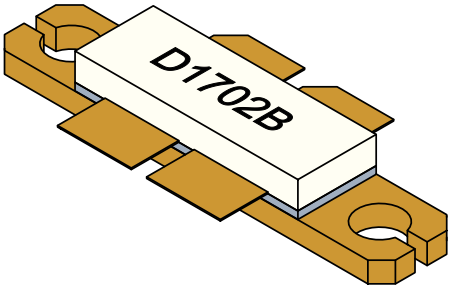
## 1. Description

- The D1702B is an 200W ($P_{SAT}$) wideband pre-matched gallium nitride (GaN) high electron mobility transistor (HEMT) with the first-generation RF GaN technology from Raytron.
- The D1702B operates from DC to 6GHz with a 28V supply rail. It can deliver 100W CW power across 80-1000MHz. The device is offered in an industry standard air cavity package.




D1702B-PDS-F01

**Figure 1. D1702B Package Outline**

## 2. Applications

- Civilian Radar
- Land Mobile Radio Communications
- Avionic and Test Instrumentation
- Balanced Amplifiers, Push-pull Amplifiers and Doherty Power Amplifiers

## 3. Features

- Operating Frequency: DC–6GHz
- Output Power[1] ($P_{SAT}$): 53.5dBm (224W)
- Linear Gain[1]: 13.8dB
- Typical DE @$P_{SAT}$[1]: 72.3%
- Operating Voltage: 28V
- CW and Pulse Capable
- Package Type: 650F-B

[1.] Typical Class AB performance in Raytron DEMO @2.6GHz

## 4. Brief Typical Performance

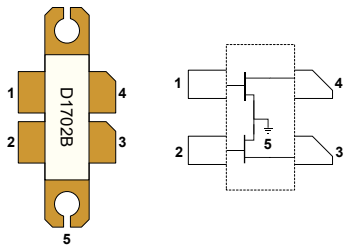
**Table 1. Brief Typical Performance**

| Parameter | 0.3GHz | 0.6GHz | 1GHz | Units |
|---|---|---|---|---|
| Linear Gain | 21.0 | 21.0 | 17.1 | dB |
| Drain Efficiency | 54.0 | 57.4 | 45.9 | % |
| Output Power | 50.9 | 50.8 | 50.6 | dBm |

- Test Condition: CW
- Typical Class AB performance in Raytron DEMO_A (80-1000MHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 400mA, $V_{GS}$ = -2.77V
- $I_{DS}$ is the sum of two discrete Drain terminals, each contributing 200mA.

## 5. Block Diagram

- Pin 3 and Pin 4 serve as two separate Drain terminals. It's suited for Balun matching on the board for the low frequency application.




1. Gate
2. Gate
3. Drain
4. Drain
5. Source

D1702B-PDS-F02

**Figure 2. D1702B 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[1] | $I_{GMax}$ | 18.5 | mA |
| Storage Temperature Range | $T_{STG}$ | -65 ~ +150 | °C |
| Operating Junction Temperature | $T_J$ | 250 | °C |

1. The current is the characteristic value for one drain terminal of the device

## 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, $I_{DS}$ | - | 400 | - | mA |
| Gate-Source Voltage, $V_{GS}$ | - | -2.77 | - | V |
| Channel Temperature, $T_{CH}$ | - | - | 225 | °C |

- $I_{DS}$ is the sum of two discrete Drain terminals, each contributing 200mA

### Table 4. Thermal Resistance[1]

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance (Active Die Surface-to-Case)[2] | $R_{thsc}$ (IR) | 1.31 | °C/W |
| Thermal Resistance (Junction-to-Case)[3] | $R_{thjc}$ (FEA) | 1.61 | °C/W |

1. Thermal Resistance simulated or measured for one drain terminal of the device
2. Thermal Resistance at average power by infrared measurement, Active Die Surface-to-Case, $T_{base\text{-}plate}$ = 85℃, $P_D$ = 64.0W
3. 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[1]

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage[2] ($V_{GS}$ = -10V, $I_{DS}$ = 18.5mA) | $V_{DS(BR)}$ | 84 | - | - | V |
| Saturated Drain Current[2] ($V_{DS}$ = 10V, $V_{GS}$ = 1.0V) | $I_{Max}$ | - | 20.41 | - | A |
| Gate Threshold Voltage[3] ($V_{DS}$ = 28V, $I_{DS}$ = 18.5mA) | $V_{GS(TH)}$ | -3.30 | -2.80 | -2.30 | V |
| Gate Quiescent Voltage[3] ($V_{DS}$ = 28V, $I_{DS}$ = 200mA) | $V_{GS(Q)}$ | - | -2.77 | - | V |

1. Performance for one drain terminal of the device
2. Scaled from PCM data
3. Measured in Raytron DEMO

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

| Parameter | 0.08GHz | 0.15GHz | 0.3GHz | 0.5GHz | 0.7GHz | 0.9GHz | 1.0GHz | Units |
|---|---|---|---|---|---|---|---|---|
| Linear Gain | 17.2 | 20.4 | 21.0 | 21.0 | 20.8 | 18.9 | 17.1 | dB |
| Drain Efficiency | 51.0 | 52.8 | 54.0 | 48.6 | 57.6 | 49.9 | 45.9 | % |
| Output Power | 50.6 | 50.9 | 50.9 | 50.5 | 51.4 | 50.4 | 50.6 | dBm |
| Output Power | 115 | 123 | 123 | 112 | 138 | 110 | 115 | W |

1. Test Condition: CW
2. Typical Class AB performance in Raytron DEMO_A (80-1000MHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 400mA, $V_{GS}$ = -2.77V

- $I_{DS}$ is the sum of two discrete drain terminals, each contributing 200mA

### Table 7. Dynamic Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Input Capacitance | $C_{GS}$ | - | 18.07 | - | pF |
| Output Capacitance | $C_{DS}$ | - | 10.29 | - | pF |
| Feedback Capacitance | $C_{GD}$ | - | 1.01 | - | pF |

- Table 7 demonstrates the capacitance of one drain terminal of the device
- Test Condition: $V_{DS}$ = 28V, $V_{GS}$ = -8V, f = 1MHz

## 9. Wide-band Application Performance

### ■ Wide-band Application Performance (DEMO_A: 80-1000MHz)

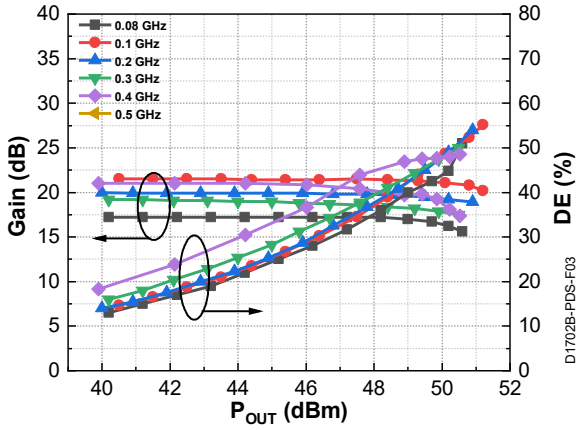



Figure 3. Wide-band Application Gain and DE vs. Output Power

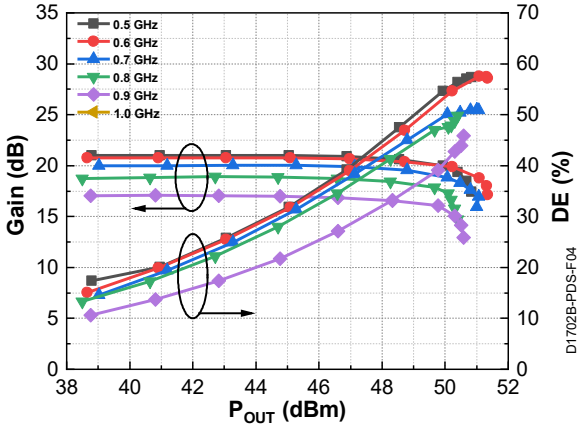



Figure 4. Wide-band Application Gain and DE vs. Output Power

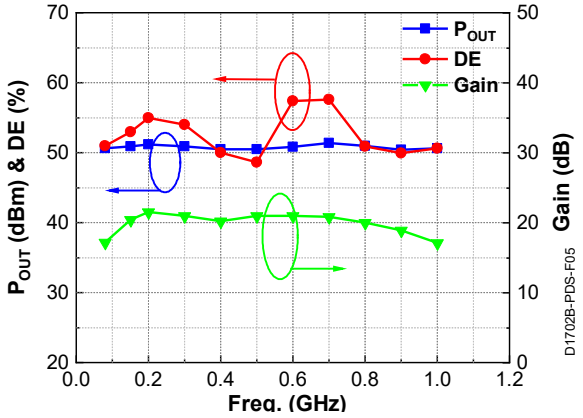



Figure 5. Gain, $P_{OUT}$, and DE vs. Freq.

- Typical Class AB performance in Raytron Wide-band Application DEMO_A with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 400mA, $V_{GS}$ = -2.77V; $I_{DS}$ is the sum of two discrete branches, each contributing 200mA.
- Test Condition: CW
- The output power is 50.3dBm (107W) at 80-1000MHz. It can be used in the radio station application.

# 10. Package Outline

## ■ Pin Layout

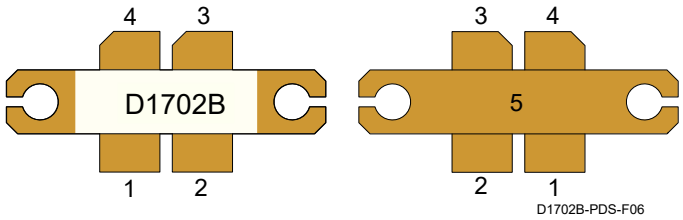



**Figure 6. D1702B Pin Layout**

### 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: 650F-A)

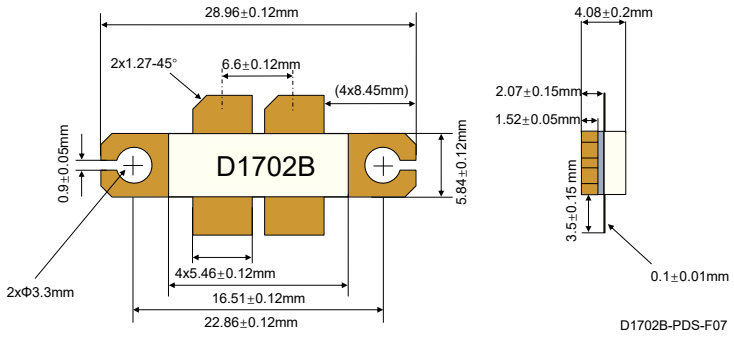



**Figure 7. D1702B Mechanical Drawing**

# 11. Application Circuit

## ■ Schematic

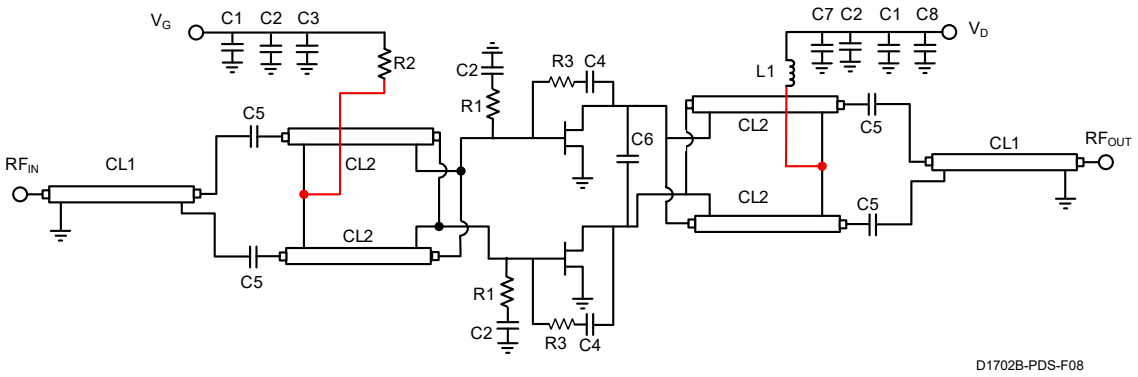



**Figure 8. D1702B DEMO_A Application Circuit Schematic**

### 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 (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

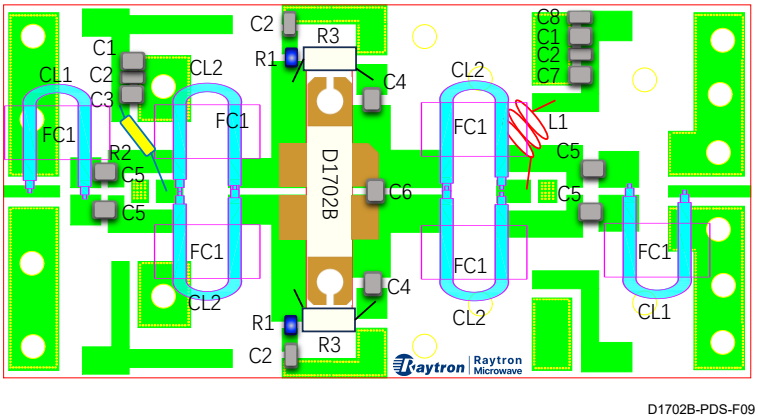



**Figure 9. D1702B DEMO_A Application Circuit Layout**
**(DEMO_A Size: 10.0cm x 5.0cm)**

**Table 10. Bill of Materials**

| Component | Value | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| PCB | 0.8mm | N/A | SYTECH | FR4 |
| C1 | 1.0uF | X7R 100V 1206 Capacitor | Murata | GRM32ER72A105KA01L |
| C2 | 0.1uF | C0G 100V 1206 Capacitor | Murata | GRM3195C2A104JA01D |
| C3 | 82pF | 1111 82pF 1500V Capacitor | Chuangtian | SQ-1111C0G820J152NT |
| C4 | 470pF | 1111 470pF 1500V Capacitor | Chuangtian | SQ-1111C0G471J152NT |
| C5 | 150pF | 1111 150pF 1500V Capacitor | Chuangtian | SQ-1111C0G151J102NT |
| C6 | 12pF | 1111 12pF 1500V Capacitor | Chuangtian | SQ-1111C0G120J152NT |
| C7 | 1000pF | 1111 1nF 1500V Capacitor | Chuangtian | SQ-1111C0G102J501NT |
| C8 | 4.7uF | X7S 100V 1206 Capacitor | Murata | GRM31CC72A475KE11L |
| L1 | N/A | 3 turns, R=2mm, r=0.5mm | N/A | N/A |
| R1 | 33Ω | 1/8W 0805 Resistor | Yageo | RC0805FR-0733RL |
| R2 | 360Ω | 3W ±5% 15.5 x 5mm | Huaxing | MOF3WS-360Ω±5%T |
| R3 | 200Ω | 30W 5 x 2.5mm | Qingda | RFG200-30W-W8 |
| CL1 | 35mm | 50Ohm Coaxial | Various | SFF-50-1.5 |
| CL2 | 35mm | 12.5Ohm Coaxial | Various | SFF-12.5-1.5 |
| FC1 | 145Ω | Ferrite Core | FAIR-RITE | 2861001502 |

## 12. DEMO Summary

**Table 11. DEMO Summary**

| NO. | D1702B DEMO Name | $V_{DS}$ (V) | Freq (GHz) | Linear Gain(dB) | $P_{SAT}$ (dBm) | $P_{SAT}$ (W) | Drain Efficiency | Pulse or CW |
|---|---|---|---|---|---|---|---|---|
| 1 | DEMO_A, 100W | 28 | 0.08-1.0 | 17.1 | 50.3 | 107 | 45.4% | CW |

## 13. Recommended Solder Temperature Profile

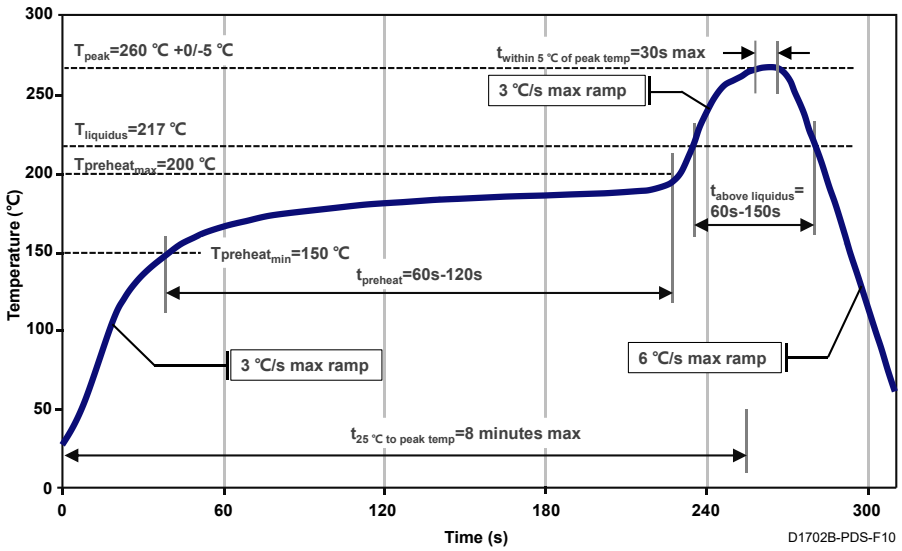



**Figure 10. Recommended Solder Temperature Profile**

## 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

## 16. Disclaimer

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