TDPA6710SP

5 W X-Band GaN Medium Power Amplifier

Product Overview

The TDPA6710SP is a two stage Medium Power GaN Amplifier operating between 8 and 12.75 GHz. It typically provides 5 W of saturated output power and 35% of Power Added Efficiency.

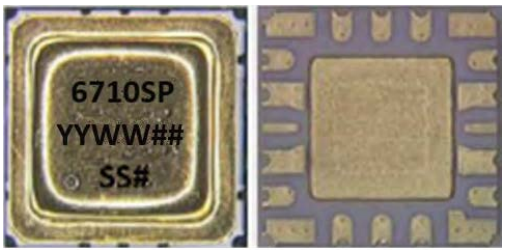
It is designed for a wide range of applications, from defense to space communication systems.

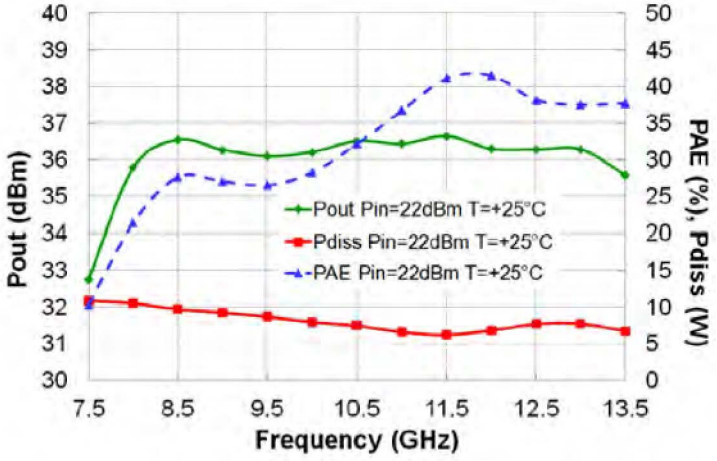
The circuit is manufactured with a GaN pHEMT process, 0.25 µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is available in a RoHS leadless surface mount hermetic metal ceramic 6 x 6 mm^2 package, compliant with SMD assembly tools.

Features

- Frequency range: 8-12.75 GHz
- High output power: 4.5 W
- High PAE: 35%
- Linear Gain: 22.5 dB
- dc bias: Vd = 25 Volt @ Idq = 0.2 A
- 6 x 6 mm^2 metal ceramic hermetic package
- Radiation Performance: 100 krad (Si) TID (Typical)





A Teledyne Defense Electronics Company

TELEDYNE e2v HIREL ELECTRONICS Everywhereyoulook™

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.

Electrical Characteristics

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

ESD Protection: Electrostatic discharge sensitive device, please observe handling precautions!

Electrical Specifications (Pulsed Mode)

Tamb.= +25 °C, Vd = +25 V, Idq = 200 mA, Pulse width = 25 µs, 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 nH to 0.3 nH.

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Electrical Specifications (CW Mode)

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

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	8		12.75	GHz
Gain	Linear Gain		22		dB
Pout	Output Power (Pin=23 dBm)		4.3		W
PAE	Associated Power Added Efficiency (Pin=22dBm)		34		%
Id	Associated current (Pin=23 dBm)		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 nH to 0.3 nH.

Electrical Specifications (Pulsed Mode)

Tamb.= +25 °C, Vd = +30 V, Idq = 200 mA, Pulse width = 25 µs, 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=23 dBm)		5		W
PAE	Associated Power Added Efficiency (Pin=23dBm)		33		%
Id	Associated current (Pin=23 dBm)		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

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

Typical Bias Conditions

Tamb.= +25 °C

Symbol	Pad N°	Parameter	Typical 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	 -3.2 -3.25 -8 to -5	 V V V

Biasing up Procedure

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

Biasing down Procedure

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

Typical FAB Sij Parameters (Pulsed Mode)

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

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

Device Thermal Information

The device thermal performances below are based on Teledyne 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 TDPA6710SP is manufactured (GaN Power HEMT 0.25 µm). 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 Pdis s= 8W CW	7.6	°C/W
Junction Temperature	Tj		86	°C
Median Life	T50		$2.31x10^{11}$	Hrs

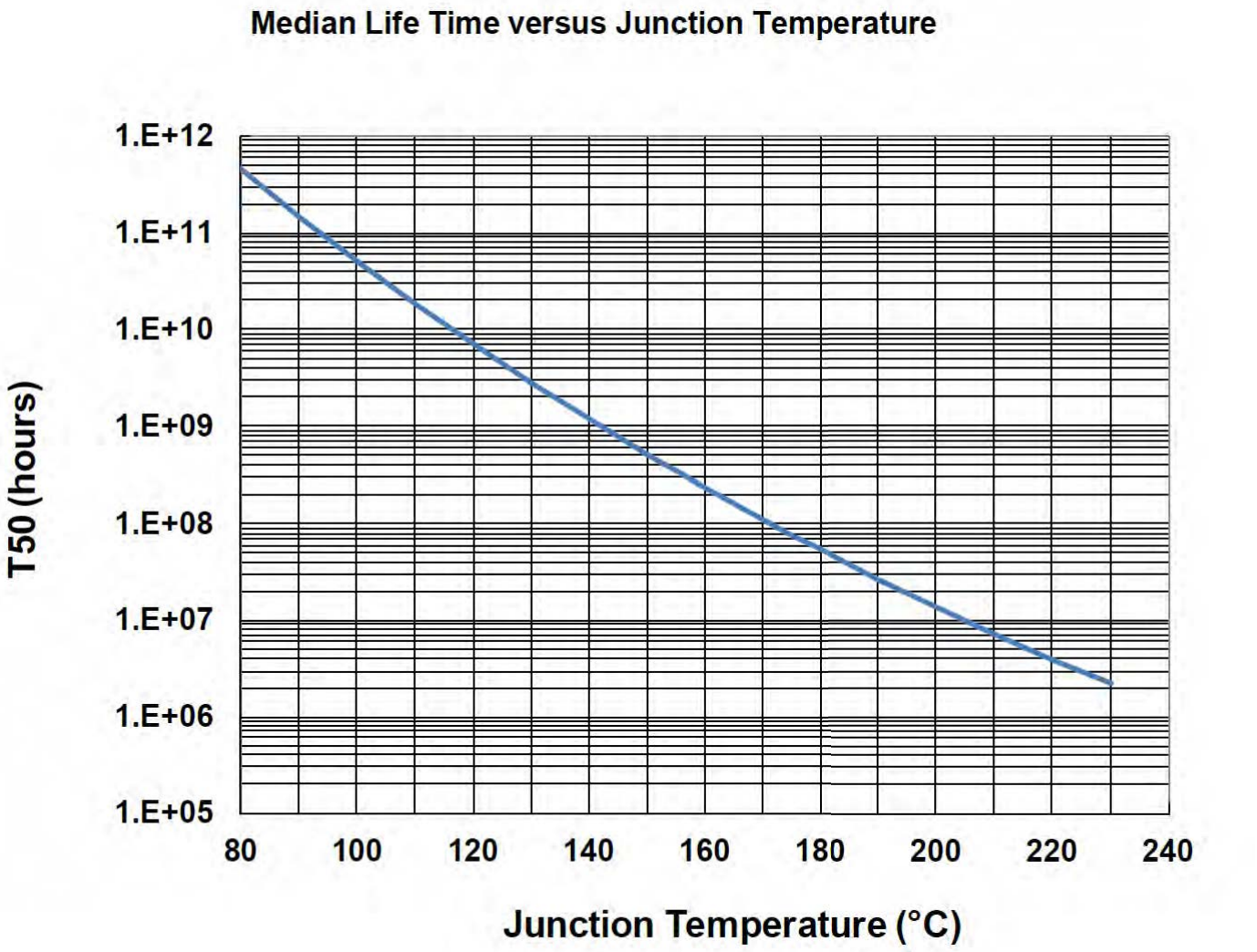
Thermal Resistance[1]	Rth_eq	Tb_{chip} = 85°C, Vd = 25V, Id_drive = 0.490A Pin=23dBm Pout=36dBm Pdiss=8.35W CW	10.8	°C/W
Junction Temperature	Tj		175	°C
Median Life	T50		$7.63x10^{7}$	Hrs

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

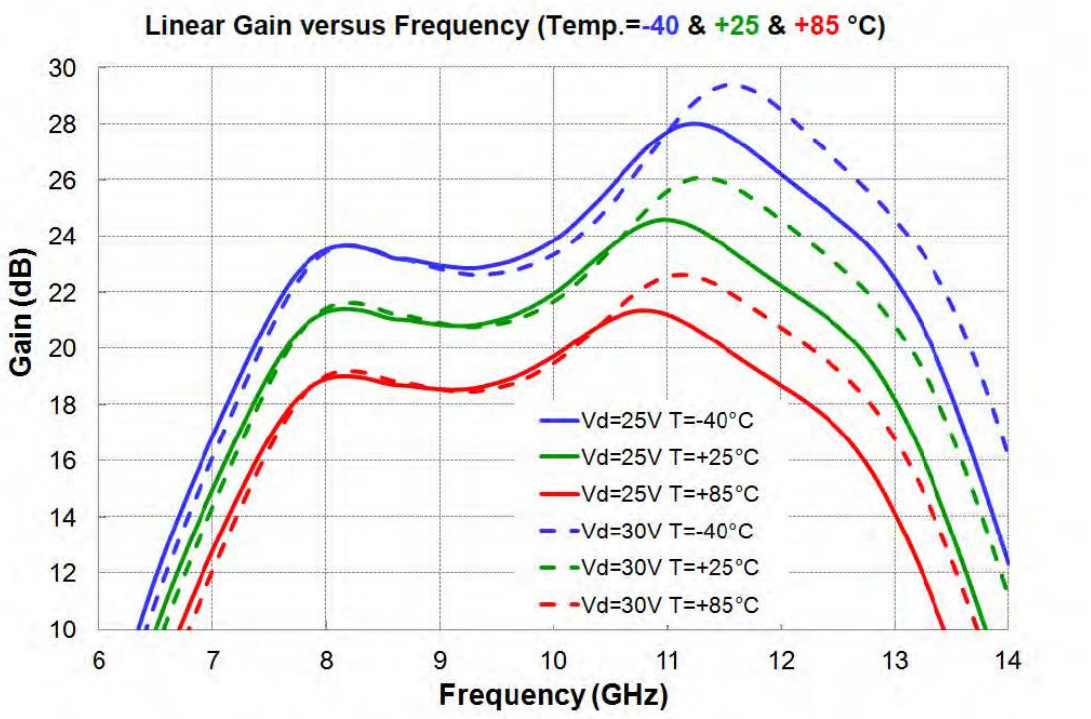
[1] Thermal resistance measured to back of the package.

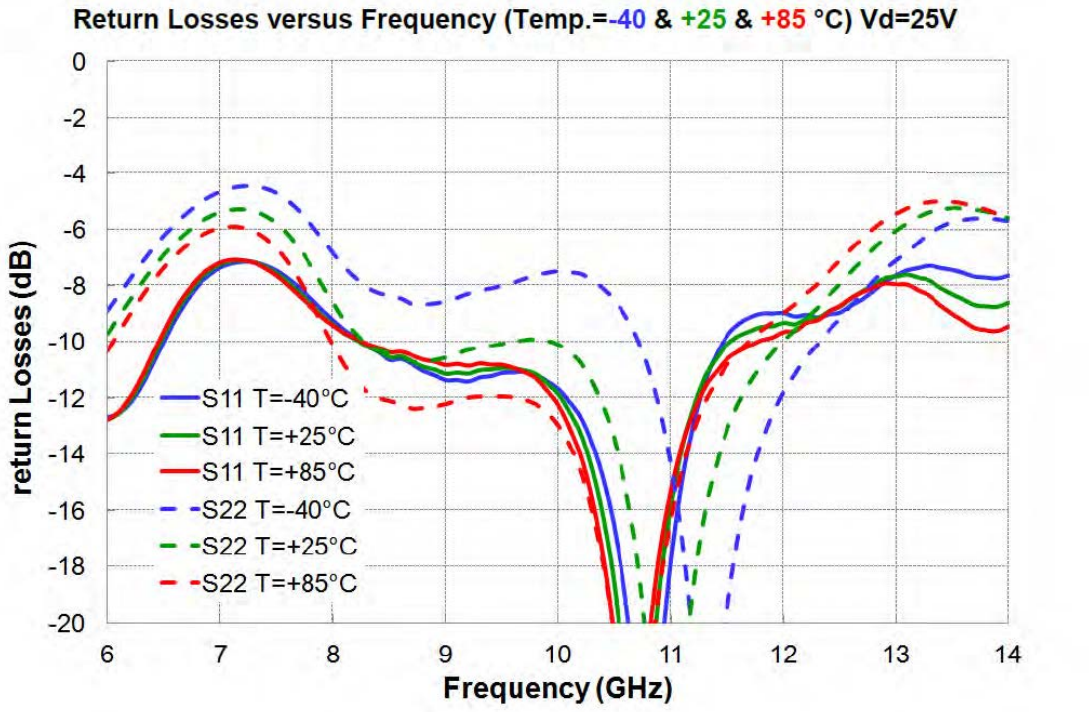
Median Lifetime vs Tj



Typical Board Measurements (CW Mode)

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





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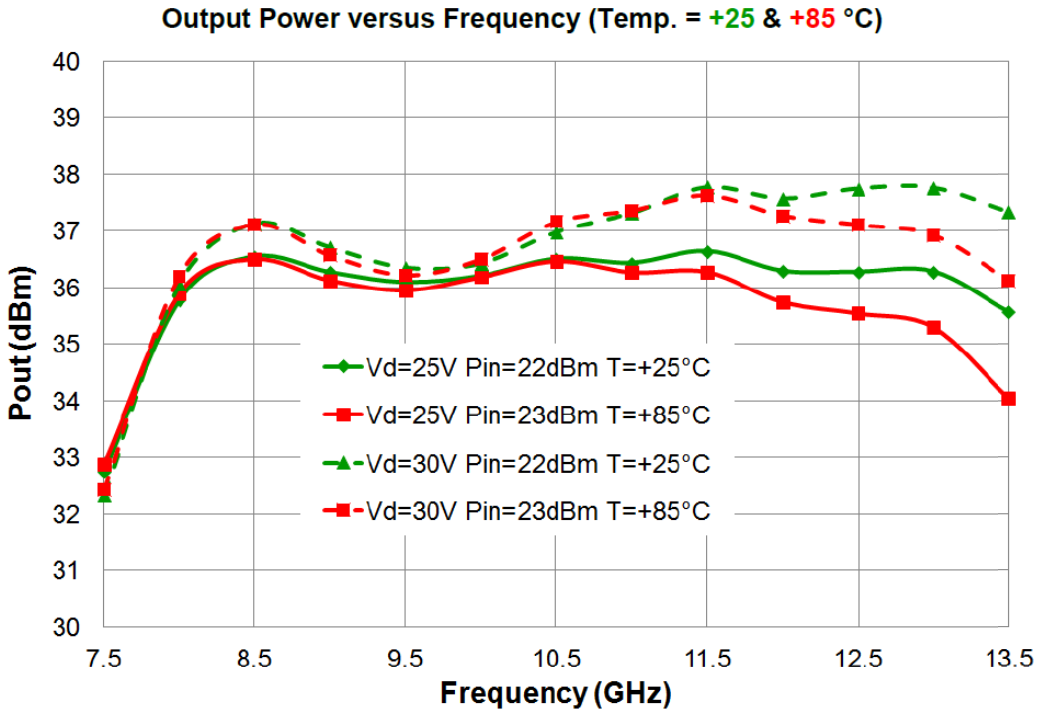

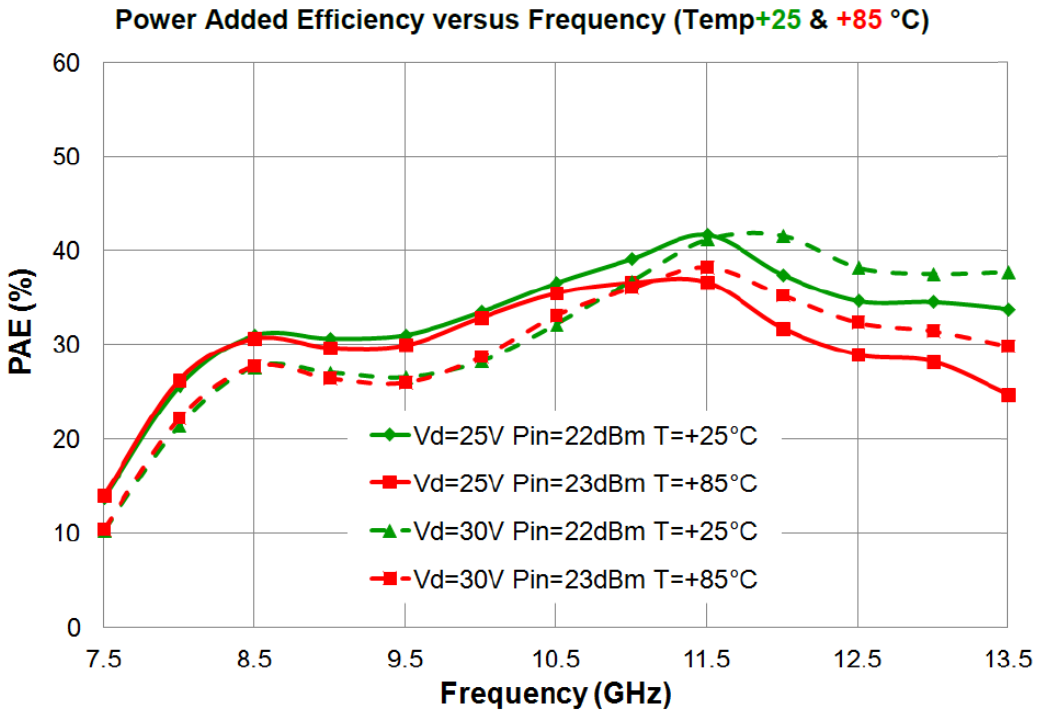

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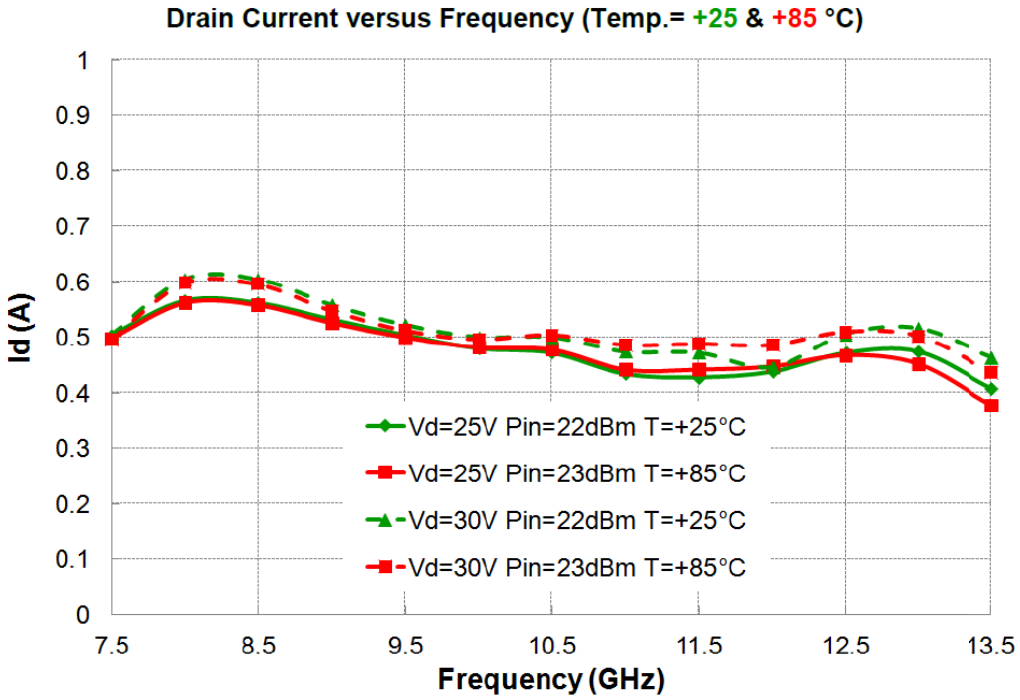

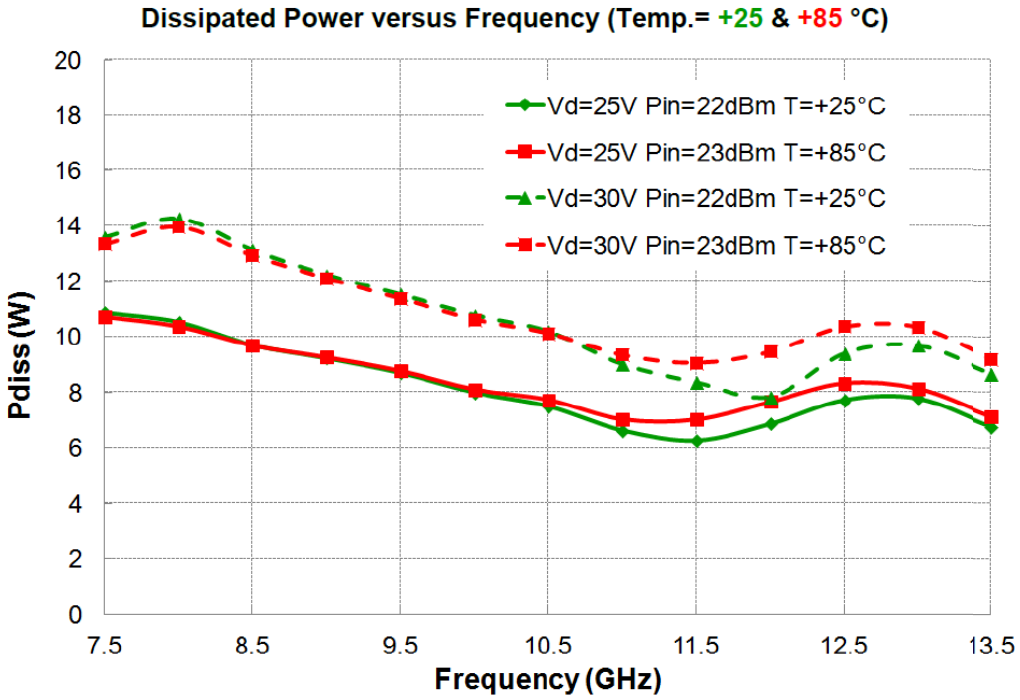

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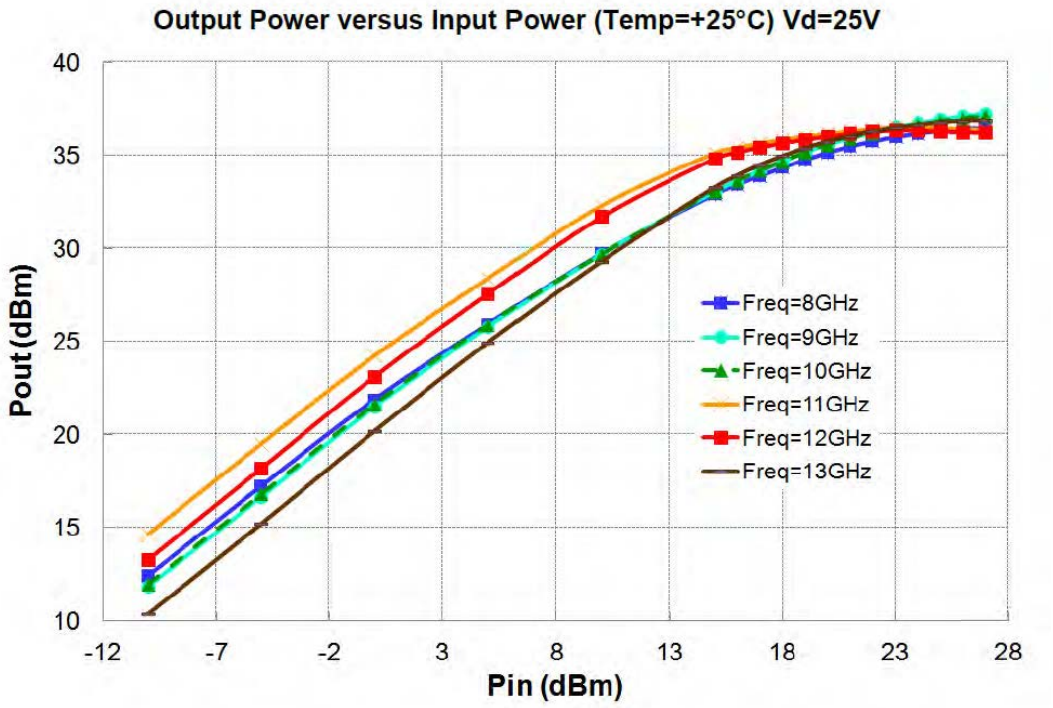

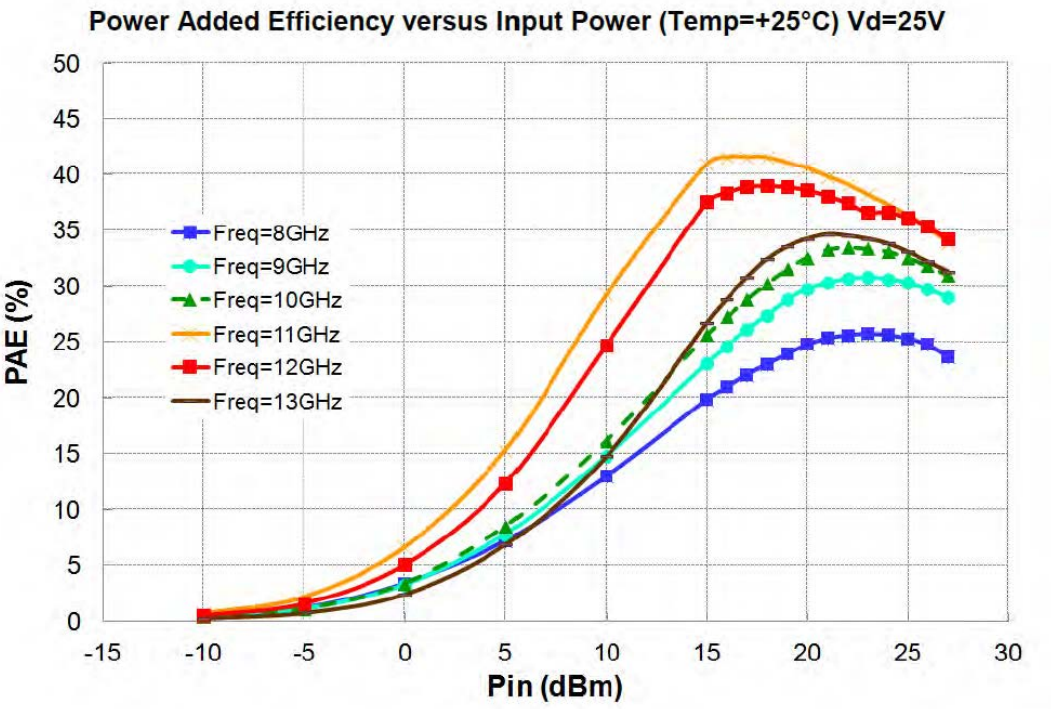

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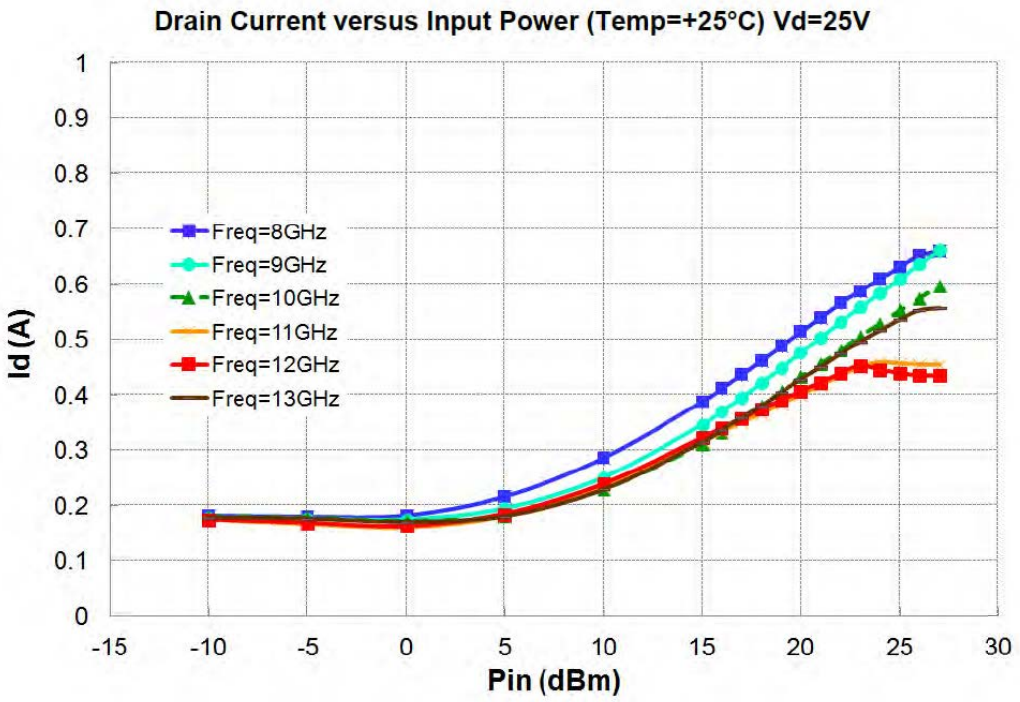

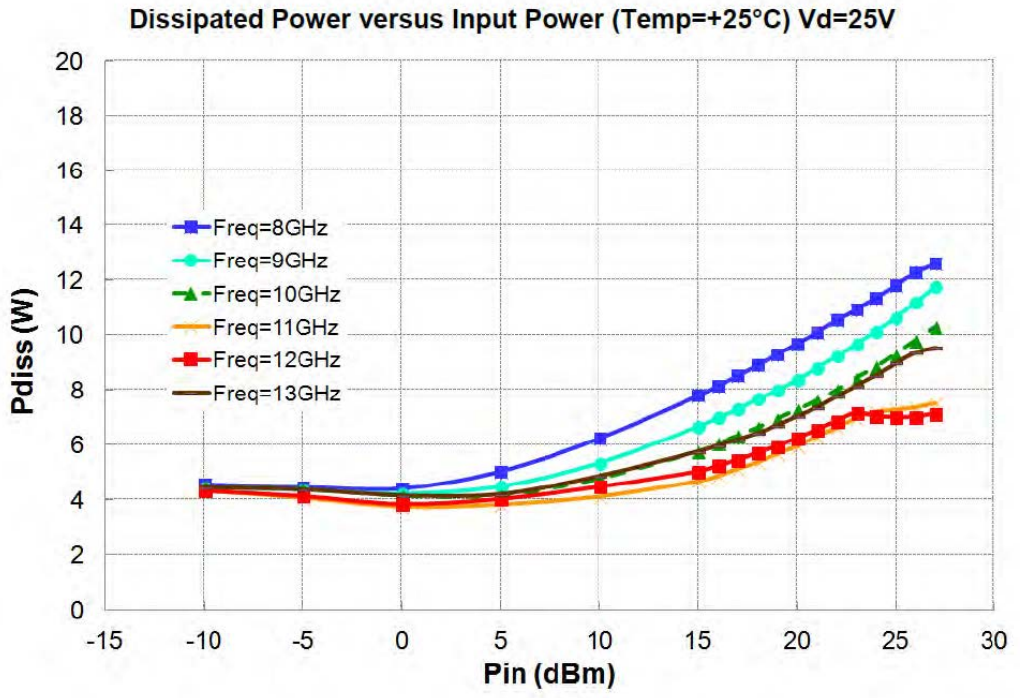

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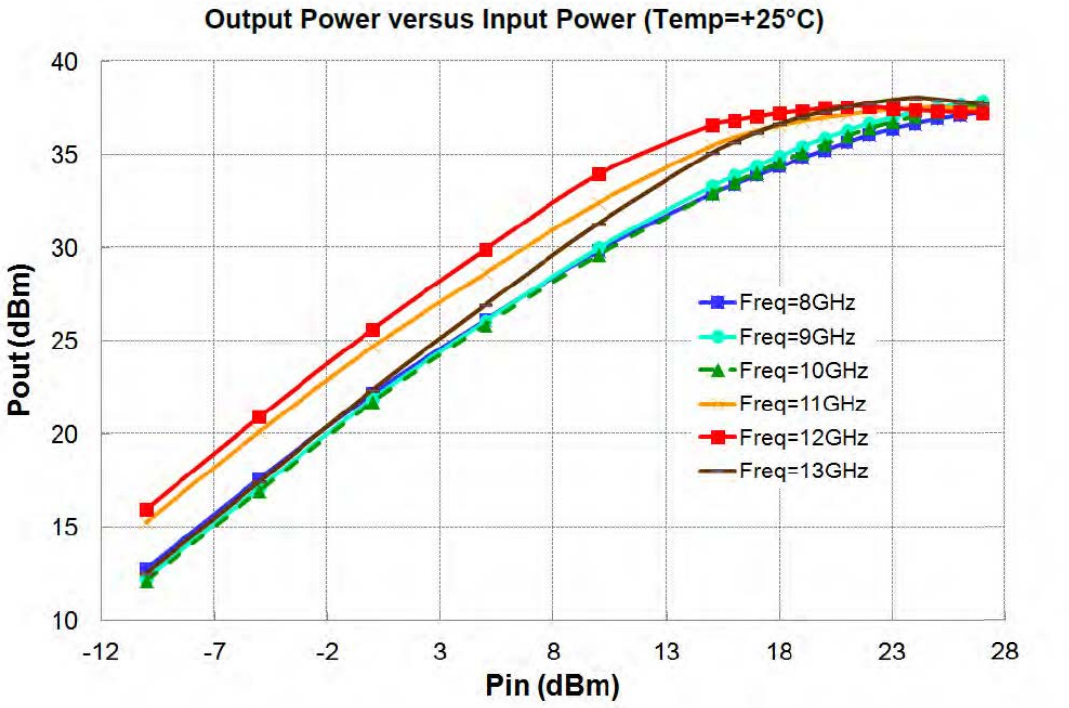
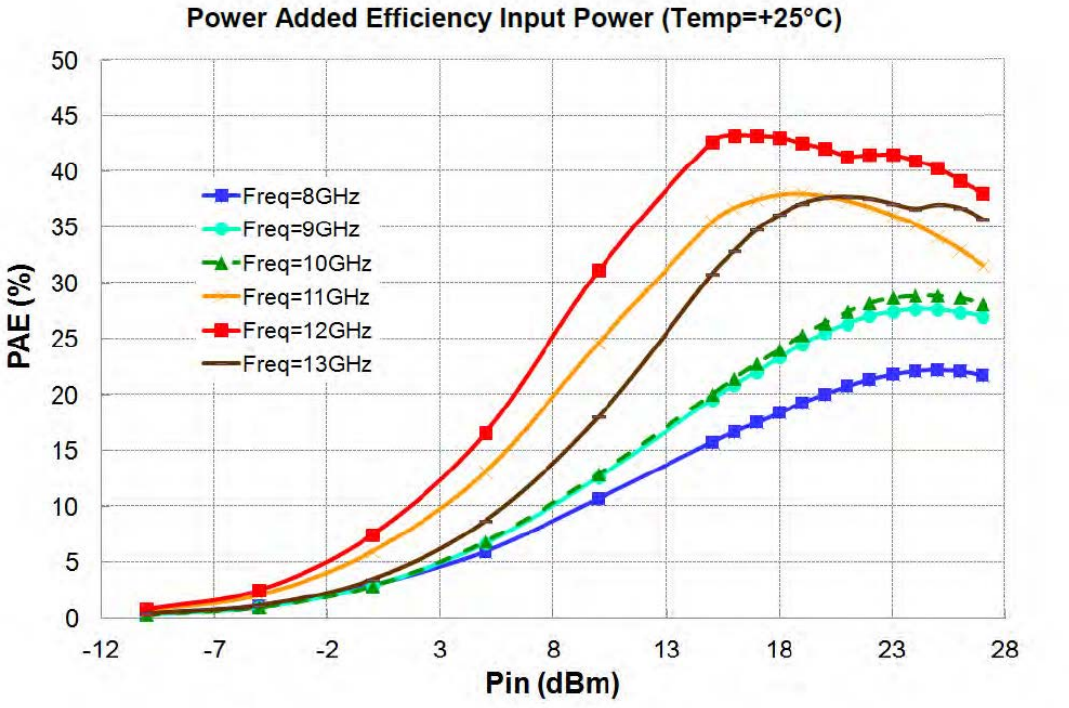
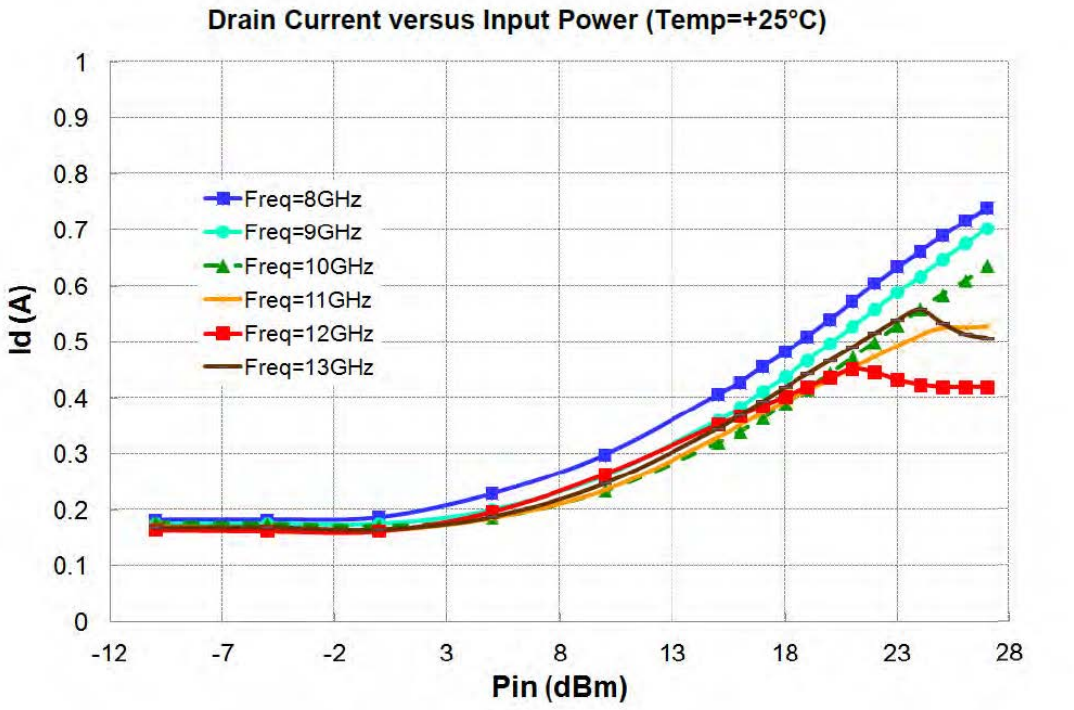
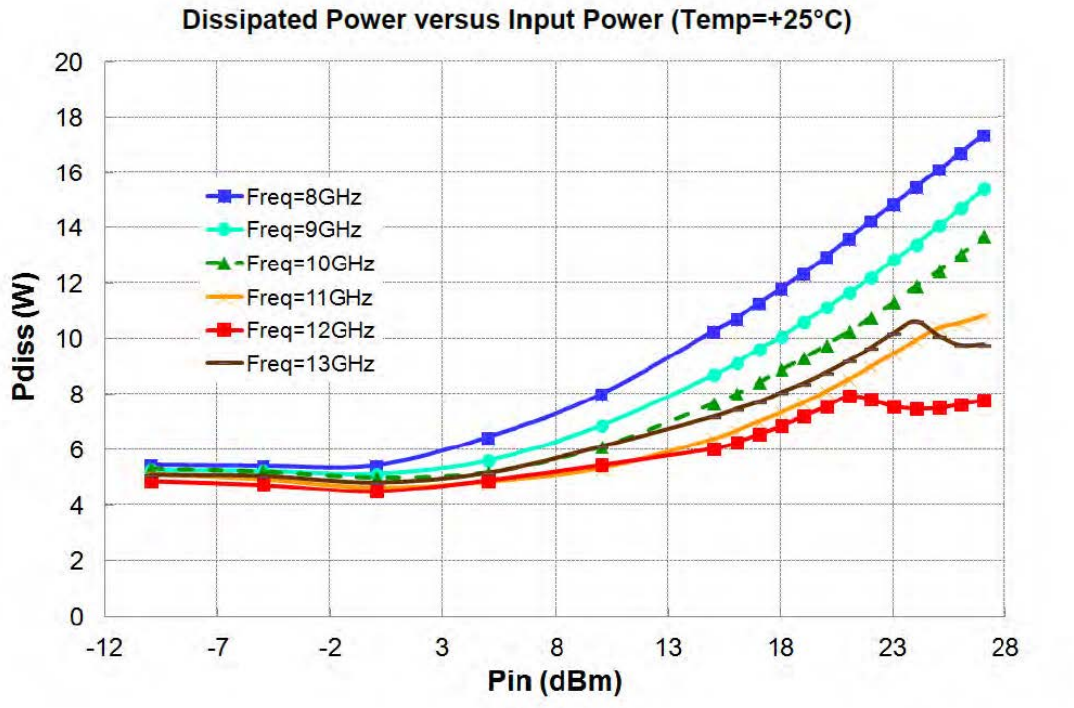




Typical Board Measurements (CW Mode)

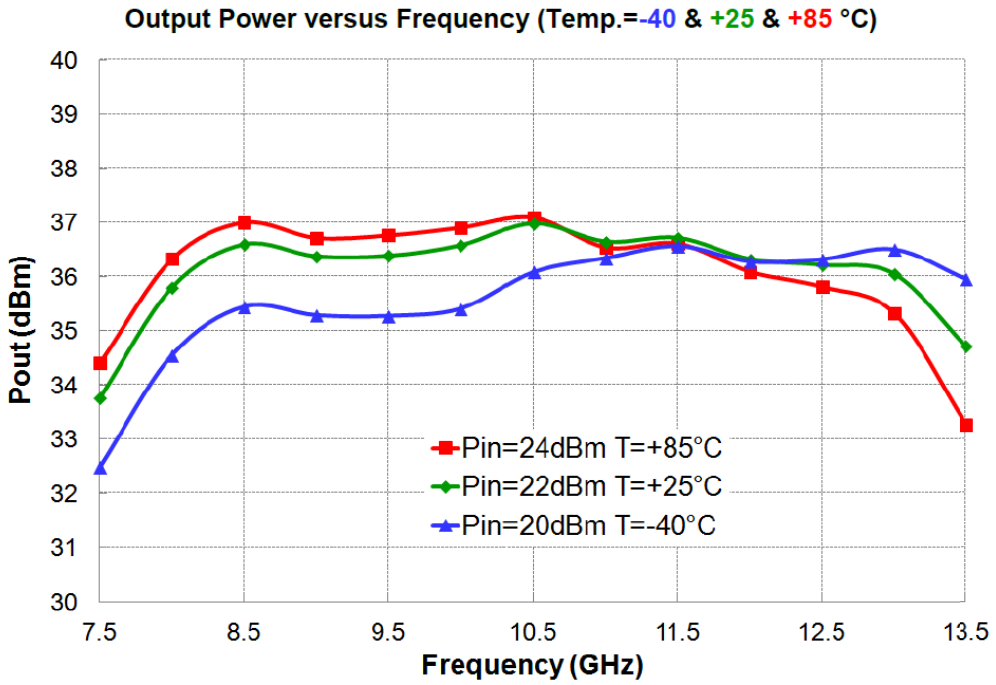
Tback side= +25 °C, Vd = +30 V, Idq = 200 mA

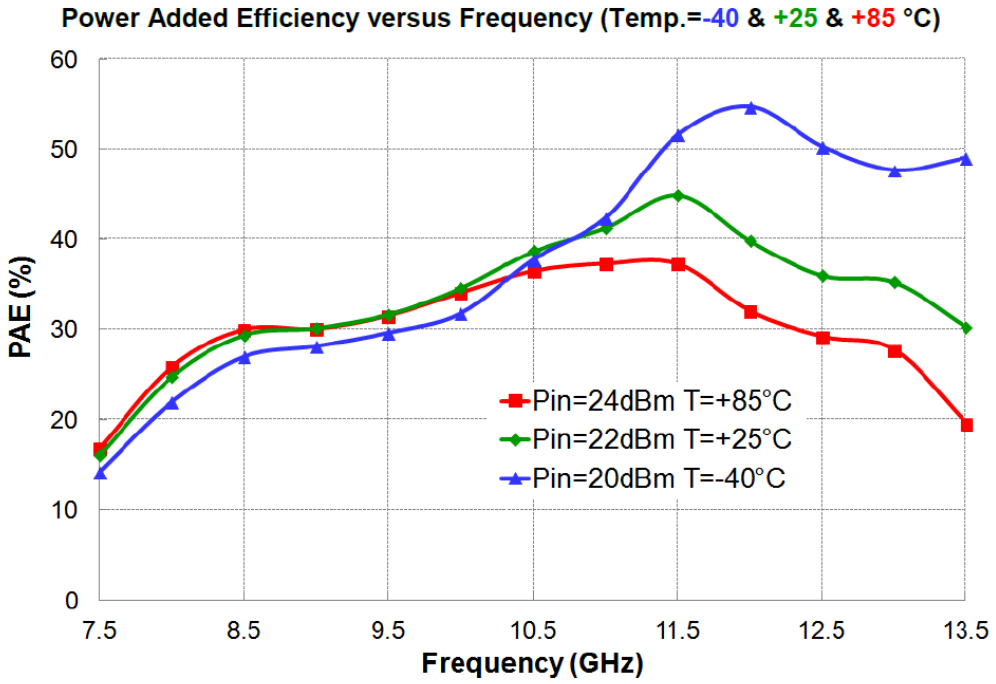




Typical Board Measurements (Pulsed Mode)

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





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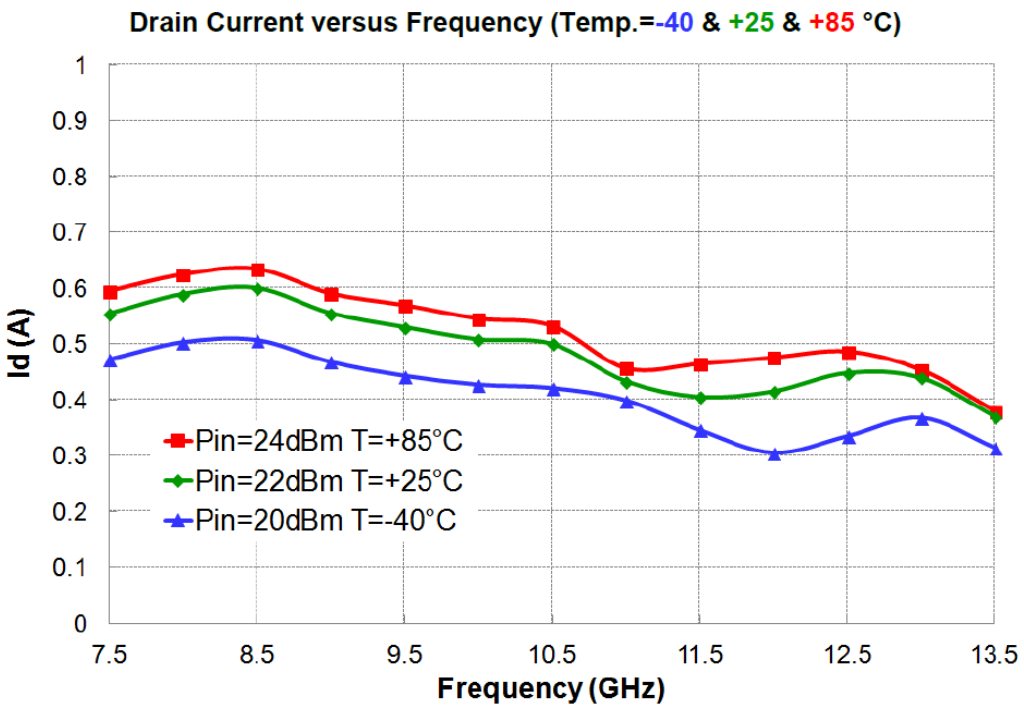

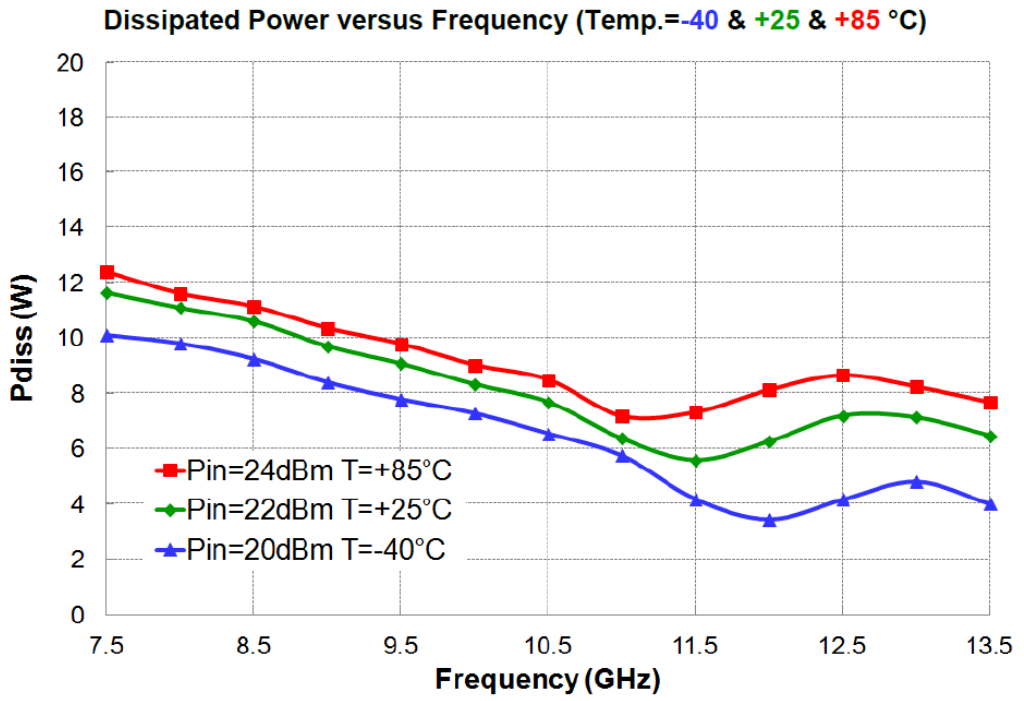

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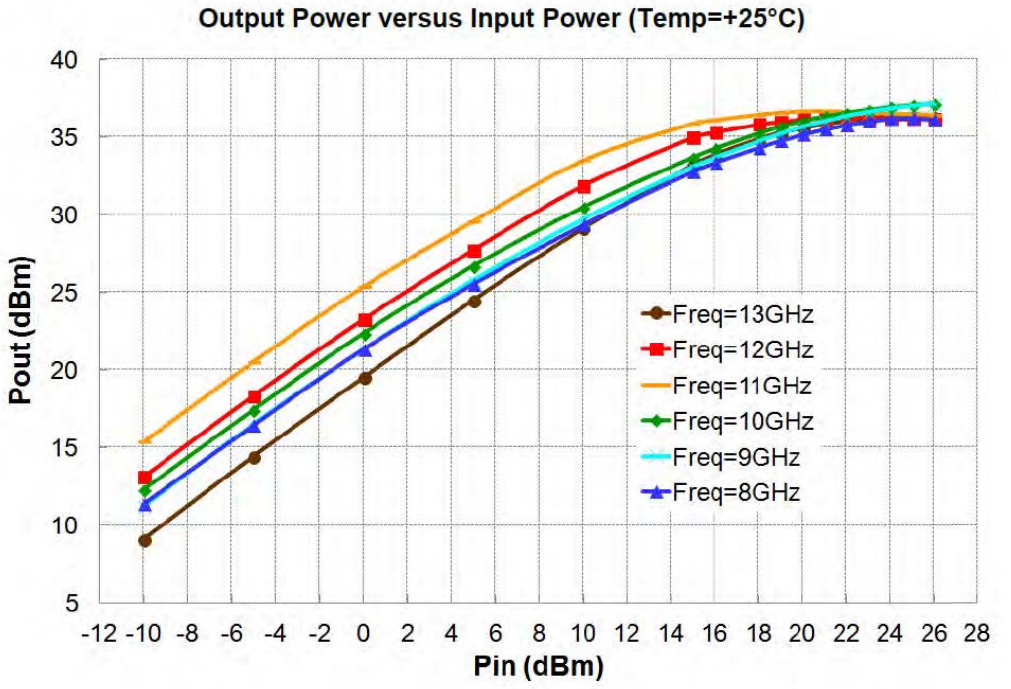

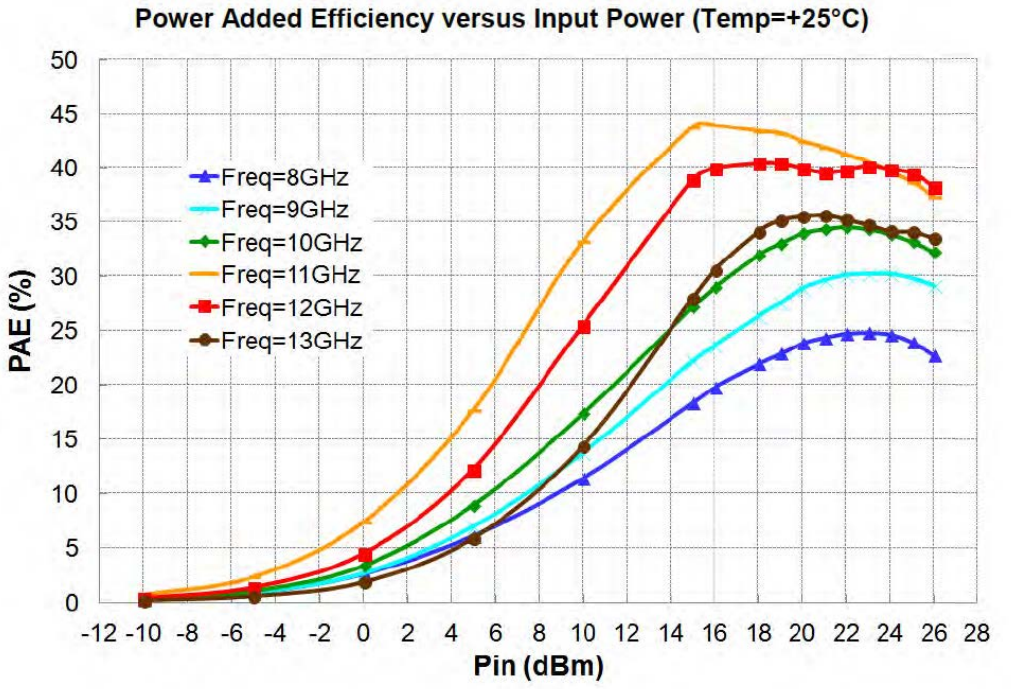

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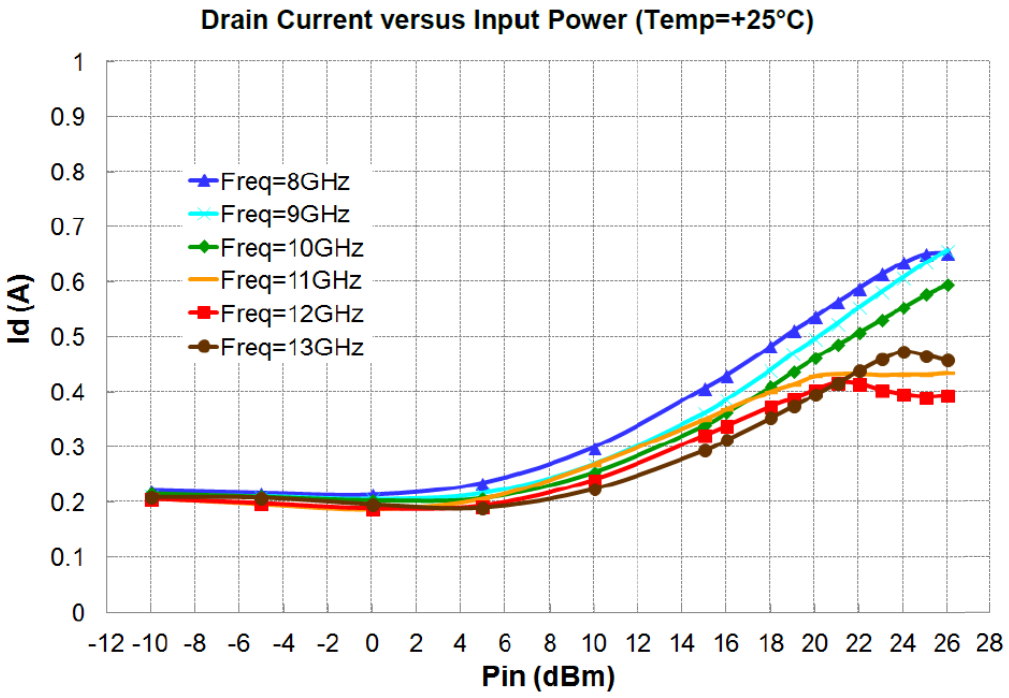

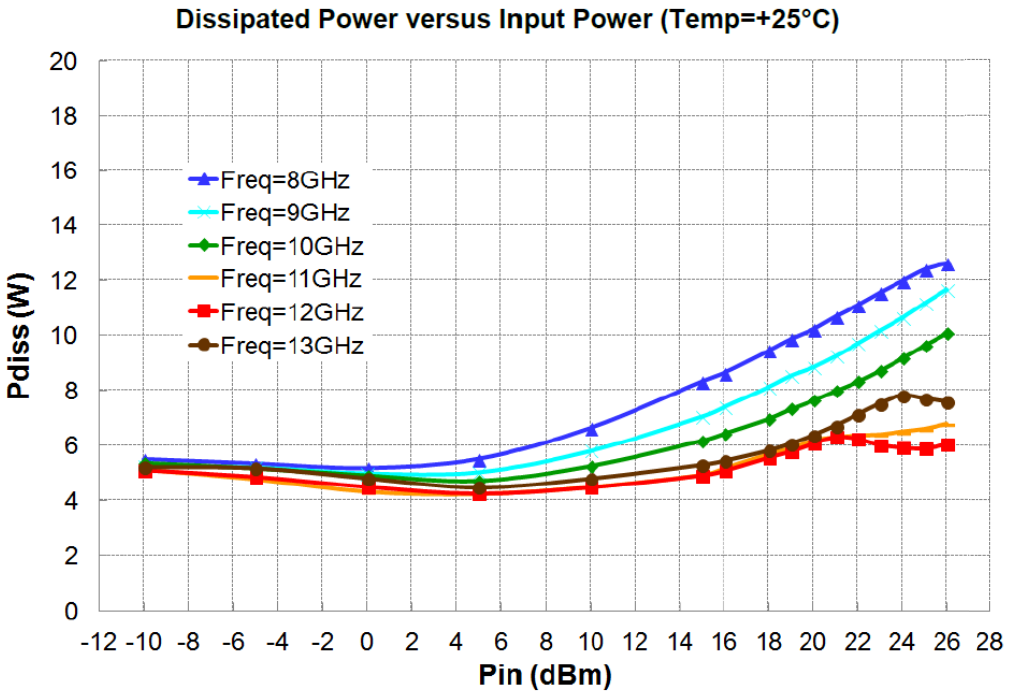

Typical Board Measurements (Pulsed Mode)

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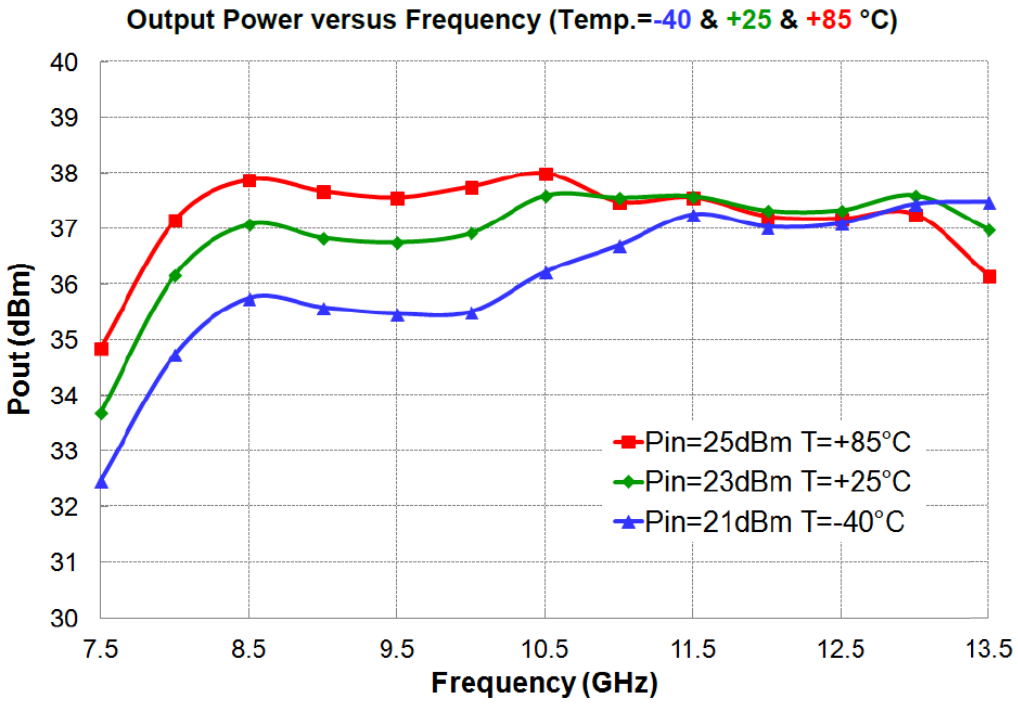

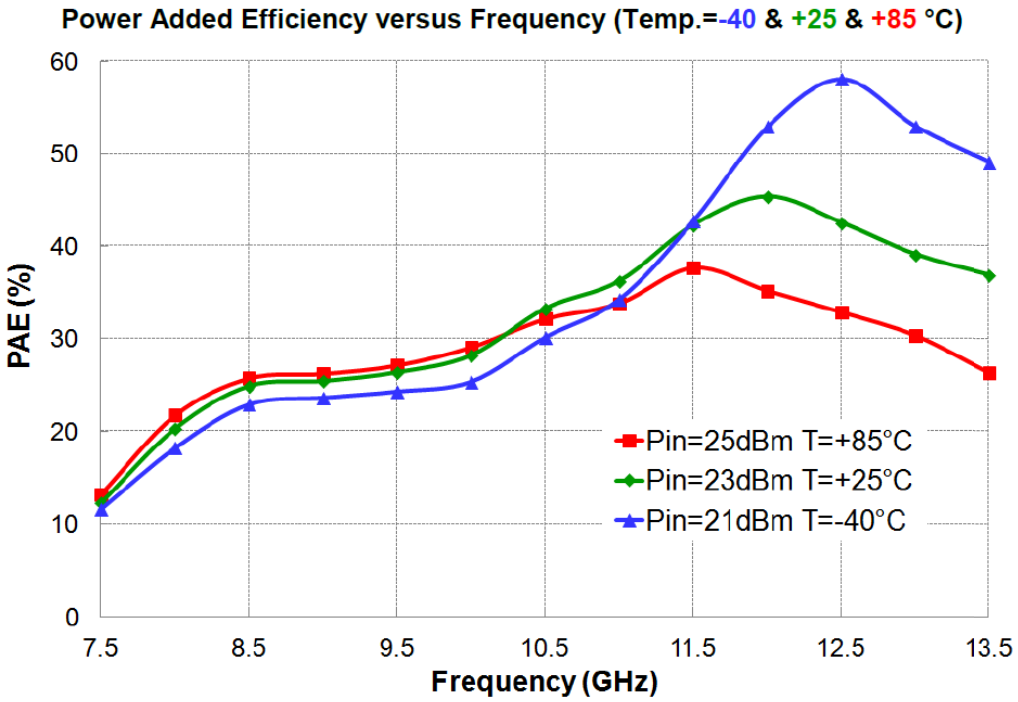

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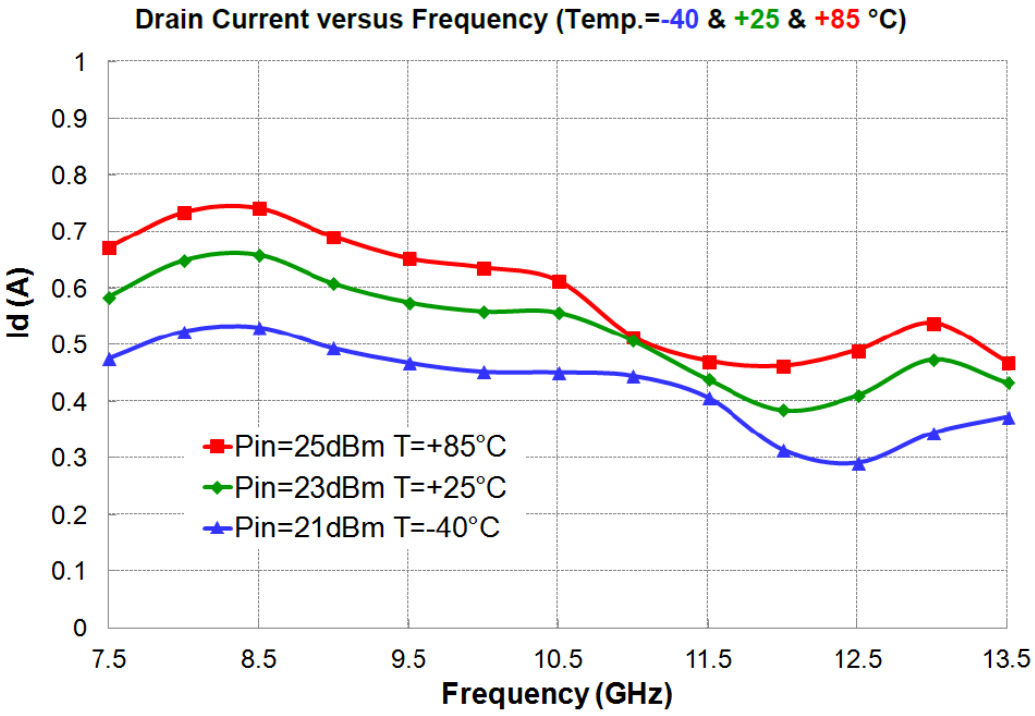
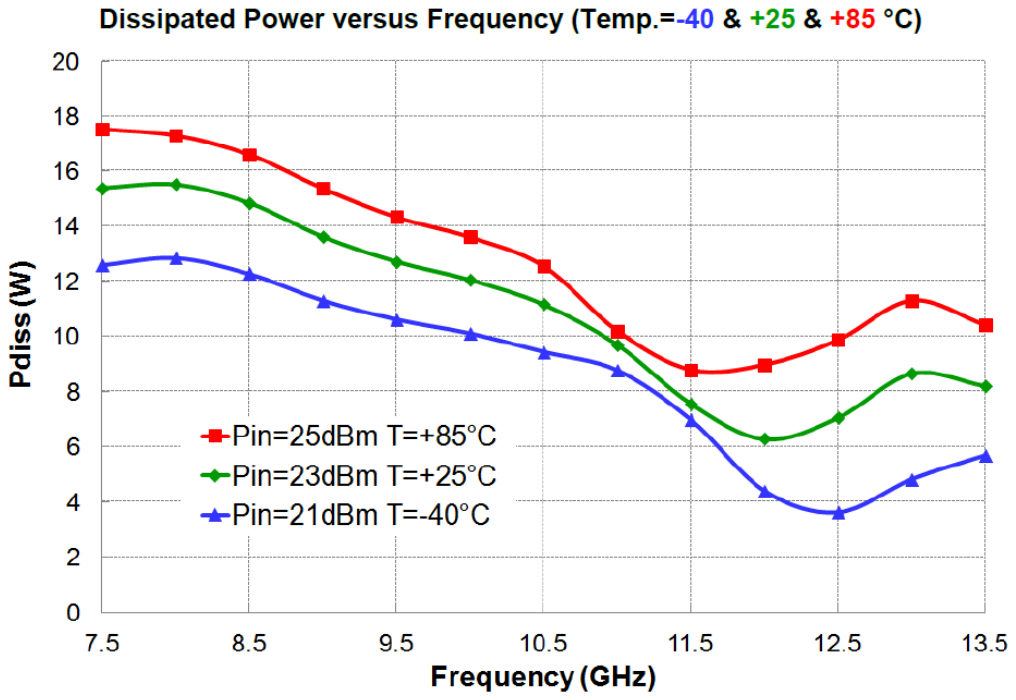
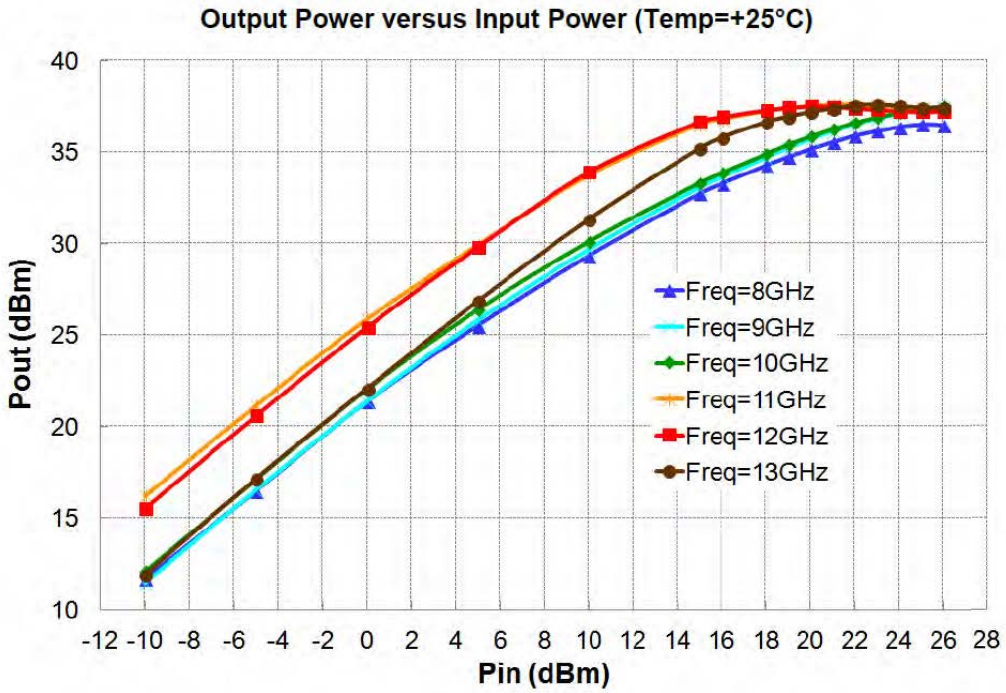
Vd = +30 V, Idq = 200 mA @ Tback side= +25 °C, Pulse width = 25 µs, Duty cycle = 10%

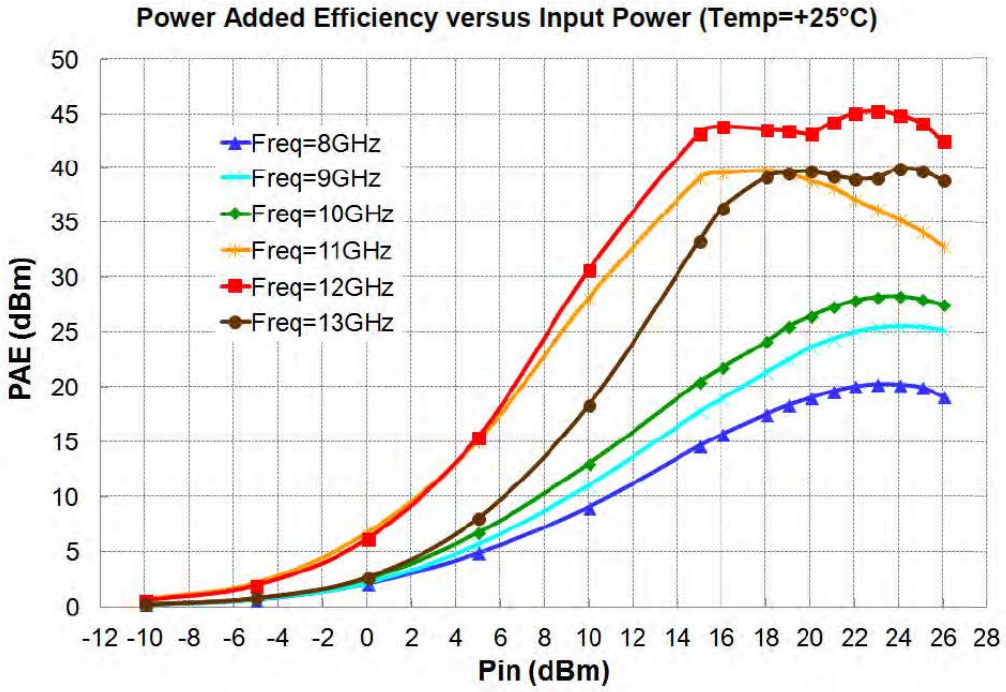




Typical Board Measurements (Pulsed Mode)

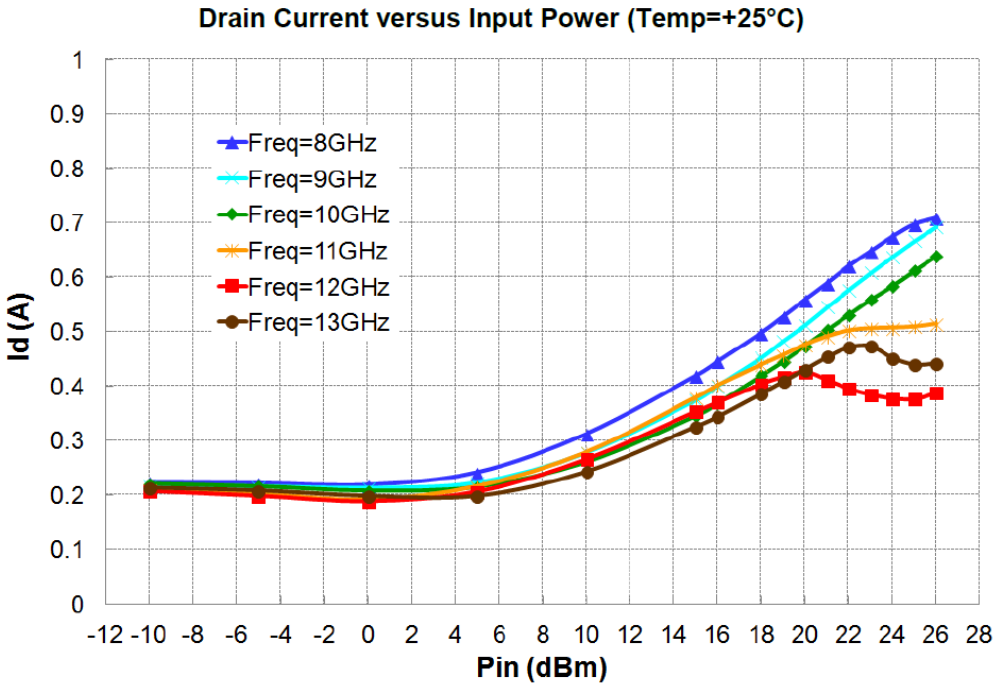
Tback side= +25 °C, Vd = +30 V, Idq = 200 mA, Pulse width = 25 µs, Duty cycle = 10%

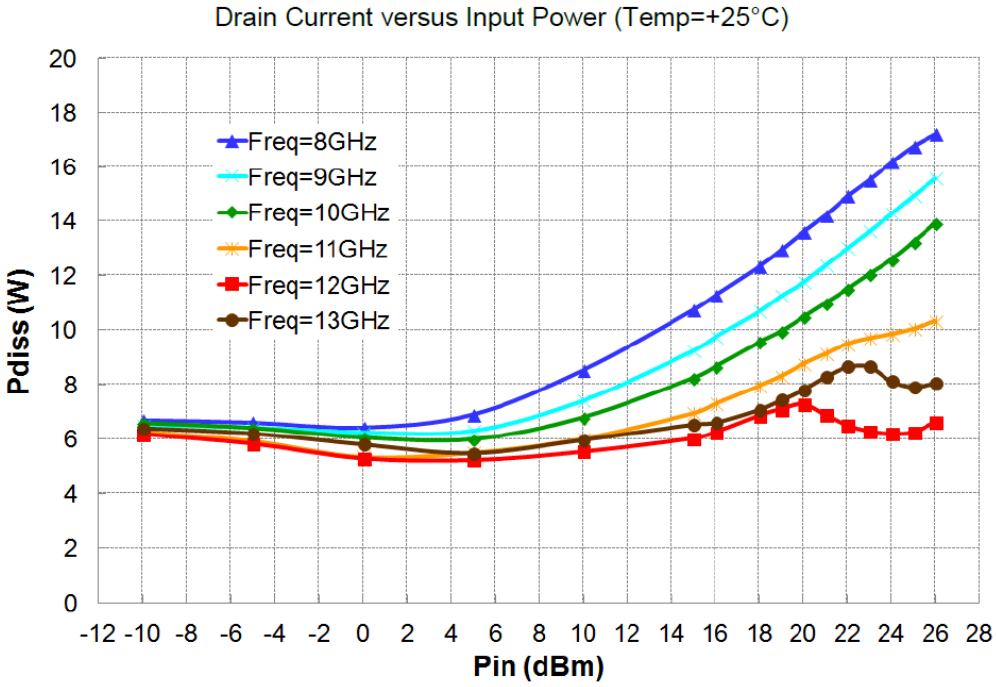




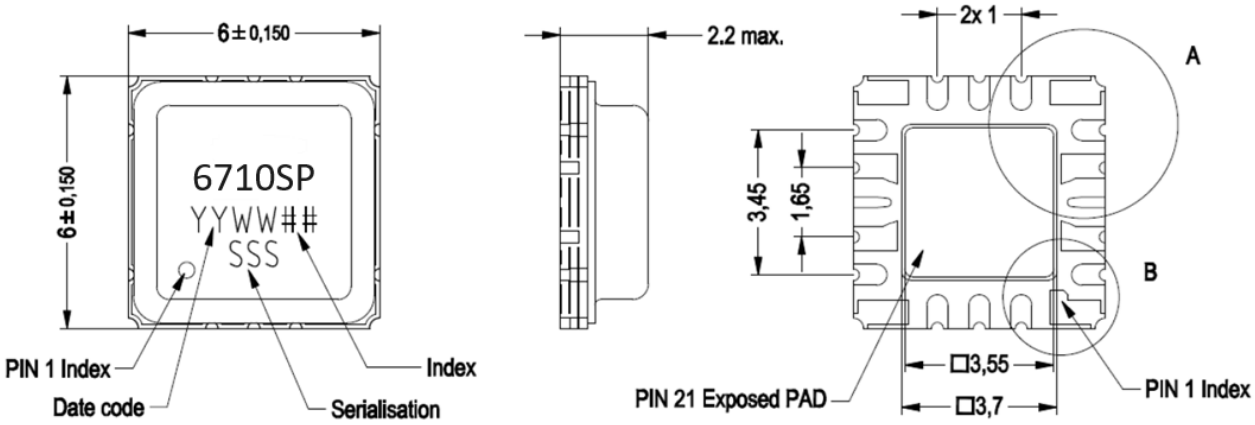
Typical Board Measurements (Pulsed Mode)

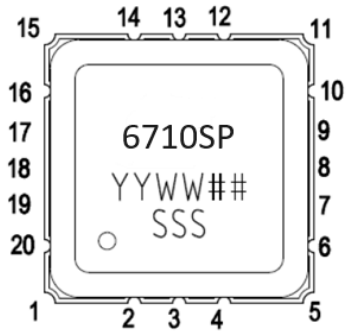
Tback side= +25 °C, Vd = +30 V, Idq = 200 mA, Pulse width = 25 µs, Duty cycle = 10%

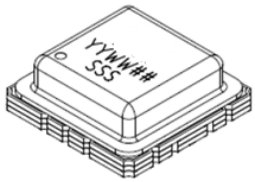




Package Outline [1]





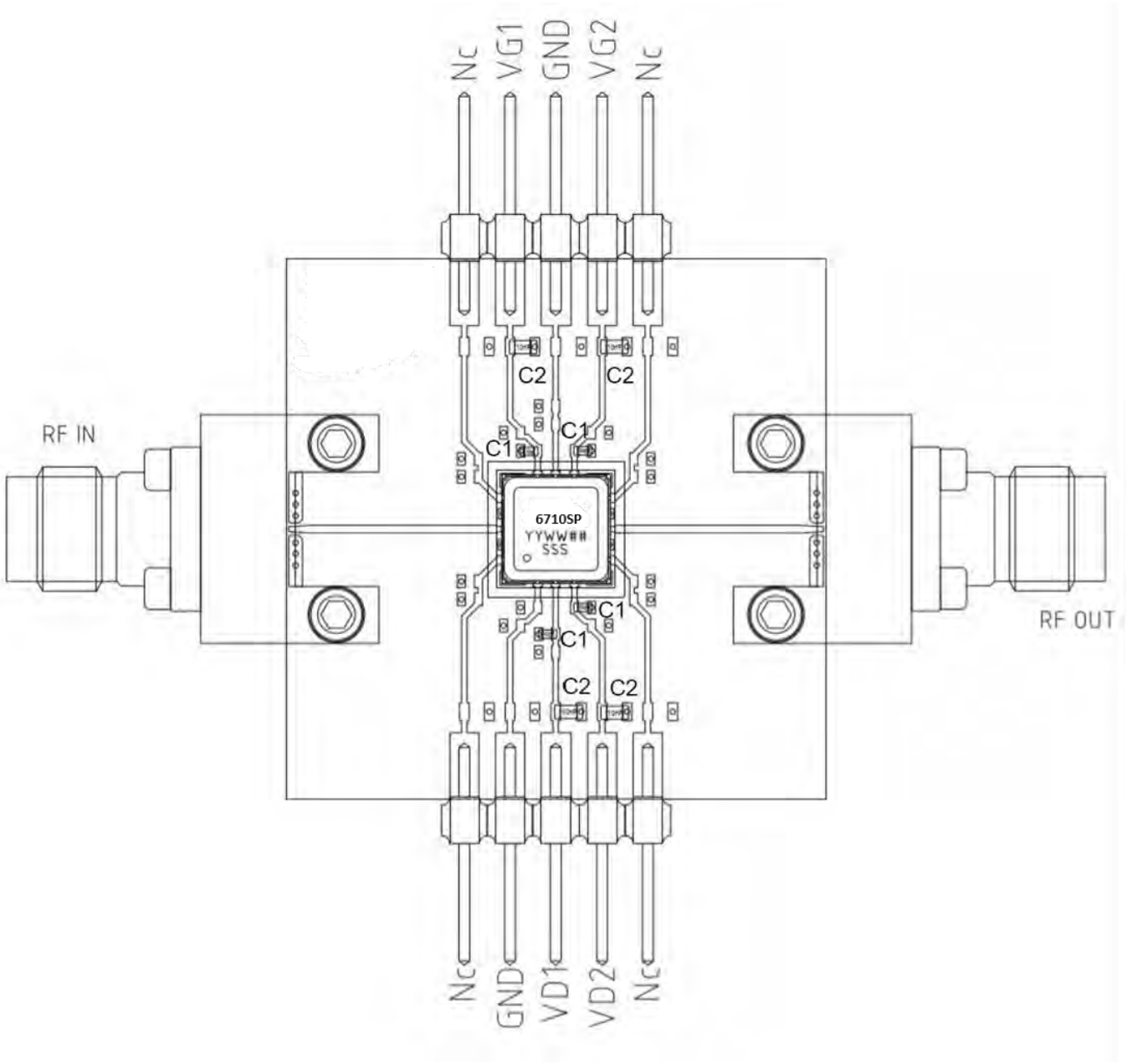


1- GND	8- RF OUT	15- GND
2- GND	9- GND	16- Nc
3- VD1	10- GND	17- GND
4- VD2	11- GND	18- RF IN
5- GND	12- VG2	19- GND
6- Nc	13- GND	20- Nc
7- GND	14- VG1	21- GND

Bill of Materials

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

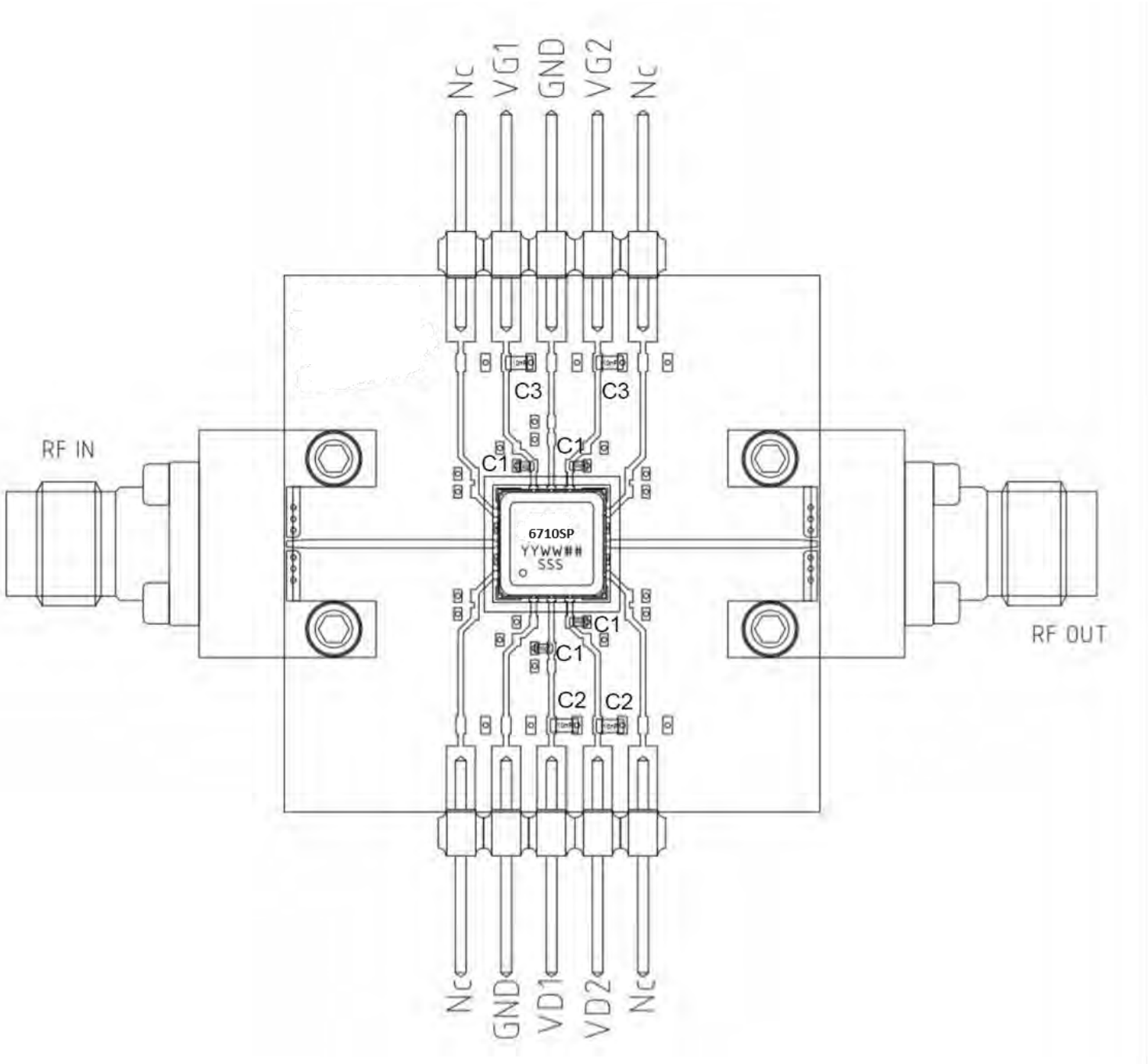
Recommended Assembly Drawing in CW Mode



All dimensions are in mm

[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.

Recommended Assembly Drawing in Gate Pulsed Mode



Bill of Materials

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

Ordering Information

Order Code	Description	Package	Shipping Method
TDPA6710SP	5W X Band Medium Power Amplifier	6 x 6 Ceramic QFN	Tray

Revision Information

Document	Description / Date	Change/Revision Details
TDPA6710SP-4-2024 Rev 0.2	TDPA6710SP / April 2023	Initial Release

Document Categories and Definitions:

Advance Information

The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The data sheet contains preliminary data. Additional data may be added at a later date. Teledyne e2v HiRel Electronics reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The data sheet contains final data. In the event Teledyne e2v HiRel Electronics decides to change the specifications, Teledyne e2v HiRel Electronics will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Sales Contact

For additional information, Email us at: **hirel@teledyne.com** **website: www.tdehirel.com**

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