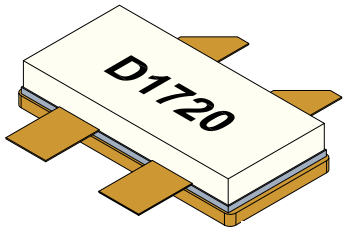
## 1. Description

- The D1720 is a 150W ($P_{SAT}$) wideband pre-matched gallium nitride (GaN) high electron mobility transistor (HEMT).
- The D1720 operates from DC to 4GHz with a 28V supply rail. The device is offered in an industry standard air cavity package.




D1720-PDS-F01

**Figure 1. D1720 Package Outline**

## 2. Applications

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

## 3. Features[1]

- Operating Frequency: DC–4GHz
- Output Power ($P_{SAT}$): 51.8dBm (151W)
- Linear Gain: 18.5dB
- Typical DE @$P_{SAT}$: 76.0%
- Operating Voltage: 28V
- CW and Pulse Capable
- Package Type: 780P-A

[1] Measured in Raytron DEMO @2.6GHz

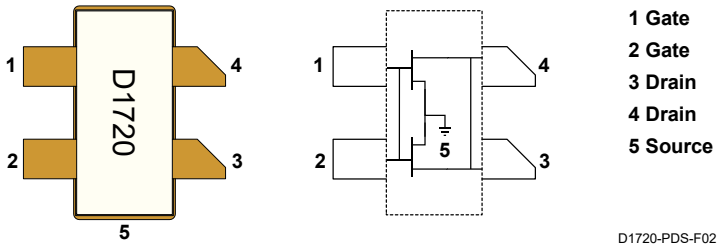
## 4. Brief Typical Performance

**Table 1. Brief Typical Performance**

| Parameter | 0.5GHz | 1GHz | 2GHz | 3GHz | Units |
|---|---|---|---|---|---|
| Linear Gain | 12.8 | 13.3 | 13.0 | 13.3 | dB |
| Drain Efficiency | 48.4 | 73.0 | 56.2 | 53.2 | % |
| Output Power | 49.3 | 49.6 | 50.0 | 49.4 | dBm |
| Output Power | 85 | 91 | 100 | 86 | W |

- Typical Class AB performance in Raytron DEMO_A (0.5-3GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 300mA, $V_{GS}$ = -2.63V
- Test Condition: CW

## 5. Block Diagram




D1720-PDS-F02

**Figure 2. D1720 Block Diagram**

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## 6. Absolute Maximum Ratings

### Table 2. Absolute Maximum Ratings

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 120 | V |
| Gate-Source Voltage | $V_{GS}$ | -10 ~ +1 | V |
| Operating Voltage | $V_{DS}$ | 10 ~ +32 | V |
| Maximum Forward Gate Current | $I_{GMax}$ | 29.8 | 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 | 40 | V |
| Drain Bias Current, $I_{DS}$ | - | 300 | - | mA |
| Gate-Source Voltage, $V_{GS}$ | - | -2.63 | - | 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) | 0.74 | °C/W |
| Thermal Resistance (Junction-to-Case)[2] | $R_{thjc}$ (FEA) | 0.95 | °C/W |

1. Thermal Resistance at average power by infrared measurement, Active Die Surface-to-Case, $T_{base\text{-}plate}$ = 85℃, $P_D$ = 100.0W

2. Thermal Resistance at average power by Finite Element Analysis, Junction-to-Case, $T_{base\text{-}plate}$ = 85℃, $P_D$ = 84.0W

## 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, $I_{DS}$ = 29.8mA) | $V_{DS(BR)}$ | 120 | - | - | V |
| Saturated Drain Current[2] ($V_{DS}$ = 10V, $V_{GS}$ = 1.0V) | $I_{Max}$ | - | 32.10 | - | A |
| Gate Threshold Voltage[3] ($V_{DS}$ = 28V, $I_{DS}$ = 29.8mA) | $V_{GS(TH)}$ | -3.30 | -2.80 | -2.30 | V |
| Gate Quiescent Voltage[3] ($V_{DS}$ = 28V, $I_{DS}$ = 300mA) | $V_{GS(Q)}$ | - | -2.63 | - | V |

1. Measured on wafer prior to packaging

2. Scaled from PCM data

3. Typical Class AB performance in Raytron DEMO_A

## Table 6. RF Characteristics @ DEMO_A [1,2]

| Freq. (GHz) | Linear Gain (dB) | Drain Efficiency (%) | Output Power (dBm) | Output Power (W) |
|---|---|---|---|---|
| 0.5 | 12.8 | 48.4 | 49.3 | 86 |
| 1.0 | 13.3 | 73 | 49.6 | 91 |
| 1.5 | 14.3 | 63.2 | 50.4 | 109 |
| 2.0 | 13 | 56.2 | 50 | 100 |
| 2.5 | 12.5 | 44.7 | 49.2 | 83 |
| 3.0 | 13.3 | 53.2 | 49.4 | 86 |

1. Typical Class AB performance in Raytron DEMO_A (0.5-3GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 300mA, $V_{GS}$ = -2.63V
2. Test Condition: CW

## Table 7. Dynamic Characteristics

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Input Capacitance | $C_{GS}$ | - | 148.30 | - | pF |
| Output Capacitance | $C_{DS}$ | - | 15.72 | - | pF |
| Feedback Capacitance | $C_{GD}$ | - | 2.44 | - | pF |

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

# 9. Wide-band Application Performance

## ■ Wide-band Application Performance (DEMO_A: 0.5-3GHz)

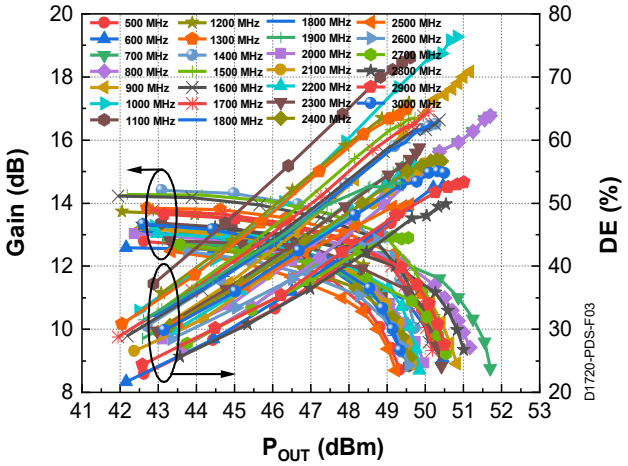



Figure 3. Wide-band Application Gain and DE vs. Output Power

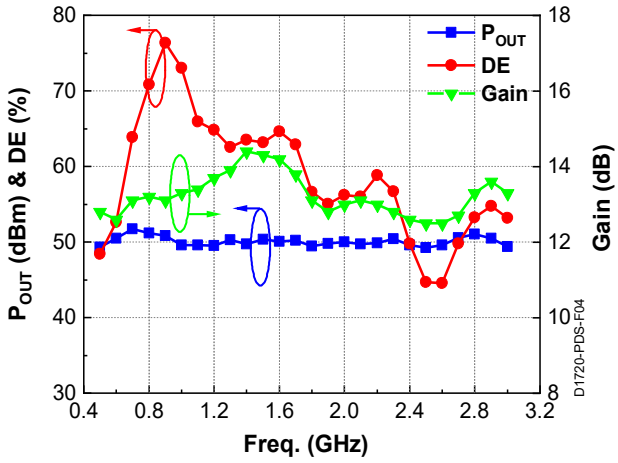



Figure 4. Wide-band Application $P_{OUT}$, Gain, and DE vs. Freq.

### Table 8. RF Characteristics @ DEMO_A

| Freq. (GHz) | Linear Gain (dB) | Drain Efficiency (%) | Output Power (dBm) | Output Power (W) |
|---|---|---|---|---|
| 0.5 | 12.8 | 48.4 | 49.3 | 86 |
| 0.6 | 12.6 | 52.7 | 50.5 | 111 |
| 0.7 | 13.1 | 63.9 | 51.7 | 148 |
| 0.8 | 13.2 | 70.8 | 51.2 | 131 |
| 0.9 | 13.1 | 76.3 | 50.8 | 121 |
| 1.0 | 13.3 | 73 | 49.6 | 91 |
| 1.1 | 13.4 | 65.9 | 49.6 | 91 |
| 1.2 | 13.7 | 64.8 | 49.5 | 90 |
| 1.3 | 13.9 | 62.6 | 50.3 | 107 |
| 1.4 | 14.4 | 63.5 | 49.7 | 94 |
| 1.5 | 14.3 | 63.2 | 50.4 | 109 |
| 1.6 | 14.2 | 64.6 | 50.1 | 102 |
| 1.7 | 13.8 | 62.9 | 50.2 | 104 |
| 1.8 | 13.1 | 56.6 | 49.4 | 87 |
| 1.9 | 12.8 | 55 | 49.8 | 96 |
| 2.0 | 13 | 56.2 | 50 | 100 |
| 2.1 | 13.1 | 56 | 49.7 | 94 |
| 2.2 | 13 | 58.8 | 49.9 | 97 |
| 2.3 | 12.8 | 56.7 | 50.4 | 110 |
| 2.4 | 12.6 | 49.8 | 49.6 | 91 |
| 2.5 | 12.5 | 44.7 | 49.2 | 83 |
| 2.6 | 12.5 | 44.5 | 49.6 | 90 |
| 2.7 | 12.7 | 49.8 | 50.5 | 113 |

| | | | | |
|---|---|---|---|---|
| 2.8 | 13.3 | 53.3 | 51 | 126 |
| 2.9 | 13.6 | 54.8 | 50.5 | 112 |
| 3.0 | 13.3 | 53.2 | 49.4 | 86 |

- Typical Class AB performance in Raytron Wide-band Application DEMO_A (0.5-3GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 300mA, $V_{GS}$ = -2.63V
- Test Condition: CW
- The output power reaches 48.0dBm(63W) at 0.5-3GHz.

## 10. Package Outline

### ■ Pin Layout

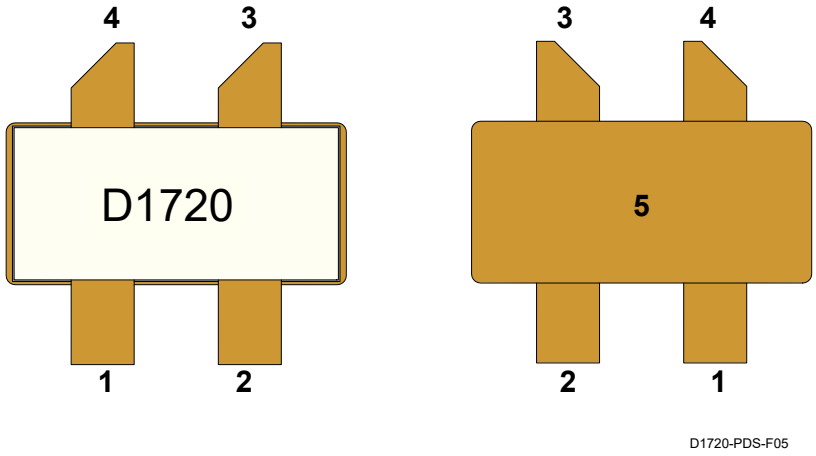



**Figure 5. D1720 Pin Layout**

**Table 8. Pin Description**

| Pin | Symbol | Description |
|---|---|---|
| 1/2 | $V_G$ / $RF_{IN}$ | Gate voltage / RF Input |
| 3/4 | $V_D$ / $RF_{OUT}$ | Drain voltage / RF Output |
| 5 | Flange | Source to be Connected to Ground |

## ■ Mechanical Drawing (Package Type: 780P-A)

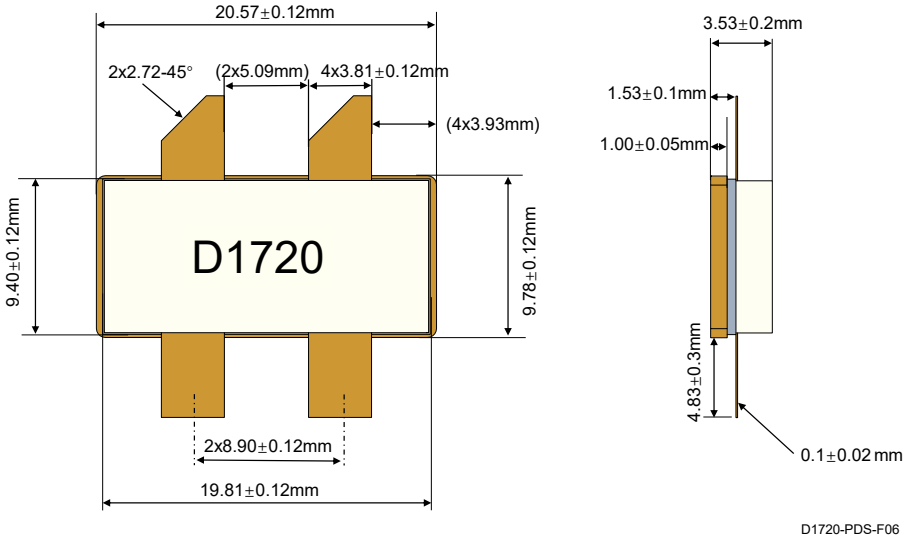



**Figure 6. D1720 Mechanical Drawing**

# 11. Application Circuit

## ■ Schematic

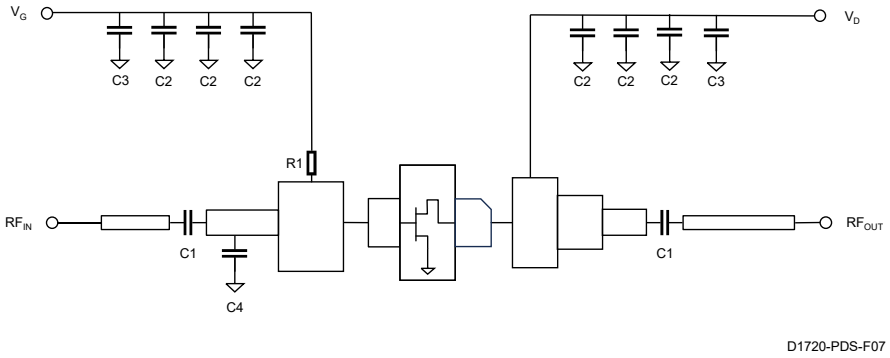



**Figure 7. D1720 DEMO_A Application Circuit Schematic (0.5-3.0GHz)**

### 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 (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

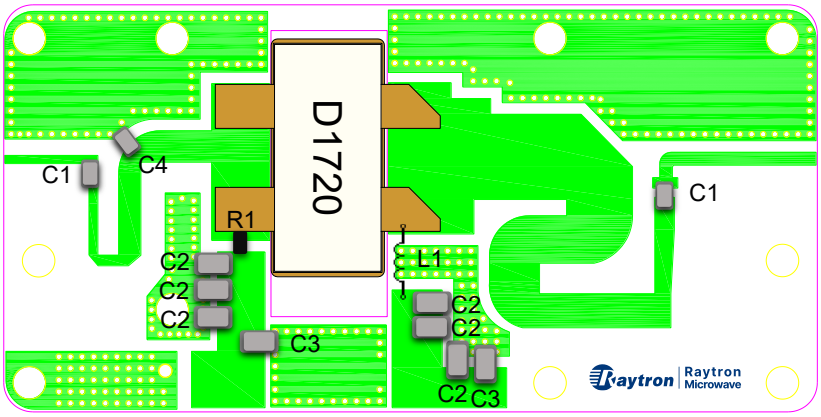



**Figure 8. D1720 Application Circuit Layout (0.5-3GHz)**
**(DEMO_A Size: 7.0cm x 3.5cm)**

**Table 10. Bill of Materials**

| Component | Value | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| PCB | 20mil | N/A | Taizhou Wangling | WL_CT615 |
| C1 | 25.0pF | C0G 250V 0805 Capacitor | Murata | GQM2195C2E250GB12 |
| C2 | 0.1uF | C0G 100V 1206 Capacitor | Murata | GRM3195C2A104JA01 |
| C3 | 4.7uF | X7R 100V 1210 Capacitor | Murata | GRM31CC72A475KE11L |
| C4 | 0.9pF | C0G 250V 0805 Capacitor | Murata | GQM2195C2ER90WB12 |
| R1 | 10Ω | 1/8W 0805 Resistor | Yageo | RC0805FR-0710RL |
| L1 | N/A | 3turns, D=7.2mm, d=1.5mm | N/A | N/A |

## 12. DEMO Summary

**Table 11. DEMO Summary**

| D1720 DEMO Name | $V_{DS}$ (V) | Freq (GHz) | Linear Gain(dB) | $P_{SAT}$ (dBm) | $P_{SAT}$ (W) | Drain Efficiency(%) | Pulse or CW |
|---|---|---|---|---|---|---|---|
| DEMO_A, 100W | 32 | 0.5-3 | 12.9 | 50.1 | 102 | 52% | CW |
| DEMO_A, 80W | 28 | 0.5-3 | 12.5 | 49.2 | 84 | 45% | CW |
| DEMO_B, 50W | 28 | 0.8-3.6 | 12.3 | 47.3 | 54 | 42% | Pulse |
| DEMO_C, 60W | 28 | 0.3-2.7 | 12.3 | 48 | 63 | 49% | CW |

## 13. Recommended Solder Temperature Profile

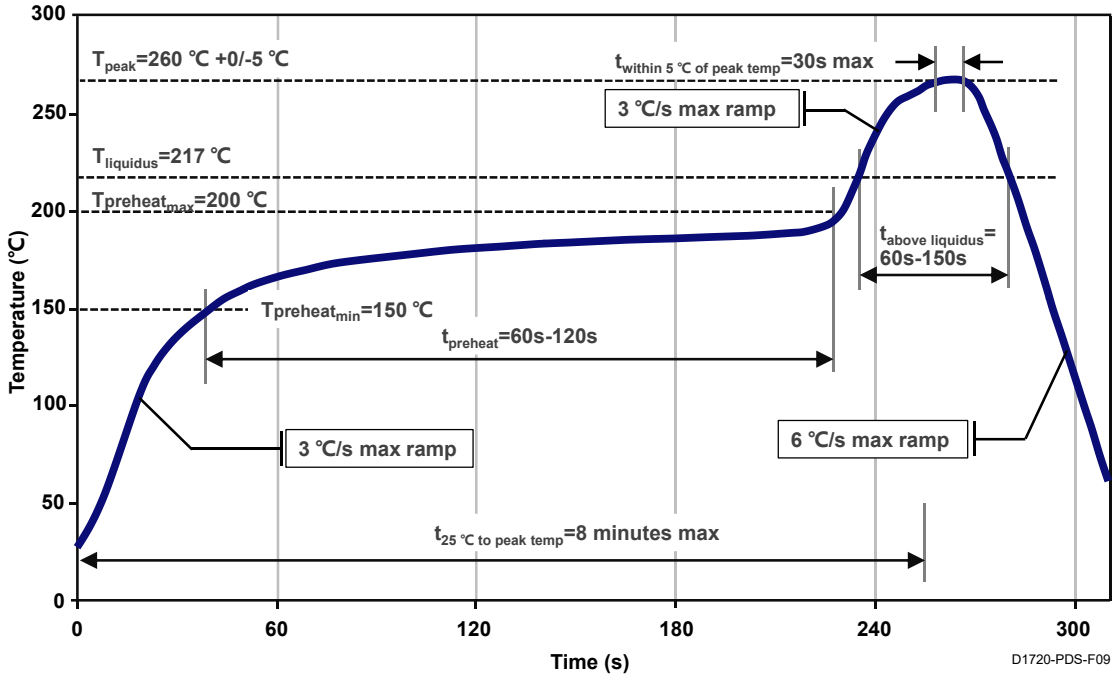



**Figure 9. Recommended Solder Temperature Profile**

## 14. 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.




## 15. 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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