

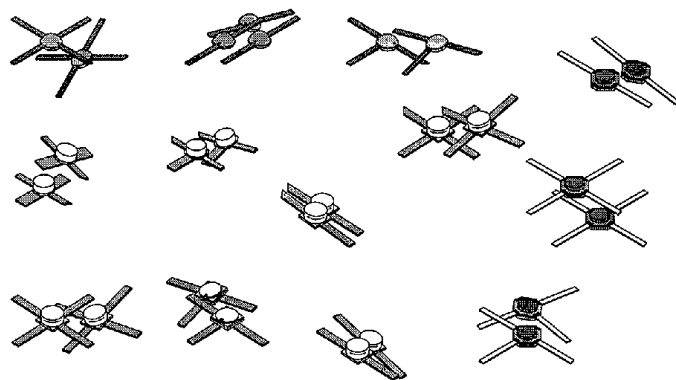
# Silicon Beam-Lead and Chip Schottky Barrier Mixer Diodes



DMB, DME, DMF and DMJ Series

## Features

- Ideal for MIC
- Low  $1/f$  Noise
- Low Intermodulation Distortion
- Low Turn On
- Hermetically Sealed Packages
- SPC Controlled Wafer Fabrication



## Description

Alpha beam-lead and chip schottky barrier mixer diodes are designed for applications through 40 GHz in Ka-band. The beam-lead design eliminates the problem of bonding to the very small junction area that is characteristic of the low capacitance involved in microwave devices.

Beam-lead schottky barrier mixer diodes are made by deposition of a suitable barrier metal on an epitaxial silicon substrate from the junction. The process and choice of materials result in low series resistance along with a narrow spread of capacitance values for close impedance control.

A variety of forward knees is available, ranging from a low value for low, or starved, local oscillator drive levels to a higher value for high drive, low intermode mixer applications. The beam-lead diodes are available in a wide range of packages as shown. Capacitance ranges and series resistances are comparable with the packaged devices that are available through K-band. The unmounted diodes are especially well suited for use in microwave integrated circuits. The mounted devices can be easily inserted as hybrid elements in stripline, microstrip or other such circuitry.

Beam-lead and chip schottky barrier diodes are categorized by noise figure for mixer applications in four frequency ranges: S, X, Ku and Ka-bands.

However, they can also be used as modulators, high speed switches and low power limiters.

Several types of semiconductor-barrier metal systems are available, thus allowing proper selection for optimum mixer design. For most applications the N-type silicon, low drive types are preferable, especially for starved LO mixers.

Beam-lead diodes are ideally suited for balanced mixers, since they exhibit low parasitics and are extremely uniform. A typical  $V_F$  vs.  $I_F$  curve is shown in Figure 1. Typical noise figures vs LO drive is shown in Figure 2 for single N-type, low drive diode types.

Refer to the Application Notes section for more information on device selections.

## Maximum Ratings

|                        |                |
|------------------------|----------------|
| Storage Temperature:   | -65°C/+175°C   |
| Operating Temperature: | -65°C/+175°C   |
| Dissipated Power:      | 75 mW/Junction |
| Max Current:           | 100 mA         |
| Reverse Voltage:       | —              |

| Band | Frequencies  |
|------|--------------|
| S    | 2 to 4       |
| C    | 4 to 8       |
| X    | 8.2 to 12.4  |
| Ku   | 12.4 to 18.0 |

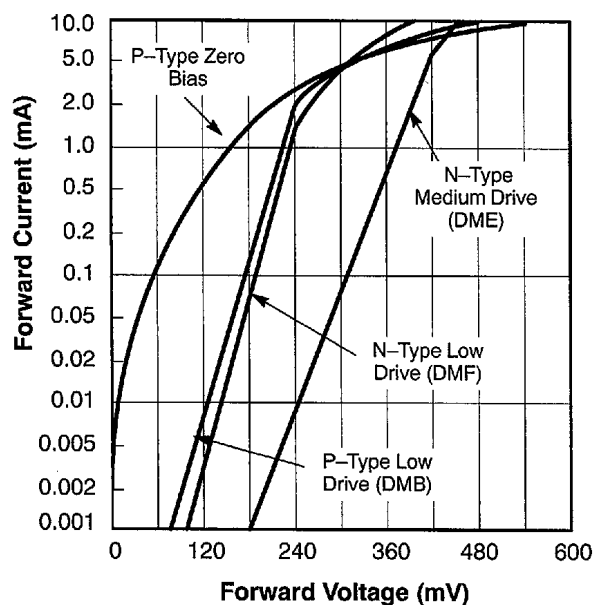


Figure 1. Typical Forward DC Characteristics Curves – Voltage vs. Current

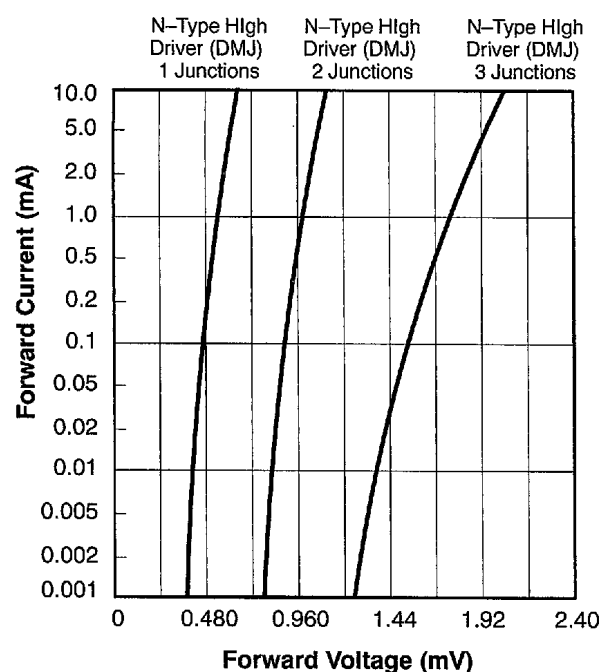


Figure 2. Typical Forward DC Characteristic Curves – Voltage vs. Current

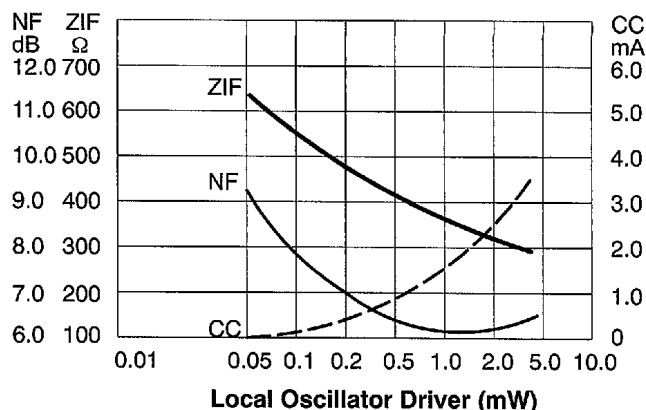
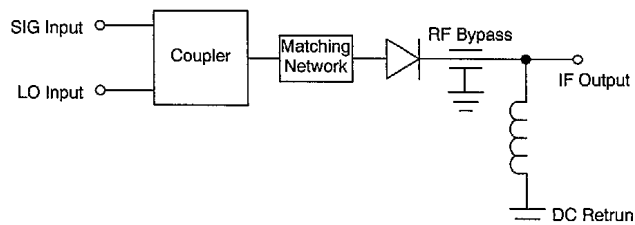
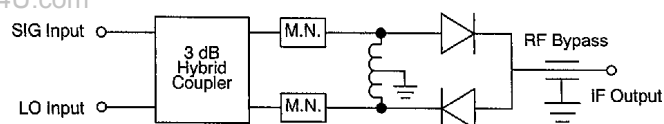


Figure 3. Typical X-Band Low Drive Mixer Diode – RF Parameters vs. Local Oscillator Drive

#### Single Ended Mixer



#### Balanced Mixer



#### Double Balanced Mixer

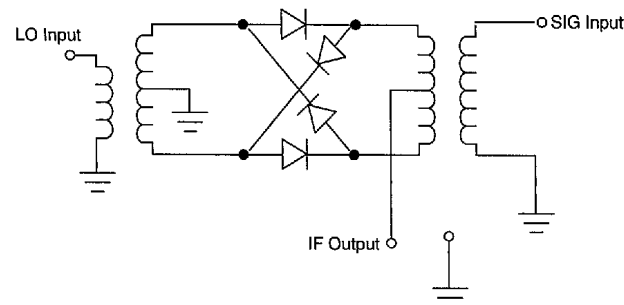


Figure 4. Typical Mixer Circuits

## Ordering Information

To order a packaged diode, simply append the part number to the package outline number. For example, a Medium Drive Ring Quad, Ku band (part number DME2859) in a 464-002 package would be ordered as DME2859-464-002.

## Beam-Lead (Singles), N-Type, Low, Medium, High Drive



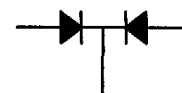
| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Beam<br>Lead | Epoxy   |         | Hermetic |         |
|---------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|----------------|--------------|---------|---------|----------|---------|
|               | Min                              | Max  | Max                          | Min                          | Min                         | Max |                | 491-011      | 130-011 | 464-011 | 325-011  | 364-011 |
| S             | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low            | DMF2820      | DMF5845 |         | DMF5079  | DMF4365 |
|               |                                  |      |                              | 3                            | 300                         | 400 | Med            | DME2127      | DME3128 |         | DME3006  | DME3124 |
|               |                                  |      |                              | 4                            | 500                         | 600 | High           | DMJ2823      | DMJ6784 |         | DMJ6785  | DMJ3153 |
| X             | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low            | DMF2821      | DMF5827 |         | DMF4035  | DMF3064 |
|               |                                  |      |                              | 3                            | 325                         | 425 | Med            | DME2957      | DME3055 |         | DME3005  | DME3125 |
|               |                                  |      |                              | 4                            | 550                         | 650 | High           | DMJ2777      | DMJ6786 |         | DMJ6789  | DMJ3154 |
| KU            | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low            | DMF2344      | DMF6022 | DMF3444 | DMF3363  | DMF3065 |
|               |                                  |      |                              | 3                            | 350                         | 450 | Med            | DME2333      | DME3056 | DME3433 | DME3316  | DME3126 |
|               |                                  |      |                              | 4                            | 500                         | 680 | High           | DMJ2824      | DMJ6670 | DMJ3439 |          | DMJ3155 |
| K             | —                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low            | DMF2822      |         | DMF3445 |          |         |
|               |                                  |      |                              | 3                            | 375                         | 550 | Med            | DME2458      |         | DME3434 |          |         |
|               |                                  |      |                              | 4                            | 600                         | 700 | High           | DMJ2825      |         | DMJ3440 |          |         |

## Beam-Lead (Series Pair), N-Type, Low, Medium, High Drive



| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Beam Lead | Epoxy   |         | Hermetic |         |
|---------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|----------------|-----------|---------|---------|----------|---------|
|               | Min                              | Max  | Max                          | Min                          | Min                         | Max |                | 504-012   | 131-012 | 464-012 | 325-012  | 364-012 |
| S             | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low            | DMF2835   | DMF5846 |         | DMF6576  |         |
|               |                                  |      |                              | 3                            | 300                         | 400 | Med            | DME2050   | DME3012 |         | DME3021  |         |
|               |                                  |      |                              | 4                            | 500                         | 600 | High           | DMJ2092   | DMJ6531 |         | DMJ4783  |         |
| X             | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low            | DMF2826   | DMF6460 |         | DMF6704  | DMF4526 |
|               |                                  |      |                              | 3                            | 325                         | 425 | Med            | DME2829   | DME3013 |         | DME3022  | DME3025 |
|               |                                  |      |                              | 4                            | 550                         | 650 | High           | DMJ2093   | DMJ4317 |         | DMJ3090  | DMJ4760 |
| KU            | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low            | DMF2827   | DMF6459 | DMF3446 |          | DMF4734 |
|               |                                  |      |                              | 3                            | 350                         | 450 | Med            | DME2830   | DME3014 | DME3435 |          | DME3026 |
|               |                                  |      |                              | 4                            | 500                         | 680 | High           | DMJ2832   | DMJ3081 | DMJ3441 |          | DMJ3089 |
| K             | —                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low            | DMF2828   |         | DMF3430 |          |         |
|               |                                  |      |                              | 3                            | 375                         | 550 | Med            | DME2831   |         | DME3436 |          |         |
|               |                                  |      |                              | 4                            | 600                         | 700 | High           | DMJ2833   |         | DMJ3442 |          |         |

## Beam-Lead (Common Cathode), N-Type, Low, Medium, High Drive



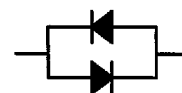
| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Beam<br>Lead | Epoxy   |         | Hermetic |         |
|---------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|----------------|--------------|---------|---------|----------|---------|
|               | Min                              | Max  | Max                          | Min                          | Min                         | Max |                | 504-013      | 131-013 | 464-013 | 325-013  | 364-013 |
| S             | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low            | DMF2182      | DMF4308 |         | DMF3448  |         |
|               |                                  |      |                              | 3                            | 300                         | 400 | Med            | DME2205      |         |         |          |         |
|               |                                  |      |                              | 4                            | 500                         | 600 | High           | DMJ2208      | DMJ4715 |         |          |         |
| X             | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low            | DMF2183      | DMF3323 |         |          |         |
|               |                                  |      |                              | 3                            | 325                         | 425 | Med            | DME2206      |         |         |          |         |
|               |                                  |      |                              | 4                            | 550                         | 650 | High           | DMJ2209      |         |         | DMJ3517  | DMJ3328 |
| KU            | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low            | DMF2184      | DMF3314 |         |          |         |
|               |                                  |      |                              | 3                            | 350                         | 450 | Med            | DME2207      |         |         |          |         |
|               |                                  |      |                              | 4                            | 500                         | 680 | High           | DMJ2210      |         |         |          |         |
| K             | —                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low            | DMF2834      |         |         |          |         |
|               |                                  |      |                              | 3                            | 375                         | 550 | Med            | DME2835      |         |         |          |         |
|               |                                  |      |                              | 4                            | 600                         | 700 | High           | DMJ2836      |         |         |          |         |

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## Beam-Lead (Anti-Parallel Pairs), N-Type, Low, Medium, High Drive

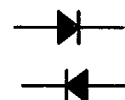


DataShe

| Freq. Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive Level | Beam Lead |         |         |
|------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|-------------|-----------|---------|---------|
|            | Min                              | Max  |                              |                              | Min                         | Max |             | 525-025   | 130-025 | 325-025 |
| <b>S</b>   | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low         | DMF2185   | DMF3226 | DMF3291 |
|            |                                  |      |                              | 3                            | 300                         | 400 | Med         | DM2282    | DME3270 | DME3278 |
|            |                                  |      |                              | 4                            | 500                         | 600 | High        | DMJ2303   | DMJ3294 | DMJ3300 |
| <b>X</b>   | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low         | DMF2186   | DMF3245 | DMF3292 |
|            |                                  |      |                              | 3                            | 325                         | 425 | Med         | DM32283   | DME3271 | DME3279 |
|            |                                  |      |                              | 4                            | 550                         | 650 | High        | DMJ2304   | DMJ3295 | DMJ3301 |
| <b>KU</b>  | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low         | DMF2187   | DMF3286 | DMF3293 |
|            |                                  |      |                              | 3                            | 350                         | 450 | Med         | DME2284   | DME3272 | DME3280 |
|            |                                  |      |                              | 4                            | 500                         | 680 | High        | DMJ2246   | DMJ3296 | DMJ3302 |
| <b>K</b>   | —                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low         | DMF2837   |         |         |
|            |                                  |      |                              | 3                            | 375                         | 550 | Med         | DME2838   |         |         |
|            |                                  |      |                              | 4                            | 600                         | 700 | High        | DMJ2839   |         |         |

## DMB, DME, DMF and DMJ Series

## Beam-Lead (Split Pairs), N-Type, Low, Medium, High Drive

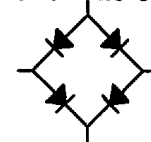


| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1 mA<br>mV |     | Drive<br>Level | Beam Lead | Epoxy   | Hermetic |         |
|---------------|----------------------------------|------|------------------------------|------------------------------|------------------------------|-----|----------------|-----------|---------|----------|---------|
|               | Min                              | Max  |                              |                              | Min                          | Max |                | 521-008   | 132-008 | 325-008  | 364-008 |
| <b>S</b>      | 0.30                             | 0.50 | 5                            | 2                            | 220                          | 290 | Low            | DMF2196   | DMF4040 | DMF3070  |         |
|               |                                  |      |                              | 3                            | 300                          | 400 | Med            | DME2199   | DME3009 | DME3019  |         |
|               |                                  |      |                              | 4                            | 500                          | 600 | High           | DMJ2844   | DMJ3095 | DMJ3098  |         |
| <b>X</b>      | 0.15                             | 0.30 | 8                            | 2                            | 250                          | 310 | Low            | DMF2197   | DMF5828 | DMF3071  | DMF4713 |
|               |                                  |      |                              | 3                            | 325                          | 425 | Med            | DME2841   | DME3010 | DME3020  | DME3023 |
|               |                                  |      |                              | 4                            | 550                          | 650 | High           | DMJ2845   | DMJ3096 | DMJ3105  | DMJ3106 |
| <b>KU</b>     | 0.05                             | 0.15 | 13                           | 2                            | 270                          | 330 | Low            | DMF2198   | DMF6023 |          | DMF3062 |
|               |                                  |      |                              | 3                            | 350                          | 450 | Med            | DME2842   | DME3011 | DME3232  | DME3024 |
|               |                                  |      |                              | 4                            | 500                          | 680 | High           | DMJ2846   | DMJ3097 | DMJ3234  | DMJ3107 |
| <b>K</b>      | -                                | 0.1  | 18                           | 2                            | 270                          | 350 | Low            | DMF2840   |         |          |         |
|               |                                  |      |                              | 3                            | 375                          | 550 | Med            | DME2843   |         |          |         |
|               |                                  |      |                              | 4                            | 600                          | 700 | High           | DMJ2847   |         |          |         |

## Beam-Lead (Ring Quad), N-Type, Low, Medium, High Drive



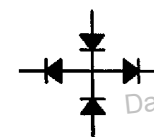
| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Beam<br>Lead | Epoxy   |         |         |         | Hermetic |  |
|---------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|----------------|--------------|---------|---------|---------|---------|----------|--|
|               | Min                              | Max  | Max                          | Min                          | Min                         | Max |                | 488-002      | 495-002 | 132-002 | 464-002 | 325-002 | 364-002  |  |
| S             | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low            | DMF2829      | DMF3954 | DMF5847 | DMF3915 | DMF4059 | DMF3244  |  |
|               |                                  |      |                              | 3                            | 300                         | 400 | Med            | DME2857      | DME3955 | DME3038 | DME3451 | DME3044 | DME3238  |  |
|               |                                  |      |                              | 4                            | 500                         | 600 | High           | DMJ2502      | DMJ3956 | DMJ4007 |         | DMJ6668 | DMJ3237  |  |
| X             | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low            | DMF2011      |         | DMF5829 | DMF3918 | DMF5080 | DMF3074  |  |
|               |                                  |      |                              | 3                            | 325                         | 425 | Med            | DME2858      |         | DME4756 |         | DME6557 | DME4790  |  |
|               |                                  |      |                              | 4                            | 550                         | 650 | High           | DMJ2990      |         | DMJ6788 |         | DMJ6669 | DMJ3108  |  |
| KU            | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low            | DMF2012      |         | DMF6395 | DMF3431 | DMF3916 | DMF3075  |  |
|               |                                  |      |                              | 3                            | 350                         | 450 | Med            | DME2859      |         | DME3039 | DME3437 |         | DME3047  |  |
|               |                                  |      |                              | 4                            | 500                         | 680 | High           | DMJ2667      |         | DMJ3082 | DMJ3443 |         | DMJ3109  |  |
| K             | —                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low            | DMF2454      |         |         | DMF3383 |         |          |  |
|               |                                  |      |                              | 3                            | 375                         | 550 | Med            | DME2459      |         |         | DME3384 |         |          |  |
|               |                                  |      |                              | 4                            | 600                         | 700 | High           | DMJ2455      |         |         | DMJ3385 |         |          |  |



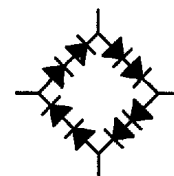
## Beam-Lead (Bridge Quad), N-Type, Low, Medium, High Drive

| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10<br>μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Beam<br>Lead | Epoxy   |         |         |         | Hermetic |  |
|---------------|----------------------------------|------|------------------------------|---------------------------------|-----------------------------|-----|----------------|--------------|---------|---------|---------|---------|----------|--|
|               | Min                              | Max  | Max                          | Min                             | Min                         | Max |                | 488-004      | 495-004 | 132-004 | 464-004 | 325-004 | 364-004  |  |
| S             | 0.30                             | 0.50 | 5                            | 2                               | 220                         | 290 | Low            | DMF2076      | DMF3957 | DMF5848 | DMF3498 | DMF3063 | DMF3373  |  |
|               |                                  |      |                              | 3                               | 300                         | 400 | Med            | DME2029      | DME3958 | DME3040 |         | DME3032 |          |  |
|               |                                  |      |                              | 4                               | 500                         | 600 | High           | DMJ2312      | DMJ3959 | DMJ6575 |         | DMJ3120 |          |  |
| X             | 0.15                             | 0.30 | 8                            | 2                               | 250                         | 310 | Low            | DMF2077      |         | DMF6288 |         | DMF4352 | DMF3079  |  |
|               |                                  |      |                              | 3                               | 325                         | 425 | Med            | DME2850      |         | DME4370 |         | DME3033 | DME3036  |  |
|               |                                  |      |                              | 4                               | 550                         | 650 | High           | DMJ2088      |         | DMJ4313 |         | DMJ3121 | DMJ3122  |  |
| KU            | 0.05                             | 0.15 | 13                           | 2                               | 270                         | 330 | Low            | DMF2078      |         | DMF6298 |         |         | DMF3080  |  |
|               |                                  |      |                              | 3                               | 350                         | 450 | Med            | DME2031      |         | DME3041 |         |         | DME3037  |  |
|               |                                  |      |                              | 4                               | 500                         | 680 | High           | DMJ2768      |         | DMJ3083 |         |         | DMJ3123  |  |
| K             | -                                | 0.1  | 18                           | 2                               | 270                         | 350 | Low            | DMF2848      |         |         |         |         |          |  |
|               |                                  |      |                              | 3                               | 375                         | 550 | Med            | DME2851      |         |         |         |         |          |  |
|               |                                  |      |                              | 4                               | 600                         | 700 | High           | DMJ2852      |         |         |         |         |          |  |

## Beam-Lead (Star Quad), N-Type, Low, Medium, High Drive



| Freq. Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive Level | 520-034 | 364-034 |
|------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|-------------|---------|---------|
|            | Min                              | Max  | Max                          | Min                          | Min                         | Max |             |         |         |
| <b>S</b>   | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low         | DMF2137 | DMF3251 |
|            |                                  |      |                              | 3                            | 300                         | 400 | Med         | DME2191 | DME3254 |
|            |                                  |      |                              | 4                            | 500                         | 600 | High        | DMJ2193 | DMJ3257 |
| <b>X</b>   | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low         | DMF2138 | DMF3252 |
|            |                                  |      |                              | 3                            | 325                         | 425 | Med         | DME2192 | DME3255 |
|            |                                  |      |                              | 4                            | 550                         | 650 | High        | DMJ2194 | DMJ3258 |
| <b>KU</b>  | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low         | DMF2189 | DMF3253 |
|            |                                  |      |                              | 3                            | 350                         | 450 | Med         | DME2178 | DME3256 |
|            |                                  |      |                              | 4                            | 500                         | 680 | High        | DMJ2195 | DMJ3259 |
| <b>K</b>   | -                                | 0.1  | 18                           | 2                            | 270                         | 350 | Low         | DMF2190 |         |
|            |                                  |      |                              | 3                            | 375                         | 550 | Med         | DME2174 |         |
|            |                                  |      |                              | 4                            | 600                         | 700 | High        | DMJ2180 |         |

**DMB, DME, DMF and DMJ Series****Beam-Lead (Octo Quad Ring), N-Type, Low, Medium, High Drive**

| Freq.<br>Band | C <sub>J</sub><br>0V 1 MHz<br>pF |      | R <sub>S</sub><br>10 mA<br>Ω | V <sub>B</sub><br>10 μA<br>Ω | V <sub>F</sub><br>1mA<br>mV |     | Drive<br>Level | Package Styles |         |         |         |
|---------------|----------------------------------|------|------------------------------|------------------------------|-----------------------------|-----|----------------|----------------|---------|---------|---------|
|               | Min                              | Max  | Max                          | Min                          | Min                         | Max |                | 132-020        | 495-020 | 325-020 | 364-020 |
| <b>S</b>      | 0.30                             | 0.50 | 5                            | 2                            | 220                         | 290 | Low            | —              | —       | DMF3179 | —       |
|               |                                  |      |                              | 3                            | 300                         | 400 | High           | —              | DMJ3961 | —       | —       |
| <b>X</b>      | 0.15                             | 0.30 | 8                            | 2                            | 250                         | 310 | Low            | DMF3242        | —       | —       | DMF3972 |
|               |                                  |      |                              | 3                            | 325                         | 425 | Med            | DME4399        | —       | DME3346 | DME3974 |
|               |                                  |      |                              | 4                            | 550                         | 650 | High           | DMJ4708        | —       | DMJ4394 | DMJ3112 |
| <b>KU</b>     | 0.05                             | 0.15 | 13                           | 2                            | 270                         | 330 | Low            | —              | —       | —       | DMF3975 |
|               |                                  |      |                              | 3                            | 350                         | 450 | Med            | —              | —       | —       | DME3978 |
|               |                                  |      |                              | 4                            | 500                         | 680 | High           | DMJ3091        | —       | —       | DMJ3113 |

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