The RF Small Signal Line

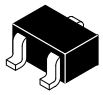
NPN Silicon High-Frequency Transistors

MRF917T1

Designed for low noise, wide dynamic range front end amplifiers, at frequencies to 1.5 GHz. Specifically aimed at portable communication devices such as pagers and hand–held phones.

- Small, Surface–Mount Package (SC–70)
- High Current Gain–Bandwidth Product (f_τ = 6.0 GHz Typ @ 6.0 V, 20 mA)
- Low Noise Figure
  NF = 1.7 dB (Typ) @ 500 MHz
- Available in Tape and Reel Packaging.
  T1 Suffix = 3,000 Units per 8 mm, 7 inch Reel

LOW NOISE HIGH FREQUENCY TRANSISTOR



CASE 419–02, STYLE 3 (SC–70/SOT–323)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	12	Vdc
Collector–Base Voltage	V_{CBO}	20	Vdc
Emitter–Base Voltage	V_{EBO}	2.0	Vdc
Collector Current — Continuous	I_C	60	mAdc
Total Device Dissipation @ T_C = 75°C (1) Derate above 75°C	P_D	222 3.0	mW mW/°C
Storage Temperature Range	T_{stg}	– 55 to +150	°C
Operating Temperature Range	T_J	150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction–to–Case (1)	$R_{\theta JC}$	338	°C/W

DEVICE MARKING

MRF917T1 = K

(1) Case temperature measured on the collector lead immediately adjacent to body of package.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–Emitter Breakdown Voltage (I_C = 0.1 mA, I_B = 0 mA)		$V_{(BR)CEO}$	12	—	—	Vdc
Collector–Base Breakdown Voltage (I_C = 0.1 mA, I_E = 0)		$V_{(BR)CBO}$	20	—	—	Vdc
Emitter–Base Breakdown Voltage (I_E = 0.1 mA, I_C = 0)		$V_{(BR)EBO}$	2.0	—	—	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)		I_{CBO}	—	—	50	nA
ON CHARACTERISTICS						
DC Current Gain (V_{CE} = 10 Vdc, I_C = 30 mA)		h_{FE}	40	—	200	—
DYNAMIC CHARACTERISTICS						
Collector–Base Capacitance (V_{CB} = 1.0 Vdc, I_E = 0, f = 1.0 MHz)		C_{cb}	—	0.54	—	pF
Current–Gain Bandwidth Product (V_{CE} = 6.0 Vdc, I_C = 20 mA, f = 1.0 GHz)		f_τ	—	6.0	—	GHz
PERFORMANCE CHARACTERISTICS						
Noise Figure — Minimum (V_{CE} = 6.0 Vdc, I_C = 5.0 mA) Figure 1	500 MHz 1.0 GHz	NF_{min}	— —	1.7 2.3	— —	dB
Associated Gain at Minimum Noise Figure (V_{CE} = 6.0 Vdc, I_C = 5.0 mA) Figure 1	500 MHz 1.0 GHz	G_{NF}	— —	15.4 10	— —	dB
Maximum Unilateral Gain (V_{CE} = 6.0 Vdc, I_C = 20 mA, f = 1000 MHz)		G_{Umax}	—	12	—	dB
Insertion Gain (V_{CE} = 6.0 Vdc, I_C = 20 mA, f = 1000 MHz)		$\|S_{21}{}^2\|$	—	11.2	—	dB
Noise Resistance (V_{CE} = 6.0 Vdc, I_C = 5.0 mA, f = 1000 MHz)		R_N	—	15	—	Ohms

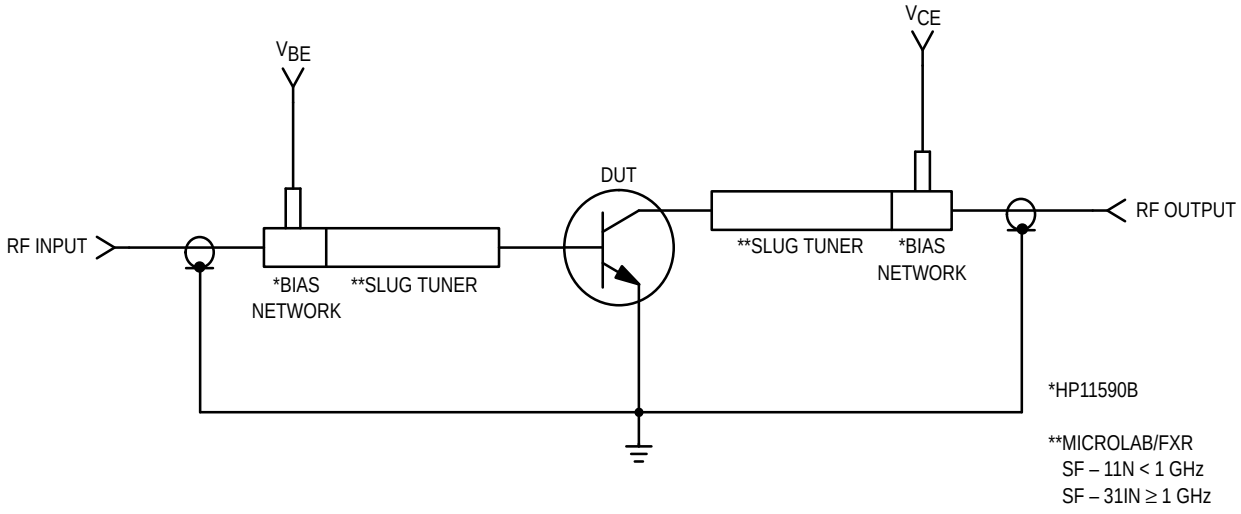


Figure 1. Functional Circuit Schematic

TYPICAL CHARACTERISTICS

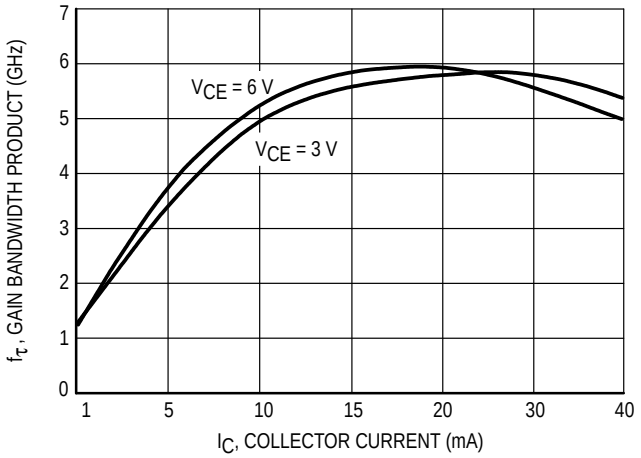


Figure 2. f_τ, Current–Gain Bandwidth Product versus Collector Current

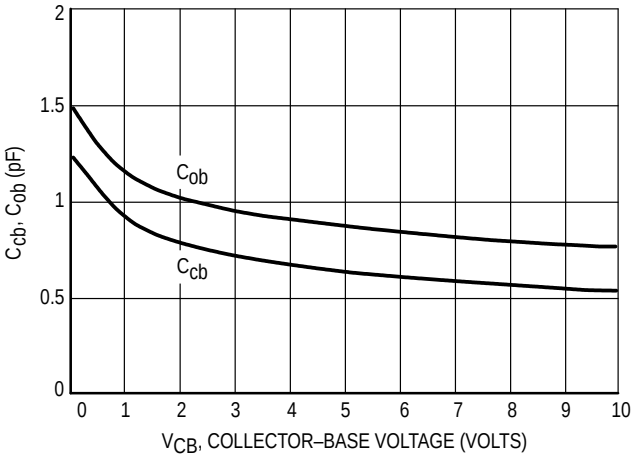


Figure 3. Output Capacitance versus Collector–Base Voltage

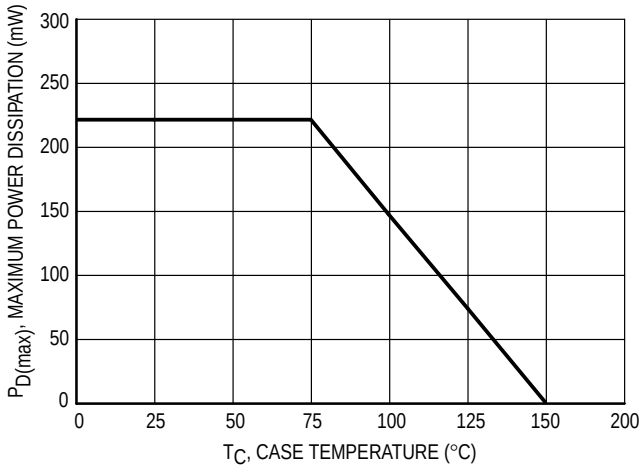


Figure 4. Maximum Power Dissipation versus Collector Lead Temperature (T_C)

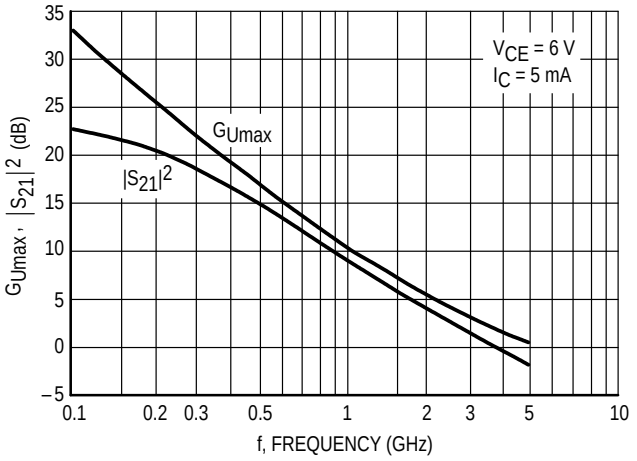


Figure 5. Forward Insertion Gain and Maximum Unilateral Gain versus Frequency

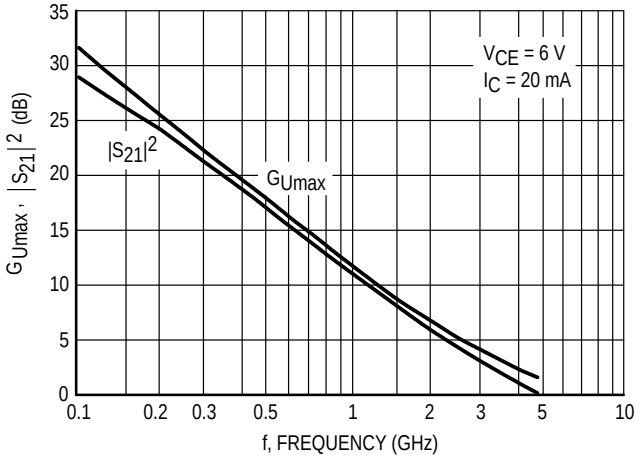


Figure 6. Forward Insertion Gain and Maximum Unilateral Gain versus Frequency

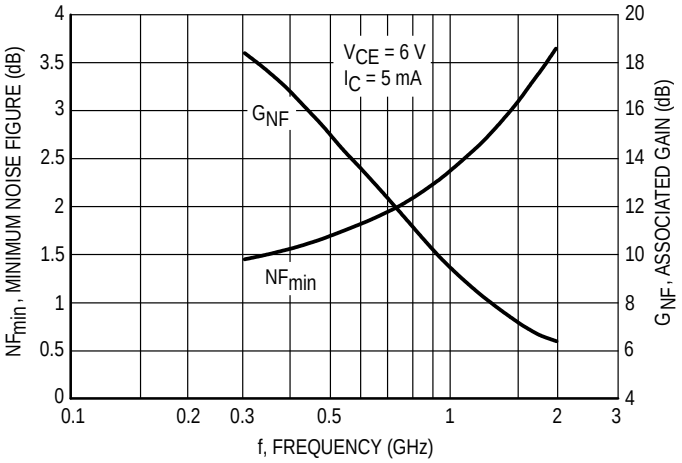


Figure 7. Minimum Noise Figure and Associated Gain versus Frequency

TYPICAL CHARACTERISTICS

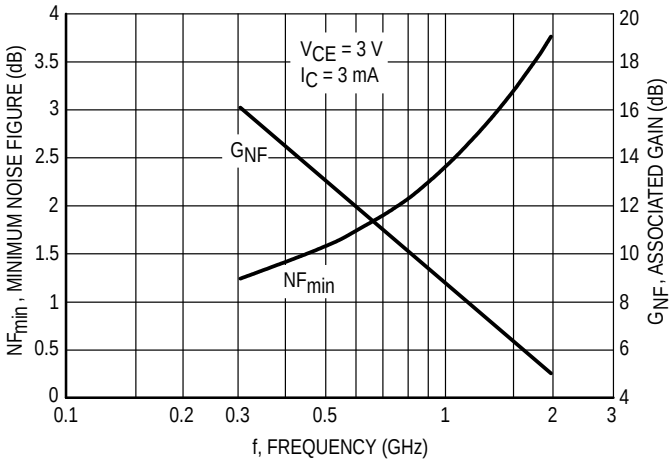


Figure 8. Minimum Noise Figure and Associated Gain versus Frequency

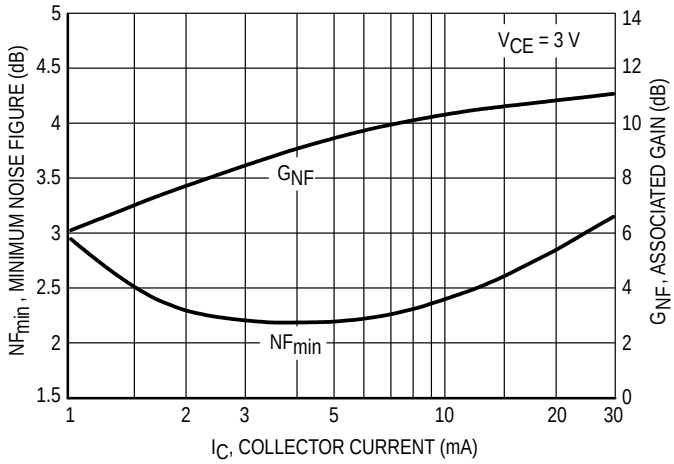


Figure 9. Minimum Noise Figure and Associated Gain versus Collector Current

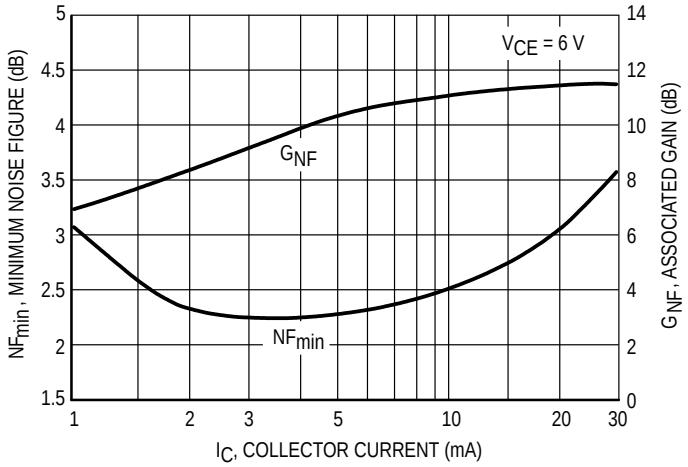
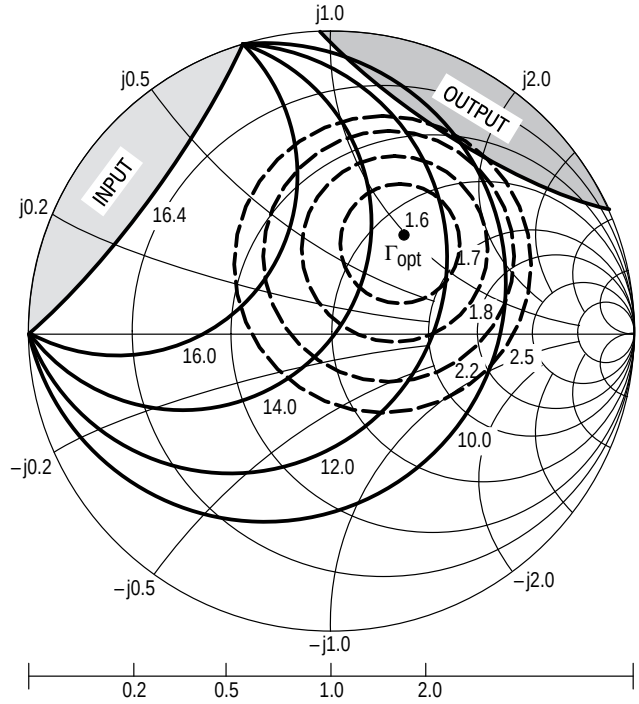


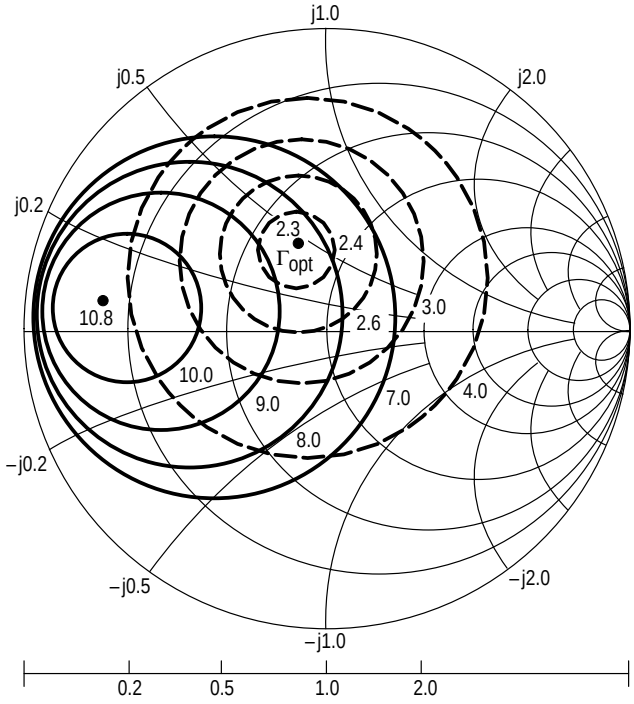
Figure 10. Minimum Noise Figure and Associated Gain versus Collector Current



V_{CE} = 3.0 V
I_C = 3.0 mA
— Potentially Unstable

f (MHz)	NF OPT (dB)	ΓMS NF OPT	R_N	K
500	1.60	0.39 ∠ 52°	19	0.67

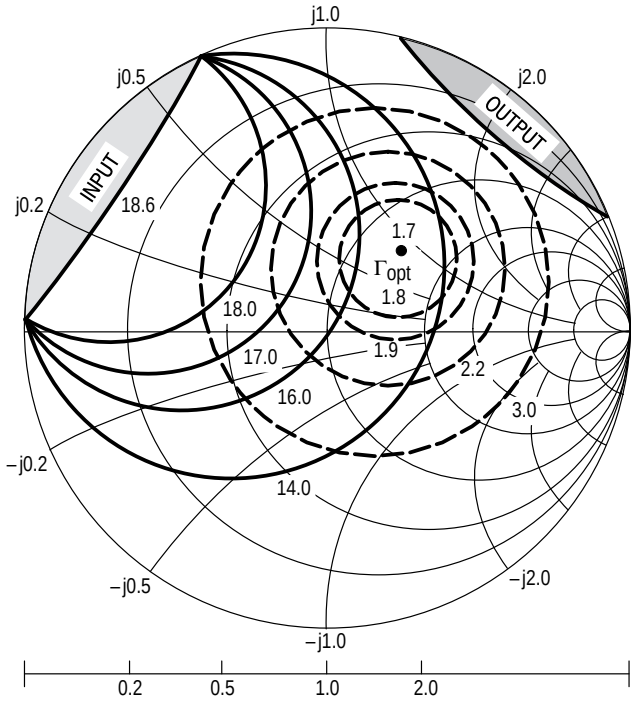
Figure 11. Constant Gain and Noise Figure Contours



V_{CE} = 3.0 V
I_C = 3.0 mA

f (MHz)	NF OPT (dB)	ΓMS NF OPT	R_N	K
1000	2.30	0.29 ∠ 110°	15	1.09

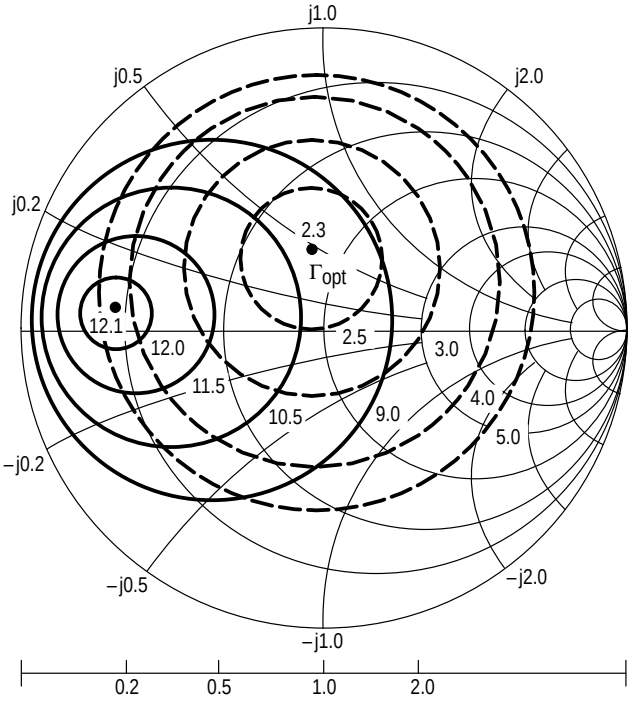
Figure 12. Constant Gain and Noise Figure Contours



V_{CE} = 6.0 V
I_C = 5.0 mA
— Potentially Unstable

f (MHz)	NF OPT (dB)	ΓMS NF OPT	R_N	K
500	1.70	0.35 ∠ 45°	19	0.80

Figure 13. Constant Gain and Noise Figure Contours



V_{CE} = 6.0 V
I_C = 5.0 mA

f (MHz)	NF OPT (dB)	ΓMS NF OPT	R_N	K
1000	2.3	0.25 ∠ 99°	16	1.09

Figure 14. Constant Gain and Noise Figure Contours

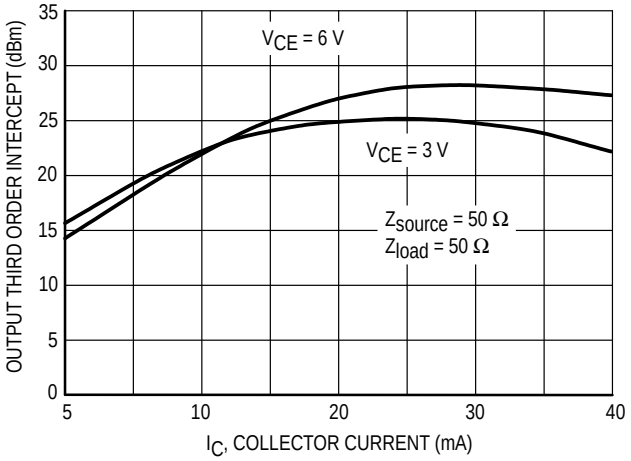


Figure 15. Output Third Order Intercept versus Collector Current

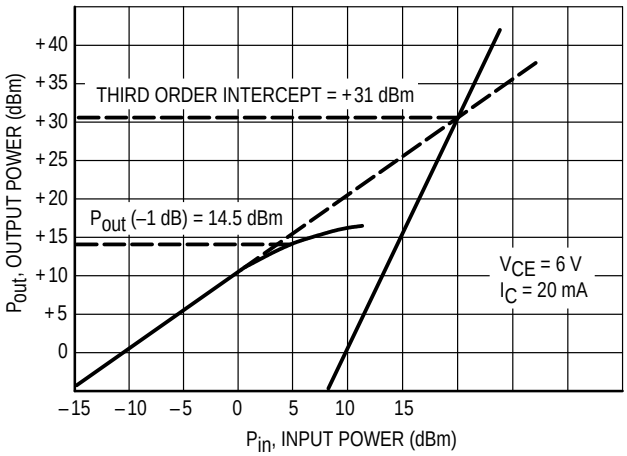


Figure 16. Third Order Intercept and 1 dB Compression Point

V_{CE}	I_C	f (MHz)	NF_{min} (dB)	|Gam Opt|	∠ Gam Opt	R_N
3.0 V	1 mA	300	1.22	0.58	33	27
		500	1.74	0.50	61	25
		900	2.70	0.41	111	19
		1000	2.93	0.40	121	18
		1500	3.96	0.41	166	13
		2000	4.83	0.54	–165	13
	3 mA	300	1.25	0.46	26	20
		500	1.57	0.39	52	19
		900	2.19	0.30	100	16
		1000	2.34	0.29	110	15
		1500	3.08	0.31	158	13
		2000	3.81	0.45	–165	11
6.0 V	3 mA	300	1.28	0.49	23	22
		500	1.60	0.41	48	20
		900	2.24	0.30	94	17
		1000	2.39	0.29	104	16
		1500	3.18	0.30	153	14
		2000	3.97	0.43	–167	12
	5 mA	300	1.45	0.41	21	20
		500	1.68	0.35	45	19
		900	2.17	0.26	89	16
		1000	2.30	0.25	100	16
		1500	2.96	0.26	149	13
		2000	3.66	0.39	–167	12
	10 mA	300	1.96	0.27	21	20
		500	2.09	0.23	46	19
		900	2.40	0.20	93	16
		1000	2.49	0.19	104	16
		1500	3.00	0.24	154	14
		2000	3.60	0.36	–164	12

Table 1. MRF917T1 Common Emitter Noise Parameters

V_{CE} (Volts)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
3.0	3.0	0.10	0.814	−38	9.28	152	0.040	70	0.921	−18
		0.20	0.704	−69	7.56	132	0.066	56	0.784	−28
		0.30	0.615	−91	6.11	117	0.081	49	0.677	−34
		0.40	0.553	−109	5.01	106	0.091	46	0.602	−37
		0.50	0.512	−122	4.24	98	0.098	45	0.552	−39
		0.60	0.465	−134	3.59	92	0.104	44	0.510	−39
		0.70	0.447	−144	3.16	86	0.110	45	0.487	−40
		0.80	0.441	−151	2.79	81	0.117	45	0.472	−41
		0.90	0.428	−159	2.54	77	0.123	46	0.457	−43
		1.00	0.424	−165	2.32	72	0.129	47	0.447	−44
		1.50	0.423	170	1.64	55	0.167	51	0.420	−55
		2.00	0.439	152	1.30	40	0.211	52	0.413	−68
		2.50	0.462	135	1.09	28	0.263	51	0.407	−83
		3.00	0.485	122	0.95	19	0.321	48	0.406	−98
		4.00	0.543	98	0.77	5	0.446	38	0.410	−133
	5.0	0.10	0.717	−48	13.51	146	0.036	67	0.864	−24
		0.20	0.589	−83	10.13	124	0.057	55	0.678	−36
		0.30	0.511	−106	7.75	110	0.068	51	0.559	−41
		0.40	0.463	−123	6.17	101	0.078	50	0.485	−43
		0.50	0.436	−135	5.12	94	0.086	51	0.440	−44
		0.60	0.400	−146	4.31	88	0.094	52	0.402	−42
		0.70	0.390	−154	3.76	84	0.103	53	0.381	−43
		0.80	0.389	−162	3.32	79	0.112	53	0.367	−44
		0.90	0.381	−168	2.99	75	0.121	54	0.356	−45
		1.00	0.380	−173	2.73	71	0.130	55	0.347	−46
		1.50	0.388	165	1.91	55	0.179	55	0.323	−56
		2.00	0.406	148	1.51	42	0.229	53	0.316	−68
		2.50	0.431	133	1.27	30	0.281	50	0.310	−83
		3.00	0.456	121	1.11	20	0.335	46	0.309	−98
		4.00	0.519	99	0.90	4	0.446	36	0.322	−133
	10	0.10	0.552	−67	19.98	136	0.031	63	0.752	−34
		0.20	0.442	−105	13.19	114	0.045	57	0.523	−45
		0.30	0.398	−127	9.51	103	0.056	58	0.413	−49
		0.40	0.377	−142	7.37	95	0.067	59	0.351	−49
		0.50	0.365	−151	6.02	89	0.078	61	0.317	−50
		0.60	0.345	−162	5.05	85	0.089	62	0.284	−46
		0.70	0.343	−168	4.37	81	0.100	62	0.269	−46
		0.80	0.345	−174	3.86	77	0.112	62	0.258	−47
		0.90	0.341	−179	3.46	74	0.123	62	0.250	−48
		1.00	0.344	177	3.14	70	0.135	62	0.243	−49
		1.50	0.359	159	2.19	56	0.192	59	0.223	−58
		2.00	0.378	144	1.72	43	0.248	54	0.216	−71
		2.50	0.404	130	1.44	32	0.301	49	0.210	−87
		3.00	0.431	119	1.26	22	0.352	44	0.210	−102
		4.00	0.492	99	1.03	5	0.452	33	0.227	−138
	20	0.10	0.394	−94	25.51	125	0.024	64	0.612	−44
		0.20	0.349	−131	15.10	106	0.037	64	0.387	−52
		0.30	0.339	−148	10.51	97	0.049	66	0.301	−54
		0.40	0.336	−159	8.03	91	0.062	68	0.255	−54
		0.50	0.333	−165	6.50	86	0.075	68	0.232	−54
		0.60	0.323	−175	5.44	82	0.088	69	0.204	−48
		0.70	0.325	−179	4.70	79	0.100	68	0.194	−48
		0.80	0.329	176	4.14	75	0.113	68	0.185	−50
		0.90	0.329	173	3.71	72	0.126	67	0.180	−50
		1.00	0.332	169	3.36	69	0.139	66	0.175	−52
		1.50	0.351	154	2.33	56	0.201	61	0.160	−62
		2.00	0.372	141	1.82	44	0.258	55	0.155	−77
		2.50	0.399	128	1.53	33	0.313	50	0.151	−95
		3.00	0.423	118	1.34	24	0.364	44	0.152	−111
		4.00	0.486	98	1.09	7	0.459	32	0.174	−149

Table 2. MRF917T1 Common Emitter S−Parameters

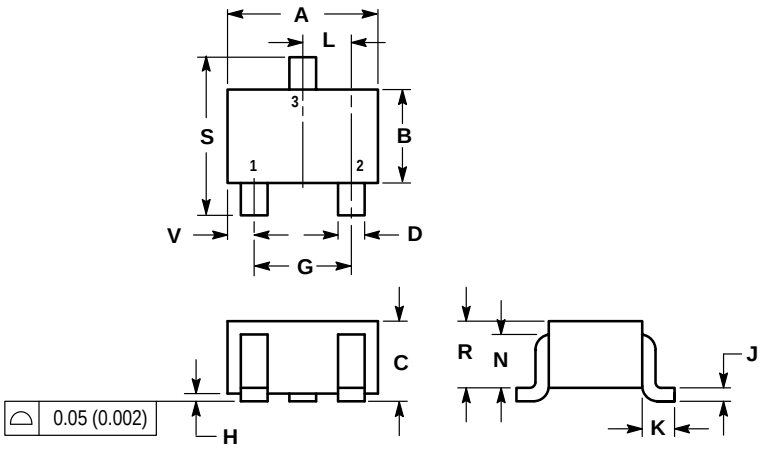
V_{CE} (Volts)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
3.0	40	0.10	0.331	−127	26.91	116	0.020	67	0.480	−49
		0.20	0.338	−154	14.86	100	0.033	70	0.297	−52
		0.30	0.342	−164	10.16	93	0.046	72	0.239	−51
		0.40	0.347	−171	7.70	88	0.060	73	0.210	−50
		0.50	0.347	−175	6.22	84	0.074	73	0.196	−50
		0.60	0.344	177	5.21	80	0.087	73	0.176	−44
		0.70	0.346	174	4.49	77	0.100	72	0.171	−45
		0.80	0.352	170	3.96	74	0.114	71	0.164	−47
		0.90	0.352	167	3.54	71	0.127	70	0.161	−47
		1.00	0.356	164	3.21	68	0.140	69	0.157	−50
		1.50	0.377	151	2.23	55	0.202	63	0.145	−62
		2.00	0.400	138	1.75	43	0.261	57	0.142	−80
		2.50	0.426	126	1.47	33	0.317	50	0.139	−100
		3.00	0.448	115	1.29	23	0.369	44	0.141	−117
		4.00	0.504	96	1.06	7	0.465	32	0.166	−156
6.0	3.0	0.10	0.829	−34	9.23	154	0.033	71	0.936	−14
		0.20	0.720	−63	7.67	134	0.056	59	0.823	−23
		0.30	0.627	−85	6.30	120	0.069	52	0.730	−28
		0.40	0.557	−102	5.21	109	0.078	49	0.664	−31
		0.50	0.509	−115	4.44	101	0.085	47	0.619	−32
		0.60	0.456	−127	3.77	94	0.091	47	0.581	−32
		0.70	0.434	−137	3.32	88	0.096	47	0.561	−33
		0.80	0.425	−145	2.93	83	0.102	48	0.547	−34
		0.90	0.408	−153	2.67	79	0.108	49	0.534	−35
		1.00	0.402	−160	2.44	75	0.114	50	0.524	−37
		1.50	0.396	174	1.72	57	0.148	54	0.501	−46
		2.00	0.411	155	1.36	43	0.189	56	0.494	−58
		2.50	0.435	137	1.14	31	0.237	56	0.485	−71
		3.00	0.463	123	0.99	21	0.294	54	0.482	−84
		4.00	0.525	99	0.79	7	0.424	45	0.473	−117
	5.0	0.10	0.736	−43	13.73	148	0.030	69	0.888	−20
		0.20	0.602	−75	10.55	126	0.048	58	0.727	−29
		0.30	0.512	−98	8.19	113	0.059	54	0.620	−33
		0.40	0.454	−114	6.56	103	0.068	53	0.553	−35
		0.50	0.418	−127	5.47	96	0.076	53	0.512	−35
		0.60	0.377	−138	4.61	90	0.083	54	0.479	−34
		0.70	0.363	−147	4.03	85	0.091	55	0.461	−34
		0.80	0.359	−155	3.55	81	0.099	56	0.448	−35
		0.90	0.348	−162	3.21	77	0.107	57	0.438	−36
		1.00	0.346	−168	2.92	73	0.116	57	0.430	−37
		1.50	0.351	169	2.04	57	0.160	58	0.409	−46
		2.00	0.370	152	1.60	44	0.206	57	0.401	−57
		2.50	0.398	136	1.30	32	0.255	54	0.392	−69
		3.00	0.425	123	1.17	22	0.307	51	0.389	−82
		4.00	0.496	100	0.93	6	0.421	42	0.385	−113
	10	0.100	0.547	−62	21.95	136	0.025	66	0.768	−29
		0.200	0.417	−99	14.53	115	0.038	60	0.558	−37
		0.300	0.362	−120	10.49	103	0.048	61	0.460	−38
		0.400	0.334	−135	8.13	96	0.058	63	0.408	−38
		0.500	0.319	−145	6.64	90	0.069	64	0.379	−38
		0.600	0.294	−156	5.56	86	0.079	65	0.354	−34
		0.700	0.291	−163	4.82	82	0.089	65	0.343	−34
		0.800	0.293	−169	4.25	78	0.100	65	0.333	−35
		0.900	0.290	−174	3.81	75	0.110	65	0.327	−36
		1.000	0.292	−179	3.46	72	0.121	65	0.321	−37
		1.500	0.307	162	2.40	58	0.174	62	0.304	−45
		2.000	0.330	147	1.87	45	0.225	58	0.296	−56
		2.500	0.359	133	1.57	34	0.275	53	0.285	−68
		3.000	0.387	122	1.36	24	0.324	49	0.280	−80
		4.000	0.461	101	1.10	7	0.424	38	0.275	−112

Table 2. MRF917T1 Common Emitter S–Parameters (continued)

V_{CE} (Volts)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
6.0	20	0.10	0.391	−85	27.76	125	0.020	66	0.637	−36
		0.20	0.313	−122	16.43	106	0.032	66	0.436	−39
		0.30	0.292	−140	11.44	98	0.043	68	0.365	−38
		0.40	0.284	−152	8.74	91	0.055	70	0.330	−36
		0.50	0.279	−159	7.08	87	0.067	70	0.313	−36
		0.60	0.266	−169	5.92	83	0.078	71	0.295	−32
		0.70	0.267	−174	5.11	80	0.090	70	0.289	−32
		0.80	0.272	−179	4.50	76	0.101	70	0.281	−33
		0.90	0.271	177	4.03	73	0.113	69	0.278	−34
		1.00	0.275	173	3.65	71	0.124	68	0.274	−35
		1.50	0.297	158	2.52	58	0.179	64	0.260	−43
		2.00	0.322	144	1.97	46	0.232	58	0.251	−55
		2.50	0.353	131	1.64	35	0.283	53	0.239	−68
		3.00	0.380	120	1.43	25	0.332	48	0.233	−81
		4.00	0.452	100	1.16	8	0.430	37	0.225	−113
	40	0.10	0.319	−114	27.96	116	0.017	67	0.532	−34
		0.20	0.295	−145	15.39	101	0.029	71	0.391	−31
		0.30	0.292	−157	10.51	93	0.040	73	0.353	−29
		0.40	0.295	−165	7.98	88	0.052	74	0.335	−28
		0.50	0.295	−170	6.45	85	0.064	74	0.327	−29
		0.60	0.290	−179	5.39	81	0.076	74	0.316	−26
		0.70	0.294	178	4.65	78	0.087	73	0.313	−27
		0.80	0.300	174	4.10	75	0.099	72	0.306	−29
		0.90	0.301	171	3.67	72	0.110	71	0.305	−30
		1.00	0.306	168	3.33	69	0.121	70	0.301	−32
		1.50	0.333	154	2.31	57	0.176	65	0.286	−42
		2.00	0.359	141	1.81	45	0.229	60	0.276	−54
		2.50	0.389	127	1.52	34	0.281	55	0.262	−68
		3.00	0.415	117	1.32	25	0.332	50	0.254	−81
		4.00	0.478	97	1.08	8	0.434	38	0.241	−113

Table 2. MRF917T1 Common Emitter S–Parameters (continued)

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.035	0.049	0.90	1.25
D	0.012	0.016	0.30	0.40
G	0.047	0.055	1.20	1.40
H	0.000	0.004	0.00	0.10
J	0.004	0.010	0.10	0.25
K	0.017 REF		0.425 REF	
L	0.026 BSC		0.650 BSC	
N	0.028 REF		0.700 REF	
R	0.031	0.039	0.80	1.00
S	0.079	0.087	2.00	2.20
V	0.012	0.016	0.30	0.40

STYLE 3:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

CASE 419–02
ISSUE H

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