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# S-Parameter Measurements using HP8510: How to deal with Instrument Options and other problems

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# Outline

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- HP 8510: Maximum allowed RF Power during S-Parameter Measurements
- HP 8510 Options table: How to deal with switches
- HP 8510 Options table: Problems

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (1)

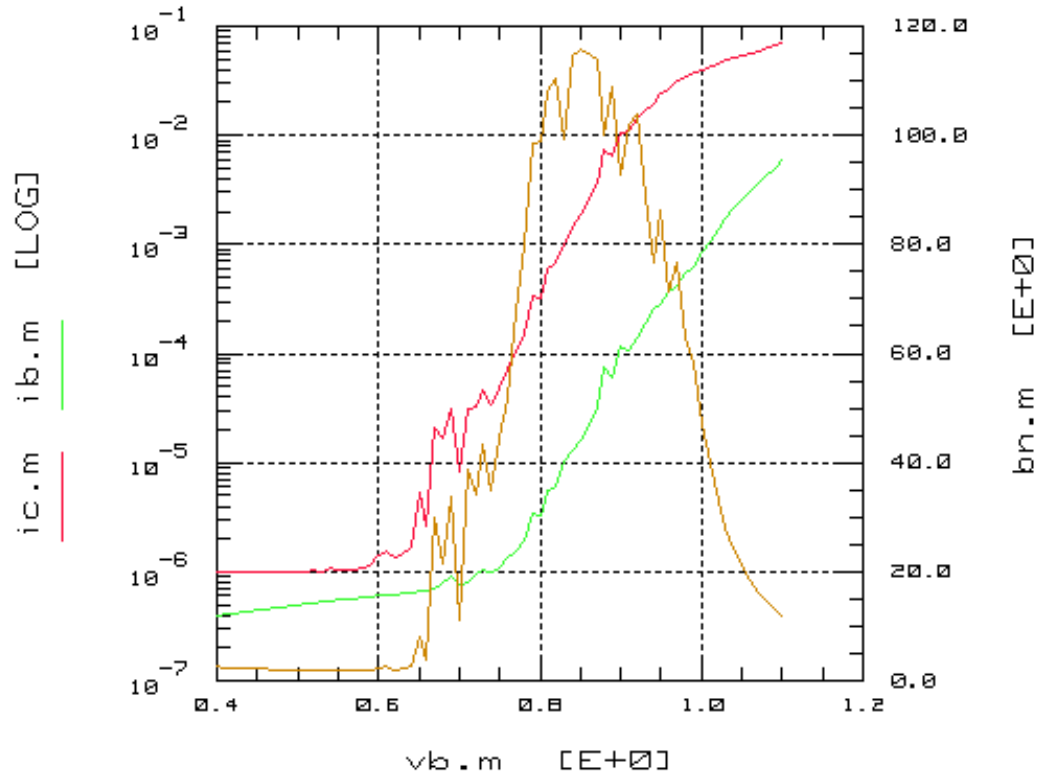
- During S-parameter measurements on active devices it is important to take care for the maximum RF power, delivered to the device in order to avoid overdrive of the DUT (cf. F.Sischka, "How to deal with S-parameters in ICCAP", 2003)
- The following pictures show Gummel plots for a b9c SiGe npn-transistor, measured thru the test set under the condition of a continuously running hp8510 power source.
- Parameters are the source power value (dBm) and the attenuation at port1 and 2 (dB):

Measurement	Source Power / dBm	Port 1 Attenuation / dB	Port 2 Attenuation / dB
1	-20	0	0
2	-20	10	10
3	-20	20	10
4	-20	20	20

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (2)

Plot: source\_power\dc\_hp8510\_n10212\_xo901804\_20\_c5\_L\fg\_3\_pm20\_att00-vgm (On)

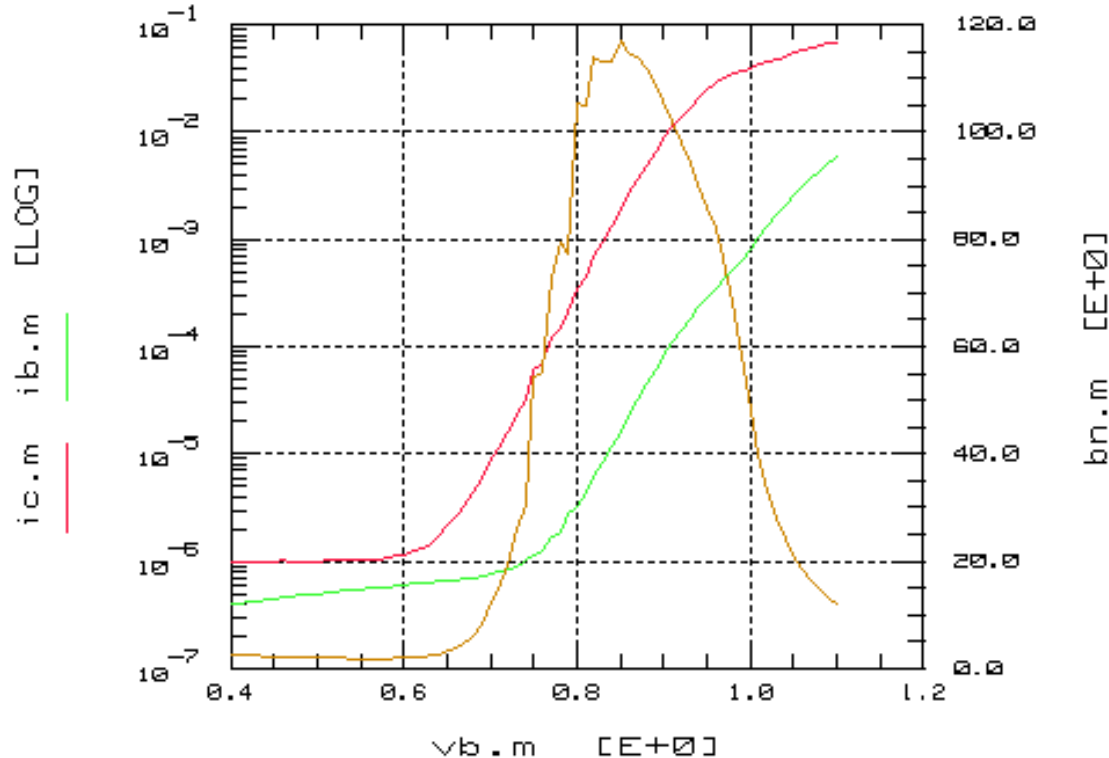


- **Case 1: Gummel Plot Forward  $I_C$  ,  $I_B = f ( V_{BE} )$  ,  $V_C = 1V$  , source power = -20dBm, Attenuation 1 = 0dB, Attenuation 2 = 0dB, overdrive for all  $V_B$**

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (3)

Plot\_source\_power/dc\_hp8510\_n10012\_x001004\_20\_03\_L/fp\_3\_0m20\_att10dB/fgm (On)

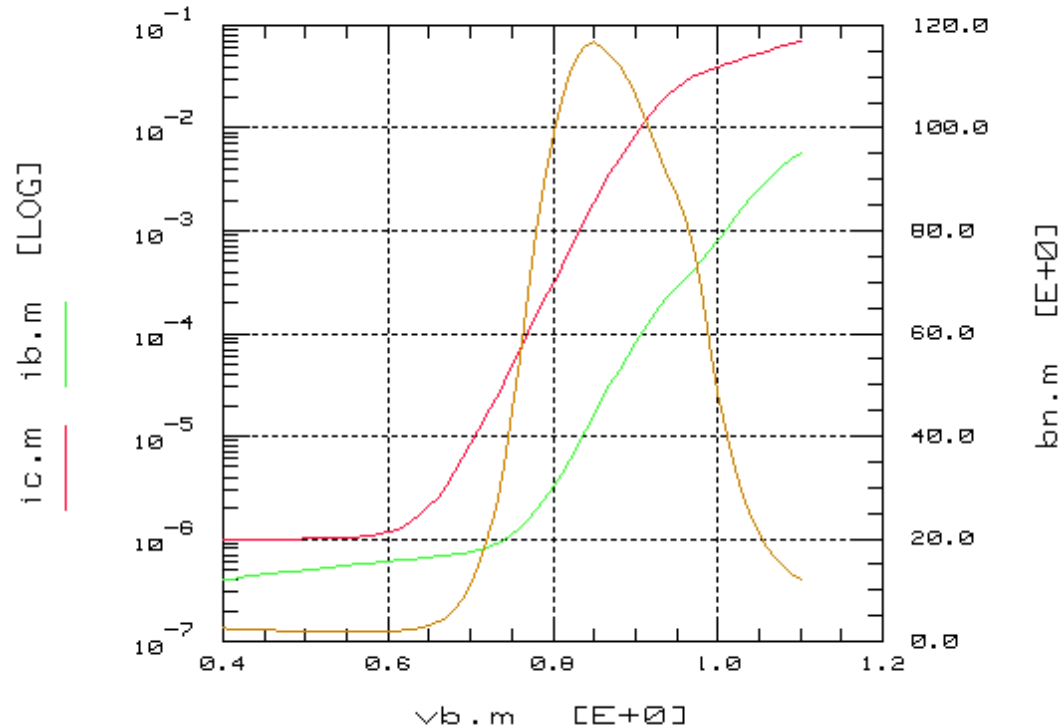


- **Case2: Gummel Plot Forward IC , IB = f ( VBE ), VC = 1V, source power = -20dBm, Attenuation 1 = 10dB, Attenuation 2 = 10dB, overdrive up to Vb=0.9V**

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (4)

Plot source\_power/do\_hp8510\_n18212\_zs301884\_20\_e5\_1/fq\_3\_pm20\_att2018/fqm (On)

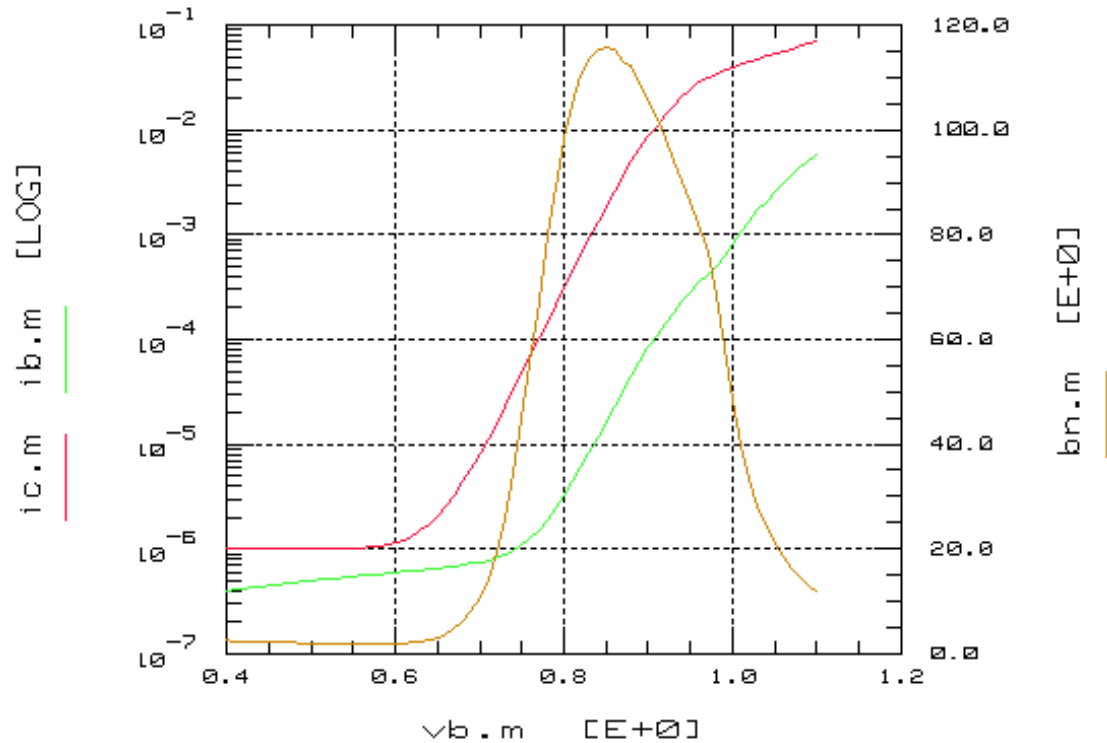


- **Case3: Gummel Plot Forward  $I_C$ ,  $I_B = f(V_{BE})$ ,  $V_C = 1V$ , source power = -20dBm, Attenuation 1 = 20dB, Attenuation 2 = 10dB, no overdrive**

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (5)

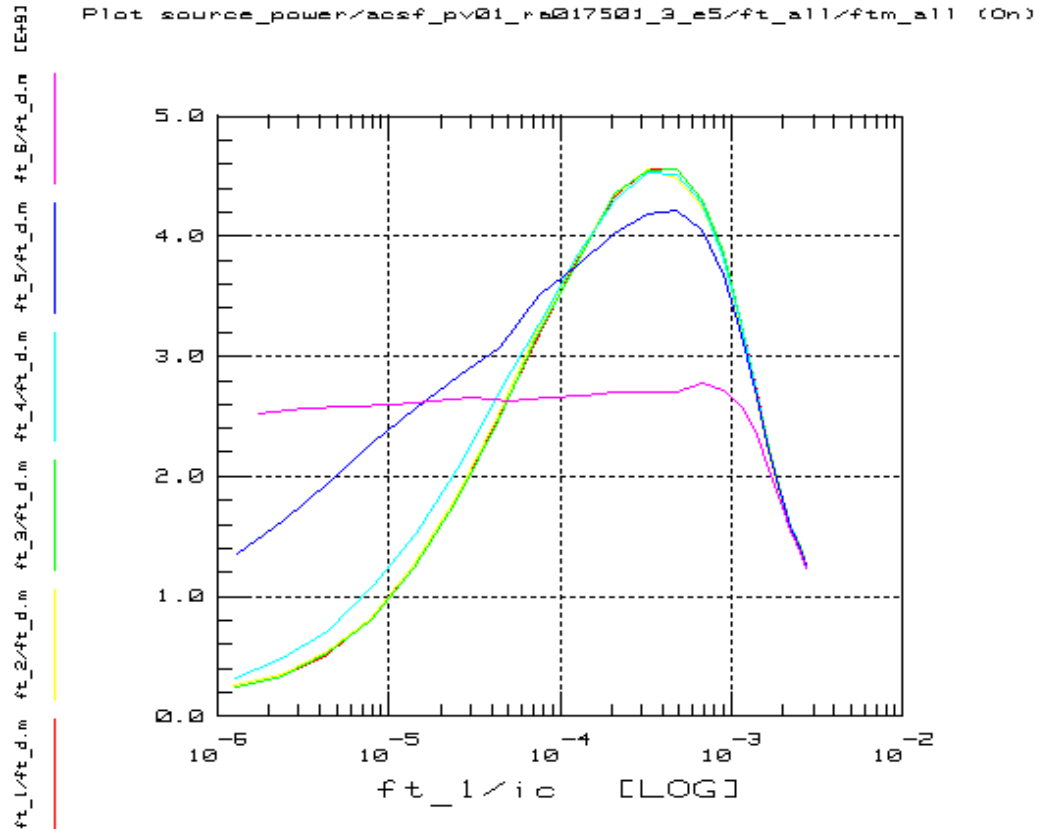
Plot source\_power/do\_hp8510\_n10212\_zs301004\_20\_05\_1/fq\_3\_pm20\_att20dB/fgm (On)



- **Case4: Gummel Plot Forward IC , IB = f ( VBE ), VC = 1V, source power = -20dBm, Attenuation 1 = 20dB, Attenuation 2 = 20dB, no overdrive**

# HP8510

## Max. allowed RF Power for S-Parameter Measurements (6)



- Ft vs. Ic: Source power 1 = 0 (violett) , -10, -20, -30, -40 -50 (rot) dBm, Source power 2 = -30 dBm

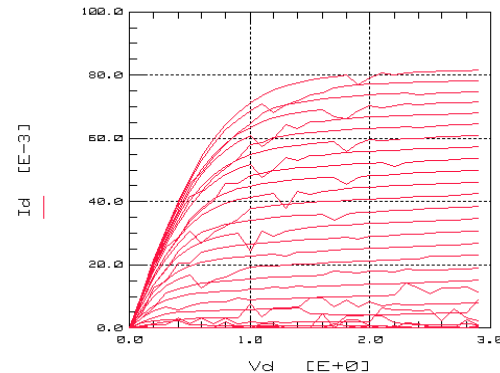


# HP8510

## DC Measurements affected by RF power

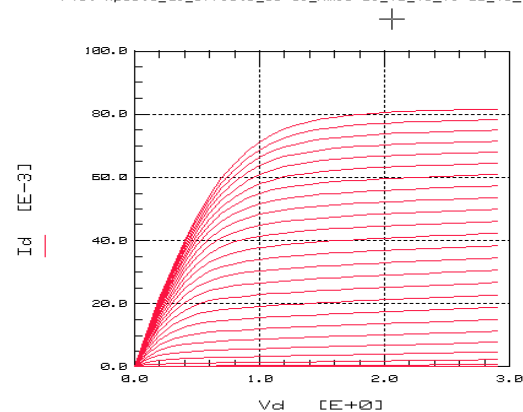
- Sometimes DC measurements are affected unintentionally by RF power, despite the setup is only a simple DC setup
- In the presented case RF power was delivered unintentionally to an nmos device during a pure DC setup measurement, directly after a complete restart of the HP8510 NWA
- The effect vanishes, if an S-parameter measurement with at least one point is done, because the HP8510 test set RF switches activated then once

Plot hp8510\_ac\_effects\_dc/dc\_nmos/dc\_id\_vs\_vd\_with\_ac/Id\_vs\_Vd (On)



DC measurement after NWA restart affected by RF power

Plot hp8510\_ac\_effects\_dc/dc\_nmos/dc\_id\_vs\_vd/Id\_vs\_Vd (On)



DC meas. without RF power, after the first S-parameter measurement

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- HP 8510: Maximum allowed RF Power during S-Parameter Measurements
- HP 8510 Options table: How to deal with switches
- HP 8510 Options table: Problems

# HP 8510 Options

## How to deal with switches (1)

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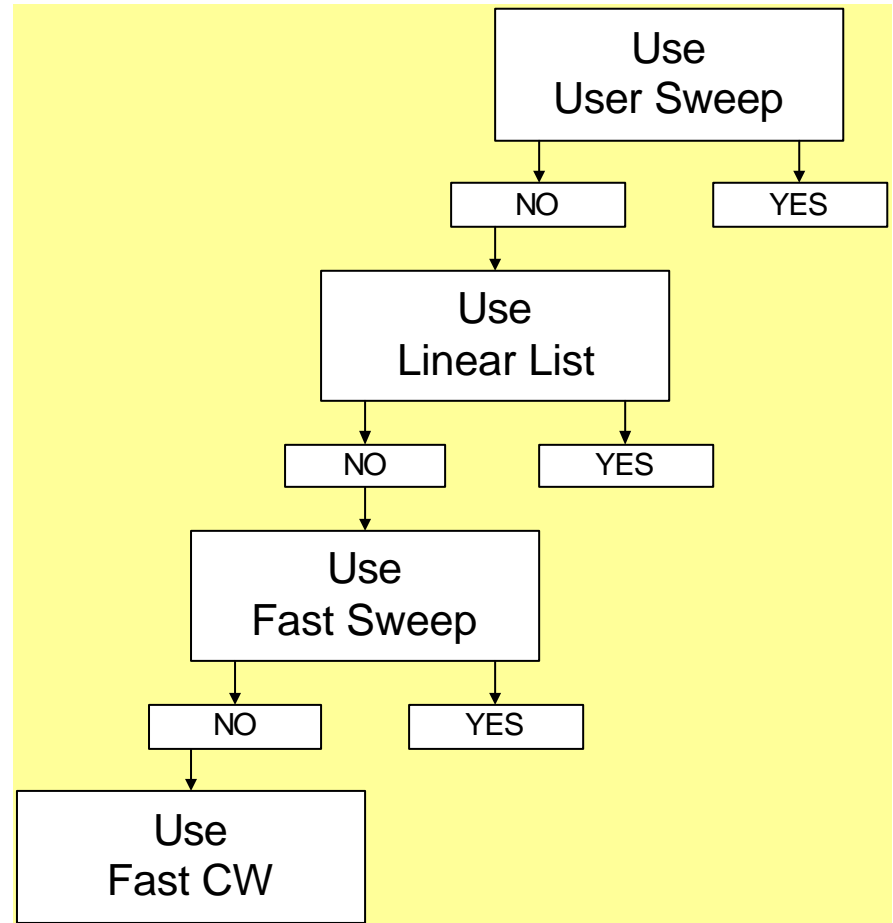
- The HP 8510 options table is not clear explained in the ICCAP documentation
- This section shows reasonable settings for single and multi frequency measurements
- There are four switches available, affecting the frequency sweep performed by the HP8510:

1. Use User Sweep
2. Use Linear List
3. Use Fast Sweep
4. Use Fast CW

# HP 8510 Options

## How to deal with switches (2)

- It is important to know, that there is a hierarchy behind these options [1]
- Use User sweep = YES means, e.g., the setting of the other switches is irrelevant



[1] Krempely, D. :“Switch Options for HP8510 Network Analyzer Frequency Sweeps“, HP EEsof Support News, sup99212.txt, 1999

# HP 8510 Options

## How to use "Cal Type" and "Use User Sweep"

### ■ For single frequency measurements:

	Use User Sweep = No	Use User Sweep = Yes
Cal Type = H	Not possible	ok
Cal Type = S	Not possible	ok

### ■ For multi frequency measurements:

	Use User Sweep = No	Use User Sweep = Yes
Cal Type = H	ok	Not possible
Cal Type = S	Not recommended (allowed by ICCAP, however, no data delivered from NWA to ICCAP)	ok

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# HP 8510 Options Problems (1)

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- Sometimes the instrument table options settings are not transferred from ICCAP to the NWA correctly
- Example:
  1. Attenuation was changed in ICCAP from att1=20, att2=10 to att1=20, **att2=20**.
  2. Then, the transfer from ICCAP to the NWA was started using the CALIBRATE button
  3. Using the buttons/menus LOCAL, STIMULUS MENU, POWER MENU at the NWA the attenuation values received by the NWA may be checked now
  4. However, one may find the old values there
- Unfortunately, this behavior is not reproducible

# HP 8510 Options Problems (2)

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- Situation: the stimulus data transfer from ICCAP to NWA using the CALIBRATE button is done and the calibration using SOLT standards is done. We are going to re-measure the standards now, but the following message appears:

**CAUTION: CORRECTION RESET**

- However, at this point all settings in the setup and the NWA must be identical. What's the reason for the message ?
- Only work around is to make a REBUILD ACTIVE LIST