

## TBQ-3018

### 14.0 to 14.5 GHz GaAs MMIC

### Power Amplifier for VSAT Applications

#### Features

- ◆ +30 dBm Output Power at 1 dB Gain Compression
- ◆ 35 dB typical Small Signal Gain
- ◆ 7 dB typical Noise Figure
- ◆ Thermally Efficient Copper-Tungsten Package



#### Product Description

The TBQ-3018 is a four stage PHEMT GaAs MMIC amplifier that is ideally suited to Ku-Band VSAT applications. The amplifier provides a minimum of 30 dB gain and delivers high efficiency at 1 watt output power from 14.0 to 14.5 GHz. The small package provides a simple, cost effective solution to customized designs. The base material is gold plated copper-tungsten to provide excellent thermal dissipation.

#### Electrical Specifications ( $T = +25^{\circ}\text{C}$ , $V_d = 8\text{V}$ , $V_g = -0.1\text{V}$ to $-1.5\text{V}$ , $I_d = 650\text{mA}$ )

| Parameter                                               | Symbol            | Min | Max  | Typical | Units                  |
|---------------------------------------------------------|-------------------|-----|------|---------|------------------------|
| Operating Frequency                                     | $F_{OP}$          | 14  | 14.5 | -       | GHz                    |
| Gain                                                    | $S_{21}$          | 30  | -    | 35      | dB                     |
| Input /Output VSWR                                      | VSWR              | -   | -    | 3:1     | -                      |
| Output Power at 1 dB Gain Compression*                  | $P_{-1\text{dB}}$ | 30  | -    | 31      | dBm                    |
| Third Order Intercept                                   | IP3               | -   | -    | 40      | dBm                    |
| Noise Figure                                            | NF                | -   | -    | 7       | dB                     |
| Gain Variation Over Operating Frequency                 | $\Delta S_{21}$   | -   | 2    | -       | dB                     |
| Gain Variation Over Operating Frequency and Temperature | $\Delta S_{21}$   | -   | -    | -0.06   | dB/ $^{\circ}\text{C}$ |

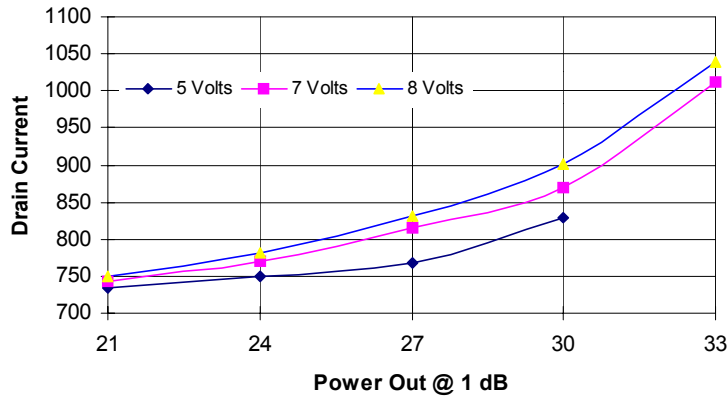
\*  $I_d = 500\text{mA}$ , typical

#### Maximum Ratings ( $T_A = +25^{\circ}\text{C}$ unless otherwise noted)

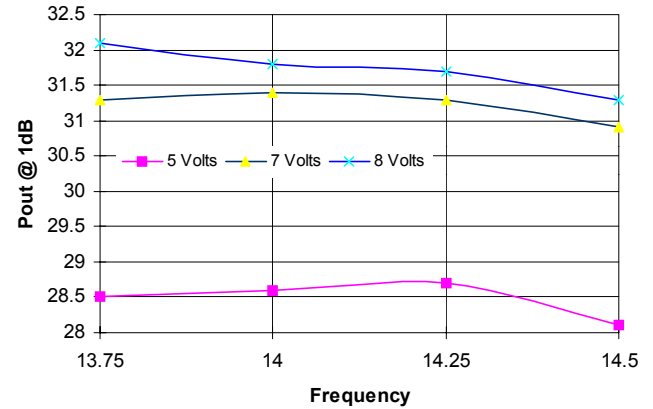
| Rating                  | Symbol    | Value       | Unit               |
|-------------------------|-----------|-------------|--------------------|
| DC Drain Supply Voltage | $V_{DD}$  | 9v          | Vdc                |
| DC Gate Supply Voltage  | $V_{GG}$  | -3V         | Vdc                |
| RF Input Power          | $P_{IN}$  | +1          | mW                 |
| Junction Temperature    | $T_J$     | +150        | $^{\circ}\text{C}$ |
| Storage Temperature     | $T_{STG}$ | -40 to +110 | $^{\circ}\text{C}$ |

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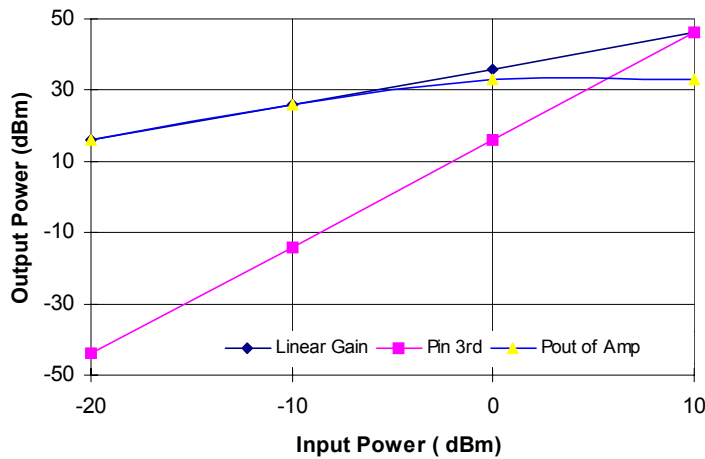
Drain Current vs Pout @ 1 dB vs Voltage



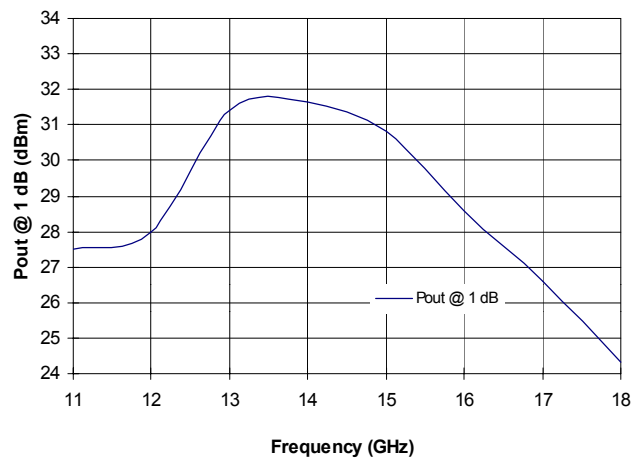
Pout@ 1 dB vs Frequency vs Drain Voltage



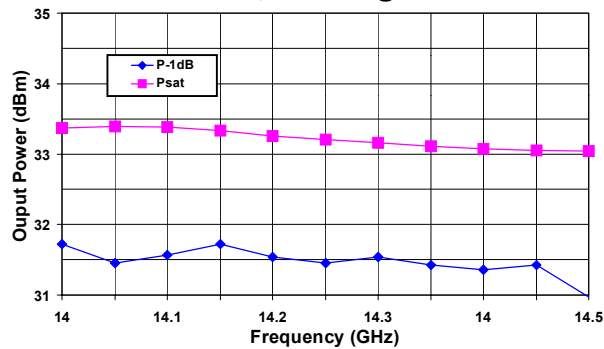
3rd Order Intercept Point (F = 14 GHz)



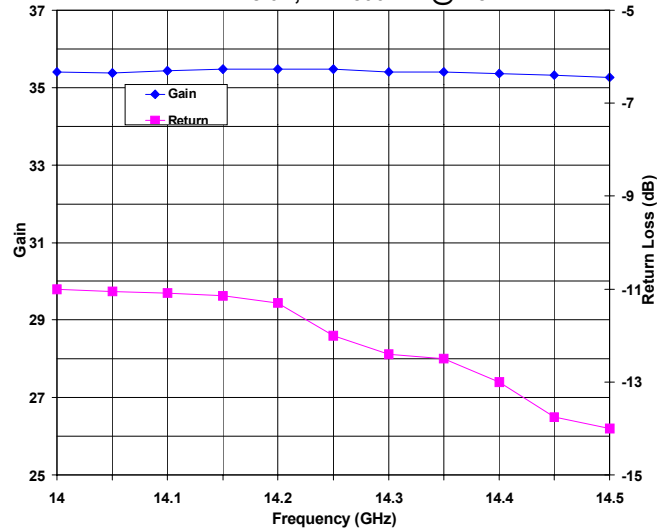
Pout @ 1 dB



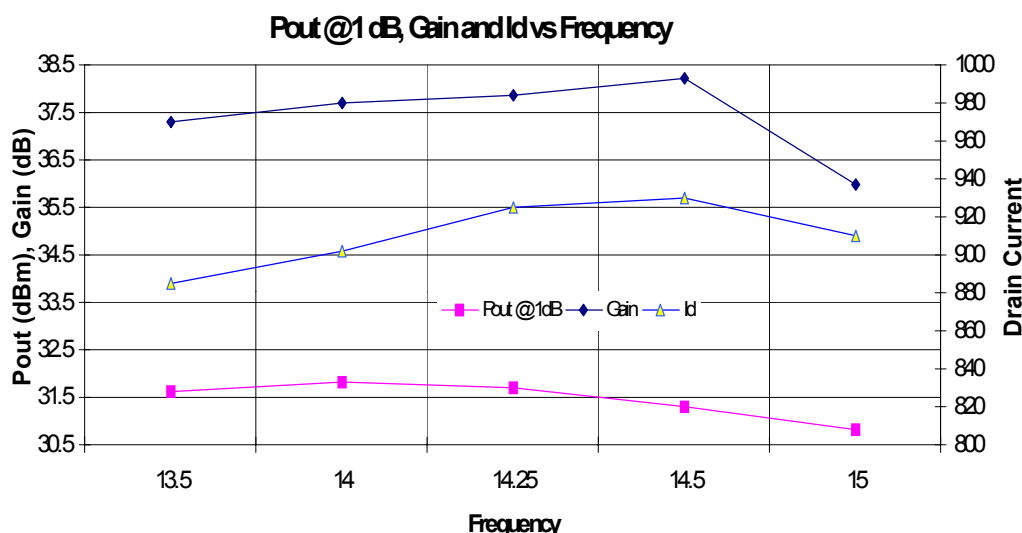
Typical Output Power  
VDD=8.0V, ID=650 mA @+25C



Typical SSG and Input Return Loss  
VDD = 8.0V, ID = 500 mA @+25C



## 14.0 to 14.5 GHz GaAs MMIC Power Amplifier for VSAT Applications



## Application Information

### Power Amplifier Biasing Procedure

CAUTION: LOSS OF GATE VOLTAGE (VG) WHILE DRAIN VOLTAGE (VD) IS PRESENT MAY DAMAGE THE AMPLIFIER. THIS AMPLIFIER IS AN ESD SENSITIVE DEVICE.

The following Procedure must be followed for the amplifier to operate properly:

1. Slowly apply Gate Voltage (typical  $V_{pinch-off} = -1.5V$ ) to terminal VG.
2. Slowly apply Drain Voltage at VD (<+5 volts) and monitor drain current  $I_{ds}$ . Adjust negative voltage VG to set the drain current ( $I_{ds}$ ) to approximately 600 mA. Adjust the drain voltage VD to nominal +8 volts (adjust Gate Voltage VG, if needed, to maintain the drain current at  $I_{ds}$ ).
3. After the bias condition is established, RF input signal may now be applied at the appropriate frequency band.
4. Follow Turn-off sequence: First, RF input power=off, next, VD=off, then, VG=off.

### Device Handling Procedures

1. **Cleanliness:** Observe proper handling procedures to ensure clean devices and PCBs. Devices should remain in their original packaging until component placement to ensure no contamination or damage to RF, DC & ground contact areas.
2. **Device Cleaning:** Standard board cleaning techniques should not present device problems provided that the boards are properly dried to remove solvents or water residues.
3. **ESD precautions to protect against ESD damage:**
  - A properly grounded static-dissipative surface on which to place devices.
  - Static-dissipative floor or mat.
  - A properly grounded conductive wrist strap for each person to wear while handling devices.
4. **General Handling:** Handle the device along the edges with a sharp pair of bent tweezers. Do not apply excessive pressure to the top of the lid.
5. **Device Storage:** Devices should be stored in a dry nitrogen environment.

## 14.0 to 14.5 GHz GaAs MMIC Power Amplifier for VSAT Applications

The drawing shows the TBQ 3018 package from three perspectives:

- Top View:** Shows a central square body with pins 1-10. Pin 1 is V<sub>d</sub>, pin 2 is GND, pin 3 is RF IN, pin 4 is GND, pin 5 is V<sub>g</sub>, pin 6 is GND, pin 7 is V<sub>g</sub>, pin 8 is RF OUT, pin 9 is GND, and pin 10 is V<sub>d</sub>. The package is marked with a butterfly logo and "TBQ 3018". It has mounting holes with a diameter of  $\phi .090$  and a distance of  $2X$  between them.
- Side View:** Shows the package height and pin spacing. The total height is  $.085$ . The pin pitch is  $.050$ . The distance from the top of the package to the top of the pins is  $.050$ . The distance from the bottom of the package to the bottom of the pins is  $.050$ . The distance from the center of the package to the center of the pins is  $.165$ . The distance from the center of the package to the edge of the pins is  $.33$ . The distance from the center of the package to the center of the pins is  $.33$ . The distance from the center of the package to the center of the pins is  $.33$ .
- End View:** Shows the package width and pin spacing. The total width is  $.085$ . The pin pitch is  $.050$ . The distance from the top of the package to the top of the pins is  $.050$ . The distance from the bottom of the package to the bottom of the pins is  $.050$ . The distance from the center of the package to the center of the pins is  $.165$ . The distance from the center of the package to the edge of the pins is  $.33$ . The distance from the center of the package to the center of the pins is  $.33$ . The distance from the center of the package to the center of the pins is  $.33$ .

EXTERNAL ELEMENTS REQUIRED:  
 BYPASS CAPACITORS: 1  $\mu$ F CAPACITOR TYPICAL  
 50 OHM MICROSTRIP INTERFACE (FOR MAXIMUM PERFORMANCE)

Figure 1 is a detailed schematic diagram of the RF input and output sections of a 2N4350 vacuum tube. The diagram shows the internal circuitry, including the RF input (RF' IN) and RF output (RF OUT) sections. Key components include the 2N4350 tube, various capacitors (e.g., .000, .065, .130, .720, .785, .850, .530, .340 MAX., .128, .385, .615, .915), and the output filter (TBQ-3017, TBQ-3018). The diagram is labeled with dimensions and part numbers.

1. Dual bias supply required.
2. DC supply sequencing or protection circuitry not included. See Amplifier Biasing Procedure
3. A 360 pF DC supply line decoupling capacitor is included on both  $V_a$  and  $V_g$  lines. (See typical biasing configuration shown above).
4. The last fixture or circuit should incorporate additional bypass capacity (25uF) on the drain and gate bias terminals to prevent oscillations caused by feedback signals.
5. Supply (drain and gate) wire/leads should be as short as possible.
6. Close placement of external components to the power amplifier is essential for stability purposes.
7. TET recommends the unit be soldered to DC and RF ground for best results.
8. Pin numbers indicated on outline drawing are for user information only. Units are not labeled with pin numbers.
9. MASK drawing for circuit board available on the Teledyne Wireless website at [www.teledynewireless.com](http://www.teledynewireless.com).



**TELEDYNE WIRELESS**  
A Teledyne Technologies Company

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