

# FMM5054VF

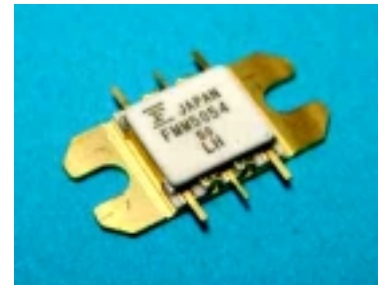
## Ku Band Power Amplifier MMIC

### FEATURES

- High Output Power: 32.5dBm(typ.)
- High Linear Gain: 31.0dB(typ.)
- Low Input VSWR
- Impedance Matched  $Z_{in}/Z_{out} = 50\Omega$
- Small Hermetic Metal-Ceramic Package(VF-pkg)

### DESCRIPTION

The FMM5054VF is a MMIC amplifier that contains a three-stage amplifier, internally matched, for standard communications in the 13.75 to 14.5GHz frequency range. This product is well suited for VSAT applications as it offers high power, high gain, and low VSWR.



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

### ABSOLUTE MAXIMUM RATING

| Item                | Symbol           | Rating      | Unit |
|---------------------|------------------|-------------|------|
| DC Input Voltage    | VDD              | +10         | V    |
| DC Input Voltage    | VGG              | -3          | V    |
| Input Power         | P <sub>in</sub>  | +23         | dBm  |
| Storage Temperature | T <sub>stg</sub> | -55 to +125 | °C   |

### RECOMMENDED OPERATING CONDITIONS

| Item                       | Symbol         | Condition  | Unit |
|----------------------------|----------------|------------|------|
| DC Input Voltage           | VDD            | $\leq 8$   | V    |
| Operating Case Temperature | T <sub>c</sub> | -40 to +85 | °C   |

### ELECTRICAL CHARACTERISTICS (Case Temperature T<sub>c</sub>=25°C)

| Item                           | Symbol            | Condition   | Limit     |       |       | Unit |
|--------------------------------|-------------------|---|-----------|-------|-------|------|
|                                |                   |   | Min.      | Typ.  | Max.  |      |
| Gate Bias Voltage              | VGG(DC)           | VDD=7V<br>IDD=700mA(typ.)<br>f=13.75-14.50GHz                 | -0.01     | -0.25 | -0.50 | V    |
| Output Power at 1dB G.C.P.     | P1dB              |   | 31.5      | 33.0  | -     | dBm  |
| Power Gain at 1dB G.C.P.       | G1dB              |   | 28        | 31.0  | -     | dB   |
| Drain Current at P1dB          | IDD(RF)           |   | -         | 1050  | 1200  | mA   |
| Power Added Efficiency at P1dB | $\eta_{add}$      |   | -         | 27    | -     | %    |
| Gain Flatness                  | $\Delta G$        |   | -         | 1.5   | 2.0   | dB   |
| Input Return Loss              | RL <sub>in</sub>  |   | Pin<-5dBm | -     | -8    | -6   |
| Output Return Loss             | RL <sub>out</sub> | -   |           | -10   | -6    | dB   |
| Intermodulation Distortion     | IM <sub>3</sub>   | $\Delta f=10\text{MHz}$<br>2-Tone Test<br>Pout=22.5dBm S.C.L. | -26       | -29   | -     | dBc  |

G.C.P. : Gain Compression Point, S.C.L. : Single Carrier Level

|     |         |        |
|-----|---------|--------|
| ESD | Class 0 | ~ 199V |
|-----|---------|--------|

Note : Based on EIAJ ED-4701 C-111A(C=100pF, R=1.5k $\Omega$ )

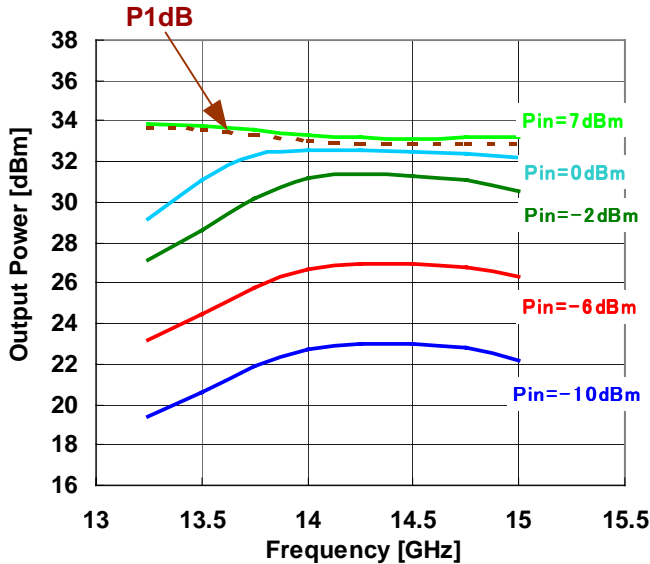
|            |    |
|------------|----|
| CASE STYLE | VF |
|------------|----|

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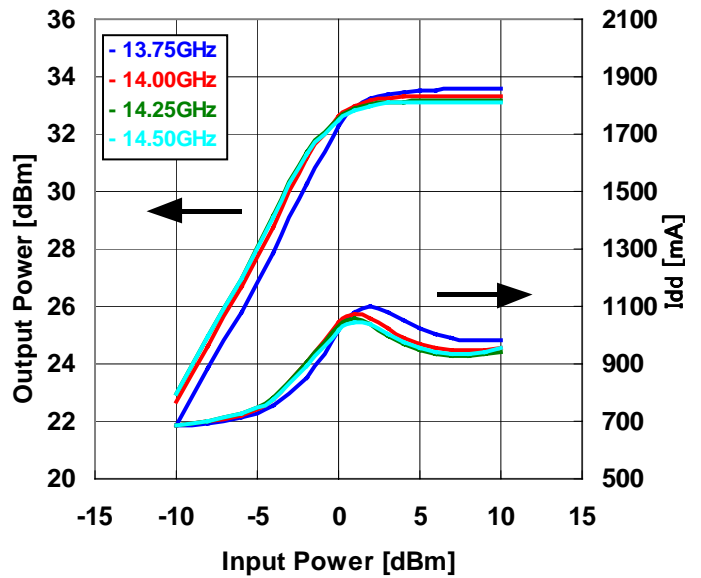
OUTPUT POWER vs. FREQUENCY

VDD=7V, IDD=700mA



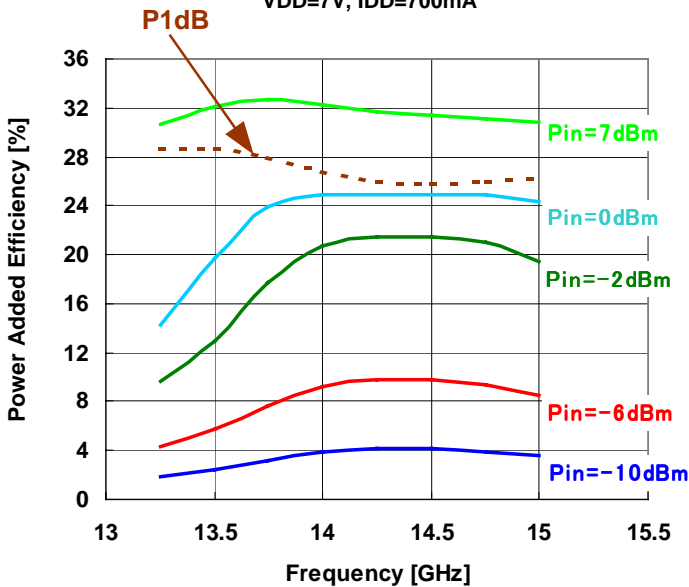
OUTPUT POWER, IDD vs. INPUT POWER

VDD=7V, IDD=700mA



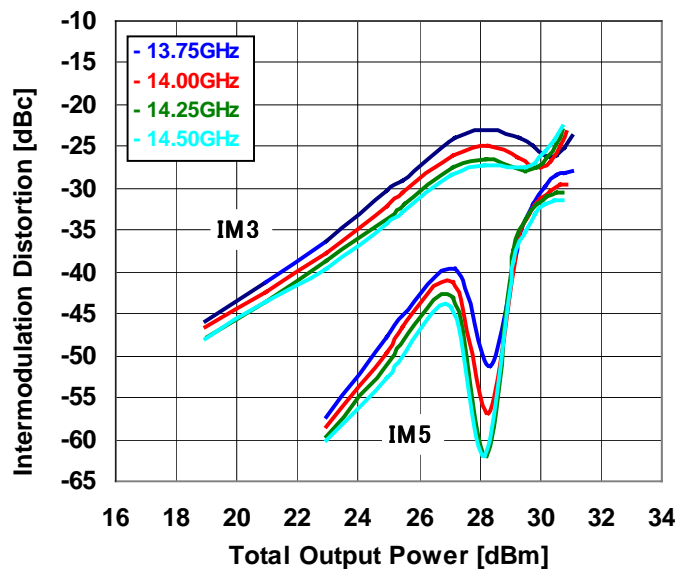
POWER ADDED EFFICIENCY vs FREQUENCY

VDD=7V, IDD=700mA



IMD vs TOTAL OUTPUT POWER

VDD=7V, IDD=700mA, Δf=+10MHz

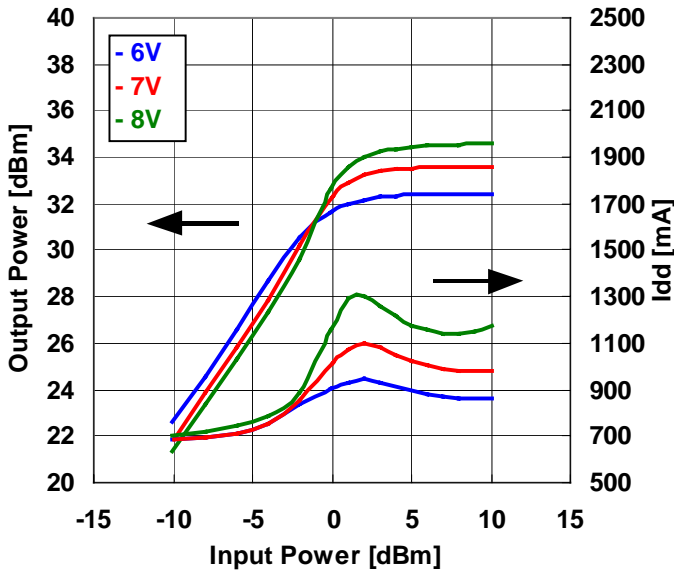


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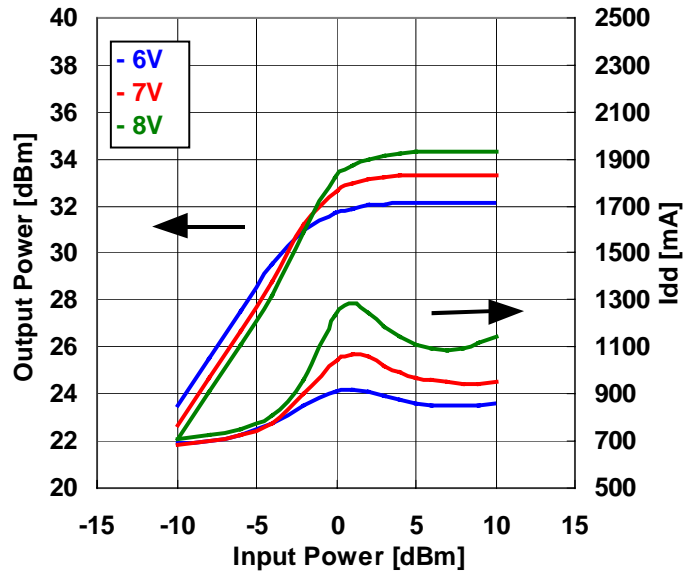
## Ku band Power Amplifier MMIC

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

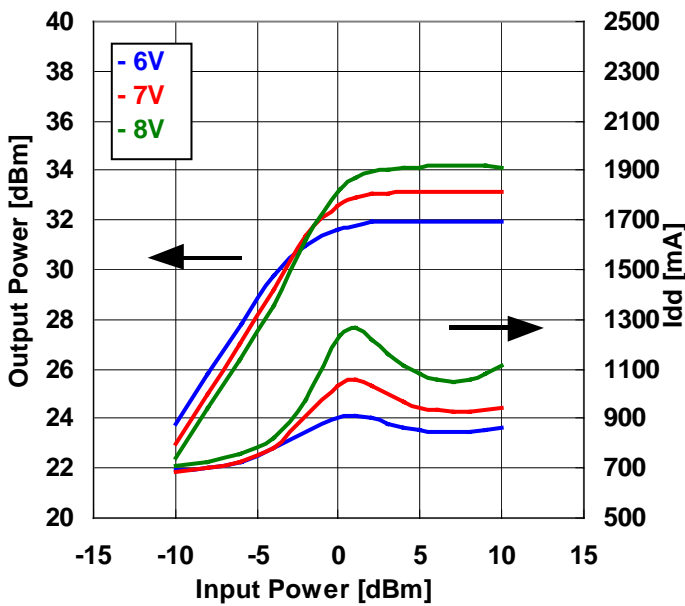
IDD=700mA @ 13.75GHz



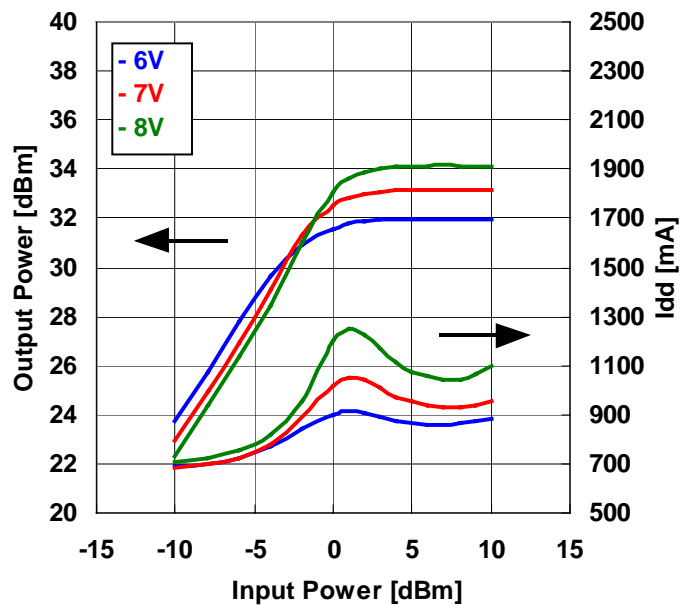
IDD=700mA @ 14.00GHz



IDD=700mA @ 14.25GHz



IDD=700mA @ 14.50GHz



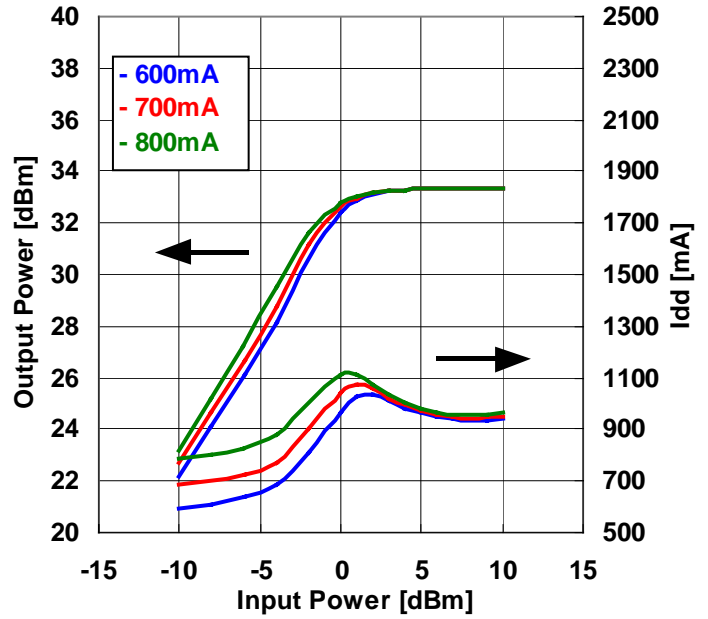
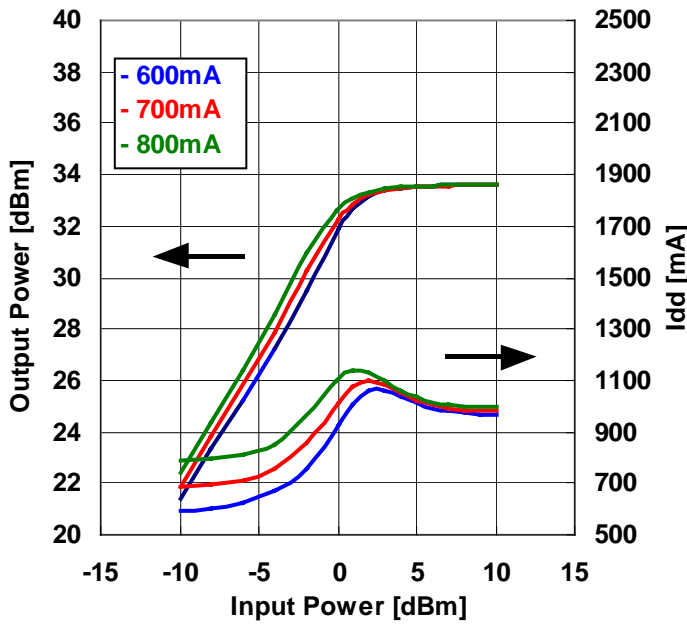
# FMM5054VF

## Ku band Power Amplifier MMIC

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

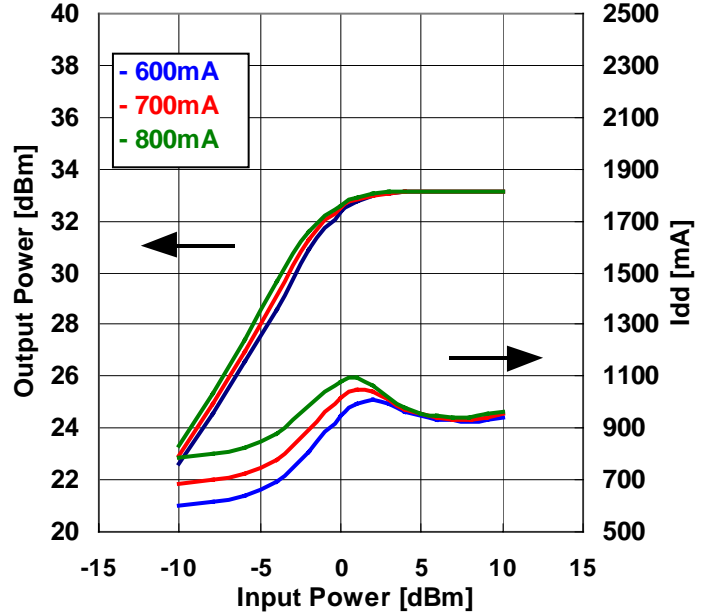
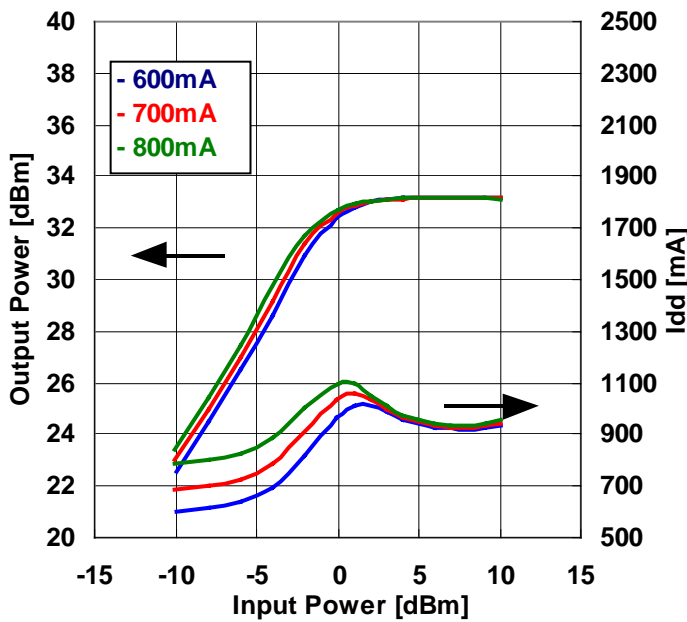
VDD=7V @ 13.75GHz

VDD=7V @ 14.00GHz



VDD=7V @ 14.25GHz

VDD=7V @ 14.50GHz

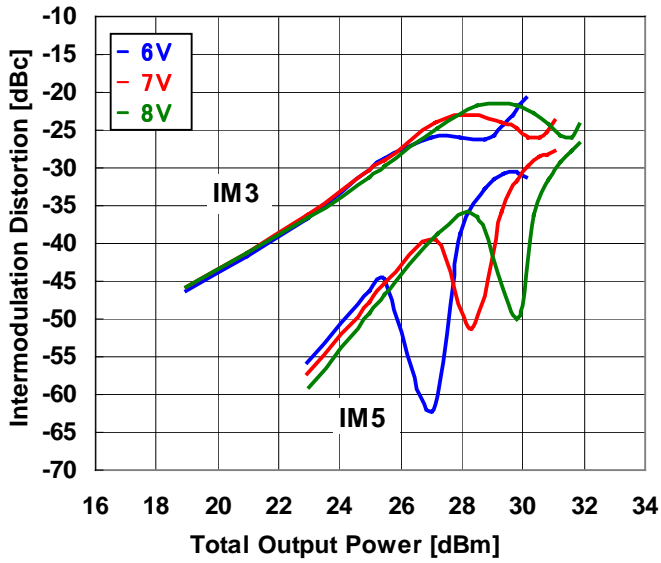


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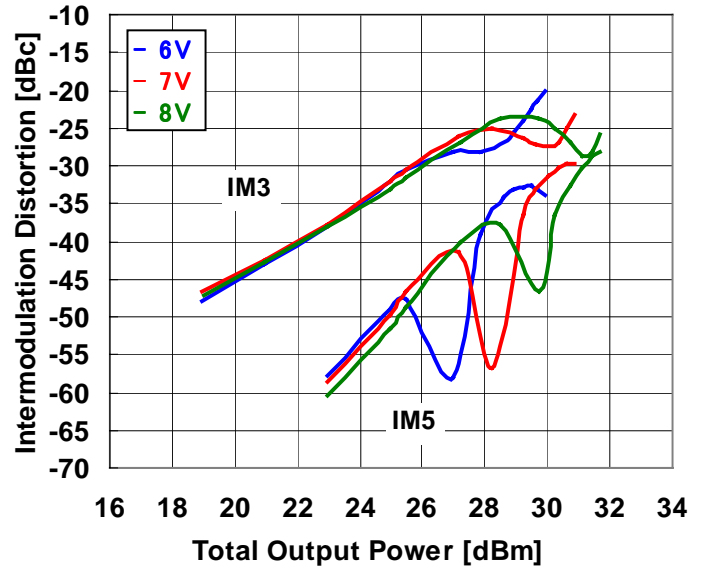
## Ku band Power Amplifier MMIC

### IMD PERFORMANCE vs OUTPUT POWER by Drain Voltage

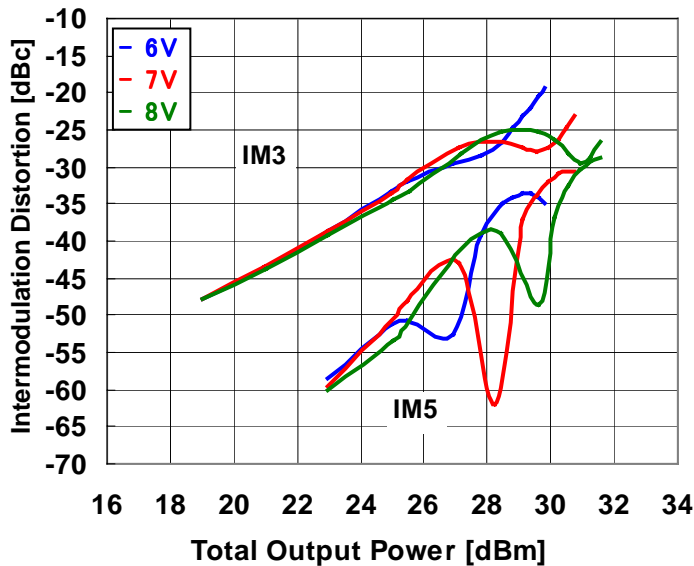
IDD=700mA ,  $\Delta f=+10\text{MHz}$  @ 13.75GHz



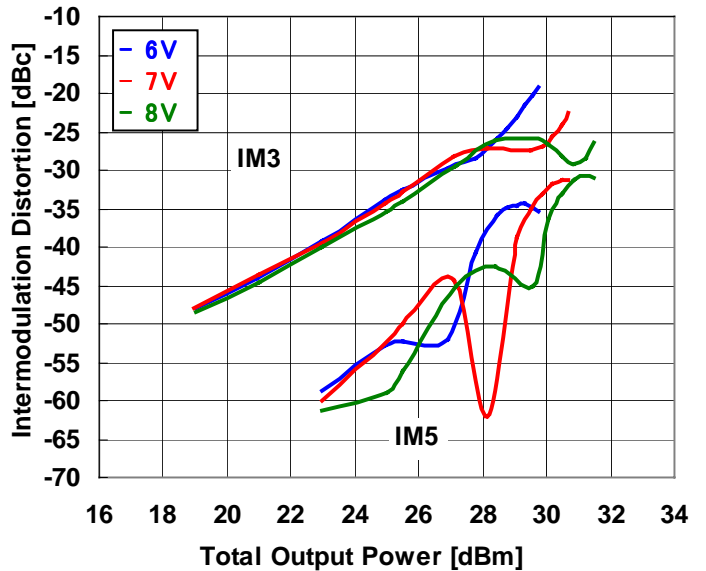
IDD=700mA ,  $\Delta f=+10\text{MHz}$  @ 14.00GHz



IDD=700mA ,  $\Delta f=+10\text{MHz}$  @ 14.25GHz



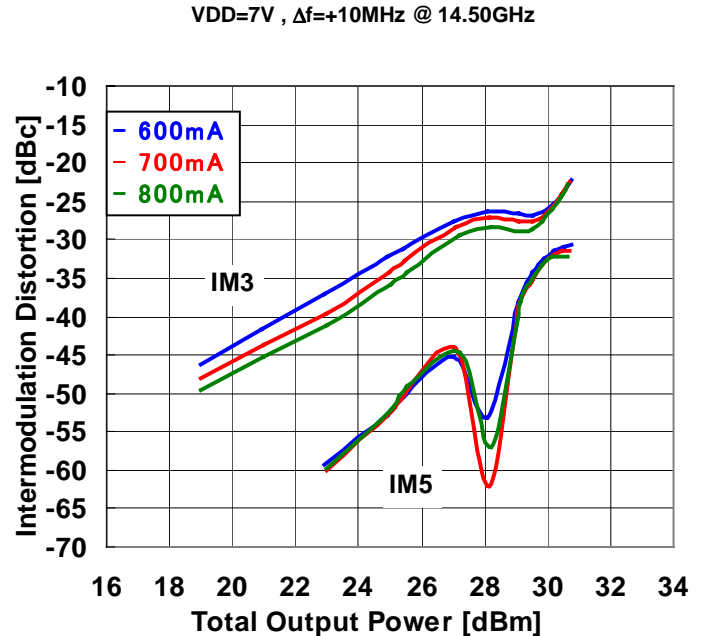
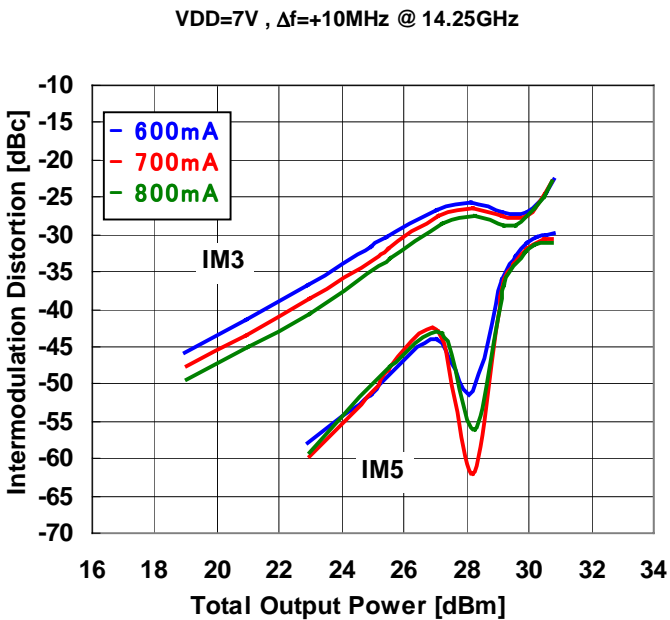
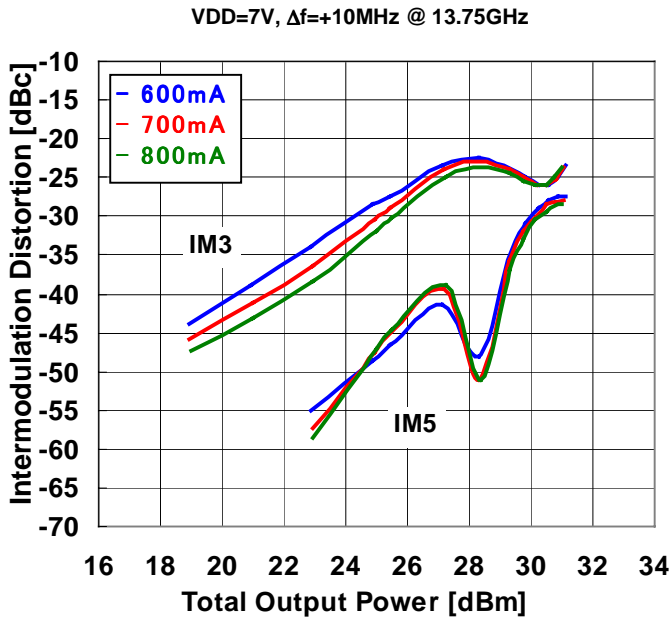
IDD=700mA ,  $\Delta f=+10\text{MHz}$  @ 14.50GHz



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

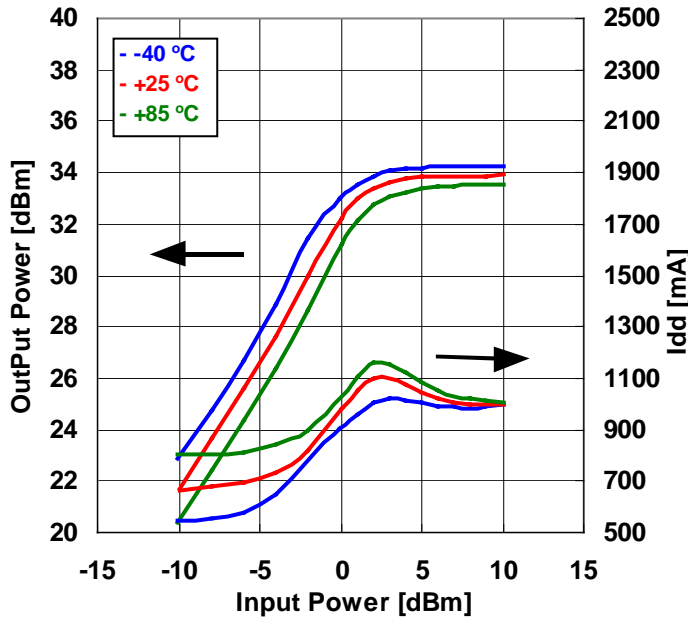


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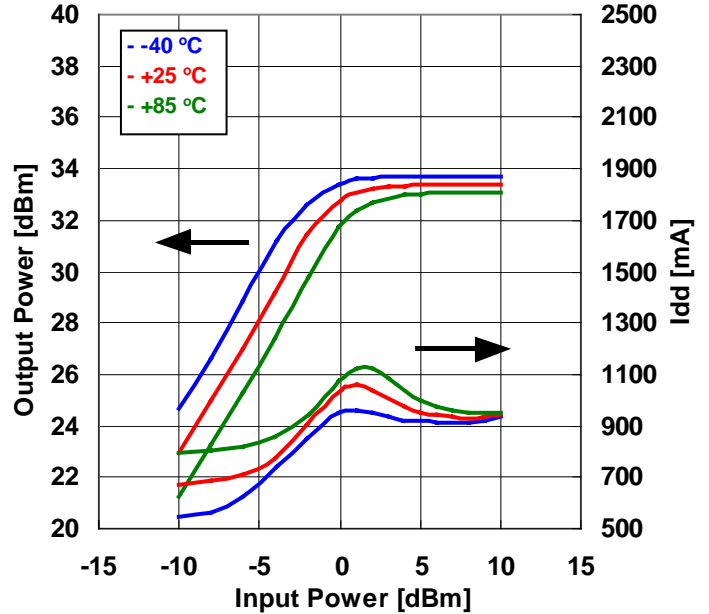
## Ku Band Power Amplifier MMIC

### OUTPUT POWER , DRAIN CURRENT vs. INPUT POWER by Temperature

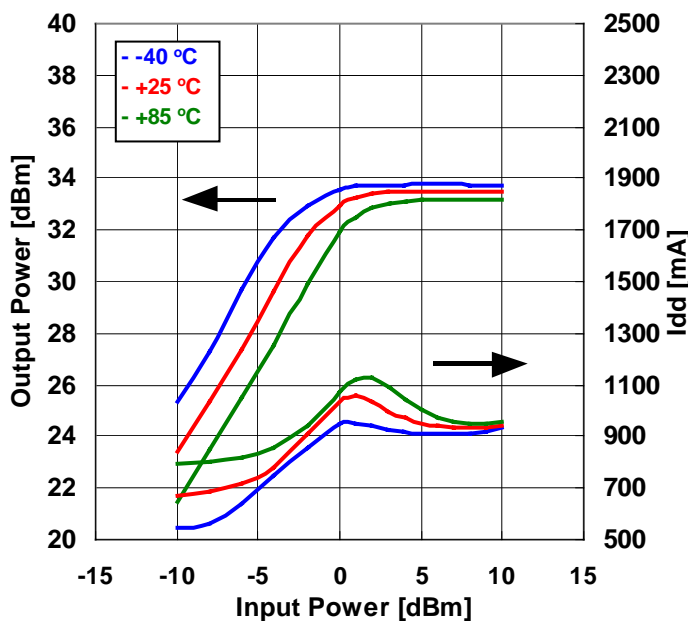
VDD=7V, IDD=700mA @ 13.75GHz



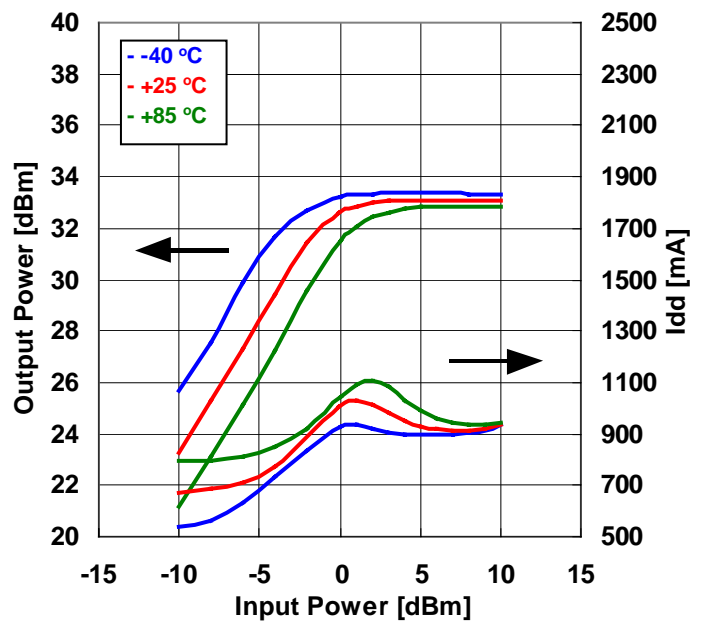
VDD=7V, IDD=700mA @ 14.00GHz



VDD=7V, IDD=700mA @ 14.25GHz



VDD=7V, IDD=700mA @ 14.50GHz

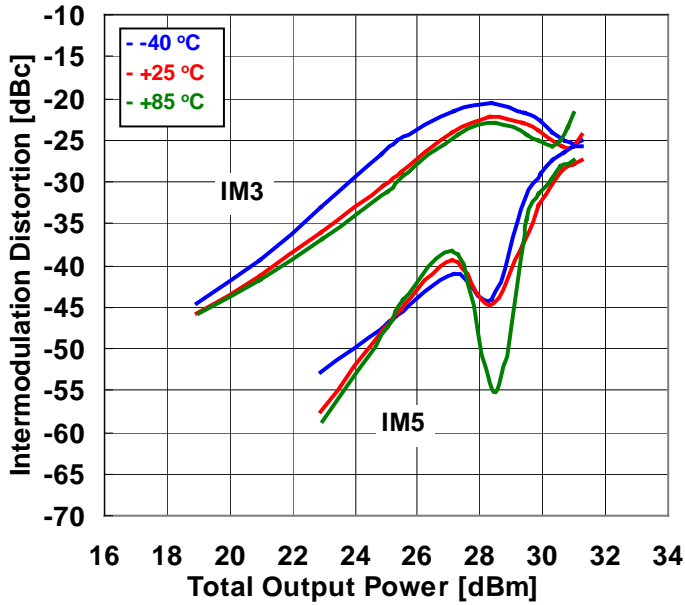


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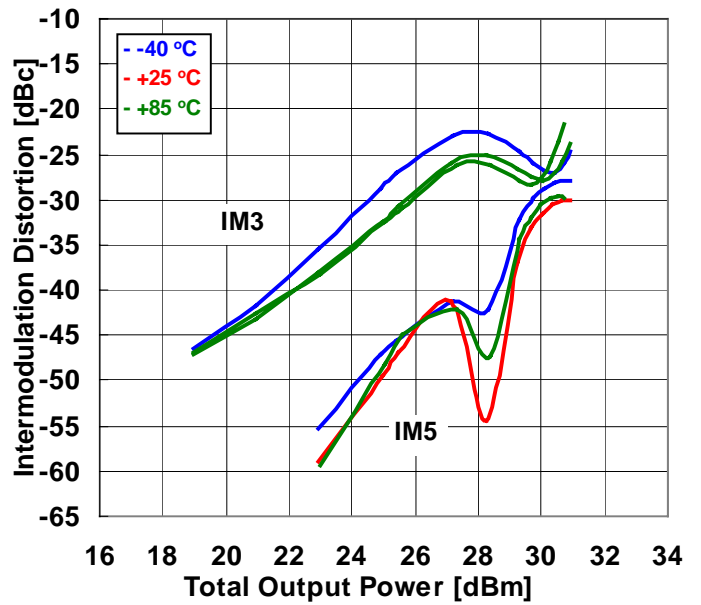
## Ku band Power Amplifier MMIC

### IMD PERFORMANCE vs. TOTAL OUTPUT POWER by Temperature

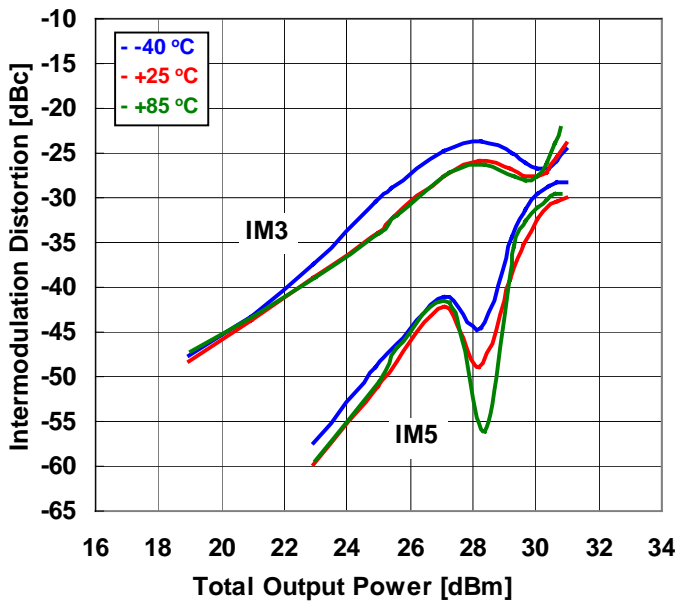
VDD=7V, IDD=700mA,  $\Delta f=+10\text{MHz}$  @ 13.75GHz



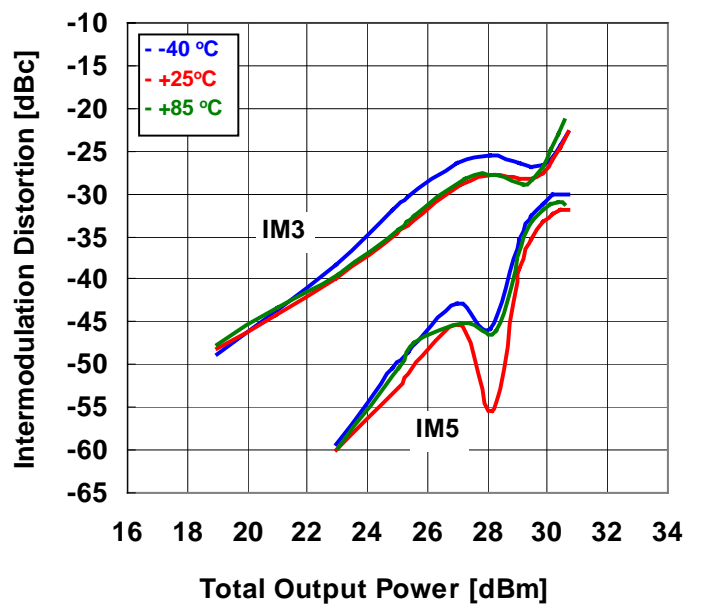
VDD=7V, IDD=700mA,  $\Delta f=+10\text{MHz}$  @ 14.00GHz



VDD=7V, IDD=700mA,  $\Delta f=+10\text{MHz}$  @ 14.25GHz



VDD=7V, IDD=700mA,  $\Delta f=+10\text{MHz}$  @ 14.50GHz

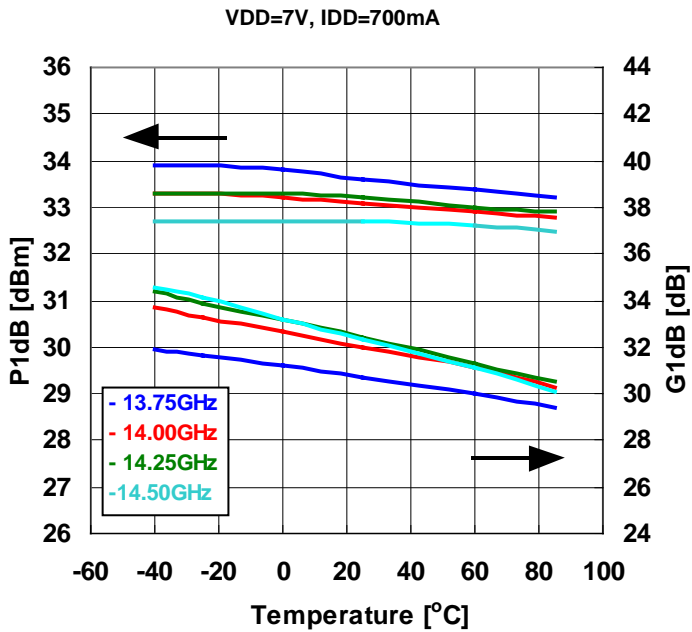




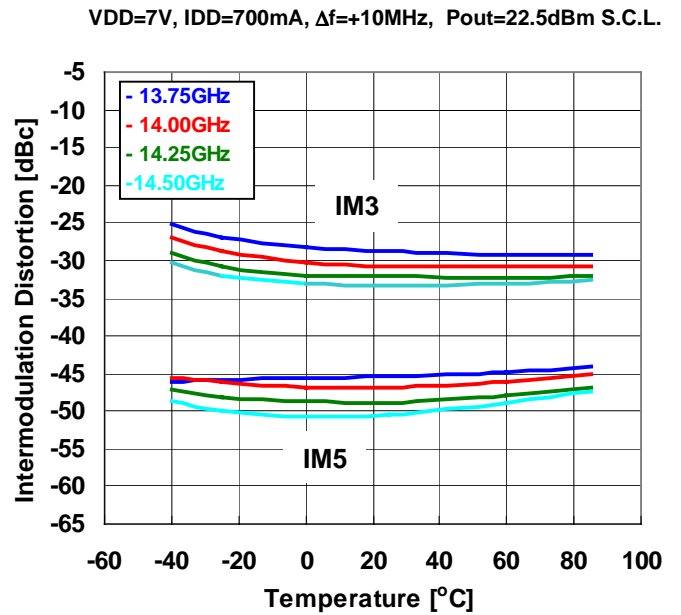
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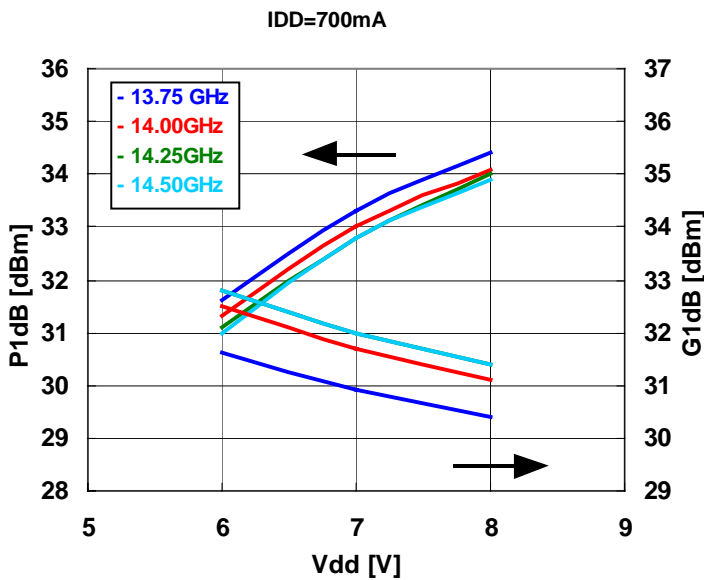
P1dB and G1dB vs. TEMPERATURE



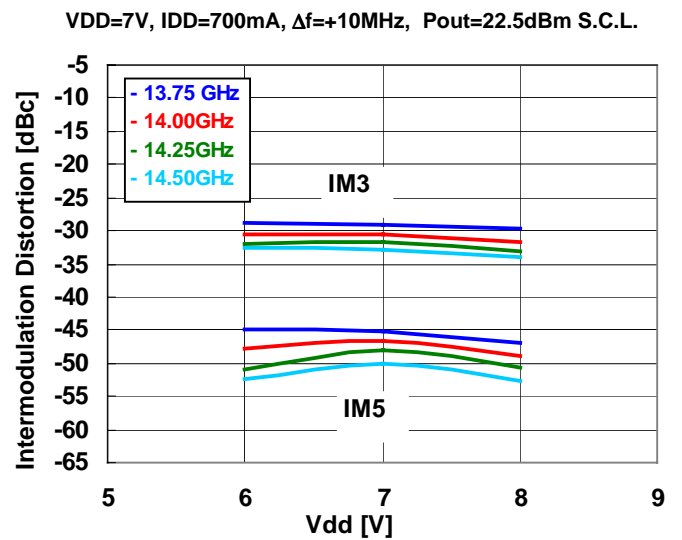
IMD PERFORMANCE vs. TEMPERATURE



P1dB and G1dB vs. Drain Voltage



INTERMODULATION DISTORTION vs. Drain Voltage



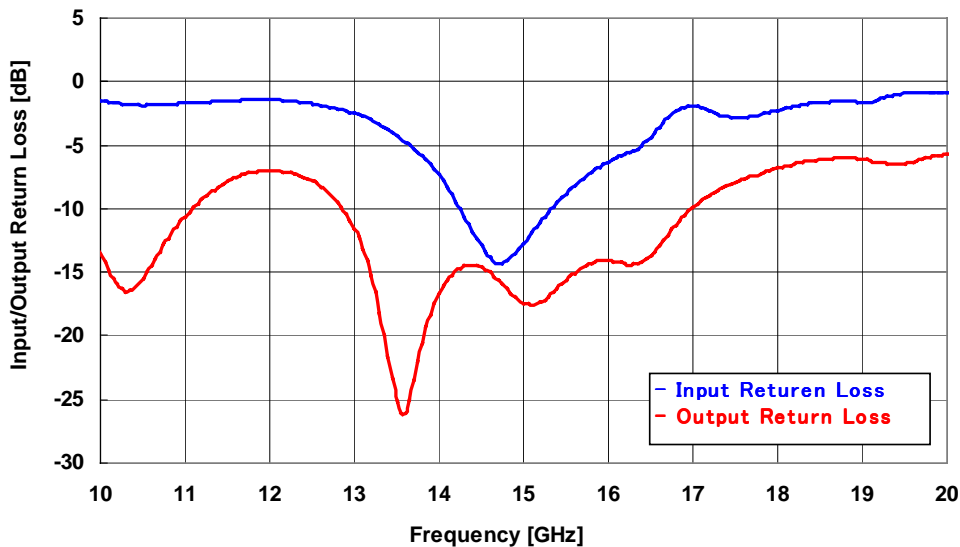
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## Ku band Power Amplifier MMIC

### ■ S-PARAMETER

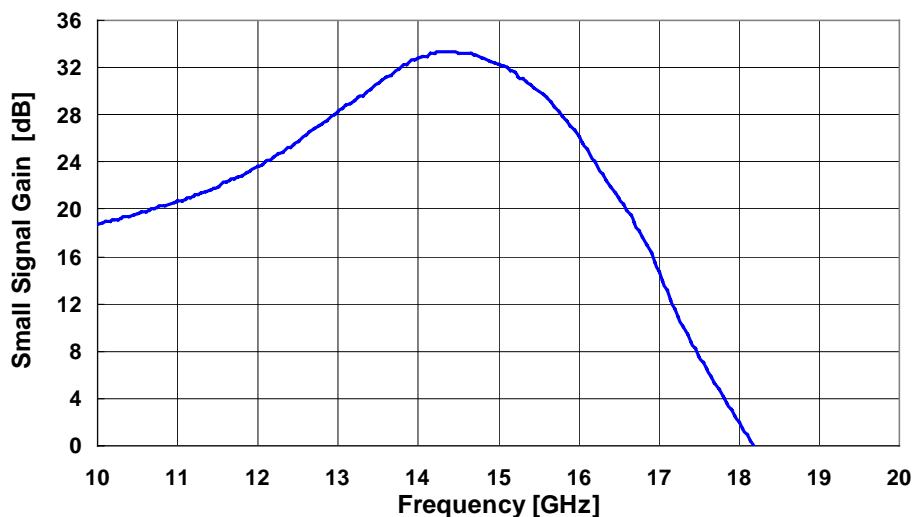
#### INPUT/OUTPUT RETURN LOSS vs. FREQUENCY

Vdd=7V, Idd=700mA, Pin=-20 dBm



#### SMALL SIGNAL GAIN vs. FREQUENCY

Vdd=7V, Idd=700mA, Pin=-20dBm



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## Ku Band Power Amplifier MMIC

### ■ S-PARAMETER

VDD=7.0V , IDD=700mA

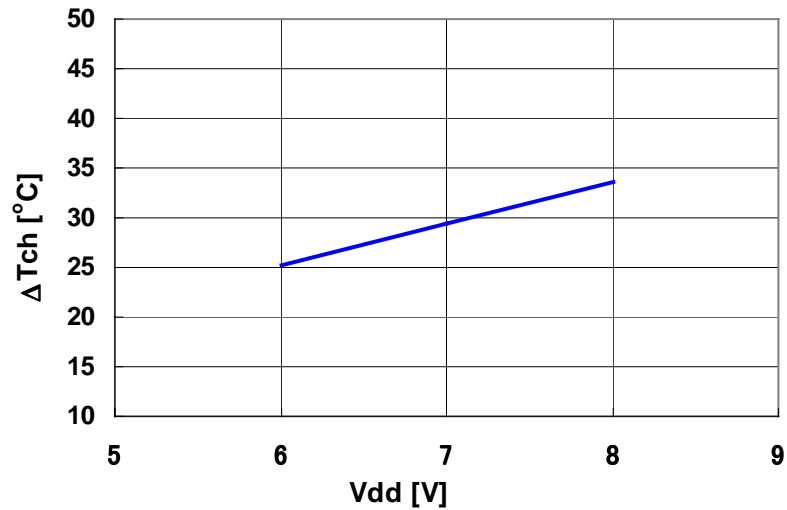
| FREQUENCY<br>[GHz] | S11   |         | S21    |         | S12   |         | S22   |         |
|--------------------|-------|---------|--------|---------|-------|---------|-------|---------|
|                    | MAG   | ANG     | MAG    | ANG     | MAG   | ANG     | MAG   | ANG     |
| 1.00               | 0.975 | -38.22  | 0.038  | 63.46   | 0.000 | 156.33  | 0.984 | -43.45  |
| 2.00               | 0.943 | -74.83  | 0.137  | -143.34 | 0.000 | -179.17 | 0.927 | -83.40  |
| 3.00               | 0.947 | -107.31 | 0.161  | 130.88  | 0.001 | 166.68  | 0.921 | -119.80 |
| 4.00               | 0.943 | -140.26 | 0.200  | 72.38   | 0.002 | 138.71  | 0.941 | -158.75 |
| 5.00               | 0.909 | 179.82  | 0.268  | 31.27   | 0.003 | 97.79   | 0.906 | 155.92  |
| 6.00               | 0.908 | 136.71  | 0.642  | -20.63  | 0.002 | 42.50   | 0.858 | 107.98  |
| 7.00               | 0.898 | 97.45   | 1.486  | -88.46  | 0.001 | -12.07  | 0.829 | 59.51   |
| 8.00               | 0.866 | 61.17   | 3.724  | -179.79 | 0.001 | -70.19  | 0.751 | 8.12    |
| 9.00               | 0.868 | 23.30   | 6.172  | 78.33   | 0.003 | -121.82 | 0.569 | -56.01  |
| 10.00              | 0.836 | -15.02  | 8.659  | -22.90  | 0.004 | -174.73 | 0.211 | -161.38 |
| 11.00              | 0.822 | -45.49  | 10.787 | -117.42 | 0.004 | 170.05  | 0.295 | 25.53   |
| 12.00              | 0.847 | -79.94  | 15.153 | 151.05  | 0.004 | 117.17  | 0.446 | -44.33  |
| 13.00              | 0.750 | -122.22 | 26.134 | 47.66   | 0.003 | 72.45   | 0.265 | -105.75 |
| 13.25              | 0.692 | -136.29 | 29.656 | 17.71   | 0.002 | 58.72   | 0.148 | -117.71 |
| 13.50              | 0.613 | -151.02 | 34.131 | -13.40  | 0.001 | 75.67   | 0.055 | -90.74  |
| 13.75              | 0.527 | -169.63 | 39.225 | -47.33  | 0.001 | 100.29  | 0.079 | -21.92  |
| 13.80              | 0.510 | -173.81 | 40.373 | -54.56  | 0.001 | 106.32  | 0.093 | -20.13  |
| 13.85              | 0.492 | -178.33 | 41.209 | -61.97  | 0.001 | 106.45  | 0.108 | -19.07  |
| 13.90              | 0.472 | 176.61  | 42.211 | -69.25  | 0.001 | 106.53  | 0.121 | -18.65  |
| 13.95              | 0.451 | 171.96  | 42.930 | -77.00  | 0.001 | 106.63  | 0.135 | -19.45  |
| 14.00              | 0.430 | 167.01  | 43.508 | -84.57  | 0.002 | 107.85  | 0.147 | -20.48  |
| 14.05              | 0.406 | 161.56  | 44.163 | -92.17  | 0.002 | 106.96  | 0.158 | -22.67  |
| 14.10              | 0.385 | 155.97  | 44.688 | -99.77  | 0.002 | 104.97  | 0.166 | -25.03  |
| 14.15              | 0.359 | 149.82  | 45.422 | -107.50 | 0.002 | 104.06  | 0.173 | -27.50  |
| 14.20              | 0.335 | 143.36  | 45.852 | -115.33 | 0.002 | 103.48  | 0.180 | -29.29  |
| 14.25              | 0.314 | 136.37  | 46.124 | -123.41 | 0.002 | 102.07  | 0.185 | -31.90  |
| 14.30              | 0.295 | 128.51  | 46.295 | -131.17 | 0.002 | 100.19  | 0.189 | -34.69  |
| 14.35              | 0.274 | 120.54  | 46.277 | -139.28 | 0.002 | 99.46   | 0.191 | -37.05  |
| 14.40              | 0.256 | 112.13  | 46.350 | -147.10 | 0.002 | 95.72   | 0.190 | -39.48  |
| 14.45              | 0.241 | 103.30  | 46.324 | -154.99 | 0.002 | 95.23   | 0.188 | -41.80  |
| 14.50              | 0.225 | 93.34   | 46.088 | -162.95 | 0.003 | 91.58   | 0.187 | -43.78  |
| 14.75              | 0.192 | 37.13   | 44.501 | 157.47  | 0.003 | 81.21   | 0.160 | -49.18  |
| 15.00              | 0.231 | -12.69  | 41.203 | 117.96  | 0.003 | 70.59   | 0.134 | -44.00  |
| 16.00              | 0.482 | -119.38 | 20.434 | -40.56  | 0.006 | 47.36   | 0.197 | -64.57  |
| 17.00              | 0.799 | -177.08 | 5.447  | -178.54 | 0.015 | -45.48  | 0.319 | -165.84 |
| 18.00              | 0.771 | 157.57  | 1.261  | 89.72   | 0.005 | -108.89 | 0.457 | 117.63  |
| 19.00              | 0.829 | 142.49  | 0.378  | 8.09    | 0.011 | -141.25 | 0.498 | 69.33   |
| 20.00              | 0.899 | 127.55  | 0.126  | -78.58  | 0.010 | 148.92  | 0.516 | 7.48    |

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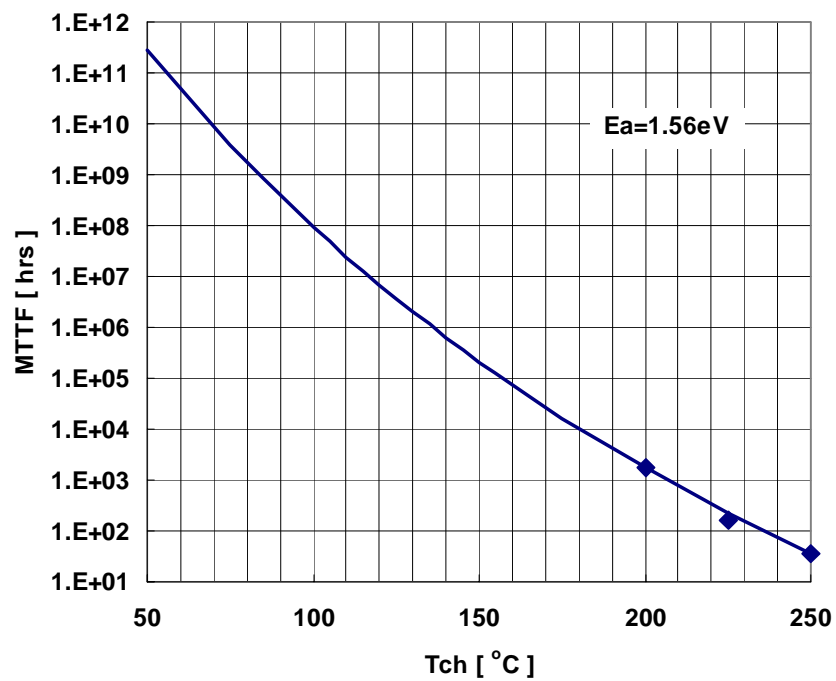
Ku band Power Amplifier MMIC

$\Delta T_{ch}$  vs. DRAIN VOLTAGE (Reference Data)

$I_{DD}=700\text{mA}$



MTTF vs.  $T_{ch}$





# FMM5054VF

## Ku band Power Amplifier MMIC

### ■ Mounting Instructions for VF Package

#### 1. Screw Mounting

- (1) The flange of package may be attached using screws. Torque conditions are shown in table 1.

Table 1. Recommended and Maximum Torque for Screw Mounting

| Package | Recommended screw | Recommended Torque  | Maximum Torque      |
|---------|-------------------|---------------------|---------------------|
| VF      | M2.0              | 10 N-cm (0.9 lb-in) | 15 N-cm (1.3 lb-in) |

- (2) First, tighten the screws with a torque driver set to 5 N-cm.
- (3) The surface finish of the heat sink should be better than 0.8  $\mu\text{m}$ , and the surface flatness must be better than 10  $\mu\text{m}$ .
- (4) Silicon based heat sink compounds should not be used for the thermal conductive grease. They cause poor grounding of the source flange, contamination and long term degradation of thermal resistance between the FET package and heat sink.

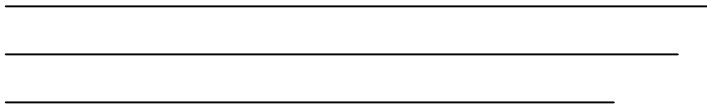
#### 2. Solder Mounting

- (1) Recommended solder are Tin-Lead solder (63Sn/37Pb), Lead-Free solder (Sn-3.0Ag-0.5Cu)\*<sup>1</sup> or equivalent.
- (2) For soldering, Tin-Lead solder (63Sn/37Pb) or Lead-Free solder (Sn-3.0Ag-0.5Cu)\*<sup>1</sup> shall be used. (\*1: The figure displays with weight %. A predominantly tin-rich alloy with 3.0% silver and 0.5% copper.)
- (3) Recommended Flux is Rosin type with chlorine content: 0.2% or less and a low halogen content. After soldering, the flux residue should be removed by appropriate cleaning methods.
- (4) The recommended soldering conditions are as follows:

Partial heating method (soldering iron, spot laser/air)

Product terminal temperature: 260 deg-C, max. 10 s./terminal or

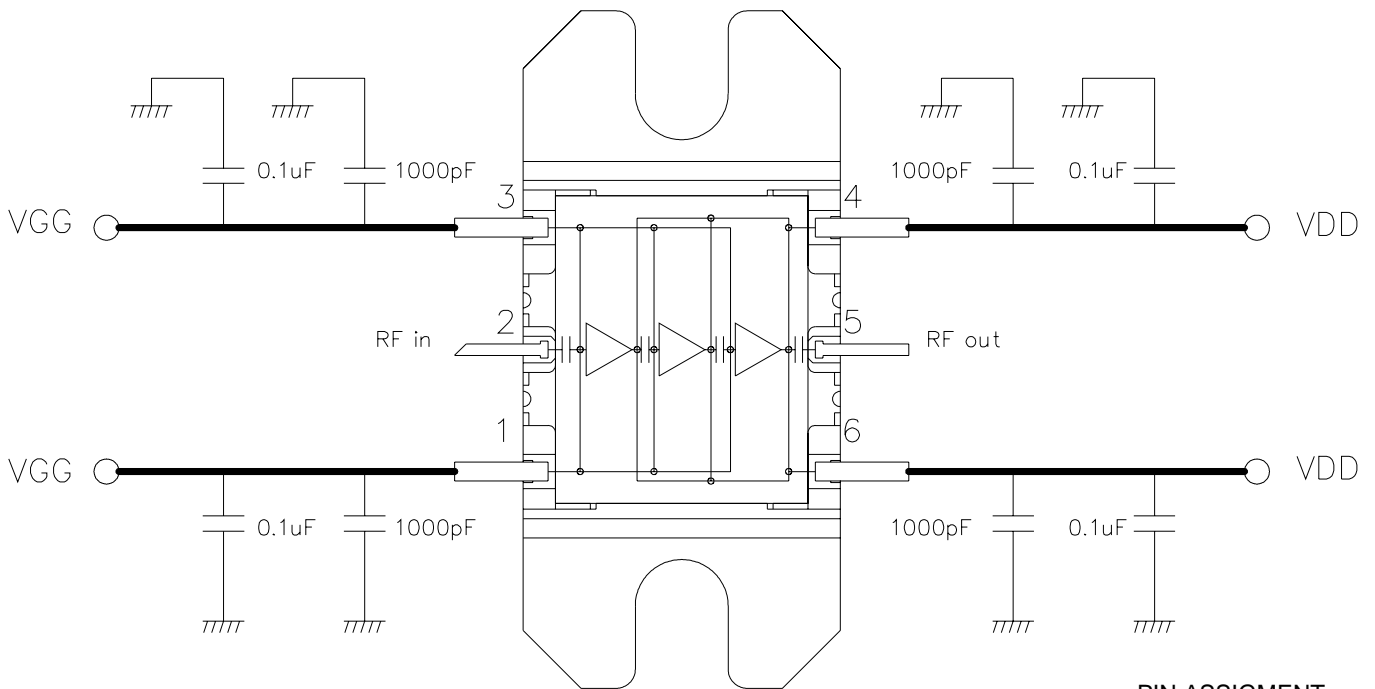
400 deg-C, max. 3 s./terminal



# FMM5054VF

## Ku Band Power Amplifier MMIC

### ■ Recommended Bias Circuit and Internal Block Diagram



- PIN ASSIGNMENT**
- 1 : VGG
  - 2 : RF in
  - 3 : VGG
  - 4 : VDD
  - 5 : RF out
  - 6 : VDD

Note 1: The capacitors are recommended on the bias supply line, close to the package, in order to prevent video oscillations which could damage the module.

Note 2: Two pins both VGG and VDD are internally connected respectively.

# **FMM5054VF**

## **Ku band Power Amplifier MMIC**

### **EUDYNA DEVICES USA INC.**

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[www.eudyna.com](http://www.eudyna.com)

#### **CAUTION**

Eudyna Devices Compound Semiconductor 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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