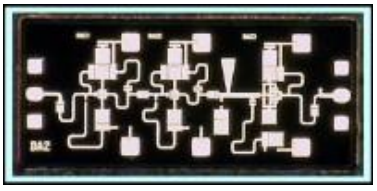
FMM5716X

60GHz Low Noise Amplifier

FEATURES

- Low Noise Figure : NF = 5 dB (Typ.) @ f = 60 GHz
- High Associated Gain: $|S_{21}|$ = 22 dB(Typ) @ f = 60 GHz
- Wide Frequency Band : 57 to 64 GHz
- Impedance Matched Zin/Zout = 50ohm



DESCRIPTION

The FMM5716X is a low noise amplifier MMIC designed for applications in the 57 to 64 GHz frequency range. This product is well suited for wireless LAN and point-to-point radio.
Sumitomo Electric's stringent Quality Assurance Program assures the highest reliability and consistent performance.

ABSOLUTE MAXIMUM RATING (Case Temperature Tc=25deg.C)

Item	Symbol	Rating	Unit
DC Input Voltage	V_{DD}	4	V
DC Input Voltage	V_{GG}	-3	V
Input Power	P_{in}	3	dBm
Storage Temperature	T_{stg}	-55 to +125	deg.C

RECOMMENDED OPERATING CONDITION (Case Temperature Tc=25deg.C)

Item	Symbol	Condition	Unit
DC Input Voltage	V_{DD}	3	V
Backside Temperature	T_B	-45 to +85	deg.C

ELECTRICAL CHARACTERISTICS (Case Temperature Tc=25deg.C)

Item	Symbol	Condition	Limit			Unit
			Min.	Typ.	Max.	
Noise Figure	NF	V_{DD}=3V I_{DD}=30mA f=57 to 64GHz	-	5	7	dB
Linear Gain	$\|S_{21}\|$		16	22	-	dB
Output Power at 1dB G.C.P.	P1dB		-	10	-	dBm
Gate Voltage	V_{GG}		-0.3	-0.1	0	V
Input Return Loss	$\|S_{11}\|$		-	-10	-	dB
Output Return Loss	$\|S_{22}\|$		-	-10	-	dB

These values are representative for CW on chip measurements that are made without bonding wires at the RF ports.

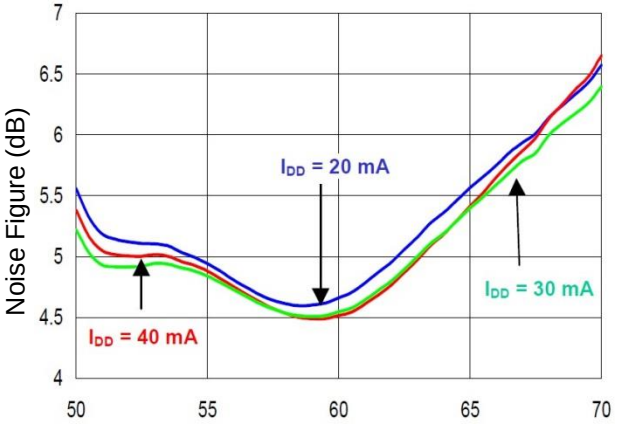
ESD	Class 0A	Up to 125V

Note : Based on ANSI/ESDA/JEDEC JS-001-2012 (C=100 pF, R=1500 ohm)

RoHS Compliance	Yes

Noise Figure vs. Frequency

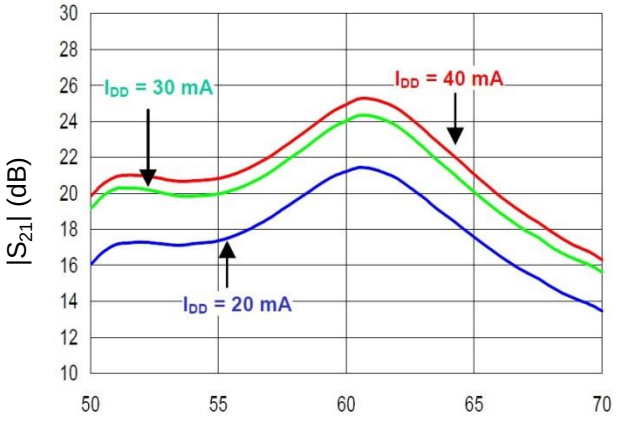
Bias Conditions: V_{DD} = 3V



Frequency (GHz)

Linear Gain vs. Frequency

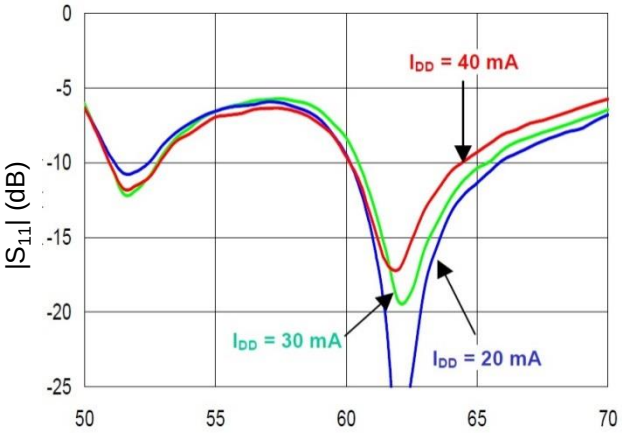
Bias Conditions: V_{DD} = 3V



Frequency (GHz)

Input Return Loss vs. Frequency

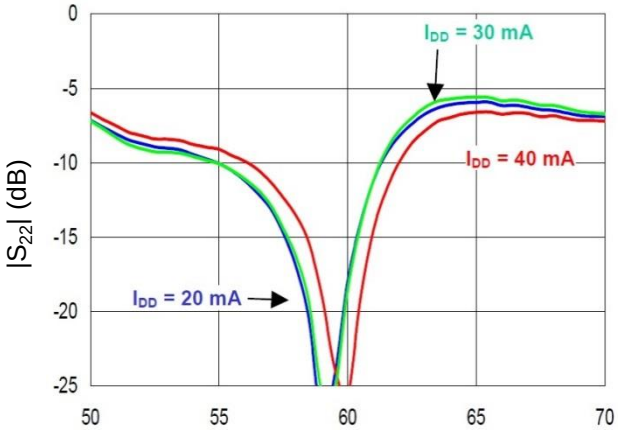
Bias Conditions: V_{DD} = 3V



Frequency (GHz)

Output Return Loss vs. Frequency

Bias Conditions: V_{DD} = 3V

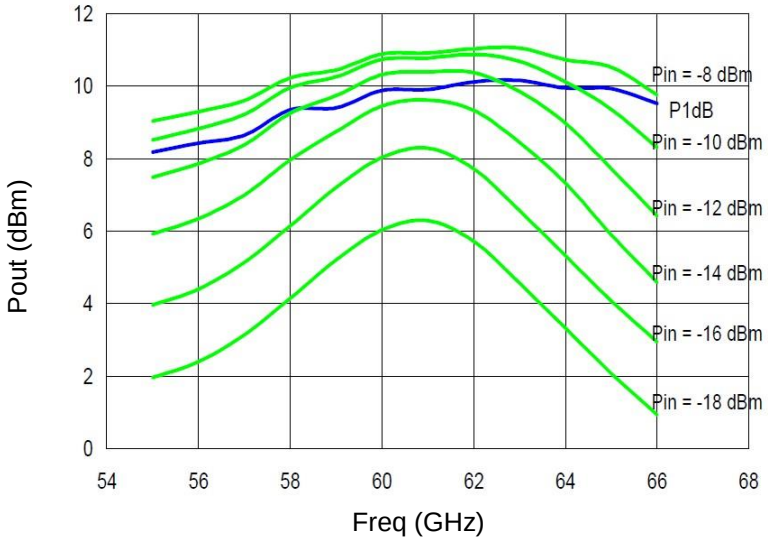


Frequency (GHz)

Typical on chip measurements

Output Power vs. Frequency

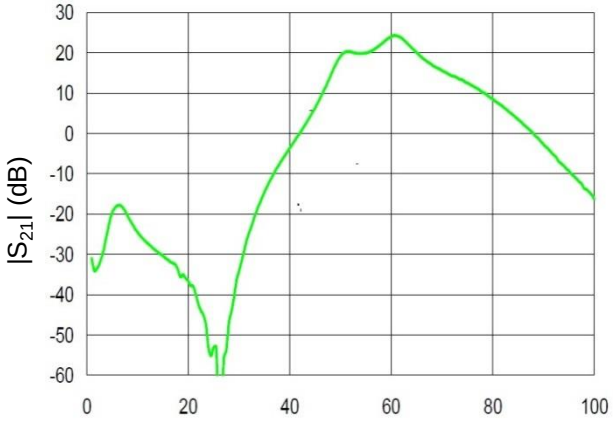
Bias Conditions: V_{DD} = 3V, I_{DD} = 30 mA



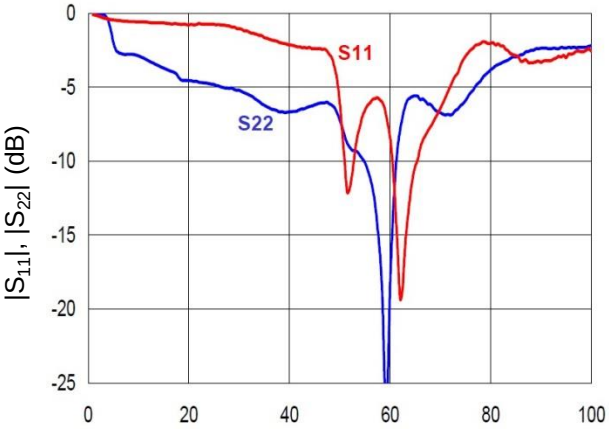
Typical on chip measurements

S-PARAMETERS

Bias Conditions: V_{DD} = 3V, I_{DD} = 30 mA



Frequency (GHz)



Frequency (GHz)

Typical on chip measurements

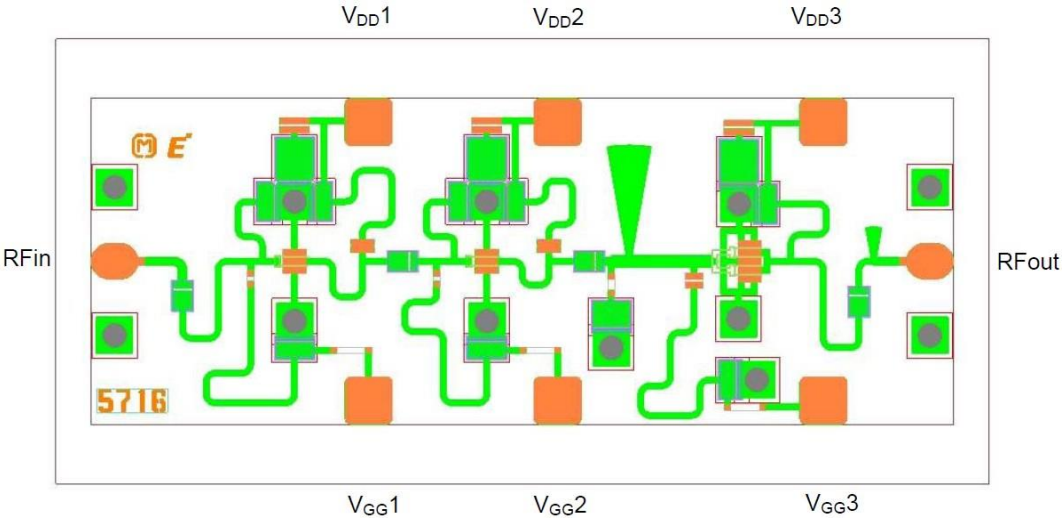
S-PARAMETERS

Bias Conditions: V_{DD} = 3V, I_{DD} = 30 mA

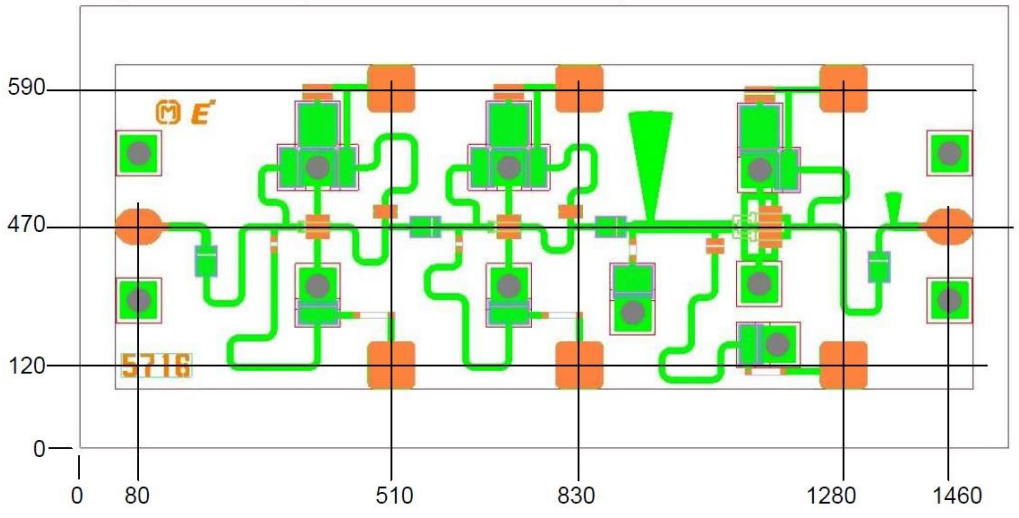
Freq	S11		S21		S12		S22	
[GHz]	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1	0.988	-10.3	0.028	-137.9	0.000	3.9	0.995	-12.7
2	0.977	-20.2	0.021	166.3	0.000	112.6	0.996	-25.9
3	0.963	-29.5	0.030	127.2	0.000	72.2	0.987	-39.9
4	0.954	-38.4	0.057	73.0	0.000	24.2	0.941	-55.8
5	0.948	-47.2	0.103	-3.1	0.001	-30.7	0.796	-68.2
6	0.944	-55.9	0.126	-75.1	0.001	-85.6	0.736	-72.4
7	0.940	-64.5	0.123	-135.3	0.000	-124.9	0.726	-78.9
8	0.937	-72.9	0.098	179.2	0.000	-146.4	0.726	-86.5
9	0.936	-81.3	0.075	149.7	0.000	-120.2	0.725	-95.1
10	0.935	-89.5	0.060	128.4	0.000	-165.8	0.717	-103.9
11	0.933	-97.7	0.050	112.0	0.000	-171.9	0.704	-112.5
12	0.929	-105.7	0.043	97.9	0.000	-171.5	0.690	-120.7
13	0.925	-113.4	0.038	84.8	0.000	-29.8	0.676	-128.6
14	0.926	-121.1	0.034	73.1	0.000	-89.8	0.664	-136.3
15	0.926	-128.7	0.031	62.5	0.000	-135.7	0.652	-143.9
16	0.920	-136.4	0.027	51.5	0.001	-134.8	0.641	-151.5
17	0.919	-143.7	0.025	41.0	0.001	-173.6	0.631	-159.3
18	0.918	-151.1	0.020	21.9	0.001	165.0	0.606	-167.6
19	0.916	-158.7	0.018	25.5	0.002	158.8	0.592	-173.1
20	0.911	-166.0	0.015	9.0	0.001	122.2	0.592	179.7
21	0.912	-173.4	0.013	1.8	0.001	125.1	0.588	171.8
22	0.922	179.1	0.008	-11.6	0.001	156.0	0.584	163.6
23	0.916	171.4	0.006	-7.7	0.001	129.0	0.581	155.5
24	0.916	164.1	0.002	-17.2	0.001	133.2	0.577	146.8
25	0.916	156.1	0.002	31.6	0.002	102.1	0.574	137.8
26	0.914	148.1	0.001	85.7	0.002	74.5	0.566	128.1
27	0.910	140.0	0.002	-134.1	0.001	9.0	0.559	118.7
28	0.904	131.9	0.004	-146.1	0.000	136.4	0.557	108.5
29	0.897	123.5	0.009	-138.8	0.001	120.8	0.553	97.4
30	0.886	115.1	0.019	-151.9	0.001	130.0	0.549	86.5
31	0.872	106.7	0.034	-163.4	0.001	116.4	0.539	75.2
32	0.862	98.0	0.058	-176.5	0.002	108.1	0.529	63.4
33	0.852	89.8	0.089	170.0	0.002	116.7	0.516	51.8
34	0.841	81.0	0.132	153.8	0.002	78.1	0.502	40.7
35	0.826	72.3	0.185	136.5	0.001	65.9	0.488	30.3
36	0.816	63.8	0.251	120.4	0.001	63.1	0.478	20.4
37	0.806	55.3	0.328	104.2	0.000	-148.2	0.471	11.2
38	0.796	46.9	0.420	87.9	0.001	88.8	0.464	2.4
39	0.789	38.5	0.528	72.2	0.001	106.9	0.462	-5.8
40	0.780	30.0	0.657	57.1	0.001	144.6	0.463	-13.7
41	0.775	21.5	0.819	42.4	0.002	106.9	0.465	-21.2
42	0.769	13.1	1.014	28.5	0.002	109.5	0.471	-28.5
43	0.765	4.7	1.269	14.3	0.002	93.2	0.475	-35.5
44	0.765	-3.8	1.614	0.3	0.002	70.3	0.484	-42.8
45	0.759	-13.0	2.075	-14.3	0.001	40.5	0.489	-50.1
46	0.759	-22.8	2.746	-29.5	0.001	-171.5	0.496	-57.5
47	0.755	-33.6	3.706	-46.9	0.001	157.6	0.497	-65.2
48	0.724	-46.9	5.086	-67.5	0.002	142.3	0.493	-73.9
49	0.653	-63.0	7.004	-92.6	0.003	121.9	0.478	-83.1
50	0.498	-78.4	9.055	-123.2	0.005	94.5	0.436	-92.5
51	0.311	-79.7	10.300	-156.1	0.005	73.7	0.383	-97.3
52	0.257	-51.9	10.297	173.6	0.006	33.6	0.352	-98.0
53	0.337	-41.8	9.951	149.6	0.005	21.3	0.343	-100.0
54	0.412	-47.5	9.812	128.5	0.005	-2.0	0.331	-106.4
55	0.468	-55.2	9.951	110.3	0.007	-12.5	0.313	-112.8
56	0.497	-65.7	10.467	92.1	0.007	-39.5	0.279	-121.9
57	0.514	-78.3	11.400	73.7	0.008	-59.3	0.229	-134.0
58	0.509	-92.8	12.799	53.5	0.009	-77.8	0.152	-149.2
59	0.472	-110.7	14.461	30.9	0.011	-92.0	0.054	160.6
60	0.382	-136.2	15.904	4.2	0.013	-125.1	0.117	32.7
61	0.233	-174.4	16.381	-25.9	0.016	-144.6	0.275	1.3
62	0.108	115.7	15.339	-54.7	0.016	-170.5	0.404	-23.1
63	0.163	32.1	13.432	-81.4	0.016	165.6	0.484	-41.1
64	0.242	4.0	11.636	-103.5	0.017	143.2	0.517	-56.2
65	0.303	-11.1	10.083	-122.6	0.014	130.1	0.526	-66.2
66	0.350	-21.4	8.836	-140.5	0.014	118.8	0.510	-73.9
67	0.384	-27.9	7.878	-157.6	0.014	106.2	0.505	-80.1
68	0.412	-34.0	7.102	-173.5	0.013	97.7	0.492	-84.0
69	0.442	-37.3	6.532	170.8	0.013	94.7	0.470	-86.8
70	0.476	-40.6	6.036	155.2	0.013	74.0	0.461	-88.3
71	0.517	-43.2	5.601	138.7	0.011	66.5	0.452	-88.1
72	0.565	-46.9	5.192	123.5	0.010	55.5	0.452	-87.9
73	0.613	-50.6	4.924	107.1	0.010	48.8	0.469	-87.8
74	0.665	-55.6	4.639	90.4	0.010	37.9	0.487	-86.9
75	0.715	-61.3	4.227	74.7	0.009	28.7	0.506	-87.5
76	0.750	-66.8	3.898	58.6	0.007	33.7	0.537	-88.9
77	0.778	-73.5	3.608	42.1	0.006	26.2	0.567	-90.4
78	0.789	-78.8	3.245	26.5	0.005	17.6	0.589	-92.4
79	0.796	-84.5	2.961	10.1	0.004	25.0	0.620	-95.3
80	0.791	-89.0	2.671	-5.0	0.004	22.0	0.643	-98.0
81	0.779	-94.4	2.389	-20.7	0.004	42.0	0.664	-100.8
82	0.773	-98.0	2.147	-36.0	0.004	45.8	0.675	-104.0
83	0.754	-101.9	1.925	-51.3	0.004	48.5	0.688	-107.1
84	0.729	-104.4	1.690	-66.1	0.002	30.4	0.703	-109.5
85	0.718	-107.5	1.501	-80.4	0.003	72.2	0.710	-111.8
86	0.687	-109.3	1.305	-94.9	0.004	66.8	0.723	-114.2
87	0.697	-110.5	1.149	-108.4	0.002	85.3	0.740	-116.6
88	0.679	-110.8	0.996	-122.7	0.006	57.9	0.747	-119.3
89	0.685	-111.8	0.870	-136.7	0.003	108.5	0.758	-122.0
90	0.681	-113.8	0.730	-150.4	0.005	80.7	0.760	-125.0
91	0.691	-113.9	0.639	-161.1	0.009	93.4	0.761	-127.0
92	0.692	-115.6	0.544	-172.6	0.011	85.2	0.758	-129.6
93	0.704	-116.6	0.451	175.7	0.014	64.9	0.758	-131.6
94	0.710	-118.9	0.397	164.9	0.015	67.0	0.766	-133.4
95	0.706	-120.0	0.346	152.3	0.012	54.8	0.762	-135.8
96	0.726	-121.9	0.297	142.3	0.013	27.8	0.763	-137.5
97	0.742	-124.0	0.253	132.2	0.014	28.6	0.764	-140.1
98	0.740	-126.1	0.209	123.5	0.008	32.2	0.765	-141.2
99	0.749	-126.5	0.188	115.2	0.011	24.5	0.766	-142.5
100	0.743	-129.0	0.153	99.9	0.016	21.8	0.776	-144.7

Typical on chip measurements

CHIP OUTLINE

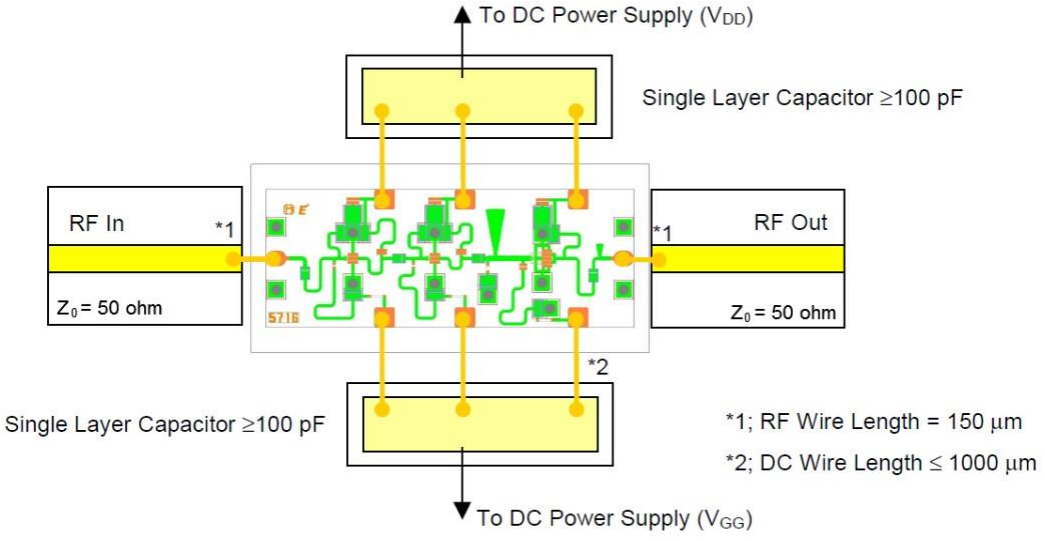


Bonding Pad Locations (Dimension in Micron Meters)

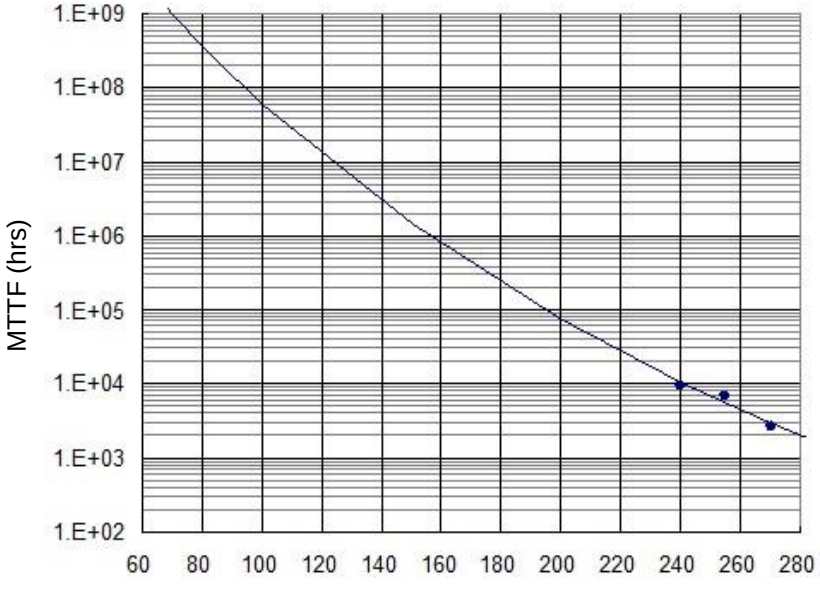


Pad Dimensions	Unit; um
DC Pads; 80 x 80 um	Chip size; 1540 x 710 um
RF Pads; 80 x 60 um	Chip Thickness; 70 um

Assembly Diagram

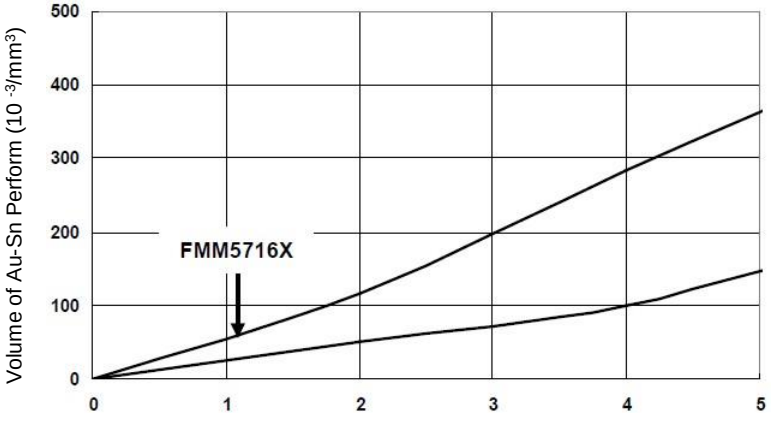


MTTF vs. Backside Temperature



■DIE ATTACH

1) The die-attach station must have accurate temperature control, and an inert forming gas should be used.
2) Chips should be kept at room temperature except during die-attach.
3) Place package or carrier on the heated stage.
4) Lightly grasp the chip edges by the longer side using tweezers.
   Die attach conditions
   Stage Temperature : 300 to 310 deg.C
   Time : less than 15 seconds
   AuSn Perform Volume : per next Figure



■ WIRE BONDING

The bonding equipment must be properly grounded. The following or equivalent equipment, tools, materials, and conditions are recommended.

1) Bonding Equipment and Bonding Tool.
   Bonding Equipment : West Bond Model 7400 (Manual Bonder)
   Bonding Tool : CCOD-1/16-S-437-60-F-2010-MP (Deweyl)
2) Bonding Wire
   Material : Hard or Half hard gold
   Diameter : 0.7 to 1.0 mil
3) Bonding Conditions
   Method : Thermal Compression Bonding with Ultrasonic Power
   Tool Force : 0.196 N +/- 0.0196 N
   Stage Temperature : 215 deg.C +/- 5 deg.C
   Tool Heater : None
   Ultrasonic Power Transmitter : West Bond Model 1400
   Duration : 150 mS/Bond

■ **BARE DIE INDEMNIFICATION**

All devices are DC probed and visually inspected at SEI, and non-compliant devices are removed. The RF electrical characteristics of the bare dice are warranted by the sampling inspection procedures. The standard sampling inspection procedure shall include the number of the sampling dice, position of the sampling dice in the wafer and RF electrical characteristics of the sampling dice measured in the test fixture. Customer shall understand that all the bare dice will not be 100% RF tested by SEI. It is the customer responsibility to verify performance of the devices.

Customer shall comply with the storage and handling requirements for condition and period of storage of the bare dice agreed by customer and SEI. Warranty will not apply when customer disregards the storage and handling requirements.

Warranty will not apply to the electrical characteristics and product quality to the bare dice after assembly by customer.

SEI will indemnify customer for warranty failures, provided however that the indemnification to customer shall be limited to supply of bare dice for substitution.

CAUTION

Sumitomo Electric Device Innovations, Inc. products contain **gallium arsenide (GaAs)** which can be hazardous to the human body and the environment. For safety, observe the following procedures:

・Do not put these products into the mouth.

・Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.

・Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.