

# APH668

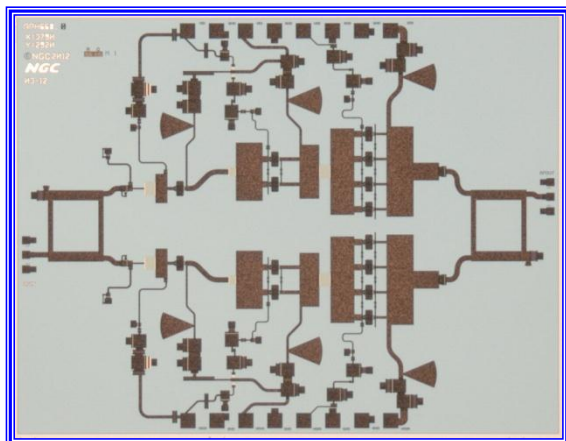
## 71-76 GHz

### High Power Amplifier

**NORTHROP GRUMMAN**

Preliminary Datasheet

Revision: December 2013



X=3790  $\mu$ m Y=2920  $\mu$ m

#### Product Features

- RF Frequency: 71 to 76 GHz
- Linear Gain: 19 dB typ.
- Psat: 28 dBm typ.
- PAE @ Psat: 22% Typ.
- Die Size: 11.07 sq. mm.
- 2 mil substrate
- DC Power: 4 VDC @ 630 mA

#### Performance Characteristics (Ta = 25°C)

| Specification      | Min  | Typ   | Max | Unit |
|--------------------|------|-------|-----|------|
| Frequency          | 71   |       | 76  | GHz  |
| Linear Gain        | 16.5 | 19    |     | dB   |
| Input Return Loss  | 15   | 20    |     | dB   |
| Output Return Loss | 16   | 20    |     | dB   |
| P1dB               |      | TBD   |     | dBm  |
| Psat               | 27   | 28    |     | dBm  |
| PAE @ Psat         |      | 22    |     | %    |
| Psat (-3)          | 26   | 26.5  |     | dBm  |
| Vd1=Vd1a, Vd2=Vd2a |      | 4     |     | V    |
| Vg1=Vg1a           |      | -0.08 |     | V    |
| Vg2=Vg2a           |      | -0.07 |     | V    |
| Id1+Id1a           |      | 270   |     | mA   |
| Id2+Id2a           |      | 360   |     | mA   |

#### Applications

- FCC E-band Communication Systems @ 71-76 GHz Frequency Band
- Short Haul / High Capacity Links
- Enterprise Wireless LAN
- Wireless Fiber Replacement

#### Product Description

The APH668 is a Gallium Arsenide-based broadband, three-stage power amplifier device, designed for use in commercial digital radios and wireless LANs. To ensure rugged and reliable operation, GaAs pHEMT devices are fully passivated. Both bond pad and backside metallization are Ti/Au, which is compatible with conventional die attach, thermocompression, and thermosonic wire bonding assembly techniques.

#### Absolute Maximum Ratings (Ta = 25°C)

| Parameter                      | Min  | Max | Unit   |
|--------------------------------|------|-----|--------|
| Vd1=Vd1a, Vd2=Vd2a             |      | 4   | V      |
| Vg1=Vg1a                       | -0.8 | 0.3 | V      |
| Vg2=Vg2a                       | -0.8 | 0.3 | V      |
| Id1+Id1a                       |      | 270 | mA     |
| Id2+Id2a                       |      | 360 | mA     |
| Input drive level              |      | 16  | dBm    |
| Assy. Temperature (60 seconds) |      | 300 | deg. C |

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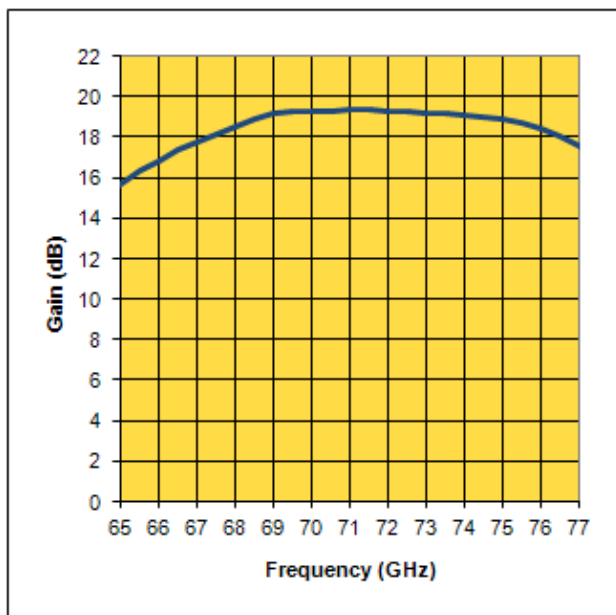
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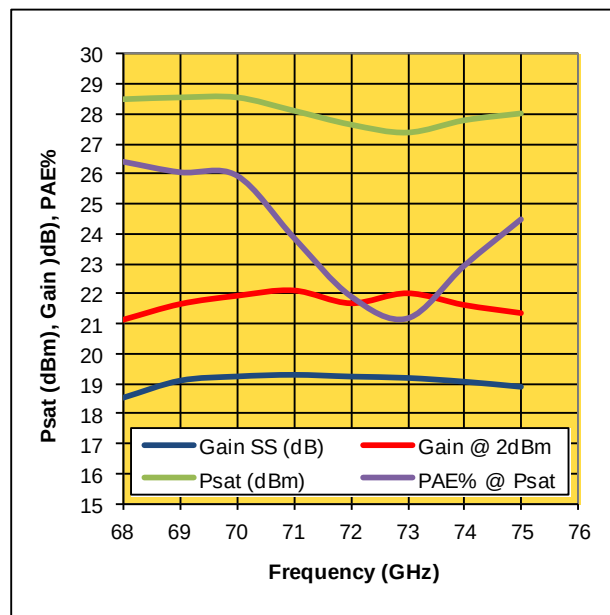
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Measured (On-Wafer) Performance Characteristics (Typical Performance at 25°C)  
 $V_d = 4V$ ,  $I_{d1} + I_{d1a} = 270\text{ mA}$ ,  $I_{d2} + I_{d2a} = 360\text{ mA}$

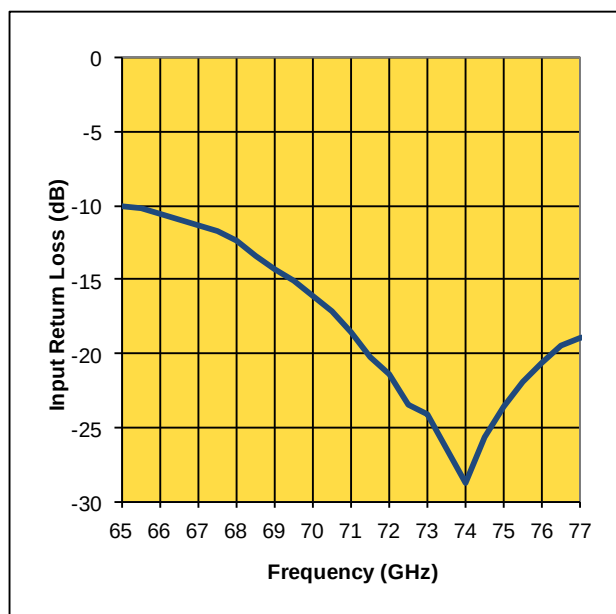
Linear Gain vs. Frequency



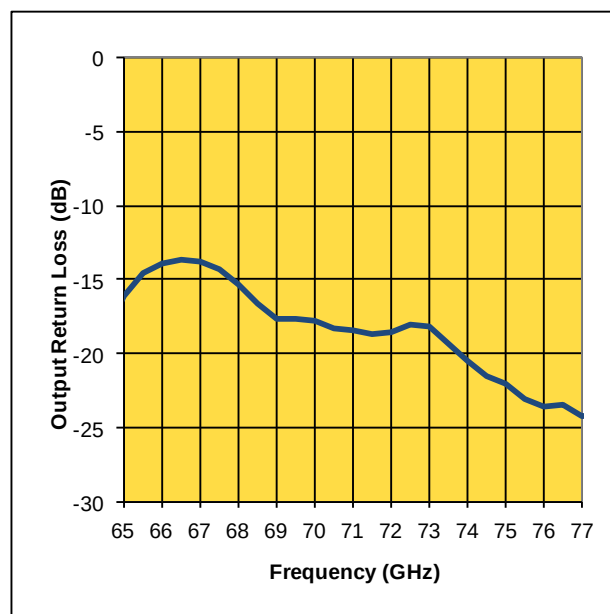
Output Power, Gain, PAE% vs. Frequency \*



Input Return Loss vs. Frequency



Output Return Loss vs. Frequency



\* Pulsed-Power On-Wafer

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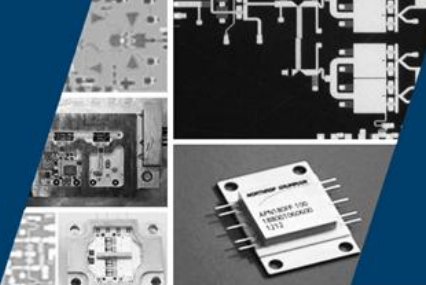
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| Freq GHz | S11 Mag | S11 Ang | S21 Mag | S21 Ang  | S12 Mag | S12 Ang  | S22 Mag | S22 Ang |
|----------|---------|---------|---------|----------|---------|----------|---------|---------|
| 66.0     | 0.301   | 127.400 | 6.324   | 175.200  | 0.002   | 114.100  | 0.223   | 124.700 |
| 66.5     | 0.286   | 123.800 | 6.736   | 157.200  | 0.002   | 119.100  | 0.227   | 119.800 |
| 67.0     | 0.279   | 120.000 | 7.123   | 138.900  | 0.001   | 80.930   | 0.220   | 114.500 |
| 67.5     | 0.263   | 116.100 | 7.488   | 120.600  | 0.001   | 144.700  | 0.204   | 110.900 |
| 68.0     | 0.246   | 111.600 | 7.863   | 102.500  | 0.001   | -171.700 | 0.184   | 107.700 |
| 68.5     | 0.219   | 107.100 | 8.276   | 83.720   | 0.001   | 111.200  | 0.159   | 108.900 |
| 69.0     | 0.195   | 104.600 | 8.561   | 64.730   | 0.001   | 79.940   | 0.147   | 115.500 |
| 69.5     | 0.179   | 101.700 | 8.760   | 45.300   | 0.001   | 48.640   | 0.149   | 119.600 |
| 70.0     | 0.163   | 96.560  | 8.821   | 26.390   | 0.001   | 31.230   | 0.154   | 119.000 |
| 70.5     | 0.144   | 90.650  | 8.887   | 8.134    | 0.000   | -29.630  | 0.151   | 118.800 |
| 71.0     | 0.120   | 85.320  | 8.928   | -10.420  | 0.001   | -50.240  | 0.147   | 119.500 |
| 71.5     | 0.094   | 83.080  | 8.954   | -28.820  | 0.001   | 1.354    | 0.144   | 120.300 |
| 72.0     | 0.075   | 79.600  | 8.922   | -47.180  | 0.002   | -127.200 | 0.145   | 121.200 |
| 72.5     | 0.054   | 83.020  | 8.908   | -65.490  | 0.001   | 174.400  | 0.150   | 117.300 |
| 73.0     | 0.052   | 81.570  | 8.811   | -83.990  | 0.002   | 93.590   | 0.142   | 110.400 |
| 73.5     | 0.044   | 65.350  | 8.732   | -102.200 | 0.002   | 48.320   | 0.124   | 101.100 |
| 74.0     | 0.036   | 35.970  | 8.656   | -120.600 | 0.002   | -71.500  | 0.108   | 101.600 |
| 74.5     | 0.043   | 1.162   | 8.584   | -139.500 | 0.001   | 89.810   | 0.093   | 98.820  |
| 75.0     | 0.045   | -26.070 | 8.426   | -159.500 | 0.001   | -29.830  | 0.085   | 95.120  |
| 75.5     | 0.058   | -35.320 | 8.227   | -179.200 | 0.001   | -68.340  | 0.072   | 90.840  |
| 76.0     | 0.070   | -44.620 | 7.927   | 161.100  | 0.001   | 61.650   | 0.062   | 74.730  |
| 76.5     | 0.083   | -51.900 | 7.567   | 141.000  | 0.001   | -19.030  | 0.056   | 57.040  |
| 77.0     | 0.096   | -63.060 | 7.161   | 120.700  | 0.003   | 38.900   | 0.040   | 22.420  |
| 77.5     | 0.109   | -73.180 | 6.647   | 100.200  | 0.004   | 15.660   | 0.034   | -9.000  |
| 78.0     | 0.122   | -84.670 | 6.078   | 79.620   | 0.004   | -1.088   | 0.041   | -31.560 |
| 78.5     | 0.125   | -90.160 | 5.442   | 59.600   | 0.005   | -43.120  | 0.060   | -41.930 |
| 79.0     | 0.140   | -92.650 | 4.829   | 40.550   | 0.005   | -48.130  | 0.080   | -59.940 |
| 79.5     | 0.152   | -94.000 | 4.250   | 22.040   | 0.003   | -60.000  | 0.098   | -70.560 |
| 80.0     | 0.163   | -94.160 | 3.688   | 3.933    | 0.005   | -63.910  | 0.115   | -76.800 |
| 80.5     | 0.177   | -91.850 | 3.182   | -13.190  | 0.004   | -80.640  | 0.134   | -82.190 |
| 81.0     | 0.199   | -92.510 | 2.743   | -29.190  | 0.001   | -88.030  | 0.148   | -87.400 |
| 81.5     | 0.214   | -95.780 | 2.371   | -45.210  | 0.004   | -31.570  | 0.164   | -90.170 |
| 82.0     | 0.227   | -98.490 | 2.037   | -60.890  | 0.006   | -51.900  | 0.181   | -93.150 |

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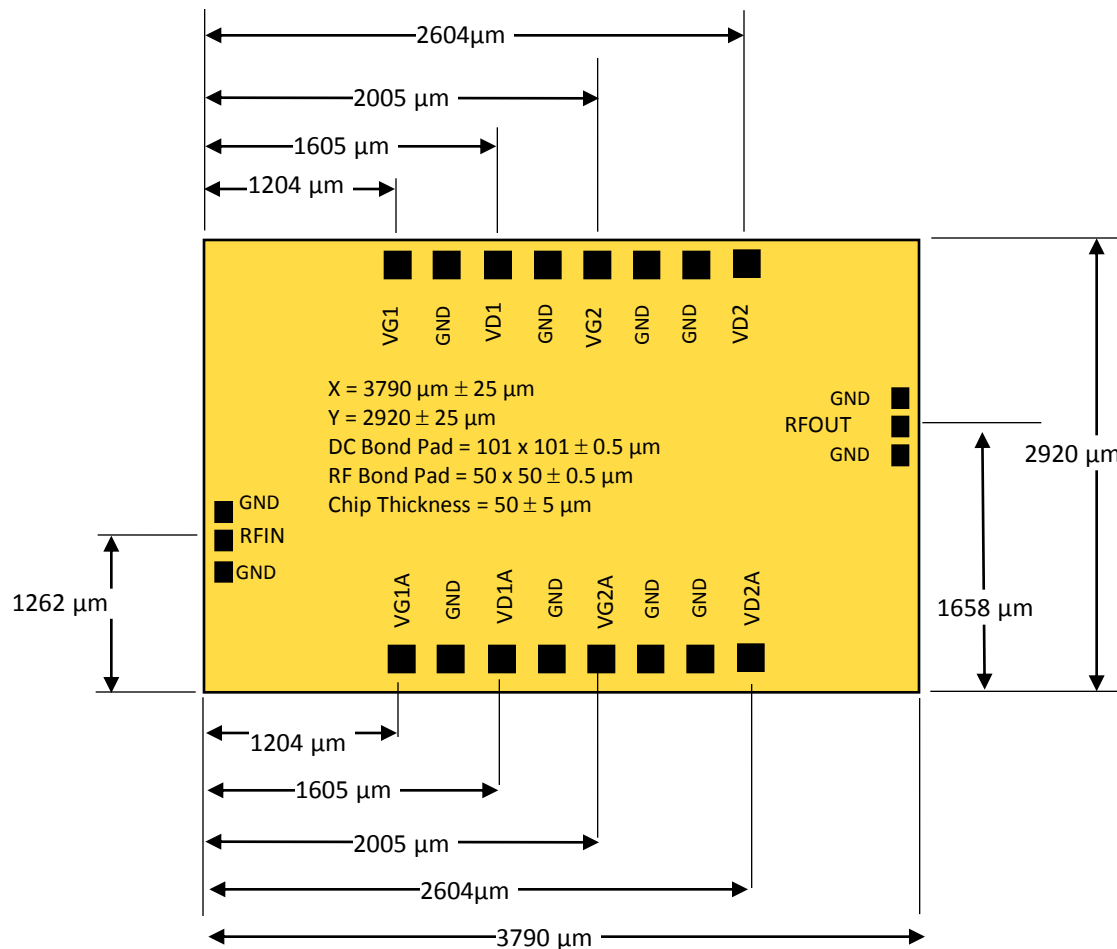
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#### Die Size and Bond Pad Locations (Not to Scale)



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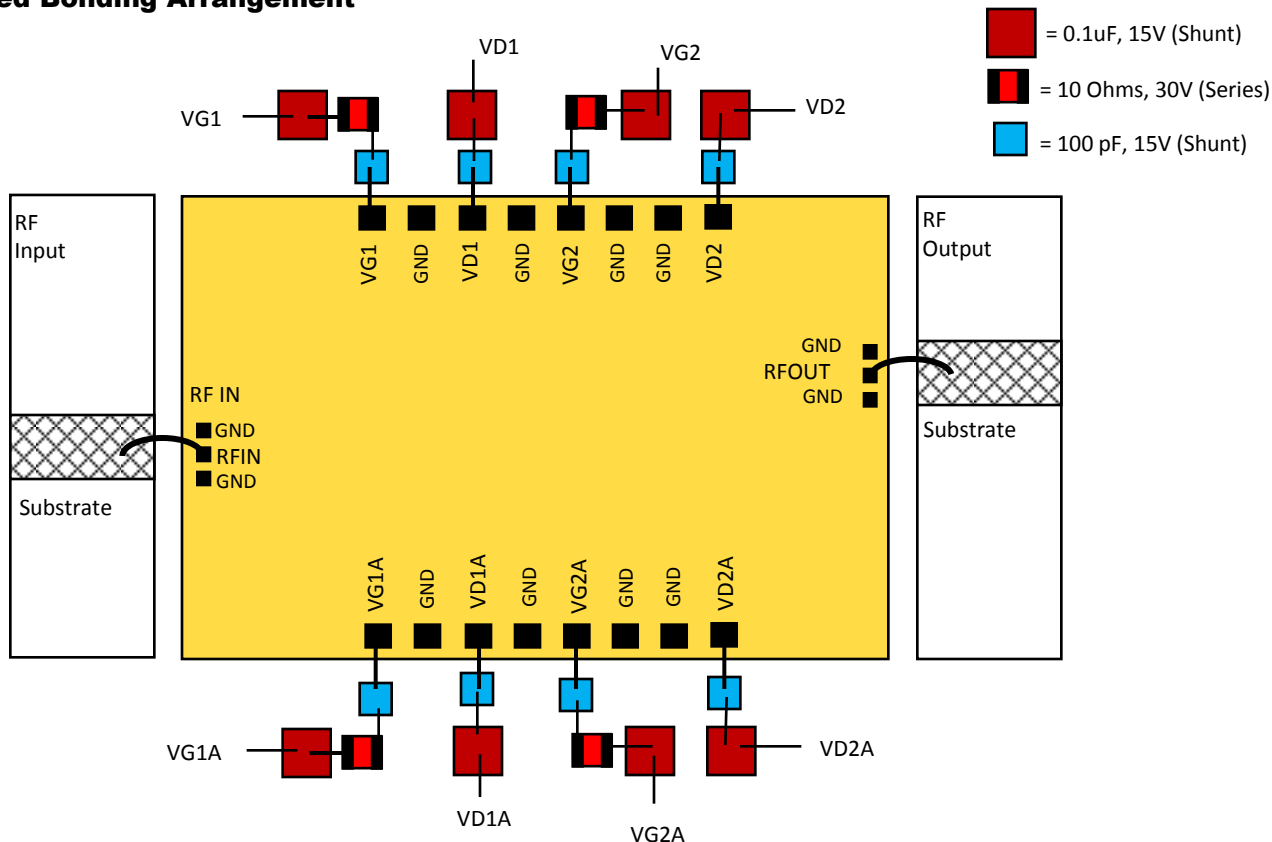
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#### Suggested Bonding Arrangement



#### Recommended Assembly Notes

1. Bypass caps should be 100 pF ceramic (single-layer) placed no further than 30 mils from the amplifier.
2. Best performance obtained from use of <6 mil (long) by 1.5 by 0.5 mil ribbons on input and output.

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