1. Description

- The D1309 is a 30W (P_{SAT}) wideband pre-matched gallium nitride (GaN) high electron mobility transistor (HEMT) with first generation RF GaN technology from Raytron.
- The D1309 operates from DC to 6.5GHz with a 28V supply rail. It can deliver 20W CW power across the 5.15 to 5.85 GHz. The device is offered in an industry standard air cavity package.

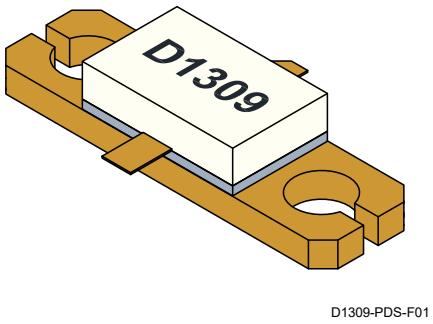


Figure 1. D1309 Package Outline

2. Applications

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

3. Features[1]

- Operating Frequency: DC–6.5GHz
- Output Power (P_{SAT}): 45.3dBm (34W)
- Linear Gain: 14.0dB
- Typical DE @P_{SAT}: 54.5%
- Operating Voltage: 28V
- CW and Pulse Capable
- Package Type: 360F-A

[1] Measured in Raytron DEMO @6GHz

4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter	5.15GHz	5.45GHz	5.85GHz	Units
Linear Gain	13.7	13.6	13.8	dB
Drain Efficiency	54.5	51.2	51.8	%
Output Power	45.3	44.8	43.5	dBm
Output Power	34	30	22	W

- Typical Class AB performance in Raytron DEMO_A with the device soldered onto the heatsink, test condition: V_{DS} = 28V, I_{DS} = 230mA, V_{GS} = -2.58V
- Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 10%

5. Block Diagram

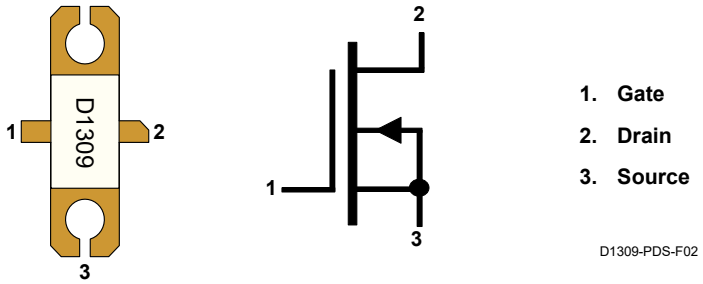


Figure 2. D1309 Block Diagram

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6. Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Drain-Source Voltage	V_{DSS}	84	V
Gate-Source Voltage	V_{GS}	-10 ~ +1	V
Operating Voltage	V_{DS}	10 ~ +32	V
Maximum Forward Gate Current	I_{GMax}	6.72	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}	-	28	32	V
Drain Bias Current, I_{DS}	-	230	-	mA
Gate-Source Voltage, V_{GS}	-	-2.58	-	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)	3.30	°C/W
Thermal Resistance (Junction-to-Case)[2]	R_{thjc} (FEA)	4.38	°C/W

1. Thermal Resistance at average power by infrared measurement, Active Die Surface-to-Case, $T_{base\text{-}plate}$ = 85℃, P_D = 23.0W
2. Thermal Resistance at average power by Finite Element Analysis, Junction-to-Case, $T_{base\text{-}plate}$ = 85℃, $T_{junction}$ = 200℃

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} = 6.72mA)	$V_{(BR)DS}$	84	-	-	V
Saturated Drain Current[2] (V_{DS} = 10V, V_{GS} = 1.0V)	I_{Max}	-	6.72	-	A
Gate Threshold Voltage[3] (V_{DS} = 28V, I_{DS} = 6.72mA)	$V_{GS(th)}$	-3.30	-2.80	-2.30	V
Gate Quiescent Voltage[3] (V_{DS} = 28V, I_{DS} = 230mA)	$V_{GS(Q)}$	-	-2.58	-	V

1. Measured on wafer prior to packaging
2. Measured with packaged device
3. Typical Class AB performance in Raytron DEMO

Table 6. Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Capacitance	C_{GS}	-	15.80	-	pF
Output Capacitance	C_{DS}	-	2.26	-	pF
Feedback Capacitance	C_{GD}	-	0.53	-	pF

- Test Condition: V_{DS} = 28V, V_{GS} = -8V, f = 1MHz

9. Wide-band Application Performance (Pulse)

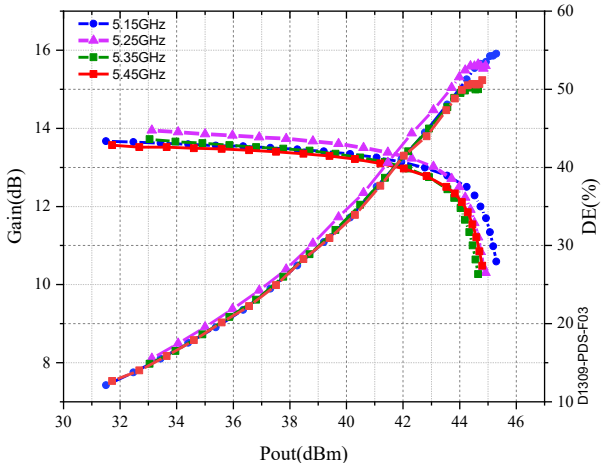


Figure 3. Pulse Gain and DE vs. Output Power

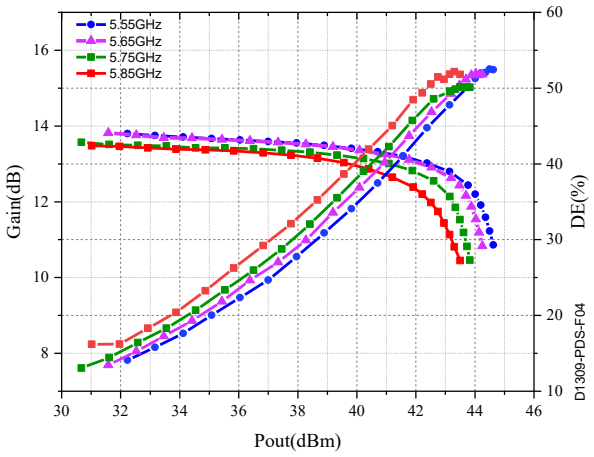


Figure 4. Pulse Gain and DE vs. Output Power

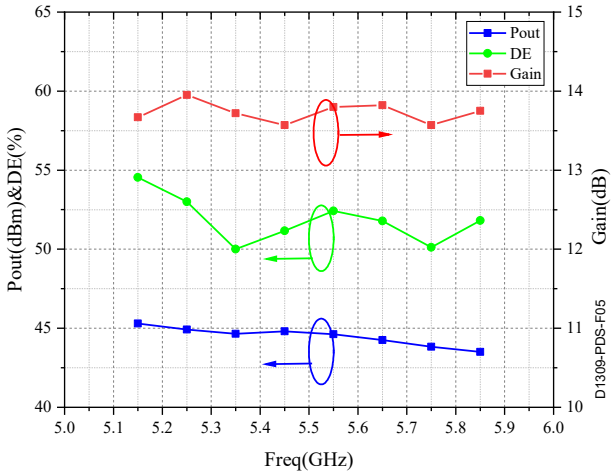


Figure 5. Pulse Gain and DE vs. Freq.

Table 7. RF Characteristics (Pulse)

Parameter	5.15GHz	5.25GHz	5.35GHz	5.45GHz	5.55GHz	5.65GHz	5.75GHz	5.85GHz	Units
Linear Gain	13.7	14.0	13.7	13.6	13.8	13.8	13.6	13.8	dB
Power Gain	10.7	11.0	10.7	10.6	10.8	10.8	10.6	10.8	dB
Drain Efficiency	54.5	53.1	50.2	51.2	52.4	51.8	50.1	51.8	%
Output Power	45.3	44.9	44.7	44.8	44.6	44.3	43.8	43.5	dBm
Output Power	34	31	30	30	29	27	24	22	W

- Typical Class AB performance in Raytron DEMO_A Wide-band Application with the device soldered onto the heatsink, test condition: V_{DS} = 28V, I_{DS} = 230mA, V_{GS} = -2.58V
- Test Condition: Pulse, Pulse width = 100μs, Duty cycle = 10%
- The output power is 43.5dBm (22W) at 5.15-5.85GHz.

10. Wide-band Application Performance (CW)

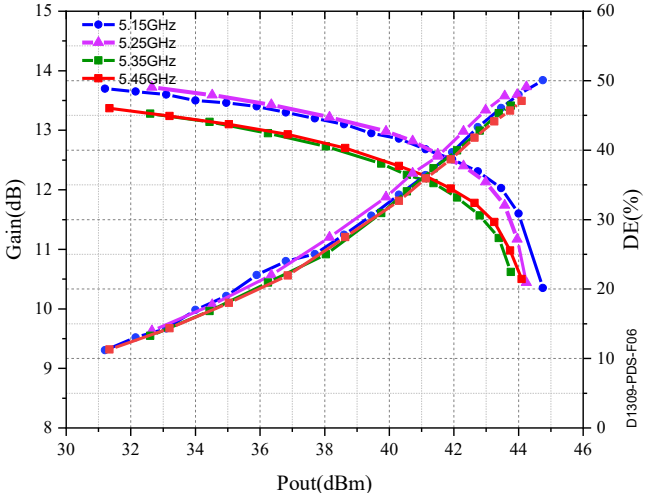


Figure 6. CW Gain and DE vs. Output Power

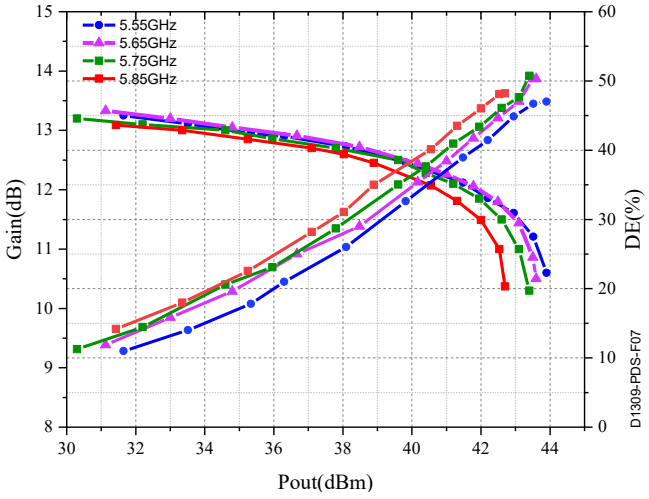


Figure 7. CW Gain and DE vs. Output Power

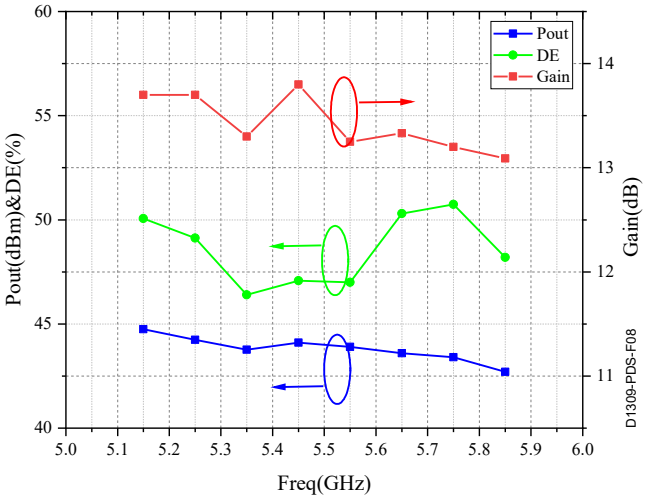


Figure 8. CW Gain and DE vs. Freq.

Table 8. RF Characteristics (CW)

Parameter	5.15GHz	5.25GHz	5.35GHz	5.45GHz	5.55GHz	5.65GHz	5.75GHz	5.85GHz	Units
Linear Gain	13.7	13.7	13.3	13.4	13.3	13.3	13.2	13.1	dB
Power Gain	10.7	10.7	10.3	10.4	10.3	10.3	10.2	10.1	dB
Drain Efficiency	50.1	49.1	46.4	47.1	47.0	50.2	47.7	48.2	%
Output Power	44.7	44.2	43.7	44.1	43.9	43.5	43.1	42.8	dBm
Output Power	30	26	23	26	25	22	20	19	W

- Typical Class AB performance in Raytron DEMO_A with the device soldered onto the heatsink, test condition: V_{DS} = 28V, I_{DS} = 230mA, V_{GS} = -2.58V
- Test Condition: CW
- The output power is 42.8dBm (19W) at 5.15-5.85GHz.

11. Package Outline

■ Pin Layout

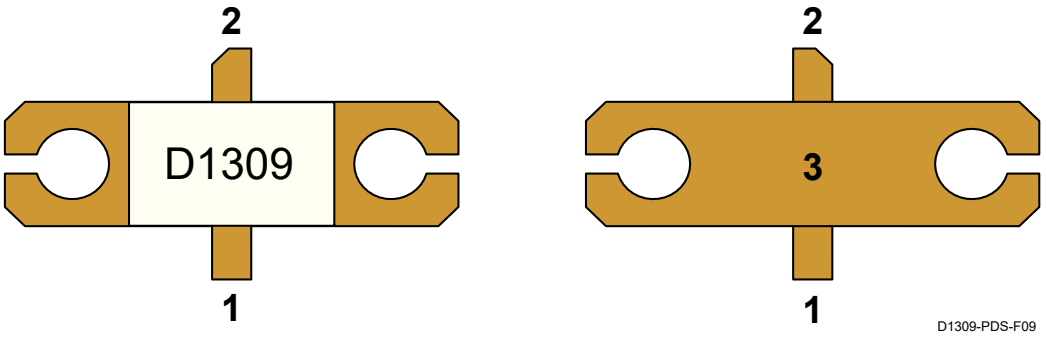


Figure 9. D1309 Pin Layout

Table 9. 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: 360F-A)

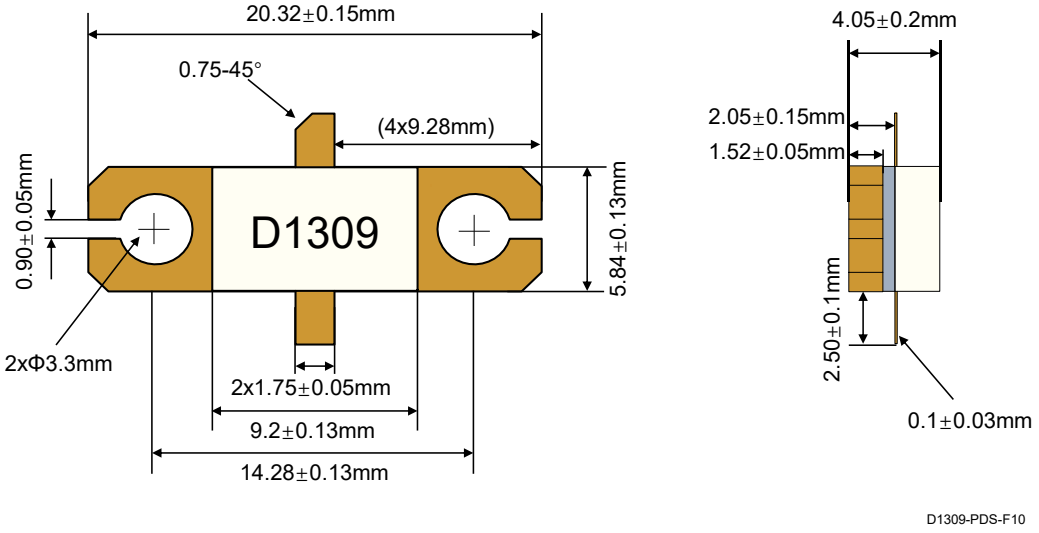


Figure 10. D1309 Mechanical Drawing

12. Application Circuit

■ Schematic

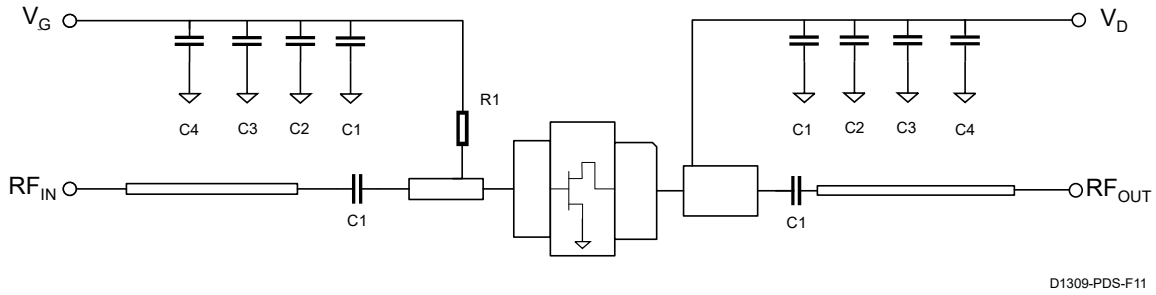


Figure 11. D1309 DEMO_A Application Circuit Schematic

Table 10. 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 (28V)	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

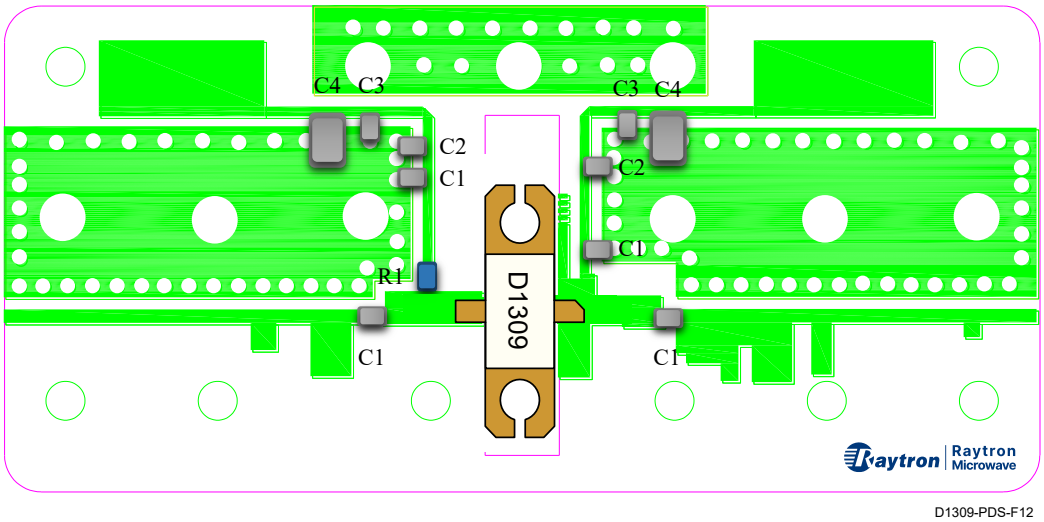


Figure 12. D1309 Application Circuit Layout
（DEMO_A Size: 8.5cm x 4.0cm）

Table 11. Bill of Materials

Component	Value	Description	Manufacturer
PCB	20mil	Rogers4350B	Rogers
C1	2.0pF	C0G 250V 0805 Capacitor	Murata
C2	100.0pF	C0G 250V 0805 Capacitor	Murata
C3	10000.0pF	X7R 100V 0603 Capacitor	Murata
C4	1.0uF	X7R 100V 1210 Capacitor	Murata
R1	10Ω	1/4W 0603 Resistor	Yageo

13. DEMO Summary

Table 12. DEMO Summary

NO.	D1309 DEMO Name	V_{DS} (V)	Freq (GHz)	Linear Gain(dB)	P_{SAT} (dBm)	P_{SAT} (W)	Drain Efficiency	Pulse or CW
1	DEMO_A, 20W	28	5.15-5.85	13.1	42.8	19	46%	CW

14. Recommended Solder Temperature Profile

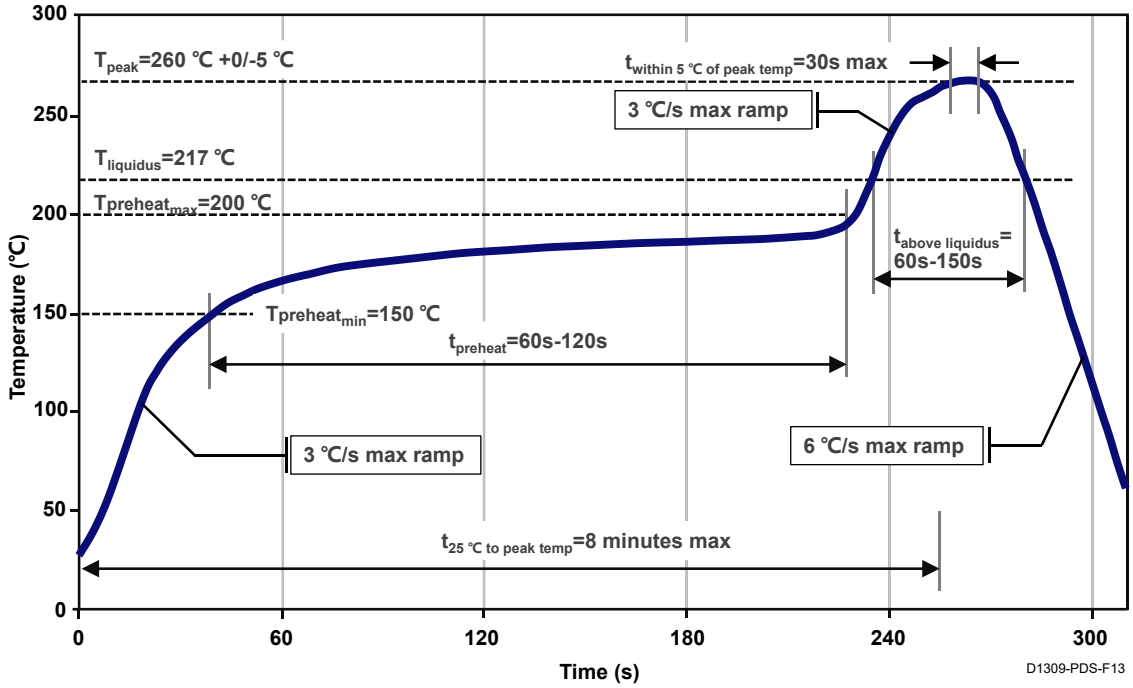


Figure 13. Recommended Solder Temperature Profile

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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