

Comparison of Results between HICUM Level 2 V2.24 & V2.23 model

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The corresponding ASCII data may be found on the HICUM website. Any modification of the code and corresponding results will be updated with newer version names.

ASCII file nomenclature:

General format: Netlist_name_x_y.elpa

where,

y=1: T=300K

y=2: T=200K

y=3: T=400K

y=4: T=600K

y=5: Electrothermal/Self-heating effect

y=6: NQS effect

y=7: Collector current spreading effect

y=8: Substrate transistor effect without substrate network

y=9: Effects with substrate transistors and substrate network

and

x=1: Intrinsic transistor

x=2: Internal Transistor:

Thermal data for x=2:

y=3: T=200K, y=4: T=400K, y=5: T=600K, y=6: T=300K.

x=3: Complete transistor

- Plot Legend: **Line** => Hicuml2v2.24 model (new) & **symbol** => Hicuml2v2.23 model (old)

Section 1: Results of Intrinsic Transistor

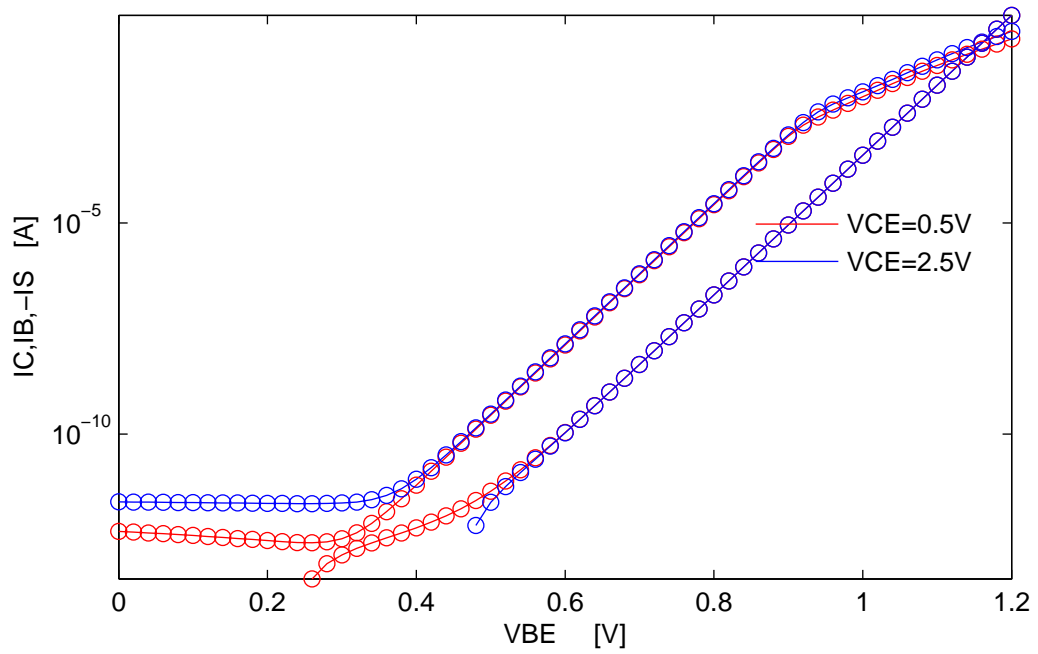


FIGURE 1. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$.

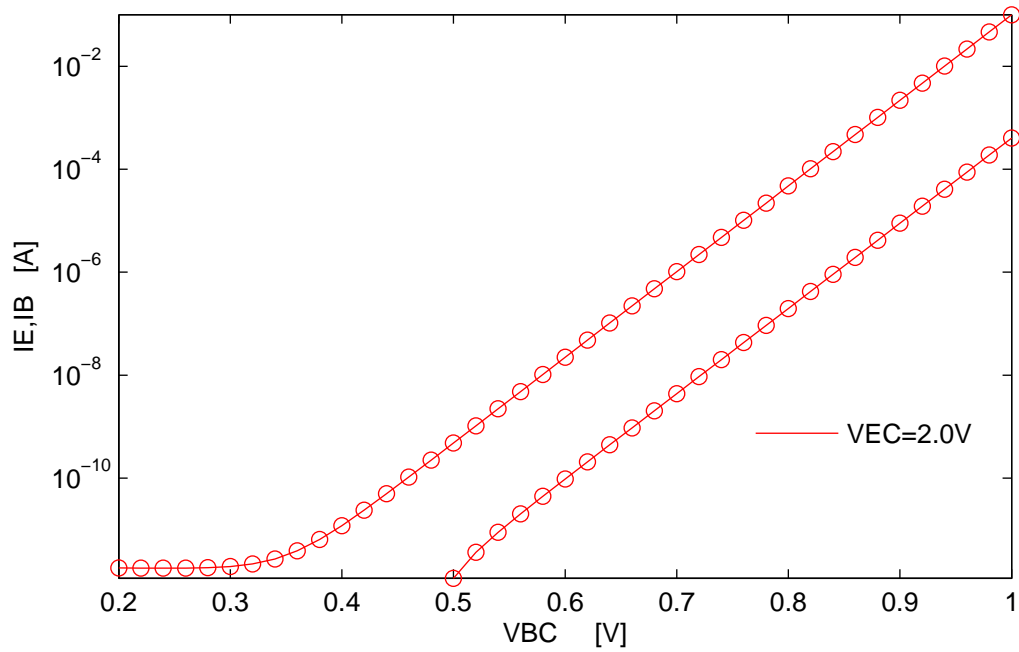


FIGURE 2. Reverse Gummel plots at $V_{EC}=2.0V$ at $T=300K$.

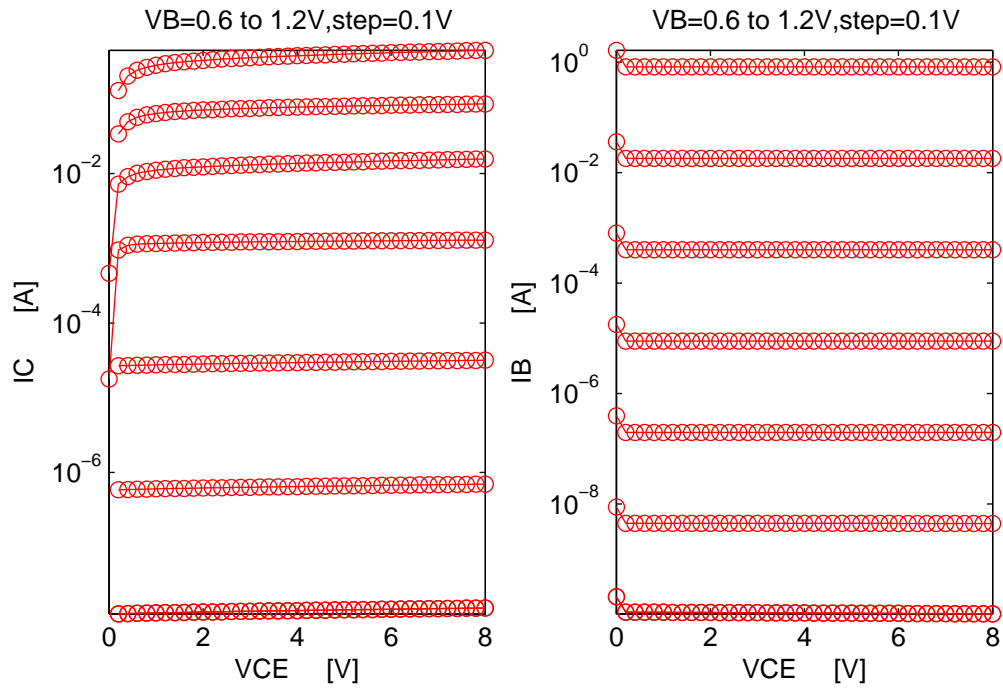


FIGURE 3. Forced-VB output characteristics and I_B - V_{CE} plots at $T=300K$.

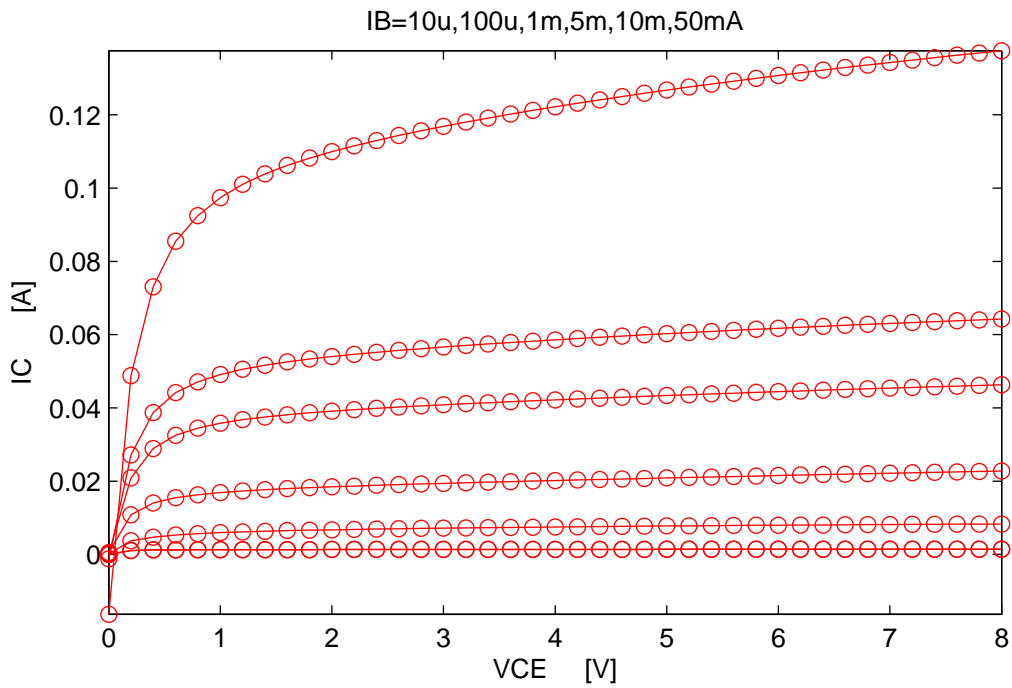


FIGURE 4. Forced-IB output characteristics at $T=300K$.

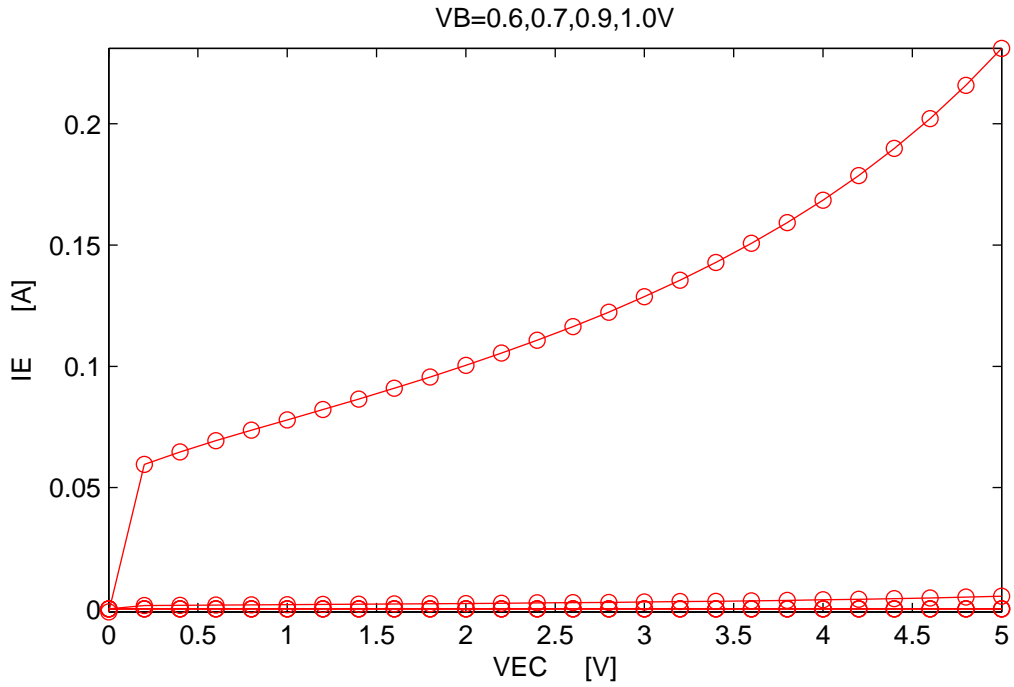


FIGURE 5. Reverse output characteristics at T=300K.

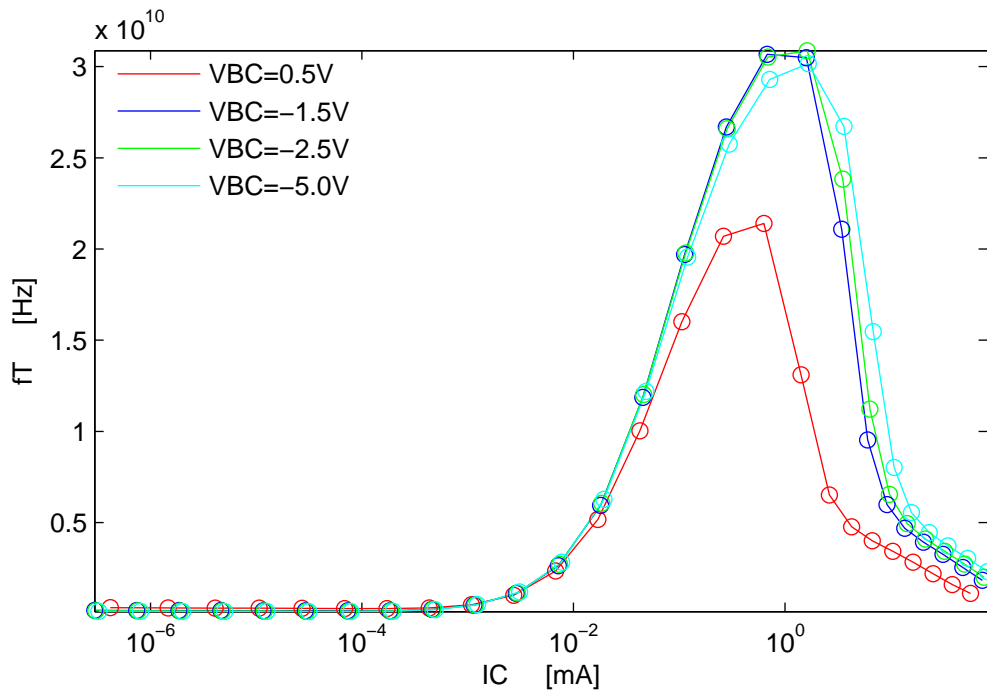


FIGURE 6. f_T (Hz) vs I_C (mA) plots at T=300K for $V_{bc}=0.5, -1.5, -2.5,$ and -5 V, f_T extracted at $f=2.8$ GHz.

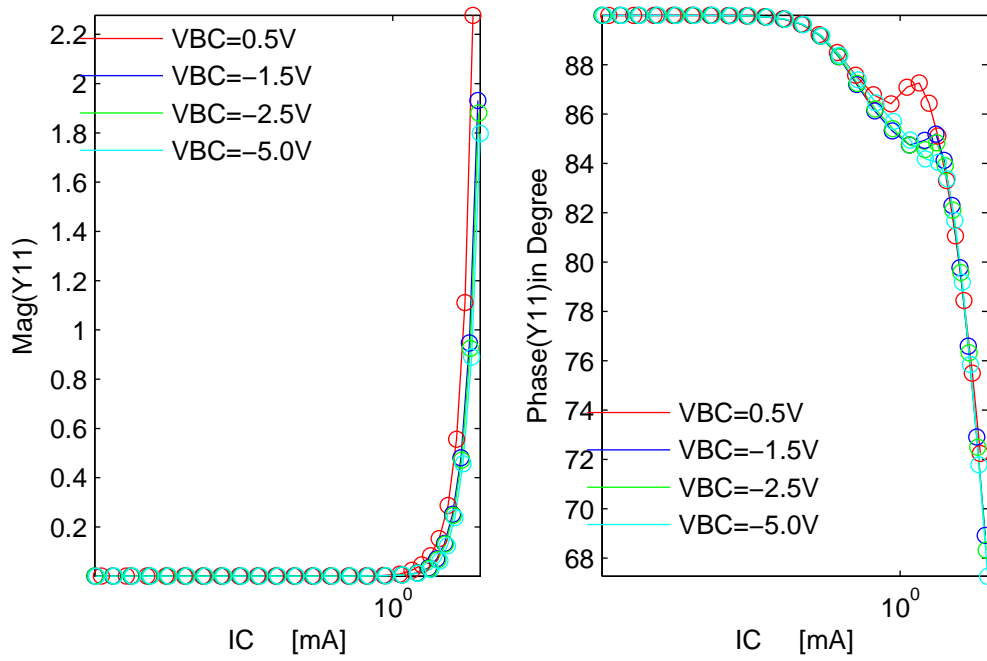


FIGURE 7. Y11 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

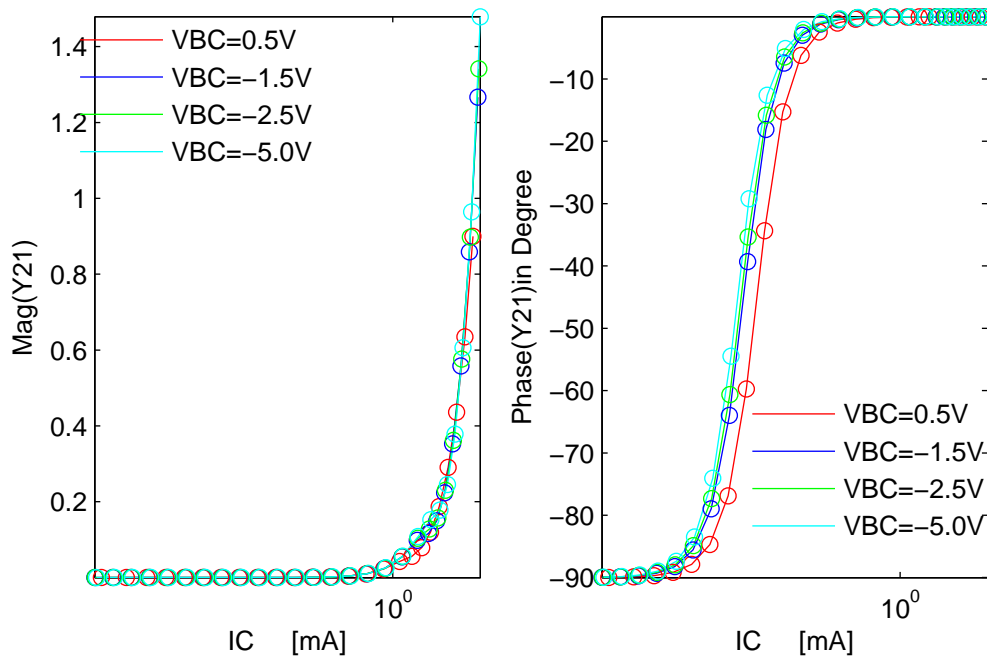


FIGURE 8. Y21 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

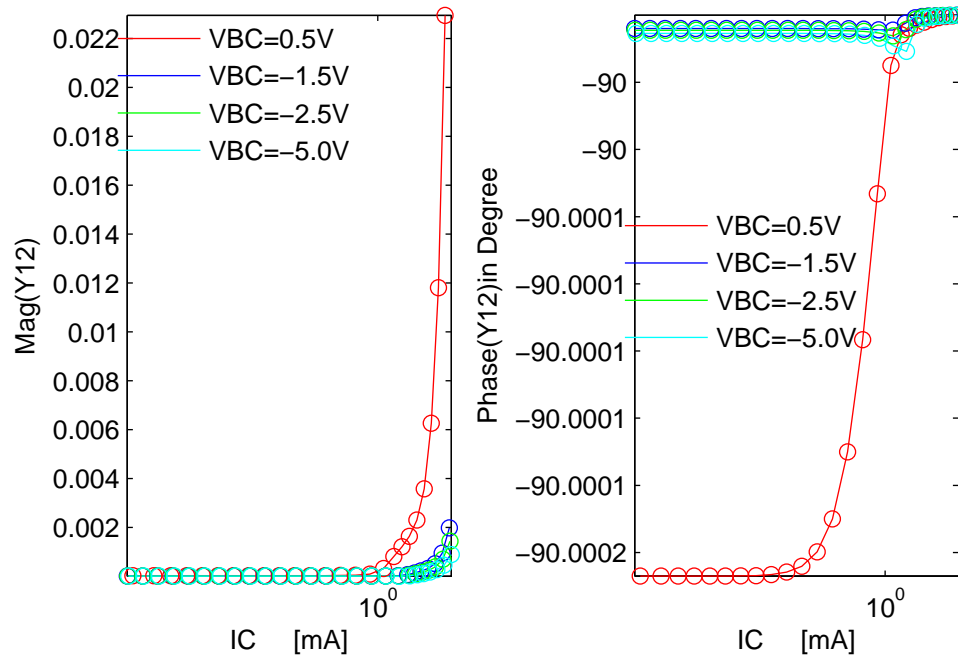


FIGURE 9. Y12 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

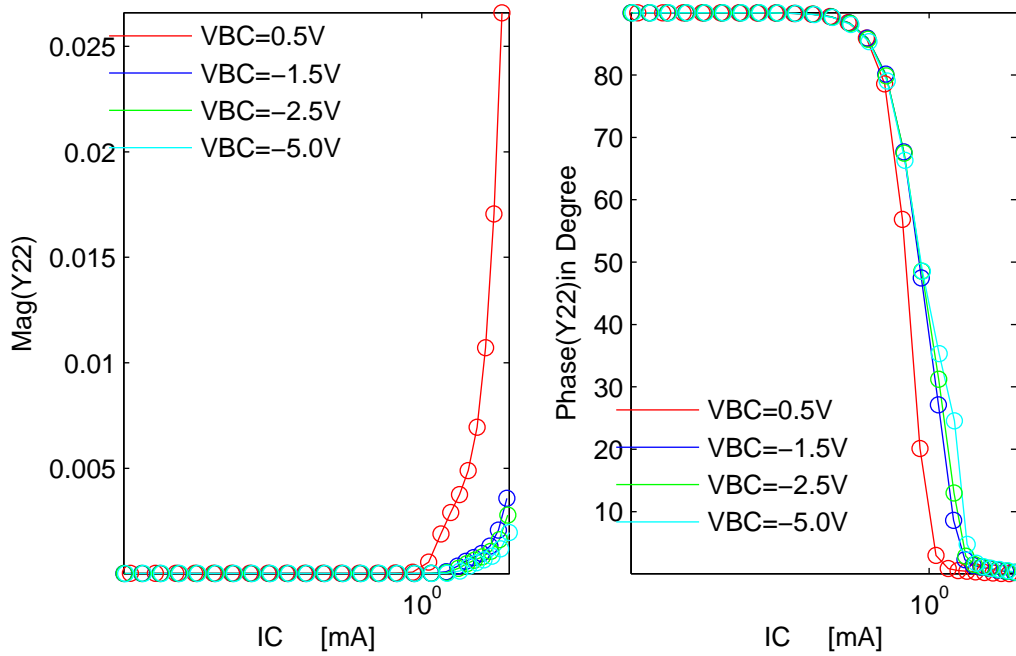


FIGURE 10. Y22 (extracted at f=2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

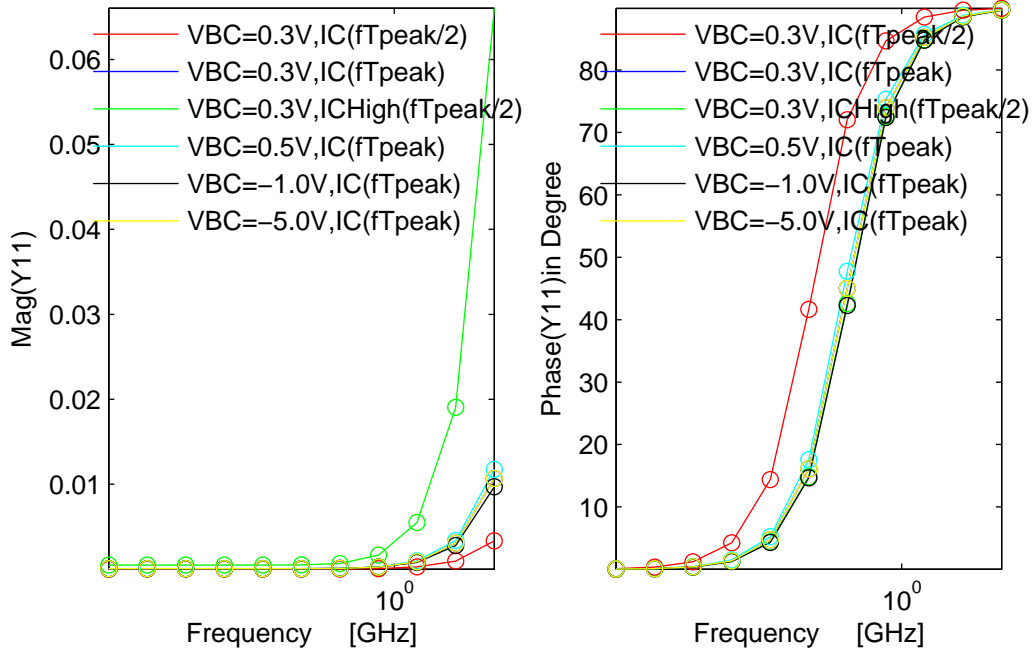


FIGURE 11. Y11 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and IChigh(fTpeak/2).

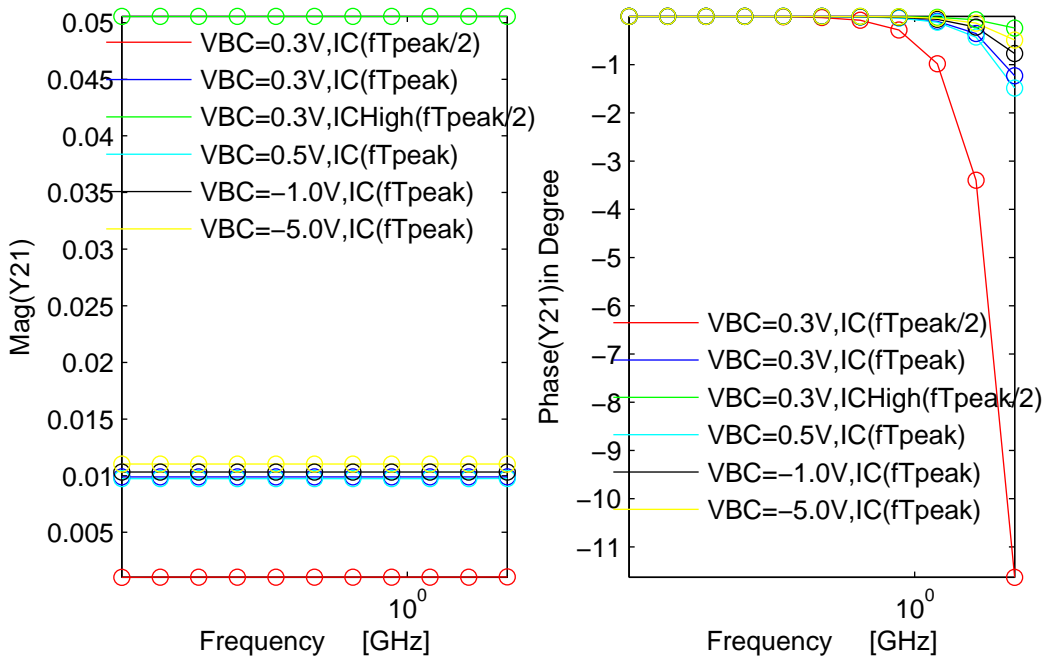


FIGURE 12. Y21 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and IChigh(fTpeak/2).

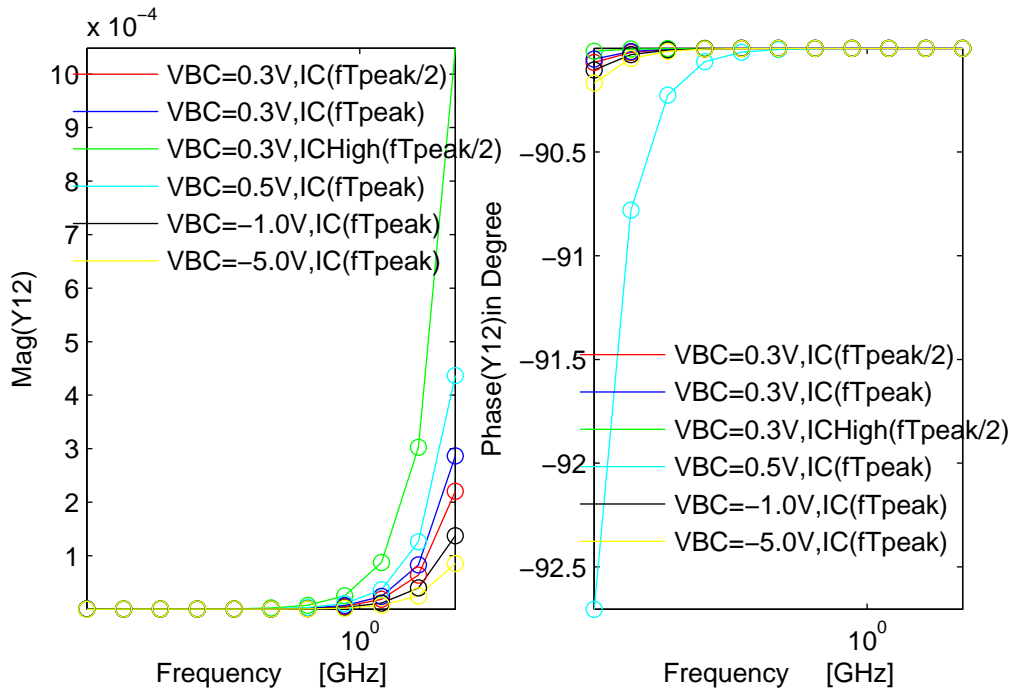


FIGURE 13. Y12 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0, -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

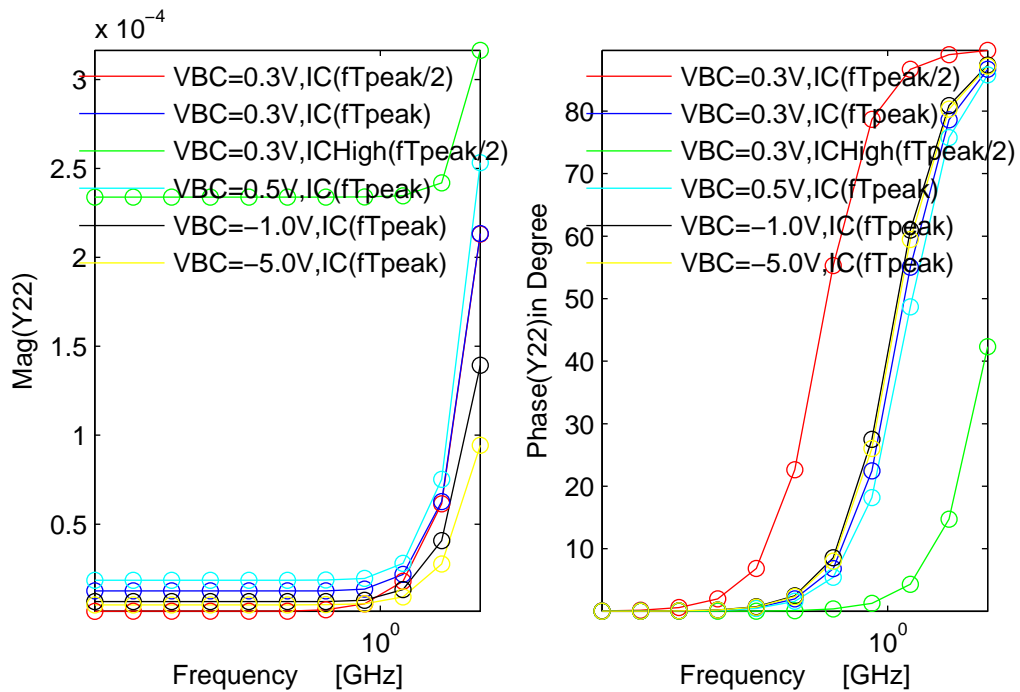


FIGURE 14. Y22 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

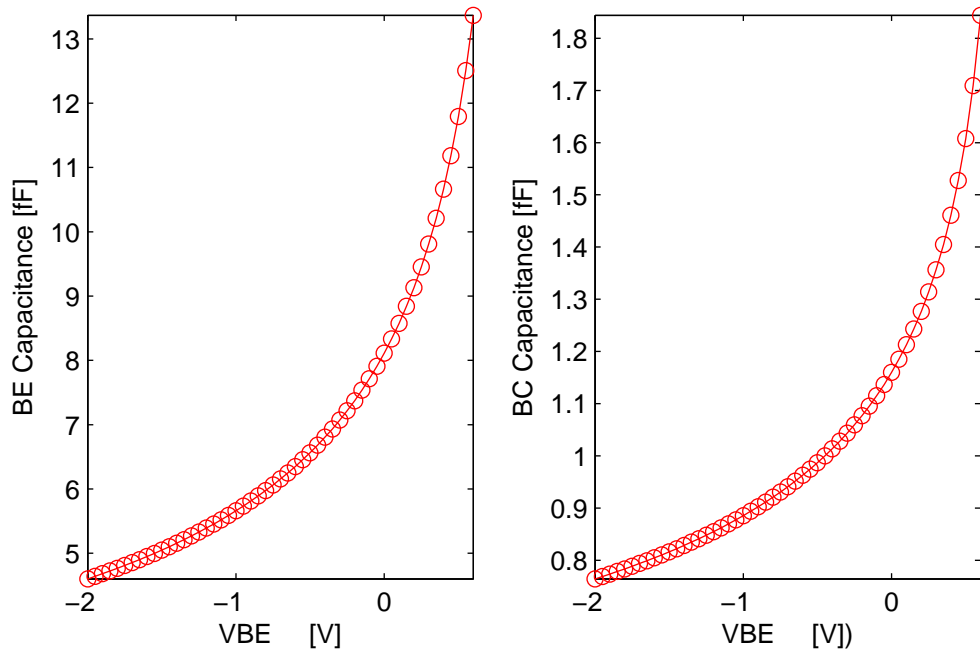


FIGURE 15. Depletion capacitances, C_{be} and C_{bc} (fF) vs BE voltages (Volt) plots at $T=300K$.

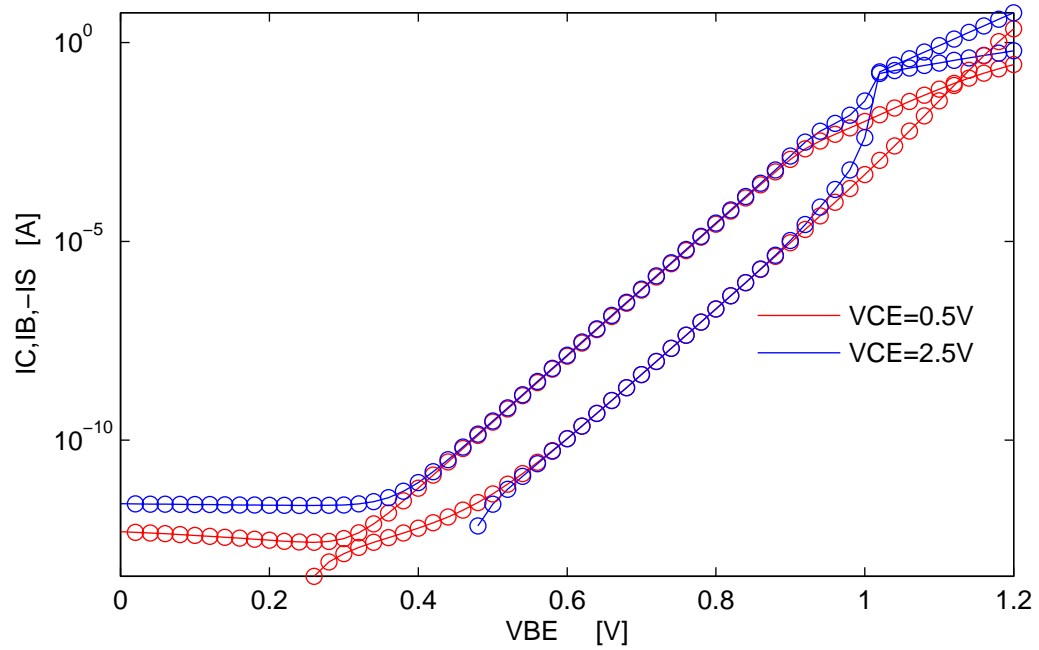


FIGURE 16. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$ with self-heating effect.

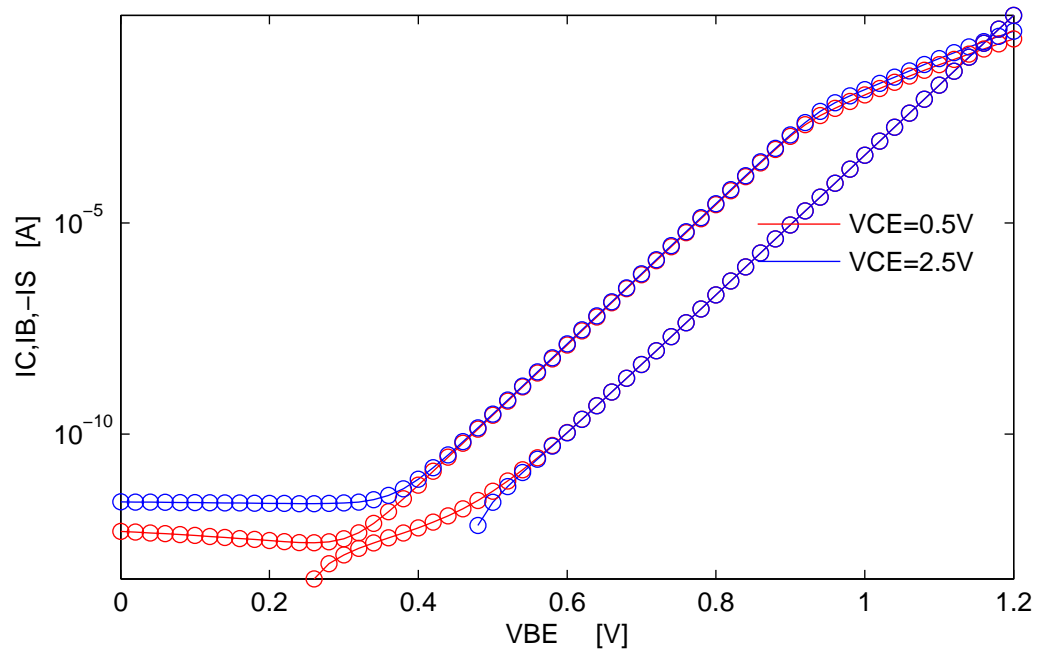


FIGURE 17. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$ with collector current spreading effect.

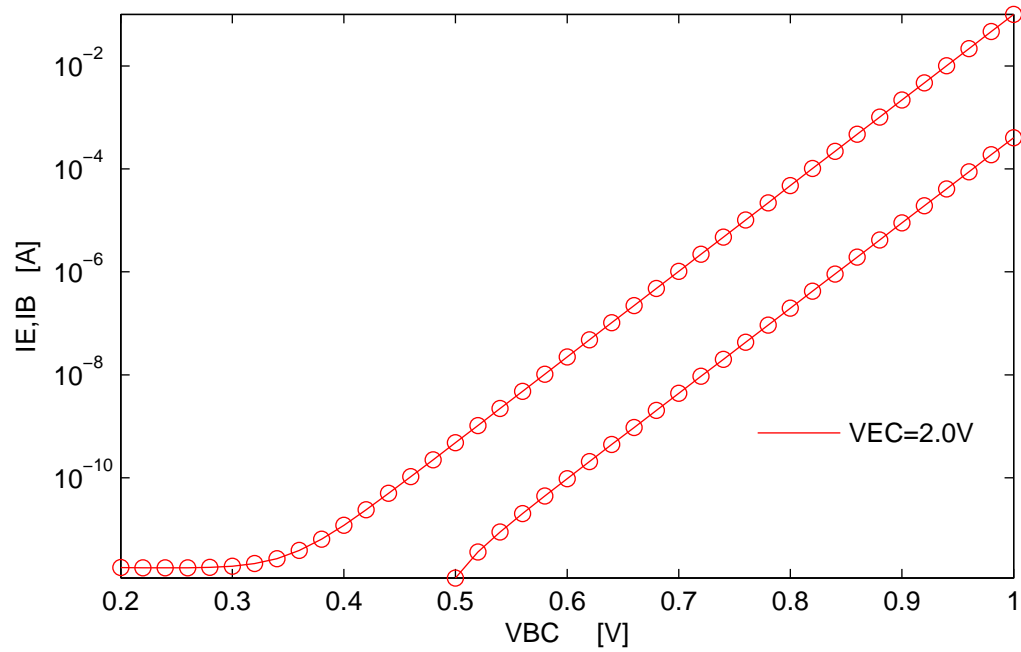


FIGURE 18. Reverse Gummel plots at $V_{EC}=2.0V$ at $T=300K$ with collector current spreading effect.

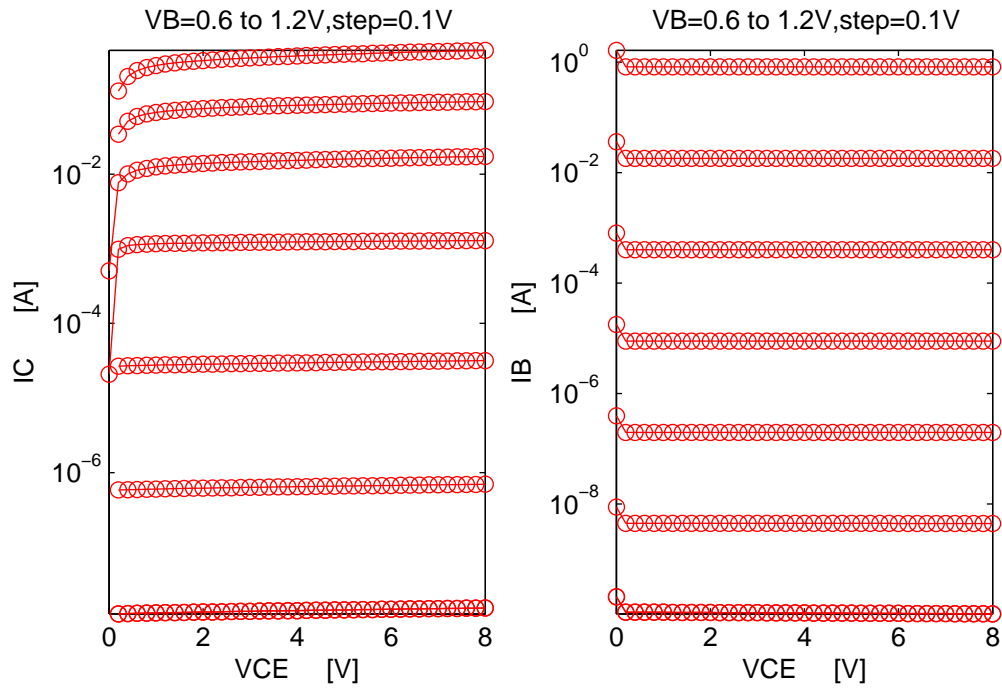


FIGURE 19. Forced-VB output characteristics and I_B - V_{CE} plots at $T=300K$ with collector current spreading effect.

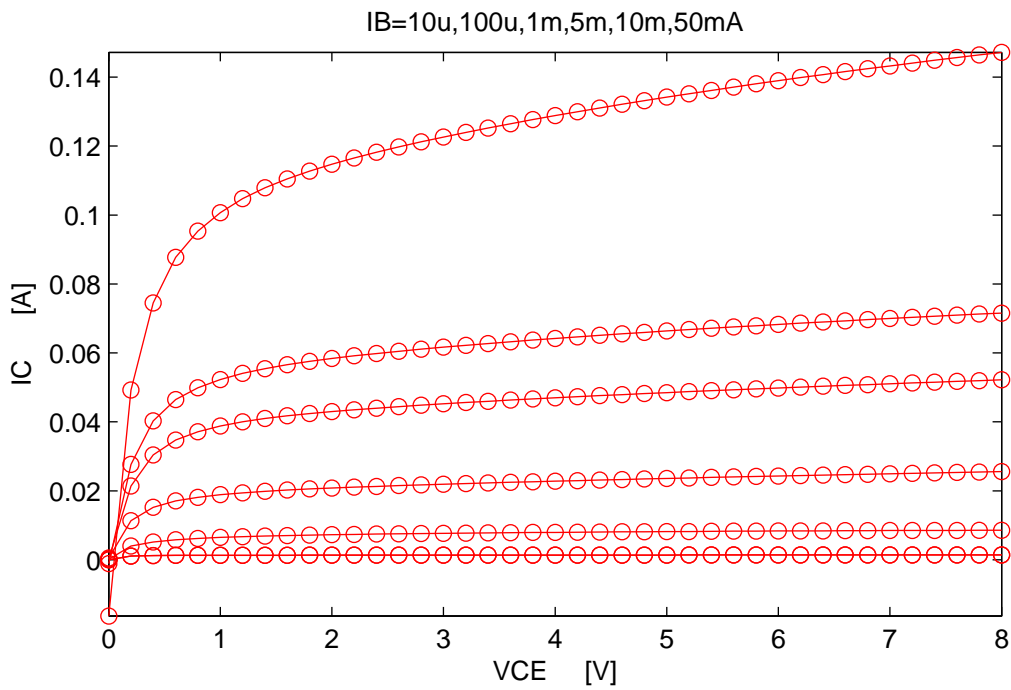


FIGURE 20. Forced-IB output characteristics at $T=300K$ with collector current spreading effect.

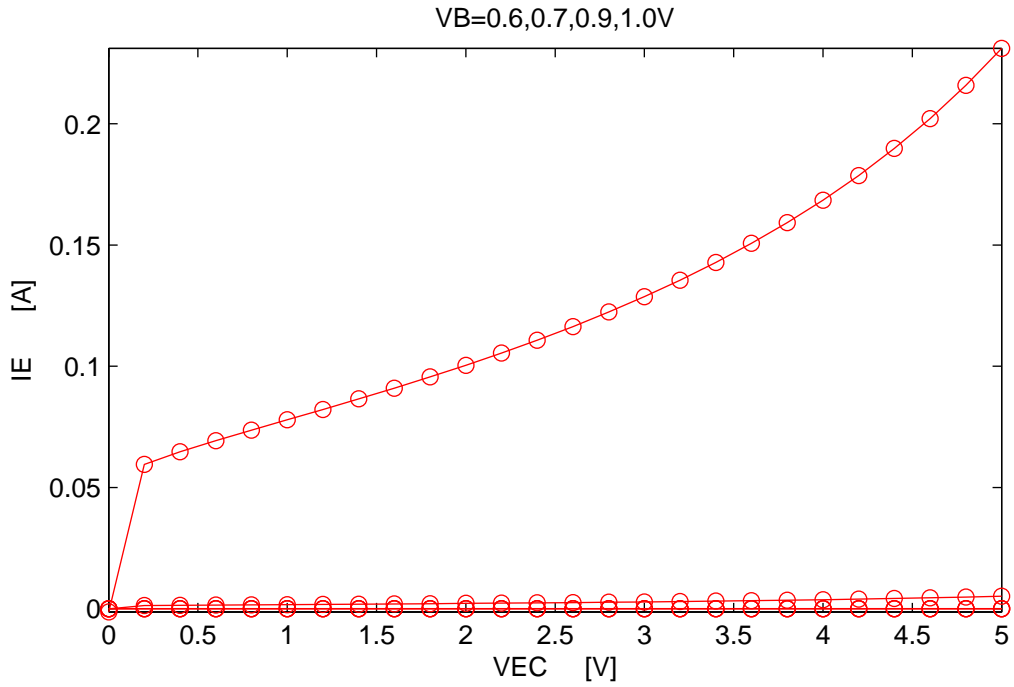


FIGURE 21. Reverse output characteristics at T=300K with collector current spreading effect.

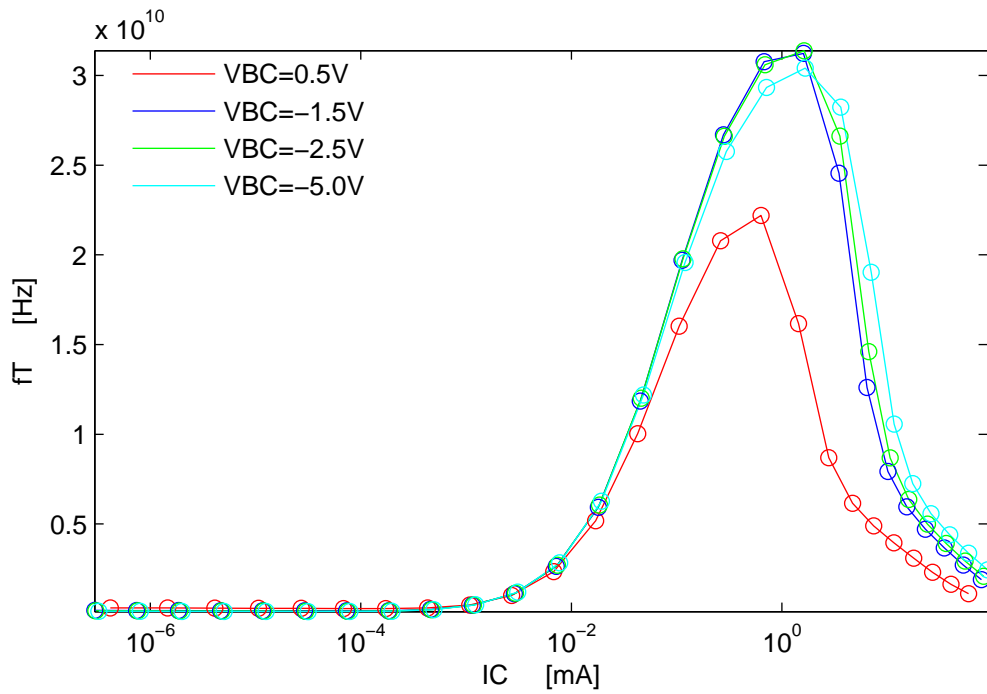


FIGURE 22. f_T (Hz) vs I_C (mA) plots at T=300K for $V_{bc}=0.5, -1.5, -2.5,$ and -5 V, f_T extracted at $f=2.8$ GHz with collector current spreading effect.

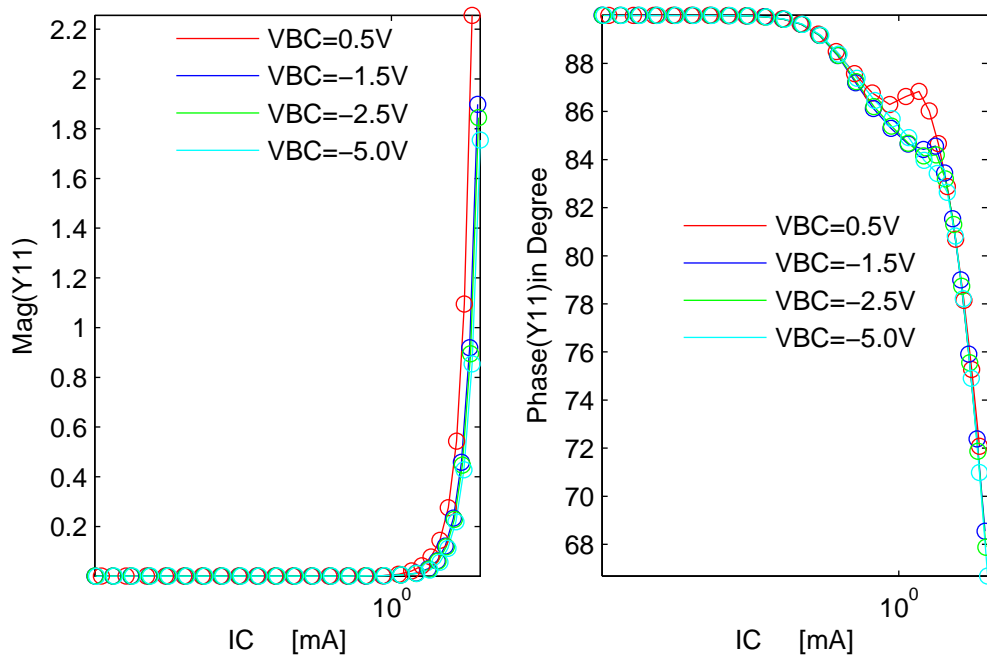


FIGURE 23. Y11 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

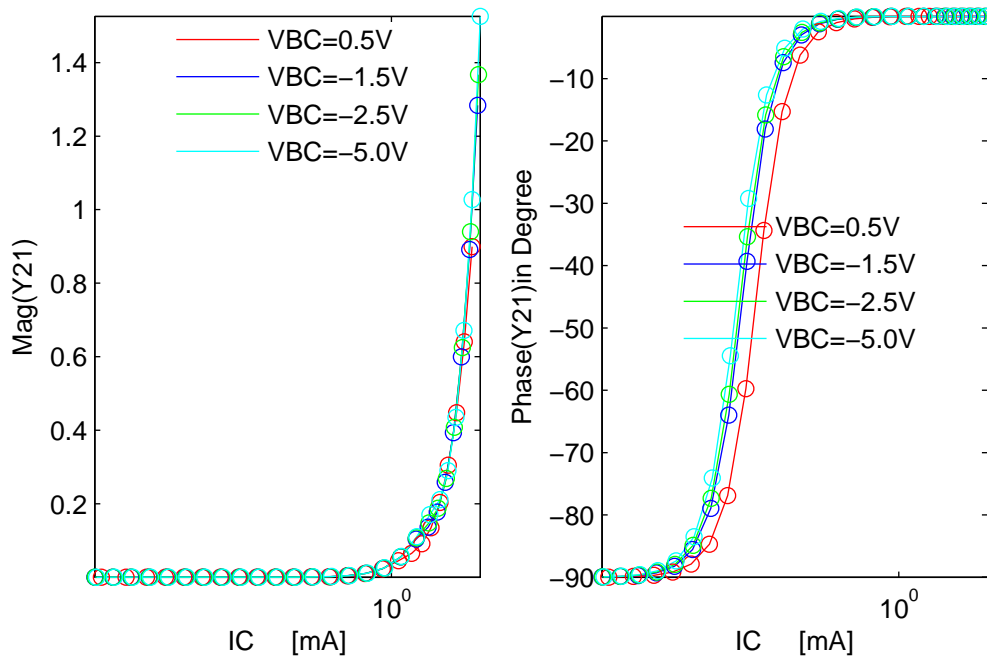


FIGURE 24. Y21 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

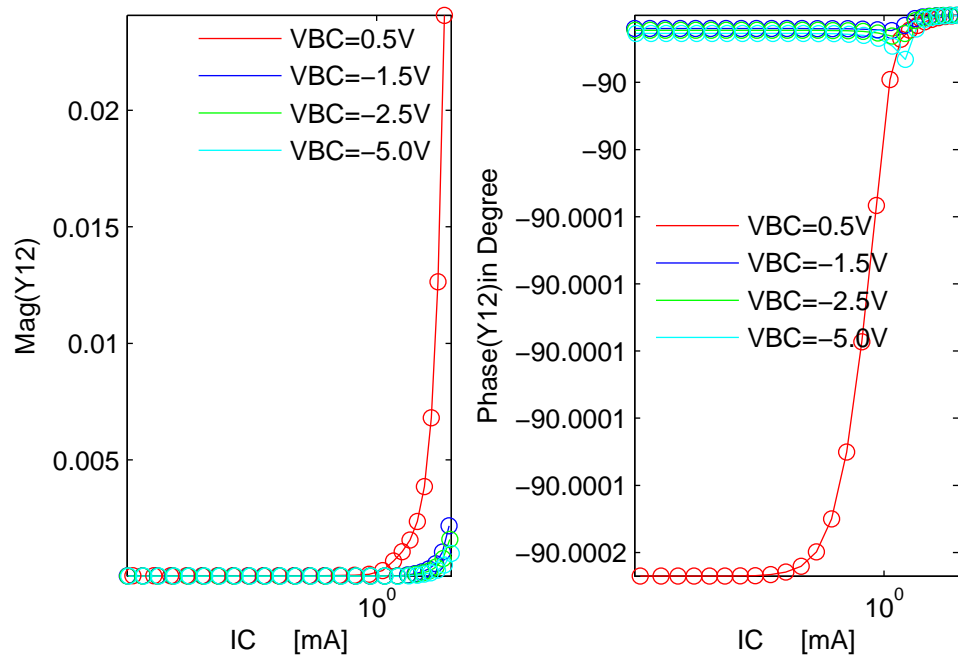


FIGURE 25. Y12 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

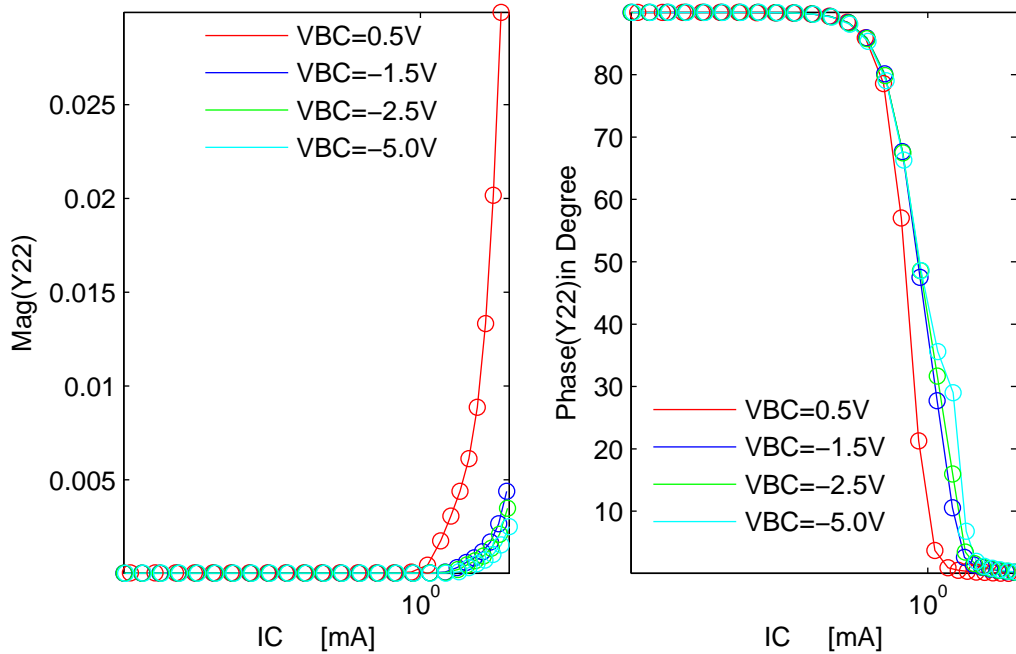


FIGURE 26. Y22 (extracted at f=2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

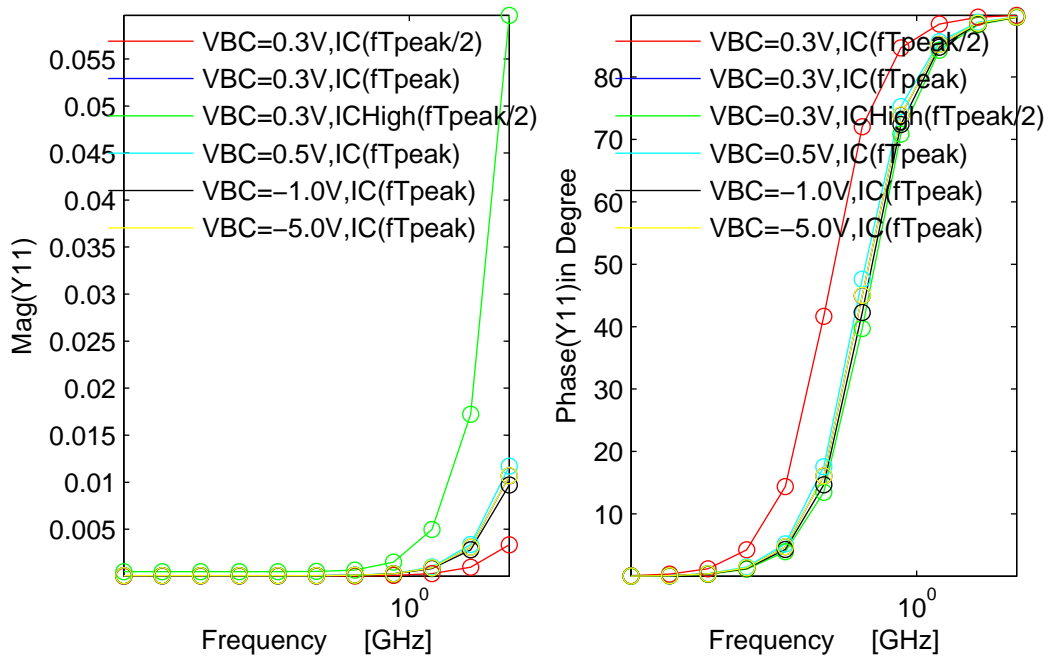


FIGURE 27. Y11 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

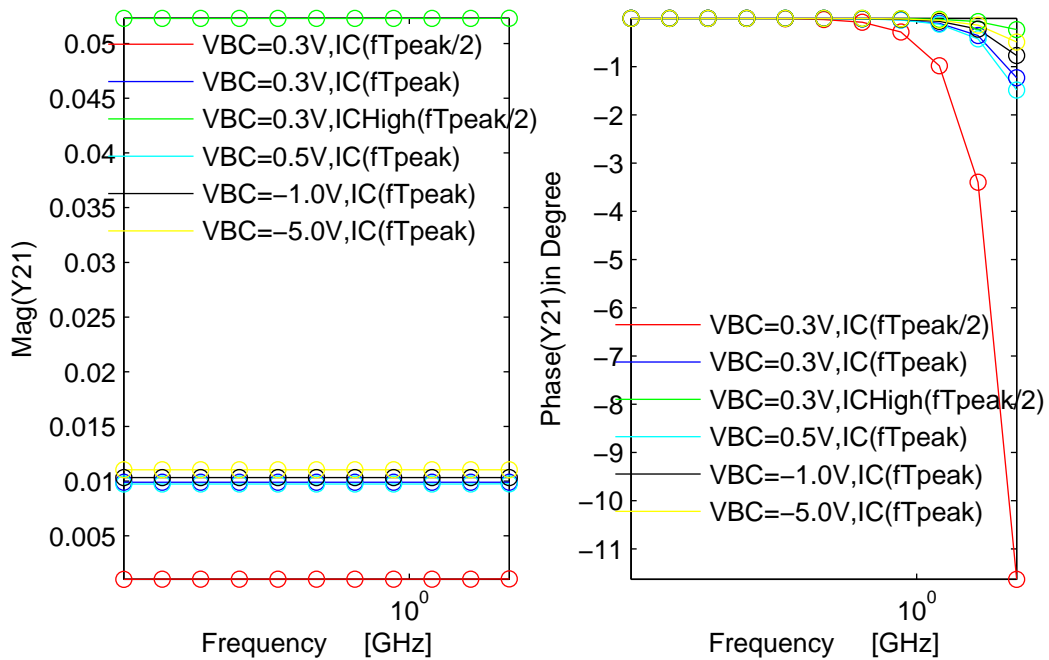


FIGURE 28. Y21 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

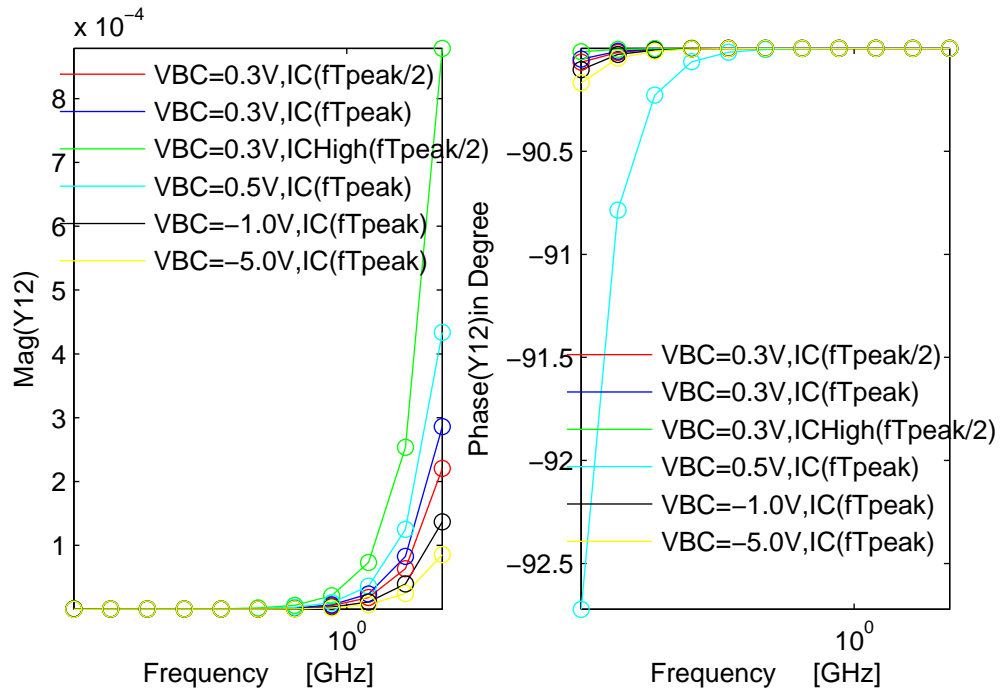


FIGURE 29. Y12 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0, -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

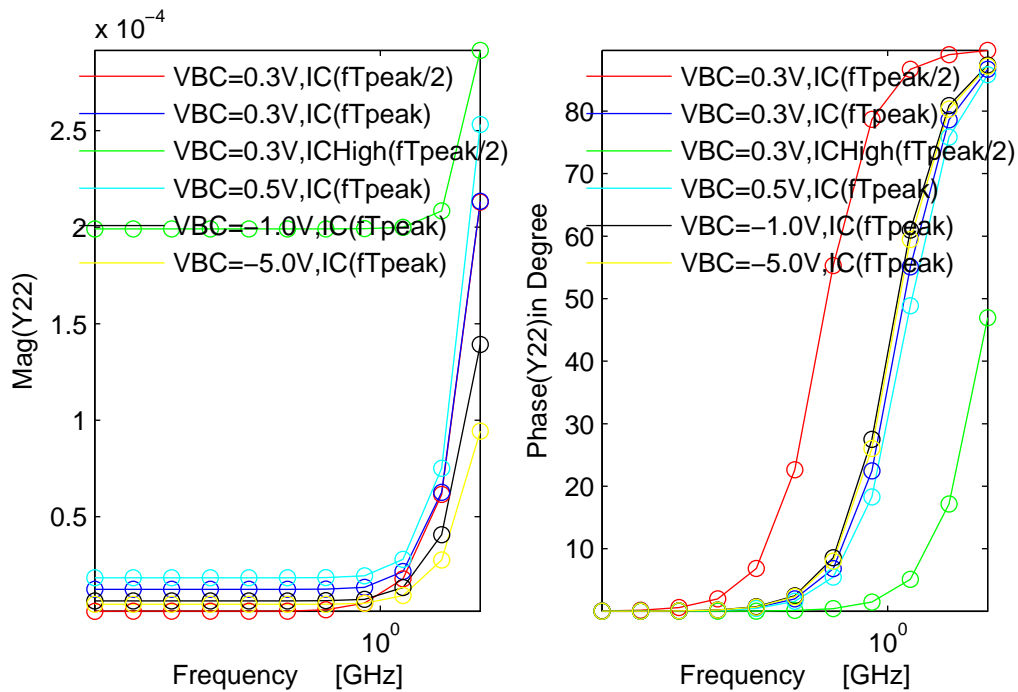


FIGURE 30. Y22 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

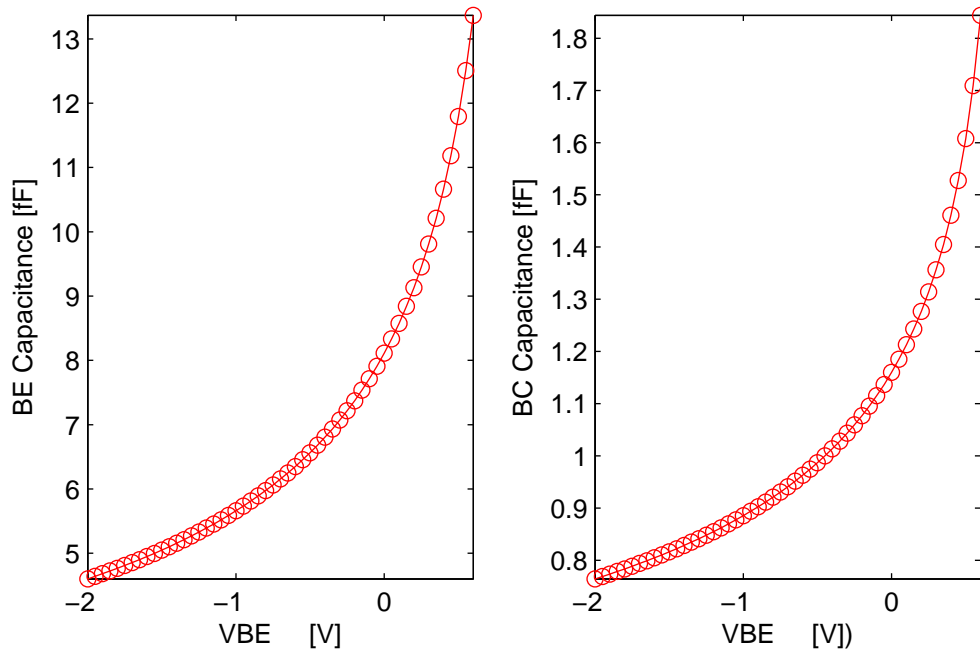


FIGURE 31. Depletion capacitances, C_{be} and C_{bc} (fF) vs BE voltages (Volt) plots at $T=300K$ with collector current spreading effect.

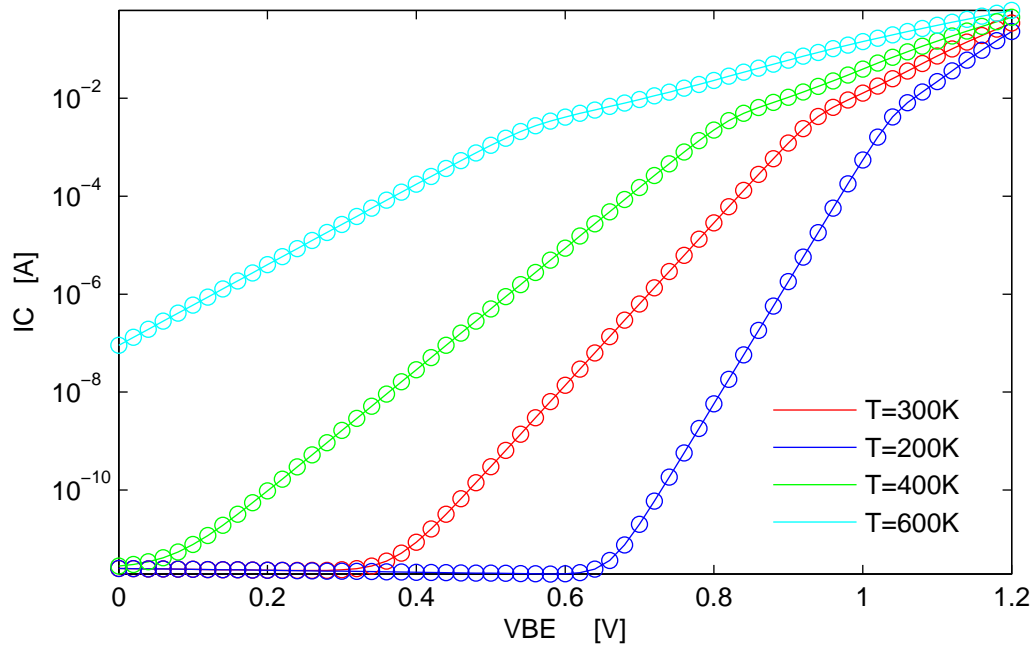


FIGURE 32. I_C vs. V_{BE} at $V_{CE}=2.5V$ and $T=200K, 300K, 400K, 600K$.

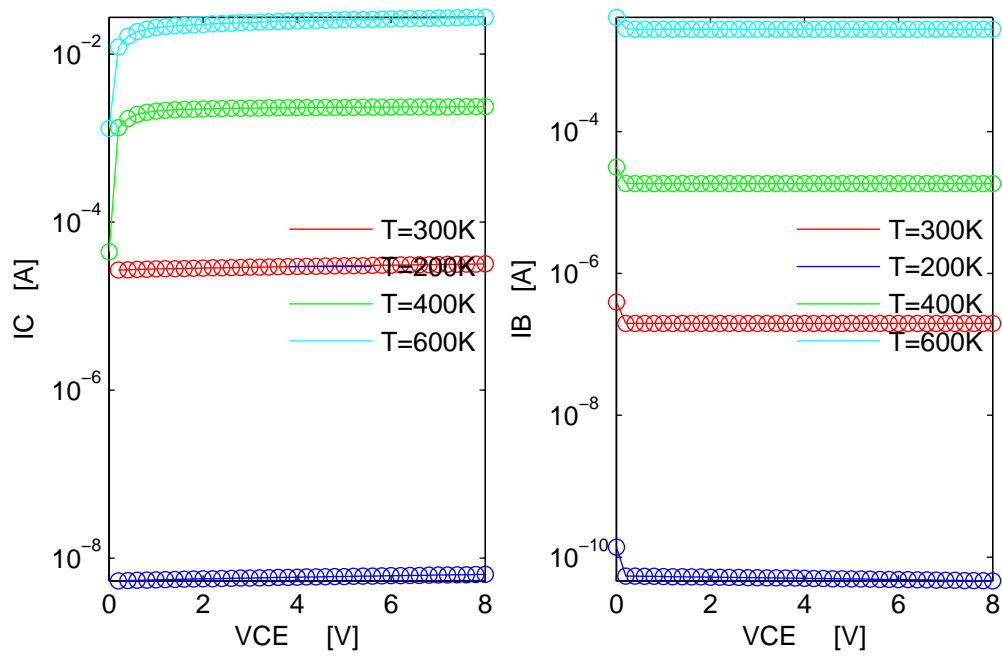


FIGURE 33. I_C and I_B vs. V_{CE} at $V_B=0.8V$ and $T=200K, 300K, 400K, 600K$.

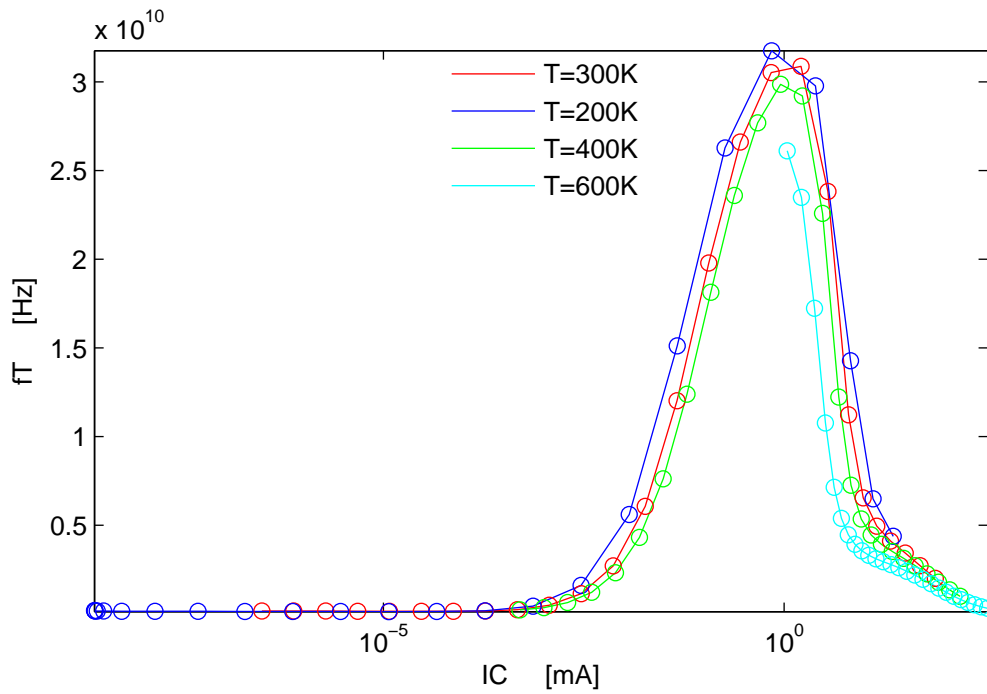


FIGURE 34. f_T (Hz) vs. I_C (mA) at $V_{BC}=-2.5V$ and $T=200K, 300K, 400K, 600K$.

Section 2: Results of Internal Transistor

Internal base resistance added. Tunneling current source tagged to the peripheral base node. Tunelling current is low. Tunelling has no influence in the forward characteristics.

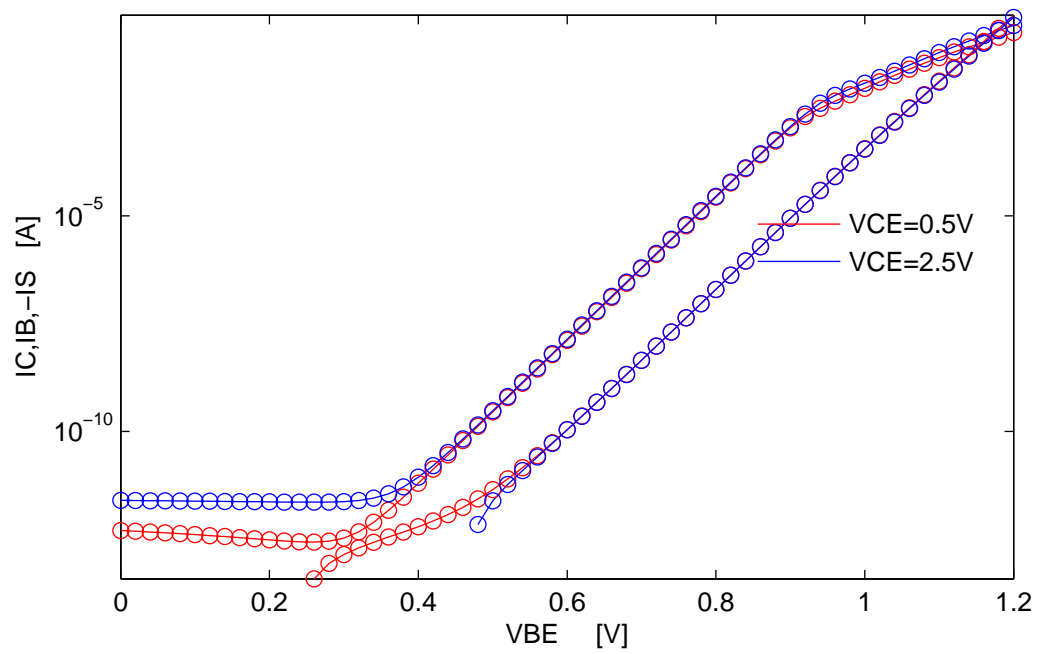


FIGURE 35. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$.

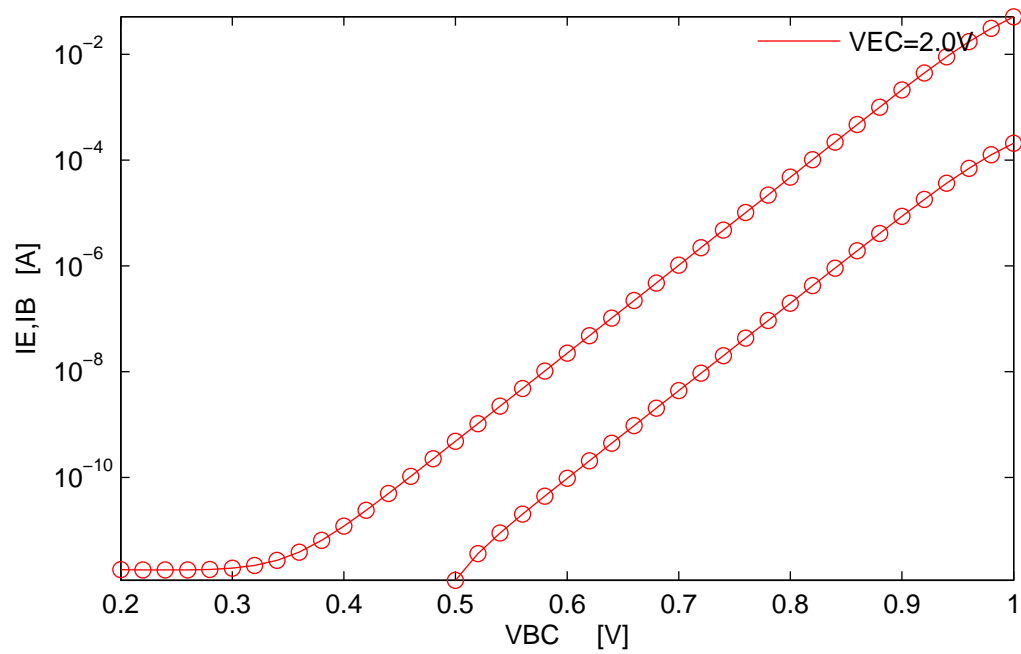


FIGURE 36. Reverse Gummel plots at $V_{EC}=2.0V$ at $T=300K$.

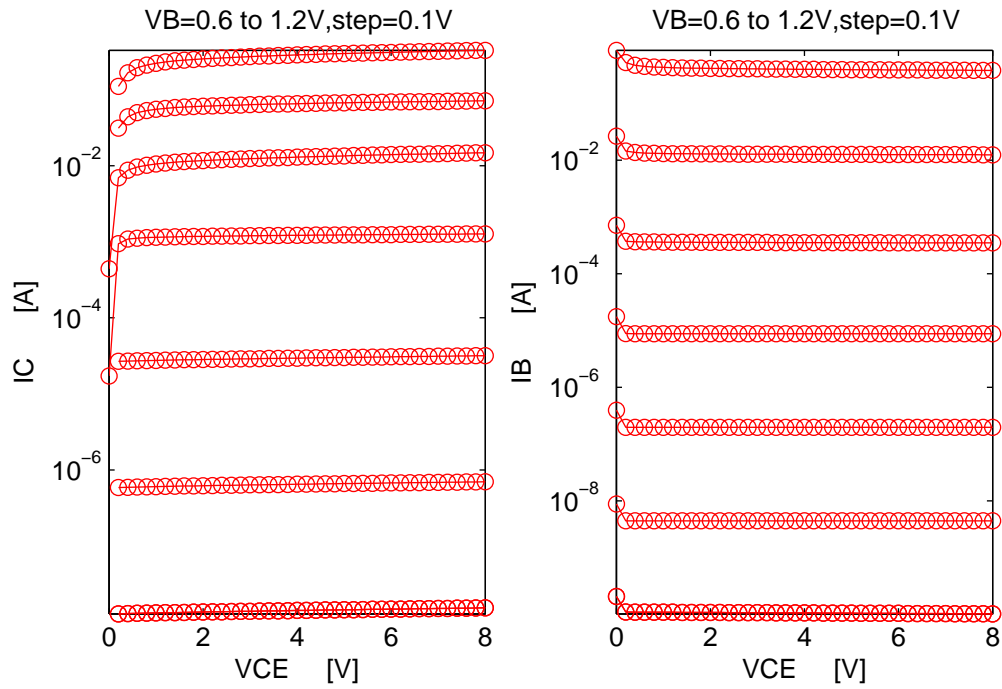


FIGURE 37. Forced-VB output characteristics and IB-VCE plots at T=300K.

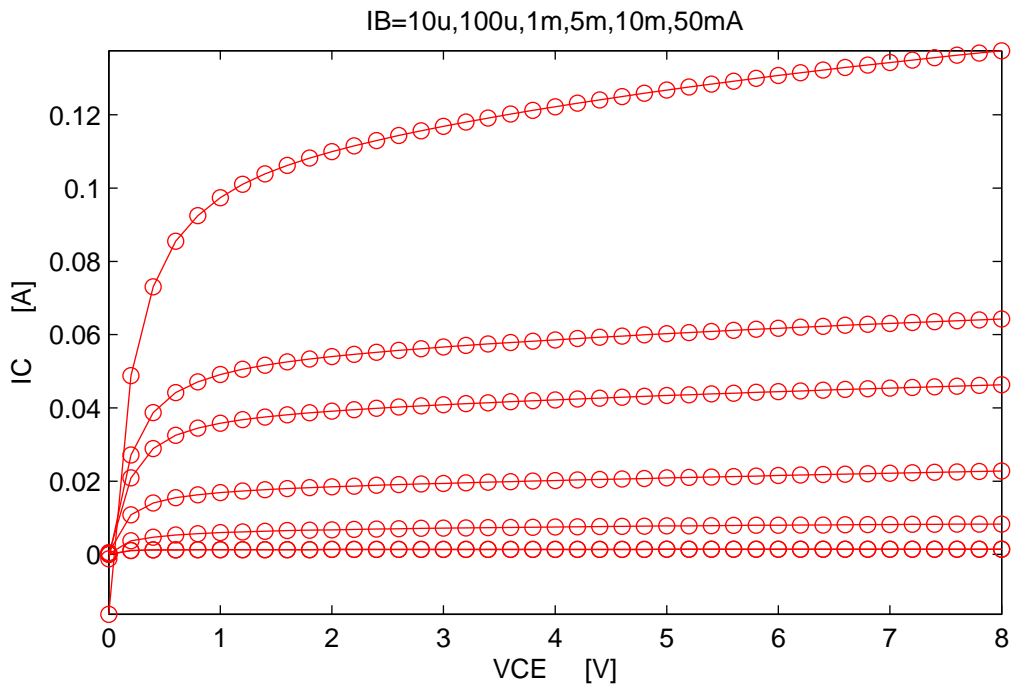


FIGURE 38. Forced-IB output characteristics at T=300K.

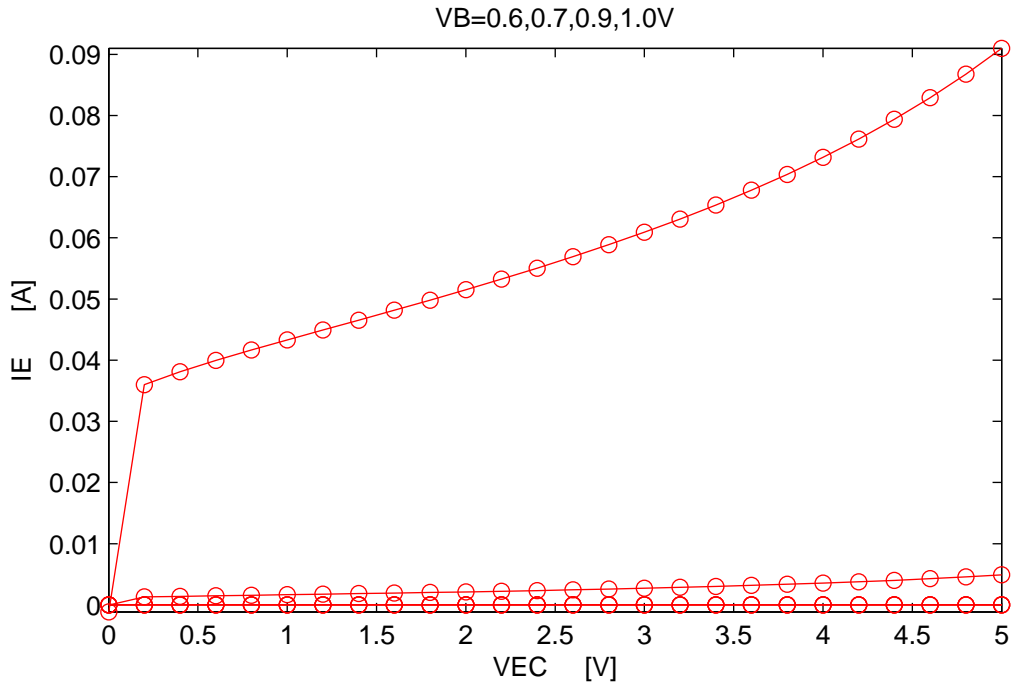


FIGURE 39. Reverse output characteristics at T=300K.

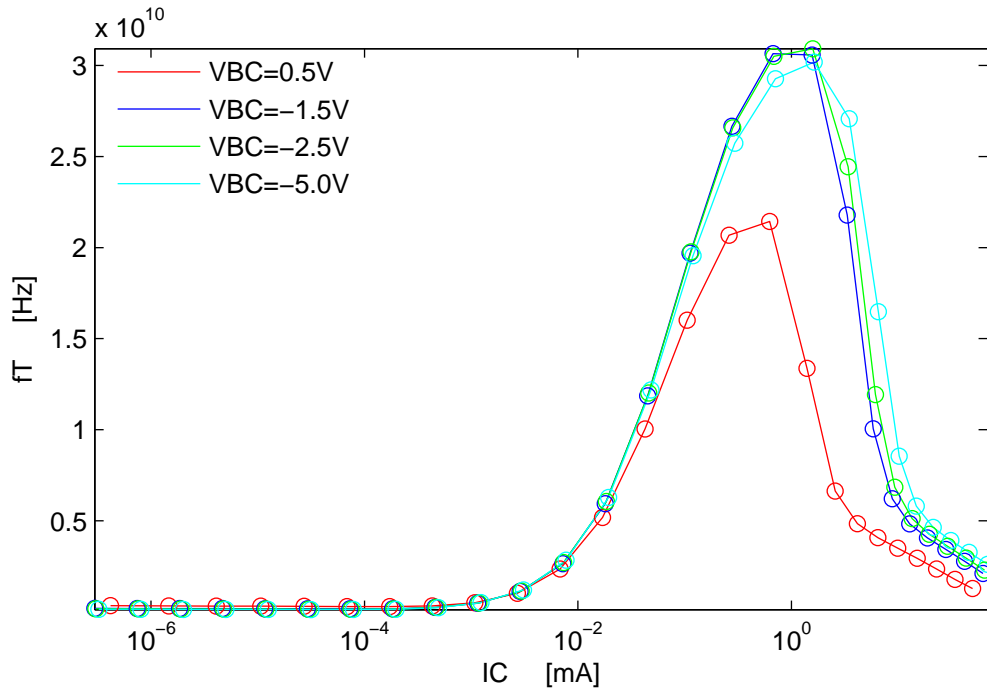


FIGURE 40. f_t (Hz) vs I_C (mA) plots at T=300K for $V_{bc}=0.5, -1.5, -2.5,$ and $-5V$, f_t extracted at $f=2.8$ GHz.

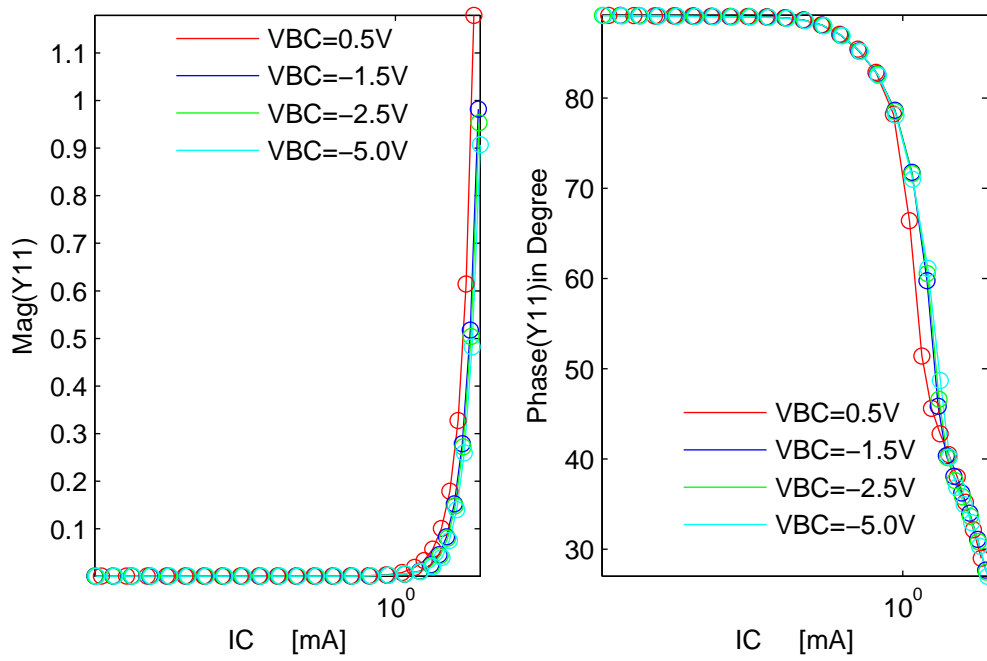


FIGURE 41. Y11 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

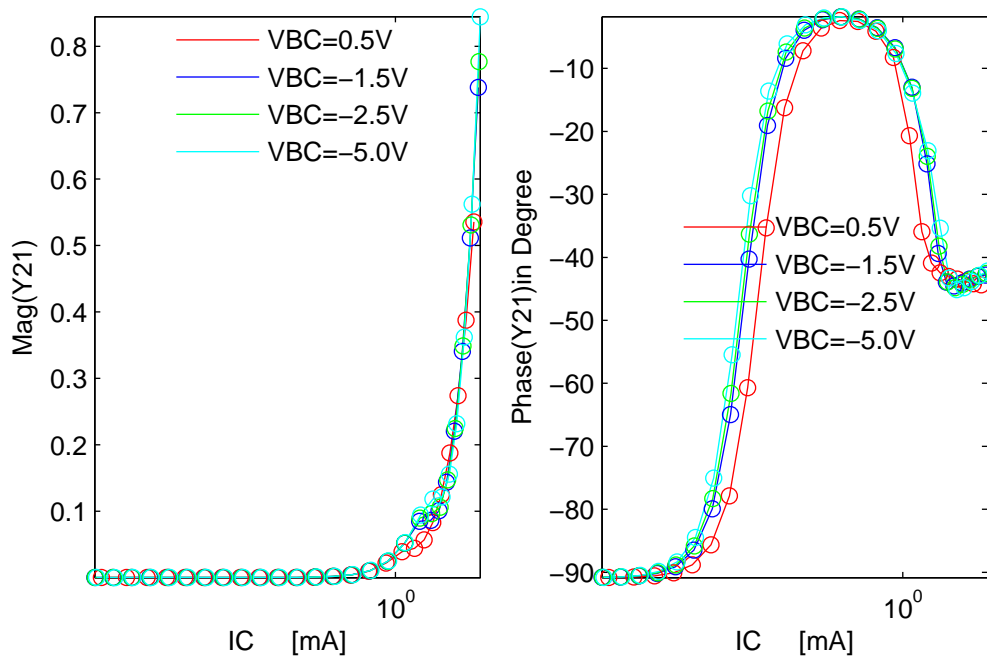


FIGURE 42. Y21 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

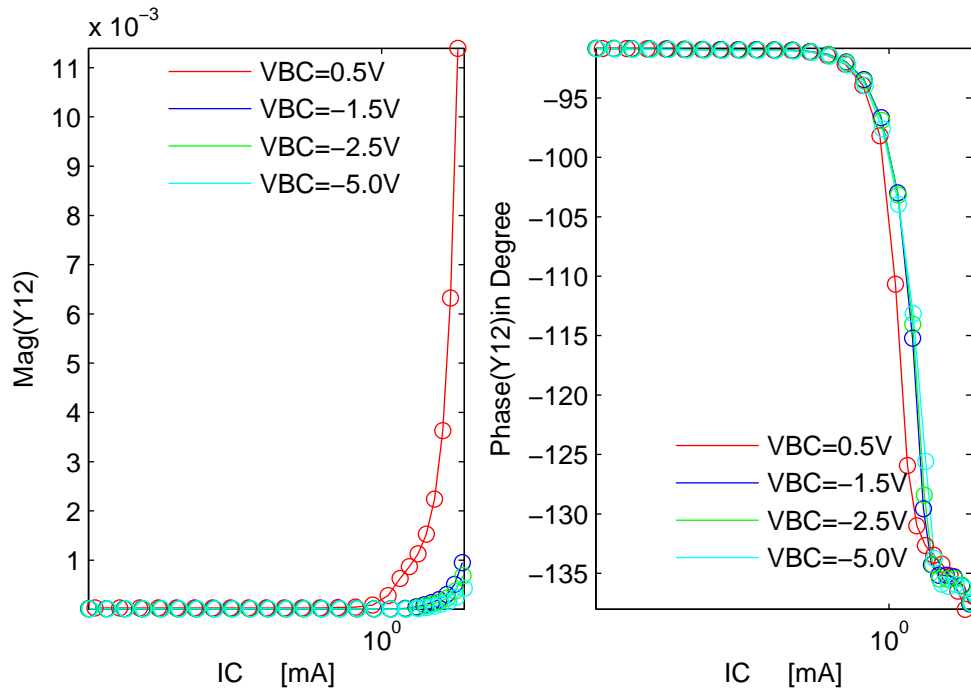


FIGURE 43. Y12 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

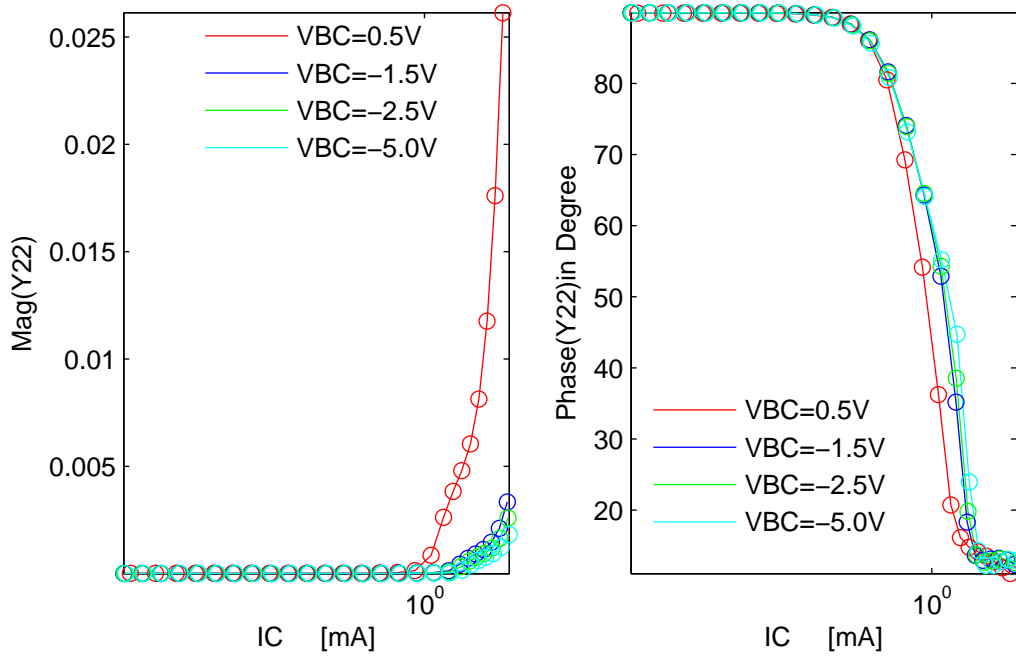


FIGURE 44. Y22 (extracted at f=2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

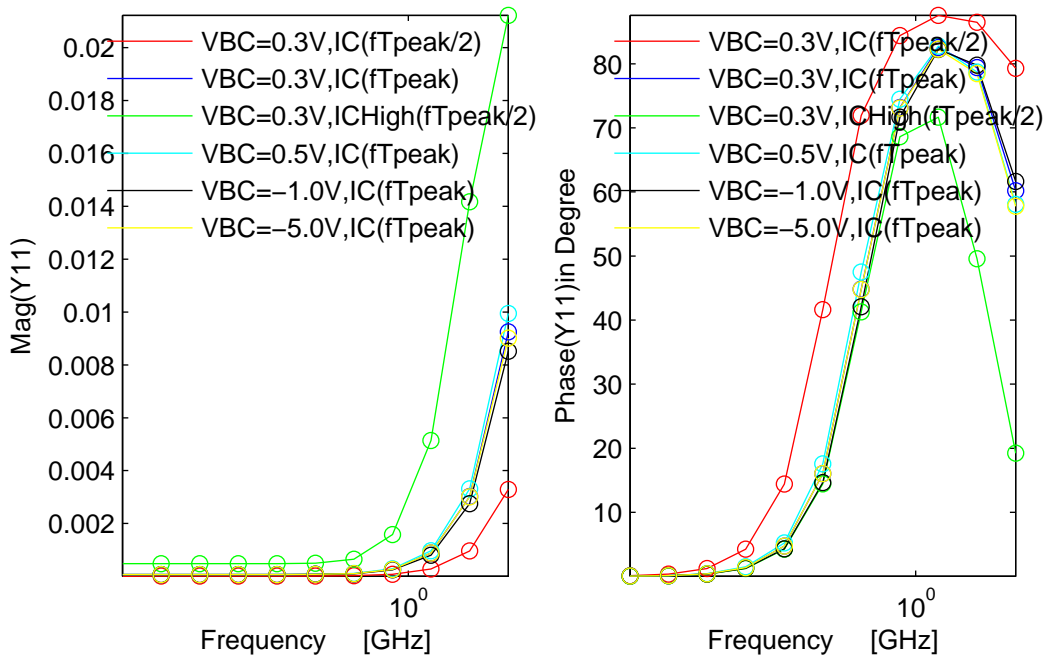


FIGURE 45. Y11 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(ftpeak),IC(ftpeak/2)and ICHigh(ftpeak/2).

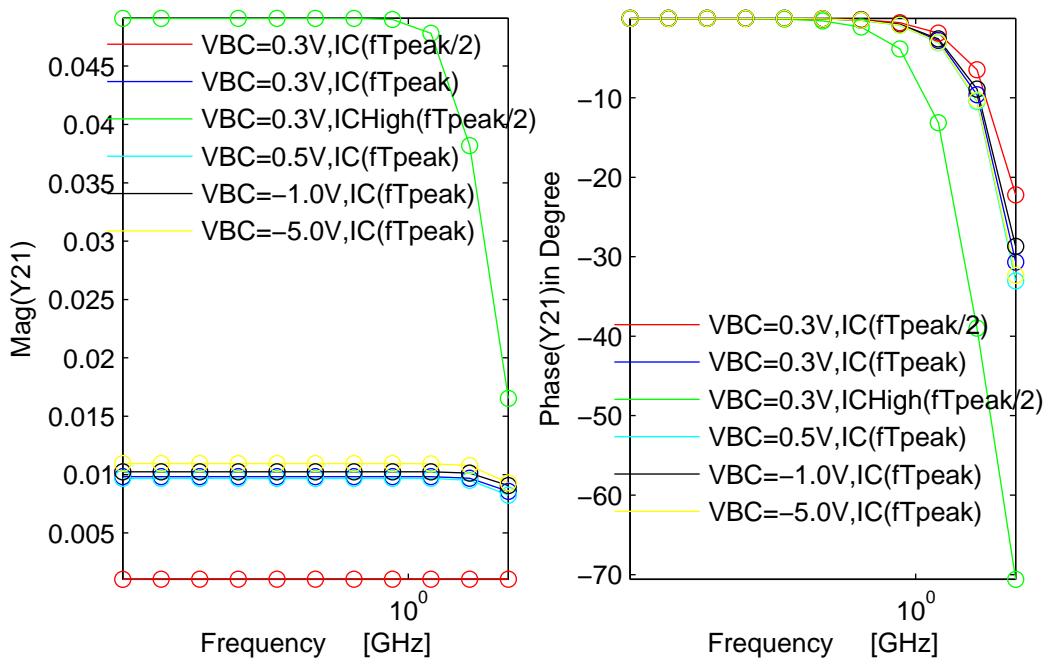


FIGURE 46. Y21 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(ftpeak),IC(ftpeak/2)and ICHigh(ftpeak/2).

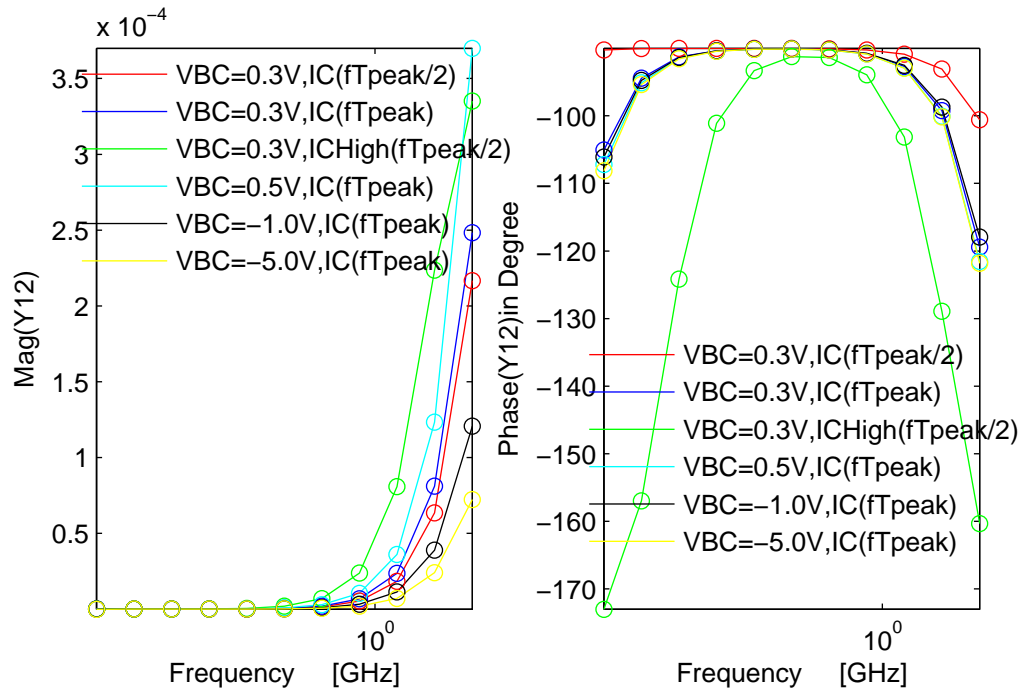


FIGURE 47. Y12 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0, -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

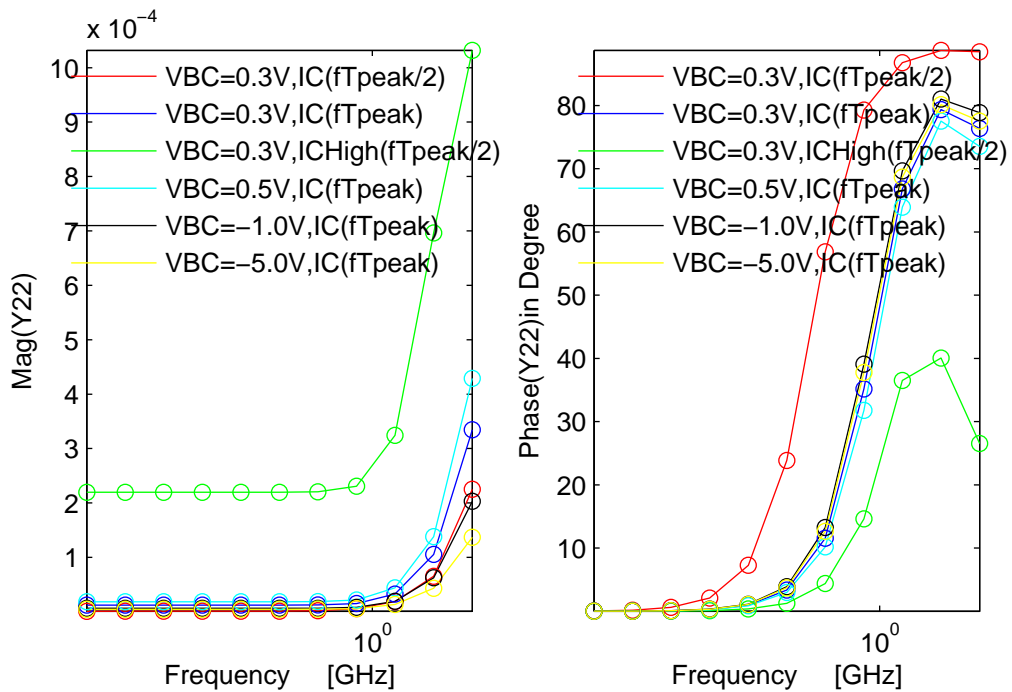


FIGURE 48. Y22 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

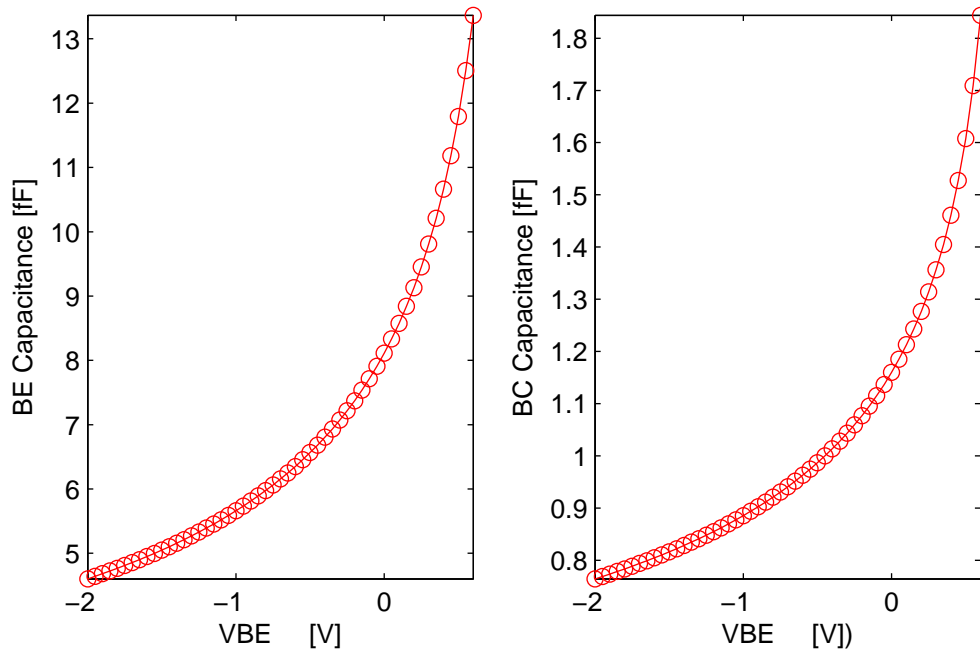


FIGURE 49. Depletion capacitances, C_{be} and C_{bc} (fF) vs BE voltages (Volt) plots at $T=300K$.

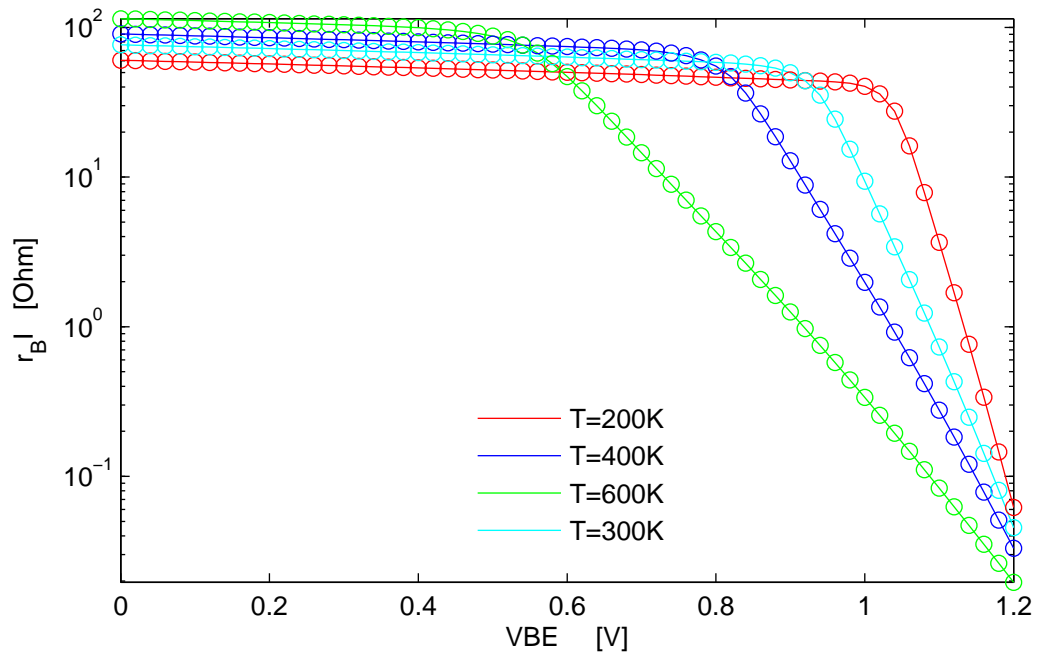


FIGURE 50. R_{Bi} vs. VBE for $T=200K$, $300K$, $400K$ and $600K$.

Section 3: Results of Complete Transistor

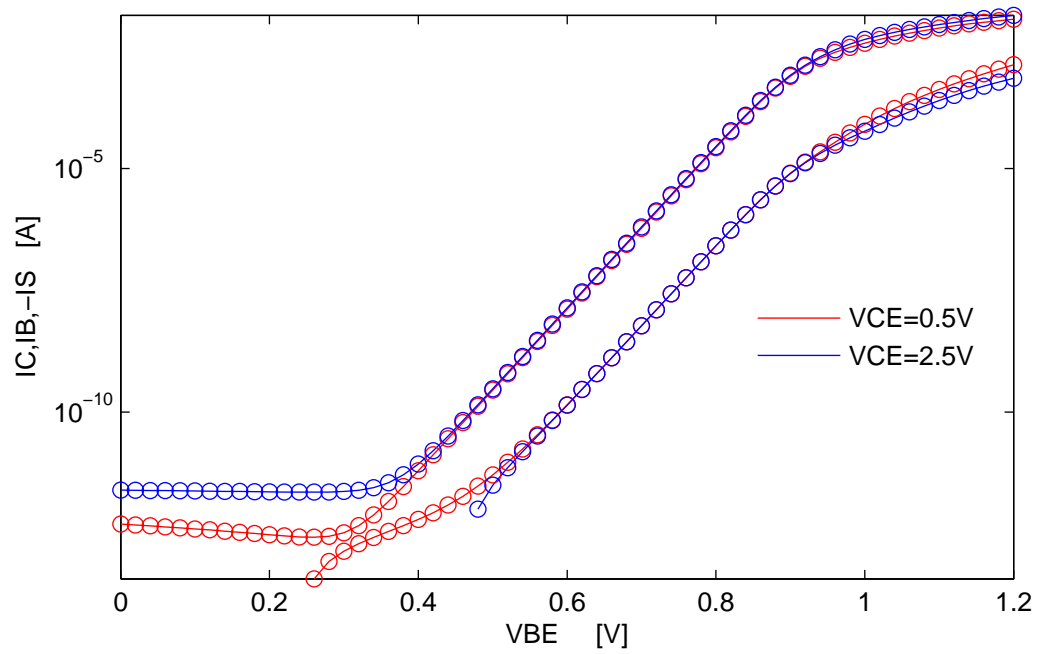


FIGURE 51. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$.

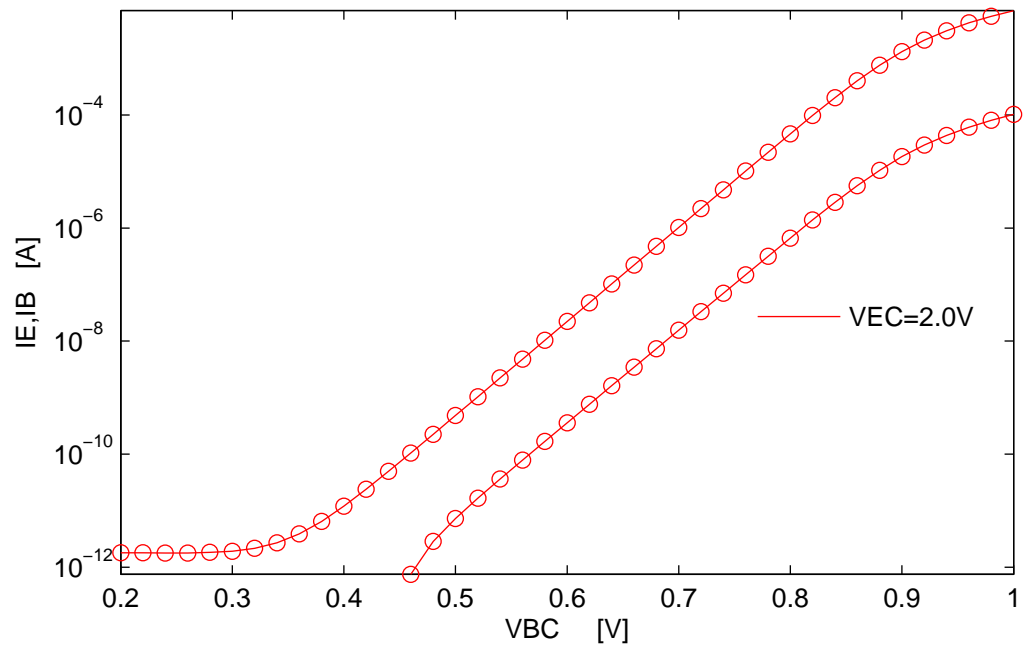


FIGURE 52. Reverse Gummel plots at $V_{EC}=2.0V$ at $T=300K$.

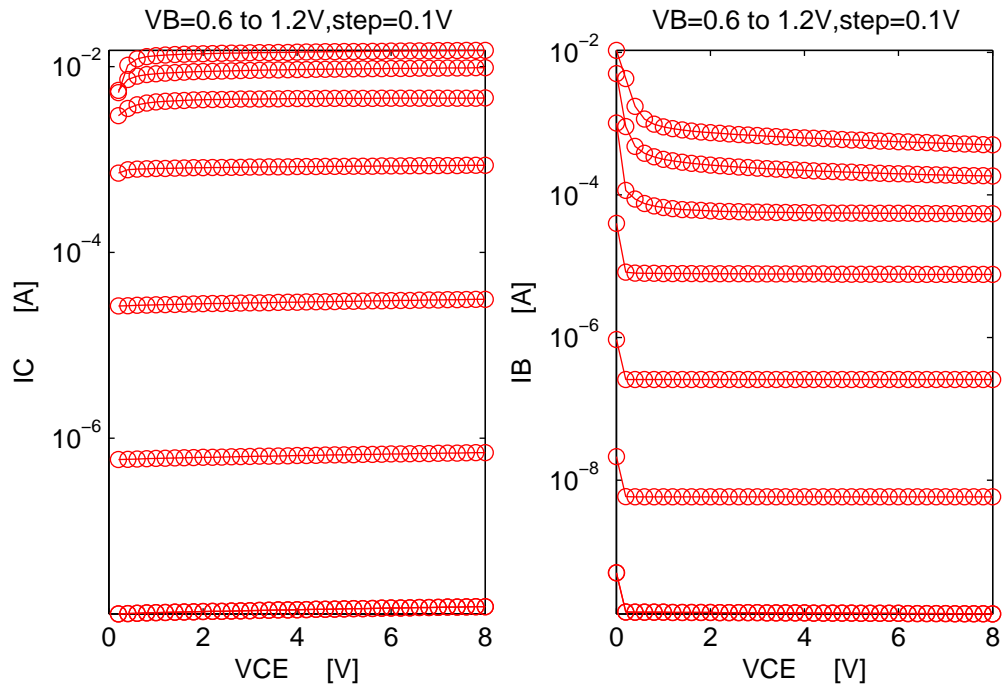


FIGURE 53. Forced-VB output characteristics and Ib-VCE plots at T=300K.

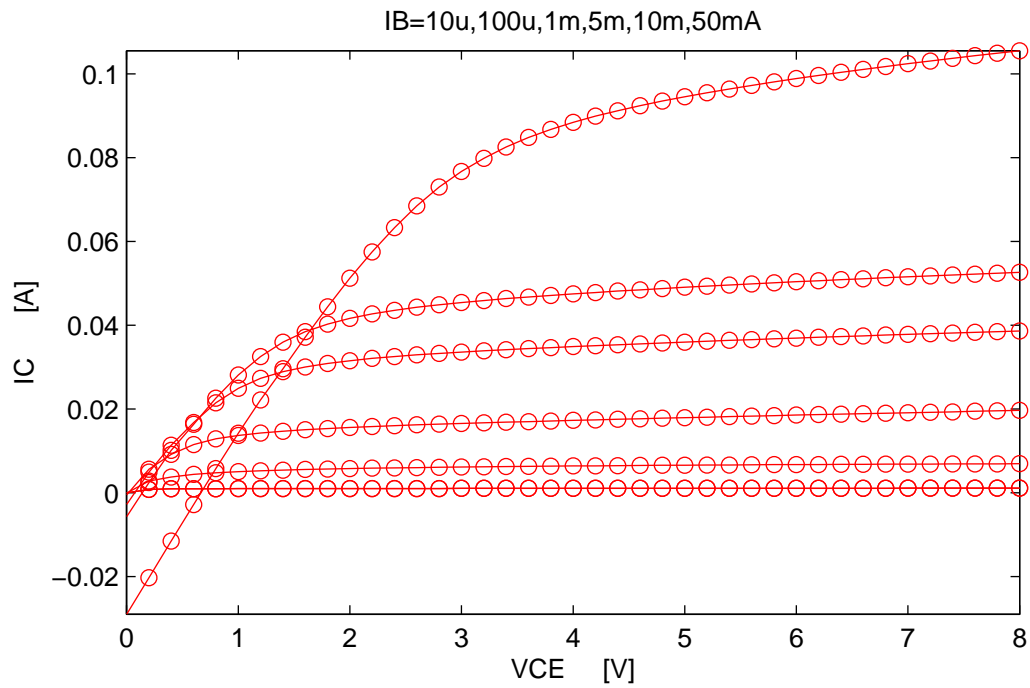


FIGURE 54. Forced-IB output characteristics at T=300K.

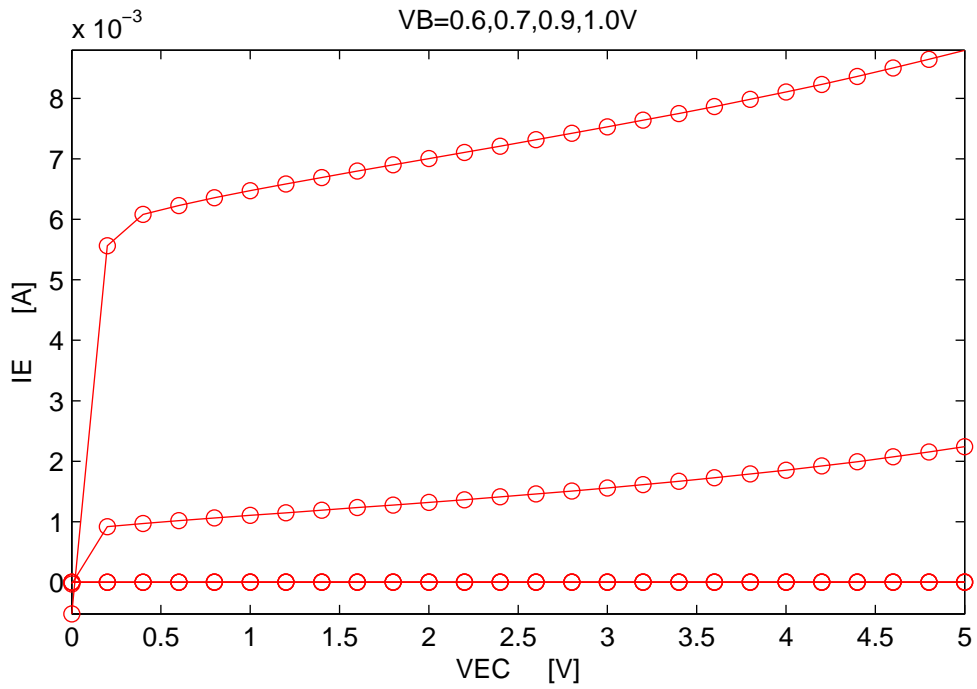


FIGURE 55. Reverse output characteristics at T=300K.

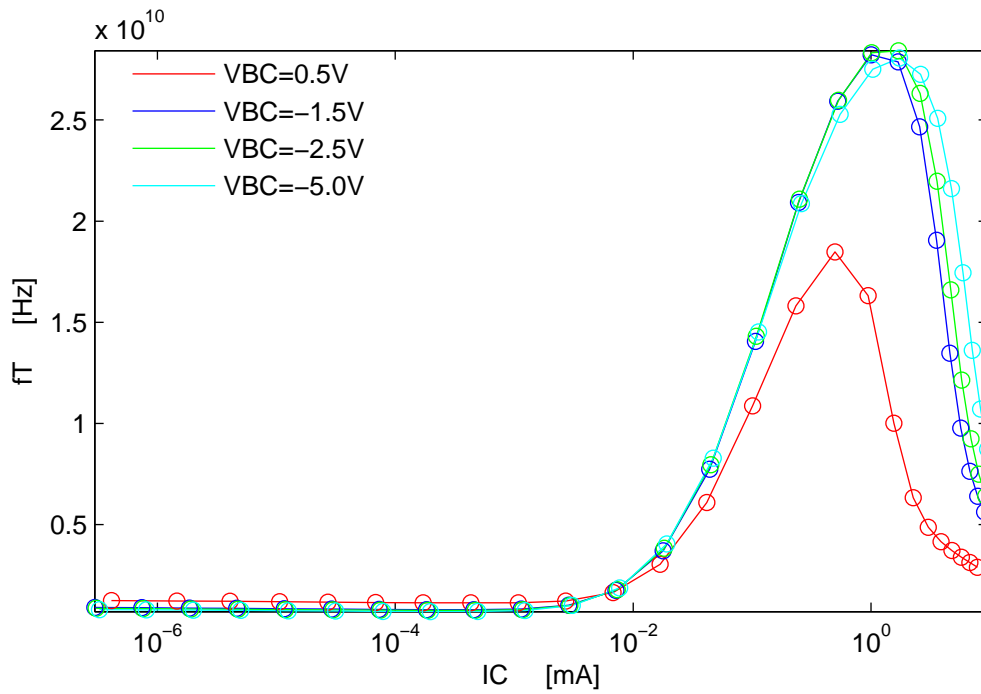


FIGURE 56. f_T (Hz) vs I_C (mA) plots at T=300K for $V_{bc}=0.5, -1.5, -2.5,$ and $-5V$, f_T extracted at $f=2.8GHz$.

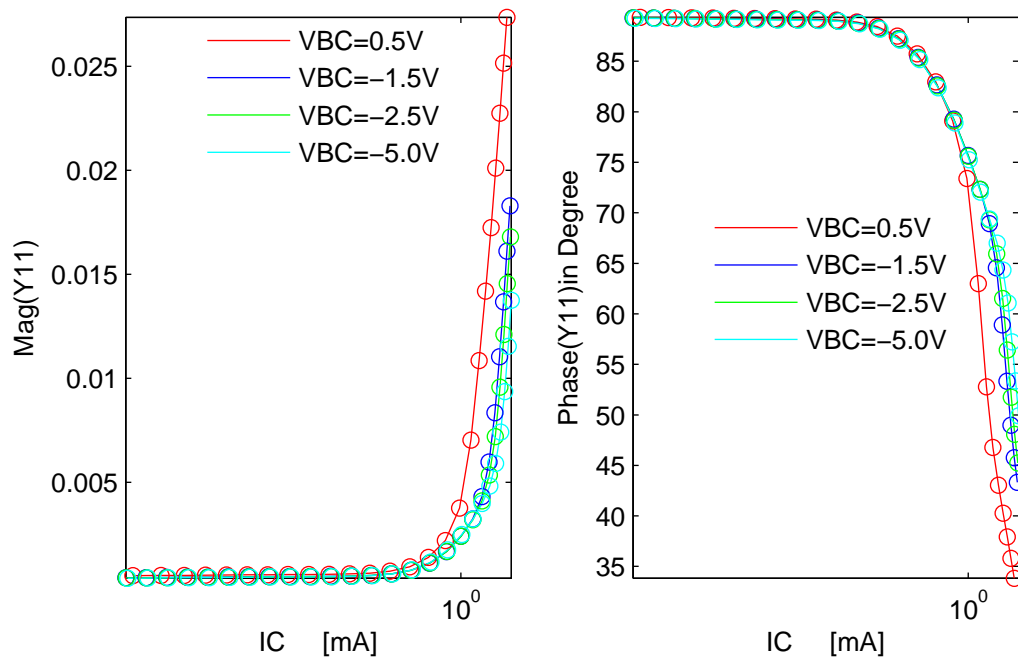


FIGURE 57. Y11 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

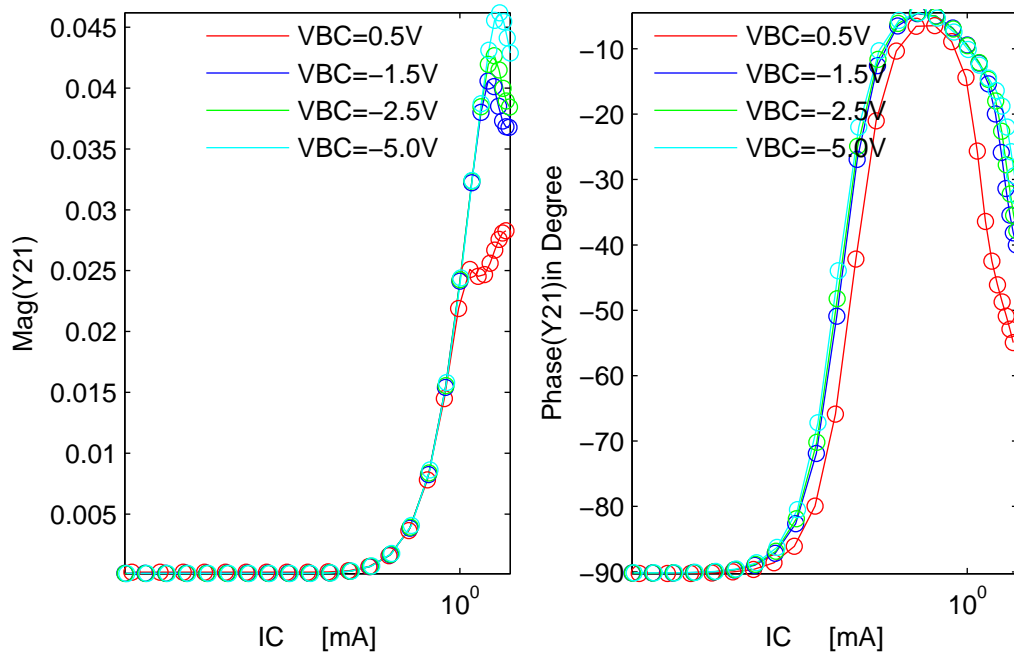


FIGURE 58. Y21 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

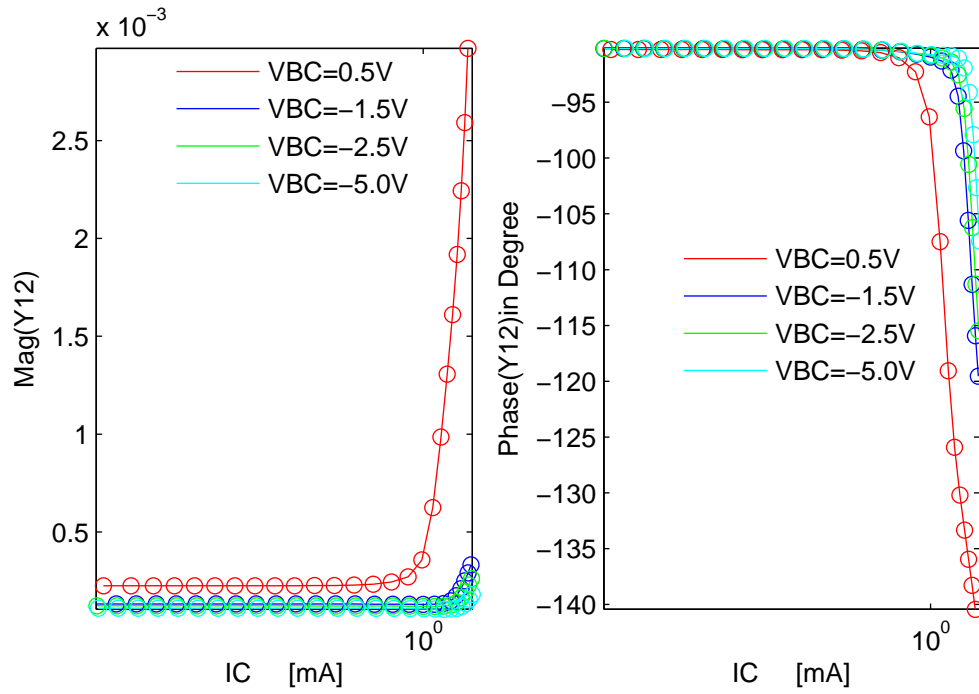


FIGURE 59. Y12 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

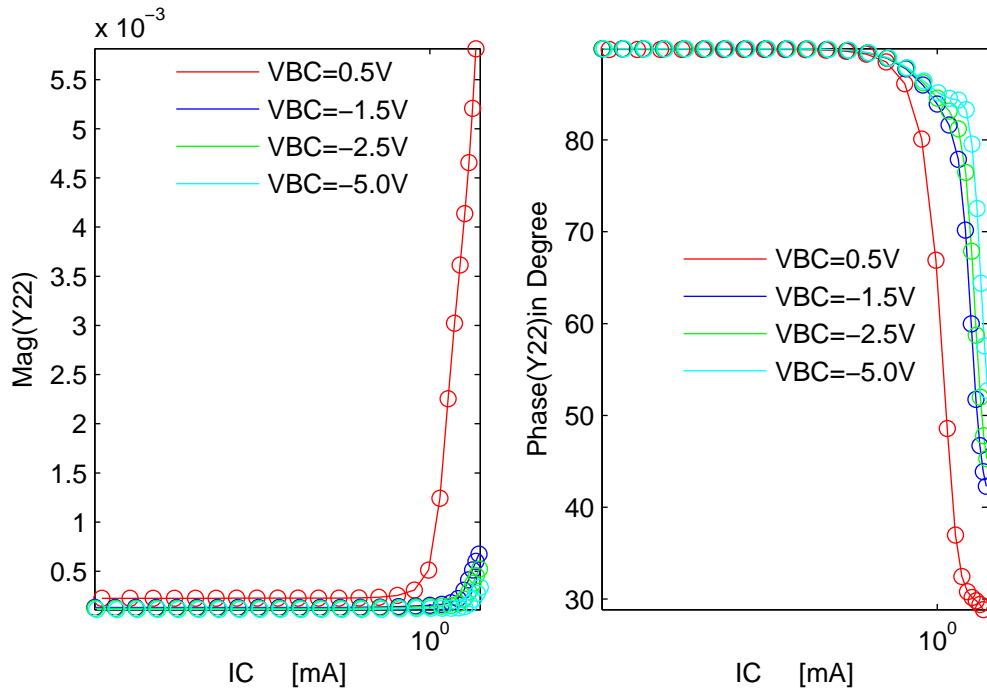


FIGURE 60. Y22 (extracted at f=2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V.

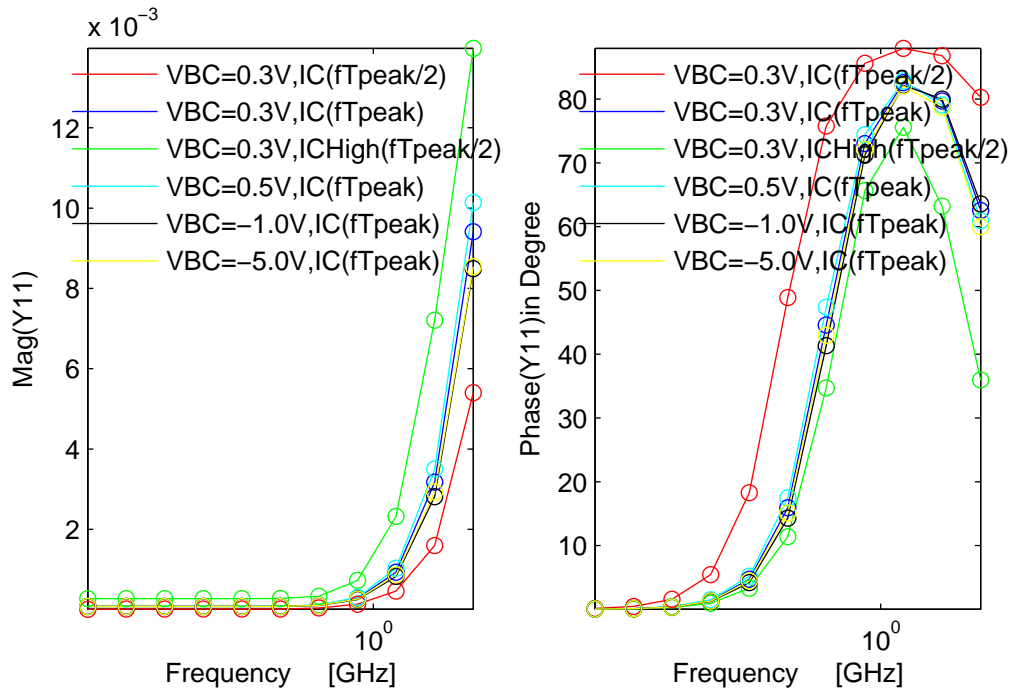


FIGURE 61. Y11 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

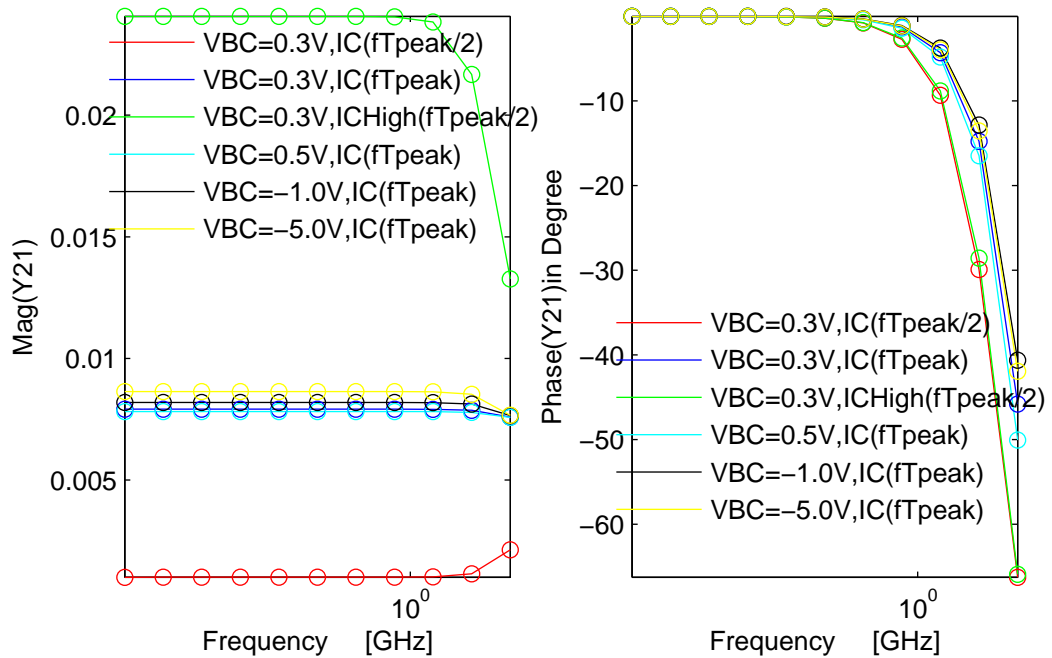


FIGURE 62. Y21 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2).

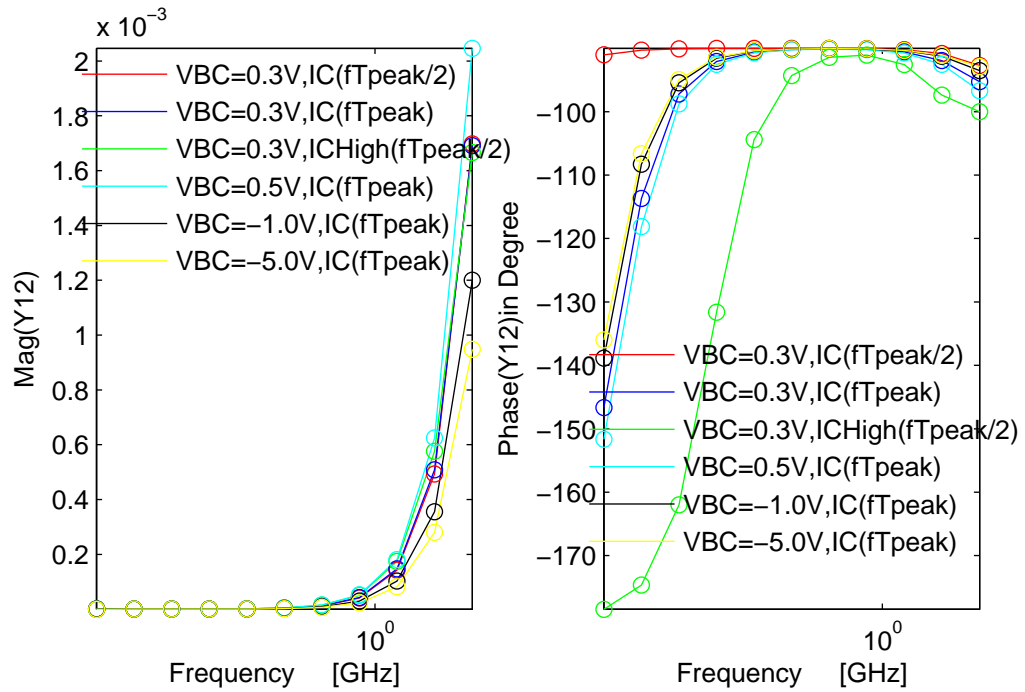


FIGURE 63. Y12 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0, -5.0V for IC(fTpeak),IC(ftpeak/2)and IChigh(fTpeak/2).

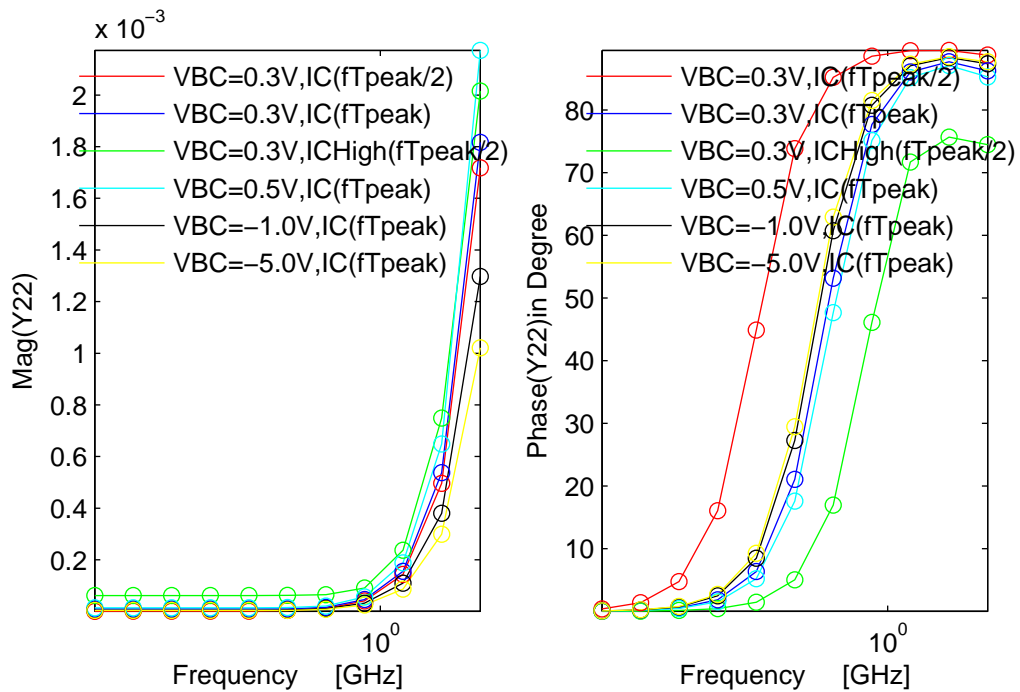


FIGURE 64. Y22 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and IChigh(fTpeak/2).

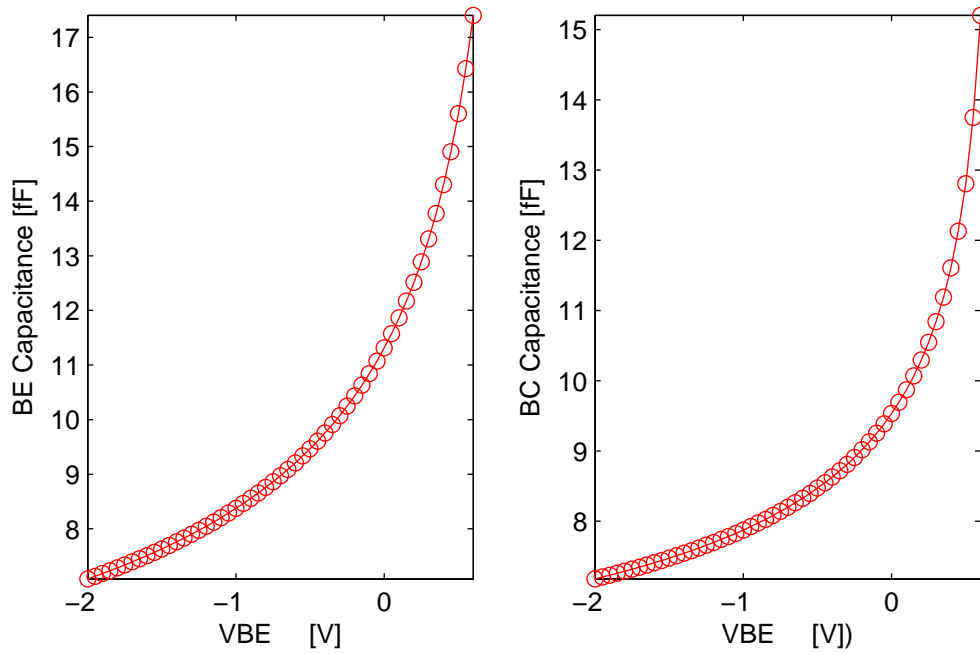


FIGURE 65. Depletion capacitances, C_{be} and C_{bc} (fF) vs BE voltages (Volt) plots at $T=300K$.

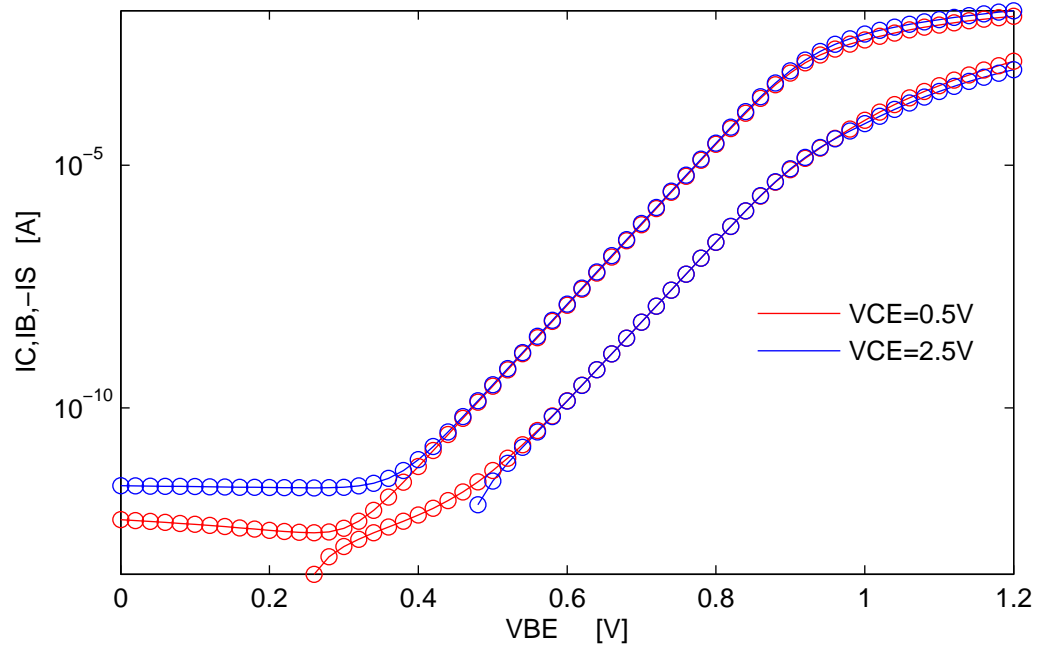


FIGURE 66. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$ with self-heating effect.

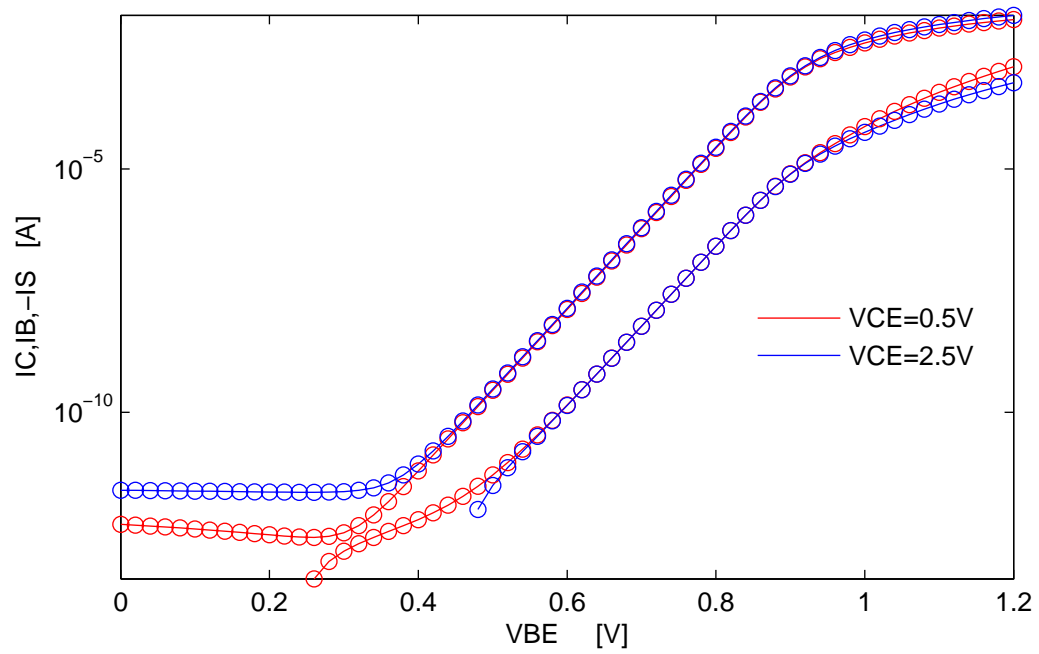


FIGURE 67. Forward Gummel plots at $V_{CE}=0.5, 2.5$ Volt and $T=300K$ with collector current spreading effect.

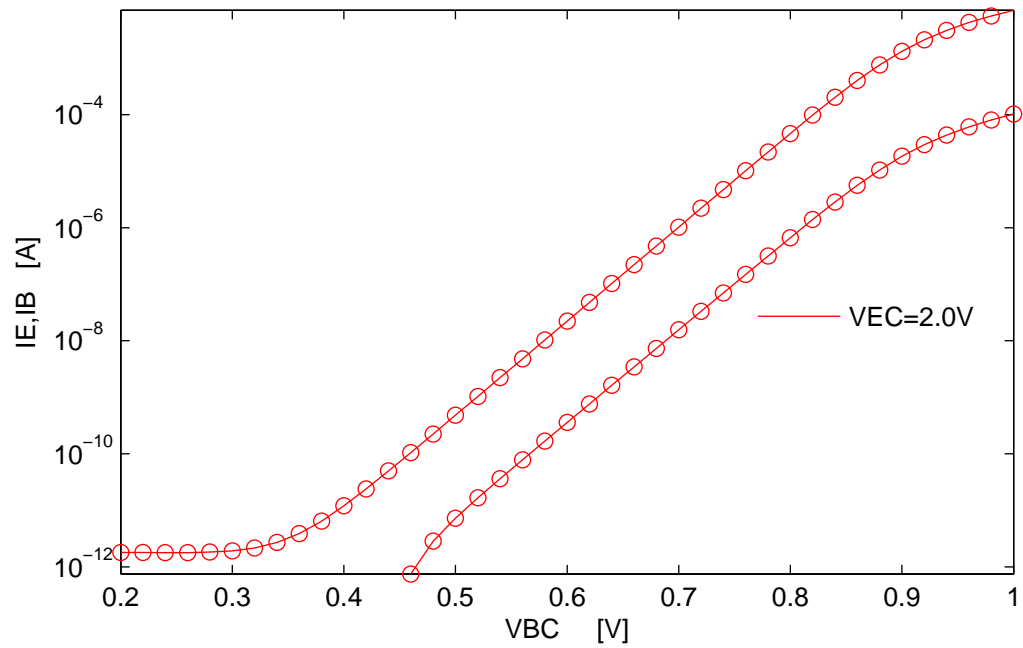


FIGURE 68. Reverse Gummel plots at $V_{EC}=2.0V$ at $T=300K$ with collector current spreading effect.

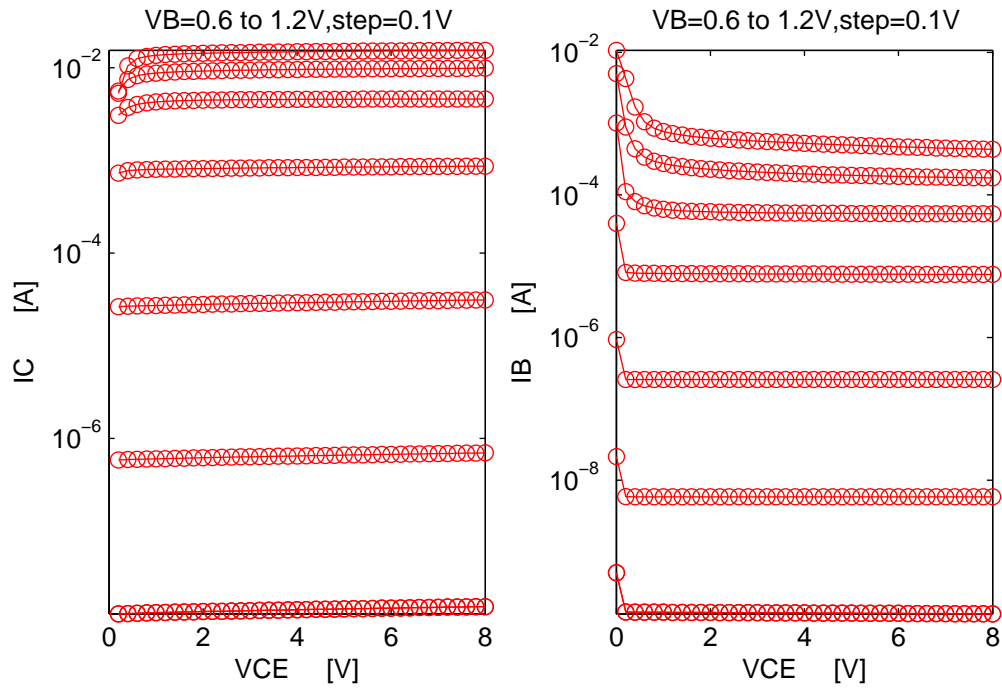


FIGURE 69. Forced-VB output characteristics and I_b -VCE plots at $T=300K$ with collector current spreading effect.

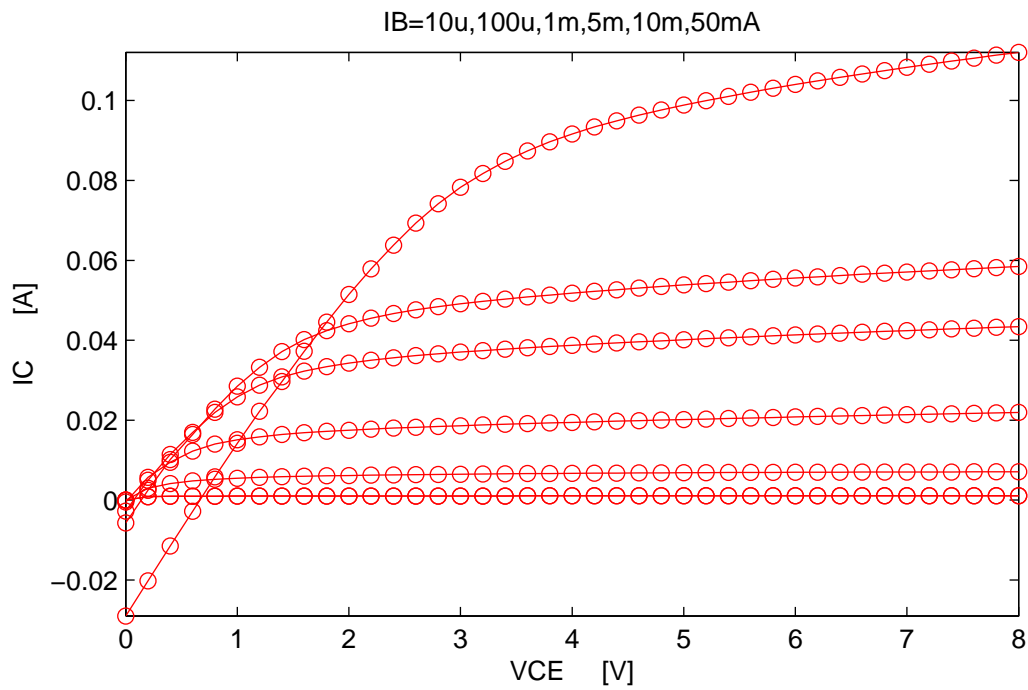


FIGURE 70. Forced-IB output characteristics at $T=300K$ with collector current spreading effect.

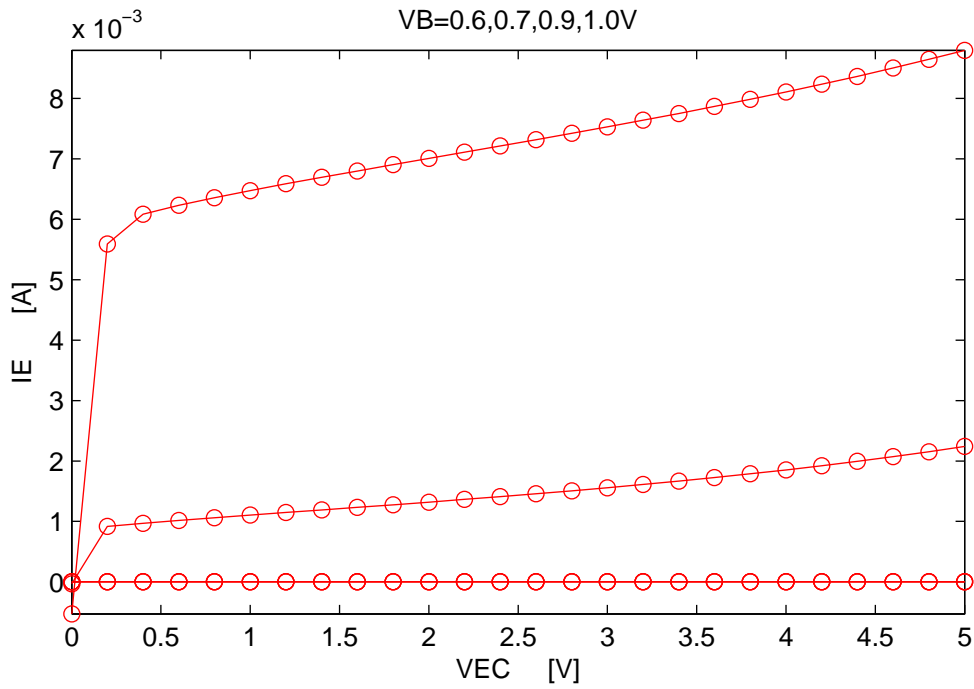


FIGURE 71. Reverse output characteristics at T=300K with collector current spreading effect.

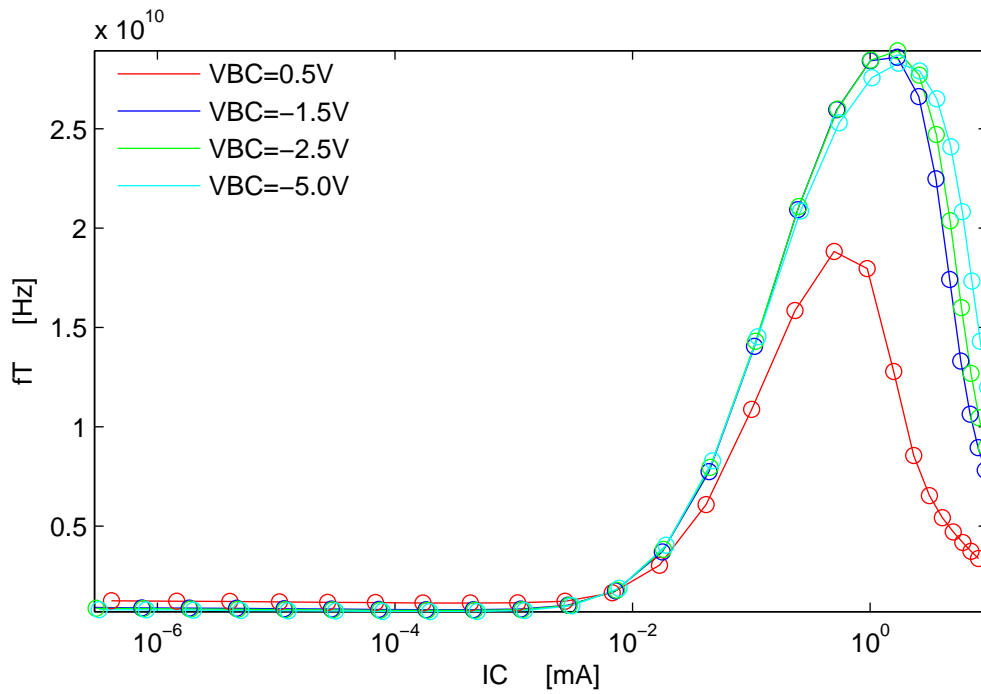


FIGURE 72. f_t (Hz) vs I_C (mA) plots at T=300K for $V_{bc}=0.5, -1.5, -2.5,$ and $-5V$, f_t extracted at $f=2.8$ GHz with collector current spreading effect.

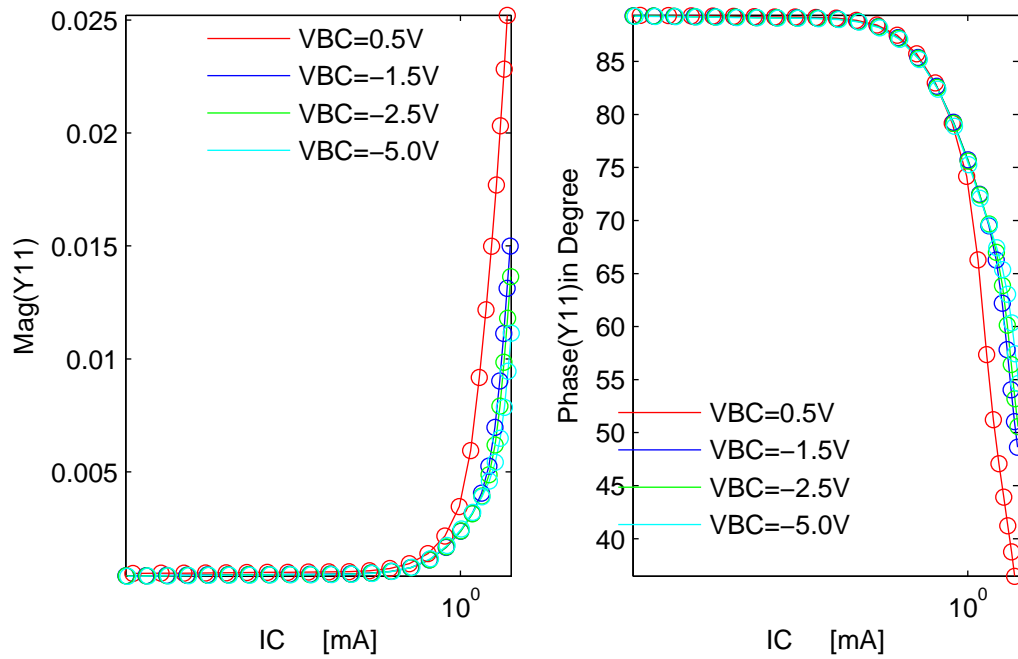


FIGURE 73. Y11 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

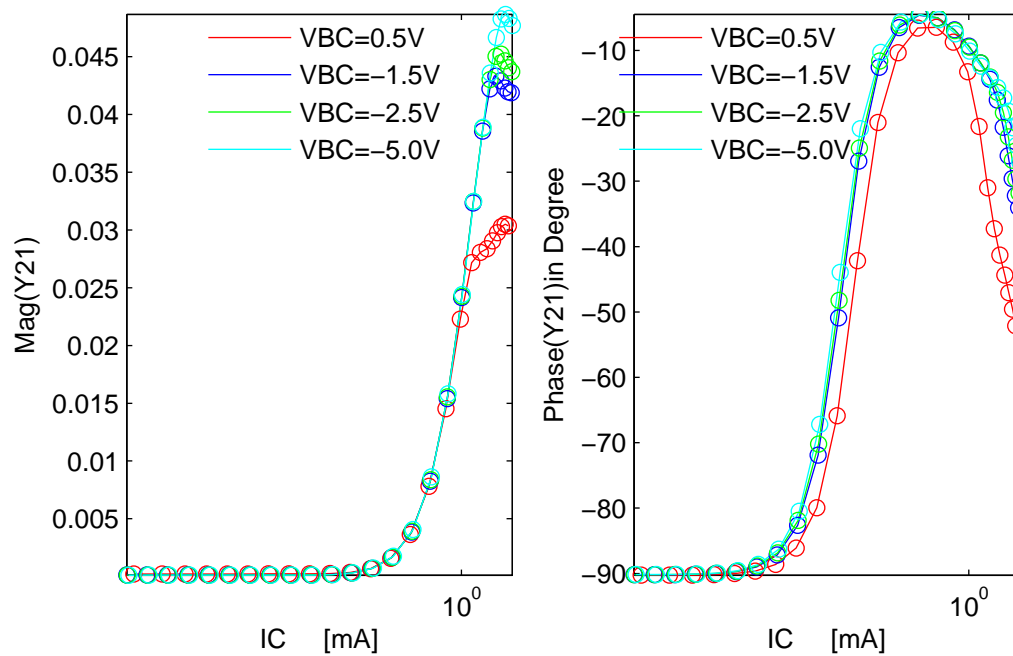


FIGURE 74. Y21 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

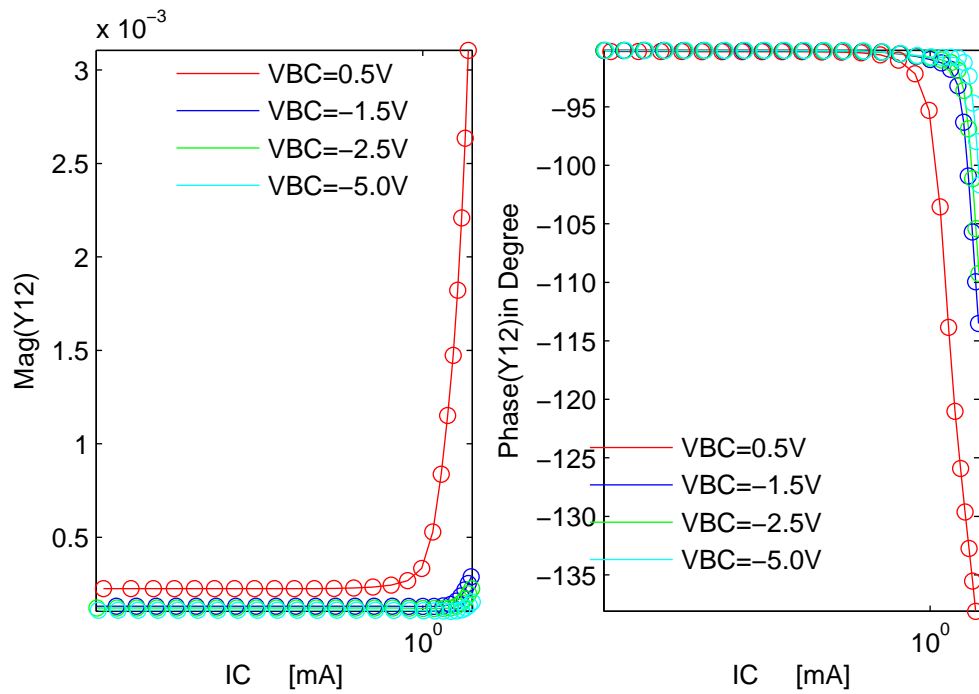


FIGURE 75. Y12 (extracted at 2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

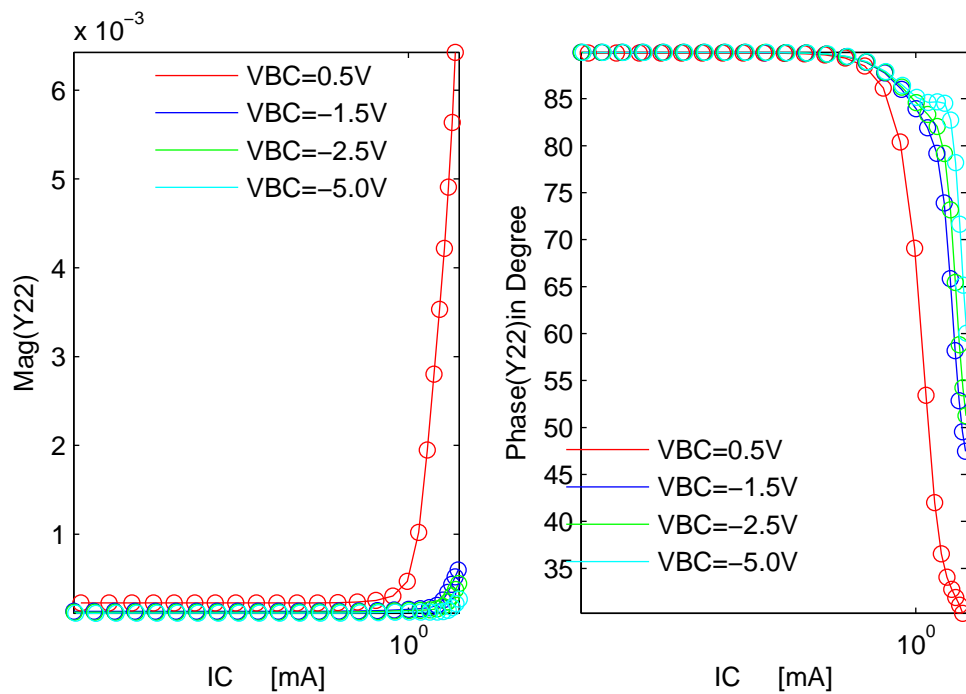


FIGURE 76. Y22 (extracted at f=2.8GHz) vs IC(mA) plots at T=300K for Vbc=0.5,-1.5,-2.5, and -5V with collector current spreading effect.

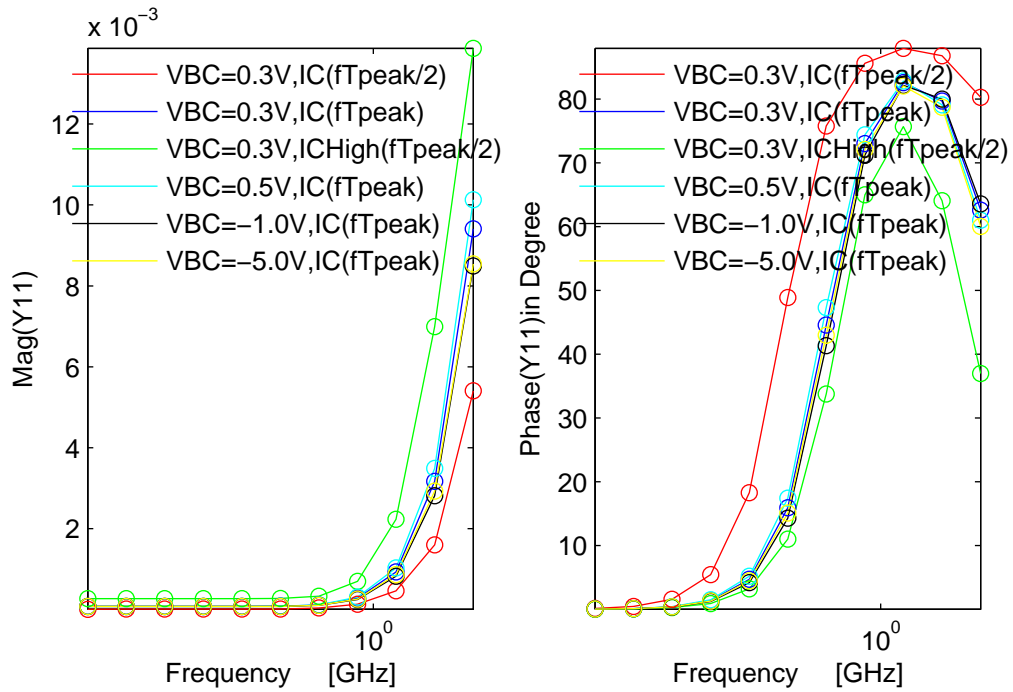


FIGURE 77. Y11 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

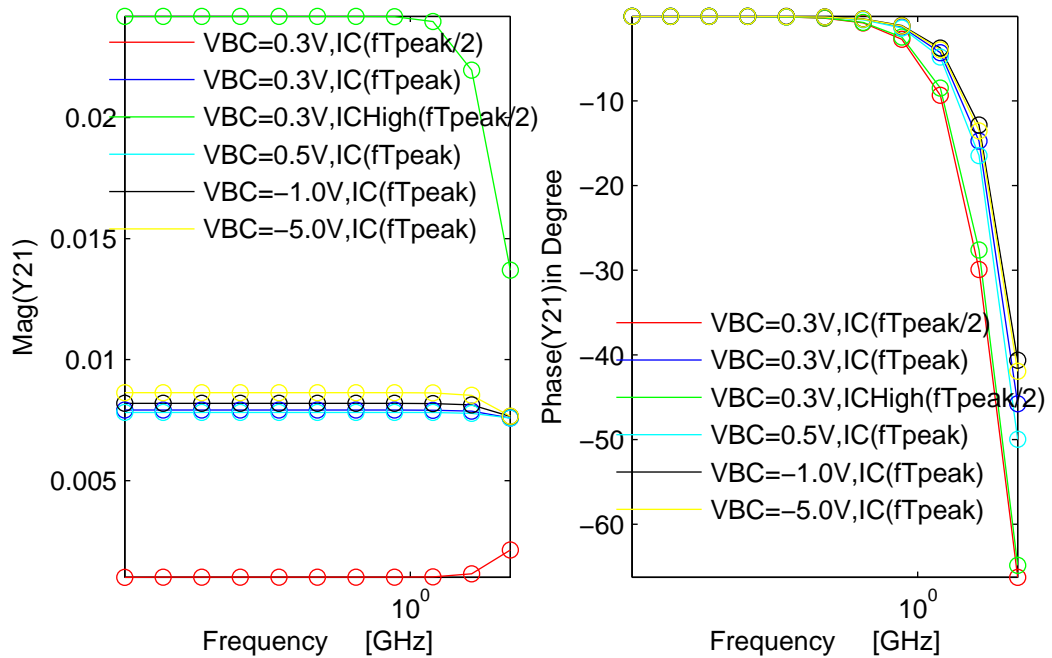


FIGURE 78. Y21 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(fTpeak),IC(ftpeak/2)and ICHigh(fTpeak/2) with collector current spreading effect.

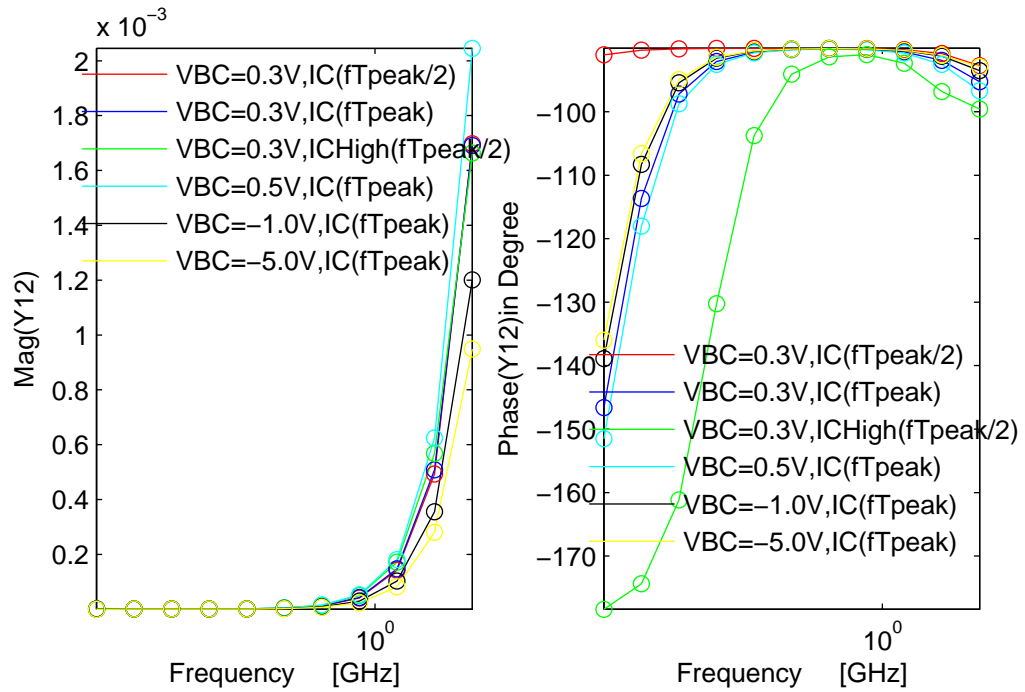


FIGURE 79. Y12 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0, -5.0V for IC(ftpeak),IC(ftpeak/2)and ICHigh(ftpeak/2) with collector current spreading effect.

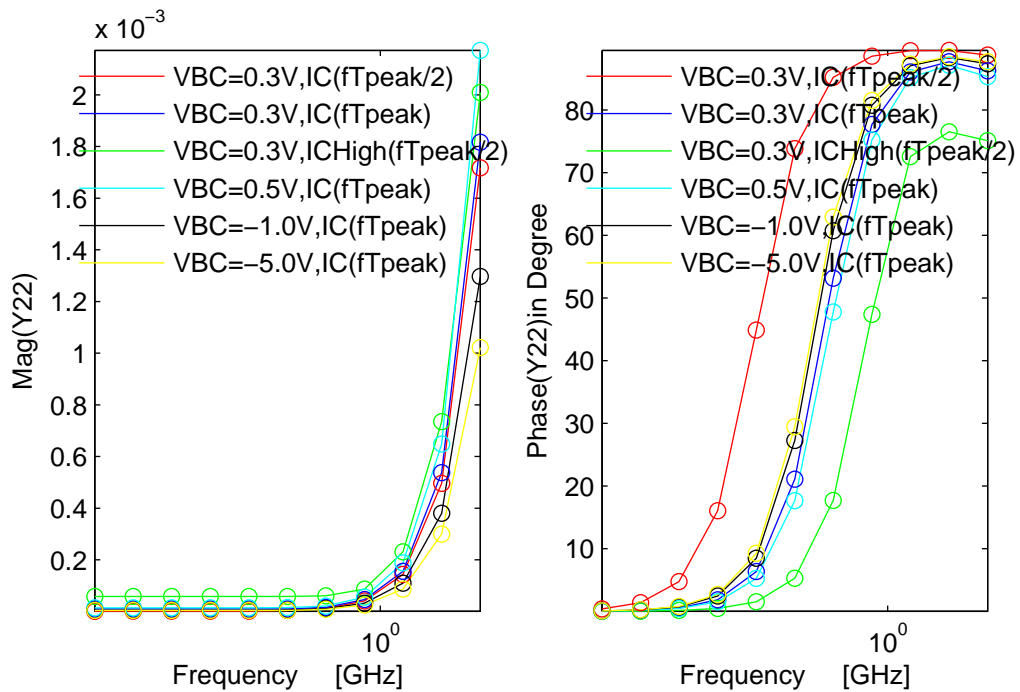


FIGURE 80. Y22 vs Frequency(GHz) plots at T=300K, Vbc=0.3, 0.5, -1.0 and -5.0V for IC(ftpeak),IC(ftpeak/2)and ICHigh(ftpeak/2) with collector current spreading effect.

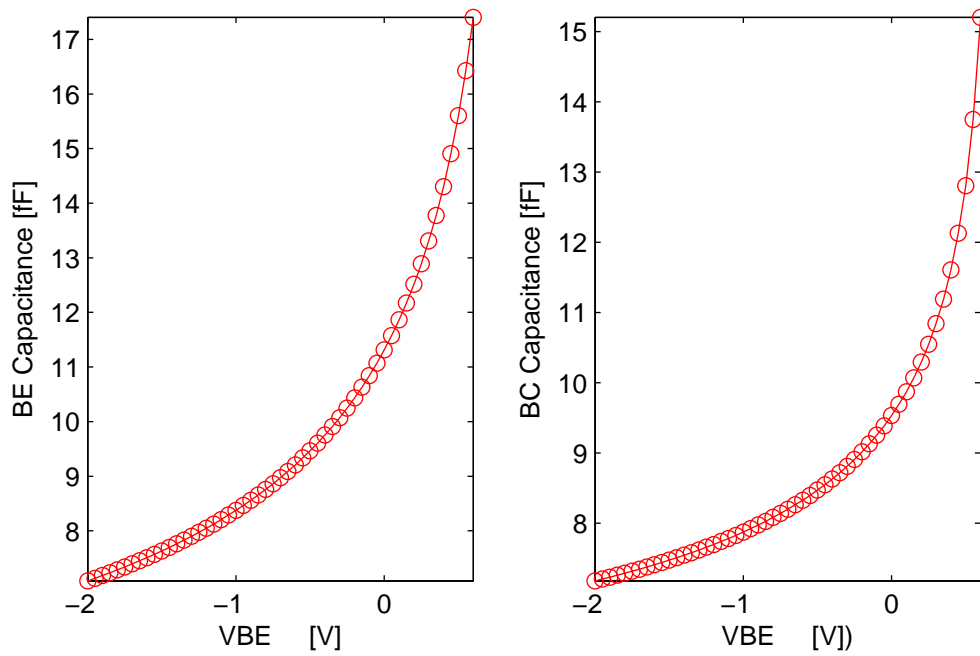


FIGURE 81. Depletion capacitances, C_{be} and C_{bc} (fF) vs BE voltages (Volt) plots at $T=300K$ with collector current spreading effect.

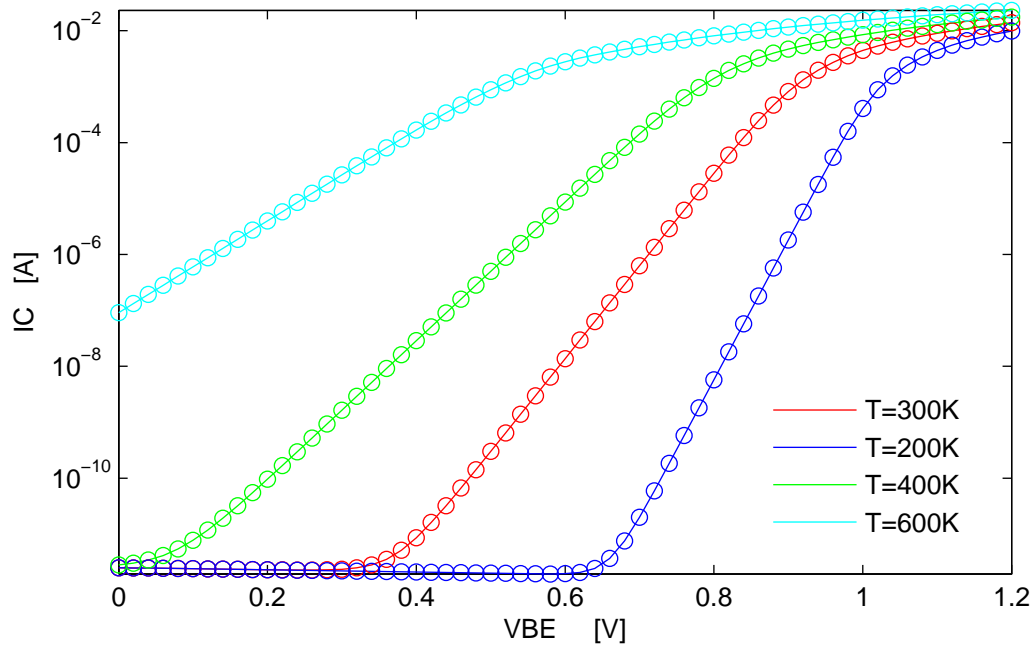


FIGURE 82. I_C vs. V_{BE} at $V_{CE}=2.5V$ and $T=200K, 300K, 400K, 600K$.

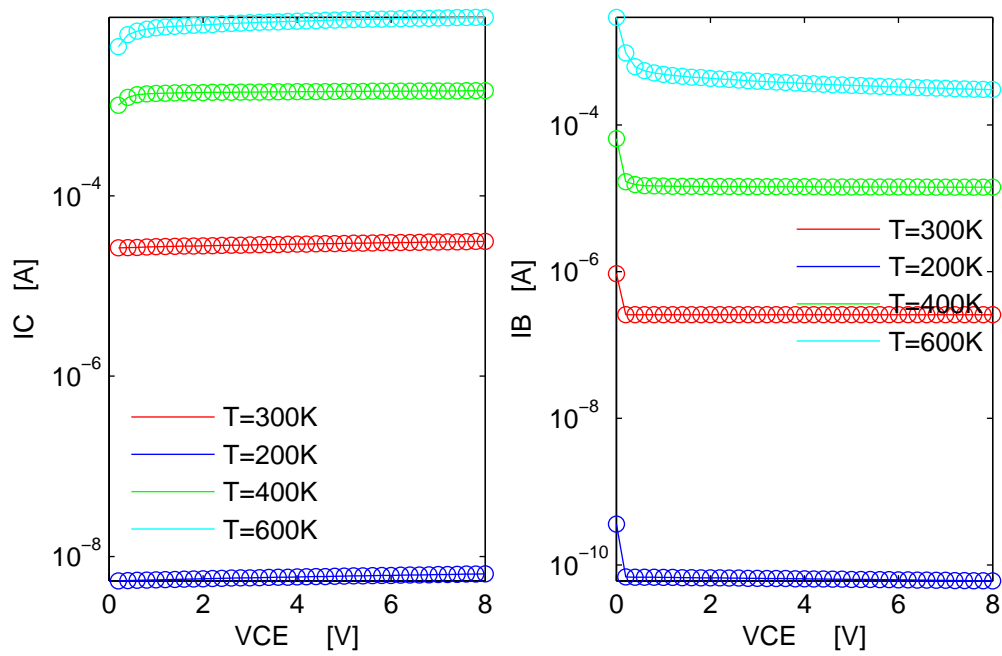


FIGURE 83. I_C and I_B vs. V_{CE} at $V_B=0.8V$ and $T=200K, 300K, 400K, 600K$.

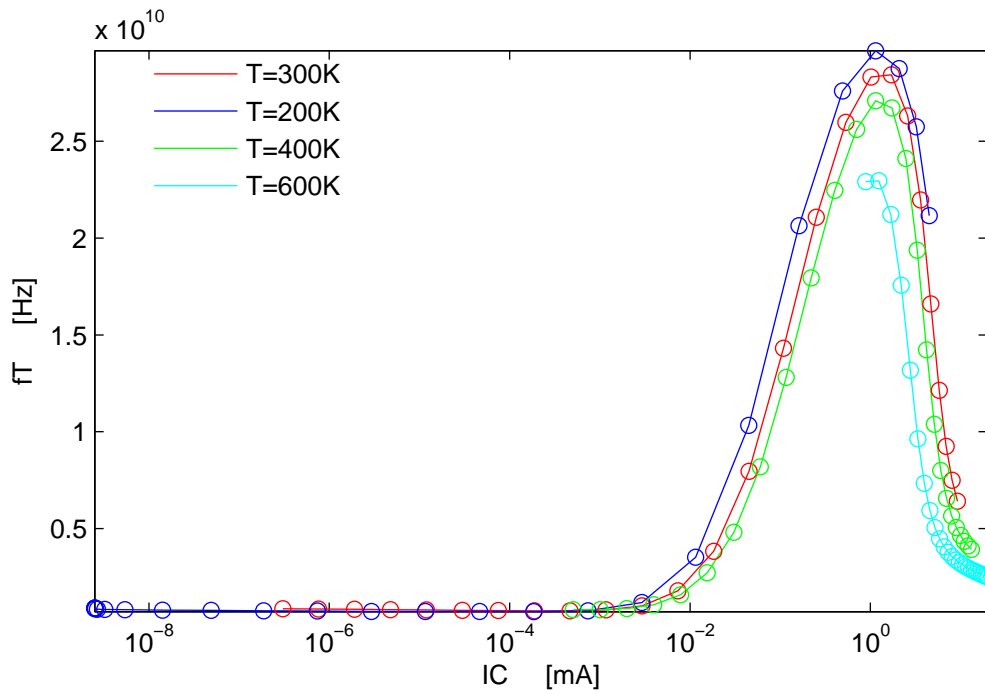


FIGURE 84. f_T (Hz) vs. I_C (mA) at $V_{BC}=-2.5V$ and $T=200K, 300K, 400K, 600K$.

Section 4: Results of Transient Simulation (NQS Effect)

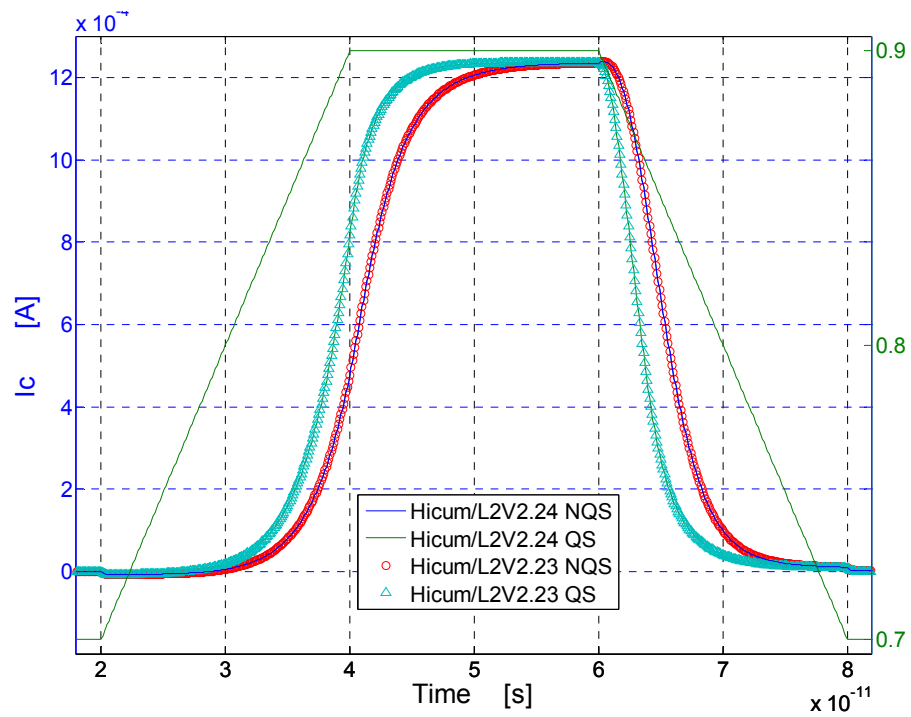


FIGURE 85. Collector current waveform for rising time of the input ramp=20ps.

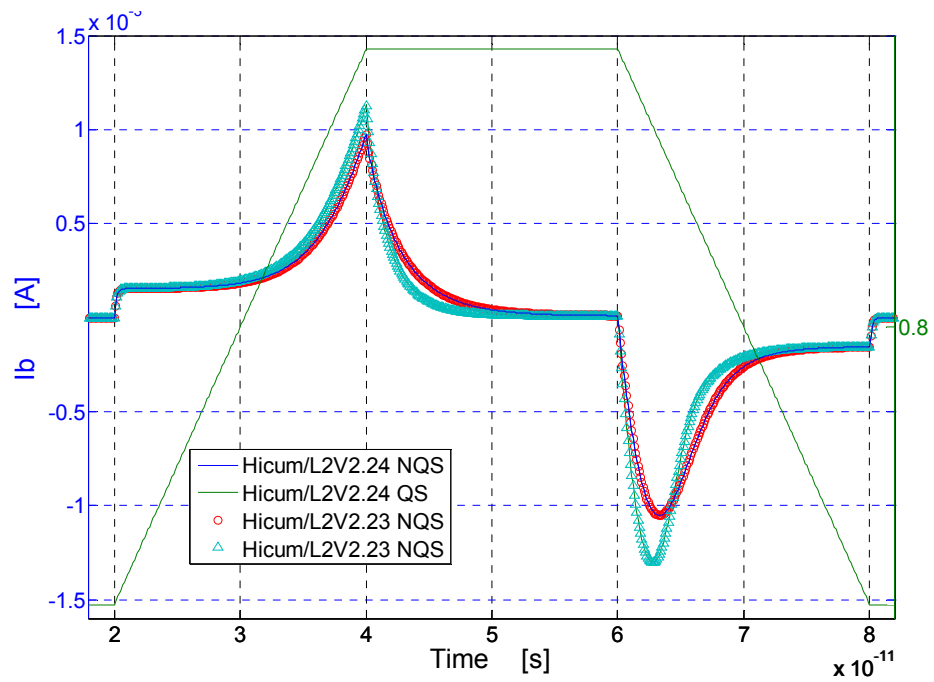


FIGURE 86. Base current waveform for rising time of the input ramp=20ps

Section 5: Results of small signal y-parameters simulation with NQS flag (FLNQS) turned on.

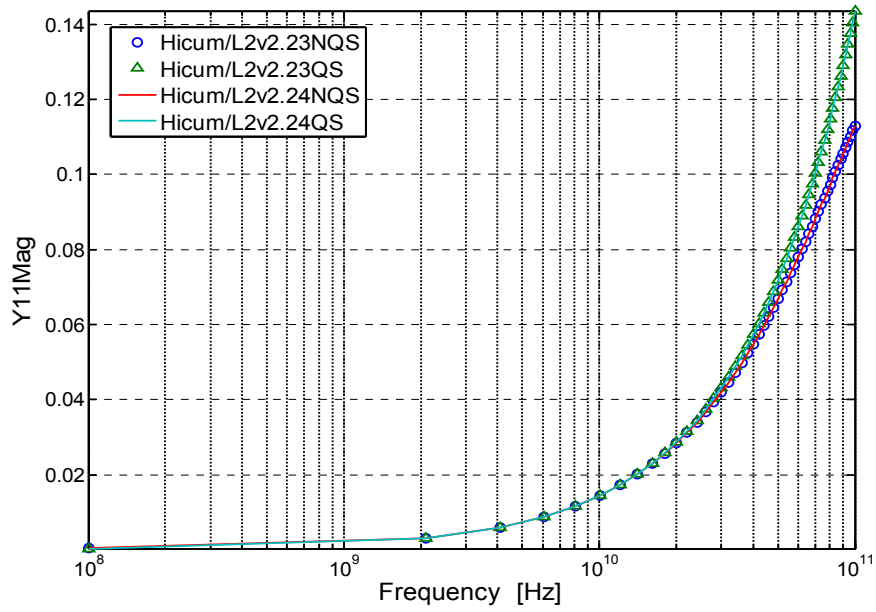


FIGURE 87. Magnitude of small signal forward y-parameter Y11

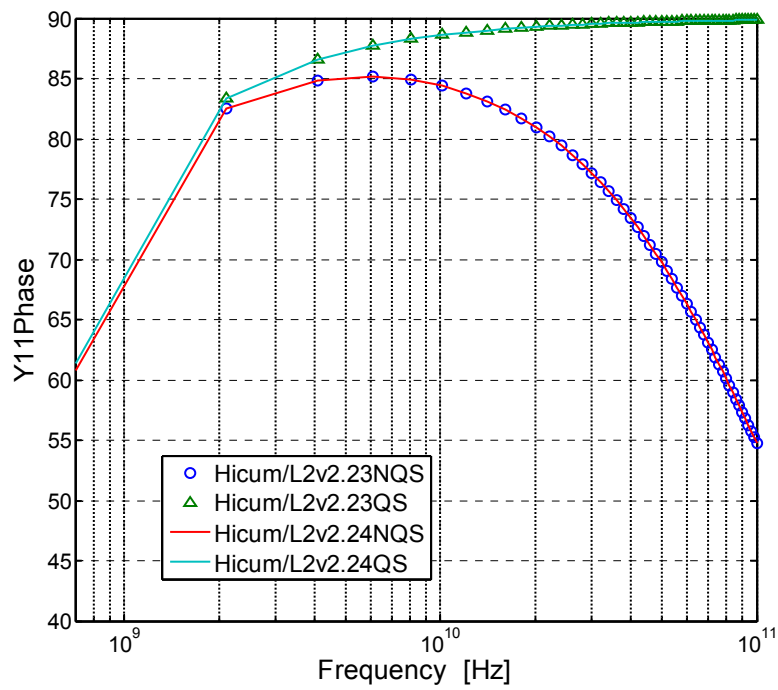


FIGURE 88. Phase of small signal forward y-parameter Y11

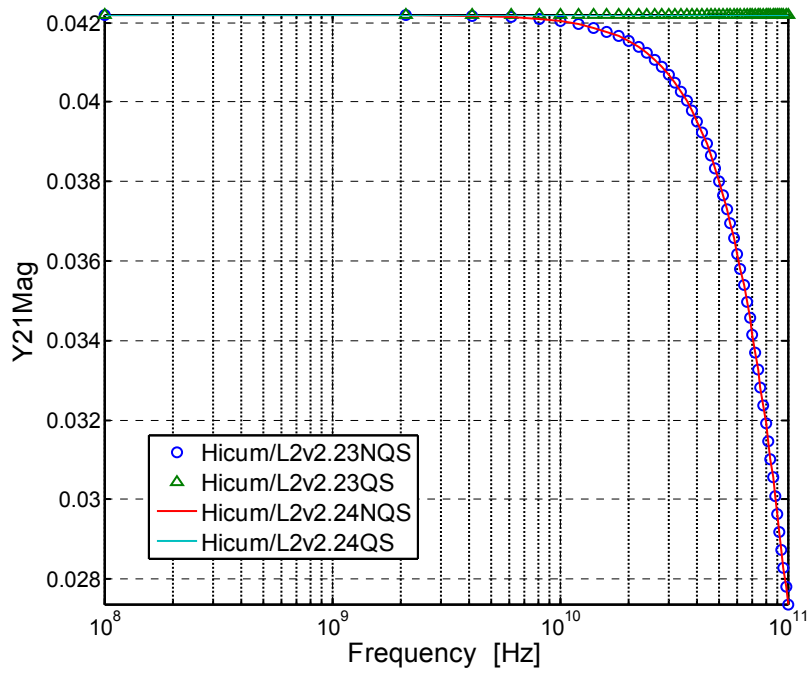


FIGURE 89. Magnitude of small signal forward y-parameter Y21

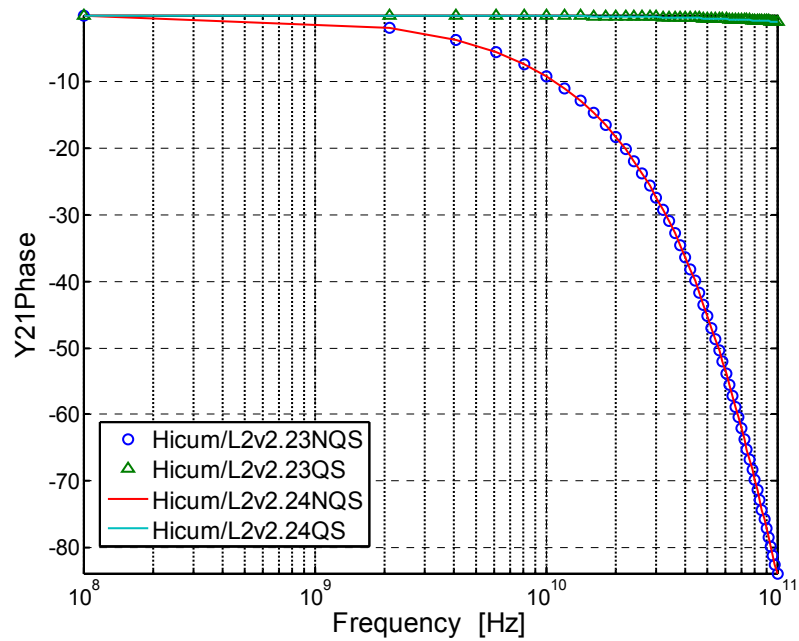


FIGURE 90. Phase of small signal forward y-parameter Y21