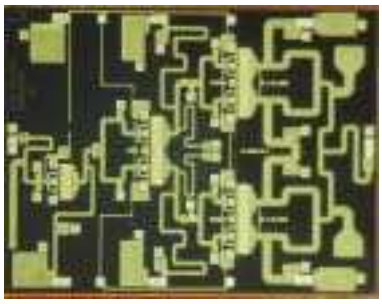
# EMM5075X

## Ku-Band Power Amplifier MMIC



**FEATURES**

- High Output Power: Pout=33.0dBm (typ.)
- High Linear Gain: GL=26.0dB (typ.)
- Broad Band: 12.7~15.4GHz
- Impedance Matched Zin/Zout=50Ω

**DESCRIPTION**

The EMM5075X is a MMIC amplifier that contains a three-stages amplifier, internally matched, for standard communications band in the 12.7 to 15.4GHz frequency range.
Sumitomo Electric Device Innovations's stringent Quality Assurance Program assures the highest reliability and consistent performance.

**ABSOLUTE MAXIMUM RATING**

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DD}$ | 10 | V |
| Gate-Source Voltage | $V_{GG}$ | -3 | V |
| Input Power | $P_{in}$ | 26 | dBm |
| Storage Temperature | $T_{stg}$ | -55 to +125 | ℃ |

**RECOMMENDED OPERATING CONDITIONS**

| Item | Symbol | Condition | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DD}$ | ≦7 | V |
| Input Power | $P_{in}$ | ≦16 | dBm |
| Operating Case Temperature | $T_C$ | -40 to +85 | ℃ |

This Product should be hermetically packaged.

**ELECTRICAL CHARACTERISTICS (Case Temperature Ta=25℃)**

| Item | Symbol | Test Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| RF Frequency Range | f | $V_{DD}$=+6V | 12.7 | - | 15.4 | GHz |
| Output Power at 1dB G.C.P. | $P_{1dB}$ | $I_{DD(DC)}$=1200mA typ. | 32 | 33 | - | dBm |
| Power Gain at 1dB G.C.P. | $G_{1dB}$ | $Z_S$=$Z_L$=50ohm | 22 | 26 | - | dB |
| Power-added Efficiency at 1dB G.C.P. | $N_{add}$ | | - | 26 | - | % |
| Drain Current at 1dB G.C.P. | $I_{DDRF}$ | | - | 1300 | 1900 | mA |
| 3rd. Order Intermodulation Distortion * | $IM_3$ | * df=+10MHz | -40 | -47 | - | dBc |
| Input Return Loss (at Pin=-20dBm) | $RL_{IN}$ | Po=20dBm S.C.L | - | -8 | - | dB |
| Output Return Loss (at Pin=-20dBm) | $RL_{OUT}$ | | - | -15 | - | dB |

Note : RF parameter sample size 10ps. Criteria (accept/reject)=(0/1)  G.C.P. : Gain Compression Point
SCL : Single Carrier Level

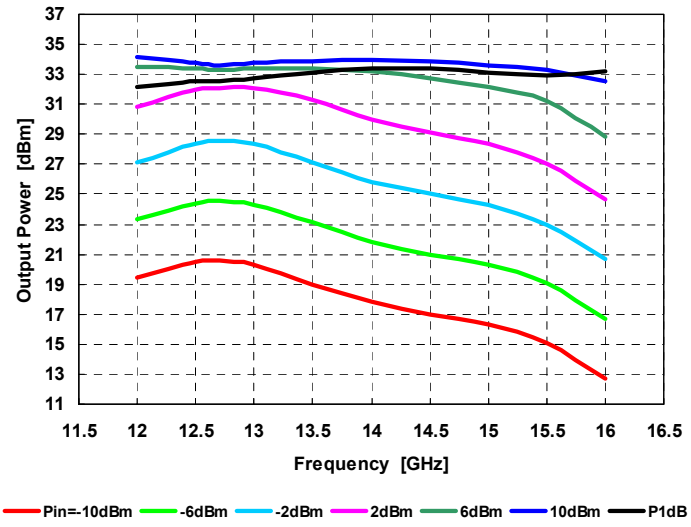
| ESD | Class 0 | ~ 249V |
|---|---|---|

Note : Based on JEDEC JESD22-A114C

| RoHs Compliance | Yes |
|---|---|

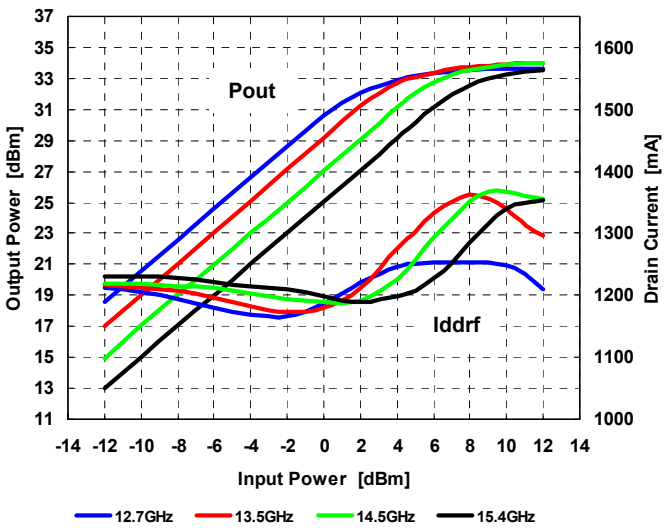
## OUTPUT POWER vs. FREQUENCY

@VDD=6V, IDD(DC)=1200mA



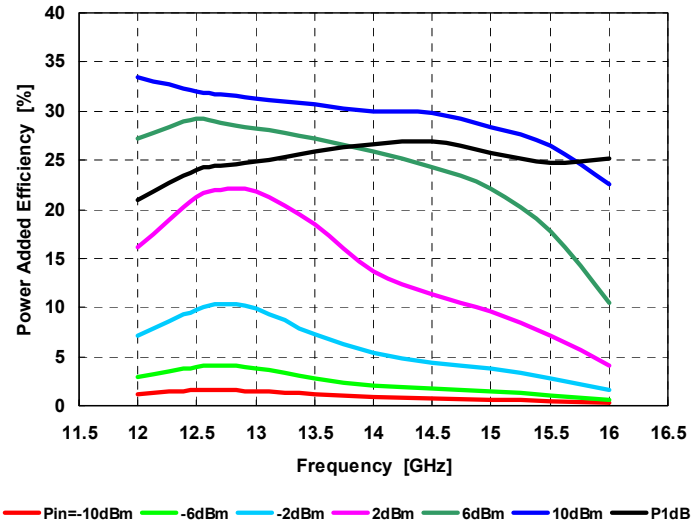

## OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER

@VDD=6V, IDD(DC)=1200mA



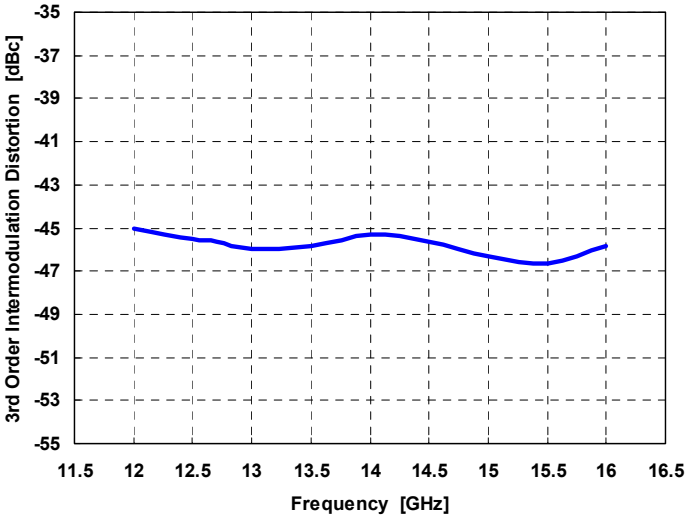

## POWER-ADDED EFFICIENCY vs FREQUENCY

@VDD=6V, IDD(DC)=1200mA



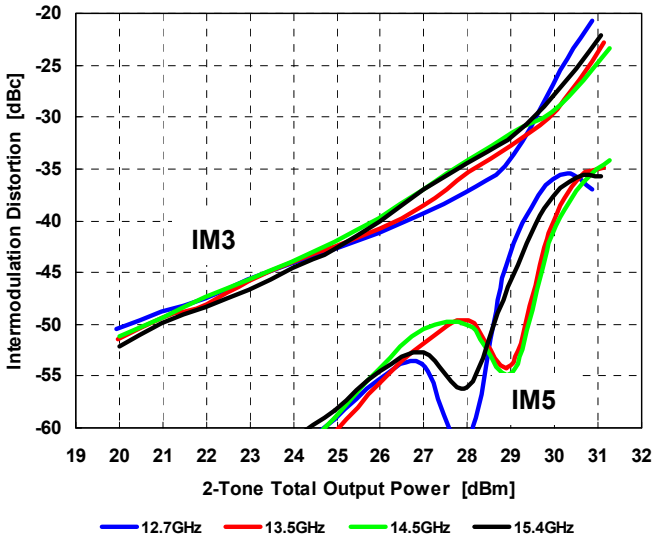
### IMD vs. FREQUENCY

@VDD=6V, IDD(DC)=1200mA, Pout=20dBm S.C.L.



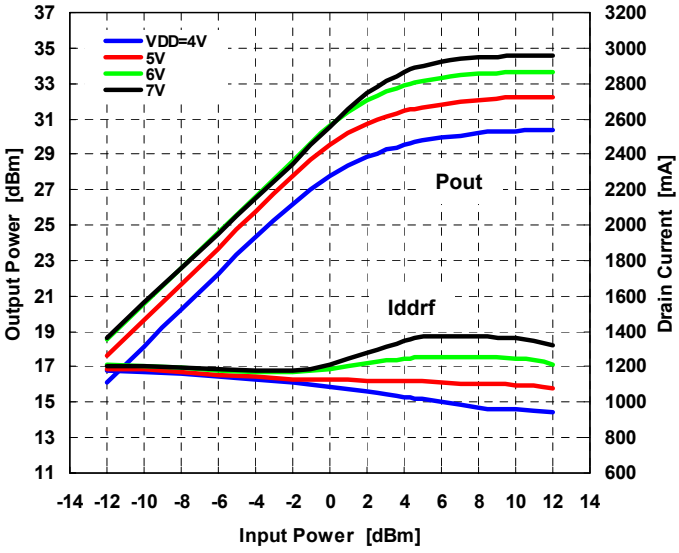

### IMD vs OUTPUT POWER

@VDD=6V, IDD(DC)=1200mA



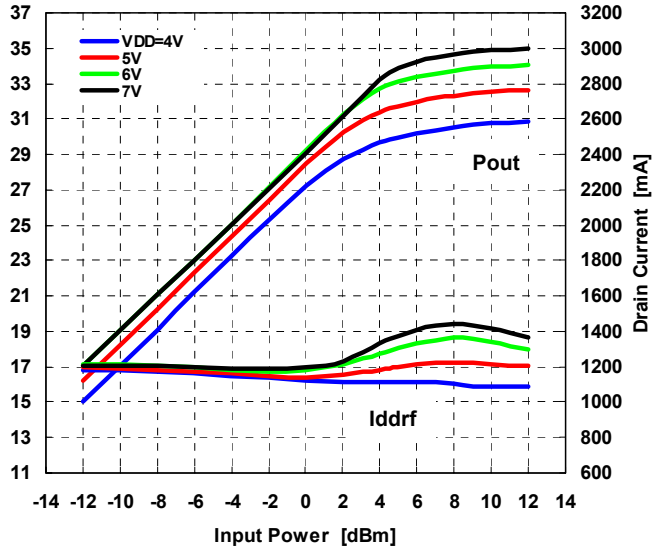
### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=12.7GHz



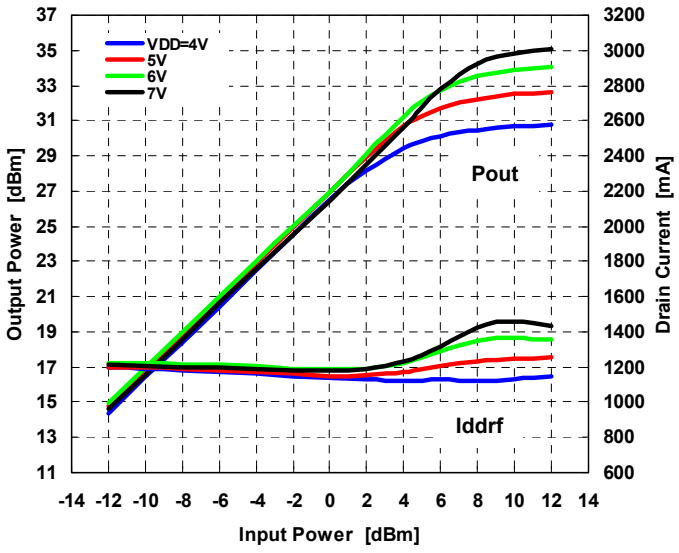

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=13.5GHz



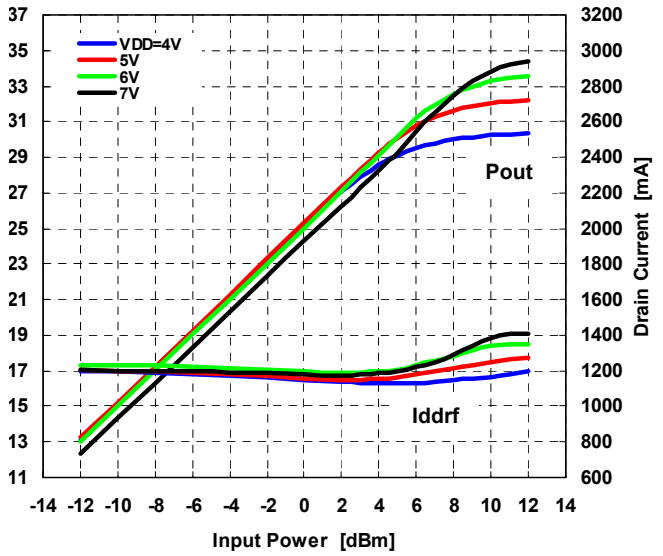

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=14.5GHz



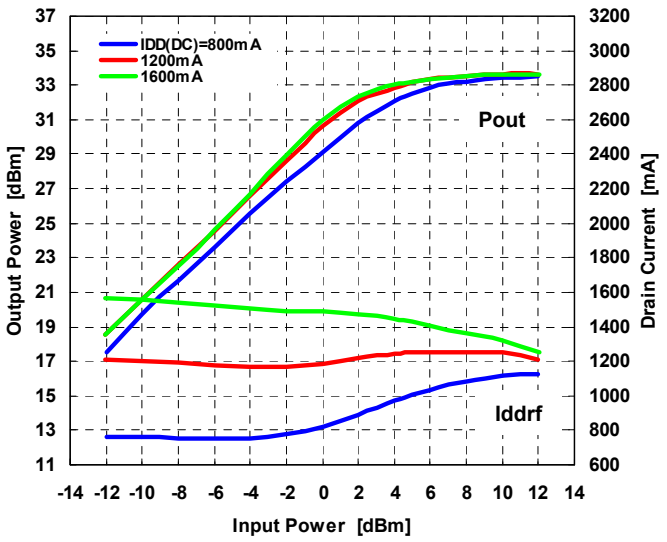

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=15.4GHz



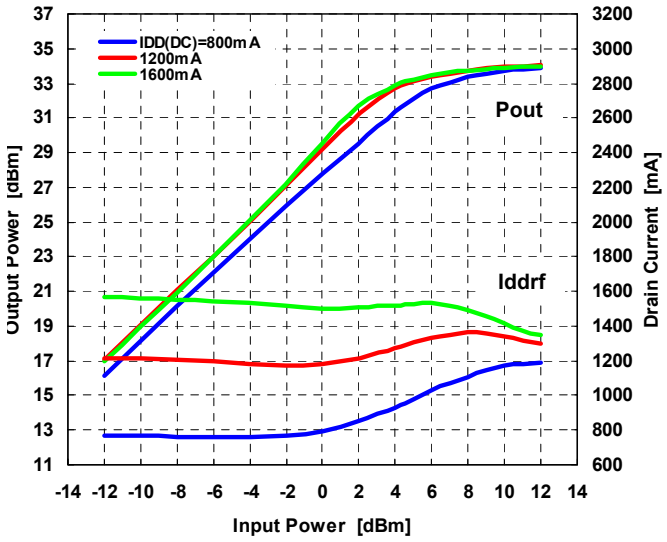
### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Current

@VDD=6V, f=12.7GHz



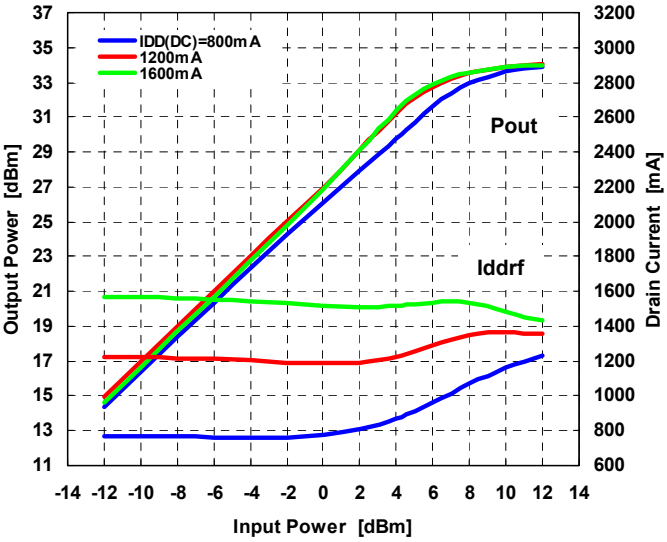

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Current

@VDD=6V, f=13.5GHz



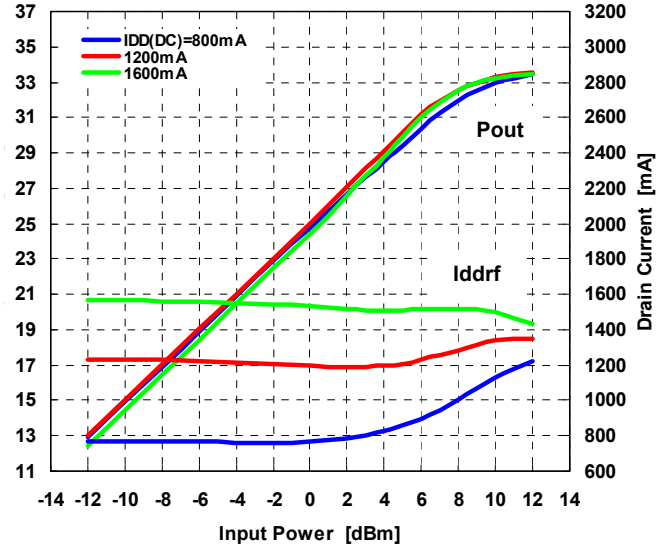

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Current

@VDD=6V, f=14.5GHz



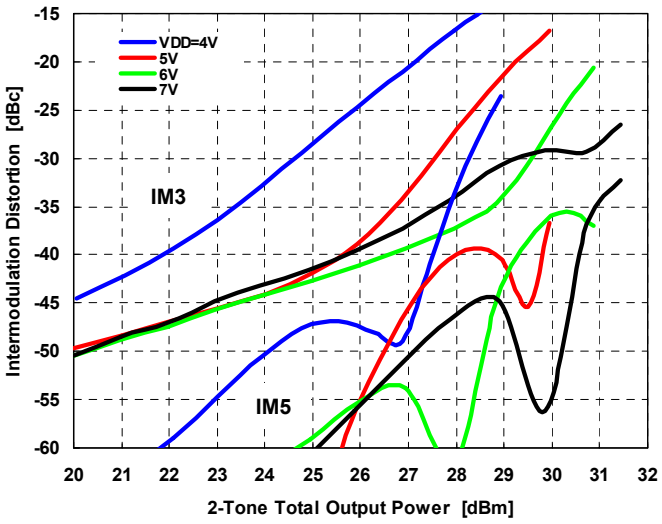

### OUTPUT POWER, DRAIN CURRENT vs. INPUT POWER by Drain Current

@VDD=6V, f=15.4GHz



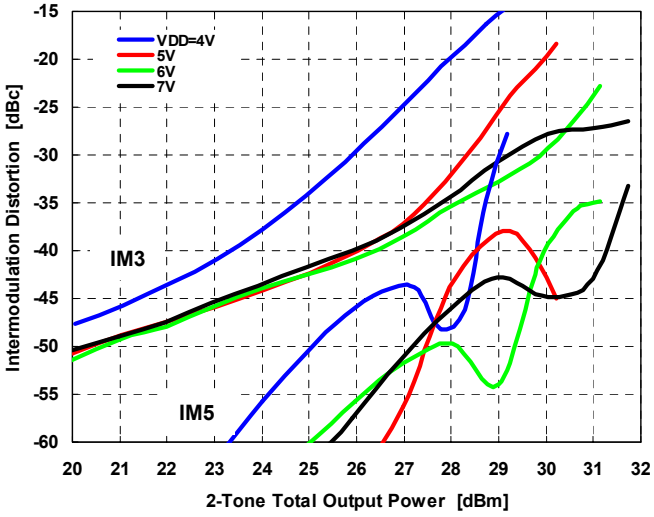
### IMD PERFORMANCE vs. OUTPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=12.7GHz



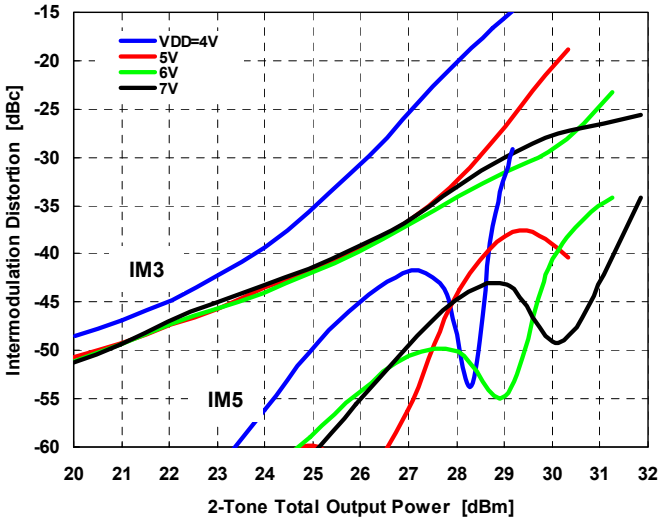

### IMD PERFORMANCE vs. OUTPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=13.5GHz



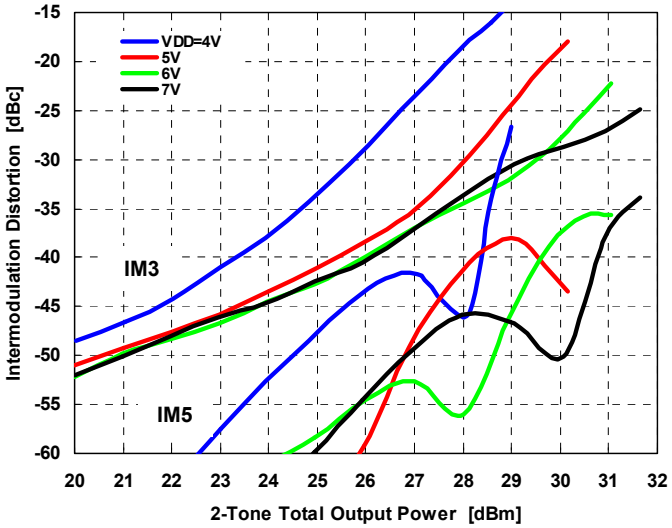

### IMD PERFORMANCE vs. OUTPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=14.5GHz



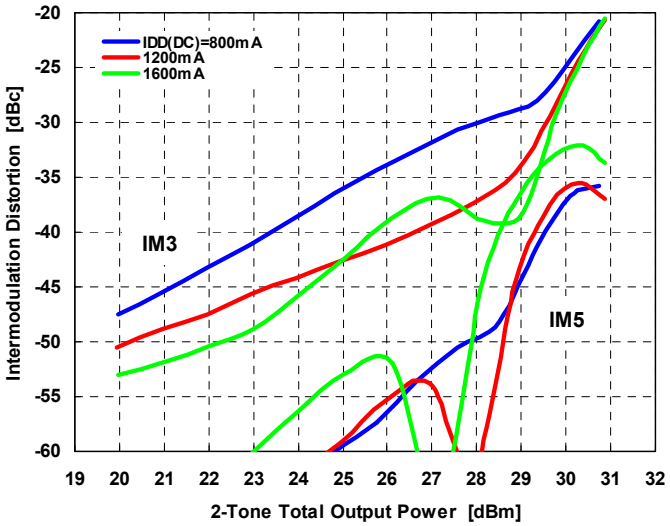

### IMD PERFORMANCE vs. OUTPUT POWER by Drain Voltage

@IDD(DC)=1200mA, f=15.4GHz



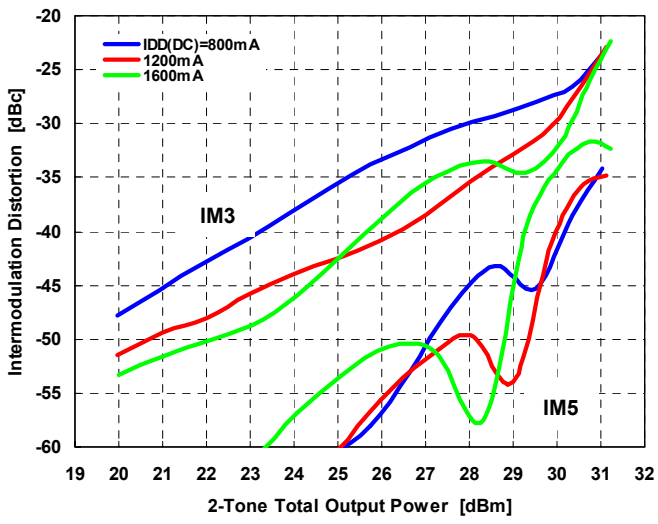
### IMD PERFORMANCE vs. OUTPUT POWER by Drain Current

@VDD=6V, f=12.7GHz



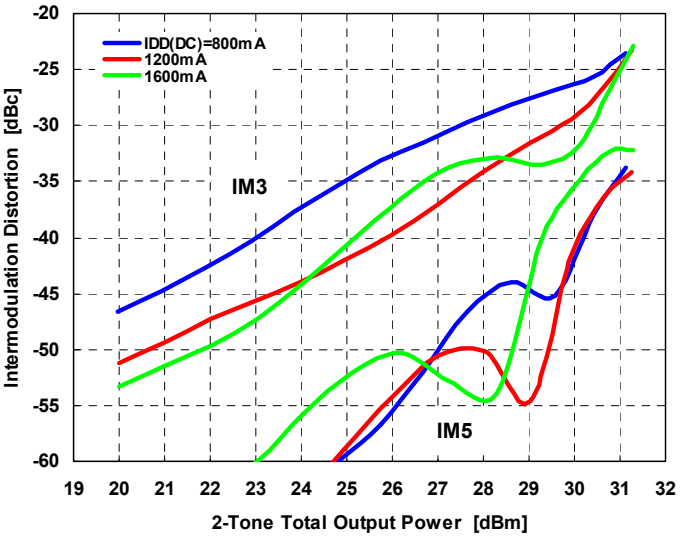

### IMD PERFORMANCE vs. OUTPUT POWER by Drain Current

@VDD=6V, f=13.5GHz



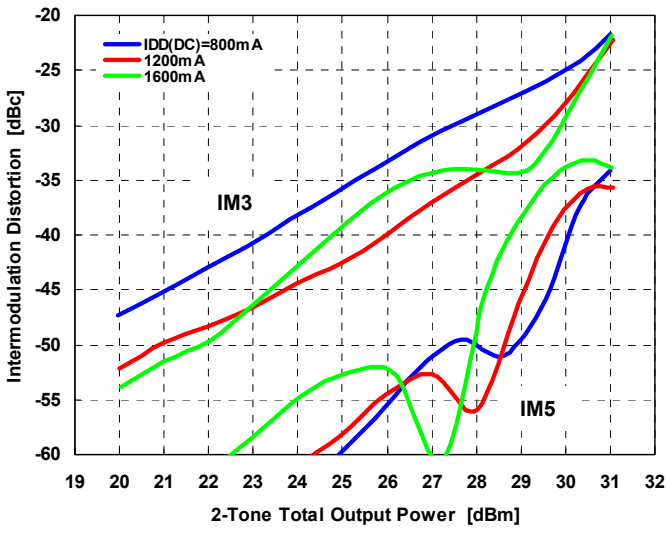

### IMD PERFORMANCE vs. OUTPUT POWER by Drain Current

@VDD=6V, f=14.5GHz




### IMD PERFORMANCE vs. OUTPUT POWER by Drain Current

@VDD=6V, f=15.4GHz



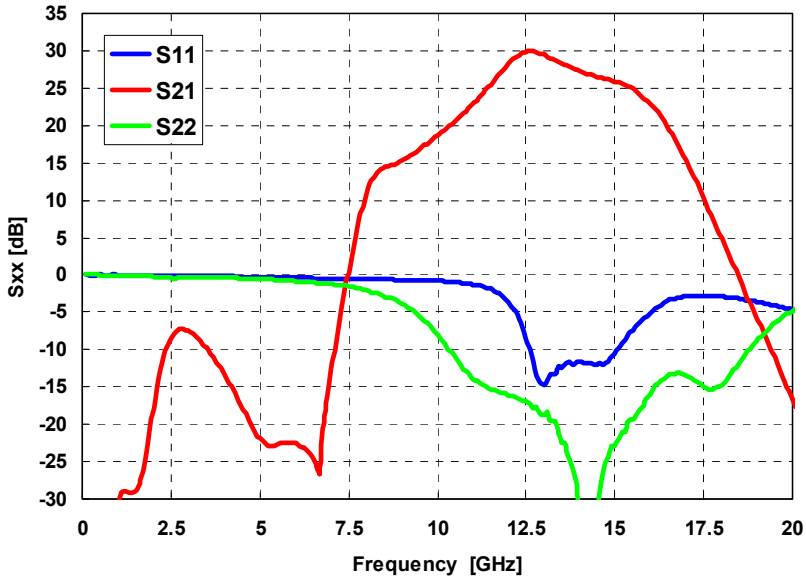
## ■S-PARAMETER

VDD=6V, IDD=1200mA

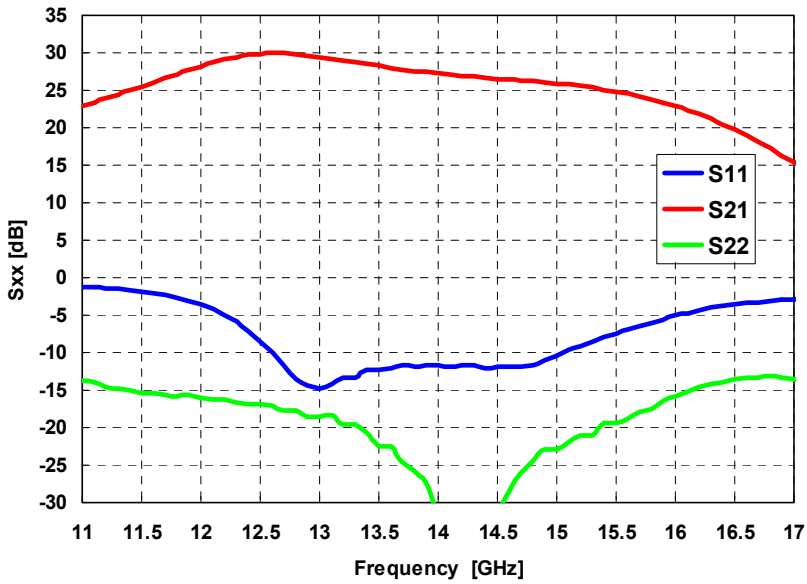
| Frequency | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| [GHz] | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. |
| 1.0 | 0.999 | -20.0 | 0.057 | 43.2 | 0.001 | -43.8 | 0.996 | -31.0 |
| 2.0 | 0.995 | -40.2 | 0.483 | -103.8 | 0.001 | -67.7 | 0.971 | -61.9 |
| 3.0 | 0.988 | -60.3 | 0.741 | 106.2 | 0.001 | -76.9 | 0.957 | -89.7 |
| 4.0 | 0.980 | -80.0 | 0.398 | 11.6 | 0.002 | -112.8 | 0.959 | -118.8 |
| 5.0 | 0.970 | -99.4 | 0.175 | -23.1 | 0.002 | -102.7 | 0.940 | -148.1 |
| 6.0 | 0.959 | -118.8 | 0.155 | -34.2 | 0.002 | -97.1 | 0.906 | -177.3 |
| 7.0 | 0.945 | -137.6 | 0.220 | 36.2 | 0.001 | -89.4 | 0.867 | 151.3 |
| 8.0 | 0.940 | -156.5 | 3.477 | -40.0 | 0.002 | -120.3 | 0.789 | 113.8 |
| 9.0 | 0.927 | -176.4 | 5.789 | -167.2 | 0.003 | -103.3 | 0.645 | 67.2 |
| 10.0 | 0.911 | 161.9 | 8.552 | 106.8 | 0.003 | -105.4 | 0.396 | 3.0 |
| 11.0 | 0.864 | 135.9 | 13.901 | 20.3 | 0.003 | -100.8 | 0.204 | -83.8 |
| 12.0 | 0.661 | 97.2 | 25.732 | -81.6 | 0.003 | -92.6 | 0.157 | -171.3 |
| 12.1 | 0.614 | 92.3 | 27.138 | -93.9 | 0.003 | -104.6 | 0.153 | -177.1 |
| 12.2 | 0.563 | 87.7 | 28.499 | -106.5 | 0.002 | -117.2 | 0.152 | 177.3 |
| 12.3 | 0.509 | 83.3 | 29.633 | -119.6 | 0.002 | -113.1 | 0.146 | 171.6 |
| 12.4 | 0.443 | 79.3 | 30.557 | -132.9 | 0.003 | -91.6 | 0.144 | 168.7 |
| 12.5 | 0.378 | 76.9 | 31.142 | -146.4 | 0.002 | -93.5 | 0.145 | 162.0 |
| 12.6 | 0.317 | 76.6 | 31.391 | -159.8 | 0.002 | -91.2 | 0.138 | 154.3 |
| 12.7 | 0.261 | 77.9 | 31.335 | -173.2 | 0.003 | -66.6 | 0.129 | 151.7 |
| 12.8 | 0.210 | 86.0 | 30.973 | 173.8 | 0.003 | -86.0 | 0.131 | 146.0 |
| 12.9 | 0.193 | 97.1 | 30.442 | 161.1 | 0.003 | -86.1 | 0.119 | 140.5 |
| 13.0 | 0.182 | 106.4 | 29.744 | 148.7 | 0.003 | -85.9 | 0.117 | 142.0 |
| 13.1 | 0.197 | 118.9 | 28.906 | 136.7 | 0.003 | -100.5 | 0.121 | 129.9 |
| 13.2 | 0.216 | 121.0 | 28.126 | 125.1 | 0.003 | -86.2 | 0.105 | 128.4 |
| 13.3 | 0.218 | 125.1 | 27.346 | 113.7 | 0.003 | -81.6 | 0.105 | 123.6 |
| 13.4 | 0.243 | 127.6 | 26.528 | 102.7 | 0.003 | -78.3 | 0.092 | 110.9 |
| 13.5 | 0.241 | 124.5 | 25.904 | 91.6 | 0.003 | -91.6 | 0.075 | 115.6 |
| 13.6 | 0.248 | 128.0 | 25.162 | 81.0 | 0.003 | -86.5 | 0.075 | 106.8 |
| 13.7 | 0.261 | 126.3 | 24.548 | 70.4 | 0.004 | -79.0 | 0.059 | 99.7 |
| 13.8 | 0.253 | 125.4 | 23.955 | 59.8 | 0.004 | -75.1 | 0.051 | 105.0 |
| 13.9 | 0.259 | 128.6 | 23.443 | 49.3 | 0.002 | -98.4 | 0.043 | 88.5 |
| 14.0 | 0.260 | 127.4 | 22.935 | 39.1 | 0.004 | -85.0 | 0.026 | 79.6 |
| 14.1 | 0.254 | 129.1 | 22.536 | 28.6 | 0.004 | -98.7 | 0.018 | 82.8 |
| 14.2 | 0.259 | 130.6 | 22.134 | 18.0 | 0.004 | -97.6 | 0.005 | 41.5 |
| 14.3 | 0.259 | 129.8 | 21.806 | 7.6 | 0.004 | -87.6 | 0.008 | -104.3 |
| 14.4 | 0.252 | 131.6 | 21.517 | -3.1 | 0.004 | -86.4 | 0.015 | -113.8 |
| 14.5 | 0.253 | 133.9 | 21.162 | -13.9 | 0.004 | -79.7 | 0.026 | -107.0 |
| 14.6 | 0.254 | 136.0 | 20.886 | -24.7 | 0.004 | -109.3 | 0.038 | -116.2 |
| 14.7 | 0.253 | 139.0 | 20.585 | -35.8 | 0.003 | -87.3 | 0.050 | -119.0 |
| 14.8 | 0.263 | 143.5 | 20.301 | -47.0 | 0.004 | -83.1 | 0.060 | -121.9 |
| 14.9 | 0.283 | 145.2 | 19.955 | -58.3 | 0.004 | -78.1 | 0.072 | -129.5 |
| 15.0 | 0.299 | 147.0 | 19.651 | -69.7 | 0.003 | -104.4 | 0.071 | -136.3 |
| 15.1 | 0.329 | 148.3 | 19.350 | -81.5 | 0.003 | -102.4 | 0.081 | -134.6 |
| 15.2 | 0.350 | 147.1 | 18.950 | -93.5 | 0.003 | -78.0 | 0.089 | -141.4 |
| 15.3 | 0.372 | 147.8 | 18.512 | -105.6 | 0.003 | -94.5 | 0.089 | -139.8 |
| 15.4 | 0.406 | 146.3 | 17.996 | -118.0 | 0.002 | -90.2 | 0.106 | -142.4 |
| 15.5 | 0.424 | 144.6 | 17.509 | -130.5 | 0.002 | -72.8 | 0.107 | -147.2 |
| 15.6 | 0.452 | 143.5 | 16.895 | -143.0 | 0.003 | -78.7 | 0.116 | -146.8 |
| 15.7 | 0.480 | 140.8 | 16.249 | -155.7 | 0.003 | -82.3 | 0.126 | -151.5 |
| 15.8 | 0.498 | 139.2 | 15.516 | -168.6 | 0.003 | -94.9 | 0.132 | -151.9 |
| 15.9 | 0.530 | 137.2 | 14.770 | 178.6 | 0.004 | -92.2 | 0.150 | -155.1 |
| 16.0 | 0.559 | 133.9 | 13.983 | 165.6 | 0.003 | -73.4 | 0.160 | -159.9 |
| 17.0 | 0.716 | 99.5 | 5.879 | 39.2 | 0.005 | -75.7 | 0.212 | 127.7 |
| 18.0 | 0.715 | 64.4 | 1.768 | -65.3 | 0.005 | -88.1 | 0.184 | 14.6 |
| 19.0 | 0.659 | 26.4 | 0.517 | -152.7 | 0.005 | -90.0 | 0.362 | -67.7 |
| 20.0 | 0.588 | -22.7 | 0.148 | 128.2 | 0.004 | -88.3 | 0.574 | -113.2 |

## ■S-PARAMETER

@VDD=6V, IDD=1200mA

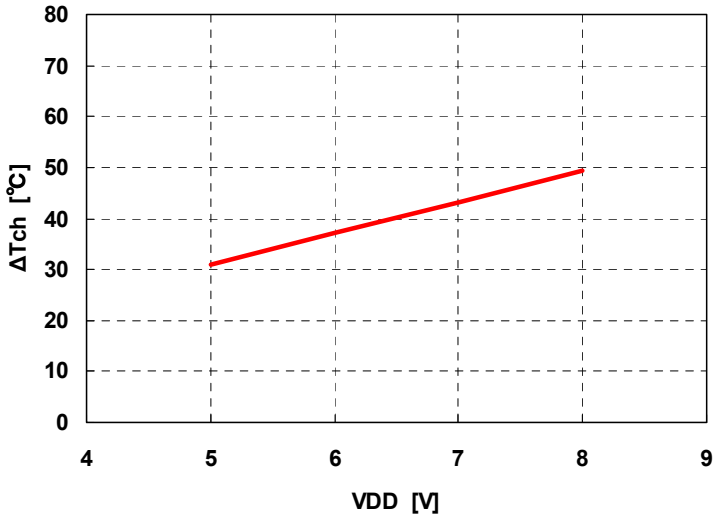



@VDD=6V, IDD=1200mA



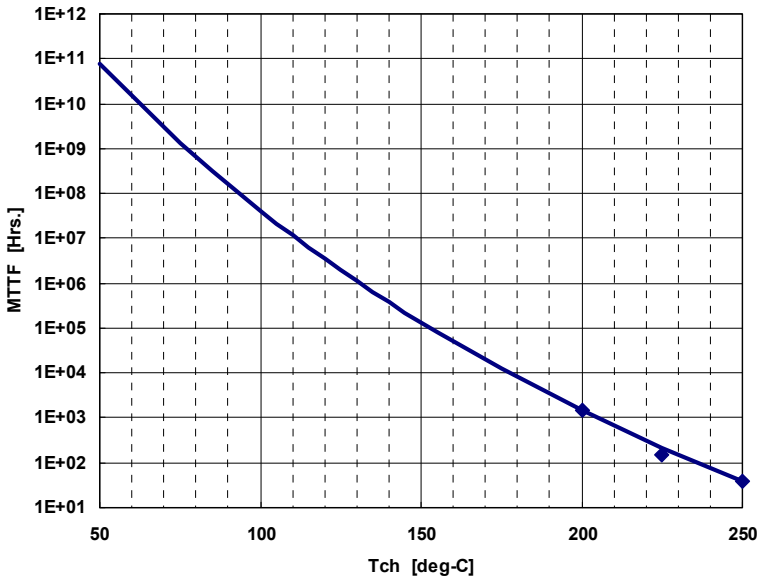
## ΔTch vs. Drain Voltage
(Reference)

IDD(DC)=1200mA



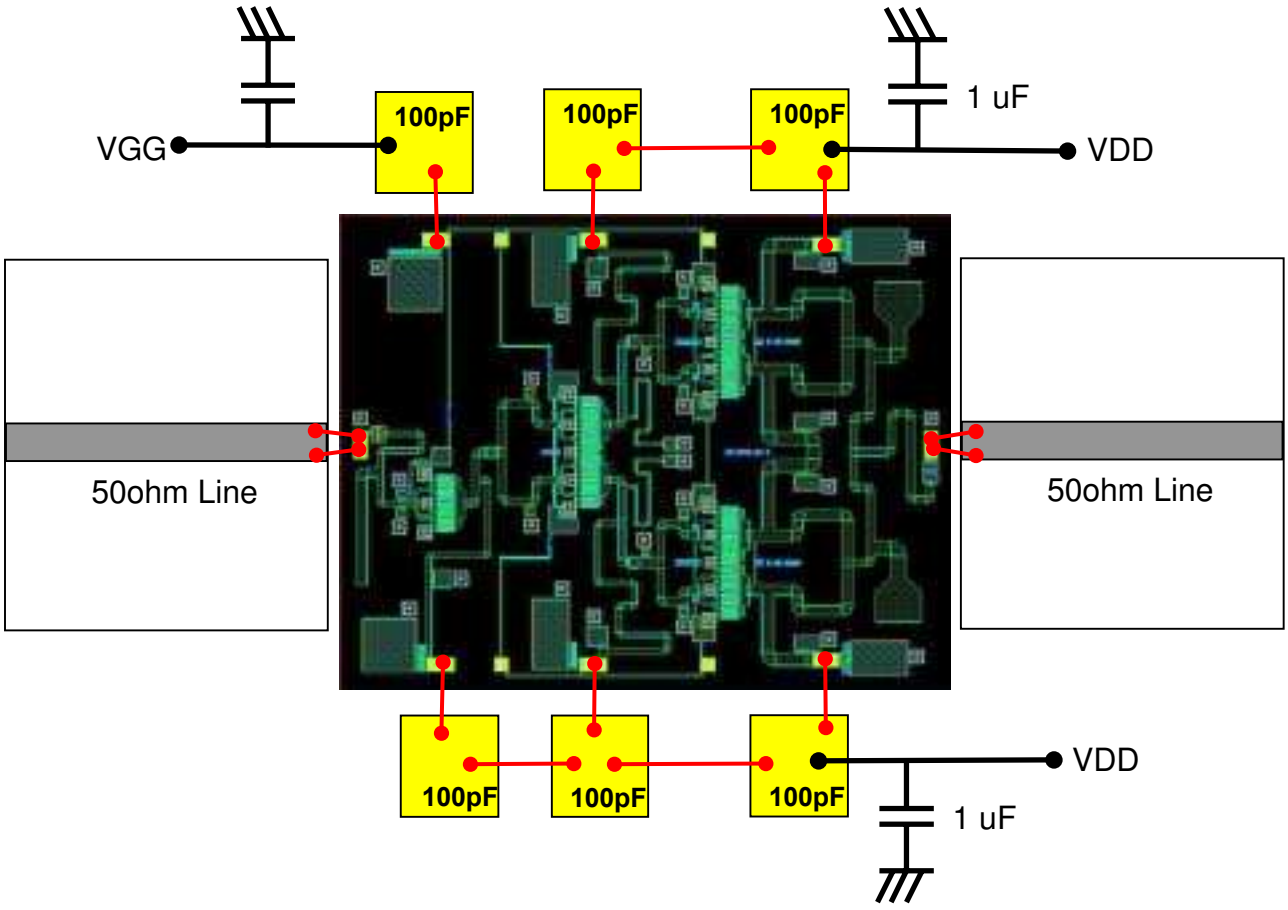

Note ΔTch : Temperature Rise from Backside of MMIC to Channel

## MTTF vs. Tch



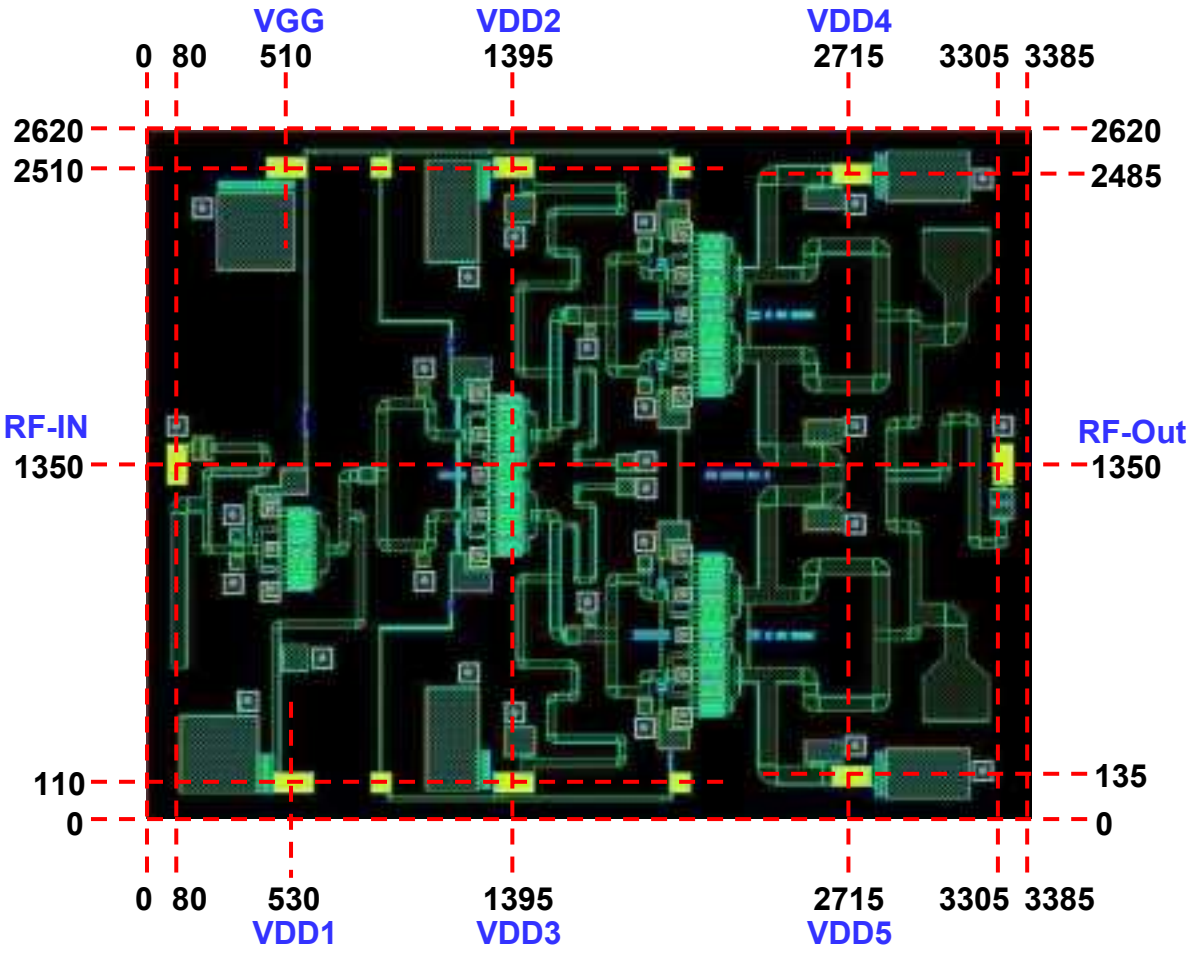
## ■ Assembly Diagrams

**Recommended assembly**




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

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




**Chip Size : 3385±30um x 2620±30um**
**Chip Thickness : 60±20um**
**Bonding Pad Size : 160um x 80um**

## ■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.

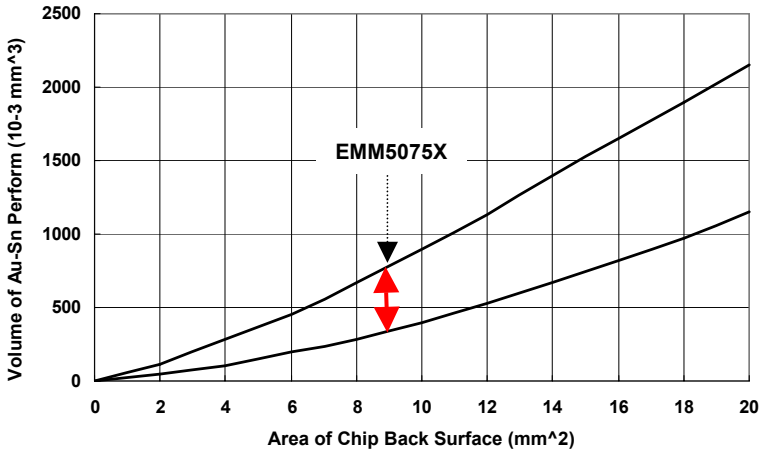
Die attach conditions

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

**For further information please contact :**

**Sumitomo Electric Device Innovations, U.S.A., Inc.**
2355 Zanker Rd.
San Jose, CA 95131-1138, U.S.A.
TEL: +1 408 232-9500
FAX: +1 408 428-9111

**Sumitomo Electric Europe Ltd.**
220 Centennial Park,
Elestree WD6 3SL United Kingdom
TEL: +44 (0) 20 89538118
FAX: +44 (0) 20 89538228

**Sumitomo Electric Europe Ltd. (Italy Branch)**
Piazza Don E. Mapelli, 60-20099
Sesto San Giovanni, Milano- Italy
TEL: +39-02-496386-01
FAX: +39-02-496386-25

**Sumitomo Electric Asia, Ltd.**
Room 2624-2637, 26F
Sun Hung Kai Centre,
30 Harbour Road Wanchai,
Hong Kong
TEL: +852-2579-0080
FAX: +852-2576-6412

**Sumitomo Electric Device Innovations, Inc.**
1000 Kamisukiahara, showa-cho
Nakakomagun, Yamanashi
409-3883, Japan
(Kokubo Industrial Park)
TEL +81-55-275-4411
FAX +81-55-275-9461

**Sumitomo Electric Industries, Ltd.**
**Head Office (Tokyo)**
3-9-1, Shibaura, Minato-ku, Tokyo 108-8539,
Japan
TEL +81-3-6722-3287
FAX +81-3-6722-3284

**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.