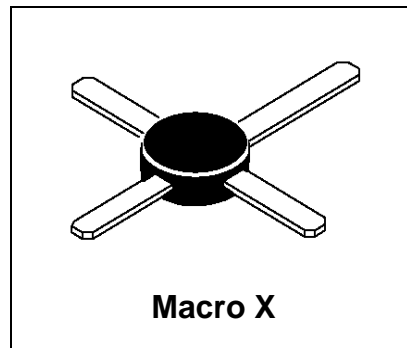


\*G Denotes RoHS Compliant, Pb free Terminal Finish

## RF & MICROWAVE DISCRETE LOW POWER TRANSISTORS

### Features

- Low Noise - 2.5 dB @ 500 MHz
- Gain at Optimum Noise Figure = 15.5 dB @ 500 MHz
- Ft<sub>au</sub> - 5.0 GHz @ 10v, 75mA
- Cost Effective MacroX Package



**DESCRIPTION:** Designed for high current, low power, low noise, amplifiers up to 1.0 GHz.

### ABSOLUTE MAXIMUM RATINGS (T<sub>case</sub> = 25°C)

| Symbol           | Parameter                 | MRF581 | MRF581A | Unit |
|------------------|---------------------------|--------|---------|------|
| V <sub>CEO</sub> | Collector-Emitter Voltage | 18     | 15      | Vdc  |
| V <sub>CBO</sub> | Collector-Base Voltage    | 30     |         | Vdc  |
| V <sub>EBO</sub> | Emitter-Base Voltage      | 2.5    |         | Vdc  |
| I <sub>C</sub>   | Collector Current         | 200    |         | mA   |

### Thermal Data

|                   |   |             |                 |
|-------------------|---|-------------|-----------------|
| P <sub>D</sub>    | Total Device Dissipation @ TC = 50°C<br>Derate above 50°C | 2.5<br>25   | Watts<br>mW/ °C |
| P <sub>D</sub>    | Total Device Dissipation @ TC = 25°C<br>Derate above 25°C | 1.25<br>10  | Watts<br>mW/ °C |
| T <sub>stg</sub>  | Storage Junction Temperature Range                        | -65 to +150 | °C              |
| T <sub>Jmax</sub> | Maximum Junction Temperature                              | 150         | °C              |

Revision A- December 2008

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## ELECTRICAL SPECIFICATIONS (T<sub>case</sub> = 25°C)

### STATIC (off)

| Symbol | Test Conditions   |                   | Value    |      |      | Unit            |
|--------|---|-------------------|----------|------|------|-----------------|
|        |   |                   | Min.     | Typ. | Max. |                 |
| BVCEO  | Collector-Emitter Breakdown Voltage<br>(I <sub>C</sub> = 5.0 mA <sub>dc</sub> , I <sub>B</sub> = 0)       | MRF581<br>MRF581A | 18<br>15 | -    | -    | V <sub>dc</sub> |
| BVCBO  | Collector-Base Breakdown Voltage<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>E</sub> = 0)          |                   | 30       | -    | -    | V <sub>dc</sub> |
| BVEBO  | Emitter-Base Breakdown Voltage<br>(I <sub>E</sub> = 0.1 mA <sub>dc</sub> , I <sub>C</sub> = 0)            |                   | 2.5      | -    | -    | V <sub>dc</sub> |
| ICBO   | Collector Cutoff Current<br>(V <sub>CB</sub> = 15 V <sub>dc</sub> , V <sub>BE</sub> = 0 V <sub>dc</sub> ) |                   | -        | -    | 0.1  | mA              |
| IEBO   | Emitter Cutoff Current<br>(V <sub>be</sub> = 2.5 V <sub>dc</sub> )  |                   | -        | -    | 0.1  | mA              |

### (on)

|     |  |                   |          |   |            |   |
|-----|--|-------------------|----------|---|------------|---|
| HFE | DC Current Gain<br>(I <sub>C</sub> = 50 mA <sub>dc</sub> , V <sub>CE</sub> = 5.0 V <sub>dc</sub> ) | MRF581<br>MRF581A | 50<br>90 | - | 200<br>250 | - |
|-----|--|-------------------|----------|---|------------|---|

### DYNAMIC

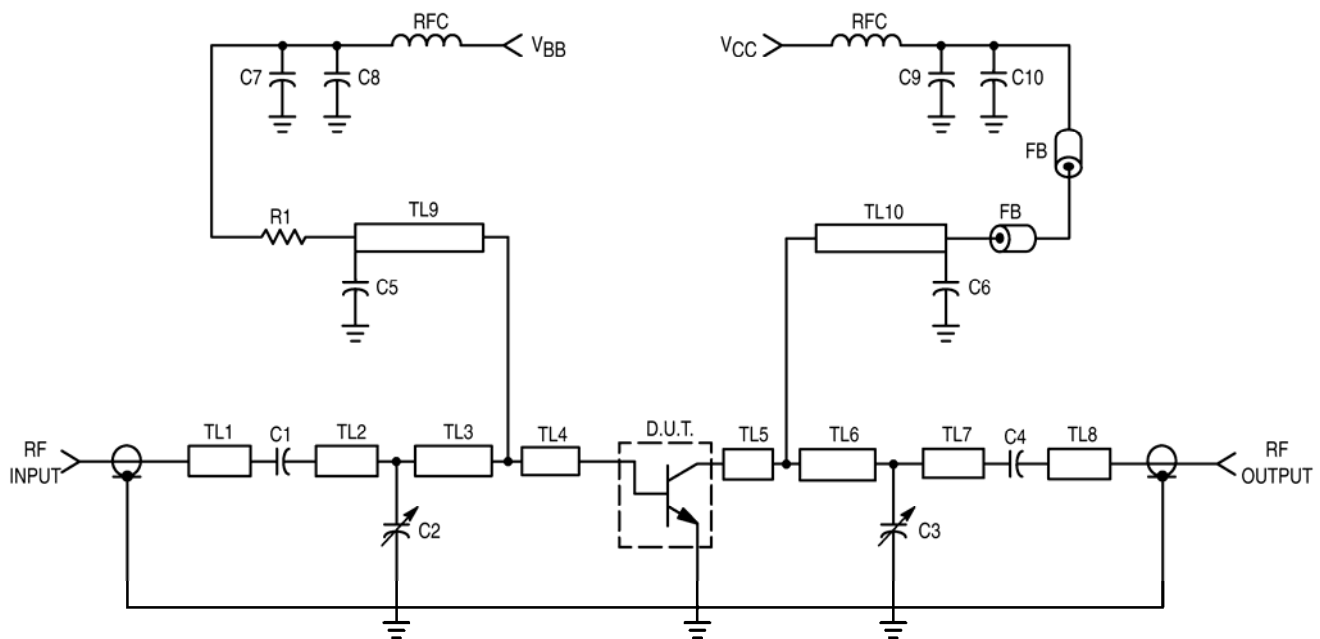
| Symbol           | Test Conditions   |  | Value |      |      | Unit |
|------------------|---|--|-------|------|------|------|
|                  |   |  | Min.  | Typ. | Max. |      |
| COB              | Output Capacitance<br>(V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)                                |  | -     | 2.0  | 3.0  | pF   |
| F <sub>tau</sub> | Current-Gain Bandwidth Product<br>(I <sub>C</sub> = 75 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 GHz) |  | -     | 5.0  | -    | GHz  |

**FUNCTIONAL**

| Symbol       | Test Conditions  | Value |      |      | Unit |
|--------------|--|-------|------|------|------|
|              |  | Min.  | Typ. | Max. |      |
| NF           | Noise Figure (50ohms)<br>(IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz)     | -     | 3.0  | 3.5  | dB   |
| $G_{NF}$     | Power Gain @ NFmin<br>(IC = 50 mAdc, VCE = 10 Vdc, f = 0.5 GHz)        | 13    | 15.5 |      | dB   |
| $G_{U\max}$  | Maximum Unilateral Gain (1)<br>IC = 50 mAdc, VCE = 10 Vdc, f = 500 MHz | -     | 17.8 | -    | dB   |
| MSG          | Maximum Stable Gain<br>IC = 50 mAdc, VCE = 10 Vdc, f = 500 MHz         | -     | 20   | -    | dB   |
| $ S_{21} ^2$ | Insertion Gain<br>IC = 50 mAdc, VCE = 10 Vdc, f = 500 MHz              | 14    | 15   | -    | dB   |

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

| f<br>(MHz) | S11  |               | S21  |               | S12  |               | S22  |               |
|------------|------|---------------|------|---------------|------|---------------|------|---------------|
|            | S11  | $\angle \phi$ | S21  | $\angle \phi$ | S12  | $\angle \phi$ | S22  | $\angle \phi$ |
| 100        | .610 | -137          | 23.8 | 116           | .026 | 46            | .522 | -78           |
| 200        | .659 | -161          | 13.2 | 98            | .033 | 47            | .351 | -106          |
| 300        | .671 | -171          | 9.0  | 89            | .040 | 51            | .304 | -120          |
| 400        | .675 | -178          | 6.8  | 83            | .047 | 55            | .292 | -128          |
| 500        | .677 | 176           | 5.5  | 77            | .055 | 58            | .293 | -132          |
| 600        | .678 | 172           | 4.6  | 72            | .064 | 61            | .299 | -134          |
| 700        | .677 | 168           | 4.0  | 68            | .073 | 62            | .306 | -135          |
| 800        | .679 | 184           | 3.5  | 64            | .082 | 63            | .314 | -136          |
| 900        | .678 | 160           | 3.1  | 60            | .092 | 64            | .322 | -138          |
| 1000       | .682 | 156           | 2.8  | 56            | .102 | 65            | .311 | -139          |



C1, C4, C5, C6, C8, C9 — 1000 pF, Chip Capacitor  
 C7, C10 — 10  $\mu$ F, Tantalum Capacitor  
 RFC — VK-200, Ferroxcube  
 TL1, TL7, TL8 — Microstrip 0.162, x 0.600,  
 TL3 — Microstrip 0.162, x 0.800,  
 TL5 — Microstrip 0.120, x 0.440,  
 TL9, TL10 — Microstrip 0.025, x 4.250,  
 Board Material — 0.0625, Thick Glass Teflon  $\epsilon r = 2.55$

C2, C3 — 1.0–10 pF, Johanson Capacitor  
 R1 — 1.0 k $\Omega$  Res.  
 FB — Ferrite Bead, Ferroxcube, 56–590–65/3B  
 TL2 — Microstrip 0.162, x 1.000,  
 TL4 — Microstrip 0.162, x 0.440,  
 TL6 — Microstrip 0.120, x 1.160,

**Figure 1. Minimum Noise Figure and Gain @ Minimum Noise Figure.**

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

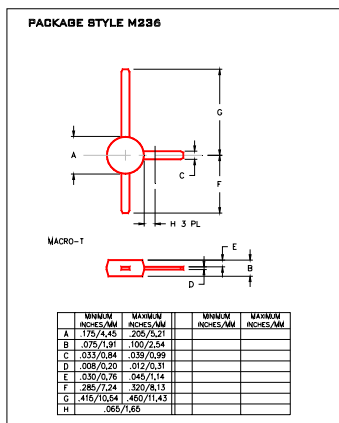
| Package     | Device          | Type | GPE Freq (MHz) | Pout (watts) | GPE (dB) | Efficiency (%) | GPE VCC | BVCEO | IC max (mA) |
|-------------|-----------------|------|----------------|--------------|----------|----------------|---------|-------|-------------|
| SO-8        | MRF4427, R2     | NPN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

RF (Low Power PA / General Purpose) Selection Guide

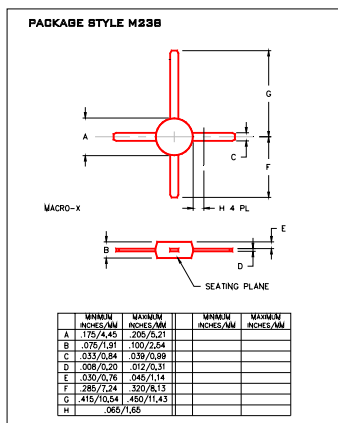
| Package | Device          | Type | Freq (MHz) | NF (dB) | NF IC (mA) | NF VCE | GN (dB) | Gu Max (dB) | Ftaw (MHz) | Ccb(pF) | BVCEO | IC max (mA) |
|---------|-----------------|------|------------|---------|------------|--------|---------|-------------|------------|---------|-------|-------------|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

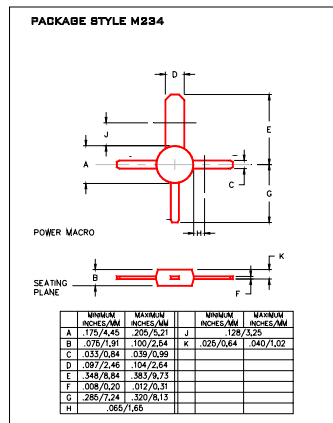
**Low Cost RF Plastic Package Options**



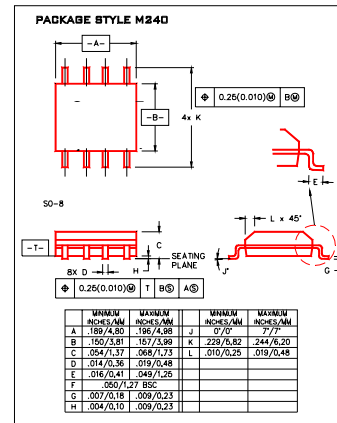
Macro T



Macro X



Power

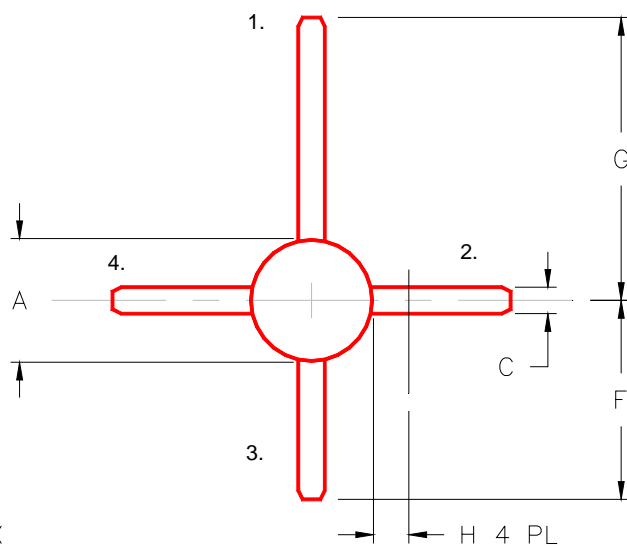


SO-8

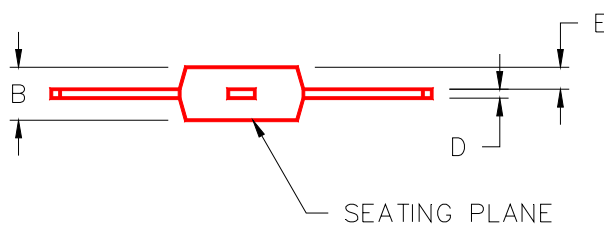
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### PACKAGE STYLE M238

- PIN 1. COLLECTOR  
 2. EMITTER  
 3. BASE  
 4. EMITTER



MACRO-X



|   | MINIMUM<br>INCHES/MM | MAXIMUM<br>INCHES/MM |  | MINIMUM<br>INCHES/MM | MAXIMUM<br>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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