

FMM5125X

15/60GHz Frequency Multiplier MMIC

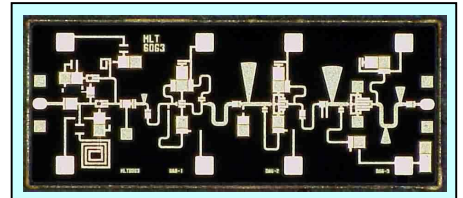
FEATURES

- Input/Output Frequency : 15 / 60 GHz
- Wide Frequency Band : 57 - 64 GHz
- Conversion Loss : $L_c = 5\text{dB}$ (Typ.) @ $f_{out} = 60\text{ GHz}$, $P_{in} = 10\text{ dBm}$
- High Output Power : $P_o = 5\text{dBm}$ (Typ.) @ $f_{out} = 60\text{ GHz}$, $P_{in} = 10\text{ dBm}$
- Impedance Matched $Z_{in}/Z_{out} = 50\Omega$

DESCRIPTION

The FMM5125X is a by 4 frequency multiplier MMIC designed for applications in the 57-64 GHz frequency range. This product is well suited for wireless LAN and point-to-point radio.

Eudyna's stringent Quality Assurance Program assures the highest reliability and consistent performance.



ABSOLUTE MAXIMUM RATING (Case Temperature $T_c=25^\circ\text{C}$)

Item	Symbol	Rating	Unit
DC Input Voltage	VDD	+4	V
DC Input Voltage	VGG	-3	V
Input Power	P_{in}	15	dBm
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITION (Case Temperature $T_c=25^\circ\text{C}$)

Item	Symbol	Condition	Unit
DC Input Voltage	VDD	3	V
Backside Temperature	T_b	-45 to + 85	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS (Case Temperature $T_c=25^\circ\text{C}$)

Item	Symbol	Condition	Limit			Unit
			Min.	Typ.	Max.	
Output Power	P_{out}	$V_{DD}=3\text{V}$ $V_{GG}=0\text{V}$ $P_{in}=10\text{ dBm}$	-5	5	-	dBm
Total Drain Current	I_{DDt}	$f = 14.25\sim 16\text{ GHz}$	-	100	-	mA
Input Return Loss	RL_{in}	$f = 14.25\sim 16\text{ GHz}$	-	8	-	dB
Output Return Loss	RL_{out}	$f = 57\sim 64\text{ GHz}$	-	12	-	dB

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

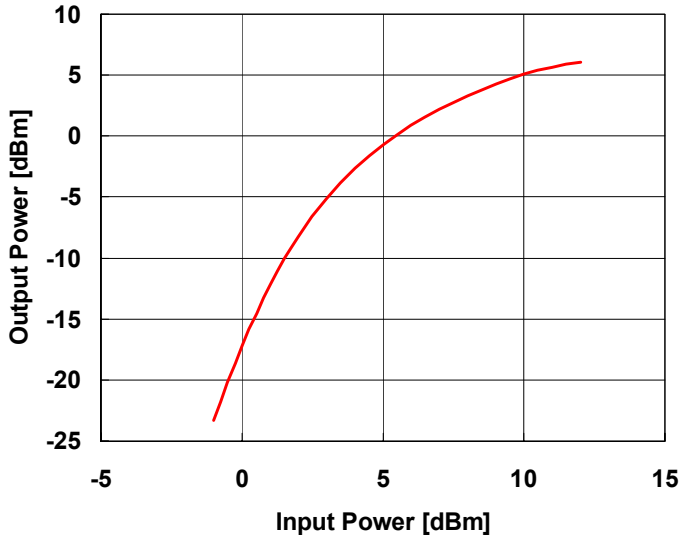
ESD	Class 0	~ 199V
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Note : Based on EIAJ ED-4701 C-111A(C=100pF, R=1.5k Ω)

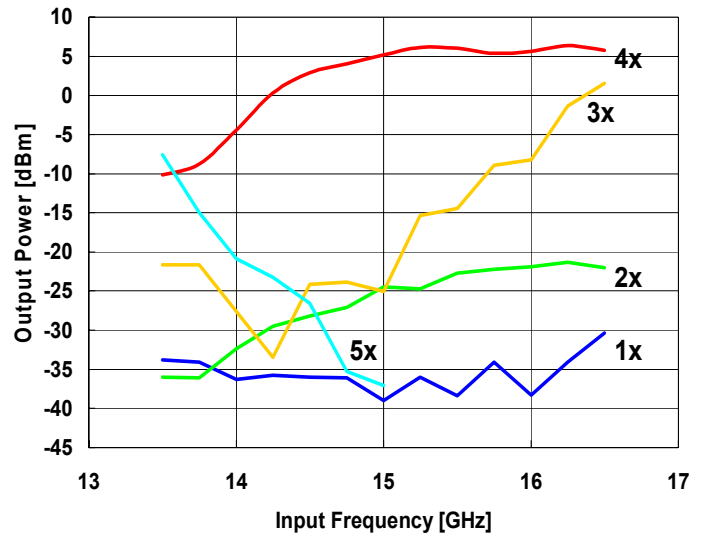
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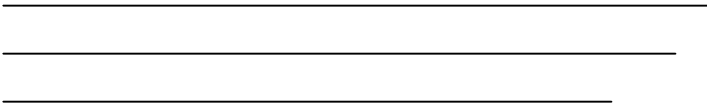
Output Power vs. Input Power
Bias Condition: Vdd = 3V, Idd = 100 mA
fin = 15 GHz



Output Power vs. Frequency
Bias Condition: Vdd = 3V, Idd = 100 mA
Pin = 10 dBm



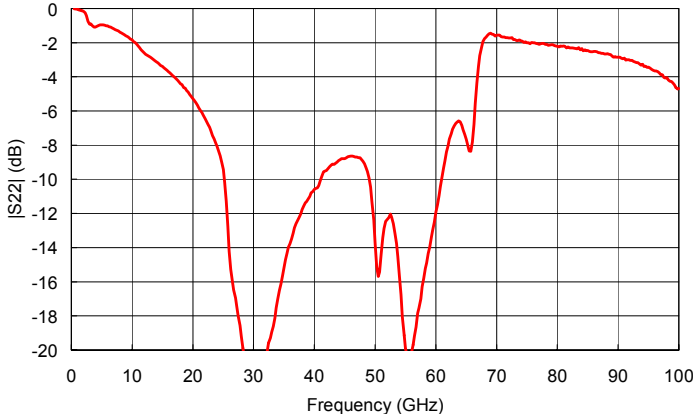
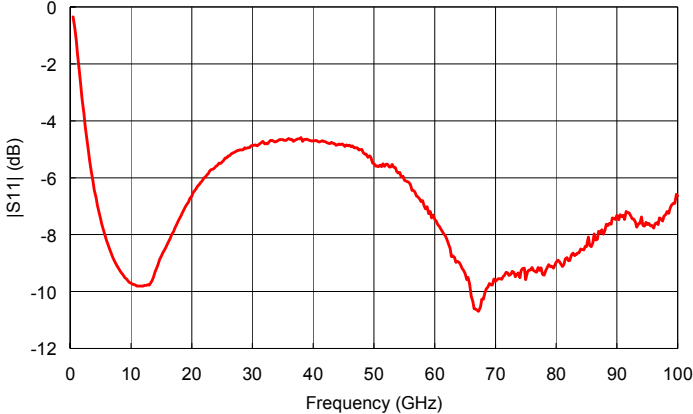
Typical on chip measurements



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S-PARAMETERS
 $V_{DD} = 3V, V_{GG} = 0V, I_{DD} = 100\text{ mA}$



Typical on chip measurements



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15/60GHz Frequency Multiplier MMIC

S-PARAMETERS
Vdd = 3V, Vgg = 0V, Idd = 100 mA

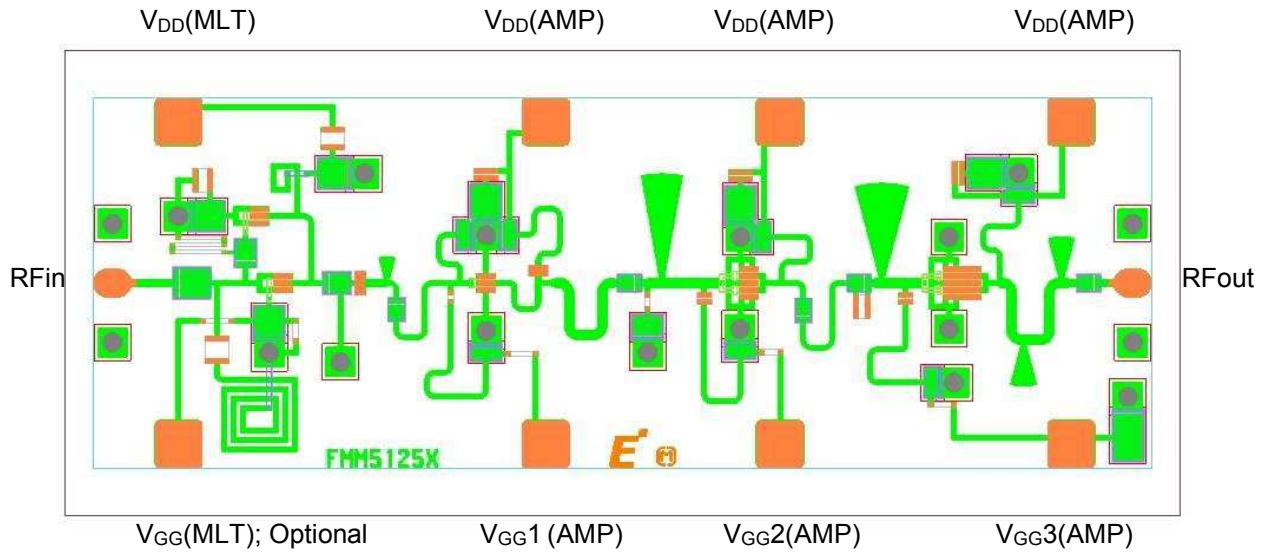
Freq. GHz	S11			S21			S12			S22			Freq. GHz	S11			S21			S12			S22		
	MAG	ANG		MAG	ANG		MAG	ANG		MAG	ANG			MAG	ANG		MAG	ANG		MAG	ANG		MAG	ANG	
1	0.874	-40.2	0.003	85.0	0.0003	107.0	0.995	-12.2		51	0.528	120.6	4.543	-4.8	0.0009	-17.5	0.191	-123.7							
2	0.689	-68.7	0.005	-71.0	0.0007	35.7	0.982	-24.5		52	0.530	117.0	4.181	-45.6	0.0020	-20.6	0.241	-130.1							
3	0.558	-88.1	0.011	55.7	0.0008	-62.7	0.899	-35.3		53	0.529	112.8	4.203	-76.5	0.0020	-25.7	0.235	-143.6							
4	0.477	-101.9	0.006	-115.6	0.0004	-91.0	0.882	-43.0		54	0.511	108.2	4.486	-109.2	0.0003	-19.5	0.165	-153.1							
5	0.425	-112.0	0.002	-164.9	0.0003	-100.2	0.896	-52.3		55	0.496	104.3	4.754	-140.3	0.0011	-140.8	0.101	-133.9							
6	0.389	-119.8	0.001	-176.4	0.0004	-125.0	0.890	-62.5		56	0.487	100.2	5.109	-172.8	0.0017	85.7	0.098	-105.3							
7	0.364	-125.5	0.001	176.9	0.0003	-147.4	0.873	-72.5		57	0.465	96.5	5.270	154.7	0.0019	34.9	0.128	-85.1							
8	0.347	-129.5	0.001	150.1	0.0004	-152.2	0.853	-82.0		58	0.457	92.4	5.457	122.9	0.0023	66.4	0.162	-75.1							
9	0.335	-132.6	0.001	120.1	0.0006	-157.7	0.833	-91.3		59	0.433	89.0	5.609	91.7	0.0027	42.3	0.201	-71.7							
10	0.327	-134.5	0.002	93.8	0.0010	170.6	0.810	-100.5		60	0.423	84.4	5.793	59.5	0.0048	33.0	0.253	-68.3							
11	0.324	-135.7	0.004	46.7	0.0015	124.2	0.779	-109.6		61	0.407	81.3	5.935	25.8	0.0044	23.8	0.320	-68.6							
12	0.323	-136.4	0.007	-18.1	0.0014	60.1	0.741	-117.3		62	0.390	77.1	6.042	-7.2	0.0036	-6.3	0.396	-74.1							
13	0.325	-136.1	0.009	-63.8	0.0013	-9.1	0.720	-124.7		63	0.365	73.1	5.809	-42.6	0.0035	-31.3	0.453	-83.2							
14	0.342	-135.0	0.010	-127.1	0.0004	-59.7	0.699	-132.5		64	0.356	72.3	5.888	-75.8	0.0031	-20.4	0.465	-92.8							
15	0.365	-136.3	0.008	-169.1	0.0001	-50.7	0.676	-140.2		65	0.340	66.9	6.089	-112.6	0.0018	-32.9	0.414	-95.5							
16	0.383	-137.9	0.006	171.6	0.0005	-81.6	0.654	-148.0		66	0.310	64.5	6.186	-160.6	0.0006	-72.2	0.406	-77.4							
17	0.403	-139.6	0.006	153.8	0.0007	-97.3	0.629	-156.1		67	0.293	66.1	4.622	144.4	0.0027	55.5	0.677	-76.4							
18	0.424	-141.9	0.008	140.9	0.0012	-143.2	0.603	-164.4		68	0.307	67.7	2.634	103.0	0.0044	22.5	0.816	-94.1							
19	0.446	-144.3	0.008	111.4	0.0013	165.8	0.576	-173.1		69	0.327	63.1	1.520	74.8	0.0046	22.1	0.847	-106.4							
20	0.465	-147.0	0.008	78.8	0.0008	142.1	0.545	-177.7		70	0.330	58.4	0.956	54.1	0.0043	12.7	0.836	-114.9							
21	0.484	-150.3	0.008	60.0	0.0005	132.6	0.512	-167.6		71	0.332	53.1	0.634	37.2	0.0064	-5.4	0.825	-121.4							
22	0.501	-153.4	0.007	42.1	0.0002	115.1	0.476	-156.6		72	0.341	48.2	0.454	23.1	0.0056	-36.7	0.819	-127.0							
23	0.515	-156.8	0.006	11.7	0.0004	-78.1	0.438	-144.3		73	0.342	42.4	0.348	9.0	0.0050	-16.5	0.810	-132.1							
24	0.525	-159.7	0.004	-0.5	0.0007	-112.1	0.395	-129.4		74	0.334	37.0	0.277	-5.3	0.0058	0.9	0.804	-136.1							
25	0.534	-162.4	0.002	-23.0	0.0019	-164.0	0.337	-107.2		75	0.332	30.8	0.217	-18.1	0.0031	-28.4	0.794	-139.9							
26	0.547	-165.8	0.001	101.2	0.0024	144.1	0.195	86.3		76	0.348	23.8	0.184	-31.1	0.0056	-52.0	0.795	-143.6							
27	0.555	-168.7	0.004	91.9	0.0019	121.6	0.142	84.4		77	0.348	19.1	0.149	-48.1	0.0046	-58.7	0.785	-146.7							
28	0.561	-172.0	0.005	59.6	0.0016	114.9	0.110	69.6		78	0.338	13.2	0.133	-63.5	0.0025	-18.6	0.786	-150.8							
29	0.564	-174.8	0.010	56.2	0.0017	70.4	0.085	51.8		79	0.350	5.7	0.106	-79.4	0.0025	-69.9	0.784	-153.1							
30	0.571	-177.7	0.014	31.8	0.0009	110.1	0.073	30.9		80	0.356	-0.3	0.094	-91.7	0.0041	-66.0	0.775	-156.6							
31	0.572	-179.9	0.016	5.1	0.0005	59.0	0.080	7.8		81	0.350	-6.2	0.080	-102.5	0.0061	-46.0	0.776	-159.6							
32	0.575	-176.5	0.019	-12.3	0.0010	73.4	0.094	-9.4		82	0.358	-13.8	0.064	-124.4	0.0055	-55.7	0.767	-162.8							
33	0.583	-174.1	0.023	-28.2	0.0013	91.6	0.113	-24.5		83	0.366	-21.0	0.062	-136.6	0.0057	-69.6	0.764	-166.4							
34	0.581	-171.6	0.026	-43.4	0.0019	100.2	0.141	-33.2		84	0.376	-27.5	0.054	-149.5	0.0049	-74.6	0.764	-169.7							
35	0.585	-168.3	0.030	-56.1	0.0010	83.5	0.174	-42.2		85	0.379	-35.4	0.041	-172.5	0.0064	-61.5	0.754	-172.8							
36	0.588	-165.8	0.037	-69.6	0.0019	79.1	0.205	-52.7		86	0.385	-42.5	0.027	-177.1	0.0040	-79.0	0.749	-175.5							
37	0.583	-163.1	0.042	-84.2	0.0017	99.0	0.235	-61.5		87	0.403	-51.5	0.020	-150.8	0.0062	-69.7	0.743	-179.0							
38	0.590	-159.7	0.052	-100.7	0.0012	87.2	0.258	-69.3		88	0.405	-57.8	0.015	-152.4	0.0060	-95.9	0.736	-178.1							
39	0.586	-157.4	0.058	-105.8	0.0020	74.4	0.277	-76.4		89	0.415	-68.2	0.012	-150.3	0.0063	-98.4	0.725	-174.5							
40	0.582	-154.3	0.071	-121.8	0.0023	42.6	0.295	-83.0		90	0.430	-78.3	0.014	-162.0	0.0066	-120.6	0.720	-171.4							
41	0.579	-151.3	0.091	-130.3	0.0023	48.0	0.314	-86.2		91	0.430	-88.3	0.005	-135.0	0.0064	-134.0	0.716	-168.1							
42	0.580	-148.5	0.115	-142.9	0.0019	19.1	0.336	-94.2		92	0.435	-97.7	0.005	-110.8	0.0024	-152.3	0.705	-163.7							
43	0.578	-145.6	0.152	-155.1	0.0018	54.7	0.350	-100.6		93	0.419	-108.5	0.008	-141.6	0.0061	-151.9	0.694	-160.4							
44	0.573	-142.7	0.210	-167.3	0.0016	31.8	0.359	-106.0		94	0.428	-118.2	0.006	-173.6	0.0037	-137.3	0.687	-156.3							
45	0.572	-139.3	0.292	-179.9	0.0010	30.8	0.363	-112.4		95	0.415	-131.3	0.008	-147.2	0.0027	-167.1	0.675	-152.1							
46	0.572	-136.4	0.435	-166.3	0.0016	45.9	0.370	-118.9		96	0.409	-142.4	0.012	-141.5	0.0038	-175.0	0.656	-147.5							
47	0.566	-132.7	0.683	-149.6	0.0021	49.3	0.368	-126.3		97	0.426	-155.2	0.002	-17.8	0.0036	-177.8	0.642	-141.8							
48	0.562	-129.2	1.161	-129.5	0.0015	64.2	0.357	-135.4		98	0.432	-169.3	0.007	-50.6	0.0029	-150.4	0.627	-137.7							
49	0.544	-125.2	2.157	-100.7	0.0027	43.9	0.319	-147.3		99	0.449	-177.4	0.007	-115.4	0.0006	-12.8	0.607	-132.1							
50	0.531	-122.6	3.905	-52.8	0.0027	46.9	0.206	-155.1		100	0.466	-158.1	0.010	-150.4	0.0011	-177.0	0.583	-128.9							

Typical on chip measurements

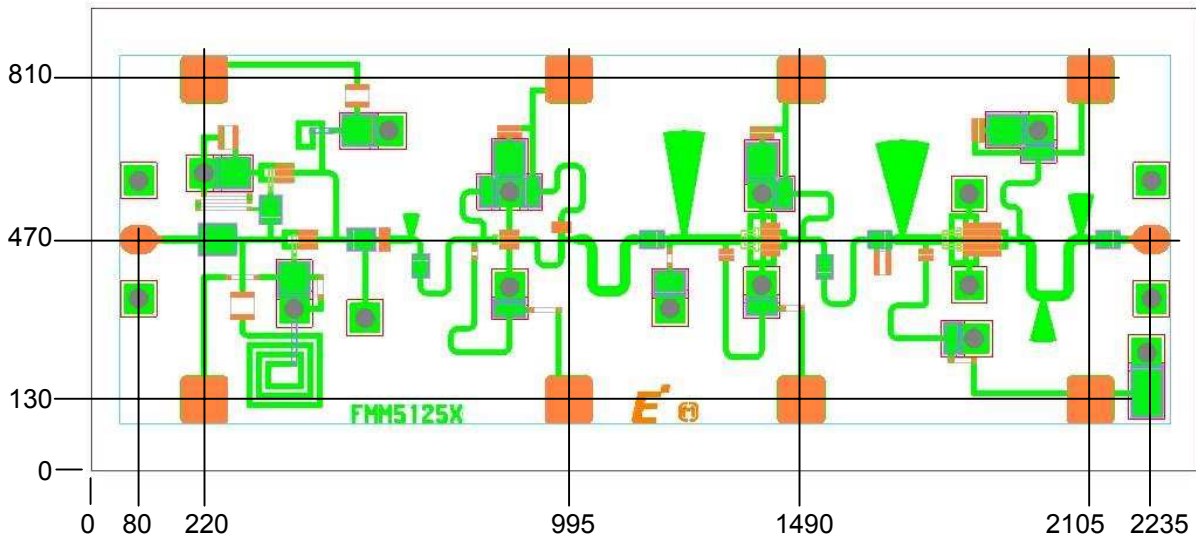
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CHIP OUTLINE



Bonding Pad Locations (Dimension in Micron Meters)



Pad Dimensions
 DC Pads; 100 x 100 μm
 RF Pads; 80 x 60 μm

Unit; μm
 Chip size; 2315 x 940 μm
 Chip Thickness; 70 μm

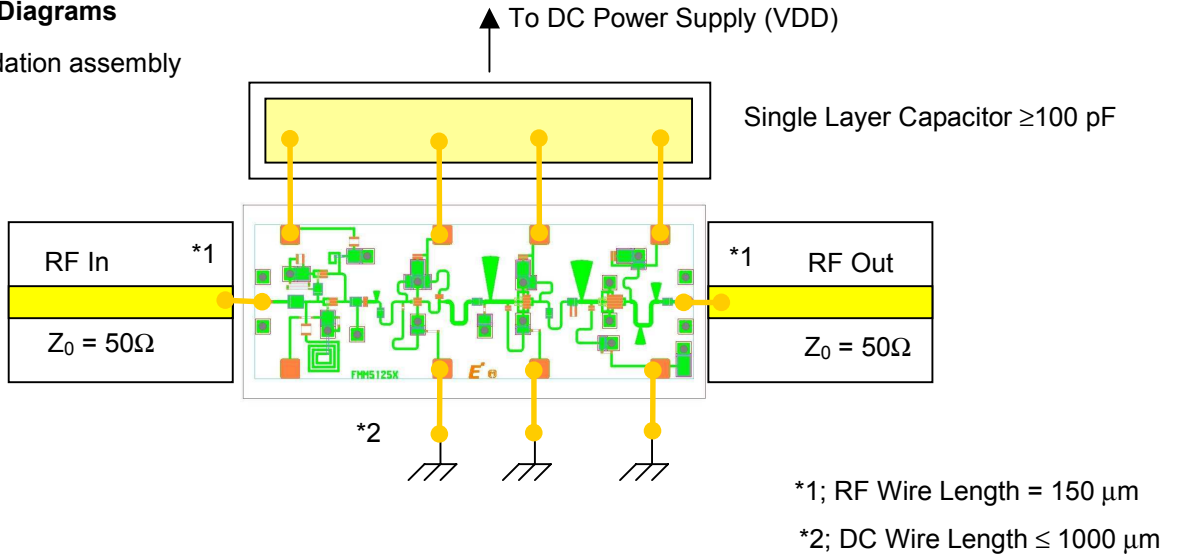
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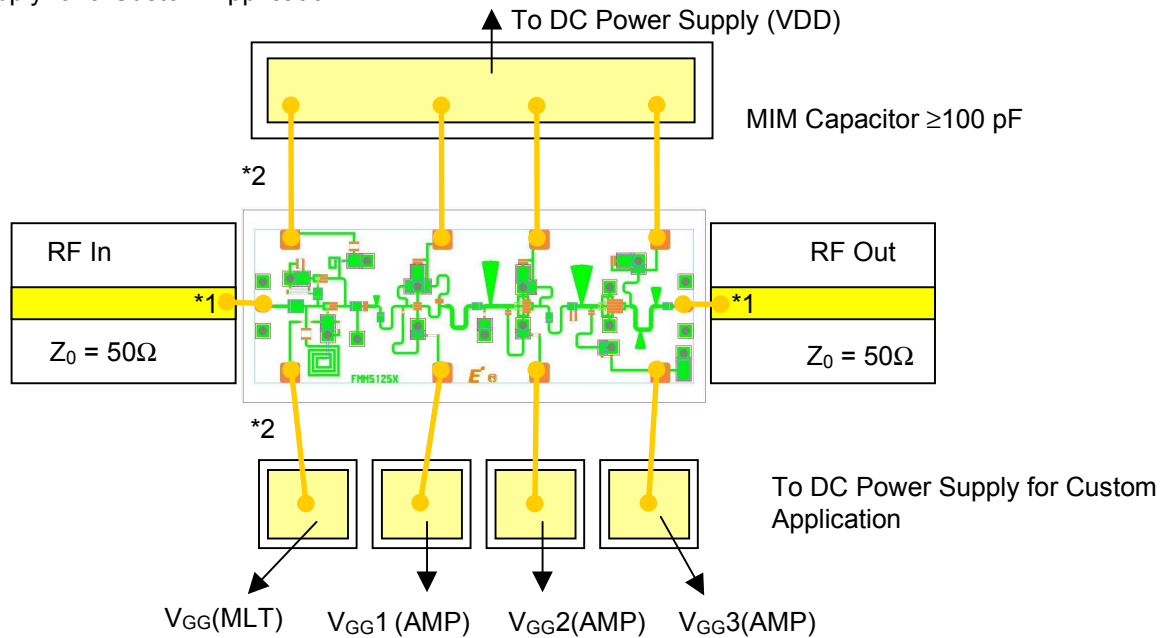
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Assembly Diagrams

Recommendation assembly



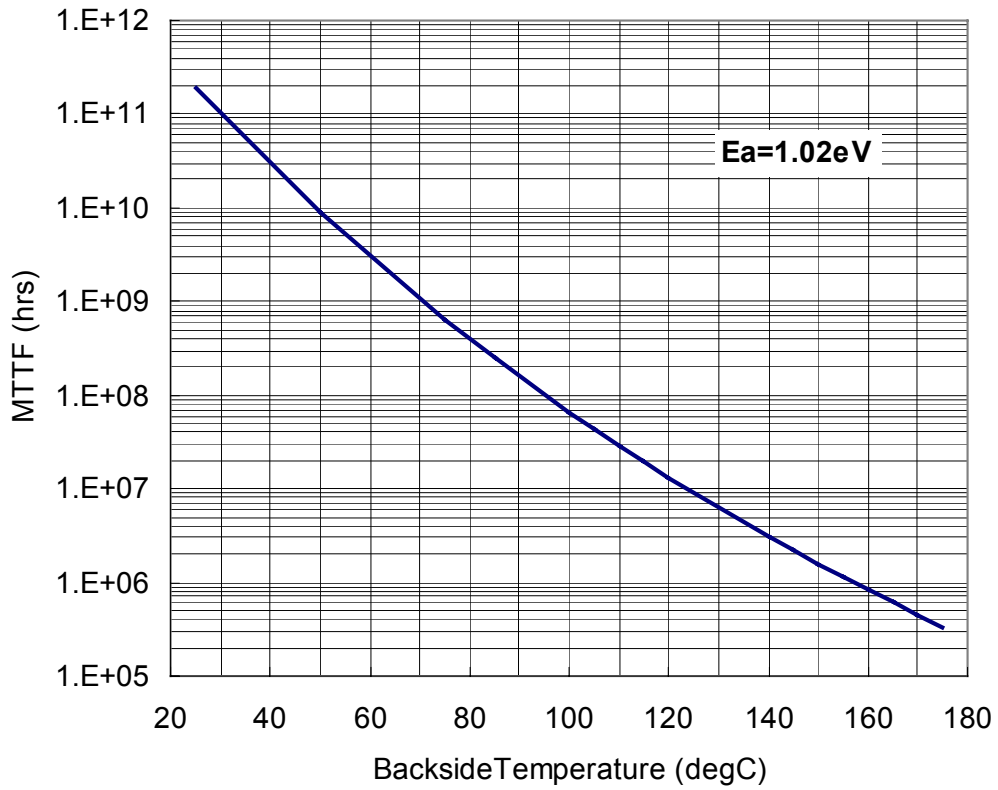
DC Power Supply for a Custom Application



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MTTF vs. Backside Temperature



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15/60GHz Frequency Multiplier MMIC

DIE ATTACH

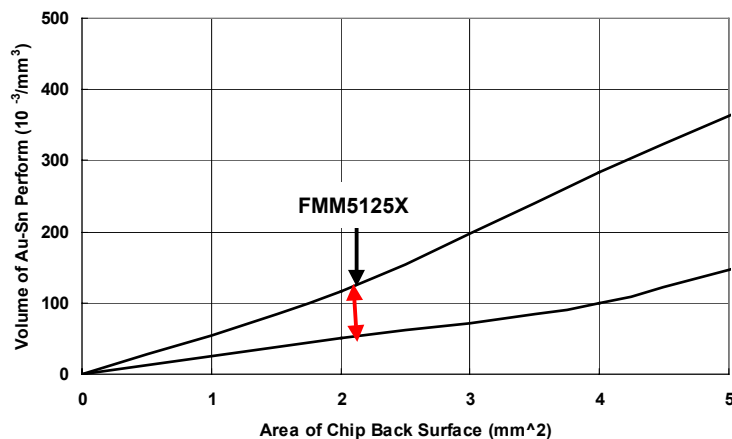
- 1) The die-attach station must have accurate temperature control, and an inert forming gas should be used.
- 2) Chips should be kept at room temperature except during die-attach.
- 3) Place package or carrier on the heated stage.
- 4) Lightly grasp the chip edges by the longer side using tweezers.

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

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Eudyna Devices USA Inc.

2355 Zanker Rd.
San Jose, CA 95131-1138, U.S.A.
TEL: (408) 232-9500
FAX: (408) 428-9111
www.us.eudyna.com

Eudyna Devices Europe Ltd.

Network House
Norreys Drive
Maidenhead, Berkshire SL6 4FJ
United Kingdom
TEL: +44 (0) 1628 504800
FAX: +44 (0) 1628 504888

Eudyna Devices Asia Pte. Ltd.

Hong Kong Branch
Suite 1906B, Tower 6, China Hong Kong City
33 Canton Road, Tsimshatsui, Kowloon
Hong Kong
TEL: +852-2377-0227
FAX: +852-2377-3921

Eudyna Devices Inc.

Sales Division
1, Kanai-cho, Sakae-ku
Yokohama, 244-0845, Japan
TEL +81-45-853-8156
FAX +81-45-853-8170

CAUTION

Eudyna Devices 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.

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