Order this document by MBC13916/D

MOTOROLA intelligence everywhere™ | digital dna™

MBC13916

The RF Building Block Series
General Purpose SiGe:C RF Cascode Amplifier

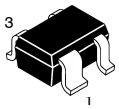
The MBC13916 is a cost–effective, high isolation amplifier fabricated with Motorola's Advanced RF BiCMOS process using the SiGe:C module. It is intended to be a similar replacement for the MRFIC0916 and is housed in the smaller SOT–343R surface mount package. As with the MRFIC0916, the device is designed for general purpose RF applications, but has improved high frequency gain and noise figure. On–chip bias circuitry sets the bias point, while matching is accomplished off–chip, affording the maximum in application flexibility.

- Usable Frequency Range = 100 to 2500 MHz
- 19 dB typical gain at 900 MHz, V_{CC} = 2.7 V
- NF_{min} (Device Level) = 0.9 dB @ 900 MHz
- NF_{min} (Device Level) = 1.9 dB @ 1.9 GHz
- 2.5 dBm typical Output Power at 1.0 dB Gain Compression at 900 MHz, V_{CC} = 2.7 V
- 45 dB Typical Reverse Isolation (Device Level) at 900 MHz, V_{CC} = 2.7 V
- 4.7 mA Typ Bias Current at V_{CC} = 2.7 V
- 2.7 to 5.0 V Supply
- Industry Standard SOT–343R Package
- Available Only in Tape and Reel Packaging
- Device Weight = 0.00642 g (Typ)

GENERAL PURPOSE SiGe:C RF CASCODE AMPLIFIER

SEMICONDUCTOR TECHNICAL DATA

Pin 1. Gnd
2. RF In
3. RF Out
4. Gnd



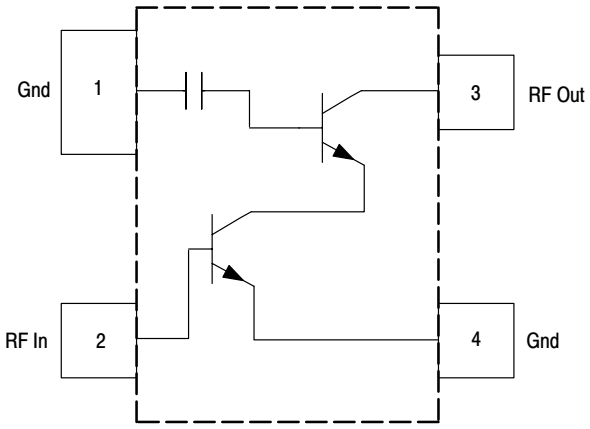
(Scale 4:1)

PLASTIC PACKAGE
SOT–343R
(Tape & Reel Only)

ORDERING INFORMATION

Device	Device Marking	Package
MBC13916T1	916	SOT–343R

Functional Block Diagram



(SOT–343R package)

Definitive Data – Motorola reserves the right to change the Production detail specifications as may be required to permit improvement in the design of its products.

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	6.0	Vdc
RF Input Power	P_{RF}	10	dBm
Power Dissipation	P_{DIS}	100	mW
Supply Current	I_{CC}	20	mA
Thermal Resistance, Junction to Case	$R_{\theta JC}$	400	C/W
Storage Temperature Range	T_{stg}	–65 to 150	°C
Operating Case Temperature	T_C	–40 to 100	°C

NOTES: 1. Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Recommended Operating Conditions and Electrical Characteristics tables.
2. ESD (electrostatic discharge) immunity meets Human Body Model (HBM) ≤550 V and Machine Model (MM) ≤50 V. Additional EST data available upon request.

RECOMMENDED OPERATING CONDITIONS

Characteristic	Symbol	Min	Typ	Max	Unit
RF Frequency	f_{RF}	100	–	2500	MHz
Supply Voltage	V_{CC}	2.7	–	5.0	Vdc

DEVICE LEVEL CHARACTERISTICS (V_{CC} = 2.7 V, T_A = 25°C, measured in S–parameter test fixture, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Insertion Gain	$\|S_{21}\|^2$				dB
f = 900 MHz		–	16.5	–	
f = 1900 MHz		–	10	–	
Maximum Stable Gain and/or Minimum Available Gain [Note 1]	MSG, MAG				dB
f = 900 MHz		–	24.5	–	
f = 1900 MHz		–	14.3	–	
Minimum Noise Figure [Note 2]	NF_{min}				dB
f = 900 MHz		–	0.9	–	
f = 1900 MHz		–	1.9	–	
Output Third Order Intercept Point [Note 3]	OIP3				dBm
f = 900 MHz		–	16.5	–	
f = 1900 MHz		–	17	–	
Reverse Isolation	$\|S_{12}\|^2$				dB
f = 900 MHz		–	–45	–	
f = 1900 MHz		–	–31	–	

NOTES: 1. Maximum Available Gain and Maximum Stable Gain are defined by the K factor as follows:

$$MAG = \left|\frac{S_{21}}{S_{12}}\left(K \pm \sqrt{K^2 - 1}\right)\right|, \text{ if } K > 1, \; MSG = \left|\frac{S_{21}}{S_{12}}\right|, \text{ if } K < 1$$

2. Device matched for best noise figure.
3. Z_{out} matched for optimum IP3.

ELECTRICAL CHARACTERISTICS (V_{CC} = 2.7 V, T_A = 25°C, f_{RF} = 900 MHz, Tested in Circuit Shown in Figure 1, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Small Signal Gain	S_{21}	17	19	21	dB
Noise Figure	NF	–	1.25	–	dB
Power Output at 1.0 dB Gain Compression	P_{1dB}	0	2.5	–	dBm
Output 3rd Order Intercept Point	OIP3	–	13	–	dBm
Reverse Isolation	S_{12}	–	–42	–	dB
Supply Current	I_{CC}	3.8	4.7	5.6	mA

Figure 1. 900 MHz Applications Circuit Configuration

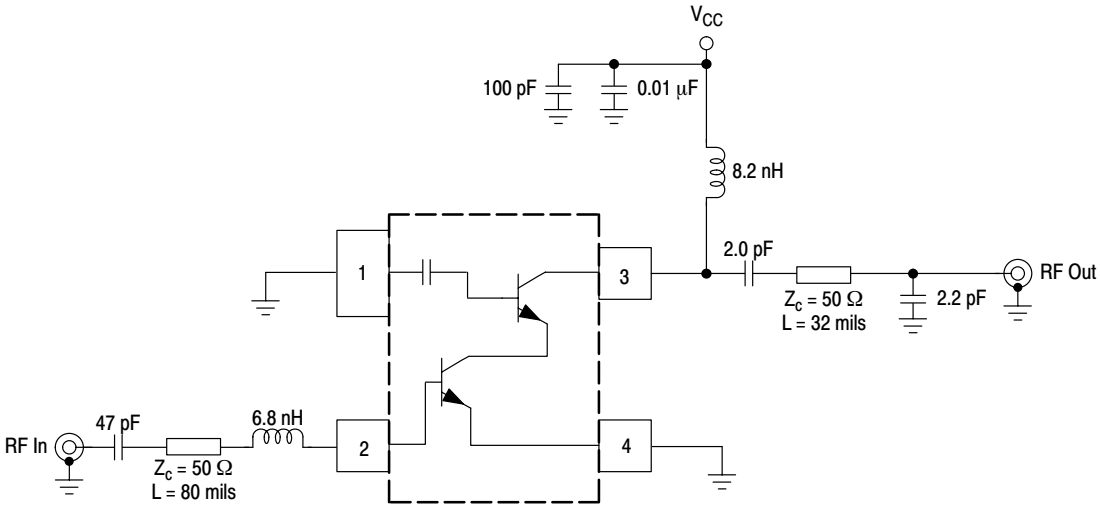
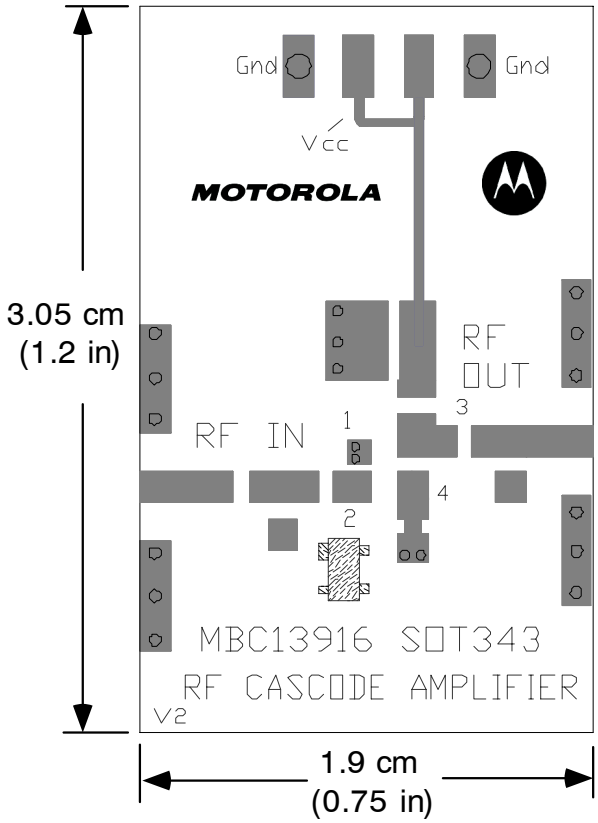


Figure 2. 900 MHz Printed Circuit Board



NOTE:
PCB material FR4
ε_r = 4.5
h = 25 mils
t = 1.75

ELECTRICAL CHARACTERISTICS (V_{CC} = 2.7 V, T_A = 25°C, f_{RF} = 1.9 GHz, Tested in Circuit Shown in Figure 3, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Small Signal Gain	S_{21}	9.5	11.5	13.5	dB
Noise Figure	NF	–	2.1	–	dB
Power Output at 1.0 dB Gain Compression	P_{1dB}	–	–4.0	–	dBm
Output 3rd Order Intercept Point	OIP3	–	5.5	–	dBm
Reverse Isolation	S_{12}	–	–28	–	dB
Supply Current	I_{CC}	3.8	4.7	5.6	mA

Figure 3. 1.9 GHz Application Configuration Circuit

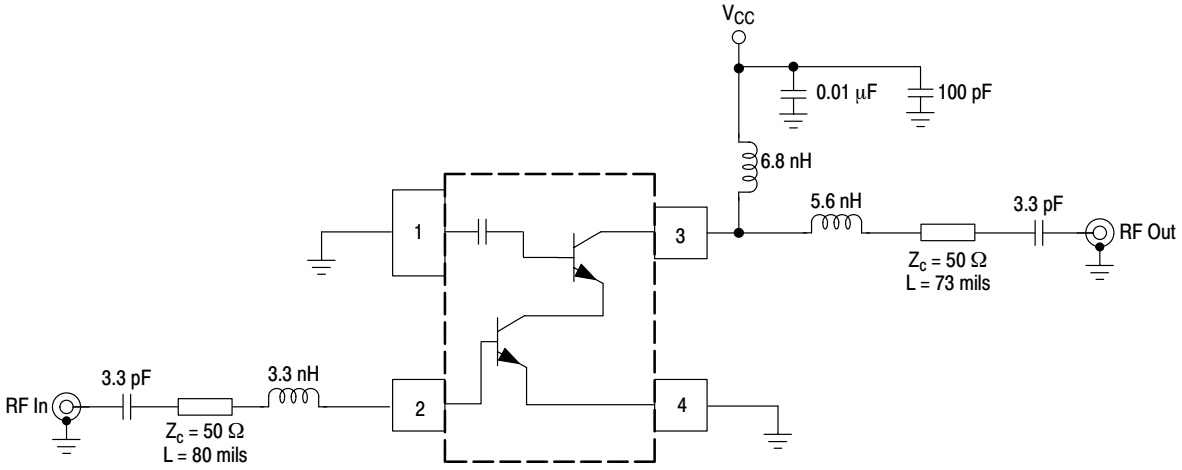
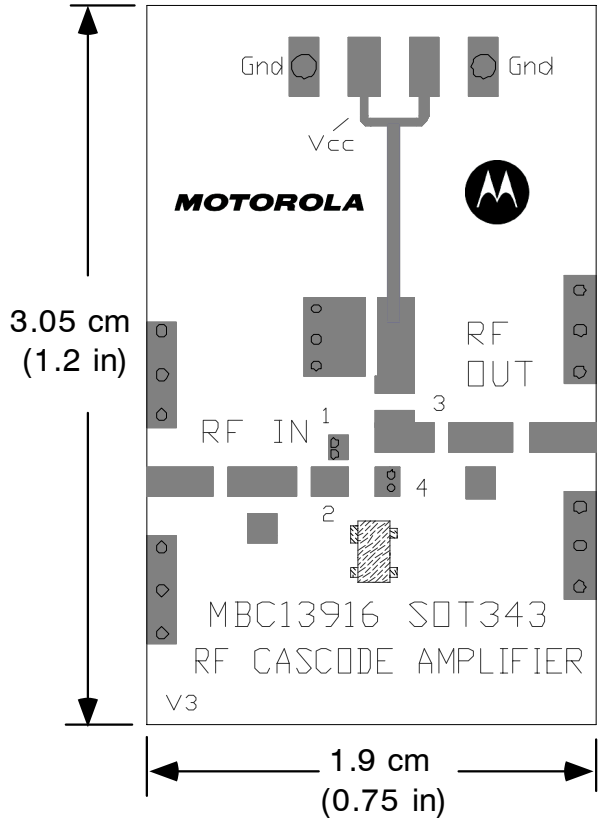


Figure 4. 1900 MHz Printed Circuit Board



NOTE:
PCB material FR4
ε_r = 4.5
h = 25 mils
t = 1.75

Figure 5. GUmax versus Frequency

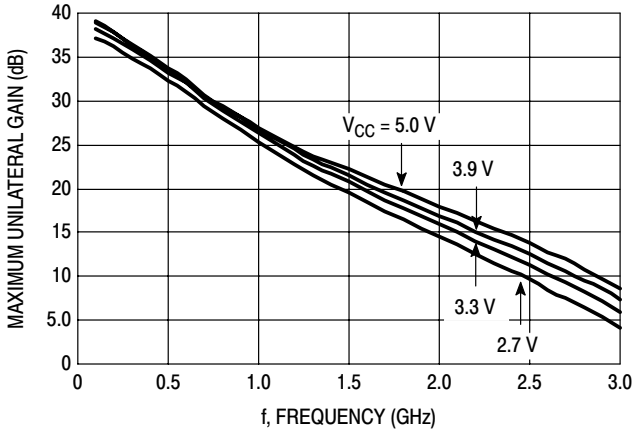


Figure 6. Output Power versus Input Power

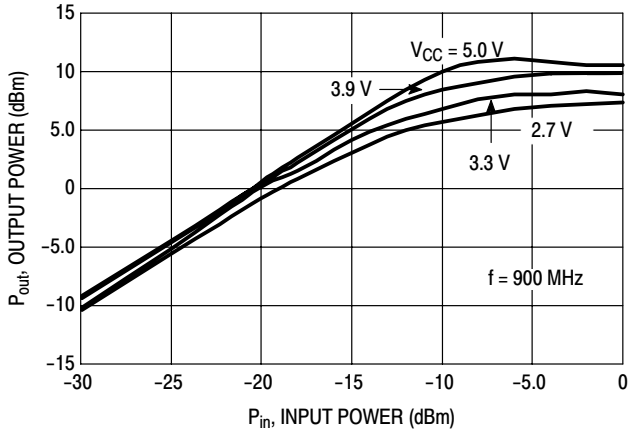


Figure 7. Output Power versus Input Power

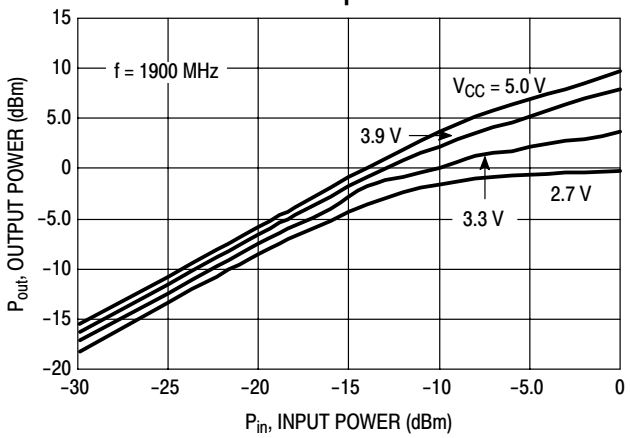


Figure 8. Supply Current versus Input Power

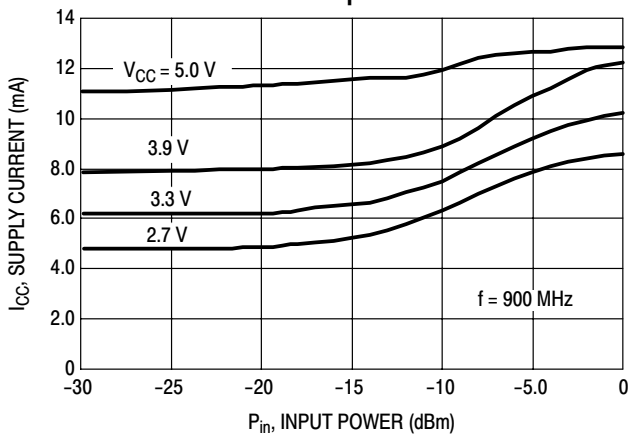


Figure 9. Supply Current versus Input Power

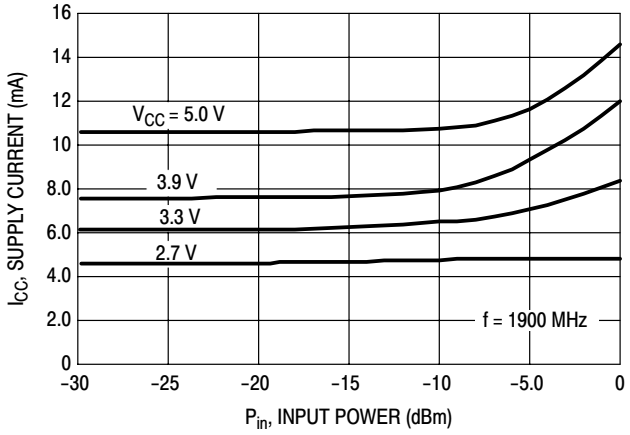


Table 1. Scattering Parameters
(V_{CC} = 2.7 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
100	0.829	–11	11.98	165	0.001	17	0.955	–4
200	0.798	–21	11.43	152	0.002	47	0.957	–7
300	0.753	–31	10.69	139	0.002	55	0.956	–11
400	0.701	–39	10.12	128	0.003	56	0.955	–14
500	0.648	–46	9.28	118	0.003	51	0.955	–18
600	0.599	–53	8.66	108	0.004	49	0.954	–22
700	0.554	–58	7.95	98	0.004	41	0.947	–26
800	0.518	–61	7.33	90	0.004	24	0.941	–30
900	0.485	–65	6.83	82	0.004	15	0.933	–34
1000	0.458	–67	6.23	74	0.004	–4	0.926	–38
1100	0.438	–69	5.78	67	0.004	–28	0.915	–43
1200	0.426	–71	5.39	60	0.005	–50	0.902	–46
1300	0.417	–72	4.97	52	0.006	–74	0.893	–51
1400	0.414	–73	4.59	46	0.008	–93	0.879	–54
1500	0.415	–74	4.31	39	0.011	–106	0.868	–58
1600	0.421	–75	3.99	32	0.014	–115	0.851	–62
1700	0.430	–76	3.66	25	0.018	–125	0.835	–66
1800	0.441	–78	3.43	19	0.022	–131	0.818	–70
1900	0.455	–80	3.16	12	0.027	–139	0.803	–73
2000	0.474	–82	2.93	5	0.033	–146	0.777	–77
2100	0.490	–85	2.70	–1	0.039	–152	0.761	–81
2200	0.504	–88	2.48	–8	0.045	–159	0.735	–85
2300	0.524	–92	2.27	–14	0.052	–163	0.707	–89
2400	0.542	–95	2.09	–21	0.059	–169	0.683	–93
2500	0.559	–98	1.90	–28	0.067	–175	0.651	–98
2600	0.572	–103	1.70	–34	0.075	180	0.624	–102
2700	0.587	–106	1.56	–40	0.083	174	0.593	–107
2800	0.603	–110	1.40	–48	0.091	169	0.562	–111
2900	0.610	–114	1.26	–55	0.098	163	0.533	–116
3000	0.613	–118	1.11	–60	0.105	160	0.501	–120

Table 2. Scattering Parameters
(V_{CC} = 3.0 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
100	0.812	–11	13.42	165	0.001	11	0.954	–3
200	0.778	–21	12.73	151	0.001	50	0.955	–7
300	0.731	–30	11.82	138	0.002	58	0.956	–11
400	0.677	–38	11.10	127	0.003	50	0.954	–14
500	0.623	–44	10.12	116	0.003	51	0.954	–18
600	0.575	–50	9.37	107	0.003	43	0.952	–22
700	0.533	–54	8.56	98	0.003	30	0.945	–26
800	0.499	–57	7.85	90	0.004	24	0.937	–30
900	0.470	–59	7.29	82	0.004	8	0.930	–34
1000	0.448	–61	6.63	74	0.003	–11	0.923	–38
1100	0.433	–63	6.14	67	0.004	–38	0.911	–42
1200	0.423	–64	5.72	60	0.005	–58	0.900	–46
1300	0.418	–65	5.27	53	0.006	–77	0.891	–50
1400	0.421	–66	4.87	47	0.008	–96	0.878	–54
1500	0.425	–67	4.56	40	0.011	–108	0.868	–58
1600	0.432	–68	4.23	34	0.014	–120	0.852	–61
1700	0.444	–70	3.89	27	0.018	–126	0.838	–65
1800	0.459	–72	3.63	21	0.022	–133	0.822	–69
1900	0.473	–74	3.35	15	0.027	–140	0.809	–73
2000	0.490	–77	3.12	8	0.033	–147	0.784	–77
2100	0.509	–80	2.87	2	0.039	–152	0.769	–80
2200	0.527	–83	2.64	–5	0.045	–159	0.744	–84
2300	0.545	–86	2.42	–11	0.051	–163	0.717	–88
2400	0.560	–90	2.23	–17	0.059	–170	0.694	–92
2500	0.579	–94	2.03	–24	0.067	–175	0.663	–97
2600	0.594	–98	1.82	–30	0.075	–180	0.637	–101
2700	0.606	–101	1.68	–36	0.083	175	0.607	–105
2800	0.620	–105	1.50	–43	0.090	169	0.576	–110
2900	0.630	–110	1.35	–50	0.097	164	0.548	–114
3000	0.636	–113	1.19	–55	0.105	160	0.516	–119

Table 3. Scattering Parameters
(V_{CC} = 3.3 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
100	0.796	–11	14.82	164	0.001	25	0.954	–3
200	0.760	–20	13.98	150	0.001	50	0.955	–7
300	0.711	–29	12.90	137	0.002	46	0.955	–11
400	0.655	–36	12.03	126	0.002	55	0.955	–14
500	0.602	–42	10.90	115	0.003	50	0.954	–18
600	0.556	–46	10.04	106	0.003	45	0.954	–22
700	0.517	–50	9.12	97	0.003	34	0.947	–26
800	0.487	–52	8.34	89	0.003	22	0.940	–30
900	0.463	–54	7.72	82	0.003	11	0.933	–34
1000	0.444	–56	7.02	74	0.003	–6	0.927	–38
1100	0.432	–57	6.49	67	0.003	–40	0.917	–42
1200	0.428	–58	6.03	61	0.005	–69	0.905	–46
1300	0.427	–59	5.55	53	0.006	–88	0.896	–50
1400	0.430	–60	5.13	48	0.008	–99	0.883	–53
1500	0.437	–61	4.81	41	0.011	–111	0.874	–57
1600	0.449	–62	4.45	35	0.014	–118	0.858	–61
1700	0.462	–64	4.09	29	0.018	–128	0.843	–64
1800	0.475	–66	3.83	23	0.022	–134	0.829	–68
1900	0.493	–69	3.53	17	0.027	–140	0.815	–72
2000	0.512	–72	3.28	10	0.032	–148	0.790	–76
2100	0.529	–75	3.03	4	0.038	–152	0.776	–79
2200	0.544	–78	2.79	–2	0.045	–159	0.752	–83
2300	0.565	–82	2.56	–8	0.051	–164	0.726	–87
2400	0.583	–85	2.37	–14	0.058	–169	0.704	–91
2500	0.599	–89	2.16	–21	0.067	–175	0.674	–96
2600	0.613	–93	1.94	–27	0.075	–179	0.648	–100
2700	0.629	–97	1.79	–32	0.083	175	0.621	–105
2800	0.643	–101	1.60	–39	0.091	170	0.589	–109
2900	0.650	–105	1.44	–46	0.098	164	0.562	–114
3000	0.653	–109	1.28	–51	0.105	160	0.531	–118

Table 4. Scattering Parameters
(V_{CC} = 3.9 V, 50 Ω System)

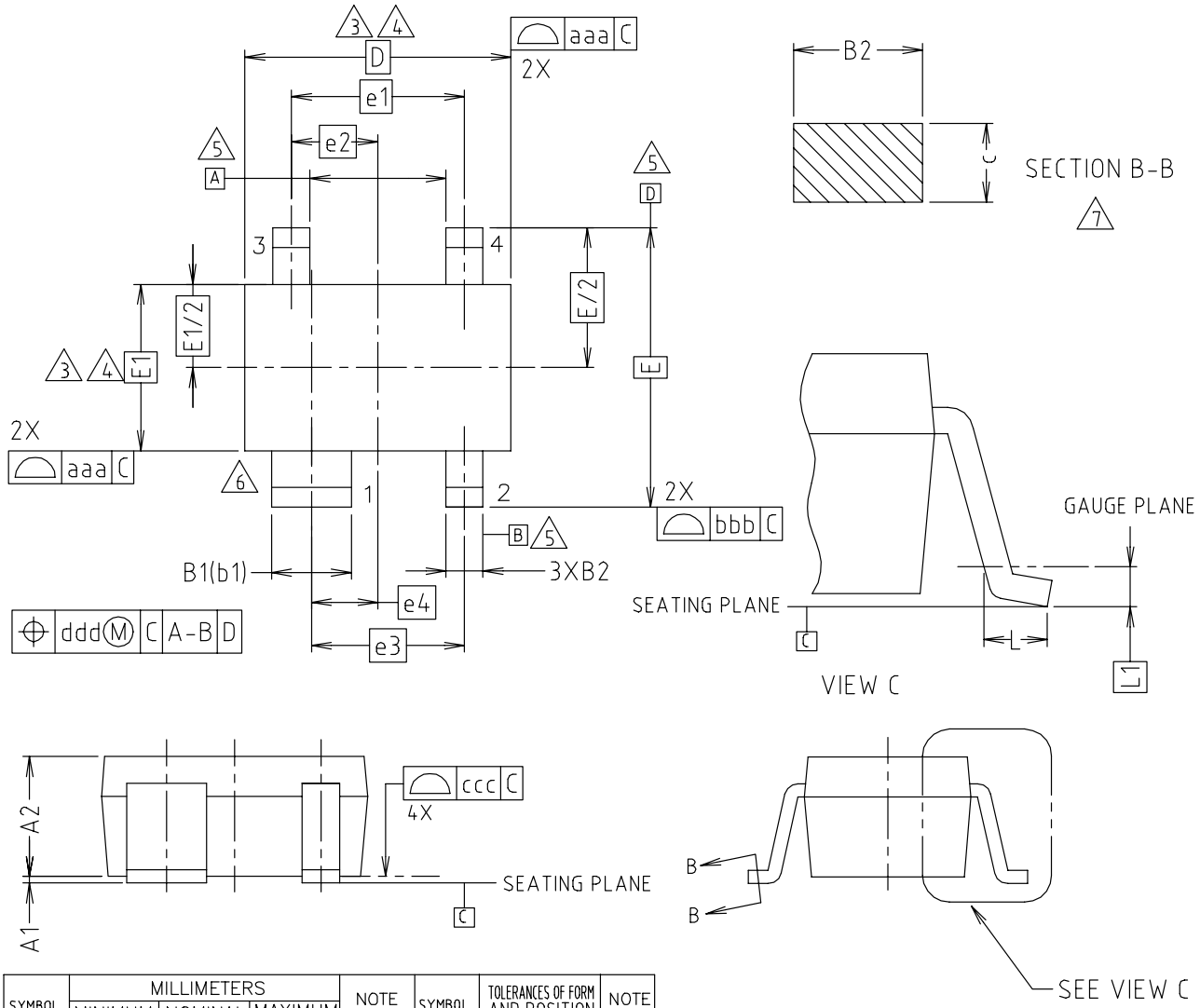
f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
100	0.768	–10	17.37	163	0.001	5	0.951	–3
200	0.728	–19	16.21	148	0.001	44	0.952	–7
300	0.676	–27	14.75	135	0.002	39	0.953	–11
400	0.621	–33	13.55	124	0.002	44	0.952	–14
500	0.573	–37	12.13	113	0.002	55	0.952	–18
600	0.532	–41	11.07	104	0.003	41	0.951	–22
700	0.498	–43	9.96	96	0.003	36	0.943	–26
800	0.477	–45	9.06	88	0.003	20	0.937	–29
900	0.461	–46	8.36	81	0.002	13	0.930	–33
1000	0.448	–47	7.56	74	0.002	–25	0.925	–37
1100	0.442	–48	6.97	68	0.003	–54	0.914	–41
1200	0.444	–49	6.48	62	0.005	–75	0.903	–45
1300	0.448	–50	5.95	54	0.006	–94	0.895	–49
1400	0.455	–51	5.50	49	0.008	–107	0.883	–52
1500	0.465	–53	5.15	43	0.011	–113	0.875	–56
1600	0.480	–55	4.77	37	0.014	–122	0.860	–60
1700	0.495	–56	4.39	32	0.018	–130	0.847	–63
1800	0.507	–59	4.11	26	0.022	–136	0.834	–67
1900	0.525	–62	3.80	20	0.027	–142	0.821	–71
2000	0.546	–65	3.54	14	0.032	–148	0.799	–74
2100	0.565	–67	3.28	8	0.038	–153	0.785	–78
2200	0.578	–71	3.02	2	0.044	–160	0.763	–82
2300	0.598	–75	2.78	–3	0.051	–163	0.739	–85
2400	0.617	–79	2.57	–9	0.059	–169	0.719	–90
2500	0.633	–82	2.36	–15	0.066	–174	0.690	–94
2600	0.645	–86	2.12	–21	0.073	–179	0.666	–98
2700	0.660	–90	1.96	–27	0.082	176	0.639	–103
2800	0.678	–94	1.76	–33	0.089	171	0.609	–107
2900	0.683	–98	1.59	–39	0.097	165	0.583	–112
3000	0.683	–102	1.42	–44	0.105	162	0.553	–116

Table 5. Scattering Parameters
(V_{CC} = 5.0 V, 50 Ω System)

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
100	0.719	–9	21.47	161	0.001	5	0.939	–3
200	0.678	–17	19.60	145	0.001	18	0.939	–7
300	0.628	–23	17.43	132	0.001	38	0.940	–10
400	0.579	–27	15.66	120	0.002	47	0.937	–14
500	0.540	–30	13.78	110	0.002	38	0.936	–18
600	0.512	–32	12.40	101	0.003	37	0.934	–22
700	0.492	–34	11.05	93	0.002	32	0.927	–26
800	0.480	–34	9.97	86	0.002	9	0.920	–30
900	0.472	–35	9.12	79	0.002	–14	0.914	–34
1000	0.470	–37	8.21	73	0.002	–54	0.908	–38
1100	0.473	–37	7.54	67	0.003	–75	0.899	–42
1200	0.478	–39	6.97	61	0.004	–90	0.890	–46
1300	0.484	–40	6.37	54	0.006	–101	0.884	–50
1400	0.496	–42	5.86	50	0.008	–114	0.875	–54
1500	0.509	–44	5.49	44	0.010	–120	0.871	–57
1600	0.521	–46	5.08	39	0.013	–128	0.858	–60
1700	0.535	–49	4.67	34	0.017	–133	0.848	–63
1800	0.552	–51	4.38	29	0.021	–139	0.838	–67
1900	0.570	–54	4.06	23	0.025	–144	0.829	–70
2000	0.587	–56	3.80	18	0.030	–150	0.807	–73
2100	0.604	–60	3.54	13	0.036	–154	0.795	–76
2200	0.621	–63	3.28	7	0.042	–160	0.772	–79
2300	0.643	–67	3.04	2	0.048	–164	0.746	–83
2400	0.658	–70	2.84	–4	0.056	–169	0.722	–87
2500	0.673	–74	2.61	–10	0.063	–175	0.687	–91
2600	0.690	–78	2.36	–16	0.071	–179	0.657	–96
2700	0.705	–82	2.19	–21	0.079	176	0.623	–101
2800	0.715	–86	1.97	–27	0.088	170	0.588	–107
2900	0.720	–91	1.78	–33	0.094	164	0.556	–113
3000	0.723	–94	1.57	–38	0.101	161	0.523	–119

OUTLINE DIMENSIONS

PLASTIC PACKAGE
SOT–343R



SYMBOL	MILLIMETERS			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A1	0.00	–	0.10	
A2	0.80	0.90	1.00	
B1	0.55	–	0.70	
B2	0.25	–	0.40	
c	0.10	–	0.25	
D	2.00 BSC			3,4
E	2.10 BSC			
E1	1.25 BSC			3,4
e1	1.30 BSC			
e2	0.65 BSC			
e3	1.15 BSC			
e4	0.50 BSC			
L	0.25	–	–	
L1	0.15 BSC			

SYMBOL	TOLERANCES OF FORM AND POSITION	NOTE
aaa	0.15	
bbb	0.20	
ccc	0.10	
ddd	0.10	

NOTE:

1. DIMENSIONS IN MILLIMETERS.

3 DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15mm PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15mm PER SIDE.

4 DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

5 DATUMS A, B AND D TO BE DETERMINED 0.10mm FROM THE LEAD TIP.

6 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

7 THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08mm AND 0.15mm FROM THE LEAD TIP.

How to reach us:
USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 1–303–675–2140 or 1–800–441–2447

Technical Information Center: 1–800–521–6274

JAPAN: Motorola Japan Ltd.; SPS, Technical Information Center, 3–20–1, Minami–Azabu. Minato–ku, Tokyo 106–8573 Japan. 81–3–3440–3569

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2, Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852–26668334

HOME PAGE: http://www.motorola.com/semiconductors/

MOTOROLA