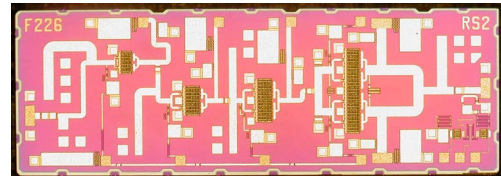


# FMM5823X

## K-Band Power Amplifier MMIC

### FEATURES

- High Output Power: P1dB = 27~29 dBm (Typ.)
- High Linear Gain: GL = 19 dB(Typ.)
- Frequency Band: 17.7 - 27.0 GHz
- High Linearity: OIP3 = 36.5dBm(typ.)
- Impedance Matched Zin/Zout = 50Ω



### DESCRIPTION

The FMM5823X is a power amplifier MMIC that contains a four stage amplifier, internally matched, for standard communications band in 17.7 to 27.0GHz frequency range. This product is well suited for point-to-point radio applications.

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

### ABSOLUTE MAXIMUM RATING

Item	Symbol	Rating	Unit
Drain-Source Voltage	VDD	10	V
Gate-Source Voltage	VGG	-3	V
Input Power	Pin	22	dBm
Storage Temperature	Tstg	-55 to +125	°C

### RECOMMENDED OPERATING CONDITIONS

Item	Symbol	Condition	Unit
Drain-Source Voltage	VDD	≤7	V
Input Power	Pin	14	dBm
Operating Backside Temperature	Top	-40 to +85	°C

This product should be hermetically packaged.

### ELECTRICAL CHARACTERISTICS (Ambient Temperature Ta=25°C)

Item	Symbol	Test Conditions	Limits			Unit
			Min.	Typ.	Max.	
Frequency Range	f	VDD=6.0V	17.7	-	19.7	GHz
Output Power at 1dB G.C.P.	P1dB	IDD(DC)=700mA typ.	25.0	27.0	-	dBm
Power Gain at 1dB G.C.P.	G1dB	Zs=Zl=50ohm	16	18	-	dB
Power Added Efficiency at 1dB G.C.P.	Nadd		-	12	-	%
Third Order Intermodulation	IM3*	*df=10MHz, Po=19dBm	-32	-35	-	dBc
Drain Current at 1dB G.C.P.	Iddrf	(S.C.L.)	-	700	1200	mA
Input Return Loss at Pin=-20dBm	RLin		-	-7	-	dB
Output Return Loss at Pin=-20dBm	RLout		-	-8	-	dB
Frequency Range	f	VDD=6.0V	21.2	-	27	GHz
Output Power at 1dB G.C.P.	P1dB	IDD(DC)=700mA typ.	27.0	29.0	-	dBm
Power Gain at 1dB G.C.P.	G1dB	Zs=Zl=50ohm	16	18	-	dB
Power Added Efficiency at 1dB G.C.P.	Nadd		-	15	-	%
Third Order Intermodulation	IM3**	**df=10MHz, Po=19dBm	-32	-35	-	dBc
Drain Current at 1dB G.C.P.	Iddrf	(S.C.L.)	-	900	1500	mA
Input Return Loss at Pin=-20dBm	RLin		-	-7	-	dB
Output Return Loss at Pin=-20dBm	RLout		-	-10	-	dB

Note : RF parameter sample size 10ps. Criteria (accept/reject)=(0/1)

G.C.P. : Gain Compression Point

S.C.L. : Single Carrier Level

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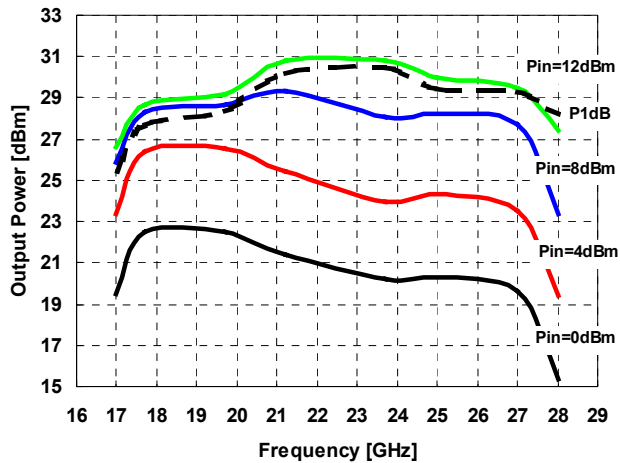
Note : Based on EIAJ ED-4701 C-111A(C=100pF, R=1.5kΩ)

# FMM5823X

## K-Band Power Amplifier MMIC

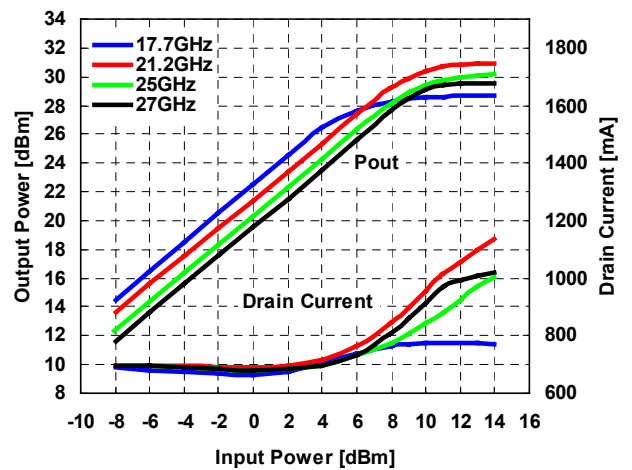
### Output Power vs. Frequency

VDD=6V, IDD(DC)=700mA



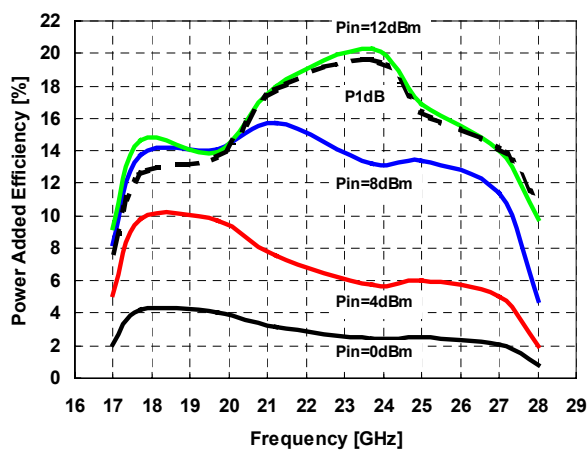
### Output Power, Drain Current vs. Input Power

VDD=6V, IDD(DC)=700mA



### Power Added Efficiency vs. Frequency

VDD=6V, IDD(DC)=700mA

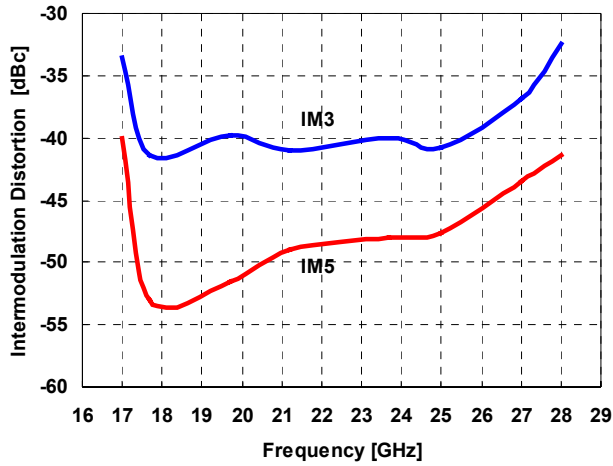


# FMM5823X

## K-Band Power Amplifier MMIC

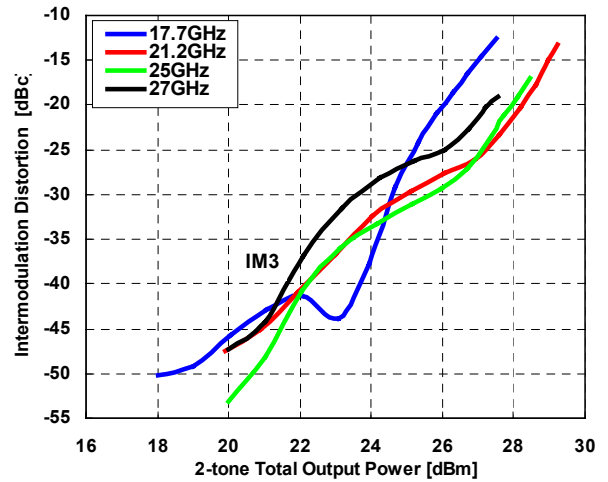
IMD vs. Frequency

VDD=6V, IDD(DC)=700mA, Pout=19dBm S.C.L.



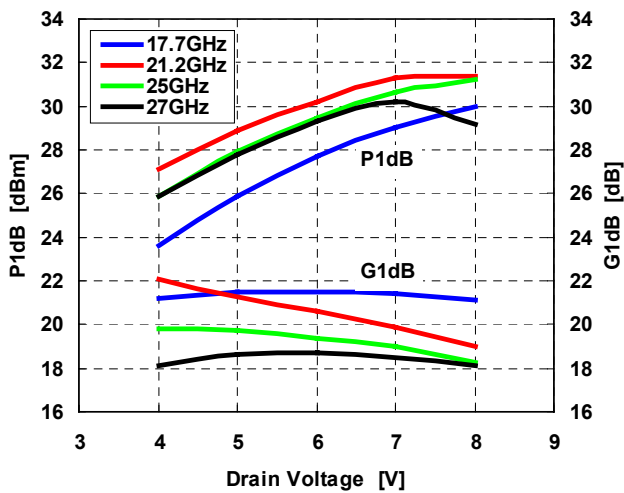
IMD vs. Output Power

VDD=6V, IDD(DC)=700mA



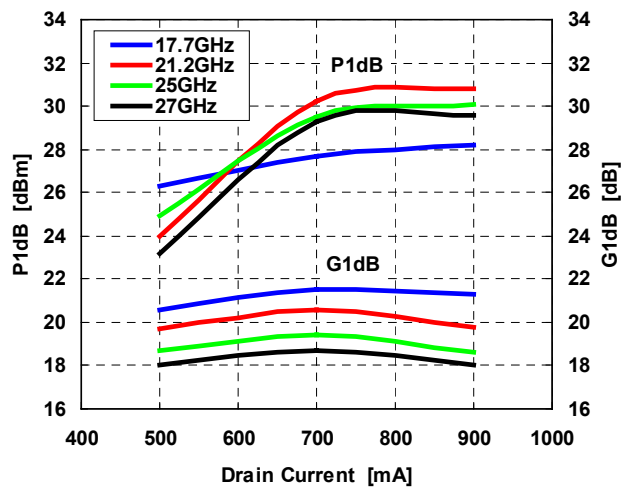
Output Power, Gain vs. Drain Voltage

IDD(DC)=700mA



Output Power, Gain vs. Drain Current

VDD=6V

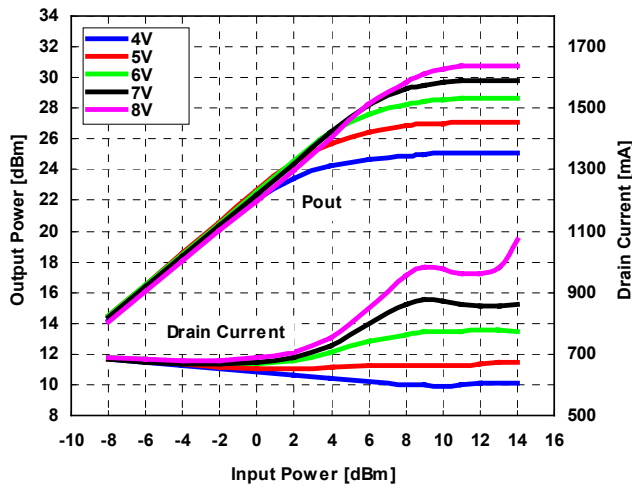


# FMM5823X

## K-Band Power Amplifier MMIC

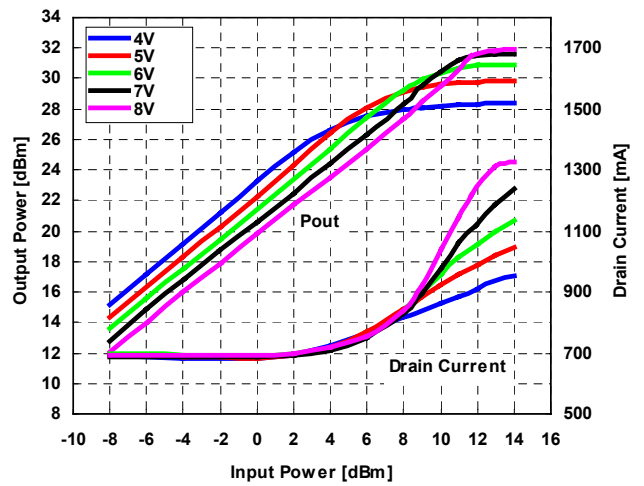
Output Power, Drain Current vs. Input Power by Drain Voltage

IDD(DC)=700mA, f=17.7GHz



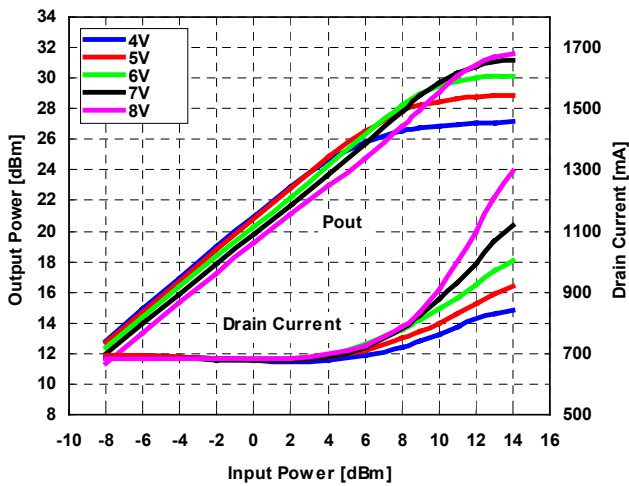
Output Power, Drain Current vs. Input Power by Drain Voltage

IDD(DC)=700mA, f=21.2GHz



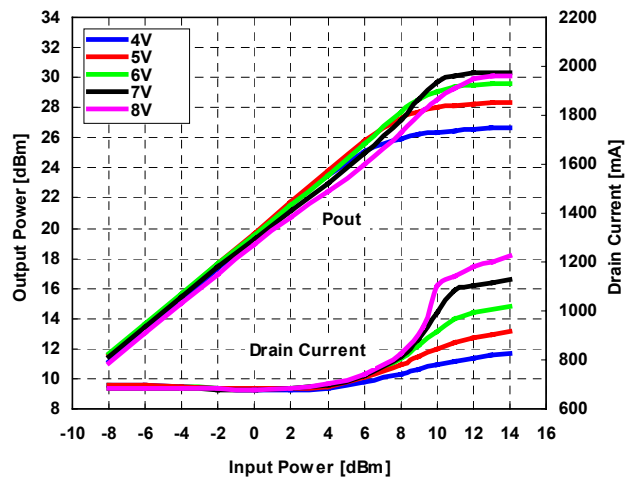
Output Power, Drain Current vs. Input Power by Drain Voltage

IDD(DC)=700mA, f=25GHz



Output Power, Drain Current vs. Input Power by Drain Voltage

IDD(DC)=700mA, f=27GHz

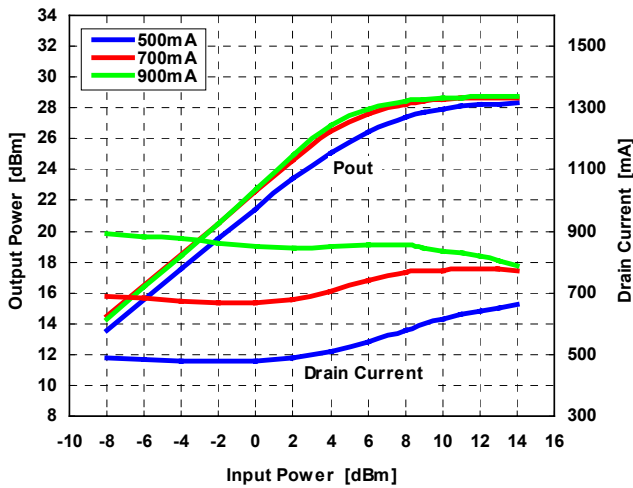


# FMM5823X

## K-Band Power Amplifier MMIC

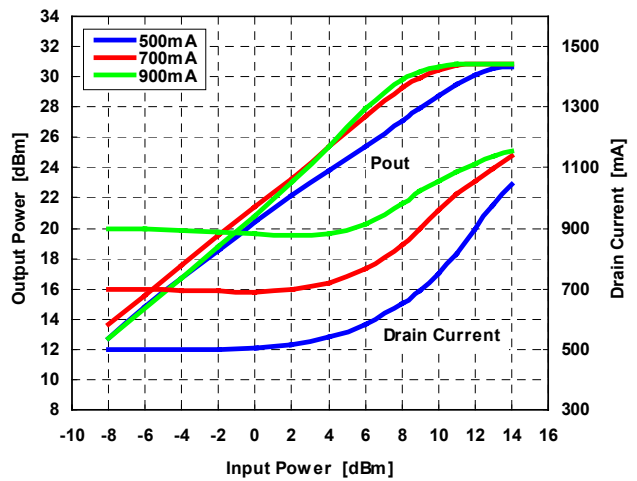
Output Power, Drain Current  
vs. Input Power by Drain Current

VDD=6V, f=17.7GHz



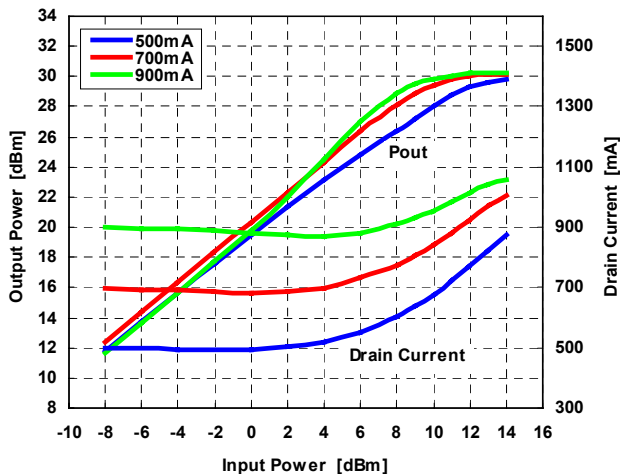
Output Power, Drain Current  
vs. Input Power by Drain Current

VDD=6V, f=21.2GHz



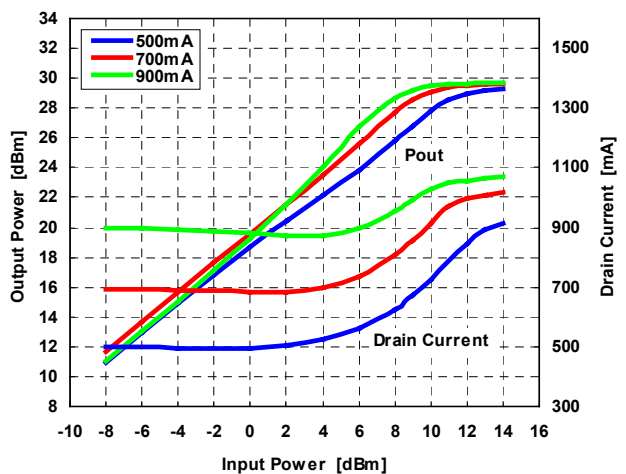
Output Power, Drain Current  
vs. Input Power by Drain Current

VDD=6V, f=25GHz



Output Power, Drain Current  
vs. Input Power by Drain Current

VDD=6V, f=27GHz

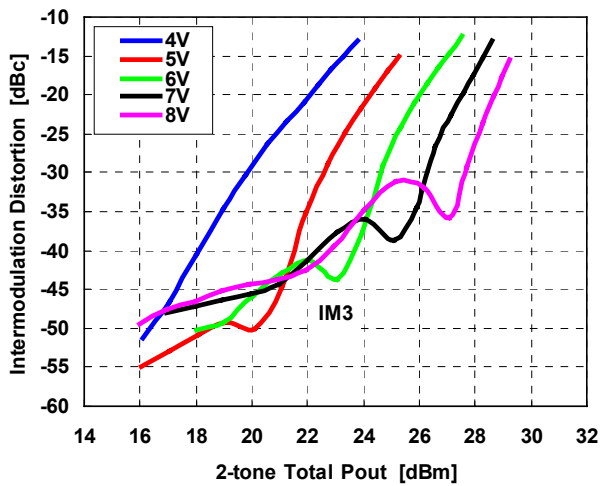


# FMM5823X

## K-Band Power Amplifier MMIC

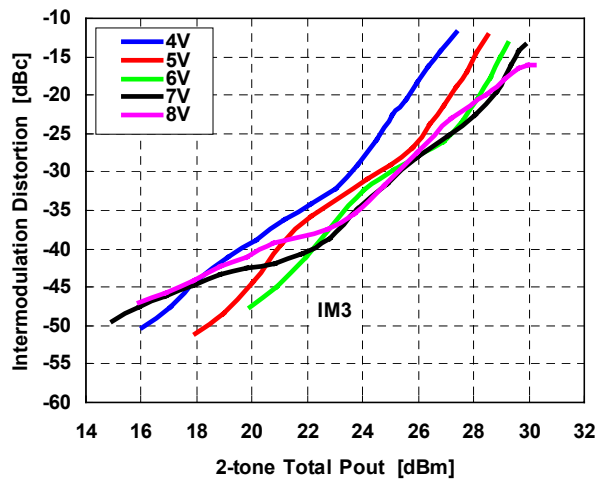
IMD vs. Output Power  
by Drain Voltage

IDD(DC)=700mA, f=17.7GHz



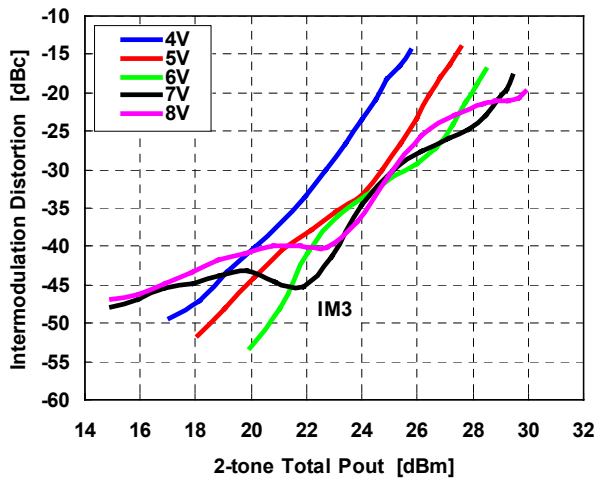
IMD vs. Output Power  
by Drain Voltage

IDD(DC)=700mA, f=21.2GHz



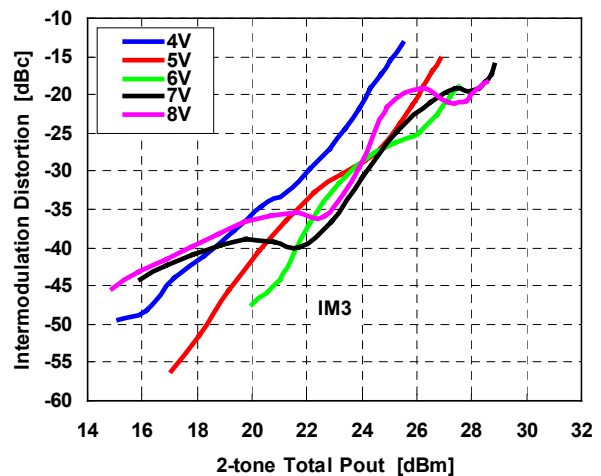
IMD vs. Output Power  
by Drain Voltage

IDD(DC)=700mA, f=25GHz



IMD vs. Output Power  
by Drain Voltage

IDD(DC)=700mA, f=27GHz



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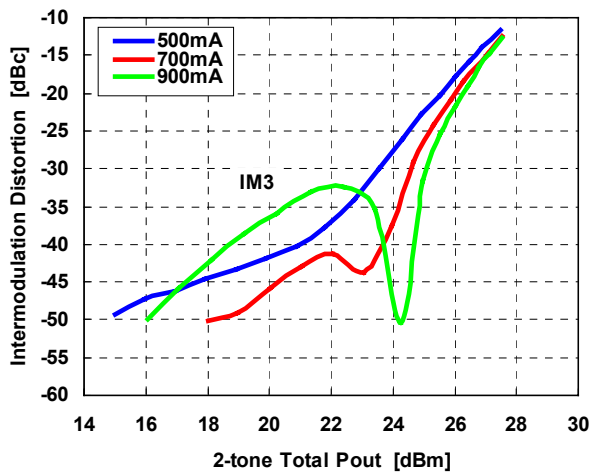
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# FMM5823X

## K-Band Power Amplifier MMIC

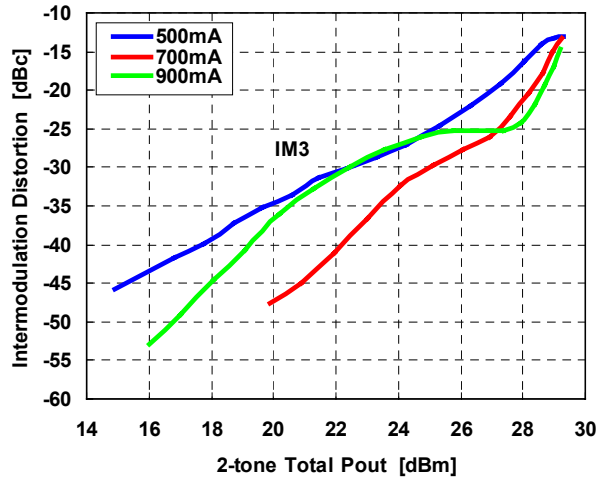
IMD vs. Output Power  
by Drain Current

VDD=6V, f=17.7GHz



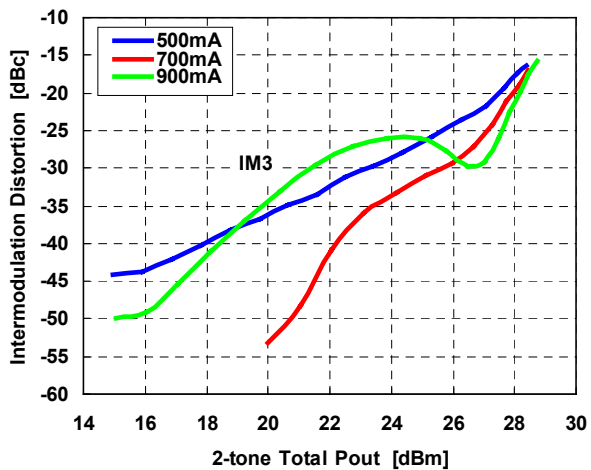
IMD vs. Output Power  
by Drain Current

VDD=6V, f=21.2GHz



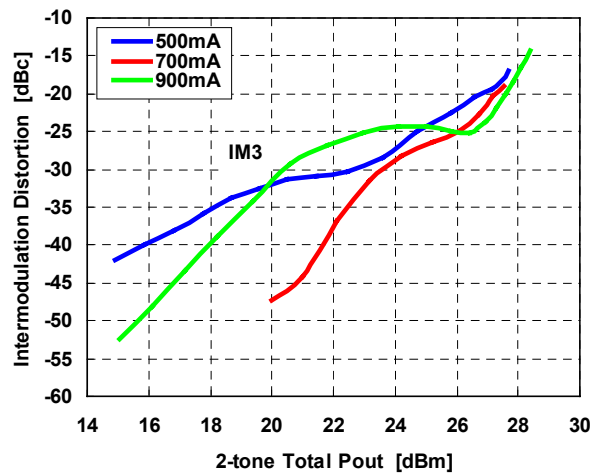
IMD vs. Output Power  
by Drain Current

VDD=6V, f=25GHz



IMD vs. Output Power  
by Drain Current

VDD=6V, f=27GHz

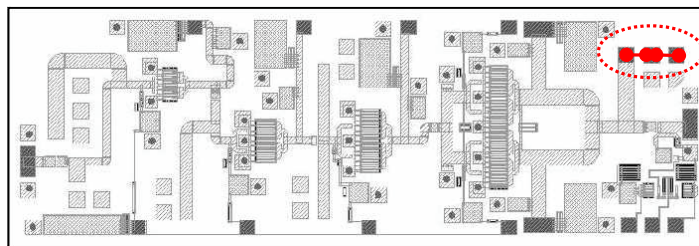


# FMM5823X

## K-Band Power Amplifier MMIC

### TUNING PERFORMANCE

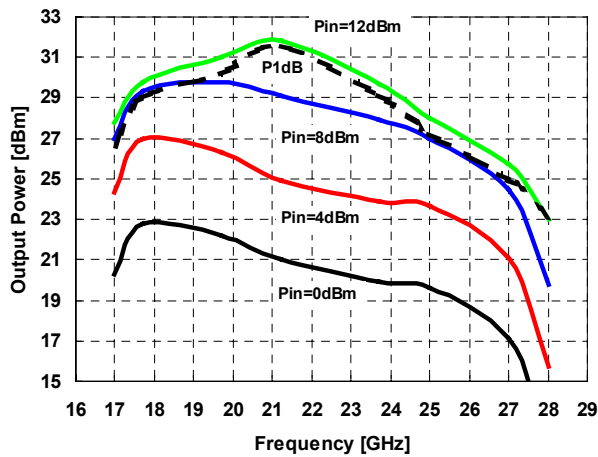
FMM5823X can be improved lower band performance by wire-bonding on MMIC chip.



Tuning Position

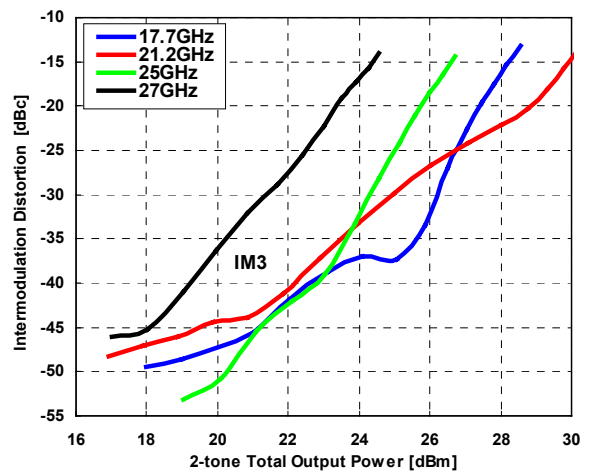
#### Output Power vs. Frequency

VDD=6V, IDD(DC)=700mA, with-Tuning



#### IMD vs. Output Power

VDD=6V, IDD(DC)=700mA, with-Tuning





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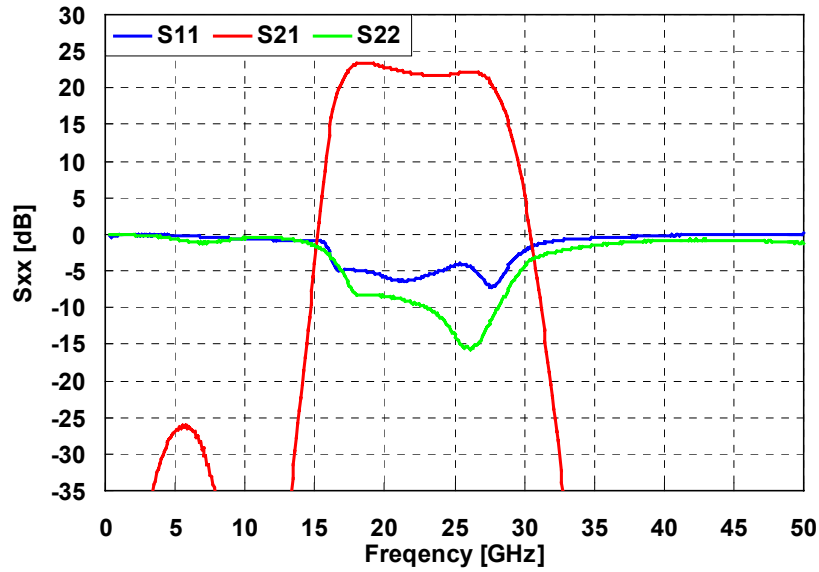
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# FMM5823X

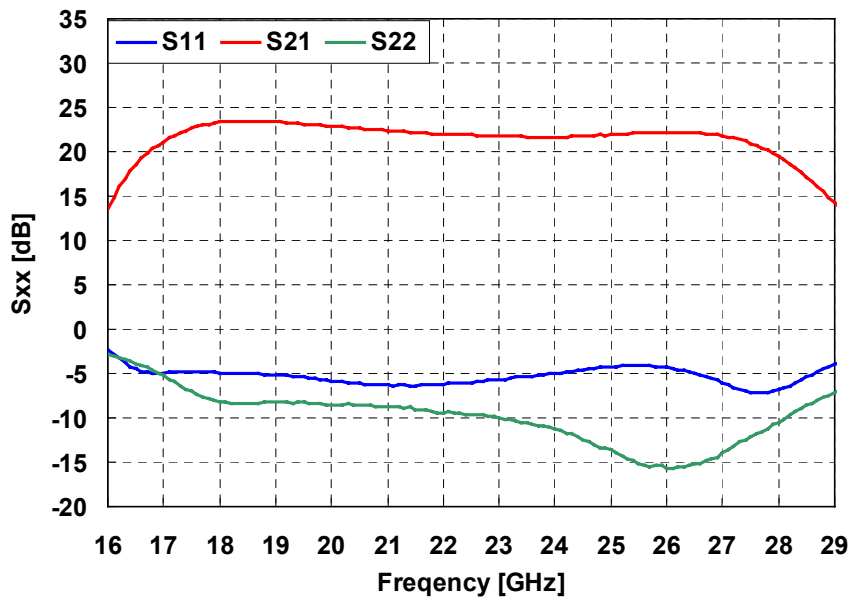
K-Band Power Amplifier MMIC

## ■ S-PARAMETER

@VDD=6V, IDD=700mA



@VDD=6V, IDD=700mA



# FMM5823X

## K-Band Power Amplifier MMIC

### ■ S-PARAMETER

@VDD=6V, IDD=700mA

Frequency [GHz]	S11		S21		S12		S22		Frequency [GHz]	S11		S21		S12		S22	
	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang		Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
1.0	0.99	-14.89	0.01	120.39	0.0001	-24.51	0.99	-31.61	25.2	0.62	-92.87	12.56	-165.09	0.0014	53.53	0.19	66.92
2.0	0.99	-28.80	0.01	-35.01	0.0001	-20.61	0.99	-60.61	25.4	0.63	-100.40	12.67	179.93	0.0017	-16.31	0.18	58.31
3.0	0.99	-42.81	0.01	-136.89	0.0001	-116.82	0.98	-83.84	25.6	0.62	-107.94	12.70	165.03	0.0011	47.68	0.17	50.35
4.0	0.99	-56.16	0.03	119.67	0.0001	83.19	0.95	-104.08	25.8	0.62	-115.84	12.77	149.62	0.0009	6.78	0.17	42.17
5.0	0.98	-69.22	0.05	22.00	0.0002	38.40	0.93	-119.04	26.0	0.61	-124.47	12.79	134.08	0.0007	-32.21	0.17	30.69
6.0	0.98	-81.91	0.05	-65.62	0.0001	-68.77	0.89	-130.59	26.2	0.59	-133.52	12.83	117.98	0.0006	67.94	0.17	19.14
7.0	0.96	-93.46	0.03	-148.65	0.0000	-10.30	0.88	-138.69	26.4	0.58	-144.20	12.81	101.33	0.0006	10.84	0.17	10.91
8.0	0.95	-104.22	0.01	141.72	0.0002	-135.47	0.89	-145.43	26.6	0.55	-155.39	12.72	84.19	0.0011	-68.05	0.18	0.06
9.0	0.94	-114.42	0.00	105.72	0.0003	-146.04	0.92	-153.48	26.8	0.53	-168.60	12.54	66.62	0.0010	30.33	0.18	-8.37
10.0	0.93	-124.79	0.00	151.63	0.0004	-146.06	0.94	-161.52	27.0	0.50	176.92	12.29	48.60	0.0005	-13.77	0.20	-14.64
11.0	0.93	-135.00	0.00	-155.34	0.0007	140.78	0.95	-170.05	28.0	0.45	81.72	9.37	-47.86	0.0002	19.37	0.30	-46.15
12.0	0.92	-145.63	0.00	-0.28	0.0006	132.62	0.95	-178.90	29.0	0.63	8.95	5.15	-147.70	0.0014	65.92	0.44	-65.59
13.0	0.91	-156.86	0.01	29.34	0.0007	83.44	0.93	171.82	30.0	0.77	-28.92	1.85	112.99	0.0024	-31.00	0.61	-85.92
14.0	0.91	-169.48	0.08	18.06	0.0009	69.99	0.90	161.87	31.0	0.86	-51.81	0.42	33.39	0.0012	-77.14	0.71	-105.06
15.0	0.91	173.95	0.63	-27.32	0.0009	11.68	0.84	150.68	32.0	0.89	-67.39	0.08	-22.65	0.0013	164.14	0.76	-118.37
16.0	0.77	147.12	4.75	-124.06	0.0005	-70.94	0.73	138.43	33.0	0.92	-78.92	0.01	-49.31	0.0006	-154.17	0.79	-128.63
17.0	0.57	145.60	11.41	104.34	0.0004	-124.07	0.55	128.21	34.0	0.93	-87.89	0.00	60.73	0.0014	-72.50	0.82	-137.00
17.6	0.57	138.71	13.82	36.89	0.0004	-179.59	0.43	130.09	35.0	0.94	-95.09	0.01	4.98	0.0010	76.56	0.84	-144.78
17.8	0.57	135.34	14.31	15.89	0.0005	-150.78	0.41	132.36	36.0	0.95	-101.06	0.00	-11.36	0.0003	-44.58	0.86	-150.87
18.0	0.57	132.14	14.68	-4.55	0.0006	-121.06	0.39	135.70	37.0	0.95	-106.85	0.00	-32.17	0.0007	109.01	0.87	-157.63
18.2	0.57	128.11	14.86	-24.36	0.0006	137.19	0.38	138.23	38.0	0.96	-111.46	0.00	-54.54	0.0009	150.06	0.89	-163.05
18.4	0.56	123.95	14.87	-43.04	0.0005	175.38	0.38	140.47	39.0	0.97	-115.56	0.00	-124.10	0.0008	70.69	0.89	-169.09
18.6	0.56	119.48	14.93	-61.37	0.0008	142.55	0.38	141.92	40.0	0.98	-119.44	0.00	-38.24	0.0006	-29.58	0.91	-174.46
18.8	0.56	114.55	14.88	-79.11	0.0008	146.79	0.39	142.82	41.0	0.99	-123.57	0.00	-54.25	0.0017	11.94	0.91	179.80
19.0	0.55	109.29	14.77	-96.03	0.0007	46.06	0.39	142.87	42.0	0.99	-126.88	0.00	125.84	0.0011	-130.60	0.91	174.11
19.2	0.55	103.58	14.58	-112.64	0.0007	98.08	0.39	142.53	43.0	0.99	-130.10	0.00	-123.75	0.0008	-123.02	0.91	168.69
19.4	0.54	97.46	14.37	-128.45	0.0010	79.04	0.38	142.66	44.0	0.99	-133.53	0.00	-125.78	0.0011	-57.23	0.92	162.96
19.6	0.53	91.69	14.22	-143.85	0.0003	-66.43	0.38	141.81	45.0	0.99	-136.46	0.00	-62.92	0.0012	-117.37	0.91	156.61
19.8	0.52	85.09	14.06	-159.26	0.0012	81.95	0.38	141.51	46.0	0.99	-139.06	0.00	148.78	0.0010	-47.81	0.91	150.46
20.0	0.51	78.45	13.85	-173.97	0.0012	-152.89	0.38	141.88	47.0	0.99	-142.33	0.00	36.80	0.0011	1.62	0.90	143.76
20.2	0.50	72.00	13.76	171.54	0.0006	125.81	0.37	141.06	48.0	0.99	-145.09	0.01	92.45	0.0012	45.14	0.89	136.62
20.4	0.50	65.01	13.59	157.09	0.0005	66.98	0.37	140.49	49.0	0.99	-147.79	0.01	143.09	0.0006	-70.26	0.88	129.61
20.6	0.49	57.96	13.46	142.88	0.0008	31.23	0.37	140.33	50.0	0.99	-167.68	0.00	173.49	0.0016	-164.23	0.87	120.93
20.8	0.49	50.49	13.31	128.92	0.0005	14.65	0.37	139.43									
21.0	0.48	43.17	13.12	115.45	0.0007	97.87	0.37	138.36									
21.2	0.48	36.08	13.01	101.92	0.0006	10.28	0.36	137.88									
21.4	0.48	28.64	12.90	88.18	0.0001	-75.66	0.36	135.98									
21.6	0.48	21.49	12.77	74.87	0.0010	129.71	0.35	134.13									
21.8	0.49	14.15	12.66	61.77	0.0004	-19.85	0.35	132.70									
22.0	0.49	7.08	12.57	48.62	0.0005	-151.98	0.34	132.29									
22.2	0.50	-0.27	12.59	35.35	0.0009	176.30	0.34	130.29									
22.4	0.50	-7.81	12.46	22.01	0.0011	97.15	0.33	129.02									
22.6	0.50	-14.02	12.38	8.99	0.0008	154.43	0.33	126.66									
22.8	0.51	-20.69	12.32	-4.17	0.0012	100.80	0.32	124.52									
23.0	0.52	-26.94	12.26	-17.27	0.0003	161.09	0.31	121.83									
23.2	0.53	-33.23	12.24	-30.17	0.0002	-42.29	0.31	118.88									
23.4	0.54	-39.57	12.21	-43.52	0.0019	119.96	0.30	115.17									
23.6	0.54	-45.35	12.15	-56.53	0.0004	38.82	0.29	111.49									
23.8	0.55	-51.03	12.14	-69.76	0.0011	80.63	0.29	108.23									
24.0	0.56	-56.68	12.09	-82.88	0.0012	113.39	0.27	103.21									
24.2	0.57	-61.71	12.10	-95.92	0.0015	49.10	0.26	98.37									
24.4	0.58	-67.71	12.19	-109.46	0.0009	70.06	0.25	92.23									
24.6	0.59	-73.01	12.23	-122.86	0.0023	43.01	0.23	86.73									
24.8	0.61	-79.81	12.41	-136.65	0.0013	-18.87	0.21	81.93									
25.0	0.62	-86.39	12.48	-150.90	0.0010	85.71	0.21	75.12									

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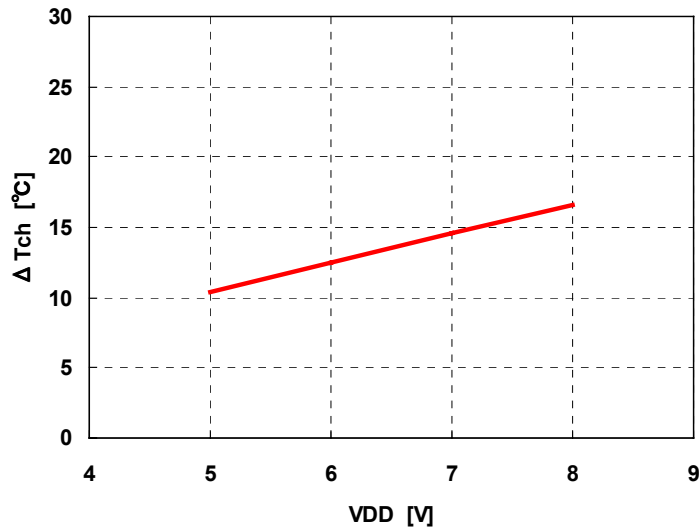
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# FMM5823X

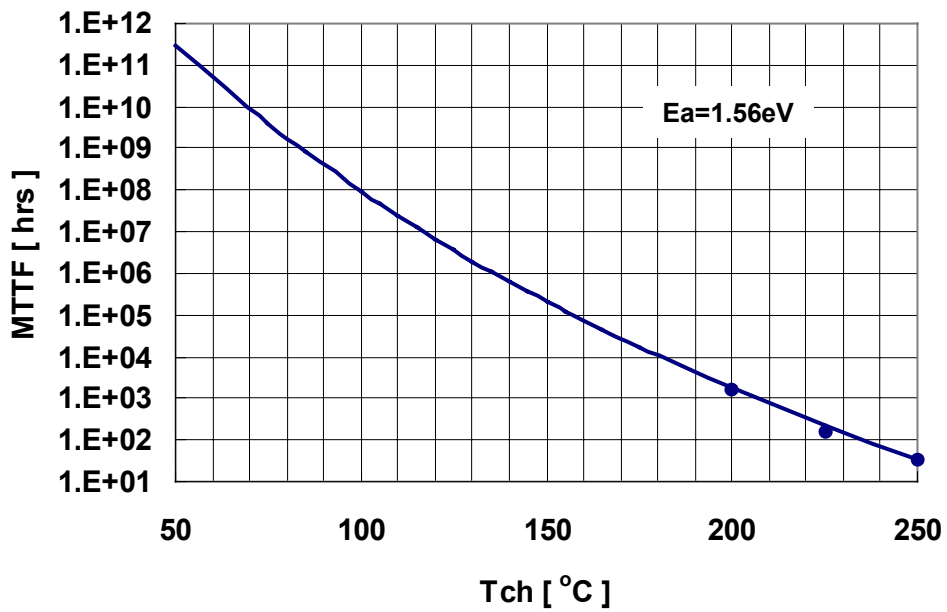
K-Band Power Amplifier MMIC

$\Delta T_{ch}$  vs. Drain Voltage  
(Reference)

IDD(DC)=700mA



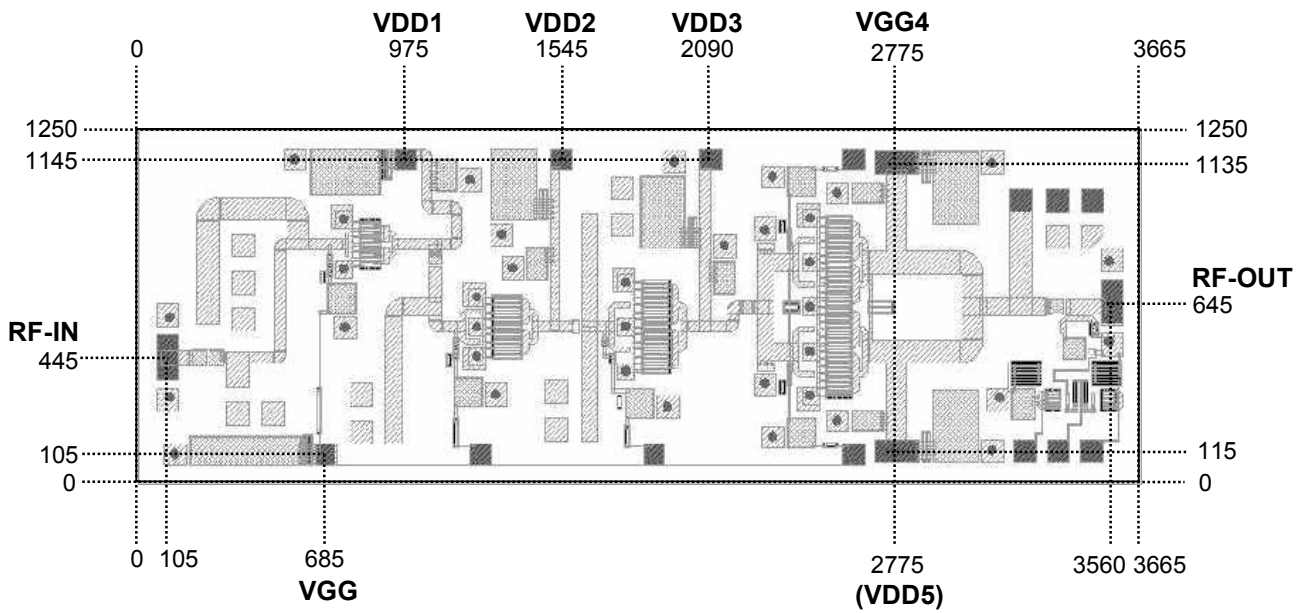
MTTF vs.  $T_{ch}$



# FMM5823X

## K-Band Power Amplifier MMIC

### ■ Chip Outline and Bonding Pad Locations (Dimension in Micro-Meters)



Chip Size :  $3665 \pm 30 \mu\text{m} \times 1250 \pm 30 \mu\text{m}$

Chip Thickness :  $60 \pm 20 \mu\text{m}$

Bonding Pad Size :

RF-Pad :  $80 \mu\text{m} \times 160 \mu\text{m}$

VGG, VDD1~3 Pad :  $80 \mu\text{m} \times 80 \mu\text{m}$

VDD4, VDD5 Pad :  $160 \mu\text{m} \times 80 \mu\text{m}$

Note : Drain voltage is required from either or both bonding pad( VDD4 or/and VDD5).

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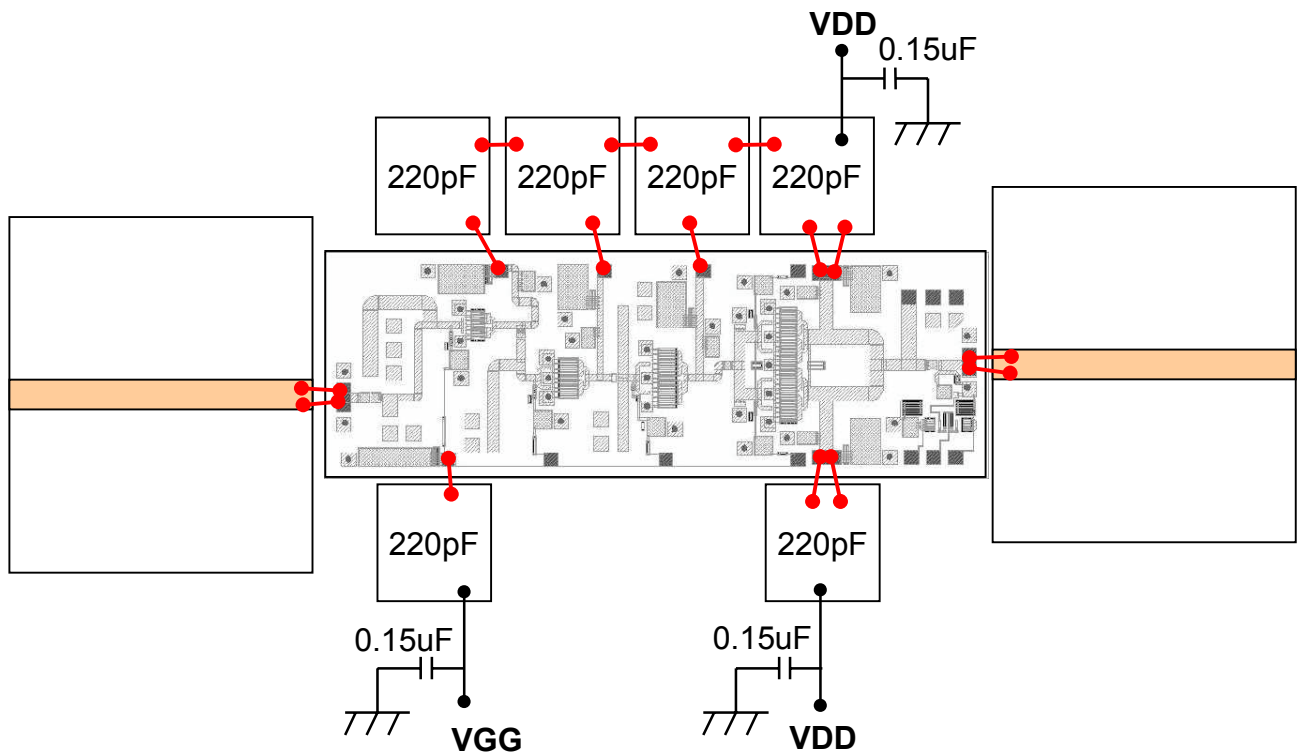
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# FMM5823X

K-Band Power Amplifier MMIC

## ■ Assembly Diagrams

### Recommended assembly



“Copper” is the recommended material for the package or carrier.

# FMM5823X

## K-Band Power Amplifier MMIC

### ■ DIE ATTACH

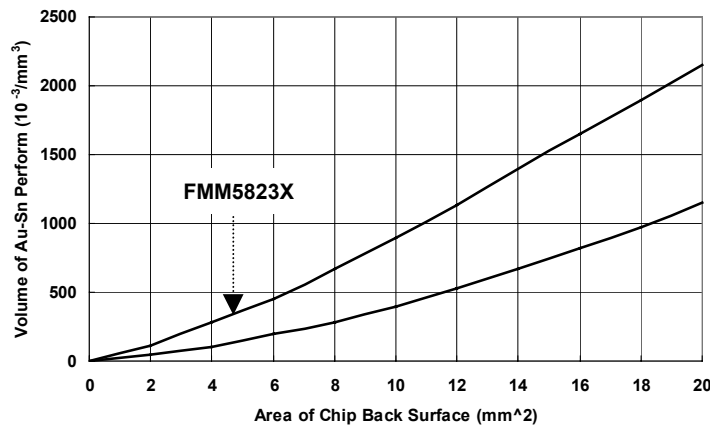
- 1) The die-attach station must have accurate temperature control and an inert forming gas should be used.
- 2) Chips should be kept at room temperature except during die-attach.
- 3) Place package or carrier on the heated stage.
- 4) Lightly grasp the chip edges by the longer side using tweezers.

#### Die attach conditions

Stage Temperature : 300 to 310 deg.C

Time : less than 15 seconds

AuSn Preform 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  $\pm$  0.0196 N

Stage Temperature : 215 deg.C  $\pm$  5 deg.C

Tool Heater : None

Ultrasonic Power Transmitter : West Bond Model 1400

Duration : 150 mS/Bond

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# FMM5823X

## K-Band Power Amplifier MMIC

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