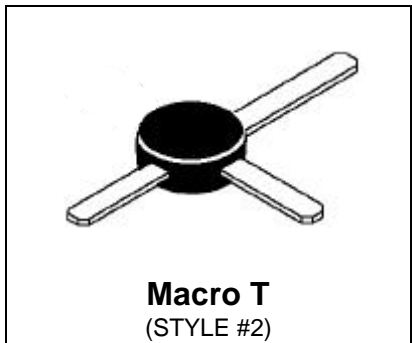


BFR90

**RF & MICROWAVE DISCRETE
 LOW POWER TRANSISTORS**

Features

- High Current-Gain – Bandwidth Product, $fT = 5.0 \text{ GHz}$ (typ) @ $I_C = 14 \text{ mA}$
- Low Noise Figure – $NF = 2.4 \text{ dB}$ (typ) @ $f = 0.5 \text{ GHz}$
- High Power Gain – $G_{max} = 18\text{dB}$ (typ) @ $f = 0.5 \text{ GHz}$



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

ABSOLUTE MAXIMUM RATINGS ($T_{case} = 25^\circ\text{C}$)

| 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 | 30 | mA |

Thermal Data

| | | | |
|-------|--|------------|--------------------------------|
| P_D | Total Device Dissipation @ $T_A = 60^\circ\text{C}$ Derate above 60°C | 180 2.0 | mWatts mW/ $^\circ\text{C}$ |
|-------|--|------------|--------------------------------|

ELECTRICAL SPECIFICATIONS (Tcase = 25°C)

STATIC
 (off)

| Symbol | Test Conditions | Value | | | Unit |
|--------|---|-------|------|------|-----------------|
| | | Min. | Typ. | Max. | |
| BVCEO | Collector-Emitter Breakdown Voltage (IC = 1.0 mA _{dc} , IB = 0) | 15 | - | - | V _{dc} |
| BVCB0 | Collector-Base Breakdown Voltage (IC = 0.1 mA _{dc} , IE = 0) | 20 | - | - | V _{dc} |
| BVEBO | Emitter-Base Breakdown Voltage (IE = 0.1 mA _{dc} , IC = 0) | 3.0 | - | - | V _{dc} |
| ICBO | Collector Cutoff Current (VCB = 10 V _{dc} , VBE = 0 V _{dc}) | - | - | 50 | nA |

(on)

| | | | | | |
|-----|---|----|---|-----|---|
| HFE | DC Current Gain (IC = 14 mA _{dc} , VCE = 10 V _{dc}) | 25 | - | 250 | - |
|-----|---|----|---|-----|---|

DYNAMIC

| Symbol | Test Conditions | Value | | | Unit |
|------------------|--|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| F _{tau} | Current-Gain – Bandwidth Product (IC = 14 mA, VCE = 10 V _{dc} , f = 0.5 GHz) | - | 5.0 | - | GHz |
| CCB | Output Capacitance (VCB = 10 V _{dc} , IE = 0, f = 1.0 MHz) | - | 0.5 | 1.0 | pF |

FUNCTIONAL

| Symbol | Test Conditions | Value | | | Unit |
|--------------------------------|--|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| NF | Noise Figure (IC = 2.0 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 2.4 | - | dB |
| | (IC = 2.0 mAdc, VCE = 10 Vdc, f = 1.0 GHz) | - | 3.0 | - | |
| GNF | Power Gain at Optimum Noise Figure (IC = 2.0 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 15 | - | dB |
| | (IC = 2.0 mAdc, VCE = 10 Vdc, f = 1.0 GHz) | - | 10 | - | |
| S ₂₁ ² | Insertion Gain (IC = 14 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | 15 | 16 | - | dB |
| | (IC = 14 mAdc, VCE = 10 Vdc, f = 1.0 GHz) | | 11 | | |
| MSG | Maximum Stable Gain (IC = 14 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 20 | - | dB |
| | (IC = 14 mAdc, VCE = 10 Vdc, f = 1.0 GHz) | | 15 | | |
| G _{U max} | Maximum Unilateral Gain (1) (IC = 14 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 18 | - | dB |
| | (IC = 14 mAdc, VCE = 10 Vdc, f = 1.0 GHz) | | 12.5 | | |

Table 1. Common Emitter S-Parameters, @ VCE = 10 V, IC = 14 mA

| f (MHz) | S11 | | S21 | | S12 | | S22 | |
|------------|-------|------|-------|-----|-------|-----|-------|-----|
| | S11 | ∠ φ | S21 | ∠ φ | S12 | ∠ φ | S22 | ∠ φ |
| 100 | 0.382 | -41 | 21.21 | 141 | 0.016 | 79 | 0.718 | -9 |
| 200 | 0.282 | -77 | 14.85 | 116 | 0.028 | 74 | 0.662 | -18 |
| 300 | 0.217 | -101 | 10.71 | 104 | 0.039 | 74 | 0.599 | -20 |
| 500 | 0.162 | -131 | 6.78 | 91 | 0.061 | 76 | 0.558 | -24 |
| 700 | 0.140 | -151 | 4.98 | 83 | 0.082 | 76 | 0.55 | -28 |
| 800 | 0.135 | -159 | 4.42 | 80 | 0.093 | 76 | 0.552 | -29 |
| 1000 | 0.124 | -176 | 3.59 | 74 | 0.117 | 75 | 0.553 | -33 |

BFR90

RF Low Power PA, LNA, and General Purpose Discrete Selector Guide

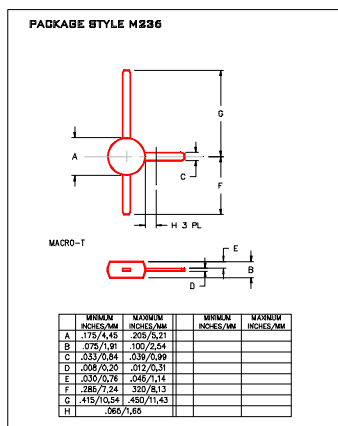
| Package | Device | Type | GPE Freq (MHz) | Pout (watts) | GPE (dB) | Efficiency (%) | GPE VCC | BVCEO | IC max (mA) |
|-------------|-----------------|------|----------------|--------------|----------|----------------|---------|-------|-------------|
| SO-8 | MRF4427, R2 | NPN | 175 | 0.15 | 18 | 60 | 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 |

| 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 | 18 | 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 |

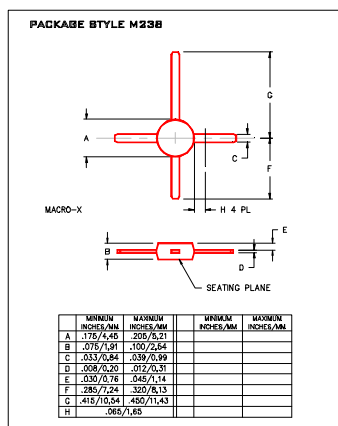
RF (Low Power PA / General Purpose) Selection Guide

RF (LNA / General Purpose) Selection Guide

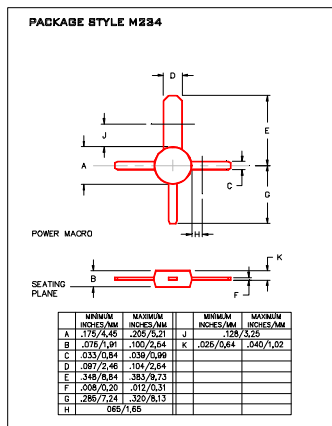
Low Cost RF Plastic Package Options



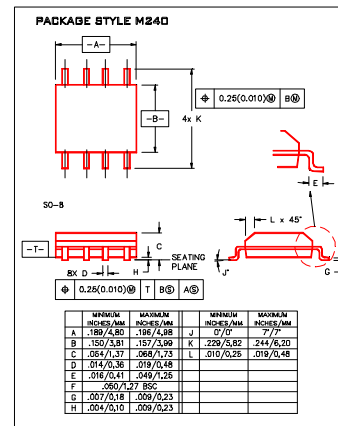
Macro T



Macro X



Power Macro

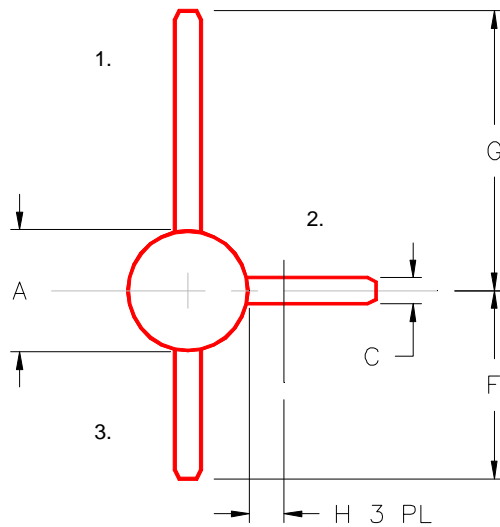


SO-8

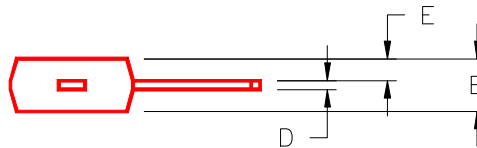
BFR90

PACKAGE STYLE M236

PIN 1. COLLECTOR
 2. EMITTER
 3. BASE



MACRO-T



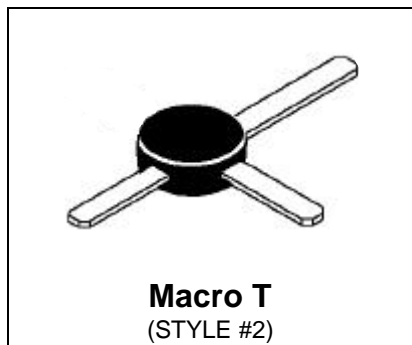
| | MINIMUM INCHES/MM | MAXIMUM INCHES/MM | | MINIMUM INCHES/MM | MAXIMUM INCHES/MM |
|---|----------------------|----------------------|--|----------------------|----------------------|
| A | .175/4,45 | .205/5,21 | | | |
| B | .075/1,91 | .100/2,54 | | | |
| C | .033/0,84 | .039/0,99 | | | |
| D | .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 | | | | |

BFR91

**RF & MICROWAVE DISCRETE
 LOW POWER TRANSISTORS**

Features

- High Current-Gain – Bandwidth Product, $fT = 5 \text{ GHz (typ) @ } I_C = 30 \text{ mA}$
- Low Noise Figure – $NF = 1.9 \text{ dB (typ) @ } f = 0.5 \text{ GHz}$, $2.5 \text{ dB (typ) @ } 1\text{GHz}$
- High Power Gain – $G_{max} = 16 \text{ dB (typ) @ } f = 0.5 \text{ GHz}$, $10.9\text{dB (typ) @ } 1\text{GHz}$



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

ABSOLUTE MAXIMUM RATINGS ($T_{case} = 25^{\circ}\text{C}$)

| Symbol | Parameter | Value | Unit |
|-----------|---------------------------|-------|------|
| V_{CEO} | Collector-Emitter Voltage | 12 | Vdc |
| V_{CBO} | Collector-Base Voltage | 15 | Vdc |
| V_{EBO} | Emitter-Base Voltage | 3.0 | Vdc |
| I_C | Collector Current | 35 | mA |

Thermal Data

| | | | |
|-----------------|--|-------------|----------------------------------|
| P_D | Total Device Dissipation @ $T_A = 60^{\circ}\text{C}$ Derate above 60°C | 180 2.0 | mWatts mW/ $^{\circ}\text{C}$ |
| T_{stg} | Storage Temperature | -65 to +150 | $^{\circ}\text{C}$ |
| $R_{\theta JA}$ | Total Device Dissipation @ $T_A = 60^{\circ}\text{C}$ Derate above 60°C | 500 | $^{\circ}\text{C/W}$ |

ELECTRICAL SPECIFICATIONS (Tcase = 25°C)

STATIC
 (off)

| Symbol | Test Conditions | Value | | | Unit |
|--------|--|-------|------|------|-----------------|
| | | Min. | Typ. | Max. | |
| BVCEO | Collector-Emitter Breakdown Voltage (IC = 1.0 mA _{dc} , IB = 0) | 12 | - | - | V _{dc} |
| BVCB0 | Collector-Base Breakdown Voltage (IC = 0.1 mA _{dc} , IE = 0) | 15 | - | - | V _{dc} |
| BVEBO | Emitter-Base Breakdown Voltage (IE = 0.1 mA _{dc} , IC = 0) | 3.0 | - | - | V _{dc} |
| ICBO | Collector Cutoff Current (VCB = 5.0 V _{dc} , VBE = 0 V _{dc}) | - | - | 50 | nA |

(on)

| | | | | | |
|-----|--|----|---|-----|---|
| HFE | DC Current Gain (IC = 30 mA _{dc} , VCE = 5.0 V _{dc}) | 25 | - | 250 | - |
|-----|--|----|---|-----|---|

DYNAMIC

| Symbol | Test Conditions | Value | | | Unit |
|------------------|---|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| F _{tau} | Current-Gain – Bandwidth Product (IC = 30 mA, VCE = 5.0 V _{dc} , f = 0.5 GHz) | - | 5.0 | - | GHz |
| CCB | Output Capacitance (VCB = 10 V _{dc} , IE = 0, f = 1.0 MHz) | - | 0.7 | 1.0 | pF |

FUNCTIONAL

| Symbol | Test Conditions | Value | | | Unit |
|--------------|--|-------|--------------|------|------|
| | | Min. | Typ. | Max. | |
| NF | Noise Figure (IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz) (IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 1.0 GHz) | - | 1.9 2.5 | - | dB |
| GNF | Power Gain at Optimum Noise Figure (IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz) (IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 1.0 GHz) | - | 11 8.0 | - | dB |
| $ S_{21} ^2$ | Insertion Gain (IC = 30 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz) (IC = 30 mAdc, VCE = 5.0 Vdc, f = 1.0 GHz) | 14.5 | 15.5 10.2 | - | dB |
| MSG | Maximum Stable Gain (IC = 30 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz) (IC = 30 mAdc, VCE = 5.0 Vdc, f = 1.0 GHz) | - | 18.6 12.9 | - | dB |
| $G_{U\max}$ | Maximum Unilateral Gain (1) (IC = 30 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz) (IC = 30 mAdc, VCE = 5.0 Vdc, f = 1.0 GHz) | - | 16.5 10.9 | - | dB |

Table 1. Common Emitter S-Parameters, @ VCE = 5.0 V, IC = 30 mA

| f (MHz) | S11 | | S21 | | S12 | | S22 | |
|------------|-------|---------------|-------|---------------|-------|---------------|-------|---------------|
| | S11 | $\angle \phi$ | S21 | $\angle \phi$ | S12 | $\angle \phi$ | S22 | $\angle \phi$ |
| 100 | 0.258 | -115 | 25.77 | 123 | 0.021 | 76 | 0.536 | -33 |
| 200 | 0.290 | -149 | 14.66 | 103 | 0.038 | 74 | 0.384 | -43 |
| 300 | 0.298 | -164 | 10.05 | 94 | 0.054 | 75 | 0.311 | -45 |
| 500 | 0.305 | -179 | 6.18 | 84 | 0.085 | 75 | 0.264 | -49 |
| 700 | 0.302 | 170 | 4.5 | 77 | 0.117 | 73 | 0.256 | -52 |
| 800 | 0.304 | 166 | 3.98 | 73 | 0.133 | 72 | 0.257 | -54 |
| 1000 | 0.304 | 158 | 3.24 | 67 | 0.166 | 70 | 0.251 | -57 |
| 1500 | 0.256 | 134 | 2.3 | 54 | 0.24 | 65 | 0.263 | -69 |

BFR91

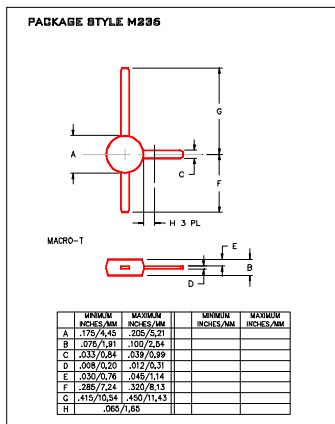
RF Low Power PA, LNA, and General Purpose RF Discrete Selector Guide

| 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 |

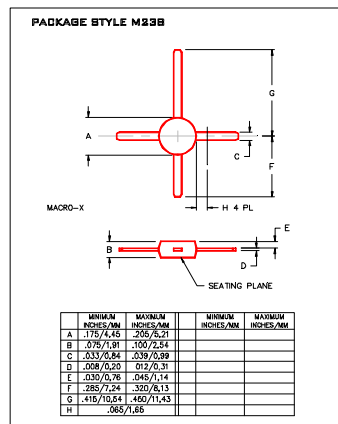
| Package | Device | Type | Freq (MHz) | NF (dB) | NF IC (mA) | NF VCE | GN (dB) | Gu Max (dB) | Ftau (MHz) | Ccb (pF) | BVCEO | IC max (mA) |
|---------|-----------------|------|------------|---------|------------|--------|---------|-------------|------------|----------|-------|-------------|
| TO-39 | 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 (Low Power PA / General Purpose) Selection Guide

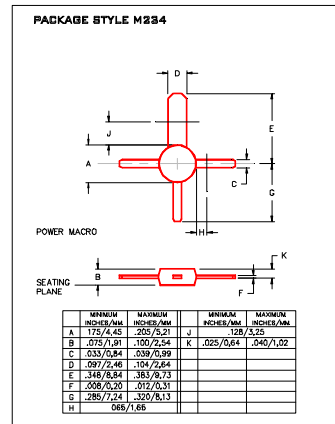
RF (LNA / General Purpose) Selection Guide



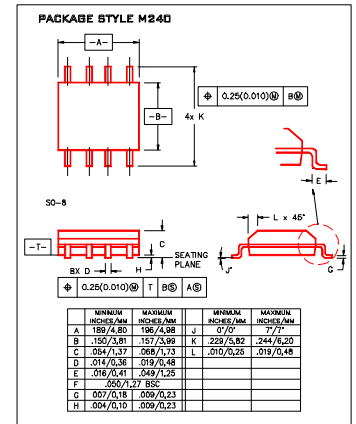
Macro T



Macro X



Power Macro

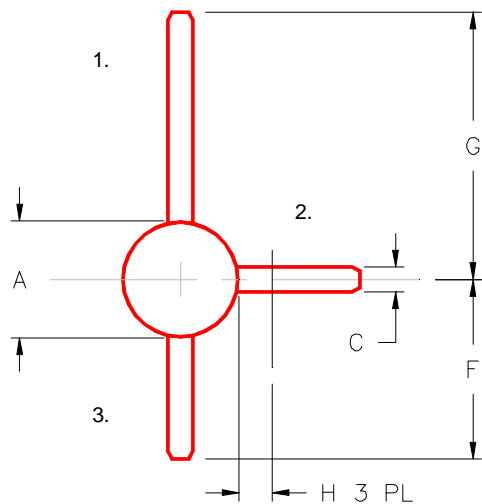


SO-8

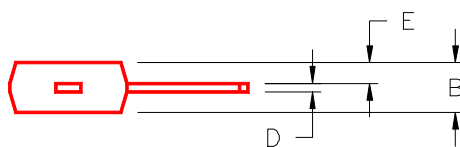
BFR91

PACKAGE STYLE M236

PIN 1. COLLECTOR
 2. EMITTER
 3. BASE



MACRO-T



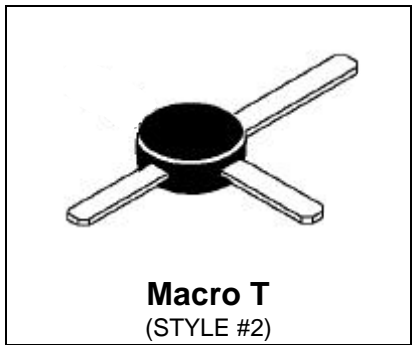
| | MINIMUM INCHES/MM | MAXIMUM INCHES/MM | | MINIMUM INCHES/MM | MAXIMUM INCHES/MM |
|---|----------------------|----------------------|--|----------------------|----------------------|
| A | .175/4,45 | .205/5,21 | | | |
| B | .075/1,91 | .100/2,54 | | | |
| C | .033/0,84 | .039/0,99 | | | |
| D | .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 | | | | |

BFR96

**RF & MICROWAVE DISCRETE
 LOW POWER TRANSISTORS**

Features

- High Current-Gain – Bandwidth Product, $fT = 4.5 \text{ GHz (typ) @ } I_C = 50 \text{ mA}$
- Low Noise Figure – $NF = 2.4 \text{ dB (typ) @ } f = 0.5 \text{ GHz}$
- High Power Gain – $G_{max} = 14.5\text{dB (typ) @ } f = 0.5 \text{ GHz}$



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

ABSOLUTE MAXIMUM RATINGS ($T_{case} = 25^{\circ}\text{C}$)

| 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 @ $T_C = 100^{\circ}\text{C}$ Derate above 100°C | 500 10 | mWatts mW/ $^{\circ}\text{C}$ |
|-------|--|-----------|----------------------------------|

ELECTRICAL SPECIFICATIONS (Tcase = 25°C)

STATIC
 (off)

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

(on)

| | | | | | |
|-----|---|----|---|-----|---|
| HFE | DC Current Gain (IC = 50 mA _{dc} , VCE = 10 V _{dc}) | 30 | - | 200 | - |
|-----|---|----|---|-----|---|

DYNAMIC

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

FUNCTIONAL

| Symbol | Test Conditions | Value | | | Unit |
|--------------|--|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| NF | Noise Figure (IC = 10 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 2.0 | - | dB |
| $ S_{21} ^2$ | Insertion Gain (IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | 12 | 13 | - | dB |
| MSG | Maximum Stable Gain (IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz) | - | 16.5 | - | dB |
| $G_{U \max}$ | Maximum Unilateral Gain (1) (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 (MHz) | S11 | | S21 | | S12 | | S22 | |
|------------|-------|---------------|-----|---------------|-------|---------------|-------|---------------|
| | S11 | $\angle \phi$ | S21 | $\angle \phi$ | S12 | $\angle \phi$ | S22 | $\angle \phi$ |
| 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 |

BFR96

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

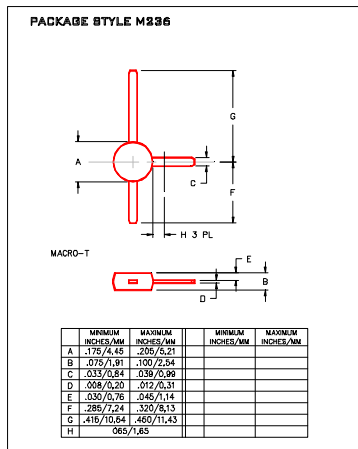
| Package | Device | | GPE Freq (MHz) | Pout (watts) | GPE (dB) | Efficiency (%) | GPE VCC | BVCEO | IC max (mA) |
|-------------|-----------------|-----|----------------|--------------|----------|----------------|---------|-------|-------------|
| SO-8 | MRF4427, R2 | NPN | 175 | 0.15 | 18 | 60 | 12 | 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

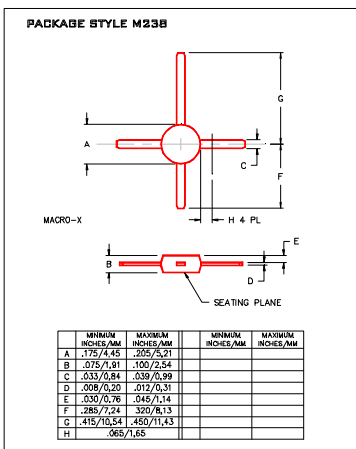
| Package | Device | Type | Freq (MHz) | NF (dB) | NF IC (mA) | NF VCE | GN (dB) | Gu Max (dB) | Ftau (MHz) | Ccb(pF) | BVCEO | IC max (mA) |
|---------|-----------------|------|------------|---------|------------|--------|---------|-------------|------------|---------|-------|-------------|
| TO-39 | 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 | 5 | 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 | MRF551 | 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

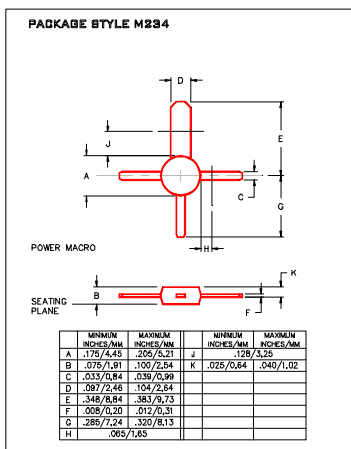
Low Cost Plastic Package Types



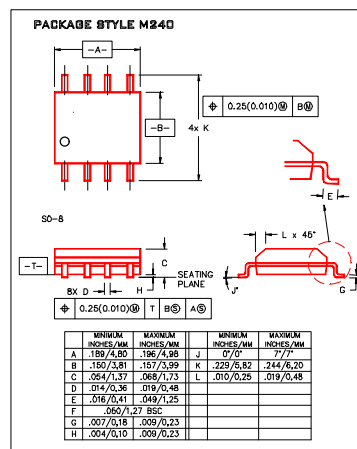
Macro T



Macro X



Power Macro



SO-8

BFR96

