# 5W X Band Medium Power Amplifier

## GaN Monolithic Microwave IC

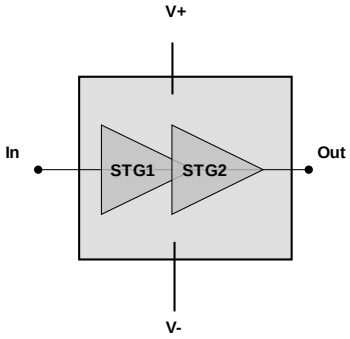
## Description

The CHA6710-FAB is a two stage Medium Power Amplifier operating between 8 and 12.75GHz. It typically provides 5W of saturated output power and 35% of Power Added Efficiency.

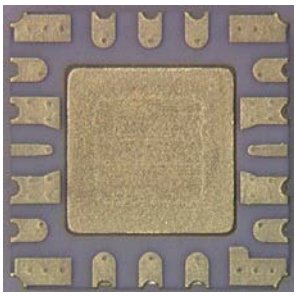
It is designed for a wide range of applications, from defence to space communication systems.

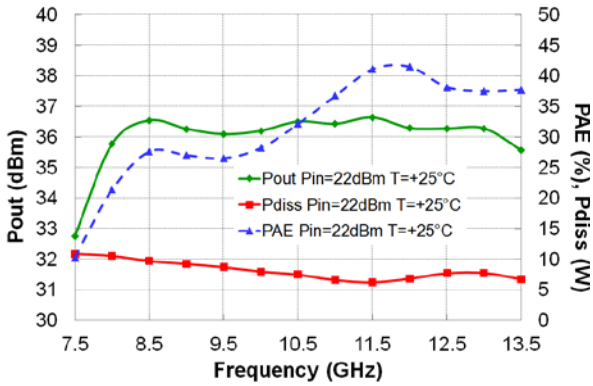
The circuit is manufactured with a GaN pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is proposed in a RoHS leadless surface mount hermetic metal ceramic 6x6mm² package, compliant SMD assembly tools.










## Main Features

- Frequency range: 8-12.75GHz
- High output power: 4.5W
- High PAE: 35%
- Linear Gain: 22.5dB
- DC bias: Vd=25Volt @ Idq=0.2A
- 6x6mm² hermetic metal ceramic package

## Main Electrical Characteristics

Tamb.= +25°C, Vd = +25V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 8 | | 12.75 | GHz |
| Gain | Linear Gain | | 22.5 | | dB |
| Pout | Output Power | | 4.5 | | W |
| PAE | Associated Power Added Efficiency | | 35 | | % |



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## Electrical Characteristics (Pulsed mode)

Tamb.= +25°C, Vd = +25V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 8 | | 12.75 | GHz |
| Gain | Linear Gain | | 22.5 | | dB |
| Pout | Output Power (Pin=23dBm) | | 4.5 | | W |
| PAE | Associated Power Added Efficiency (Pin=22dBm) | | 35 | | % |
| Id | Associated current (Pin=23dBm) | | 0.49 | | A |
| IRL | Input Return Loss | | 10 | | dB |
| ORL | Output Return Loss | | 10 | | dB |
| Idq | Quiescent Current | | 0.2 | | A |
| Vd | Drain Voltage | | 25 | | V |
| Vg | Gate Voltage | | -3.2 | | V |

These values are representative of measurements done in test fixture with a bonding wire of typically 0.25 to 0.3nH.

## Electrical Characteristics (CW mode)

Tamb.= +25°C, Vd = +25V, Idq = 200mA

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 8 | | 12.75 | GHz |
| Gain | Linear Gain | | 22 | | dB |
| Pout | Output Power (Pin=23dBm) | | 4.3 | | W |
| PAE | Associated Power Added Efficiency (Pin=22dBm) | | 34 | | % |
| Id | Associated current (Pin=23dBm) | | 0.49 | | A |
| IRL | Input Return Loss | | 10 | | dB |
| ORL | Output Return Loss | | 10 | | dB |
| Idq | Quiescent Current | | 0.2 | | A |
| Vd | Drain Voltage | | 25 | | V |
| Vg | Gate Voltage | | -3.25 | | V |

These values are representative of measurements done in test fixture with a bonding wire of typically 0.25 to 0.3nH.



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## Electrical Characteristics (Pulsed mode)

Tamb.= +25°C, Vd = +30V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 8 | | 12.75 | GHz |
| Gain | Linear Gain | | 23.5 | | dB |
| Pout | Output Power (Pin=23dBm) | | 5 | | W |
| PAE | Associated Power Added Efficiency (Pin=23dBm) | | 33 | | % |
| Id | Associated current (Pin=23dBm) | | 0.53 | | A |
| IRL | Input Return Loss | | 10 | | dB |
| ORL | Output Return Loss | | 10 | | dB |
| Idq | Quiescent Current | | 0.2 | | A |
| Vd | Drain Voltage | | 30 | | V |
| Vg | Gate Voltage | | -3.2 | | V |

These values are representative of measurements done in test fixture with a bonding wire of typically 0.25 to 0.3nH.

## Electrical Characteristics (CW mode)

Tamb.= +25°C, Vd = +30V, Idq = 200mA

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 8 | | 12.75 | GHz |
| Gain | Linear Gain | | 23 | | dB |
| Pout | Output Power (Pin=23dBm) | | 5 | | W |
| PAE | Associated Power Added Efficiency (Pin=23dBm) | | 33 | | % |
| Id | Associated current (Pin=23dBm) | | 0.52 | | A |
| IRL | Input Return Loss | | 10 | | dB |
| ORL | Output Return Loss | | 10 | | dB |
| Idq | Quiescent Current | | 0.2 | | A |
| Vd | Drain Voltage | | 30 | | V |
| Vg | Gate Voltage | | -3.25 | | V |

These values are representative of measurements done in test fixture with a bonding wire of typically 0.25 to 0.3nH.



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## Absolute Maximum Ratings (1)

## Tamb.= +25°C

| Symbol | Parameter | Values | Unit |
|---|---|---|---|
| Vd | Drain bias voltage | 55V | V |
| Pin | Maximum peak input power overdrive | 30 | dBm |
| Pdiss | Maximum dissipated power | 22 | W |
| Tj | Junction temperature | 230 | °C |
| Tstg | Storage temperature range | -55 to +150 | °C |

(1) Operation of this device above anyone of these parameters may cause permanent damage.

## Typical Bias Conditions

Tamb.= +25°C

| Symbol | Pad Nº | Parameter | Typical Values | Unit |
|---|---|---|---|---|
| Vd | Vd1, Vd2 | Drain voltage | 25 / 30 | V |
| Vg | Vg1, Vg2 | Gate voltage<br>HPA on (pulsed mode)<br>HPA on (CW mode)<br>HPA off | <br>-3.2<br>-3.25<br>-8 to -5 | <br>V<br>V<br>V |

## Biasing up Procedure

1. Bias HPA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -5V)
2. Apply Vds bias voltage (Typically: Vd = 25V)
3. Increase Vgs up to quiescent bias drain current Idq (pulsed applied on the gate)
4. Apply RF signal

## Biasing down Procedure

1. Turn off RF signal
2. Bias HPA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -5V)
3. Turn Vds bias voltage to 0V
4. Turn Vgs bias voltage to 0V



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## Typical FAB Sij parameters (Pulsed mode)

Tback side.= +25°C, Vd = +25V, Idq = 200mA

| Freq (GHz) | S11 (dB) | PhS11 (°) | S12 (dB) | PhS12 (°) | S21 (dB) | PhS21 (°) | S22 (dB) | PhS22 (°) |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.24 | -55.91 | -51.10 | 175.72 | -28.62 | -115.54 | -1.08 | -62.61 |
| 1.50 | -0.50 | -85.78 | -65.61 | 43.68 | -42.67 | -50.94 | -0.61 | -99.09 |
| 2.00 | -1.25 | -117.12 | -46.77 | -143.57 | -46.49 | 43.31 | -0.78 | -132.58 |
| 2.50 | -2.56 | -152.25 | -78.40 | 148.85 | -39.26 | -121.21 | -1.20 | -165.85 |
| 3.00 | -5.33 | 171.98 | -56.43 | -32.21 | -17.29 | 171.91 | -1.81 | 161.66 |
| 3.5 | -9.49 | 137.13 | -52.84 | 158.34 | -11.52 | 71.25 | -2.70 | 129.06 |
| 4 | -16.40 | 98.24 | -54.98 | -138.52 | -10.11 | 21.65 | -3.85 | 96.06 |
| 4.5 | -28.15 | 14.63 | -57.36 | -168.81 | -9.16 | -12.75 | -5.43 | 62.87 |
| 5 | -22.24 | -91.28 | -51.20 | 58.81 | -8.10 | -27.52 | -7.18 | 30.76 |
| 5.5 | -19.49 | -117.83 | -48.80 | 111.72 | -3.48 | -34.47 | -8.64 | 1.49 |
| 6 | -20.91 | -114.54 | -52.40 | 95.90 | 3.78 | -57.88 | -8.93 | -25.71 |
| 6.5 | -13.30 | -119.66 | -49.19 | 106.58 | 10.76 | -102.19 | -8.80 | -60.55 |
| 7 | -9.50 | -149.07 | -55.71 | -92.56 | 16.12 | -157.22 | -8.03 | -105.67 |
| 7.5 | -9.36 | 178.83 | -46.99 | -20.07 | 20.12 | 139.79 | -8.44 | -157.69 |
| 8 | -9.93 | 158.56 | -48.77 | -72.82 | 21.66 | 72.81 | -10.98 | 160.41 |
| 8.5 | -9.93 | 142.46 | -46.81 | -30.76 | 21.37 | 15.78 | -13.68 | 143.00 |
| 9 | -9.95 | 121.37 | -51.02 | -143.52 | 21.08 | -31.16 | -13.09 | 123.10 |
| 9.5 | -10.43 | 96.72 | -48.64 | -88.22 | 21.45 | -74.83 | -12.49 | 95.23 |
| 10 | -11.98 | 66.70 | -65.90 | 119.84 | 22.43 | -120.29 | -12.30 | 60.64 |
| 10.5 | -15.64 | 24.58 | -49.17 | 30.63 | 23.59 | -171.46 | -12.12 | 18.37 |
| 11 | -25.62 | -80.46 | -58.31 | -167.21 | 24.24 | 130.61 | -13.01 | -36.11 |
| 11.5 | -17.01 | 167.15 | -47.96 | -76.00 | 23.69 | 70.75 | -13.92 | -91.42 |
| 12 | -13.01 | 130.99 | -47.28 | -36.46 | 22.60 | 13.22 | -13.18 | -136.08 |
| 12.5 | -10.50 | 107.31 | -41.36 | -124.75 | 21.58 | -46.85 | -11.33 | -170.76 |
| 13 | -7.10 | 84.06 | -47.53 | -128.99 | 19.64 | -116.85 | -7.93 | 151.98 |
| 13.5 | -4.98 | 52.20 | -44.14 | -159.10 | 14.73 | 171.24 | -6.10 | 112.87 |
| 14 | -4.16 | 21.78 | -49.74 | 30.00 | 8.08 | 114.52 | -5.30 | 79.70 |
| 14.5 | -3.85 | -3.13 | -48.80 | -166.79 | 1.42 | 69.01 | -4.77 | 53.38 |
| 15 | -3.56 | -24.58 | -46.81 | -41.71 | -5.11 | 30.11 | -3.97 | 28.98 |
| 15.5 | -3.19 | -44.27 | -51.71 | -22.98 | -11.43 | -4.41 | -3.17 | 5.49 |
| 16 | -2.87 | -62.91 | -46.22 | 9.78 | -17.90 | -35.33 | -2.65 | -16.38 |
| 16.5 | -2.54 | -80.24 | -54.16 | 46.75 | -23.96 | -65.82 | -2.14 | -36.52 |
| 17 | -2.35 | -96.21 | -51.63 | 29.94 | -30.16 | -97.16 | -1.72 | -55.12 |
| 17.5 | -2.14 | -110.93 | -46.79 | 76.33 | -38.91 | -117.18 | -1.42 | -73.58 |
| 18 | -1.94 | -125.42 | -41.09 | 87.76 | -39.16 | -115.64 | -1.24 | -90.39 |
| 18.5 | -1.79 | -138.77 | -42.09 | 31.39 | -51.27 | -78.39 | -1.03 | -105.93 |
| 19 | -1.65 | -151.96 | -44.34 | 8.57 | -45.73 | -5.09 | -0.91 | -120.73 |
| 19.5 | -1.52 | -163.87 | -41.87 | -2.86 | -57.05 | -58.99 | -0.89 | -134.44 |
| 20 | -1.40 | -176.01 | -42.21 | -53.02 | -49.33 | -116.03 | -0.68 | -146.35 |



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## Device thermal information

The device thermal performances below are based on UMS rules to evaluate the junction temperature.
This same procedure is the basis for junction temperature evaluation of the samples used to derive the Median lifetime and activation energy for the particular technology on which the CHA6710-FAB is manufactured (GaN Power HEMT 0.25µm).
The temperature $T_{case}$ is defined as the case back side. The thermal resistance (Rth_eq) is given for the full circuit, and assumes CW and pulsed operation mode are given in the table.

| | | | | |
|---|---|---|---|---|
| Thermal Resistance(1) | Rth_eq | $Tb_{chip}$ =25°C, Vd=25V, Id_drive=0.49A Pin=22dBm Pout=36.3dBm Pdiss=8W **CW** | 7.6 | °C/W |
| Junction Temperature | Tj | | 86 | °C |
| Median Life | T50 | | $2.31x10^{11}$ | Hrs |

| | | | | |
|---|---|---|---|---|
| Thermal Resistance(1) | Rth_eq | $Tb_{chip}$ =85°C, Vd=25V, Id_drive=0.490A Pin=23dBm Pout=36dBm Pdiss=8.35W **CW** | 10.8 | °C/W |
| Junction Temperature | Tj | | 175 | °C |
| Median Life | T50 | | $7.63x10^{7}$ | Hrs |

| | | | | |
|---|---|---|---|---|
| Thermal Resistance(1) | Rth_eq | $Tb_{chip}$ =25°C, Vd=30V, Id_drive=0.518A Pin=22dBm Pout=37.1dBm Pdiss=10.56W **CW** | 8.33 | °C/W |
| Junction Temperature | Tj | | 92 | °C |
| Median Life | T50 | | $2.19x10^{11}$ | Hrs |

| | | | | |
|---|---|---|---|---|
| Thermal Resistance(1) | Rth_eq | $Tb_{chip}$ =85°C, Vd=30V, Id_drive=0.520A Pin=23dBm Pout=36.9dBm Pdiss=10.87W **CW** | 10.38 | °C/W |
| Junction Temperature | Tj | | 198 | °C |
| Median Life | T50 | | $1.57x10^{7}$ | Hrs |

(1) Thermal resistance measured to back of the package.



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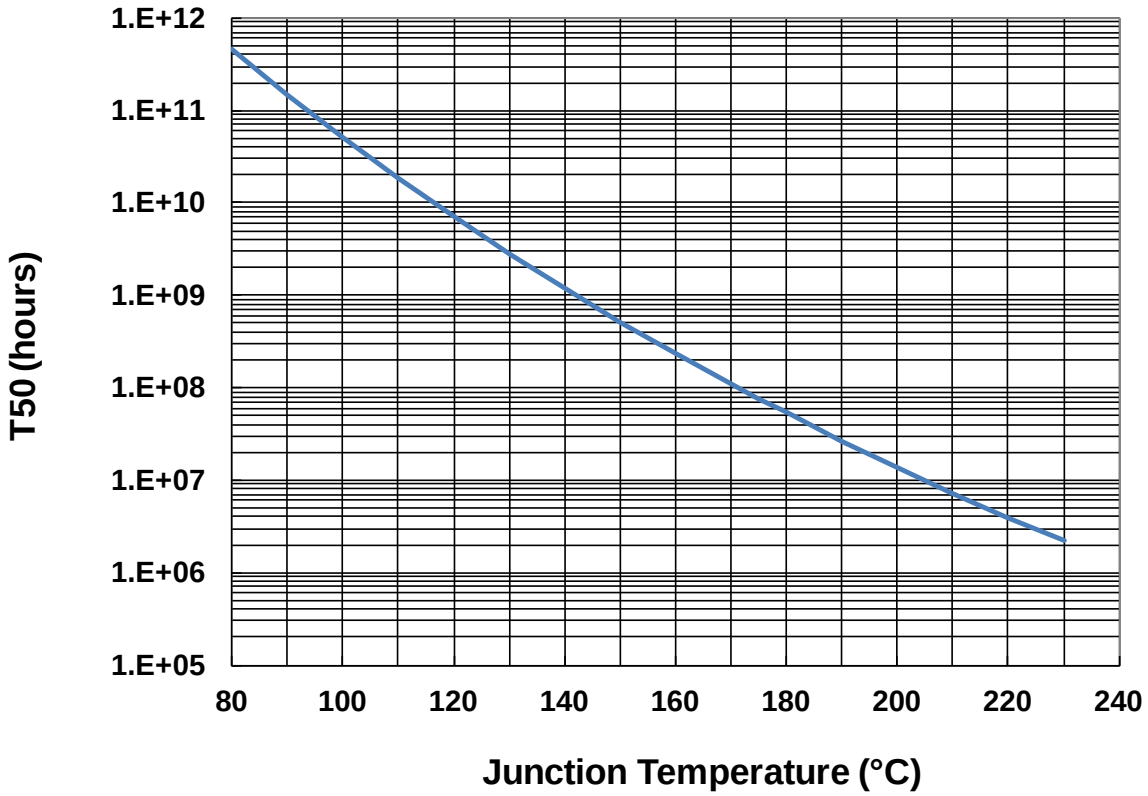
**Median Life Time versus Junction Temperature**



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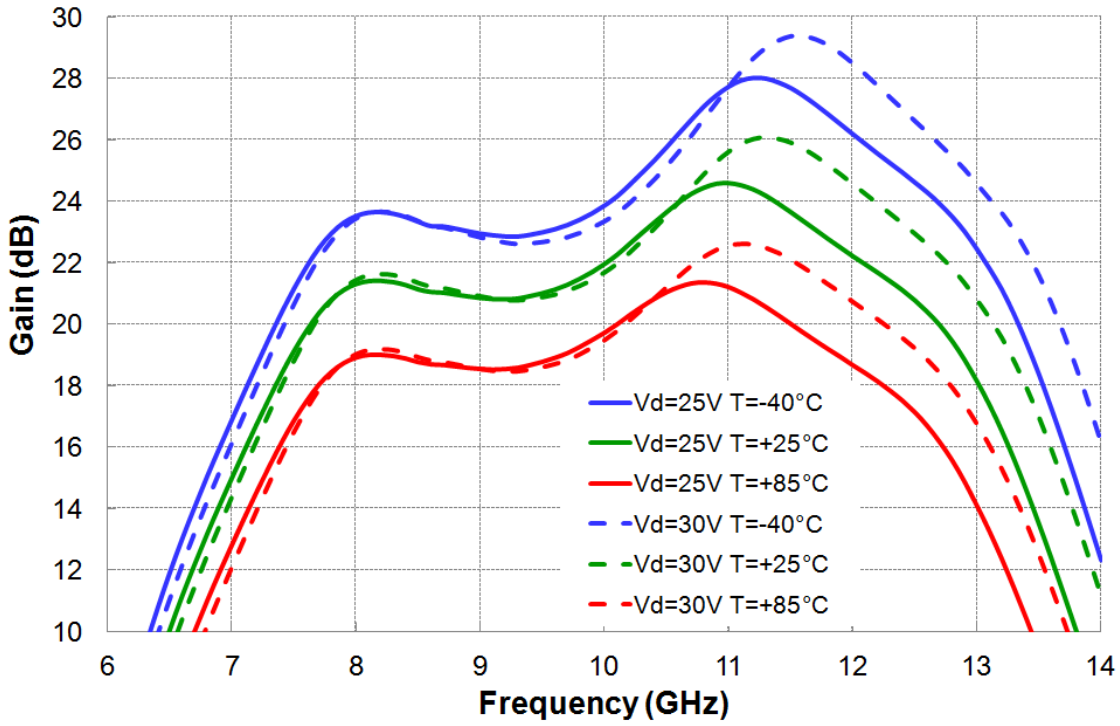
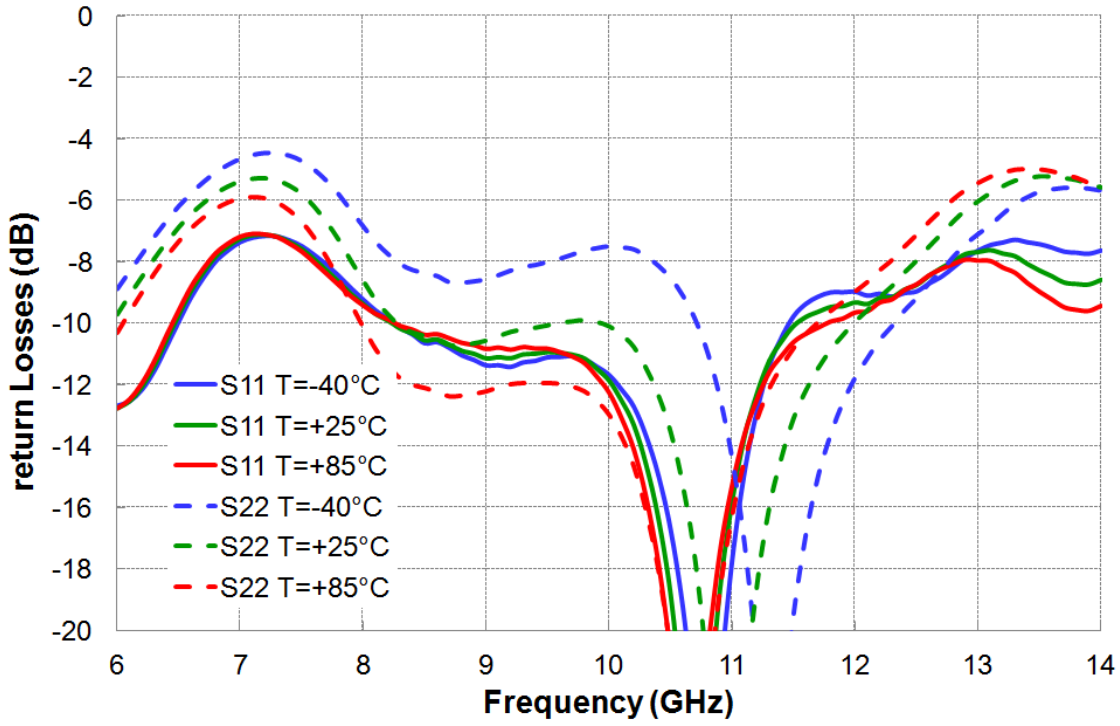
## Typical Board Measurements (CW mode)

Vd = +25 & 30V, Idq = 200mA @ Tback side = +25°C

**Linear Gain versus Frequency (Temp.=-40 & +25 & +85 °C)**




**Return Losses versus Frequency (Temp.=-40 & +25 & +85 °C) Vd=25V**



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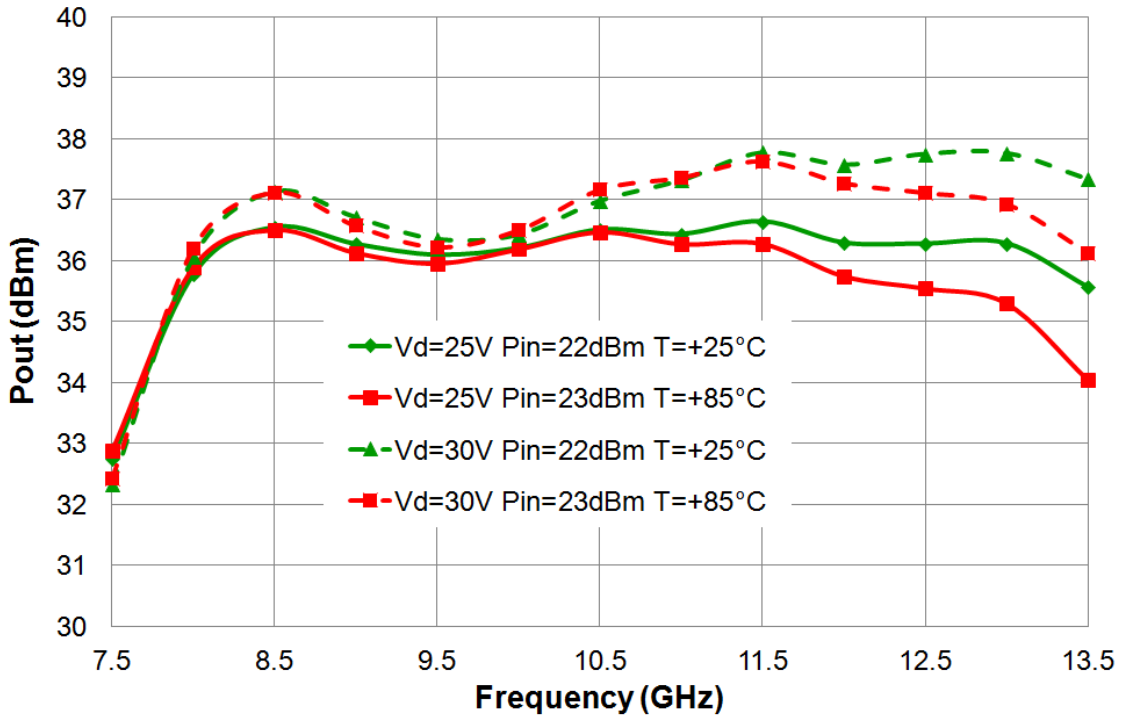
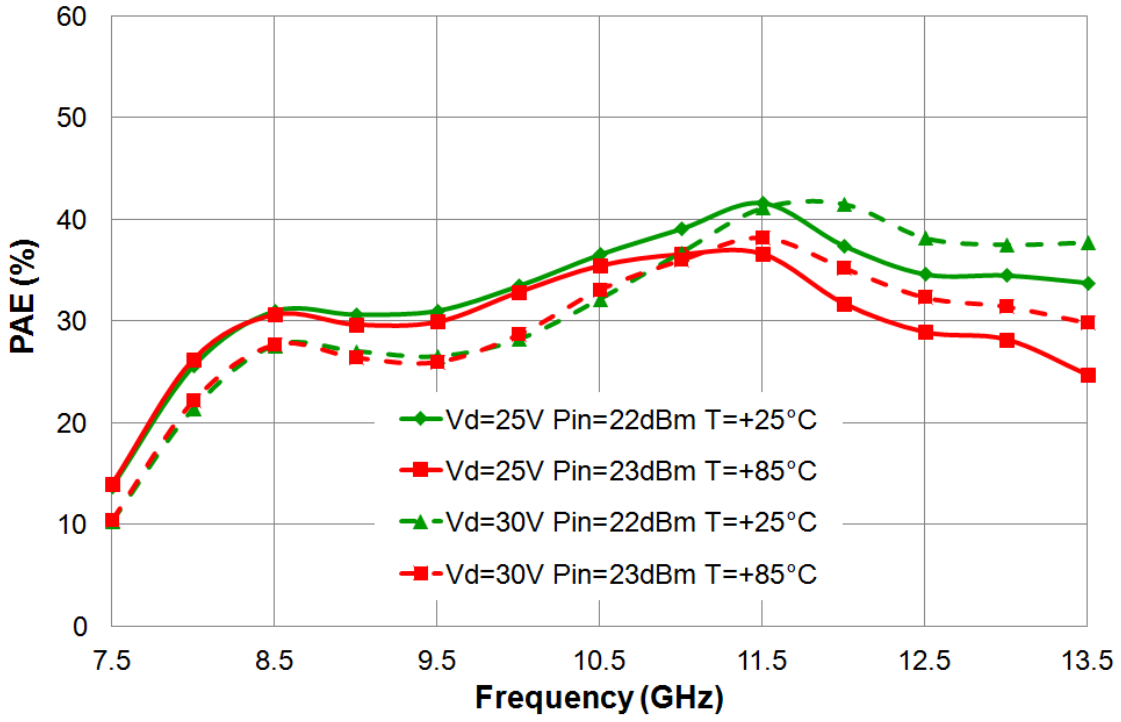
## Typical Board Measurements (CW mode)

Vd = +25 & 30V, Idq = 200mA @ Tback side = +25°C

**Output Power versus Frequency (Temp. = +25 & +85 °C)**




**Power Added Efficiency versus Frequency (Temp+25 & +85 °C)**



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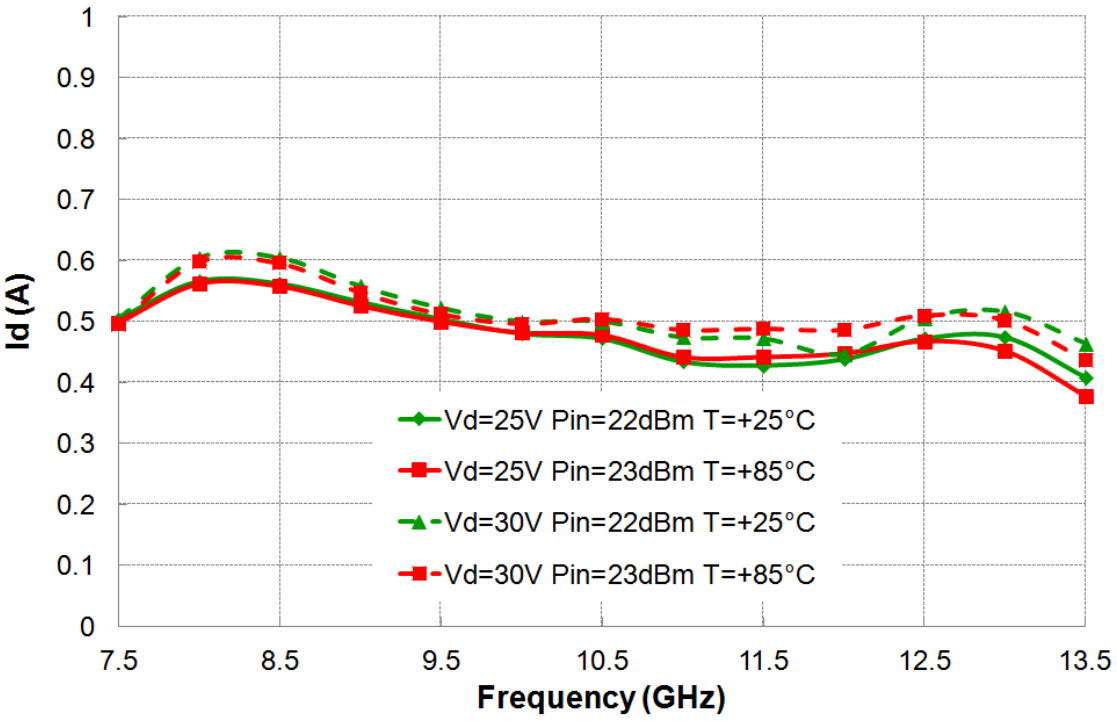
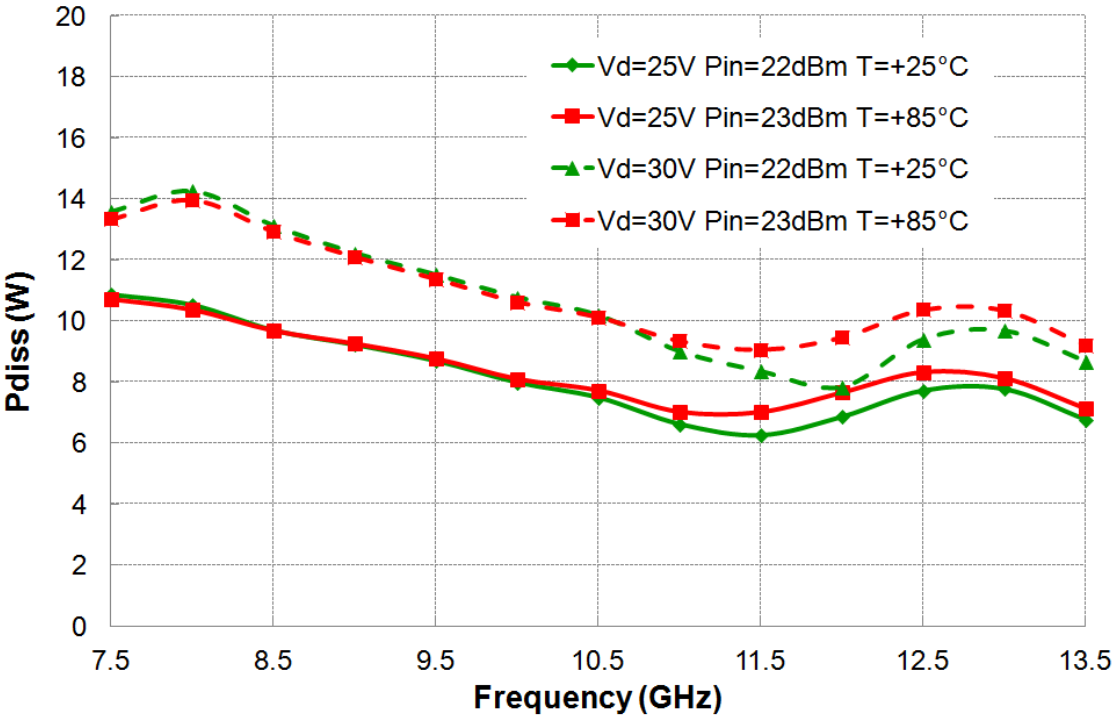
## Typical Board Measurements (CW mode)

Vd = +25 & 30V, Idq = 200mA @ Tback side = +25°C

**Drain Current versus Frequency (Temp.= +25 & +85 °C)**




**Dissipated Power versus Frequency (Temp.= +25 & +85 °C)**



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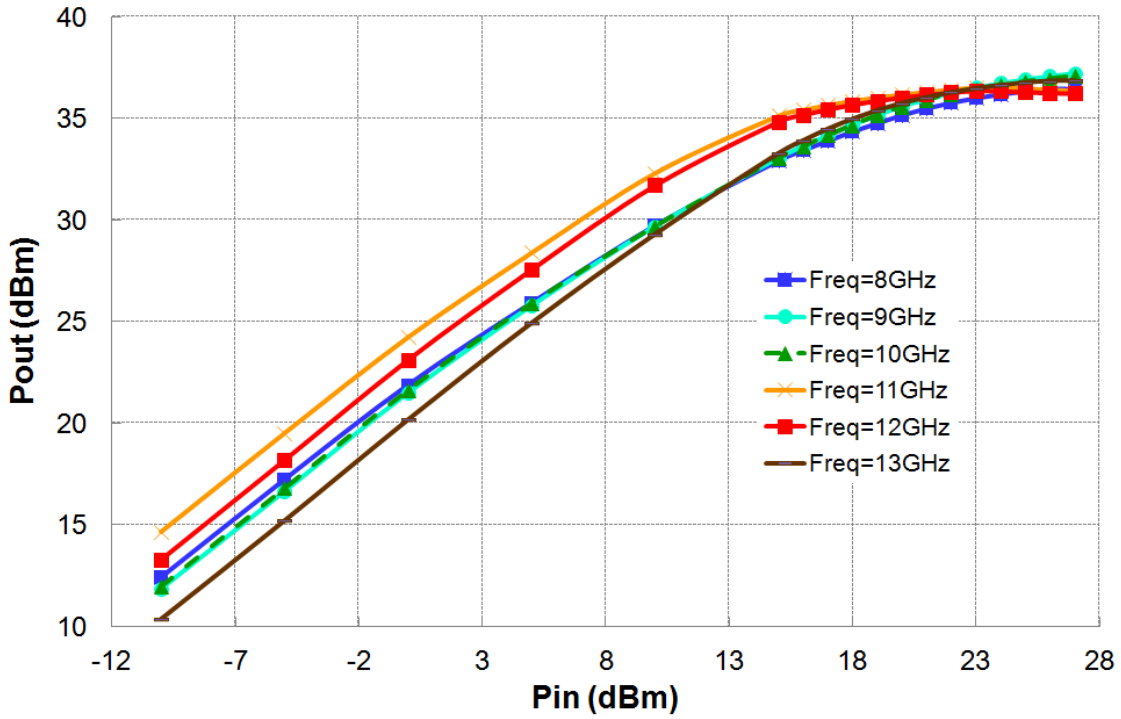
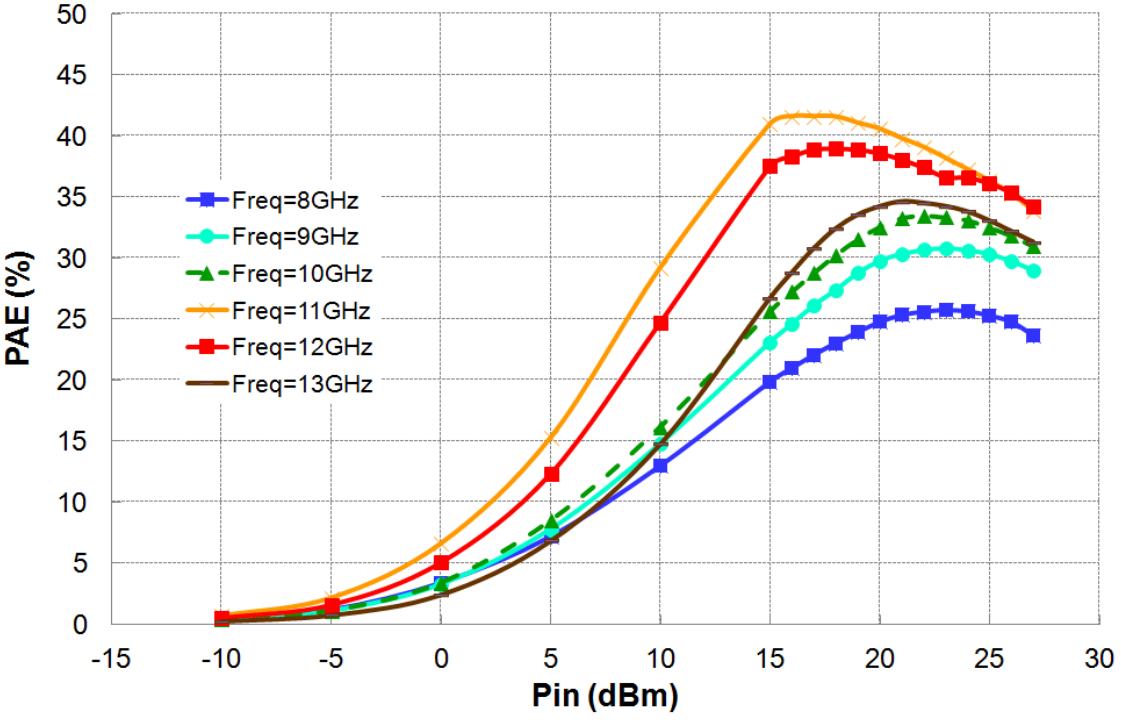
## Typical Board Measurements (CW mode)

Tback side = +25°C, Vd = +25V, Idq = 200mA

**Output Power versus Input Power (Temp=+25°C) Vd=25V**




**Power Added Efficiency versus Input Power (Temp=+25°C) Vd=25V**



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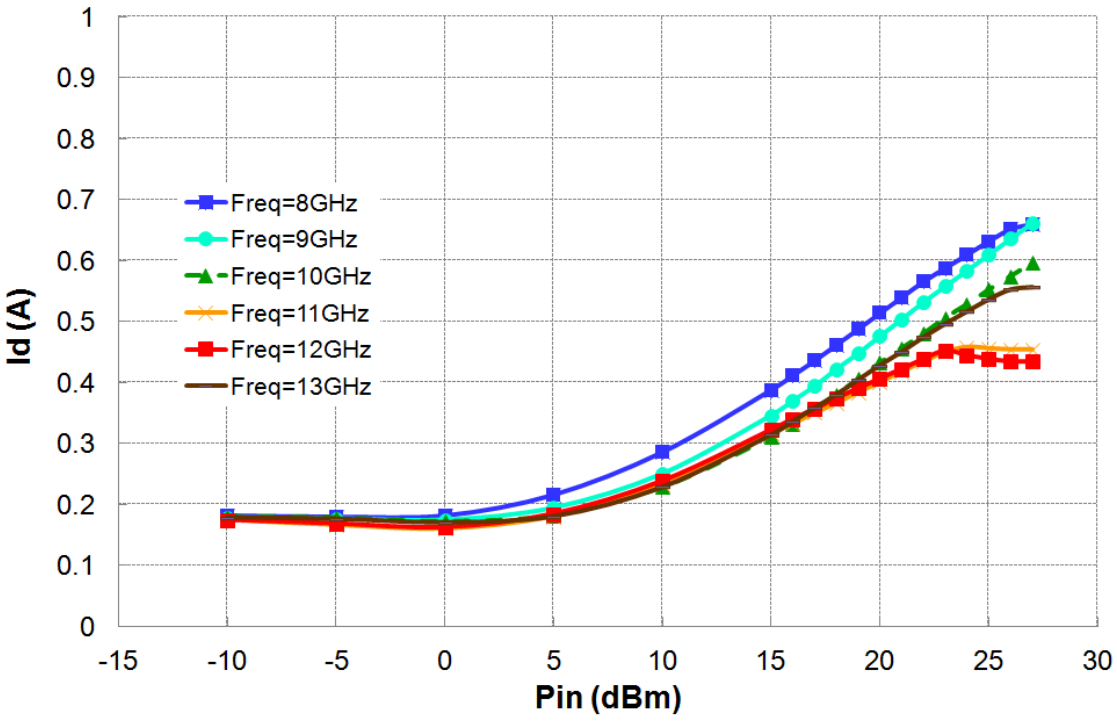
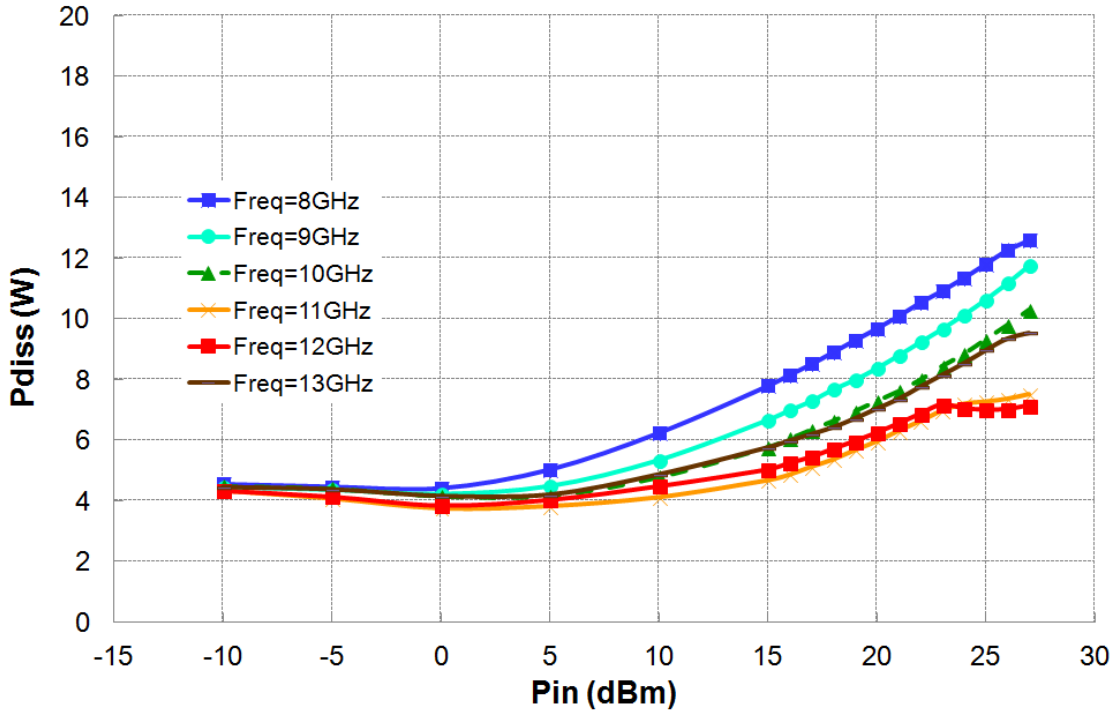
## Typical Board Measurements (CW mode)

Tback side = +25°C, Vd = +25V, Idq = 200mA

**Drain Current versus Input Power (Temp=+25°C) Vd=25V**




**Dissipated Power versus Input Power (Temp=+25°C) Vd=25V**



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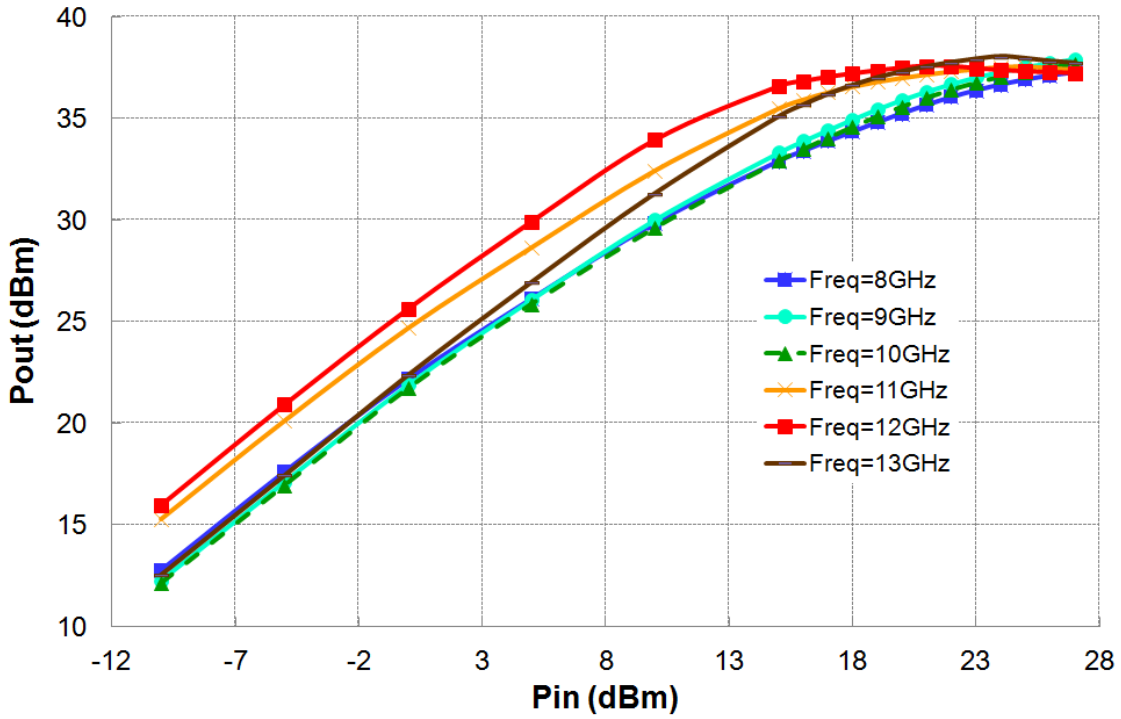
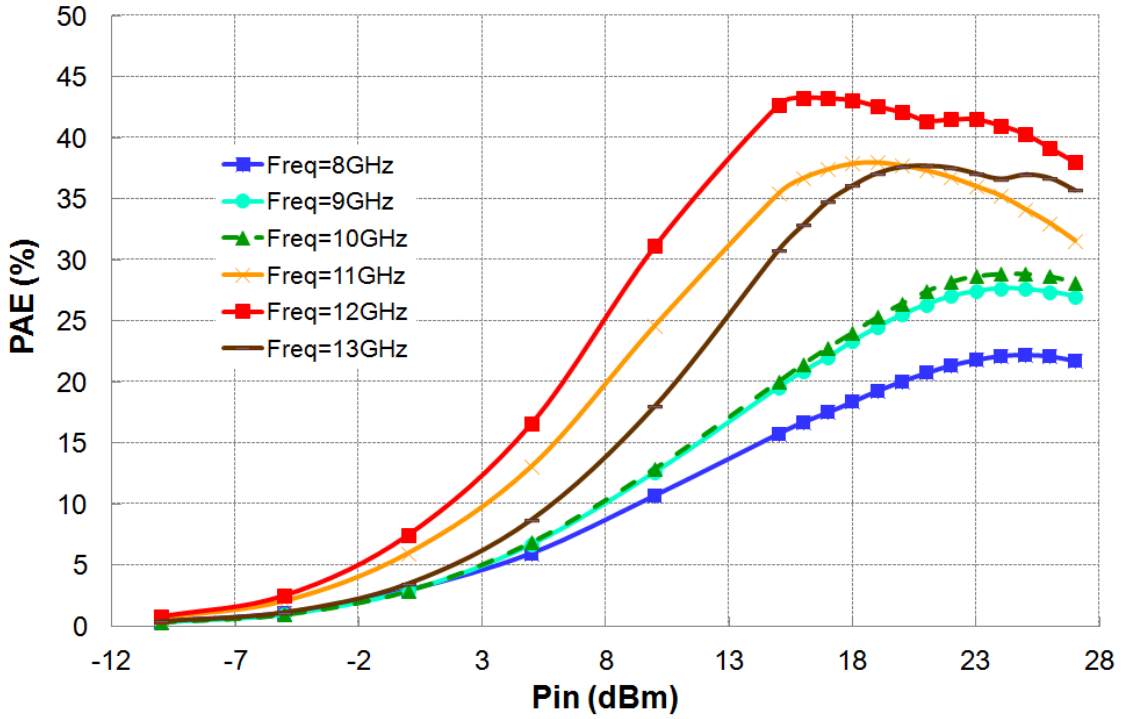
## Typical Board Measurements (CW mode)

Tback side = +25°C, Vd = +30V, Idq = 200mA

**Output Power versus Input Power (Temp=+25°C)**




**Power Added Efficiency Input Power (Temp=+25°C)**



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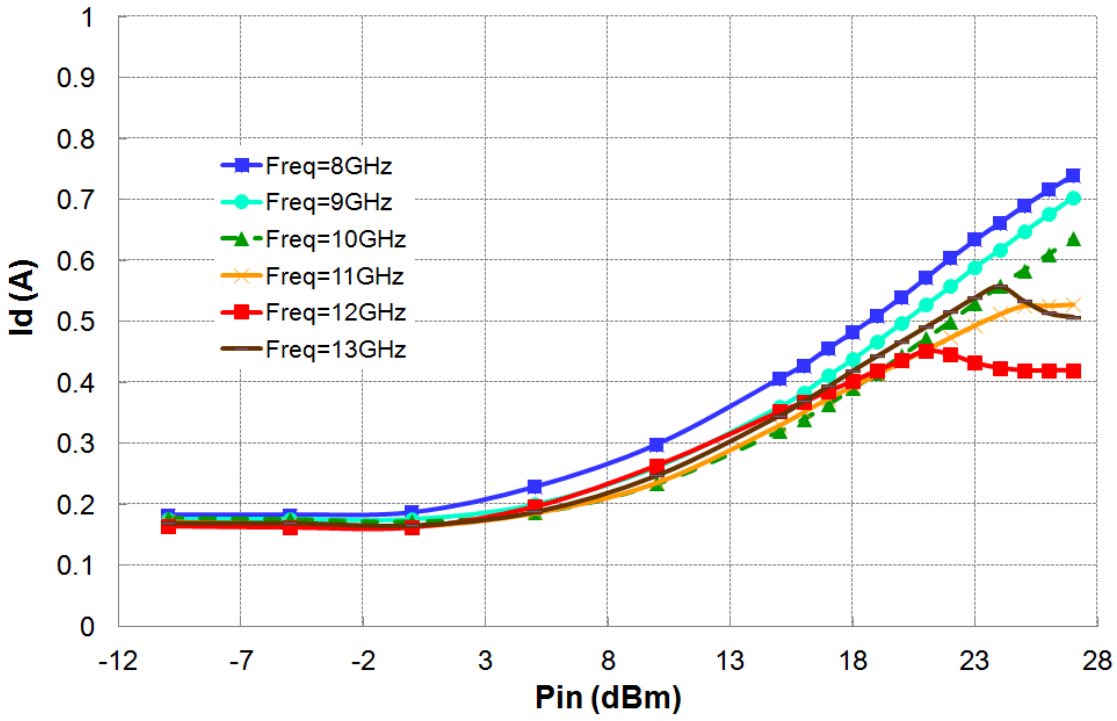
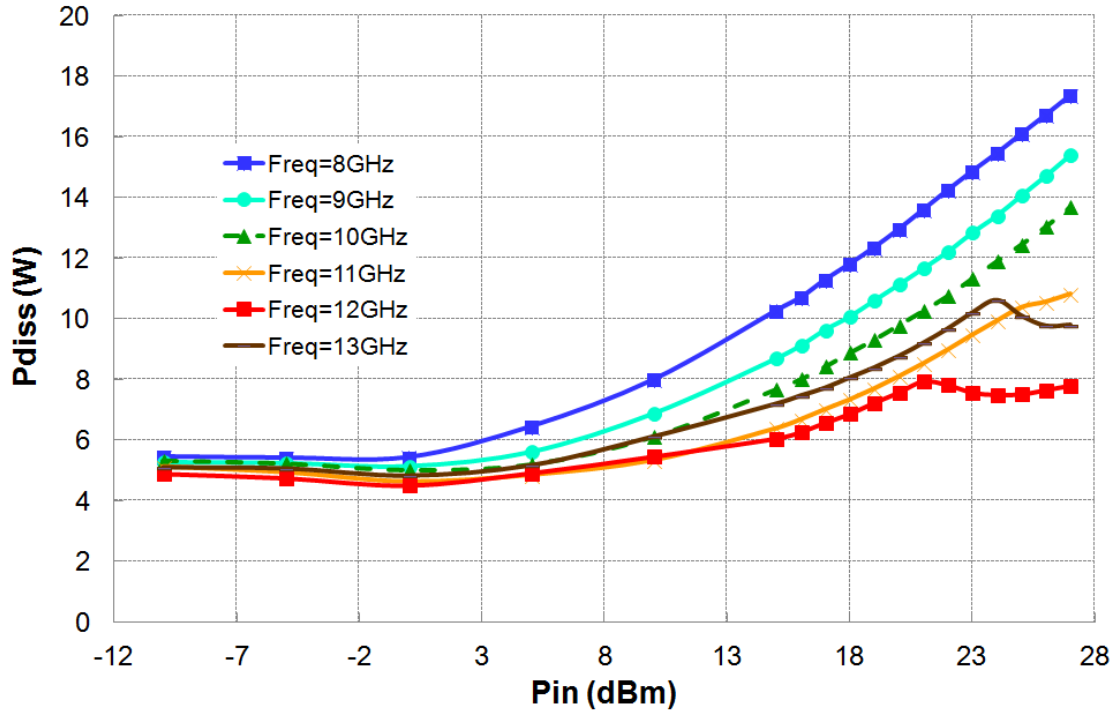
## Typical Board Measurements (CW mode)

Tback side = +25°C, Vd = +30V, Idq = 200mA

**Drain Current versus Input Power (Temp=+25°C)**




**Dissipated Power versus Input Power (Temp=+25°C)**



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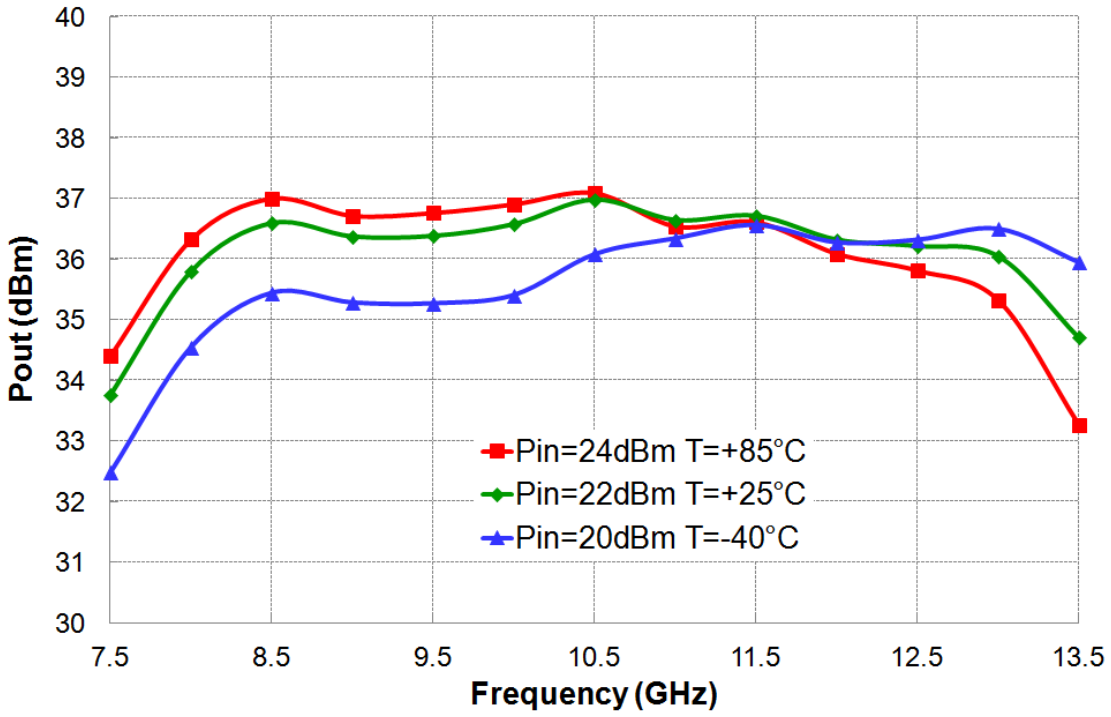
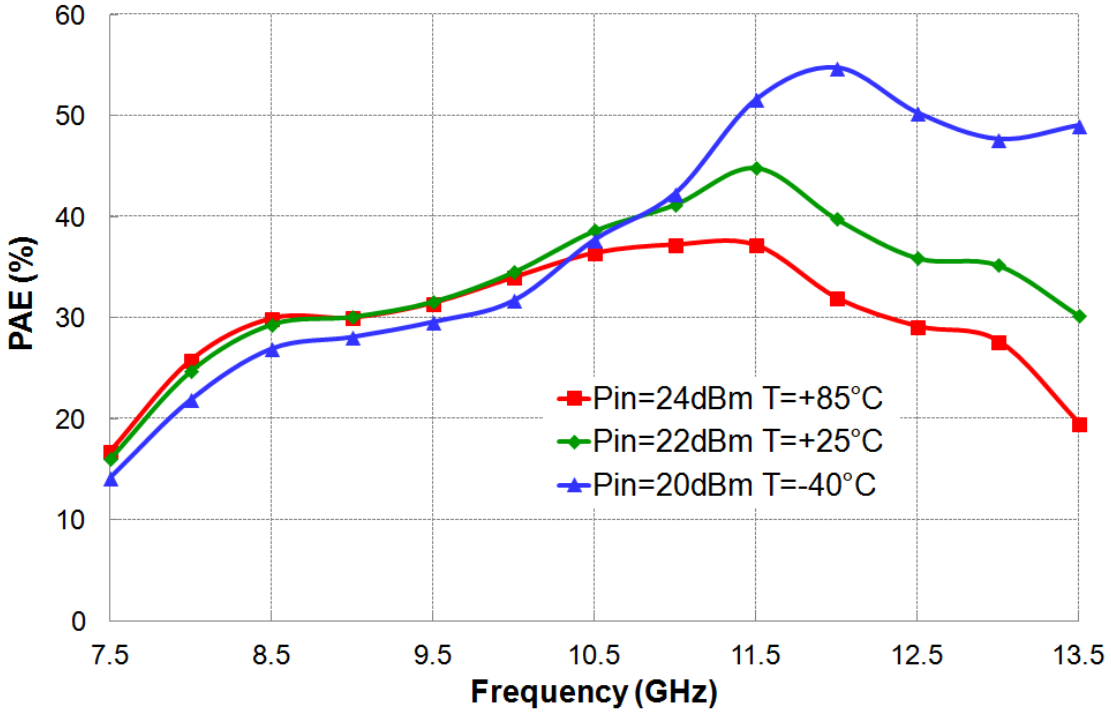
## Typical Board Measurements (Pulsed mode)

Vd = +25V, Idq = 200mA @ Tback side = +25°C, Pulse width=25µs, Duty cycle =10%

**Output Power versus Frequency (Temp.=-40 & +25 & +85 °C)**




**Power Added Efficiency versus Frequency (Temp.=-40 & +25 & +85 °C)**



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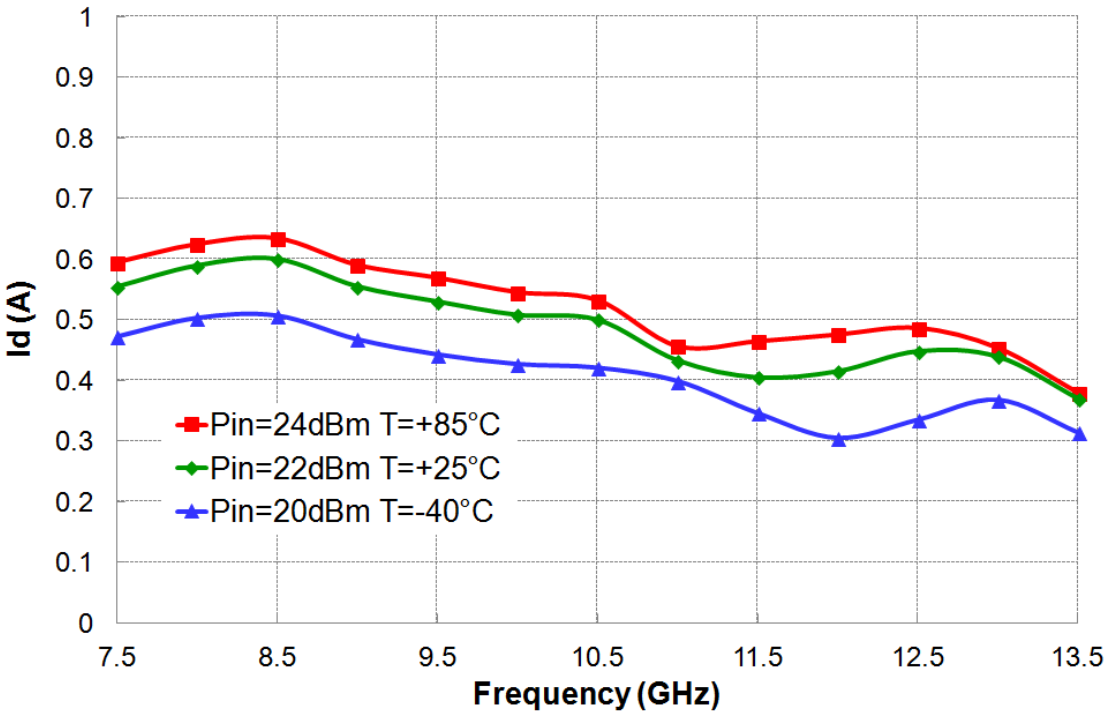
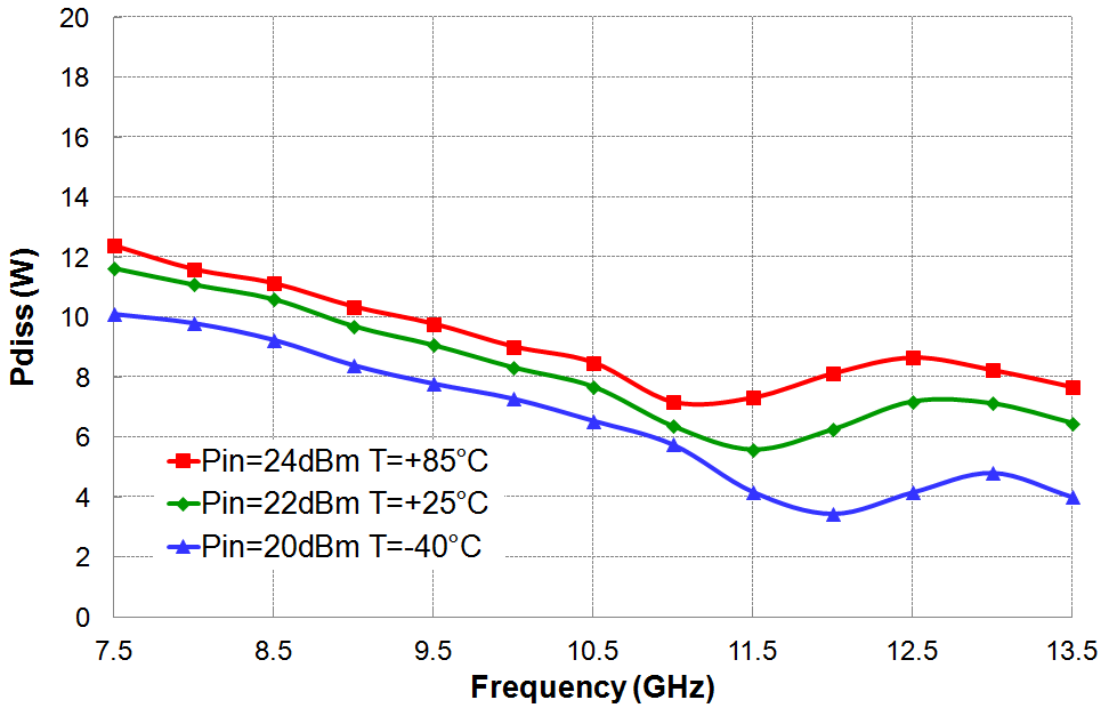
## Typical Board Measurements (Pulsed mode)

Vd = +25V, Idq = 200mA @ Tback side = +25°C, Pulse width=25µs, Duty cycle =10%

**Drain Current versus Frequency (Temp.=-40 & +25 & +85 °C)**




**Dissipated Power versus Frequency (Temp.=-40 & +25 & +85 °C)**



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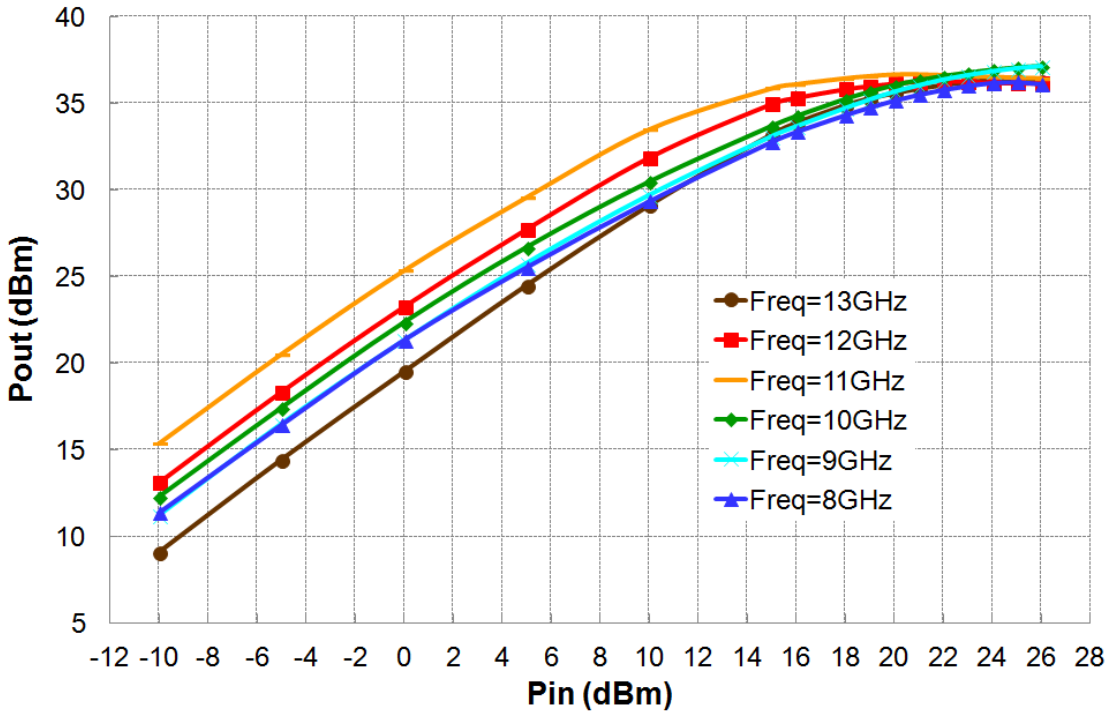
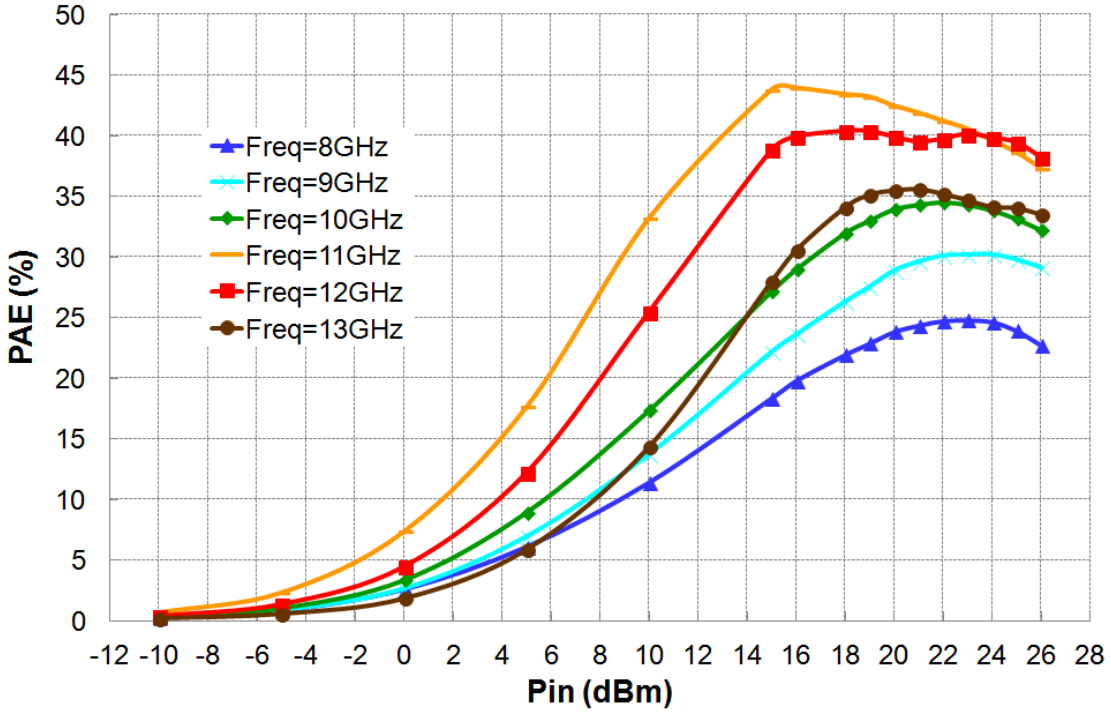
## Typical Board Measurements (Pulsed mode)

Tback side = +25°C, Vd = +25V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

**Output Power versus Input Power (Temp=+25°C)**




**Power Added Efficiency versus Input Power (Temp=+25°C)**



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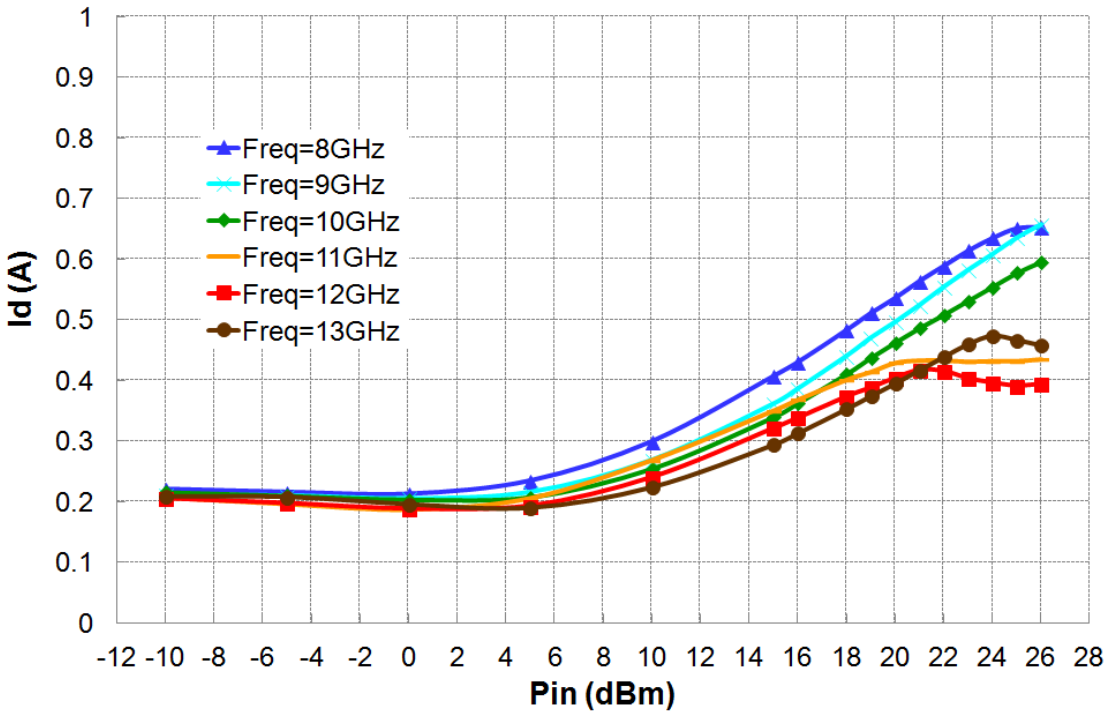
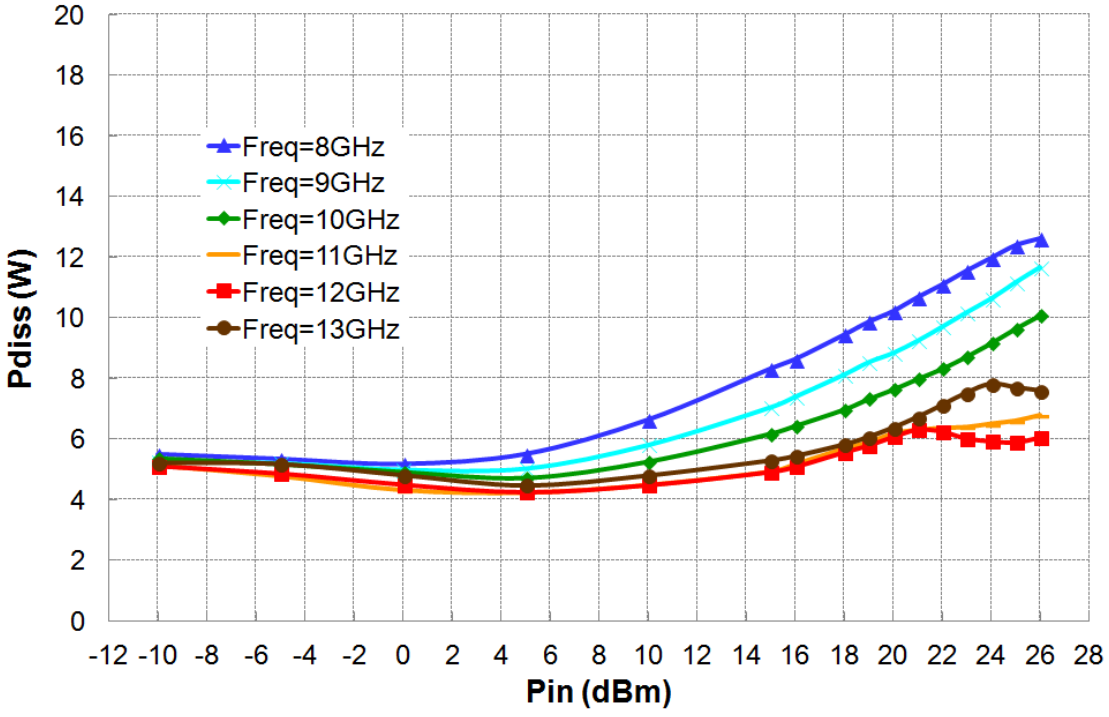
## Typical Board Measurements (Pulsed mode)

Tback side = +25°C, Vd = +25V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

**Drain Current versus Input Power (Temp=+25°C)**




**Dissipated Power versus Input Power (Temp=+25°C)**



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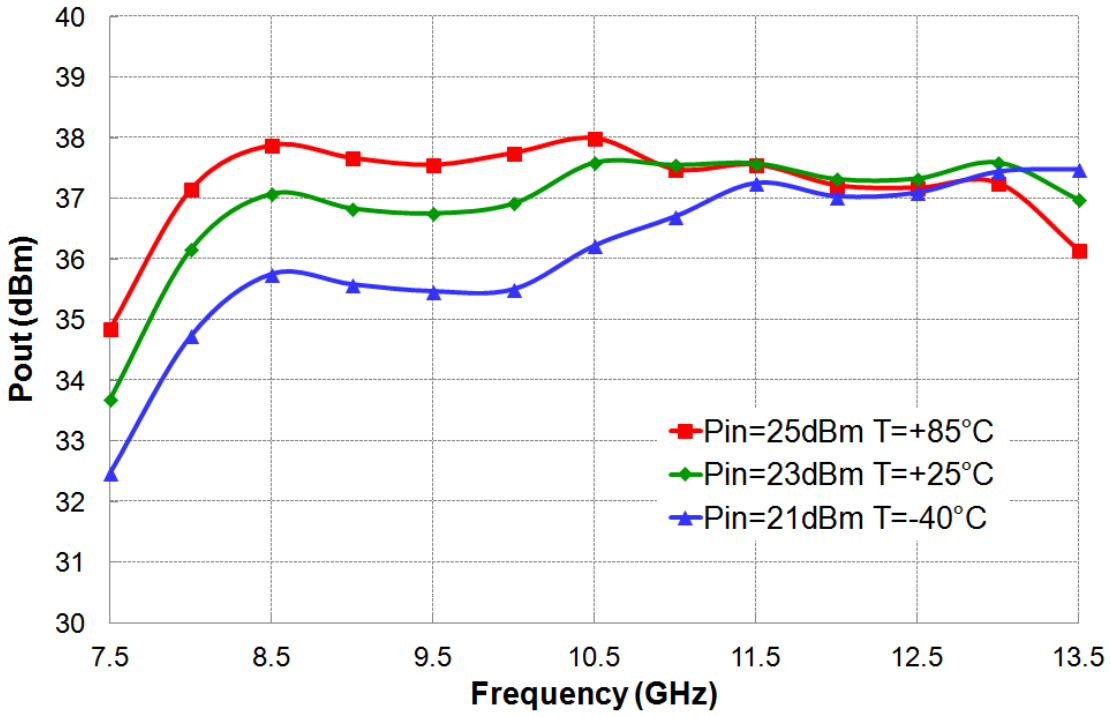
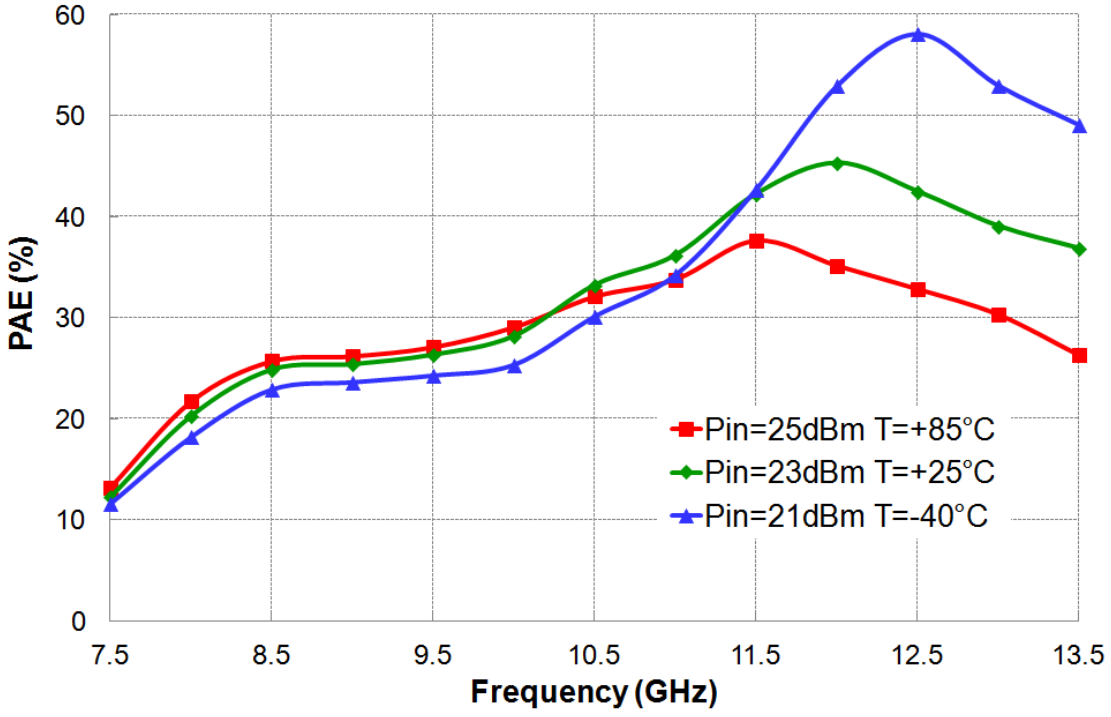
## Typical Board Measurements (Pulsed mode)

Vd = +30V, Idq = 200mA @ Tback side = +25°C, Pulse width=25µs, Duty cycle =10%

**Output Power versus Frequency (Temp.=-40 & +25 & +85 °C)**




**Power Added Efficiency versus Frequency (Temp.=-40 & +25 & +85 °C)**



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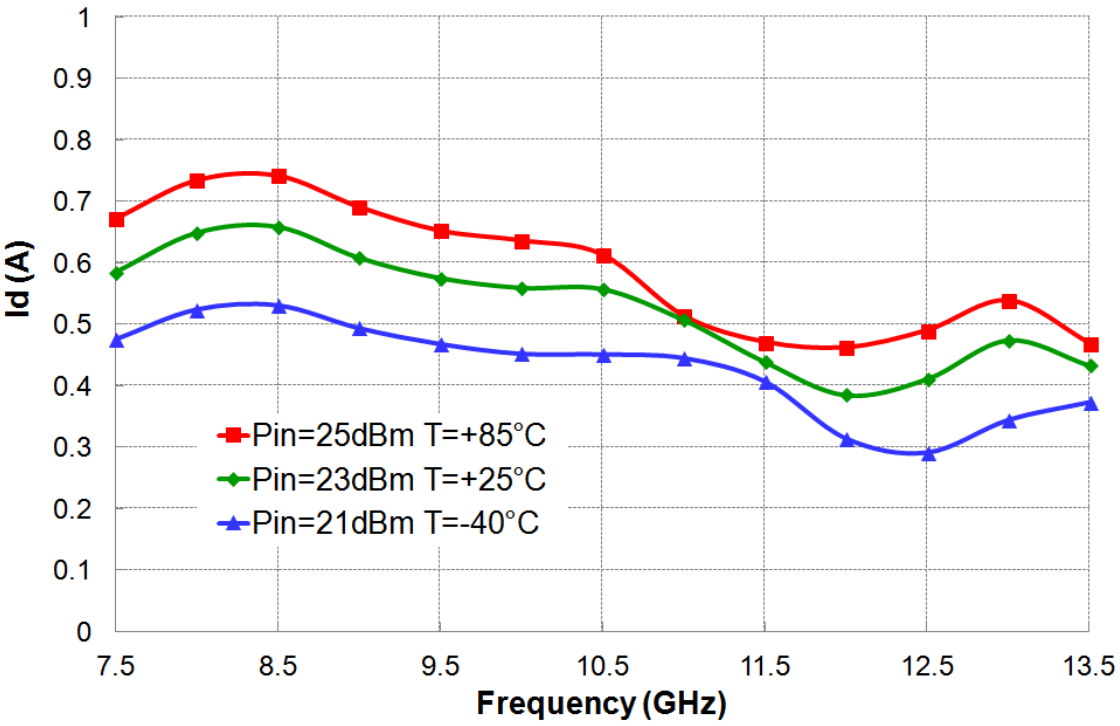
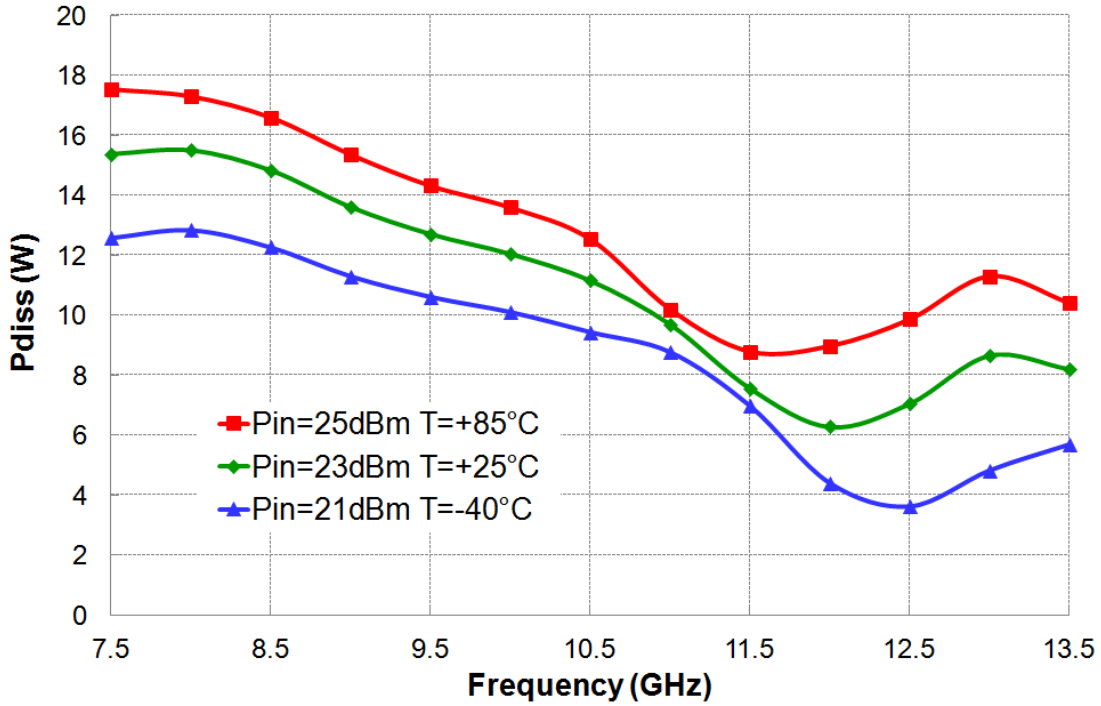
## Typical Board Measurements (Pulsed mode)

Vd = +30V, Idq = 200mA @ Tback side = +25°C, Pulse width=25µs, Duty cycle =10%

**Drain Current versus Frequency (Temp.=-40 & +25 & +85 °C)**




**Dissipated Power versus Frequency (Temp.=-40 & +25 & +85 °C)**



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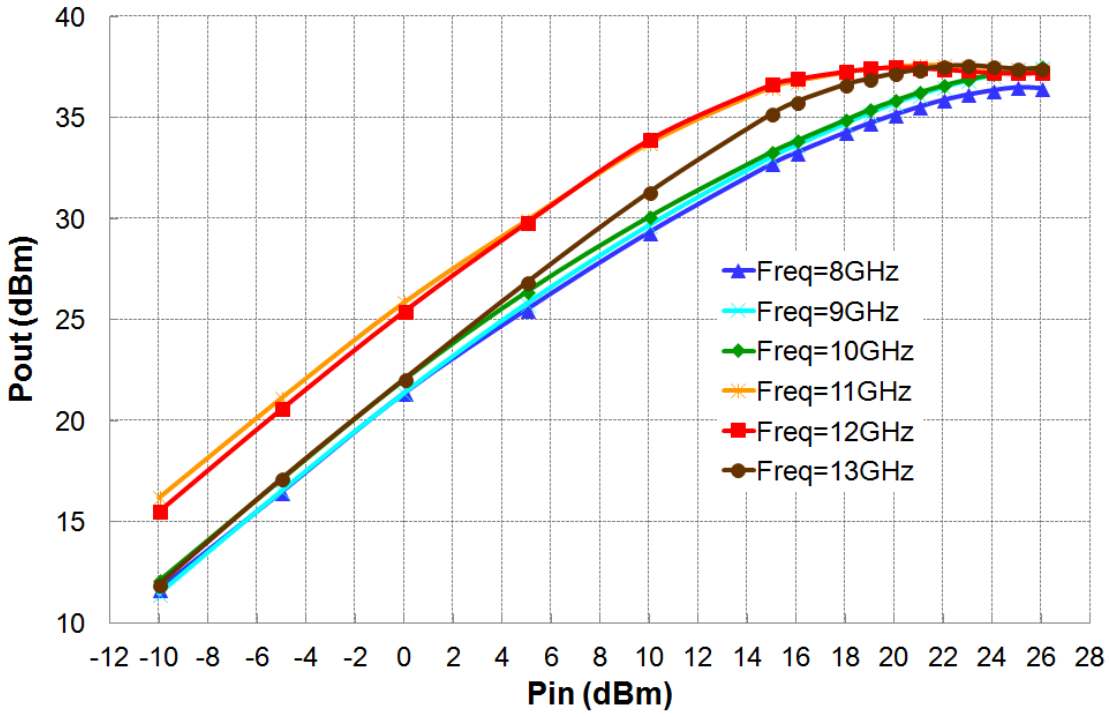
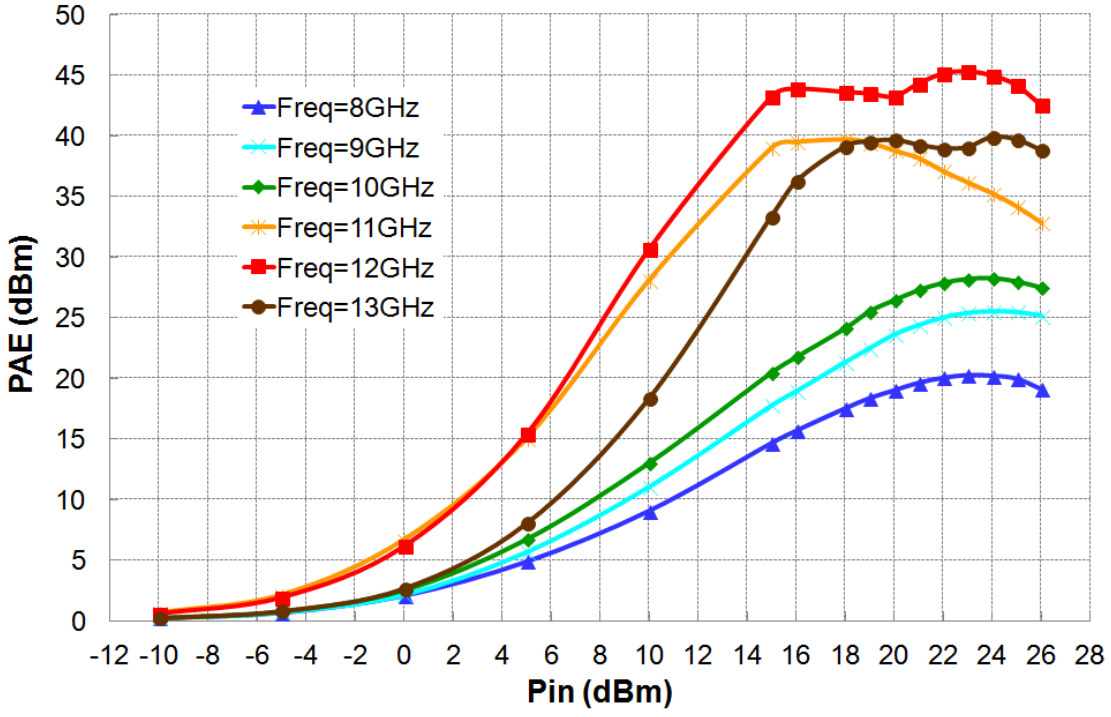
## Typical Board Measurements (Pulsed mode)

Tback side = +25°C, Vd = +30V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%

**Output Power versus Input Power (Temp=+25°C)**




**Power Added Efficiency versus Input Power (Temp=+25°C)**



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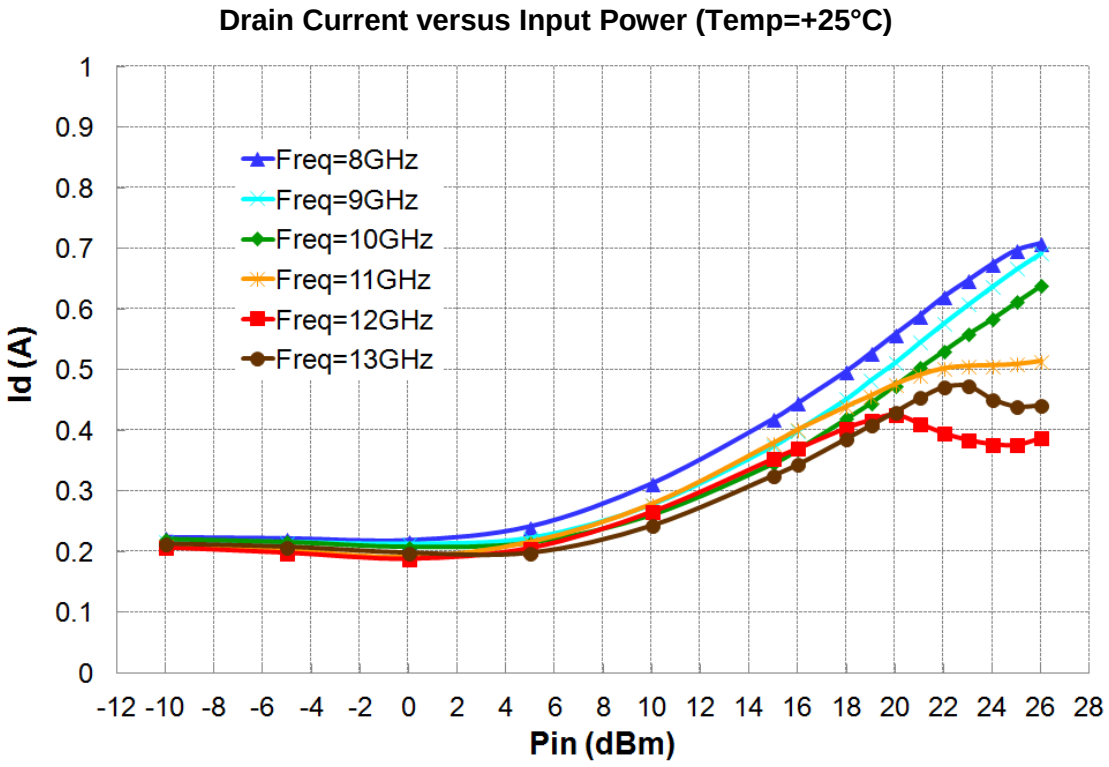
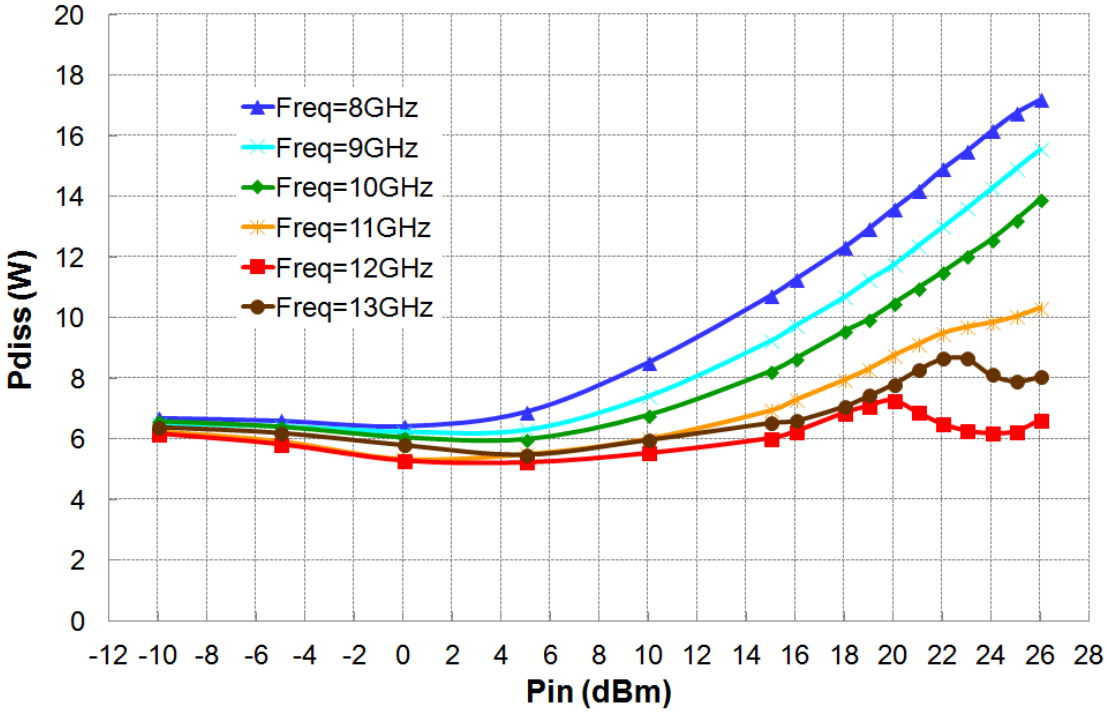
## Typical Board Measurements (Pulsed mode)

Tback side = +25°C, Vd = +30V, Idq = 200mA, Pulse width=25µs, Duty cycle =10%




Drain Current versus Input Power (Temp=+25°C)



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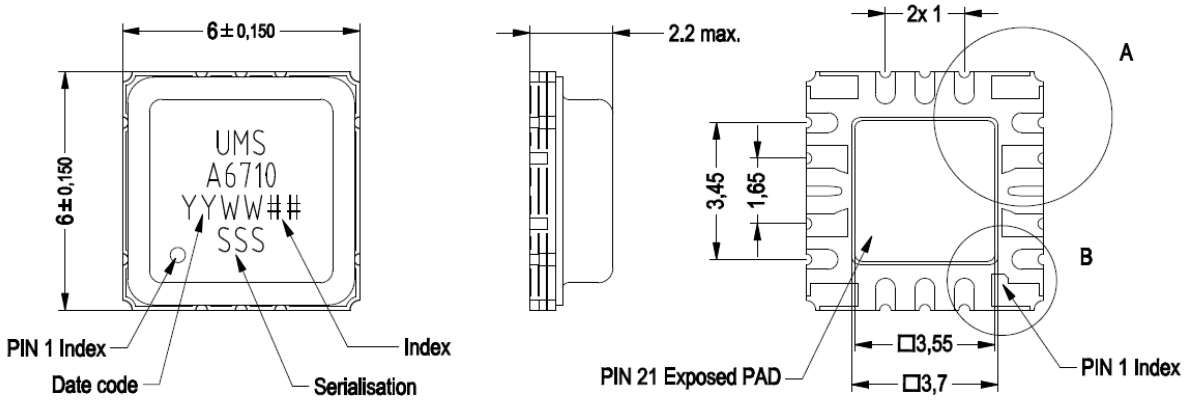
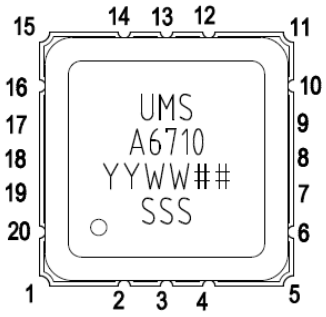
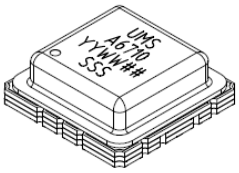
## Mechanical data




| | | |
|---|---|---|
| 1- GND | 8- RF OUT | 15- GND |
| 2- GND | 9- GND | 16- Nc |
| 3- VD1 | 10- GND | 17- GND |
| 4- VD2 | 11- GND | 18- RF IN |
| 5- GND | 12- VG2 | 19- GND |
| 6- Nc | 13- GND | 20- Nc |
| 7- GND | 14- VG1 | 21- GND |



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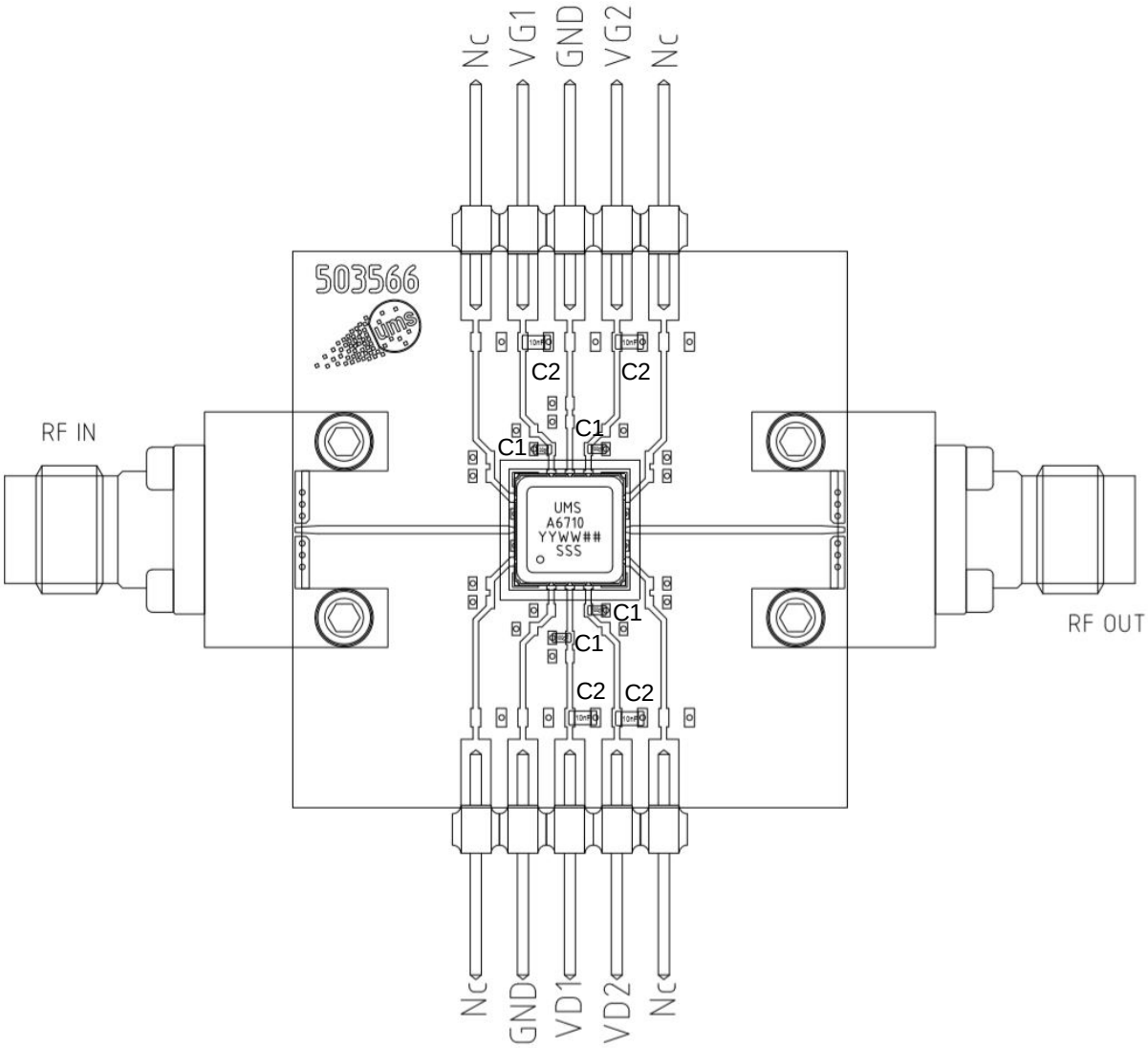
## Recommended assembly drawing in CW mode




## Bill of Materials

| Label | Value | Description |
|---|---|---|
| C1 | RF | Capa 100pF +-10% 50V |
| C2 | RF | Capa 10nF +-20% 50V |



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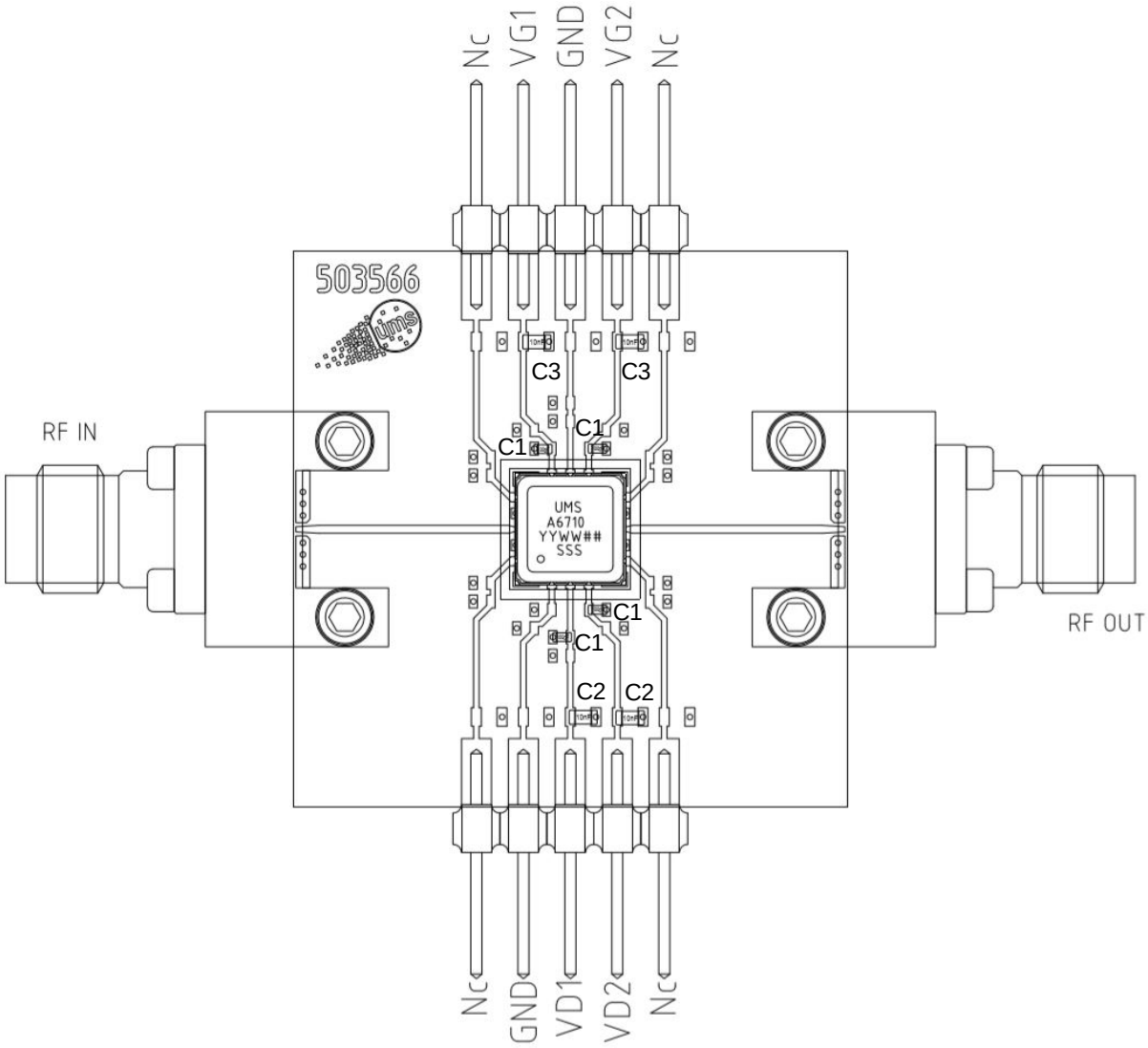
## Recommended assembly drawing in gate pulsed mode




## Bill of Materials

| Label | Value | Description |
|---|---|---|
| C1 | RF | Capa 120pF +-10% 50V |
| C2 | RF | Capa 10nF +-20% 50V |
| C3 | RF | Capa 0nF (no capacitor) |



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## SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017 available at http://www.ums-gaas.com.

## Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at http://www.ums-gaas.com.

## Recommended ESD management

Refer to the application note AN0020 available at http://www.ums-gaas.com for ESD sensitivity and handling recommendations for the UMS package products.

## FAB Type Surface Mount Hermetic Package

Refer to the application note AN0024 available at http://www.ums-gaas.com for assembly recommendations for the UMS FAB package products.

## Ordering Information

| | |
|---|---|
| Chip form: | CHA6710-FAB/XY<br>Stick: XY = 24 |





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