

## HFA3046, HFA3096, HFA3127, HFA3128

Ultra High Frequency Transistor Arrays

FN3076  
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The [HFA3046](#), [HFA3096](#), [HFA3127](#) and the [HFA3128](#) are ultra high frequency transistor arrays that are fabricated from the Renesas complementary bipolar UHF-1 process. Each array consists of five dielectrically isolated transistors on a common monolithic substrate. The NPN transistors exhibit a  $f_T$  of 8GHz while the PNP transistors provide a  $f_T$  of 5.5GHz. Both types exhibit low noise (3.5dB), making them ideal for high frequency amplifier and mixer applications.

The HFA3046 and HFA3127 are all NPN arrays while the HFA3128 has all PNP transistors. The HFA3096 is an NPN-PNP combination. Access is provided to each of the terminals for the individual transistors for maximum application flexibility. Monolithic construction of these transistor arrays provides close electrical and thermal matching of the five transistors.

Application note [AN9315](#) illustrates the use of these devices as RF amplifiers.

### Related Literature

For a full list of related documents, visit our website:

- [HFA3046](#), [HFA3096](#), [HFA3127](#), [HFA3128](#) device pages

### Features

- NPN transistor ( $f_T$ ) . . . . . 8GHz
- NPN current gain ( $h_{FE}$ ) . . . . . 130
- NPN early voltage ( $V_A$ ) . . . . . 50V
- PNP transistor ( $f_T$ ) . . . . . 5.5GHz
- PNP current gain ( $h_{FE}$ ) . . . . . 60
- PNP early voltage ( $V_A$ ) . . . . . 20V
- Noise figure (50Ω) at 1.0GHz . . . . . 3.5dB
- Collector to collector leakage . . . . . <1pA
- Complete isolation between transistors
- Pin compatible with industry standard 3XXX series arrays
- Pb-free (RoHS compliant)

### Applications

- VHF/UHF amplifiers
- VHF/UHF mixers
- IF converters
- Synchronous detectors

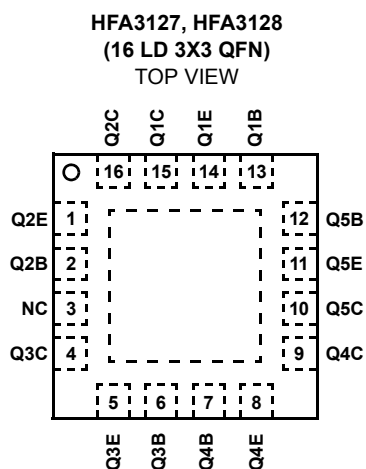
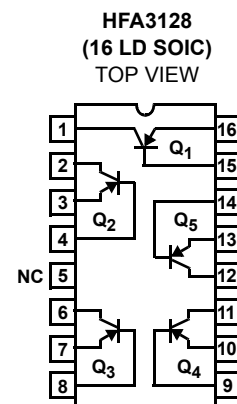
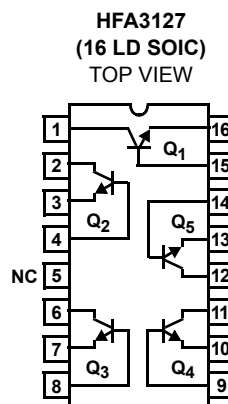
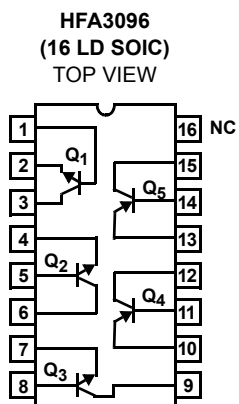
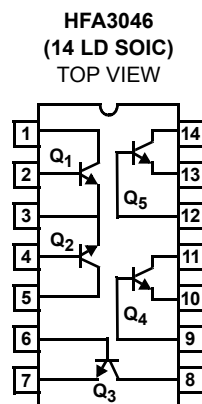
## Ordering Information

| PART NUMBER<br>(Notes 2, 3)                  | PART<br>MARKING | TEMP. RANGE<br>(°C) | TAPE AND REEL<br>(UNITS) (Note 1) | PACKAGE<br>(RoHS Compliant) | PKG.<br>DWG. # |
|----------------------------------------------|-----------------|---------------------|-----------------------------------|-----------------------------|----------------|
| HFA3046BZ                                    | HFA3046BZ       | -55 to +125         | -                                 | 14 Ld SOIC                  | M14.15         |
| HFA3096BZ                                    | HFA3096BZ       | -55 to +125         | -                                 | 16 Ld SOIC                  | M16.15         |
| HFA3096BZ96                                  | HFA3096BZ       | -55 to +125         | 2.5k                              | 16 Ld SOIC                  | M16.15         |
| HFA3127BZ                                    | HFA3127BZ       | -55 to +125         | -                                 | 16 Ld SOIC                  | M16.15         |
| HFA3127BZ96                                  | HFA3127BZ       | -55 to +125         | 2.5k                              | 16 Ld SOIC                  | M16.15         |
| HFA3127RZ                                    | 127Z            | -55 to +125         | -                                 | 16 Ld 3x3 QFN               | L16.3x3        |
| HFA3127RZ96                                  | 127Z            | -55 to +125         | 6k                                | 16 Ld 3x3 QFN               | L16.3x3        |
| HFA3128BZ (No longer available or supported) | HFA3128BZ       | -55 to +125         | -                                 | 16 Ld SOIC                  | M16.15         |
| HFA3128RZ (No longer available or supported) | 128Z            | -55 to +125         | -                                 | 16 Ld 3x3 QFN               | L16.3x3        |

### NOTE:

1. See [TB347](#) for details about reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), see the [HFA3046](#), [HFA3096](#), [HFA3127](#), or [HFA3128](#) device page. For more information about MSL, see [TB363](#).

## Pinouts



**Absolute Maximum Ratings**

|                                                    |                                                                                                                        |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Collector to Emitter Voltage (Open Base) . . . . . | 8V                                                                                                                     |
| Collector to Base Voltage (Open Emitter) . . . . . | 12V                                                                                                                    |
| Emitter to Base Voltage (Reverse Bias) . . . . .   | 5.5V                                                                                                                   |
| Collector Current (100% Duty Cycle) . . . . .      | 18.5mA at $T_J = +150^{\circ}\text{C}$<br>34mA at $T_J = +125^{\circ}\text{C}$<br>37mA at $T_J = +110^{\circ}\text{C}$ |
| Peak Collector Current (Any Condition) . . . . .   | 65mA                                                                                                                   |

**Operating Information**

Temperature Range . . . . .  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

**Thermal Information**

| Thermal Resistance (Typical)                             | $\theta_{JA}$ ( $^{\circ}\text{C}/\text{W}$ )   | $\theta_{JC}$ ( $^{\circ}\text{C}/\text{W}$ ) |
|----------------------------------------------------------|-------------------------------------------------|-----------------------------------------------|
| 14 Ld SOIC Package ( <a href="#">Note 4</a> ) . . . . .  | 120                                             | N/A                                           |
| 16 Ld SOIC Package ( <a href="#">Note 4</a> ) . . . . .  | 115                                             | N/A                                           |
| QFN Package ( <a href="#">Notes 5, 6</a> ) . . . . .     | 57                                              | 10                                            |
| Maximum Power Dissipation (Any One Transistor) . . . . . | 0.15W                                           |                                               |
| Maximum Junction Temperature (Die) . . . . .             | $+175^{\circ}\text{C}$                          |                                               |
| Maximum Junction Temperature (Plastic Package) . . . . . | $+150^{\circ}\text{C}$                          |                                               |
| Maximum Storage Temperature Range . . . . .              | $-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ |                                               |
| Pb-Free Reflow Profile . . . . .                         | see <a href="#">TB493</a>                       |                                               |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" can cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

**NOTES:**

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.
- For  $\theta_{JC}$ , the "case temp" location is the center of the exposed metal pad on the package underside.
- $\theta_{JA}$  is measured with the component mounted on a high-effective thermal conductivity test board in free air. See [TB379](#) for details.

**Electrical Specifications**  $T_A = +25^{\circ}\text{C}$ 

| PARAMETER                                                     | TEST CONDITIONS                                                              | DIE |      |      | SOIC, QFN |      |      | UNIT  |
|---------------------------------------------------------------|------------------------------------------------------------------------------|-----|------|------|-----------|------|------|-------|
|                                                               |                                                                              | MIN | TYP  | MAX  | MIN       | TYP  | MAX  |       |
| DC NPN CHARACTERISTICS                                        |                                                                              |     |      |      |           |      |      |       |
| Collector to Base Breakdown Voltage, V <sub>(BR)CBO</sub>     | I <sub>C</sub> = 100μA, I <sub>E</sub> = 0                                   | 12  | 18   | -    | 12        | 18   | -    | V     |
| Collector to Emitter Breakdown Voltage, V <sub>(BR)CEO</sub>  | I <sub>C</sub> = 100μA, I <sub>B</sub> = 0                                   | 8   | 12   | -    | 8         | 12   | -    | V     |
| Collector to Emitter Breakdown Voltage, V <sub>(BR)CES</sub>  | I <sub>C</sub> = 100μA, Base Shorted to Emitter                              | 10  | 20   | -    | 10        | 20   | -    | V     |
| Emitter to Base Breakdown Voltage, V <sub>(BR)EBO</sub>       | I <sub>E</sub> = 10μA, I <sub>C</sub> = 0                                    | 5.5 | 6    | -    | 5.5       | 6    | -    | V     |
| Collector-Cutoff-Current, I <sub>CEO</sub>                    | V <sub>CE</sub> = 6V, I <sub>B</sub> = 0                                     | -   | 2    | 100  | -         | 2    | 100  | nA    |
| Collector-Cutoff-Current, I <sub>CBO</sub>                    | V <sub>CB</sub> = 8V, I <sub>E</sub> = 0                                     | -   | 0.1  | 10   | -         | 0.1  | 10   | nA    |
| Collector to Emitter Saturation Voltage, V <sub>CE(SAT)</sub> | I <sub>C</sub> = 10mA, I <sub>B</sub> = 1mA                                  | -   | 0.3  | 0.5  | -         | 0.3  | 0.5  | V     |
| Base to Emitter Voltage, V <sub>BE</sub>                      | I <sub>C</sub> = 10mA                                                        | -   | 0.85 | 0.95 | -         | 0.85 | 0.95 | V     |
| DC Forward-Current Transfer Ratio, h <sub>FE</sub>            | I <sub>C</sub> = 10mA, V <sub>CE</sub> = 2V                                  | 40  | 130  | -    | 40        | 130  | -    |       |
| Early Voltage, V <sub>A</sub>                                 | I <sub>C</sub> = 1mA, V <sub>CE</sub> = 3.5V                                 | 20  | 50   | -    | 20        | 50   | -    | V     |
| Base to Emitter Voltage Drift                                 | I <sub>C</sub> = 10mA                                                        | -   | -1.5 | -    | -         | -1.5 | -    | mV/°C |
| Collector to Collector Leakage                                |                                                                              | -   | 1    | -    | -         | 1    | -    | pA    |
| DYNAMIC NPN CHARACTERISTICS                                   |                                                                              |     |      |      |           |      |      |       |
| Noise Figure                                                  | f = 1.0GHz, V <sub>CE</sub> = 5V, I <sub>C</sub> = 5mA, Z <sub>S</sub> = 50Ω | -   | 3.5  | -    | -         | 3.5  | -    | dB    |
| f <sub>T</sub> Current Gain-Bandwidth Product                 | I <sub>C</sub> = 1mA, V <sub>CE</sub> = 5V                                   | -   | 5.5  | -    | -         | 5.5  | -    | GHz   |
|                                                               | I <sub>C</sub> = 10mA, V <sub>CE</sub> = 5V                                  | -   | 8    | -    | -         | 8    | -    | GHz   |
| Power Gain-Bandwidth Product, f <sub>MAX</sub>                | I <sub>C</sub> = 10mA, V <sub>CE</sub> = 5V                                  | -   | 6    | -    | -         | 2.5  | -    | GHz   |
| Base to Emitter Capacitance                                   | V <sub>BE</sub> = -3V                                                        | -   | 200  | -    | -         | 500  | -    | fF    |
| Collector to Base Capacitance                                 | V <sub>CB</sub> = 3V                                                         | -   | 200  | -    | -         | 500  | -    | fF    |

**Electrical Specifications**  $T_A = +25^\circ\text{C}$ 

| PARAMETER                                                     | TEST CONDITIONS                                                                | DIE |      |      | SOIC, QFN |      |      | UNITS |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|-----|------|------|-----------|------|------|-------|
|                                                               |                                                                                | MIN | TYP  | MAX  | MIN       | TYP  | MAX  |       |
| DC PNP CHARACTERISTICS                                        |                                                                                |     |      |      |           |      |      |       |
| Collector to Base Breakdown Voltage, V <sub>(BR)CBO</sub>     | I <sub>C</sub> = -100μA, I <sub>E</sub> = 0                                    | 10  | 15   | -    | 10        | 15   | -    | V     |
| Collector to Emitter Breakdown Voltage, V <sub>(BR)CEO</sub>  | I <sub>C</sub> = -100μA, I <sub>B</sub> = 0                                    | 8   | 15   | -    | 8         | 15   | -    | V     |
| Collector to Emitter Breakdown Voltage, V <sub>(BR)CES</sub>  | I <sub>C</sub> = -100μA, Base Shorted to Emitter                               | 10  | 15   | -    | 10        | 15   | -    | V     |
| Emitter to Base Breakdown Voltage, V <sub>(BR)EBO</sub>       | I <sub>E</sub> = -10μA, I <sub>C</sub> = 0                                     | 4.5 | 5    | -    | 4.5       | 5    | -    | V     |
| Collector Cutoff Current, I <sub>CEO</sub>                    | V <sub>CE</sub> = -6V, I <sub>B</sub> = 0                                      | -   | 2    | 100  | -         | 2    | 100  | nA    |
| Collector Cutoff Current, I <sub>CBO</sub>                    | V <sub>CB</sub> = -8V, I <sub>E</sub> = 0                                      | -   | 0.1  | 10   | -         | 0.1  | 10   | nA    |
| Collector to Emitter Saturation Voltage, V <sub>CE(SAT)</sub> | I <sub>C</sub> = -10mA, I <sub>B</sub> = -1mA                                  | -   | 0.3  | 0.5  | -         | 0.3  | 0.5  | V     |
| Base to Emitter Voltage, V <sub>BE</sub>                      | I <sub>C</sub> = -10mA                                                         | -   | 0.85 | 0.95 | -         | 0.85 | 0.95 | V     |
| DC Forward-Current Transfer Ratio, h <sub>FE</sub>            | I <sub>C</sub> = -10mA, V <sub>CE</sub> = -2V                                  | 20  | 60   | -    | 20        | 60   | -    |       |
| Early Voltage, V <sub>A</sub>                                 | I <sub>C</sub> = -1mA, V <sub>CE</sub> = -3.5V                                 | 10  | 20   | -    | 10        | 20   | -    | V     |
| Base to Emitter Voltage Drift                                 | I <sub>C</sub> = -10mA                                                         | -   | -1.5 | -    | -         | -1.5 | -    | mV/°C |
| Collector to Collector Leakage                                |                                                                                | -   | 1    | -    | -         | 1    | -    | pA    |
| DYNAMIC PNP CHARACTERISTICS                                   |                                                                                |     |      |      |           |      |      |       |
| Noise Figure                                                  | f = 1.0GHz, V <sub>CE</sub> = -5V, I <sub>C</sub> = -5mA, Z <sub>S</sub> = 50Ω | -   | 3.5  | -    | -         | 3.5  | -    | dB    |
| f <sub>T</sub> Current Gain-Bandwidth Product                 | I <sub>C</sub> = -1mA, V <sub>CE</sub> = -5V                                   | -   | 2    | -    | -         | 2    | -    | GHz   |
|                                                               | I <sub>C</sub> = -10mA, V <sub>CE</sub> = -5V                                  | -   | 5.5  | -    | -         | 5.5  | -    | GHz   |
| Power Gain-Bandwidth Product                                  | I <sub>C</sub> = -10mA, V <sub>CE</sub> = -5V                                  | -   | 3    | -    | -         | 2    | -    | GHz   |
| Base to Emitter Capacitance                                   | V <sub>BE</sub> = 3V                                                           | -   | 200  | -    | -         | 500  | -    | fF    |
| Collector to Base Capacitance                                 | V <sub>CB</sub> = -3V                                                          | -   | 300  | -    | -         | 600  | -    | fF    |

**Common Emitter S-Parameters of NPN  $3\mu\text{m} \times 50\mu\text{m}$  Transistor**

| FREQ. (Hz)                                                               | $ S_{11} $ | PHASE( $S_{11}$ ) | $ S_{21} $ | PHASE( $S_{21}$ ) | $ S_{12} $ | PHASE( $S_{12}$ ) | $ S_{22} $ | PHASE( $S_{22}$ ) |
|--------------------------------------------------------------------------|------------|-------------------|------------|-------------------|------------|-------------------|------------|-------------------|
| <b><math>V_{CE} = 5\text{V}</math> and <math>I_C = 5\text{mA}</math></b> |            |                   |            |                   |            |                   |            |                   |
| 1.0E+08                                                                  | 0.83       | -11.78            | 11.07      | 168.57            | 1.41E-02   | 78.88             | 0.97       | -11.05            |
| 2.0E+08                                                                  | 0.79       | -22.82            | 10.51      | 157.89            | 2.69E-02   | 68.63             | 0.93       | -21.35            |
| 3.0E+08                                                                  | 0.73       | -32.64            | 9.75       | 148.44            | 3.75E-02   | 59.58             | 0.86       | -30.44            |
| 4.0E+08                                                                  | 0.67       | -41.08            | 8.91       | 140.36            | 4.57E-02   | 51.90             | 0.79       | -38.16            |
| 5.0E+08                                                                  | 0.61       | -48.23            | 8.10       | 133.56            | 5.19E-02   | 45.50             | 0.73       | -44.59            |
| 6.0E+08                                                                  | 0.55       | -54.27            | 7.35       | 127.88            | 5.65E-02   | 40.21             | 0.67       | -49.93            |
| 7.0E+08                                                                  | 0.50       | -59.41            | 6.69       | 123.10            | 6.00E-02   | 35.82             | 0.62       | -54.37            |
| 8.0E+08                                                                  | 0.46       | -63.81            | 6.11       | 119.04            | 6.27E-02   | 32.15             | 0.57       | -58.10            |
| 9.0E+08                                                                  | 0.42       | -67.63            | 5.61       | 115.57            | 6.47E-02   | 29.07             | 0.53       | -61.25            |
| 1.0E+09                                                                  | 0.39       | -70.98            | 5.17       | 112.55            | 6.63E-02   | 26.45             | 0.50       | -63.96            |

**Common Emitter S-Parameters of NPN 3 $\mu$ m $\times$ 50 $\mu$ m Transistor** (Continued)

| FREQ. (Hz)                                          | S <sub>11</sub> | PHASE(S <sub>11</sub> ) | S <sub>21</sub> | PHASE(S <sub>21</sub> ) | S <sub>12</sub> | PHASE(S <sub>12</sub> ) | S <sub>22</sub> | PHASE(S <sub>22</sub> ) |
|-----------------------------------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|
| 1.1E+09                                             | 0.36            | -73.95                  | 4.79            | 109.91                  | 6.75E-02        | 24.19                   | 0.47            | -66.31                  |
| 1.2E+09                                             | 0.34            | -76.62                  | 4.45            | 107.57                  | 6.85E-02        | 22.24                   | 0.45            | -68.37                  |
| 1.3E+09                                             | 0.32            | -79.04                  | 4.15            | 105.47                  | 6.93E-02        | 20.53                   | 0.43            | -70.19                  |
| 1.4E+09                                             | 0.30            | -81.25                  | 3.89            | 103.57                  | 7.00E-02        | 19.02                   | 0.41            | -71.83                  |
| 1.5E+09                                             | 0.28            | -83.28                  | 3.66            | 101.84                  | 7.05E-02        | 17.69                   | 0.40            | -73.31                  |
| 1.6E+09                                             | 0.27            | -85.17                  | 3.45            | 100.26                  | 7.10E-02        | 16.49                   | 0.39            | -74.66                  |
| 1.7E+09                                             | 0.25            | -86.92                  | 3.27            | 98.79                   | 7.13E-02        | 15.41                   | 0.38            | -75.90                  |
| 1.8E+09                                             | 0.24            | -88.57                  | 3.10            | 97.43                   | 7.17E-02        | 14.43                   | 0.37            | -77.05                  |
| 1.9E+09                                             | 0.23            | -90.12                  | 2.94            | 96.15                   | 7.19E-02        | 13.54                   | 0.36            | -78.12                  |
| 2.0E+09                                             | 0.22            | -91.59                  | 2.80            | 94.95                   | 7.21E-02        | 12.73                   | 0.35            | -79.13                  |
| 2.1E+09                                             | 0.21            | -92.98                  | 2.68            | 93.81                   | 7.23E-02        | 11.98                   | 0.35            | -80.09                  |
| 2.2E+09                                             | 0.20            | -94.30                  | 2.56            | 92.73                   | 7.25E-02        | 11.29                   | 0.34            | -80.99                  |
| 2.3E+09                                             | 0.20            | -95.57                  | 2.45            | 91.70                   | 7.27E-02        | 10.64                   | 0.34            | -81.85                  |
| 2.4E+09                                             | 0.19            | -96.78                  | 2.35            | 90.72                   | 7.28E-02        | 10.05                   | 0.33            | -82.68                  |
| 2.5E+09                                             | 0.18            | -97.93                  | 2.26            | 89.78                   | 7.29E-02        | 9.49                    | 0.33            | -83.47                  |
| 2.6E+09                                             | 0.18            | -99.05                  | 2.18            | 88.87                   | 7.30E-02        | 8.96                    | 0.33            | -84.23                  |
| 2.7E+09                                             | 0.17            | -100.12                 | 2.10            | 88.00                   | 7.31E-02        | 8.47                    | 0.33            | -84.97                  |
| 2.8E+09                                             | 0.17            | -101.15                 | 2.02            | 87.15                   | 7.31E-02        | 8.01                    | 0.33            | -85.68                  |
| 2.9E+09                                             | 0.16            | -102.15                 | 1.96            | 86.33                   | 7.32E-02        | 7.57                    | 0.33            | -86.37                  |
| 3.0E+09                                             | 0.16            | -103.11                 | 1.89            | 85.54                   | 7.32E-02        | 7.16                    | 0.33            | -87.05                  |
| <b>V<sub>CE</sub> = 5V and I<sub>C</sub> = 10mA</b> |                 |                         |                 |                         |                 |                         |                 |                         |
| 1.0E+08                                             | 0.72            | -16.43                  | 15.12           | 165.22                  | 1.27E-02        | 75.41                   | 0.95            | -14.26                  |
| 2.0E+08                                             | 0.67            | -31.26                  | 13.90           | 152.04                  | 2.34E-02        | 62.89                   | 0.88            | -26.95                  |
| 3.0E+08                                             | 0.60            | -43.76                  | 12.39           | 141.18                  | 3.13E-02        | 52.58                   | 0.79            | -37.31                  |
| 4.0E+08                                             | 0.53            | -54.00                  | 10.92           | 132.57                  | 3.68E-02        | 44.50                   | 0.70            | -45.45                  |
| 5.0E+08                                             | 0.47            | -62.38                  | 9.62            | 125.78                  | 4.05E-02        | 38.23                   | 0.63            | -51.77                  |
| 6.0E+08                                             | 0.42            | -69.35                  | 8.53            | 120.37                  | 4.31E-02        | 33.34                   | 0.57            | -56.72                  |
| 7.0E+08                                             | 0.37            | -75.26                  | 7.62            | 116.00                  | 4.49E-02        | 29.47                   | 0.51            | -60.65                  |
| 8.0E+08                                             | 0.34            | -80.36                  | 6.86            | 112.39                  | 4.63E-02        | 26.37                   | 0.47            | -63.85                  |
| 9.0E+08                                             | 0.31            | -84.84                  | 6.22            | 109.36                  | 4.72E-02        | 23.84                   | 0.44            | -66.49                  |
| 1.0E+09                                             | 0.29            | -88.83                  | 5.69            | 106.77                  | 4.80E-02        | 21.75                   | 0.41            | -68.71                  |
| 1.1E+09                                             | 0.27            | -92.44                  | 5.23            | 104.51                  | 4.86E-02        | 20.00                   | 0.39            | -70.62                  |
| 1.2E+09                                             | 0.25            | -95.73                  | 4.83            | 102.53                  | 4.90E-02        | 18.52                   | 0.37            | -72.28                  |
| 1.3E+09                                             | 0.24            | -98.75                  | 4.49            | 100.75                  | 4.94E-02        | 17.25                   | 0.35            | -73.76                  |
| 1.4E+09                                             | 0.22            | -101.55                 | 4.19            | 99.16                   | 4.97E-02        | 16.15                   | 0.34            | -75.08                  |
| 1.5E+09                                             | 0.21            | -104.15                 | 3.93            | 97.70                   | 4.99E-02        | 15.19                   | 0.33            | -76.28                  |
| 1.6E+09                                             | 0.20            | -106.57                 | 3.70            | 96.36                   | 5.01E-02        | 14.34                   | 0.32            | -77.38                  |
| 1.7E+09                                             | 0.20            | -108.85                 | 3.49            | 95.12                   | 5.03E-02        | 13.60                   | 0.31            | -78.41                  |
| 1.8E+09                                             | 0.19            | -110.98                 | 3.30            | 93.96                   | 5.05E-02        | 12.94                   | 0.31            | -79.37                  |
| 1.9E+09                                             | 0.18            | -113.00                 | 3.13            | 92.87                   | 5.06E-02        | 12.34                   | 0.30            | -80.27                  |

**Common Emitter S-Parameters of NPN 3 $\mu$ m x 50 $\mu$ m Transistor** (Continued)

| FREQ. (Hz) | S <sub>11</sub> | PHASE(S <sub>11</sub> ) | S <sub>21</sub> | PHASE(S <sub>21</sub> ) | S <sub>12</sub> | PHASE(S <sub>12</sub> ) | S <sub>22</sub> | PHASE(S <sub>22</sub> ) |
|------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|
| 2.0E+09    | 0.18            | -114.90                 | 2.98            | 91.85                   | 5.07E-02        | 11.81                   | 0.30            | -81.13                  |
| 2.1E+09    | 0.17            | -116.69                 | 2.84            | 90.87                   | 5.08E-02        | 11.33                   | 0.30            | -81.95                  |
| 2.2E+09    | 0.17            | -118.39                 | 2.72            | 89.94                   | 5.09E-02        | 10.89                   | 0.29            | -82.74                  |
| 2.3E+09    | 0.16            | -120.01                 | 2.60            | 89.06                   | 5.10E-02        | 10.50                   | 0.29            | -83.50                  |
| 2.4E+09    | 0.16            | -121.54                 | 2.49            | 88.21                   | 5.11E-02        | 10.13                   | 0.29            | -84.24                  |
| 2.5E+09    | 0.16            | -122.99                 | 2.39            | 87.39                   | 5.12E-02        | 9.80                    | 0.29            | -84.95                  |
| 2.6E+09    | 0.15            | -124.37                 | 2.30            | 86.60                   | 5.12E-02        | 9.49                    | 0.29            | -85.64                  |
| 2.7E+09    | 0.15            | -125.69                 | 2.22            | 85.83                   | 5.13E-02        | 9.21                    | 0.29            | -86.32                  |
| 2.8E+09    | 0.15            | -126.94                 | 2.14            | 85.09                   | 5.13E-02        | 8.95                    | 0.29            | -86.98                  |
| 2.9E+09    | 0.15            | -128.14                 | 2.06            | 84.36                   | 5.14E-02        | 8.71                    | 0.29            | -87.62                  |
| 3.0E+09    | 0.14            | -129.27                 | 1.99            | 83.66                   | 5.15E-02        | 8.49                    | 0.29            | -88.25                  |

**Common Emitter S-Parameters of PNP 3 $\mu$ m x 50 $\mu$ m Transistor**

| FREQ. (Hz)                                           | S <sub>11</sub> | PHASE(S <sub>11</sub> ) | S <sub>21</sub> | PHASE(S <sub>21</sub> ) | S <sub>12</sub> | PHASE(S <sub>12</sub> ) | S <sub>22</sub> | PHASE(S <sub>22</sub> ) |
|------------------------------------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|
| <b>V<sub>CE</sub> = -5V and I<sub>C</sub> = -5mA</b> |                 |                         |                 |                         |                 |                         |                 |                         |
| 1.0E+08                                              | 0.72            | -16.65                  | 10.11           | 166.77                  | 1.66E-02        | 77.18                   | 0.96            | -10.76                  |
| 2.0E+08                                              | 0.68            | -32.12                  | 9.44            | 154.69                  | 3.10E-02        | 65.94                   | 0.90            | -20.38                  |
| 3.0E+08                                              | 0.62            | -45.73                  | 8.57            | 144.40                  | 4.23E-02        | 56.39                   | 0.82            | -28.25                  |
| 4.0E+08                                              | 0.57            | -57.39                  | 7.68            | 135.95                  | 5.05E-02        | 48.66                   | 0.74            | -34.31                  |
| 5.0E+08                                              | 0.52            | -67.32                  | 6.86            | 129.11                  | 5.64E-02        | 42.52                   | 0.67            | -38.81                  |
| 6.0E+08                                              | 0.47            | -75.83                  | 6.14            | 123.55                  | 6.07E-02        | 37.66                   | 0.61            | -42.10                  |
| 7.0E+08                                              | 0.43            | -83.18                  | 5.53            | 118.98                  | 6.37E-02        | 33.79                   | 0.55            | -44.47                  |
| 8.0E+08                                              | 0.40            | -89.60                  | 5.01            | 115.17                  | 6.60E-02        | 30.67                   | 0.51            | -46.15                  |
| 9.0E+08                                              | 0.38            | -95.26                  | 4.56            | 111.94                  | 6.77E-02        | 28.14                   | 0.47            | -47.33                  |
| 1.0E+09                                              | 0.36            | -100.29                 | 4.18            | 109.17                  | 6.91E-02        | 26.06                   | 0.44            | -48.15                  |
| 1.1E+09                                              | 0.34            | -104.80                 | 3.86            | 106.76                  | 7.01E-02        | 24.33                   | 0.41            | -48.69                  |
| 1.2E+09                                              | 0.33            | -108.86                 | 3.58            | 104.63                  | 7.09E-02        | 22.89                   | 0.39            | -49.05                  |
| 1.3E+09                                              | 0.32            | -112.53                 | 3.33            | 102.72                  | 7.16E-02        | 21.67                   | 0.37            | -49.26                  |
| 1.4E+09                                              | 0.30            | -115.86                 | 3.12            | 101.01                  | 7.22E-02        | 20.64                   | 0.36            | -49.38                  |
| 1.5E+09                                              | 0.30            | -118.90                 | 2.92            | 99.44                   | 7.27E-02        | 19.76                   | 0.34            | -49.43                  |
| 1.6E+09                                              | 0.29            | -121.69                 | 2.75            | 98.01                   | 7.32E-02        | 19.00                   | 0.33            | -49.44                  |
| 1.7E+09                                              | 0.28            | -124.24                 | 2.60            | 96.68                   | 7.35E-02        | 18.35                   | 0.32            | -49.43                  |
| 1.8E+09                                              | 0.28            | -126.59                 | 2.47            | 95.44                   | 7.39E-02        | 17.79                   | 0.31            | -49.40                  |
| 1.9E+09                                              | 0.27            | -128.76                 | 2.34            | 94.29                   | 7.42E-02        | 17.30                   | 0.30            | -49.38                  |
| 2.0E+09                                              | 0.27            | -130.77                 | 2.23            | 93.19                   | 7.45E-02        | 16.88                   | 0.30            | -49.36                  |
| 2.1E+09                                              | 0.26            | -132.63                 | 2.13            | 92.16                   | 7.47E-02        | 16.52                   | 0.29            | -49.35                  |
| 2.2E+09                                              | 0.26            | -134.35                 | 2.04            | 91.18                   | 7.50E-02        | 16.20                   | 0.28            | -49.35                  |
| 2.3E+09                                              | 0.26            | -135.96                 | 1.95            | 90.24                   | 7.52E-02        | 15.92                   | 0.28            | -49.38                  |
| 2.4E+09                                              | 0.25            | -137.46                 | 1.87            | 89.34                   | 7.55E-02        | 15.68                   | 0.28            | -49.42                  |

**Common Emitter S-Parameters of PNP 3 $\mu$ m x 50 $\mu$ m Transistor** (Continued)

| FREQ. (Hz)                                         | S <sub>11</sub> | PHASE(S <sub>11</sub> ) | S <sub>21</sub> | PHASE(S <sub>21</sub> ) | S <sub>12</sub> | PHASE(S <sub>12</sub> ) | S <sub>22</sub> | PHASE(S <sub>22</sub> ) |
|----------------------------------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|-----------------|-------------------------|
| 2.5E+09                                            | 0.25            | -138.86                 | 1.80            | 88.48                   | 7.57E-02        | 15.48                   | 0.27            | -49.49                  |
| 2.6E+09                                            | 0.25            | -140.17                 | 1.73            | 87.65                   | 7.59E-02        | 15.30                   | 0.27            | -49.56                  |
| 2.7E+09                                            | 0.25            | -141.39                 | 1.67            | 86.85                   | 7.61E-02        | 15.15                   | 0.26            | -49.67                  |
| 2.8E+09                                            | 0.25            | -142.54                 | 1.61            | 86.07                   | 7.63E-02        | 15.01                   | 0.26            | -49.81                  |
| 2.9E+09                                            | 0.24            | -143.62                 | 1.56            | 85.31                   | 7.65E-02        | 14.90                   | 0.26            | -49.96                  |
| 3.0E+09                                            | 0.24            | -144.64                 | 1.51            | 84.58                   | 7.67E-02        | 14.81                   | 0.26            | -50.13                  |
| <b>V<sub>CE</sub> = -5V, I<sub>C</sub> = -10mA</b> |                 |                         |                 |                         |                 |                         |                 |                         |
| 1.0E+08                                            | 0.58            | -23.24                  | 13.03           | 163.45                  | 1.43E-02        | 73.38                   | 0.93            | -13.46                  |
| 2.0E+08                                            | 0.53            | -44.07                  | 11.75           | 149.11                  | 2.58E-02        | 60.43                   | 0.85            | -24.76                  |
| 3.0E+08                                            | 0.48            | -61.50                  | 10.25           | 137.78                  | 3.38E-02        | 50.16                   | 0.74            | -33.10                  |
| 4.0E+08                                            | 0.43            | -75.73                  | 8.88            | 129.12                  | 3.90E-02        | 42.49                   | 0.65            | -38.83                  |
| 5.0E+08                                            | 0.40            | -87.36                  | 7.72            | 122.49                  | 4.25E-02        | 36.81                   | 0.58            | -42.63                  |
| 6.0E+08                                            | 0.37            | -96.94                  | 6.78            | 117.33                  | 4.48E-02        | 32.59                   | 0.51            | -45.07                  |
| 7.0E+08                                            | 0.35            | -104.92                 | 6.01            | 113.22                  | 4.64E-02        | 29.39                   | 0.47            | -46.60                  |
| 8.0E+08                                            | 0.33            | -111.64                 | 5.39            | 109.85                  | 4.76E-02        | 26.94                   | 0.43            | -47.49                  |
| 9.0E+08                                            | 0.32            | -117.36                 | 4.87            | 107.05                  | 4.85E-02        | 25.04                   | 0.40            | -47.97                  |
| 1.0E+09                                            | 0.31            | -122.27                 | 4.44            | 104.66                  | 4.92E-02        | 23.55                   | 0.37            | -48.18                  |
| 1.1E+09                                            | 0.30            | -126.51                 | 4.07            | 102.59                  | 4.97E-02        | 22.37                   | 0.35            | -48.20                  |
| 1.2E+09                                            | 0.30            | -130.21                 | 3.76            | 100.76                  | 5.02E-02        | 21.44                   | 0.33            | -48.11                  |
| 1.3E+09                                            | 0.29            | -133.46                 | 3.49            | 99.14                   | 5.06E-02        | 20.70                   | 0.32            | -47.95                  |
| 1.4E+09                                            | 0.29            | -136.33                 | 3.25            | 97.67                   | 5.09E-02        | 20.11                   | 0.31            | -47.77                  |
| 1.5E+09                                            | 0.28            | -138.89                 | 3.05            | 96.33                   | 5.12E-02        | 19.65                   | 0.30            | -47.58                  |
| 1.6E+09                                            | 0.28            | -141.17                 | 2.87            | 95.10                   | 5.15E-02        | 19.29                   | 0.29            | -47.39                  |
| 1.7E+09                                            | 0.28            | -143.21                 | 2.70            | 93.96                   | 5.18E-02        | 19.01                   | 0.28            | -47.23                  |
| 1.8E+09                                            | 0.28            | -145.06                 | 2.56            | 92.90                   | 5.21E-02        | 18.80                   | 0.27            | -47.09                  |
| 1.9E+09                                            | 0.27            | -146.73                 | 2.43            | 91.90                   | 5.23E-02        | 18.65                   | 0.27            | -46.98                  |
| 2.0E+09                                            | 0.27            | -148.26                 | 2.31            | 90.95                   | 5.26E-02        | 18.55                   | 0.26            | -46.91                  |
| 2.1E+09                                            | 0.27            | -149.65                 | 2.20            | 90.05                   | 5.28E-02        | 18.49                   | 0.26            | -46.87                  |
| 2.2E+09                                            | 0.27            | -150.92                 | 2.10            | 89.20                   | 5.30E-02        | 18.46                   | 0.25            | -46.87                  |
| 2.3E+09                                            | 0.27            | -152.10                 | 2.01            | 88.37                   | 5.33E-02        | 18.47                   | 0.25            | -46.90                  |
| 2.4E+09                                            | 0.27            | -153.18                 | 1.93            | 87.59                   | 5.35E-02        | 18.50                   | 0.25            | -46.97                  |
| 2.5E+09                                            | 0.27            | -154.17                 | 1.86            | 86.82                   | 5.38E-02        | 18.55                   | 0.24            | -47.07                  |
| 2.6E+09                                            | 0.26            | -155.10                 | 1.79            | 86.09                   | 5.40E-02        | 18.62                   | 0.24            | -47.18                  |
| 2.7E+09                                            | 0.26            | -155.96                 | 1.72            | 85.38                   | 5.42E-02        | 18.71                   | 0.24            | -47.34                  |
| 2.8E+09                                            | 0.26            | -156.76                 | 1.66            | 84.68                   | 5.45E-02        | 18.80                   | 0.24            | -47.55                  |
| 2.9E+09                                            | 0.26            | -157.51                 | 1.60            | 84.01                   | 5.47E-02        | 18.91                   | 0.24            | -47.76                  |
| 3.0E+09                                            | 0.26            | -158.21                 | 1.55            | 83.35                   | 5.50E-02        | 19.03                   | 0.23            | -48.00                  |



## Typical Performance Curves

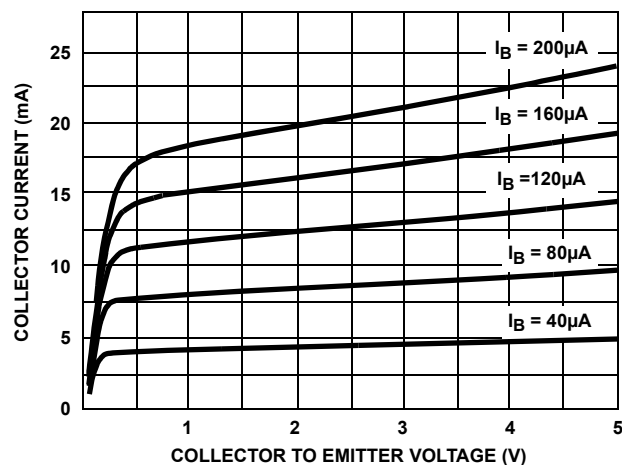


FIGURE 1. NPN COLLECTOR CURRENT vs COLLECTOR TO EMITTER VOLTAGE

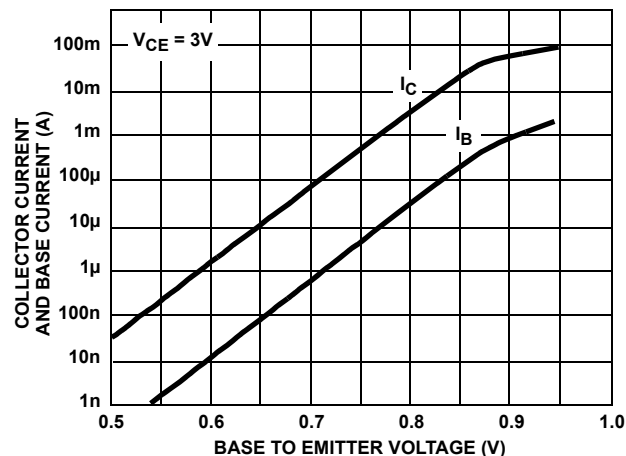


FIGURE 2. NPN COLLECTOR CURRENT AND BASE CURRENT vs BASE TO EMITTER VOLTAGE

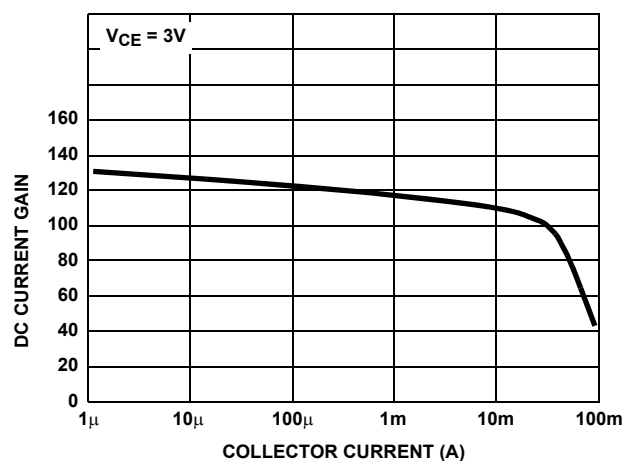


FIGURE 3. NPN DC CURRENT GAIN vs COLLECTOR CURRENT

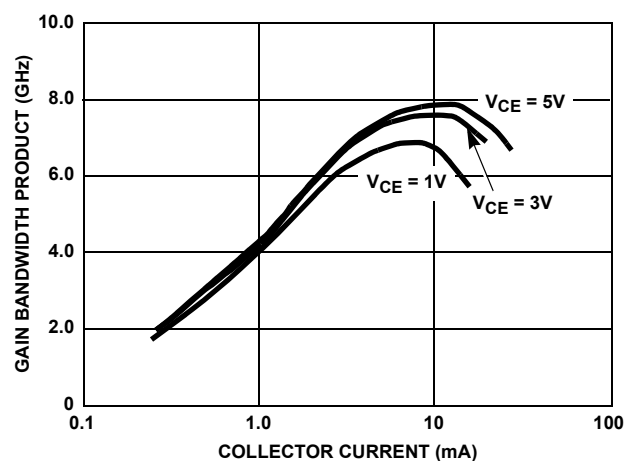


FIGURE 4. NPN GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT (UHF 3 x 50 WITH BOND PADS)

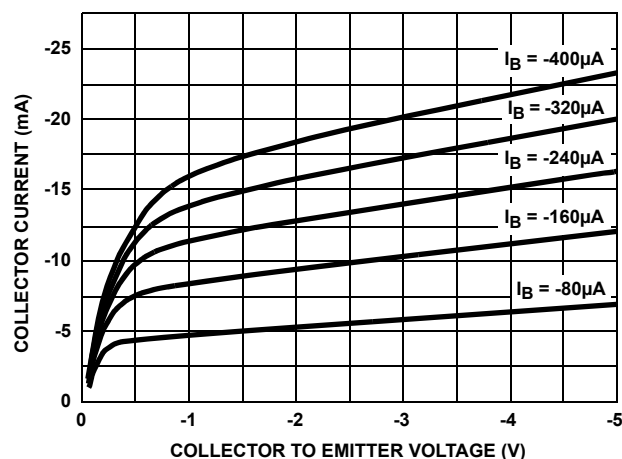


FIGURE 5. PNP COLLECTOR CURRENT vs COLLECTOR TO EMITTER VOLTAGE

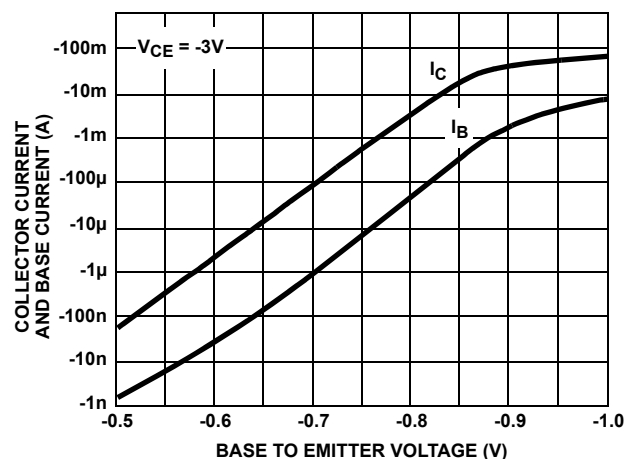


FIGURE 6. PNP COLLECTOR CURRENT AND BASE CURRENT vs BASE TO EMITTER VOLTAGE

Typical Performance Curves (Continued)

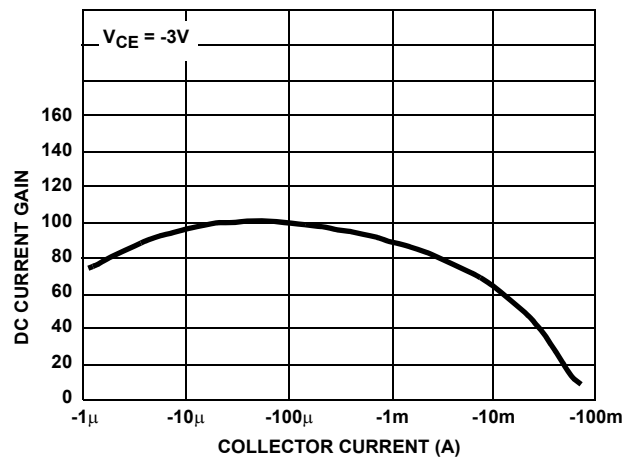


FIGURE 7. PNP DC CURRENT GAIN vs COLLECTOR CURRENT

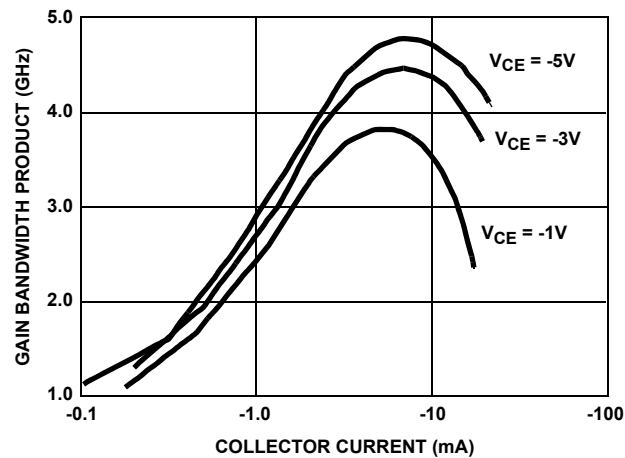


FIGURE 8. PNP GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT (UHF 3 x 50 WITH BOND PADS)

## Die Characteristics

### DIE DIMENSIONS:

53 mils x 52 mils  
1340 $\mu$ m x 1320 $\mu$ m

### METALLIZATION:

Type: Metal 1: AlCu(2%)/TiW  
Thickness: Metal 1: 8k $\text{\AA}$   $\pm$ 0.4k $\text{\AA}$   
Type: Metal 2: AlCu(2%)  
Thickness: Metal 2: 16k $\text{\AA}$   $\pm$ 0.8k $\text{\AA}$

### PASSIVATION:

Type: Nitride  
Thickness: 4k $\text{\AA}$   $\pm$ 0.5k $\text{\AA}$

### PROCESS:

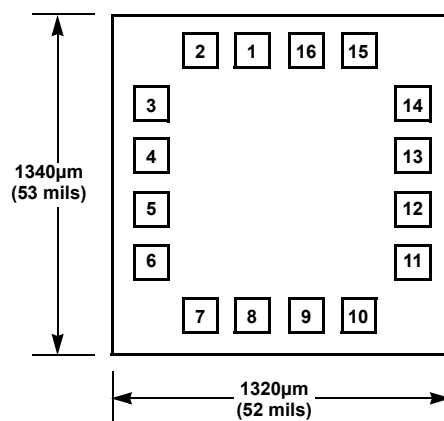
UHF-1

### SUBSTRATE POTENTIAL: (POWERED UP)

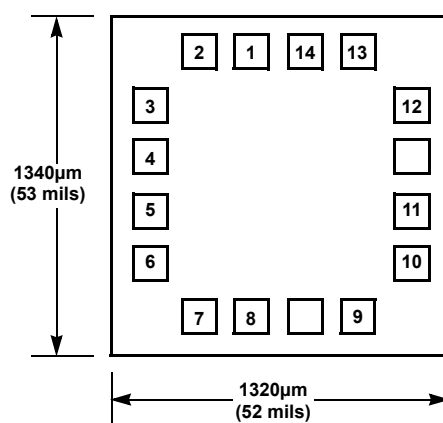
Unbiased

## Metallization Mask Layout

HFA3096, HFA3127, HFA3128



HFA3046



Pad numbers correspond to SOIC pinout.

**Revision History** The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to the web to make sure that you have the latest revision.

| DATE         | REVISION  | CHANGE                                                                                                                                                                                                                                                                                                                                     |
|--------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jan 24, 2019 | FN3076.16 | Added Related Literature section.<br>Updated ordering information table by adding tape and reel versions, and updating notes.<br>Updated links throughout document.<br>Updated POD M16.15 to the latest revision, changes are as follows:<br>-Update graphics to new standard layout, removing the dimension table.<br>Updated disclaimer. |
| Aug 11, 2015 | FN3076.15 | Added Revision History beginning with Rev 15.<br>Updated ordering information table with "No longer available or supported" next to HFA3128 part numbers                                                                                                                                                                                   |

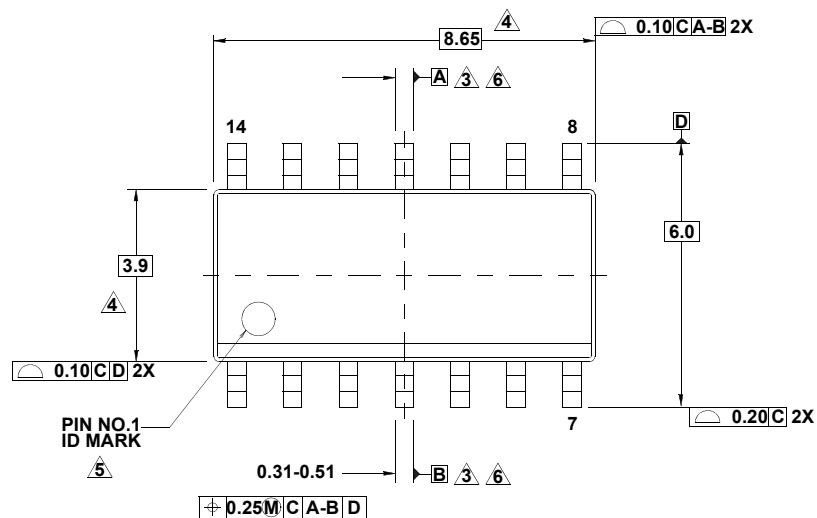
## Package Outline Drawings

For the most recent package outline drawing, see [M14.15](#).

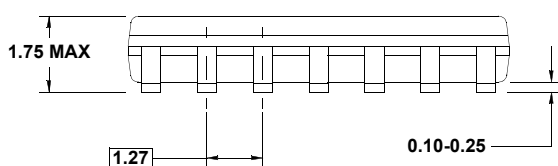
### M14.15

#### 14 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

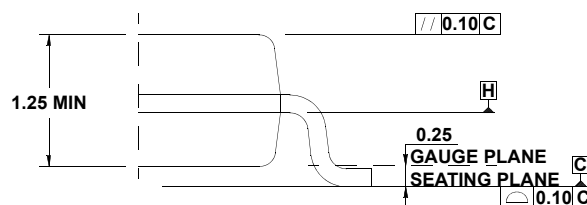
Rev 1, 10/09



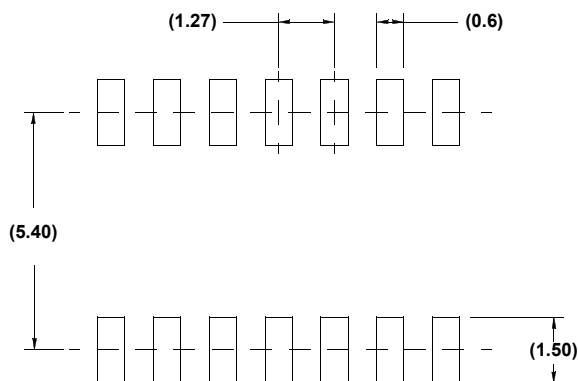
TOP VIEW



SIDE VIEW



DETAIL "A"



TYPICAL RECOMMENDED LAND PATTERN

#### NOTES:

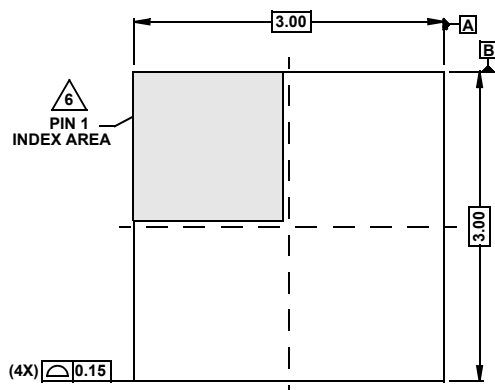
1. Dimensions are in millimeters.  
Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSEY14.5m-1994.
3. Datums A and B to be determined at Datum H.
4. Dimension does not include interlead flash or protrusions.  
Interlead flash or protrusions shall not exceed 0.25mm per side.
5. The pin #1 identifier may be either a mold or mark feature.
6. Does not include dambar protrusion. Allowable dambar protrusion shall be 0.10mm total in excess of lead width at maximum condition.
7. Reference to JEDEC MS-012-AB.

For the most recent package outline drawing, see [M16.15](#).

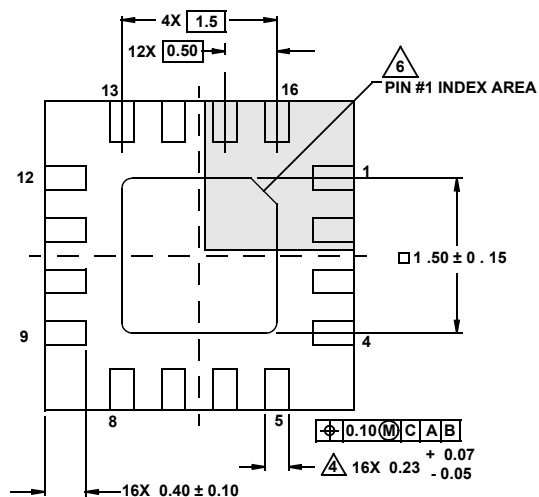


**L16.3x3****16 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE**

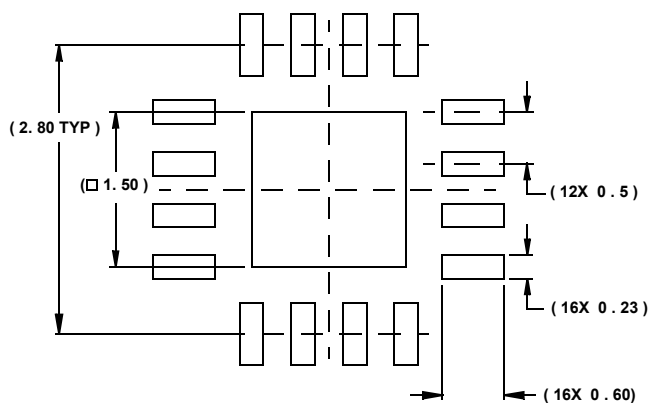
Rev 2, 4/07

For the most recent package outline drawing, see [L16.3x3](#).

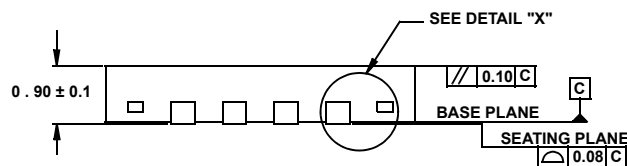
TOP VIEW



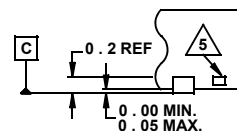
BOTTOM VIEW



TYPICAL RECOMMENDED LAND PATTERN



SIDE VIEW



DETAIL "X"

## NOTES:

1. Dimensions are in millimeters.  
Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSE Y14.5m-1994.
3. Unless otherwise specified, tolerance : Decimal  $\pm 0.05$
4. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
5. Tiebar shown (if present) is a non-functional feature.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.

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