



SANYO Semiconductors

## DATA SHEET

# EC3H02BA — NPN Epitaxial Planar Silicon Transistor

## VHF to UHF Wide-Band Low-Noise Amplifier Applications

### Features

- Low noise : NF=1.0dB typ (f=1GHz).
- High gain :  $|S_{21e}|^2=12\text{dB}$  typ (f=1GHz).
- High cutoff frequency :  $f_T=7\text{GHz}$  typ.
- Ultrasmall (1006size), slim (0.5mm) leadless package.
- Halogen free compliance (UL94 HB).

### Specifications

**Absolute Maximum Ratings** at Ta=25°C

| Parameter                    | Symbol           | Conditions | Ratings     | Unit |
|------------------------------|------------------|------------|-------------|------|
| Collector-to- Base Voltage   | V <sub>CB0</sub> |            | 20          | V    |
| Collector-to-Emitter Voltage | V <sub>CEO</sub> |            | 10          | V    |
| Emitter-to-Base Voltage      | V <sub>EBO</sub> |            | 2           | V    |
| Collector Current            | I <sub>C</sub>   |            | 70          | mA   |
| Collector Dissipation        | P <sub>C</sub>   |            | 100         | mW   |
| Junction Temperature         | T <sub>J</sub>   |            | 150         | °C   |
| Storage Temperature          | T <sub>stg</sub> |            | -55 to +150 | °C   |

**Electrical Characteristics** at Ta=25°C

| Parameter                    | Symbol           | Conditions                                | Ratings |      |     | Unit |
|------------------------------|------------------|---|---------|------|-----|------|
|                              |                  |   | min     | typ  | max |      |
| Collector Cutoff Current     | I <sub>CBO</sub> | V <sub>CB</sub> =10V, I <sub>E</sub> =0A  |         |      | 1.0 | μA   |
| Emitter Cutoff Current       | I <sub>EBO</sub> | V <sub>EB</sub> =1V, I <sub>C</sub> =0A   |         |      | 10  | μA   |
| DC Current Gain              | h <sub>FE</sub>  | V <sub>CE</sub> =5V, I <sub>C</sub> =20mA | 120     |      | 180 |      |
| Gain-Bandwidth Product       | f <sub>T1</sub>  | V <sub>CE</sub> =5V, I <sub>C</sub> =20mA | 5       | 7    |     | GHz  |
| Output Capacitance           | C <sub>ob</sub>  | V <sub>CB</sub> =10V, f=1MHz              |         | 0.7  | 1.2 | pF   |
| Reverse Transfer Capacitance | C <sub>re</sub>  | V <sub>CB</sub> =10V, f=1MHz              |         | 0.45 |     | pF   |

Continued on next page.

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**SANYO Semiconductor Co., Ltd.**

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# EC3H02BA

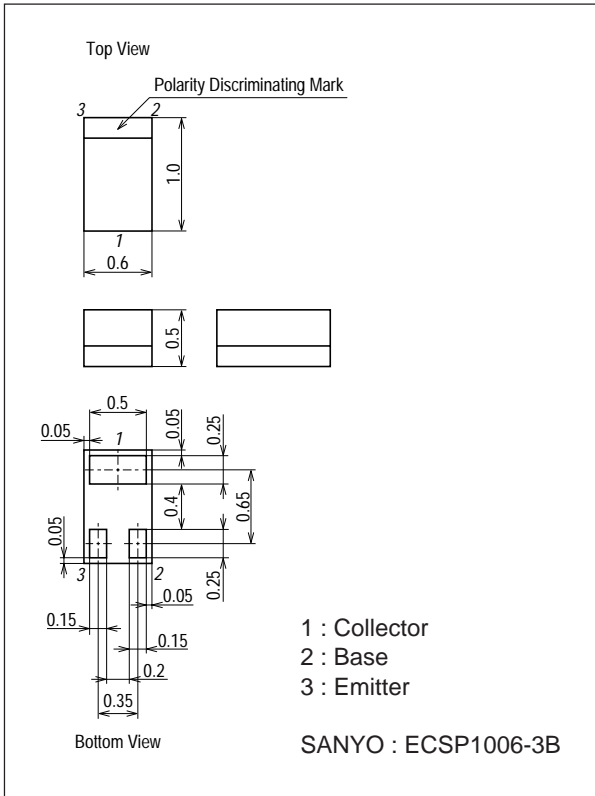
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| Parameter             | Symbol              | Conditions  | Ratings |     |     | Unit |
|-----------------------|---------------------|---|---------|-----|-----|------|
|                       |                     |   | min     | typ | max |      |
| Forward Transfer Gain | S21e  <sub>21</sub> | V <sub>CE</sub> =5V, I <sub>C</sub> =20mA, f=1GHz | 9       | 12  |     | dB   |
|                       | S21e  <sub>22</sub> | V <sub>CE</sub> =2V, I <sub>C</sub> =3mA, f=1GHz  |         | 8.5 |     | dB   |
| Noise Figure          | NF                  | V <sub>CE</sub> =5V, I <sub>C</sub> =7mA, f=1GHz  |         | 1.0 | 1.8 | dB   |

## Package Dimensions

unit : mm (typ)

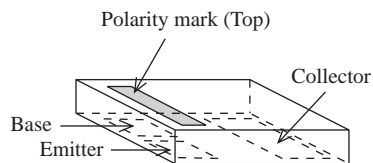
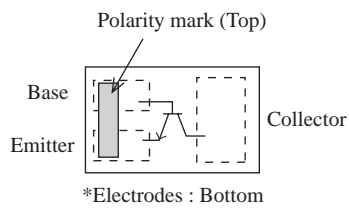
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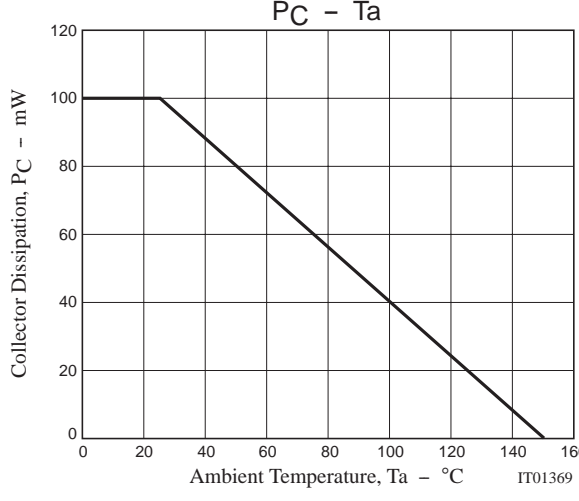
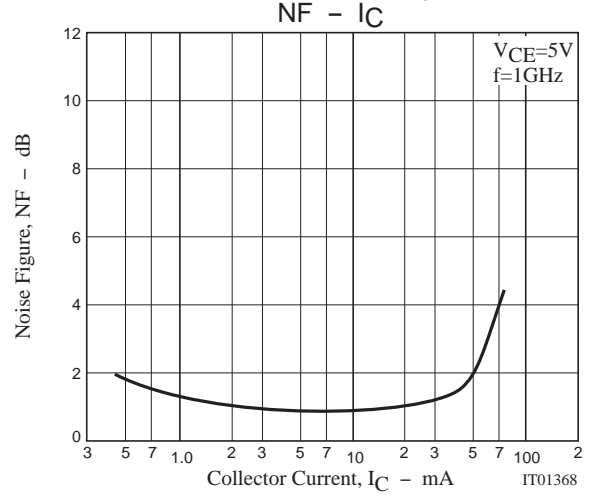
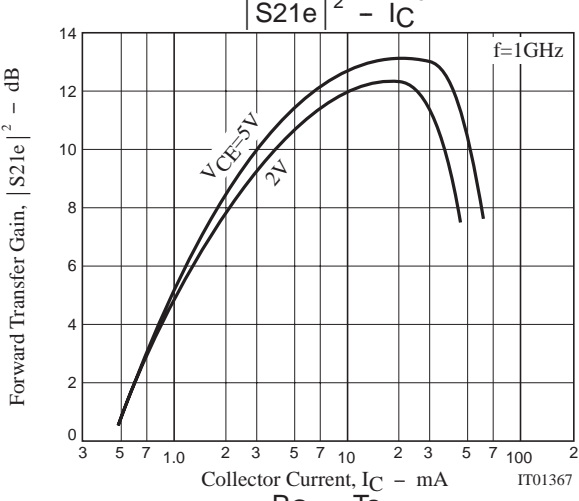
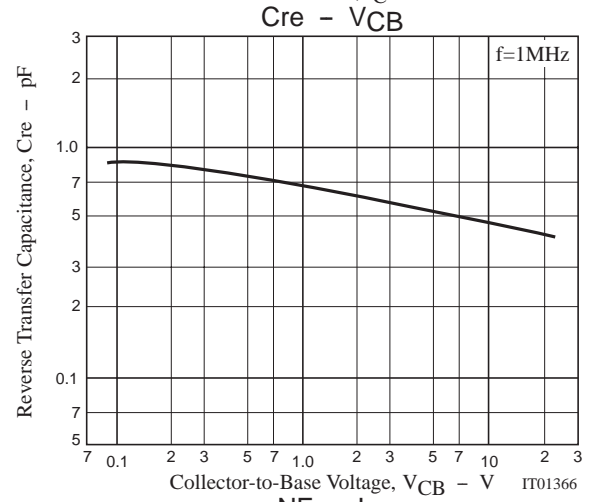
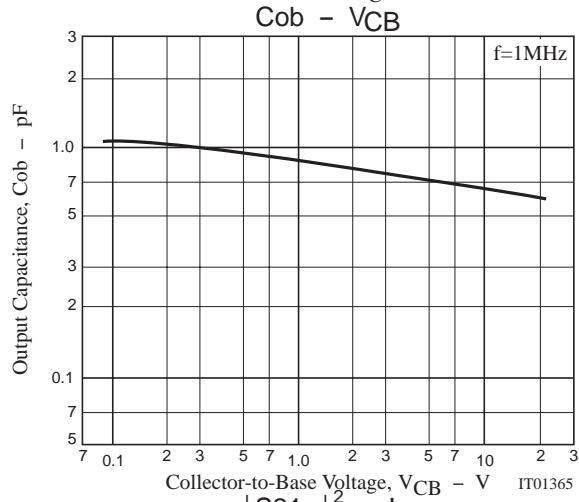
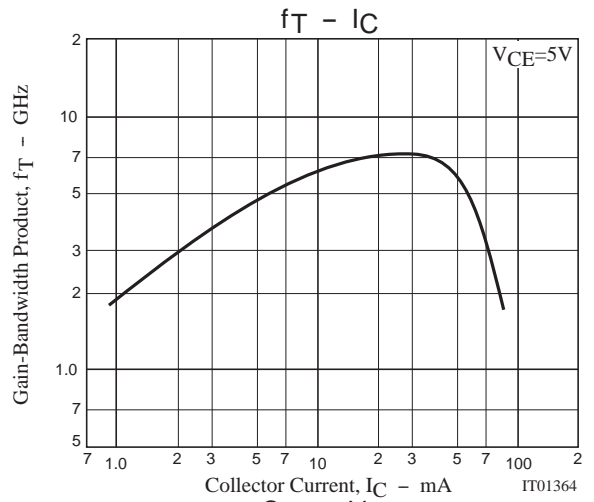
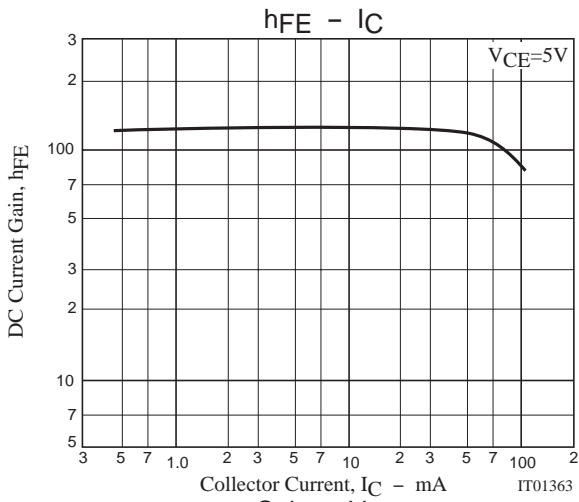
### Type No. Indication (Top view)



### Electrical Connection (Top view)



# EC3H02BA



## EC3H02BA

### S Parameters (Common emitter)

$V_{CE}=1V, I_C=1mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.955      | -22.6           | 3.418      | 163.3           | 0.056      | 76.0            | 0.975      | -10.5           |
| 200       | 0.922      | -43.0           | 3.109      | 148.7           | 0.104      | 63.2            | 0.921      | -19.6           |
| 400       | 0.845      | -77.2           | 2.617      | 124.8           | 0.165      | 44.2            | 0.794      | -32.9           |
| 600       | 0.782      | -101.8          | 2.156      | 107.7           | 0.189      | 31.3            | 0.694      | -41.5           |
| 800       | 0.746      | -119.1          | 1.788      | 94.2            | 0.200      | 23.5            | 0.630      | -47.7           |
| 1000      | 0.734      | -131.1          | 1.498      | 83.7            | 0.201      | 17.7            | 0.596      | -52.2           |
| 1200      | 0.717      | -141.2          | 1.326      | 74.6            | 0.198      | 14.7            | 0.573      | -57.6           |
| 1400      | 0.707      | -148.9          | 1.154      | 66.6            | 0.193      | 12.0            | 0.559      | -61.9           |
| 1600      | 0.708      | -155.5          | 1.029      | 60.2            | 0.182      | 10.7            | 0.561      | -66.1           |
| 1800      | 0.711      | -161.6          | 0.953      | 54.6            | 0.171      | 10.8            | 0.561      | -71.6           |
| 2000      | 0.712      | -166.5          | 0.880      | 49.3            | 0.160      | 13.0            | 0.569      | -76.5           |

$V_{CE}=1V, I_C=5mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.818      | -47.9           | 13.330     | 150.0           | 0.049      | 64.3            | 0.869      | -29.8           |
| 200       | 0.739      | -83.2           | 10.545     | 129.6           | 0.076      | 49.6            | 0.681      | -50.0           |
| 400       | 0.661      | -122.9          | 6.688      | 107.4           | 0.098      | 37.8            | 0.445      | -71.3           |
| 600       | 0.627      | -142.2          | 4.726      | 95.9            | 0.106      | 35.4            | 0.334      | -81.7           |
| 800       | 0.616      | -153.8          | 3.653      | 87.5            | 0.114      | 36.3            | 0.279      | -89.2           |
| 1000      | 0.614      | -161.8          | 2.989      | 80.7            | 0.122      | 38.4            | 0.252      | -94.7           |
| 1200      | 0.611      | -167.3          | 2.534      | 75.1            | 0.130      | 40.8            | 0.238      | -99.0           |
| 1400      | 0.607      | -172.2          | 2.207      | 70.1            | 0.139      | 43.1            | 0.231      | -102.8          |
| 1600      | 0.607      | -176.6          | 1.965      | 65.5            | 0.149      | 45.1            | 0.227      | -106.4          |
| 1800      | 0.610      | 179.8           | 1.776      | 61.1            | 0.159      | 47.1            | 0.230      | -109.8          |
| 2000      | 0.609      | 176.9           | 1.627      | 57.0            | 0.171      | 48.6            | 0.237      | -112.1          |

$V_{CE}=2V, I_C=3mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.890      | -32.1           | 9.129      | 158.3           | 0.042      | 72.1            | 0.938      | -17.1           |
| 200       | 0.827      | -59.6           | 7.989      | 141.0           | 0.073      | 57.6            | 0.824      | -30.2           |
| 400       | 0.725      | -98.7           | 5.823      | 117.5           | 0.104      | 41.8            | 0.618      | -45.5           |
| 600       | 0.666      | -121.9          | 4.355      | 103.4           | 0.115      | 34.5            | 0.496      | -52.3           |
| 800       | 0.641      | -136.9          | 3.448      | 93.1            | 0.121      | 32.2            | 0.429      | -56.5           |
| 1000      | 0.631      | -147.3          | 2.854      | 85.1            | 0.125      | 32.0            | 0.392      | -59.9           |
| 1200      | 0.624      | -154.9          | 2.436      | 78.5            | 0.128      | 33.1            | 0.372      | -62.9           |
| 1400      | 0.618      | -161.3          | 2.124      | 72.8            | 0.131      | 35.2            | 0.360      | -66.0           |
| 1600      | 0.616      | -166.7          | 1.894      | 67.5            | 0.134      | 37.6            | 0.352      | -69.1           |
| 1800      | 0.618      | -171.4          | 1.715      | 62.7            | 0.139      | 40.3            | 0.351      | -72.9           |
| 2000      | 0.618      | -175.1          | 1.571      | 58.1            | 0.144      | 43.2            | 0.357      | -76.4           |

$V_{CE}=2V, I_C=10mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.715      | -60.8           | 21.486     | 143.7           | 0.035      | 62.1            | 0.806      | -36.1           |
| 200       | 0.643      | -98.6           | 15.499     | 122.8           | 0.051      | 49.2            | 0.580      | -56.8           |
| 400       | 0.589      | -135.1          | 9.112      | 103.3           | 0.065      | 44.8            | 0.355      | -75.8           |
| 600       | 0.570      | -151.5          | 6.296      | 93.9            | 0.075      | 47.3            | 0.261      | -84.5           |
| 800       | 0.564      | -161.1          | 4.816      | 86.9            | 0.087      | 50.9            | 0.215      | -90.9           |
| 1000      | 0.563      | -167.7          | 3.921      | 81.1            | 0.098      | 53.6            | 0.192      | -95.4           |
| 1200      | 0.560      | -172.3          | 3.308      | 76.3            | 0.112      | 56.0            | 0.181      | -99.0           |
| 1400      | 0.558      | -176.2          | 2.867      | 72.1            | 0.125      | 57.7            | 0.172      | -102.6          |
| 1600      | 0.558      | 180.0           | 2.550      | 68.1            | 0.139      | 58.8            | 0.169      | -105.3          |
| 1800      | 0.562      | 176.8           | 2.293      | 64.2            | 0.155      | 59.5            | 0.170      | -107.8          |
| 2000      | 0.561      | 174.4           | 2.092      | 60.5            | 0.169      | 59.8            | 0.176      | -109.2          |

## EC3H02BA

### S Parameters (Common emitter)

$V_{CE}=5V, I_C=7mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.797      | -42.9           | 17.630     | 152.0           | 0.030      | 68.4            | 0.892      | -22.3           |
| 200       | 0.708      | -76.1           | 14.170     | 132.4           | 0.048      | 55.1            | 0.723      | -36.7           |
| 400       | 0.608      | -116.0          | 9.186      | 110.4           | 0.064      | 45.4            | 0.494      | -48.9           |
| 600       | 0.565      | -136.4          | 6.534      | 98.9            | 0.073      | 44.6            | 0.385      | -52.5           |
| 800       | 0.550      | -148.8          | 5.055      | 90.8            | 0.081      | 46.8            | 0.329      | -54.0           |
| 1000      | 0.547      | -157.0          | 4.134      | 84.3            | 0.089      | 49.9            | 0.299      | -55.4           |
| 1200      | 0.541      | -163.2          | 3.497      | 79.0            | 0.098      | 52.4            | 0.285      | -56.7           |
| 1400      | 0.537      | -168.1          | 3.025      | 74.4            | 0.109      | 55.0            | 0.277      | -57.9           |
| 1600      | 0.539      | -172.5          | 2.687      | 70.0            | 0.119      | 57.0            | 0.270      | -60.1           |
| 1800      | 0.540      | -176.5          | 2.425      | 65.8            | 0.130      | 58.6            | 0.271      | -63.0           |
| 2000      | 0.540      | -179.4          | 2.212      | 61.9            | 0.142      | 59.9            | 0.277      | -65.8           |

$V_{CE}=5V, I_C=20mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100       | 0.618      | -71.5           | 30.252     | 138.1           | 0.023      | 60.6            | 0.748      | -37.0           |
| 200       | 0.554      | -110.5          | 20.311     | 117.7           | 0.034      | 52.7            | 0.511      | -52.9           |
| 400       | 0.519      | -143.1          | 11.419     | 100.5           | 0.046      | 54.5            | 0.306      | -62.6           |
| 600       | 0.507      | -156.8          | 7.810      | 92.4            | 0.058      | 58.7            | 0.230      | -64.0           |
| 800       | 0.504      | -165.0          | 5.941      | 86.2            | 0.071      | 62.2            | 0.193      | -64.9           |
| 1000      | 0.505      | -170.5          | 4.816      | 81.1            | 0.084      | 64.7            | 0.175      | -66.0           |
| 1200      | 0.504      | -174.3          | 4.051      | 76.8            | 0.098      | 66.2            | 0.167      | -67.0           |
| 1400      | 0.502      | -177.8          | 3.502      | 73.0            | 0.112      | 67.2            | 0.162      | -68.2           |
| 1600      | 0.504      | 178.9           | 3.107      | 69.3            | 0.127      | 67.4            | 0.159      | -70.1           |
| 1800      | 0.508      | 176.0           | 2.788      | 65.7            | 0.142      | 67.4            | 0.161      | -72.4           |
| 2000      | 0.507      | 173.9           | 2.539      | 62.3            | 0.155      | 67.1            | 0.169      | -74.8           |

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