Preliminary

SiGe High Dynamic Range Low Noise Transistor

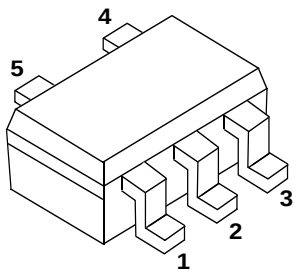
Features

- Low Noise Figure: NFmin ≈ 1.1dB @ 2.0GHz
- Input IIP3 Capability: ≈ + 10dBm @ 2.0GHz, V_{CC} = 3V, I_C=5mA
- Low Operating Voltage
- Package: SOT353

Description

The IBM43RF0100 is a Silicon-Germanium (SiGe) NPN transistor designed for high performance, low cost applications. Utilizing IBM's SiGe process and packaging technologies, high gain, low noise and exceptional linearity at low power consumption are possible. Assembled in a miniature surface mount package, this product is designed for applications requiring high performance such as LNAs, VCOs, and other low noise transistor applications.

Pin Diagram



Pin Assignments

Pin 1	Base
Pin 2	Ground[1]
Pin 3	Emitter
Pin 4	Collector
Pin 5	Emitter

1. Connection requires a low resistance path to signal ground.

Ordering Information

Part Number	Description
IBM43RF0100	Supplied in Tape and Reel packaging
IBM43RF0100EV19	1900MHz evaluation board for IBM43RF0100
IBM43RF0100EV09	900MHz evaluation board for IBM43RF0100

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit	Notes
V_{CBO}	Collector to Base Voltage	7	V	1
V_{CEO}	Collector to Emitter Voltage	4.5	V	1
V_{EBO}	Emitter to Base Voltage	2.0	V	1
I_C	Collector Current	75	mA	1
T_J	Operating Junction Temperature	150	°C	1
T_{STG}	Storage Temperature	-65 to +150	°C	1

1. Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

DC Electrical Characteristics (T_A = +25°C)

Symbol	Parameter	Min.	Typ.	Max.	Units	Notes
β	Beta	45	100	125		1
V_A	Early Voltage	30	65		V	
V_{BE}	Base Emitter Voltage I_{CC}=10µA	755	770	785	mV	
BV_{CEO}	Collector Emitter Breakdown Voltage Base open.	3	3.3		V	2
BV_{CES}	Collector Emitter Breakdown Voltage Base shorted.	7	10.5		V	
BV_{EBO}	Emitter Base Breakdown Voltage	3.2	4.0		V	2
BV_{CBO}	Collector Base Breakdown Voltage	7	10.5		V	2
BV_{SO}	Collector Substrate Breakdown Voltage	30	45.0		V	2

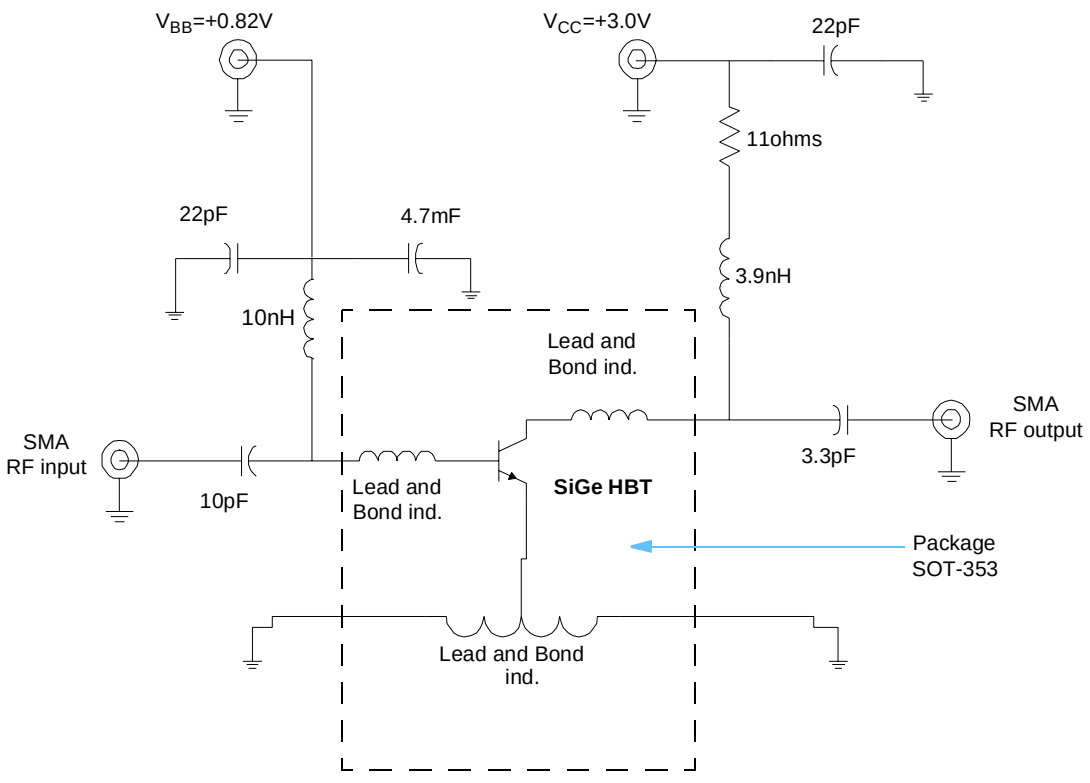
1. V_{CE}=2.5V, I_C= 5mA
2. I_R=10µA

AC Characteristics (V_{CC} = 3V, T_A = +25°C)

Symbol	Parameter		Min.	Typ.	Max.	Units	Notes
F_T	Gain Bandwidth Product		41	47.0	53	GHz	1
$\|S_{21}\|^2$	Small Signal Insertion Power Gain	900 MHz		17.5		dB	2
		1900 MHz		12.5			
NF	Noise Figure	900 MHz		0.9			2
		1900 MHz		1.1			
IIP3	Input Third Order Intercept			10	13	dBm	2

1. V_{CB}=1.0V, I_C=Ipeak
2. I_{CE}=7.5mA, V_{CE}=3V
3. Class AB bias, base voltage constant

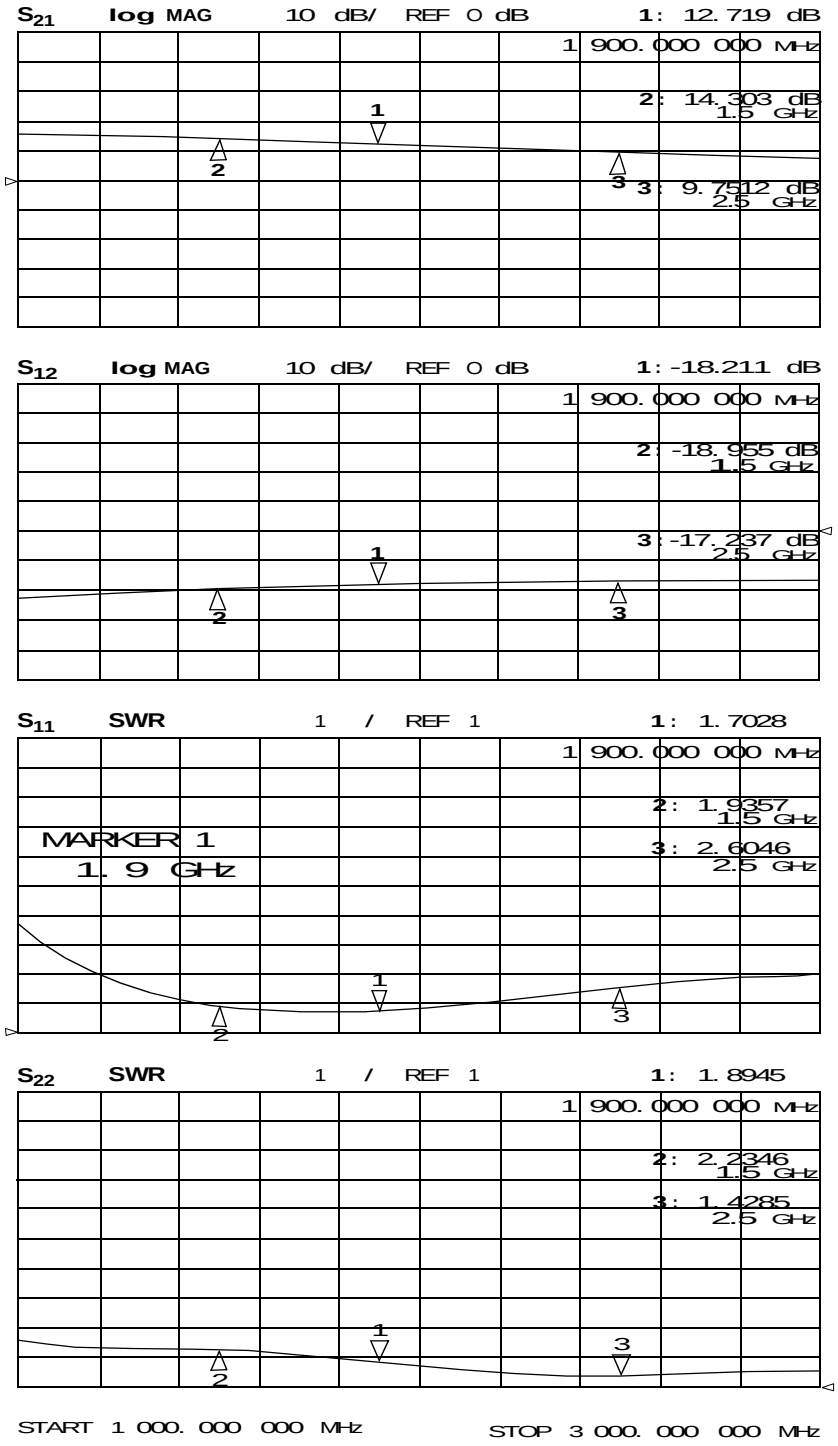
Prototype Test Circuit



Note: All discrete components SMT

Typical Performance Curves

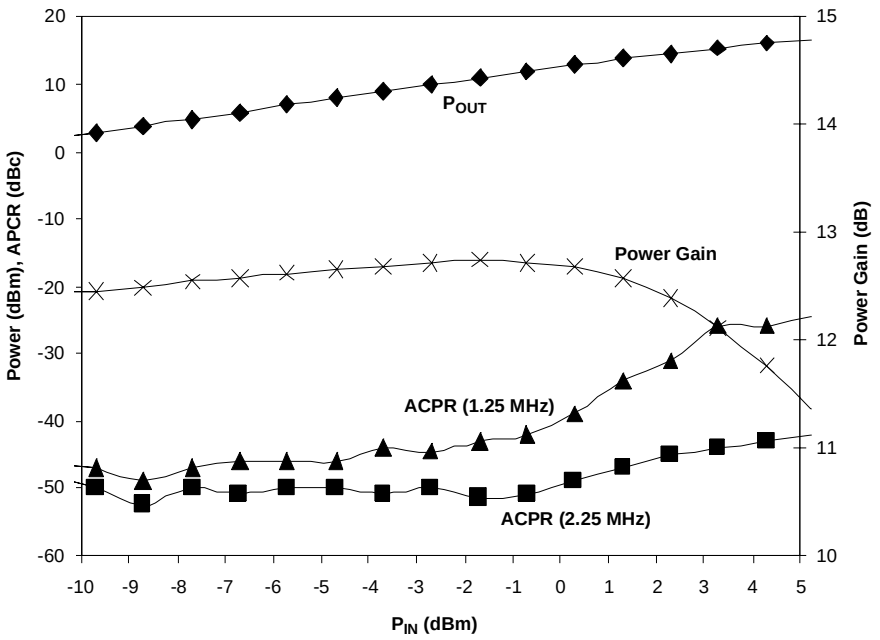
Measured RF Performance (See Prototype Test Circuit on page 3.)



Measured Performance for Prototype CDMA High Input IIP3 Low Noise and Driver Amplifier Test Circuits (See Prototype Test Circuit on page 3. T_A = +25°C, Freq.=1900MHz, I_{CQ}≈5.4mA, V_{BE}≈+0.823V)

Symbol	Parameter	V_{CC}=3.0V	V_{CC}=2.0V	V_{CC}=1.0V	Units
$\|S_{21}\|^2$	Small Signal Insertion Power Gain	12.4	12.0	11.0	dB
NF	Noise Figure	1.2	1.2	1.3	dB
I/O SWR	Input/Output SWR	2:1	2:1	2:1	
Ip1dB	Input Power for 1dB Output Power Compression	+3	+1	-2	dBm
IIP3	Input Third Order Intercept	+13	+10	+7	dB

CDMA Driver Amplifier Performance (See Prototype Test Circuit on page 3. T_A = +25°C, Freq.=1900MHz, I_{CQ}≈5.4mA, V_{BE}≈+0.823V)



Measured Performance of SiGe Prototype Driver Amplifier (See Prototype Test Circuit on page 3. T_A = +25°C, Freq.=1900MHz, I_{CQ}≈5.4mA, V_{BE}≈+0.823V)

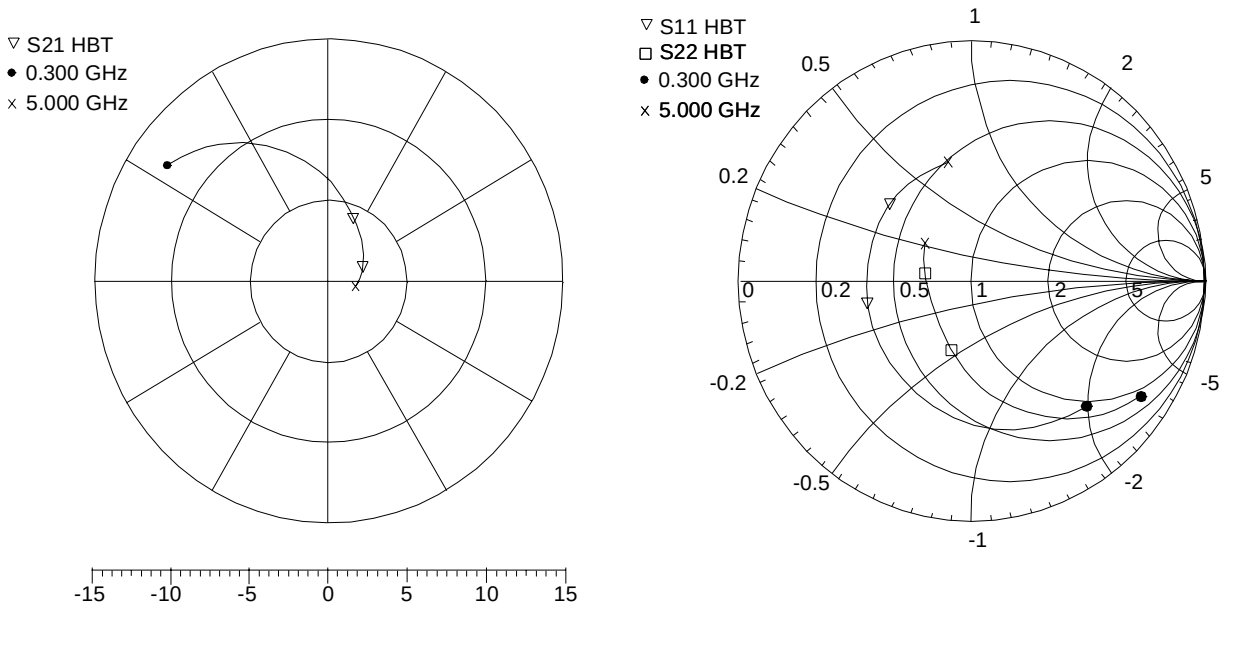
V_{CC} (V)	P_{OUT} (dBm)	P_{IN} (dBm)	G (dB)	ACPR1	ACPR2	I_{CQ} (mA)	I_{CC} @ P_{OUT} (mA)	Notes
2	5.6	-6.7	12.30	-47	-50	5	11.6	1
3	5.97	-6.7	12.67	-47	-52	5	12.2	1
3.7	6.12	-6.7	12.82	-52	-53	5	12	1
4.2	6.22	-6.7	12.92	-48	-52	5	13	1
Measurement System Noise Floor				-48	-52			1

1. The above measured performance was obtained using voltage sources to bias the prototype test circuit.

Typical Scattering Parameters (T_A=25°C, V_{CE}=2.0V, I_{CQ}=5.0mA)

Frequency (GHz)	S11		S21		S12		S22	
	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
0.100	0.805	-19.1	14.445	164.2	0.025	77.3	1.008	-15.2
0.200	0.765	-32.8	13.558	155.0	0.036	70.8	0.943	-24.2
0.300	0.725	-46.5	12.671	145.8	0.047	64.3	0.878	-33.2
0.400	0.685	-60.2	11.784	136.6	0.058	57.8	0.813	-42.2
0.500	0.650	-72.7	10.919	128.3	0.067	52.4	0.747	-50.0
1.000	0.522	-119.2	7.309	98.9	0.093	36.8	0.503	-77.4
1.500	0.472	-150.1	5.294	79.5	0.109	30.0	0.368	-95.2
2.000	0.457	-173.3	4.108	64.1	0.123	25.4	0.287	-109.7
2.500	0.461	167.7	3.369	50.5	0.139	21.2	0.233	-125.3
3.000	0.465	151.4	2.842	37.7	0.156	16.0	0.204	-141.0
3.500	0.477	137.4	2.451	25.7	0.176	10.9	0.169	-164.0
4.000	0.488	124.5	2.164	14.3	0.190	3.8	0.198	179.7
4.500	0.499	112.6	1.929	3.0	0.209	-2.8	0.215	157.8
5.000	0.507	101.2	1.740	-8.1	0.229	-9.3	0.259	141.3

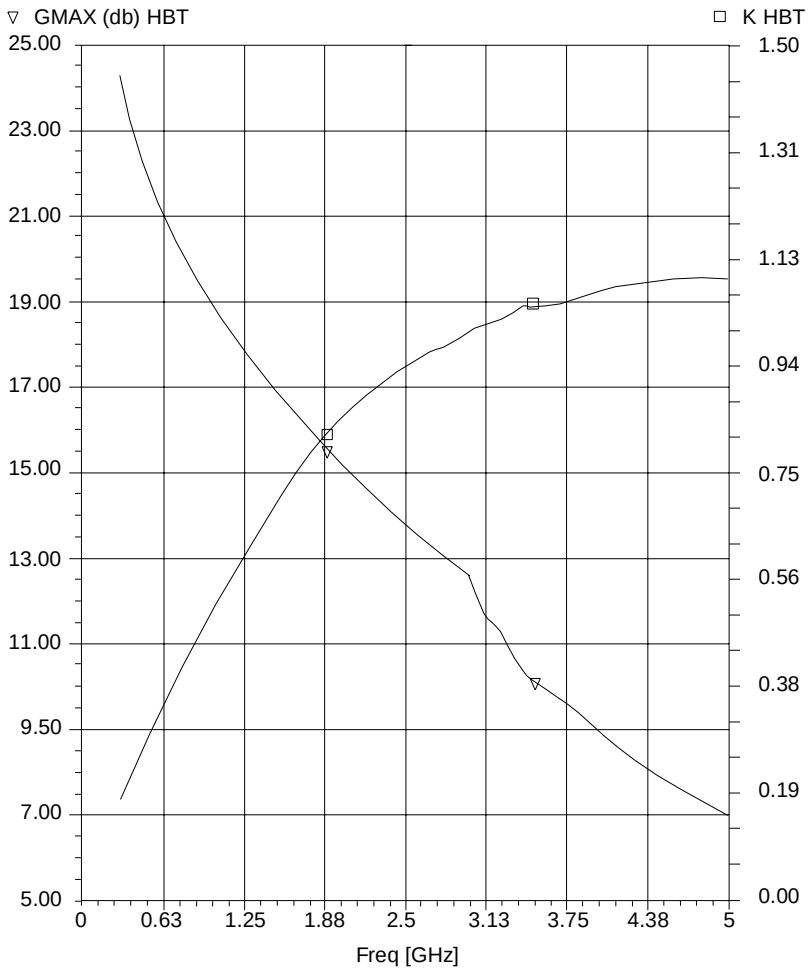
Polar Plot of S21 and Smith Chart of S11 & S22 (T_A=25°C, V_{CE}=2.0V, I_{CQ}=5.0mA)



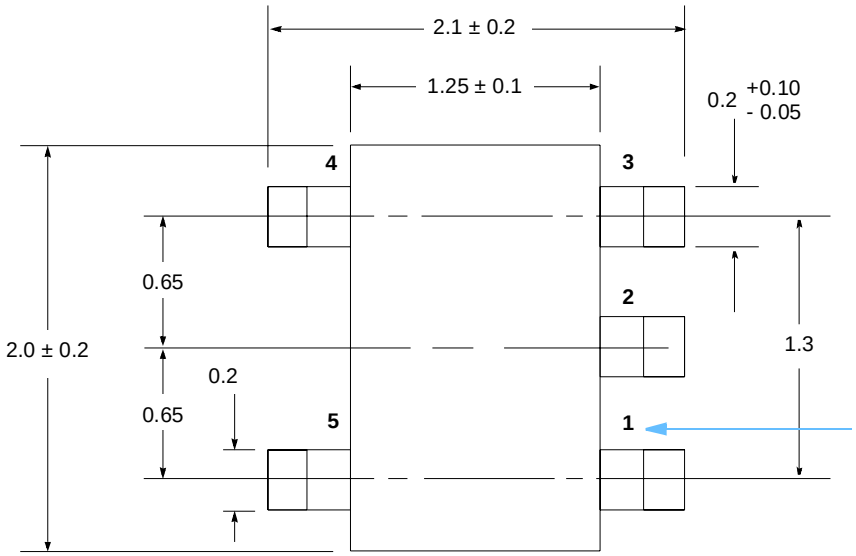
Typical Noise Parameters (T_A=25°C, V_{CE}=2.0V, I_{CQ}=5.0mA)

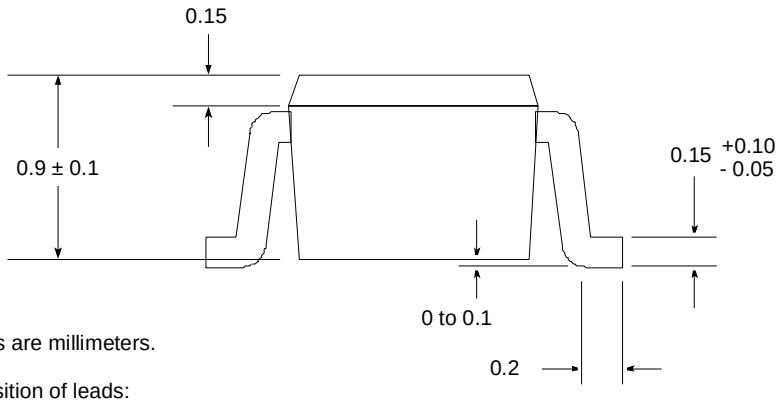
Frequency (GHz)	NFmin (dB)	Gamma (mag)	Gamma (ang)	R_N (normalized to 50 ohms)	NF 50 Ohms (dB)	Associated Gain (dB)
0.5	0.8	0.35	32	0.18	0.9	25.5
0.8	0.9	0.34	43	0.16	1.0	21
1.0	0.9	0.32	50	0.16	1.0	19
1.8	1.1	0.30	93	0.12	1.2	14
2.0	1.1	0.28	101	0.12	1.2	13
2.5	1.3	0.23	127	0.11	1.4	11
3.0	1.4	0.28	157	0.09	1.5	10
4.0	1.6	0.32	-160	0.09	1.7	8

Gmax dB (2V/5.0mA) and K (stability factor)



Package Diagram: SOT 353

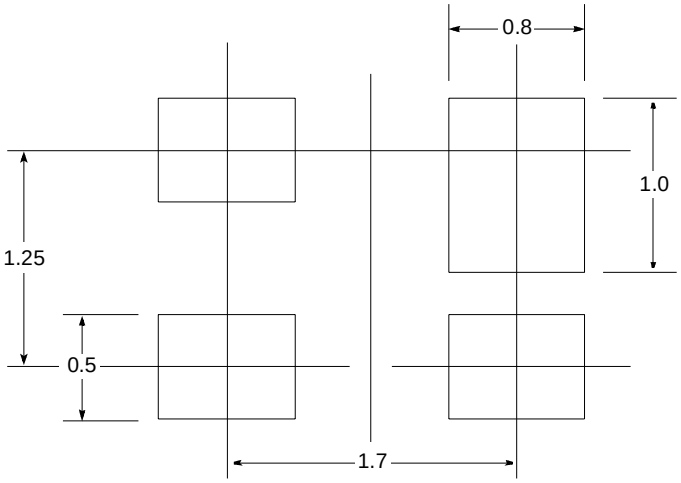




All dimensions are millimeters.

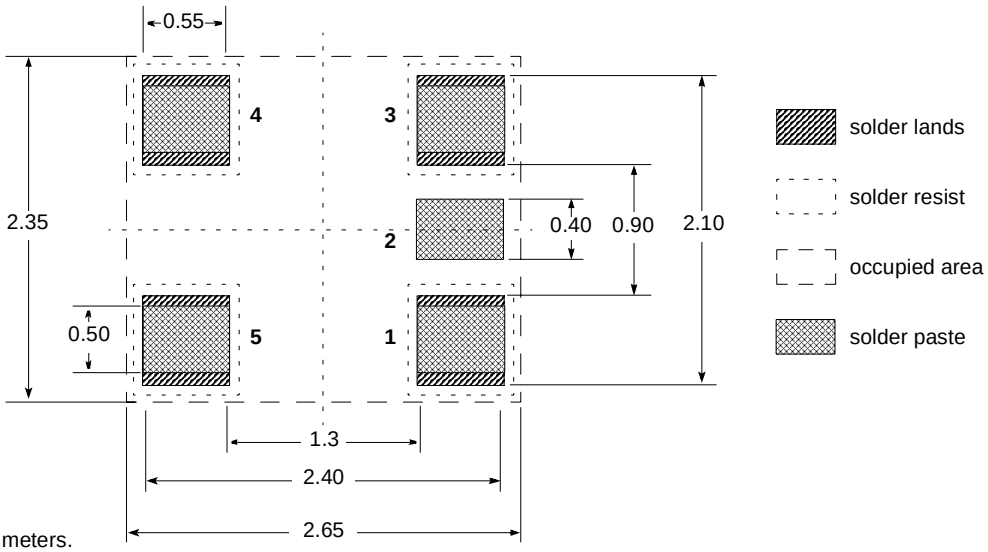
Note: Composition of leads:
Core is alloy 42 or Cu Alloy CAC-92,
clad with 4-25µm Sn/Pb 85/15.

Recommended PCB Layout



All dimensions are millimeters.

Recommended Reflow Soldering Footprint - All Leads Separated



All dimensions are millimeters.

Revision Log

Rev	Contents of Modification
7/98	Initial release.
8/98	First revision. Refined layout without changing content.
9/98	Second revision. Added Recommended Reflow Soldering Footprint.
11/98	Third revision. Revised scattering and noise parameter data.
04/99	Fourth revision (04). Changed part number IBMSGRF0100 to IBM43RF0100. Distinguished between two evaluation boards in Ordering Information table. Revised low noise figure in Features list.
05/03/99	Fifth revision (05). Corrected V_{CC} value in Features list. Distinguished between 900MHz and 1900MHz frequencies for two parameters in AC Characteristics on page 3. Added Associated Gain column to Typical Noise Parameters on page 8. Added Composition of leads note to Package Diagram: SOT 353 on page 9.

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