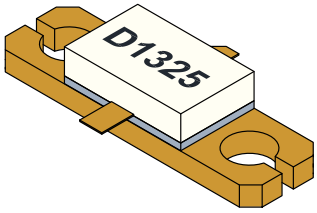
## 1. Description

- The D1325 is a 20W ($P_{SAT}$) multi-octave wideband pre-matched gallium nitride (GaN) high electron mobility transistor (HEMT).
- The D1325 operates from DC to 6.5GHz with a 28V supply rail. The device is offered in an industry standard air cavity package.




D1325-PDS-F01

**Figure 1. D1325 Package Outline**

## 2. Applications

- Wireless Communication Infrastructure
- Drone Countermeasure system
- Wideband Amplifier
- Electro-magnetic Compatibility (EMC) Testing

## 3. Features[1]

- Operating Frequency: DC–6.5GHz
- Output Power ($P_{SAT}$): 46.9dBm (49W)
- Linear Gain: 16.2dB
- Typical DE @$P_{SAT}$: 84.6%
- Operating Voltage: 28V
- CW and Pulse Capable
- Package Type: 360F-A

[1] Measured in load-pull system @2.6GHz

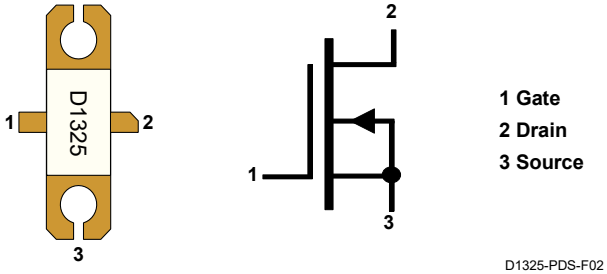
## 4. Brief Typical Performance

**Table 1. Brief Typical Performance**

| Parameter | 1.0GHz | 2.0GHz | 3.0GHz | 4.0GHz | 5.0GHz | 6.0GHz | Units |
|---|---|---|---|---|---|---|---|
| Linear Gain | 11.4 | 12.9 | 10.9 | 10.6 | 9.3 | 11.6 | dB |
| Drain Efficiency | 61.2 | 64.6 | 53.1 | 55.7 | 37.6 | 39.0 | % |
| Output Power | 44.0 | 44.3 | 43.8 | 45.3 | 42.6 | 42.6 | dBm |

- Typical Class AB performance in Raytron DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
- Test Condition: CW

## 5. Block Diagram




D1325-PDS-F02

**Figure 2. D1325 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, $I_{DS}$ | - | 100 | - | mA |
| Gate-Source Voltage, $V_{GS}$ | - | -3.06 | - | V |
| Channel Temperature, $T_{CH}$ | - | - | 225 | °C |

### Table 4. Thermal Resistance

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance (Active Die Surface-to-Case)[1] | $R_{thcs}$ (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) | $V_{DS(BR)}$ | 84 | - | - | V |
| Saturated Drain Current[2] ($V_{DS}$ = 10V, $V_{GS}$ = 1.0V) | $I_{Max}$ | - | 7.73 | - | 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, $I_{DS}$ = 200mA) | $V_{GS(Q)}$ | - | -3.06 | - | 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) |
|---|---|---|---|---|
| 1.0 | 11.4 | 61.2 | 44.0 | 25 |
| 2.0 | 12.9 | 64.6 | 44.3 | 27 |
| 3.0 | 10.9 | 53.1 | 43.8 | 24 |
| 4.0 | 10.6 | 55.7 | 45.3 | 34 |
| 5.0 | 9.3 | 37.6 | 42.6 | 18 |
| 6.0 | 11.6 | 39.0 | 42.6 | 18 |

1. Typical Class AB performance in Raytron DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
2. Test Condition: CW

## Table 7. Dynamic Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Input Capacitance | $C_{GS}$ | - | 13.47 | - | pF |
| Output Capacitance | $C_{DS}$ | - | 2.83 | - | pF |
| Feedback Capacitance | $C_{GD}$ | - | 0.53 | - | pF |

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

# 9. Wide-band Application Performance

## ■ Wide-band Application Performance (DEMO_A: 1-6GHz, Pulse)

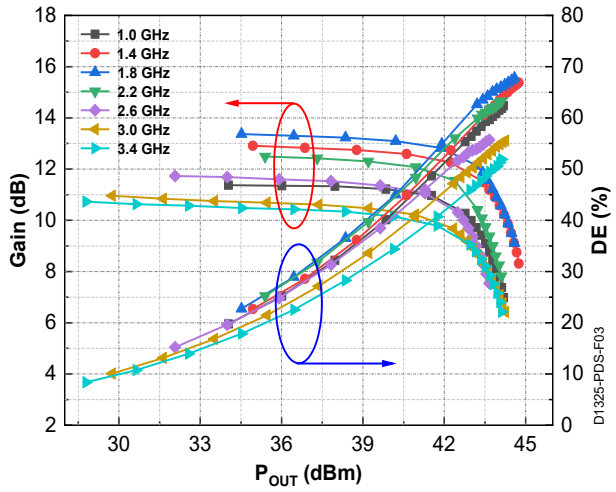



**Figure 3. Wide-band Application Gain and DE vs. Output Power**

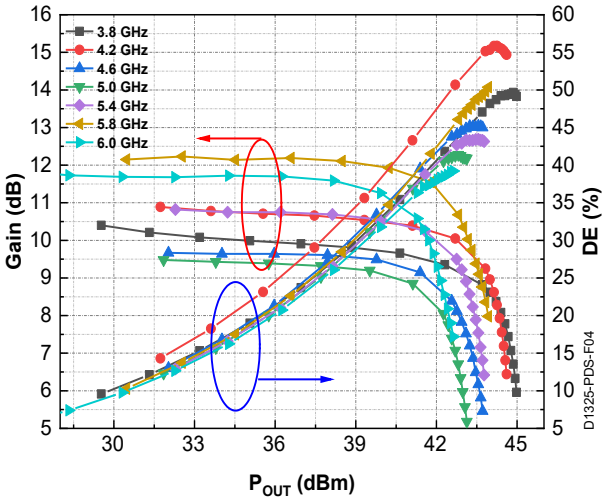



**Figure 4. Wide-band Application Gain and DE vs. Output Power**

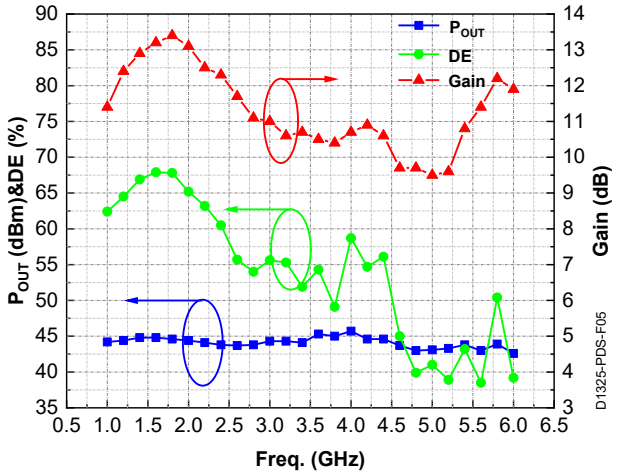



**Figure 5. Wide-band Application $P_{OUT}$, Gain, and DE vs. Freq.**

- Typical Class AB performance in Raytron Wide-band Application DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
- Test Condition: Pulse, Pulse Width = 100us, Duty cycle=10%
- The output power is 42.6dBm (18.2W) at 1-6GHz.

## Table 8. RF Characteristics @ DEMO_A [1,2,3]

| Freq. (GHz) | Linear Gain (dB) | Drain Efficiency (%) | Output Power (dBm) | Output Power (W) |
|---|---|---|---|---|
| 1.0 | 11.4 | 62.4 | 44.2 | 26 |
| 1.2 | 12.4 | 64.5 | 44.4 | 28 |
| 1.4 | 12.9 | 66.9 | 44.8 | 30 |
| 1.6 | 13.2 | 67.9 | 44.8 | 30 |
| 1.8 | 13.4 | 67.8 | 44.6 | 29 |
| 2.0 | 13.1 | 65.2 | 44.4 | 28 |
| 2.2 | 12.5 | 63.2 | 44.1 | 26 |
| 2.4 | 12.3 | 60.5 | 43.8 | 24 |
| 2.6 | 11.7 | 55.7 | 43.7 | 24 |
| 2.8 | 11.1 | 54.0 | 43.8 | 24 |
| 3.0 | 11.0 | 55.6 | 44.3 | 27 |
| 3.2 | 10.6 | 55.3 | 44.3 | 27 |
| 3.4 | 10.7 | 51.9 | 44.1 | 26 |
| 3.6 | 10.5 | 54.3 | 45.3 | 34 |
| 3.8 | 10.4 | 49.1 | 45.0 | 32 |
| 4.0 | 10.7 | 58.7 | 45.7 | 37 |
| 4.2 | 10.9 | 54.7 | 44.6 | 29 |
| 4.4 | 10.6 | 56.1 | 44.6 | 29 |
| 4.6 | 9.7 | 45.0 | 43.7 | 23 |
| 4.8 | 9.7 | 39.9 | 43.0 | 20 |
| 5.0 | 9.5 | 41.0 | 43.1 | 20 |
| 5.2 | 9.6 | 38.9 | 43.3 | 21 |
| 5.4 | 10.8 | 43.2 | 43.8 | 24 |
| 5.6 | 11.4 | 38.5 | 43.0 | 20 |
| 5.8 | 12.2 | 50.4 | 43.9 | 25 |
| 6.0 | 11.9 | 39.2 | 42.6 | 18 |

1. Typical Class AB performance in Raytron DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
2. Test Condition: Pulse, Pulse Width=100 us, Duty cycle=10%
3. The output power is 42.6dBm (18.2W) at 1-6GHz.

## ■ Wide-band Application Performance (DEMO_A: 1-6GHz, CW)

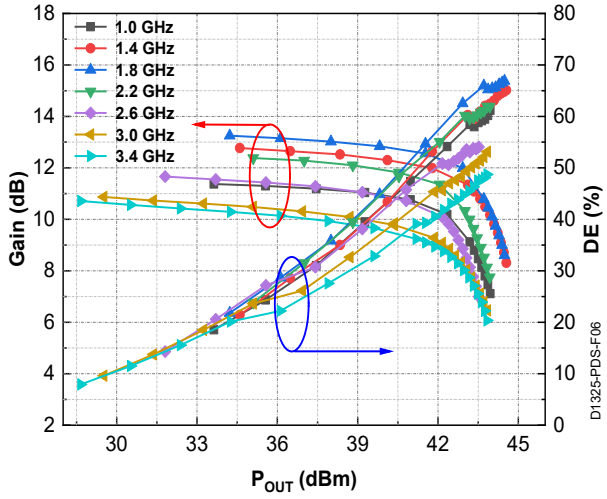



**Figure 6. Wide-band Application Gain and DE vs. Output Power**

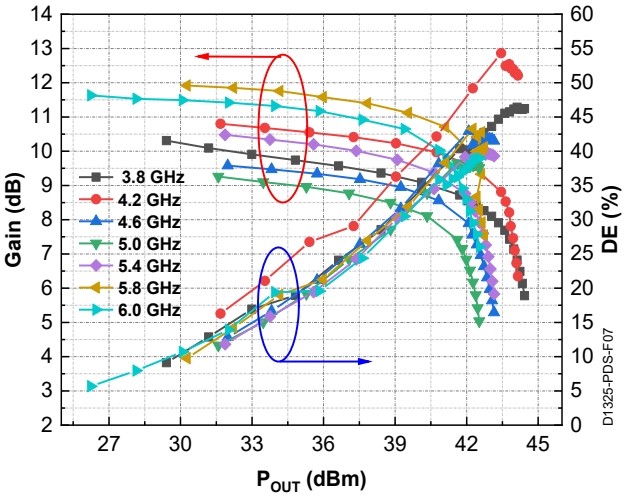



**Figure 7. Wide-band Application Gain and DE vs. Output Power**

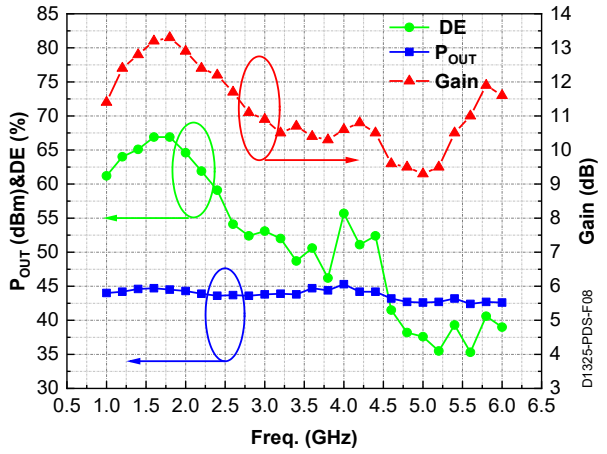



**Figure 8. Wide-band Application $P_{OUT}$, Gain, and DE vs. Freq.**

- Typical Class AB performance in Raytron Wide-band Application DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
- Test Condition: CW
- The output power is 42.4dBm (17.4W) at 1-6GHz.

## Table 9. RF Characteristics @ DEMO_A [1,2,3]

| Freq. (GHz) | Linear Gain (dB) | Drain Efficiency (%) | Output Power (dBm) | Output Power (W) |
|---|---|---|---|---|
| 1.0 | 11.4 | 61.2 | 44.0 | 25 |
| 1.2 | 12.4 | 64.0 | 44.2 | 26 |
| 1.4 | 12.8 | 65.1 | 44.6 | 29 |
| 1.6 | 13.2 | 66.9 | 44.7 | 30 |
| 1.8 | 13.3 | 66.9 | 44.5 | 28 |
| 2.0 | 12.9 | 64.6 | 44.3 | 27 |
| 2.2 | 12.4 | 61.9 | 43.9 | 25 |
| 2.4 | 12.2 | 59.1 | 43.6 | 23 |
| 2.6 | 11.7 | 54.1 | 43.7 | 23 |
| 2.8 | 11.1 | 52.4 | 43.6 | 23 |
| 3.0 | 10.9 | 53.1 | 43.8 | 24 |
| 3.2 | 10.5 | 52.0 | 43.9 | 25 |
| 3.4 | 10.7 | 48.7 | 43.8 | 24 |
| 3.6 | 10.4 | 50.6 | 44.7 | 30 |
| 3.8 | 10.3 | 46.2 | 44.4 | 28 |
| 4.0 | 10.6 | 55.7 | 45.3 | 34 |
| 4.2 | 10.8 | 51.1 | 44.2 | 26 |
| 4.4 | 10.5 | 52.4 | 44.2 | 26 |
| 4.6 | 9.6 | 41.5 | 43.2 | 21 |
| 4.8 | 9.5 | 38.2 | 42.7 | 19 |
| 5.0 | 9.3 | 37.6 | 42.6 | 18 |
| 5.2 | 9.5 | 35.5 | 42.7 | 19 |
| 5.4 | 10.5 | 39.3 | 43.2 | 21 |
| 5.6 | 11.0 | 35.3 | 42.4 | 17 |
| 5.8 | 11.9 | 40.6 | 42.7 | 19 |
| 6.0 | 11.6 | 39.0 | 42.6 | 18 |

1. Typical Class AB performance in Raytron DEMO_A (1-6GHz) with the device soldered onto the heatsink, test condition: $V_{DS}$ = 28V, $I_{DS}$ = 200mA, $V_{GS}$ = -3.06V
2. Test Condition: CW
3. The output power is 42.4dBm (17.4W) at 1-6GHz.

# 10. Package Outline

## ■ Pin Layout

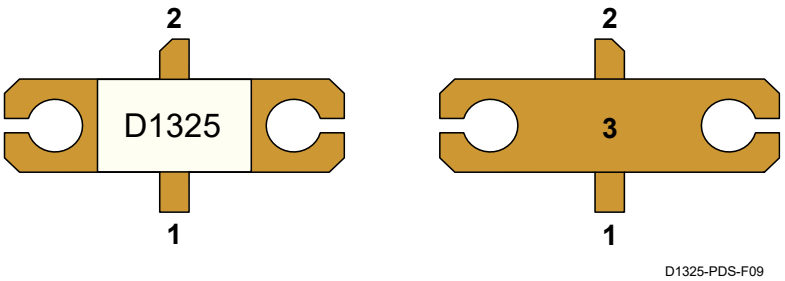



**Figure 9. D1325 Pin Layout**

### Table 10. 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)

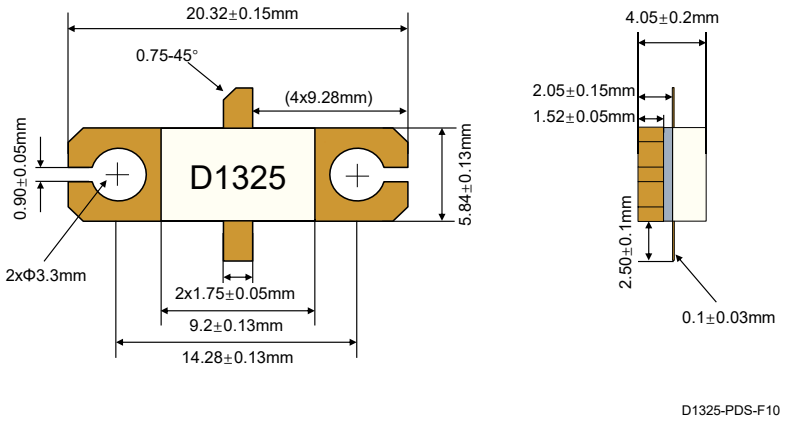



**Figure 10. D1325 Mechanical Drawing**

# 11. Application Circuit

## ■ Schematic

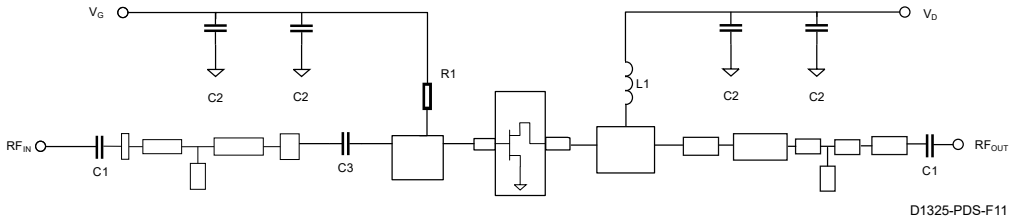



**Figure 11. D1325 DEMO_A Application Circuit Schematic (1-6GHz)**

### Table 11. 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

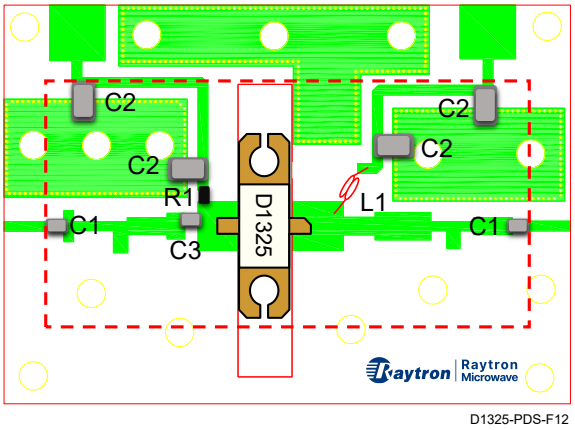



**Figure 12. D1325 Application Circuit Layout (1.0-6.0GHz)**
**(DEMO_A Effective Size: 5.5cm x 3.0cm)**

### Table 12. Bill of Materials

| Component | Value | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| PCB | 20mil | N/A | Rogers | RO4350B |
| C1 | 6.0pF | C0G 250V 0805 Capacitor | Murata | GQM2195C2E6R0CB12D |
| C2 | 4.7uF | X7S 100V 1206 Capacitor | Murata | GRM31CC72A475KE11L |
| C3 | 5.5pF | C0G 250V 0805 Capacitor | Murata | GQM2195C2E5R5BB12D |
| R1 | 110Ω | 1/8W 0805 Resistor | Yageo | RC0805FR-07110RL |
| L1 | N/A | 2turns, D=5mm, d=4mm | N/A | N/A |

## 12. DEMO Summary

**Table 13. DEMO Summary**

| D1325 DEMO Name | $V_{DS}$ (V) | Freq (GHz) | Linear Gain(dB) | $P_{SAT}$ (dBm) | $P_{SAT}$ (W) | Drain Efficiency (%) | Pulse or CW |
|---|---|---|---|---|---|---|---|
| DEMO_A, 20W | 28 | 1-6 | 9.3 | 42.4 | 17 | 35% | CW |
| DEMO_A, 20W | 28 | 1-6 | 9.5 | 42.6 | 18 | 39% | Pulse |

## 13. Recommended Solder Temperature Profile

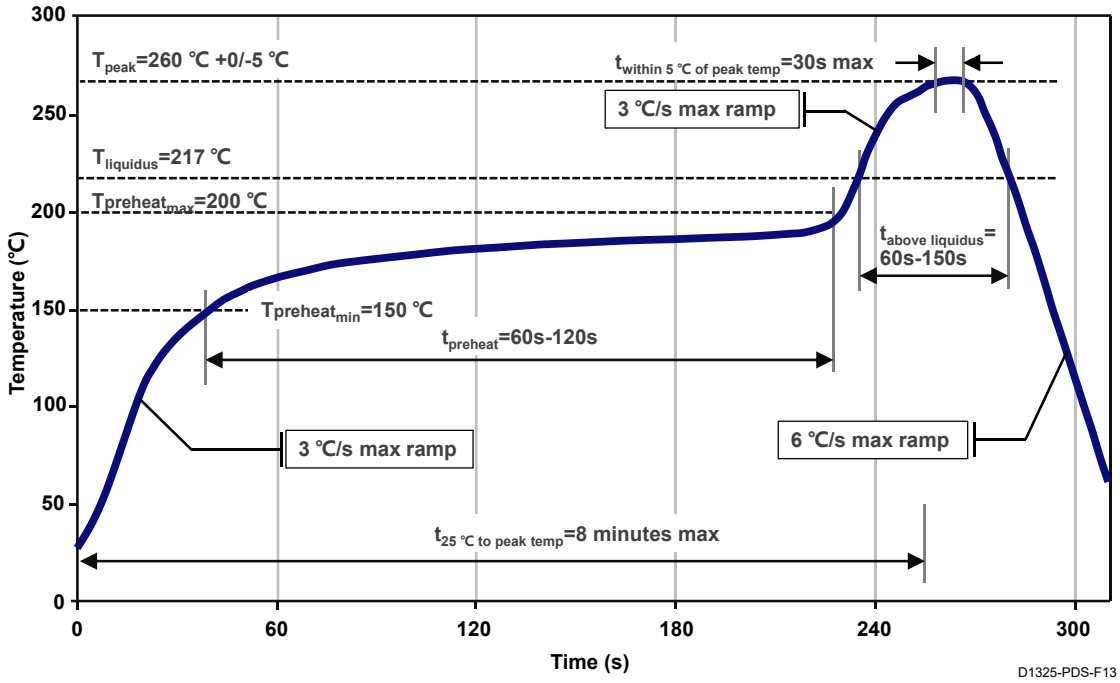



**Figure 13. Recommended Solder Temperature Profile**

## 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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