United Monolithic Semiconductors

CHA8710-QDB

25W X-Band High Power Amplifier

Monolithic Microwave IC in SMD leadless package

Description

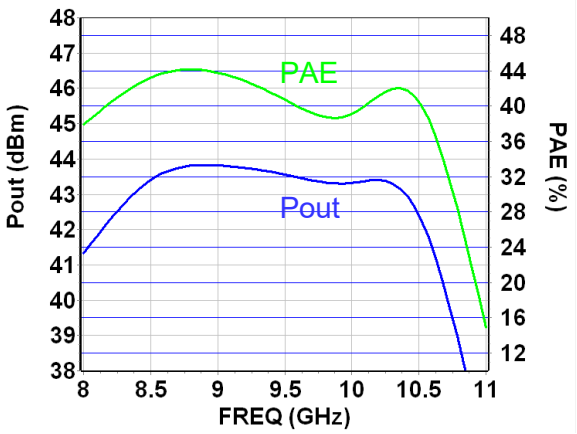
The CHA8710-QDB is a two stage High Power Amplifier operating between 8.5 and 10.5GHz and providing typically 25W of saturated output power and 41% of power added efficiency.

It is designed for a wide range of applications, from defense to commercial communication and radar systems.

The circuit is manufactured with a robust GaN HEMT process, via holes through the substrate, air bridges and electron beam gate lithography.

Main Features

- Frequency range: 8.5-10.5GHz
- High output power: 25W
- High PAE: 41%
- Linear Gain: 29.5dB
- DC bias: Vd=30Volt @ Idq=0.75A
- 46 Leads QFN 7x7



Main Electrical Characteristics

Vd = +30V, Idq = 750mA, Pulse width=25µs & Duty cycle =10%, Tcase.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8.5		10.5	GHz
Gain	Linear Gain		29.5		dB
Pout	Output Power		25		W
PAE	Associated Power Added Efficiency		41		%

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Electrical Characteristics (Pulsed mode)

Vd = +25V, Idq = 750mA at Tcase= +25°C, Pulse width=25µs & Duty cycle =10%

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8.5		10.5	GHz
Gain	Linear Gain		28.5		dB
Pout	Output Power (Pin=23dBm)		43.3		dBm
PAE	Associated Power Added Efficiency (Pin=23dBm)		41.5		%
Id	Associated current (Pin=23dBm)		2.1		A
IRL	Input Return Loss		8		dB
ORL	Output Return Loss		9		dB
Idq	Quiescent Current		0.75		A
Vd	Drain Voltage		25		V
Vg	Gate Voltage		-3.25		V

These values are representative of onboard measurements as defined on the drawing in paragraph " Definition of the reference planes for power measurements ".

Electrical Characteristics (CW mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8.5		10.5	GHz
Gain	Linear Gain		28.5		dB
Pout	Output Power (Pin=22.5dBm)		43		dBm
PAE	Associated Power Added Efficiency (Pin=22.5dBm)		41		%
Id	Associated current (Pin=22.5dBm)		1.95		A
IRL	Input Return Loss		11		dB
ORL	Output Return Loss		10		dB
Idq	Quiescent Current		0.75		A
Vd	Drain Voltage		25		V
Vg	Gate Voltage		-3.25		V

These values are representative of onboard measurements as defined on the drawing in paragraph " Definition of the reference planes for power measurements ".

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Electrical Characteristics (Pulse mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%.

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8.5		10.5	GHz
Gain	Linear Gain		29.4		dB
Pout	Output Power (Pin=22.5dBm)		44.4		dBm
PAE	Associated Power Added Efficiency (Pin=22.5dBm)		41		%
Id	Associated current (Pin=22.5dBm)		2.3		A
IRL	Input Return Loss		8		dB
ORL	Output Return Loss		10		dB
Idq	Quiescent Current		0.75		A
Vd	Drain Voltage		30		V
Vg	Gate Voltage		-3.25		V

These values are representative of onboard measurements as defined on the drawing in paragraph " Definition of the reference planes for power measurements ".

Electrical Characteristics (CW mode)

Vd = +30V, Idq = 750mA, Tcase = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8.5		10.5	GHz
Gain	Linear Gain		29.5		dB
Pout	Output Power (Pin=22.5dBm)		44		dBm
PAE	Associated Power Added Efficiency (Pin=22.5dBm)		41		%
Id	Associated current (Pin=22.5dBm)		2.15		A
IRL	Input Return Loss		11		dB
ORL	Output Return Loss		12		dB
Idq	Quiescent Current		0.75		A
Vd	Drain Voltage		25		V
Vg	Gate Voltage		-3.25		V

These values are representative of onboard measurements as defined on the drawing in paragraph " Definition of the reference planes for power measurements ".

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Absolute Maximum Ratings (1)

Tcase = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	35V	V
Pin	Maximum peak input power overdrive	33	dBm
Pdiss	Maximum dissipated power at Tcase =85°C	80	W

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

Recommended Operating Range (2), (3)

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	25 - 30	V
Tj	Junction temperature	200	°C
Tcase	Operating temperature range	-30 to +85	°C
Tstg	Storage temperature range	-55 to +150	°C

(2) Electrical performances are defined for specified test conditions

(3) Electrical performances are not guaranteed over all recommended operating conditions

Typical Bias Conditions

Tcase = +25°C

Symbol	Pad N°	Parameter	Values	Unit
Vd	Vd1, Vd2	Drain voltage	25, 30	V
Vg	Vg1, Vg2	Gate voltage HPA on (pulsed mode) HPA on (CW mode) HPA off	 -3.25 -3.25 -8 to -5	 V V V

Bias-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

Bias-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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Device thermal information

All the figures given in this section are obtained assuming that the QFN device is only cooled down by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase).
The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

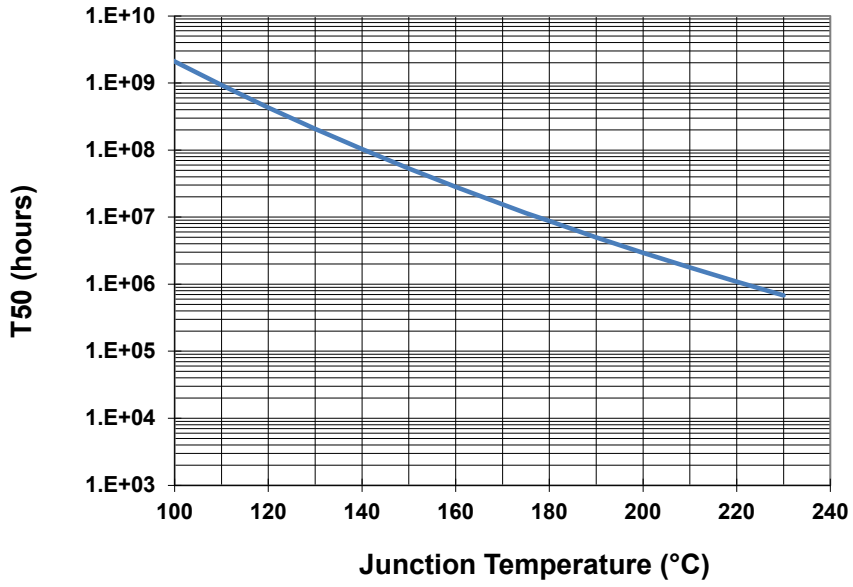
Thermal Resistance(1)	Rth_eq	Tcase =85°C, Vd=25V, Pout=43dBm Pdiss=34W CW	1.82	°C/W
Junction Temperature	Tj		147	°C
Median Life	T50		$6.5x10^7$	Hrs

(1) Thermal resistance measured to back of the package

Thermal Resistance(1)	Rth_eq	Tcase =85°C, Vd=30V, Pout=44dBm Pdiss=44W CW	1.89	°C/W
Junction Temperature	Tj		168	°C
Median Life	T50		$1.75x10^7$	Hrs

(1) Thermal resistance measured to back of the package

Median Life Time versus Junction Temperature



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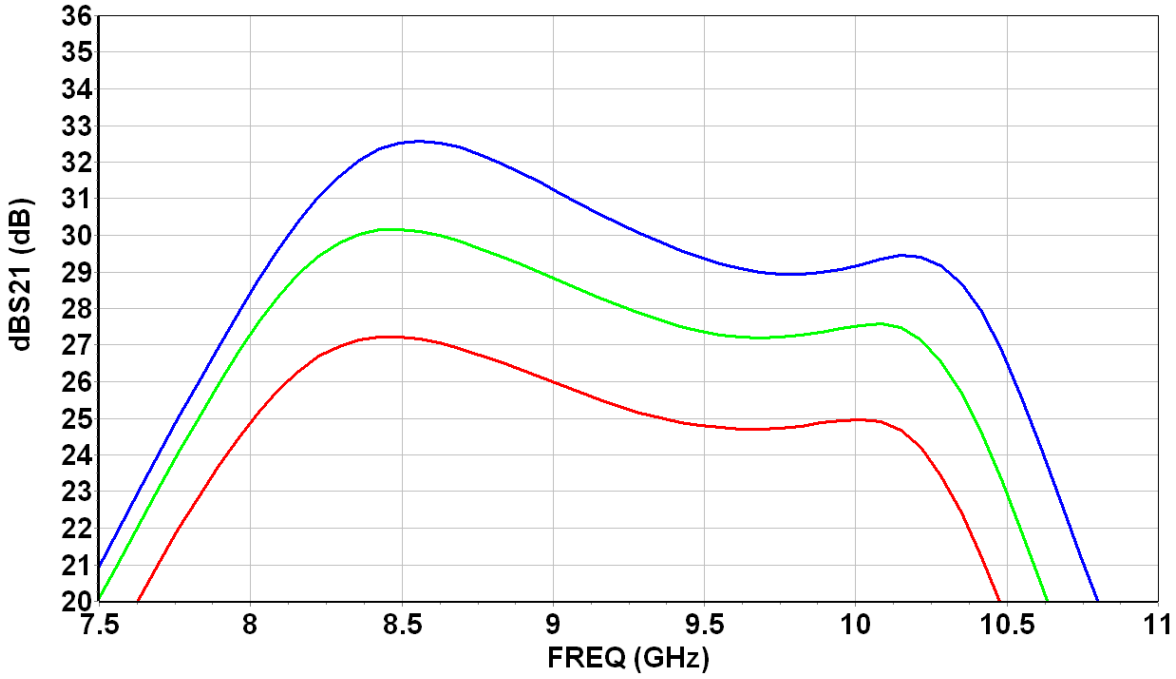
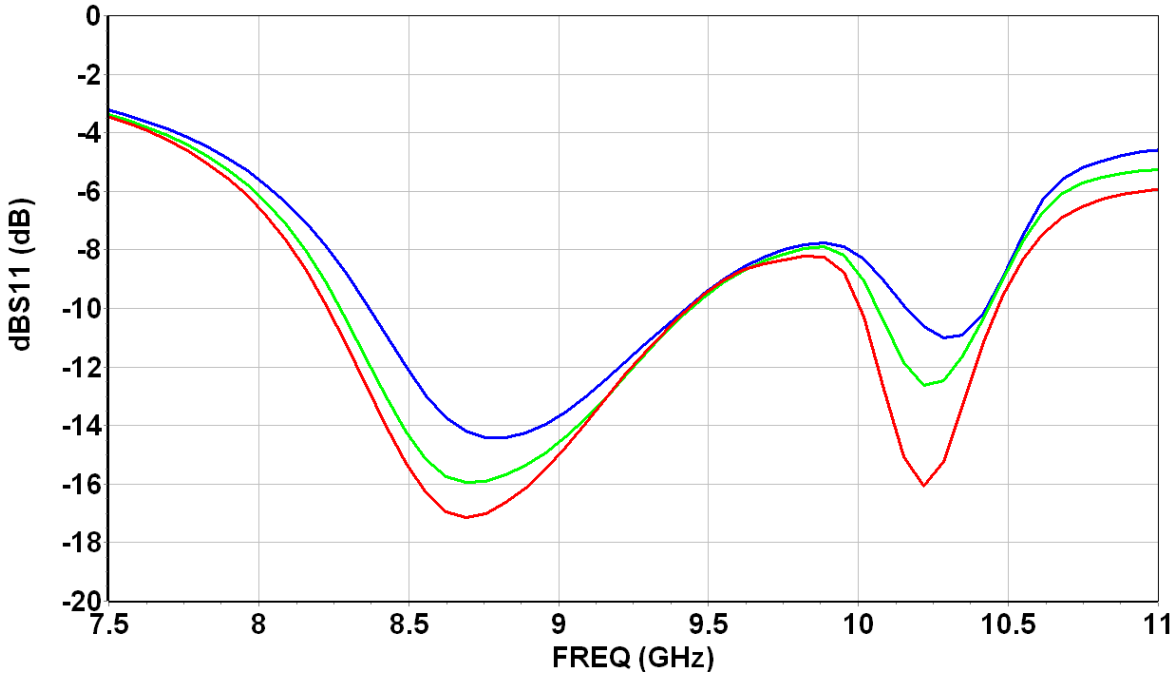
Typical Board Measurements (Pulsed mode)

Idq = 750mA at Tcase = +25°C Pulse width=25µs & Duty cycle =10%
Reference planned of the measurement = connectors

Linear Gain versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



Input Return Losses versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



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Typical Board Measurements (Pulsed mode)

Idq = 750mA at Tcase = +25°C Pulse width=25µs & Duty cycle =10%
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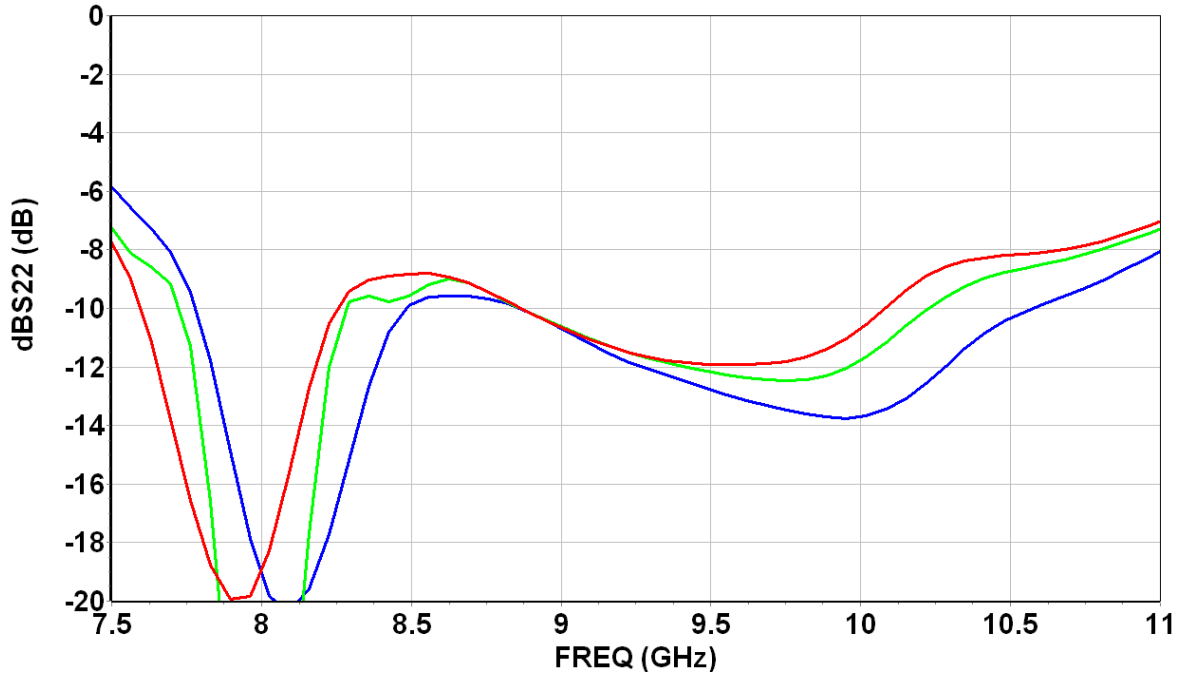
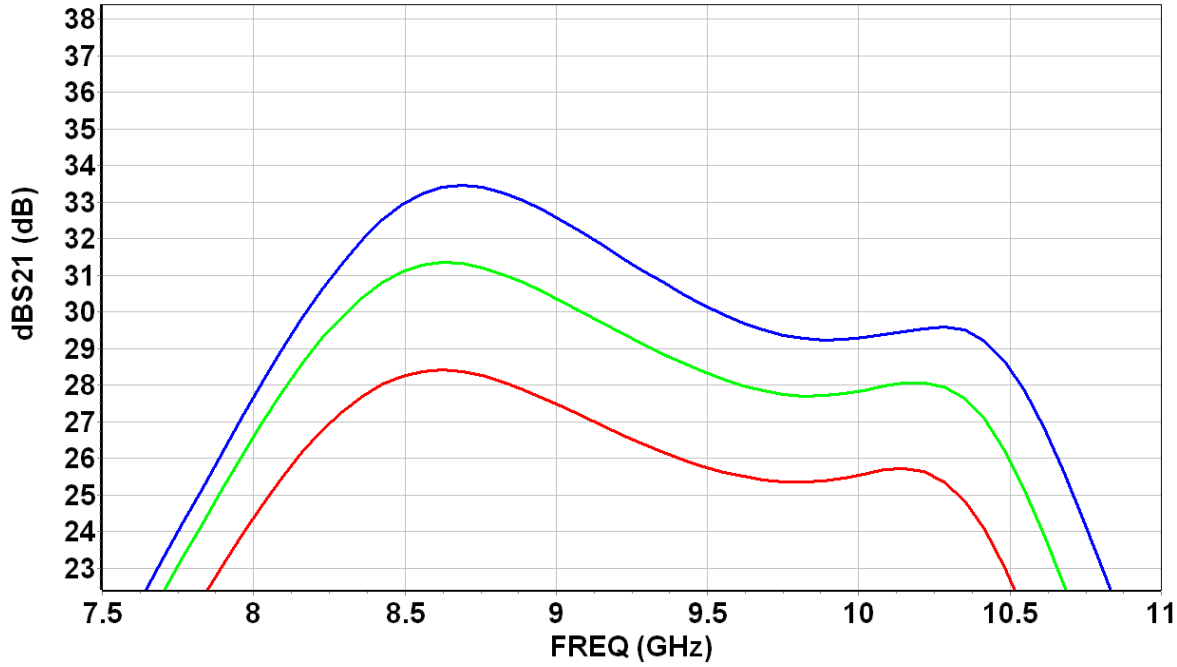
Output Return Losses versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



Linear Gain versus Frequency (Vd=30V Temp.=-30 & +25 & +85 °C)



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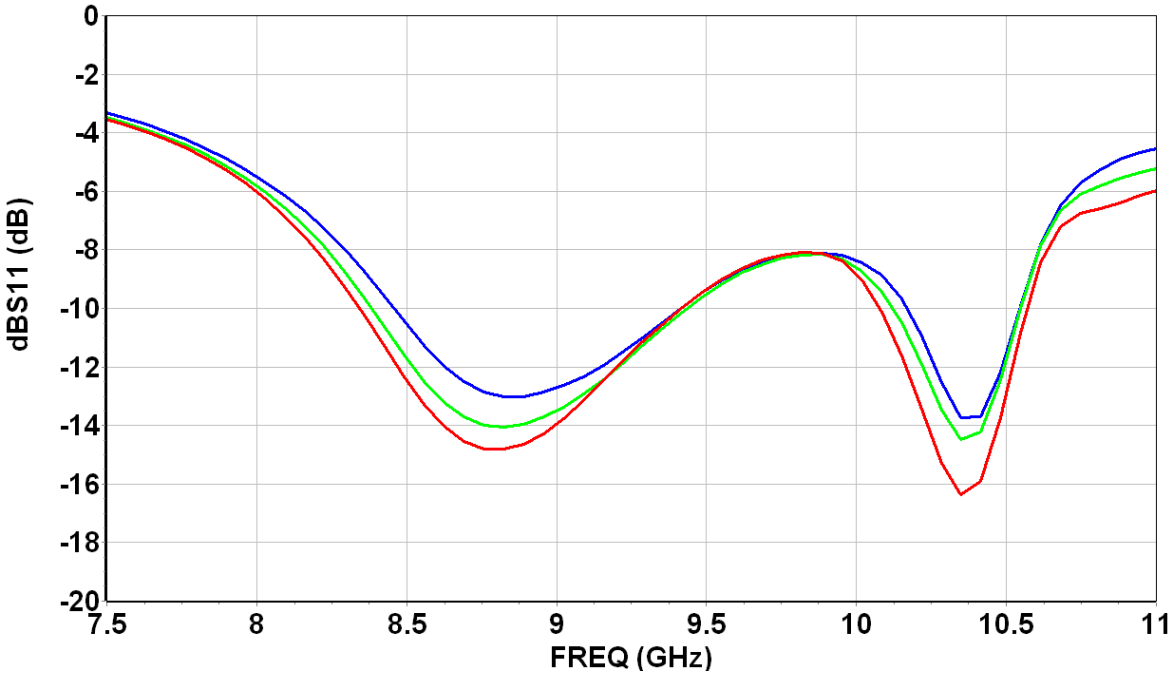
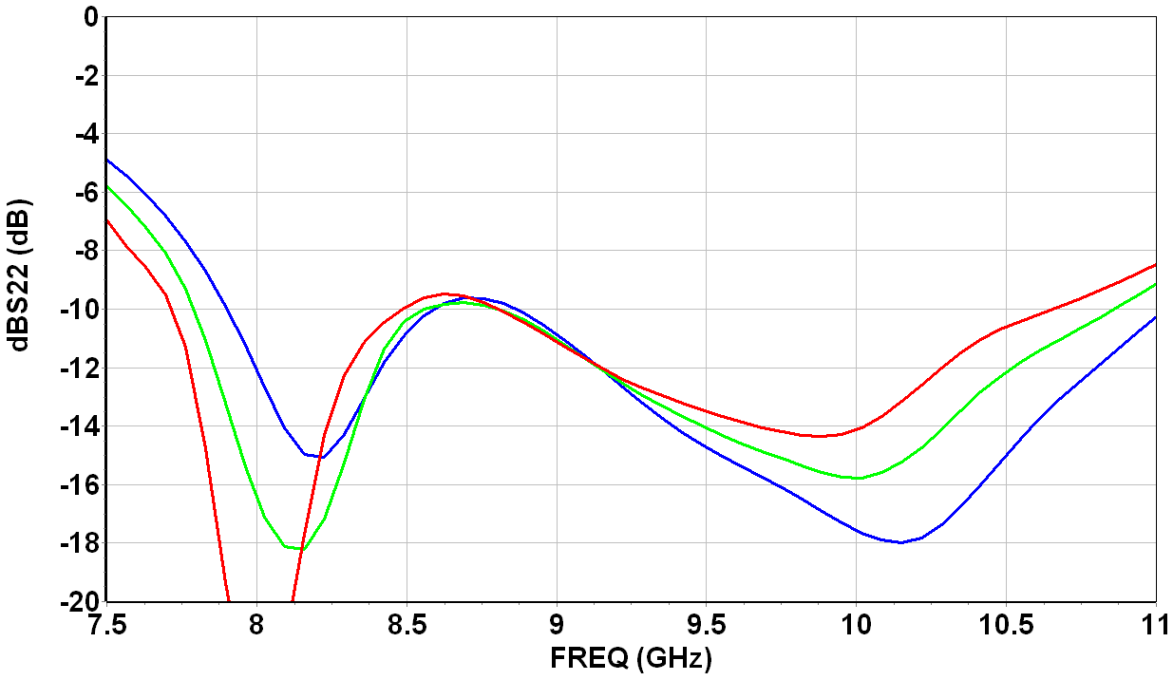


Output Return Losses versus Frequency (Vd=30V Temp.=-30 & +25 & +85 °C)



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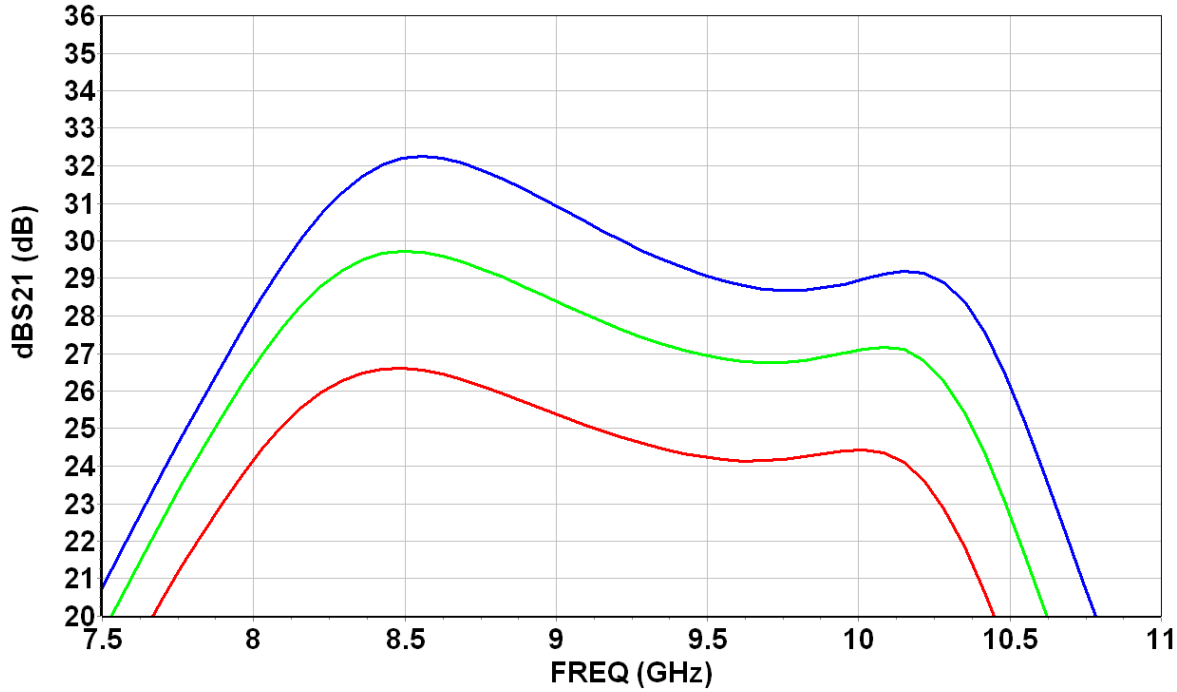
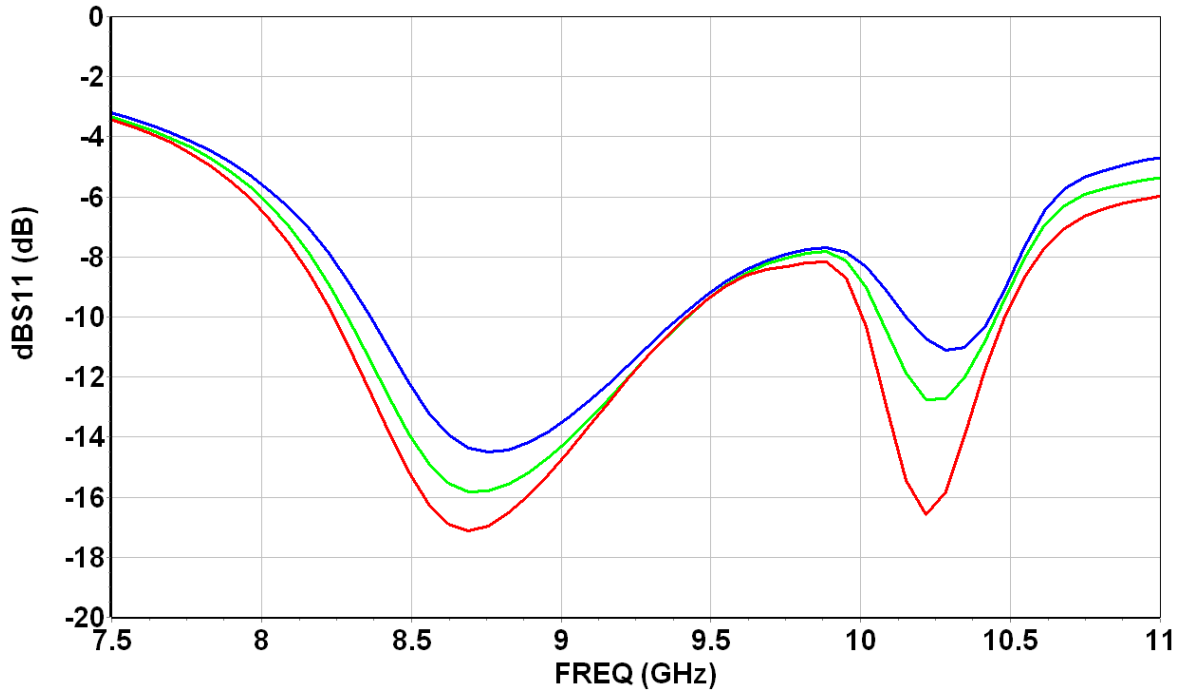
Typical Board Measurements (CW mode)

Idq = 750mA at Tcase = +25°C Reference planned of the measurement = connectors

Linear Gain versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



Input Return Losses versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



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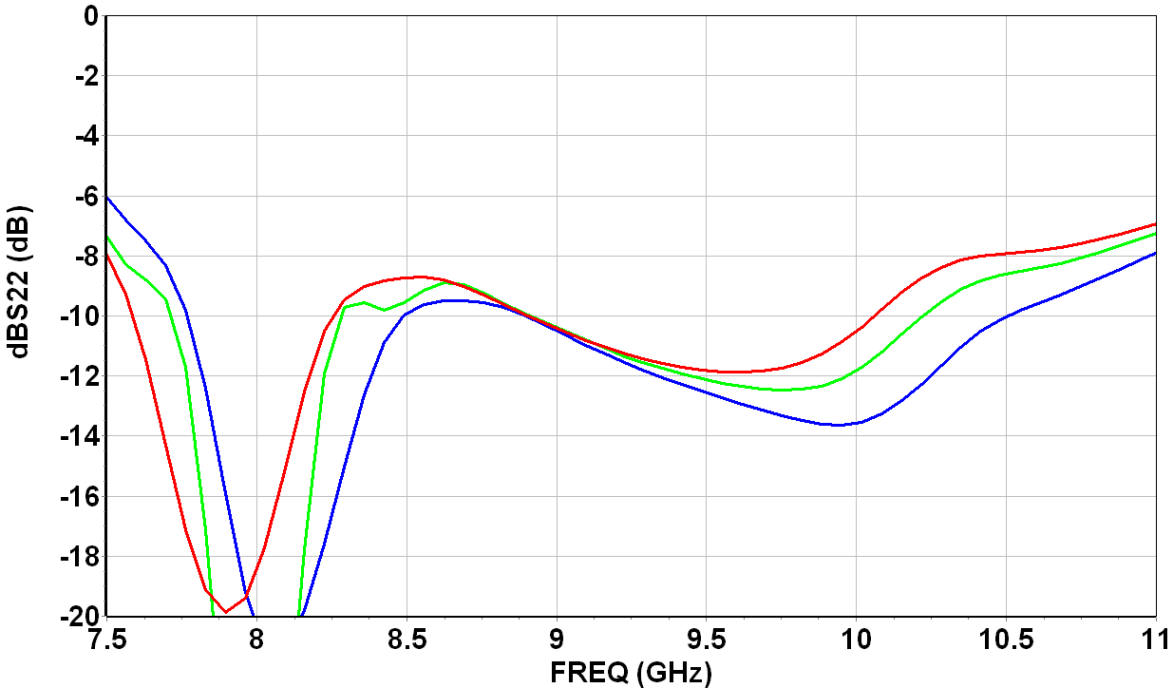
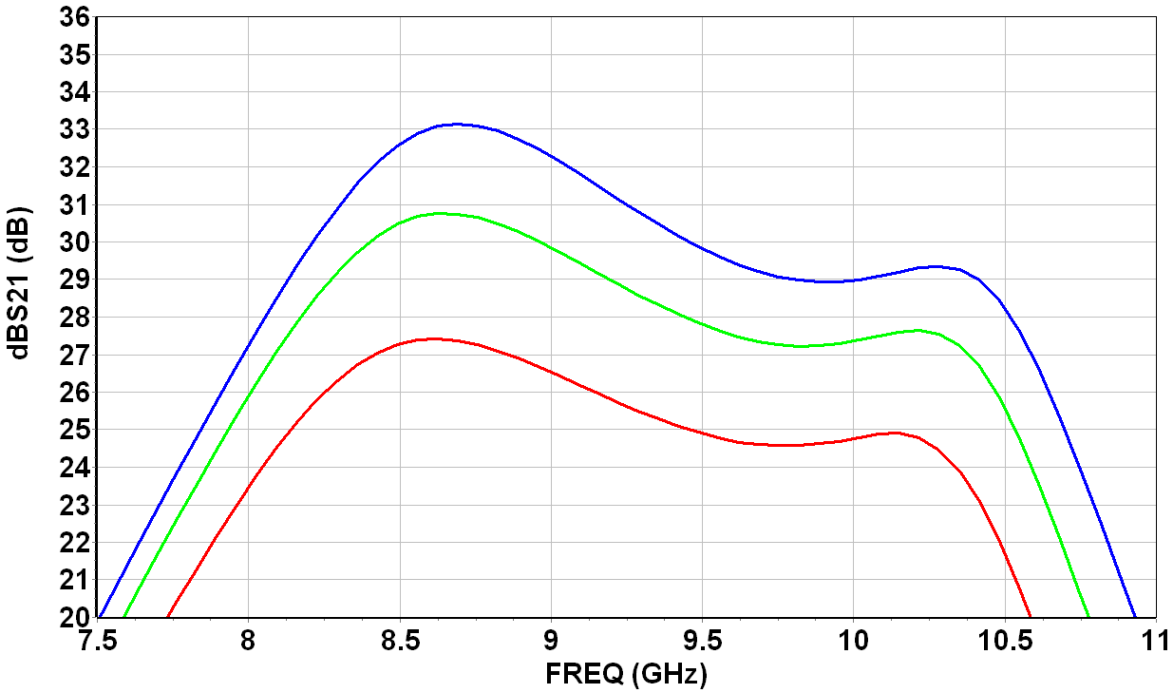
Output Return Losses versus Frequency (Vd=25V Temp.=-30 & +25 & +85 °C)



Linear Gain versus Frequency (Vd=30V Temp.=-30 & +25 & +85 °C)



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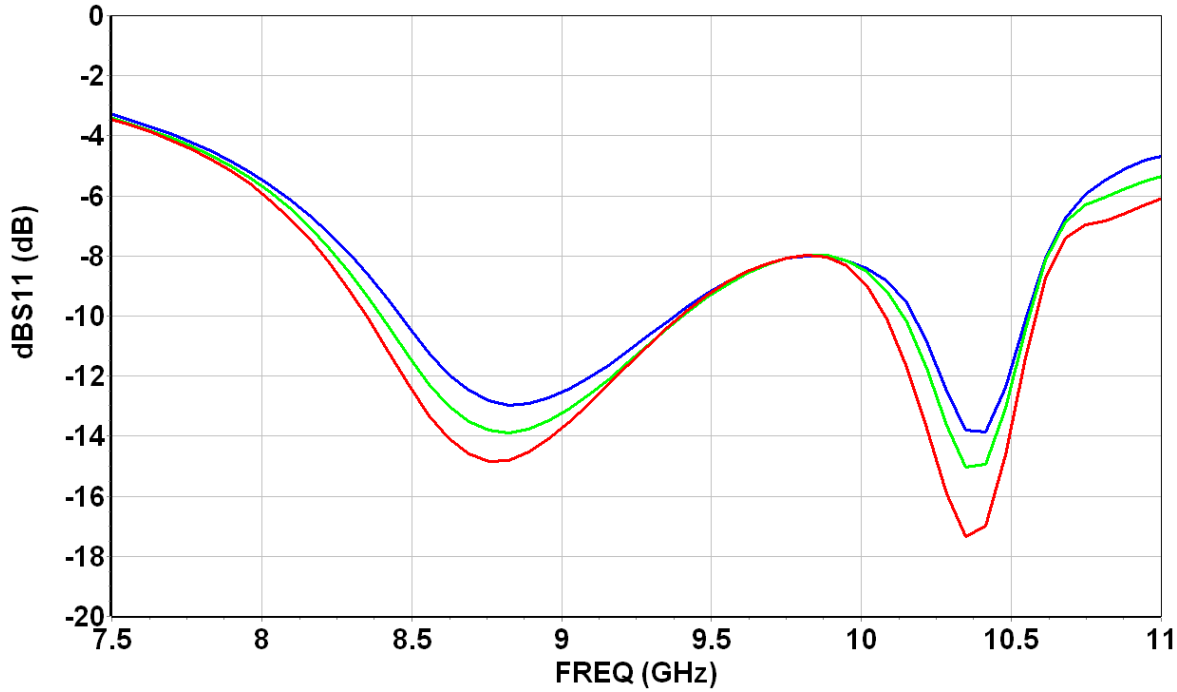
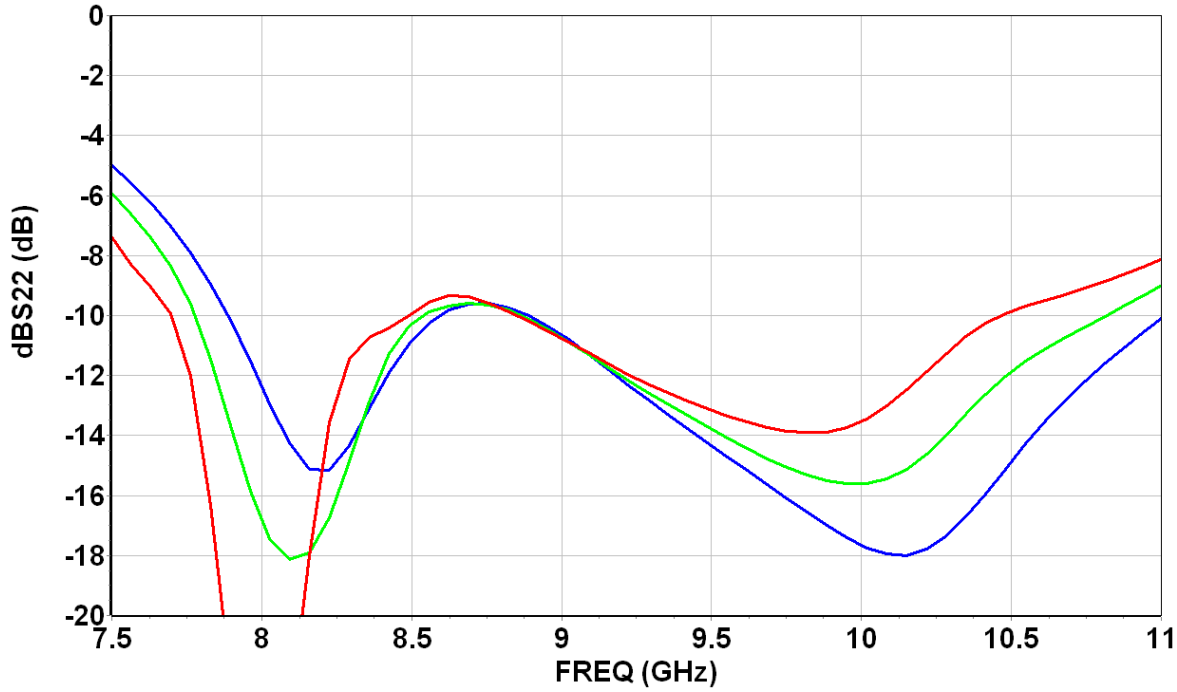
Input Return Losses versus Frequency (Vd=30V Temp.=-30 & +25 & +85 °C)



Output Return Losses versus Frequency (Vd=30V Temp.=-30 & +25 & +85 °C)



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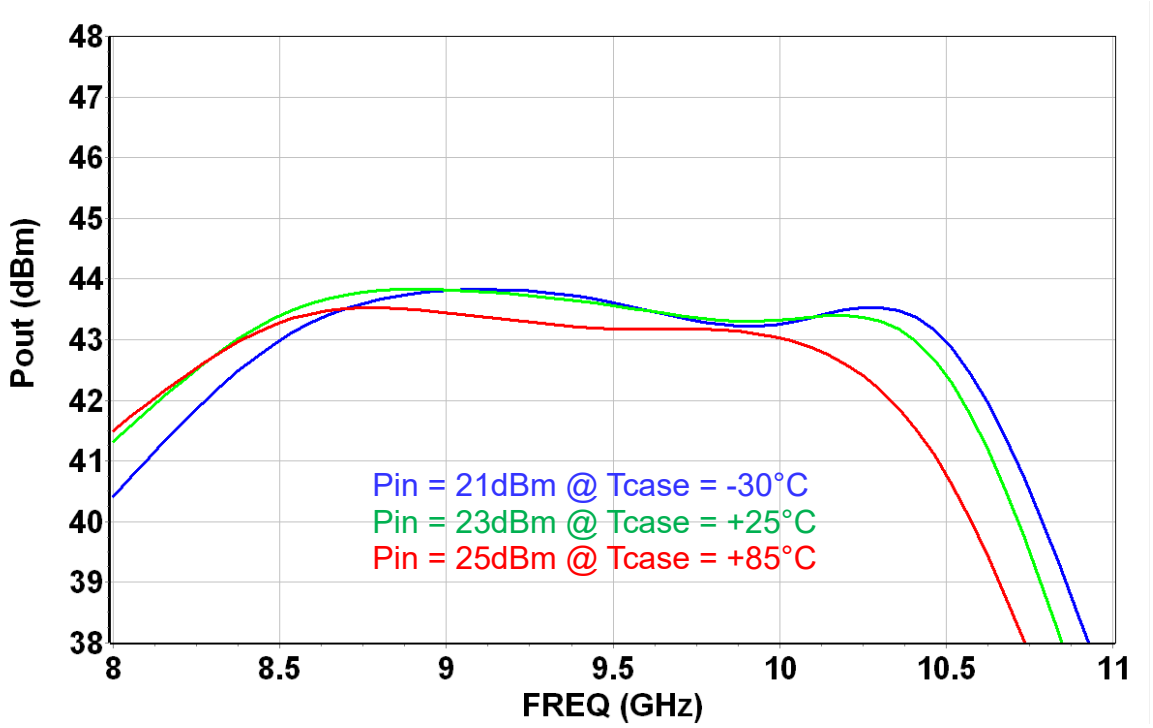
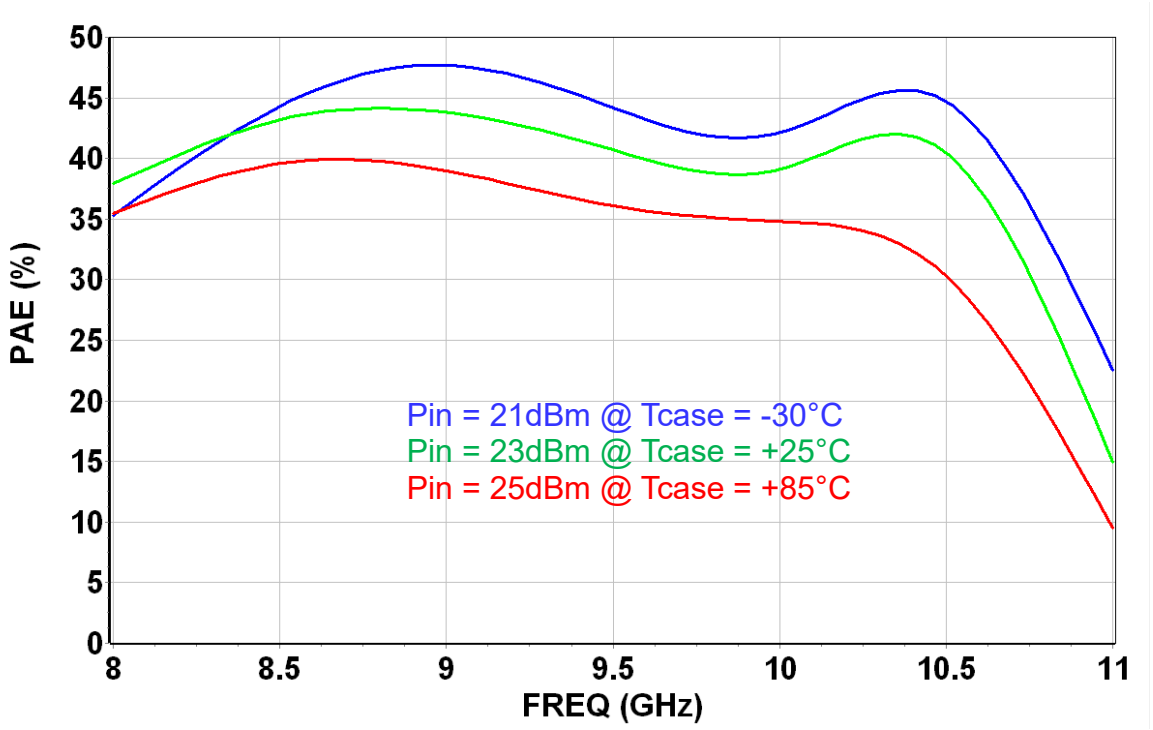
Typical Board Measurements (Pulsed mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%
Reference planes as indicated in page 25

Output Power versus Frequency (Temp.=-30 & +25 & +85 °C)



Power Added Efficiency versus Frequency (Temp.=-30 & +25 & +85 °C)



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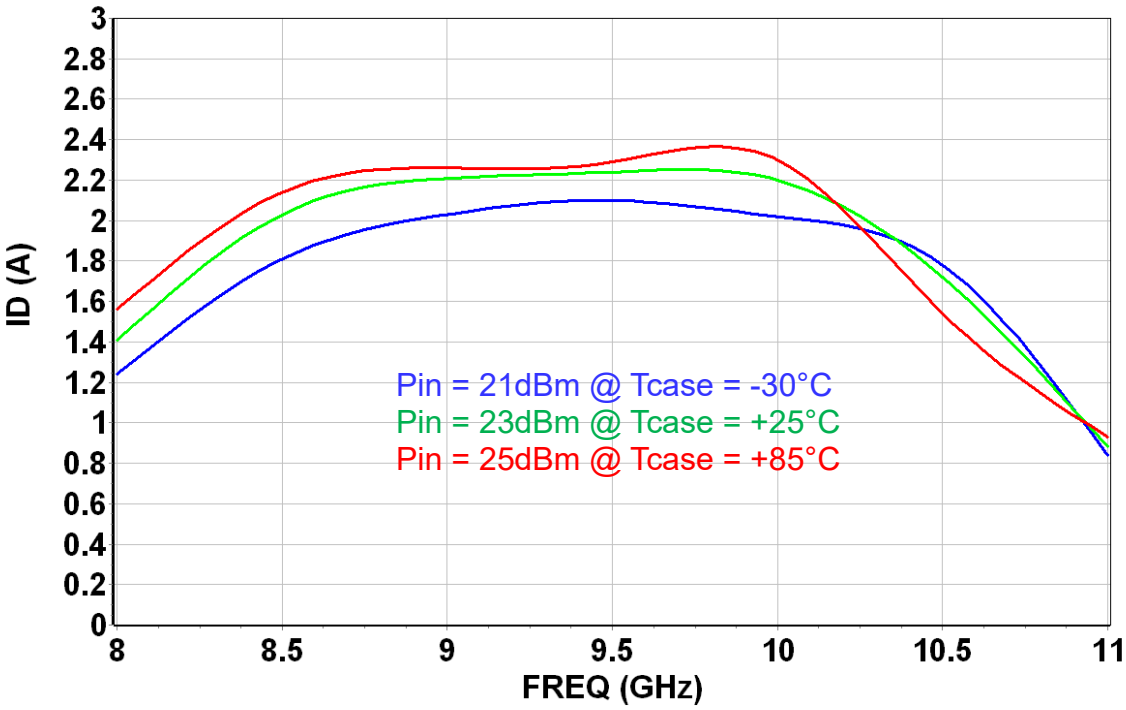
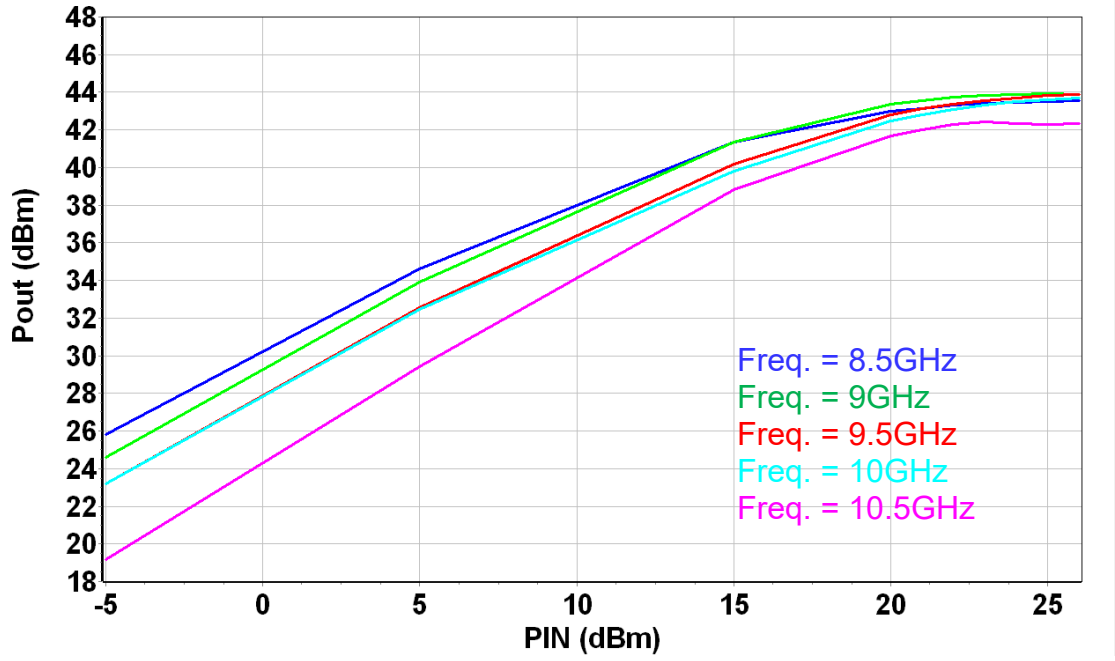
Typical Board Measurements (Pulsed mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%
Reference planes as indicated in page 25

Drain Current versus Frequency (Temp.=-30 & +25 & +85 °C)





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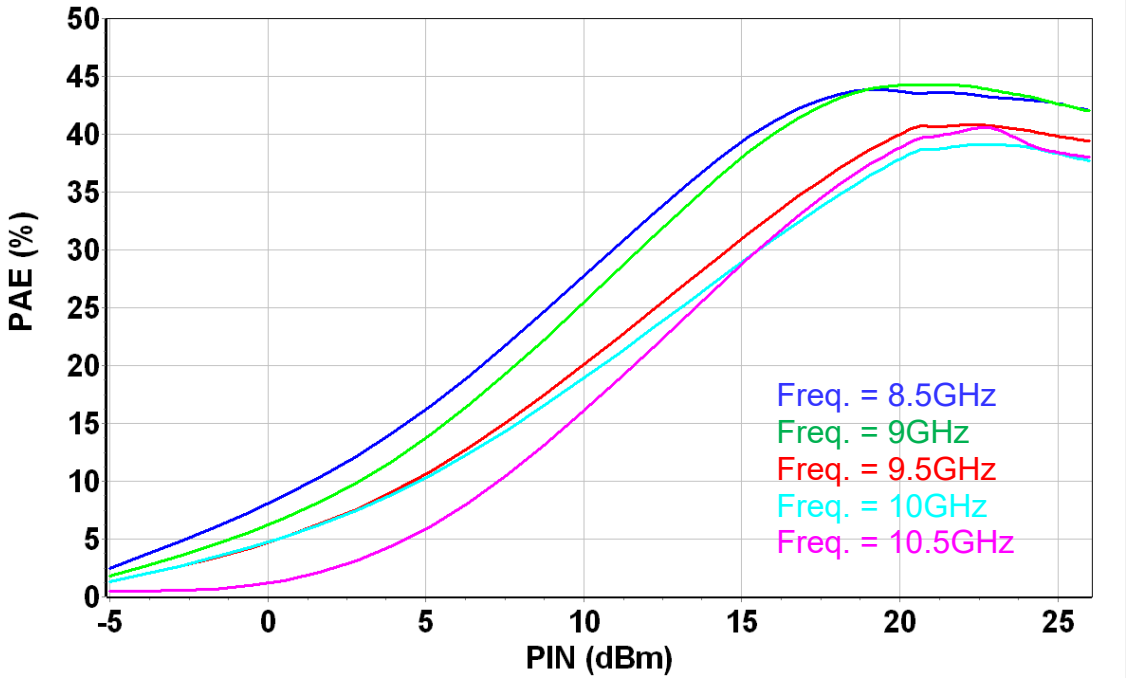
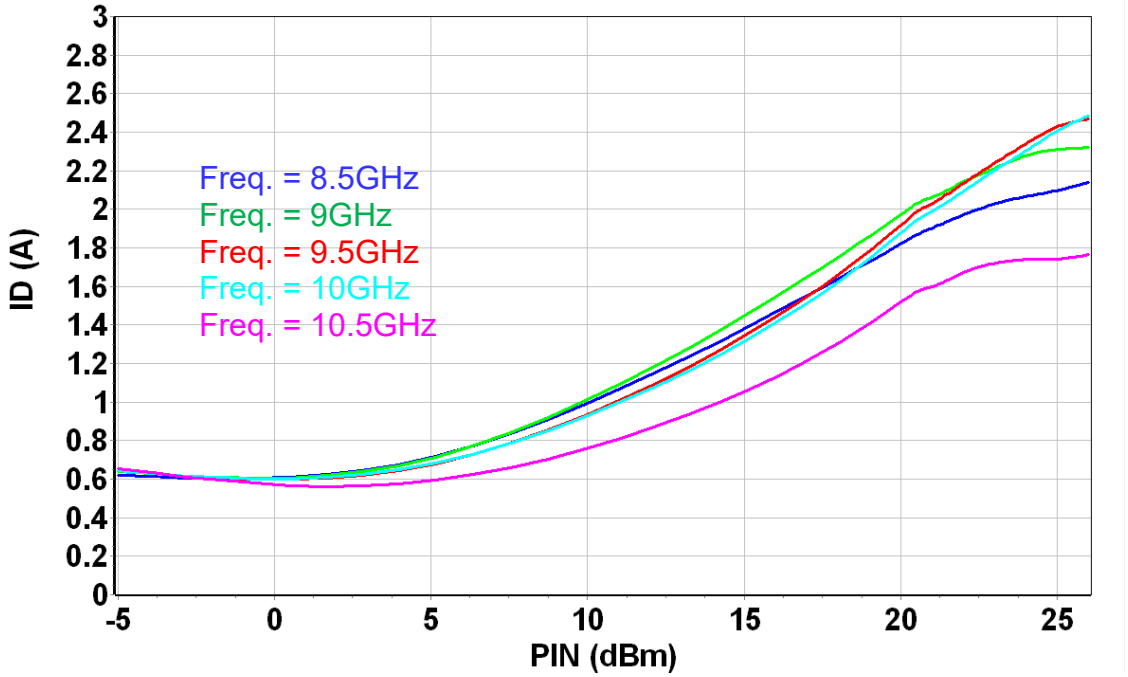
Typical Board Measurements (Pulsed mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%
Reference planes as indicated in page 25

Power Added Efficiency versus Input Power (Temp=+25°C)
Frequencies 8.5, 9, 9.5, 10, 10.5GHz



Drain Current versus Input Power (Temp=+25°C)
Frequencies 8.5, 9, 9.5, 10, 10.5GHz



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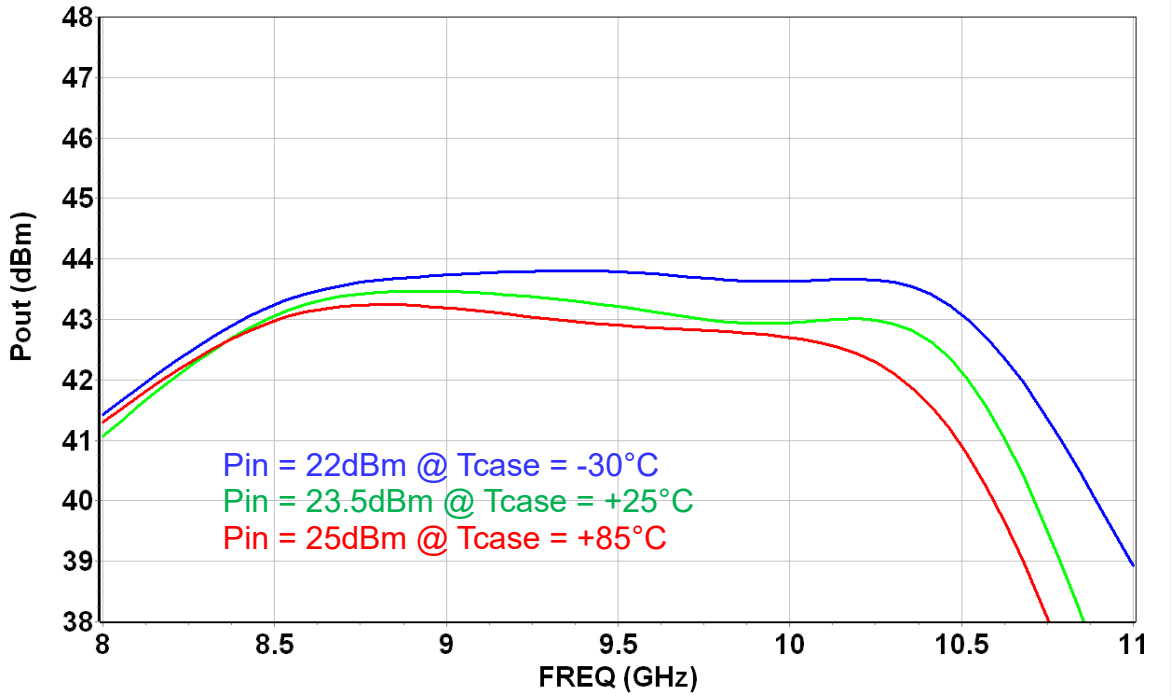
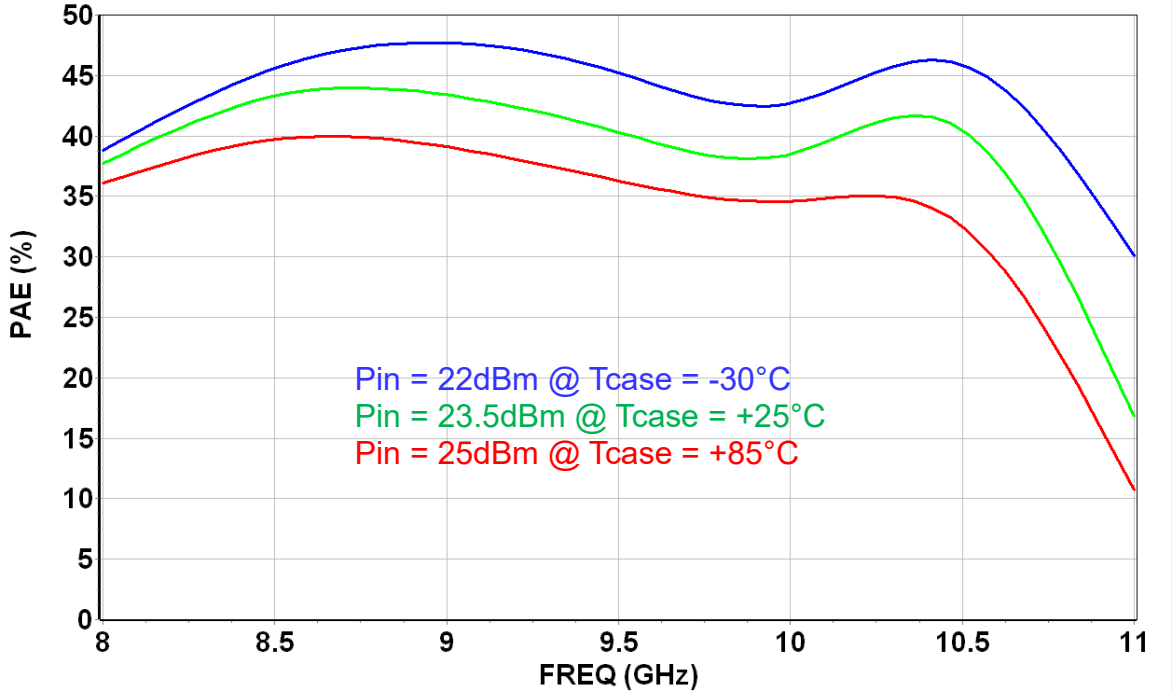
Typical Board Measurements (CW mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C
Reference planes as indicated in page 25

Output Power versus Frequency (Temp.=-30 & +25 & +85 °C)



Power Added Efficiency versus Frequency (Temp.=-30 & +25 & +85 °C)



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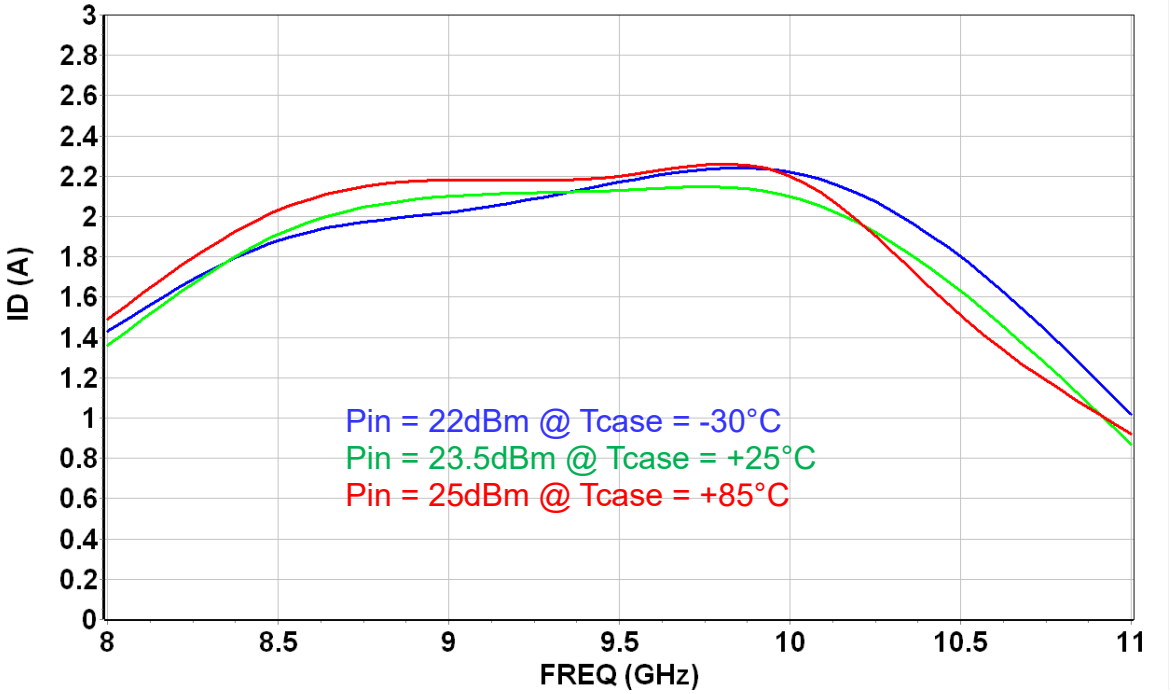
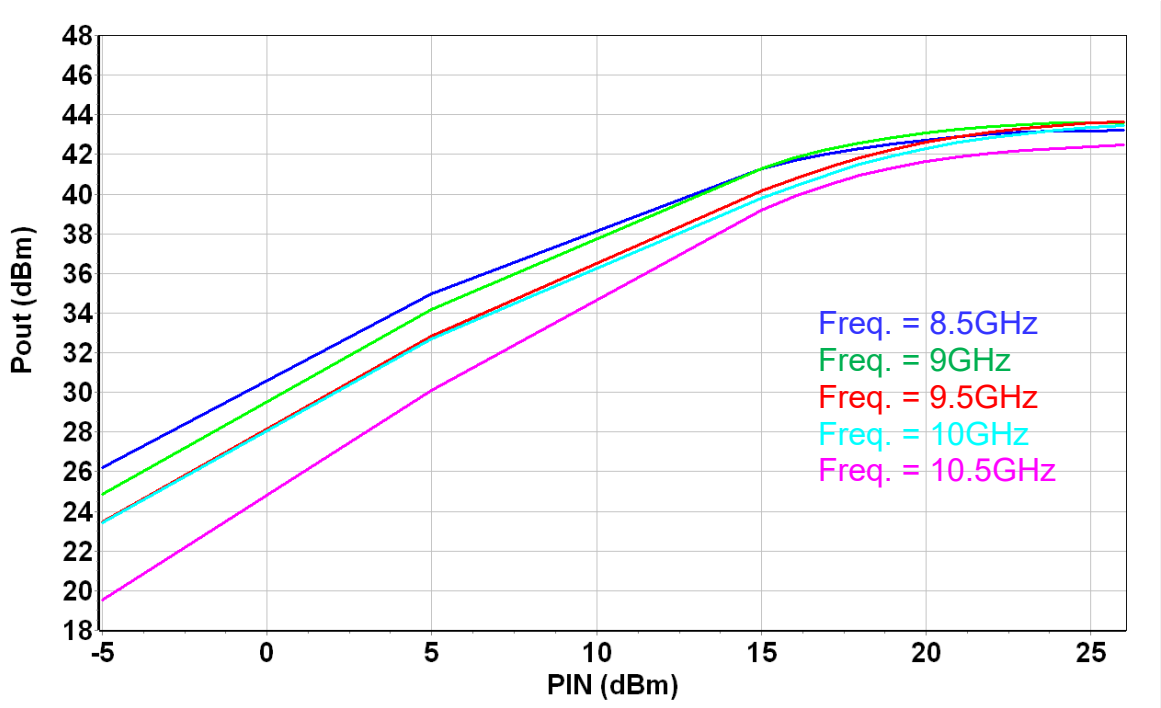
Typical Board Measurements (CW mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C
Reference planes as indicated in page 25

Drain Current versus Frequency (Temp.=-30 & +25 & +85 °C)



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



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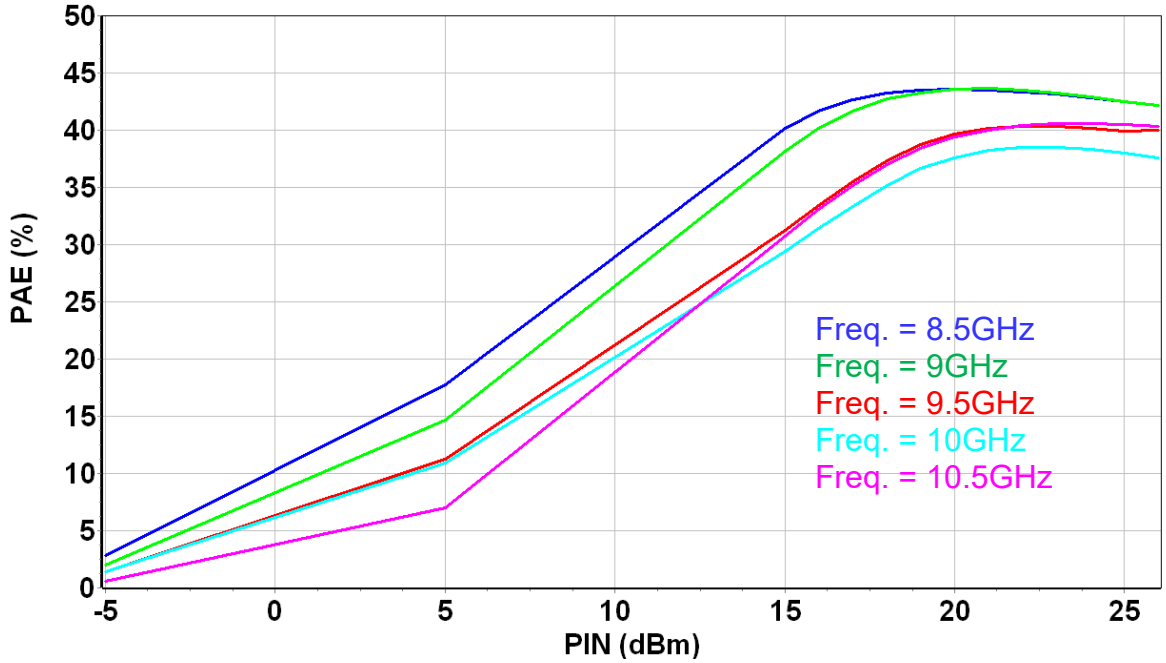
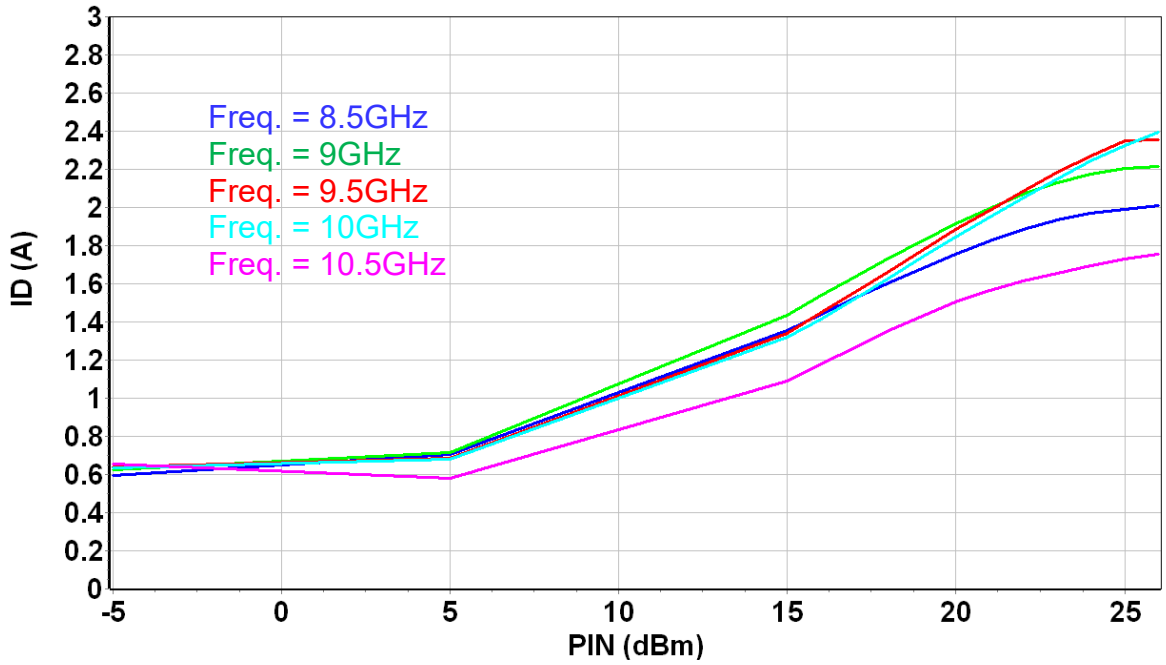
Typical Board Measurements (CW mode)

Vd = +25V, Idq = 750mA at Tcase = +25°C
Reference planes as indicated in page 25

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



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



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Typical Board Measurements (Pulsed mode)

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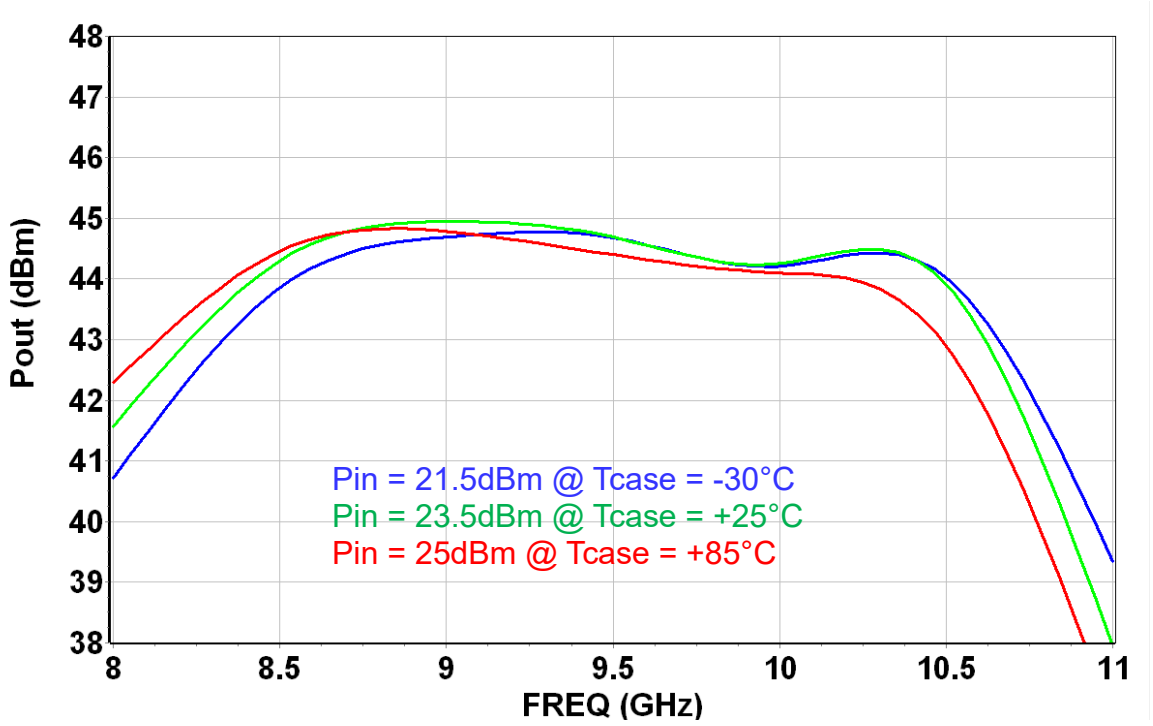
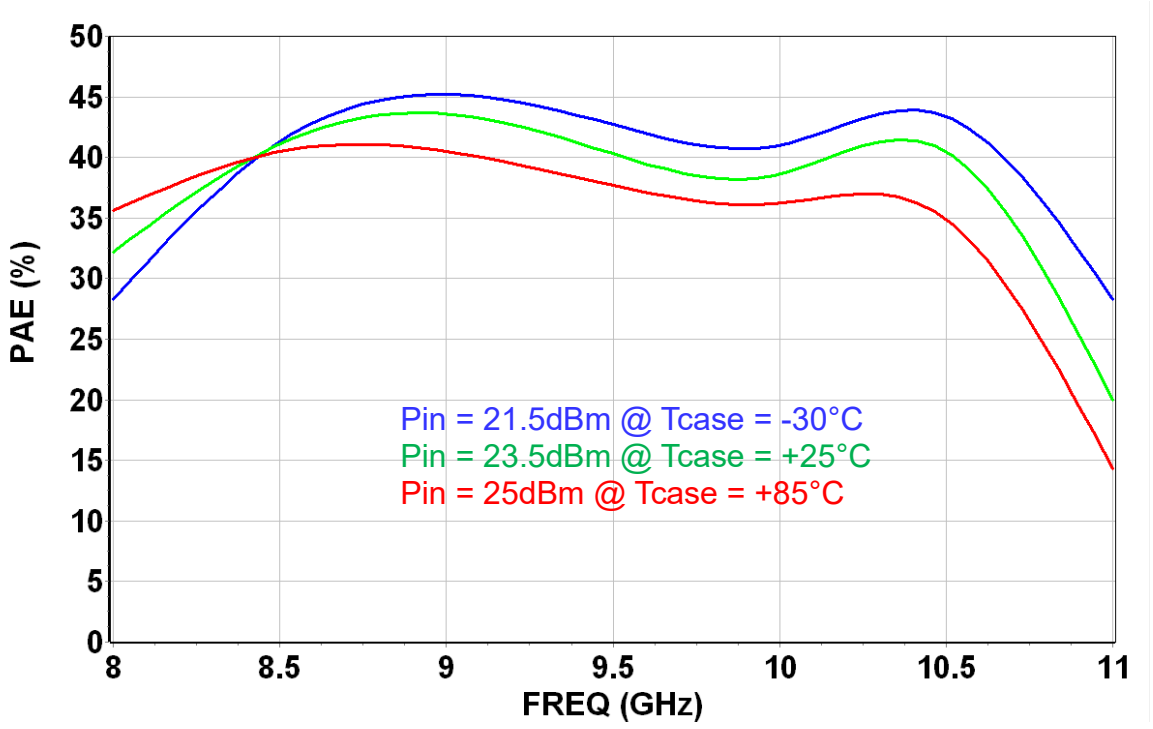
Reference planes as indicated in page 25

Output Power versus Frequency (Temp.=-30 & +25 & +85 °C)



Power Added Efficiency versus Frequency (Temp.=-30 & +25 & +85 °C)



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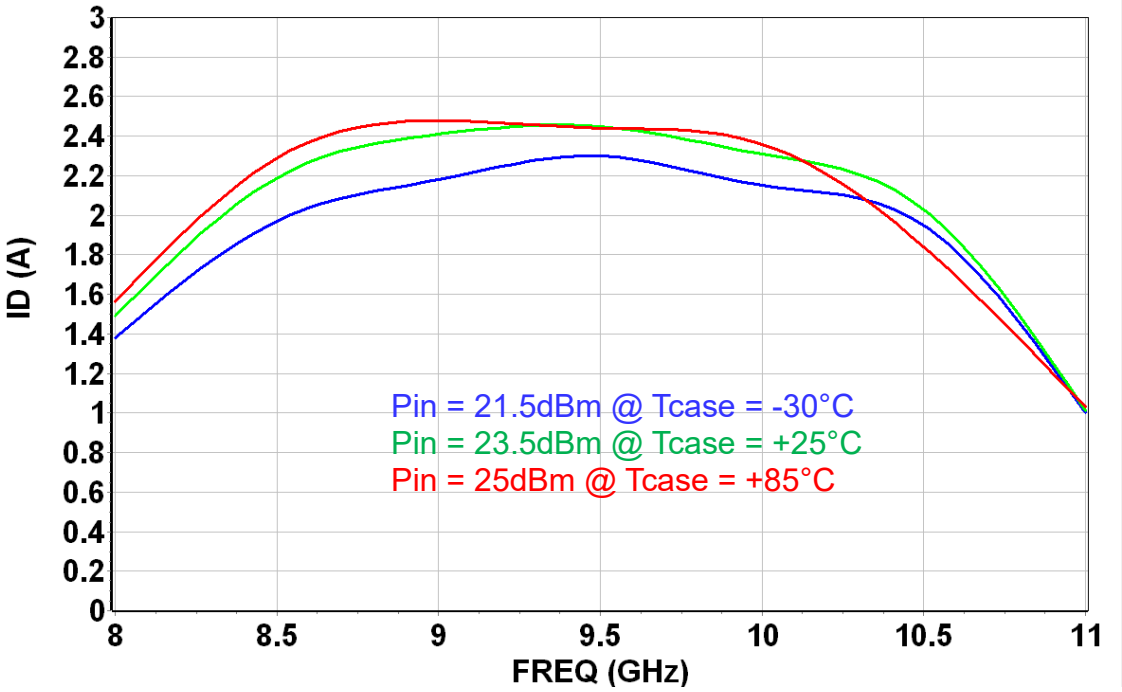
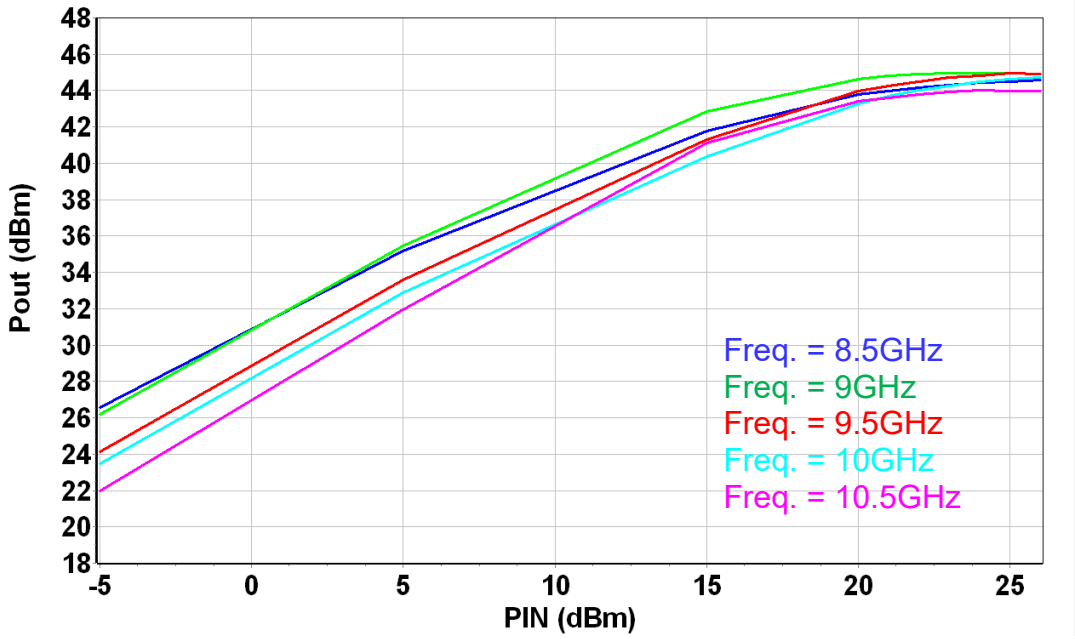
Typical Board Measurements (Pulsed mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%
Reference planes as indicated in page 25

Drain Current versus Frequency (Temp.=-30 & +25 & +85 °C)



Output Power versus Input Power (Temp=+25°C)
Frequencies 8.5, 9, 9.5, 10, 10.5GHz



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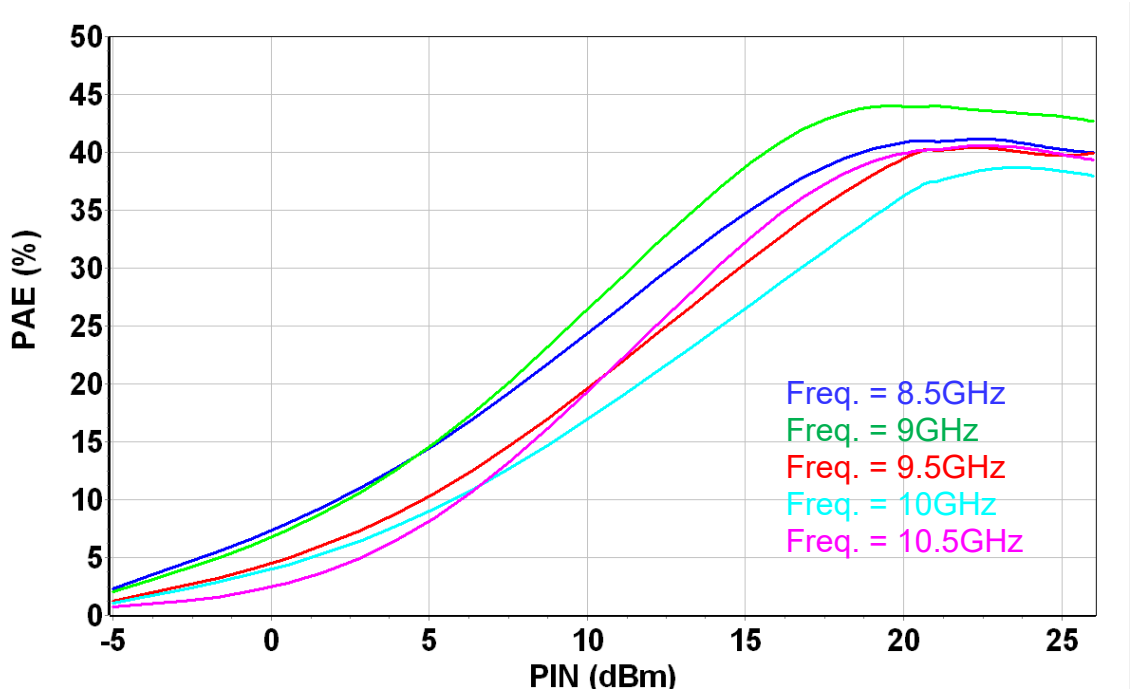
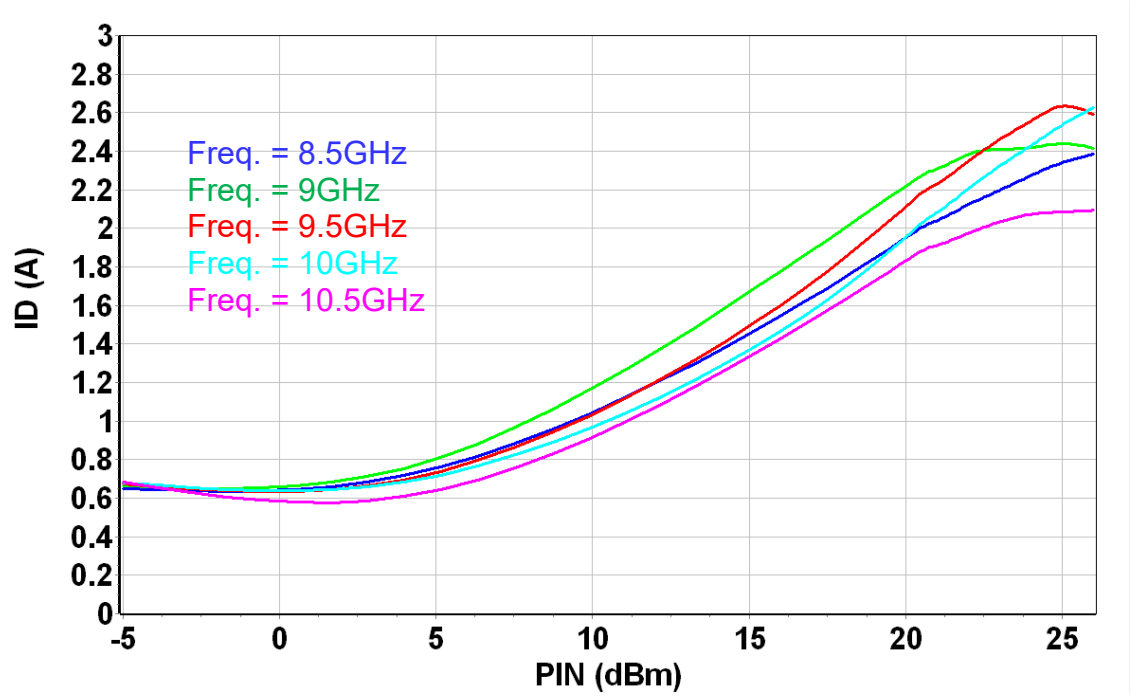
Typical Board Measurements (Pulsed mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C, Pulse width=25µs & Duty cycle =10%
Reference planes as indicated in page 25

Power Added Efficiency versus Input Power (Temp=+25°C)
Frequencies 8.5, 9, 9.5, 10, 10.5GHz



Drain Current versus Input Power (Temp=+25°C)
Frequencies 8.5, 9, 9.5, 10, 10.5GHz



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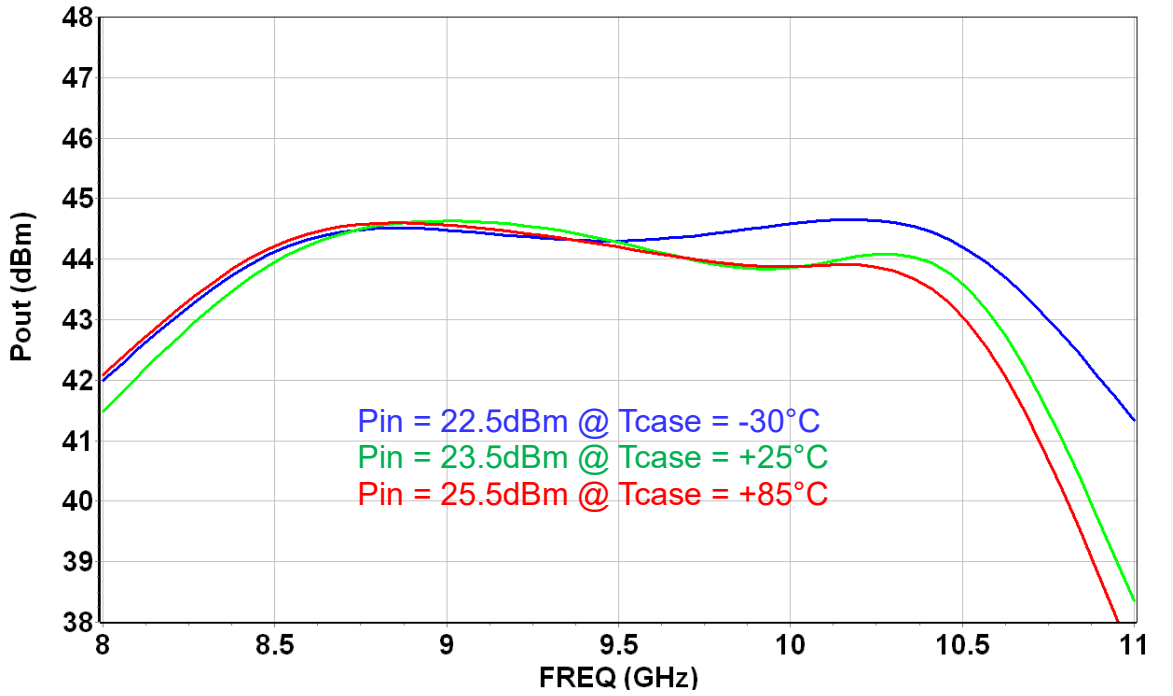
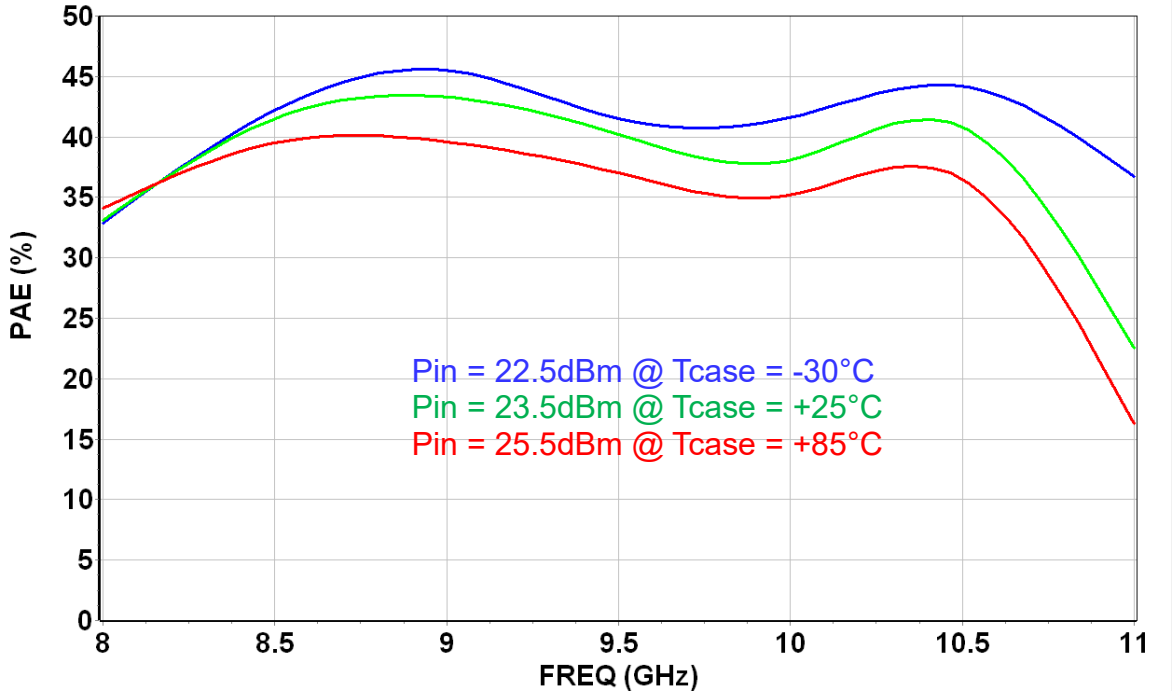
Typical Board Measurements (CW mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C, Tcase = +25°C
Reference planes as indicated in page 25

Output Power versus Frequency (Temp.=-30 & +25 & +85 °C)



Power Added Efficiency versus Frequency (Temp.=-30 & +25 & +85 °C)



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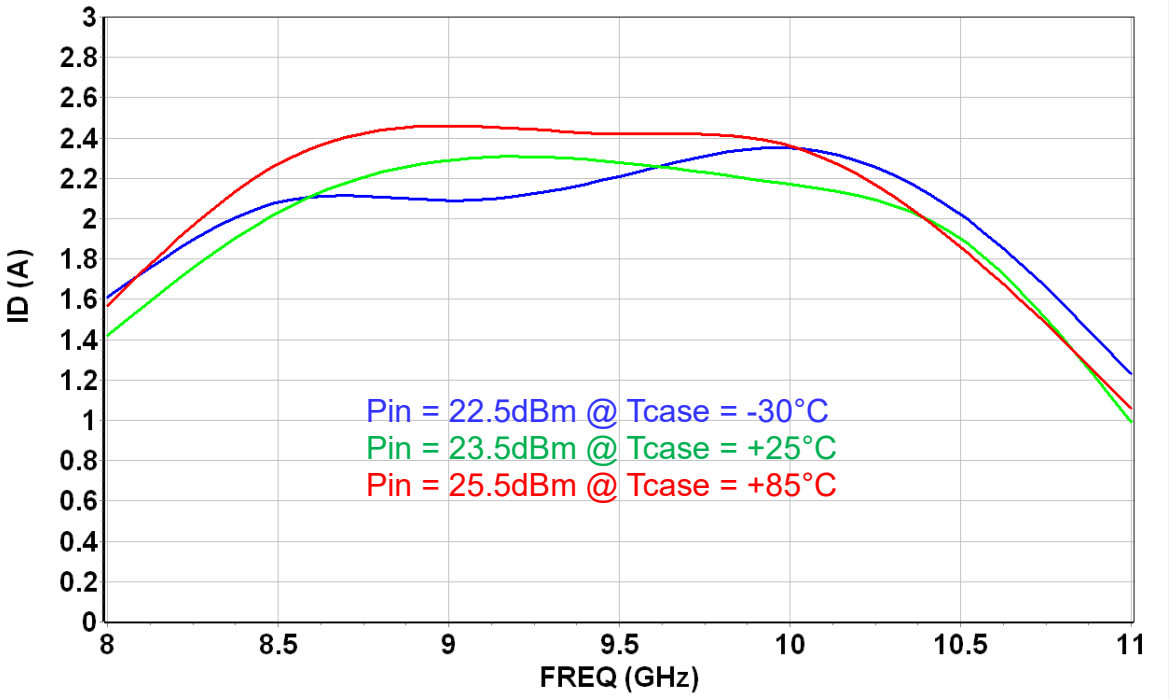
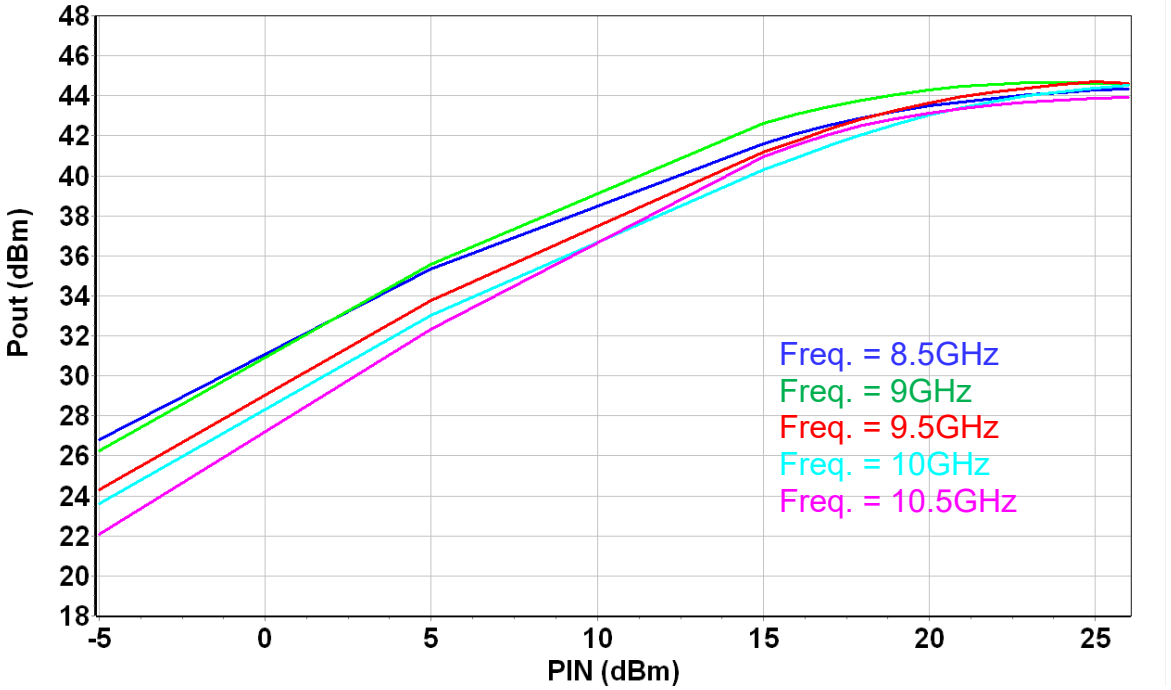
Typical Board Measurements (CW mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C
Reference planes as indicated in page 25

Drain Current versus Frequency (Temp.=-30 & +25 & +85 °C)



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



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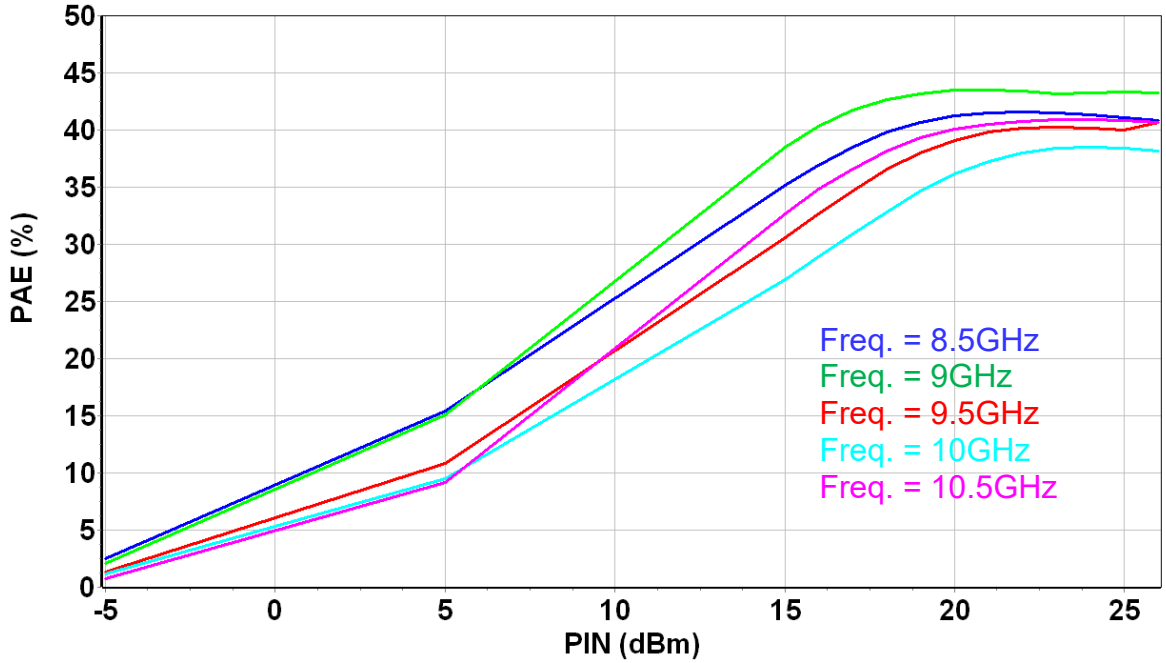
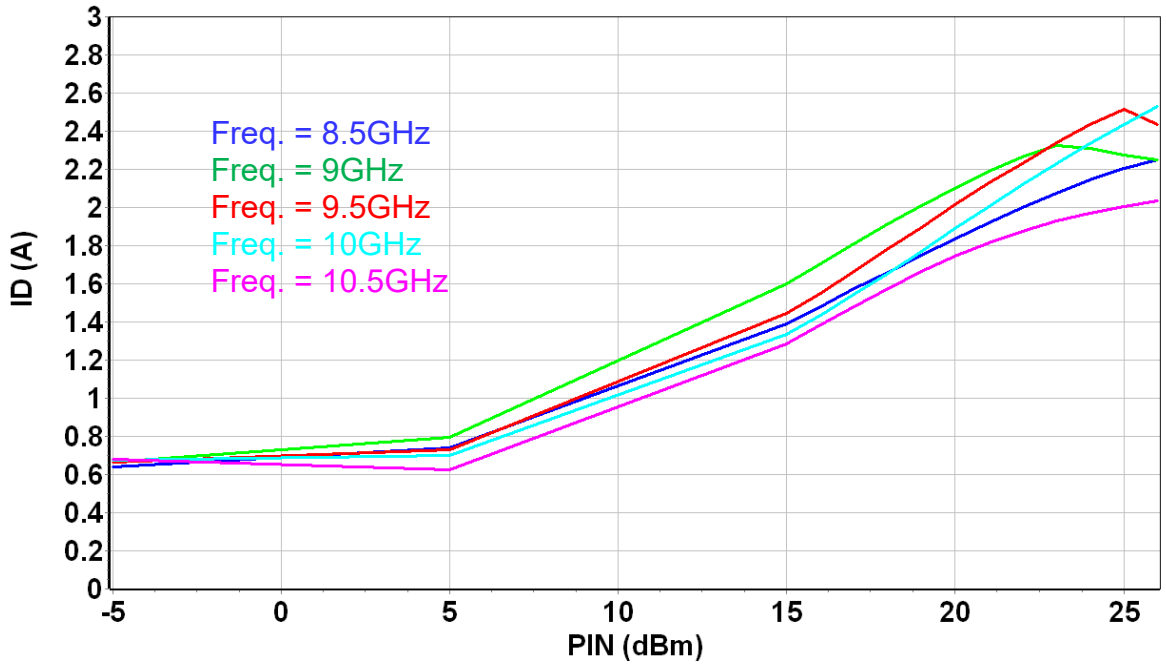
Typical Board Measurements (CW mode)

Vd = +30V, Idq = 750mA at Tcase = +25°C
Reference planes as indicated in page 25

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



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



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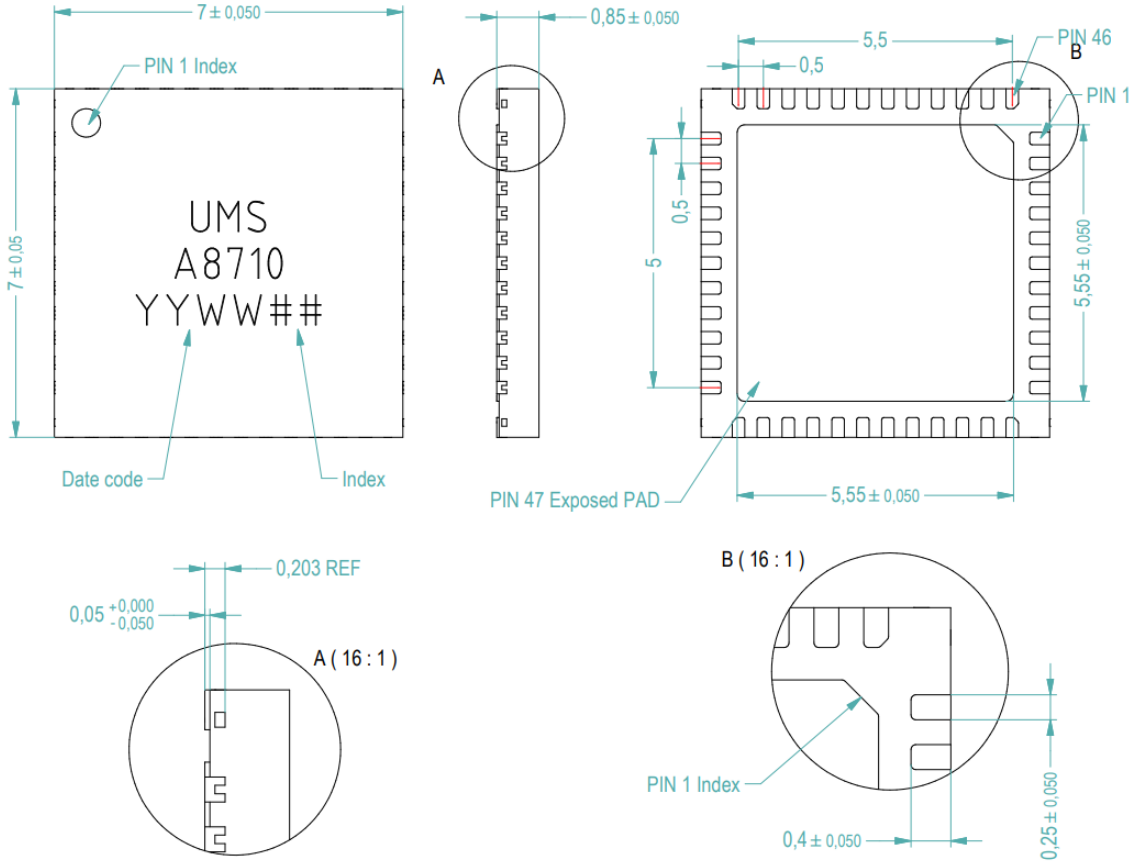
Package outline



Matte tin, Lead Free	(Green)	1- Nc	17- VG2	33- Nc
Units :	mm	2- Nc	18- Gnd(1)	34- Nc
From the standard :	JEDEC MO-220	3- Gnd(1)	19- Nc	35- Nc
	(VKKD)	4- RF in	20- Nc	36- Nc
47-	Gnd	5- Gnd(1)	21- VD2	37- VD2
		6- Nc	22- Nc	38 Nc
		7- Nc	23- Nc	39 Nc
		8- Nc	24- Nc	40- Gnd
		9- Nc	25- Nc	41- VG2
		10- Nc	26- Nc	42- Nc
		11- Nc	27- Nc	43 VD1
		12- Nc	28- Gnd(1)	44- Nc
		13- VG1	29- RF out	45- Nc
		14- Nc	30- Gnd(1)	46- Nc
		15- VD1	31- Nc	
		16- Nc	32- Nc	

(1) It is strongly recommended to ground all pins marked “Gnd” through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

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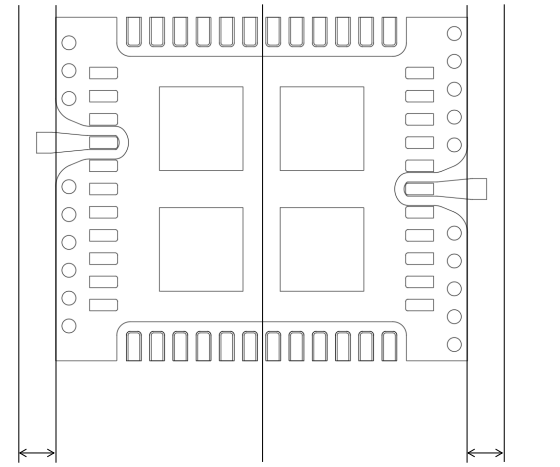
Definition of the reference planes for power measurements

The reference planes used for power measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 4.6 mm offset (input wise and output wise respectively) from this axis.



ESD sensitivity

Standard	Value
MIL-STD-1686C	HBM Class 1 (<2000V)
ESD STM5.1-1998	HBM Class 0 (<250V)

Package Information

Parameter	Value
Package body material	RoHS-compliant
	Low stress Injection Molded Plastic
Lead finish	100% NiPdAu-Ag
MSL Rating	MSL3

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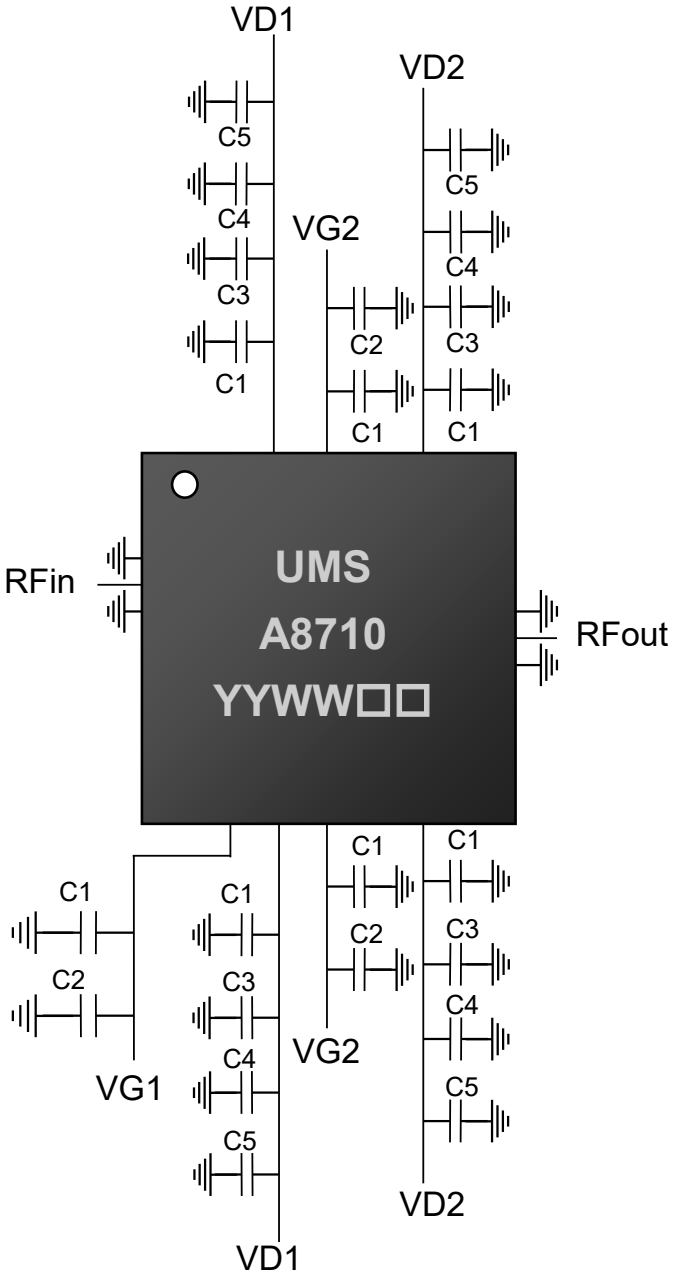
Recommended assembly plan



Bill of Materials

Label	Value	Description
C1	RF	Capa 120pF ±15% 50V
C2	RF	Capa 2nF ±10% 50V
C3	RF	Capa 10nF ±10% 50V
C4	RF	Capa 100nF ±10% 50V
C5	RF	Capa 1µF ±10% 50V

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Notes

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Recommended package footprint

Refer to the application note AN0017 available at https://www.ums-rf.com for package foot print recommendations.

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 at https://www.ums-rf.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 https://www.ums-rf.com.

Recommended ESD management

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

Ordering Information

QFN 7x7 package	CHA8710-QDB Stick: XY = 20

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