

FMM5716X

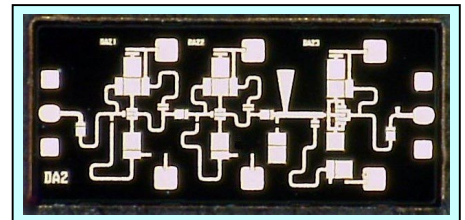
60GHz Low Noise Amplifier

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 - 64 GHz
- Impedance Matched $Z_{in}/Z_{out} = 50\Omega$

DESCRIPTION

The FMM5716X is a low noise 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	V _{DD}	+4	V
DC Input Voltage	V _{GG}	-3	V
Input Power	P _{in}	3	dBm
Storage Temperature	T _{stg}	-55 to +125	°C

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

Item	Symbol	Condition	Unit
DC Input Voltage	V _{DD}	3	V
Backside Temperature	T _B	-45 to +85	°C

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

Item	Symbol	Condition	Limit			Unit
			Min.	Typ.	Max.	
Noise Figure	NF	V _{DD} = 3V	-	5	7	dB
Linear Gain	$ S_{21} $	I _{DD} = 30 mA	16	22	-	dB
Output Power at 1dB G.C.P.	P _{1dB}	f = 57~64 GHz	-	10	-	dBm
Gate Voltage	V _{GG}		-0.3	-0.1	0	mA
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.

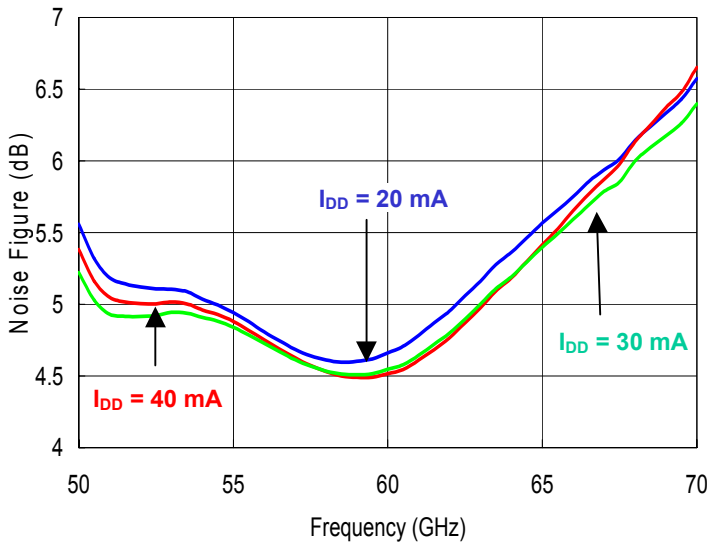
ESD	Class 0	~ 199V
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Note : Based on EIAJ ED-4701 C-111A(C=100pF, R=1.5kΩ)

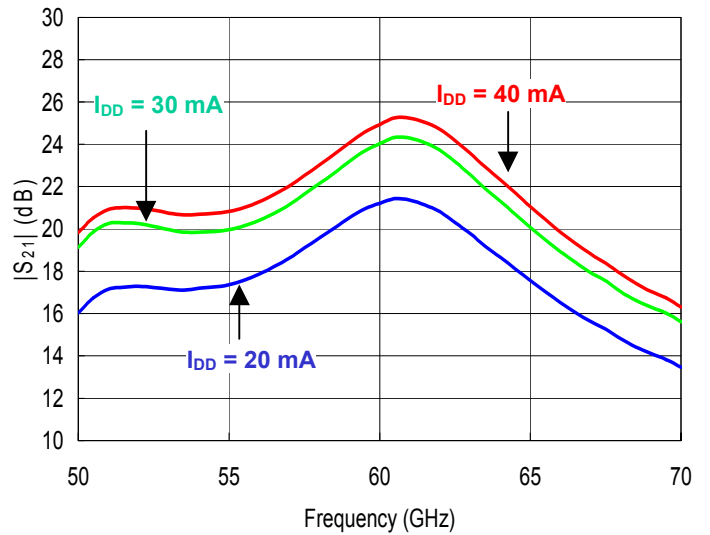
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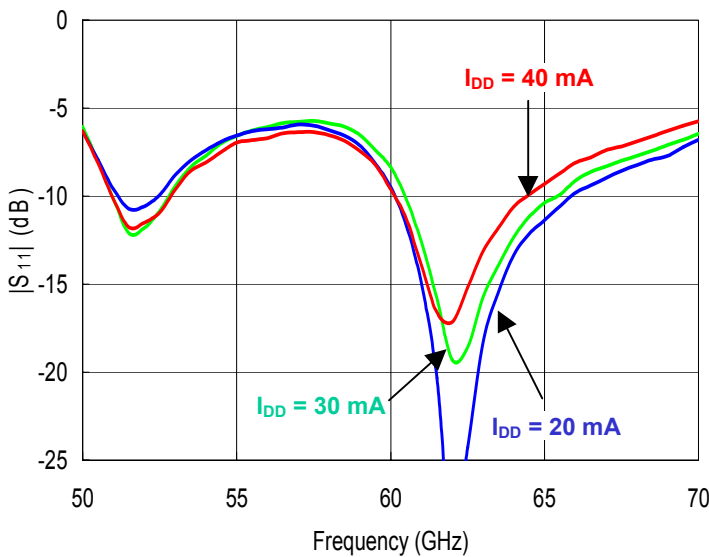
Noise Figure vs. Frequency
Bias Conditions: $V_{DD} = 3V$



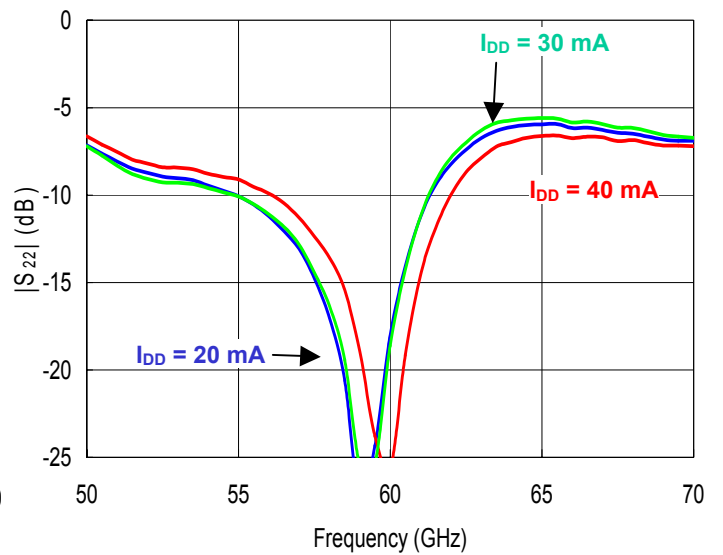
Linear Gain vs. Frequency
Bias Conditions: $V_{DD} = 3V$

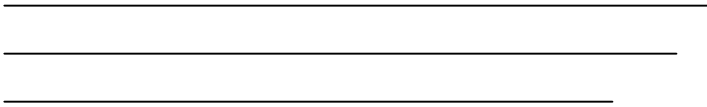


Input Return Loss vs. Frequency
Bias Conditions: $V_{DD} = 3V$



Output Return Loss vs. Frequency
Bias Conditions: $V_{DD} = 3V$

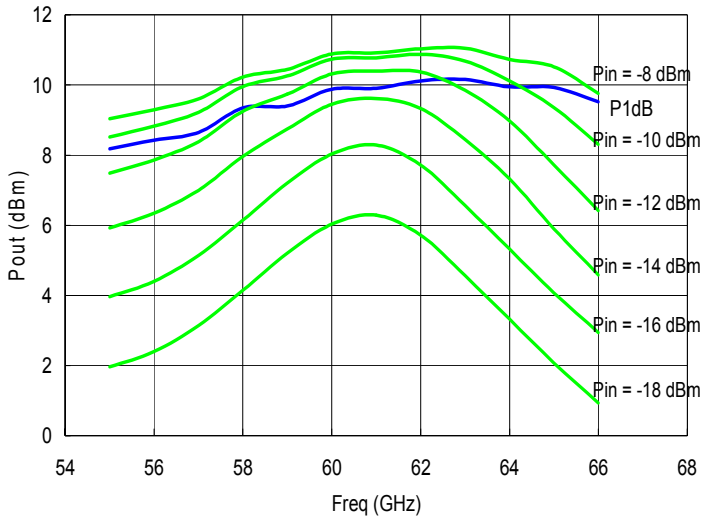




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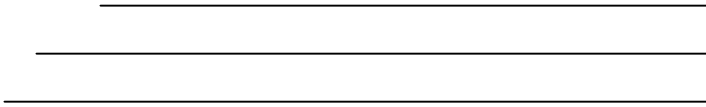
Output Power vs. Frequency
Bias Conditions: $V_{DD} = 3V$, $I_{DD} = 30\text{ mA}$



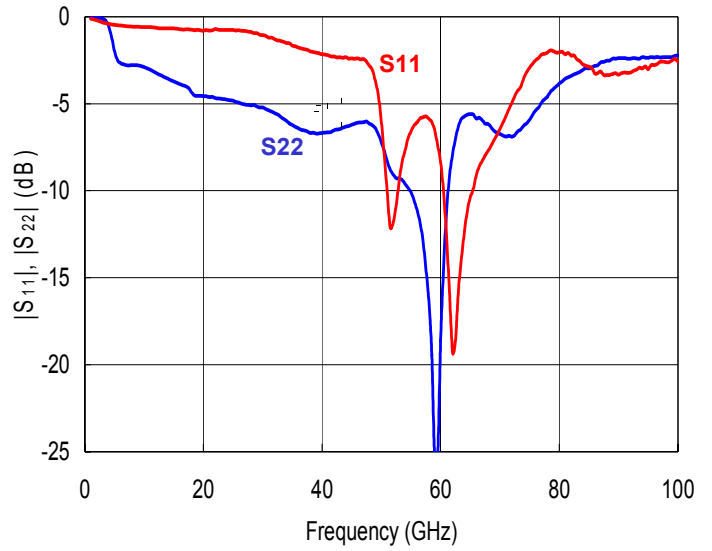
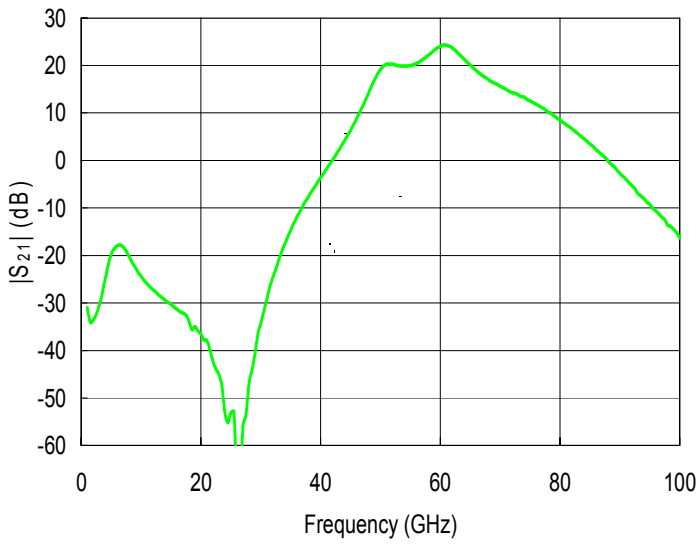
Typical on chip measurements

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60GHz Low Noise Amplifier



S-PARAMETERS
Bias Conditions: $V_{DD} = 3V$, $I_{DD} = 30\text{ mA}$



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60GHz Low Noise Amplifier

S-PARAMETERS

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

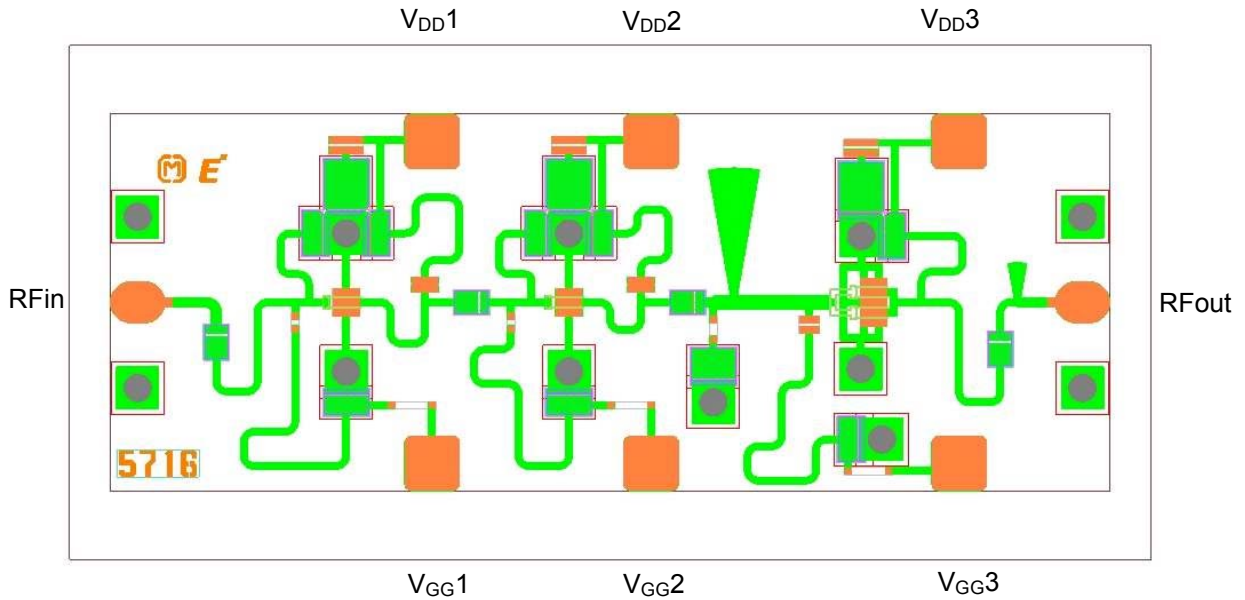
Freq GHz	S11			S21			S12			S22			Freq GHz	S11			S21			S12			S22		
	MAG	ANG		MAG	ANG		MAG	ANG		MAG	ANG			MAG	ANG		MAG	ANG		MAG	ANG		MAG	ANG	
1	0.988	-10.3	0.028	-137.9	0.00004	3.9	0.995	-12.7	51	0.311	-79.701	10.300	-156.080	0.00512	73.721	0.383	-97.256								
2	0.977	-20.2	0.021	166.3	0.00003	112.6	0.996	-25.9	52	0.257	-51.9	10.297	173.6	0.00603	33.6	0.352	-98.0								
3	0.963	-29.5	0.030	127.2	0.00016	72.2	0.987	-39.9	53	0.337	-41.8	9.951	149.6	0.00516	21.3	0.343	-100.0								
4	0.954	-38.4	0.057	73.0	0.00035	24.2	0.941	-55.8	54	0.412	-47.5	9.812	128.5	0.00461	-2.0	0.331	-106.4								
5	0.948	-47.2	0.103	-3.1	0.00052	-30.7	0.796	-68.2	55	0.468	-55.2	9.951	110.3	0.00654	-12.5	0.313	-112.8								
6	0.944	-55.9	0.126	-75.1	0.00058	-85.6	0.736	-72.4	56	0.497	-65.7	10.467	92.1	0.00692	-39.5	0.279	-121.9								
7	0.940	-64.5	0.123	-135.3	0.00036	-124.9	0.726	-78.9	57	0.514	-78.3	11.400	73.7	0.00766	-59.3	0.229	-134.0								
8	0.937	-72.9	0.098	179.2	0.00015	-146.4	0.726	-86.5	58	0.509	-92.8	12.799	53.5	0.00852	-77.8	0.152	-149.2								
9	0.936	-81.3	0.075	149.7	0.00022	-120.2	0.725	-95.1	59	0.472	-110.7	14.461	30.9	0.01061	-92.0	0.054	-160.6								
10	0.935	-89.5	0.060	128.4	0.00033	-165.8	0.717	-103.9	60	0.382	-136.2	15.904	4.2	0.01285	-125.1	0.117	32.7								
11	0.933	-97.7	0.050	112.0	0.00027	-171.9	0.704	-112.5	61	0.233	-174.4	16.381	-25.9	0.01563	-144.6	0.275	-1.3								
12	0.929	-105.7	0.043	97.9	0.00022	-171.5	0.690	-120.7	62	0.108	115.7	15.339	-54.7	0.01601	-170.5	0.404	-23.1								
13	0.925	-113.4	0.038	84.8	0.00023	-29.8	0.676	-128.6	63	0.163	32.1	13.432	-81.4	0.01587	165.6	0.484	-41.1								
14	0.926	-121.1	0.034	73.1	0.00033	-89.8	0.664	-136.3	64	0.242	4.0	11.636	-103.5	0.01679	143.2	0.517	-56.2								
15	0.926	-128.7	0.031	62.5	0.00043	-135.7	0.652	-143.9	65	0.303	-11.1	10.083	-122.6	0.01444	130.1	0.526	-66.2								
16	0.920	-136.4	0.027	51.5	0.00081	-134.8	0.641	-151.5	66	0.350	-21.4	8.836	-140.5	0.01386	118.8	0.510	-73.9								
17	0.919	-143.7	0.025	41.0	0.00101	-173.6	0.631	-159.3	67	0.384	-27.9	7.878	-157.6	0.01350	106.2	0.505	-80.1								
18	0.918	-151.1	0.020	21.9	0.00053	165.0	0.606	-167.6	68	0.412	-34.0	7.102	-173.5	0.01280	97.7	0.492	-84.0								
19	0.916	-158.7	0.018	25.5	0.00174	158.8	0.592	-173.1	69	0.442	-37.3	6.532	170.8	0.01292	94.7	0.470	-86.8								
20	0.911	-166.0	0.015	9.0	0.00081	122.2	0.592	-179.7	70	0.476	-40.6	6.036	155.2	0.01259	74.0	0.461	-88.3								
21	0.912	-173.4	0.013	1.8	0.00072	125.1	0.588	-171.8	71	0.517	-43.2	5.601	138.7	0.01148	66.5	0.452	-88.1								
22	0.922	179.1	0.008	-11.6	0.00084	156.0	0.584	163.6	72	0.565	-46.9	5.192	123.5	0.01026	55.5	0.452	-87.9								
23	0.916	171.4	0.006	-7.7	0.00131	129.0	0.581	155.5	73	0.613	-50.6	4.924	107.1	0.00950	48.8	0.469	-87.8								
24	0.916	164.1	0.002	-17.2	0.00135	133.2	0.577	146.8	74	0.665	-55.6	4.639	90.4	0.01027	37.9	0.487	-86.9								
25	0.916	156.1	0.002	31.6	0.00186	102.1	0.574	137.8	75	0.715	-61.3	4.227	74.7	0.00856	28.7	0.506	-87.5								
26	0.914	148.1	0.001	85.7	0.00157	74.5	0.566	128.1	76	0.750	-66.8	3.898	58.6	0.00740	33.7	0.537	-88.9								
27	0.910	140.0	0.002	-134.1	0.00066	9.0	0.559	118.7	77	0.778	-73.5	3.608	42.1	0.00638	26.2	0.567	-90.4								
28	0.904	131.9	0.004	-146.1	0.00025	136.4	0.557	108.5	78	0.789	-78.8	3.245	26.5	0.00477	17.6	0.589	-92.4								
29	0.897	123.5	0.009	-138.8	0.00093	120.8	0.553	97.4	79	0.796	-84.5	2.961	10.1	0.00377	25.0	0.620	-95.3								
30	0.886	115.1	0.019	-151.9	0.00088	130.0	0.549	86.5	80	0.791	-89.0	2.671	-5.0	0.00380	22.0	0.643	-98.0								
31	0.872	106.7	0.034	-163.4	0.00096	116.4	0.539	75.2	81	0.779	-94.4	2.389	-20.7	0.00406	42.0	0.664	-100.8								
32	0.862	98.0	0.058	-176.5	0.00172	108.1	0.529	63.4	82	0.773	-98.0	2.147	-36.0	0.00375	45.8	0.675	-104.0								
33	0.852	89.8	0.089	170.0	0.00189	116.7	0.516	51.8	83	0.754	-101.9	1.925	-51.3	0.00430	48.5	0.688	-107.1								
34	0.841	81.0	0.132	153.8	0.00150	78.1	0.502	40.7	84	0.729	-104.4	1.690	-66.1	0.00224	30.4	0.703	-109.5								
35	0.826	72.3	0.185	136.5	0.00114	65.9	0.488	30.3	85	0.718	-107.5	1.501	-80.4	0.00340	72.2	0.710	-111.8								
36	0.816	63.8	0.251	120.4	0.00133	63.1	0.478	20.4	86	0.687	-109.3	1.305	-94.9	0.00370	66.8	0.723	-114.2								
37	0.806	55.3	0.328	104.2	0.00046	-148.2	0.471	11.2	87	0.697	-110.5	1.149	-108.4	0.00206	85.3	0.740	-116.6								
38	0.796	46.9	0.420	87.9	0.00098	88.8	0.464	2.4	88	0.679	-110.8	0.996	-122.7	0.00636	57.9	0.747	-119.3								
39	0.789	38.5	0.528	72.2	0.00051	106.9	0.462	-5.8	89	0.685	-111.8	0.870	-136.7	0.00288	108.5	0.758	-122.0								
40	0.780	30.0	0.657	57.1	0.00122	144.6	0.463	-13.7	90	0.681	-113.8	0.730	-150.4	0.00458	80.7	0.760	-125.0								
41	0.775	21.5	0.819	42.4	0.00191	106.9	0.465	-21.2	91	0.691	-113.9	0.639	-161.1	0.00908	93.4	0.761	-127.0								
42	0.769	13.1	1.014	28.5	0.00209	109.5	0.471	-28.5	92	0.692	-115.6	0.544	-172.6	0.01079	85.2	0.758	-129.6								
43	0.765	4.7	1.269	14.3	0.00193	93.2	0.475	-35.5	93	0.704	-116.6	0.451	175.7	0.01433	64.9	0.758	-131.6								
44	0.765	-3.8	1.614	0.3	0.00160	70.3	0.484	-42.8	94	0.710	-118.9	0.397	164.9	0.01459	67.0	0.766	-133.4								
45	0.759	-13.0	2.075	-14.3	0.00132	40.5	0.489	-50.1	95	0.706	-120.0	0.346	152.3	0.01214	54.8	0.762	-135.8								
46	0.759	-22.8	2.746	-29.5	0.00070	-171.5	0.496	-57.5	96	0.726	-121.9	0.297	142.3	0.01322	27.8	0.763	-137.5								
47	0.755	-33.6	3.706	-46.9	0.00111	157.6	0.497	-65.2	97	0.742	-124.0	0.253	132.2	0.01379	28.6	0.764	-140.1								
48	0.724	-46.9	5.086	-67.5	0.00246	142.3	0.493	-73.9	98	0.740	-126.1	0.209	123.5	0.00798	32.2	0.765	-141.2								
49	0.653	-63.0	7.004	-92.6	0.00326	121.9	0.478	-83.1	99	0.749	-126.5	0.188	115.2	0.01061	24.5	0.766	-142.5								
50	0.498	-78.4	9.055	-123.2	0.00515	94.5	0.436	-92.5	100	0.743	-129.0	0.153	99.9	0.01638	21.8	0.776	-144.7								

Typical on chip measurements

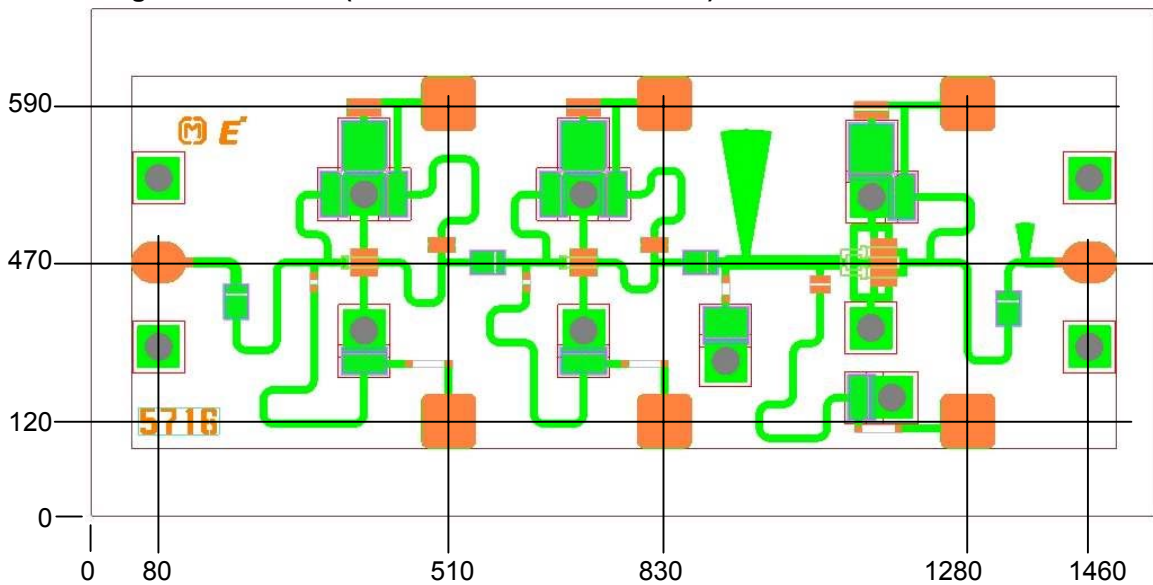
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CHIP OUTLINE



Bonding Pad Locations (Dimension in Micron Meters)



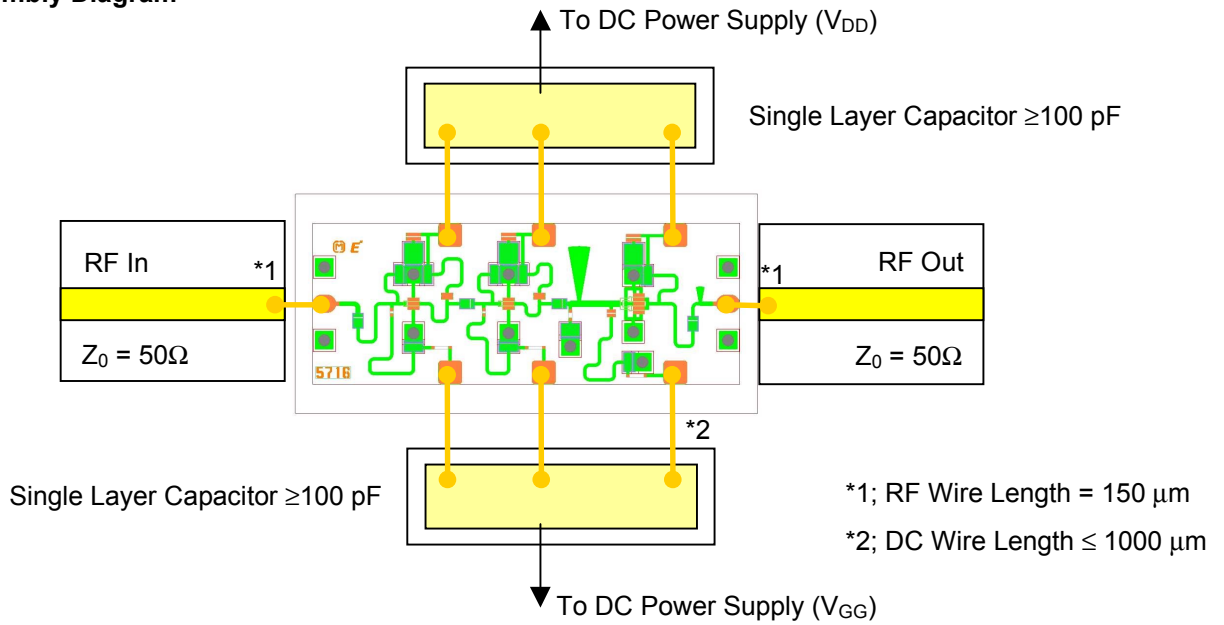
Pad Dimensions
 DC Pads; 80 x 80 μm
 RF Pads; 80 x 60 μm

Unit; μm
 Chip size; 1540 x 710 μm
 Chip Thickness; 70 μm

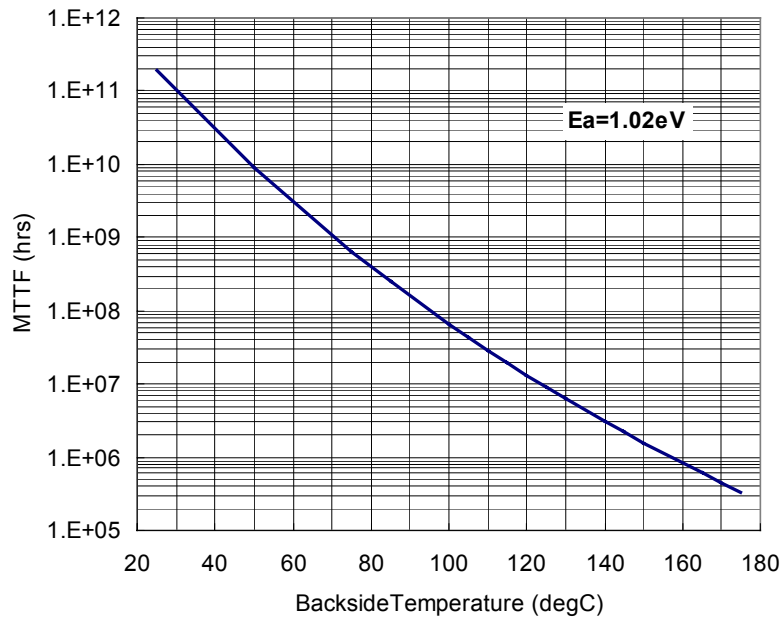
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Assembly Diagram



MTTF vs. Backside Temperature



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DIE ATTACH

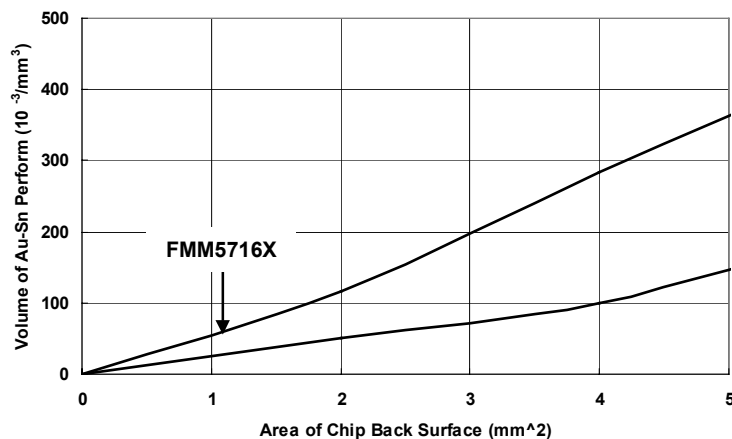
- 1) The die-attach station must have accurate temperature control, and an inert forming gas should be used.
- 2) Chips should be kept at room temperature except during die-attach.
- 3) Place package or carrier on the heated stage.
- 4) Lightly grasp the chip edges by the longer side using tweezers.

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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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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