

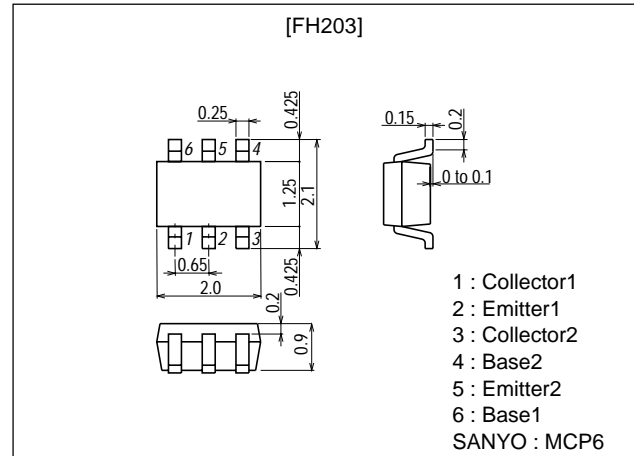
**FH203****VCO OSC Circuit Applications****Features**

- Composite type with a buffer transistor (2SC5245) and an oscillator transistors (2SC5415) contained in the currently provided MCP package as a VCO oscillator, improving the mounting efficiency greatly.
- The FH203 is formed with two chips, being equivalent to the 2SC5245 and 2SC5415, placed in one package.
- Optimal for use in UHF band oscillator circuit.

**Package Dimensions**

unit:mm

2160

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

| Parameter                    | Symbol    | Conditions | Ratings     | Unit             |
|------------------------------|-----------|------------|-------------|------------------|
| Tr1 [2SC5245]                |           |            |             |                  |
| Collector-to-Base Voltage    | $V_{CBO}$ |            | 20          | V                |
| Collector-to-Emitter Voltage | $V_{CEO}$ |            | 10          | V                |
| Emitter-to-Base Voltage      | $V_{EBO}$ |            | 1.5         | V                |
| Collector Current            | $I_C$     |            | 30          | mA               |
| Collector Dissipation        | $P_C$     |            | 150         | mW               |
| Tr2 [2SC5415]                |           |            |             |                  |
| Collector-to-Base Voltage    | $V_{CBO}$ |            | 20          | V                |
| Collector-to-Emitter Voltage | $V_{CEO}$ |            | 10          | V                |
| Emitter-to-Base Voltage      | $V_{EBO}$ |            | 2           | V                |
| Collector Current            | $I_C$     |            | 100         | mA               |
| Collector Dissipation        | $P_C$     |            | 150         | mW               |
| [Common specifications]      |           |            |             |                  |
| Total Dissipation            | $P_T$     |            | 200         | mW               |
| Junction Temperature         | $T_J$     |            | 150         | $^\circ\text{C}$ |
| Storage Temperature          | $T_{stg}$ |            | -55 to +150 | $^\circ\text{C}$ |

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**SANYO Electric Co.,Ltd. Semiconductor Company**

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N0199TS (KOTO) TA-1709 No.6179-1/9

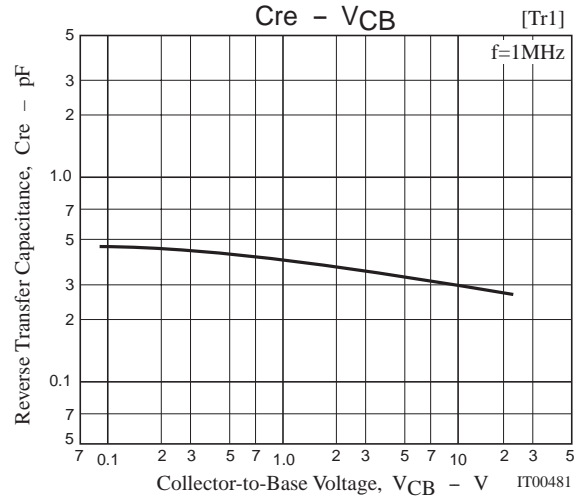
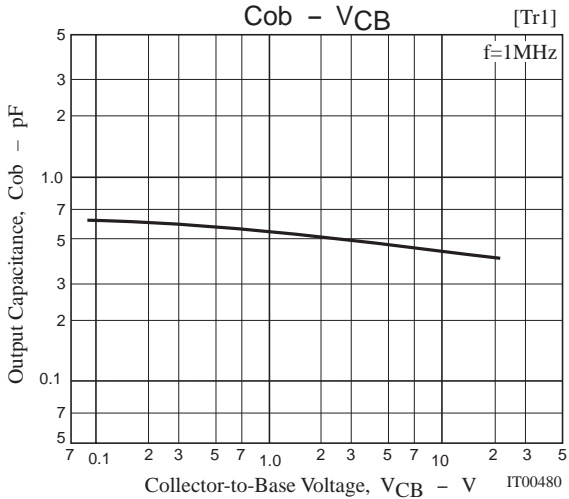
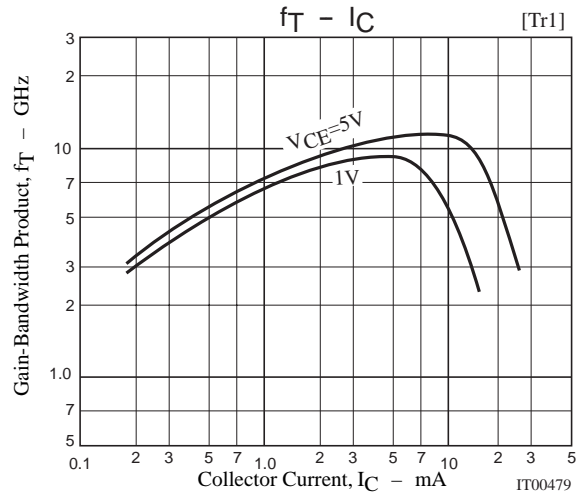
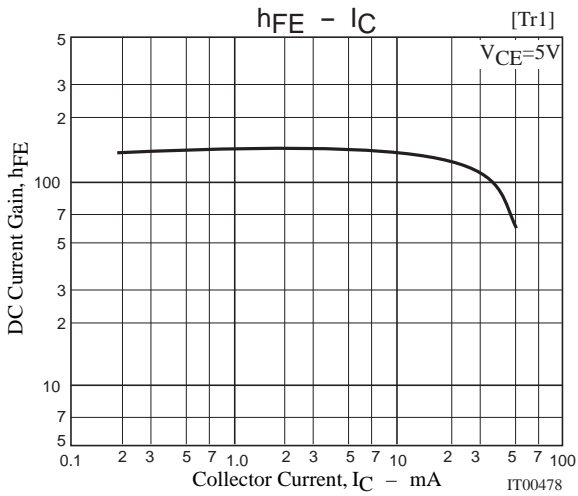
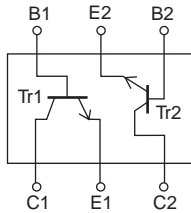
# FH203

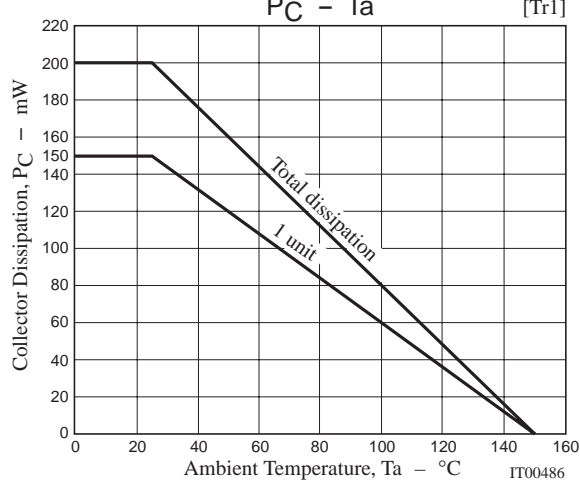
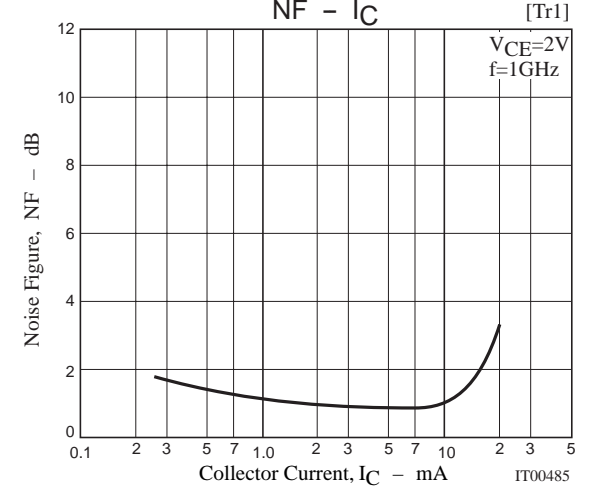
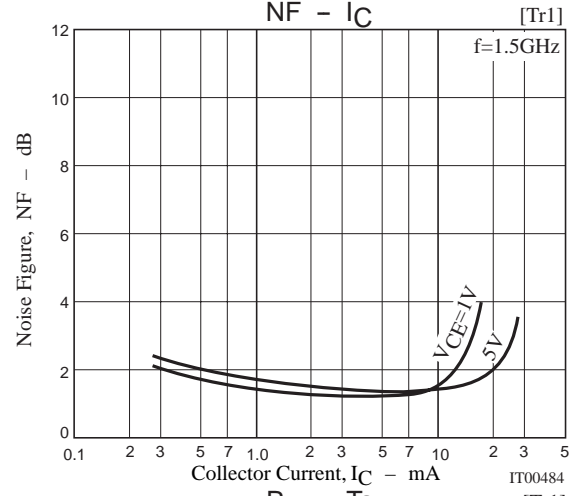
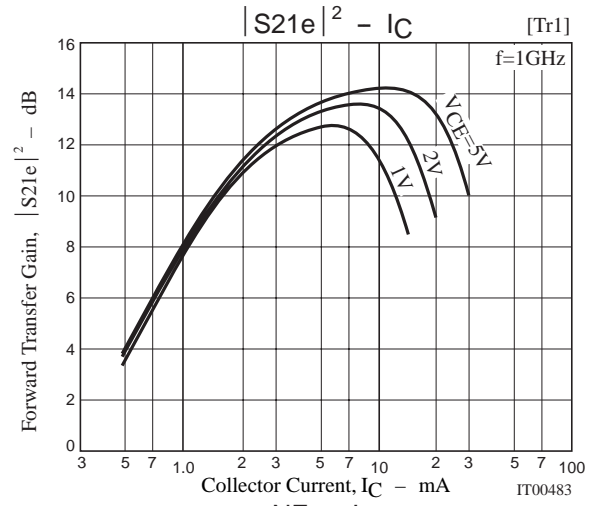
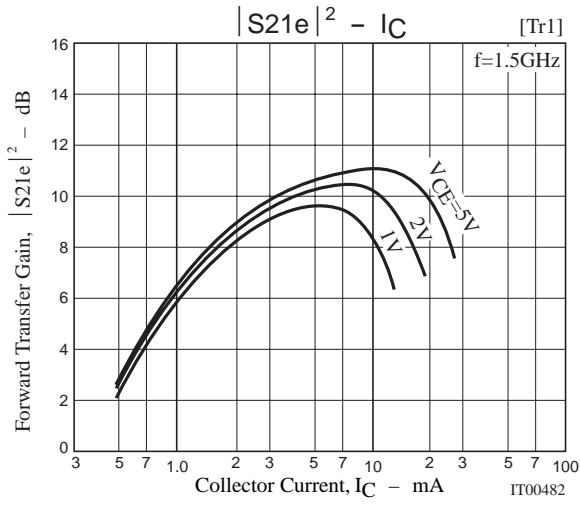
## Electrical Characteristics at Ta = 25°C

| Parameter                | Symbol        | Conditions                      | Ratings |      |     | Unit    |
|--------------------------|---------------|---------------------------------|---------|------|-----|---------|
|                          |               |                                 | min     | typ  | max |         |
| Tr1 [2SC5245]            |               |                                 |         |      |     |         |
| Collector Cutoff Current | $I_{CBO}$     | $V_{CB}=10V, I_E=0$             |         |      | 1.0 | $\mu A$ |
| Emitter Cutoff Current   | $I_{EBO}$     | $V_{EB}=1V, I_C=0$              |         |      | 10  | $\mu A$ |
| DC Current Gain          | $h_{FE}$      | $V_{CE}=5V, I_C=10mA$           | 90      |      | 200 |         |
| Gain-Bandwidth Product   | $f_T$         | $V_{CE}=5V, I_C=10mA$           | 8       | 11   |     | GHz     |
| Output Capacitance       | $C_{ob}$      | $V_{CB}=10V, f=1MHz$            |         | 0.45 | 0.7 | pF      |
| Forward Transfer Gain    | $ S_{21e} ^2$ | $V_{CE}=5V, I_C=10mA, f=1.5GHz$ | 8       | 10   |     | dB      |
| Noise Figure             | NF            | $V_{CE}=5V, I_C=5mA, f=1.5GHz$  |         | 1.4  | 3.0 | dB      |
| Tr2 [2SC5415]            |               |                                 |         |      |     |         |
| Collector Cutoff Current | $I_{CBO}$     | $V_{CB}=10V, I_E=0$             |         |      | 1.0 | $\mu A$ |
| Emitter Cutoff Current   | $I_{EBO}$     | $V_{EB}=1V, I_C=0$              |         |      | 10  | $\mu A$ |
| DC Current Gain          | $h_{FE}$      | $V_{CE}=5V, I_C=30mA$           | 90      |      | 200 |         |
| Gain-Bandwidth Product   | $f_T$         | $V_{CE}=5V, I_C=30mA$           | 6       | 7.5  |     | GHz     |
| Output Capacitance       | $C_{ob}$      | $V_{CB}=10V, f=1MHz$            |         | 0.9  | 1.4 | pF      |
| Forward Transfer Gain    | $ S_{21e} ^2$ | $V_{CE}=5V, I_C=30mA, f=1GHz$   | 10      | 12   |     | dB      |
| Noise Figure             | NF            | $V_{CE}=5V, I_C=7mA, f=1GHz$    |         | 1.1  | 2.0 | dB      |

Marking : 203

## Electrical Connection





# FH203

## S Parameters (Common emitter) [Tr1]

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

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200        | 0.763      | -37.5           | 11.926     | 146.9           | 0.036      | 70.7            | 0.892      | -19.1           |
| 400        | 0.590      | -65.4           | 9.202      | 124.3           | 0.058      | 60.9            | 0.740      | -29.1           |
| 600        | 0.456      | -85.5           | 7.173      | 109.4           | 0.073      | 57.4            | 0.631      | -33.7           |
| 800        | 0.374      | -102.0          | 5.743      | 98.7            | 0.086      | 56.7            | 0.566      | -35.8           |
| 1000       | 0.323      | -115.0          | 4.785      | 90.5            | 0.098      | 56.7            | 0.528      | -37.2           |
| 1200       | 0.288      | -127.5          | 4.105      | 83.6            | 0.110      | 57.2            | 0.505      | -38.4           |
| 1400       | 0.264      | -137.7          | 3.599      | 77.5            | 0.123      | 57.7            | 0.488      | -39.6           |
| 1600       | 0.248      | -147.4          | 3.213      | 71.3            | 0.136      | 57.6            | 0.476      | -41.2           |
| 1800       | 0.239      | -156.9          | 2.905      | 66.4            | 0.150      | 57.6            | 0.466      | -43.3           |
| 2000       | 0.235      | -165.7          | 2.651      | 61.3            | 0.165      | 57.2            | 0.462      | -45.4           |

$V_{CE}=5V, I_C=10mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200        | 0.605      | -52.6           | 16.354     | 136.2           | 0.031      | 67.5            | 0.804      | -23.9           |
| 400        | 0.417      | -84.6           | 11.011     | 113.3           | 0.048      | 62.4            | 0.622      | -30.5           |
| 600        | 0.319      | -106.3          | 8.026      | 100.5           | 0.062      | 62.2            | 0.533      | -32.0           |
| 800        | 0.266      | -124.6          | 6.250      | 91.3            | 0.076      | 63.4            | 0.491      | -32.4           |
| 1000       | 0.238      | -136.5          | 5.115      | 84.7            | 0.090      | 64.3            | 0.469      | -33.2           |
| 1200       | 0.225      | -148.9          | 4.336      | 78.8            | 0.104      | 64.4            | 0.458      | -34.6           |
| 1400       | 0.215      | -158.3          | 3.813      | 73.4            | 0.119      | 64.5            | 0.449      | -35.8           |
| 1600       | 0.213      | -167.3          | 3.365      | 68.1            | 0.135      | 63.8            | 0.443      | -37.7           |
| 1800       | 0.212      | -175.6          | 3.030      | 63.5            | 0.150      | 63.1            | 0.436      | -39.6           |
| 2000       | 0.216      | -177.5          | 2.754      | 58.9            | 0.166      | 62.5            | 0.438      | -41.9           |

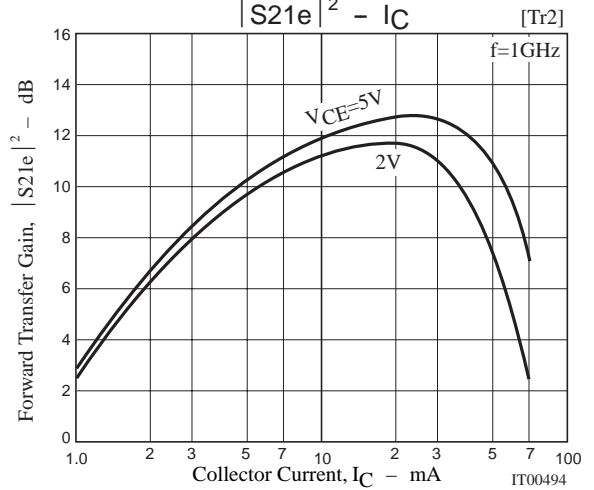
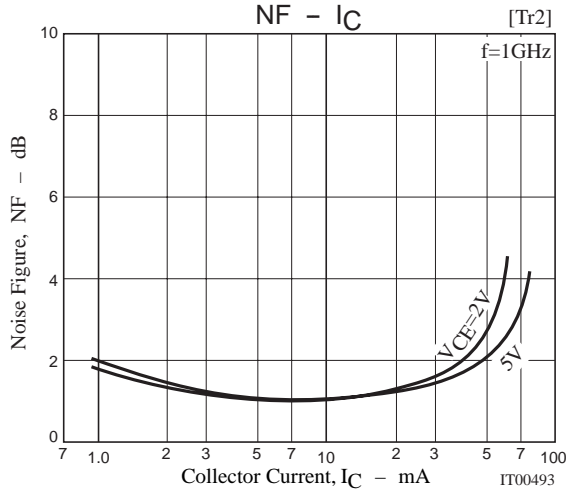
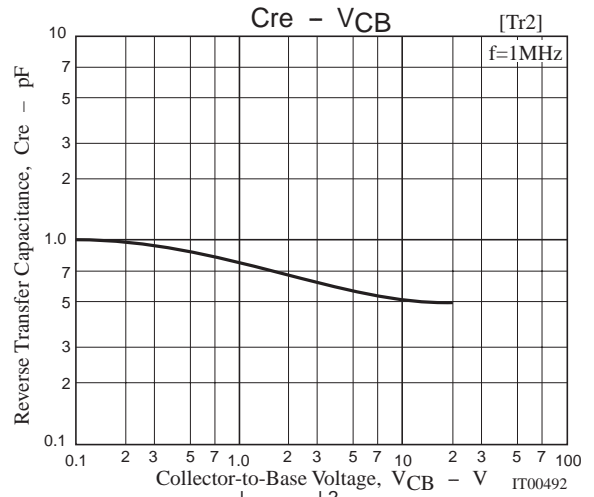
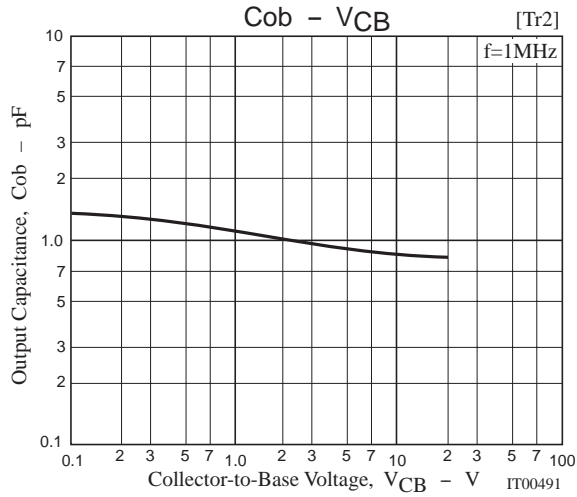
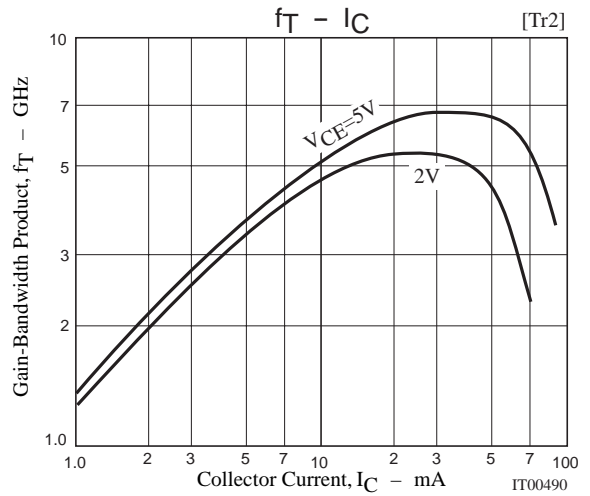
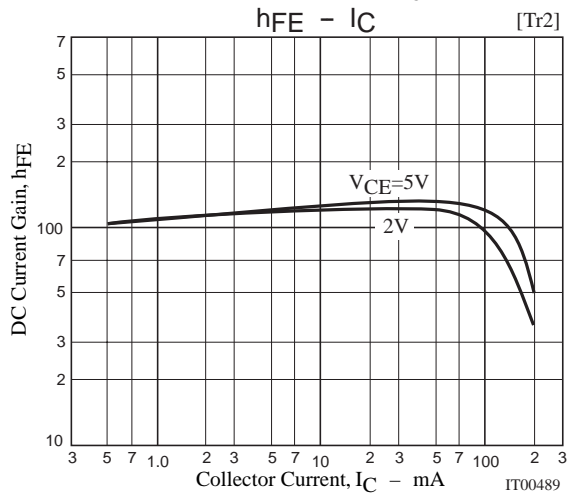
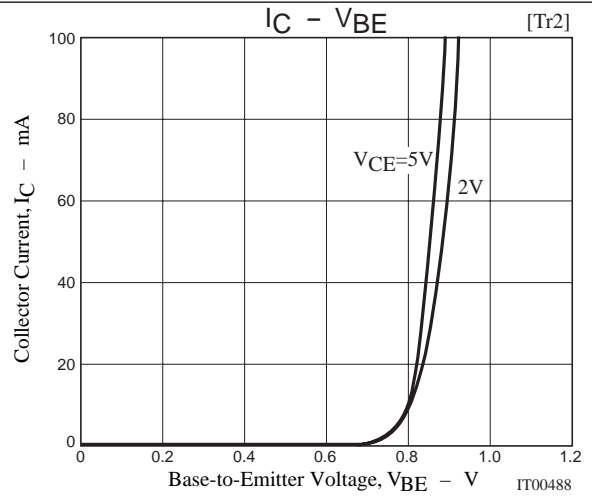
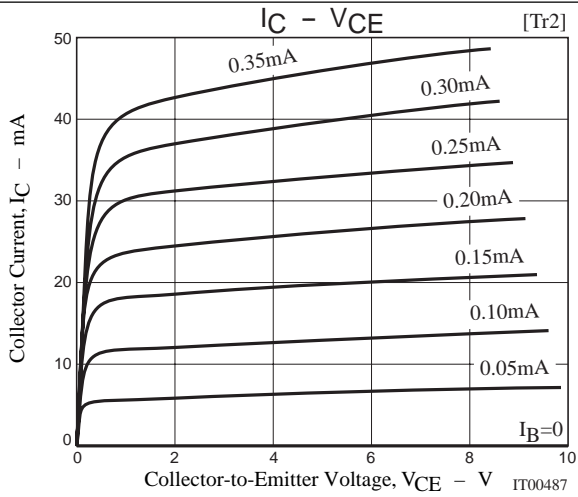
$V_{CE}=2V, I_C=3mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200        | 0.842      | -30.7           | 8.491      | 153.0           | 0.044      | 72.5            | 0.931      | -17.1           |
| 400        | 0.704      | -56.3           | 7.161      | 131.9           | 0.075      | 60.9            | 0.808      | -28.8           |
| 600        | 0.579      | -76.1           | 5.879      | 116.3           | 0.095      | 54.1            | 0.696      | -36.2           |
| 800        | 0.480      | -93.1           | 4.882      | 104.2           | 0.109      | 51.0            | 0.615      | -40.6           |
| 1000       | 0.417      | -106.3          | 4.154      | 95.0            | 0.121      | 49.3            | 0.564      | -43.5           |
| 1200       | 0.376      | -119.6          | 3.597      | 87.1            | 0.132      | 48.7            | 0.526      | -45.8           |
| 1400       | 0.343      | -130.2          | 3.212      | 80.2            | 0.143      | 48.6            | 0.469      | -47.5           |
| 1600       | 0.319      | -140.5          | 2.875      | 73.4            | 0.154      | 48.7            | 0.475      | -49.6           |
| 1800       | 0.303      | -150.0          | 2.604      | 67.7            | 0.166      | 48.6            | 0.461      | -51.6           |
| 2000       | 0.298      | -160.0          | 2.383      | 62.1            | 0.179      | 48.9            | 0.451      | -52.9           |

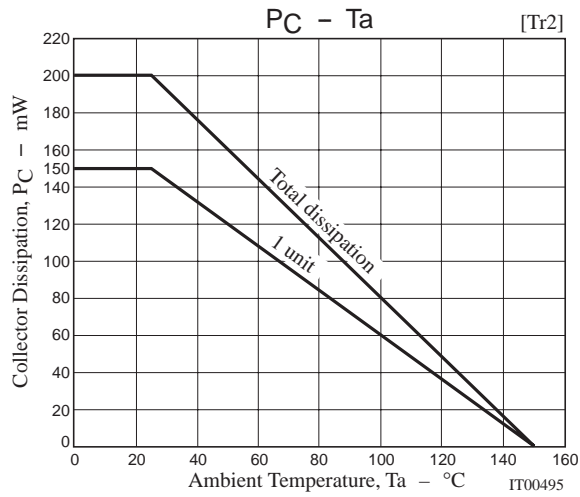
$V_{CE}=1V, I_C=1mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200        | 0.945      | -18.9           | 3.296      | 162.5           | 0.054      | 77.2            | 0.980      | -11.0           |
| 400        | 0.884      | -37.3           | 3.206      | 145.9           | 0.102      | 65.9            | 0.934      | -20.5           |
| 600        | 0.810      | -53.6           | 2.942      | 131.2           | 0.139      | 56.3            | 0.870      | -29.0           |
| 800        | 0.728      | -69.4           | 2.711      | 117.8           | 0.166      | 48.6            | 0.811      | -35.5           |
| 1000       | 0.667      | -82.5           | 2.449      | 107.0           | 0.187      | 42.5            | 0.763      | -40.9           |
| 1200       | 0.605      | -95.8           | 2.252      | 96.9            | 0.199      | 37.3            | 0.715      | -45.7           |
| 1400       | 0.561      | -106.1          | 2.061      | 88.1            | 0.207      | 33.5            | 0.673      | -49.4           |
| 1600       | 0.518      | -117.2          | 1.909      | 79.5            | 0.212      | 30.6            | 0.638      | -53.4           |
| 1800       | 0.492      | -127.5          | 1.766      | 72.2            | 0.215      | 28.6            | 0.611      | -56.5           |
| 2000       | 0.465      | -137.9          | 1.658      | 65.2            | 0.217      | 27.6            | 0.592      | -59.9           |

# FH203



# FH203



## S Parameters (Common emitter) [Tr2]

$V_{CE}=2V, I_C=5mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.849      | -40.1           | 9.957      | 151.0           | 0.039      | 67.0            | 0.887      | -22.9           |
| 200        | 0.772      | -74.0           | 8.916      | 131.5           | 0.061      | 51.0            | 0.711      | -36.9           |
| 400        | 0.670      | -120.2          | 6.255      | 107.5           | 0.079      | 39.3            | 0.503      | -47.1           |
| 600        | 0.626      | -145.2          | 4.746      | 92.7            | 0.085      | 38.6            | 0.424      | -49.5           |
| 800        | 0.614      | -158.6          | 3.652      | 83.9            | 0.093      | 39.6            | 0.369      | -52.6           |
| 1000       | 0.608      | -168.4          | 3.001      | 76.2            | 0.099      | 42.3            | 0.345      | -55.5           |
| 1200       | 0.607      | -175.8          | 2.518      | 69.4            | 0.107      | 44.9            | 0.332      | -58.8           |
| 1400       | 0.608      | 178.5           | 2.185      | 63.5            | 0.116      | 47.5            | 0.329      | -62.4           |
| 1600       | 0.606      | 172.4           | 1.911      | 57.9            | 0.124      | 49.7            | 0.325      | -66.7           |
| 1800       | 0.605      | 167.5           | 1.717      | 53.0            | 0.137      | 52.8            | 0.331      | -70.7           |
| 2000       | 0.605      | 162.6           | 1.580      | 48.3            | 0.152      | 55.0            | 0.345      | -74.5           |

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

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.743      | -57.3           | 17.164     | 142.7           | 0.034      | 60.5            | 0.797      | -32.6           |
| 200        | 0.655      | -99.5           | 13.461     | 120.8           | 0.049      | 48.5            | 0.570      | -48.8           |
| 400        | 0.589      | -140.3          | 8.090      | 100.0           | 0.061      | 44.8            | 0.363      | -58.8           |
| 600        | 0.572      | -158.3          | 5.662      | 88.7            | 0.073      | 48.1            | 0.289      | -61.2           |
| 800        | 0.569      | -169.0          | 4.311      | 81.5            | 0.085      | 51.2            | 0.250      | -63.7           |
| 1000       | 0.567      | -176.5          | 3.506      | 74.9            | 0.098      | 54.1            | 0.233      | -66.5           |
| 1200       | 0.568      | 177.4           | 2.945      | 68.9            | 0.111      | 55.8            | 0.225      | -69.7           |
| 1400       | 0.566      | 172.3           | 2.561      | 63.6            | 0.125      | 56.8            | 0.223      | -73.3           |
| 1600       | 0.567      | 167.2           | 2.255      | 58.7            | 0.140      | 57.9            | 0.224      | -77.7           |
| 1800       | 0.567      | 163.1           | 2.028      | 54.4            | 0.155      | 58.6            | 0.228      | -81.4           |
| 2000       | 0.569      | 159.0           | 1.848      | 49.8            | 0.171      | 58.0            | 0.236      | -85.0           |

## FH203

### S Parameters (Common emitter) [Tr2]

$V_{CE}=2V, I_C=20mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.625      | -84.7           | 24.593     | 132.0           | 0.028      | 56.0            | 0.685      | -43.4           |
| 200        | 0.576      | -125.3          | 16.266     | 111.2           | 0.039      | 49.5            | 0.442      | -59.3           |
| 400        | 0.554      | -155.3          | 8.969      | 94.8            | 0.052      | 52.2            | 0.265      | -68.5           |
| 600        | 0.551      | -168.4          | 6.117      | 85.7            | 0.067      | 57.3            | 0.205      | -72.0           |
| 800        | 0.552      | -176.6          | 4.632      | 79.5            | 0.083      | 60.1            | 0.179      | -74.9           |
| 1000       | 0.551      | 177.4           | 3.752      | 73.6            | 0.098      | 62.1            | 0.169      | -78.2           |
| 1200       | 0.553      | 172.4           | 3.143      | 68.2            | 0.115      | 62.6            | 0.164      | -81.7           |
| 1400       | 0.553      | 167.9           | 2.725      | 63.3            | 0.132      | 62.1            | 0.165      | -85.1           |
| 1600       | 0.554      | 163.7           | 2.410      | 58.7            | 0.148      | 61.9            | 0.168      | -89.7           |
| 1800       | 0.555      | 159.9           | 2.169      | 54.6            | 0.166      | 61.3            | 0.174      | -92.8           |
| 2000       | 0.556      | 156.2           | 1.972      | 50.2            | 0.183      | 60.1            | 0.180      | -96.5           |

$V_{CE}=2V, I_C=30mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.587      | -105.4          | 25.998     | 124.3           | 0.026      | 53.7            | 0.607      | -48.2           |
| 200        | 0.572      | -139.6          | 16.084     | 106.4           | 0.034      | 50.7            | 0.373      | -62.2           |
| 400        | 0.564      | -162.6          | 8.697      | 92.1            | 0.048      | 56.4            | 0.224      | -69.1           |
| 600        | 0.563      | -173.3          | 5.919      | 83.8            | 0.064      | 61.5            | 0.176      | -72.2           |
| 800        | 0.564      | 179.6           | 4.493      | 77.9            | 0.081      | 63.5            | 0.157      | -74.6           |
| 1000       | 0.566      | 174.2           | 3.630      | 72.2            | 0.097      | 65.2            | 0.151      | -78.0           |
| 1200       | 0.568      | 169.7           | 3.045      | 66.9            | 0.115      | 65.2            | 0.151      | -81.8           |
| 1400       | 0.567      | 165.7           | 2.635      | 62.2            | 0.132      | 64.7            | 0.154      | -85.5           |
| 1600       | 0.569      | 161.6           | 2.332      | 57.6            | 0.150      | 64.1            | 0.158      | -90.1           |
| 1800       | 0.568      | 158.1           | 2.100      | 53.4            | 0.168      | 63.0            | 0.165      | -93.5           |
| 2000       | 0.570      | 154.5           | 1.906      | 49.3            | 0.187      | 61.8            | 0.171      | -97.7           |

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

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.868      | -35.6           | 10.432     | 152.9           | 0.030      | 68.8            | 0.917      | -16.7           |
| 200        | 0.777      | -68.9           | 8.971      | 135.0           | 0.049      | 53.9            | 0.777      | -27.4           |
| 400        | 0.668      | -113.6          | 6.913      | 109.9           | 0.064      | 42.4            | 0.595      | -35.1           |
| 600        | 0.626      | -137.4          | 5.027      | 95.9            | 0.071      | 40.1            | 0.501      | -37.4           |
| 800        | 0.600      | -153.7          | 3.883      | 86.8            | 0.078      | 41.7            | 0.460      | -38.9           |
| 1000       | 0.588      | -164.5          | 3.228      | 78.7            | 0.083      | 45.0            | 0.443      | -41.0           |
| 1200       | 0.585      | -172.6          | 2.775      | 71.8            | 0.090      | 50.0            | 0.442      | -43.4           |
| 1400       | 0.581      | -179.1          | 2.407      | 66.0            | 0.097      | 53.0            | 0.435      | -46.5           |
| 1600       | 0.581      | 174.8           | 2.134      | 60.5            | 0.106      | 56.1            | 0.430      | -50.1           |
| 1800       | 0.581      | 169.8           | 1.914      | 55.5            | 0.118      | 59.1            | 0.433      | -53.8           |
| 2000       | 0.587      | 165.2           | 1.741      | 50.7            | 0.130      | 60.9            | 0.433      | -57.6           |

## FH203

### S Parameters (Common emitter) [Tr2]

$V_{CE}=5V, I_C=10mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.762      | -50.3           | 17.603     | 145.9           | 0.027      | 64.2            | 0.846      | -24.5           |
| 200        | 0.664      | -89.3           | 14.157     | 124.8           | 0.040      | 52.5            | 0.647      | -36.3           |
| 400        | 0.573      | -131.9          | 8.865      | 102.9           | 0.053      | 47.4            | 0.453      | -41.5           |
| 600        | 0.544      | -152.3          | 6.246      | 91.1            | 0.062      | 49.9            | 0.381      | -41.8           |
| 800        | 0.537      | -164.1          | 4.783      | 83.6            | 0.072      | 53.9            | 0.349      | -42.5           |
| 1000       | 0.533      | -172.3          | 3.910      | 76.9            | 0.082      | 56.9            | 0.334      | -44.1           |
| 1200       | 0.536      | -178.7          | 3.292      | 71.1            | 0.095      | 59.6            | 0.327      | -46.5           |
| 1400       | 0.533      | 175.7           | 2.843      | 65.8            | 0.107      | 61.1            | 0.322      | -49.3           |
| 1600       | 0.535      | 170.4           | 2.510      | 61.0            | 0.119      | 62.0            | 0.324      | -52.9           |
| 1800       | 0.535      | 166.1           | 2.254      | 56.3            | 0.134      | 63.2            | 0.326      | -56.3           |
| 2000       | 0.537      | 161.7           | 2.043      | 51.8            | 0.148      | 63.4            | 0.330      | -60.0           |

$V_{CE}=5V, I_C=30mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.589      | -84.0           | 29.588     | 131.2           | 0.021      | 59.1            | 0.699      | -35.5           |
| 200        | 0.530      | -123.9          | 18.896     | 111.2           | 0.030      | 53.4            | 0.471      | -44.4           |
| 400        | 0.506      | -153.8          | 10.319     | 95.1            | 0.042      | 58.1            | 0.318      | -44.4           |
| 600        | 0.502      | -167.0          | 7.012      | 86.5            | 0.055      | 62.7            | 0.270      | -43.2           |
| 800        | 0.502      | -175.2          | 5.310      | 80.4            | 0.070      | 65.3            | 0.252      | -43.5           |
| 1000       | 0.503      | 178.6           | 4.303      | 74.7            | 0.084      | 66.7            | 0.244      | -45.3           |
| 1200       | 0.505      | 173.7           | 3.602      | 69.5            | 0.100      | 67.2            | 0.241      | -48.1           |
| 1400       | 0.505      | 169.3           | 3.117      | 64.8            | 0.114      | 67.1            | 0.243      | -51.2           |
| 1600       | 0.507      | 165.2           | 2.753      | 60.3            | 0.130      | 67.0            | 0.243      | -55.2           |
| 1800       | 0.508      | 161.5           | 2.479      | 56.3            | 0.146      | 66.5            | 0.248      | -58.6           |
| 2000       | 0.510      | 157.9           | 2.245      | 52.0            | 0.163      | 65.7            | 0.251      | -62.6           |

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

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100        | 0.569      | -109.2          | 27.869     | 122.4           | 0.019      | 53.8            | 0.603      | -35.3           |
| 200        | 0.558      | -142.4          | 16.434     | 105.1           | 0.025      | 52.5            | 0.416      | -37.5           |
| 400        | 0.554      | -164.6          | 8.680      | 91.6            | 0.037      | 60.7            | 0.321      | -34.0           |
| 600        | 0.556      | -174.9          | 5.895      | 83.7            | 0.050      | 66.4            | 0.295      | -34.0           |
| 800        | 0.557      | 178.4           | 4.465      | 78.0            | 0.065      | 69.3            | 0.286      | -36.2           |
| 1000       | 0.559      | 173.3           | 3.616      | 72.4            | 0.079      | 70.3            | 0.282      | -39.6           |
| 1200       | 0.560      | 169.0           | 3.032      | 67.4            | 0.096      | 71.0            | 0.283      | -43.5           |
| 1400       | 0.560      | 164.9           | 2.627      | 62.5            | 0.111      | 70.9            | 0.283      | -47.4           |
| 1600       | 0.560      | 161.2           | 2.319      | 58.0            | 0.127      | 70.6            | 0.285      | -52.3           |
| 1800       | 0.561      | 157.8           | 2.087      | 53.7            | 0.144      | 70.3            | 0.289      | -56.4           |
| 2000       | 0.563      | 154.2           | 1.900      | 49.5            | 0.161      | 69.4            | 0.293      | -61.1           |



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