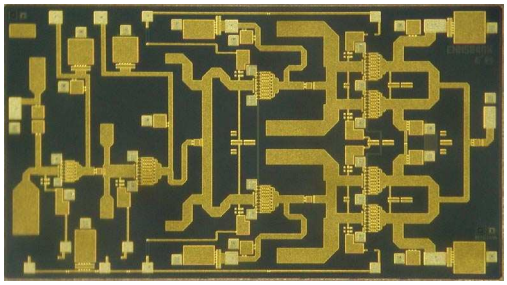
EMM5840X

K-Band Power Amplifier MMIC

FEATURES

- High Output Power; P_{1dB} = 31 dBm (Typ.)
- High Linear Gain; G_L = 25 dB(Typ.)
- Frequency Band ; 21.0 - 27.0 GHz
- High Linearity ; OIP_3 = 39dBm
- Impedance Matched Z_{in}/Z_{out} = 50Ω



DESCRIPTION

The EMM5840X is a power amplifier MMIC that contains a four stage amplifier, internally matched, for standard communications band in 21.0 to 27.0GHz frequency range. This product is well suited for point-to-point radio applications.

SEDI'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	26	dBm
Storage Temperature	Tstg	-55 to +125	°C

Note : Semiconductor devices can be permanently damaged by appreciation of stress (Voltage, Current, Temperature, etc.) not exceed these ratings.

RECOMMENDED OPERATING CONDITIONS

Item	Symbol	Rating	Unit
Drain-Source Voltage	VDD	≦ 7	V
Input Power	Pin	≦ 12	dBm
Operating Case Temperature	Tc	-40 to +85	°C

ELECTRICAL CHARACTERISTICS (Ambient Temperature Ta=25°C)

Item	Symbol	Test Conditions	Limits			Unit
			min.	Typ.	Max.	
Frequency Range	f		21	-	27	GHz
Output Power at 1dB G.C.P.	P1dB	VDD=6V	29	31	-	dBm
Power Gain at 1dB G.C.P.	G1dB	IDD(DC)=800mA typ.	19	24	-	dB
Power-added Efficiency at 1dB G.C.P.	ηadd		-	21	-	%
Third Order Intermodulation Distortion	IM3 *	* : delta f =+10MHz	-34	-38	-	dBc
Drain Current at 1dB G.C.P.	IDDRF	2-tone Test	-	1000	1500	mA
Input Return Loss	RLin	Pout=20dBm S.C.L.	-	8	-	dB
Output Return Loss	RLout		-	8	-	dB

Note : a) The electrical characteristics are guaranteed by the wafer acceptance test, the number of the sample size is 10 pcs. / Wafer. Criteria (accept / reject) = (0 , 1)
b) 1dB G.C.P. : 1dB Gain Compression Point
c) S.C.L. : Single Carrier Level

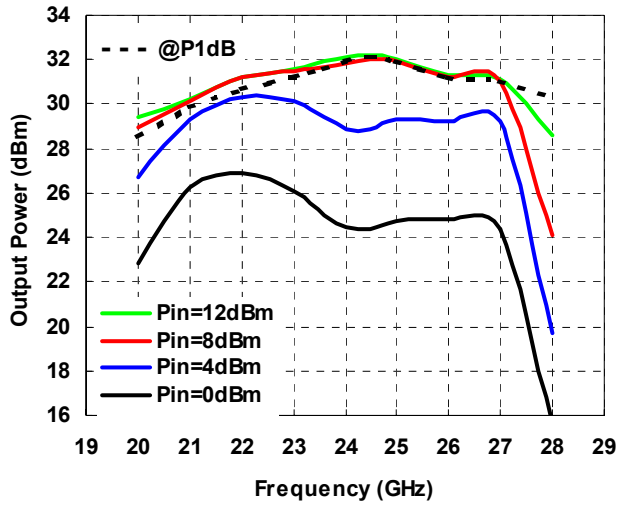
ESD	Class 0	≦ 250V

Note : Based on JEDEC JESD22-A114C (C=100pF, R=1.5kohm)

RoHS Compliance	YES

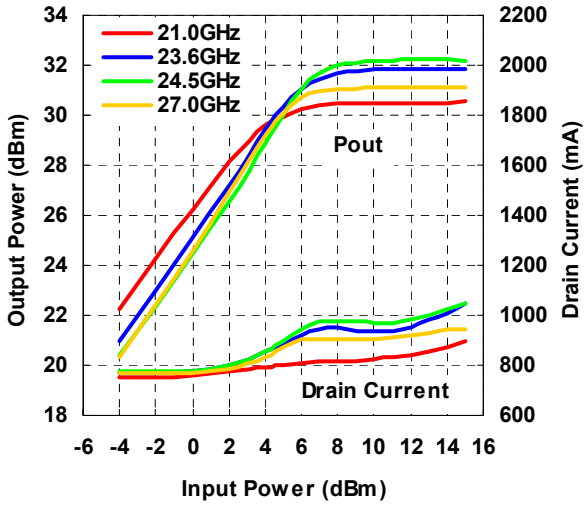
Output Power vs. Frequency

@ VDD=6V, IDD(DC)=800mA



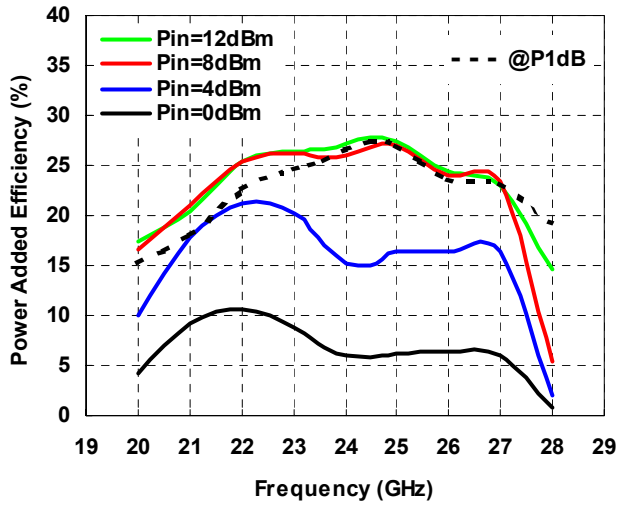
Output Power, Drain Current vs. Input Power

@ VDD=6V, IDD(DC)=800mA



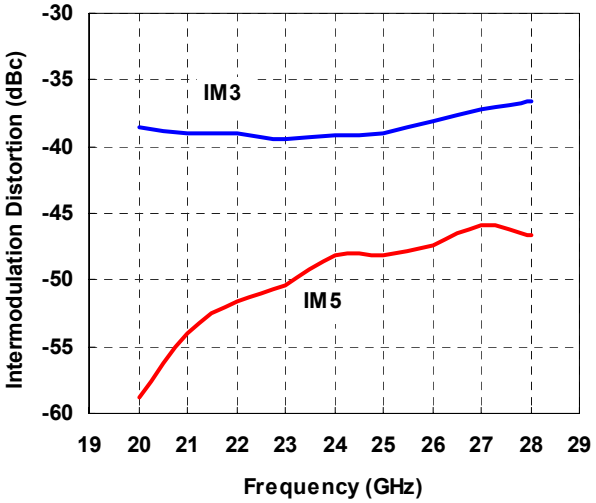
Power Added Efficiency vs. Frequency

@ VDD=6V, IDD(DC)=800mA



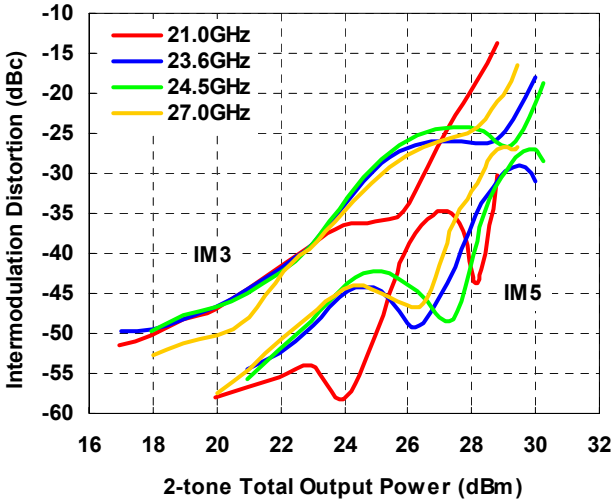
IMD vs. Frequency

@ VDD=6V, IDD(DC)=800mA, Pout=20dBm (S.C.L.)



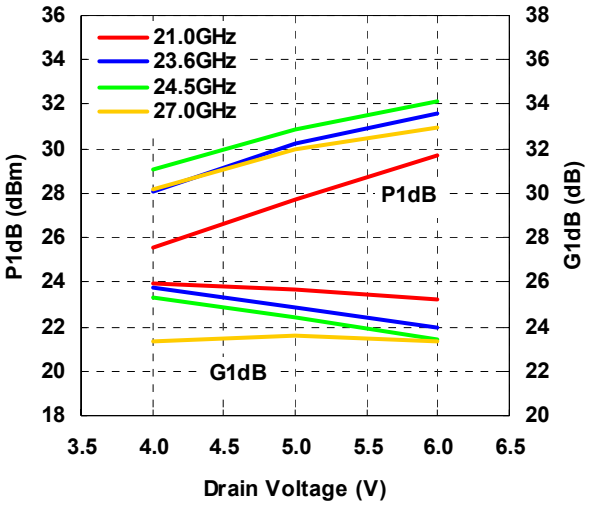
IMD vs. Output Power

@ VDD=6V, IDD(DC)=800mA



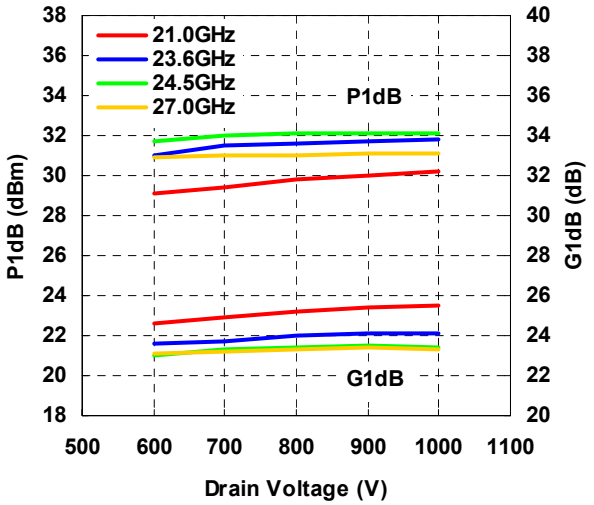
Output Power, Gain vs. Drain Voltage

@ IDD(DC)=800mA



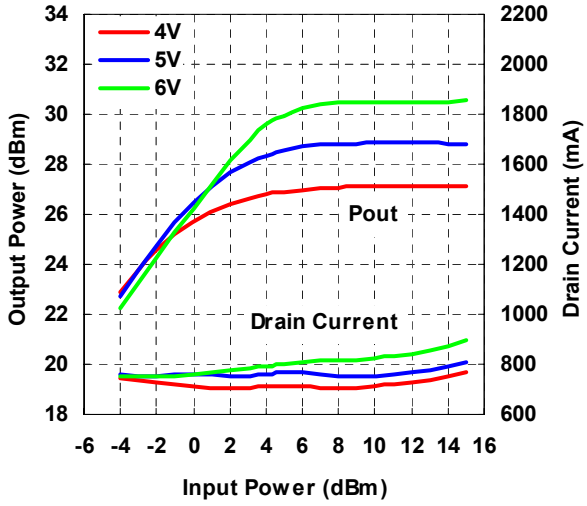
Output Power, Gain vs. Drain Current

@ VDD=6V



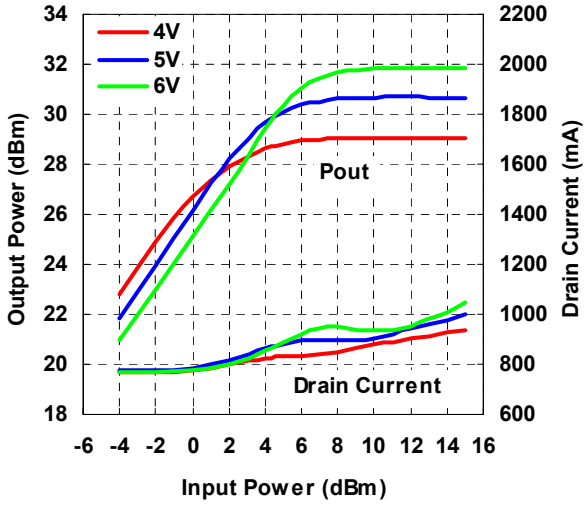
Output Power, Drain Current vs. Input Power by Drain Voltage

@ freq.=21.0GHz, IDD(DC)=800mA



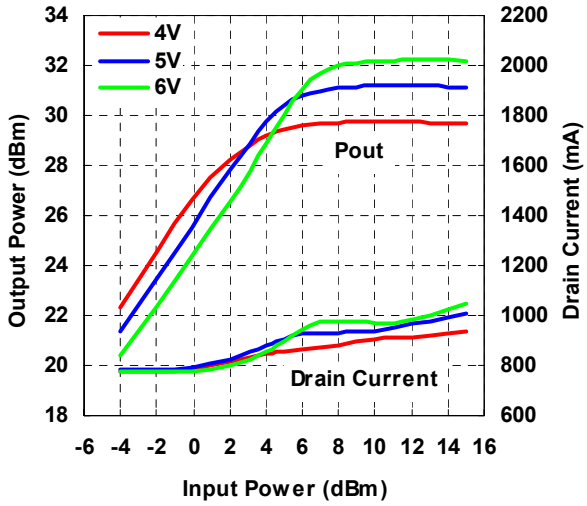
Output Power, Drain Current vs. Input Power by Drain Voltage

@ freq.=23.6GHz, IDD(DC)=800mA



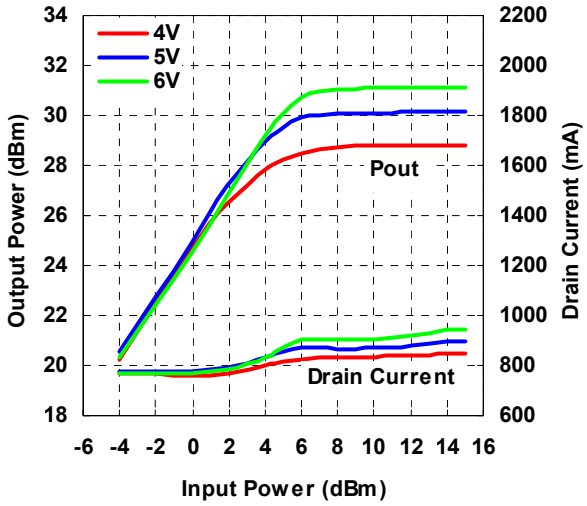
Output Power, Drain Current vs. Input Power by Drain Voltage

@ freq.=24.5GHz, IDD(DC)=800mA



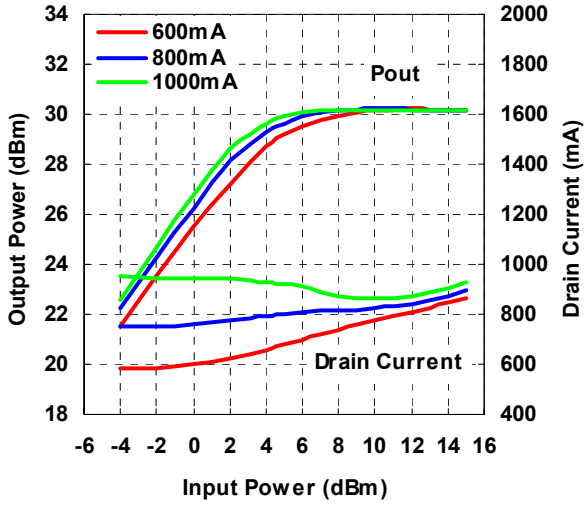
Output Power, Drain Current vs. Input Power by Drain Voltage

@ freq.=27.0GHz, IDD(DC)=800mA



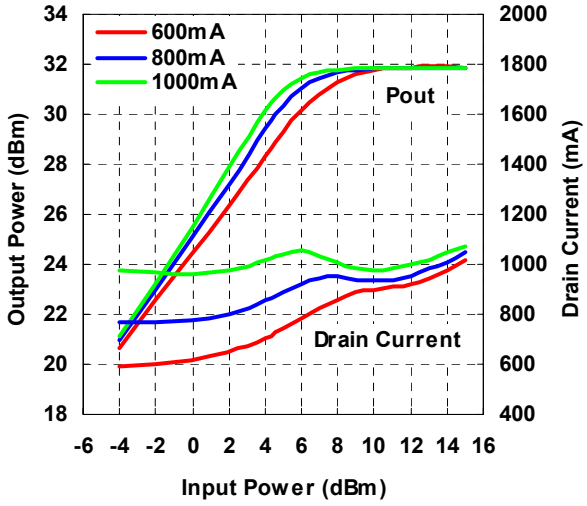
Output Power, Drain Current vs. Input Power by Drain Current

@ freq.=21.0GHz, VDD(DC)=6V



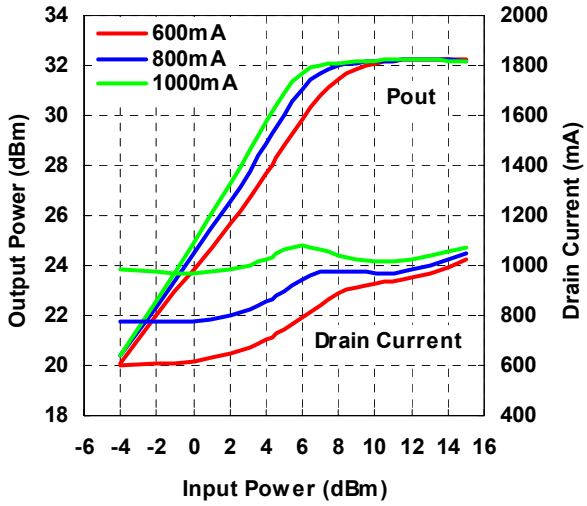
Output Power, Drain Current vs. Input Power by Drain Current

@ freq.=23.6GHz, VDD=6V



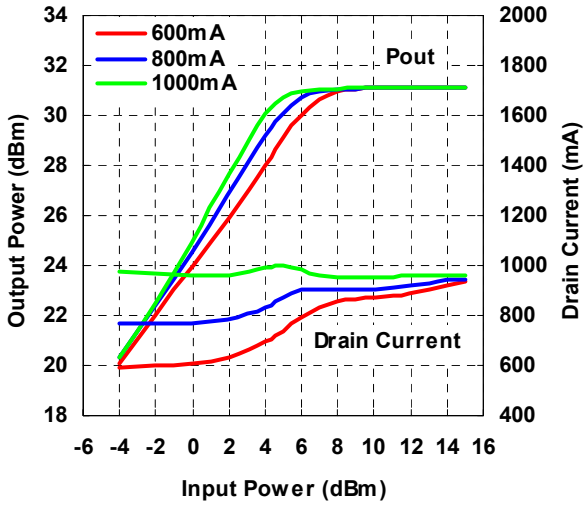
Output Power, Drain Current vs. Input Power by Drain Current

@ freq.=24.5GHz, VDD=6V



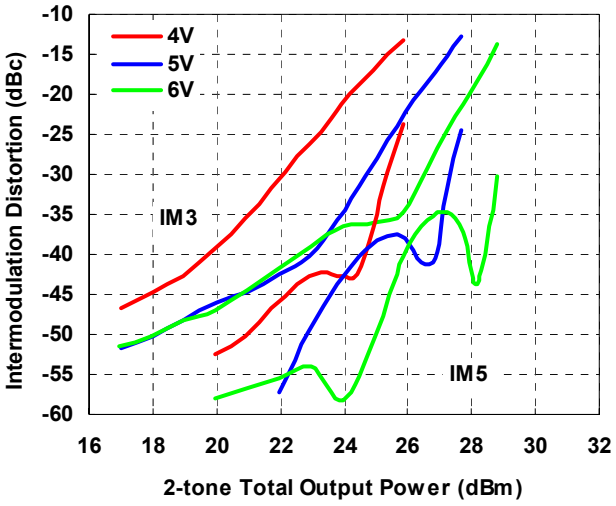
Output Power, Drain Current vs. Input Power by Drain Current

@ freq.=27.0GHz, VDD(DC)=6V



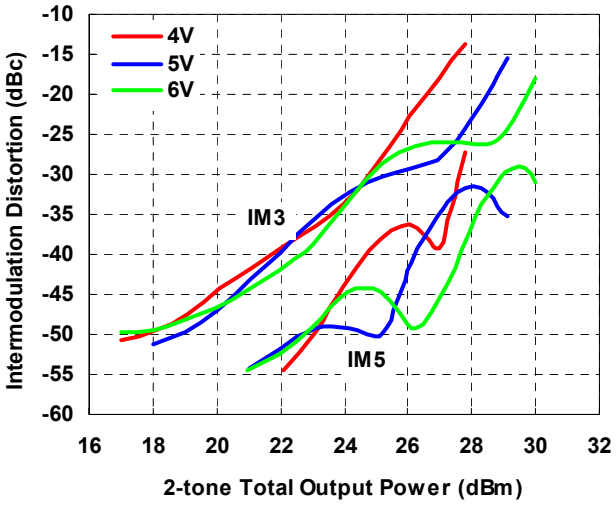
IMD vs. Output Power by Drain Voltage

@ freq.=21.0GHz, IDD(DC)=800mA



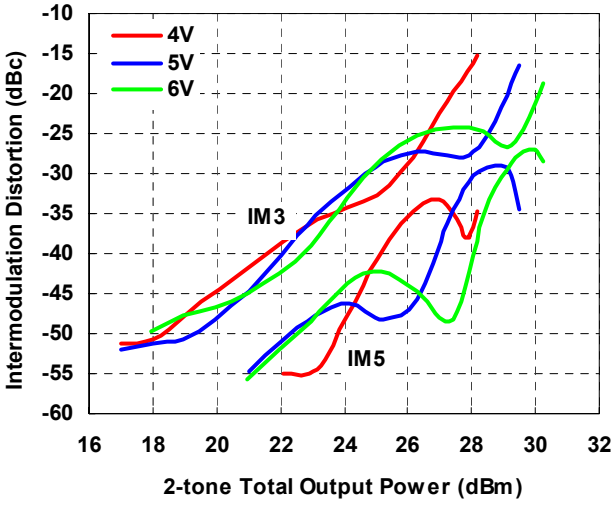
IMD vs. Output Power by Drain Voltage

@ freq.=23.6GHz, IDD(DC)=800mA



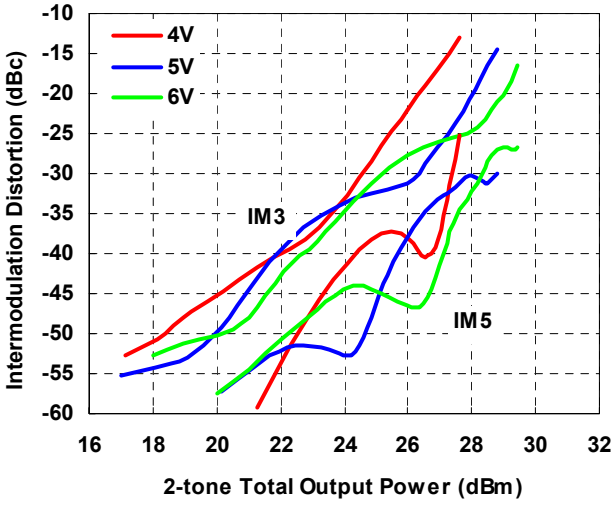
IMD vs. Output Power by Drain Voltage

@ freq.=24.5GHz, IDD(DC)=800mA



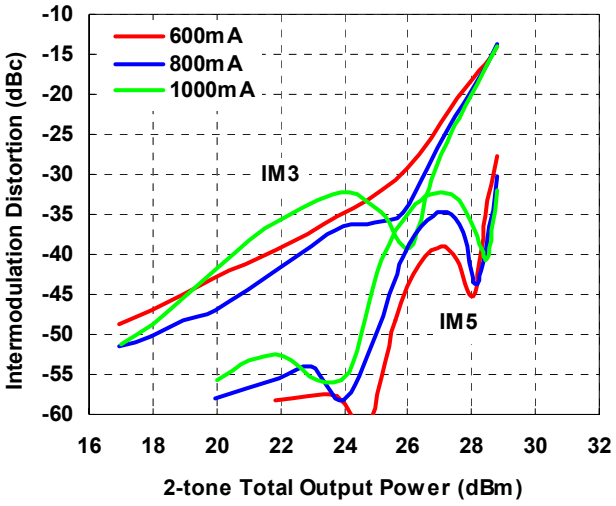
IMD vs. Output Power by Drain Voltage

@ freq.=27.0GHz, IDD(DC)=800mA



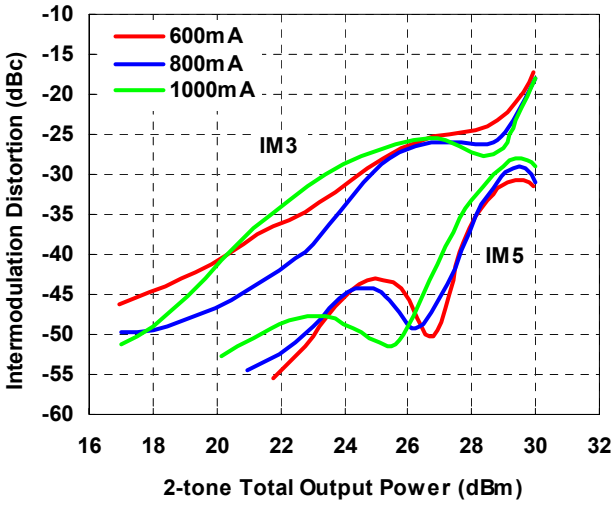
IMD vs. Output Power by Drain Current

@ freq.=21.0GHz, VDD=6V



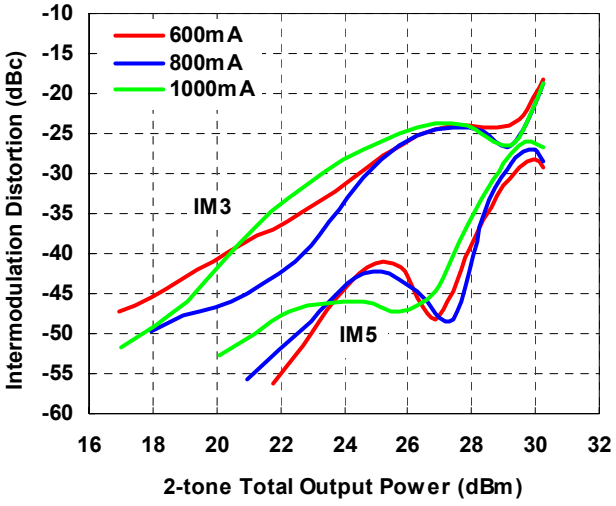
IMD vs. Output Power by Drain Current

@ freq.=23.6GHz, VDD=6V



IMD vs. Output Power by Drain Current

@ freq.=24.5GHz, VDD=6V



IMD vs. Output Power by Drain Current

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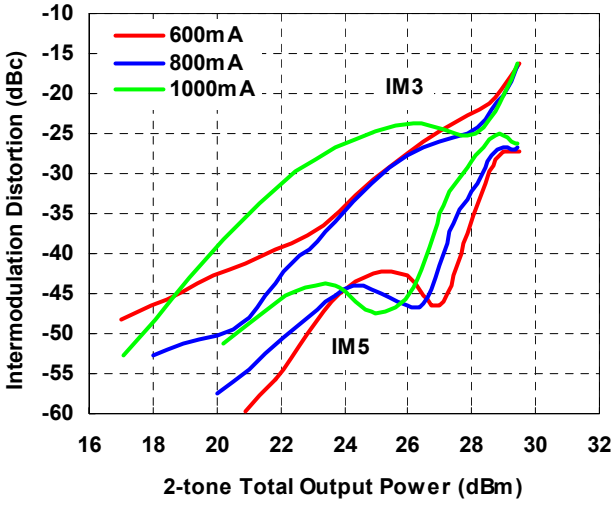
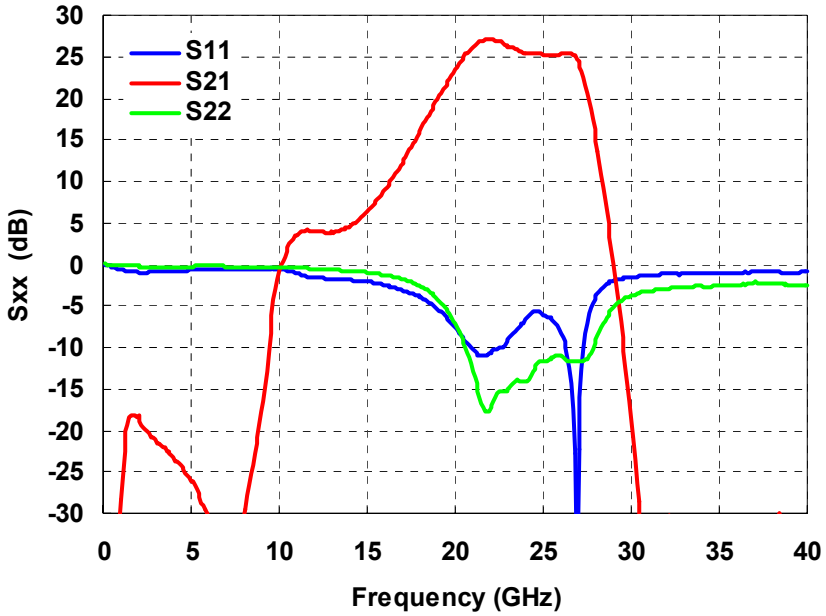
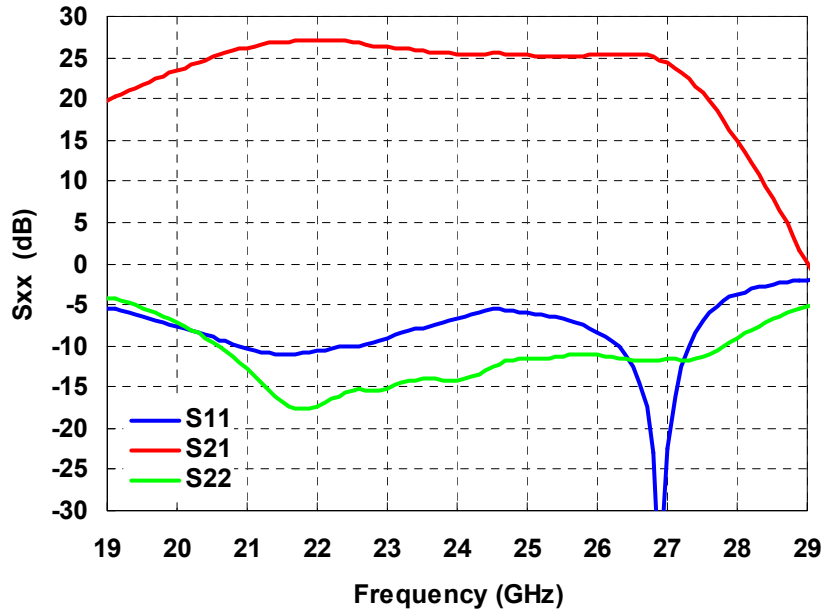


■S-PARAMETER

VDD=6V, IDD=800mA



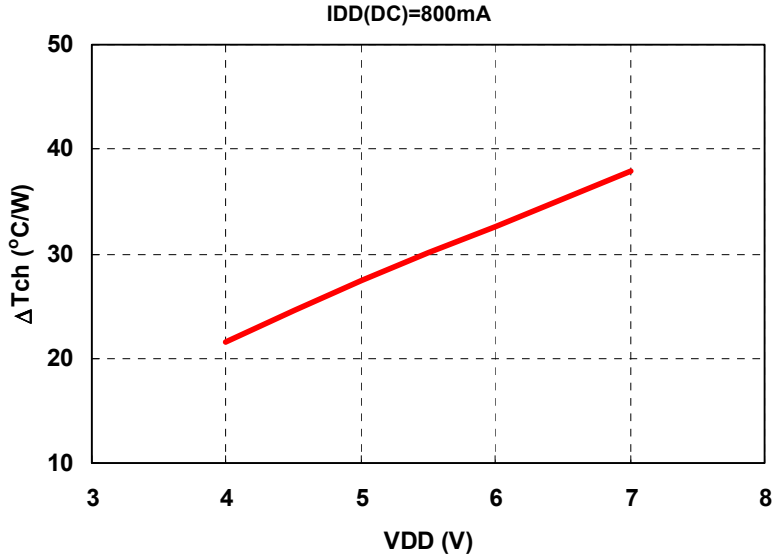


■S-PARAMETER

VDD=6V, IDD=800mA

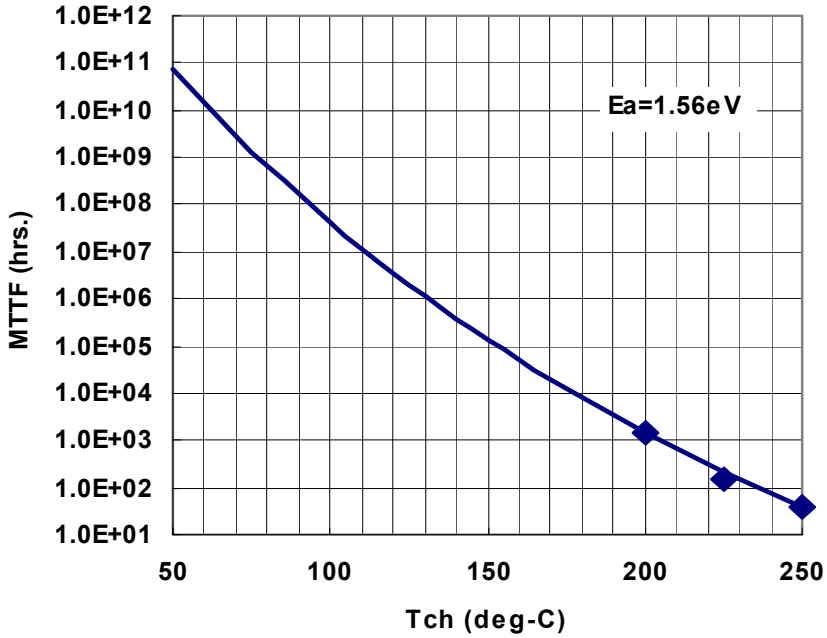
FREQ.	S11		S21		S12		S22	
[MHz]	mag.	ang.	mag.	ang.	mag.	ang.	mag.	ang.
1000	0.928	-42.9	0.038	-82.4	0.000	48.7	0.993	-31.8
2000	0.894	-74.5	0.122	64.6	0.000	83.3	0.973	-59.4
3000	0.899	-98.0	0.088	-23.2	0.000	-42.9	0.967	-82.6
4000	0.911	-116.2	0.068	-79.1	0.000	-110.2	0.966	-101.7
5000	0.922	-130.5	0.049	-122.4	0.000	175.7	0.972	-117.7
6000	0.930	-142.2	0.030	-151.2	0.000	-146.8	0.974	-131.5
7000	0.936	-152.1	0.015	-137.9	0.000	-31.4	0.972	-143.4
8000	0.938	-160.9	0.029	-67.9	0.000	-74.1	0.967	-153.9
9000	0.943	-169.2	0.129	-66.7	0.001	-86.3	0.962	-163.5
10000	0.937	-178.6	0.900	-134.2	0.001	-138.0	0.959	-172.5
11000	0.882	173.1	1.506	129.1	0.002	-176.7	0.953	178.5
12000	0.834	168.2	1.585	53.7	0.002	145.2	0.942	169.8
13000	0.817	163.0	1.559	-0.9	0.002	136.2	0.930	160.8
14000	0.803	156.3	1.686	-45.7	0.002	94.0	0.914	151.2
15000	0.784	148.6	2.091	-87.6	0.002	72.4	0.894	140.6
16000	0.750	139.0	2.816	-130.8	0.002	27.5	0.864	128.1
17000	0.696	128.2	4.099	-177.4	0.001	-2.7	0.815	113.4
18000	0.635	114.4	6.379	129.3	0.001	87.4	0.741	95.0
19000	0.540	95.2	9.897	68.1	0.001	51.6	0.619	70.5
20000	0.414	68.6	14.897	-0.4	0.001	37.1	0.437	37.2
21000	0.307	24.4	20.461	-79.6	0.000	83.2	0.230	-16.6
21200	0.292	13.0	21.334	-96.5	0.001	85.2	0.189	-33.1
21400	0.282	1.0	21.984	-113.7	0.001	79.9	0.157	-51.8
21600	0.281	-11.7	22.237	-130.8	0.001	78.4	0.137	-73.2
21800	0.286	-24.6	22.356	-147.5	0.000	92.6	0.130	-96.5
22000	0.293	-37.6	22.486	-164.1	0.000	101.5	0.137	-119.0
22200	0.304	-49.6	22.413	179.4	0.000	118.2	0.149	-139.8
22400	0.311	-61.2	22.346	162.7	0.001	145.4	0.166	-158.6
22600	0.316	-70.0	21.752	145.9	0.001	144.0	0.173	-175.7
22800	0.329	-76.2	21.077	130.0	0.002	121.3	0.170	173.5
23000	0.355	-82.6	20.551	115.0	0.002	105.2	0.176	166.7
23200	0.378	-89.5	20.113	99.9	0.002	101.8	0.188	159.3
23400	0.399	-95.8	19.829	85.0	0.002	101.1	0.196	151.2
23600	0.416	-101.3	19.360	69.9	0.002	104.8	0.200	142.8
23800	0.435	-106.1	19.011	55.1	0.003	98.9	0.196	136.3
24000	0.460	-110.6	18.770	40.5	0.004	92.5	0.195	132.2
24200	0.491	-116.2	18.740	25.7	0.004	78.0	0.204	129.5
24400	0.517	-122.7	18.843	10.2	0.005	63.7	0.224	124.7
24600	0.527	-130.6	18.864	-6.2	0.005	44.6	0.247	115.8
24800	0.517	-137.4	18.603	-22.7	0.004	32.5	0.260	104.4
25000	0.499	-142.5	18.371	-39.3	0.003	25.3	0.262	93.7
25200	0.485	-146.6	18.260	-55.5	0.003	26.3	0.262	84.8
25400	0.473	-151.6	18.256	-72.8	0.003	18.5	0.271	75.3
25600	0.452	-156.7	18.257	-90.2	0.003	8.0	0.278	64.3
25800	0.425	-161.7	18.295	-108.3	0.003	0.2	0.280	52.6
26000	0.386	-167.3	18.420	-127.4	0.003	-9.7	0.279	41.3
26200	0.342	-173.1	18.623	-147.4	0.002	-21.1	0.270	31.0
26400	0.277	179.8	18.807	-169.5	0.002	-33.3	0.263	22.2
26600	0.192	171.3	18.623	166.6	0.001	-36.8	0.258	15.3
26800	0.072	165.3	17.933	140.3	0.000	1.7	0.258	9.1
27000	0.076	-46.4	16.477	113.0	0.001	68.6	0.262	3.0
28000	0.648	-98.6	5.563	-19.2	0.002	46.9	0.353	-11.9
29000	0.798	-124.5	1.006	-119.5	0.004	20.6	0.550	-44.1
30000	0.838	-138.9	0.116	166.5	0.003	28.1	0.647	-73.4
31000	0.858	-148.2	0.004	-95.6	0.003	-33.4	0.686	-93.9
32000	0.875	-155.6	0.010	-96.0	0.004	-21.7	0.715	-108.6
33000	0.875	-161.3	0.006	-152.7	0.001	-56.4	0.735	-121.0
34000	0.880	-165.8	0.004	162.2	0.001	-95.4	0.738	-130.7
35000	0.883	-170.1	0.006	63.3	0.002	53.4	0.749	-138.3
36000	0.892	-173.3	0.005	26.3	0.004	33.2	0.750	-144.7
37000	0.899	-176.9	0.005	8.1	0.005	-1.3	0.780	-151.8
38000	0.906	179.4	0.007	-7.5	0.008	-13.0	0.776	-158.8
39000	0.889	176.9	0.008	-47.0	0.008	-51.7	0.755	-165.8
40000	0.904	175.2	0.008	-49.7	0.005	-62.1	0.757	-170.2

ΔTch vs. Drain Voltage (Reference)

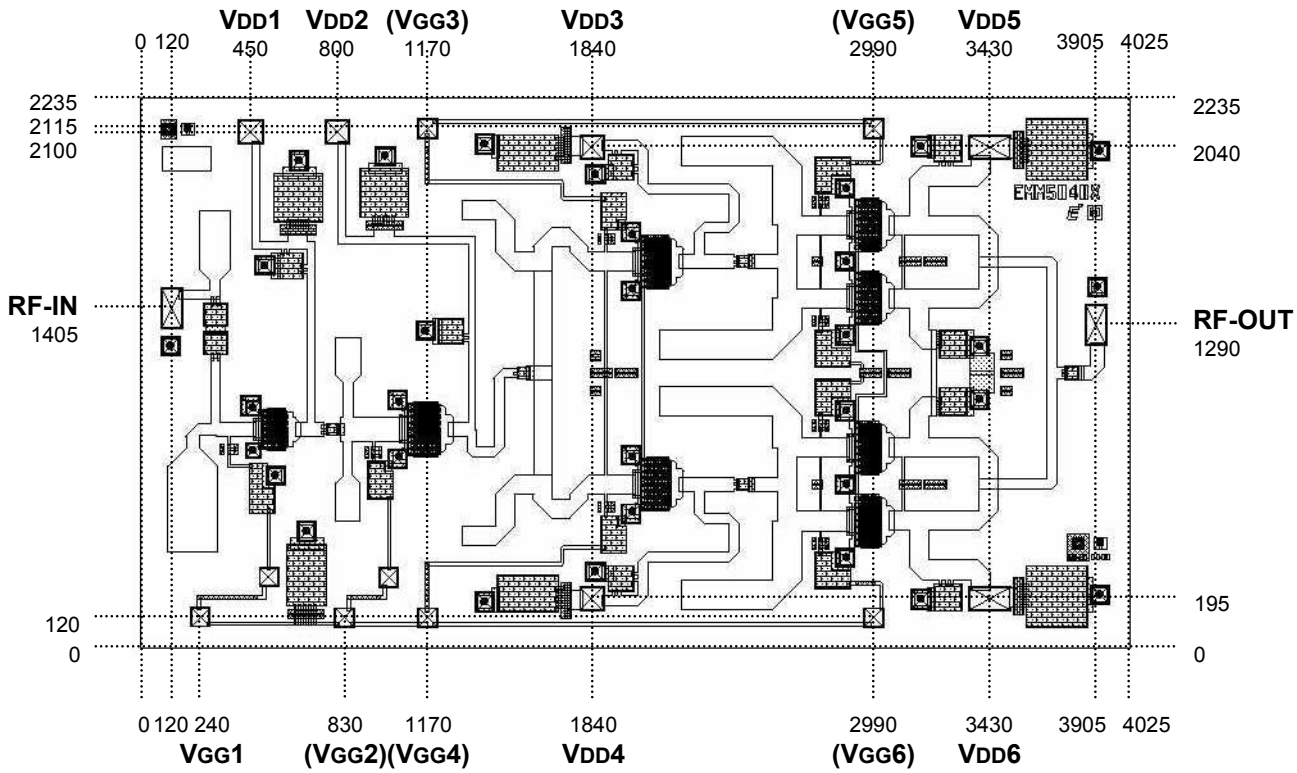


Note: ΔTch : Temperature Rise from Backside of the Package to Channel.

MTTF vs. Tch



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

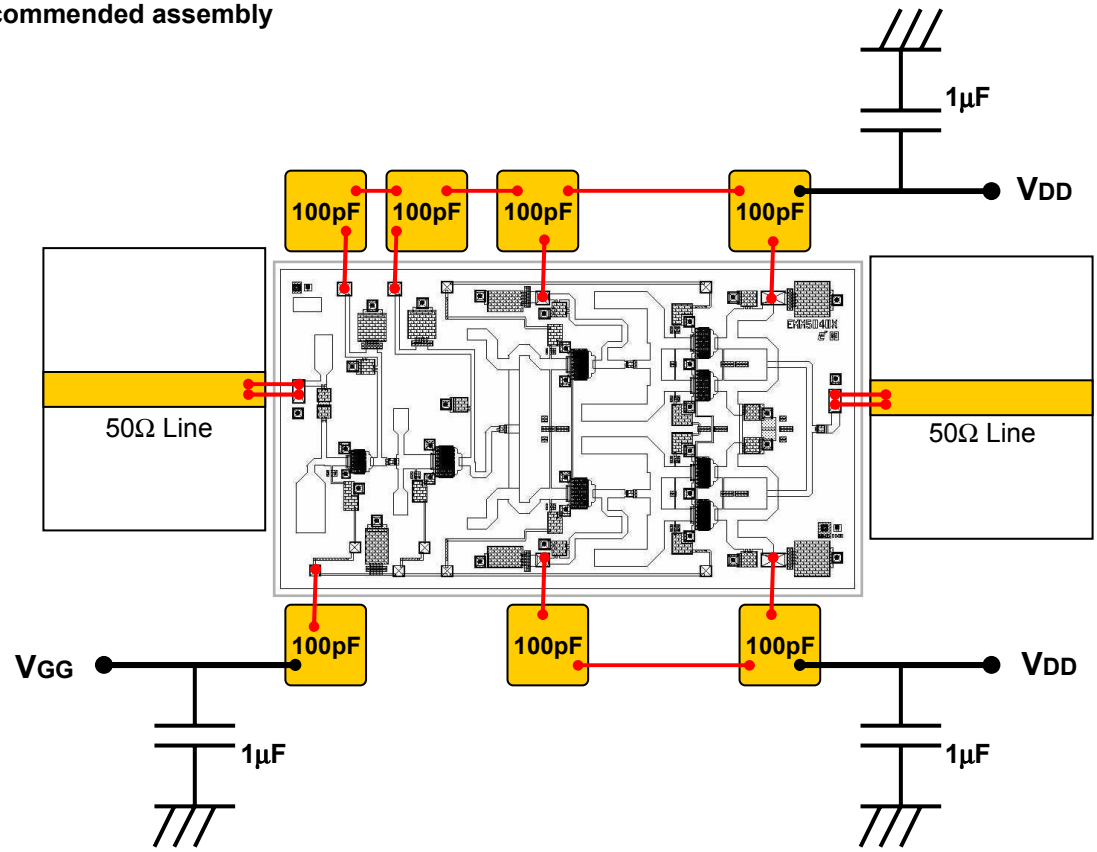


Chip Size : 4025 x 2235 μm (+/- 30μm)
Chip Thickness : 60μm (+/- 20μm)
Bonding Pad Size :
RF-Pad : 90 x 170μm
VGG1~6 : 80um x 80um
VDD1~4 : 100um x 100um
VDD5~6 : 170um x 100um

Note : Gate voltage is required from either or both bonding pad(VGG1 or/and VGG2~6).

■ Assembly Diagrams

Recommended assembly



"Copper" is the recommended material for the package or carrier.

■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.

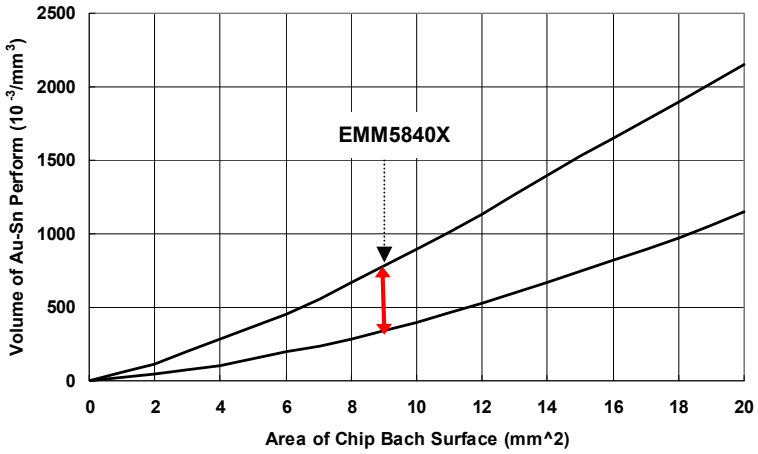
Die attach conditions

Stage Temperature : 300 to 310 deg.C

Time : less than 15 seconds

Die attach material : AuSn

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.
However, when bonding wire on the MMIC, the condition should be verified by customer using their equipment and materials.

1) Bonding Equipment and Bonding Tool.

Bonding Equipment : SINKAWA UTC-300 (automatic ball bonder)

Bonding Tool : ADAMANT AD-2-38LB20

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 : 0.294 N to 0.882 N

Stage Temperature : 230 deg.C +/- 5 deg.C

Ultrasonic Power : 30 to 90

Ultrasonic Power Time : 10ms to 60ms

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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.