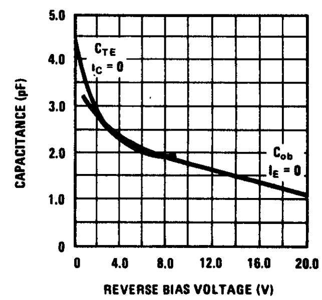
Collector Saturation Voltage vs Collector Current



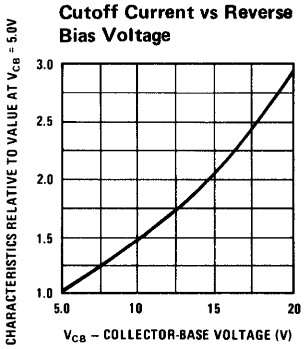
Contours Of Constant Gain Bandwidth Product (f_T)



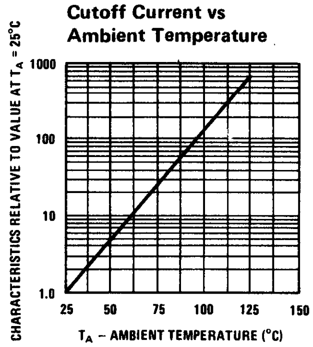
Input And Output Capacitance vs Reverse Bias Voltage



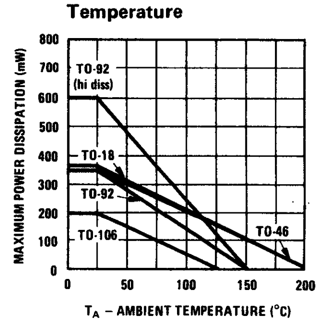
Normalized Collector Cutoff Current vs Reverse Bias Voltage



Normalized Collector Cutoff Current vs Ambient Temperature

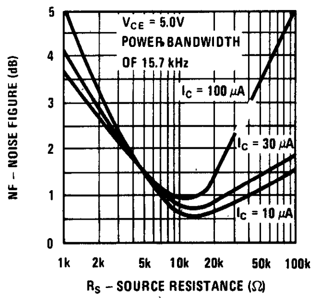


Maximum Power Dissipation vs Temperature

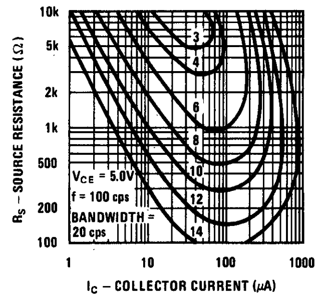


Process 07

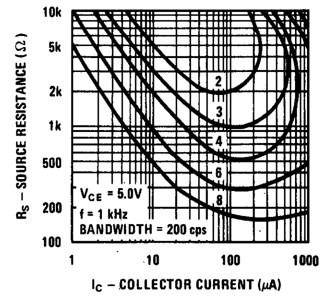
Wide Band Noise Figure vs Source Resistance



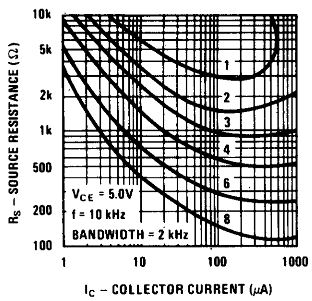
Contours Of Constant Narrow Band Noise Figure



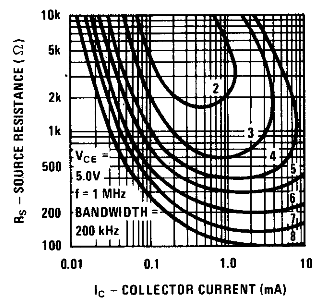
Contours Of Constant Narrow Band Noise Figure



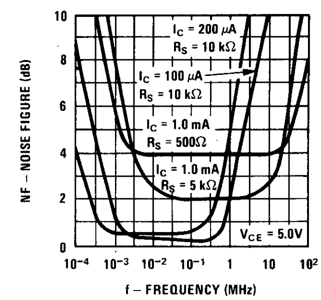
Contours Of Constant Narrow Band Noise Figure



Contours Of Constant Narrow Band Noise Figure

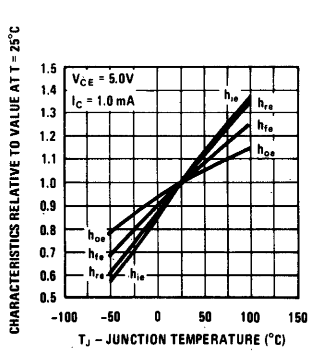


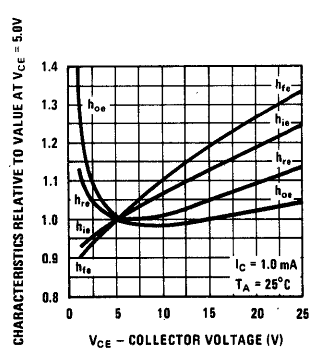
Noise Figure vs Frequency

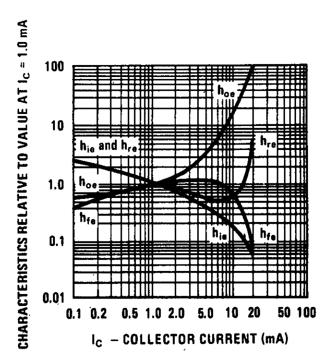


SMALL SIGNAL CHARACTERISTICS (f = 1 kc)

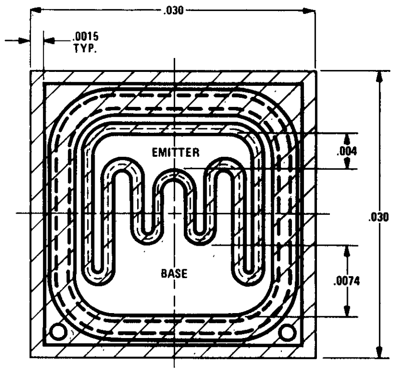
SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	15	kΩ	I_C = 1.0 mA V_{CE} = 5.0V
h_{oe}	Output Conductance	15	µmho	I_C = 1.0 mA V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	425	$x10^{-6}$	I_C = 1.0 mA V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	400		I_C = 1.0 mA V_{CE} = 5.0V
h_{ib}	Input Resistance	27	ohms	I_C = 1.0 mA V_{CB} = 5.0V







Process 12 NPN Medium Power



description

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

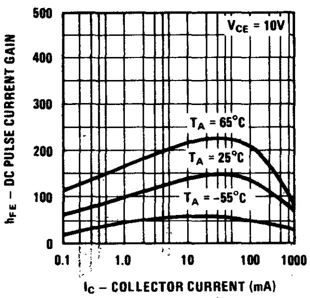
application

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.

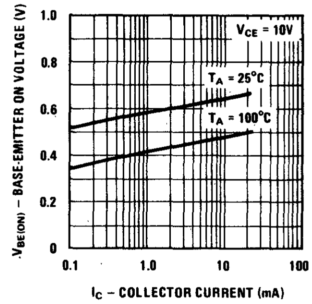
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		50	60	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		400	500	ns	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	4.0	6.5			
C_{cb}	V_{CB} = 10V		6.5	10	pF	TO-39
C_{eb}	V_{EB} = 0.5		50	60	pF	
NF	I_C = 100 μA, V_{CE} = 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

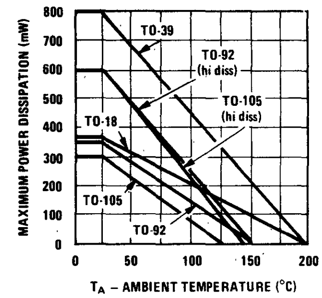
Pulsed DC Current Gain vs Collector Current



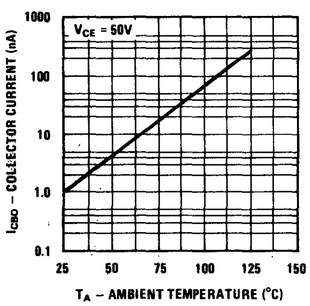
Base-Emitter On Voltage vs Collector Current



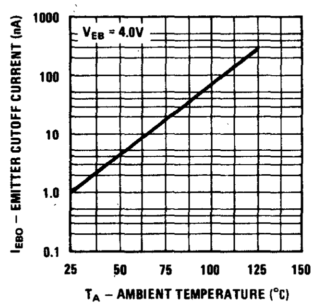
Maximum Power Dissipation vs Temperature



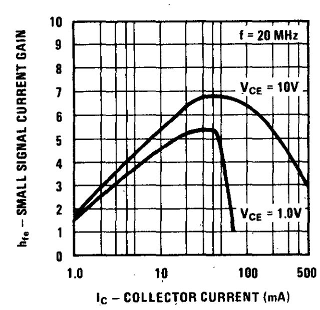
Collector Reverse Current vs Ambient Temperature



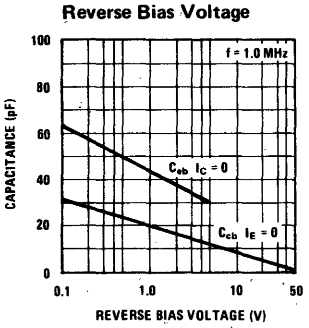
Emitter Cutoff Current vs Ambient Temperature



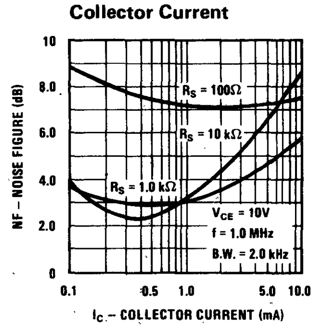
Small Signal Current Gain at 20 MHz



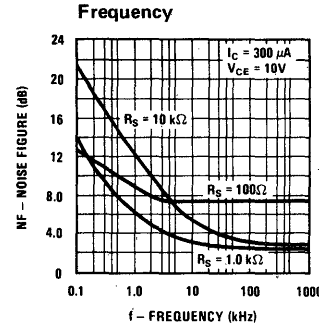
Collector-Base and Emitter Base Capacitance vs Reverse Bias Voltage



Noise Figure vs Collector Current

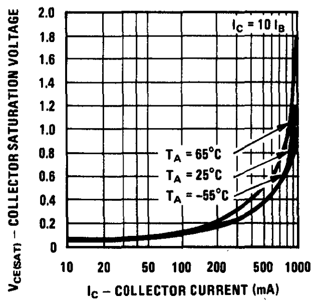


Noise Figure vs Frequency

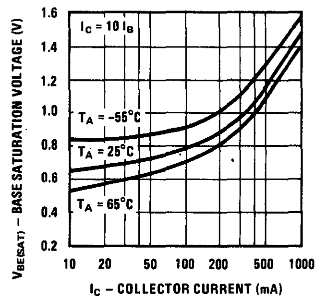


Process 12

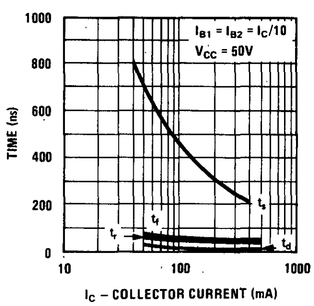
Collector Saturation Voltage vs Collector Current



Base Saturation Voltage vs Collector Current



Switching Times vs Collector Current



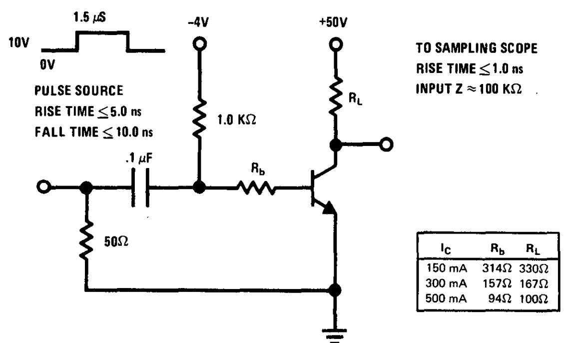
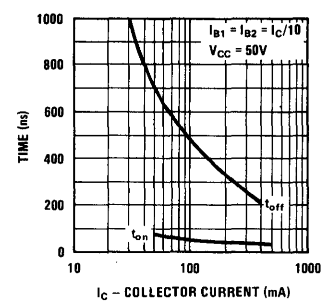


FIGURE 1. t_{on}, t_{off} **Test Circuit**

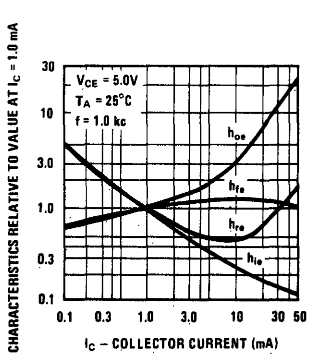
Turn (on) and Turn (off) Times vs Collector Current

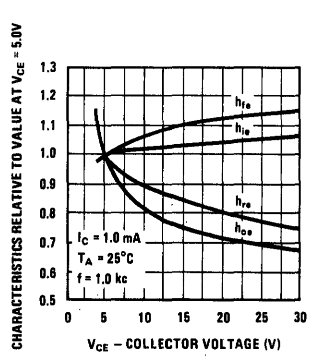


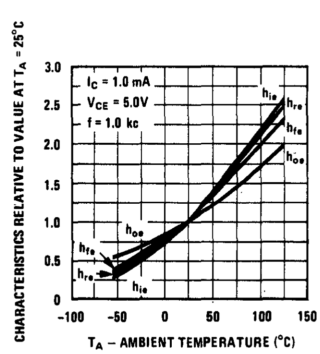
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kc)

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	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CE} = 5.0V$
h_{fe}	Small Signal Current Gain	100		$I_C = 1.0$ mA	$V_{CE} = 5.0V$

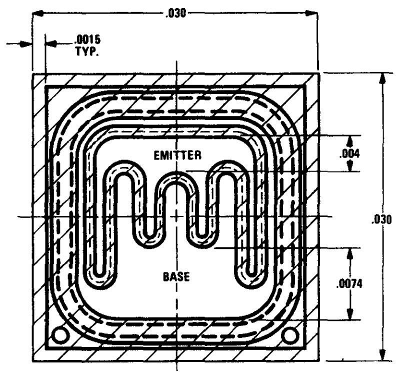
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kc)







Process 14 NPN Medium Power



description

Process 14 is a nonoverlay double diffused silicon epitaxial device.

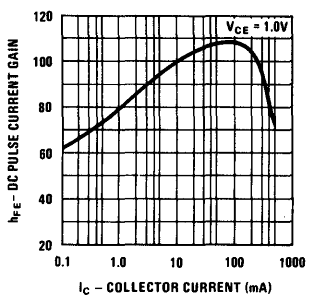
application

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

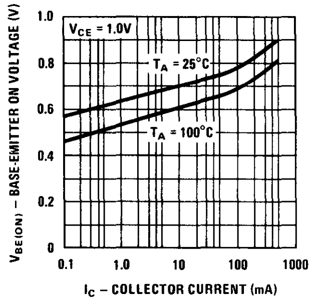
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{ob}	V_{CB} = 10V		8	10	pF	
C_{ib}	V_{EB} = 0.5V		55	65	pF	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	5	10			
h_{FE}	I_C = 0.1 mA, V_{CE} = 1V	20	60			
h_{FE}	I_C = 1 mA	20	80			
h_{FE}	I_C = 10 mA	20	100	400		
h_{FE}	I_C = 100 mA	20	110			
h_{FE}	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

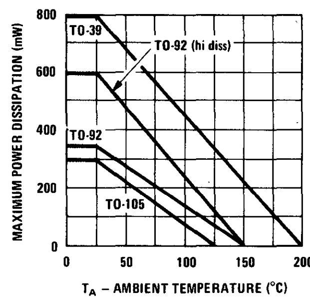
DC Pulse Current Gain vs Collector Current



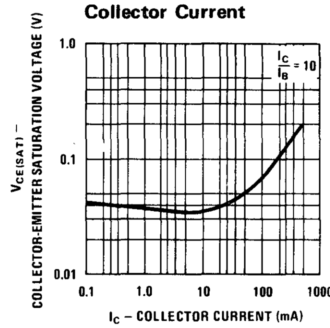
Base-Emitter On Voltage vs Collector Current



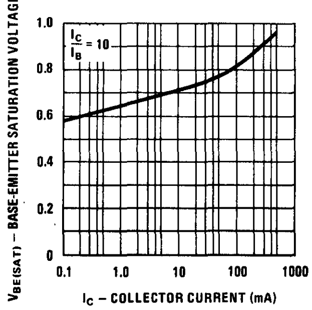
Maximum Power Dissipation vs Temperature



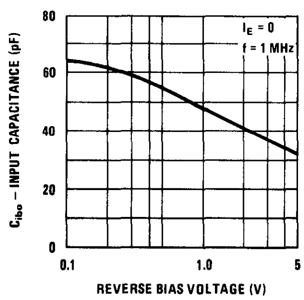
Collector-Emitter Saturation Voltage vs Collector Current



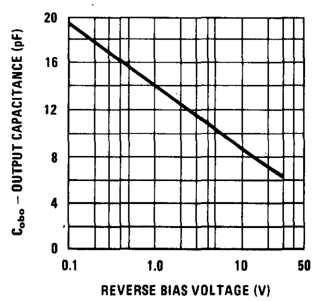
Base-Emitter Saturation Voltage vs Collector Current



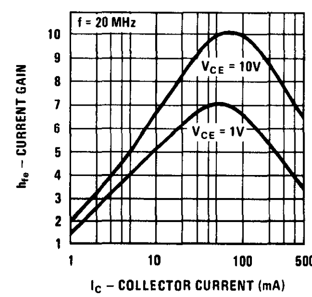
Input Capacitance vs Reverse Bias Voltage



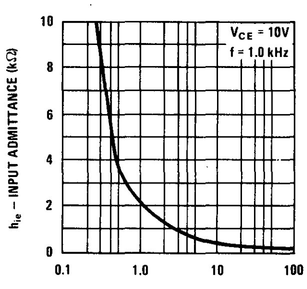
Output Capacitance vs Reverse Bias Voltage



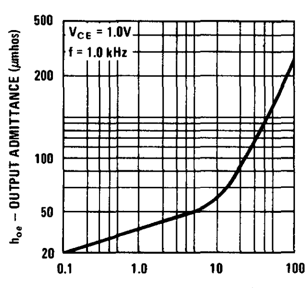
Small Signal Current Gain At 20 MHz vs Collector Current



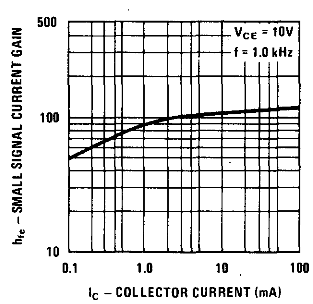
Input Admittance



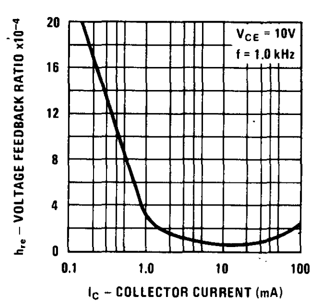
Output Admittance



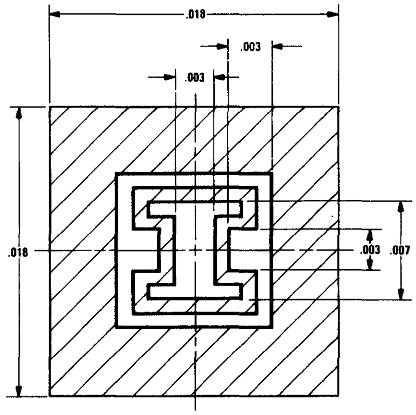
Small Signal Current Gain



Voltage Feedback Ratio



Process 20 Medium Power



description

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

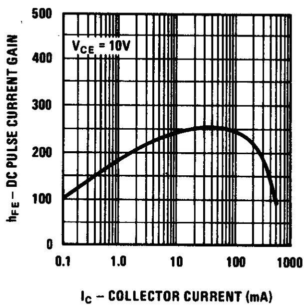
application

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

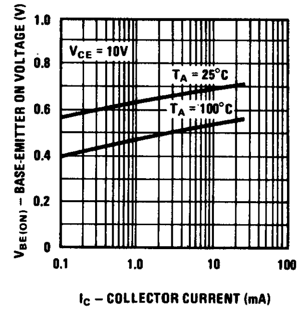
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{cb}	V_{EB} = 0.5V		18	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 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

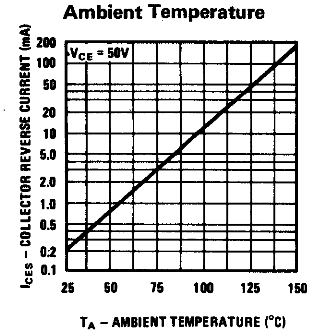
DC Pulse Current Gain vs Collector Current



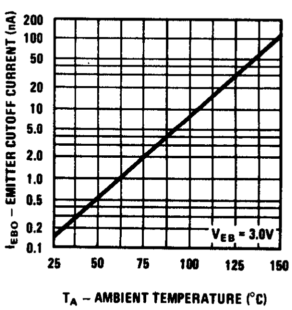
Base-Emitter On Voltage vs Collecter Current



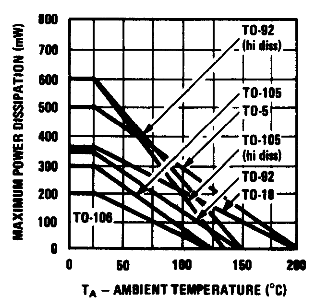
Collector Reverse Current vs Ambient Temperature



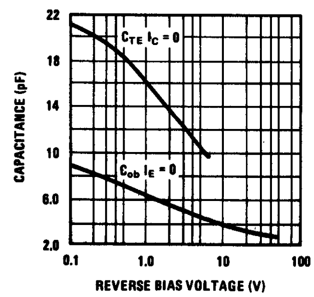
Emitter Cutoff Current vs Ambient Temperature



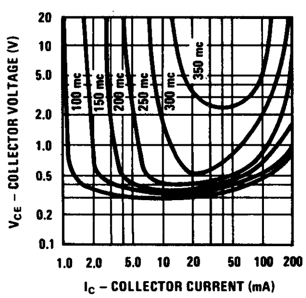
Maximum Power Dissipation vs Temperature



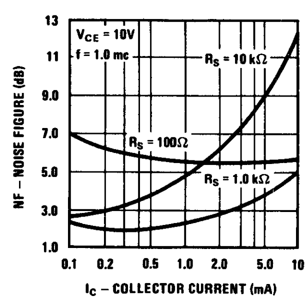
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



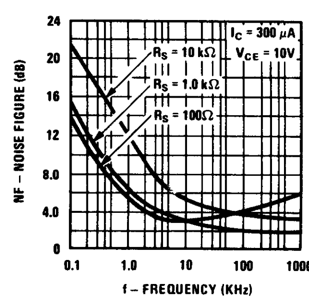
Contours of Constant Gain Bandwidth Product (f_T)



Noise Figure vs Collector Current

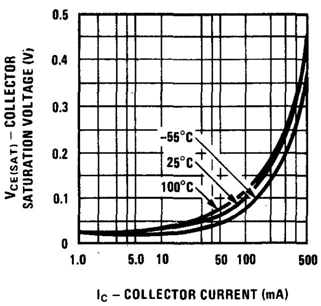


Noise Figure vs Frequency

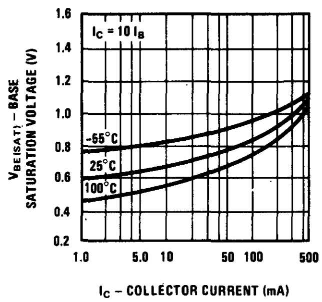


Process 20

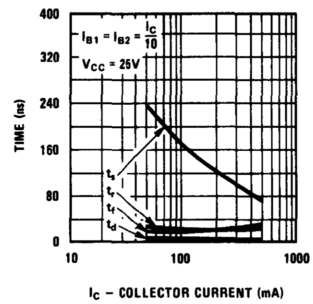
Collector Saturation Voltage vs Collector Current



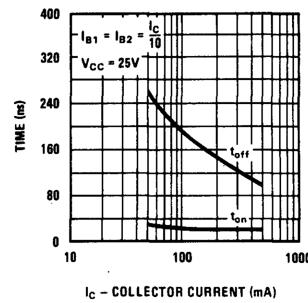
Base Saturation Voltage vs Collector Current



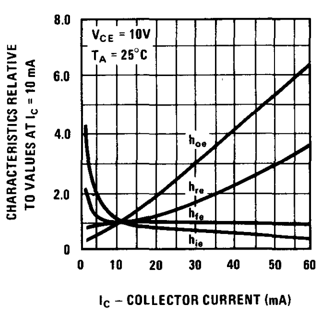
Switching Times vs Collector Current

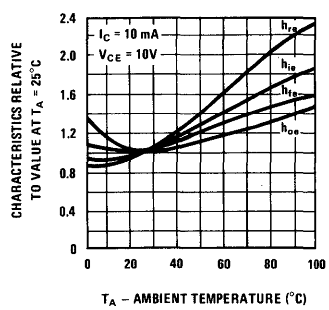


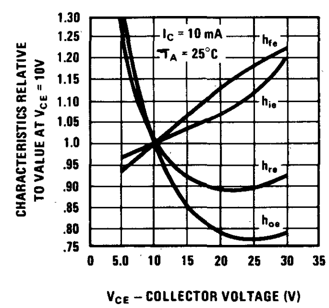
Turn(On) and Turn(Off) Times vs Collector Current



TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1 KHZ)



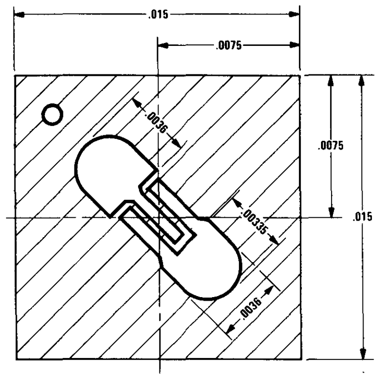




SMALL SIGNAL CHARACTERISTICS (f = 1 KHZ)

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 $V_{CE} = 10V$

Process 21 NPN High Speed Switch



description

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

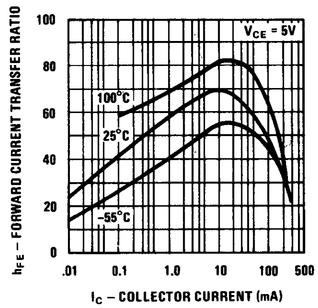
application

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

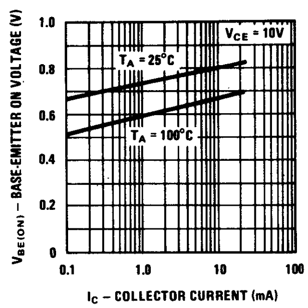
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	$I_{B1} = I_{B2} = I_C = 10$ mA		7	13	ns	Fig. 1
t_{on}	$I_C = 10$ mA, $I_{B1} = 3$ mA		9	12	ns	Fig. 2
t_{off}	$I_C = 10$ mA, $I_{B2} = 1.50$ mA		10	18	ns	Fig. 2
h_{fe}	$I_C = 10$ mA, $V_{CE} = 10V$, f = 100 MHz	5.0	7.0			
C_{cb}	$V_{CB} = 5V$		2.0	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

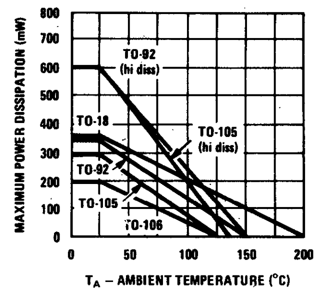
Pulse DC Current Gain vs Collector Current



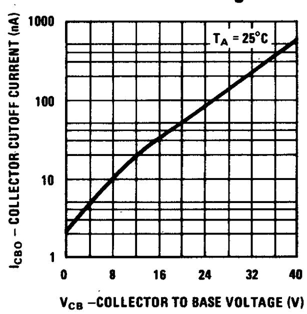
Base-Emitter On Voltage vs Collector Current



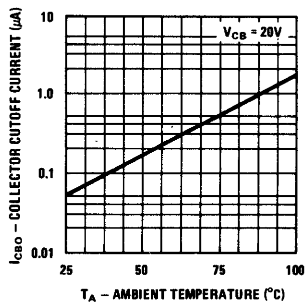
Maximum Power Dissipation vs Temperature



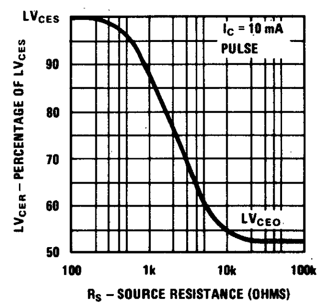
Collector Cutoff Current vs Reverse Bias Voltage



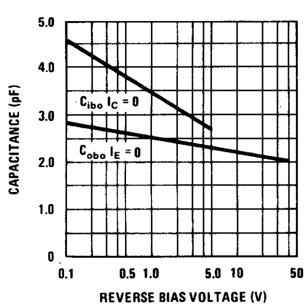
Collector Cutoff Current vs Ambient Temperature



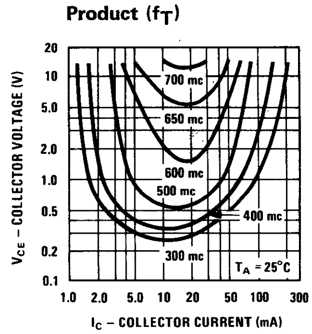
Lower Limiting Voltage vs Source Resistance



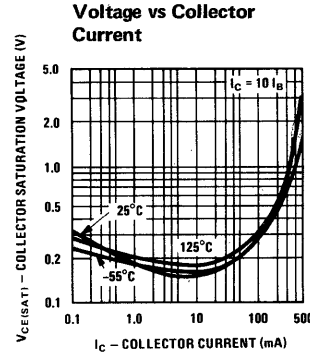
Emitter Transition And Output Capacitances vs Reverse Bias Voltage



Contours Of Constant Gain Bandwidth Product (f_T)

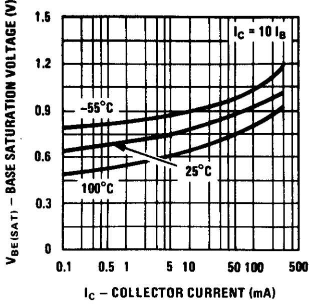


Collector Saturation Voltage vs Collector Current

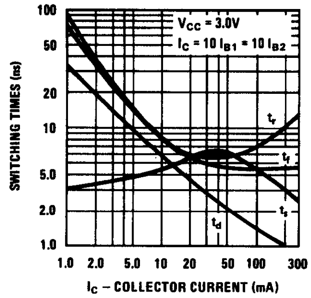


Process 21

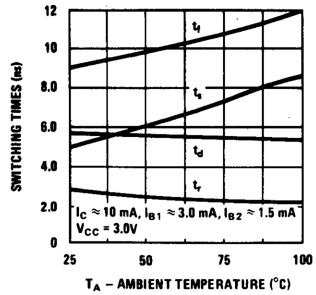
Base Saturation Voltage vs Collector Current



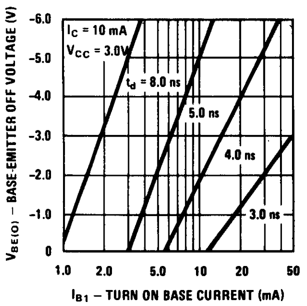
Switching Times vs Collector Current



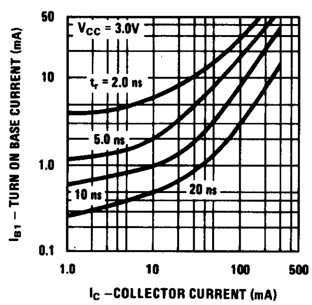
Switching Times vs Ambient Temperature



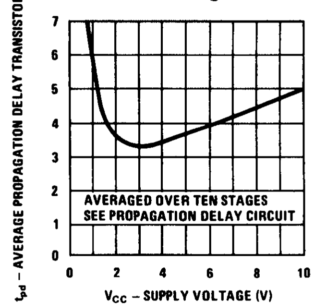
Delay Time vs Base Emitter Off Voltage And Turn On Base Current



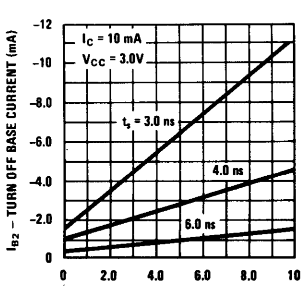
Rise Time vs Turn On Base Current And Collector Current



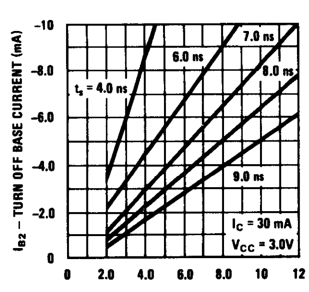
Average Propagation Delay Per Transistor vs Collector Voltage



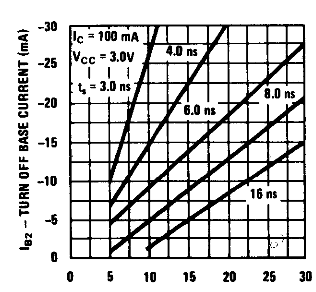
Storage Time vs Turn On And Turn Off Base Currents



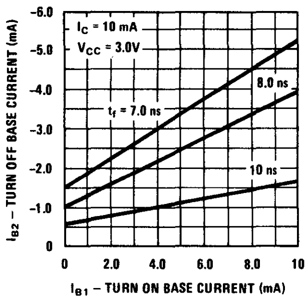
Storage Time vs Turn On And Turn Off Base Currents



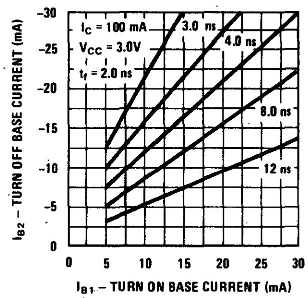
Storage Time vs Turn On And Turn Off Base Currents



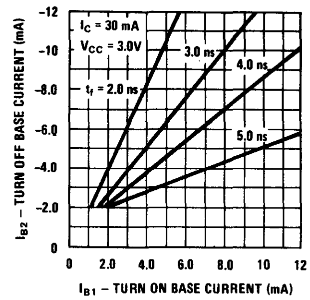
Fall Time vs Turn On And Turn Off Base Currents



Fall Time vs Turn On And Turn Off Base Currents



Fall Time vs Turn On And Turn Off Base Currents



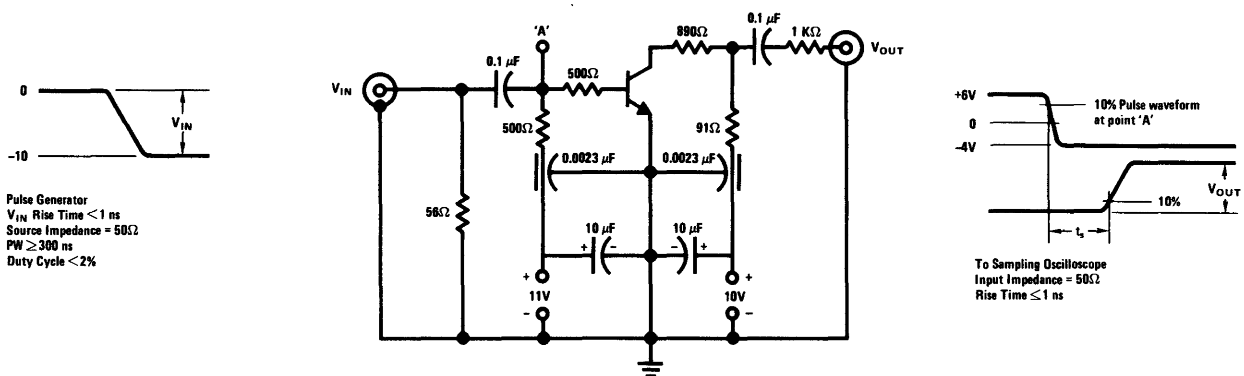


FIGURE 1. Charge Storage Time Measurement Circuit

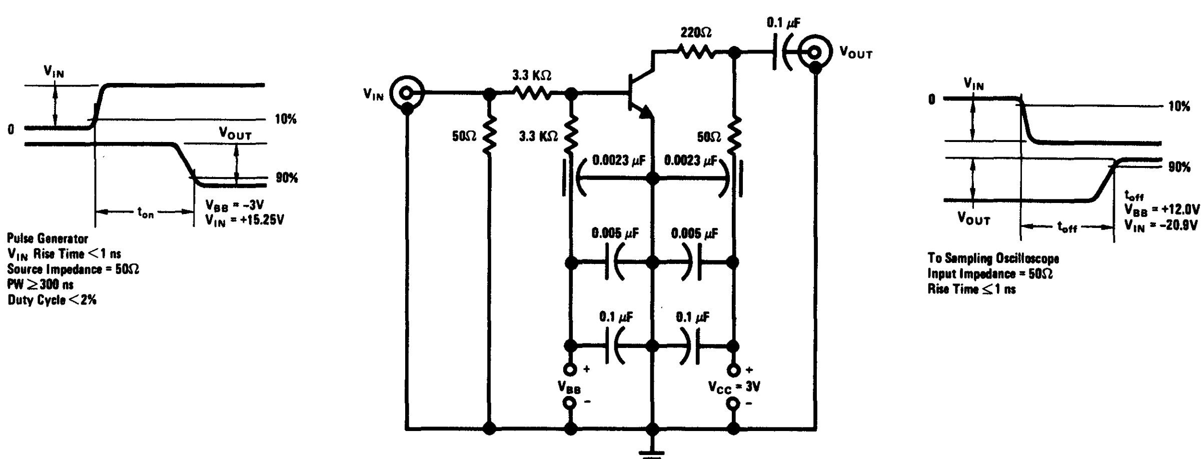
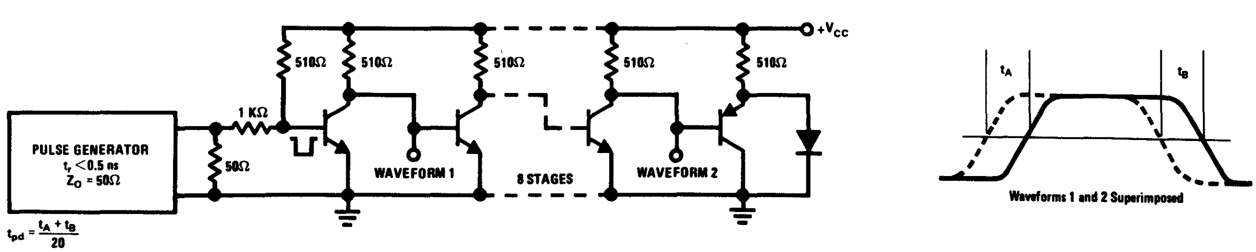


FIGURE 2. t_{on}, t_{off} Measurement Circuit

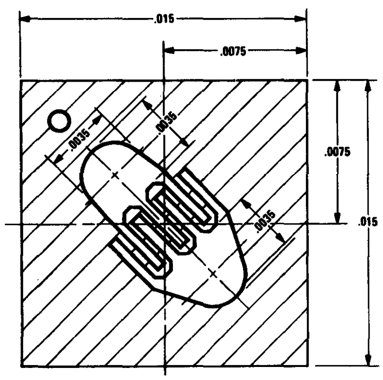


$t_{pd} = \frac{t_A + t_B}{20}$

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.

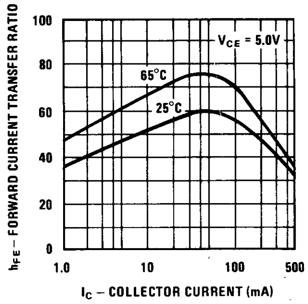
application

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

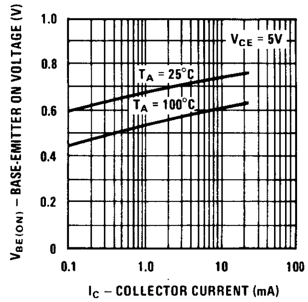
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	I_C = 10 mA, I_{B1} = I_{B2} = 10 mA		12	18	ns	Fig. 2
t_{on}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		10	18	ns	Fig. 1
t_{off}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		18	30	ns	
C_{ob}	V_{CB} = 5V		3.2	5.0	pF	TO-18
C_{eb}	V_{EB} = 0.5V		6.2	8.0	pF	TO-18
h_{fe}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	7.0	10.0		
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

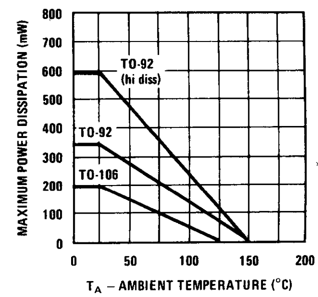
DC Pulse Current Gain vs Collector Current



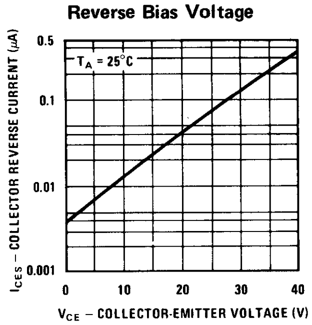
Base-Emitter On Voltage vs Collecter Current



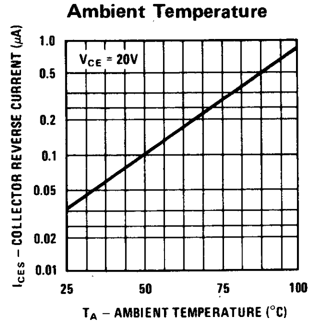
Maximum Power Dissipation vs Temperature



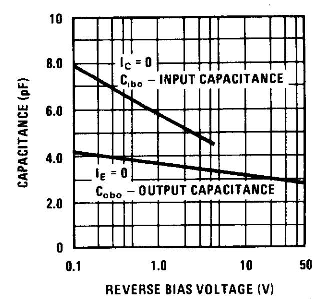
Collector Reverse Current vs Reverse Bias Voltage



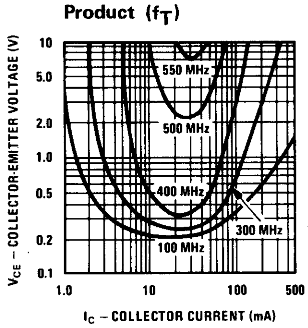
Collector Reverse Current vs Ambient Temperature



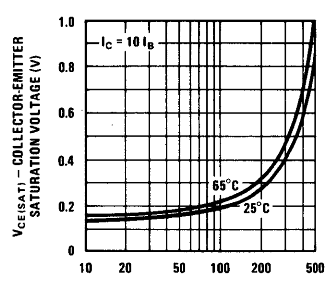
Input and Output Capacitances vs Reverse Bias Voltage



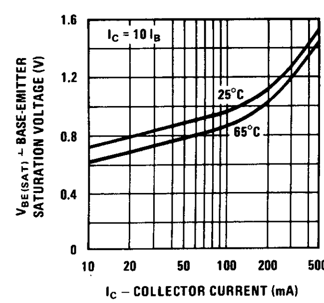
Contours of Constant Gain Bandwidth Product (f_T)

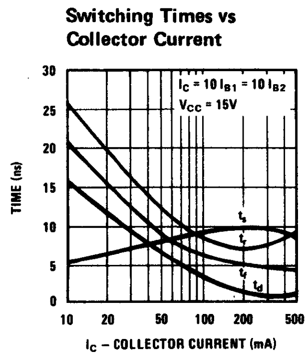


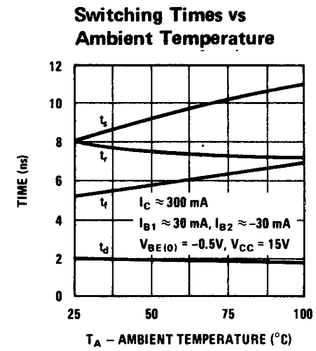
Collector Saturation Voltage vs Collector Current



Base Saturation Voltage vs Collector Current







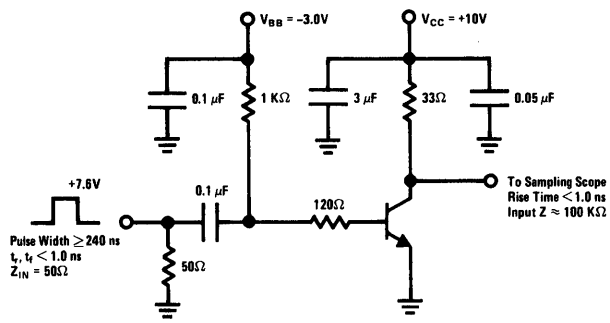


FIGURE 1. t_{on}, t_{off} Test Circuit

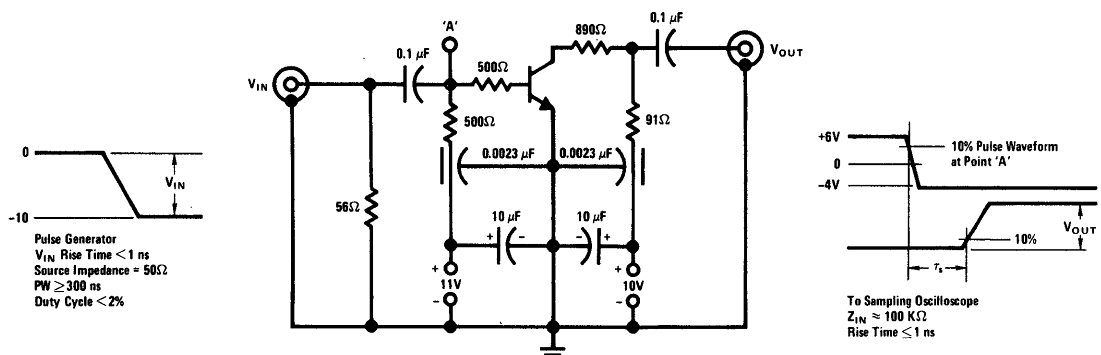
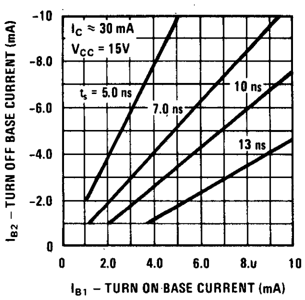


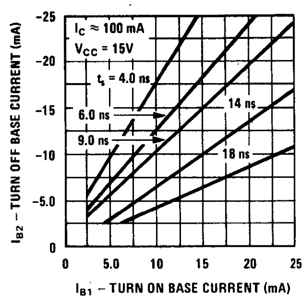
FIGURE 2. Charge Storage Time Measurement Circuit

Process 22

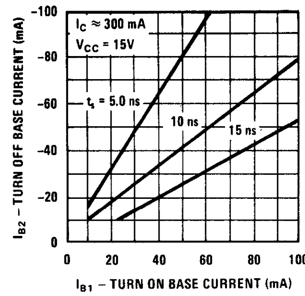
Storage Time vs Turn On and Turn Off Base Currents



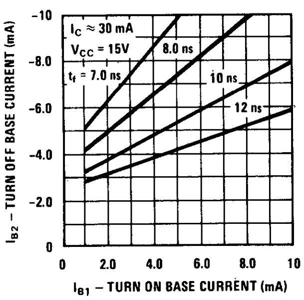
Storage Time vs Turn On and Turn Off Base Currents



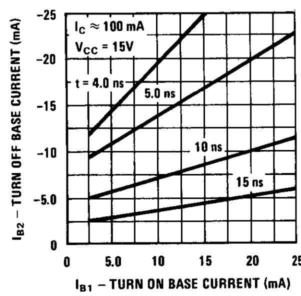
Storage Time vs Turn On and Turn Off Base Currents



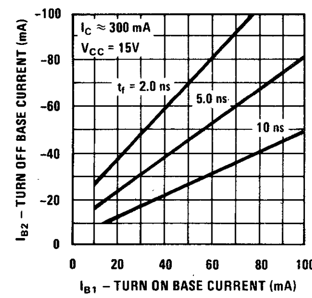
Fall Time vs Turn On and Turn Off Base Currents



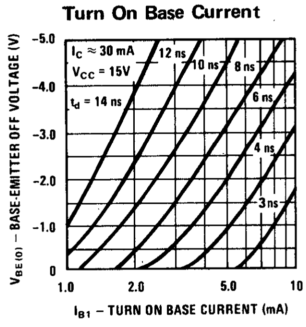
Fall Time vs Turn On and Turn Off Base Currents



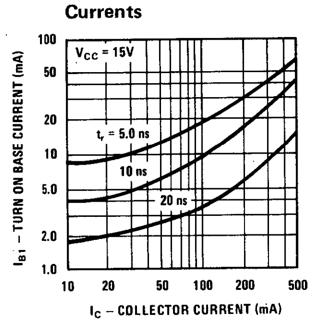
Fall Time vs Turn On and Turn Off Base Currents



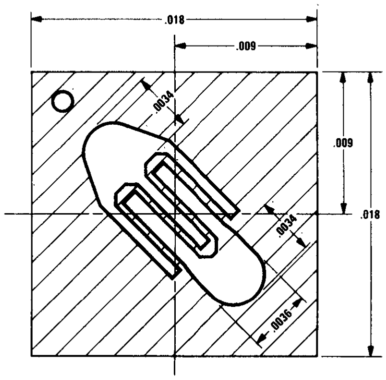
Delay Time vs Base Emitter Off Voltage and Turn On Base Current



Rise Time vs Collector and Turn On Base Currents



Process 23 NPN Small Signal



description

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

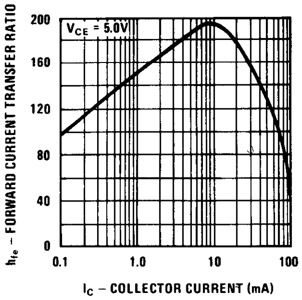
application

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.

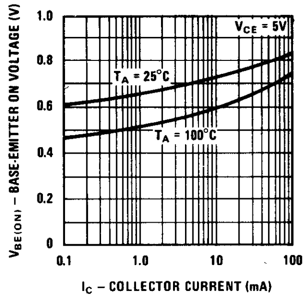
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	Fig. 1
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		70	200	ns	Fig. 2
C_{ob}	V_{CB} = 5V, f = 1 MHz		2.0	4.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		4.0	8.0	pF	TO-18
NF	V_{CE} = 5V, I_C = 100 μA, R_S = 1 kΩ, P_{BW} = 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

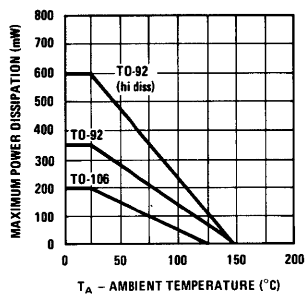
Pulsed DC Current Gain vs Collector Current



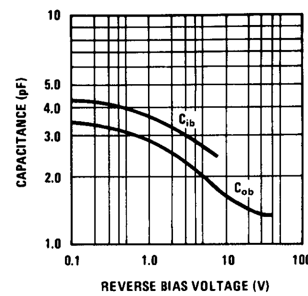
Base-Emitter On Voltage vs Collector Current



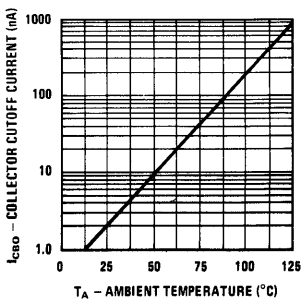
Maximum Power Dissipation vs Temperature



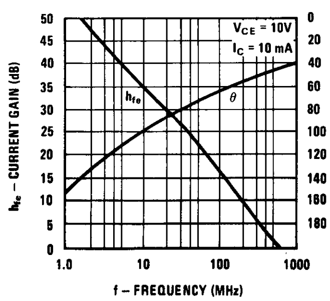
Capacitance vs Reverse Bias Voltage



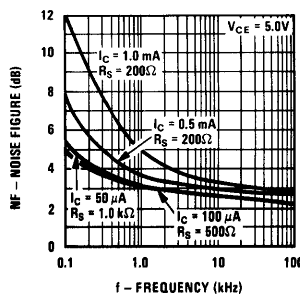
Collector Cutoff Current vs Ambient Temperature



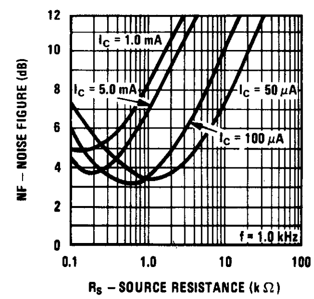
Current Gain and Phase Angle vs Frequency



Noise Figure vs Frequency

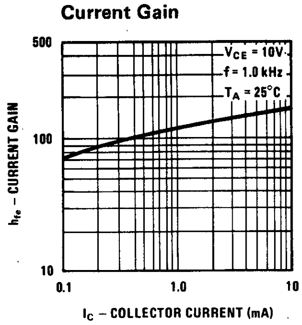


Noise Figure vs Source Resistance

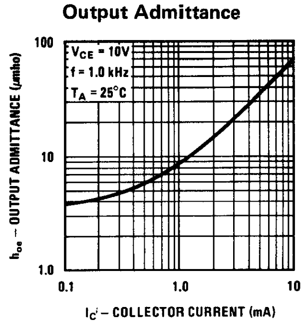


H PARAMETERS (V_{CE} = 10 Vdc, f = 1.0 KHZ, T_A = 25°C)

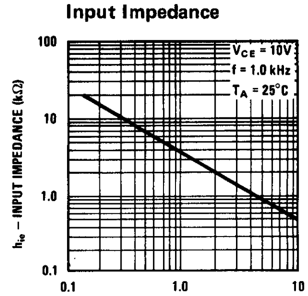
Current Gain



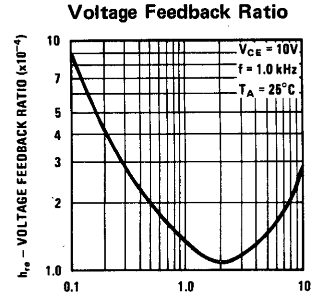
Output Admittance



Input Impedance



Voltage Feedback Ratio



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

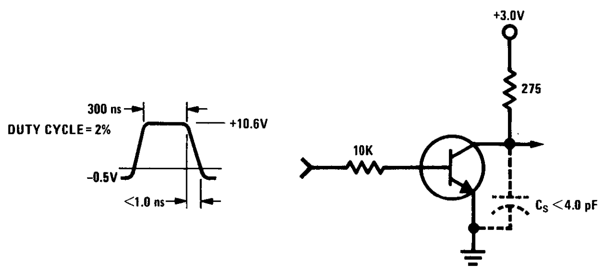


FIGURE1. Delay and Rise Time Equivalent Test Circuit

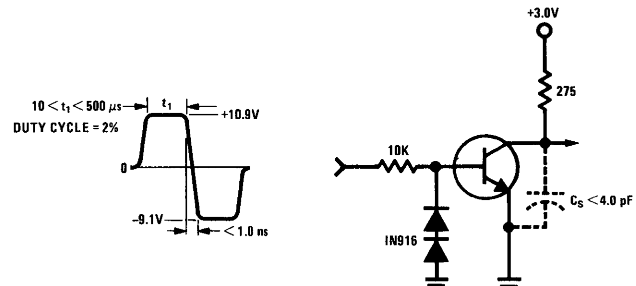
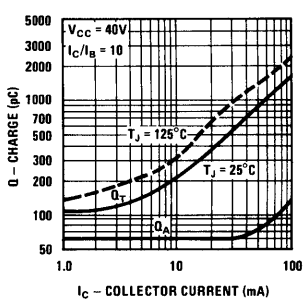
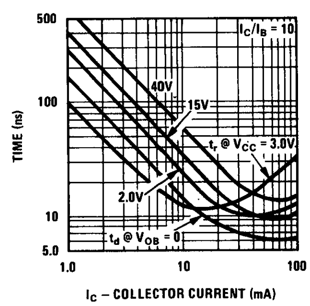


FIGURE 2. Storage and Fall Time Equivalent Test Circuit

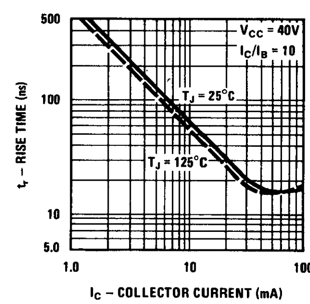
Charge Data



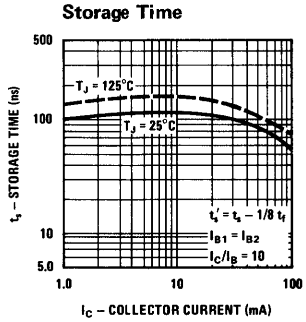
Turn-On Time



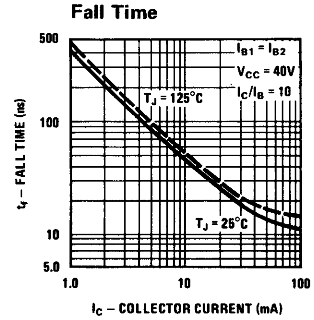
Rise Time



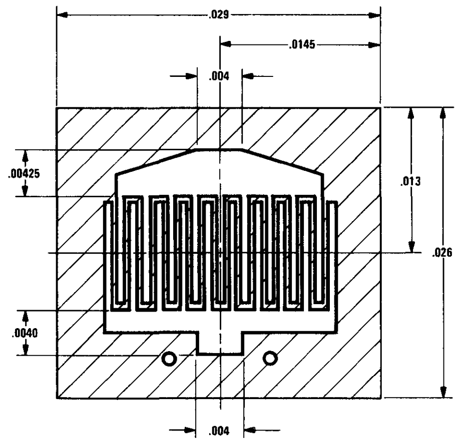
Storage Time



Fall Time



Process 25 NPN Small Signal



description

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

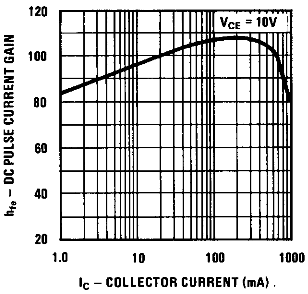
application

This device was designed for high speed core driver applications.

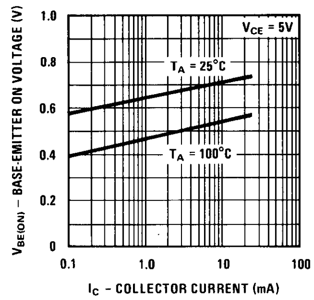
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA		12	35	ns	Fig. 1
t_{off}	I_C = 500 mA, I_{B2} = 50 mA		50	60	ns	Fig. 1
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 100 MHz	2.5	4.25			
C_{cb}	V_{CB} = 10V		5	10	pF	
C_{eb}	V_{EB} = 0.5V		45	55	pF	
h_{FE}	I_C = 10 mA, V_{CE} = 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

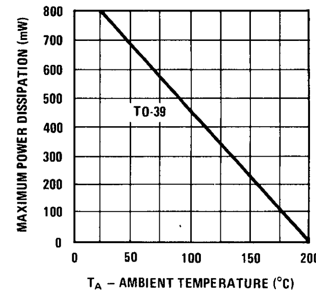
DC Pulse Current Gain vs Collector Current



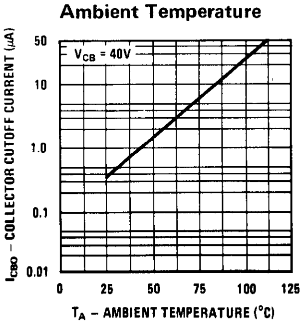
Base-Emitter On Voltage vs Collecter Current



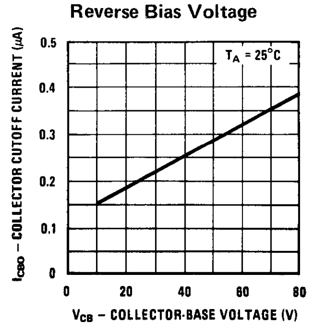
Maximum Power Dissipation vs Temperature



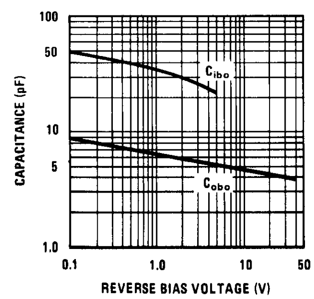
Collector Cutoff Current vs Ambient Temperature



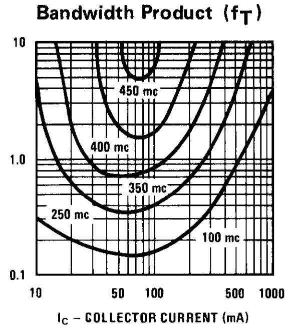
Collector Cutoff Current vs Reverse Bias Voltage



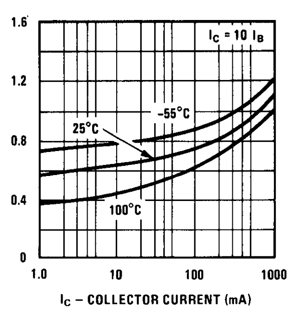
Input and Output Capacitance vs Reverse Bias



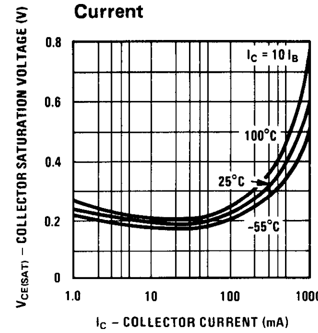
Contours of Constant Bandwidth Product (f_T)



Base Saturation Voltage vs Collector Current

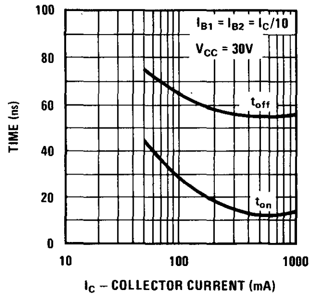


Collector Saturation Voltage vs Collector Current

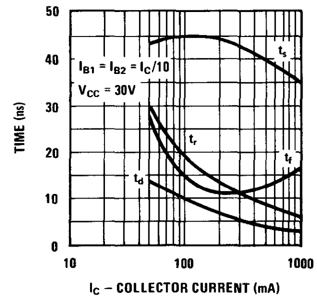


Process 25

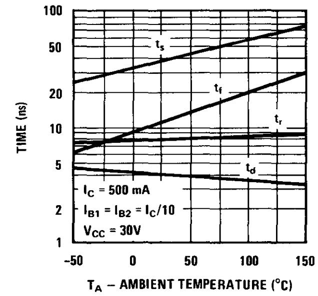
Turn (on) and Turn (off) Times vs Collector Current



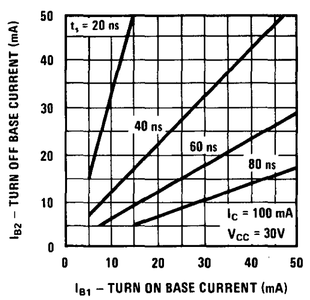
Switching Times vs Collector Current



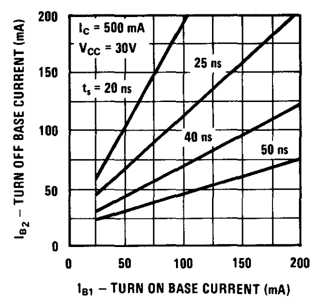
Switching Times vs Ambient Temperature



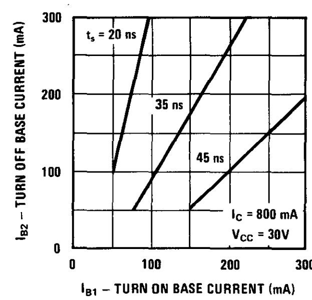
Storage Time vs Turn On and Turn Off Base Currents



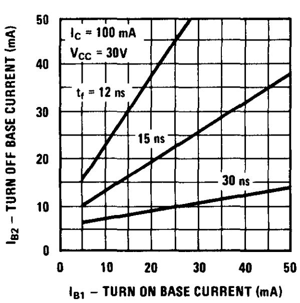
Storage Time vs Turn On and Turn Off Base Currents



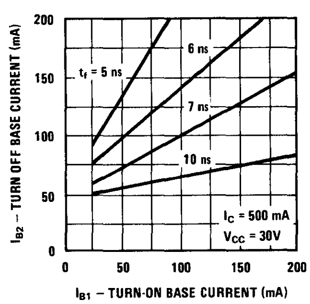
Storage Time vs Turn On and Turn Off Base Currents



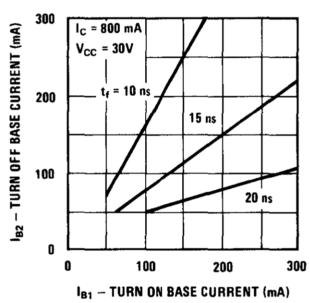
Fall Time vs Turn On and Turn Off Base Currents



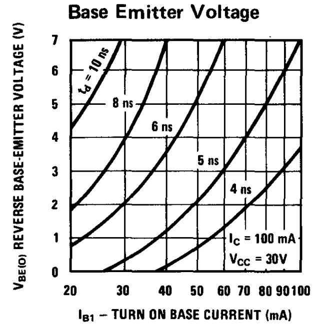
Fall Time vs Turn On and Turn Off Base Currents



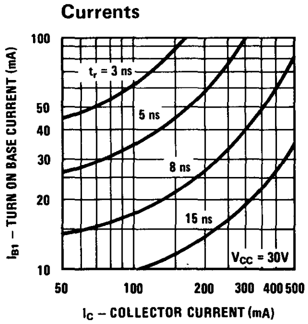
Fall Time vs Turn On and Turn Off Base Currents



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



Rise Time vs Collector and Turn On Base Currents



SWITCHING TIME TEST CIRCUIT

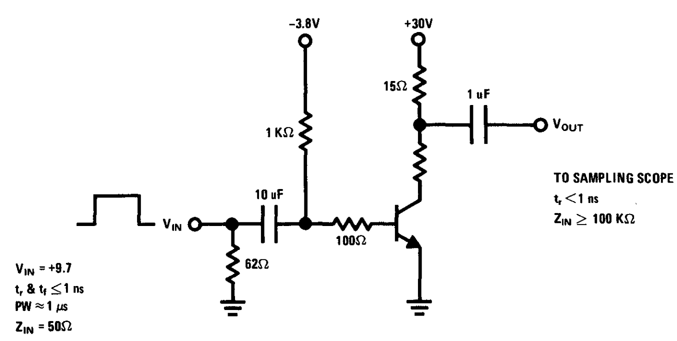
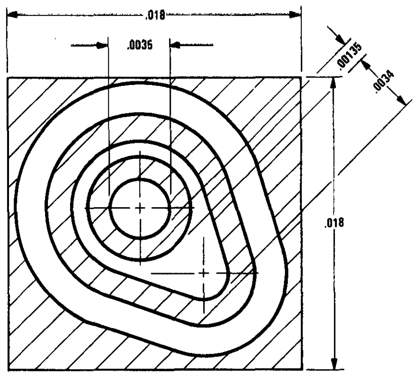


FIGURE 1. $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

Process 26 NPN Small Signal



description

Process 26 is a nonoverlay double diffused, silicon device.

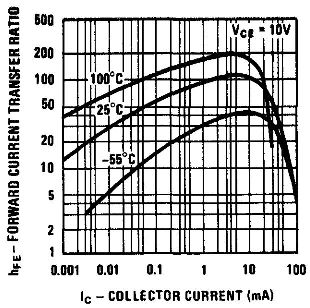
application

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

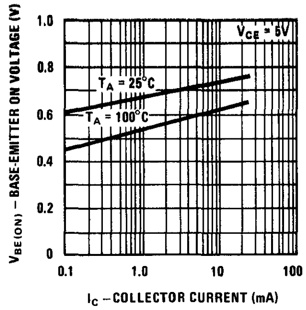
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V R_S = 2k, f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 10V f = 100 MHz	2	4			
C_{cb}	V_{CB} = 10V		2.0	3.5	pF	TO-92
C_{eb}	V_{EB} = .5V		7.0	10	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 10V	20	50			
h_{FE}	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

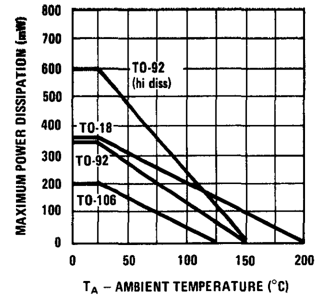
Pulsed DC Current Gain vs Collector Current



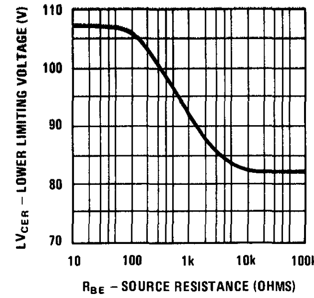
Base-Emitter on Voltage vs Collector Current



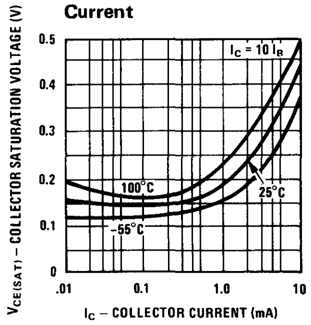
Maximum Power Dissipation vs Temperature



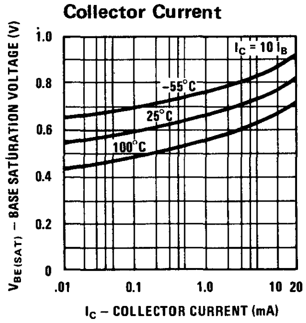
Lower Limiting Voltage vs Source Resistance



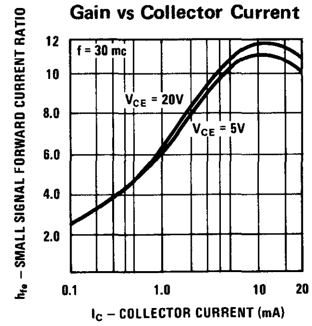
Collector Saturation Voltage vs Collector Current



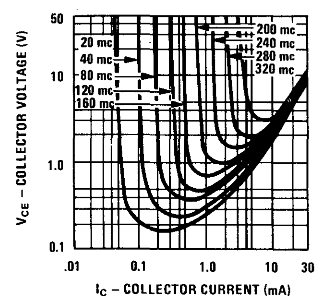
Base Saturation Voltage vs Collector Current



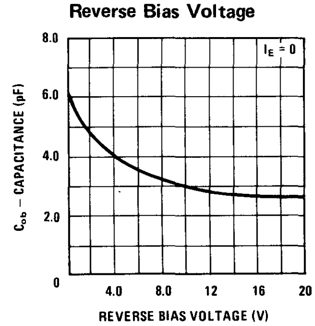
High Frequency Current Gain vs Collector Current



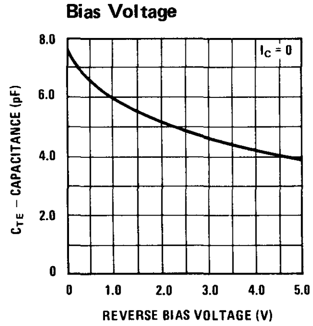
Contours of Constant Gain Bandwidth Product (f_T)



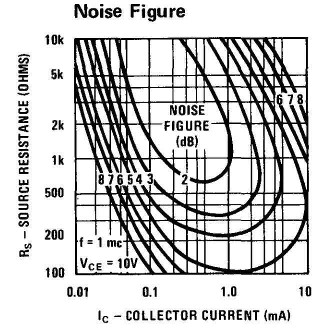
Output Capacitance vs Reverse Bias Voltage



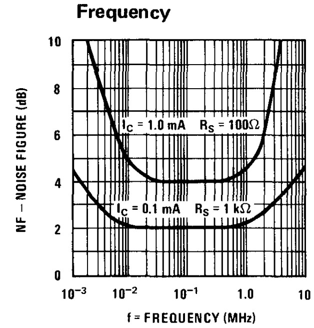
Emitter Transition Capacitance vs Reverse Bias Voltage



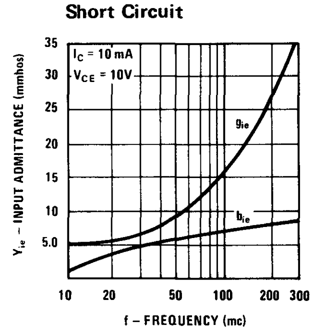
Contours of Spot Noise Figure



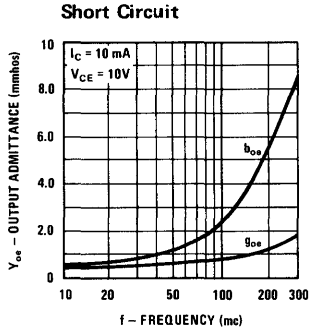
Noise Figure vs Frequency



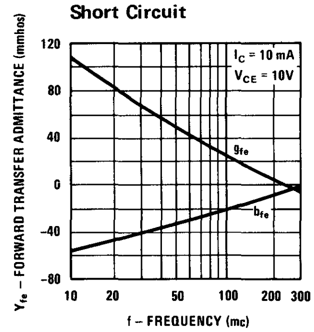
Input Admittance vs Frequency-Output Short Circuit



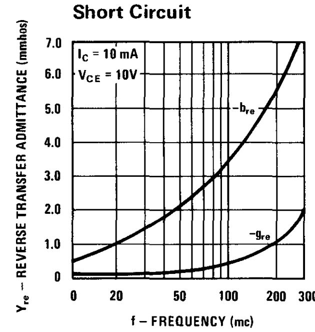
Output Admittance vs Frequency-Input Short Circuit



Forward Transfer Admittance vs Frequency-Output Short Circuit

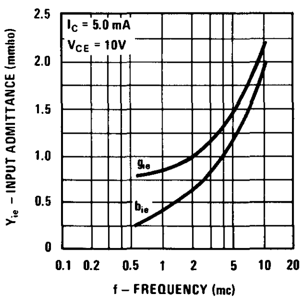


Reverse Transfer Admittance vs Frequency-Input Short Circuit

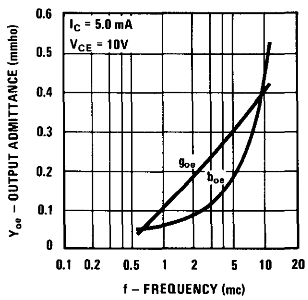


Process 26

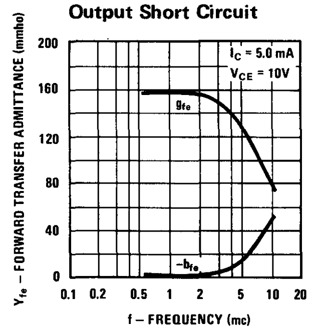
Input Admittance vs Frequency-Output Short Circuit



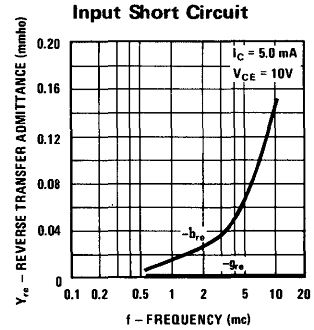
Output Admittance vs Frequency-Input Short Circuit



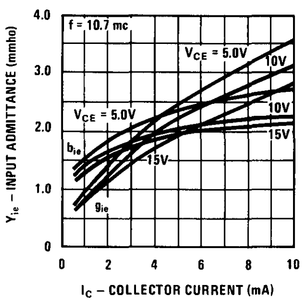
Forward Transfer Admittance vs Frequency-Output Short Circuit



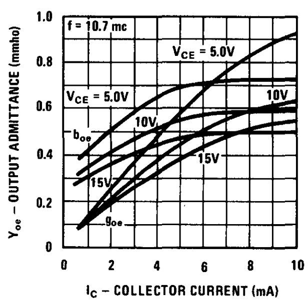
Reverse Transfer Admittance vs Frequency-Input Short Circuit



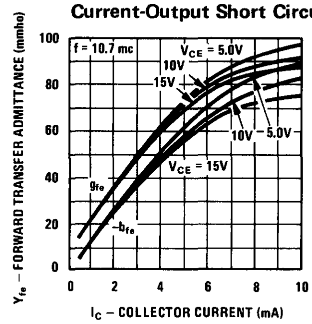
Input Admittance vs Collector Current-Output Short Circuit



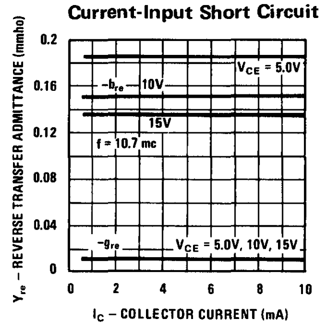
Output Admittance vs Collector Current-Input Short Circuit



Forward Transfer Admittance vs Collector Current-Output Short Circuit



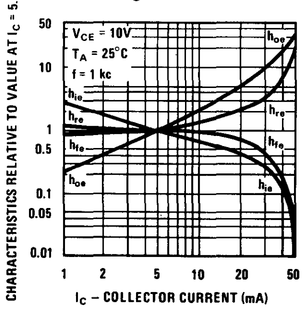
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



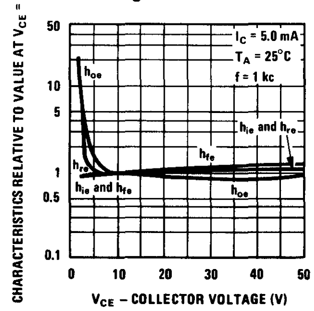
SMALL SIGNAL CHARACTERISTICS (f = 1 kc)

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

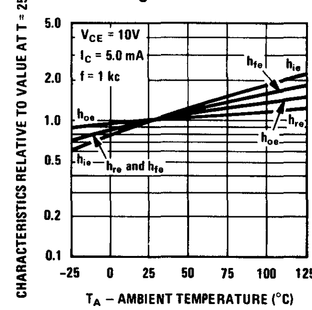
Small Signal Characteristics



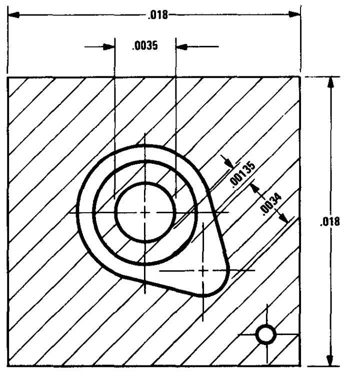
Small Signal Characteristics



Small Signal Characteristics



Process 27 NPN Small Signal



description

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

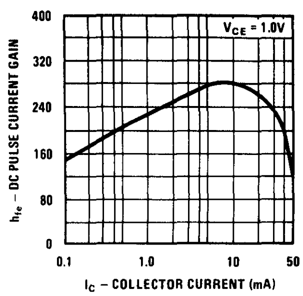
application

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

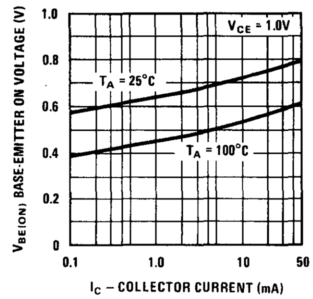
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (wide band)	V_{CE} = 5, I_C = 100 μA, f_{BW} = 15.7 kHz		1.5		dB	
NF (spot)	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1k		1.5	3.0	dB	
C_{cb}	V_{CB} = 10V, f = 1 MHz		2.0	2.5	pF	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 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

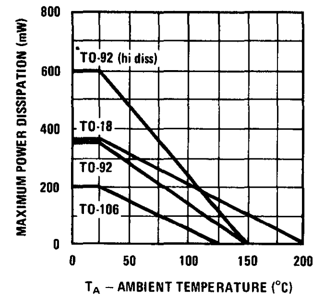
DC Pulse Current Gain vs Collector Current



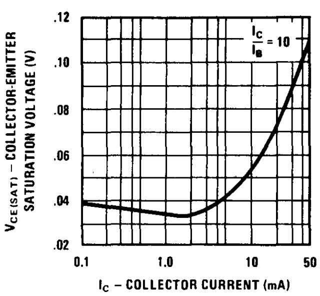
Base-Emitter On Voltage vs Collector Current



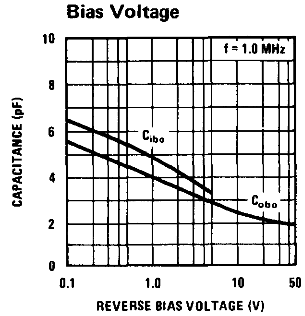
Maximum Power Dissipation vs Temperature



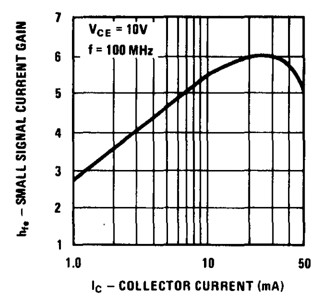
Collector-Emitter Saturation Voltage vs Collector Current



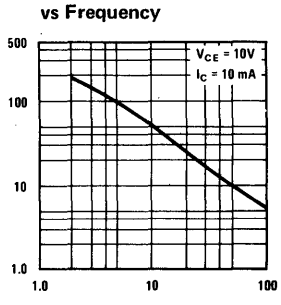
Capacitance vs Reverse Bias Voltage



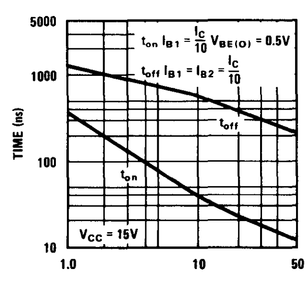
Small Signal Current Gain vs Collector Current



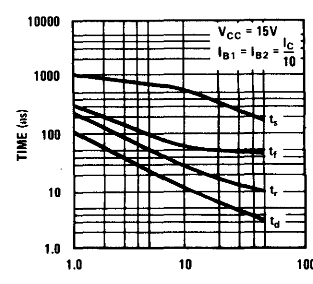
Small Signal Current Gain vs Frequency



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

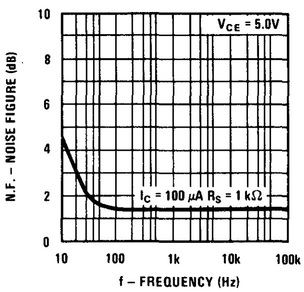


Switching Times vs Collector Current

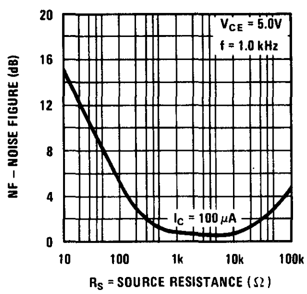


Process 27

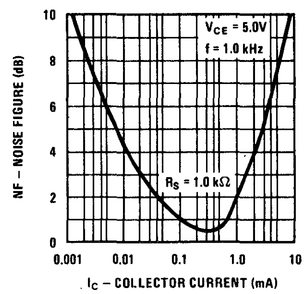
Noise Figure vs Frequency



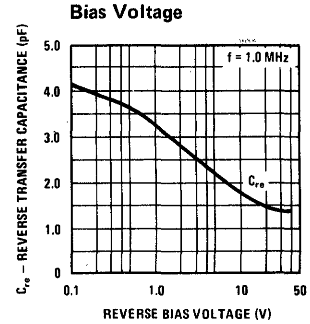
Noise Figure vs Source Resistance



Noise Figure vs Collector Current

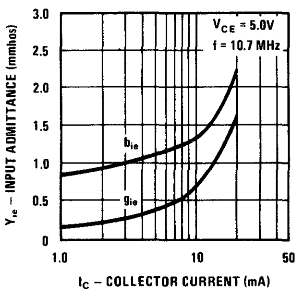


Capacitance vs Reverse Bias Voltage

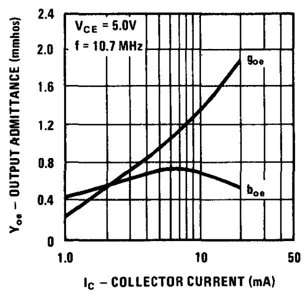


COMMON EMITTER Y PARAMETERS

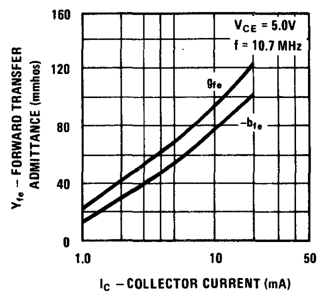
Input Admittance vs Collector Current



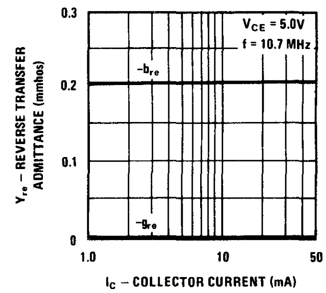
Output Admittance vs Collector Current



Forward Transfer Admittance vs Collector Current

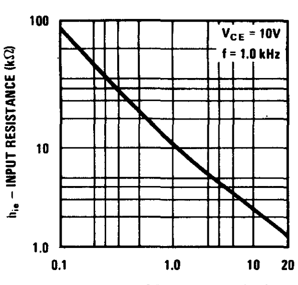


Reverse Transfer Admittance vs Collector Current

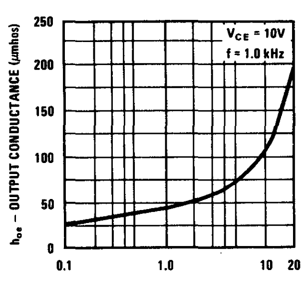


COMMON EMITTER H PARAMETERS

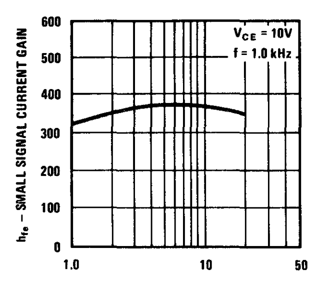
Small Signal Input Resistance vs Collector Current



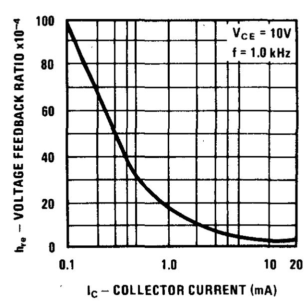
Small Signal Output Conductance vs Collector Current



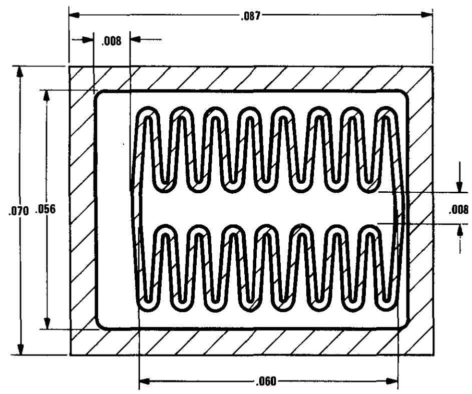
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 34 NPN Power



description

This device in nonoverlay double diffused, silicon epitaxial transistor.

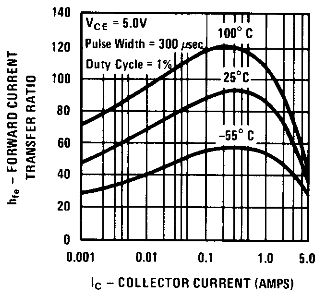
application

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

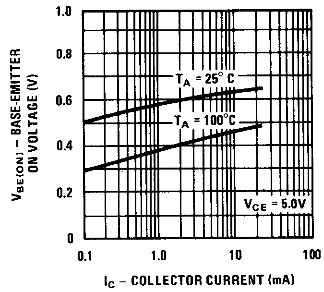
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 1A, I_{B1} = 0.1A		90	120	ns	
t_{off}	I_C = 1A, I_{B2} = 0.1A		200	260	ns	
C_{ob}	V_{CB} = 10V		60	70	pF	
C_{ib}	V_{EB} = 0.5V		425	500	pF	
h_{fe}	I_C = 200 mA, V_{CE} = 10V, f = 20 MHz	4.0	5.0			
h_{FE}	I_C = 1 mA, V_{CE} = 5V	40	50	100		
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

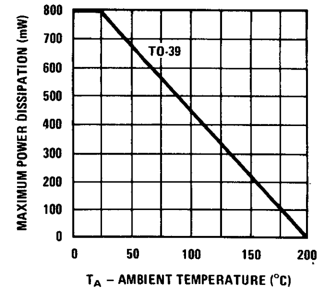
Pulsed DC Current Gain vs Collector Current



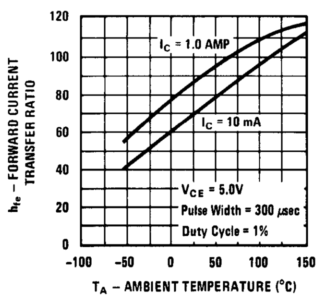
Base-Emitter on Voltage vs Collector Current



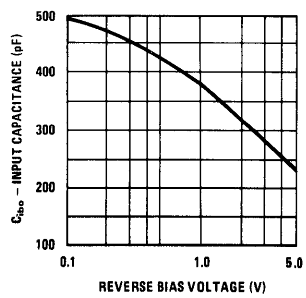
Maximum Power Dissipation vs Temperature



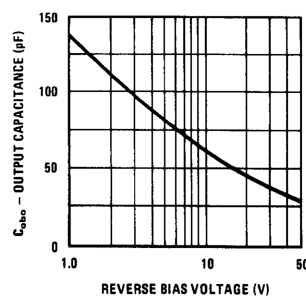
Pulsed DC Current Gain vs Ambient Temperature



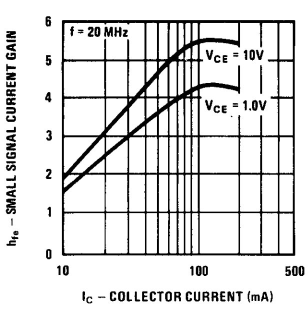
Input Capacitance vs Reverse Bias Voltage



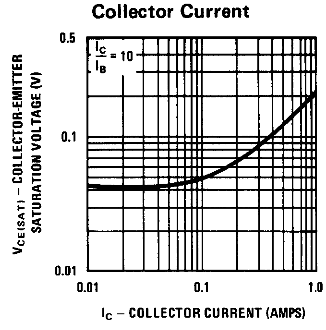
Output Capacitance vs Reverse Bias Voltage



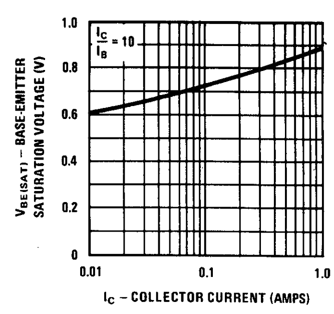
Small Signal Current Gain vs Collector Current



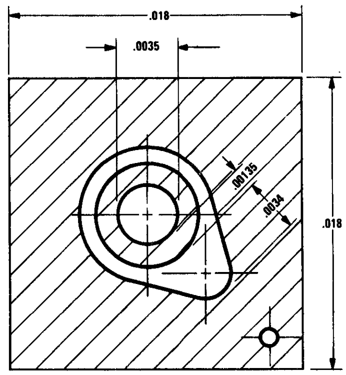
Collector-Emitter Saturation Voltage vs Collector Current



Base-Emitter Saturation Voltage vs Collector Current



Process 43 NPN Small Signal



description

Process 43 is an overlay double diffused, silicon epitaxial device

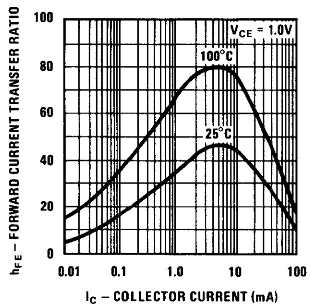
application

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

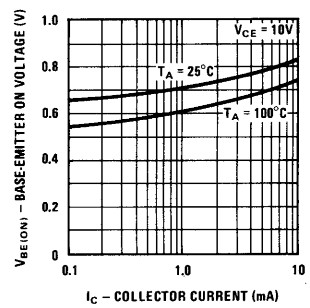
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{TE}	f = 200 MHz, I_C = 5 mA, V_{CE} = 10V	15	18		dB	
NF	f = 60 MHz, I_C = 1 mA, V_{CE} = 10V R_S = 200Ω		3	5	dB	
PO	f = 500 MHz, I_C = 8 mA, V_{CE} = 15V	30	35		mW	
PO	f = 900 MHz, I_C = 8 mA, V_{CE} = 15V	3	7		mW	
h_{fe}	I_C = 4 mA, V_{CE} = 10V, f = 100 MHz	6	9			
C_{cb}	V_{CB} = 10V		1.5	2.5	pF	TO-18
C_{eb}	V_{EB} = .5V		1.4	2.0	pF	Pkg
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		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

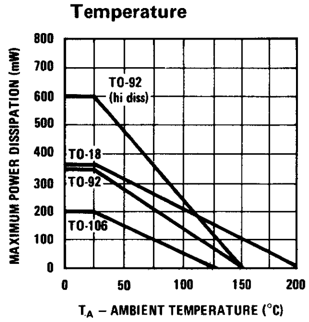
Pulsed DC Current Gain vs Collector Current



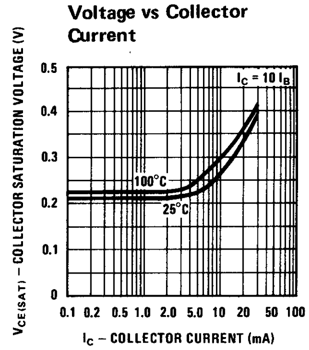
Base-Emitter On Voltage vs Collector Current



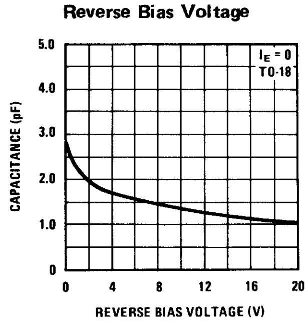
Maximum Power Dissipation vs Temperature



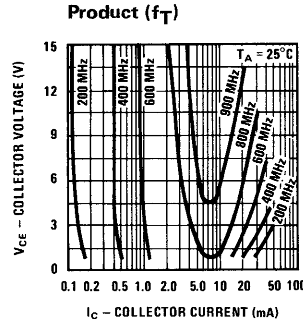
Collector Saturation Voltage vs Collector Current



Output Capacitance vs Reverse Bias Voltage



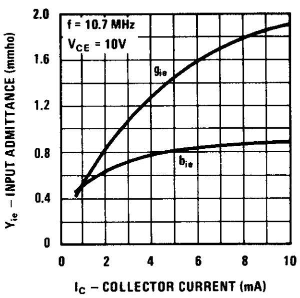
Contours of Constant Gain Bandwidth Product (f_T)



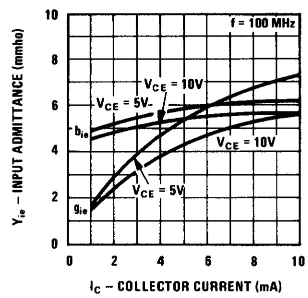
Process 43

COMMON EMITTER "Y" PARAMETERS

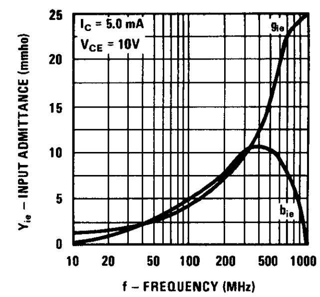
Input Admittance vs Collector Current-Output Short Circuit



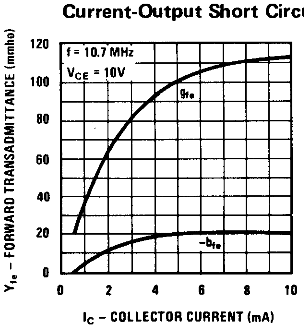
Input Admittance vs Collector Current-Output Short Circuit



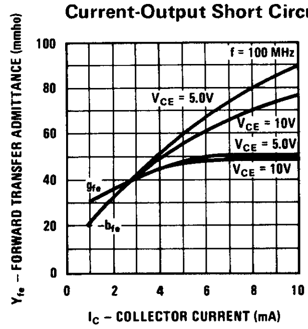
Input Admittance vs Frequency-Output Short Circuit



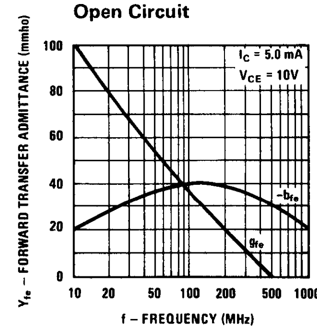
Forward Transfer Admittance vs Collector Current-Output Short Circuit



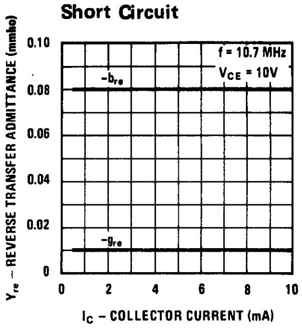
Forward Transfer Admittance vs Collector Current-Output Short Circuit



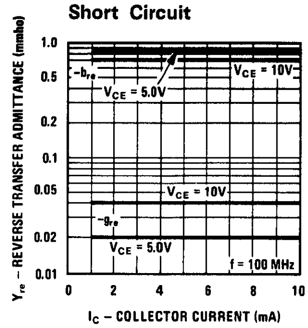
Forward Transfer Admittance vs Frequency-Output Open Circuit



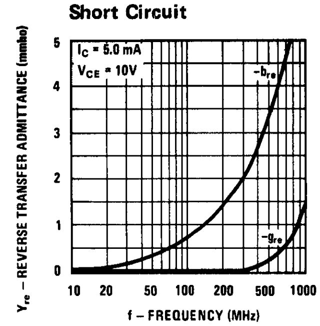
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



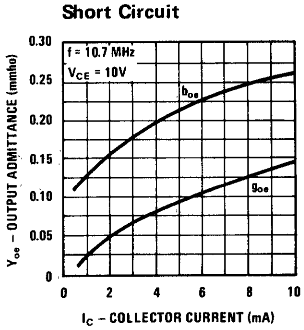
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



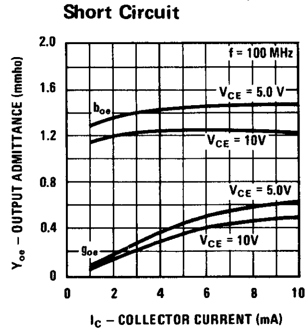
Reverse Transfer Admittance vs Frequency-Input Short Circuit



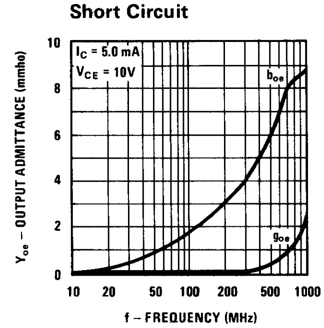
Output Admittance vs Collector Current-Input Short Circuit



Output Admittance vs Collector Current-Input Short Circuit

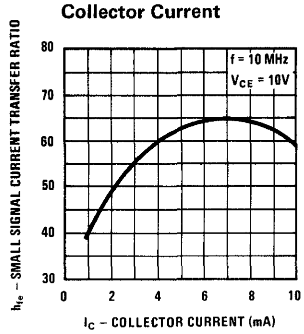


Output Admittance vs Frequency-Input Short Circuit

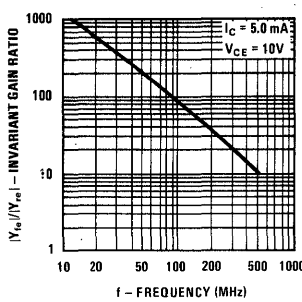


Process 43

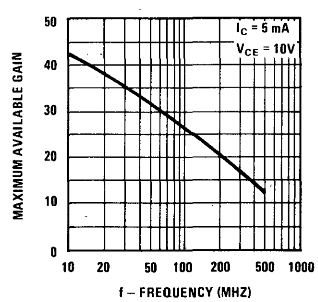
Small Signal Current Gain vs Collector Current



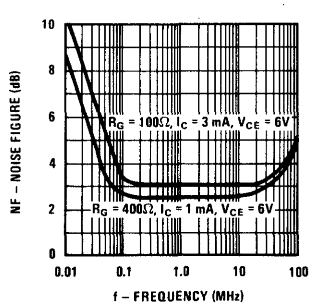
Invariant Maximum Stable Power Gain vs Frequency



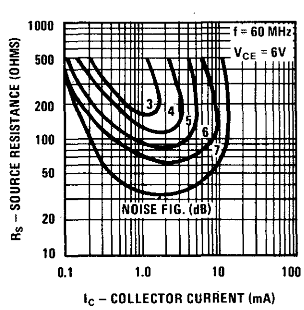
Maximum Available Gain vs Frequency



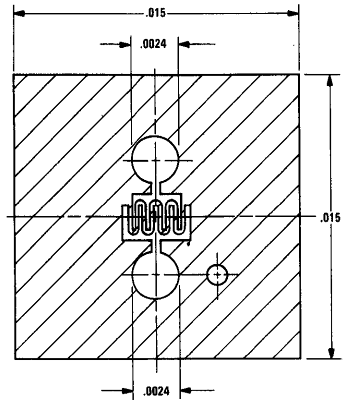
Noise Figure vs Frequency



Contours of Constant Noise Figure



Process 44 NPN AGC-RF Amplifier



description

Process 44 is an overlay double diffused, silicon device.

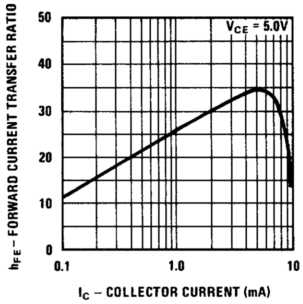
application

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

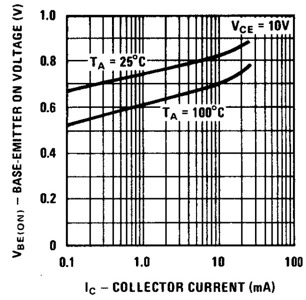
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω		2.5	3.3	dB	Fig. 1
P_G	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω	20	24	27	dB	Fig. 1
NF	f = 45 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω		3.0	5.0	dB	Fig. 2
P_G	f = 45 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω	23	25	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

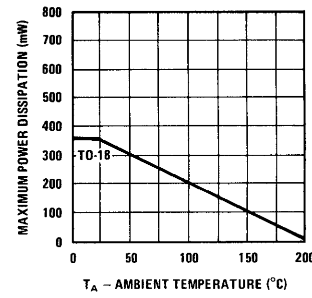
Pulsed DC Current Gain vs Collector Current



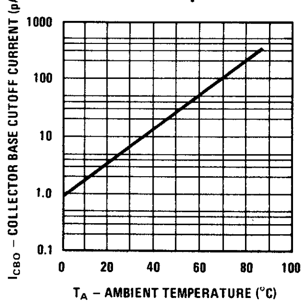
Base-Emitter On Voltage vs Collector Current



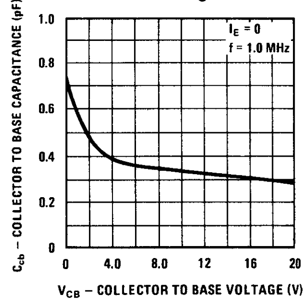
Maximum Power Dissipation vs Temperature



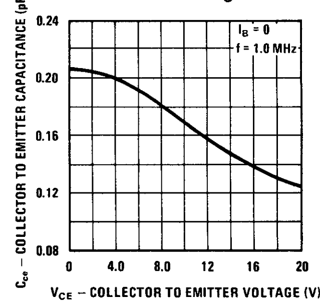
Collector Cutoff Current vs Ambient Temperature



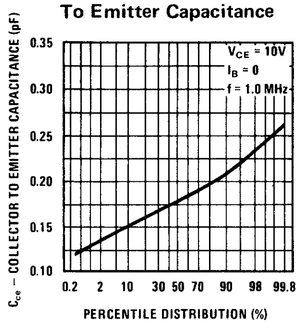
Collector To Base Capacitance vs Collector To Base Voltage



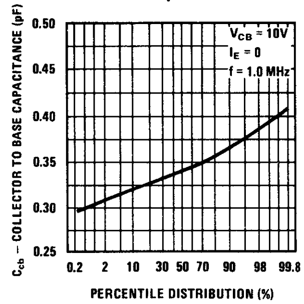
Collector To Emitter Capacitance vs Collector To Emitter Voltage



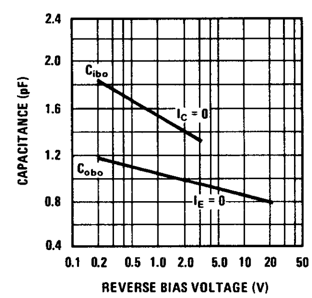
Distribution Of Collector To Emitter Capacitance



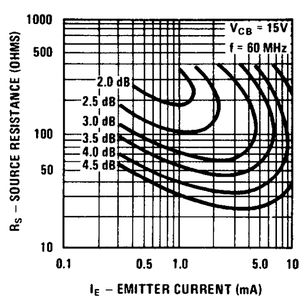
Distribution Of Collector To Base Capacitance



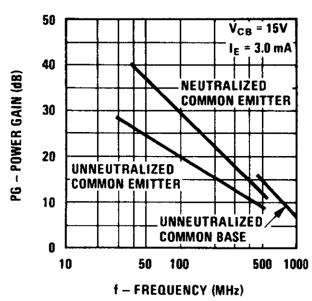
Input And Output Capacitance vs Reverse Bias Voltage



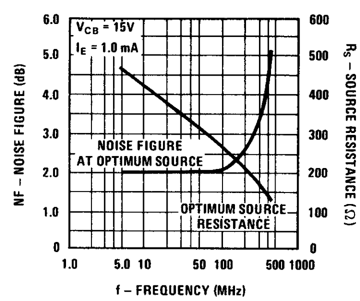
Noise Figure vs Source Resistance and Collector Current



Power Gain vs Frequency



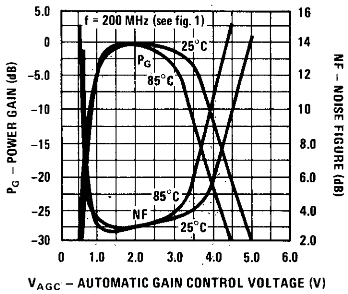
Noise Figure and Source Resistance vs Frequency



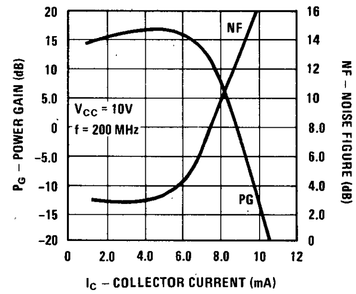
Process 44

COMMON EMITTER PERFORMANCE

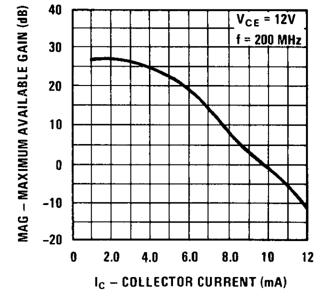
Power Gain and Noise Figure vs Automatic Gain Control Voltage



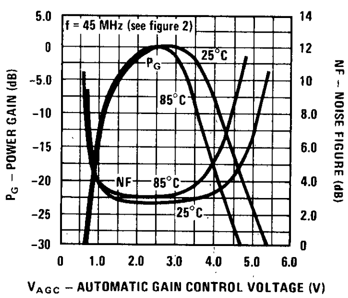
Power Gain and Noise Figure vs Collector Current



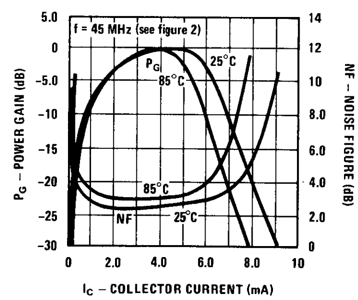
Maximum Available Gain vs Collector Current



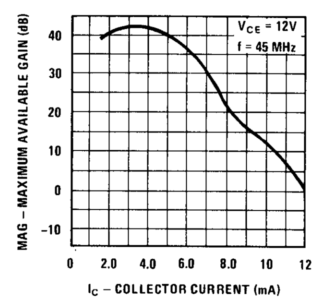
Power Gain and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Maximum Available Gain vs Collector Current



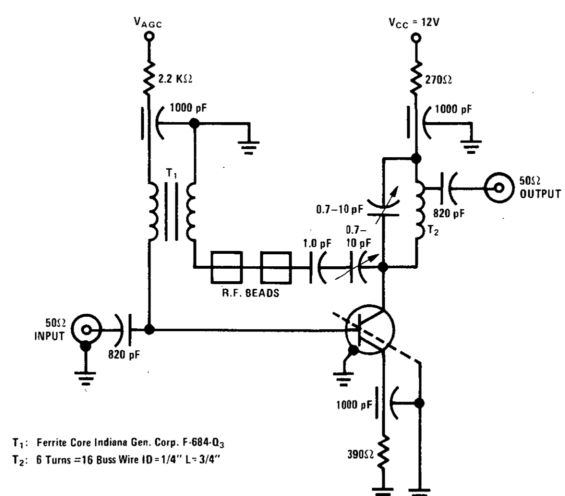


FIGURE 1. 200 MHz, AGC, Power Gain and Noise Figure Test Jig

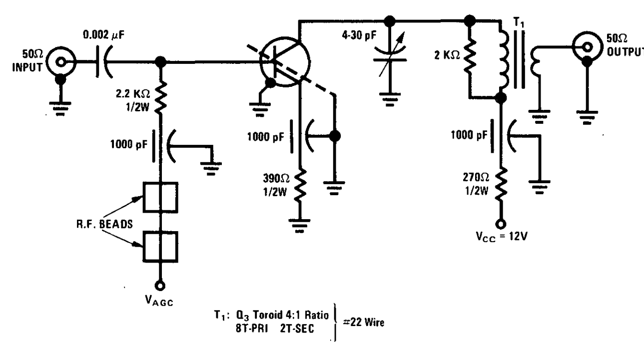
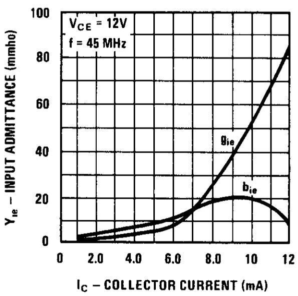


FIGURE 2. 45 MHz, AGC, Power Gain and Noise Figure Test Jig

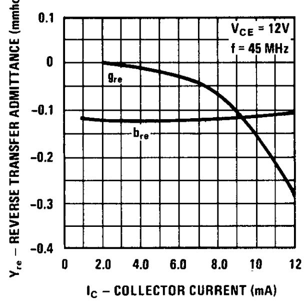
COMMON EMITTER "Y" PARAMETERS

Process 44

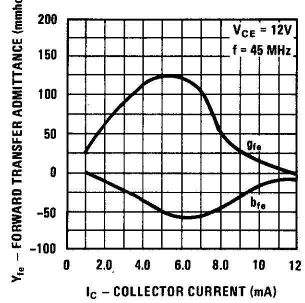
Input Admittance vs Collector Current-Output Short Circuit



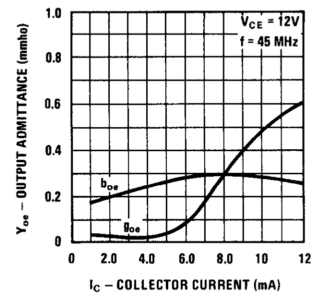
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



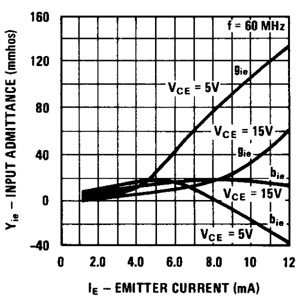
Forward Transfer Admittance vs Collector Current-Output Short Circuit



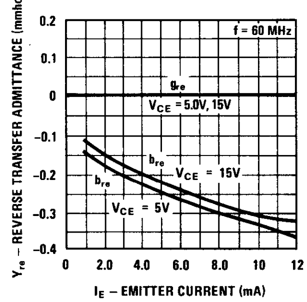
Output Admittance vs Collector Current-Input Short Circuit



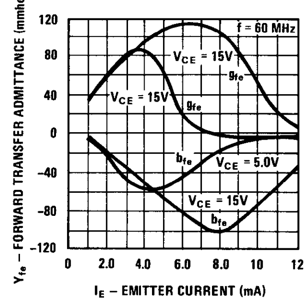
Input Admittance vs Emitter Current-Output Short Circuit



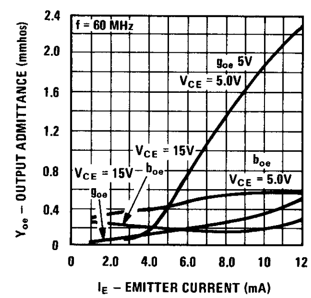
Reverse Transfer Admittance vs Emitter Current-Input Short Circuit



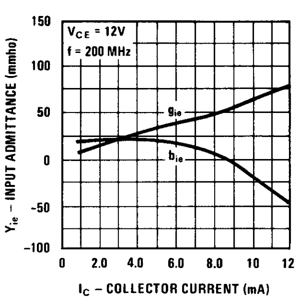
Forward Transfer Admittance vs Emitter Current-Output Short Circuit



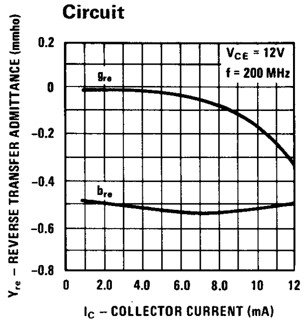
Output Admittance vs Emitter Current - Input Short Circuit



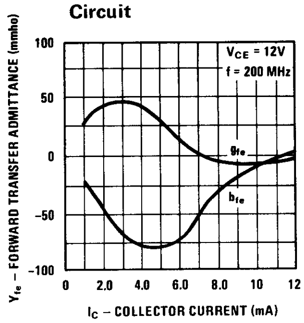
Input Admittance vs Collector Current-Output Short Circuit



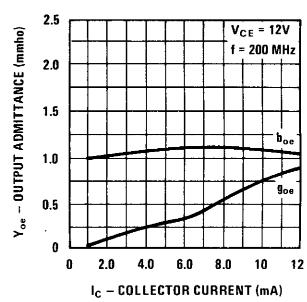
Reverse Transfer Admittance vs Collector Current - Input Short Circuit



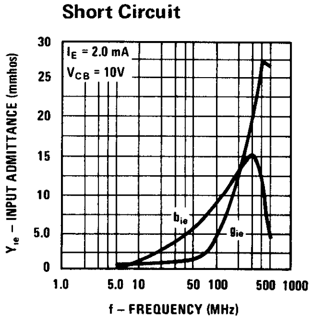
Forward Transfer Admittance vs Collector Current - Output Short Circuit



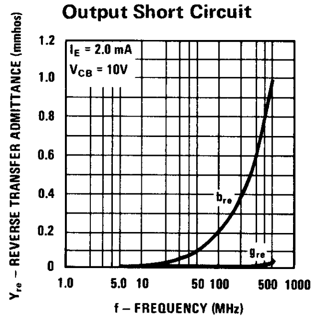
Output Admittance vs Collector Current - Input Short Circuit



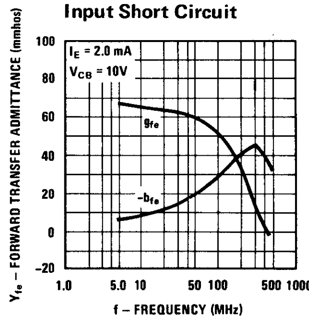
Input Admittance vs Frequency - Output Short Circuit



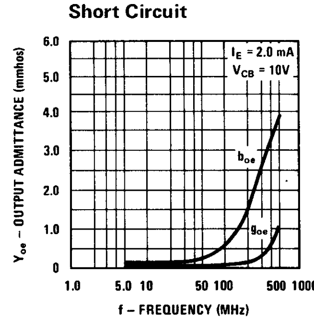
Reverse Transfer Admittance vs Frequency Output Short Circuit



Forward Transfer Admittance vs Frequency Input Short Circuit



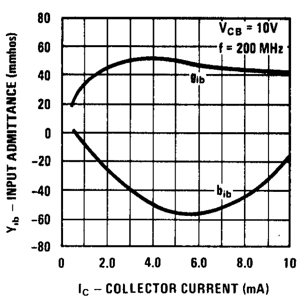
Output Admittance vs Frequency - Input Short Circuit



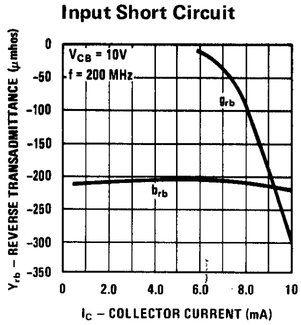
Process 44

COMMON BASE "Y" PARAMETERS

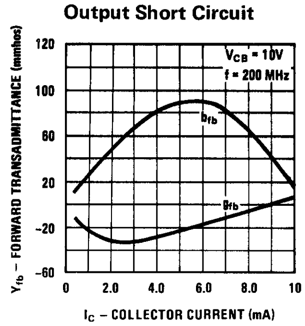
Input Admittance vs Collector Current-Output Short Circuit



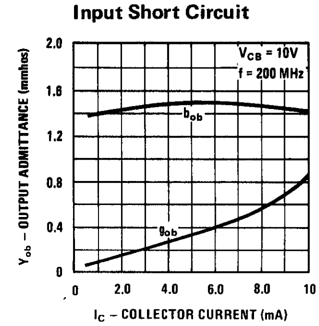
Reverse Transadmittance vs Collector Current-Input Short Circuit



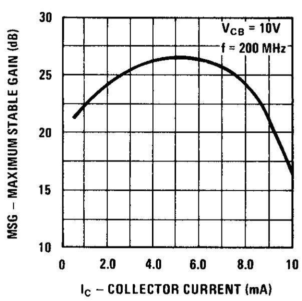
Forward Transadmittance vs Collector Current-Output Short Circuit



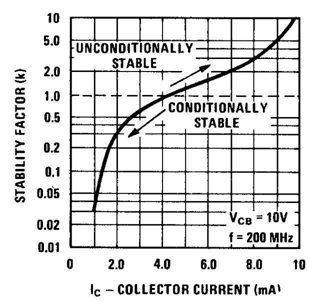
Output Admittance vs Collector Current-Input Short Circuit



Maximum Stable Gain vs Collector Current Common Base Configuration

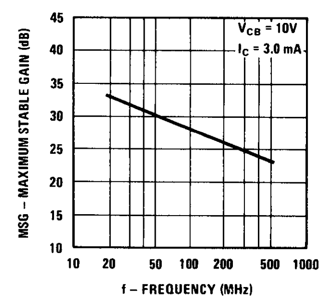


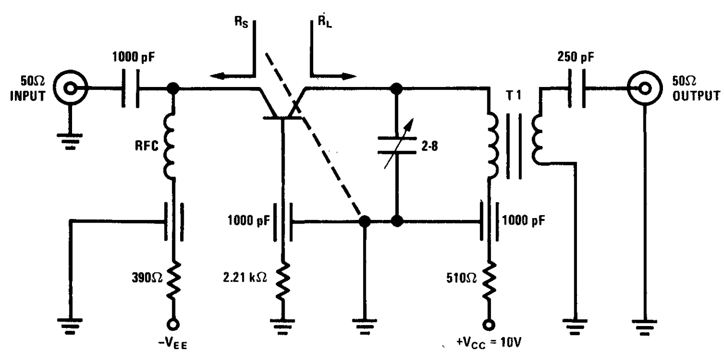
Common Base Configuration Stability Factor—k vs Collector Current



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

Maximum Stable Gain vs Frequency Common Base Configuration





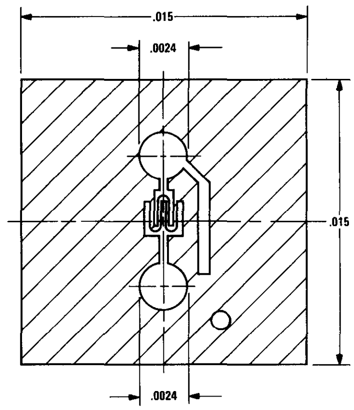
T_1–3:1 Ratio No. 22 Bifilar on Micrometals Toroid, P/N T30-12

R_S = 50Ω, R_L = 2.5 kΩ

f_{bw} = 8.0 MHz

Figure 1. 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.

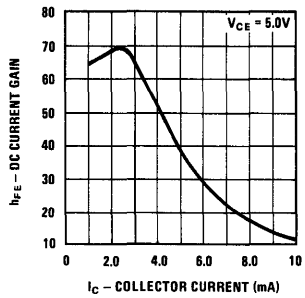
application

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

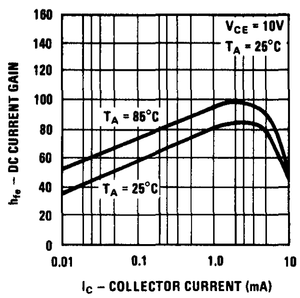
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω	27	29		dB	Fig. 1
NF	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω		2.8	5.0	dB	
C_{re}	V_{CB} = 10V		0.13	0.22	pF	
V_{AGC}	f = 45 MHz, V_{CC} = 12V 30 dB Gain Reduction	3.31	4.10	5.0	V	
V_{AGC}	f = 45 MHz, V_{CC} = 12V 50 dB Gain Reduction		6.10	7.5	V	
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	20			V	
BV_{CBO}	I_C = 100 μA	20			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

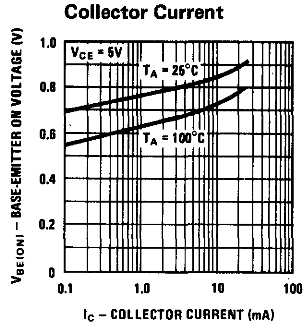
DC Current Gain vs Collector Current



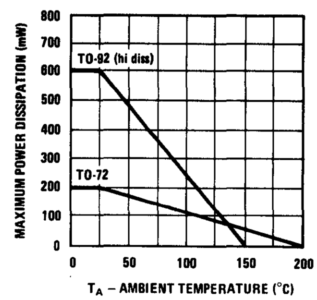
DC Pulse Current Gain vs Collector Current



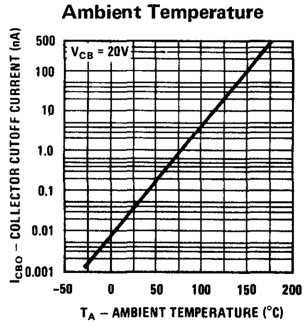
Base-Emitter On Voltage vs Collector Current



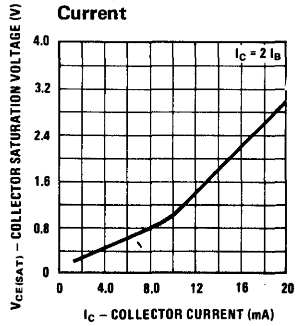
Maximum Power Dissipation vs Temperature



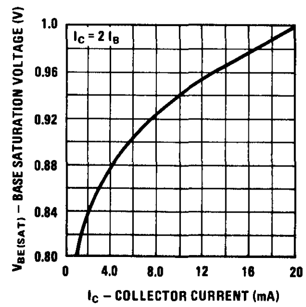
Collector Cutoff Current vs Ambient Temperature



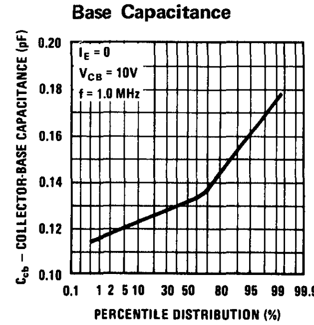
Collector Saturation Voltage vs Collector Current



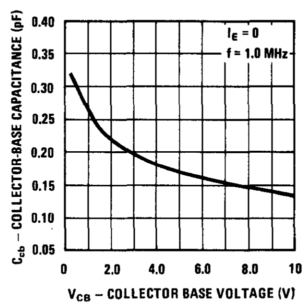
Base Saturation Voltage vs Collector Current



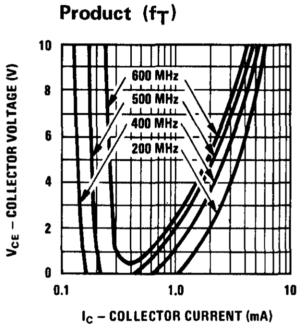
Distribution of Collector-Base Capacitance



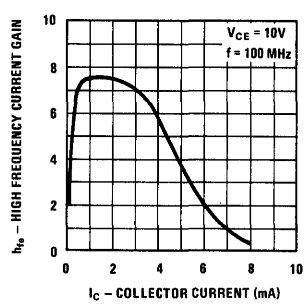
Collector-Base Capacitance vs Collector-Base Voltage



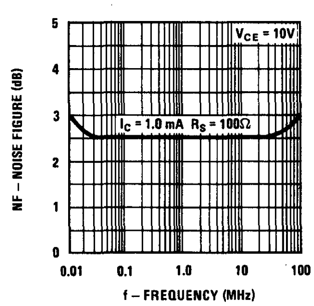
Contours of Constant Gain Bandwidth Product (f_T)



High Frequency Current Gain vs Collector Current



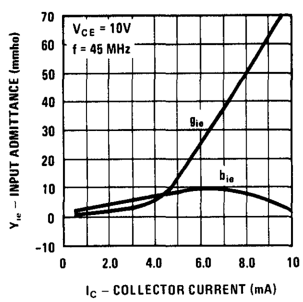
Noise Figure vs Frequency



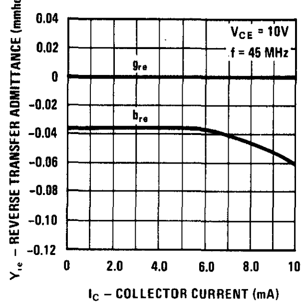
COMMON EMITTER "Y" PARAMETERS

Process 45

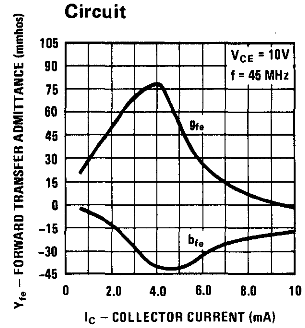
Input Admittance vs Collector Current-Output Short Circuit



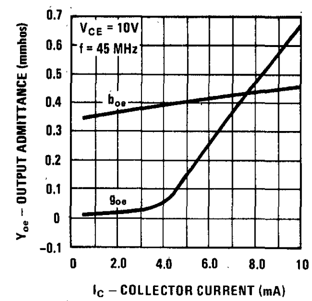
Reverse Transfer Admittance vs Collector Current—Input Short Circuit



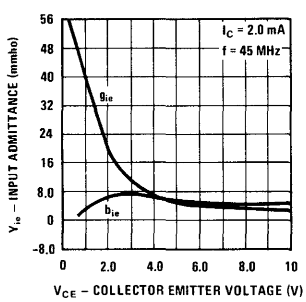
Forward Transfer Admittance vs Collector Current - Output Short Circuit



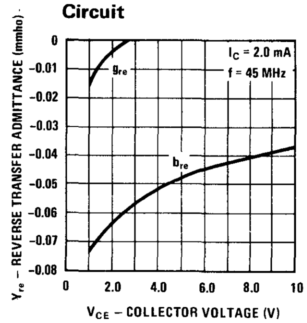
Output Admittance vs Collector Current-Input Short Circuit



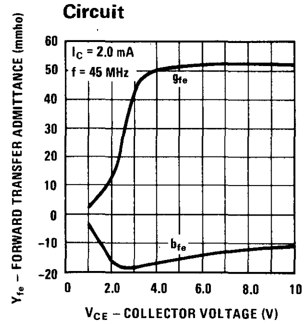
Input Admittance vs Collector Voltage-Output Short Circuit



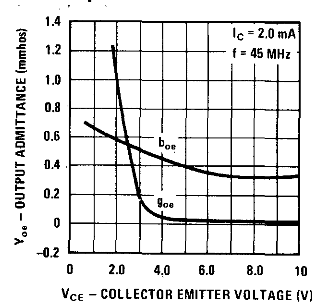
Reverse Transfer Admittance vs Collector Voltage - Input Short Circuit



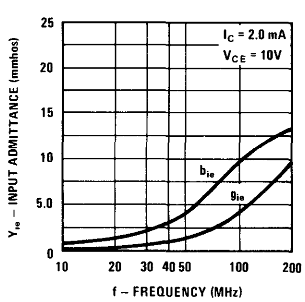
Forward Transfer Admittance vs Collector Voltage - Output Short Circuit



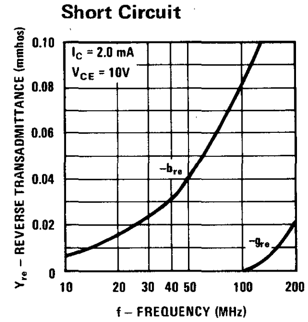
Output Admittance vs Collector Voltage-Input Short Circuit



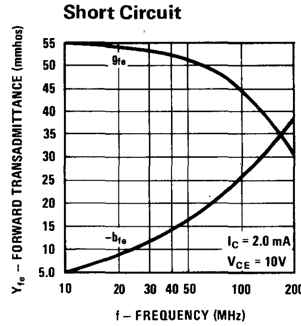
Input Admittance vs Frequency - Output Short Circuit



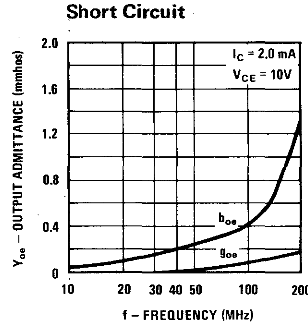
Reverse Transadmittance vs Frequency - Input Short Circuit



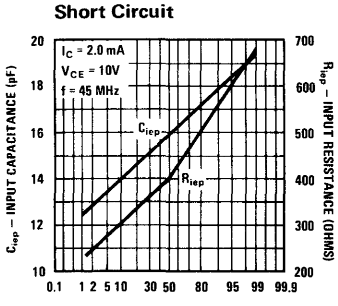
Forward Transadmittance vs Frequency - Output Short Circuit



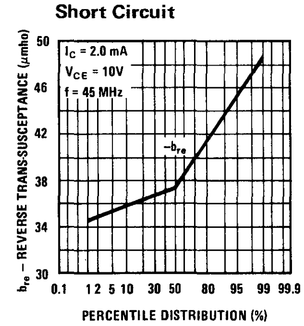
Output Admittance vs Frequency - Input Short Circuit



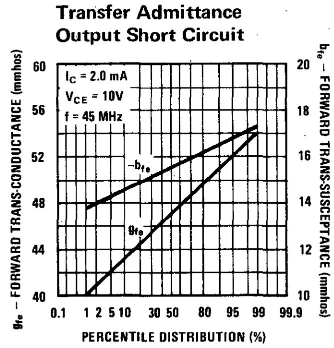
Distribution of Input Capacitance and Input Resistance - Output Short Circuit



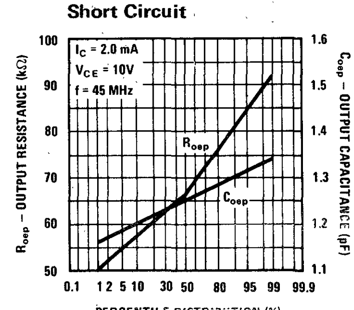
Distribution of Reverse Transadmittance - Input Short Circuit



Distribution of Forward Transfer Admittance Output Short Circuit

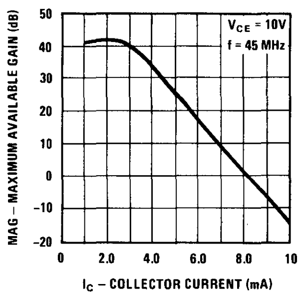


Distribution of Output Capacitance and Output Resistance - Input Short Circuit

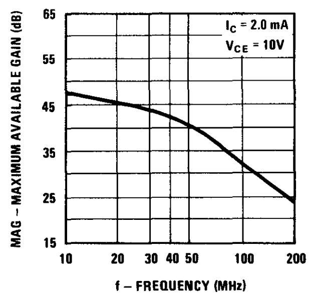


Process 45

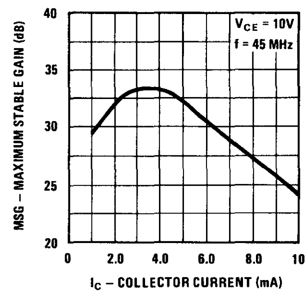
Maximum Available Gain vs Collector Current



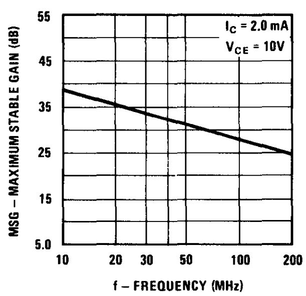
Maximum Available Gain vs Frequency



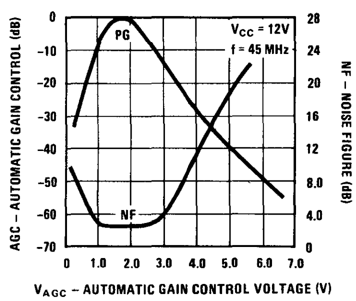
Maximum Stable Gain vs Collector Current



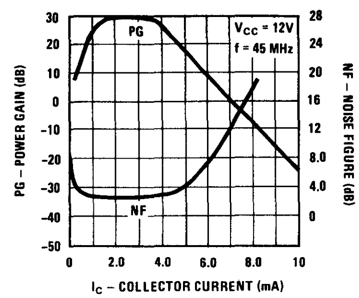
Maximum Stable Gain vs Frequency



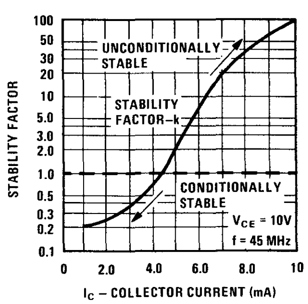
Automatic Gain Control and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Stability Factor* vs Collector Current



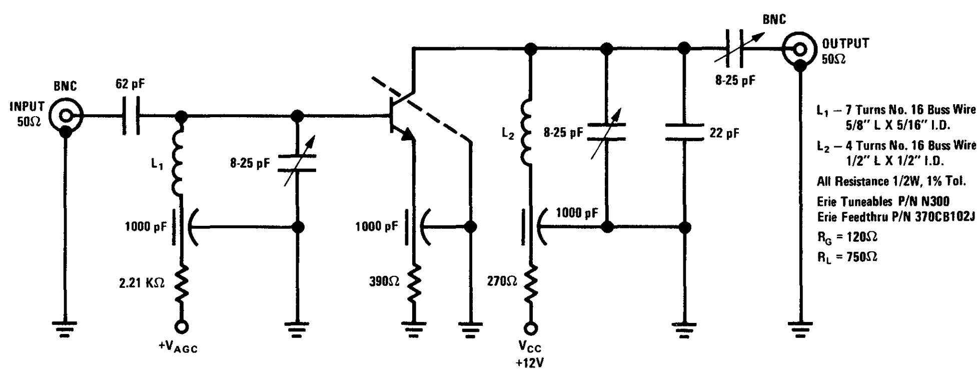
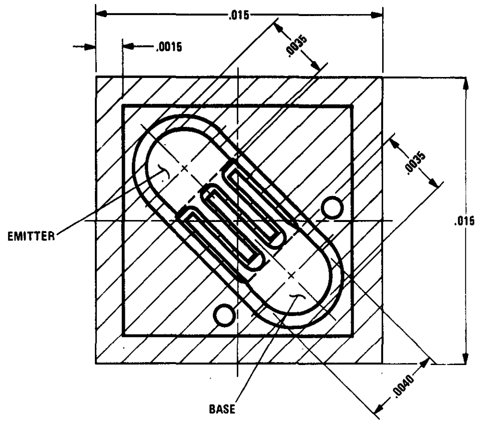


FIGURE 1. SE5055 45 MHz Gain, Noise Figure, AGC Circuit

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

Process 46 NPN RF-IF Amplifier



description

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

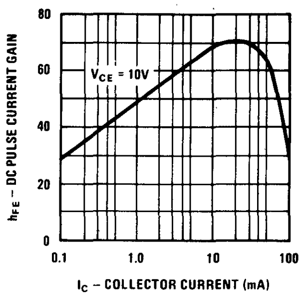
application

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

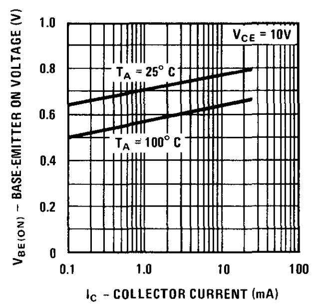
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{pe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	28		dB	
C_{cb}	V_{CB} = 10V		0.8	1.0	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			200	μmho	
h_{fe}	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	3.0	4.50			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	70	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA			0.6	V	
BV_{CEO}	I_C = 1 mA	30			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

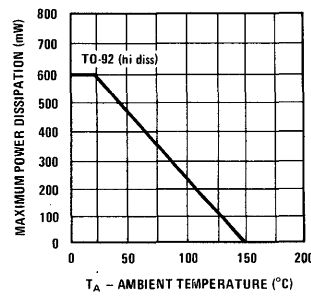
DC Pulse Current Gain vs Collector Current



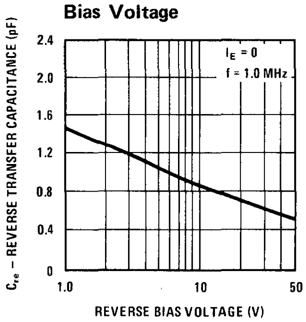
Base-Emitter On Voltage vs Collector Current



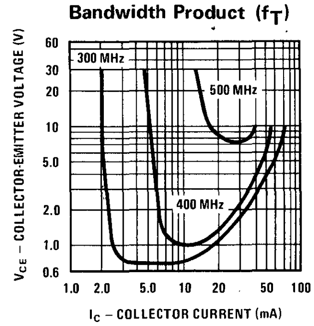
Maximum Power Dissipation vs Temperature



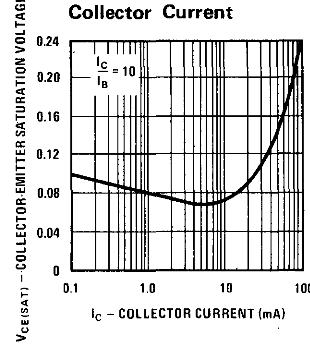
Reverse Transfer Capacitance vs Reverse Bias Voltage



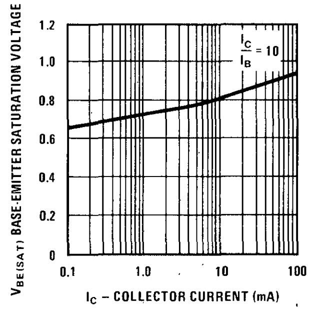
Contours of Constant Gain Bandwidth Product (f_T)



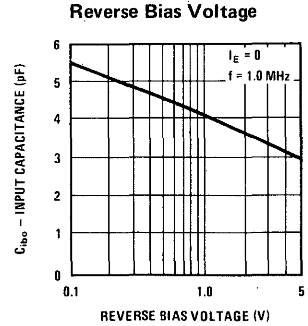
Collector-Emitter Saturation Voltage vs Collector Current



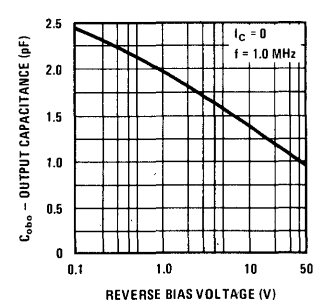
Base-Emitter Saturation Voltage vs Collector Current



Input Capacitance vs Reverse Bias Voltage

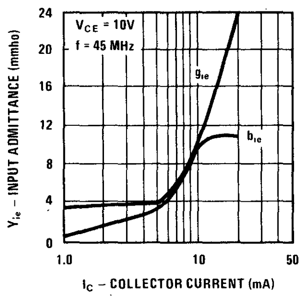


Output Capacitance vs Reverse Bias Voltage

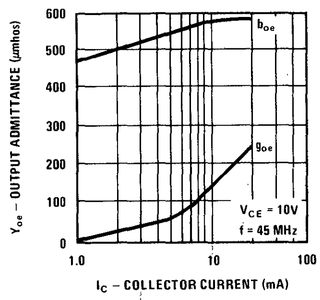


Process 46

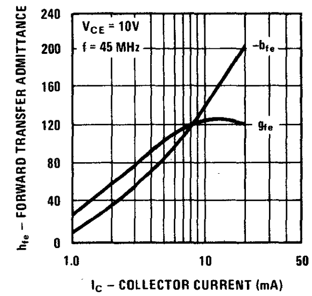
Input Admittance vs Collector Current



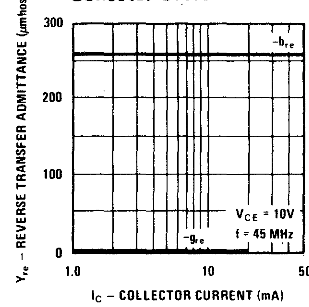
Output Admittance vs Collector Current



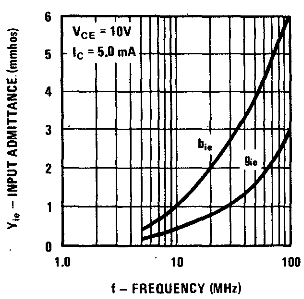
Forward Transfer Admittance vs Collector Current



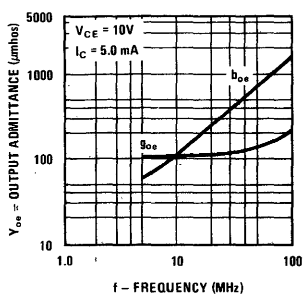
Reverse Transfer Admittance vs Collector Current



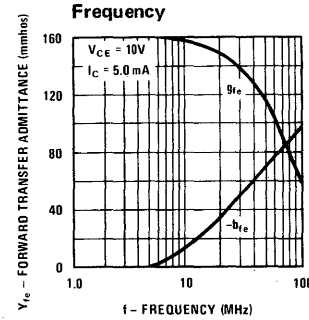
Input Admittance vs Frequency



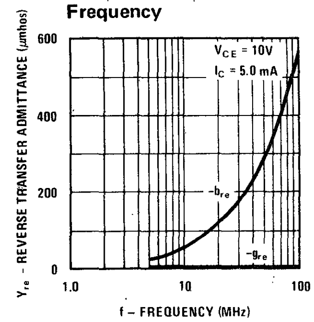
Output Admittance vs Frequency



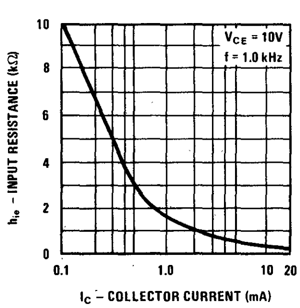
Forward Transfer Admittance vs Frequency



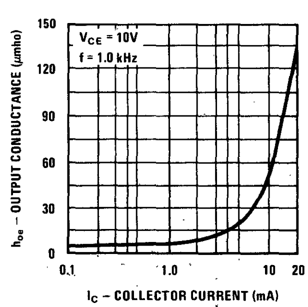
Reverse Transfer Admittance vs Frequency



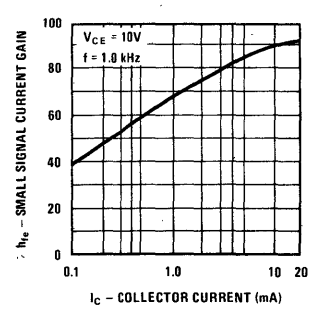
Small Signal Input Resistance vs Collector Current



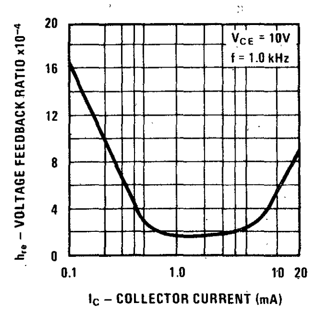
Small Signal Output Conductance vs Collector Current



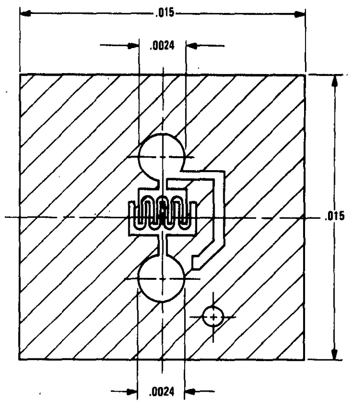
Small Signal Current Gain vs Collector Current



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.

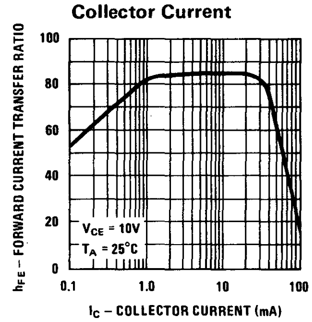
application

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.

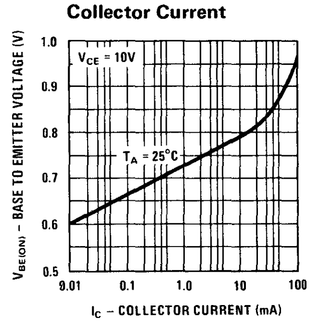
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{pe}	f = 200 MHz, V_{CE} = 10V, I_C = 4 mA	19	23		dB	Fig. 2
NF	f = 200 MHz, V_{CE} = 10V, I_C = 4 mA, R_S = 50Ω			4.0	dB	Fig. 2
G_{ve}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA	38	42	46	dB	
G_{ms}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA	27			dB	
C_{ib}	V_{EB} = 0.5V		2.0	3.0	pF	TO-92
C_{cb}	V_{CB} = 15V	0.25	0.28	0.40	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA			125	μmho	
Y_{fe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA		130		mmho	
θ_{fe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA		–25		Degrees	
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		1.0	3.0	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

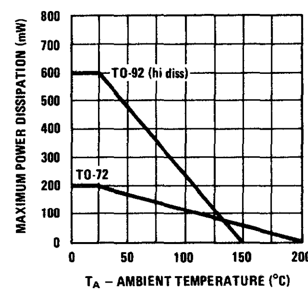
DC Pulse Current Gain vs Collector Current



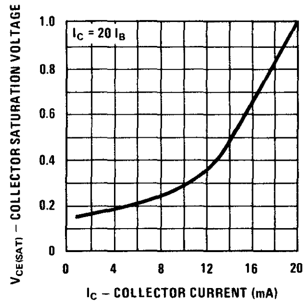
Base-Emitter On Voltage vs Collector Current



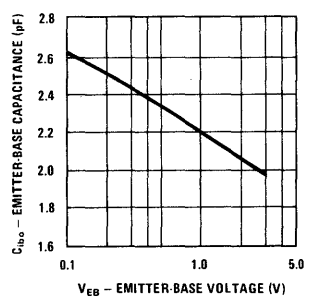
Maximum Power Dissipation vs Temperature



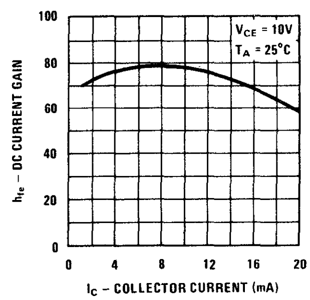
Collector Saturation Voltage vs Collector Current



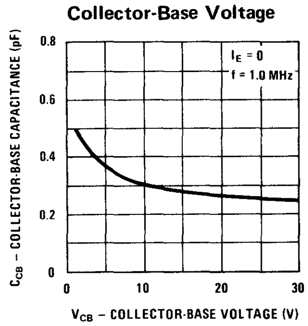
Emitter-Base Capacitance vs Emitter Base Voltage



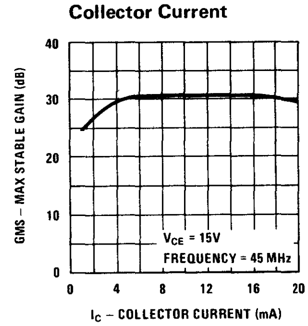
DC Current Gain vs Collector Current



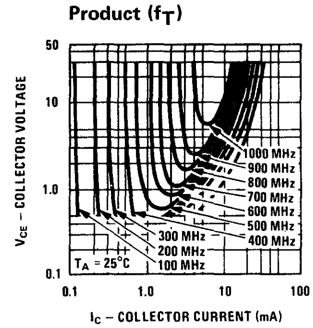
Collector-Base Capacitance vs Collector-Base Voltage



Max Stable Gain vs Collector Current



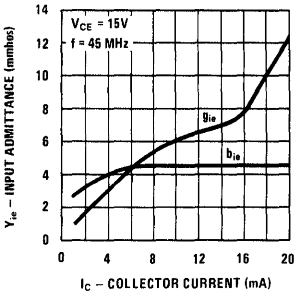
Contours Of Constant Gain Bandwidth Product (f_T)



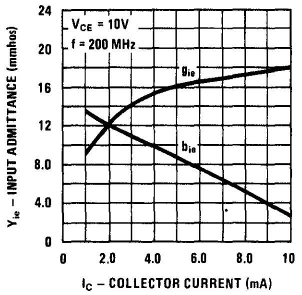
Process 47

COMMON EMITTER Y PARAMETERS

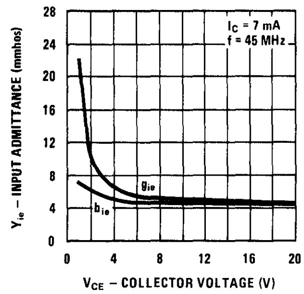
Input Admittance vs Collector Current



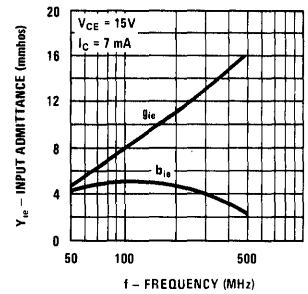
Input Admittance vs Collector Current



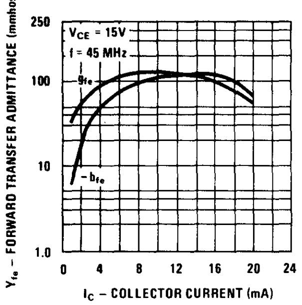
Input Admittance vs Collector Voltage



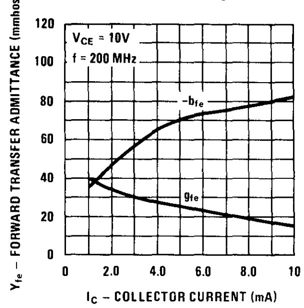
Input Admittance vs Frequency



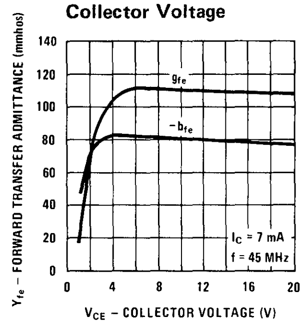
Forward Transfer Admittance vs Collector Current



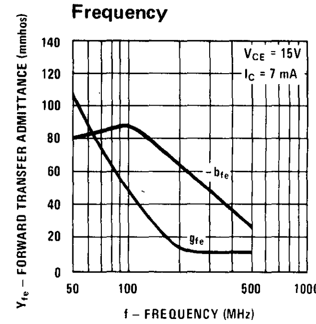
Forward Transfer Admittance vs Collector Current



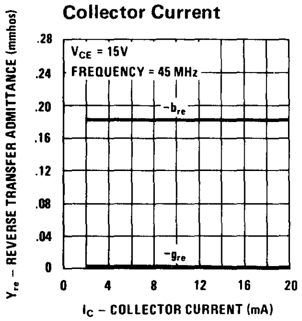
Forward Transfer Admittance vs Collector Voltage



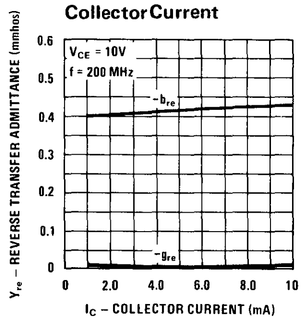
Forward Transfer Admittance vs Frequency



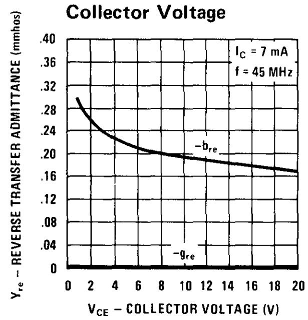
Reverse Transfer Admittance vs Collector Current



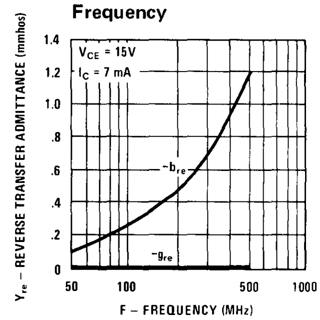
Reverse Transfer Admittance vs CollectorCurrent



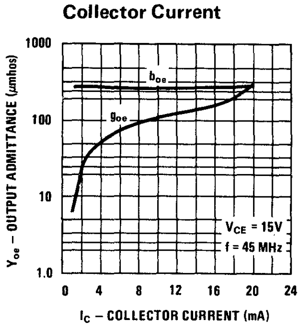
Reverse Transfer Admittance vs Collector Voltage



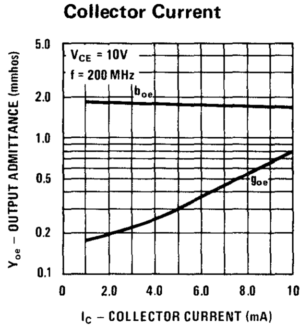
Reverse Transfer Admittance vs Frequency



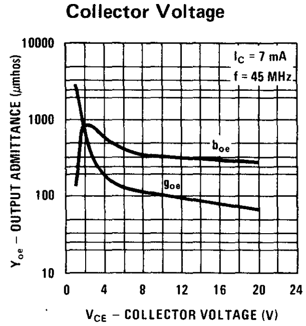
Output Admittance vs Collector Current



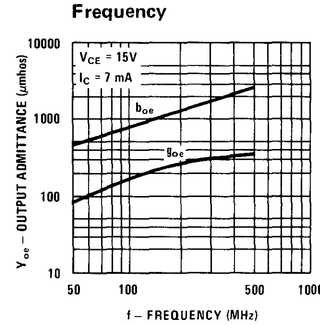
Output Admittance vs Collector Current



Output Admittance vs Collector Voltage

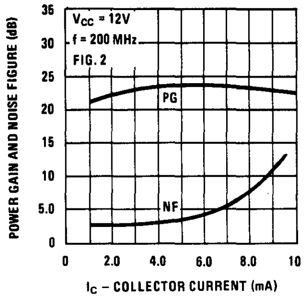


Output Admittance vs Frequency

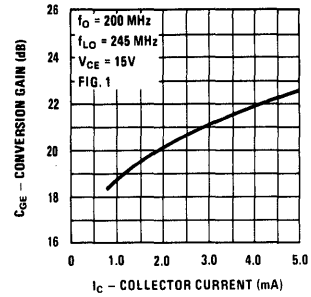


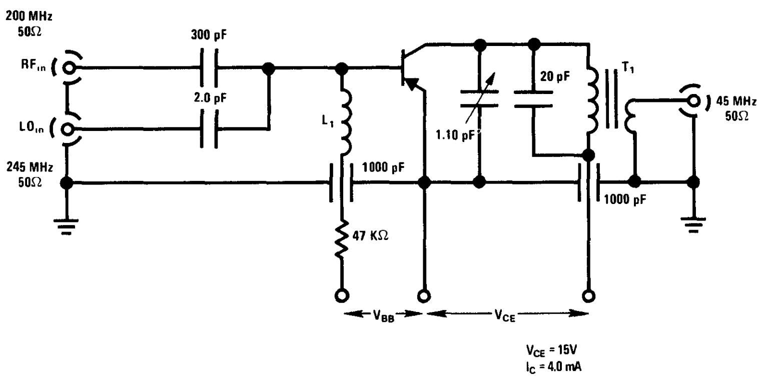
Process 47

Power Gain and Noise Figure vs Collector Current



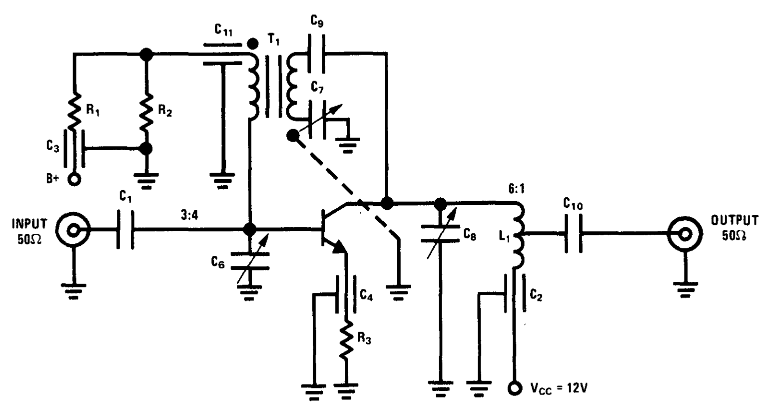
Conversion Gain vs Collector Current





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



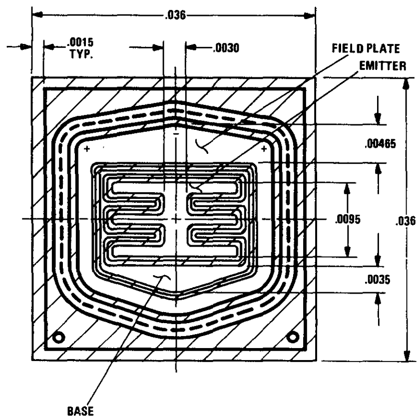
C_1, C_{10} = 1000 pF Duramica
C_2, C_3, C_4, C_5, C_{11} = 1000 pF feed thru
C_6 = 8 - 25 pF
C_7, C_8 = 0.7 - 10 pF
C_9 = 2 pF Duramica

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

Process 48 NPN High Voltage Video Output



description

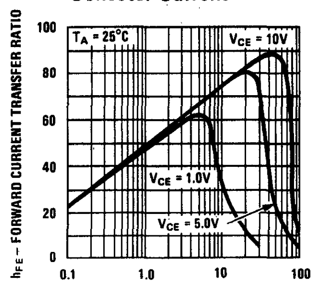
Process 48 is a nonoverlay triple diffused, silicon device with a field plate.

application

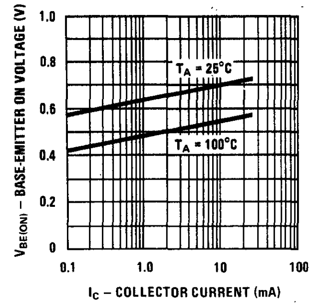
This device was designed for application as a video output to drive color CRT.

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	

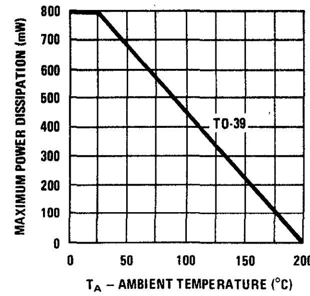
DC Pulse Current Gain vs Collector Current



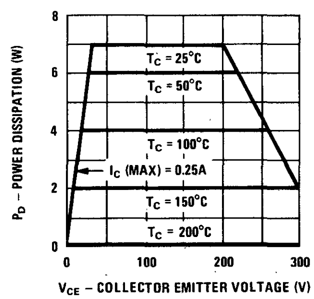
Base-Emitter On Voltage vs Collector Current



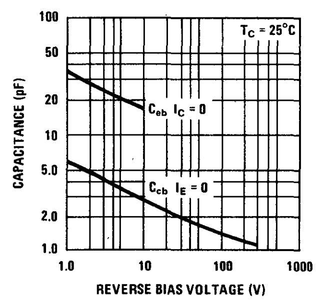
Maximum Power Dissipation vs Temperature



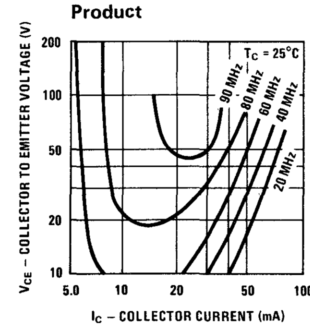
Guaranteed Maximum DC Power Dissipation vs Collector-Emitter Voltage



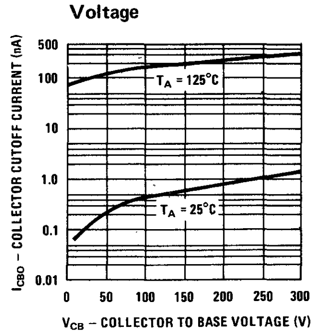
Collector To Base and Emitter To Base Capacitance vs Reverse Bias Voltage



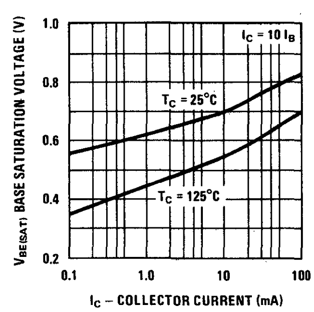
Contours of Constant Gain Bandwidth Product



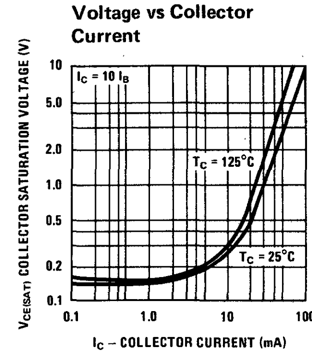
Collector Cutoff Current vs Collector Voltage



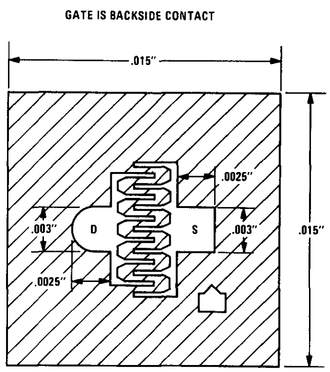
Base Saturation Voltage vs Collector Current



Collector Saturation Voltage vs Collector Current



Process 50 N-Channel Junction FET



PACKAGES:

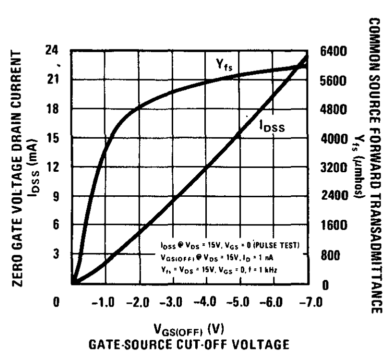
TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

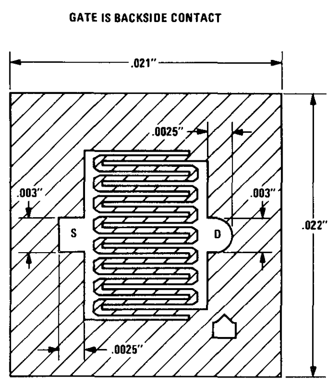
2N4416
2N5485
KE4416

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0, I_G = 1\ \mu A$	15	30		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V, V_{GS} = 0V$	1	10	25	mA
Forward Transconductance	Y_{fs}	$V_{DS} = 15V, V_{GS} = 0$	2.5	5.0	6.0	mmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 20V, V_{DS} = 0$		0.02	50	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	0.5	3	8	V
Feedback Capacitance	C_{rss}	$V_{DG} = 15V, I_S = 0$	0.6	0.7	1.0	pF
Input Capacitance	C_{iss}	$V_{DS} = 15V, V_{GS} = 0$	2.6	3.2	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



PACKAGES:

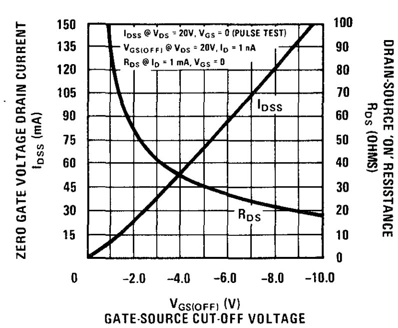
TO-18, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

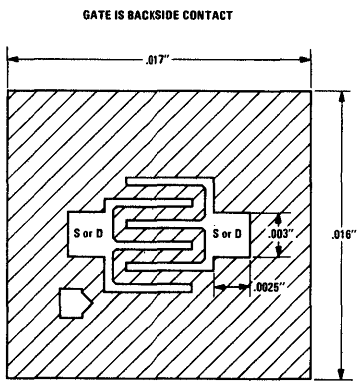
2N4391, 92, 93
2N5638, 39, 40
KE 4391, 92, 93

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	40		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0 Pulse Test	5	65	150	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.05	100	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0 , V_{GS} = 0	25	50	100	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20 , I_D = 1 nA	0.5	5.0	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:

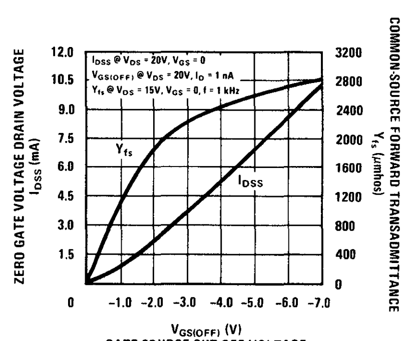
TO-18, TO-72, TO-106

PRINCIPAL DEVICE TYPES:

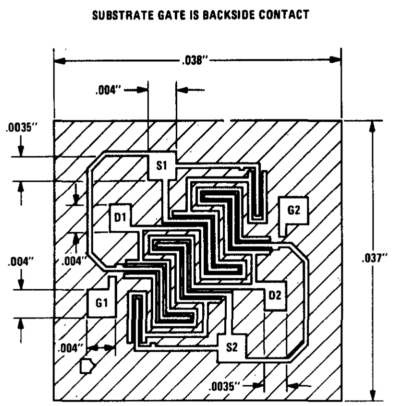
2N4338, 39, 40, 41
2N3684, 85, 86, 87

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	50		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	2.5	3.0	mmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = 30V, V_{DS} = 0		0.01	10	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0, V_{GS} = 0	400	500	2500	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 54 N-Channel Junction FET

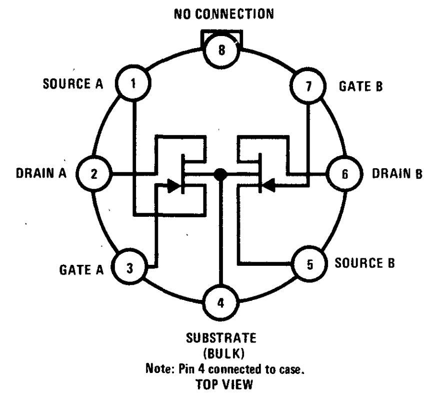


PACKAGE:

TO-99

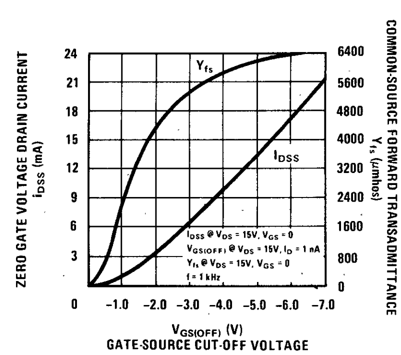
PRINCIPAL DEVICE TYPE:

FM1200 SERIES

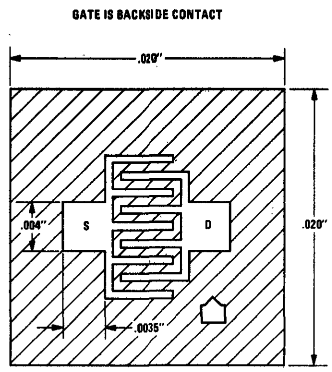


CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	35		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.2	5.0	20	mA
Forward Transconductance	Y_{fs}	V_{DS} = 15V, V_{GS} = 0	0.8	3.5	10	mmho
Reverse Gate Leakage	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 μV/° C.



Process 55 N-Channel Junction FET



PACKAGES:

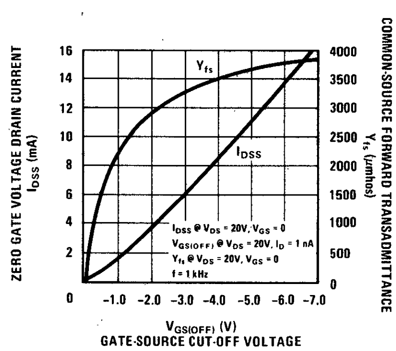
TO-18, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

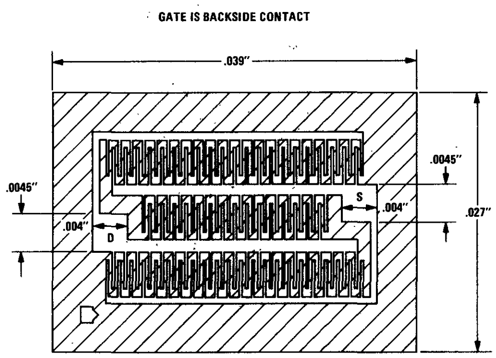
2N4220, 21, 22
2N5457, 58, 59
2N4302, 03, 04

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	50		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.1	5.0	17	mA
Forward Transconductance	Y_{fs}	V_{DS} = 20V, V_{GS} = 0	500	3000	5000	mmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = 30V, V_{DS} = 0		0.02	10	nA
"ON" Resistance	$R_{DS(ON)}$	V_{DS} = 0, V_{GS} = 0	2000	350	225	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, V_{GS} = 0, f = 1 MHz	4.0	5.0	6.0	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



PACKAGE:

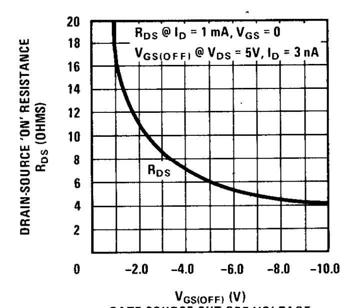
TO-52

PRINCIPAL DEVICE TYPES:

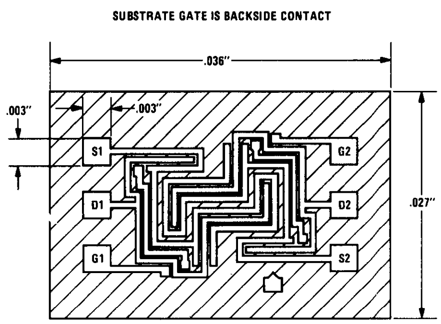
2N5432, 33, 34
NF 580 SERIES

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	15	25		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		0.20	50	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		0.20	50	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

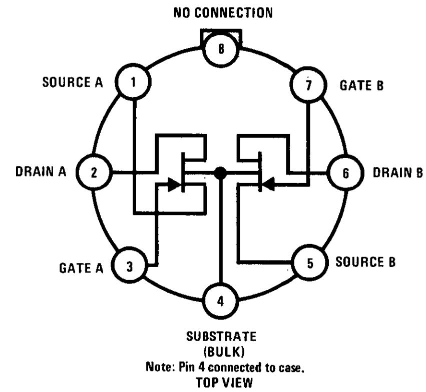


PACKAGE:

TO-99

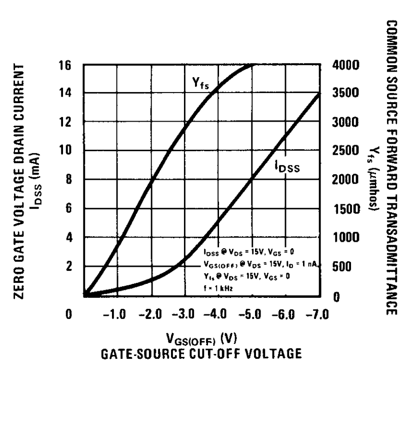
PRINCIPAL DEVICE TYPES:

FM3954 SERIES
FM1100 SERIES

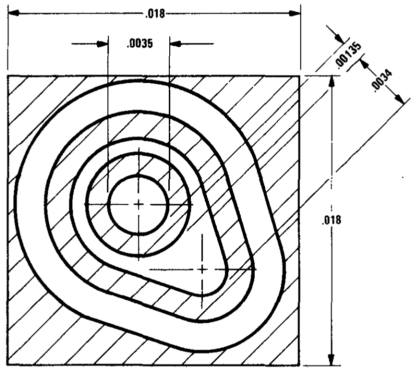


CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	$V_{DS} = 0V$, $I_G = 1\ \mu A$	20	50		V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 15V$, $V_{GS} = 0$	0.1	3.0	10.0	mA
Forward Trans-conductance	Y_{fs}	$V_{DS} = 15V$, $V_{GS} = 0$	0.5	3.0	6.0	mmho
Reverse Gate Leakage	I_{GSS}	$V_{GS} = 20V$, $V_{DS} = 0$		0.05	10	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 $\mu V/^{\circ}C$.



Process 62 PNP Small Signal



description

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

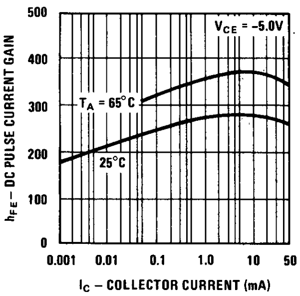
application

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

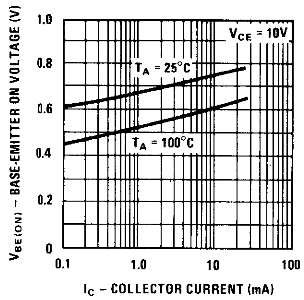
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	V_{CE} = 5V, I_C = 10 μA, R_S = 10 kΩ, P_{BW} = 15.70 kHz		1.20	3	dB	
h_{fe}	V_{CE} = 5V, I_C = 500 μA, f = 20 MHz	5	6			
C_{eb}	V_{EB} = 0.5V		6	7	pF	
C_{cb}	V_{CB} = 5V		3	5	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 5V	50	200	400		
h_{FE}	I_C = 100 μA, V_{CE} = 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

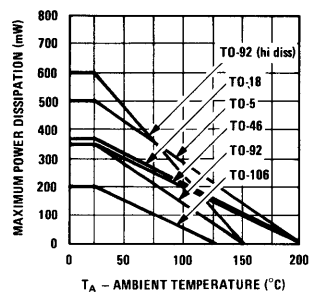
DC Pulse Current Gain vs Collector Current



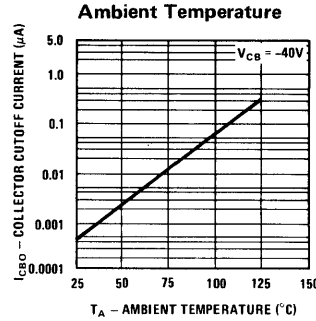
Base-Emitter On Voltage vs Collector Current



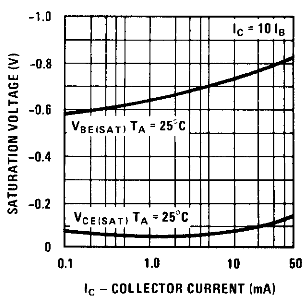
Maximum Power Dissipation vs Temperature



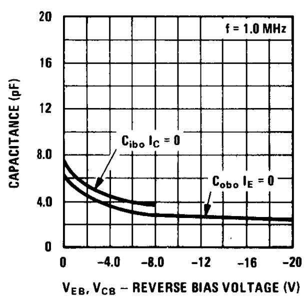
Collector Cutoff Current vs Ambient Temperature



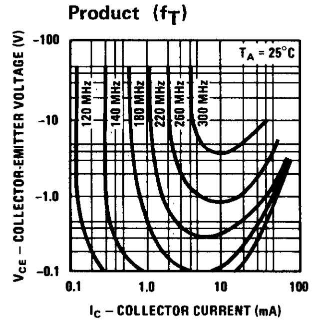
Collector and Base Saturation Voltage vs Collector Current



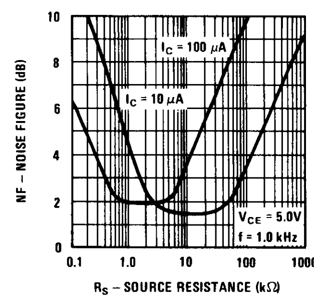
Input and Output Capacitances vs Reverse Bias Voltage



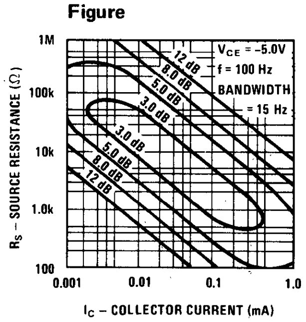
Contours of Constant Gain Bandwidth Product (f_T)



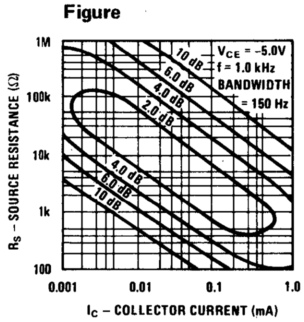
Noise Figure vs Source Resistance



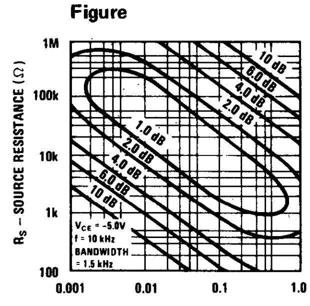
Contours of Constant Narrow Band Noise Figure



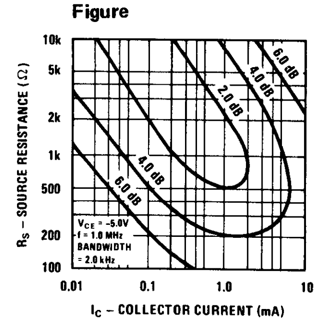
Contours of Constant Narrow Band Noise Figure



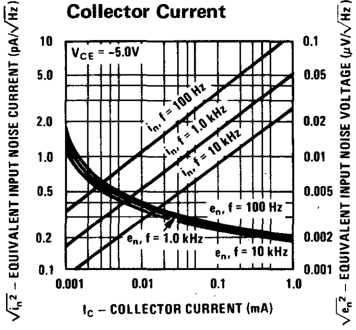
Contours of Constant Narrow Band Noise Figure



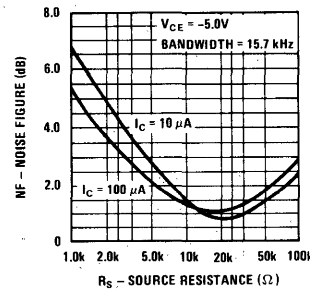
Contours of Constant Narrow Band Noise Figure



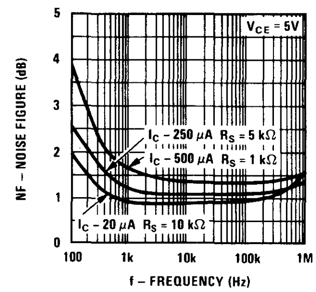
Equivalent Input Noise Voltage and Noise Current vs Collector Current



Wide Band Noise Figure vs Source Resistance



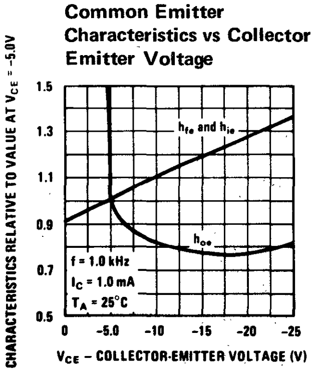
Noise Figure vs Frequency



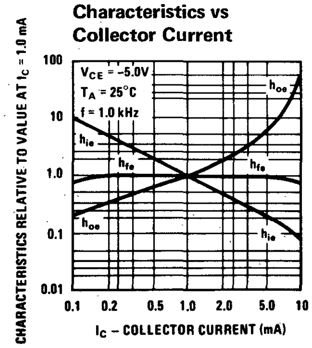
SMALL SIGNAL CHARACTERISTICS (f = 1 kHz)

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	$x10^{-4}$	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

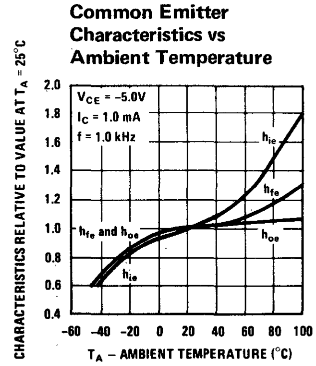
Common Emitter Characteristics vs Collector Emitter Voltage



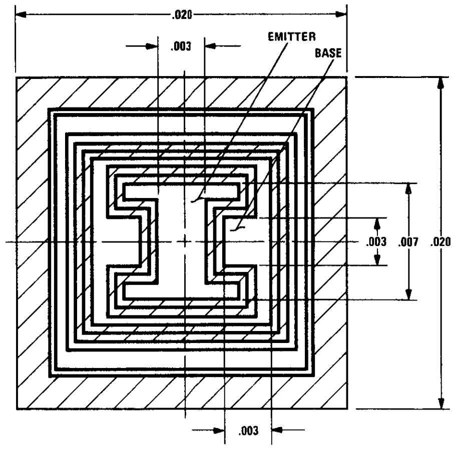
Common Emitter Characteristics vs Collector Current



Common Emitter Characteristics vs Ambient Temperature



Process 63 PNP Medium Power



description

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

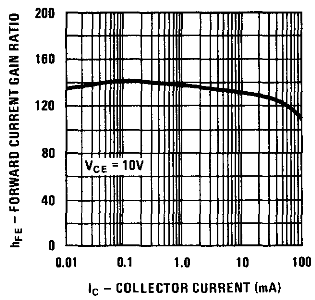
application

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

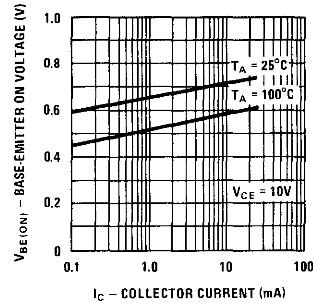
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		30	45	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		220	290	ns	
C_{cb}	V_{CB} = 10V		6	8	pF	TO-18
C_{eb}	V_{EB} = 0.50V		15	18	pF	TO-18
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2	3.00			
NF (spot)	I_C = 100 μA, V_{CE} = 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

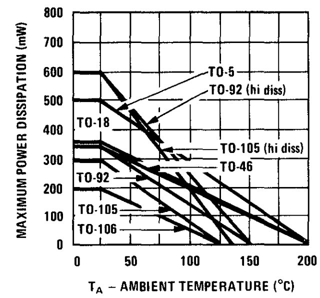
DC Pulse Current Gain vs Collector Current



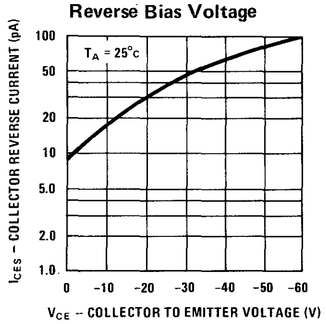
Base-Emitter On Voltage vs Collector Current



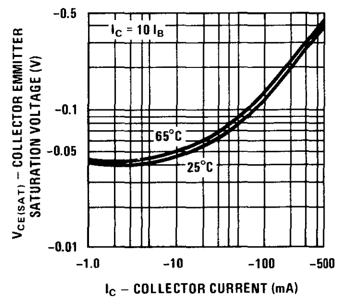
Maximum Power Dissipation vs Temperature



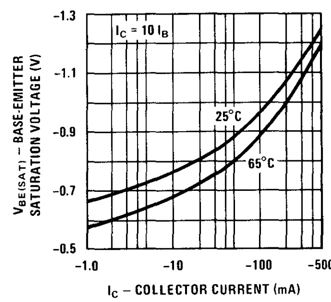
Collector Reverse Current vs Reverse Bias Voltage



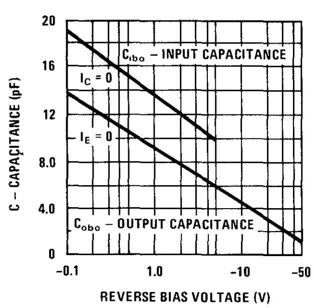
Pulsed Collector Saturation Voltage vs Collector Current



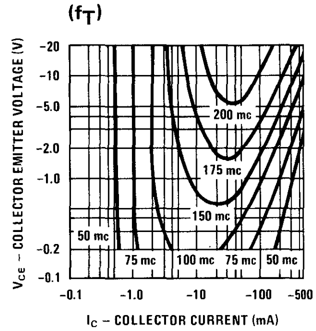
Pulsed Base Saturation Voltage vs Collector Current



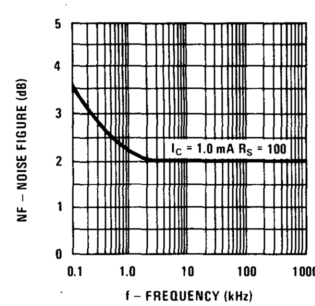
Input And Output Capacitances vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

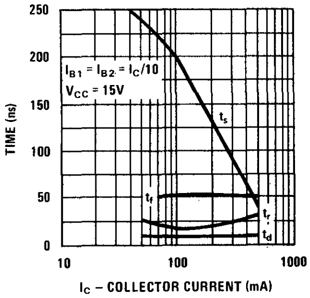


Noise Figure vs Frequency

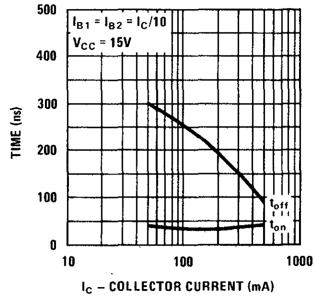


Process 63

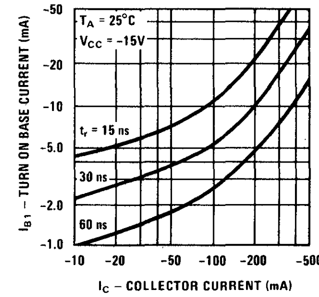
Switching Times vs Collector Current



Turn (on) And Turn (off) Times vs Collector Current



Rise Time vs Collector And Turn On Base Currents



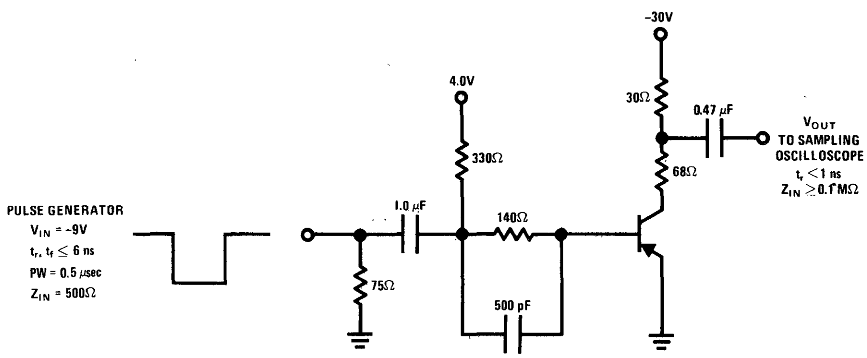
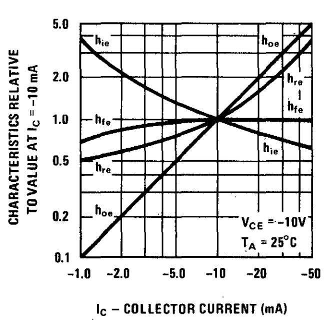
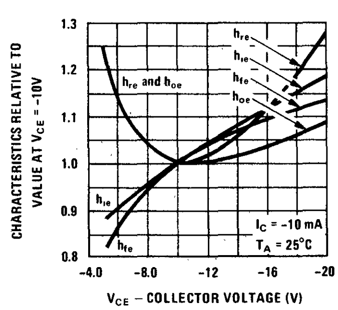
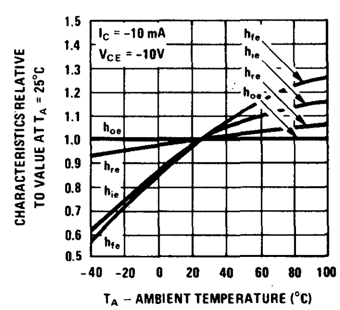


FIGURE 1. t_{on}, t_{off} Test Circuit

SMALL SIGNAL CHARACTERISTICS



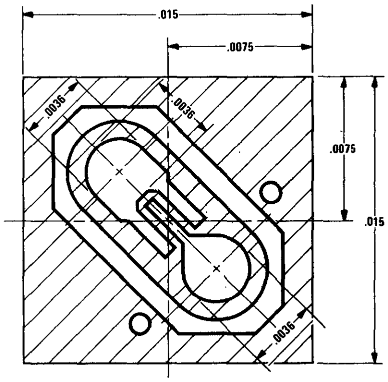




H PARAMETERS (f = 1 kc)

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

Process 64 PNP High Speed Switch



description

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

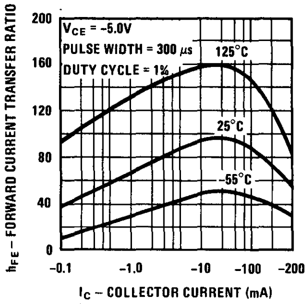
application

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

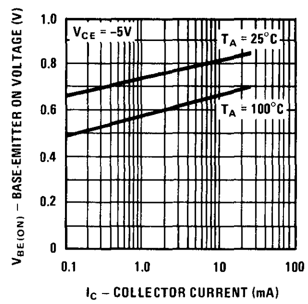
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA		10	20	ns	
t_{off}	I_C = 30 mA, I_{B2} = 3 mA		15	25	ns	
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CE} = 5V		3.0	4.5	pF	TO-18
C_{ib}	V_{EB} = 0.5V		5.0	6.0	pF	TO-18
h_{fe}	f = 100 MHz, I_C = 30 mA, V_{CE} = 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

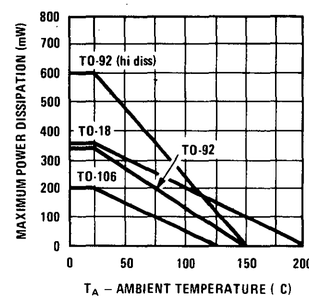
Pulsed DC Current Gain vs Collector Current



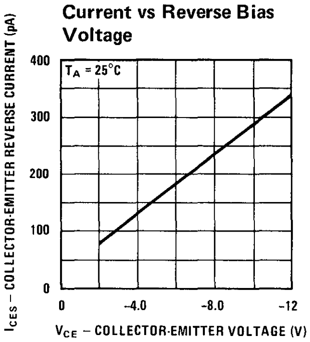
Base-Emitter On Voltage vs Collector Current



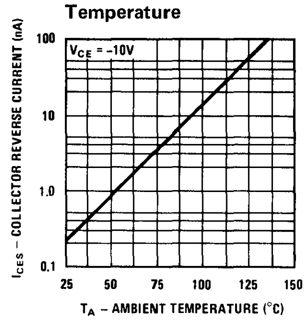
Maximum Power Dissipation vs Temperature



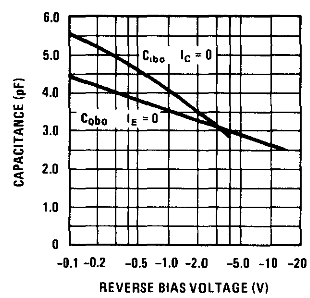
Collector-Base Reverse Current vs Reverse Bias Voltage



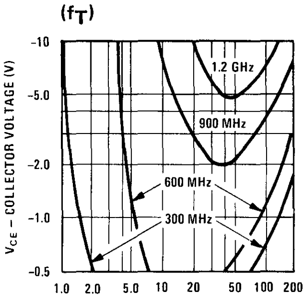
Collector-Base Diode Reverse Current vs Temperature



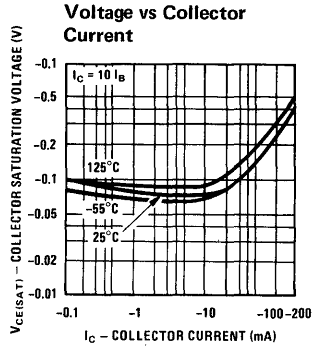
Input and Output Capacitance vs Reverse Bias Voltage



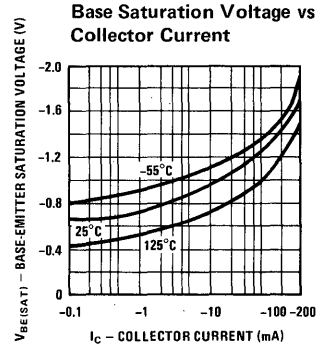
Contours of Constant Gain Bandwidth Product (f_T)



Collector Saturation Voltage vs Collector Current

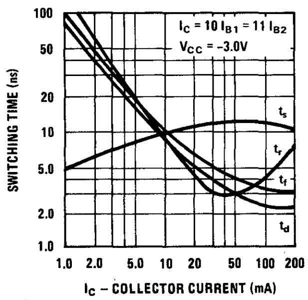


Base Saturation Voltage vs Collector Current



Process 64

Switching Times vs Collector Current



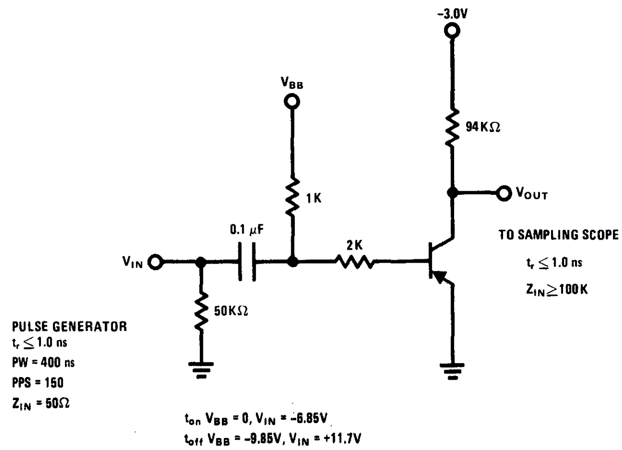
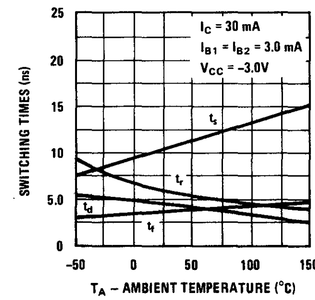
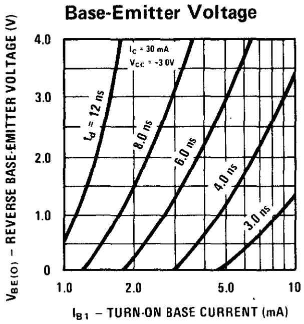


FIGURE 1. Switching Time Test Circuit

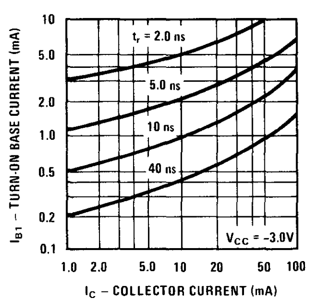
Switching Times vs Temperature



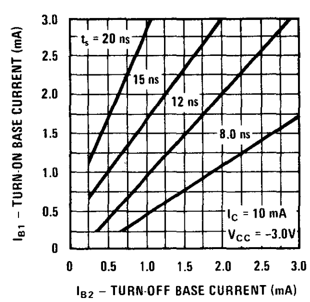
Delay Time vs Turn-On Base Current and Reverse Base-Emitter Voltage



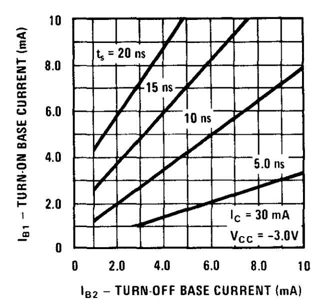
Rise Time vs Collector and Turn-On Base Currents



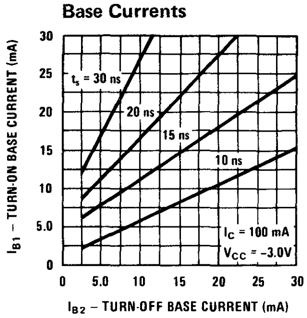
Storage Time vs Turn-On and Turn-Off Base Currents



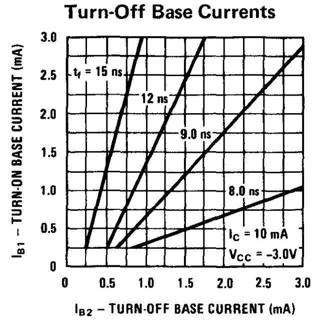
Storage Time vs Turn-On and Turn-Off Base Currents



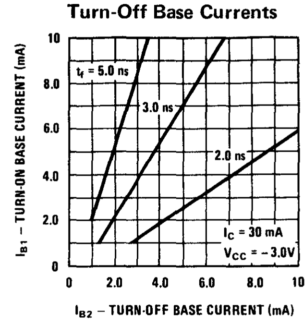
Storage Time vs Turn-On and Turn-Off Base Currents



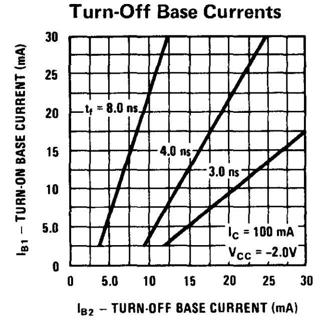
Fall Time vs Turn-On and Turn-Off Base Currents



Fall Time vs Turn-On and Turn-Off Base Currents

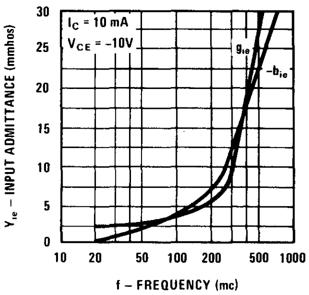


Fall Time vs Turn-On and Turn-Off Base Currents

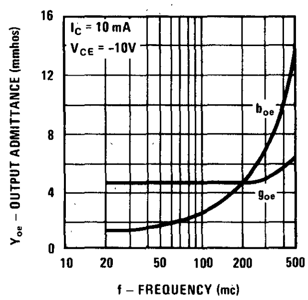


TYPICAL COMMON EMITTER Y PARAMETERS

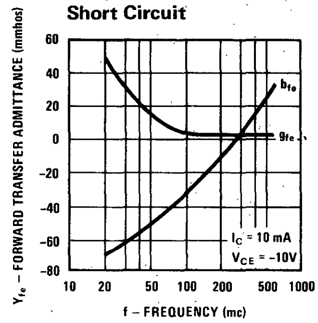
Input Admittance vs Frequency-Output Short Circuit



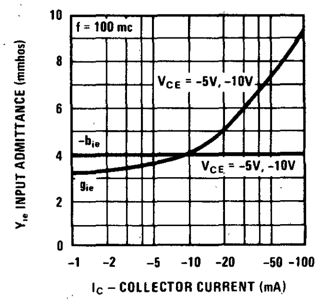
Output Admittance vs Frequency-Input Short Circuit



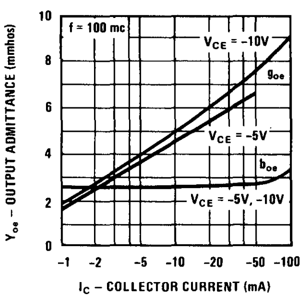
Forward Transfer Admittance vs Frequency-Output Short Circuit



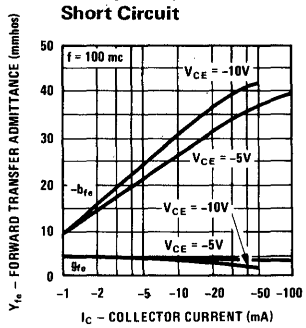
Input Admittance vs Collector Current and Voltage-Output Short Circuit



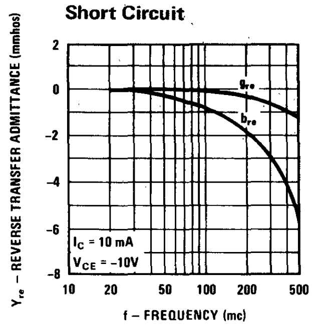
Output Admittance vs Collector Current and Voltage-Input Short Circuit



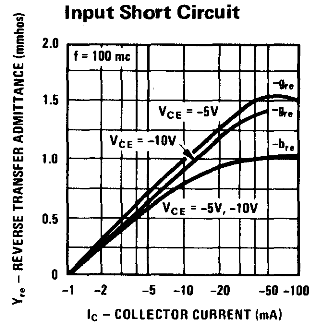
Forward Transfer Admittance vs Collector Current and Voltage-Output Short Circuit



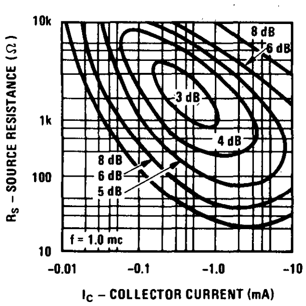
Reverse Transfer Admittance vs Frequency-Input Short Circuit



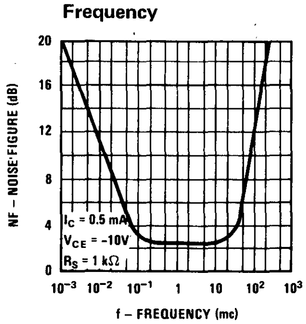
Reverse Transfer Admittance vs Collector Current and Voltage-Input Short Circuit



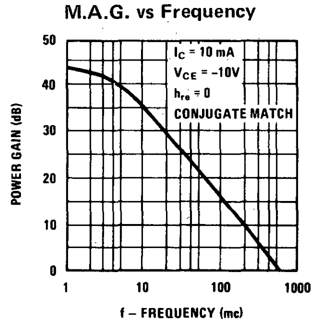
Noise Figure vs Source Resistance and Collector Current



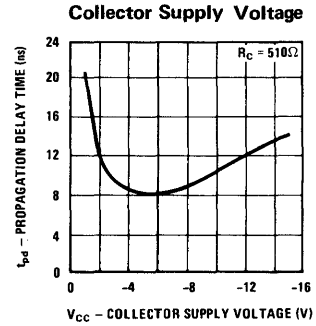
Noise Figure vs Frequency



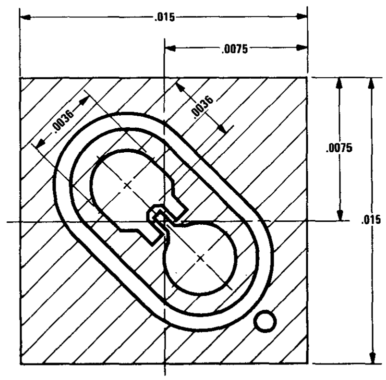
M.A.G. vs Frequency



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.

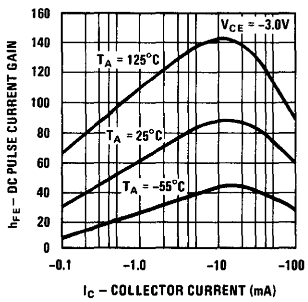
application

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

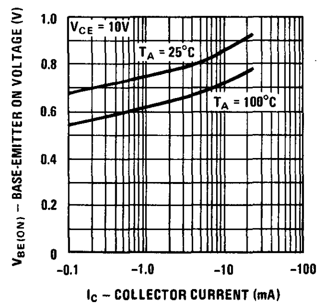
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		15	20	ns	Fig. I
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		11	15	ns	
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CB} = 5V		2	3	pF	TO-18
C_{ib}	V_{EB} = .5V		2.5	3.5	pF	
h_{fe}	V_{CE} = 10V, I_C = 10 mA, f = 100 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

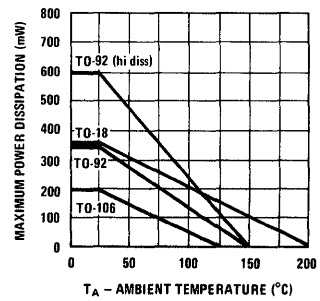
DC Pulse Current Gain vs Collector Current



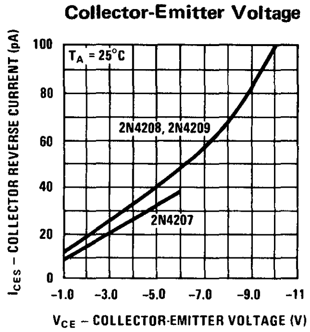
Base-Emitter On Voltage vs Collector Current



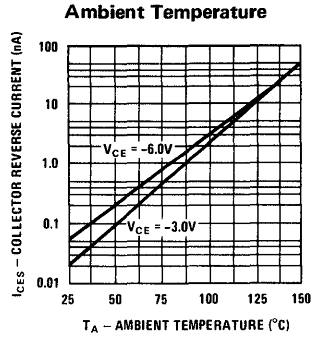
Maximum Power Dissipation vs Temperature



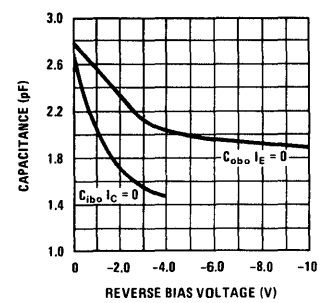
Collector Reverse Current vs Collector-Emitter Voltage



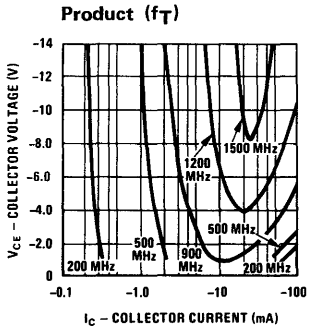
Collector Reverse Current vs Ambient Temperature



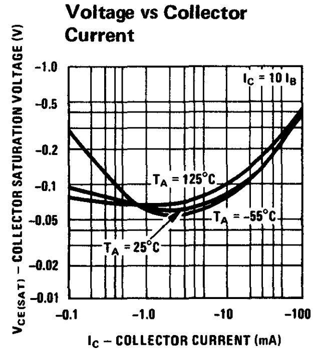
Input and Output Capacitance vs Reverse Bias Voltage



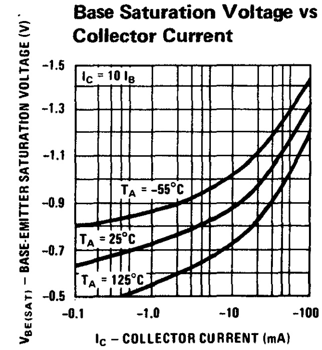
Contours Of Constant Gain Bandwidth Product (f_T)



Collector Saturation Voltage vs Collector Current

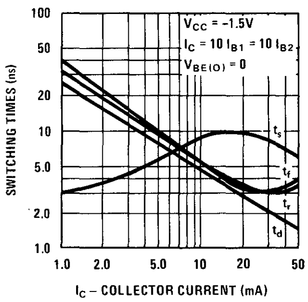


Base Saturation Voltage vs Collector Current

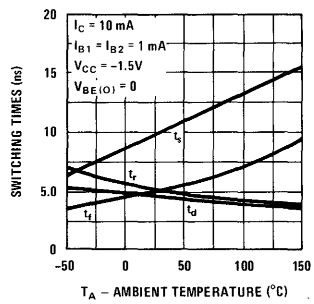


Process 65

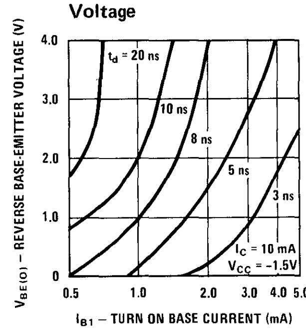
Switching Times vs Collector Current



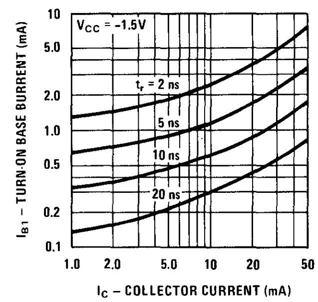
Switching Times vs Ambient Temperature



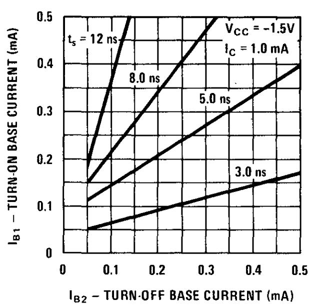
Delay Time vs Turn On Base Current And Reverse Base-Emitter Voltage



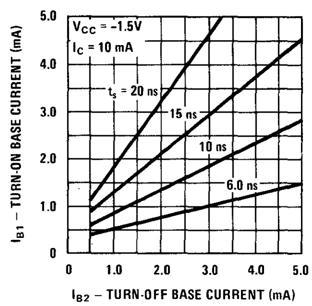
Rise Time vs Collector And Turn On Base Currents



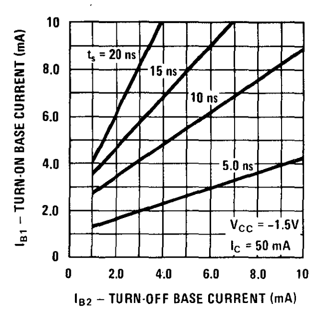
Storage Time vs Turn-On And Turn-Off Base Currents



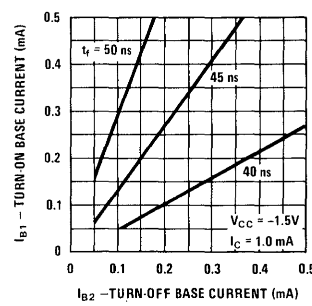
Storage Time vs Turn-On And Turn-Off Base Currents



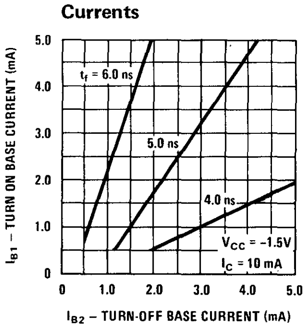
Storage Time vs Turn-On And Turn-Off Base Currents



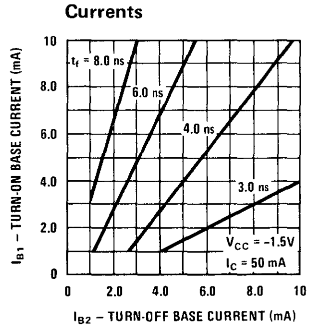
Fall Time vs Turn-On And Turn-Off Base Currents



Fall Time vs Turn-On And Turn-Off Base Currents



Fall Time vs Turn-On And Turn-Off Base Currents



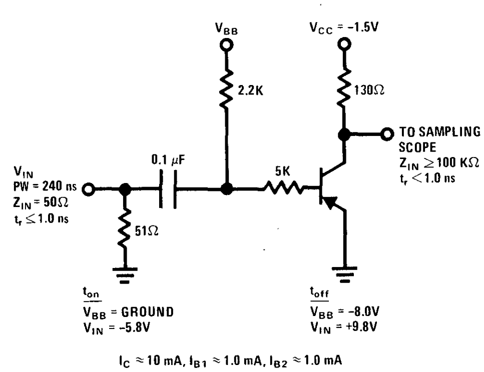
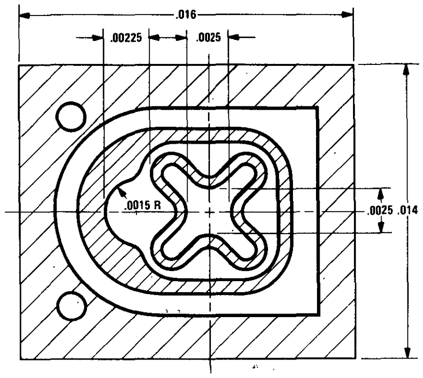


FIGURE 1. Turn On and Turn Off Test Circuit

Process 66 PNP Small Signal



description

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

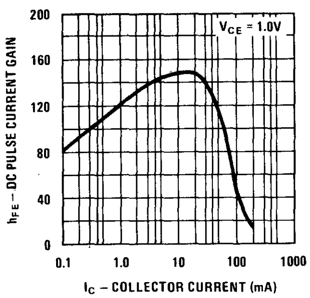
application

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

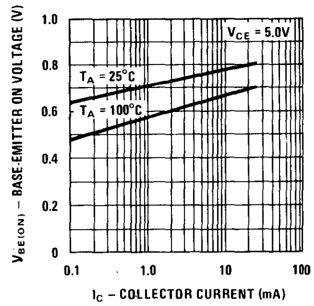
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		125	300	ns	
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	
C_{ob}	V_{CB} = 5V		3.0	4.5	pF	TO-92
C_{ib}	V_{EB} = 0.5V		6.0	10.0	pF	TO-92
h_{fe}	f = 100 MHz, V_{CE} = 20V, I_C = 10 mA	2.5	6.0			
NF (wide band)	I_C = 100 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

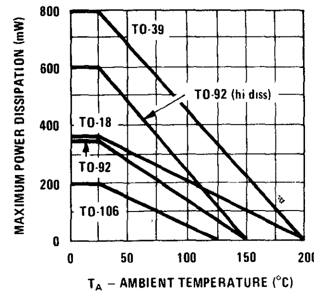
DC Pulse Current Gain vs Collector Current



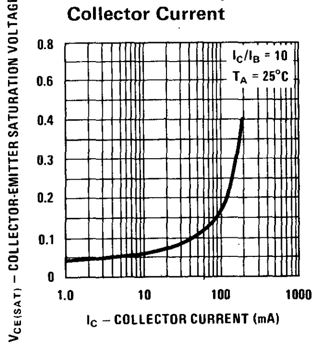
Base-Emitter On Voltage vs Collector Current



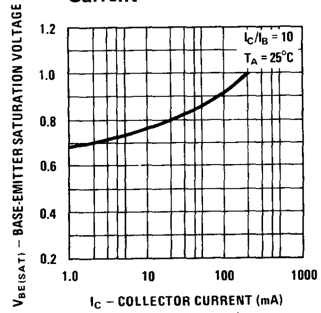
Maximum Power Dissipation vs Temperature



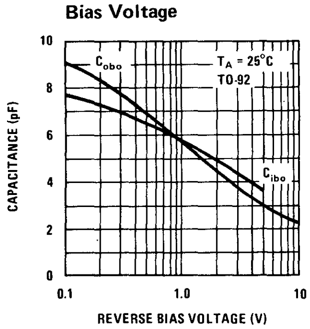
Collector-Emitter Saturation Voltage vs Collector Current



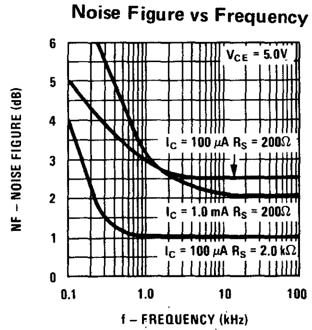
Base-Emitter Saturation Voltage vs Collector Current



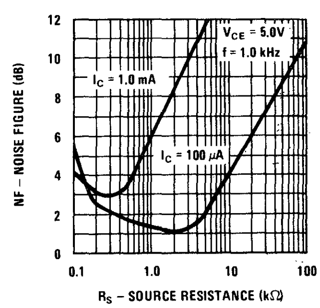
Common Base Open Circuit Input And Output Capacitance vs Reverse Bias Voltage



Noise Figure vs Frequency

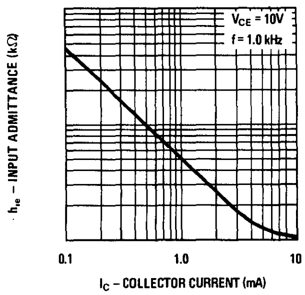


Noise Figure vs Source Resistance

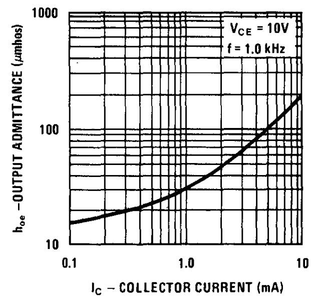


Process 66

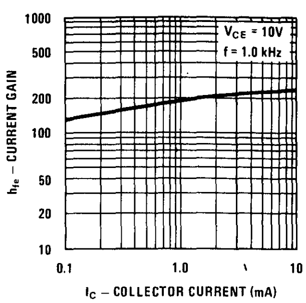
Input Admittance



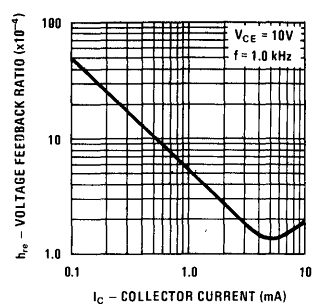
Output Admittance



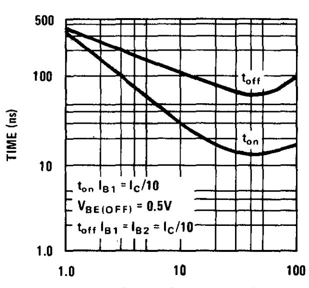
Current Gain



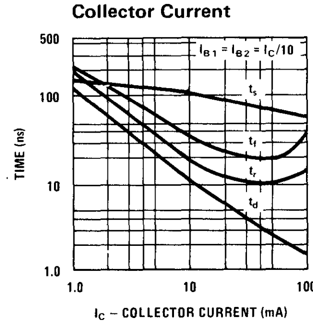
Voltage Feedback Ratio



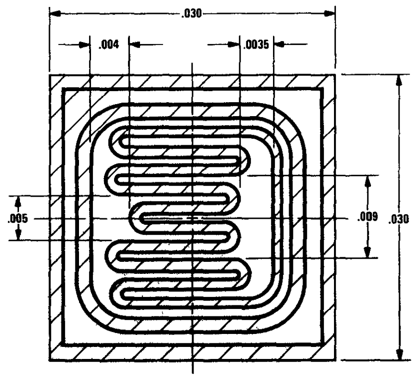
Turn On And Off Times Collector Current



Switching Times vs Collector Current



Process 67 PNP Medium Power



description

Process 67 is a nonoverlay double diffused silicon device.

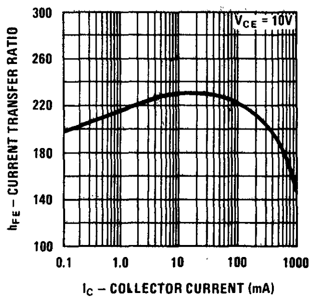
application

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

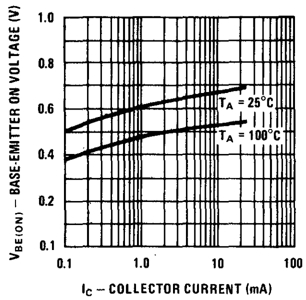
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA	20	25	60	ns	
t_{off}	I_C = 500 mA, I_{B2} = 50 mA	200	250	400	ns	
C_{ob}	V_{CB} = 10V		14	18	pF	TO-39
C_{ib}	V_{EB} = 0.50V		80	100	pF	TO-39
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	1.5	2			
NF (spot)	I_C = 100 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

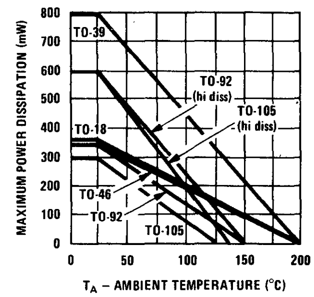
DC Pulse Current Gain vs Collector Current



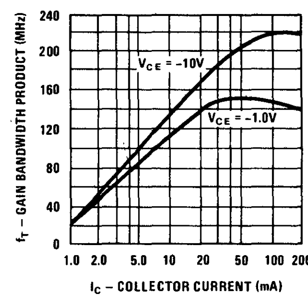
Base-Emitter On Voltage vs Collector Current



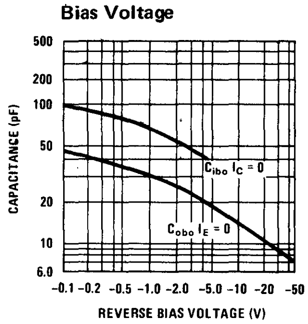
Maximum Power Dissipation vs Temperature



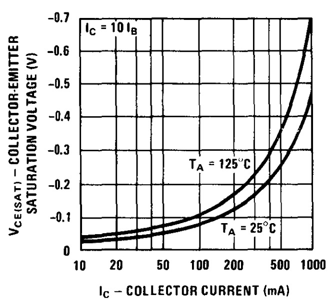
Gain Bandwidth Product vs Collector Current



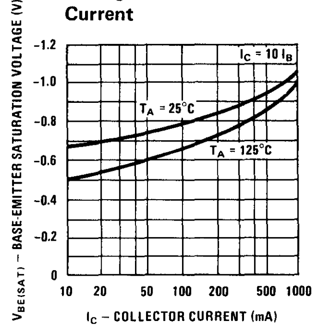
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



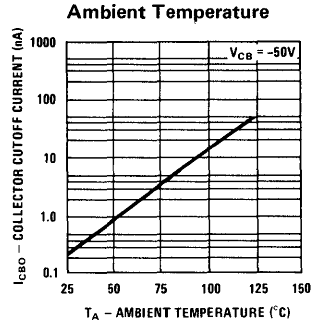
Collector-Emitter Saturation Voltage vs Collector Current



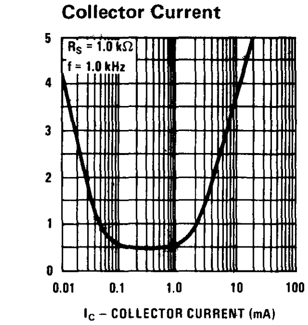
Base-Emitter Saturation Voltage vs Collector Current



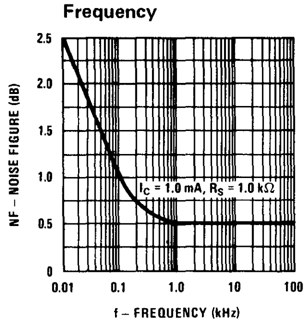
Collector Cutoff Current vs Ambient Temperature



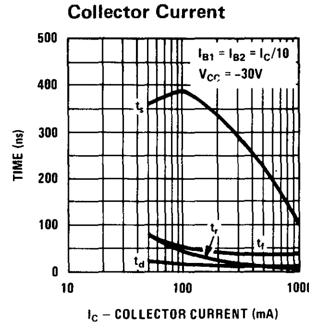
Noise Figure vs Collector Current



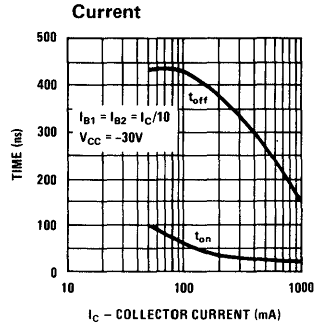
Noise Figure vs Frequency



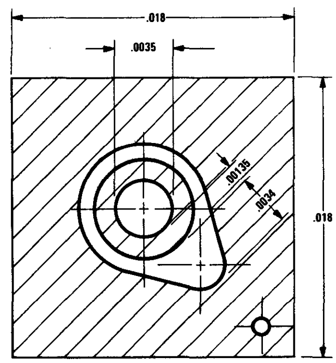
Switching Times vs Collector Current



Turn(On) and Turn(Off) Times vs Collector Current



Process 71 PNP Small Signal



description

Process 71 is a nonoverlay, double diffused, silicon device.

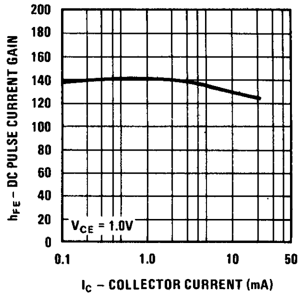
application

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

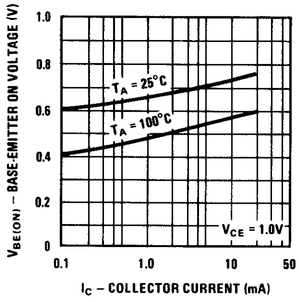
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_C = 5V, R_S = 2k, f = 1 kHz		0.5	2.50	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 5V, f = 100 MHz	3	5			
C_{ob}	V_{CB} = 10V		4	6	pF	TO-18
C_{ib}	V_{EB} = 0.50V		8	12	pF	TO-18
h_{FE}	I_C = 100 μA, V_{CE} = 1V	40	140	400		
h_{FE}	I_C = 1 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

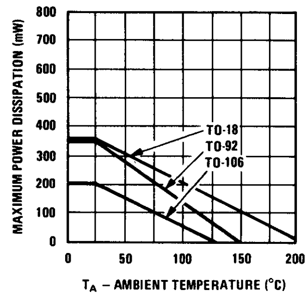
DC Pulse Current Gain vs Collector Current



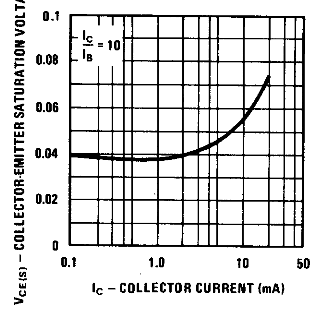
Base-Emitter On Voltage vs Collector Current



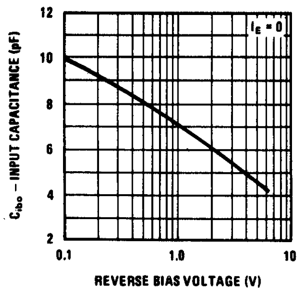
Maximum Power Dissipation vs Temperature



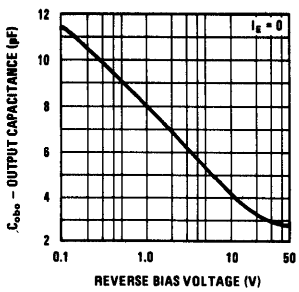
Collector-Emitter Saturation Voltage vs Collector Current



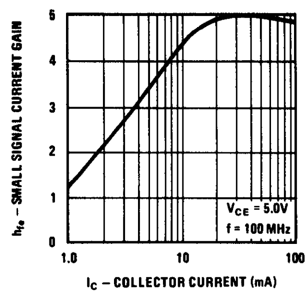
Input Capacitance vs Reverse Bias Voltage



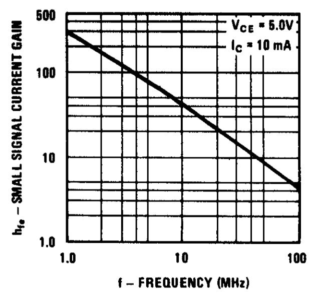
Ouput Capacitance vs Reverse Bias Voltage



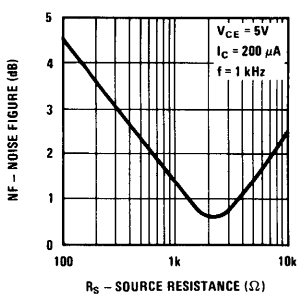
Small Signal Current Gain vs Collector Current



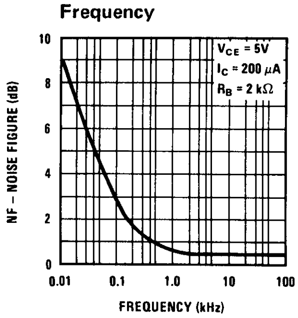
Small Signal Current Gain vs Frequency



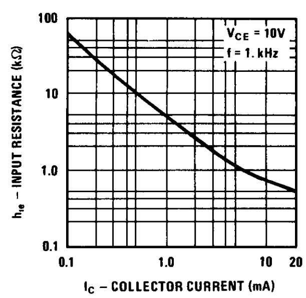
Noise Figure vs Source Resistance



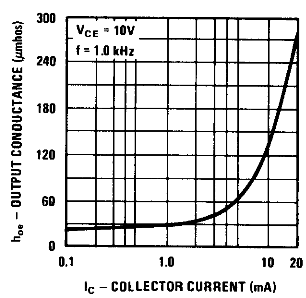
Noise Figure vs Frequency



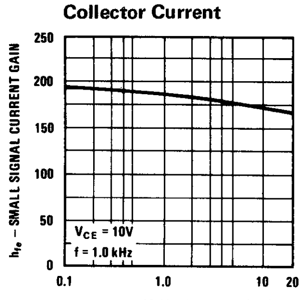
Small Signal Input Resistance vs Collector Current



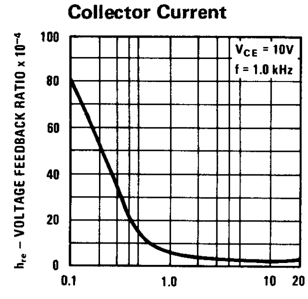
Small Signal Output Conductance vs Collector Current



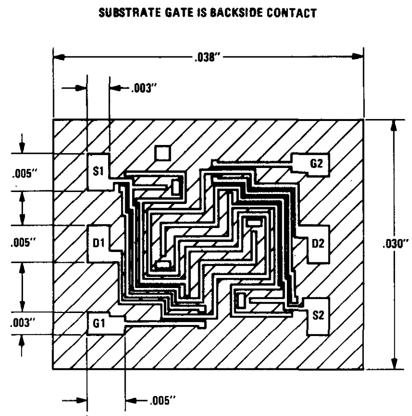
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 82 N-Channel Junction FET

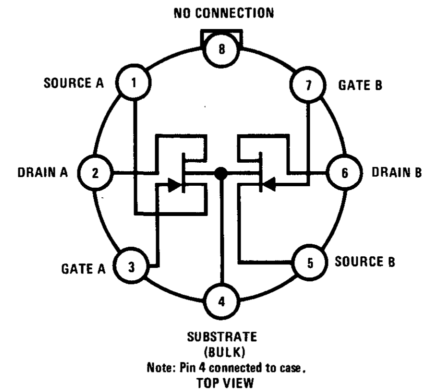


PACKAGE:

TO-99

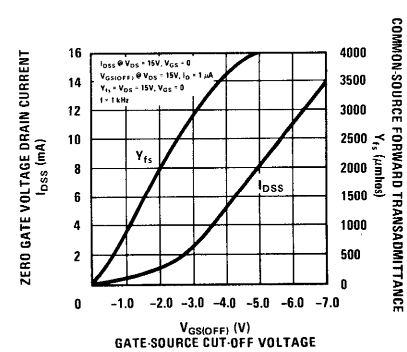
PRINCIPAL DEVICE TYPE:

FM1100A SERIES

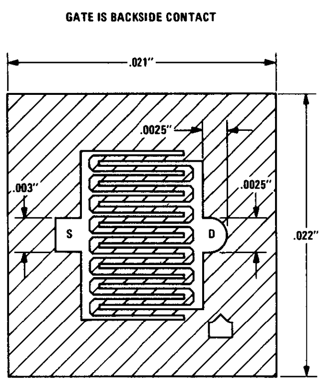


CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	35		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.1	3.0	10	mA
Forward Transconductance	Y_{fs}	V_{DS} = 15V, V_{GS} = 0	0.5	3.0	6.0	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 μA	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 88 P-Channel Junction FET



PACKAGES:

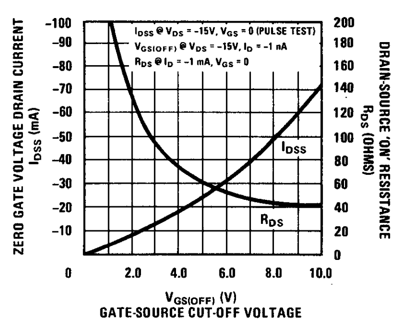
TO-18P, TO-106

PRINCIPAL DEVICE TYPES:

2N5114
P1086E

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	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		0.50	50	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		0.10	100	nA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_S = 0, f = 1MHz	3.0	4.0	3.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 2 mA, f = 1 MHz	12	14	25	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.



NS

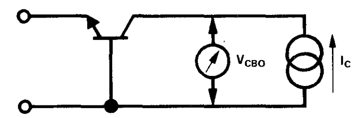
Glossary of Symbols

DC PARAMETERS

BV_{CBO}

Collector-Base Breakdown Voltage with Emitter Open-Circuited

The breakdown voltage of the collector-base junction, measured at a specified current, with the emitter open-circuited.



BV_{CEO}

Collector-Emitter Breakdown Voltage with the Base Open-Circuited

The collector-emitter breakdown voltage, measured at a specified collector current, with the base open-circuited.

BV_{CER}

Collector-Emitter Breakdown Voltage with Resistance between Emitter and Base

The collector-emitter breakdown voltage measured at a specified current with a specified resistance R connected between the base and the emitter.

BV_{CES}

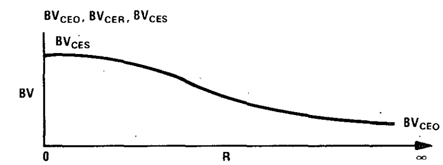
Collector-Emitter Breakdown Voltage with Base Shorted to Emitter

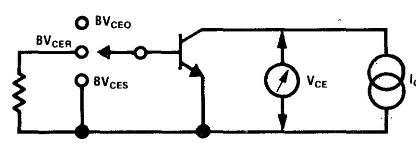
The collector-emitter breakdown, measured at a specified current, with the base shorted to the emitter.

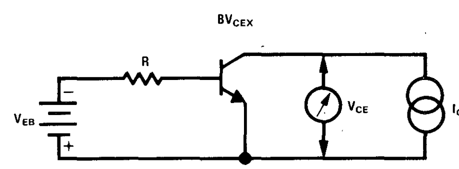
BV_{CEX}

Collector-Emitter Breakdown Voltage at a Specified Condition

The collector-emitter breakdown voltage measured at a specified current with the base-emitter junction forward or reverse biased by a specified voltage or current.



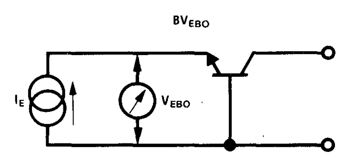




BV_{EBO}

Emitter-Base Breakdown Voltage with Collector Open-Circuited

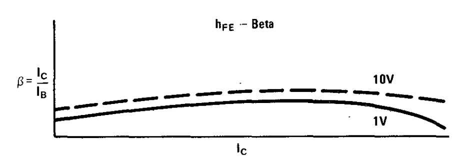
The emitter-base breakdown voltage, measured at a specified current, with the collector open-circuited.

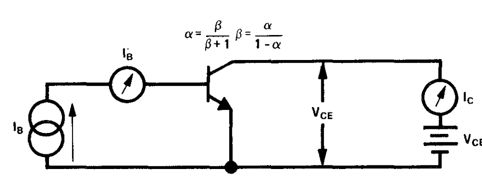


h_{FE}

Common-Emitter DC Current Gain

The ratio of DC collector current to DC base current measured at a specified collector-emitter voltage and a specified collector current.

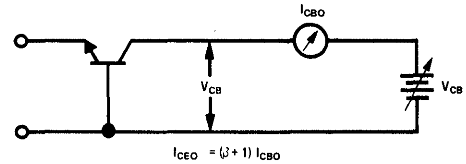




I_{CBO}

Inverse Collector-Base Current

The collector-base current with the junction reverse biased by a specified voltage, with the emitter open-circuited.



I_{CEX}

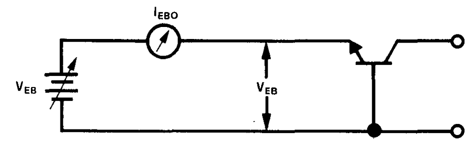
Inverse Collector-Emitter Current at a Specified Condition

The collector-emitter current measured at a specified collector-emitter voltage with the base forward or reverse biased by a specified voltage or current.

I_{EBO}

Inverse Emitter-Base Current

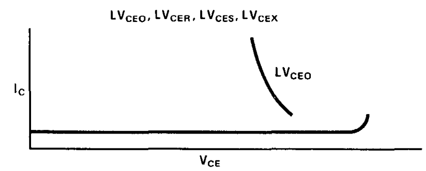
The emitter-base current with the junction reverse biased by a specified voltage with the collector open-circuited.

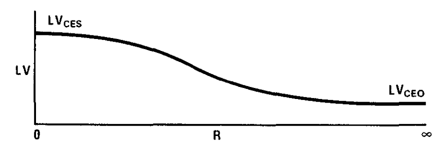


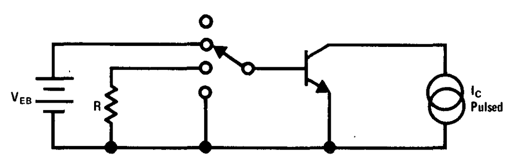
LV_{CEO}, LV_{CER}, LV_{CES}, LV_{CEX}, or $V_{CEO}(sust)$ $V_{CER}(sust)$ $V_{CES}(sust)$ $V_{CEX}(sust)$

Pulsed Limiting Breakdown Voltages

These are similar to the corresponding, above defined, BV parameters but are measured at a specified high current point where collector-emitter voltage is lowest. The duration of the pulse and its duty cycle must be specified. The letter L indicates LIMITING Value and is measured outside the negative resistance zone of the reverse characteristic.



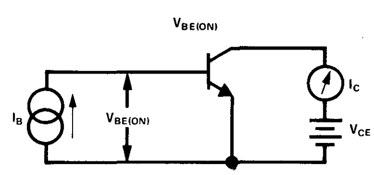


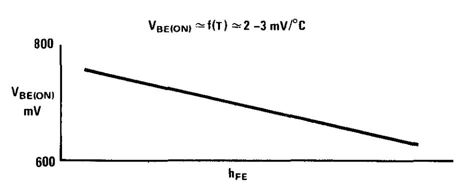


$V_{BE\ (ON)}$

Unsaturated Base-Emitter Voltage

The base-emitter voltage measured in the common-emitter connection at a specified collector to emitter voltage and specified collector current.





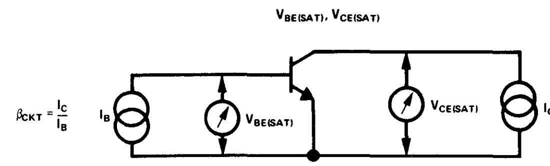
$V_{BE(SAT)}$
$V_{CE\,(SAT)}$

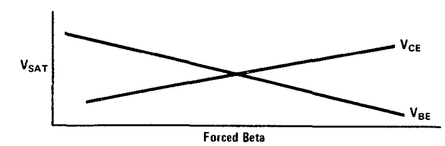
Base-Emitter Saturation Voltage

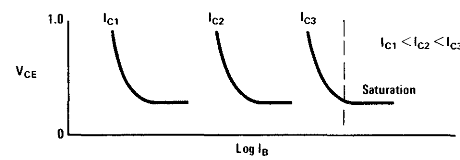
The base-emitter voltage measured in the common-emitter connection at a specified collector and base saturation currents.

Collector-Emitter Saturation Voltage

The collector-emitter voltage measured in the common-emitter connection at specified collector and base saturation currents.







V_{RT}
V_{PT}

Reach Through Voltage

Punch Through Voltage

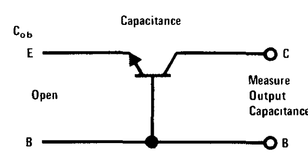
The collector-base voltage above which an increase of applied voltage can be measured in the emitter-base open circuit.

SMALL SIGNAL PARAMETERS

C_{ob}

Common-Base Output Capacitance

The common-base output capacitance with input ac open.



C_{re}

Common Emitter Reverse Transfer Capacitance

This parameter is the imaginary part of y_{re}. When $I_C = 0$, C_{re} is identical to C_{CB}.

C_{TE}

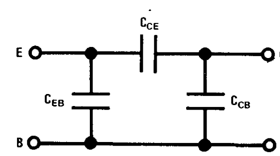
Base-Emitter Capacitance

The capacity of the base-emitter junction at a specified inverse voltage with the collector open.

C_{CB}

Collector Base Capacitance

Collector Base Capacitance measured at some Specified Collector Base Voltage.



$$C_{ob} = C_{CB} + \frac{C_{CE} \cdot C_{EB}}{C_{CE} + C_{EB}} \approx C_{CB} + C_{CE}$$

C_{CB}

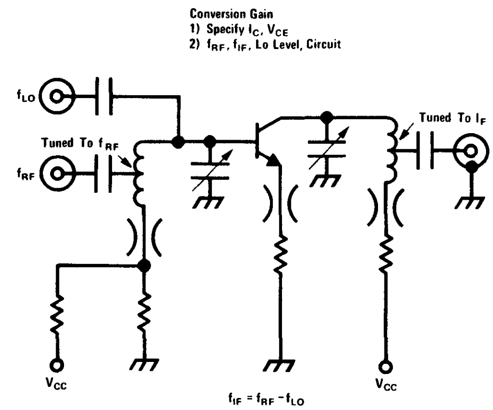
$C_{CB} = C_{ob}$ (With Emitter Guarded)

$\therefore C_{CB} \approx C_{CB}$

CG_e, CG_b

Conversion Gain, Common-Emitter or Common-Base

The ratio of the output power of a mixer, at one specified frequency, to its input power, at another specified frequency. This parameter is a function of oscillator injection voltage and the mixer operating point.



$f_{\alpha b}$, $f_{h_{fb}}$

Common-Base Cut Off Frequency

The frequency at which the h_{fb} (α) is reduced to 0.707 of its low frequency value.

f_β, $f_{h_{fe}}$

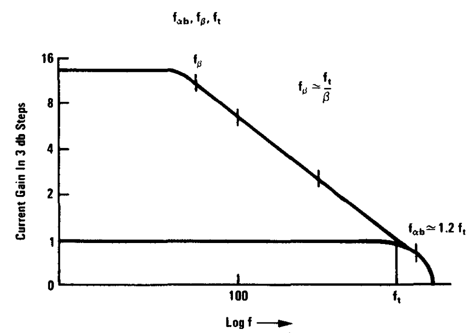
Common-Emitter Cut Off Frequency

The frequency at which the h_{fe} (β) is reduced to 0.707 of its low frequency value.

f_T

Gain Band-Width Product

The common-emitter current gain band-width product in the frequency range where the current gain is falling at approximately 6 db/octave.



$f_{(max)}$

Maximum Frequency of Oscillation

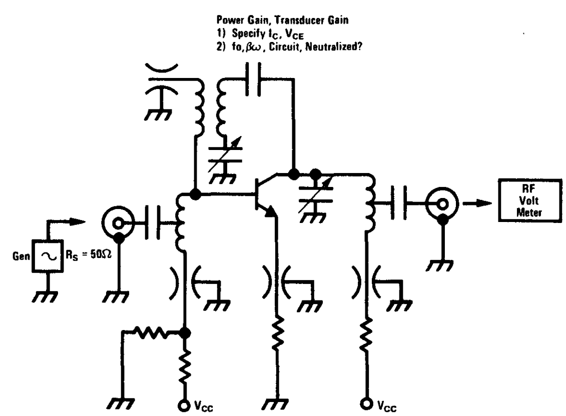
This parameter is a device figure of merit that is calculated from ft and rb′Cc.

f_{MAX} = Max Frequency of Oscillation
Frequency at Which MAG = 1

$$f_{MAX} = \sqrt{\frac{f_T}{8\pi\, rb\, Cc}} = f\sqrt{PG}$$

G_e

Common-Emitter Power Gain



G_{TE}

Common Emitter Transducer Gain

A test fixture must be specified.

$$G_{TE} = \frac{\text{Power Delivered To The Load}}{\text{Power Available From The Source}}$$

GMA

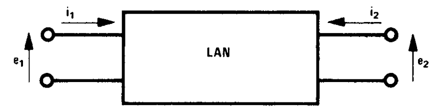
Stability Limited Gain or Gain Maximum Available

This parameter is a device figure of merit and must be calculated from the two port "y" parameters.

$$GMA = 10 \text{ Log}\left[\frac{|y_{fe}|}{|y_{re}|}\left(K - \sqrt{K^2 - 1}\right)\right]$$

Not Defined For $K < 1$

h Parameters

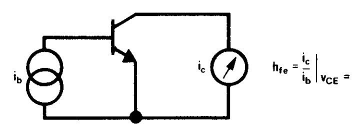


Where e_1, i_1, e_2, i_2 Are Small Signal Voltages and Currents
The h – (Hybrid) Parameters Are Defined By
$e_1 = h_{11}\, i_1 + h_{12}\, e_2$
$i_2 = h_{21}\, i_1 + h_{22}\, e_2$
And For Common Emitter Operation These EQ Become
$e_1 = h_{ie}\, i_1 + h_{re}\, e_2$
$i_2 = h_{fe}\, i_1 + h_{oe}\, e_2$

h_{fe}

Common-Emitter Current Gain

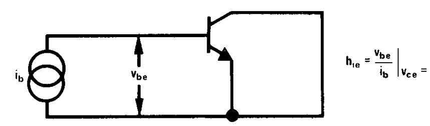
The common-emitter forward current transfer ratio with output ac shorted. This is a complex quantity.



h_{ie}

Common-Emitter Input Impedance

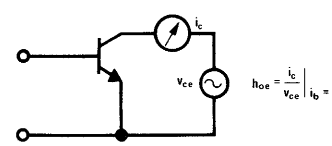
The common-emitter input impedance with the output ac shorted. This is a complex quantity.



h_{oe}

Common-Emitter Output Admittance

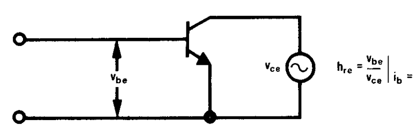
The common-emitter output admittance with the input ac open. This is a complex quantity.



h_{re}

Common-Emitter Reverse Voltage Transfer Ratio

The common-emitter reverse voltage transfer ratio with input ac open. This is a complex quantity.



MAG

Maximum Available Gain

Device figure of merit that must be calculated from the two port ' y" parameters.

$$\text{MAG} = 10 \text{ Log } \frac{|Y_{21}|^2}{4 \text{ Re } (Y_{11}) \text{ RE } (Y_{22})}$$

MSG

Maximum Stable Gain

This parameter is a device figure of merit that is calculated from the two port "y" parameters.

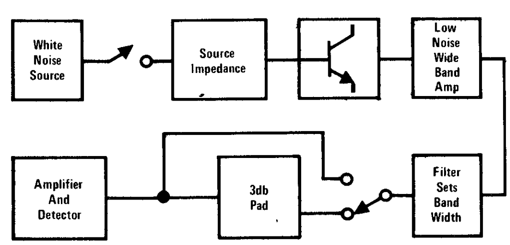
$$\text{MSG} = 10 \text{ Log } \frac{|Y_{fe}|}{|Y_{re}|}$$

NF

Noise Figure

Noise figure = 10 $\log_{10}$F, where F is the ratio of total output noise power to the output power due solely to the thermal noise of the source impedance.

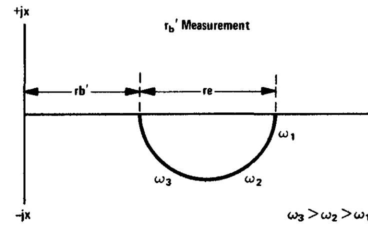
Noise Figure
Must Specify
1) V_{CE}, I_C
2) R_S, f_o, PBW



$r_{bb'}$, $r_{b'}$

Base ≪ Spreading ≫ Resistance

Equivalent to the real part of h_{ie} at some specified very high frequency.



rb'Cc

Collector Base Time Constant

This parameter is a device figure of merit and is measured in a specified test circuit.

rb' Cc = Collector Base Time Constant
Specify – I_C, V_{CE}, Frequency

Common-Emitter Switching Parameters

In the following, drive circuit conditions and collector circuit conditions must be specified. The transition times of the input must be negligible compared to the measured times.

t_d

Delay Time

The time interval during turn-on from the point when the input pulse at the base reaches 10% of its full amplitude to the point when the collector pulse changes from 0 to 10% of its maximum amplitude.

t_r

Rise Time

The time interval during turn-on in which the collector pulse changes from 10% to 90% of its maximum amplitude.

t_s

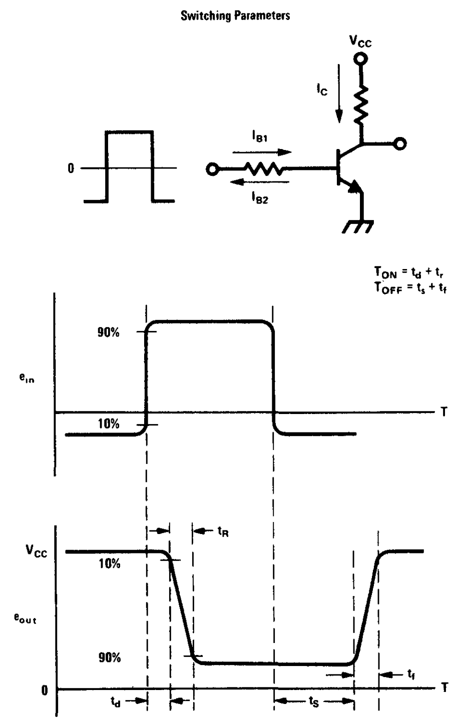
Storage Time

The time interval during turn-off from the point when the turn-off pulse at the base changes from 100% to 90% of its full amplitude to the time when the collector current has changed from 100% to 90% of its maximum amplitude.

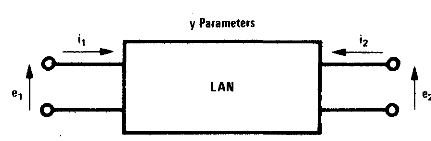
t_f

Fall Time

The time interval during turn-off in which the collector pulse decreases from 90% to 10% of its maximum amplitude.



y Parameters



y Parameters Are Defined By

$i_1 = y_{11} e_1 + y_{12} e_2$

$i_2 = y_{21} e_1 + y_{22} e_2$

Or In Common Emitter Notation

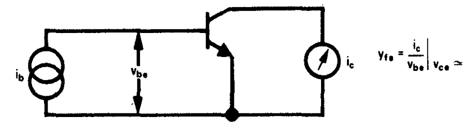
$i_1 = y_{ie} e_1 + y_{re} e_2$

$i_2 = y_{fe} e_1 + y_{oe} e_2$

y_{fe}

Common-Emitter Forward Transfer Admittance

The common-emitter forward transfer admittance with output ac shorted. This is a complex quantity ($g_{fe} + jb_{fe}$).

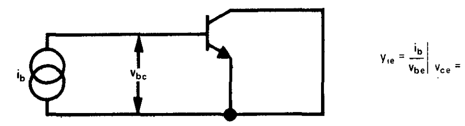


y_{ie}

Common-Emitter Input Admittance

The common-emitter input admittance with output ac shorted. This is a complex quantity ($g_{ie} + b_{ie}$).

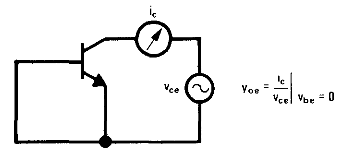
y Parameters—Common Emitter



y_{oe}

Common-Emitter Output Admittance

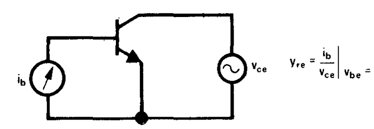
The common-emitter output admittance with input ac open. This is a complex quantity ($g_{oe} + jb_{oe}$).



y_{re}

Common-Emitter Reverse Transfer Admittance

The common-emitter reverse transfer admittance with input ac shorted. This is a complex quantity ($g_{re} + jb_{re}$).



LARGE SIGNAL PARAMETERS

η

Collector Efficiency

This parameter applies to oscillators and class C amplifiers, predominantly. It is defined as the ratio of RF Power Out/DC Power In.

η – Collector Efficiency

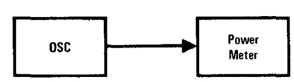
$$\eta = \frac{P_o\,(RF)}{P_{IN(DC)}} = \frac{vi}{I_C \times V_{CE}}$$

P_o

Power Out

This parameter applies to oscillators. The units are watts and a test circuit must be specified.

Po



Specify – I_C, V_{CE} Under Quiescent Conditions
– f_o, R_{LOAD}

THERMAL PARAMETERS

R_{TH}

Internal Junction-to-Case Thermal Resistance

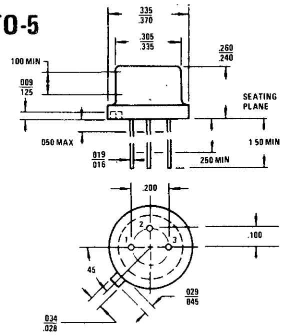
The rated increase of junction temperature with respect to the case temperature per unit of dissipated power. It is also called Thermal Resistance with infinite heat sink.

θ_{JC} **Junction-to-Case Thermal Rating**

θ_{JA} **Junction-to-Ambient Thermal Rating**

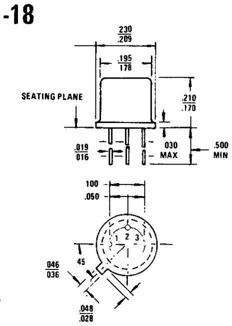
Package Outlines

TO-5



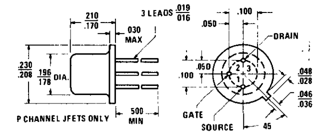
PIN	T
1	E
2	B
3	C

TO-18



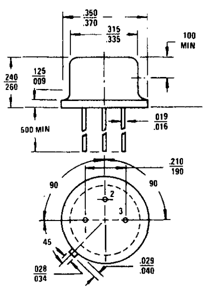
PIN	FET	T
1	S	E
2	D	B
3	G	C

TO-18P



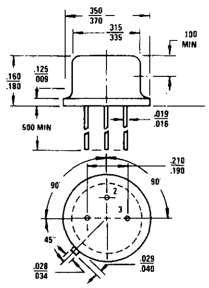
PIN	FET
1	S
2	G
3	D

TO-39



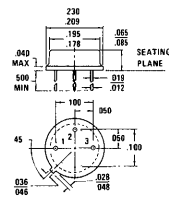
PIN	T
1	E
2	B
3	C

TO-39 LO-PROFILE



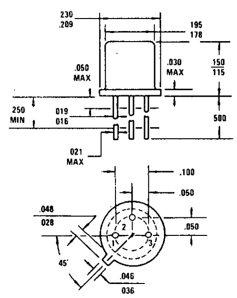
PIN	T
1	E
2	B
3	C

TO-46



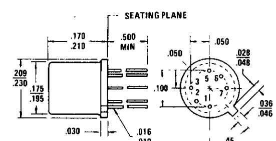
PIN	T
1	E
2	B
3	C

TO-52



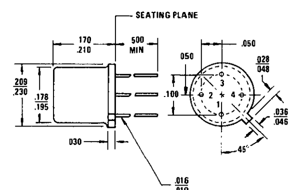
PIN	FET	T
1	S	E
2	D	B
3	G	C

TO-71



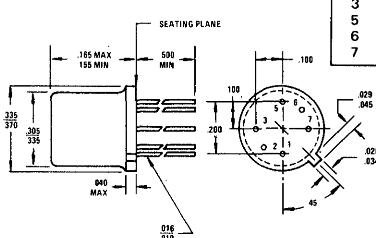
PIN	T
1	E
2	B
3	C
5	E
6	B
7	C

TO-72



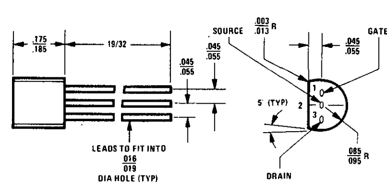
PIN	FET	T
1	S	E
2	D	B
3	G	C
4	CASE	GND

TO-78



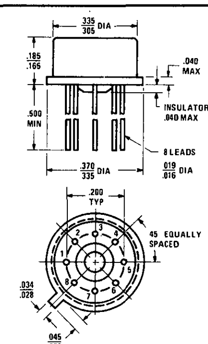
PIN	T
1	C
2	B
3	E
5	E
6	B
7	C

TO-92



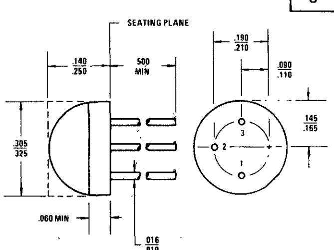
PIN	FET	T
1	G	E
2	S	B
3	D	C

TO-99



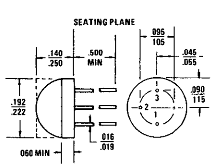
PIN	FET
1	S
2	D
3	G
4	SUB
5	S
6	D
7	G
8	NC

TO-105



PIN	T
1	E
2	B
3	C

TO-106



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

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