1. Description

- The D2210 is a 400W (P_{SAT}) wideband pre-matched gallium nitride (GaN) high electron mobility transistor (HEMT) with first generation RF GaN technology from Raytron.
- The D2210 operates from DC to 3GHz with a 48V supply rail. The device is offered in an industry standard air cavity package.

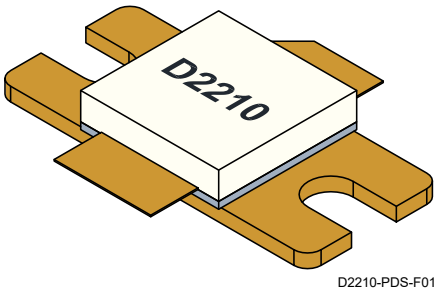


Figure 1. D2210 Package Outline

2. Applications

- Military and Civilian Radar
- Land Mobile and Military Radio Communications
- Avionic and Test Instrumentation

3. Features

- Operating Frequency: DC–3GHz
- Output Power[1] (P_{SAT}): 56.1dBm (407W)
- Linear Gain[1]: 18.9dB
- Typical DE @P_{SAT}[1]: 72.0%
- Operating Voltage: 48V
- CW and Pulse Capable
- Package Type: 400F-A

[1] Measured in Raytron DEMO @2.1GHz

4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter	1.2GHz	2.1GHz	Units
Linear Gain	19.5	18.9	dB
Drain Efficiency	78.6	72.0	%
Output Power	56.2	56.1	dBm

- Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 5%
- Typical Class AB performance in Raytron DEMO with the device soldered onto the heatsink, test condition: V_{DS} = 48V, I_{DS} = 400mA, V_{GS} = -3.15V

5. Block Diagram

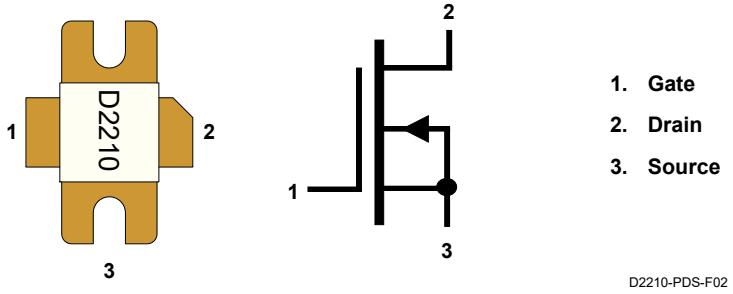


Figure 2. D2210 Block Diagram

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6. Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Drain-Source Voltage	V_{DSS}	150	V
Gate-Source Voltage	V_{GS}	-10 ~ +1	V
Operating Voltage	V_{DS}	10 ~ +55	V
Maximum Forward Gate Current	I_{GMax}	50.4	mA
Storage Temperature Range	T_{STG}	-65 ~ +150	°C
Operating Junction Temperature	T_J	250	°C

7. Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Drain-Source Voltage Range, V_{DS}	-	48	55.0	V
Drain Bias Current, I_{DS}	-	400	-	mA
Gate-Source Voltage, V_{GS}	-	-3.15	-	V
Channel Temperature, T_{CH}	-	-	225	°C

Table 4. Thermal Resistance

Parameter	Symbol	Value	Unit
Thermal Resistance (Active Die Surface-to-Case)[1]	R_{thsc} (IR)	-	°C/W
Thermal Resistance (Junction-to-Case)[2]	R_{thjc} (FEA)	1.0	°C/W

[1] Thermal Resistance at average power by infrared measurement, Active Die Surface-to-Case, $T_{base\text{-}plate}$ = 85℃, P_D = 70.0W

[2] Thermal Resistance at average power by Finite Element Analysis, Junction-to-Case, $T_{base\text{-}plate}$ = 85℃, P_D = 70.0W

8. Electrical Characteristics (T_C = 25˚C)

Table 5. DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Drain-Source Breakdown Voltage[1] (V_{GS} = -10V, I_{DS} = 50.4mA)	$V_{DS(BR)}$	150	-	-	V
Saturated Drain Current[1] (V_{DS} = 10V, V_{GS} = 1.0V)	I_{Max}	-	52.40	-	A
Gate Threshold Voltage[2] (V_{DS} = 48V, I_{DS} = 50.4mA)	$V_{GS(TH)}$	-3.95	-3.32	-2.60	V
Gate Quiescent Voltage[2] (V_{DS} = 48V, I_{DS} = 400mA)	$V_{GS(Q)}$	-	-3.15	-	V

[1] Scaled from PCM data

[2] Measured in Raytron DEMO

Table 6. RF Characteristics[1,2]

Test Method	Parameter	Symbol	Min.	Typ.	Max.	Units
DEMO @1.2GHz	Linear Gain	G_{LIN}	-	19.5	-	dB
	Drain Efficiency	η_D	-	78.6	-	%
	Output Power	P_{Sat}	-	56.2	-	dBm
DEMO @2.1GHz	Linear Gain	G_{LIN}	-	18.9	-	dB
	Drain Efficiency	η_D	-	72.0	-	%
	Output Power	P_{Sat}	-	56.1	-	dBm

1. Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 5%
2. Typical Class AB performance in Raytron DEMO with the device soldered onto the heatsink, test condition: V_{DS} = 48V, I_{DS} = 400mA, V_{GS} = -3.15V

Table 7. Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Capacitance	C_{GS}	-	81.68	-	pF
Output Capacitance	C_{DS}	-	19.31	-	pF
Feedback Capacitance	C_{GD}	-	2.40	-	pF

- Test Condition: V_{DS} = 48V, V_{GS} = -8V, f = 1MHz

9. Typical Performance

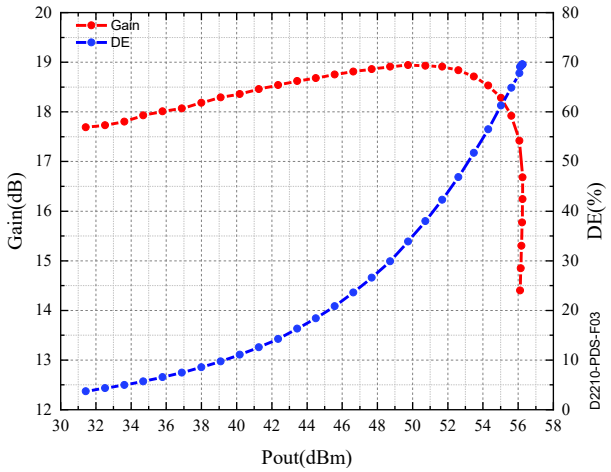


Figure 3. 1.2GHz Gain and DE @MXP vs. Output Power

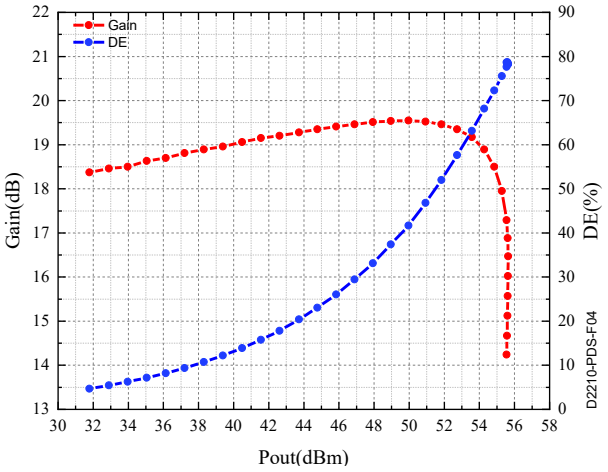


Figure 4. 1.2GHz Gain and DE @MXE vs. Output Power

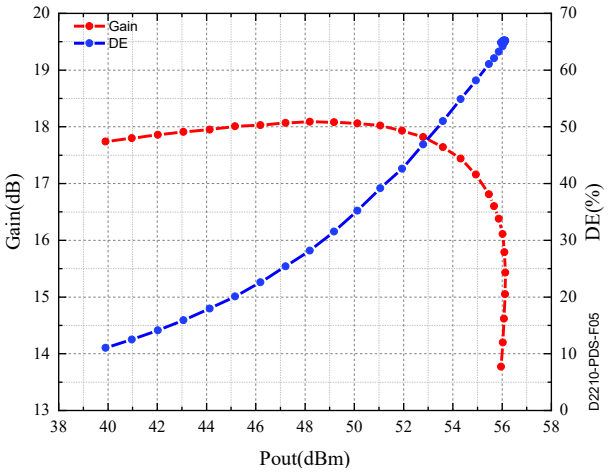


Figure 5. 2.1GHz Gain and DE @MXP vs. Output Power

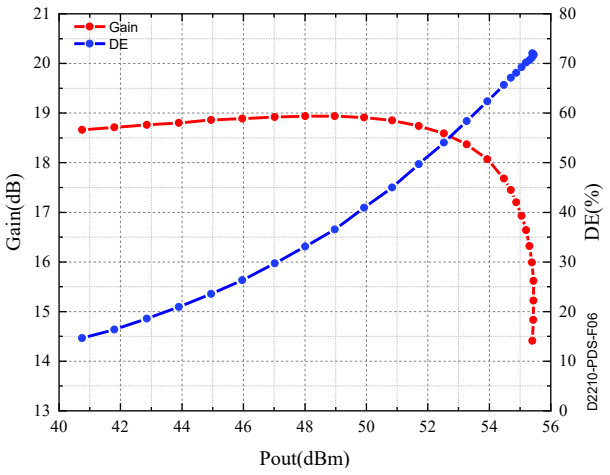


Figure 6. 2.1GHz Gain and DE @MXE vs. Output Power

- Typical Class AB performance in Raytron DEMO with the device soldered onto the heatsink, test condition: V_{DS} = 48V, I_{DS}= 400mA, V_{GS} = -3.15V
- Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 5%

10. Wide-band Application Performance

■ Wide-band Application Performance 1 (DEMO_A: 0.96-1.2GHz)

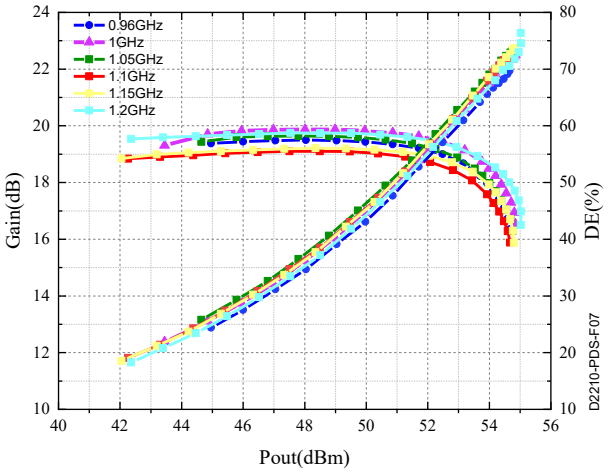


Figure 7. Wide-band Application Gain and DE vs. Output Power

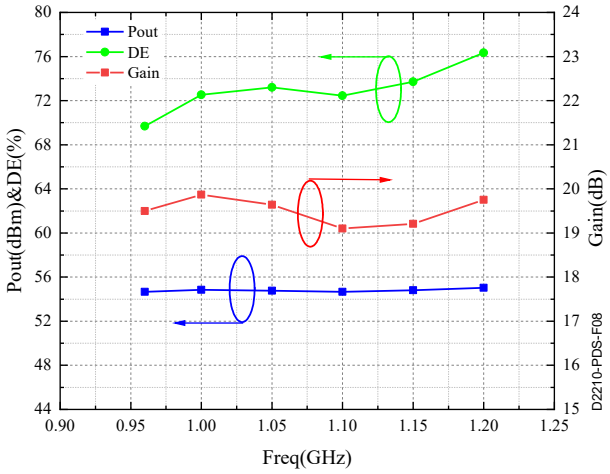


Figure 8. Wide-band Application Gain and DE vs. Freq.

- Typical Class AB performance in Raytron Wide-band Application DEMO_A with the device soldered onto the heatsink, test condition: V_{DS} = 48V, I_{DS} = 400mA, V_{GS} = -3.15V
- Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 5%
- The output power is 54.7dBm (295W) at 0.96-1.2GHz. It can be used in the avionics and L band radar application

11. Package Outline

■ Pin Layout

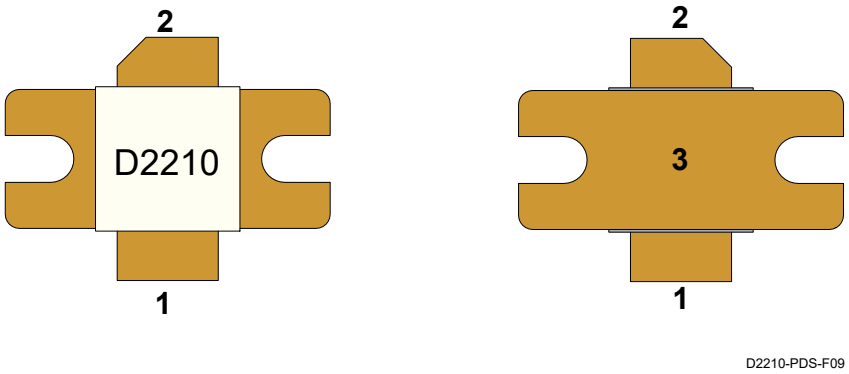


Figure 9. D2210 Pin Layout

Table 8. Pin Description

Pin	Symbol	Description
1	V_G / RF_{IN}	Gate Voltage / RF Input
2	V_D / RF_{OUT}	Drain Voltage / RF Output
3	Flange	Source to be Connected to Ground

■ Mechanical Drawing (Package Type: 400F-A)

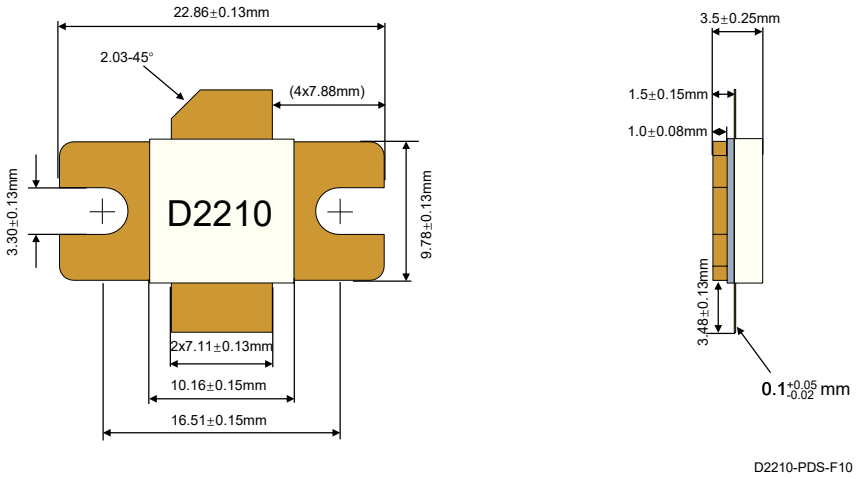


Figure 10. D2210 Mechanical Drawing

12. Application Circuit

■ Schematic

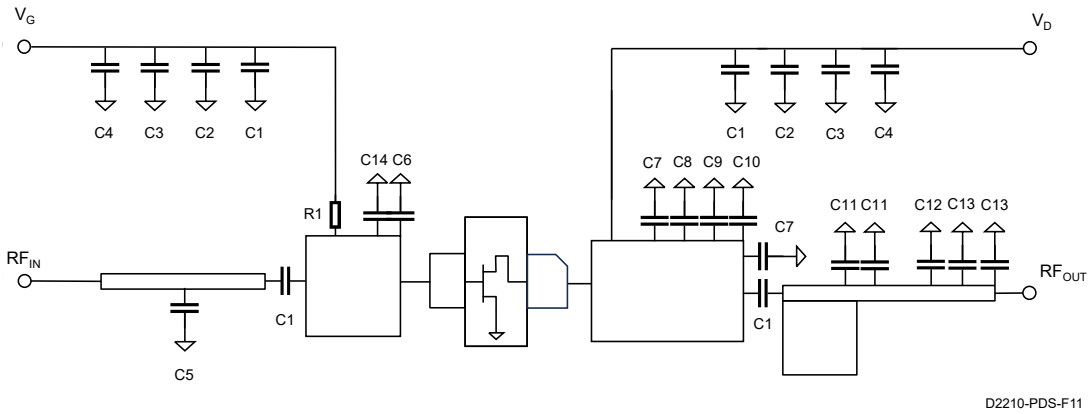


Figure 11. D2210 DEMO_A Application Circuit Schematic

Table 9. Bias Procedure

Bias-up Procedure	Bias-down Procedure
1) Set V_{GS} to the pinch-off voltage, typically -6V	1) Turn off RF signal
2) Turn on V_{DS} to nominal supply voltage (48V)	2) Turn off V_{DS}
3) Slowly adjust V_{GS} until I_{DS} current is attained	3) Wait two seconds to allow drain capacitor to discharge
4) Apply RF input power to desired level	4) Turn off V_{GS}

■ Layout

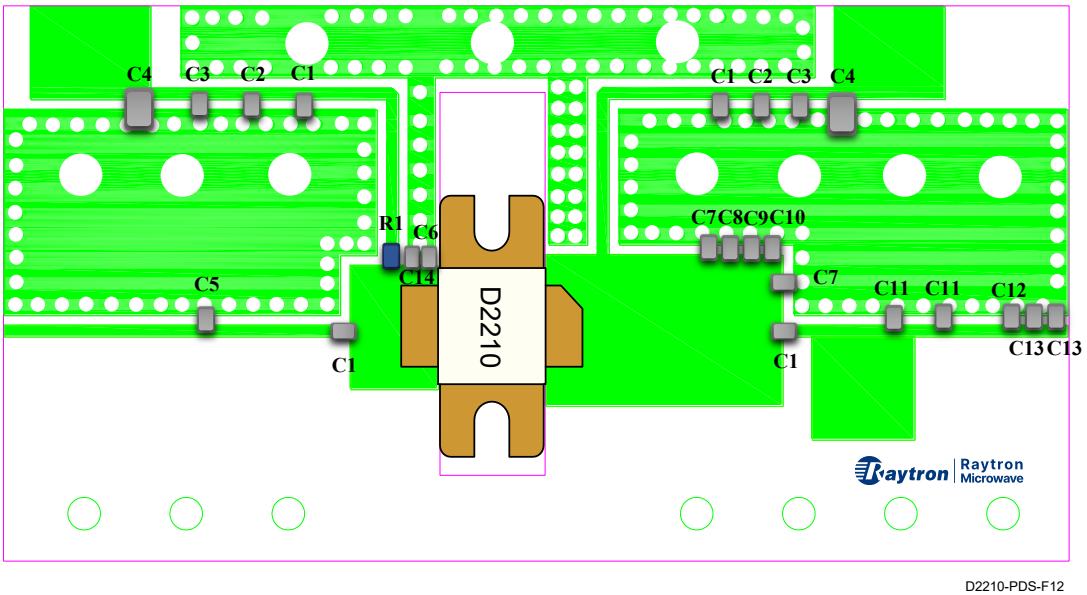


Figure 12. D2210 Application Circuit Layout
(DEMO_A Size: 10.5cm x 5.5cm)

Table 10. Bill of Materials

Component	Value	Description	Manufacturer	Part Number
PCB	20mil	N/A	Rogers	RO4350B
C1	25pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E250GB12
C2	100pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E101JB12
C3	10000pF	X7R 100V 0603 Capacitor	Murata	GCM188R72A103KA37D
C4	1.0uF	X7R 100V 1210 Capacitor	Murata	GRM32ER72A105KA01
C5	5.0pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E5R0CB12
C6	9.0pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E9R0CB12
C7	3.5pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E3R5BB12
C8	0.6pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2ER60WB12
C9	0.4pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2ER40WB12
C10	1.7pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E1R7BB12
C11	1.5pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E1R5BB12
C12	1.0pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E1R0BB12
C13	1.2pF	C0G 250V 0805 Capacitor	Murata	GQM2195C2E1R2BB12
R1	10Ω	1/4W 0805	Yageo	RC0805FR-0710RL

13. DEMO Summary

Table 11. DEMO Summary

NO.	D2210 DEMO Name	V_{DS} (V)	Freq (GHz)	Linear Gain(dB)	P_{SAT} (dBm)	P_{SAT} (W)	Drain Efficiency	Pulse or CW
1	DEMO_A, 300W	50	0.96-1.2	19.1	54.7	295	70%	Pulse

14. Recommended Solder Temperature Profile

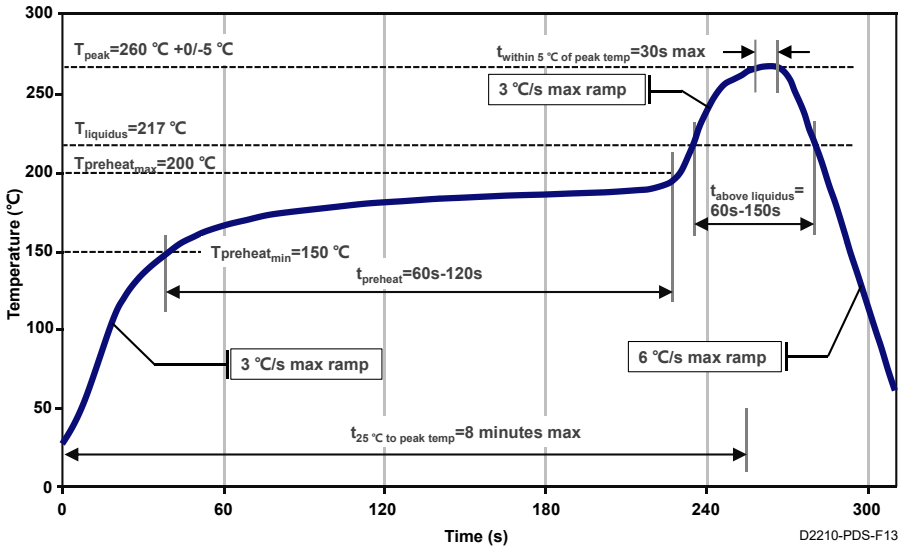


Figure 13. Recommended Solder Temperature Profile

15. Handling Precautions

- **ESD Caution**
  ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore proper ESD precautions should be taken to avoid performance degradation or loss of functionality.



16. Contact Information

For the latest specifications, additional product information, technical support and sales support, please contact:

- **Email:** RF.support@raytrontek.com
- **Web:** www.raytrontek.com

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