



MCH4015

RF Transistor

12V, 100mA, $f_T=10\text{GHz}$, NPN Single MCPH4

ON Semiconductor®

<http://onsemi.com>

Features

- Low-noise use : $NF=1.2\text{dB typ (}f=1\text{GHz)}$
- High cut-off frequency : $f_T=10\text{GHz typ (}V_{CE}=5\text{V)}$
- High gain : $|S_{21e}|^2=17\text{dB typ (}f=1\text{GHz)}$
- Halogen free compliance

Specifications

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

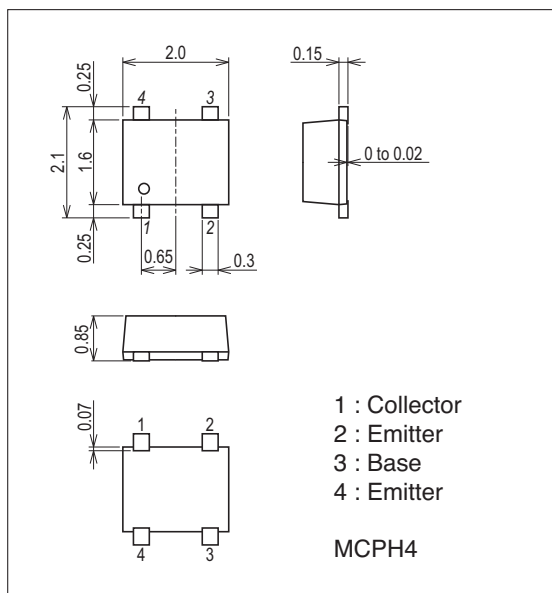
| Parameter | Symbol | Conditions | Ratings | Unit |
|------------------------------|-----------|------------|-------------|------------------|
| Collector-to-Base Voltage | V_{CBO} | | 20 | V |
| Collector-to-Emitter Voltage | V_{CEO} | | 12 | V |
| Emitter-to-Base Voltage | V_{EBO} | | 2 | V |
| Collector Current | I_C | | 100 | mA |
| Collector Dissipation | P_C | | 450 | mW |
| Junction Temperature | T_J | | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | | -55 to +150 | $^\circ\text{C}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Package Dimensions

unit : mm (typ)

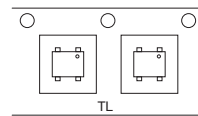
7020A-002



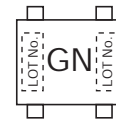
Product & Package Information

- Package : MCPH4
- JEITA, JEDEC : SC-82AB, SOT-343, SC-82
- Minimum Packing Quantity : 3,000 pcs./reel

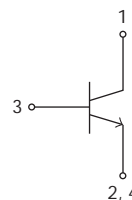
Packing Type: TL



Marking



Electrical Connection

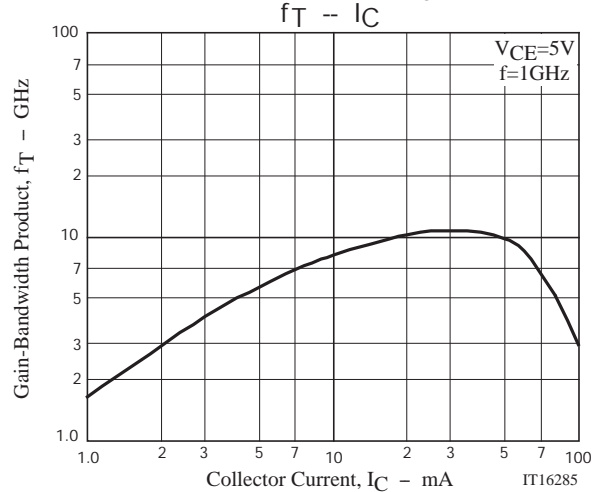
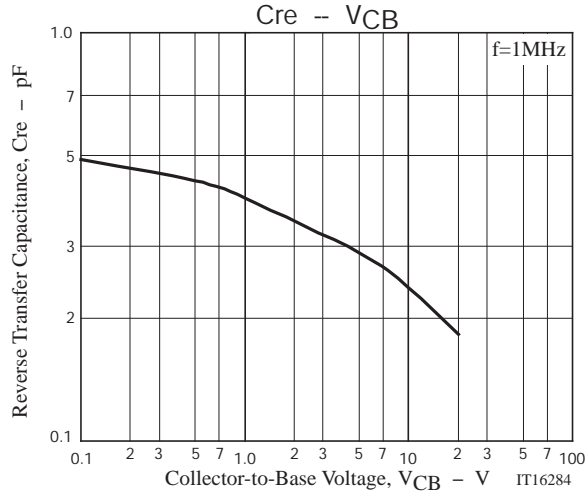
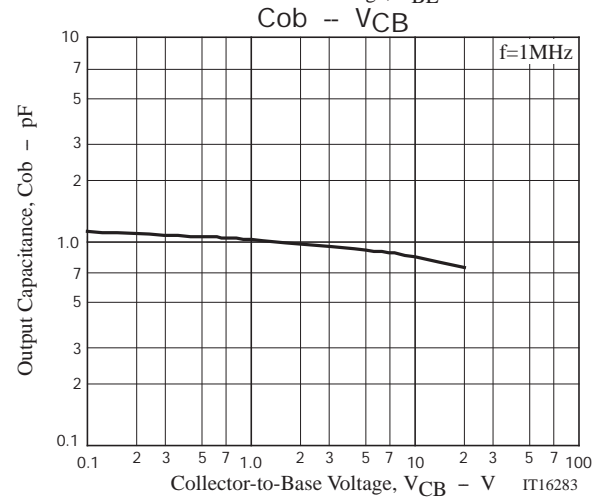
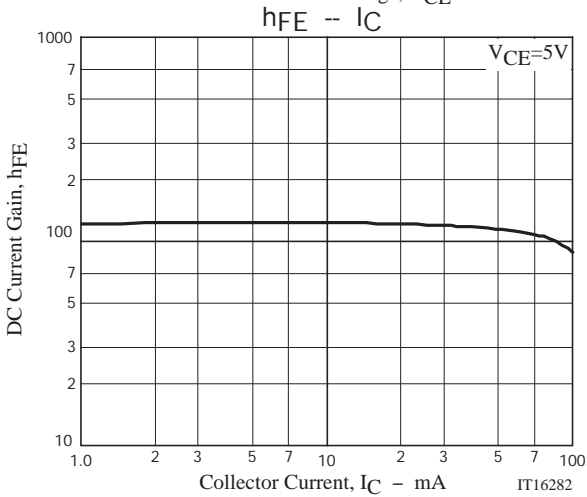
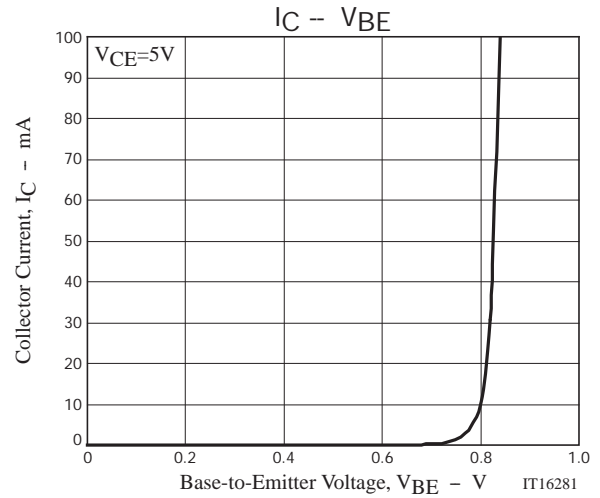
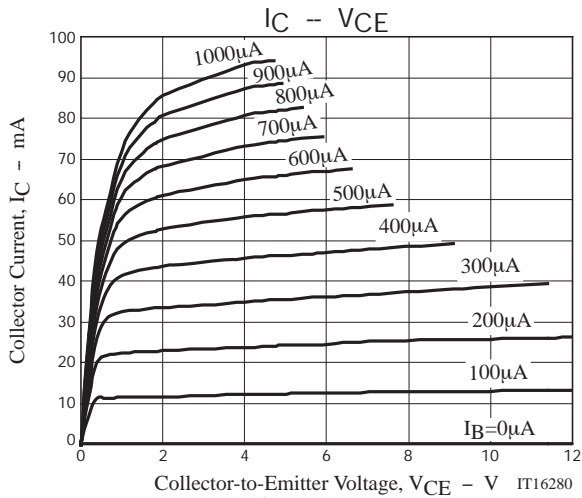


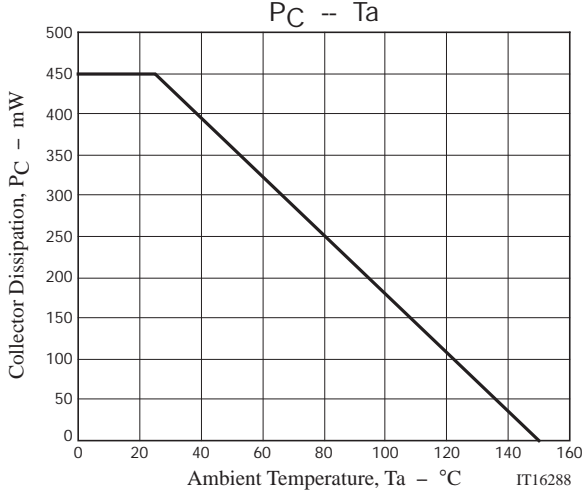
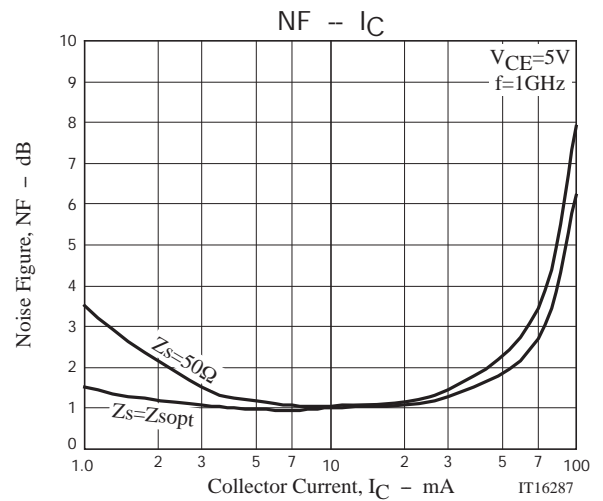
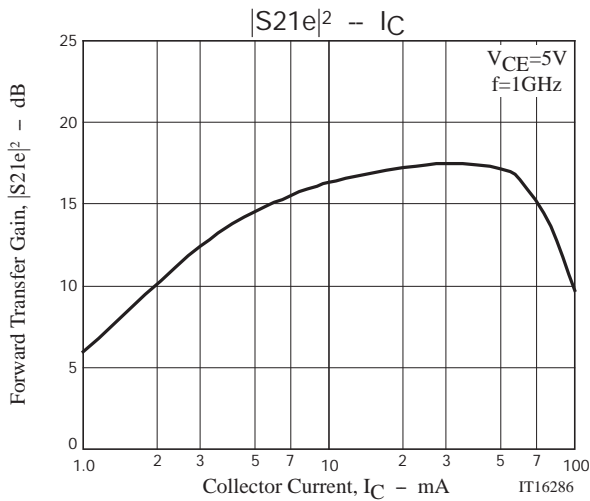
MCH4015

Electrical Characteristics at Ta=25°C

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--------------------------|---------------------------------|---|---------|-----|-----|------|
| | | | min | typ | max | |
| Collector Cutoff Current | ICBO | V _{CB} =5V, I _E =0A | | | 1.0 | μA |
| Emitter Cutoff Current | IEBO | V _{EB} =1V, I _C =0A | | | 1.0 | μA |
| DC Current Gain | h _{FE} | V _{CE} =5V, I _C =50mA | 60 | | 150 | |
| Gain-Bandwidth Product | f _T | V _{CE} =5V, I _C =30mA | 8 | 10 | | GHz |
| Forward Transfer Gain | S _{21e} ² | V _{CE} =5V, I _C =30mA, f=1GHz | 14 | 17 | | dB |
| Noise Figure | NF | V _{CE} =5V, I _C =10mA, f=1GHz | | 1.2 | 1.8 | dB |

Pay attention to handling since it is liable to be affected by static electricity due to the high-frequency process adopted.





S Parameters (Common emitter)

$V_{CE}=3V, I_C=10mA$

| Freq(MHz) | S11 | ∠S11 | S21 | ∠S21 | S12 | ∠S12 | S22 | ∠S22 |
|-----------|-------|--------|--------|-------|-------|------|-------|--------|
| 100 | 0.763 | -38.0 | 22.980 | 155.3 | 0.018 | 71.5 | 0.923 | -22.7 |
| 200 | 0.733 | -71.8 | 20.122 | 135.9 | 0.031 | 58.6 | 0.798 | -40.2 |
| 300 | 0.702 | -98.5 | 17.019 | 121.3 | 0.038 | 50.6 | 0.703 | -53.5 |
| 400 | 0.690 | -116.5 | 14.110 | 110.7 | 0.043 | 46.3 | 0.626 | -62.9 |
| 500 | 0.701 | -127.2 | 12.307 | 103.5 | 0.048 | 45.0 | 0.592 | -67.4 |
| 600 | 0.679 | -137.1 | 10.431 | 97.5 | 0.050 | 43.7 | 0.531 | -72.0 |
| 700 | 0.663 | -145.1 | 8.949 | 92.7 | 0.052 | 43.6 | 0.484 | -75.2 |
| 800 | 0.651 | -152.1 | 7.848 | 88.4 | 0.054 | 43.9 | 0.446 | -78.7 |
| 900 | 0.646 | -157.6 | 6.993 | 84.8 | 0.057 | 44.0 | 0.422 | -81.6 |
| 1000 | 0.639 | -162.3 | 6.272 | 81.9 | 0.059 | 45.1 | 0.404 | -84.4 |
| 1200 | 0.635 | -170.2 | 5.211 | 76.5 | 0.063 | 47.1 | 0.375 | -88.7 |
| 1400 | 0.634 | -176.5 | 4.462 | 71.7 | 0.068 | 49.1 | 0.362 | -92.4 |
| 1600 | 0.633 | 177.9 | 3.907 | 67.3 | 0.073 | 51.2 | 0.352 | -95.9 |
| 1800 | 0.636 | 173.2 | 3.463 | 63.4 | 0.079 | 52.7 | 0.351 | -99.0 |
| 2000 | 0.637 | 169.1 | 3.122 | 59.5 | 0.085 | 54.3 | 0.352 | -102.3 |
| 2200 | 0.637 | 164.9 | 2.838 | 55.8 | 0.091 | 55.5 | 0.356 | -105.2 |
| 2400 | 0.638 | 161.0 | 2.604 | 52.1 | 0.098 | 56.5 | 0.364 | -108.1 |
| 2600 | 0.639 | 157.3 | 2.413 | 48.7 | 0.105 | 57.2 | 0.372 | -111.1 |
| 2800 | 0.642 | 153.7 | 2.244 | 45.1 | 0.112 | 57.9 | 0.384 | -113.5 |
| 3000 | 0.641 | 150.0 | 2.095 | 41.8 | 0.120 | 57.8 | 0.396 | -116.2 |

MCH4015

S Parameters (Common emitter)

V_{CE}=3V, I_C=30mA

| Freq(MHz) | S ₁₁ | ∠S ₁₁ | S ₂₁ | ∠S ₂₁ | S ₁₂ | ∠S ₁₂ | S ₂₂ | ∠S ₂₂ |
|-----------|-----------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| 100 | 0.542 | -76.9 | 42.437 | 142.3 | 0.013 | 63.9 | 0.801 | -36.2 |
| 200 | 0.588 | -118.2 | 30.735 | 119.6 | 0.020 | 53.9 | 0.602 | -56.8 |
| 300 | 0.614 | -138.6 | 22.677 | 106.5 | 0.024 | 52.3 | 0.505 | -69.3 |
| 400 | 0.626 | -150.0 | 17.506 | 98.4 | 0.027 | 53.8 | 0.448 | -77.9 |
| 500 | 0.635 | -155.0 | 14.522 | 92.7 | 0.031 | 55.6 | 0.423 | -79.8 |
| 600 | 0.630 | -161.3 | 12.035 | 88.5 | 0.035 | 57.8 | 0.381 | -83.6 |
| 700 | 0.627 | -166.4 | 10.249 | 85.2 | 0.038 | 59.8 | 0.350 | -86.9 |
| 800 | 0.626 | -170.9 | 8.902 | 82.2 | 0.042 | 61.3 | 0.327 | -90.4 |
| 900 | 0.627 | -174.7 | 7.888 | 79.5 | 0.045 | 62.3 | 0.314 | -93.2 |
| 1000 | 0.626 | -177.8 | 7.046 | 77.3 | 0.049 | 63.4 | 0.303 | -96.1 |
| 1200 | 0.629 | 176.7 | 5.835 | 73.1 | 0.057 | 65.4 | 0.287 | -100.4 |
| 1400 | 0.631 | 171.9 | 4.976 | 69.2 | 0.065 | 66.2 | 0.282 | -103.8 |
| 1600 | 0.633 | 167.7 | 4.344 | 65.6 | 0.073 | 66.5 | 0.280 | -106.9 |
| 1800 | 0.637 | 163.9 | 3.854 | 62.0 | 0.082 | 66.8 | 0.281 | -109.7 |
| 2000 | 0.638 | 160.5 | 3.474 | 58.7 | 0.090 | 66.6 | 0.287 | -112.5 |
| 2200 | 0.638 | 156.8 | 3.160 | 55.5 | 0.099 | 66.5 | 0.293 | -115.1 |
| 2400 | 0.640 | 153.5 | 2.900 | 52.2 | 0.108 | 65.8 | 0.302 | -117.3 |
| 2600 | 0.640 | 150.2 | 2.684 | 49.0 | 0.117 | 65.2 | 0.312 | -119.5 |
| 2800 | 0.642 | 146.9 | 2.499 | 45.9 | 0.125 | 64.3 | 0.324 | -121.6 |
| 3000 | 0.640 | 143.6 | 2.337 | 42.8 | 0.134 | 63.6 | 0.337 | -123.8 |

V_{CE}=3V, I_C=50mA

| Freq(MHz) | S ₁₁ | ∠S ₁₁ | S ₂₁ | ∠S ₂₁ | S ₁₂ | ∠S ₁₂ | S ₂₂ | ∠S ₂₂ |
|-----------|-----------------|------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| 100 | 0.514 | -110.3 | 43.067 | 133.3 | 0.011 | 59.0 | 0.700 | -40.9 |
| 200 | 0.607 | -141.4 | 29.221 | 112.3 | 0.016 | 53.1 | 0.495 | -58.9 |
| 300 | 0.642 | -154.9 | 20.818 | 101.0 | 0.019 | 55.3 | 0.417 | -68.7 |
| 400 | 0.657 | -162.5 | 15.865 | 94.1 | 0.023 | 58.5 | 0.376 | -75.5 |
| 500 | 0.660 | -165.8 | 13.033 | 88.9 | 0.027 | 61.4 | 0.360 | -75.7 |
| 600 | 0.659 | -170.3 | 10.812 | 85.3 | 0.030 | 64.0 | 0.330 | -78.7 |
| 700 | 0.658 | -174.3 | 9.213 | 82.3 | 0.034 | 66.1 | 0.307 | -81.5 |
| 800 | 0.660 | -177.8 | 7.995 | 79.5 | 0.038 | 67.8 | 0.291 | -84.5 |
| 900 | 0.663 | 179.2 | 7.097 | 77.1 | 0.042 | 68.6 | 0.284 | -87.1 |
| 1000 | 0.662 | 176.6 | 6.333 | 74.8 | 0.046 | 69.6 | 0.277 | -89.7 |
| 1200 | 0.666 | 172.0 | 5.247 | 70.8 | 0.055 | 70.9 | 0.268 | -93.7 |
| 1400 | 0.670 | 167.9 | 4.475 | 67.0 | 0.063 | 71.3 | 0.269 | -97.1 |
| 1600 | 0.673 | 164.1 | 3.897 | 63.4 | 0.072 | 71.5 | 0.270 | -100.2 |
| 1800 | 0.676 | 160.6 | 3.469 | 59.9 | 0.080 | 71.4 | 0.275 | -103.3 |
| 2000 | 0.678 | 157.5 | 3.113 | 56.5 | 0.089 | 71.0 | 0.284 | -106.5 |
| 2200 | 0.679 | 154.1 | 2.836 | 53.1 | 0.098 | 70.4 | 0.293 | -109.3 |
| 2400 | 0.681 | 150.9 | 2.598 | 49.8 | 0.107 | 69.8 | 0.304 | -111.9 |
| 2600 | 0.682 | 147.8 | 2.404 | 46.6 | 0.116 | 68.9 | 0.316 | -114.4 |
| 2800 | 0.683 | 144.6 | 2.241 | 43.4 | 0.125 | 67.8 | 0.330 | -117.0 |
| 3000 | 0.682 | 141.3 | 2.094 | 40.3 | 0.135 | 66.8 | 0.346 | -119.6 |

MCH4015

S Parameters (Common emitter)

$V_{CE}=3V, I_C=80mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.662 | -146.8 | 29.622 | 120.5 | 0.011 | 47.5 | 0.455 | -44.8 |
| 200 | 0.751 | -164.0 | 16.762 | 102.8 | 0.014 | 46.9 | 0.315 | -52.9 |
| 300 | 0.774 | -171.2 | 11.369 | 94.2 | 0.017 | 52.5 | 0.288 | -57.1 |
| 400 | 0.783 | -175.6 | 8.549 | 88.9 | 0.019 | 58.6 | 0.279 | -61.3 |
| 500 | 0.778 | -178.0 | 6.977 | 84.2 | 0.023 | 62.0 | 0.283 | -61.0 |
| 600 | 0.778 | 179.0 | 5.801 | 81.0 | 0.027 | 66.0 | 0.272 | -62.9 |
| 700 | 0.778 | 176.3 | 4.965 | 78.3 | 0.030 | 68.6 | 0.265 | -65.2 |
| 800 | 0.780 | 173.9 | 4.316 | 75.7 | 0.034 | 70.2 | 0.260 | -68.0 |
| 900 | 0.782 | 171.6 | 3.846 | 73.3 | 0.038 | 71.9 | 0.263 | -70.7 |
| 1000 | 0.782 | 169.6 | 3.439 | 71.0 | 0.042 | 73.0 | 0.263 | -73.7 |
| 1200 | 0.787 | 166.0 | 2.860 | 66.6 | 0.051 | 74.5 | 0.268 | -78.5 |
| 1400 | 0.789 | 162.5 | 2.454 | 62.4 | 0.059 | 75.3 | 0.278 | -83.1 |
| 1600 | 0.792 | 159.2 | 2.139 | 58.4 | 0.068 | 75.7 | 0.288 | -87.5 |
| 1800 | 0.796 | 156.0 | 1.912 | 54.5 | 0.077 | 75.7 | 0.300 | -91.7 |
| 2000 | 0.797 | 153.1 | 1.721 | 50.8 | 0.086 | 75.4 | 0.314 | -96.1 |
| 2200 | 0.797 | 149.9 | 1.569 | 47.1 | 0.095 | 75.0 | 0.328 | -100.0 |
| 2400 | 0.799 | 146.8 | 1.436 | 43.4 | 0.105 | 74.1 | 0.343 | -103.8 |
| 2600 | 0.800 | 143.8 | 1.331 | 39.9 | 0.115 | 73.4 | 0.359 | -107.4 |
| 2800 | 0.801 | 140.6 | 1.238 | 36.5 | 0.125 | 72.2 | 0.377 | -110.9 |
| 3000 | 0.799 | 137.4 | 1.157 | 33.3 | 0.135 | 71.1 | 0.394 | -114.4 |

$V_{CE}=5V, I_C=10mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.771 | -35.8 | 23.180 | 156.3 | 0.016 | 72.7 | 0.933 | -20.3 |
| 200 | 0.741 | -68.2 | 20.484 | 137.3 | 0.028 | 60.4 | 0.820 | -36.2 |
| 300 | 0.706 | -94.4 | 17.503 | 122.8 | 0.035 | 53.0 | 0.722 | -48.5 |
| 400 | 0.691 | -112.7 | 14.633 | 111.9 | 0.040 | 48.5 | 0.656 | -57.3 |
| 500 | 0.701 | -123.8 | 12.817 | 104.7 | 0.044 | 47.2 | 0.622 | -61.7 |
| 600 | 0.677 | -133.9 | 10.891 | 98.4 | 0.047 | 46.0 | 0.560 | -66.0 |
| 700 | 0.659 | -142.2 | 9.349 | 93.5 | 0.049 | 45.5 | 0.513 | -68.9 |
| 800 | 0.646 | -149.5 | 8.209 | 89.1 | 0.051 | 45.7 | 0.474 | -72.0 |
| 900 | 0.640 | -155.2 | 7.315 | 85.3 | 0.053 | 46.1 | 0.449 | -74.7 |
| 1000 | 0.633 | -160.1 | 6.557 | 82.3 | 0.055 | 46.9 | 0.428 | -77.4 |
| 1200 | 0.628 | -168.2 | 5.459 | 76.8 | 0.060 | 49.0 | 0.399 | -81.4 |
| 1400 | 0.625 | -174.7 | 4.663 | 71.9 | 0.064 | 51.0 | 0.385 | -84.9 |
| 1600 | 0.625 | 179.5 | 4.086 | 67.5 | 0.069 | 53.3 | 0.373 | -88.4 |
| 1800 | 0.627 | 174.7 | 3.616 | 63.5 | 0.075 | 54.8 | 0.372 | -91.5 |
| 2000 | 0.628 | 170.5 | 3.260 | 59.5 | 0.080 | 56.6 | 0.372 | -94.9 |
| 2200 | 0.628 | 166.2 | 2.960 | 55.7 | 0.086 | 57.9 | 0.376 | -98.0 |
| 2400 | 0.630 | 162.2 | 2.715 | 52.0 | 0.093 | 58.9 | 0.383 | -101.1 |
| 2600 | 0.631 | 158.5 | 2.517 | 48.5 | 0.100 | 59.8 | 0.391 | -104.3 |
| 2800 | 0.634 | 154.8 | 2.337 | 44.9 | 0.107 | 60.4 | 0.402 | -107.0 |
| 3000 | 0.633 | 151.1 | 2.180 | 41.5 | 0.115 | 60.6 | 0.416 | -109.9 |

MCH4015

S Parameters (Common emitter)

$V_{CE}=5V, I_C=30mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.542 | -70.6 | 43.013 | 144.3 | 0.012 | 66.3 | 0.826 | -31.8 |
| 200 | 0.577 | -112.5 | 32.303 | 121.4 | 0.018 | 56.3 | 0.636 | -50.4 |
| 300 | 0.599 | -134.2 | 24.068 | 107.8 | 0.022 | 55.0 | 0.539 | -61.6 |
| 400 | 0.611 | -146.5 | 18.636 | 99.4 | 0.025 | 55.5 | 0.478 | -69.3 |
| 500 | 0.620 | -151.9 | 15.457 | 93.6 | 0.029 | 57.7 | 0.454 | -71.4 |
| 600 | 0.614 | -158.6 | 12.813 | 89.2 | 0.033 | 59.6 | 0.410 | -74.7 |
| 700 | 0.611 | -164.1 | 10.898 | 85.6 | 0.036 | 61.5 | 0.376 | -77.5 |
| 800 | 0.610 | -168.7 | 9.470 | 82.5 | 0.039 | 62.9 | 0.351 | -80.5 |
| 900 | 0.611 | -172.7 | 8.381 | 79.8 | 0.043 | 64.1 | 0.337 | -83.2 |
| 1000 | 0.610 | -176.0 | 7.487 | 77.5 | 0.047 | 65.3 | 0.324 | -85.8 |
| 1200 | 0.612 | -178.3 | 6.186 | 73.2 | 0.054 | 66.8 | 0.306 | -89.7 |
| 1400 | 0.615 | -173.4 | 5.277 | 69.2 | 0.062 | 67.7 | 0.299 | -93.1 |
| 1600 | 0.617 | -169.0 | 4.596 | 65.6 | 0.070 | 68.2 | 0.296 | -96.3 |
| 1800 | 0.620 | -165.1 | 4.085 | 62.0 | 0.078 | 68.6 | 0.297 | -99.3 |
| 2000 | 0.622 | -161.6 | 3.669 | 58.7 | 0.086 | 68.4 | 0.301 | -102.5 |
| 2200 | 0.622 | -158.0 | 3.344 | 55.5 | 0.095 | 68.3 | 0.307 | -105.1 |
| 2400 | 0.625 | -154.6 | 3.065 | 52.1 | 0.103 | 67.8 | 0.316 | -107.9 |
| 2600 | 0.625 | -151.3 | 2.835 | 48.8 | 0.112 | 67.2 | 0.326 | -110.5 |
| 2800 | 0.628 | -148.0 | 2.638 | 45.7 | 0.120 | 66.5 | 0.339 | -113.0 |
| 3000 | 0.626 | -144.6 | 2.464 | 42.6 | 0.129 | 65.6 | 0.352 | -115.5 |

$V_{CE}=5V, I_C=50mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.479 | -97.2 | 42.927 | 137.2 | 0.010 | 63.4 | 0.761 | -35.0 |
| 200 | 0.566 | -132.9 | 32.978 | 115.4 | 0.015 | 56.7 | 0.560 | -51.6 |
| 300 | 0.603 | -148.8 | 23.718 | 103.2 | 0.018 | 58.0 | 0.485 | -60.6 |
| 400 | 0.620 | -157.8 | 18.120 | 95.7 | 0.021 | 60.4 | 0.427 | -66.9 |
| 500 | 0.625 | -161.4 | 14.893 | 90.4 | 0.025 | 63.7 | 0.410 | -68.0 |
| 600 | 0.624 | -166.7 | 12.324 | 86.4 | 0.029 | 66.0 | 0.375 | -70.7 |
| 700 | 0.624 | -171.0 | 10.482 | 83.2 | 0.032 | 68.0 | 0.348 | -73.2 |
| 800 | 0.626 | -174.8 | 9.088 | 80.4 | 0.036 | 69.2 | 0.328 | -75.9 |
| 900 | 0.628 | -178.1 | 8.053 | 77.9 | 0.040 | 70.4 | 0.317 | -78.4 |
| 1000 | 0.628 | -179.1 | 7.184 | 75.6 | 0.044 | 70.9 | 0.308 | -80.9 |
| 1200 | 0.633 | -174.2 | 5.943 | 71.5 | 0.052 | 72.2 | 0.295 | -84.6 |
| 1400 | 0.636 | -169.8 | 5.061 | 67.7 | 0.060 | 72.7 | 0.292 | -88.2 |
| 1600 | 0.640 | -165.9 | 4.407 | 64.1 | 0.069 | 72.7 | 0.292 | -91.5 |
| 1800 | 0.643 | -162.3 | 3.917 | 60.6 | 0.077 | 72.6 | 0.295 | -94.7 |
| 2000 | 0.645 | -159.1 | 3.518 | 57.2 | 0.086 | 72.3 | 0.301 | -98.1 |
| 2200 | 0.646 | -155.6 | 3.202 | 54.0 | 0.094 | 71.8 | 0.309 | -101.1 |
| 2400 | 0.648 | -152.4 | 2.931 | 50.6 | 0.103 | 71.1 | 0.319 | -104.0 |
| 2600 | 0.650 | -149.3 | 2.708 | 47.3 | 0.112 | 70.3 | 0.331 | -106.8 |
| 2800 | 0.652 | -146.0 | 2.520 | 44.2 | 0.121 | 69.3 | 0.344 | -109.6 |
| 3000 | 0.650 | -142.7 | 2.353 | 41.1 | 0.130 | 68.2 | 0.358 | -112.5 |

MCH4015

S Parameters (Common emitter)

V_{CE}=5V, I_C=80mA

| Freq(MHz) | S11 | ∠S11 | S21 | ∠S21 | S12 | ∠S12 | S22 | ∠S22 |
|-----------|-------|--------|--------|-------|-------|------|-------|--------|
| 100 | 0.558 | -133.0 | 39.014 | 127.8 | 0.009 | 54.5 | 0.618 | -33.7 |
| 200 | 0.671 | -155.6 | 23.364 | 107.6 | 0.012 | 52.6 | 0.457 | -41.5 |
| 300 | 0.704 | -165.1 | 16.107 | 97.6 | 0.014 | 57.5 | 0.415 | -45.4 |
| 400 | 0.718 | -170.7 | 12.150 | 91.5 | 0.017 | 62.9 | 0.395 | -49.0 |
| 500 | 0.716 | -173.4 | 9.907 | 86.7 | 0.021 | 66.8 | 0.385 | -50.4 |
| 600 | 0.717 | -177.0 | 8.214 | 83.3 | 0.024 | 69.5 | 0.378 | -52.4 |
| 700 | 0.718 | 179.9 | 7.015 | 80.4 | 0.028 | 72.5 | 0.364 | -54.4 |
| 800 | 0.720 | 177.1 | 6.091 | 77.8 | 0.031 | 73.9 | 0.354 | -57.0 |
| 900 | 0.723 | 174.5 | 5.413 | 75.3 | 0.035 | 75.7 | 0.351 | -59.7 |
| 1000 | 0.723 | 172.3 | 4.829 | 72.9 | 0.039 | 76.8 | 0.346 | -62.4 |
| 1200 | 0.728 | 168.3 | 4.009 | 68.8 | 0.047 | 78.1 | 0.343 | -67.0 |
| 1400 | 0.731 | 164.7 | 3.423 | 64.7 | 0.055 | 78.9 | 0.347 | -71.8 |
| 1600 | 0.735 | 161.2 | 2.987 | 60.8 | 0.063 | 78.9 | 0.352 | -76.2 |
| 1800 | 0.738 | 157.9 | 2.662 | 57.1 | 0.072 | 79.1 | 0.359 | -80.6 |
| 2000 | 0.740 | 155.0 | 2.393 | 53.5 | 0.081 | 78.7 | 0.369 | -85.3 |
| 2200 | 0.741 | 151.7 | 2.179 | 50.0 | 0.090 | 78.2 | 0.379 | -89.5 |
| 2400 | 0.743 | 148.6 | 1.993 | 46.4 | 0.099 | 77.4 | 0.391 | -93.5 |
| 2600 | 0.744 | 145.6 | 1.843 | 43.0 | 0.109 | 76.5 | 0.404 | -97.4 |
| 2800 | 0.746 | 142.4 | 1.716 | 39.6 | 0.119 | 75.4 | 0.418 | -101.3 |
| 3000 | 0.744 | 139.2 | 1.601 | 36.3 | 0.129 | 74.2 | 0.433 | -105.1 |

V_{CE}=8V, I_C=10mA

| Freq(MHz) | S11 | ∠S11 | S21 | ∠S21 | S12 | ∠S12 | S22 | ∠S22 |
|-----------|-------|--------|--------|-------|-------|------|-------|--------|
| 100 | 0.784 | -33.9 | 22.973 | 157.1 | 0.014 | 73.5 | 0.941 | -18.1 |
| 200 | 0.754 | -64.8 | 20.491 | 138.6 | 0.025 | 62.4 | 0.839 | -32.6 |
| 300 | 0.715 | -90.5 | 17.690 | 124.1 | 0.032 | 55.0 | 0.739 | -44.1 |
| 400 | 0.697 | -109.0 | 14.905 | 113.1 | 0.037 | 50.3 | 0.685 | -52.2 |
| 500 | 0.704 | -120.4 | 13.108 | 105.8 | 0.041 | 49.3 | 0.652 | -56.5 |
| 600 | 0.678 | -130.9 | 11.176 | 99.3 | 0.044 | 47.7 | 0.591 | -60.6 |
| 700 | 0.659 | -139.5 | 9.599 | 94.2 | 0.046 | 47.3 | 0.544 | -63.3 |
| 800 | 0.645 | -146.9 | 8.439 | 89.7 | 0.048 | 47.3 | 0.504 | -66.1 |
| 900 | 0.638 | -152.9 | 7.523 | 85.8 | 0.050 | 47.5 | 0.478 | -68.7 |
| 1000 | 0.629 | -158.0 | 6.746 | 82.7 | 0.052 | 48.6 | 0.457 | -71.2 |
| 1200 | 0.623 | -166.3 | 5.618 | 77.1 | 0.056 | 50.5 | 0.427 | -75.0 |
| 1400 | 0.621 | -173.1 | 4.797 | 72.1 | 0.060 | 52.6 | 0.411 | -78.5 |
| 1600 | 0.620 | -179.0 | 4.199 | 67.5 | 0.065 | 55.0 | 0.399 | -81.8 |
| 1800 | 0.622 | 176.1 | 3.717 | 63.4 | 0.071 | 56.9 | 0.398 | -85.2 |
| 2000 | 0.623 | 171.8 | 3.348 | 59.4 | 0.076 | 58.6 | 0.397 | -88.5 |
| 2200 | 0.623 | 167.4 | 3.039 | 55.5 | 0.082 | 60.1 | 0.401 | -91.7 |
| 2400 | 0.625 | 163.5 | 2.786 | 51.8 | 0.089 | 61.4 | 0.407 | -95.0 |
| 2600 | 0.626 | 159.6 | 2.581 | 48.2 | 0.096 | 62.2 | 0.415 | -98.3 |
| 2800 | 0.629 | 155.9 | 2.395 | 44.6 | 0.103 | 62.8 | 0.426 | -101.3 |
| 3000 | 0.629 | 152.2 | 2.233 | 41.1 | 0.111 | 63.0 | 0.439 | -104.4 |

MCH4015

S Parameters (Common emitter)

$V_{CE}=8V, I_C=30mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.556 | -65.2 | 43.179 | 145.8 | 0.011 | 67.8 | 0.846 | -28.0 |
| 200 | 0.578 | -106.8 | 32.894 | 123.0 | 0.017 | 57.9 | 0.669 | -44.6 |
| 300 | 0.594 | -129.7 | 24.775 | 109.1 | 0.021 | 56.2 | 0.584 | -54.7 |
| 400 | 0.604 | -142.8 | 19.256 | 100.3 | 0.024 | 57.0 | 0.512 | -61.6 |
| 500 | 0.614 | -148.7 | 15.997 | 94.4 | 0.028 | 59.0 | 0.488 | -63.9 |
| 600 | 0.606 | -155.8 | 13.266 | 89.8 | 0.031 | 60.8 | 0.443 | -66.9 |
| 700 | 0.603 | -161.6 | 11.285 | 86.1 | 0.034 | 62.5 | 0.409 | -69.3 |
| 800 | 0.602 | -166.5 | 9.802 | 82.9 | 0.037 | 64.2 | 0.382 | -72.0 |
| 900 | 0.602 | -170.7 | 8.672 | 80.0 | 0.041 | 65.4 | 0.366 | -74.3 |
| 1000 | 0.600 | -174.1 | 7.739 | 77.6 | 0.044 | 66.3 | 0.352 | -76.7 |
| 1200 | 0.603 | 179.9 | 6.401 | 73.3 | 0.051 | 68.1 | 0.333 | -80.3 |
| 1400 | 0.605 | 174.9 | 5.453 | 69.2 | 0.059 | 69.2 | 0.325 | -83.7 |
| 1600 | 0.607 | 170.4 | 4.753 | 65.4 | 0.066 | 69.8 | 0.321 | -87.0 |
| 1800 | 0.611 | 166.4 | 4.215 | 61.8 | 0.074 | 70.0 | 0.321 | -90.2 |
| 2000 | 0.613 | 162.9 | 3.791 | 58.4 | 0.082 | 69.9 | 0.325 | -93.4 |
| 2200 | 0.614 | 159.2 | 3.445 | 55.1 | 0.090 | 70.1 | 0.330 | -96.5 |
| 2400 | 0.616 | 155.8 | 3.155 | 51.7 | 0.099 | 69.6 | 0.339 | -99.4 |
| 2600 | 0.617 | 152.4 | 2.916 | 48.4 | 0.107 | 69.1 | 0.349 | -102.4 |
| 2800 | 0.619 | 149.1 | 2.711 | 45.2 | 0.115 | 68.5 | 0.361 | -105.3 |
| 3000 | 0.619 | 145.7 | 2.531 | 42.0 | 0.124 | 67.5 | 0.375 | -108.2 |

$V_{CE}=8V, I_C=50mA$

| Freq(MHz) | S11 | $\angle S11$ | S21 | $\angle S21$ | S12 | $\angle S12$ | S22 | $\angle S22$ |
|-----------|-------|--------------|--------|--------------|-------|--------------|-------|--------------|
| 100 | 0.477 | -88.8 | 42.926 | 139.6 | 0.009 | 65.5 | 0.793 | -30.4 |
| 200 | 0.554 | -127.0 | 34.154 | 117.2 | 0.014 | 59.2 | 0.603 | -45.1 |
| 300 | 0.589 | -144.5 | 24.758 | 104.4 | 0.017 | 59.1 | 0.529 | -53.1 |
| 400 | 0.606 | -154.4 | 18.954 | 96.6 | 0.020 | 61.9 | 0.478 | -58.7 |
| 500 | 0.613 | -158.4 | 15.585 | 91.2 | 0.024 | 64.8 | 0.453 | -60.2 |
| 600 | 0.611 | -164.1 | 12.888 | 87.0 | 0.027 | 67.3 | 0.416 | -62.6 |
| 700 | 0.611 | -168.8 | 10.954 | 83.7 | 0.031 | 69.1 | 0.388 | -64.8 |
| 800 | 0.613 | -172.8 | 9.503 | 80.7 | 0.034 | 70.4 | 0.366 | -67.2 |
| 900 | 0.616 | -176.3 | 8.407 | 78.1 | 0.038 | 71.5 | 0.355 | -69.5 |
| 1000 | 0.615 | -179.2 | 7.494 | 75.7 | 0.042 | 72.3 | 0.343 | -71.9 |
| 1200 | 0.619 | 175.7 | 6.192 | 71.6 | 0.049 | 73.7 | 0.329 | -75.5 |
| 1400 | 0.623 | 171.2 | 5.272 | 67.7 | 0.057 | 74.1 | 0.324 | -79.0 |
| 1600 | 0.626 | 167.2 | 4.586 | 64.0 | 0.065 | 74.5 | 0.323 | -82.4 |
| 1800 | 0.631 | 163.5 | 4.071 | 60.4 | 0.073 | 74.4 | 0.325 | -85.8 |
| 2000 | 0.633 | 160.2 | 3.658 | 57.0 | 0.081 | 74.0 | 0.331 | -89.4 |
| 2200 | 0.634 | 156.7 | 3.322 | 53.7 | 0.090 | 73.7 | 0.337 | -92.7 |
| 2400 | 0.637 | 153.5 | 3.041 | 50.3 | 0.099 | 73.0 | 0.347 | -95.9 |
| 2600 | 0.638 | 150.3 | 2.809 | 47.0 | 0.107 | 72.2 | 0.358 | -99.1 |
| 2800 | 0.641 | 147.0 | 2.611 | 43.8 | 0.116 | 71.3 | 0.371 | -102.3 |
| 3000 | 0.640 | 143.7 | 2.435 | 40.7 | 0.125 | 70.4 | 0.386 | -105.5 |

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