2 to 18GHz - 10W
GaN/SiC WideBand Power Amplifier

VM209D

General Description

VM209D is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high power gain of 22dB and wide bandwidth capabilities of 2 to 18GHz. The VM209D delivers 40dBm of saturated output power.

This MMIC is manufactured on a 150nm GaN on SiC process and is especially suited for radar applications.

The device contains internal DC block and internal drain bias, therefore, no need for external bias-tee.

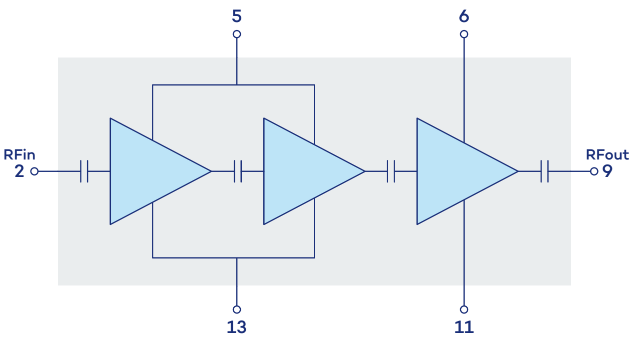
Features

Frequency range	**2 – 18GHz**
Output Power	**40dBm @Pin = 18dBm**
PAE	**22% @Pin = 18dBm**
Power Gain	**22dB @Pin = 18dBm**
Linear Gain	**30dB**
DC bias	**V_D = +28V, I_{DQ} = 1.12A, V_G = -1.72V (Typical)**
Chip size	**3.24 x 3.24 x 0.1 (mm)**

Applications

- Radar
- Test and Measurement

Pins Assignement & Functional Block Diagram



Function	Pin number
RF in	2
$V_{D1,2}$	5
V_{D3}	6
RF out	9
V_{G3}	11
$V_{G1,2}$	13

Electrical Specifications

Test conditions: unless otherwise noted
- Room Temperature = +25°C
- V_D = +28V
- I_{DQ} = 1.12A (V_G=-1.72V Typ.)
- CW

Symbol	Parameter	Min	Typ	Max	Unit
F	Frequency range	2		18	GHz
Temp	Temperature	-40		+85	°C
V_D	Drain voltage		28		V
I_{DQ}	Drain current		1.12		A
G	Linear gain		30		dB
S11	Input return loss		-11		dB
S22	Output return loss		-11		dB
Pout	Output power (@Pin=18dBm)	40			dBm
PAE	Associated Power Added Efficiency (@Pin=18dBm)		22		%
PG	Large Signal Gain (@Pin=18dBm)	21			dB
Flat	Gain Flatness		+/-1		dB
I_D	Drain Current (@Pin=18dBm)		1.8		A
	Input and Output Matching		50		Ω
IM3	Third Intermodulation product (Pout=34dBm/tone & 100MHz spacing)	15			dBc

Temporal Specification

Symbol	Parameter	Min	Typ	Max	Unit
Trise / Tfall	Rise time, Fall time			15	ns
	Pulse width	50		CW	ns

Recommended Operating Conditions

Symbol	Parameter	Value	Unit
V_D	Drain voltage	28	V
I_{DQ}	Drain quiescent current	1.12	A
V_G	Gate voltage	-1.72 (Typ.)	V

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_D	Drain bias voltage	35	V
I_D	Drain bias current	2.4	A
Pin	Maximum peak input power overdrive	22	dBm
Tj	Junction Temperature	-	°C
Ta	Operating temperature range	-40/+85	°C
Tstg	Storage temperature range	-55/+150	°C

Operation of this device above any of these parameters may cause permanent damage.

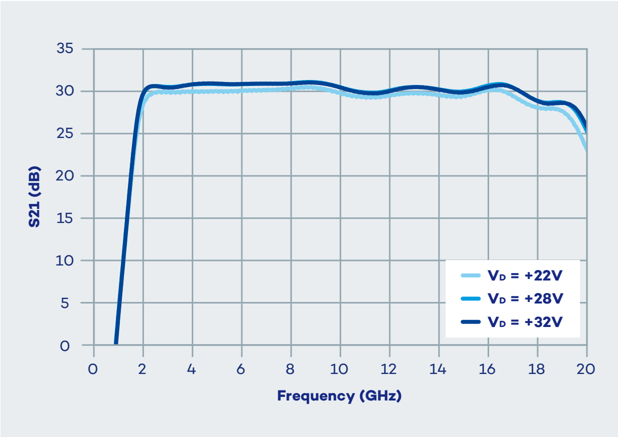
Thermal Information

A heatsink equipped with a fan is used to manage thermal cooling.
On standard test condition (V_D = 28V / I_{DQ} = 1.12A / RF OFF) : Tbase is estimated around 35°C more than room temperature used as instruction.

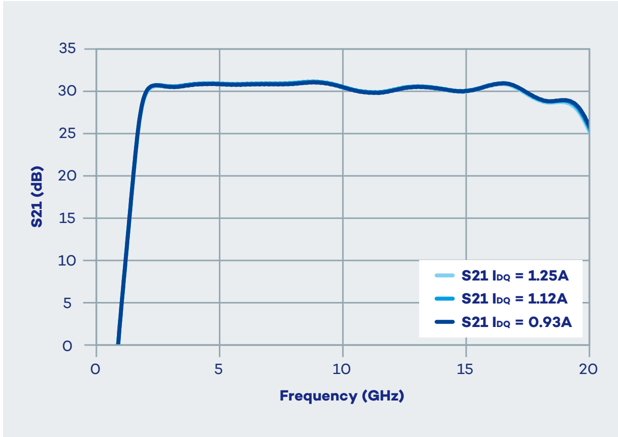
Typical Performance
(Small signal / Test Under Probe)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)

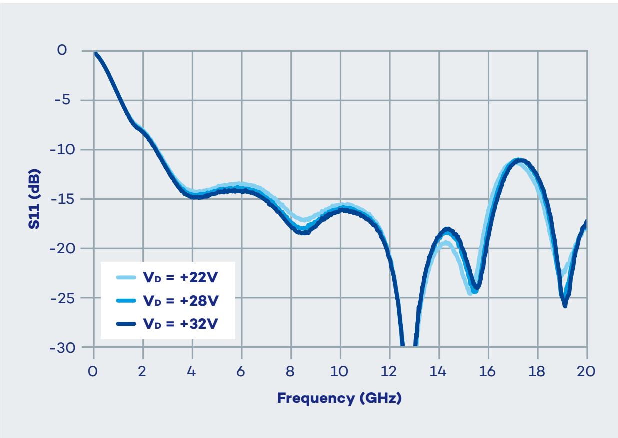
Gain vs Frequency vs V_D



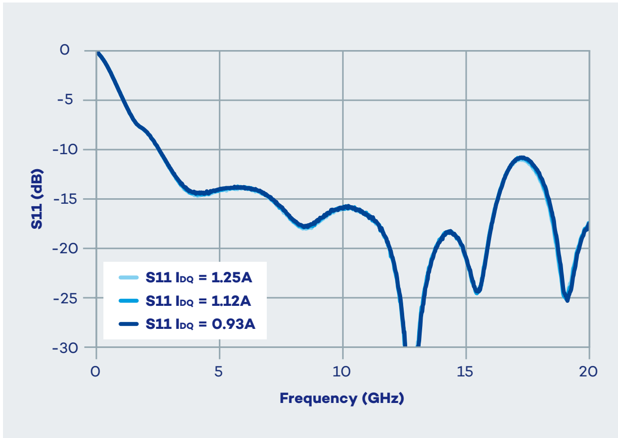
Gain vs Frequency vs I_{DQ}



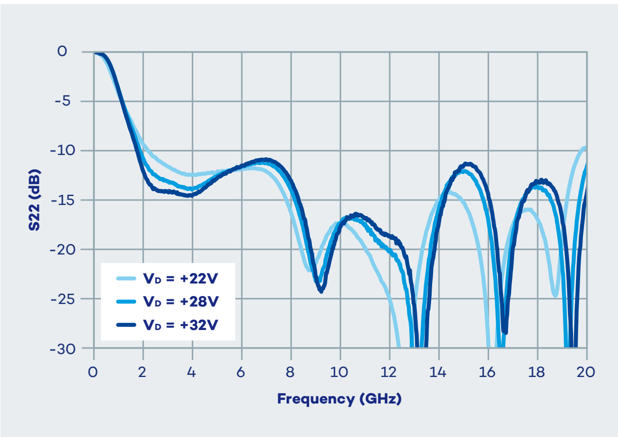
Input Return Loss vs V_D



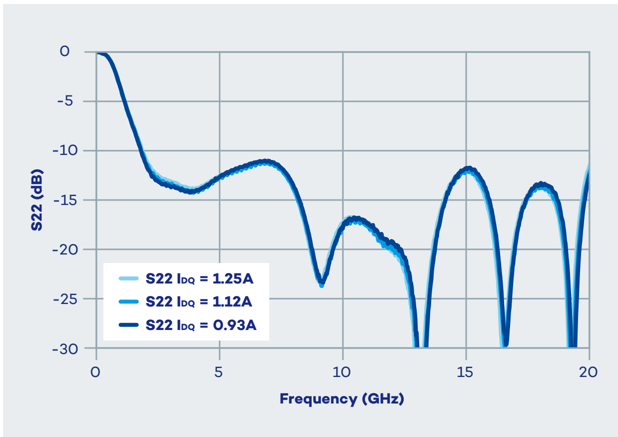
Input Return Loss vs I_{DQ}



Output Return Loss vs V_D



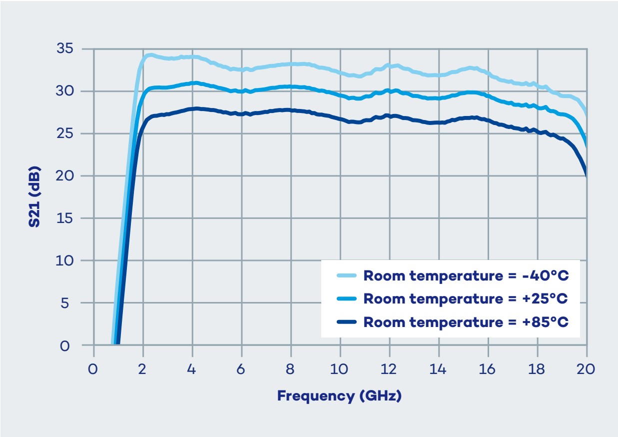
Output Return Loss vs I_{DQ}



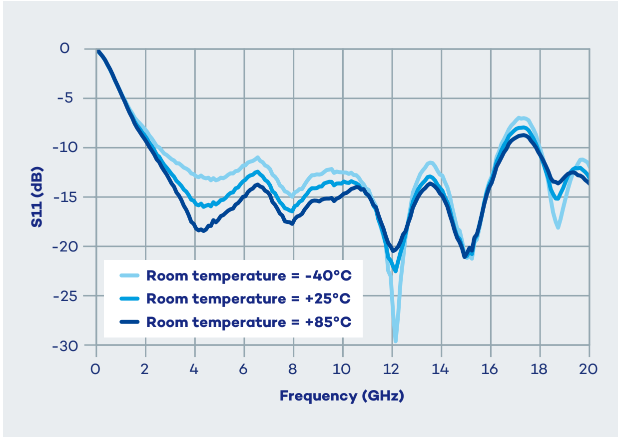
Typical Performance
(Small signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: connector access
- V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)

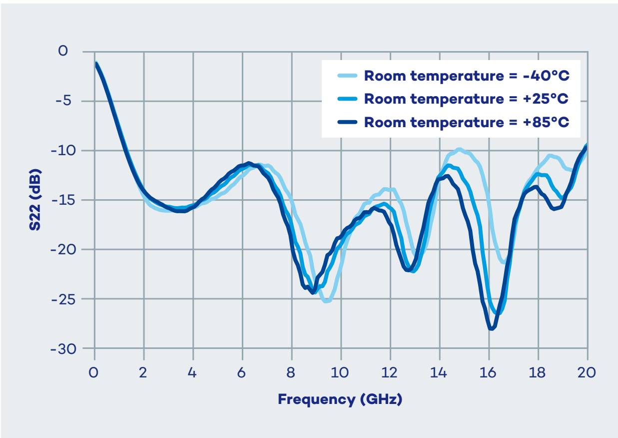
Gain vs Frequency vs Temperature



Input Return Loss vs Temperature



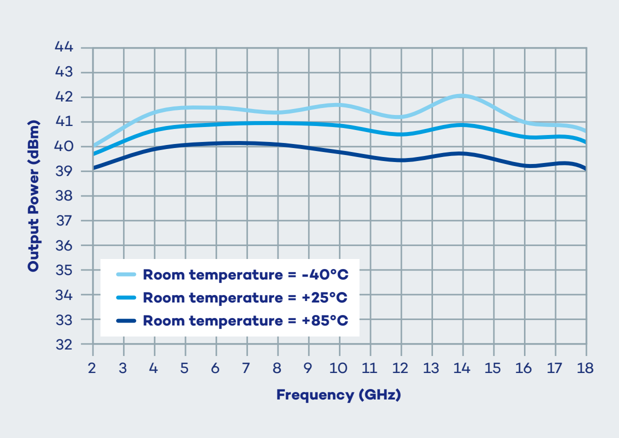
Output Return Loss vs Temperature



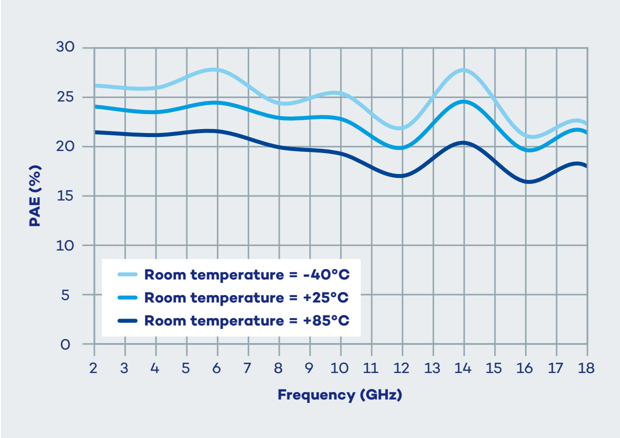
Typical Performance
(Large signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- Pin = 18dBm • CW
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)

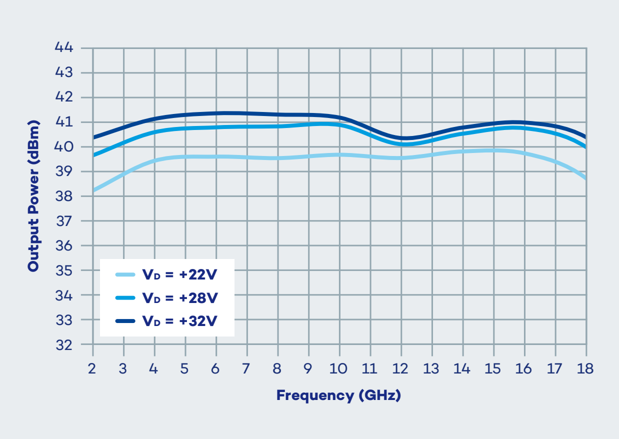
Output Power vs Frequency vs Temperature



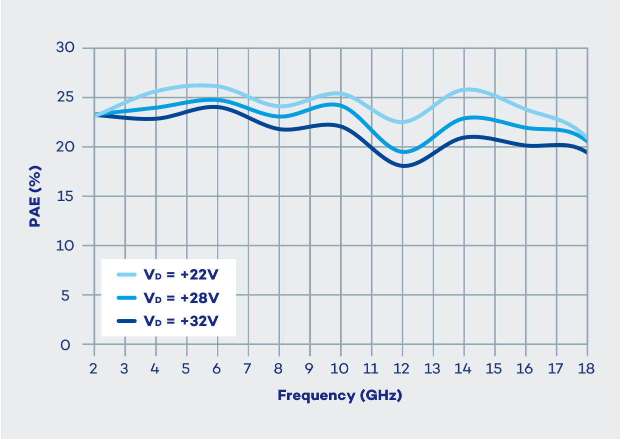
PAE vs Frequency vs Temperature



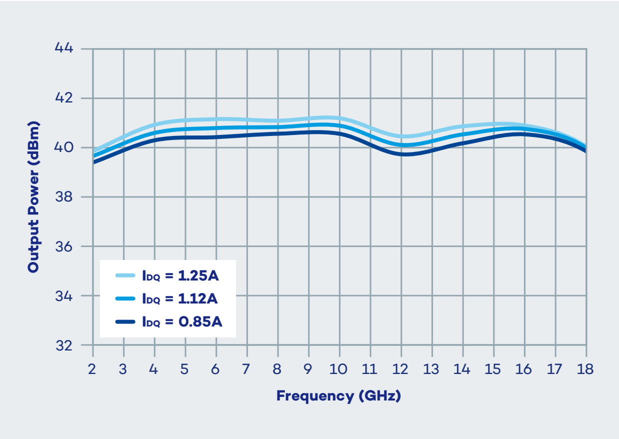
Output Power vs Frequency vs V_D



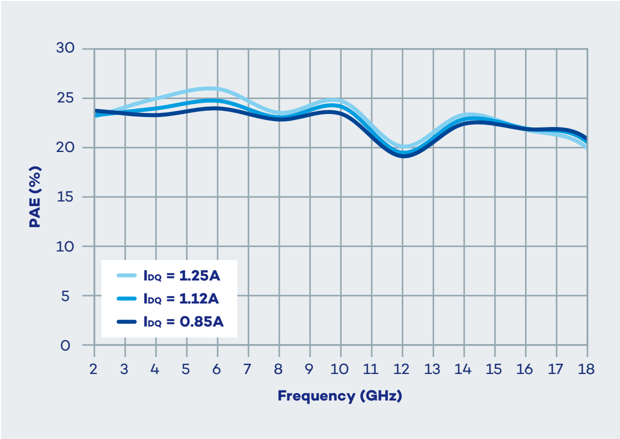
PAE vs Frequency vs V_D



Output Power vs Frequency vs I_{DQ}



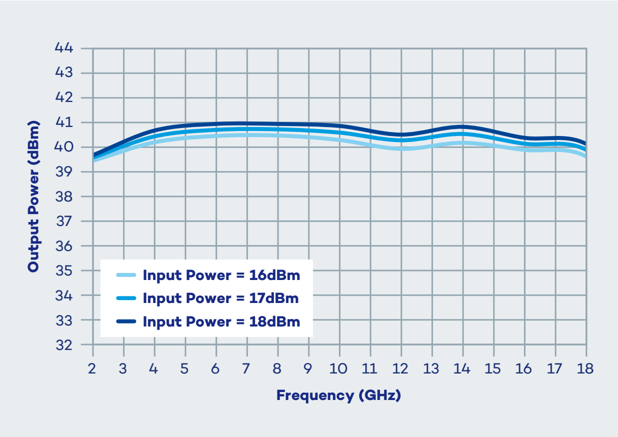
PAE vs Frequency vs I_{DQ}



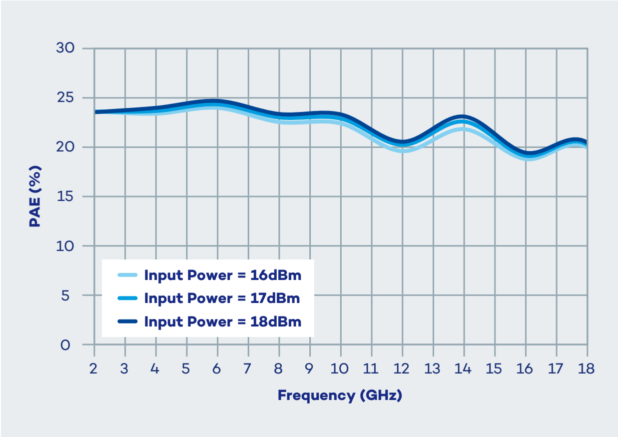
Typical Performance
(Large signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- Pin = 18dBm • CW
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)

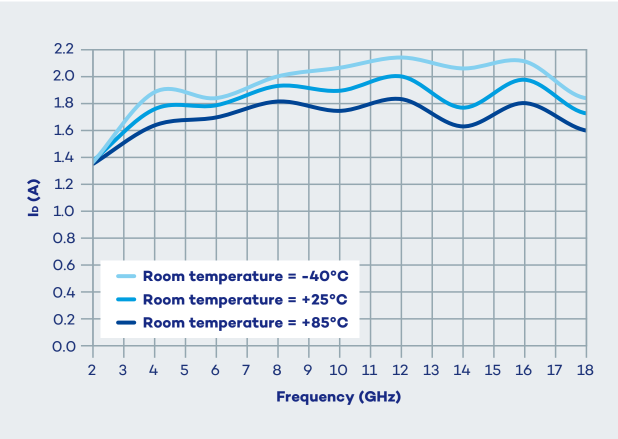
Output Power vs Frequency vs Input Power



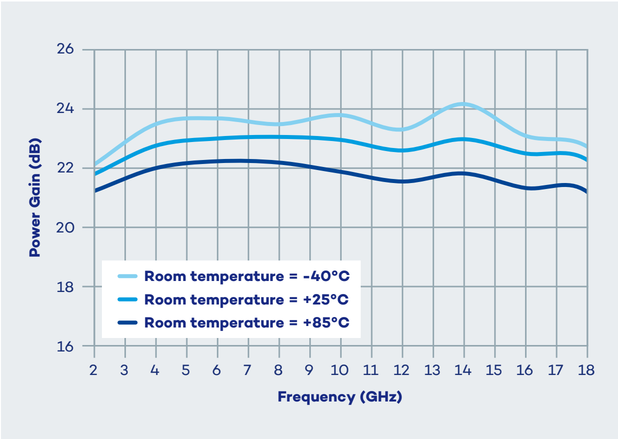
PAE vs Frequency vs Input Power



Drain Current vs Frequency vs Temperature



Power Gain vs Frequency vs Temperature



Typical Performance
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- T_{amb} = +25°C • V_D = +28V
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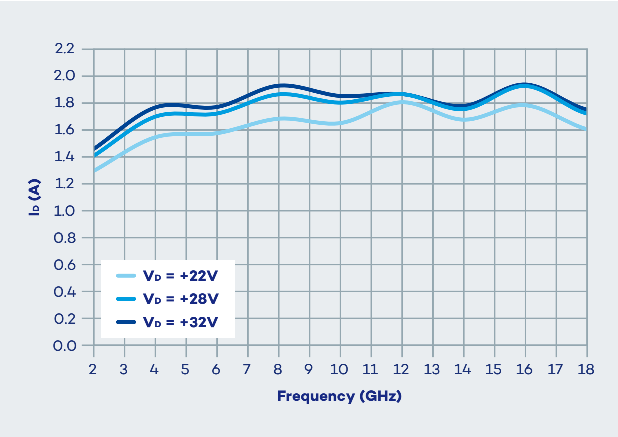
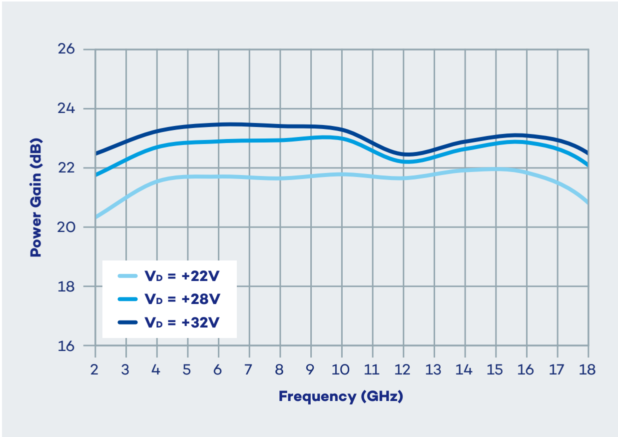
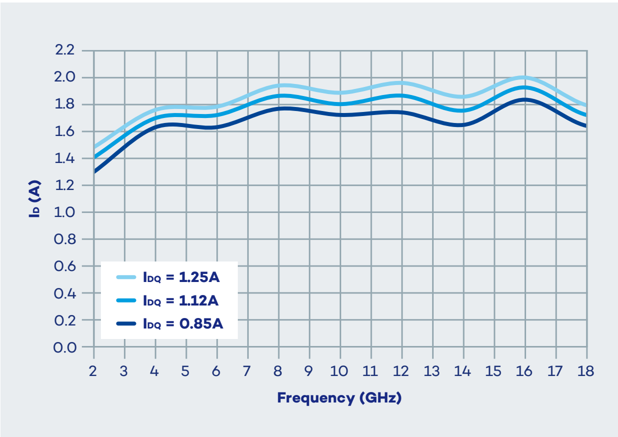
Drain Current vs Frequency vs V_D



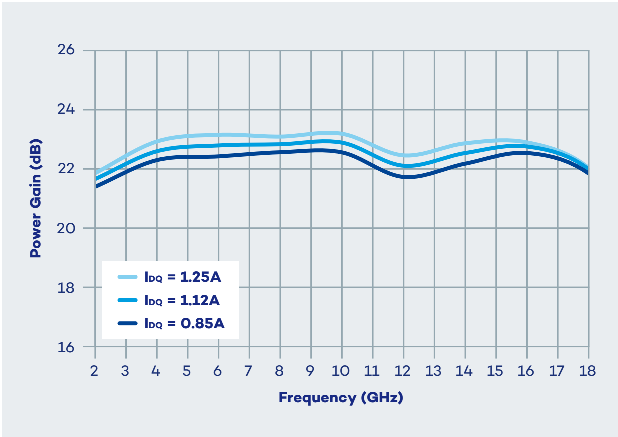
Power Gain vs Frequency vs V_D



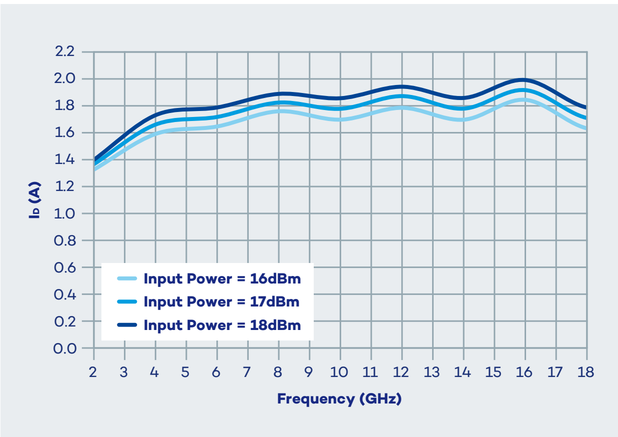
Drain Current vs Frequency vs I_{DQ}



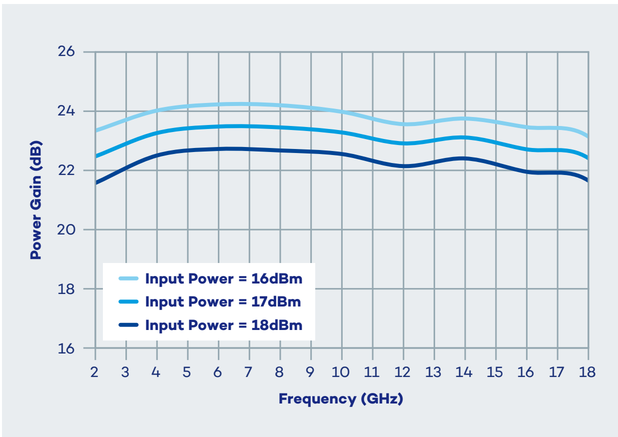
Power Gain vs Frequency vs I_{DQ}



Drain Current vs Frequency vs Input Power



Power Gain vs Frequency vs Input Power



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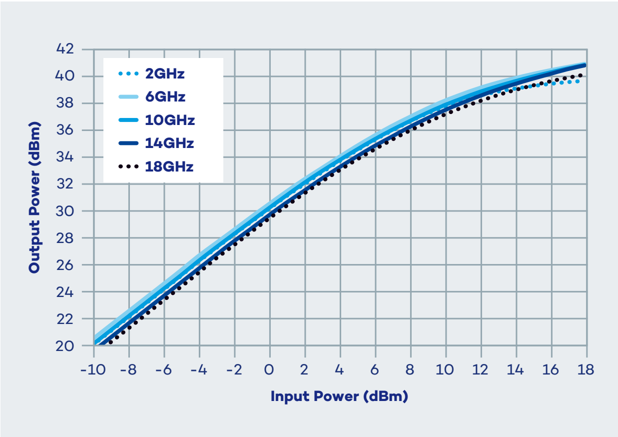
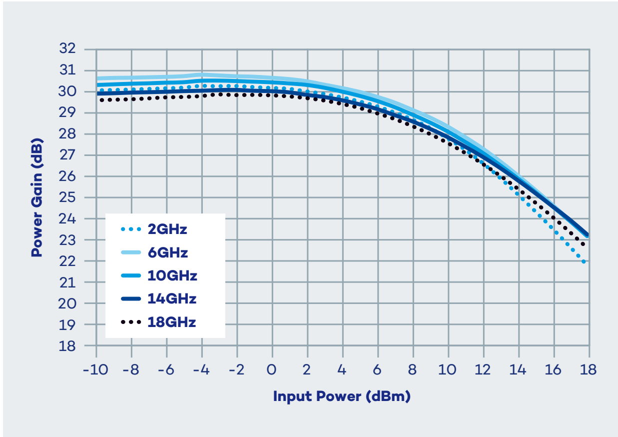
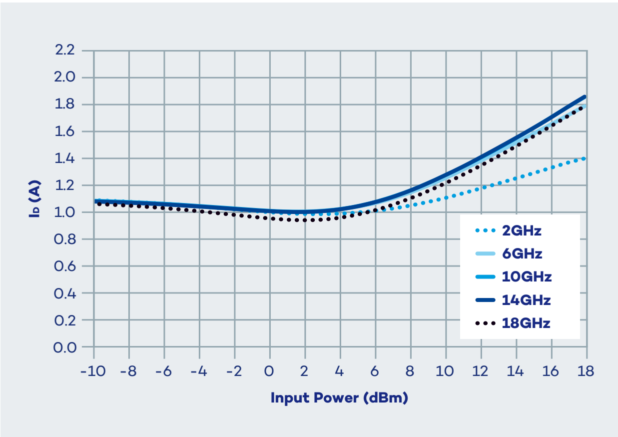
Output Power vs Input Power vs Frequency



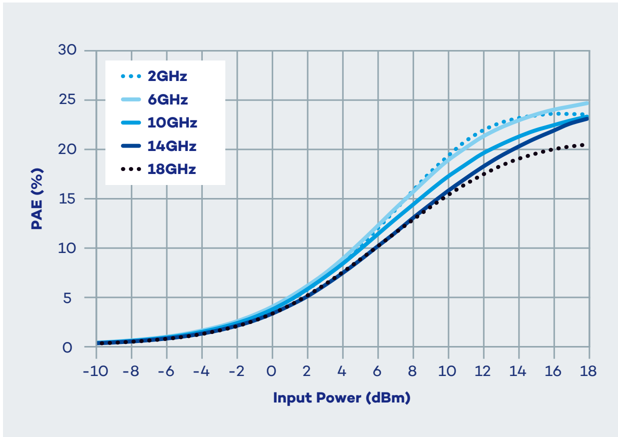
Power Gain vs Input Power vs Frequency



Drain Current vs Input Power vs Frequency



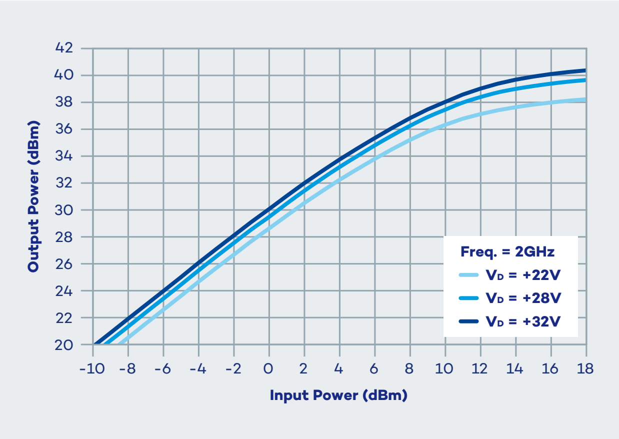
PAE vs Input Power vs Frequency



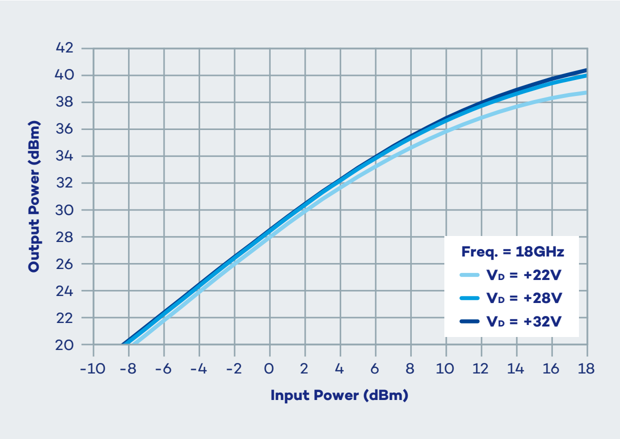
Typical Performance
(Large signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)
- CW

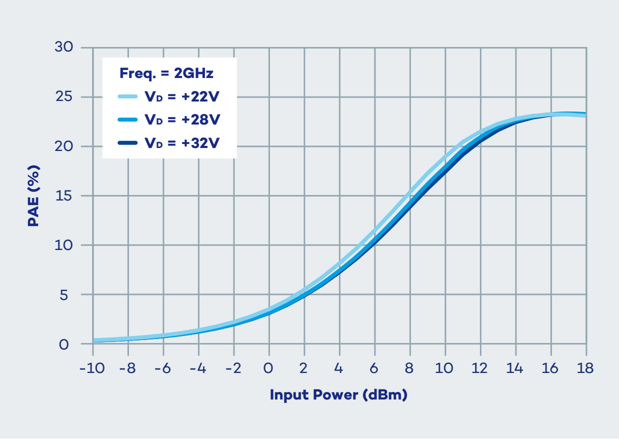
Output Power vs Input Power vs V_D



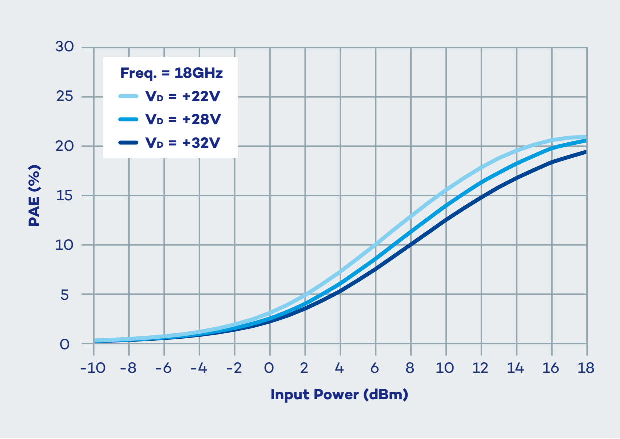
Output Power vs Input Power vs V_D



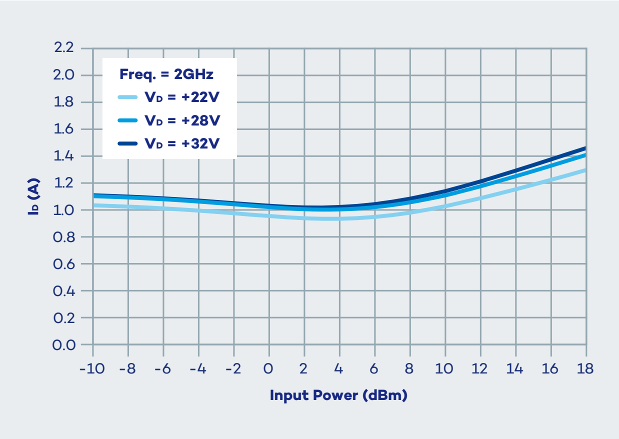
PAE vs Input Power vs V_D



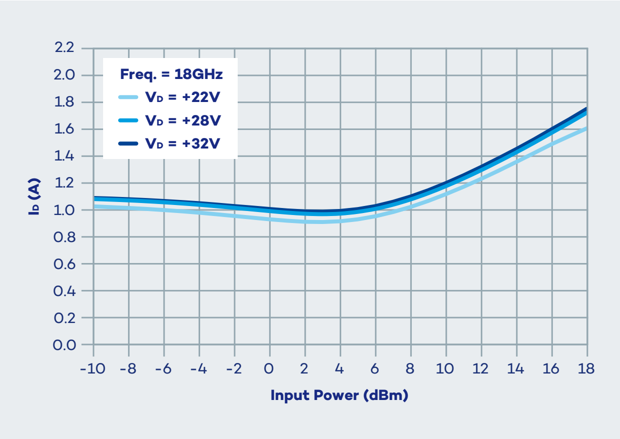
PAE vs Input Power vs V_D



Drain Current vs Input Power vs V_D



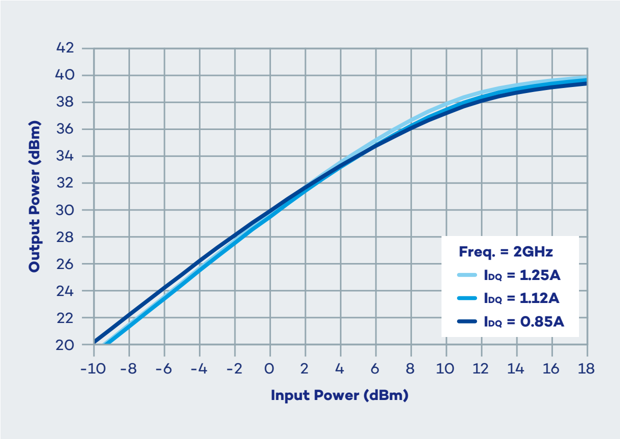
Drain Current vs Input Power vs V_D



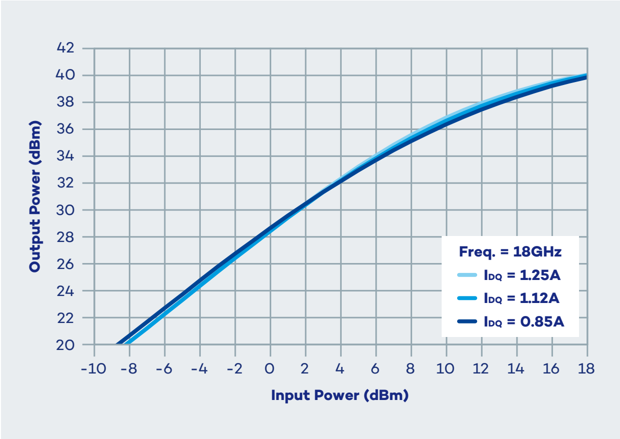
Typical Performance
(Large signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)
- CW

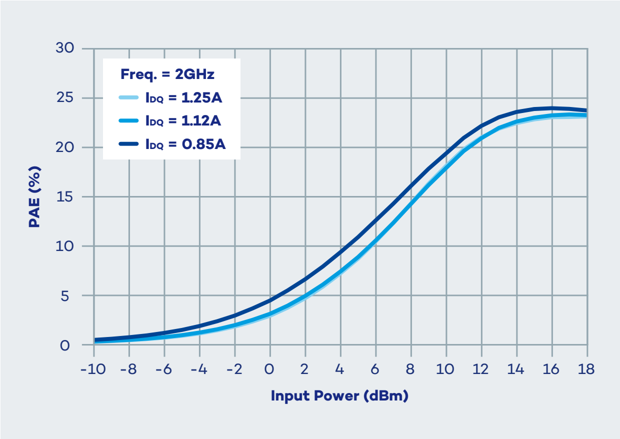
Output Power vs Input Power vs I_{DQ}



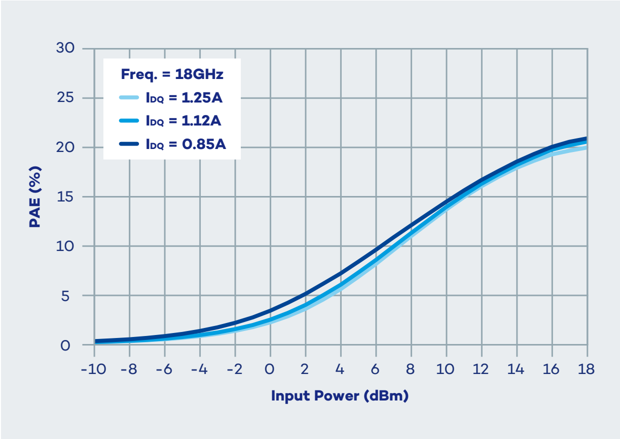
Output Power vs Input Power vs I_{DQ}



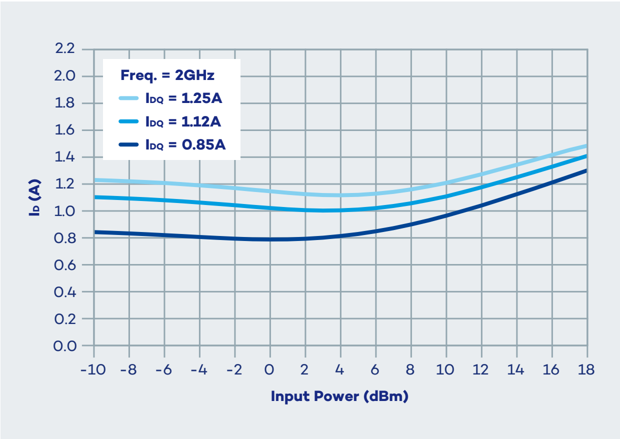
PAE vs Input Power vs I_{DQ}



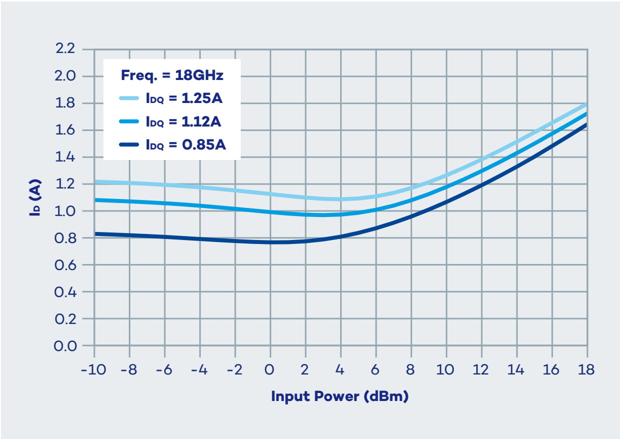
PAE vs Input Power vs I_{DQ}



Drain Current vs Input Power vs I_{DQ}



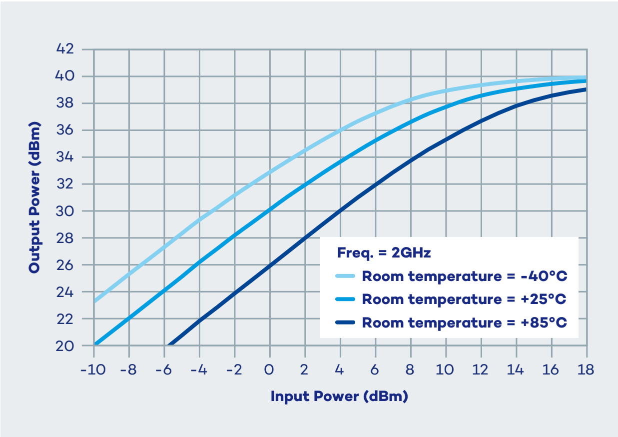
Drain Current vs Input Power vs I_{DQ}



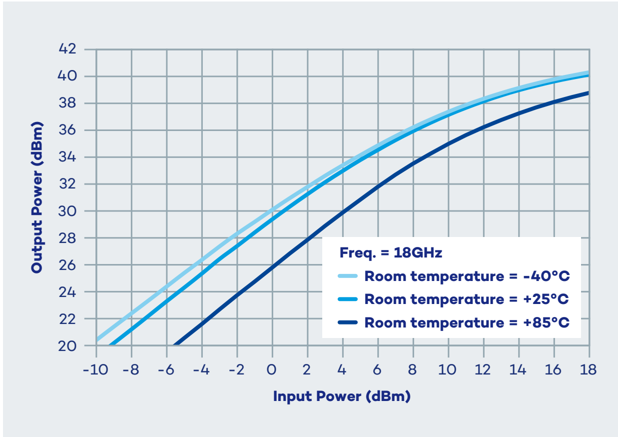
Typical Performance
(Large signal / Board Measurement)

Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)
- CW

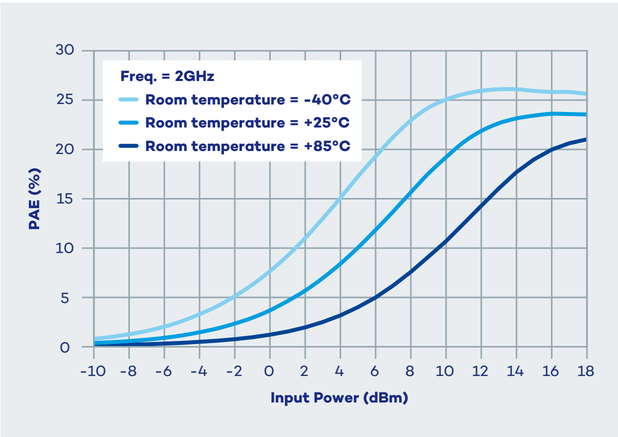
Output Power vs Input Power vs Temperature



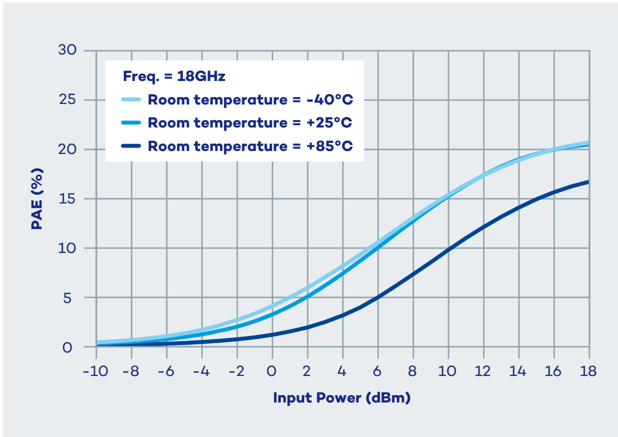
Output Power vs Input Power vs Temperature



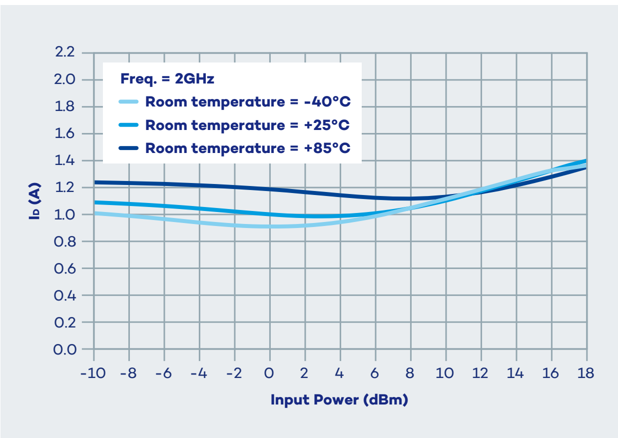
PAE vs Input Power vs Temperature



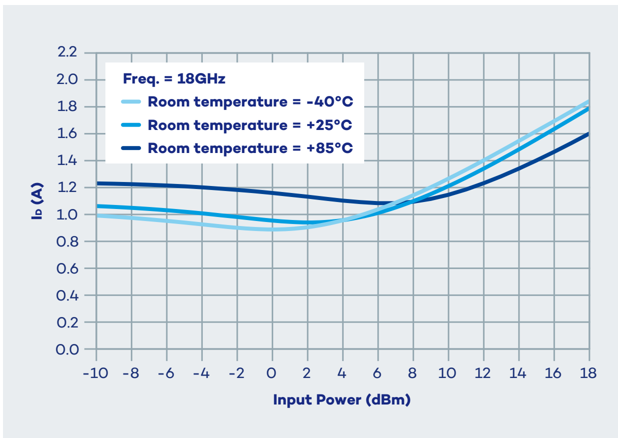
PAE vs Input Power vs Temperature



Drain Current vs Input Power vs Temperature



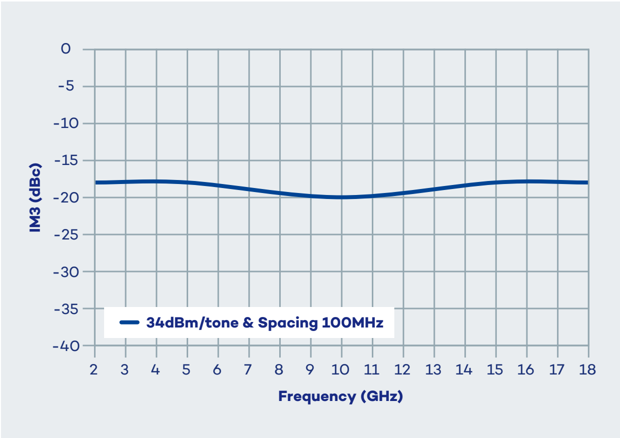
Drain Current vs Input Power vs Temperature



Typical Performance
(Large signal / Board Measurement)

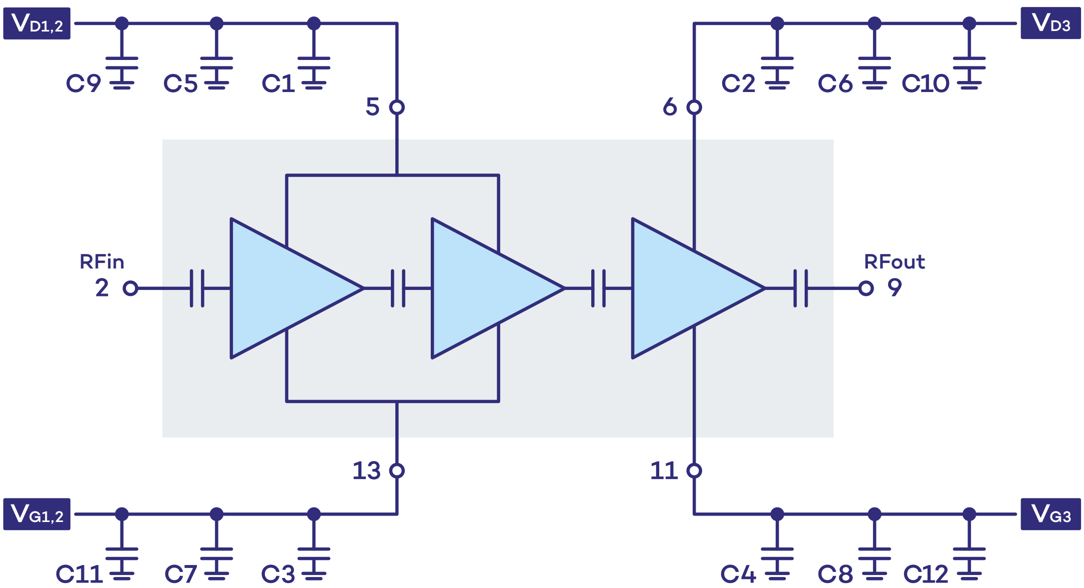
Test conditions: unless otherwise noted
- Reference plane: die access
- T_{amb} = +25°C • V_D = +28V
- I_{DQ} = 1.12A (V_G = -1.72V Typ.)
- CW

IM3 vs Frequency



Application circuit

- C1 to C4 = 1nF (MIM capacitors)
- C5 to C8 = 10nF (MIM capacitors)
- C9 to C12 = 1µF



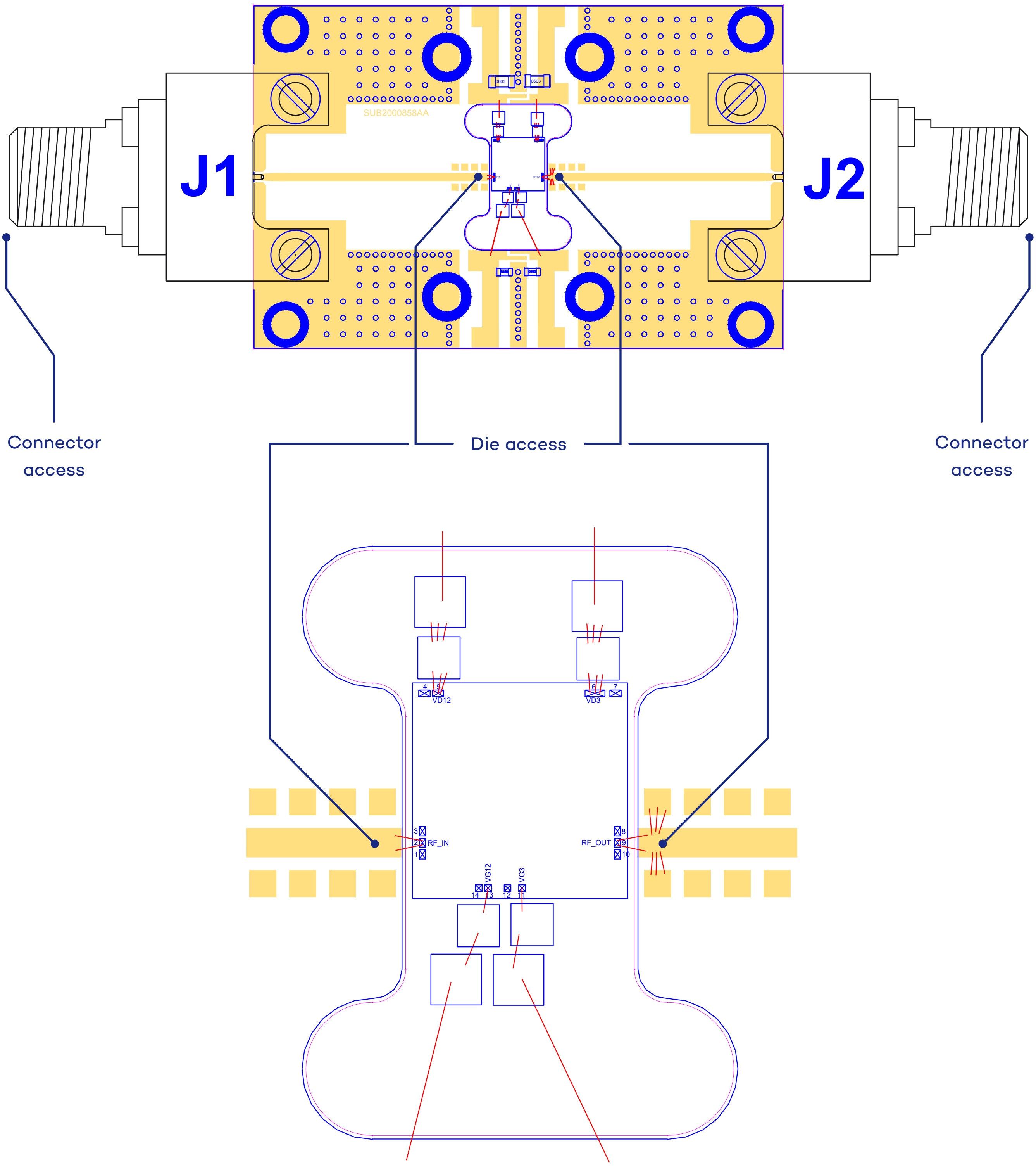
Bias-up procedure

1. Apply V_G = -3V
2. Apply V_D = +28V
3. Increase V_G to obtain the specificied I_{DQ} = 1.12A
4. Apply RF signal

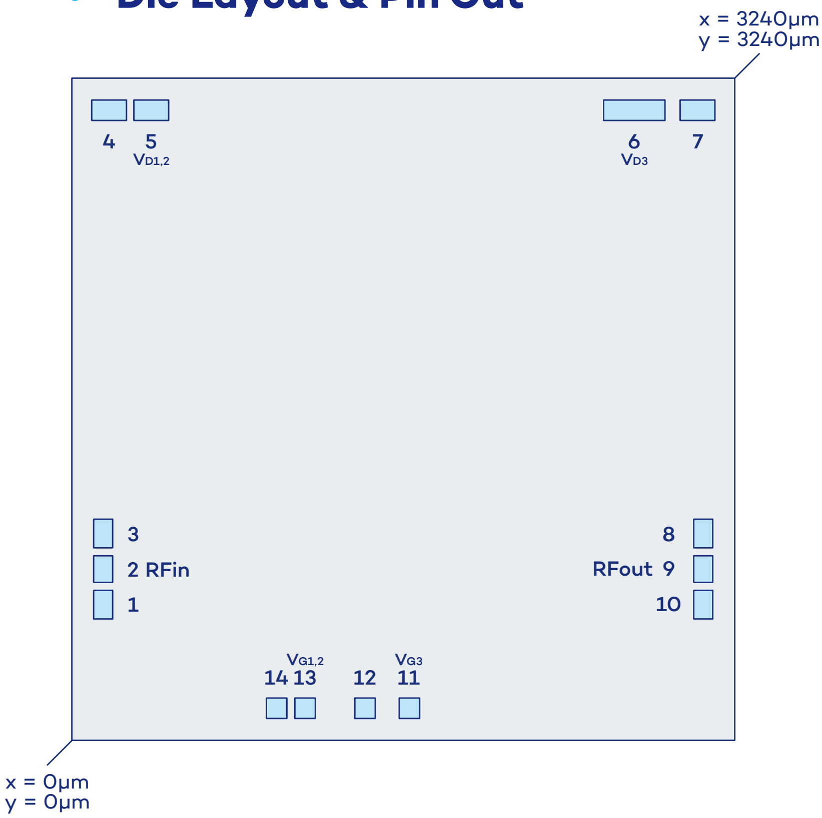
Bias-down procedure

1. Turn off RF signal
2. Reduce V_G to -3V
3. Reduce V_D to +28V
4. Turn off power supply

Evaluation Board (EVB) Layout Assembly



• Die Layout & Pin Out



- Die size = 3240µm x 3240µm
- Die thickness = 100µm
- Die size tolerance = 50µm

Pad number	Pad center X (µm)	Pad center Y (µm)	Size (µm x µm)	Name	Function
1	153	664	93 x 140	Gnd	
2	153	838	93 x 130	RFin	RF Input
3	153	1012	93 x 140	Gnd	
4	182	3083	170 x 100	Gnd	
5	388	3083	170 x 100	$V_{D1,2}$	Drain Bias Stage 1 & 2
6	2749	3083	300 x 100	V_{D3}	Drain Bias Stage 3
7	3058	3083	170 x 100	Gnd	
8	3086	1012	93 x 140	Gnd	
9	3086	838	93 x 130	RFout	RF Output
10	3086	664	93 x 140	Gnd	
11	1650	157	100 x 100	V_{G3}	Gate Bias Stage 3
12	1433	157	100 x 100	Gnd	
13	1140	157	100 x 100	$V_{G1,2}$	Gate Bias Stage 1 & 2
14	1001	157	100 x 100	Gnd	

- Die bottom must be connected to ground (RF and DC)

Ordering information

Product Code	Parameter
VM209D	2 to 18GHz - 10W GaN/SiC Power Amplifier in die form

Associated Material

- Packaged die
- Die Evaluation Board (die EVB)
- Packaged die Evaluation Board (packaged die EVB)
- Mechanical files (DXF)
- Measurents files (S2P)

Product Compliance Information

Solderability
Use only AuSn (80/20) solder and limit exposure to temperature above 300 °C during 3-4 minutes, maximum.

ESD Sensitivy Rating
Test: Human Body Model (HBM)
Std: JEDEC Standard JESD22-A114

RoHS-Compliance
This part is compliant with EU 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

Other attributes
- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C15H12Br4O2) Free
- PFOS Free
- SVHC Free

Contact information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about Vectrawave.

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