ADVANCED POWER TECHNOLOGY RF®
140 COMMERCE DRIVE
MONTGOMERYVILLE, PA
18936-1013
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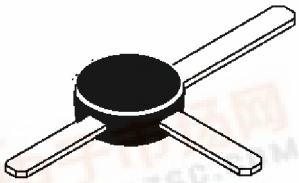
# BFR96
# BFR96G

* G Denotes RoHS Compliant, Pb Free Terminal Finish

## RF & MICROWAVE DISCRETE LOW POWER TRANSISTORS

### Features

- High Current-Gain – Bandwidth Product, fT = 4.5 GHz (typ) @ IC = 50 mA
- Low Noise Figure – NF = 2.4 dB (typ) @ f = 0.5 GHz
- High Power Gain – Gmax = 14.5dB (typ) @ f = 0.5 GHz



**Macro T**
(STYLE #2)

DESCRIPTION: Designed primarily for use in high-gain, low noise, small-signal amplifiers. Also used in applications requiring fast switching times.

### ABSOLUTE MAXIMUM RATINGS (Tcase = 25°C)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CEO}$ | Collector-Emitter Voltage | 15 | Vdc |
| $V_{CBO}$ | Collector-Base Voltage | 20 | Vdc |
| $V_{EBO}$ | Emitter-Base Voltage | 3.0 | Vdc |
| $I_C$ | Collector Current | 100 | mA |

### Thermal Data

| | | | |
|---|---|---|---|
| $P_D$ | Total Device Dissipation @ TC = 100ºC<br>Derate above 100ºC | 500<br>10 | mWatts<br>mW/ ºC |

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## ELECTRICAL SPECIFICATIONS (Tcase = 25°C)

### STATIC

(off)

| Symbol | Test Conditions | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| BVCEO | Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0) | 15 | - | - | Vdc |
| BVCB0 | Collector-Base Breakdown Voltage (IC = 0.1 mAdc, IE = 0) | 20 | - | - | Vdc |
| BVEBO | Emitter-Base Breakdown Voltage (IE = 0.1 mAdc, IC = 0) | 3.0 | - | - | Vdc |
| ICBO | Collector Cutoff Current (VCB = 10 Vdc, VBE = 0 Vdc) | - | - | 100 | nA |

(on)

| | | | | | |
|---|---|---|---|---|---|
| HFE | DC Current Gain (IC = 50 mAdc, VCE = 10 Vdc) | 30 | - | 200 | - |

### DYNAMIC

| Symbol | Test Conditions | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Ftau | Current-Gain – Bandwidth Product (IC = 50 mA, VCE = 10 Vdc, f = 0.5 GHz) | - | 5.0 | - | GHz |
| CCB | Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz) | - | 2.6 | 3.2 | pF |

ADVANCED POWER TECHNOLOGY RF®

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FUNCTIONAL

| Symbol | Test Conditions | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| NF | Noise Figure<br>(IC = 10 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 2.0 | - | dB |
| $\|S_{21}\|^2$ | Insertion Gain<br>(IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | 12 | 13 | - | dB |
| MSG | Maximum Stable Gain<br>(IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 16.5 | - | dB |
| $G_{U\ max}$ | Maximum Unilateral Gain (1)<br>(IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 14.5 | - | dB |

## Table 1. Common Emitter S-Parameters, @ VCE = 10 V, IC = 50 mA

| f | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| (MHz) | \|S11\| | ∠ ϕ | \|S21\| | ∠ ϕ | \|S12\| | ∠ ϕ | \|S22\| | ∠ ϕ |
| 100 | 0.388 | -130 | 21 | 112 | 0.029 | 66 | 0.416 | -54 |
| 200 | 0.422 | -158 | 11 | 94 | 0.046 | 89 | 0.277 | -71 |
| 300 | 0.432 | -168 | 7.5 | 86 | 0.064 | 72 | 0.229 | -79 |
| 500 | 0.447 | 178 | 4.6 | 75 | 0.103 | 75 | 0.224 | -92 |
| 700 | 0.454 | 170 | 3.4 | 65 | 0.144 | 74 | 0.246 | -100 |
| 800 | 0.462 | 167 | 3 | 61 | 0.165 | 74 | 0.26 | -103 |
| 1000 | 0.479 | 159 | 2.5 | 53 | 0.212 | 72 | 0.284 | -112 |
| 1500 | 0.470 | 138 | 1.8 | 32 | 0.333 | 66 | 0.375 | -134 |

ADVANCED POWER TECHNOLOGY RF®

# BFR96

# BFR96G

## RF Low Power, PA, LNA, & General Purpose Selector Guide.

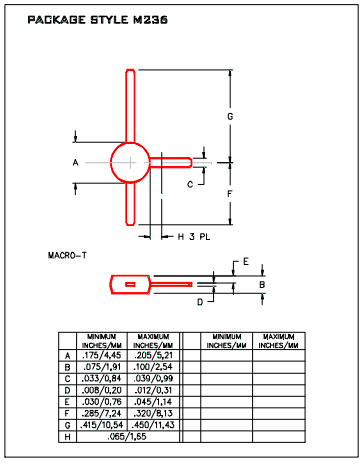
| Package | Device | Type | GPE Freq (MHz) | Pout (watts) | GPE (dB) | Efficiency (%) | GPE VCC | BVCEO | IC max (mA) |
|---|---|---|---|---|---|---|---|---|---|
| SO-8 | MRF4427, R2 | NPN | 175 | 0.15 | 18 | 60 | 12 | 20 | 400 |
| TO-39 | 2N4427 | NPN | 175 | 1 | 10 | 50 | 12 | 20 | 400 |
| POWER MACRO | MRF553 | NPN | 175 | 1.5 | 11.5 | 60 | 12.5 | 16 | 500 |
| POWER MACRO | MRF553T | NPN | 175 | 1.5 | 11.5 | 50 | 12.5 | 16 | 500 |
| TO-39 | MRF607 | NPN | 175 | 1.75 | 11.5 | 50 | 12.5 | 16 | 330 |
| TO-39 | 2N6255 | NPN | 175 | 3 | 7.8 | 50 | 12.5 | 18 | 1000 |
| TO-72 | 2N5179 | NPN | 200 | | 20 | | 6 | 12 | 50 |
| MACRO X | MRF559 | NPN | 512 | 0.5 | 10 | 65 | 7.5 | 16 | 150 |
| MACRO X | MRF559 | NPN | 512 | 0.5 | 13 | 60 | 12.5 | 16 | 150 |
| TO-39 | 2N3866A | NPN | 400 | 1 | 10 | 45 | 28 | 30 | 400 |
| SO-8 | MRF3866, R1, R2 | NPN | 400 | 1 | 10 | 45 | 28 | 30 | 400 |
| POWER MACRO | MRF555 | NPN | 470 | 1.5 | 11 | 50 | 12.5 | 16 | 400 |
| POWER MACRO | MRF555T | NPN | 470 | 1.5 | 11 | 50 | 12.5 | 16 | 400 |
| MACRO X | MRF559 | NPN | 870 | 0.5 | 6.5 | 70 | 7.5 | 16 | 150 |
| MACRO X | MRF559 | NPN | 870 | 0.5 | 9.5 | 65 | 12.5 | 16 | 150 |
| SO-8 | MRF8372,R1,R2 | NPN | 870 | 0.75 | 8 | 55 | 12.5 | 16 | 200 |
| POWER MACRO | MRF557 | NPN | 870 | 1.5 | 8 | 55 | 12.5 | 16 | 400 |
| POWER MACRO | MRF557T | NPN | 870 | 1.5 | 8 | 55 | 12.5 | 16 | 400 |

RF (Low Power PA / General Purpose) Selection Guide

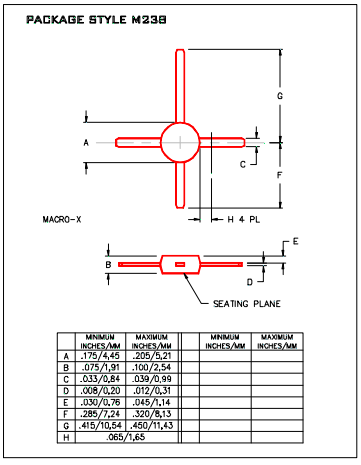
| Package | Device | Type | Freq (MHz) | NF (dB) | NF IC (mA) | NF VCE | GN (dB) | Gu Max (dB) | Ftau (MHz) | Ccb(pF) | BVCEO | IC max (mA) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TO-39 | 2N5109 | NPN | 200 | 3 | 10 | 15 | | 12 | 1200 | 3.5 | 20 | 400 |
| TO-39 | MRF5943C | NPN | 200 | 3.4 | 30 | 15 | | 11.4 | 1000 | | 30 | 400 |
| SO-8 | MRF5943, R1, R2 | NPN | 200 | 3.4 | 30 | 15 | | 15 | 1300 | | 30 | 400 |
| TO-72 | 2N5179 | NPN | 200 | 4.5 | 1.5 | 6 | | 17 | 900 | 1 | 12 | 50 |
| TO-72 | 2N2857 | NPN | 300 | 5.5 | 50 | 6 | | 13 | 1600 | 1 | 15 | 40 |
| TO-39 | MRF517 | NPN | 300 | 7.5 | 50 | 15 | | 5.5 | 4600 | 3 | 25 | 150 |
| TO-72 | MRF904 | NPN | 450 | 1.5 | 5 | 6 | | 11 | 4000 | 1 | 15 | 30 |
| TO-72 | 2N6304 | NPN | 450 | 5 | 2 | 5 | | 14 | 1400 | 1 | 15 | 50 |
| MACRO T | BFR91 | NPN | 500 | 1.9 | 2 | 5 | 11 | 16.5 | 5000 | 1 | 12 | 35 |
| MACRO T | BFR96 | NPN | 500 | 2 | 10 | 10 | | 14.5 | 500 | 2.6 | 15 | 100 |
| SO-8 | MRF5812, R1, R2 | NPN | 500 | 2 | 50 | 10 | 15.5 | 17.8 | 5000 | | 15 | 200 |
| MACRO X | MRF581A | NPN | 500 | 2 | 50 | 10 | 14 | 15 | 5000 | | 15 | 200 |
| Macro | BFR90 | NPN | 500 | 2.4 | 2 | 10 | 15 | 18 | 5000 | 1 | 15 | 30 |
| TO-72 | BFY90 | NPN | 500 | 2.5 | 2 | 5 | | 20 | 1300 | | 15 | 50 |
| TO-72 | MRF914 | NPN | 500 | 2.5 | 5 | 10 | | 15 | 4500 | | 12 | 40 |
| MACRO X | MRF581 | NPN | 500 | 2.5 | 50 | 10 | 15 | 17.8 | 5000 | | 16 | 200 |
| TO-39 | MRF586 | NPN | 500 | 3 | 90 | 15 | 11 | 14.5 | 4500 | 2.2 | 17 | 200 |
| MACRO X | MRF951 | NPN | 1000 | 1.3 | 5 | 6 | 14 | 17 | 8000 | 0.45 | 10 | 100 |
| MACRO X | MRF571 | NPN | 1000 | 1.5 | 10 | 6 | 10 | | 8000 | 1 | 10 | 70 |
| MACRO T | BFR91 | NPN | 1000 | 2.5 | 2 | 5 | 8 | 11 | 5000 | 1 | 12 | 35 |
| MACRO T | BFR90 | NPN | 1000 | 3 | 2 | 10 | 10 | 12.5 | 5000 | 1 | 15 | 30 |
| TO-39 | MRF545 | PNP | | | | | | 14 | 1400 | 2 | 70 | 400 |
| TO-39 | MRF544 | NPN | | | | | | 13.5 | 1500 | | 70 | 400 |

RF (LNA / General Purpose) Selection Guide

## Low Cost Plastic Package Types




| | MINIMUM INCHES/MM | MAXIMUM INCHES/MM | | MINIMUM INCHES/MM | MAXIMUM INCHES/MM |
|---|---|---|---|---|---|
| A | .175/4,45 | .205/5,21 | | | |
| B | .075/1,91 | .100/2,54 | | | |
| C | .033/0,84 | .039/0,99 | | | |
| D | .008/0,20 | .012/0,31 | | | |
| E | .030/0,76 | .045/1,14 | | | |
| F | .285/7,24 | .320/8,13 | | | |
| G | .415/10,54 | .450/11,43 | | | |
| H | .065/1,65 | | | | |

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|---|---|---|---|---|---|
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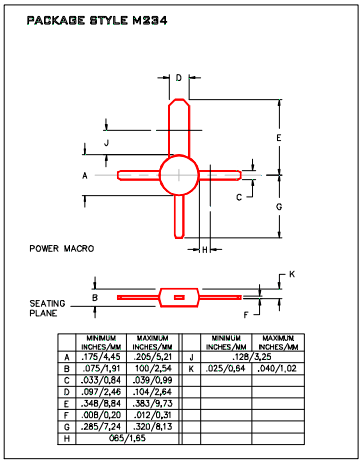
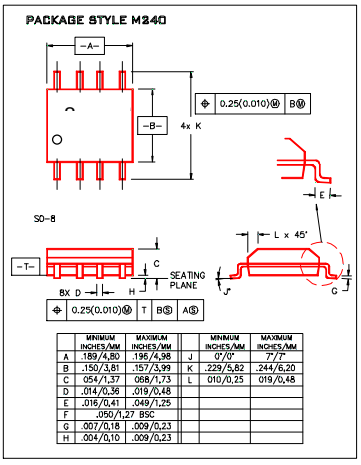
| B | .075/1,91 | .100/2,54 | | | |
| C | .033/0,84 | .039/0,99 | | | |
| D | .008/0,20 | .012/0,31 | | | |
| E | .030/0,76 | .045/1,14 | | | |
| F | .285/7,24 | .320/8,13 | | | |
| G | .415/10,54 | .450/11,43 | | | |
| H | .065/1,65 | | | | |




| | MINIMUM INCHES/MM | MAXIMUM INCHES/MM | | MINIMUM INCHES/MM | MAXIMUM INCHES/MM |
|---|---|---|---|---|---|
| A | .175/4,45 | .205/5,21 | J | .128/3,25 | |
| B | .075/1,91 | 100/2,54 | K | .025/0,64 | .040/1,02 |
| C | .033/0,84 | .039/0,99 | | | |
| D | .097/2,46 | .104/2,64 | | | |
| E | .348/8,84 | .383/9,73 | | | |
| F | .008/0,20 | .012/0,31 | | | |
| G | .285/7,24 | .320/8,13 | | | |
| H | 065/1,65 | | | | |




| | MINIMUM INCHES/MM | MAXIMUM INCHES/MM | | MINIMUM INCHES/MM | MAXIMUM INCHES/MM |
|---|---|---|---|---|---|
| A | .189/4,80 | .196/4,98 | J | 0°/0° | 7°/7° |
| B | .150/3,81 | .157/3,99 | K | .229/5,82 | .244/6,20 |
| C | .054/1,37 | .068/1,73 | L | 010/0,25 | 019/0,48 |
| D | .014/0,36 | .019/0,48 | | | |
| E | .016/0,41 | .049/1,25 | | | |
| F | .050/1,27 BSC | | | | |
| G | .007/0,18 | .009/0,23 | | | |
| H | .004/0,10 | .009/0,23 | | | |

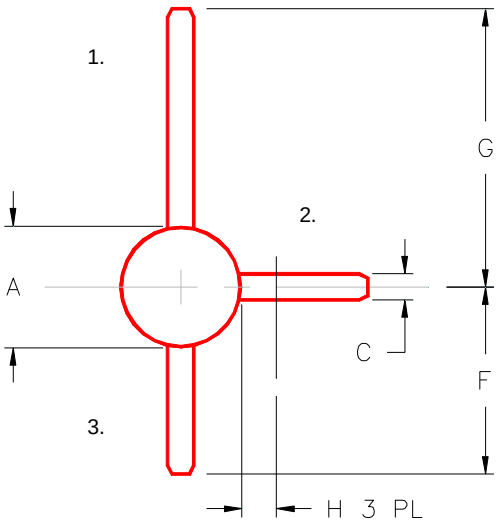
**BFR96**

**BFR96G**

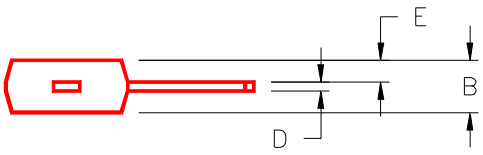
Macro T Macro X Power Macro SO-8

PACKAGE STYLE M236

PIN 1. COLLECTOR
2. EMITTER
3. BASE




MACRO–T

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| C | .033/0,84 | .039/0,99 | | | |
| D | .008/0,20 | .012/0,31 | | | |
| E | .030/0,76 | .045/1,14 | | | |
| F | .285/7,24 | .320/8,13 | | | |
| G | .415/10,54 | .450/11,43 | | | |
| H | .065/1,65 | | | | |