

# FMM5715X

## 60GHz Power Amplifier

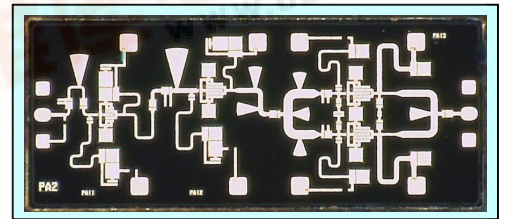
### FEATURES

- High Output Power; P1dB = 16 dBm (Typ.) @ f = 60 GHz
- High Linear Gain:  $|S_{21}| = 17$  dB(Typ) @ f = 60 GHz
- Wide Frequency Band : 57 - 64 GHz
- Impedance Matched  $Z_{in}/Z_{out} = 50\Omega$

### DESCRIPTION

The FMM5715X is a power amplifier 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	Pin	3	dBm
Storage Temperature	Tstg	-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 at 1dB G.C.P.	P1dB	$V_{DD}=3V$	12	16	-	dBm
Linear Gain	$ S_{21} $	$V_{GG}=0V$	14	18	-	dB
Total Drain Current	IDDt	$f = 57\sim 64$ GHz	-	150	-	mA
Input Return Loss	$ S_{11} $		-	8	-	dB
Output Return Loss	$ S_{22} $		-	8	-	dB

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

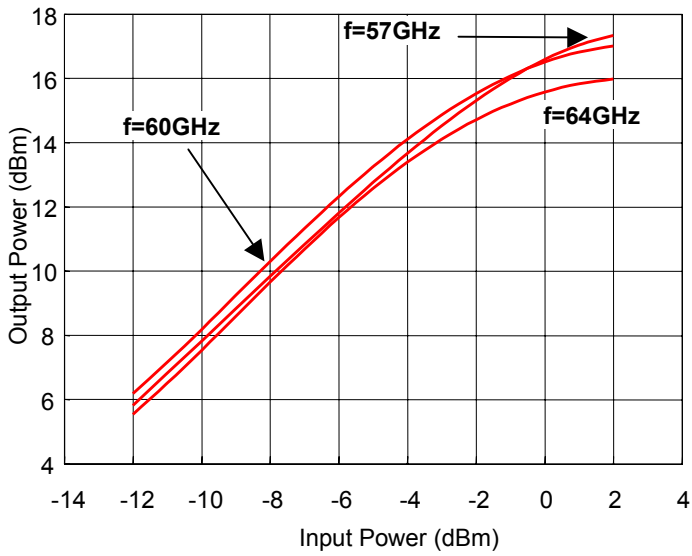
ESD	Class 0	~ 199V
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Note : Based on EIAJ ED-4701 C-111A(C=100pF, R=1.5k $\Omega$ )

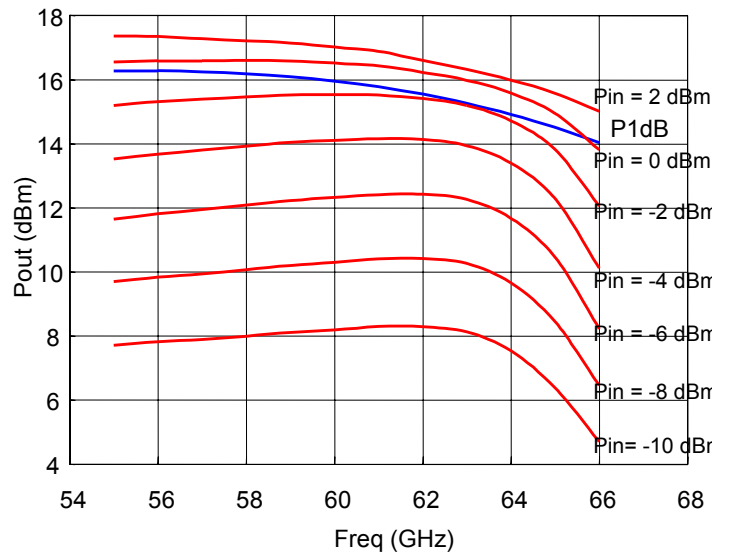
# FMM5715X

## 60GHz Power Amplifier MMIC

Output Power vs. Input Power  
Bias Conditions:  $V_{DD} = 3V$ ,  $V_{GG} = 0V$



Output Power vs. Frequency  
Bias Conditions:  $V_{DD} = 3V$ ,  $V_{GG} = 0V$

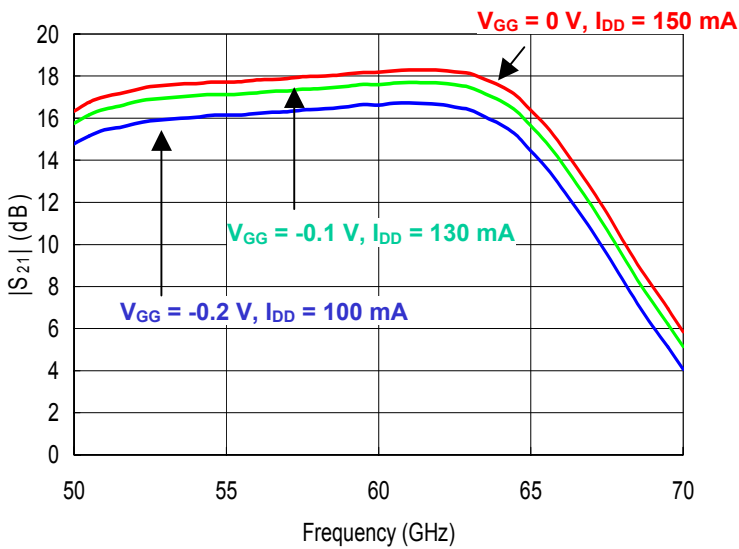


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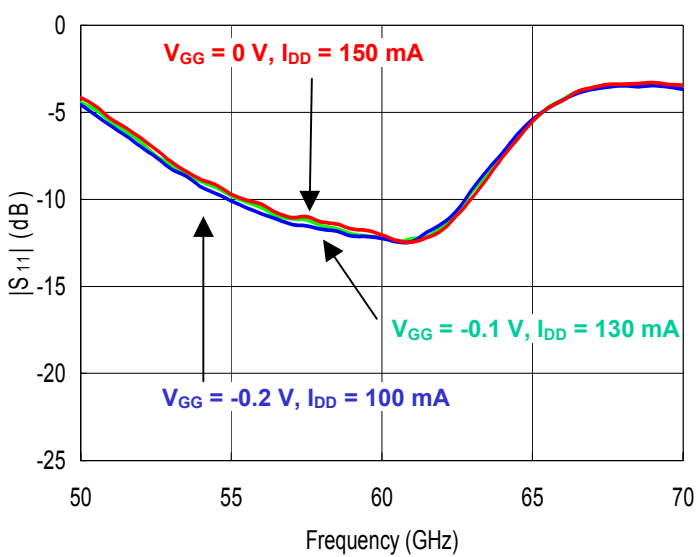
## Linear Gain vs. Frequency

Bias Conditions:  $V_{DD} = 3V$ ,  $V_{GG} = 0, -0.1, -0.2 V$



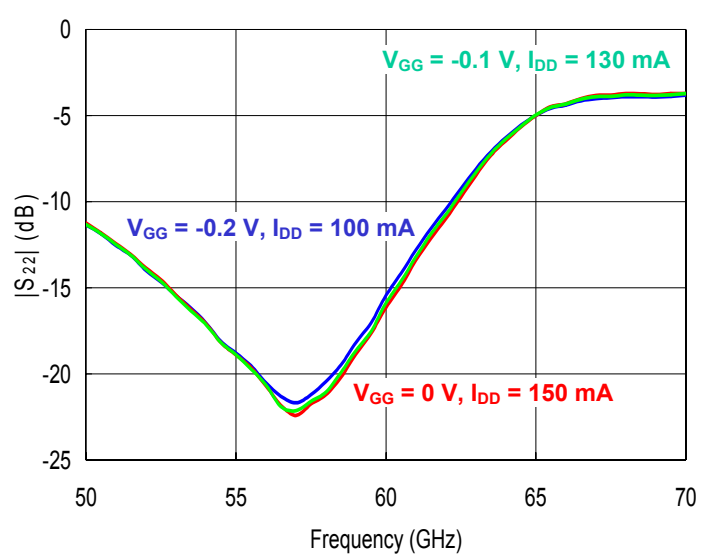
## Input Return Loss vs. Frequency

Bias Conditions:  $V_{DD} = 3V$ ,  $V_{GG} = 0, -0.1, -0.2 V$



## Output Return Loss vs. Frequency

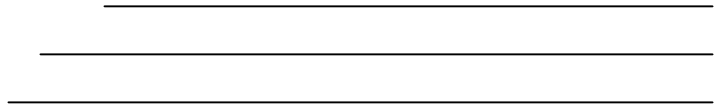
Bias Conditions:  $V_{DD} = 3V$ ,  $V_{GG} = 0, -0.1, -0.2 V$



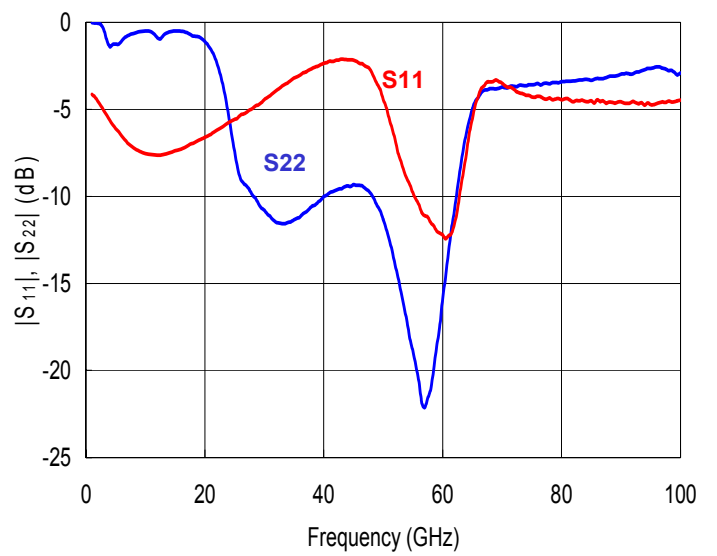
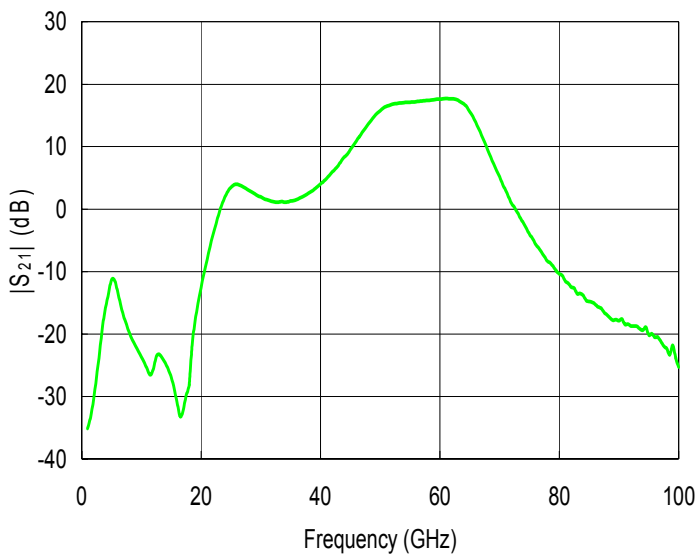
Typical on chip measurements

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**S-PARAMETERS**  
 $V_{DD} = 3V, V_{GG} = 0V, I_{DD} = 150\text{ mA}$



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**S-PARAMETERS**  
**VDD = 3V, VGG = 0V, IDD= 150 mA**

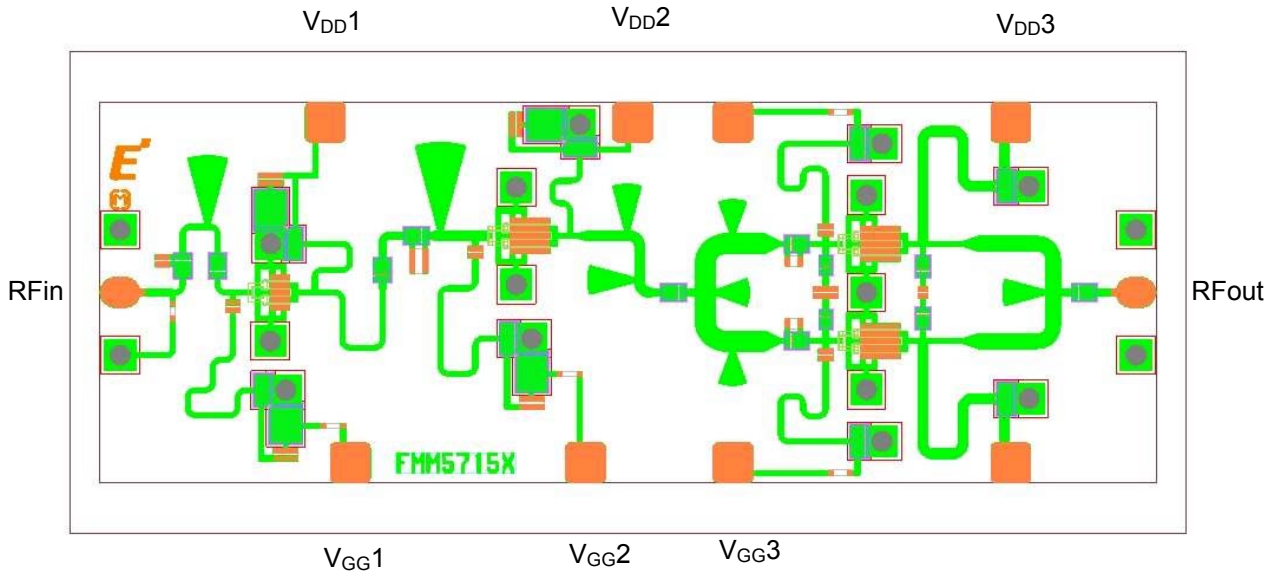
Freq. GHz	S11		S21		S12		S22		Freq. GHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
1	0.621	-14.4	0.017	-120.8	0.00014	-72.6	0.997	-11.7	51	0.539	63.0	7.091	-170.0	0.00306	86.8	0.239	126.3
2	0.594	-27.8	0.031	163.7	0.00010	99.9	0.994	-23.8	52	0.474	51.1	7.366	164.1	0.00443	77.6	0.203	119.0
3	0.557	-39.5	0.075	95.4	0.00029	65.9	0.952	-37.4	53	0.406	40.2	7.559	138.8	0.00442	66.8	0.170	112.6
4	0.523	-49.5	0.170	10.6	0.00060	-7.4	0.851	-43.9	54	0.360	29.1	7.621	113.2	0.00520	48.4	0.140	104.9
5	0.496	-57.9	0.290	-71.5	0.00072	-95.9	0.867	-50.7	55	0.327	17.3	7.686	89.6	0.00858	35.4	0.114	94.2
6	0.472	-65.8	0.237	-153.2	0.00037	-155.0	0.884	-57.2	56	0.306	3.3	7.781	64.9	0.00716	3.4	0.092	73.9
7	0.451	-72.3	0.153	164.6	0.00018	155.9	0.913	-65.9	57	0.280	-11.1	7.841	41.7	0.00672	-5.2	0.076	47.1
8	0.436	-77.8	0.110	139.6	0.00012	118.3	0.930	-74.8	58	0.272	-26.2	7.938	17.2	0.00558	-17.1	0.087	14.3
9	0.425	-82.9	0.086	122.5	0.00007	-41.9	0.939	-83.6	59	0.260	-41.3	8.046	-7.1	0.00725	-22.4	0.114	-12.7
10	0.419	-87.5	0.071	109.1	0.00017	-169.4	0.944	-92.3	60	0.250	-52.8	8.118	-32.4	0.00711	-57.6	0.156	-29.2
11	0.416	-91.7	0.056	101.6	0.00015	-161.2	0.938	-101.0	61	0.238	-58.3	8.218	-59.3	0.00784	-84.1	0.214	-39.9
12	0.415	-95.6	0.056	112.7	0.00035	177.6	0.904	-108.5	62	0.258	-59.3	8.207	-86.5	0.00681	-108.3	0.282	-49.9
13	0.416	-99.0	0.074	90.6	0.00032	36.7	0.916	-113.1	63	0.319	-62.2	8.059	-117.0	0.00671	-137.5	0.377	-60.3
14	0.420	-102.4	0.063	70.8	0.00026	8.6	0.938	-120.7	64	0.417	-70.1	7.527	-148.2	0.00818	-168.1	0.475	-73.7
15	0.426	-105.7	0.048	59.9	0.00017	-4.8	0.945	-128.4	65	0.529	-82.9	6.591	-179.3	0.00671	149.7	0.562	-87.0
16	0.431	-108.9	0.030	63.3	0.00059	-101.0	0.943	-136.1	66	0.608	-99.0	5.437	150.7	0.00734	112.2	0.608	-100.5
17	0.439	-111.8	0.026	110.9	0.00032	-106.7	0.934	-144.1	67	0.662	-114.1	4.272	122.6	0.00429	98.2	0.643	-111.5
18	0.449	-115.0	0.044	150.1	0.00101	-142.6	0.913	-151.4	68	0.678	-127.9	3.252	98.8	0.00629	70.4	0.651	-120.4
19	0.457	-118.3	0.135	142.7	0.00121	147.0	0.909	-159.4	69	0.685	-139.7	2.512	77.2	0.00633	70.3	0.647	-127.7
20	0.465	-120.9	0.254	122.9	0.00060	93.4	0.881	-168.6	70	0.672	-149.3	1.962	58.0	0.00578	61.1	0.652	-133.5
21	0.477	-123.9	0.424	99.8	0.00019	167.5	0.834	-178.2	71	0.652	-158.2	1.543	39.8	0.00716	52.8	0.652	-138.5
22	0.488	-126.5	0.668	73.6	0.00028	-175.4	0.765	171.7	72	0.644	-165.6	1.209	23.7	0.00683	33.0	0.656	-143.0
23	0.501	-129.5	0.995	42.7	0.00055	-99.4	0.664	162.6	73	0.628	-171.6	1.007	7.4	0.00710	25.4	0.659	-147.5
24	0.513	-132.1	1.341	8.8	0.00103	-157.2	0.540	155.6	74	0.619	-177.6	0.827	-8.1	0.00660	20.9	0.663	-151.0
25	0.525	-135.2	1.607	-27.4	0.00193	168.1	0.424	154.7	75	0.609	-177.7	0.675	-21.7	0.00819	19.7	0.658	-154.5
26	0.541	-137.9	1.713	-62.7	0.00154	159.5	0.355	160.3	76	0.605	172.2	0.562	-34.4	0.00823	14.0	0.665	-158.0
27	0.551	-141.2	1.633	-93.4	0.00174	149.5	0.340	165.3	77	0.611	167.2	0.497	-47.0	0.00701	-4.7	0.667	-160.9
28	0.565	-144.1	1.530	-118.8	0.00157	115.7	0.321	166.5	78	0.608	161.8	0.420	-60.0	0.01034	-3.8	0.663	-163.9
29	0.578	-146.8	1.431	-141.8	0.00233	105.5	0.304	168.0	79	0.600	156.2	0.367	-72.4	0.00994	-20.5	0.673	-166.8
30	0.599	-150.1	1.355	-161.5	0.00132	94.0	0.291	170.1	80	0.602	150.6	0.328	-84.8	0.00836	-20.5	0.674	-169.3
31	0.615	-153.4	1.284	-179.5	0.00094	64.0	0.279	172.7	81	0.599	145.5	0.288	-96.8	0.00812	-35.3	0.675	-172.2
32	0.636	-157.1	1.241	164.4	0.00089	83.0	0.268	174.8	82	0.594	139.6	0.262	-112.8	0.00798	-44.6	0.676	-174.6
33	0.655	-160.8	1.223	148.5	0.00098	118.6	0.264	177.4	83	0.592	134.8	0.233	-123.3	0.00873	-59.2	0.680	-177.4
34	0.671	-165.2	1.221	133.4	0.00110	117.8	0.266	-179.6	84	0.591	129.0	0.214	-136.8	0.01010	-62.9	0.683	-179.3
35	0.693	-169.3	1.249	118.5	0.00084	100.7	0.269	-178.2	85	0.596	122.6	0.179	-147.9	0.00993	-79.3	0.679	178.1
36	0.708	-173.5	1.277	105.4	0.00137	97.6	0.274	-177.0	86	0.592	116.9	0.180	-162.7	0.00722	-97.1	0.683	176.0
37	0.723	-178.4	1.349	91.1	0.00151	101.2	0.282	-176.1	87	0.594	110.4	0.174	-175.5	0.00510	-117.5	0.688	174.2
38	0.733	-176.6	1.432	77.2	0.00222	84.0	0.294	-176.7	88	0.588	103.9	0.157	168.8	0.00493	-104.3	0.697	172.0
39	0.752	-171.3	1.544	63.4	0.00155	75.6	0.301	-177.0	89	0.591	97.1	0.149	154.2	0.00488	-92.7	0.699	169.4
40	0.764	-165.7	1.702	49.2	0.00181	85.4	0.313	-178.1	90	0.584	90.6	0.139	137.5	0.00399	-97.3	0.703	167.0
41	0.775	-159.6	1.878	34.0	0.00218	51.3	0.321	-179.6	91	0.593	82.6	0.133	123.7	0.00317	-136.6	0.714	164.4
42	0.782	-153.3	2.114	19.3	0.00182	70.5	0.327	177.2	92	0.584	75.9	0.123	108.4	0.00200	-111.8	0.712	162.3
43	0.788	-146.0	2.388	3.2	0.00176	47.2	0.331	174.1	93	0.586	68.4	0.125	91.0	0.00256	-104.6	0.721	159.8
44	0.787	-138.6	2.779	-14.0	0.00248	60.8	0.337	170.8	94	0.583	59.6	0.113	72.3	0.00254	14.5	0.735	157.6
45	0.785	-130.4	3.178	-32.0	0.00156	37.4	0.341	166.8	95	0.582	53.5	0.115	52.9	0.00210	-8.0	0.737	154.5
46	0.776	-121.7	3.717	-50.8	0.00149	38.9	0.340	162.1	96	0.584	45.5	0.104	27.2	0.00369	-8.0	0.743	151.1
47	0.759	-110.9	4.379	-71.9	0.00133	123.7	0.333	155.8	97	0.582	37.5	0.091	13.9	0.00491	-9.6	0.739	147.0
48	0.730	-99.9	5.101	-93.8	0.00156	65.1	0.321	148.7	98	0.589	30.9	0.078	-13.9	0.00359	-27.7	0.731	144.9
49	0.680	-87.9	5.891	-118.2	0.00239	89.0	0.299	142.1	99	0.587	23.4	0.082	-34.7	0.00488	-22.7	0.715	142.2
50	0.620	-75.0	6.554	-143.2	0.00186	97.9	0.275	134.2	100	0.595	15.9	0.057	-63.6	0.00667	-38.3	0.717	141.6

Typical on chip measurements

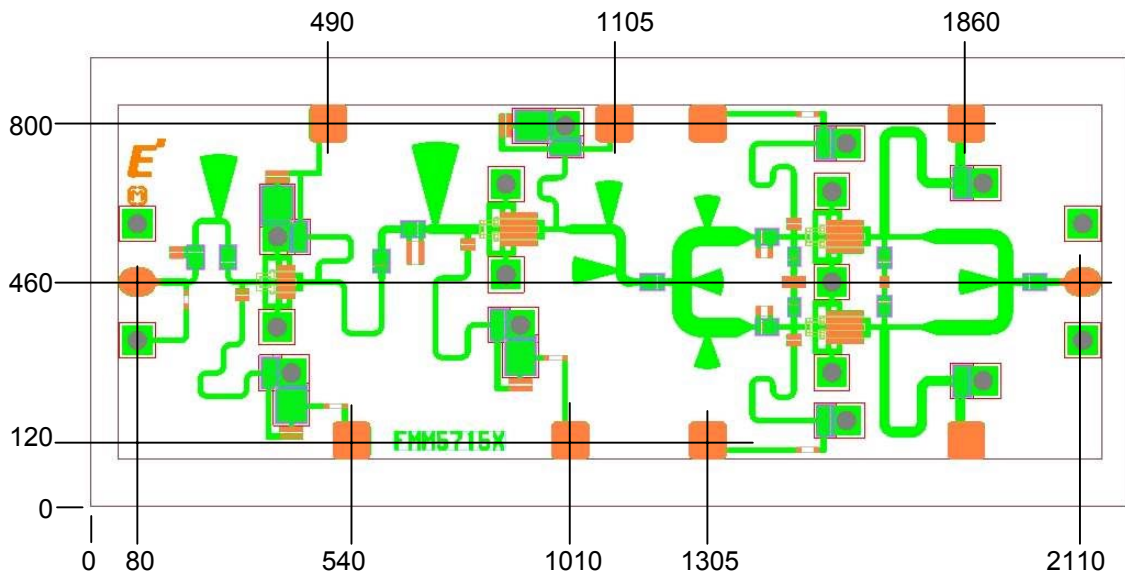
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## 60GHz Power Amplifier MMIC

### CHIP OUTLINE



### Bonding Pad Locations (Dimension in Micron Meters)



Pad Dimensions  
 DC Pads; 80 x 80  $\mu\text{m}$   
 RF Pads; 80 x 60  $\mu\text{m}$

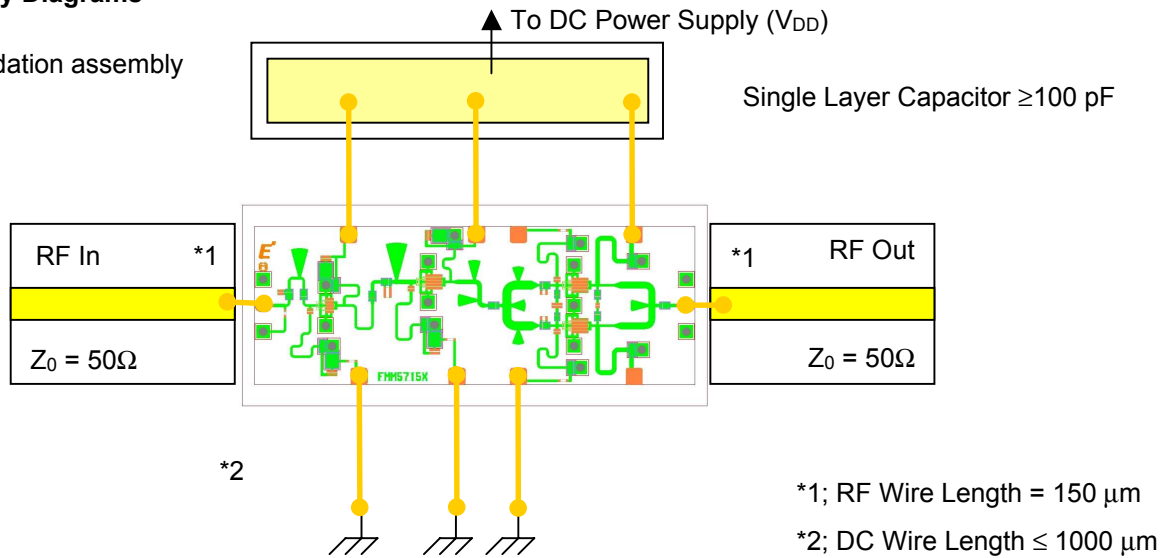
Unit;  $\mu\text{m}$   
 Chip size; 2190 x 920  $\mu\text{m}$   
 Chip Thickness; 70  $\mu\text{m}$

# FMM5715X

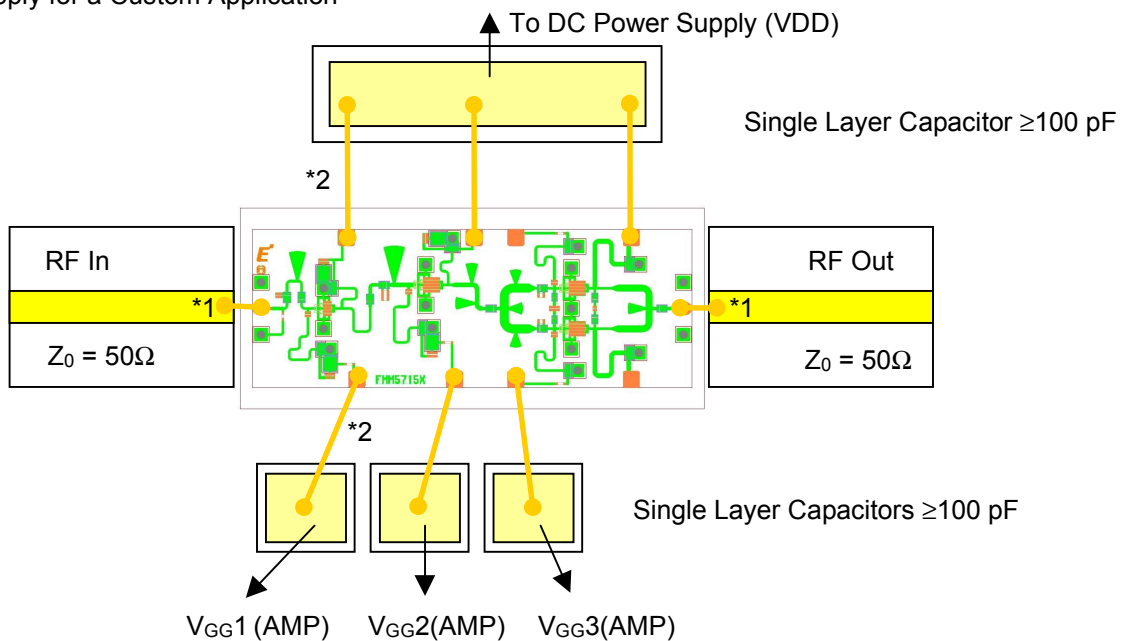
## 60GHz Power Amplifier MMIC

### Assembly Diagrams

Recommendation assembly



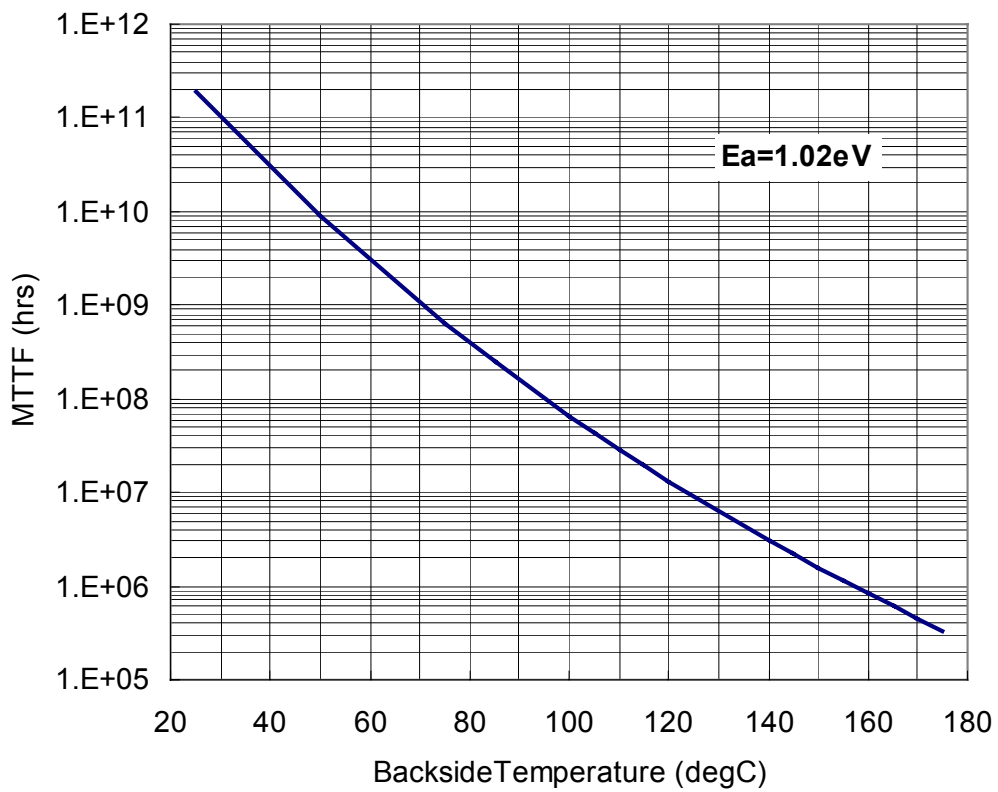
DC Power Supply for a Custom Application



# FMM5715X

60GHz Power Amplifier MMIC

MTTF vs. Backside Temperature





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60GHz Power Amplifier MMIC

## DIE ATTACH

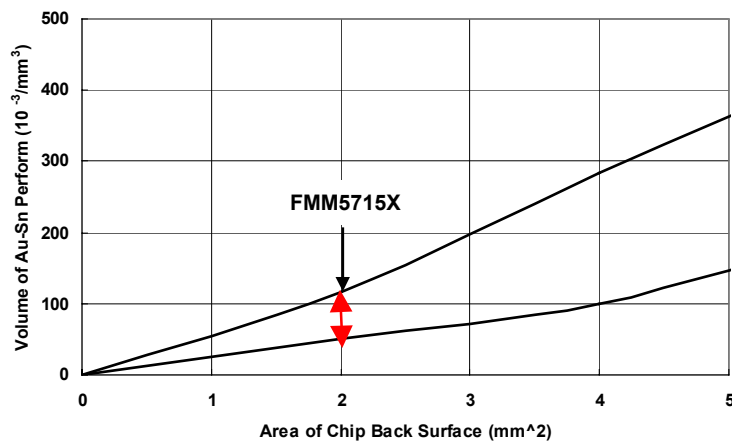
- 1) The die-attach station must have accurate temperature control, and an inert forming gas should be used.
- 2) Chips should be kept at room temperature except during die-attach.
- 3) Place package or carrier on the heated stage.
- 4) Lightly grasp the chip edges by the longer side using tweezers.

### 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.**

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### **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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