

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MOTOROLA SC XSTRS/R F

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The RF Line
NPN Silicon
High Frequency Transistors

... designed for use in high frequency, high current applications requiring low distortion.

- High Gain — $|S_{21}|^2 = 15 \text{ dB Typ @ } f = 500 \text{ MHz}$
- High Cutoff Frequency — $f_{r \text{ die}} = 6 \text{ GHz Typ}$
- Diffused Ballast Resistors
- Gold Metallization
- Ion Implantation
- Available in Chip Only — Order CD6150

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}	3	Vdc
Collector Current — Continuous	I_C	0.4	Adc
Operating Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ($I_C = 5 \text{ mA}, I_E = 0$)	$V_{(BR)CEO}$	20	—	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 1 \text{ mA}, I_E = 0$)	$V_{(BR)CBO}$	40	—	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \text{ mA}, I_C = 0$)	$V_{(BR)EBO}$	3.5	—	—	Vdc
Collector Cutoff Current ($V_{CB} = 10 \text{ V}, I_E = 0$)	I_{CBO}	—	—	100	μAdc
Collector Cutoff Current ($V_{CE} = 9 \text{ V}, I_B = 0$)	I_{CEO}	—	—	500	μAdc

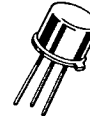
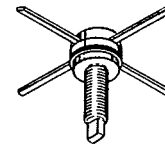
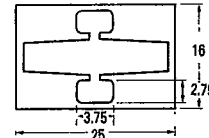
ON CHARACTERISTICS

DC Current Gain ($I_C = 50 \text{ mA}, V_{CE} = 5 \text{ V}$)	h_{FE}	70	150	300	—
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DYNAMIC CHARACTERISTICS

Collector-Base Capacitance ($V_{CB} = 10 \text{ V}, I_E = 0, f = 1 \text{ MHz}$)	C_{cb}	—	—	2.5 2	pF
Emitter Resistance ($I_E = 100 \text{ mA}$)	R_E	—	1.4	—	Ω

(continued)

LT4217
LT4239
CD6150
 $I_C = 400 \text{ mA}$
HIGH FREQUENCY
TRANSISTORS
NPN SILICON

TO-39
CASE 79-04, STYLE 1
LT4239

TO-117A
CASE 244D-01, STYLE 1
LT4217

(DIMENSIONS IN MILS)
CHIP OUTLINE
CD6150

LT4217, LT4239, CD6150

MOTOROLA SC XSTRS/R F

ELECTRICAL CHARACTERISTICS — continued ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS					
Noise Figure, Optimum ($V_{CE} = 8\text{ V}$, $I_C = 50\text{ mA}$, $f = 500\text{ MHz}$)	NFOPT.	—	2.5	—	dB
Cutoff Frequency ($V_{CE} = 8\text{ V}$, $I_C = 90\text{ mA}$, $f = 500\text{ MHz}$)	LT4217 LT4239 CD6150	— — —	5.5 5 6	— — —	GHz
Insertion Gain ($V_{CE} = 8\text{ V}$, $I_C = 90\text{ mA}$, $f = 500\text{ MHz}$)	LT4217 LT4239 CD6150	— — —	15 14 18	— — —	dB

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TYPICAL CHARACTERISTICS

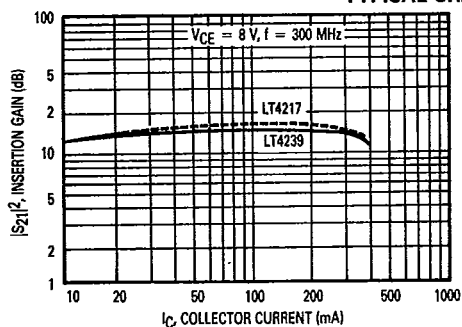
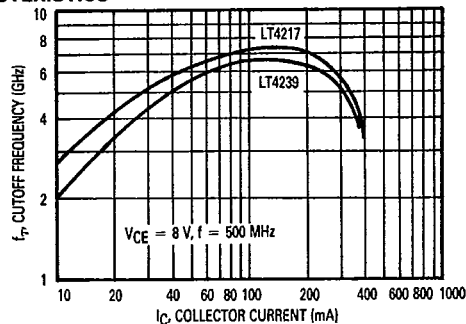
Figure 1. Common Emitter Insertion Gain (50 Ω) versus Collector Current

Figure 2. Gain Bandwidth Product versus Collector Current

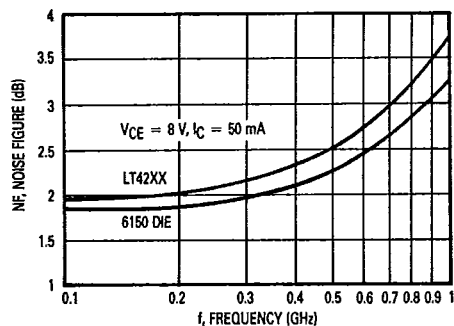


Figure 3. Noise Figure versus Frequency

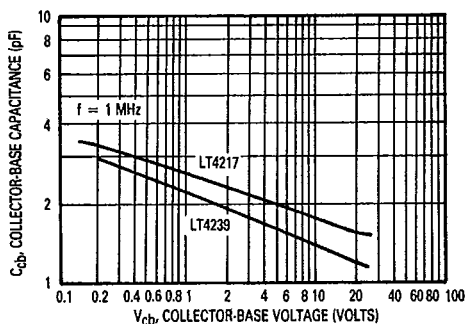


Figure 4. Collector-Base Capacitance versus Voltage

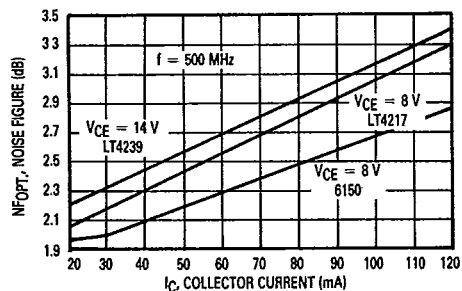


Figure 5. Noise Figure versus Collector Current

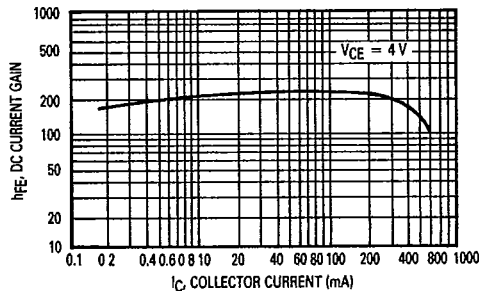


Figure 6. DC Beta versus Collector Current

Frequency (GHz)	S ₁₁		S ₁₂		S ₂₁		S ₂₂	
	dB	Ang	dB	Ang	dB	Ang	dB	Ang
V_{CE} = 8 V, I_C = 50 mA								
200	-7.78	-161.1	-23.35	62.3	19.21	92.1	-10.66	-116.6
300	-7.73	-177.8	-20.64	64.7	15.88	83.2	-11.37	-129.6
400	-7.59	171.4	-18.55	66.1	13.62	76.2	-11.49	-137.2
500	-7.41	163.1	-16.87	66.9	11.73	71.5	-11.09	-142.9
600	-7.28	155.8	-15.33	66.0	10.29	66.2	-10.78	-145.7
700	-7.22	149.5	-14.17	64.3	9.06	60.1	-10.35	-150.6
800	-7.12	143.5	-13.03	63.8	7.97	56.0	-9.90	-152.7
900	-7.10	138.2	-12.23	61.9	7.08	52.0	-9.50	-156.4
1000	-7.08	132.8	-11.39	60.5	6.27	47.4	-8.97	-159.2
1100	-7.10	126.4	-11.07	58.8	5.59	44.1	-8.35	-161.3
1200	-7.10	120.0	-10.24	58.5	5.12	39.1	-8.06	-165.3
1300	-7.10	114.6	-9.72	56.6	4.33	36.7	-7.84	-168.9
1400	-7.16	108.2	-9.14	55.0	4.00	33.2	-7.61	-172.2
1500	-7.19	102.1	-8.41	53.5	3.51	28.7	-7.35	-175.7
1600	-7.18	95.7	-7.88	51.6	3.05	28.1	-7.02	-179.3
1700	-7.14	88.8	-7.43	49.3	2.89	22.6	-6.88	-177.4
1800	-6.94	82.2	-6.94	46.9	2.37	20.2	-6.67	-173.3
1900	-6.67	76.5	-6.39	45.5	2.42	19.1	-6.64	-169.6
2000	-6.51	71.5	-5.87	42.0	2.01	13.0	-6.52	-164.7
V_{CE} = 14 V, I_C = 90 mA								
200	-9.03	-162.7	-23.74	61.7	19.99	94.8	-13.45	-120.5
300	-8.84	-179.4	-20.90	64.6	16.70	85.4	-13.54	-132.0
400	-8.62	169.9	-18.70	66.1	14.46	78.4	-13.34	-138.4
500	-8.43	161.7	-17.03	66.8	12.57	73.9	-12.67	-142.9
600	-8.28	154.5	-15.49	65.7	11.14	68.4	-12.25	-145.0
700	-8.18	148.2	-14.32	63.9	9.91	62.5	-11.70	-149.2
800	-8.06	142.5	-13.19	63.2	8.83	58.3	-11.15	-150.8
900	-8.07	137.3	-12.40	61.4	7.90	54.4	-10.67	-154.2
1000	-8.04	131.8	-11.59	59.8	7.09	49.9	-10.07	-156.6
1100	-8.04	125.8	-11.27	58.2	6.42	46.8	-9.35	-158.9
1200	-8.05	119.4	-10.53	58.0	5.90	42.3	-9.01	-163.0
1300	-8.07	114.1	-9.93	55.8	5.22	39.2	-8.87	-165.7
1400	-8.15	107.6	-9.41	54.4	4.83	35.9	-8.60	-168.8
1500	-8.17	101.4	-8.72	52.8	4.34	31.4	-8.30	-172.1
1600	-8.18	94.9	-8.20	51.0	3.85	30.5	-7.95	-175.4
1700	-8.10	88.1	-7.78	48.9	3.70	25.3	-7.78	-178.4
1800	-7.88	81.4	-7.31	46.8	3.17	22.6	-7.54	-172.0
1900	-7.57	76.0	-6.77	45.4	3.17	21.5	-7.50	-174.7
2000	-7.38	71.0	-6.28	42.3	2.82	15.3	-7.40	-170.2

Figure 7. LT4217 Common Emitter S-Parameters

Frequency (GHz)	S ₁₁		S ₁₂		S ₂₁		S ₂₂	
	dB	Ang	dB	Ang	dB	Ang	dB	Ang
V_{CE} = 8 V, I_C = 50 mA								
200	-11.60	-144.8	-20.45	68.0	17.41	89.4	-12.42	-105.7
300	-13.07	-166.2	-17.54	69.0	14.16	82.1	-12.68	-118.1
400	-13.54	173.2	-15.40	68.3	11.93	74.2	-12.21	-121.9
500	-12.87	157.7	-13.64	68.0	10.18	70.4	-11.80	-122.6
600	-12.28	150.0	-12.27	66.3	8.73	63.4	-11.70	-123.6
700	-12.24	145.2	-11.01	64.9	7.71	59.1	-11.61	-126.7
800	-12.92	140.1	-10.15	63.3	6.77	54.1	-11.43	-131.4
900	-13.83	128.6	- 9.18	61.1	6.13	50.0	-10.83	-136.3
1000	-13.78	112.9	- 8.51	59.3	5.41	46.4	-10.08	-139.8
1100	-12.91	104.2	- 8.09	55.0	4.81	40.5	- 8.44	-140.2
1200	-12.03	99.8	- 7.48	53.3	4.27	36.8	- 7.96	-141.2
1300	-11.82	99.7	- 7.00	51.1	3.66	33.1	- 7.79	-142.0
1400	-12.19	98.6	- 6.49	49.6	3.35	29.6	- 7.63	-143.8
1500	-13.10	94.6	- 6.09	47.7	3.03	26.3	- 7.43	-147.1
1600	-14.04	83.3	- 5.74	46.5	2.78	22.7	- 7.18	-149.8
1700	-13.92	72.7	- 5.32	44.0	2.61	20.3	- 6.84	-152.4
1800	-13.47	65.5	- 4.98	43.1	2.26	18.2	- 6.64	-154.0
1900	-13.26	62.5	- 4.62	40.3	2.08	15.5	- 6.26	-154.9
2000	-13.61	60.7	- 4.19	39.9	1.87	13.1	- 6.28	-156.3

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V_{CE} = 14 V, I_C = 90 mA								
200	-12.86	-141.3	-20.72	67.8	17.84	90.1	-13.31	- 99.5
300	-14.72	-163.9	-17.71	69.2	14.62	82.8	-13.54	-112.0
400	-15.30	172.9	-15.59	68.3	12.36	75.0	-12.90	-115.6
500	-14.45	155.4	-13.80	67.9	10.61	71.2	-12.33	-116.2
600	-13.70	147.5	-12.49	66.2	9.15	64.3	-12.15	-116.9
700	-13.68	143.2	-11.20	64.6	8.13	60.0	-12.01	-119.9
800	-14.47	137.7	-10.39	63.0	7.15	55.1	-11.85	-124.6
900	-15.58	125.0	- 9.42	60.7	6.51	50.8	-11.20	-129.7
1000	-15.33	106.9	- 8.77	59.1	5.76	47.3	-10.39	-133.6
1100	-14.18	96.9	- 8.34	54.9	5.18	41.6	- 8.68	-135.1
1200	-13.13	93.5	- 7.70	53.0	4.62	37.8	- 8.15	-136.1
1300	-12.96	94.2	- 7.32	51.3	4.00	34.0	- 7.91	-136.9
1400	-13.40	93.1	- 6.81	49.8	3.68	30.5	- 7.72	-138.6
1500	-14.46	89.3	- 6.42	48.0	3.36	27.2	- 7.48	-141.9
1600	-15.39	76.4	- 6.09	47.0	3.07	23.4	- 7.21	-144.6
1700	-15.08	65.2	- 5.67	44.6	2.88	21.1	- 6.83	-147.3
1800	-14.47	58.5	- 5.35	43.9	2.47	18.8	- 6.48	-148.9
1900	-14.21	56.0	- 4.99	41.3	2.27	16.0	- 6.15	-149.7
2000	-14.54	54.5	- 4.58	41.2	2.05	13.5	- 6.12	-151.0

Figure 8. LT4239 Common Emitter S-Parameters

LT4217, LT4239, CD6150

MOTOROLA SC XSTRS/R F

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Frequency (GHz)	S ₁₁		S ₁₂		S ₂₁		S ₂₂	
	dB	Ang	dB	Ang	dB	Ang	dB	Ang

VCE = 14 V, IC = 30 mA

100	-2.30	-114.0	-28.21	36.0	27.35	118.7	-4.84	-76.7
200	-2.40	-143.8	-27.16	27.7	22.62	102.0	-7.85	-105.7
300	-2.41	-156.1	-26.64	26.3	19.48	93.6	-9.18	-119.9
400	-2.42	-163.1	-26.67	27.9	17.18	87.3	-9.69	-127.7
500	-2.25	-166.2	-26.13	28.8	15.17	82.9	-9.97	-130.4
550	-2.23	-167.6	-26.00	30.3	14.44	81.3	-9.97	-131.7
600	-2.21	-169.0	-25.81	30.5	13.70	79.6	-9.97	-132.5
650	-2.18	-170.2	-25.67	32.8	13.02	77.5	-9.95	-133.3
700	-2.17	-171.3	-25.62	33.5	12.44	75.6	-9.90	-134.4
750	-2.14	-172.2	-25.35	34.7	11.81	74.1	-9.70	-135.4
800	-2.15	-173.2	-25.27	36.3	11.30	72.4	-9.58	-135.3
850	-2.14	-174.0	-25.10	37.7	10.74	70.8	-9.47	-135.6
900	-2.11	-174.8	-24.96	36.7	10.27	69.1	-9.26	-135.3
950	-2.08	-175.6	-24.08	40.0	9.75	67.9	-9.17	-135.0
1000	-2.11	-177.3	-24.70	42.1	9.16	63.2	-9.10	-135.0
1100	-2.10	-178.7	-24.35	44.3	8.46	61.9	-8.81	-130.6
1200	-2.10	180.0	-24.03	46.9	7.54	59.1	-8.46	-136.5
1300	-2.13	178.9	-23.70	48.8	6.81	56.2	-7.99	-136.3
1400	-2.15	178.1	-23.28	51.6	6.10	53.6	-7.82	-135.4
1500	-2.16	177.0	-23.19	53.9	5.35	51.4	-7.40	-136.1
1600	-2.19	176.2	-22.78	54.9	4.50	47.9	-7.06	-136.3
1700	-2.18	175.6	-22.39	55.7	4.05	44.6	-6.63	-135.8
1800	-2.18	174.9	-21.97	57.5	3.42	42.1	-6.40	-138.6
1900	-2.19	174.4	-21.62	59.6	2.93	40.7	-6.05	-136.8
2000	-2.17	173.0	-21.34	69.9	2.34	39.2	-5.75	-136.8

VCE = 14 V, IC = 100 mA

100	-2.65	-125.7	-30.13	36.1	28.61	115.1	-5.35	-95.4
200	-2.48	-151.5	-28.82	29.2	23.82	100.4	-7.35	-125.7
300	-2.42	-161.6	-28.27	29.6	20.42	93.0	-8.07	-139.9
400	-2.40	-167.3	-27.69	33.5	18.10	87.4	-8.28	-146.9
500	-2.21	-169.8	-27.21	35.8	16.13	83.1	-8.41	-150.0
550	-2.19	-171.0	-26.00	37.6	15.46	81.0	-8.48	-152.5
600	-2.18	-172.1	-26.58	38.8	14.72	81.0	-8.48	-152.5
650	-2.16	-173.1	-26.32	40.7	14.06	79.1	-8.58	-153.0
700	-2.14	-174.1	-26.14	41.8	13.47	77.6	-8.56	-154.7
750	-2.12	-175.0	-25.76	43.1	12.85	76.3	-8.40	-155.2
800	-2.12	-175.7	-25.59	45.0	12.33	74.8	-8.43	-155.0
850	-2.11	-176.4	-25.26	46.0	11.78	73.4	-8.38	-155.2
900	-2.11	-177.1	-25.17	46.2	11.31	72.0	-8.29	-154.7
950	-2.07	-177.8	-24.87	47.6	10.78	70.1	-8.29	-154.6
1000	-2.10	-179.4	-24.74	49.8	10.20	66.6	-8.28	-153.6
1100	-2.09	179.4	-24.21	51.4	9.49	65.5	-8.15	-154.8
1200	-2.10	178.2	-23.81	53.4	8.59	63.1	-7.97	-154.3
1300	-2.12	177.2	-23.34	54.6	7.89	60.5	-7.69	-153.2
1400	-2.14	176.5	-22.87	56.8	7.20	58.6	-7.72	-152.0
1500	-2.16	175.5	-22.59	58.6	6.46	56.6	-7.46	-151.8
1600	-2.18	174.7	-22.28	59.2	5.73	53.6	-7.24	-151.1
1700	-2.18	174.2	-21.84	59.4	5.21	56.2	-6.95	-149.8
1800	-2.19	173.6	-21.38	60.4	4.62	48.2	-6.78	-149.7
1900	-2.20	173.1	-21.02	62.0	4.17	47.0	-6.52	-149.3
2000	-2.19	172.7	-20.74	62.8	3.61	45.6	-6.32	-148.2

Figure 9. CD6150 Common Emitter S-Parameters