YSG 3001 - 3011 0.1-1.1 GHz cryogenic low noise amplifier report

Yebes IT-CDT-2021-10

Authors: Isaac López-Fernández, Carmen Diez, Ricardo Amils, Juan Daniel Gallego, Inmaculada Malo

Observatorio de Yebes
Apartado 148
19080 Guadalajara
SPAIN

Date: 2021-08-17

Revision: B

CHANGE RECORD

Date/version	Affected Section(s)	Change / Reason / Remark
A	All	First Issue
B	I.3, II	15 K noise plots and data included
B	II	Typo in ambient temperature value corrected
B	II	Corrected mistake in K factor data

INDEX OF DOCUMENTS

YSG 3 AMPLIFIER REPORT

1. Introduction

YSG series 3 are 0.1 – 1.1 GHz low noise cryogenic amplifiers designed and built at the *Observatorio de Yebes* for the Purple Mountain Observatory SIS receivers. They are based on the wider band design YSG 0.

This document includes a description of the amplifier and how to operate it, details about the tests performed, the measurements techniques utilized and datasheets and plots with the relevant data collected.

Figure 1: External view of a YSG 3 LNA. Dimensions excluding, connectors are 24×23×8.6 mm (X×Y×Z in the picture)

2. Description and operating procedures of the amplifier

2.1 Dimensions and mechanical interfaces

Figure 1 shows an outside view of an amplifier. The external dimensions and mechanical interfaces of the amplifier are shown in figure 2.

The amplifier chassis is made of gold plated aluminum. Four M2 threaded holes, which can be seen on the bottom side of the LNA chassis in figure 2, could be used for thermal anchoring. Take into account that the available thread length is 4.5 mm.

2.2 Electrical interfaces

- **Input port** is a male SMA connector.
- **Output port** is a female SMA connector.
- **DC bias connector** is a 5 pin Nano-D socket connector complying with standard MIL-DTL-32139. Commercial part number is Glenair 890-013-5SA2-BRST. The mating plug connector could be Glenair 890-001-5PA2-0B7-12J.

2.3 Bias and ESD

This unit has two stages of SiGe HBT transistors sensitive to ESD. Appropriate cautions must be taken during the manipulation and operation of the unit. The amplifier incorporates internal protection elements (diodes, resistors and capacitors) in the bias circuitry.

To bias the amplifier, a single voltage has to be supplied between the pins labeled ‘VCC’ and ‘GND’ in Figure 2. The common ground ‘GND’ pin is connected to the chassis of the LNA. Never exceed the maximum values indicated in the table below.

Two cryogenic bias settings have been selected for each unit and are indicated in the corresponding data sheet. The end-user should evaluate the optimum bias depending on the trade-off between power dissipation, gain flatness and in some cases, noise and reflection that best complies with its application. The data sheet reflects also the typical current consumption of the amplifier. A significant deviation from this value could indicate a malfunction of the unit.

MAXIMUM RATINGS	
VCC	4.0 V
IC	50 mA
Power dissipation	200 mW
RF Input level	0 dBm

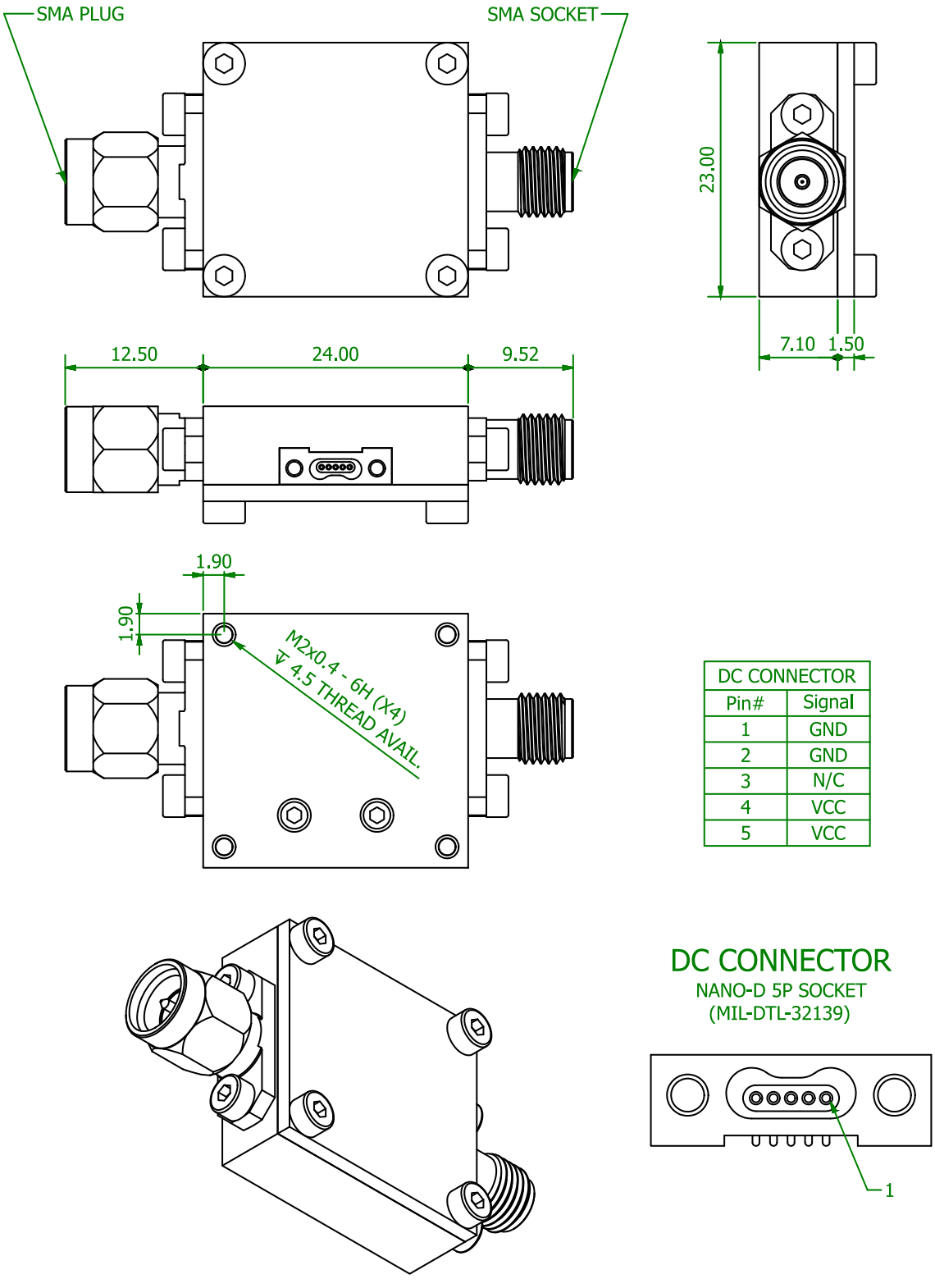


Figure 2: *YSG 3 mechanical and electrical interface, external dimensions and DC connector pinout.*

3. Measurements

Noise temperature was measured with a system based on a computer controlled PNA-X N5247A Vector network analyzer [1], [2] (10 MHz-67 GHz) with option 029 (Source-Corrected Noise Figure Measurements) (Keysight). The receiver noise temperature was measured with a noise source HP 346C. The DUT is cooled in a Dewar with Sumitomo RDK 415D cold head capable of cooling down to 4 K. The temperature of the DUT is stabilized by a PID loop. Cryogenic measurements were taken with the "variable temperature load" method, using an in-house matched load [3]. An absolute accuracy (@ 2 σ) of 0.7 K at T_{amb}=14 K can be estimated with methods presented in [4]. Repeatability is significantly better than these values.

S parameters were measured in another Dewar equipped with a CTI 1020 refrigerator (capable of cooling down to 12 K) with an Agilent E8364B Vector Network Analyzer from 0.1 to 20.1 GHz. A detailed description of the measurement procedure used at cryogenic temperature can be found in [2]. The amplifier output is connected to one of the stainless steel Dewar transitions and its input to the other through a semi-flexible Cu cable. A full two port calibration is done at room temperature with the electronic calibration kit Agilent N4693-60001 inside the Dewar in place of the amplifier, with the same semi-flexible cable. The stainless steel lines are supposed to be invariant with temperature. The Cu cable is measured at cryogenic temperature independently and its loss is taken into account to correct S11 and S21. Time domain gating is used to correct for the residual reflection changes in the lines.

Additional measurements to ensure the absence of oscillations were performed at room and cryogenic temperatures.

The amplifier reports which follows this page contains:

1) Datasheet:
   Amplifier identification, nominal biases and a summary of the measurements performed at room and cryogenic temperature.
2) Noise and gain plots: Noise temperature and available gain at room temperature. Noise temperature and available gain at 8 K (two bias settings) and 15 K. Gain curves are taken with the Vector Network Analyzer.
3) Return loss plots: |S11| and |S22| at room and cryogenic temperature (two bias settings)

References

[1] J.D. Gallego, R. Amils, C. Diez, I. López-Fernández, I. Malo "Using Keysight PNA-X and NFA Noise Receivers for Noise Temperature Measurements with Cryogenic Variable Temperature Loads," CDT Technical Report 2019-17, available at https://icts-yebes.oan.es/reports/doc/IT-CDT-2019-17.pdf

[2] J.D. Gallego, C. Diez, I. López-Fernández, I. Malo, "Development and Prototyping of a Cryogenic IF Low Noise Amplifier: Definition of the Measurement Procedures", CDT Technical Report 2020-6.

[3] Daniel Bruch, RI Amils, JD Gallego, M Seelmann-Eggebert, B Aja, F Schafer, C Diez, A Leuther, M Schlechtweg, O Ambacher, I Kallfass, "A Noise Source Module for In-Situ Noise Figure Measurements From DC to 50 GHz at Cryogenic Temperatures," in IEEE Microwave and Wireless Components Letters, vol. 22, no. 12, pp. 657-659, Dec. 2012.

[4] J. D. Gallego, J. L. Cano, "Estimation of Uncertainty in Noise Measurements Using Monte Carlo Analysis", 1st Radionet Engineering Forum Workshop, 23-24/06/2009, Gothenburg. http://www.radioneteu.org/fp7wiki/lib/exe/fetch.php?media=na:engineering:ew:gallego_final.pdf

OBSERVATORIO DE YEBES

CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3003

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.6	**12.2**
Bias #2				**1.8**	10.2	**18.4**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	49.4	5.5	5.0	5.3
	min. - max.	44.9 - 56.9	5.3 - 5.6	4.9 - 5.1	5.1 - 5.6
Gain	**average**	40.8	44.9	46.8	46.8
	flatness	3.2	1.9	2.2	2.2

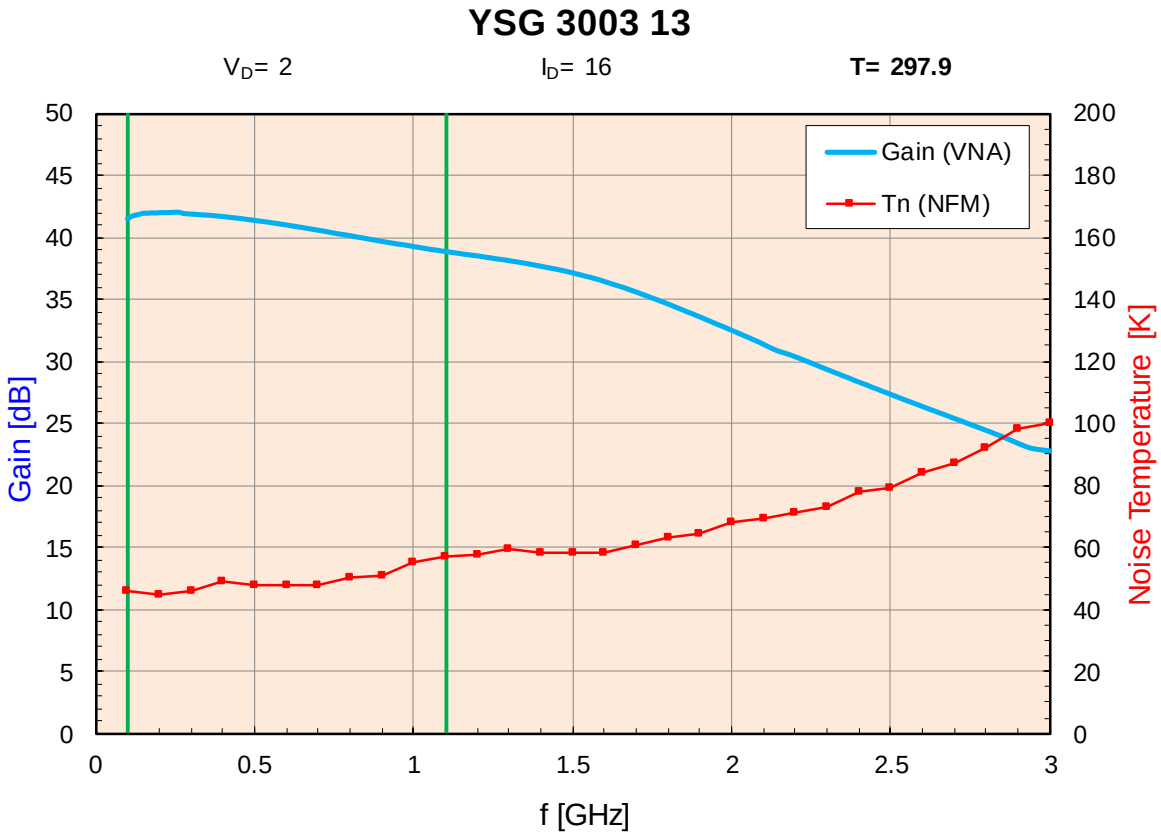
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-11.1	-14.9	-15.5	-15.5
	max. (95%)	-14.2	-15.6	-15.6	-15.6
ORL	**max.**	-16.7	-17.8	-15.6	-15.6
	max. (95%)	-19.6	-18.2	-17.9	-17.9

Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	1.8	1.2	1.2

Remarks:

- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz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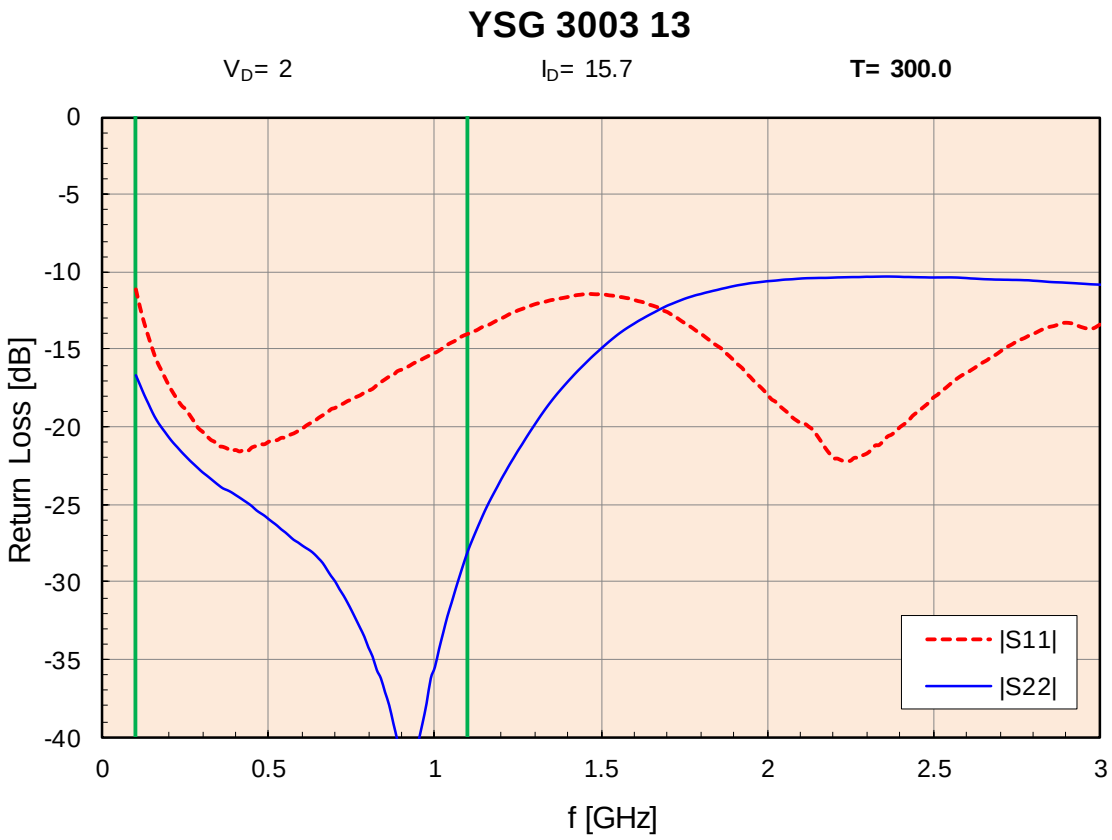
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]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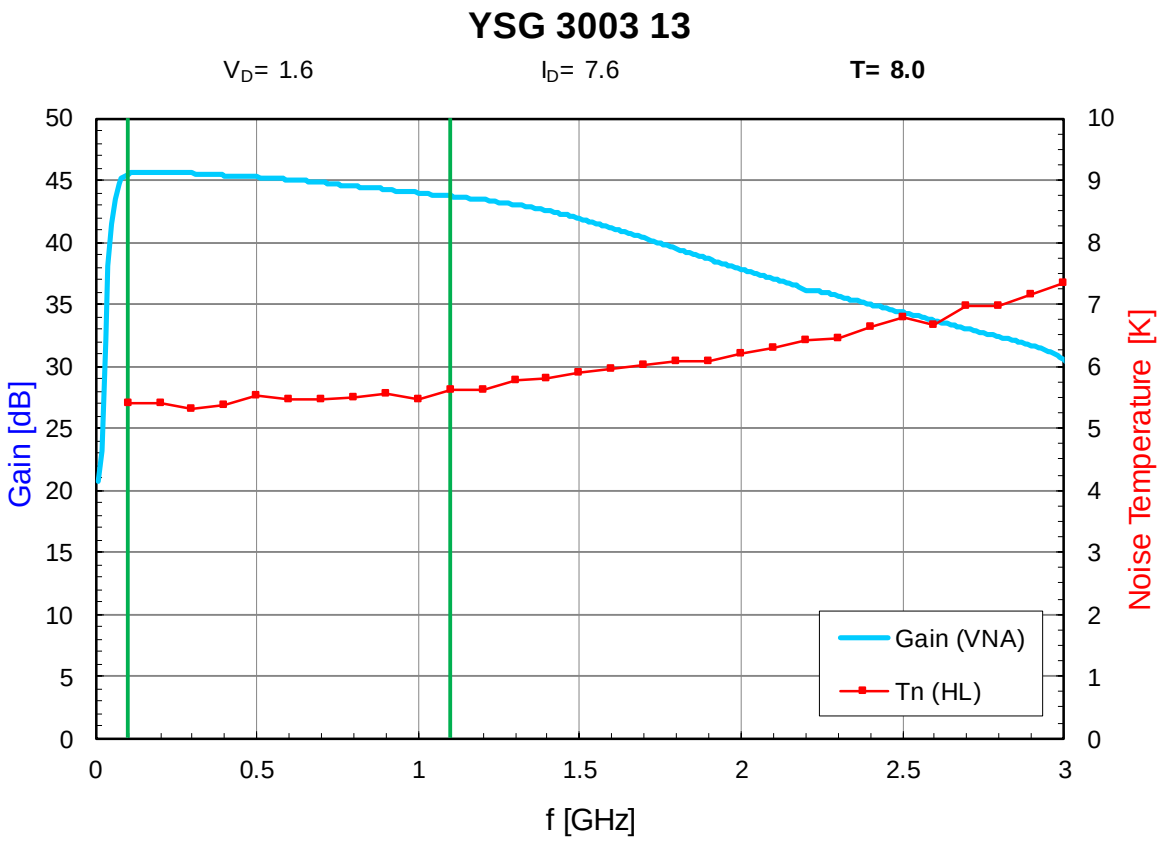
V_D= 2
I_D= 15.7
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]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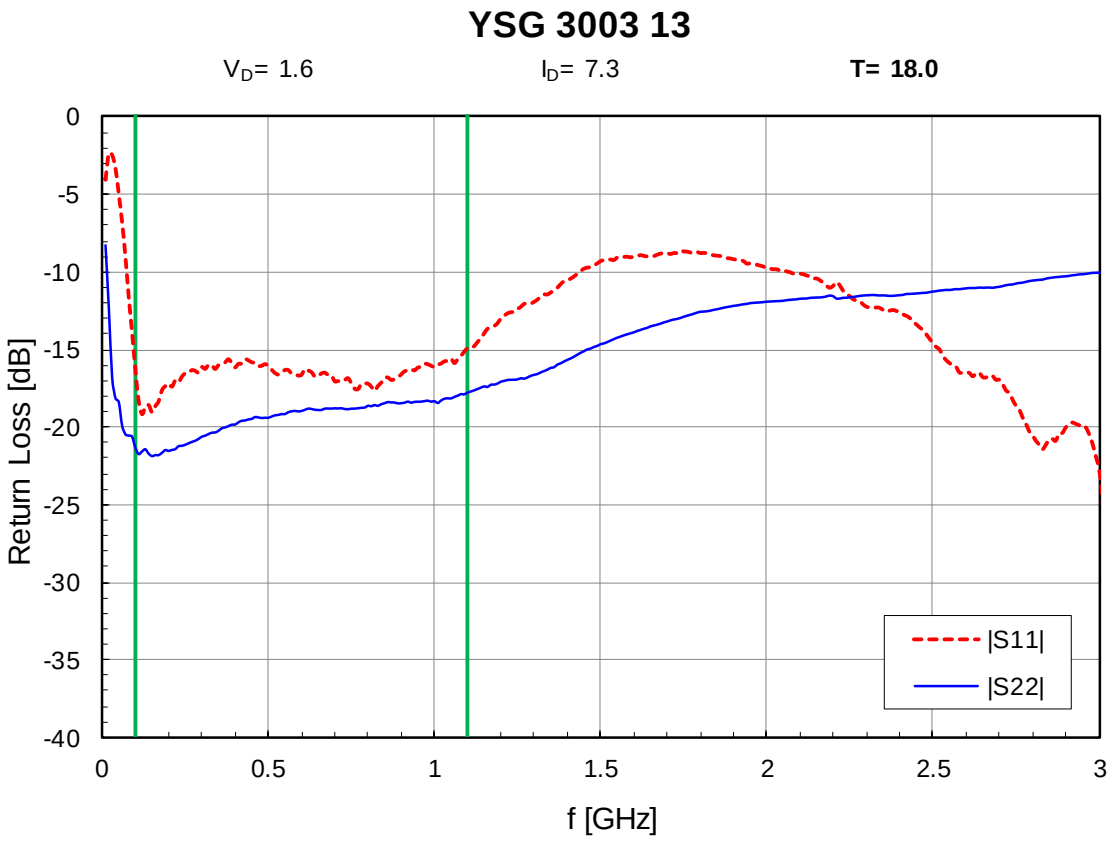
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)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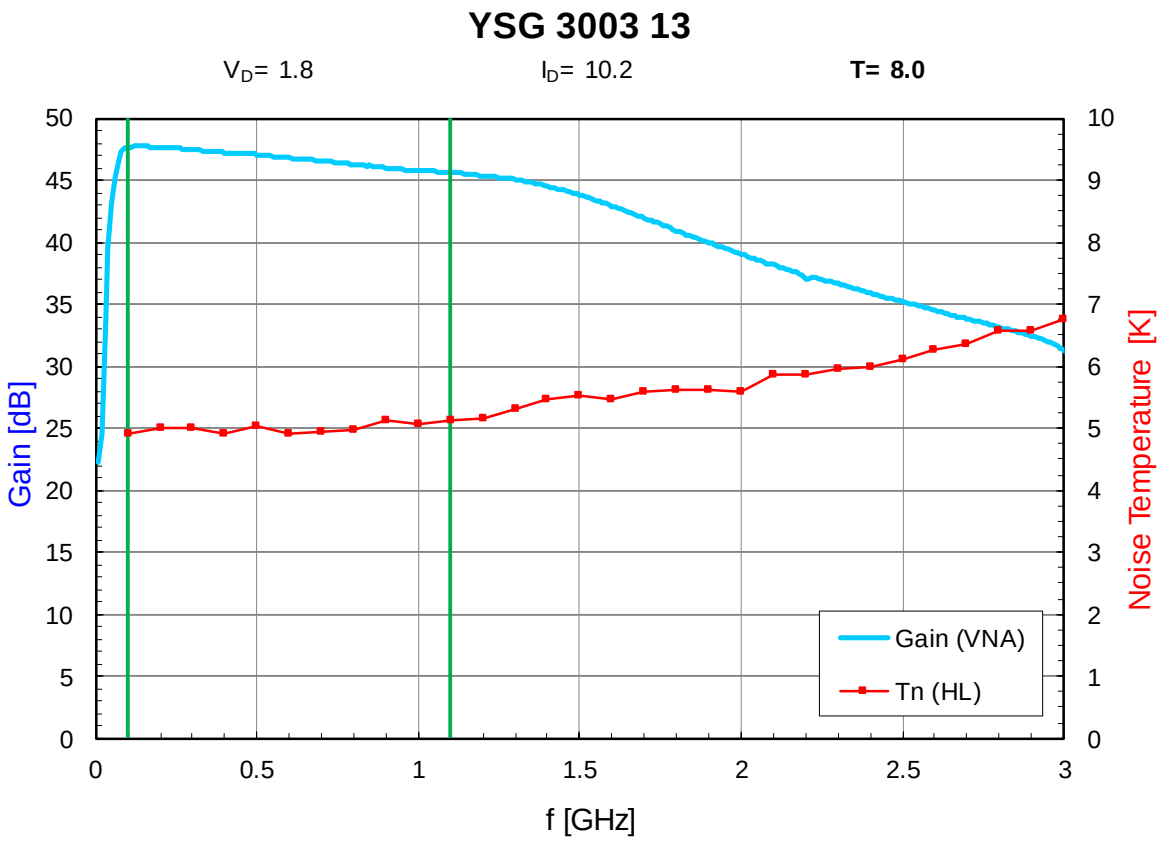
I_D= 7.3
T= 18.0
Return Loss [dB]
f [GHz]
|S11|
|S22|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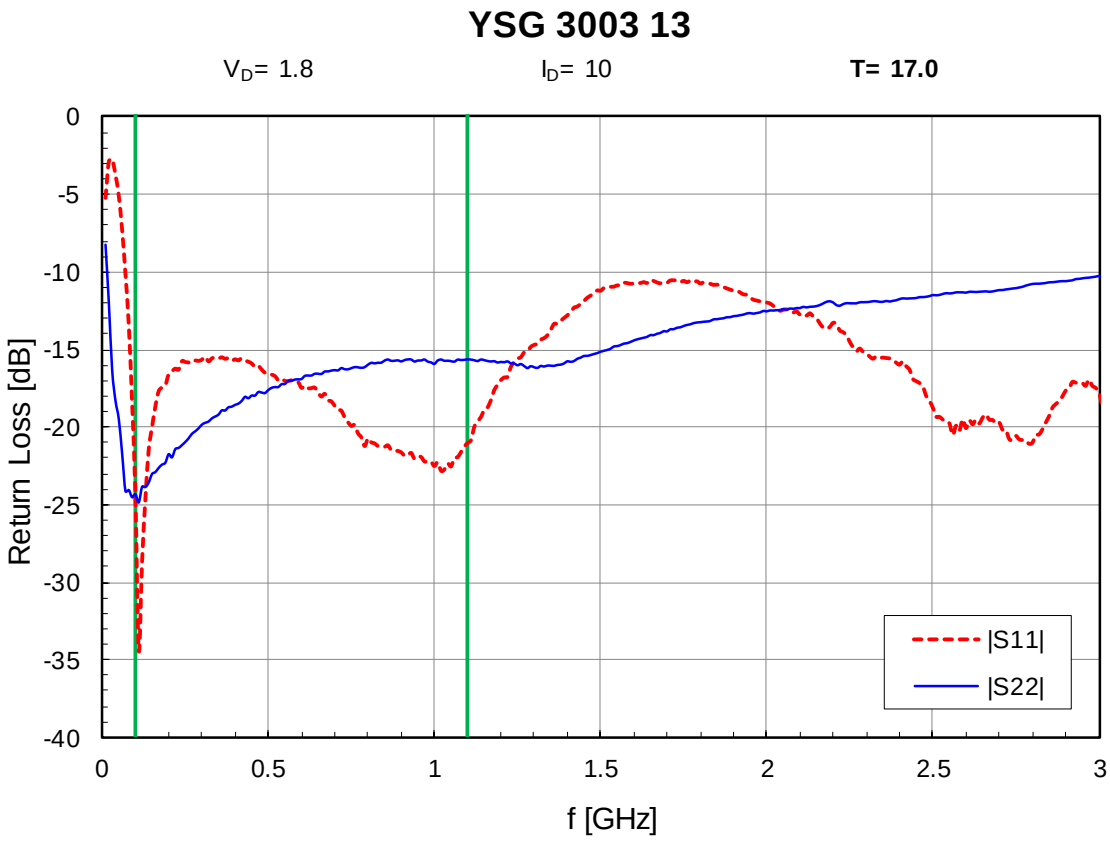
V_D= 1.8
I_D= 10.2
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)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I_D= 10
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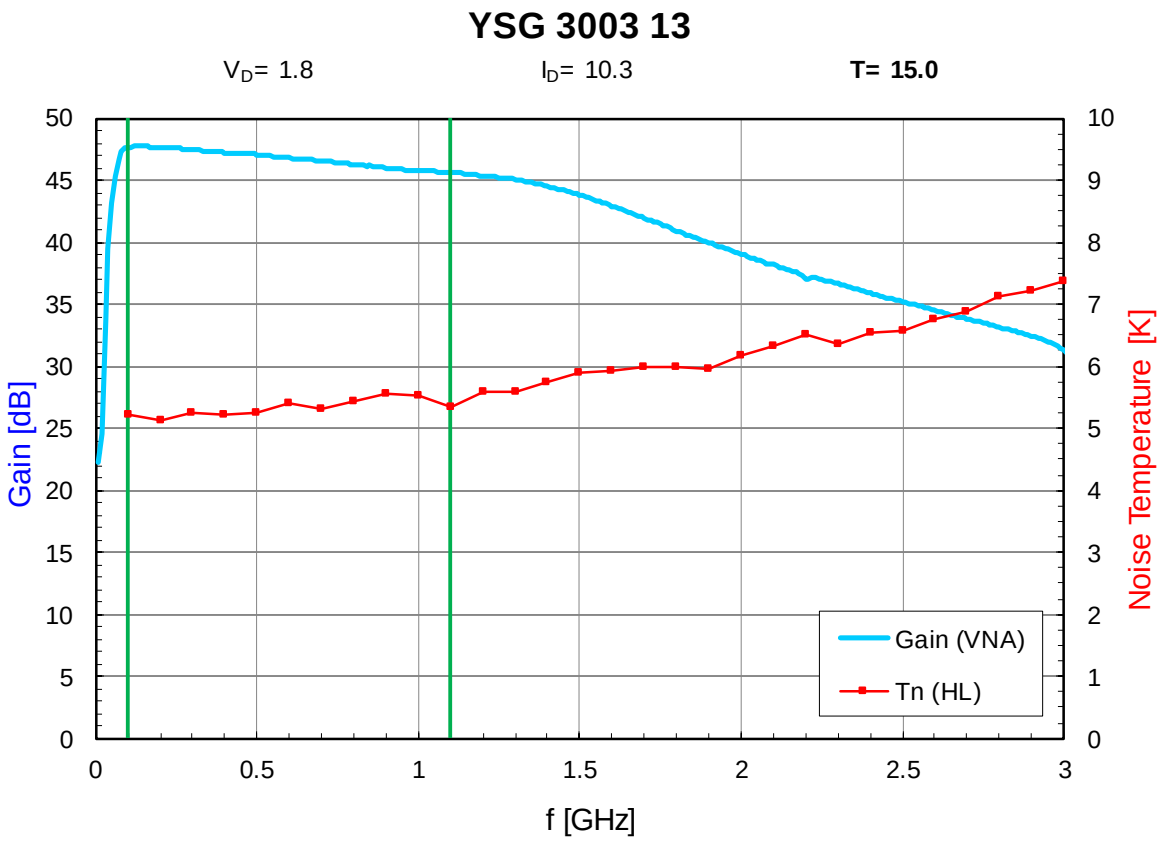
Return Loss [dB]
f [GHz]
|S11|
|S22|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V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

OBSERVATORIO DE YEBES

CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3004

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.4	**18.7**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	53.0	4.5	4.4	4.6
	min. - max.	47.9 - 61	4.4 - 4.6	4.2 - 4.5	4.5 - 4.8
Gain	**average**	40.9	45.5	47.0	47.0
	flatness	3.1	2.0	2.1	2.1

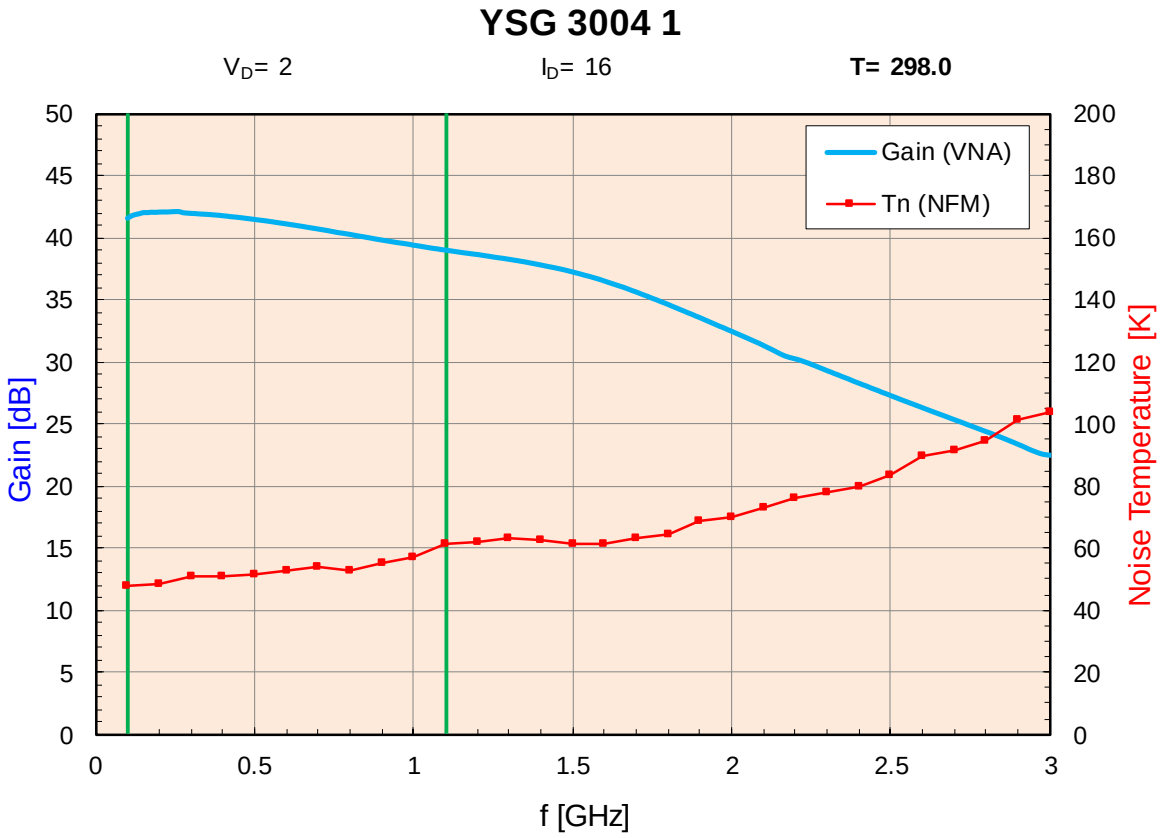
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-11.2	-14.9	-17.6	-17.6
	max. (95%)	-14.1	-15.9	-17.7	-17.7
ORL	**max.**	-16.7	-18.1	-15.5	-15.5
	max. (95%)	-19.3	-18.2	-17.7	-17.7

Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	1.9	1.7	1.7

Remarks:

- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz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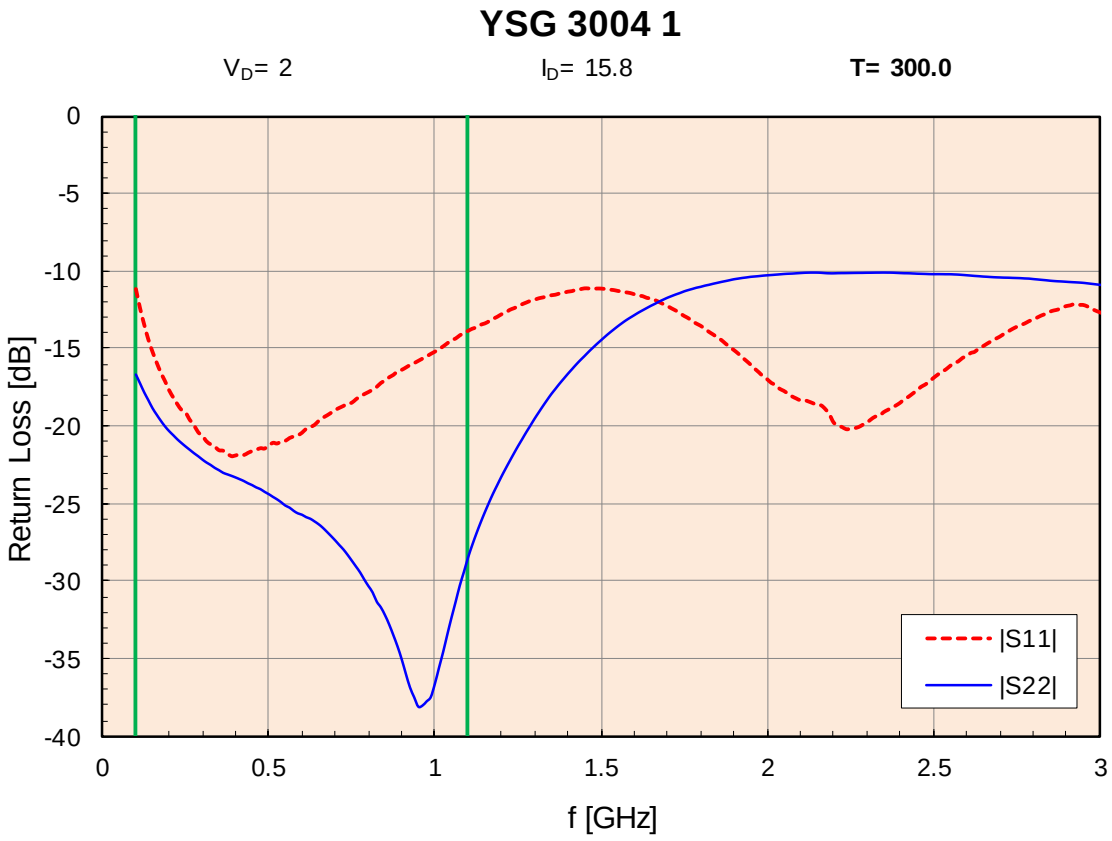
V_D= 2
I_D= 16
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]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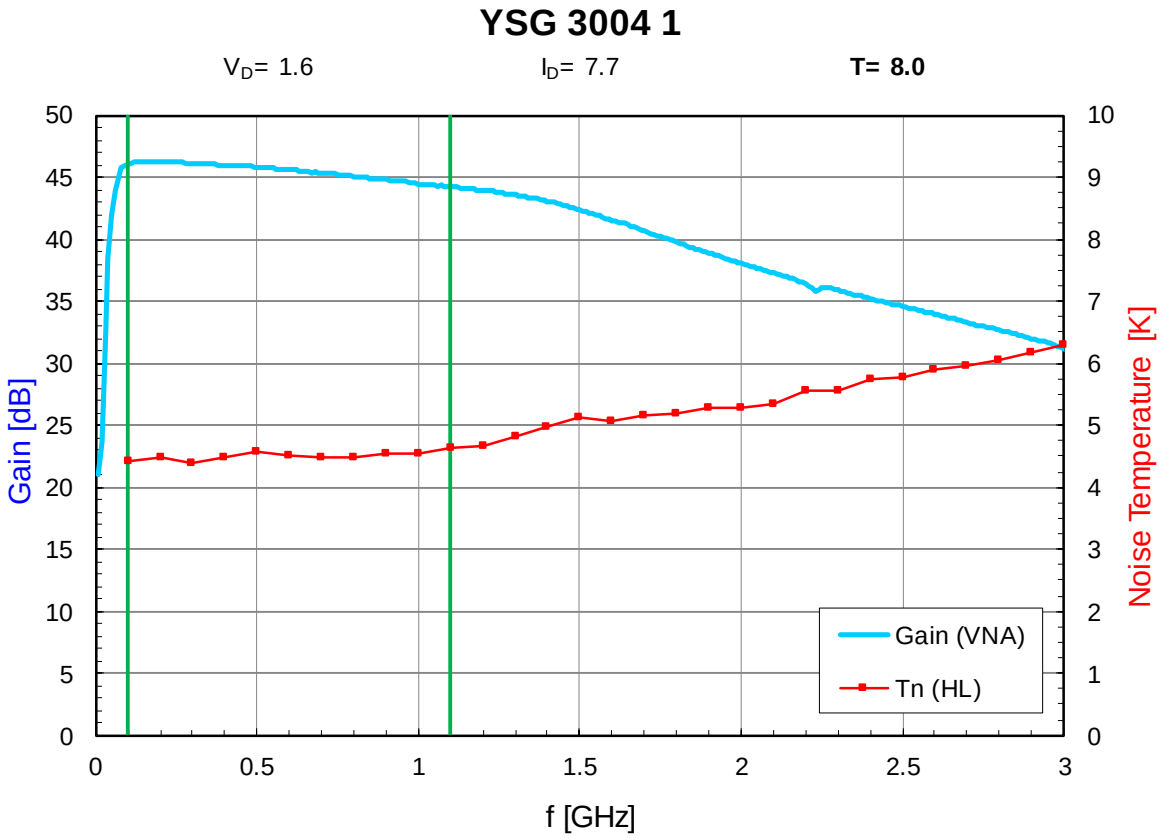
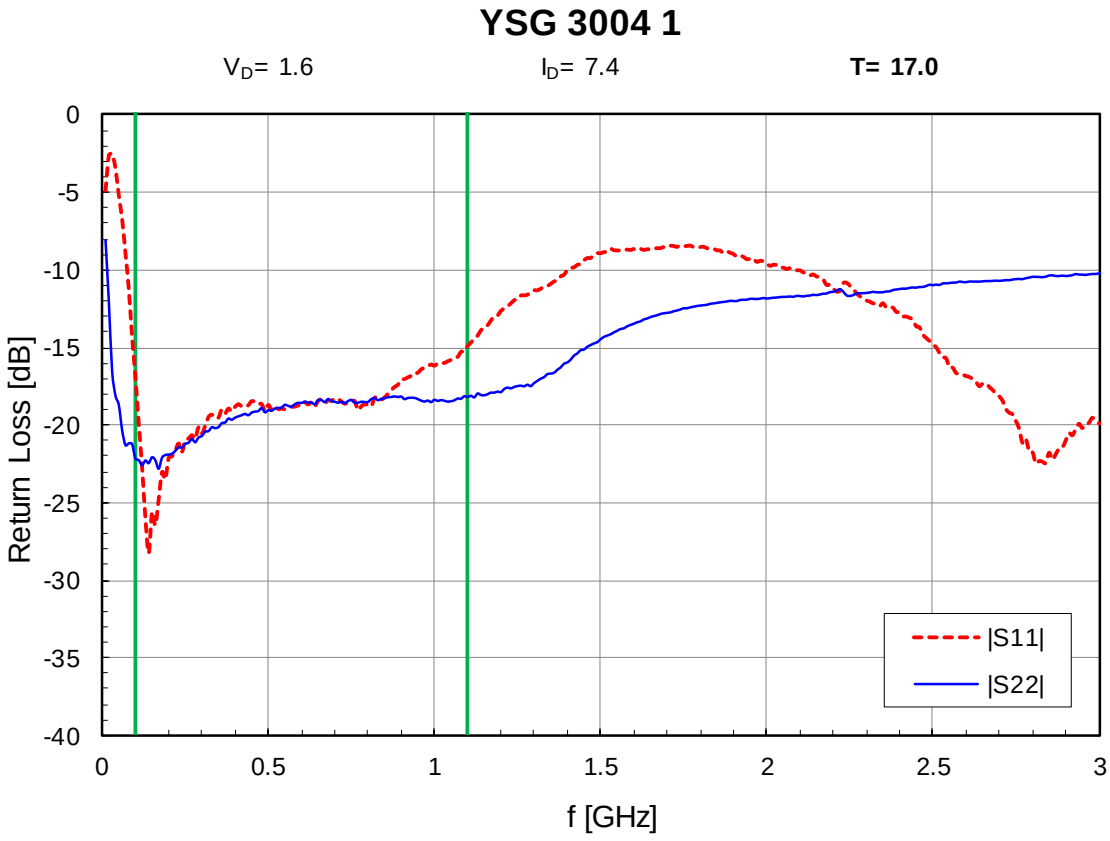
V_D= 2
I_D= 15.8
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3004 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)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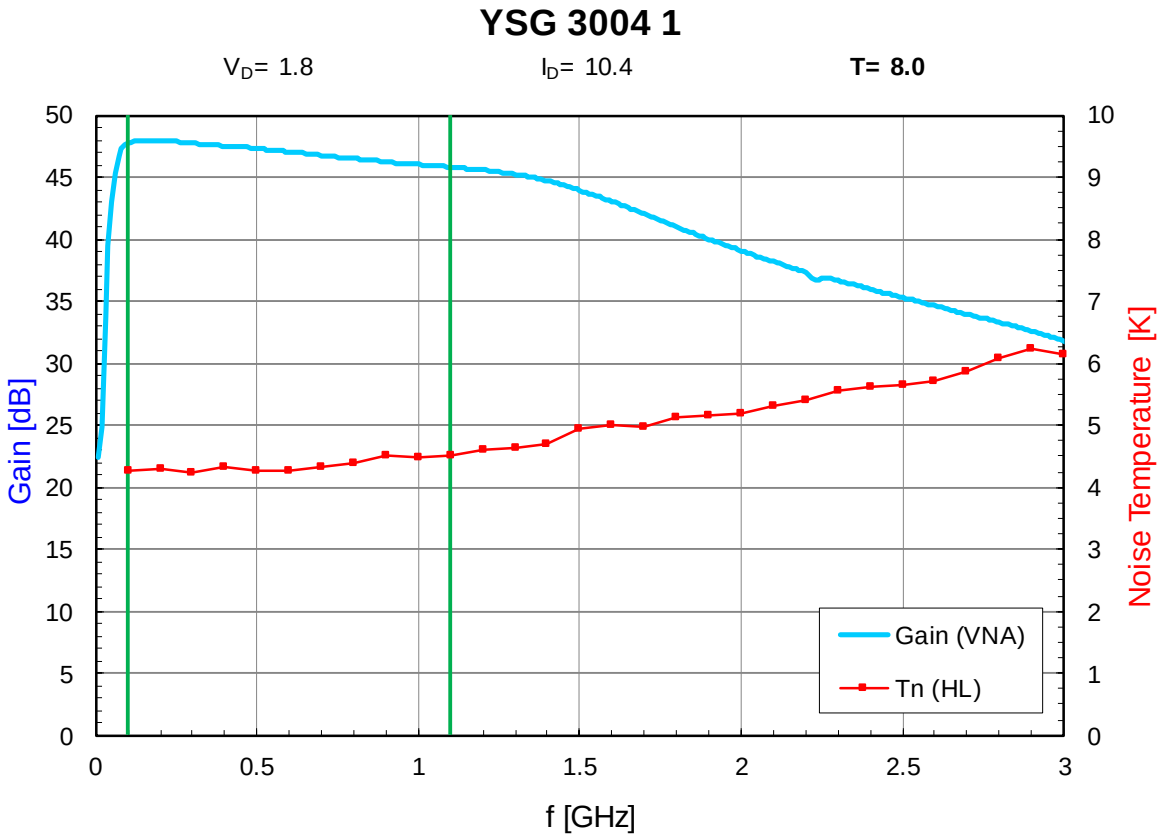
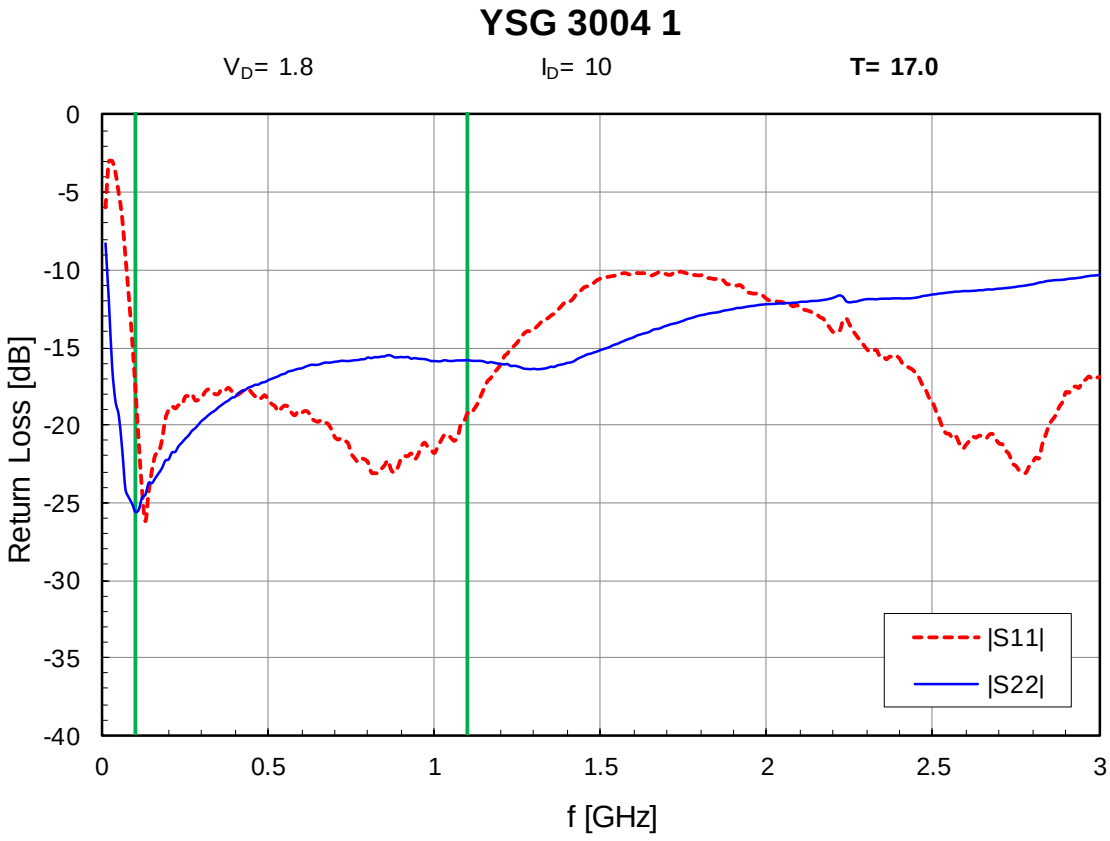
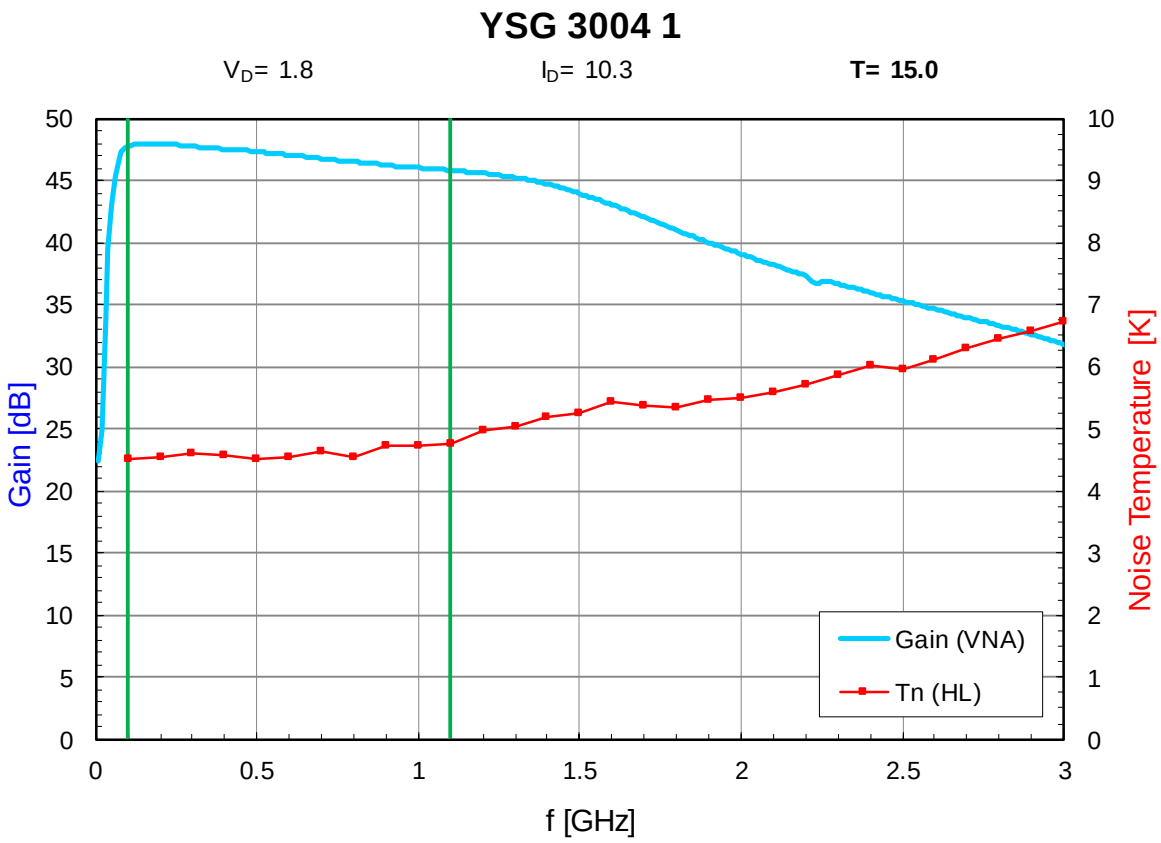
V_D= 1.6
I_D= 7.4
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3004 1
V_D= 1.8
I_D= 10.4
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3004 1
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3004 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

OBSERVATORIO DE YEBES

CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3005

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.4	**18.7**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	52.3	4.0	3.9	4.3
	min. - max.	48.6 - 58.6	3.9 - 4.2	3.8 - 4.2	4.1 - 4.5
Gain	**average**	40.7	45.4	46.8	46.8
	flatness	3.1	2.3	2.6	2.6

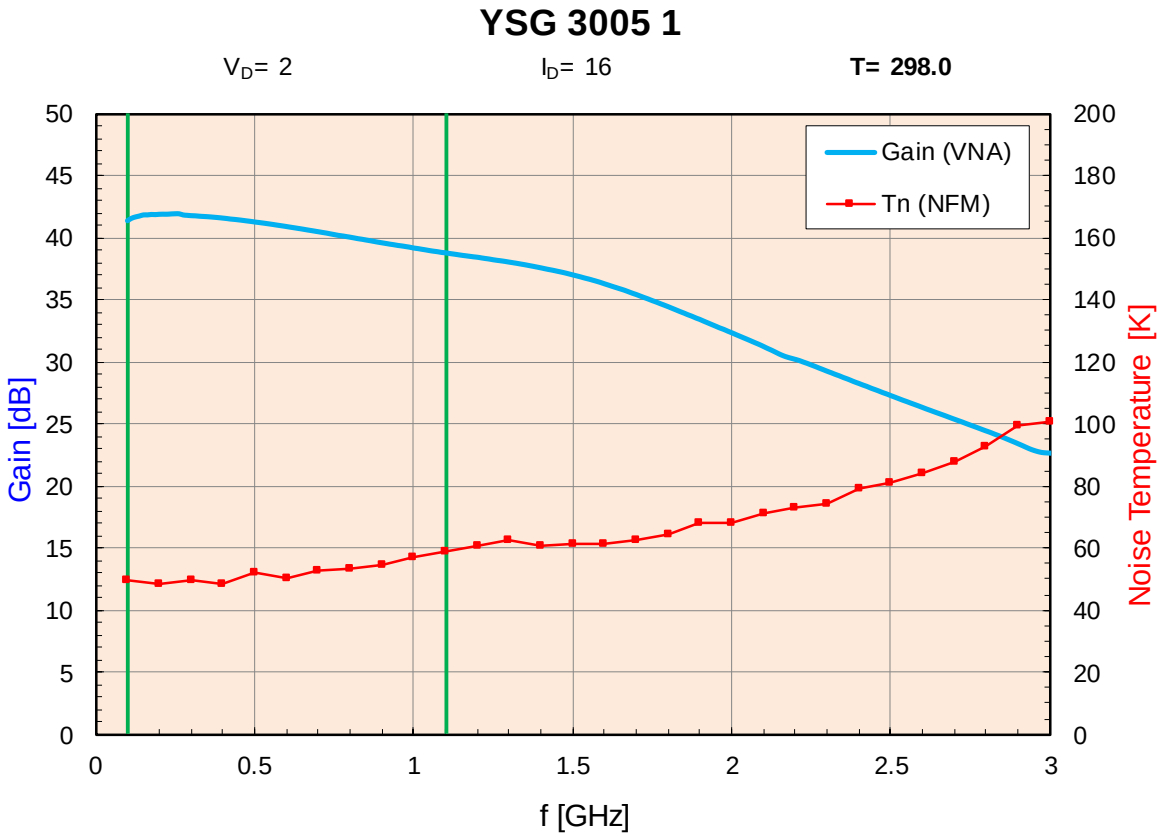
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-10.8	-15.3	-15.9	-15.9
	max. (95%)	-14.7	-16.0	-20.5	-20.5
ORL	**max.**	-16.4	-20.5	-18.3	-18.3
	max. (95%)	-19.1	-20.7	-19.4	-19.4

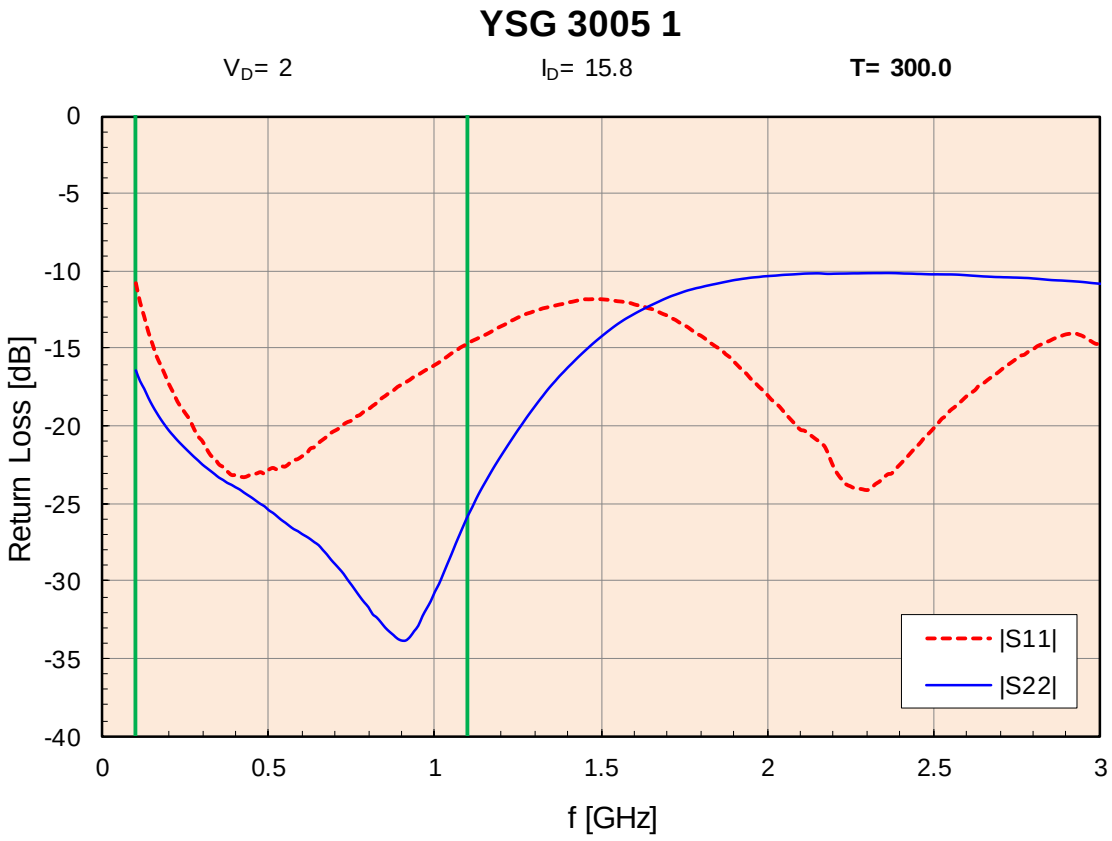
Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	1.9	1.8	1.8

Remarks:

- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz


YSG 3005 1
V_D= 2
I_D= 16
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]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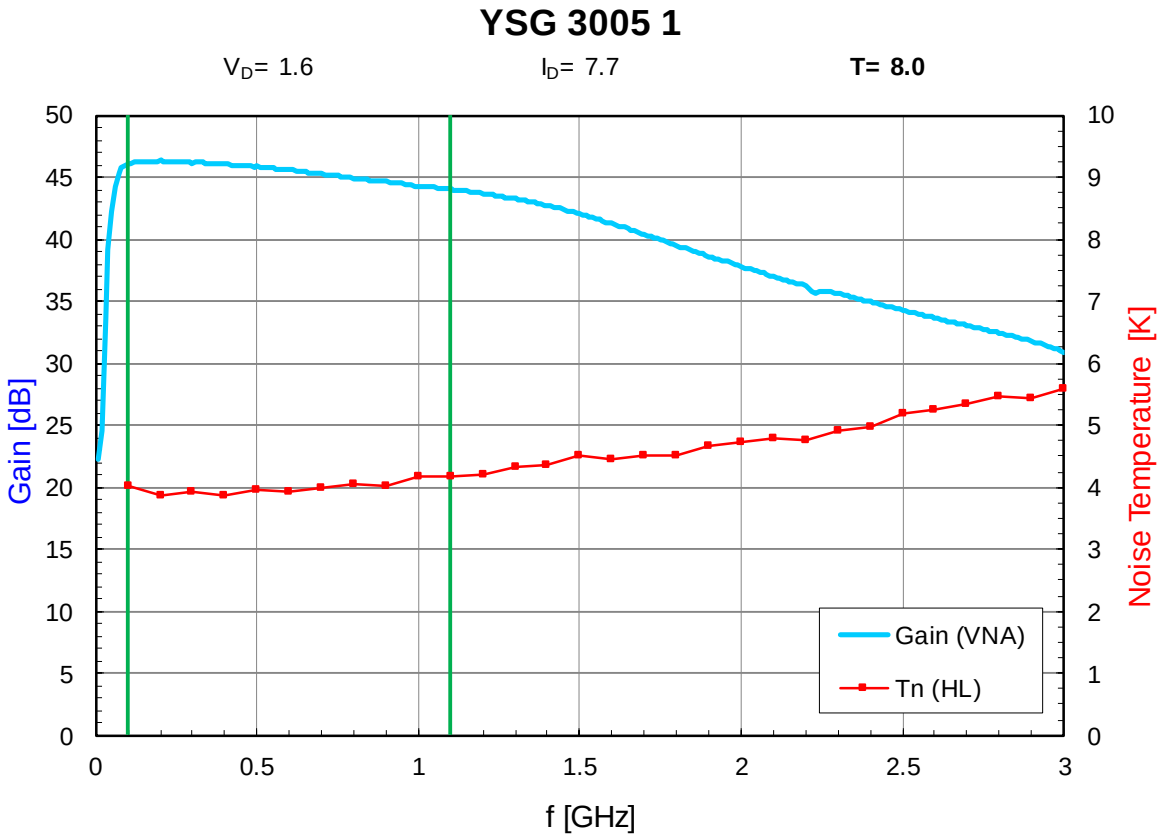
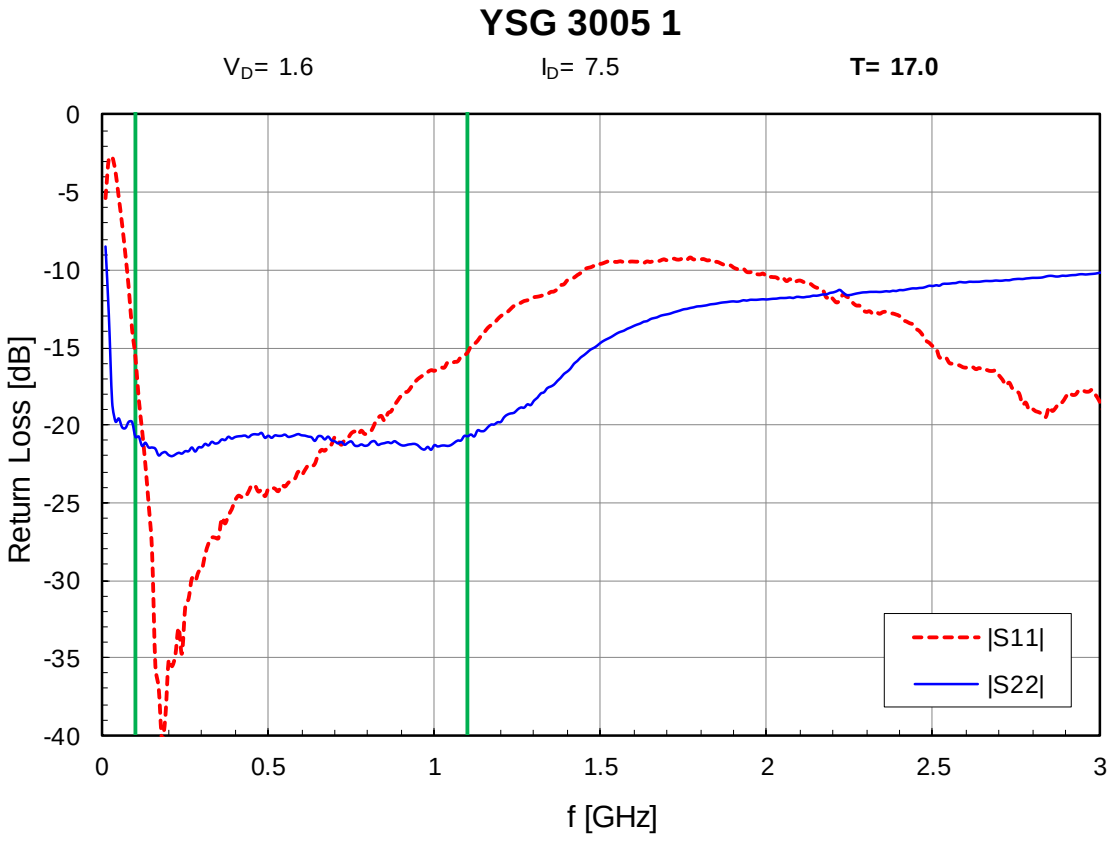
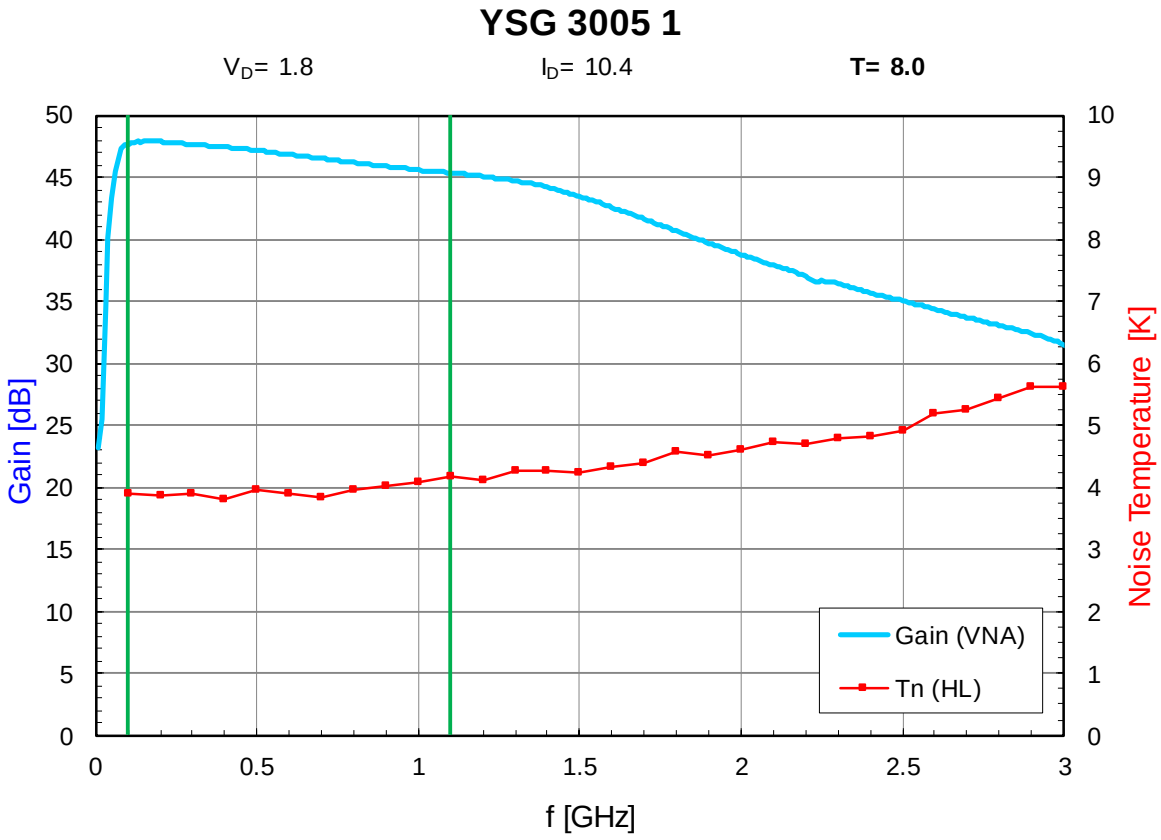
V_D= 2
I_D= 15.8
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3005 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3005 1
V_D= 1.6
I_D= 7.5
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|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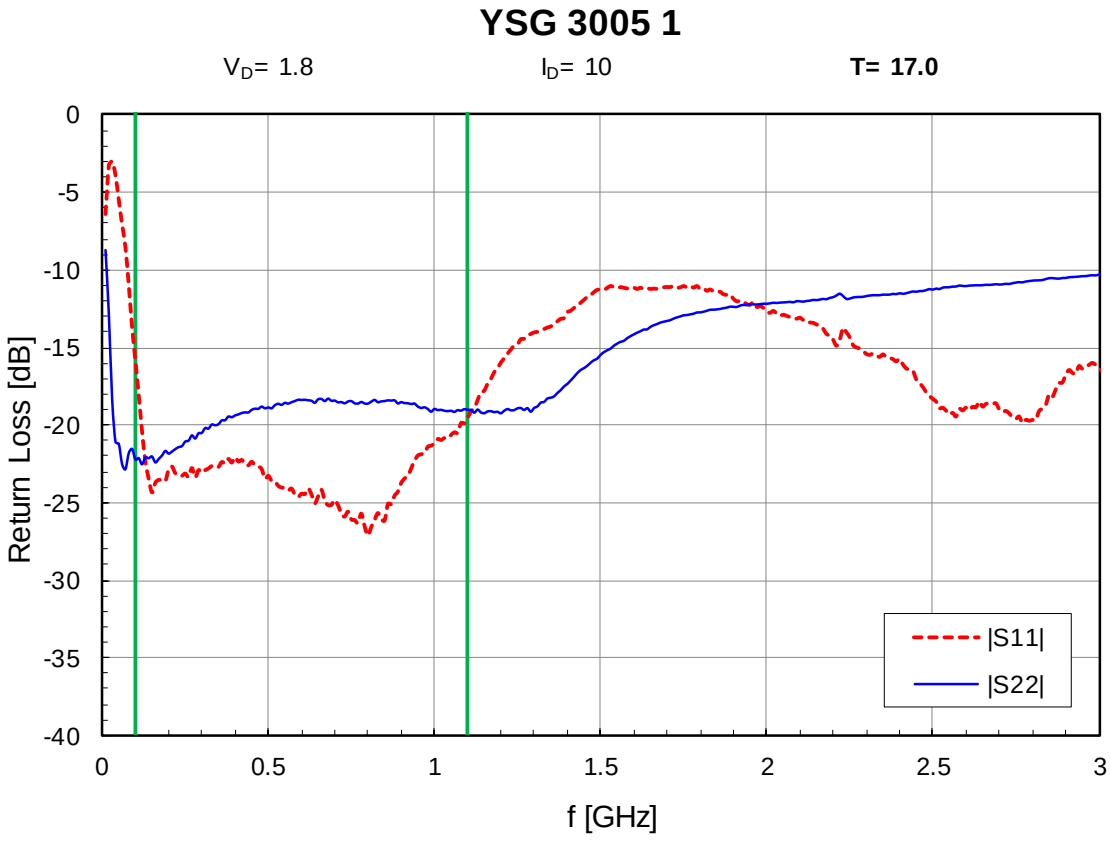
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)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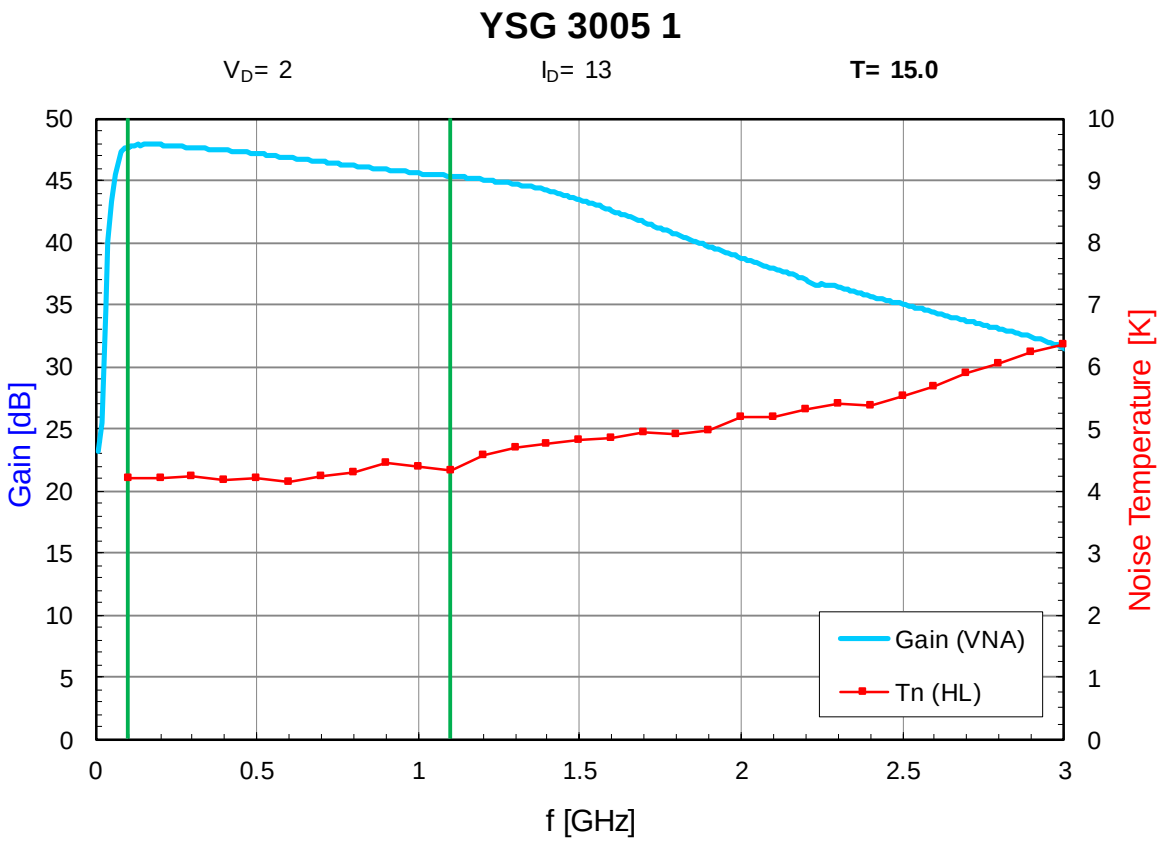
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|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V_D= 2
I_D= 13
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

OBSERVATORIO DE YEBES

CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3006

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16.1	32.2	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.3	**18.5**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	52.3	4.6	4.6	4.8
	min. - max.	48.7 - 58.9	4.5 - 4.7	4.4 - 4.8	4.6 - 5
Gain	**average**	40.8	45.2	46.7	46.7
	flatness	3.1	2.1	2.4	2.4

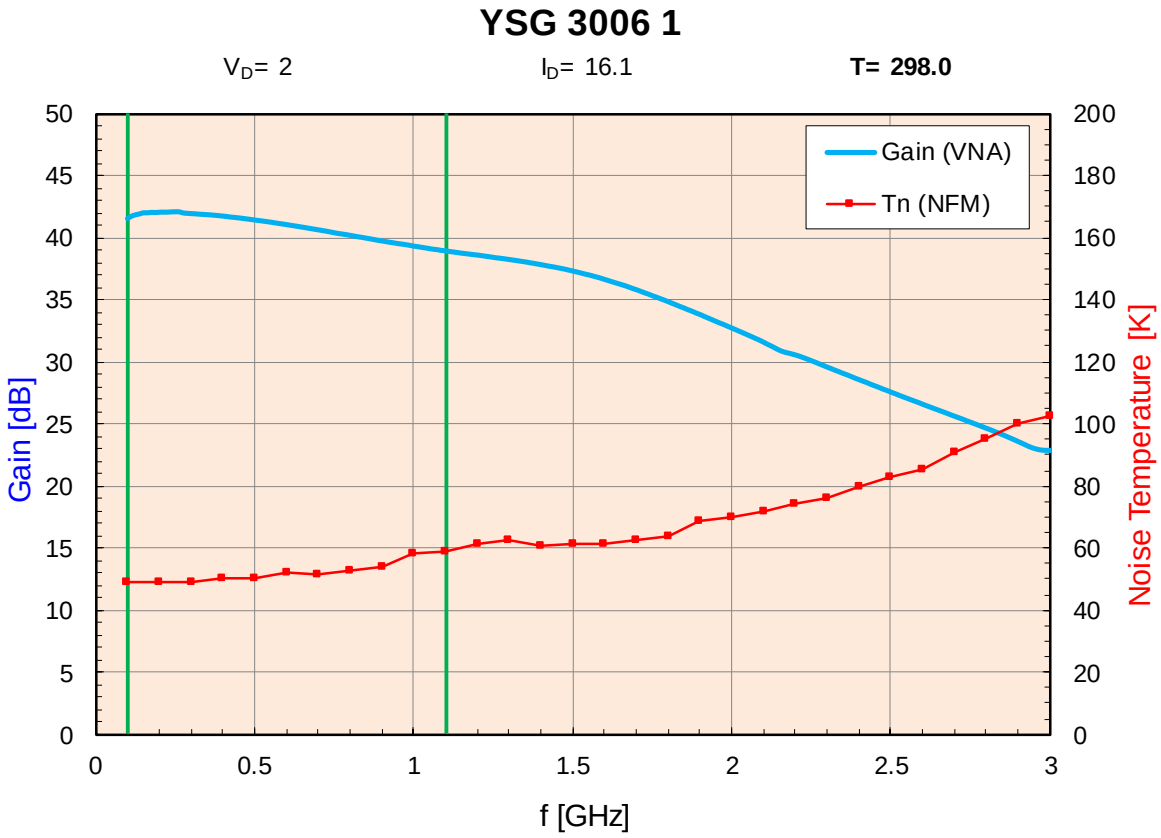
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-10.8	-15.7	-17.0	-17.0
	max. (95%)	-15.3	-16.8	-20.3	-20.3
ORL	**max.**	-16.5	-19.9	-17.1	-17.1
	max. (95%)	-19.2	-20.2	-18.8	-18.8

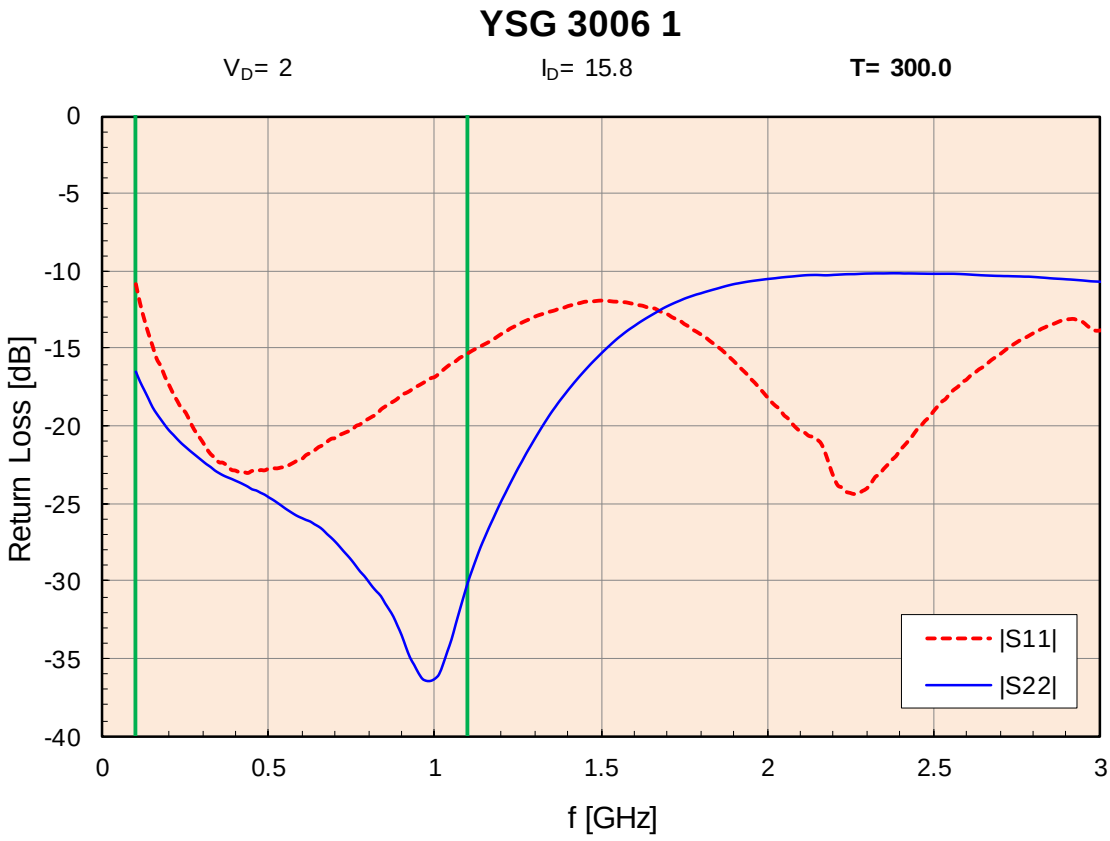
Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	1.9	1.5	1.5

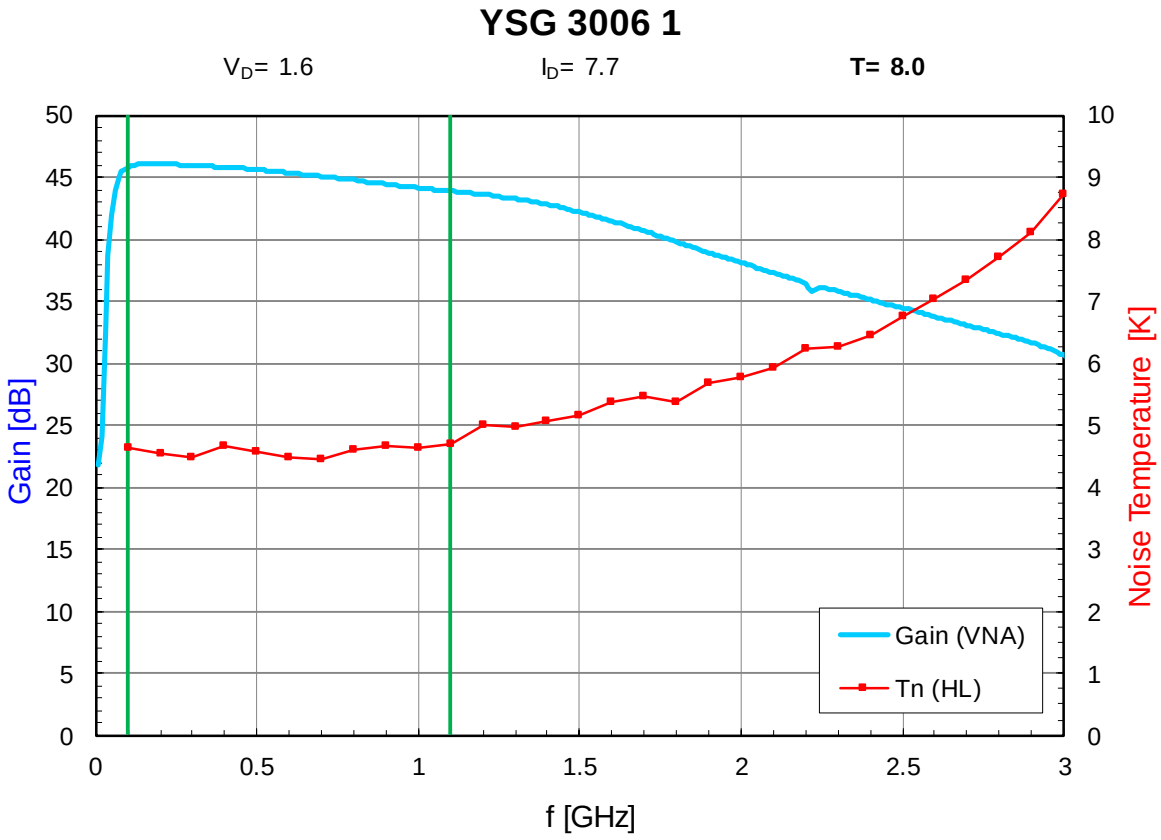
Remarks:

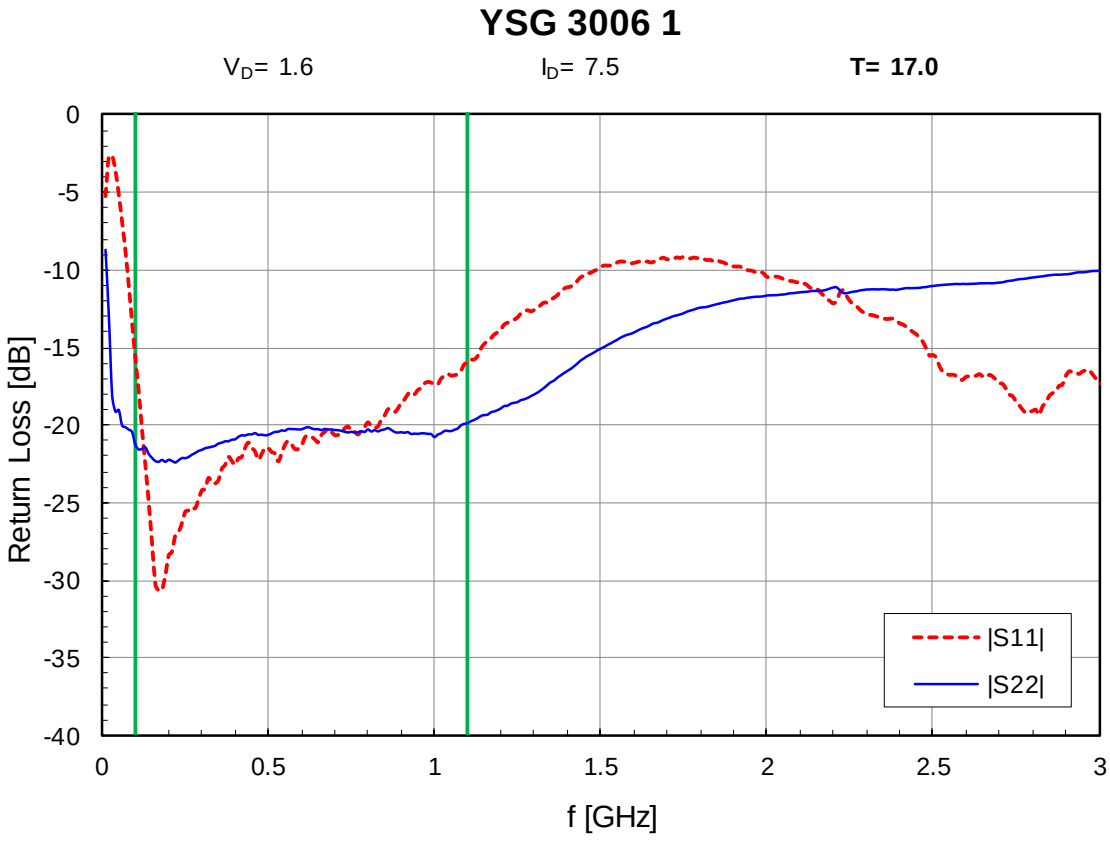
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

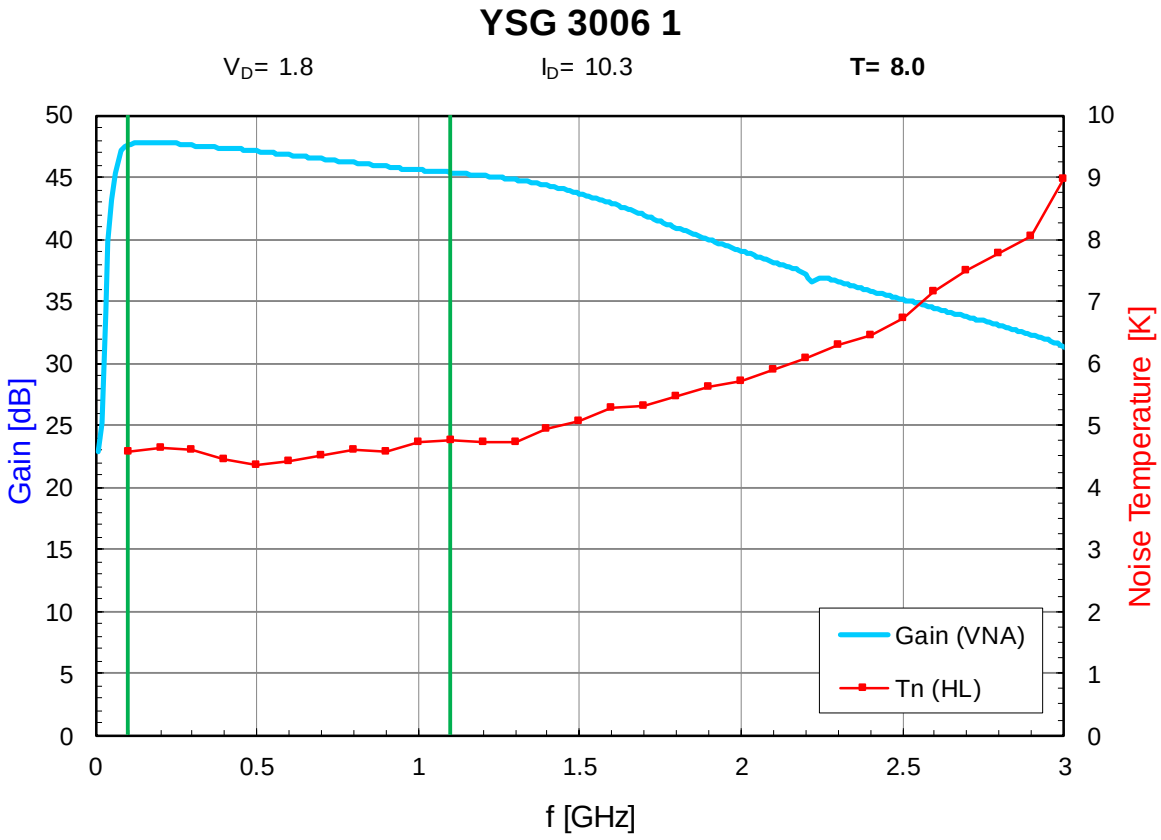
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

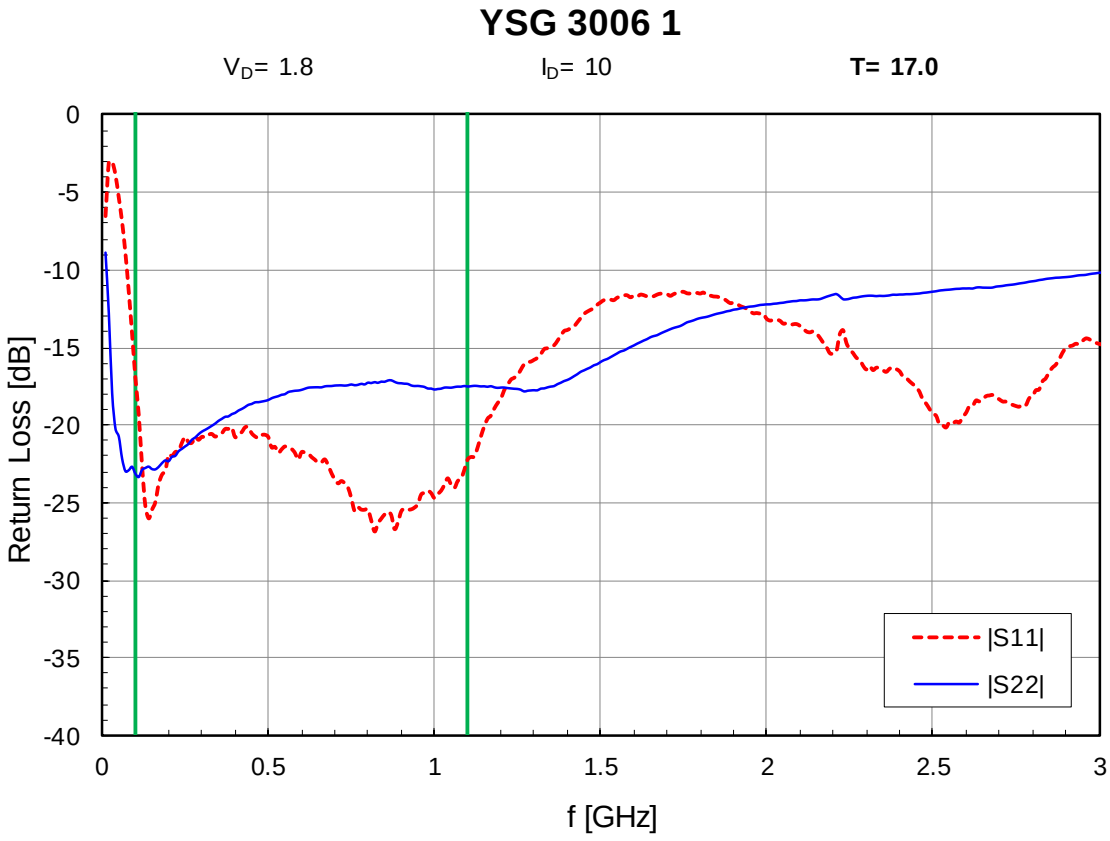

YSG 3006 1
V_D= 2
I_D= 16.1
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

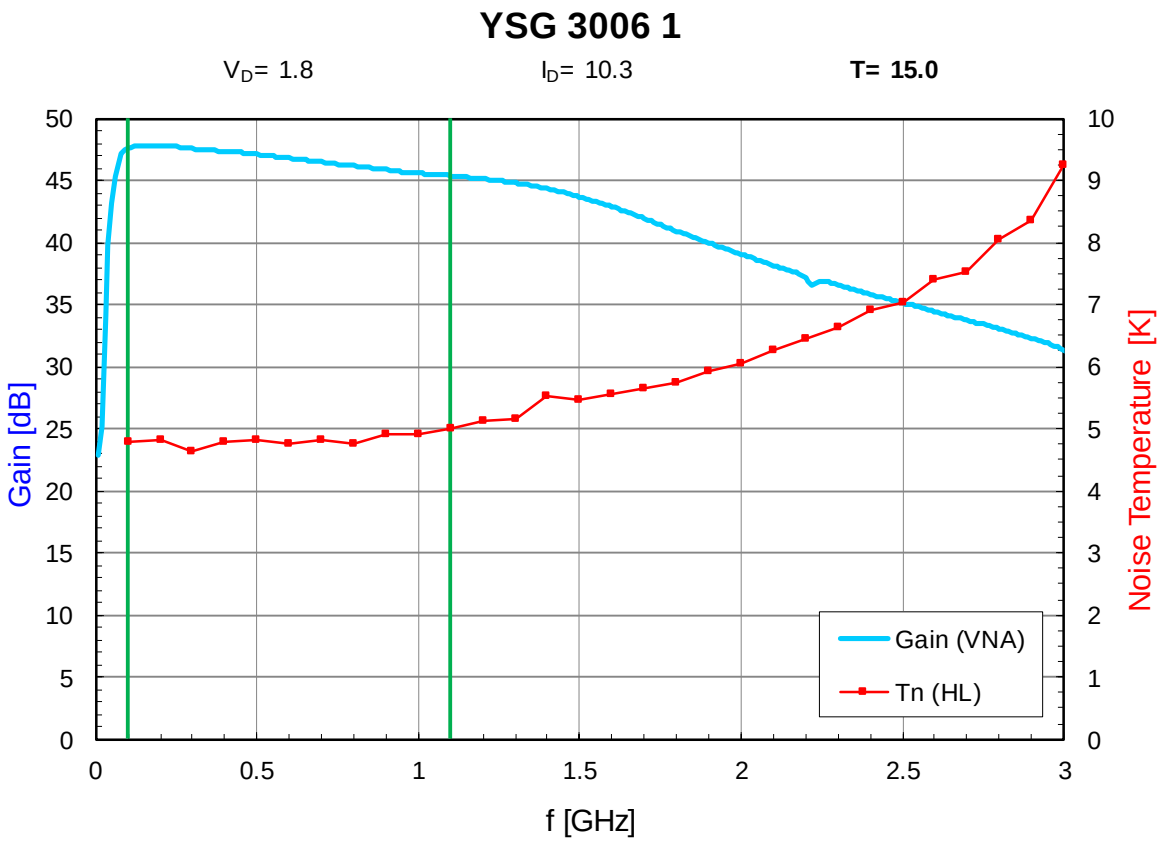

YSG 3006 1
V_D= 2
I_D= 15.8
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3006 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3006 1
V_D= 1.6
I_D= 7.5
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3006 1
V_D= 1.8
I_D= 10.3
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3006 1
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3006 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

OBSERVATORIO DE YEBES

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Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3007

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16.1	32.2	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.4	**18.7**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	52.4	4.1	4.1	4.4
	min. - max.	47.9 - 59.8	3.9 - 4.3	3.9 - 4.3	4.2 - 4.5
Gain	**average**	40.9	45.8	47.5	47.5
	flatness	3.0	2.0	2.2	2.2

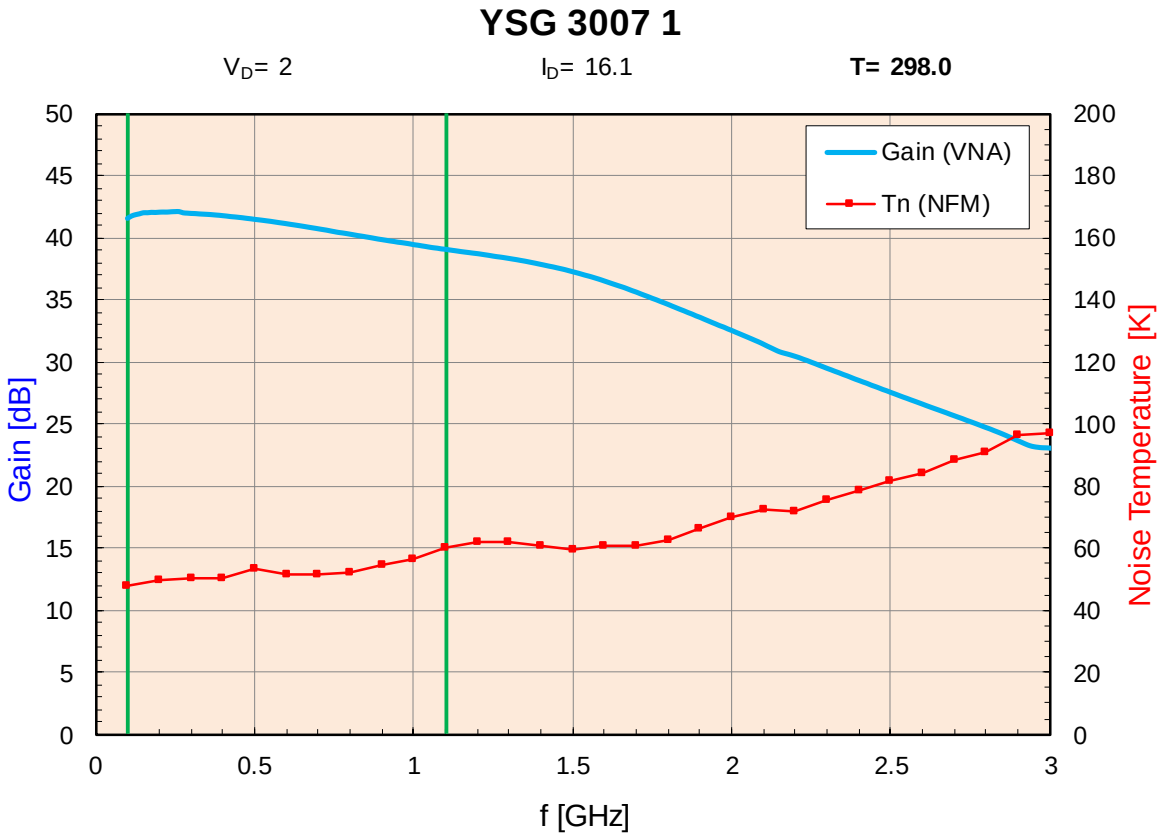
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-11.2	-14.4	-15.0	-15.0
	max. (95%)	-14.4	-15.2	-18.6	-18.6
ORL	**max.**	-16.8	-17.7	-15.0	-15.0
	max. (95%)	-19.4	-17.8	-17.5	-17.5

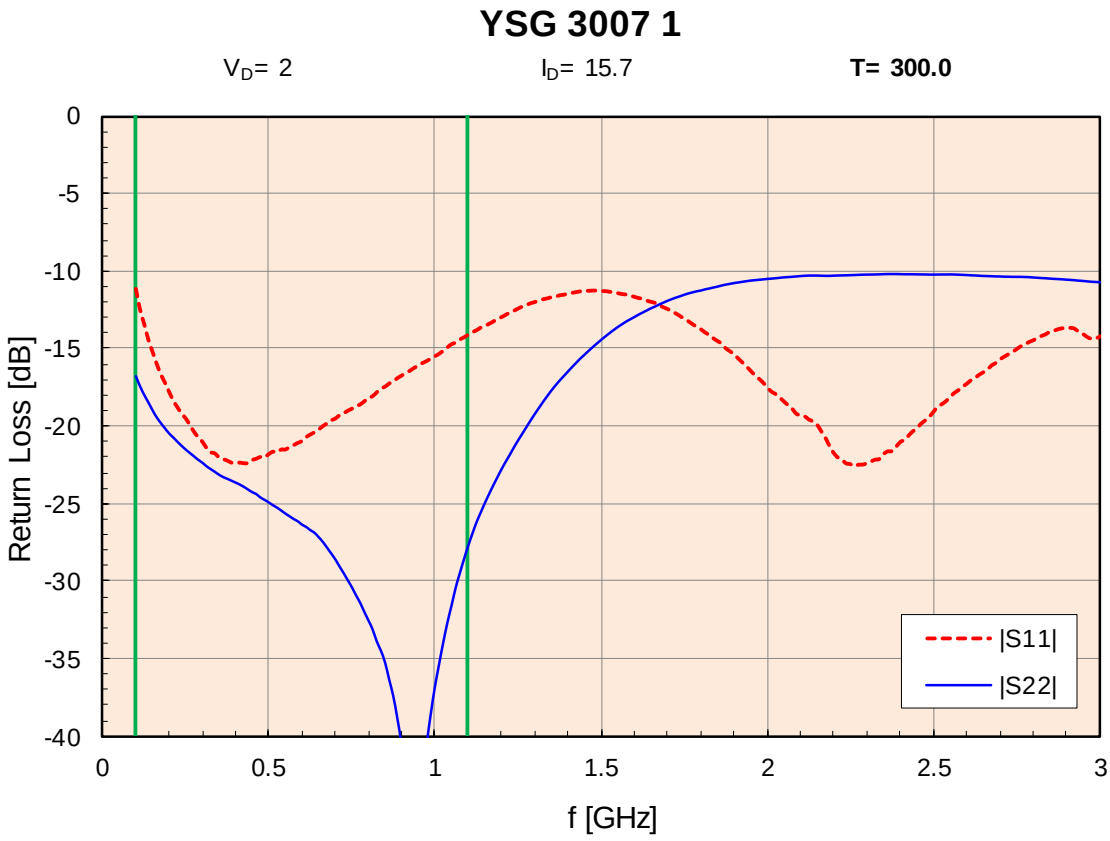
Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	1.8	1.6	1.6

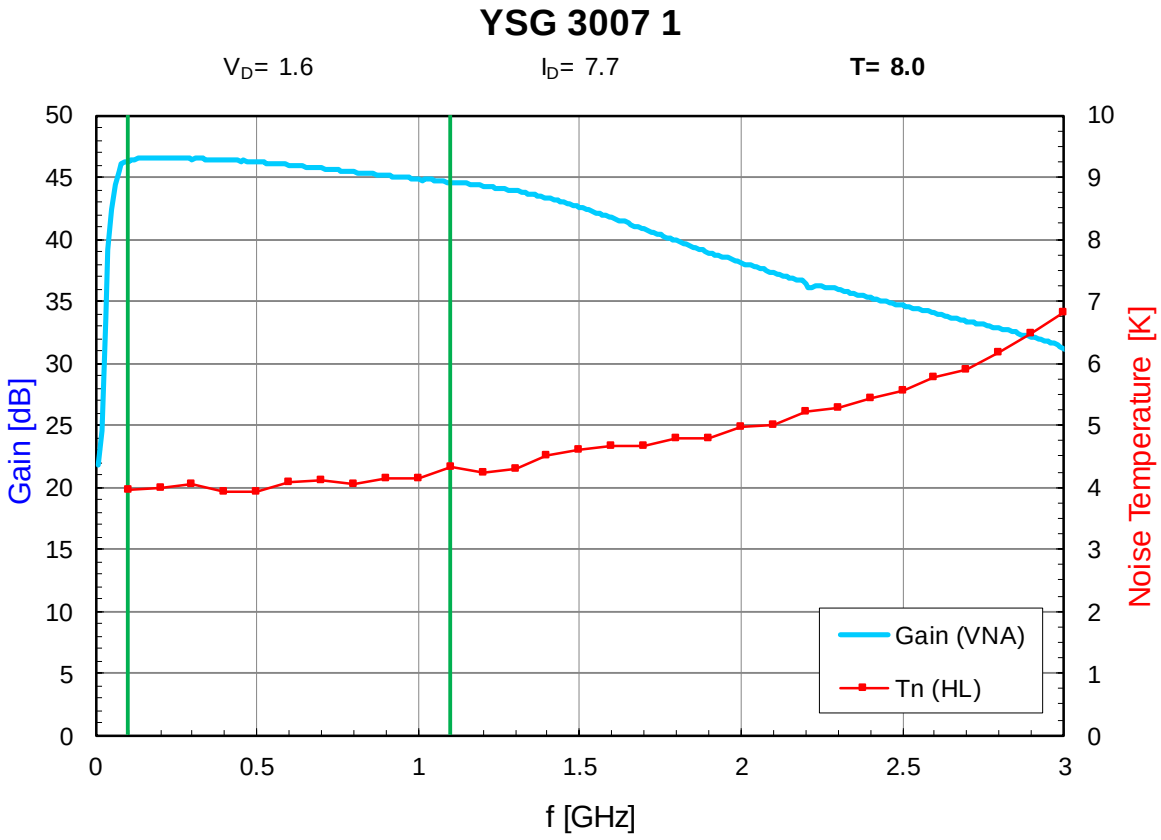
Remarks:

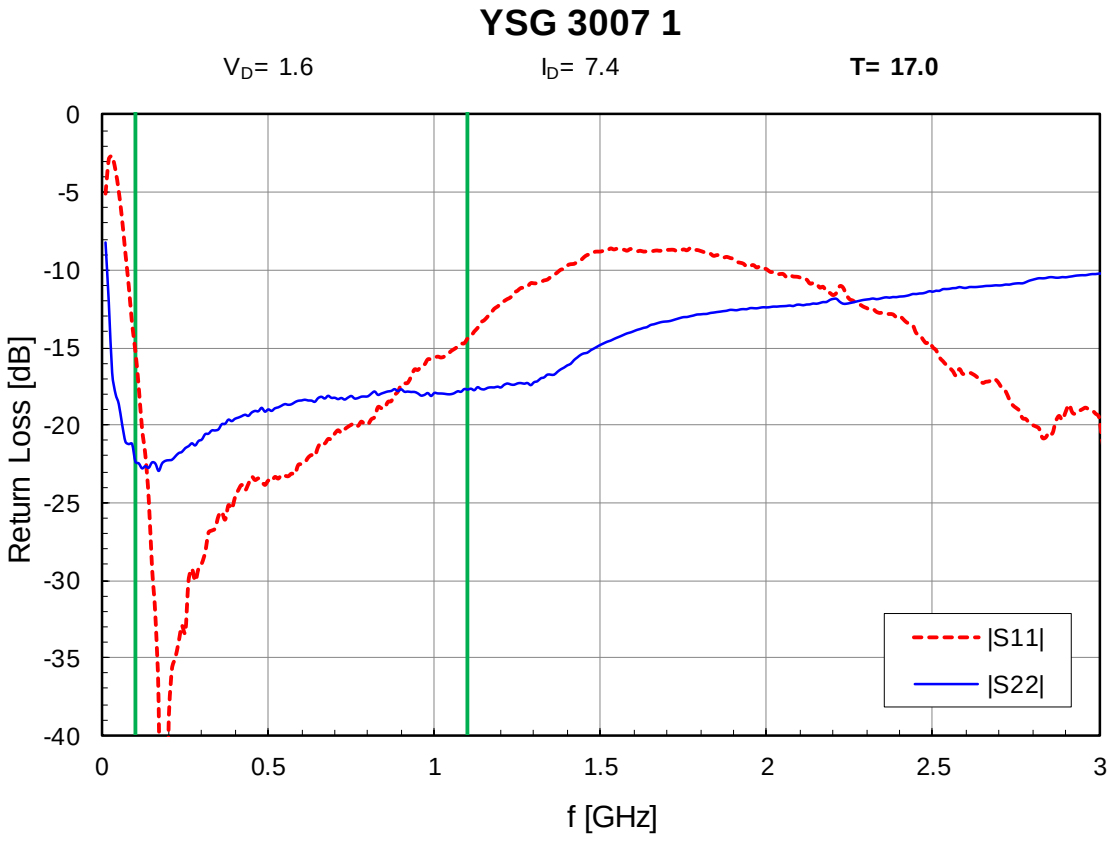
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

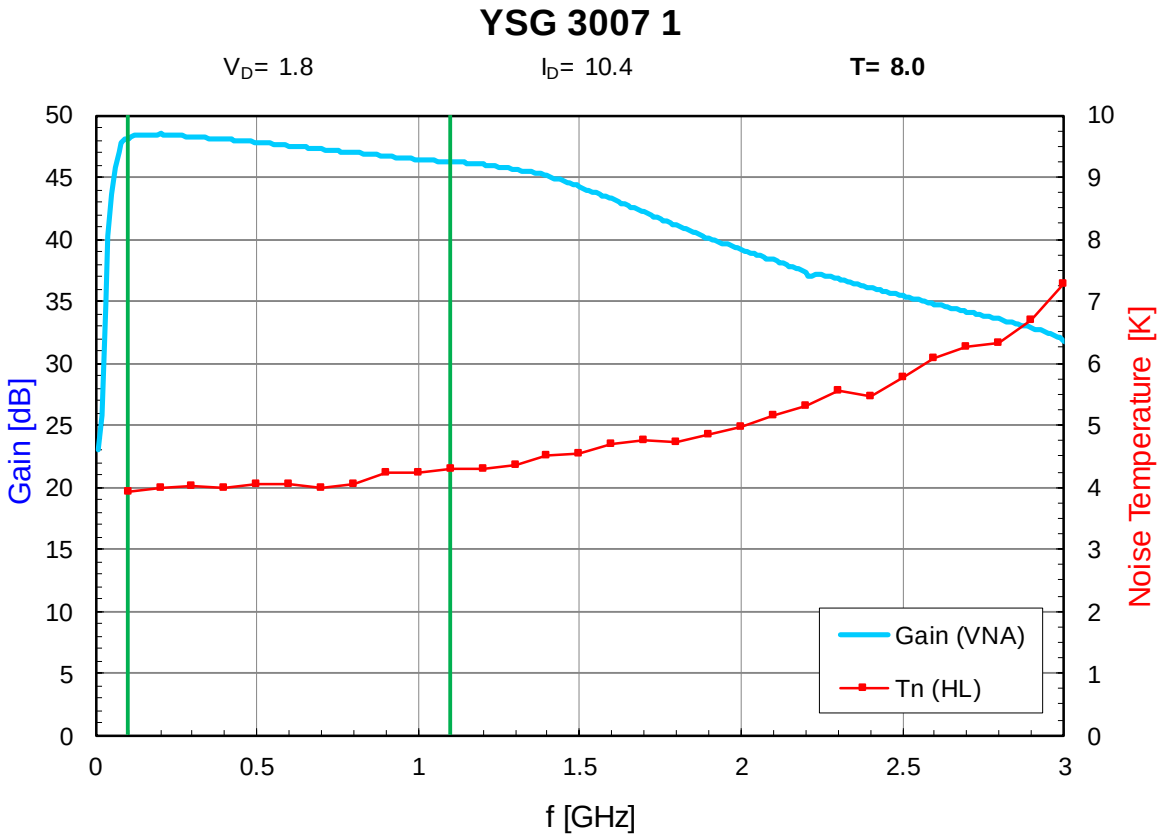
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

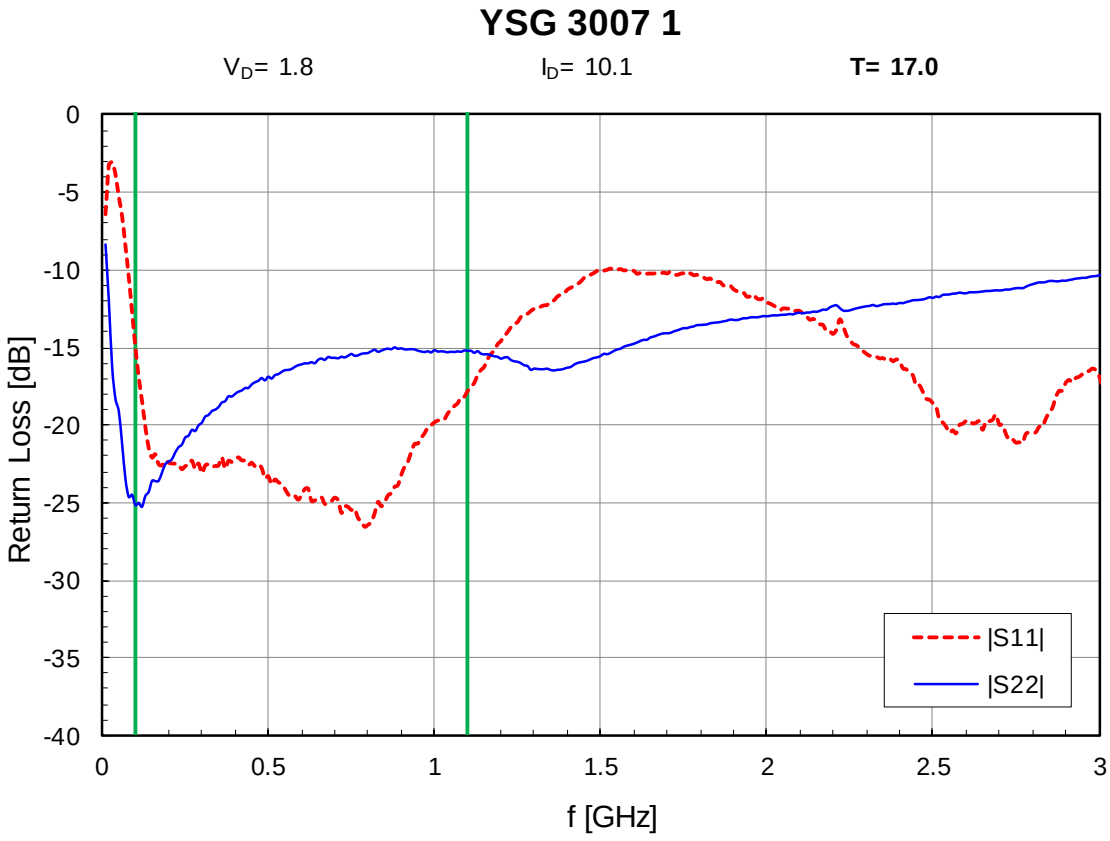

YSG 3007 1
V_D= 2
I_D= 16.1
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

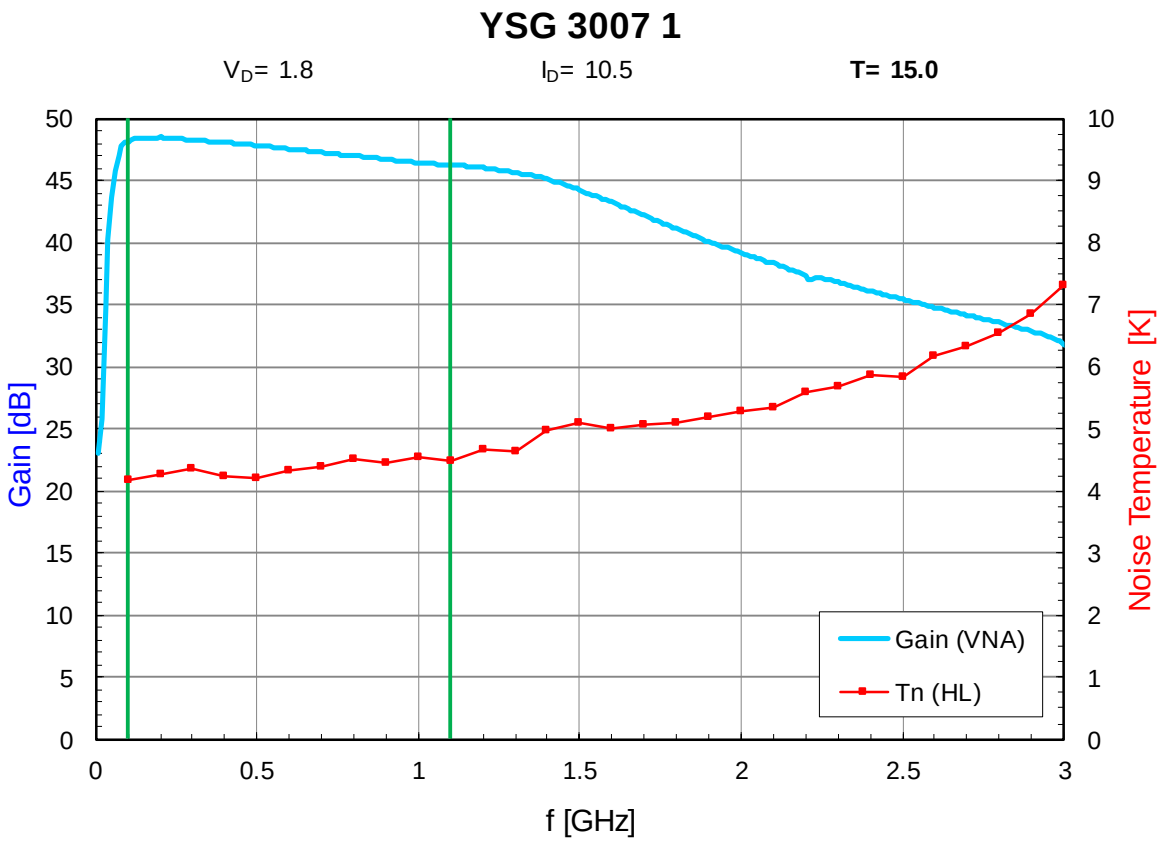

YSG 3007 1
V_D= 2
I_D= 15.7
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3007 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3007 1
V_D= 1.6
I_D= 7.4
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3007 1
V_D= 1.8
I_D= 10.4
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3007 1
V_D= 1.8
I_D= 10.1
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3007 1
V_D= 1.8
I_D= 10.5
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

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CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3008

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.6	**12.2**
Bias #2				**1.8**	10.3	**18.5**

Performance:

Bias #		1	1	2	2
Noise	**average**	52.5	3.9	3.7	4.0
	min. - max.	49.5 - 59.6	3.8 - 4.1	3.5 - 3.8	3.9 - 4.2
Gain	**average**	40.7	45.2	46.7	46.7
	flatness	3.2	2.2	2.5	2.5

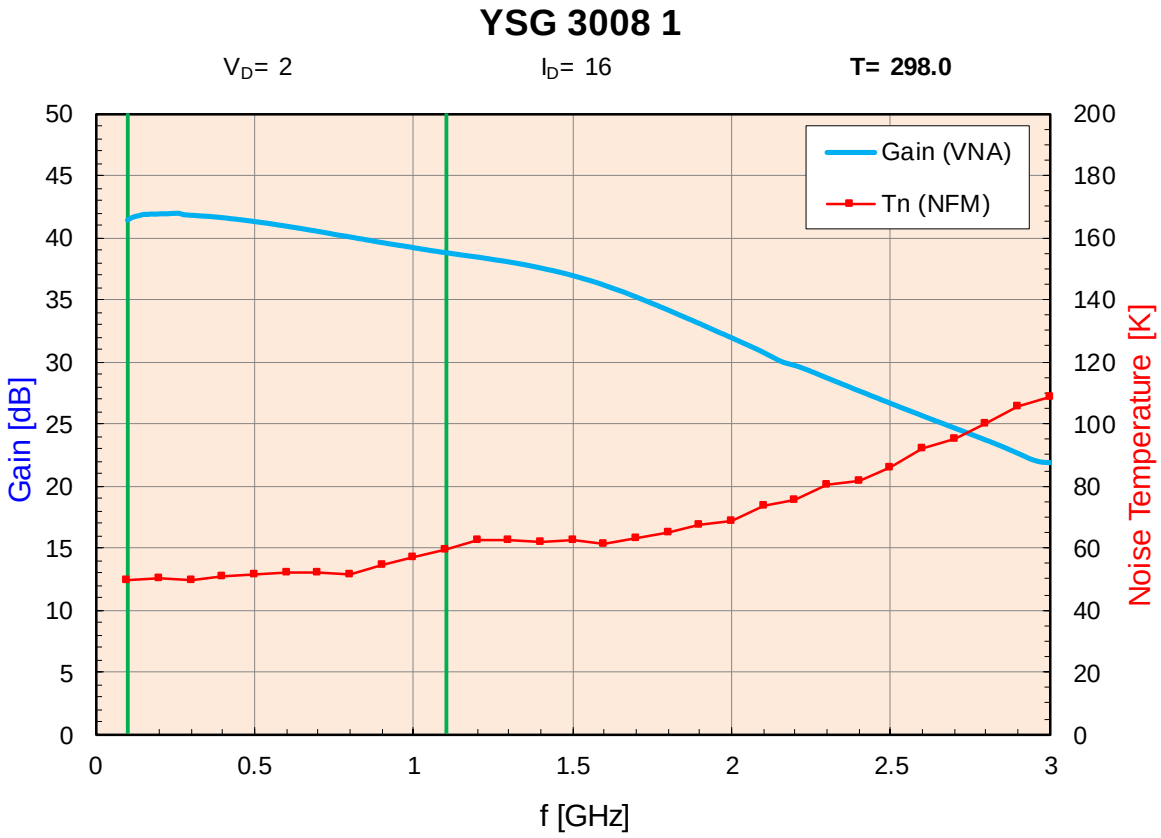
Bias #		1	1	2	2
IRL	**max.**	-11.0	-14.8	-15.5	-15.5
	max. (95%)	-14.3	-15.6	-20.2	-20.2
ORL	**max.**	-16.5	-19.5	-17.4	-17.4
	max. (95%)	-19.2	-20.0	-18.8	-18.8

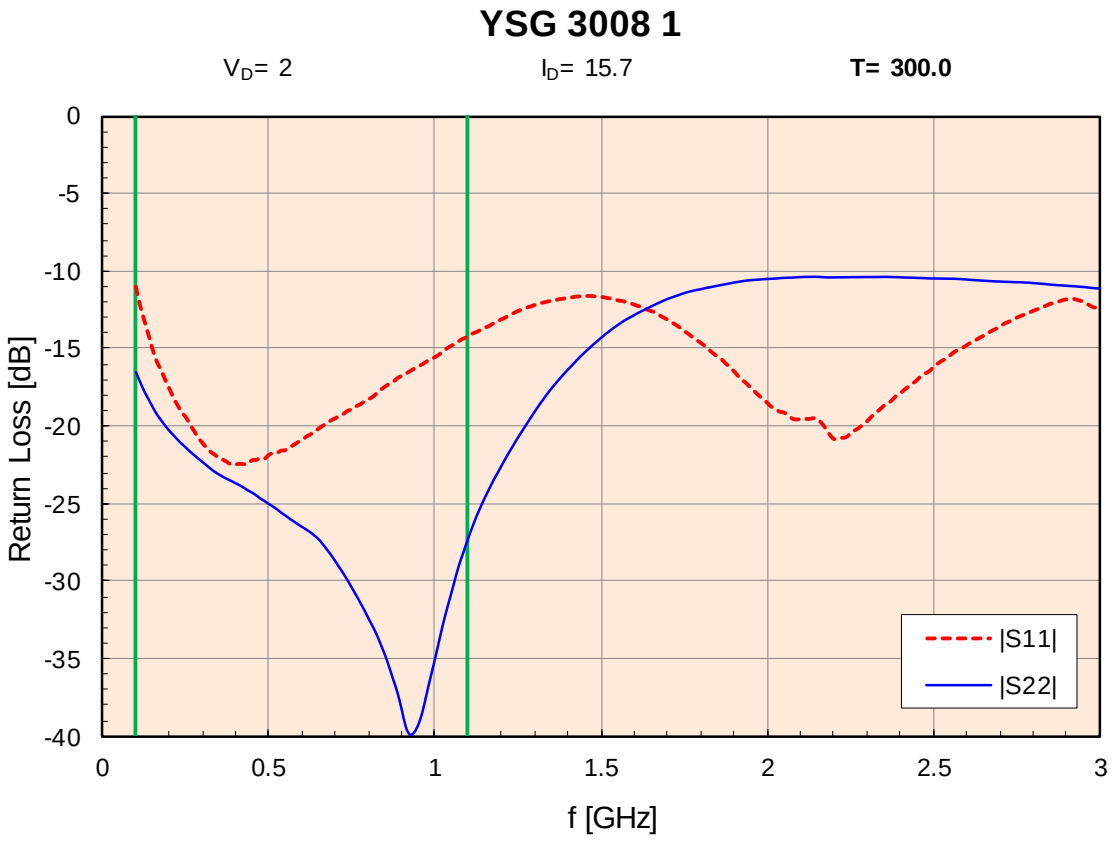
Bias #		1	2	2
Stability	**K factor min. 0-26.5 GHz**	1.9	1.9	1.9

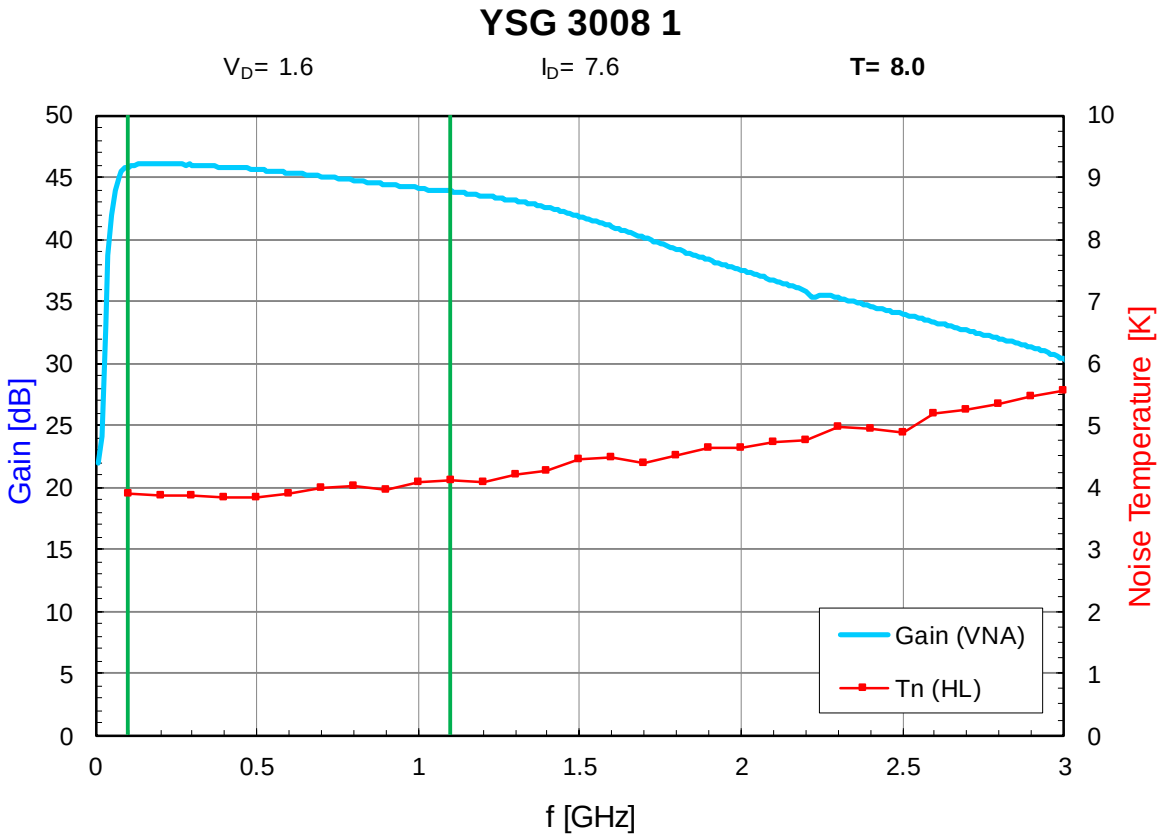
Remarks:

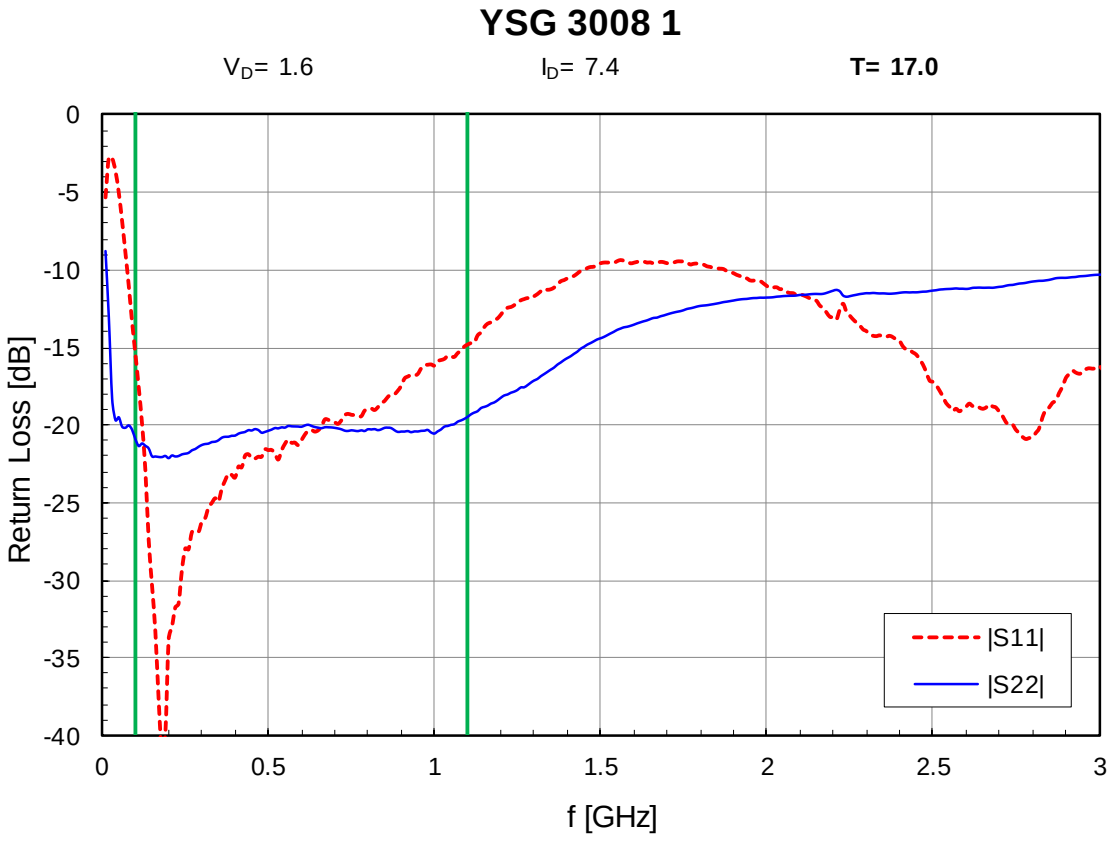
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

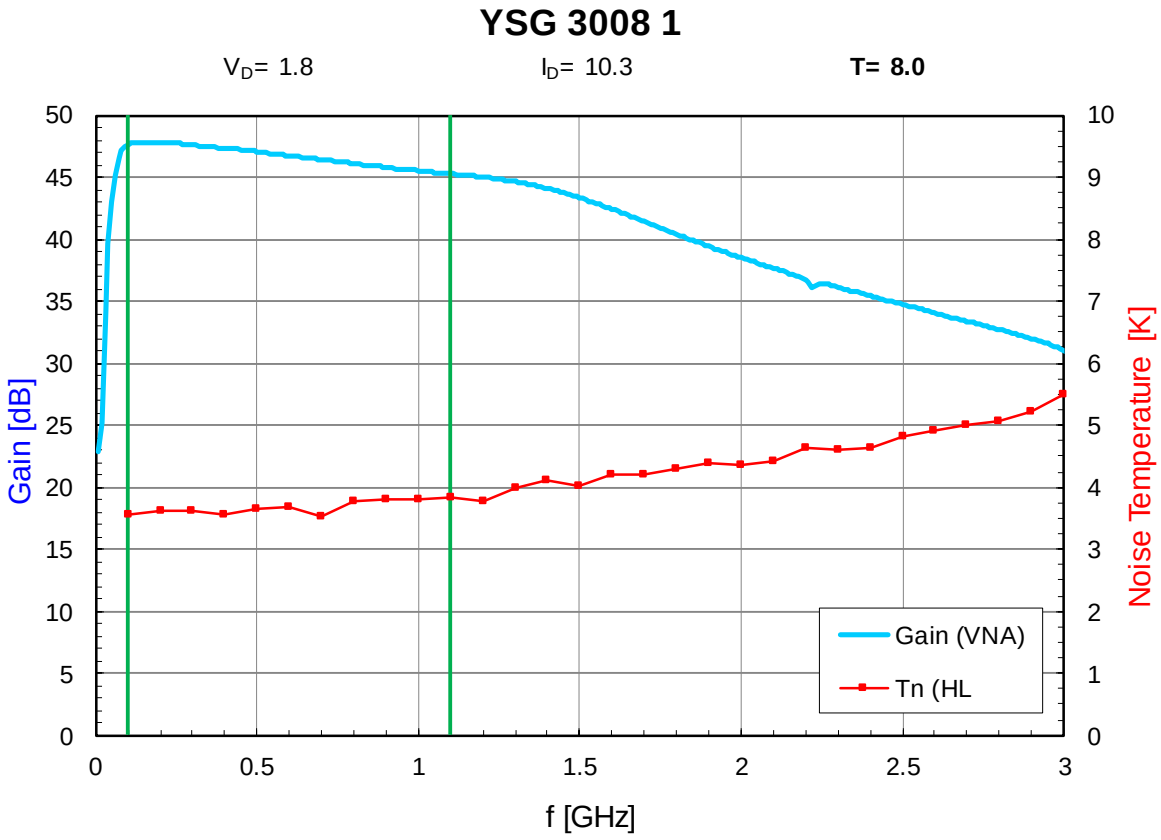
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

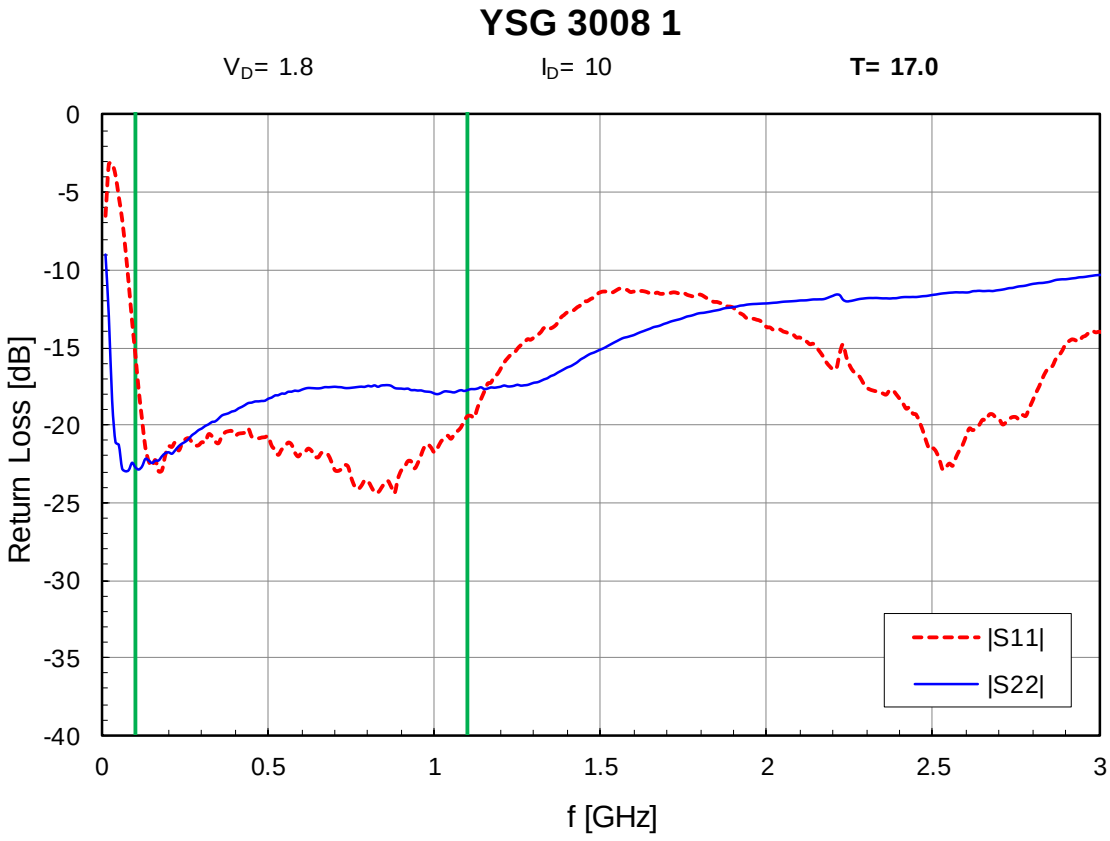

YSG 3008 1
V_D= 2
I_D= 16
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

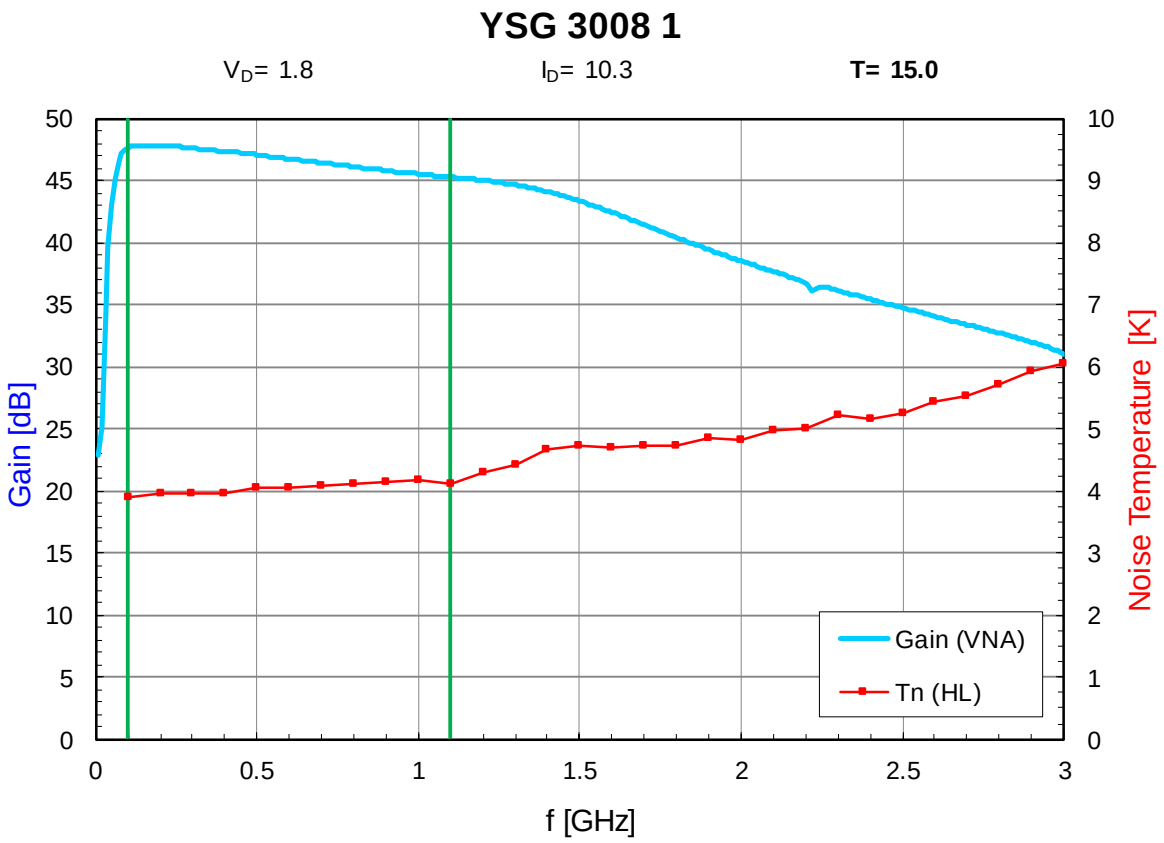

YSG 3008 1
V_D= 2
I_D= 15.7
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3008 1
V_D= 1.6
I_D= 7.6
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3008 1
V_D= 1.6
I_D= 7.4
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3008 1
V_D= 1.8
I_D= 10.3
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL


YSG 3008 1
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3008 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

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CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3009

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.3	**18.5**

Performance:

Bias #		T = 298	T = 8		T = 15
		1	1	2	2
Noise	**average**	52.9	4.0	4.0	4.3
	min. - max.	48.6 - 61.2	3.8 - 4.2	3.8 - 4.1	4.1 - 4.5
Gain	**average**	40.6	45.2	46.6	46.6
	flatness	3.2	2.5	2.7	2.7

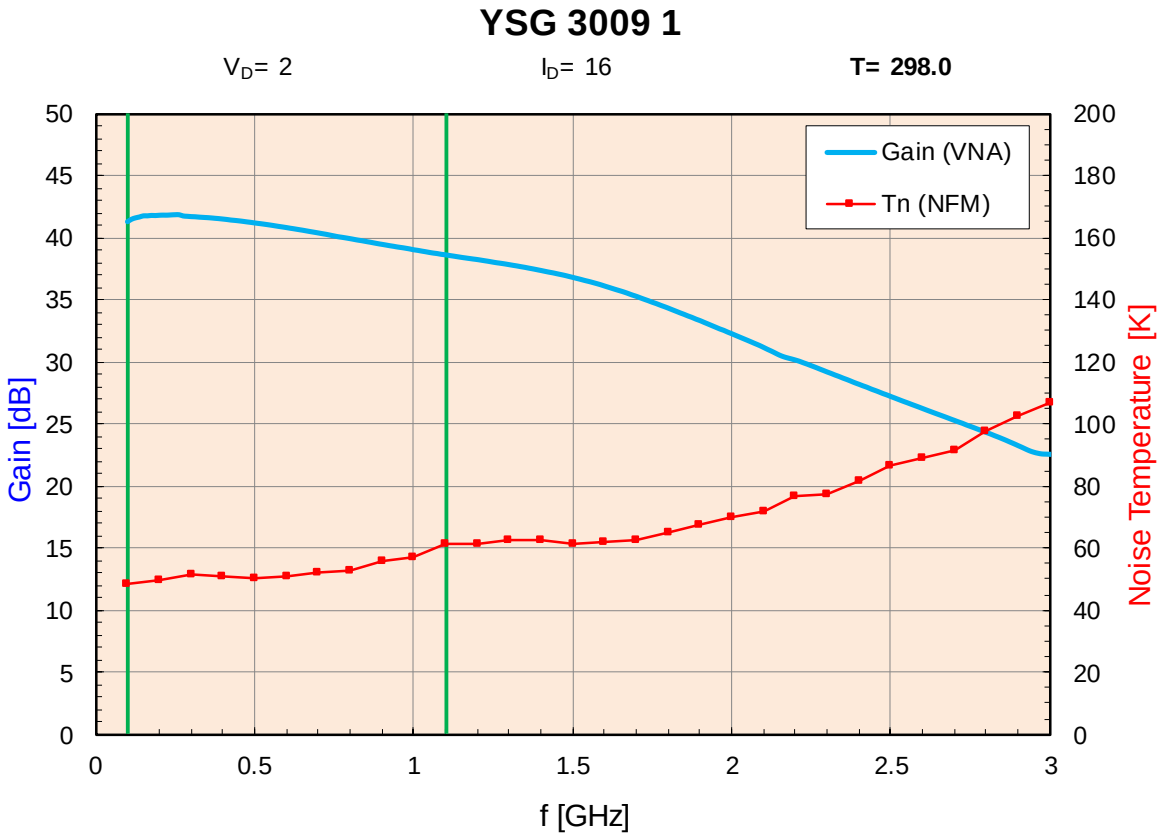
Bias #		1	1	2	2
IRL	**max.**	-11.0	-14.5	-15.1	-15.1
	max. (95%)	-14.3	-15.2	-19.3	-19.3
ORL	**max.**	-16.5	-20.5	-18.4	-18.4
	max. (95%)	-19.2	-20.9	-19.4	-19.4

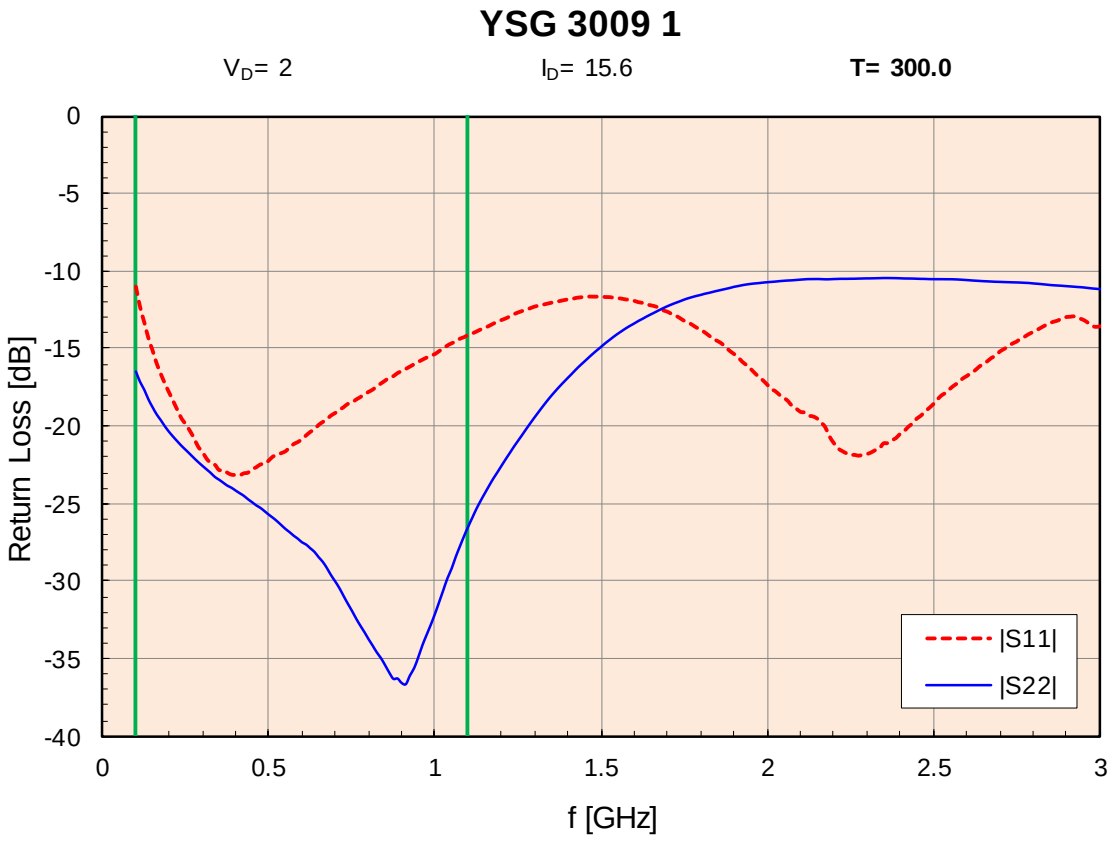
Bias #		1	2	2
Stability	**K factor min. 0-26.5 GHz**	2.0	1.9	1.9

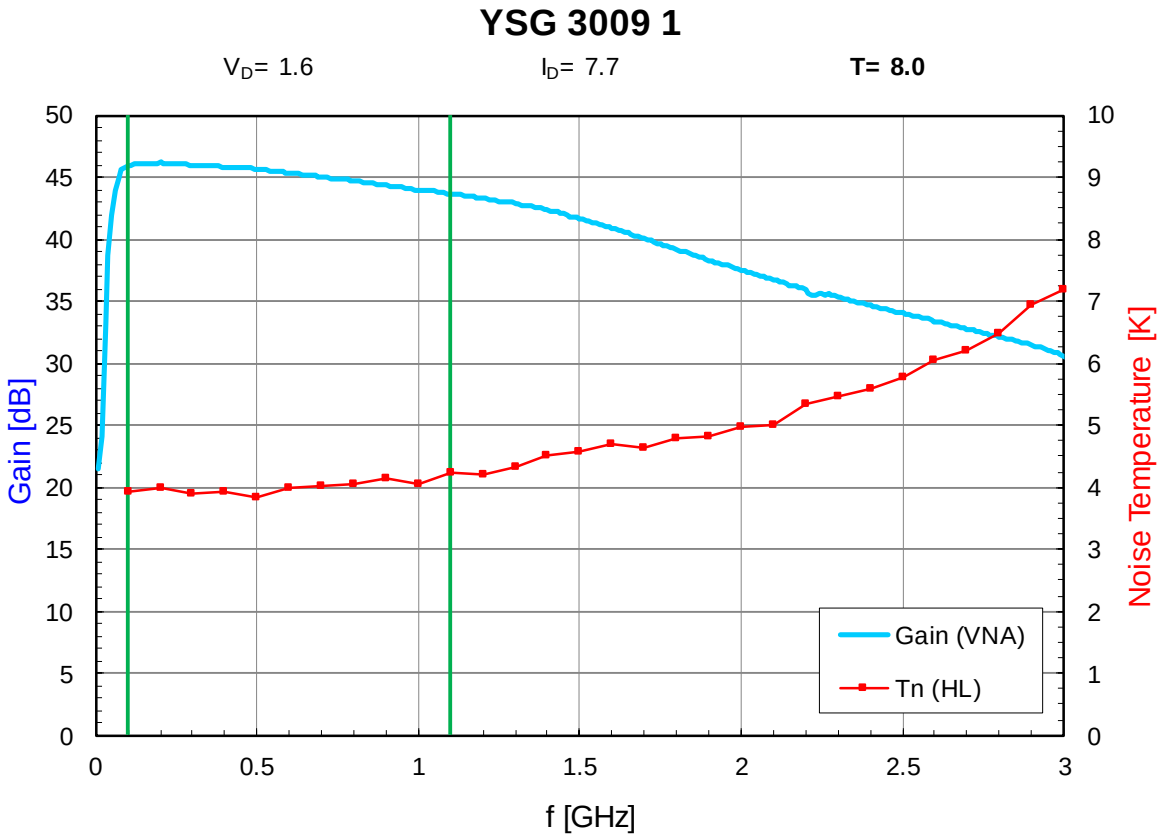
Remarks:

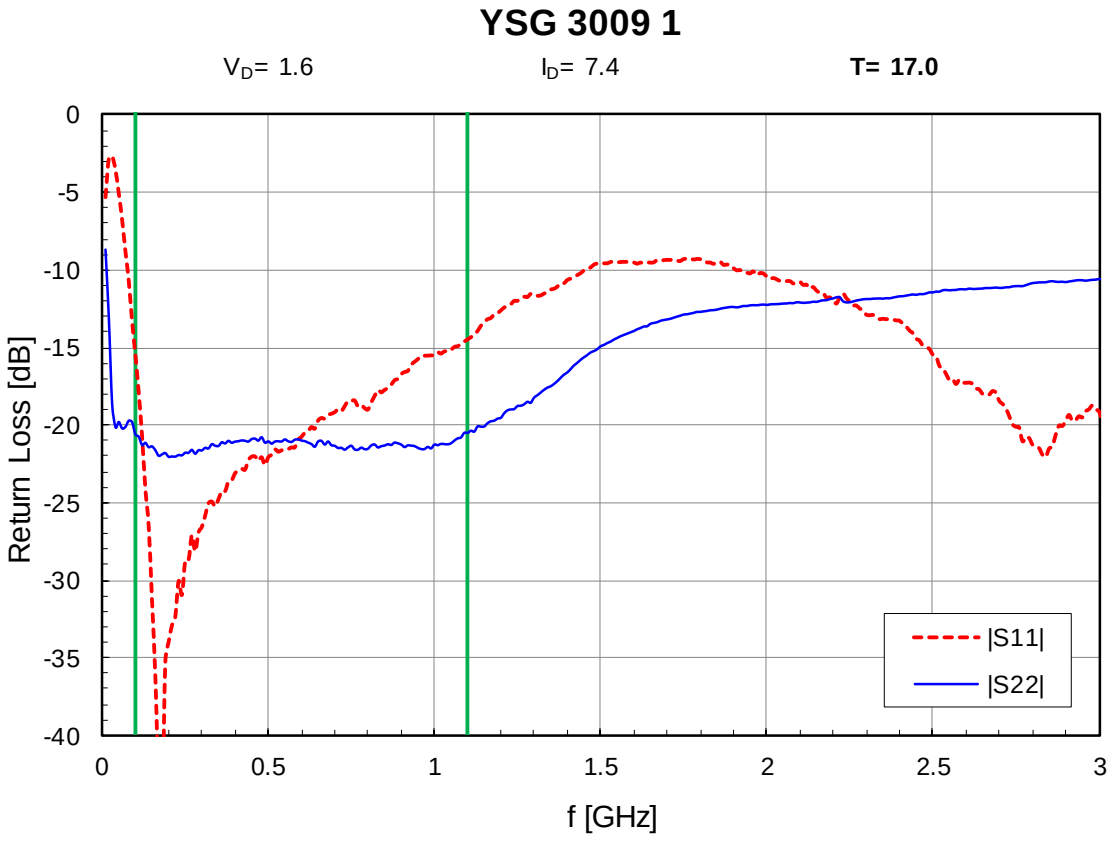
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

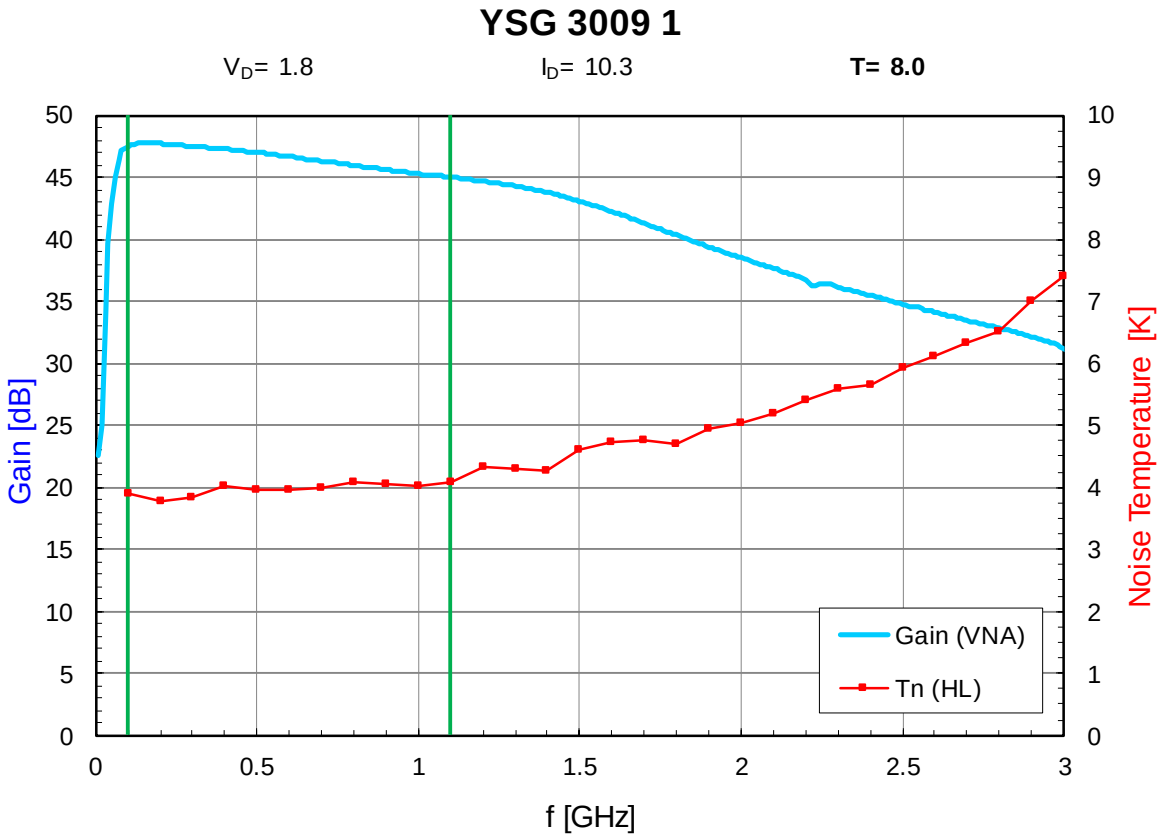
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

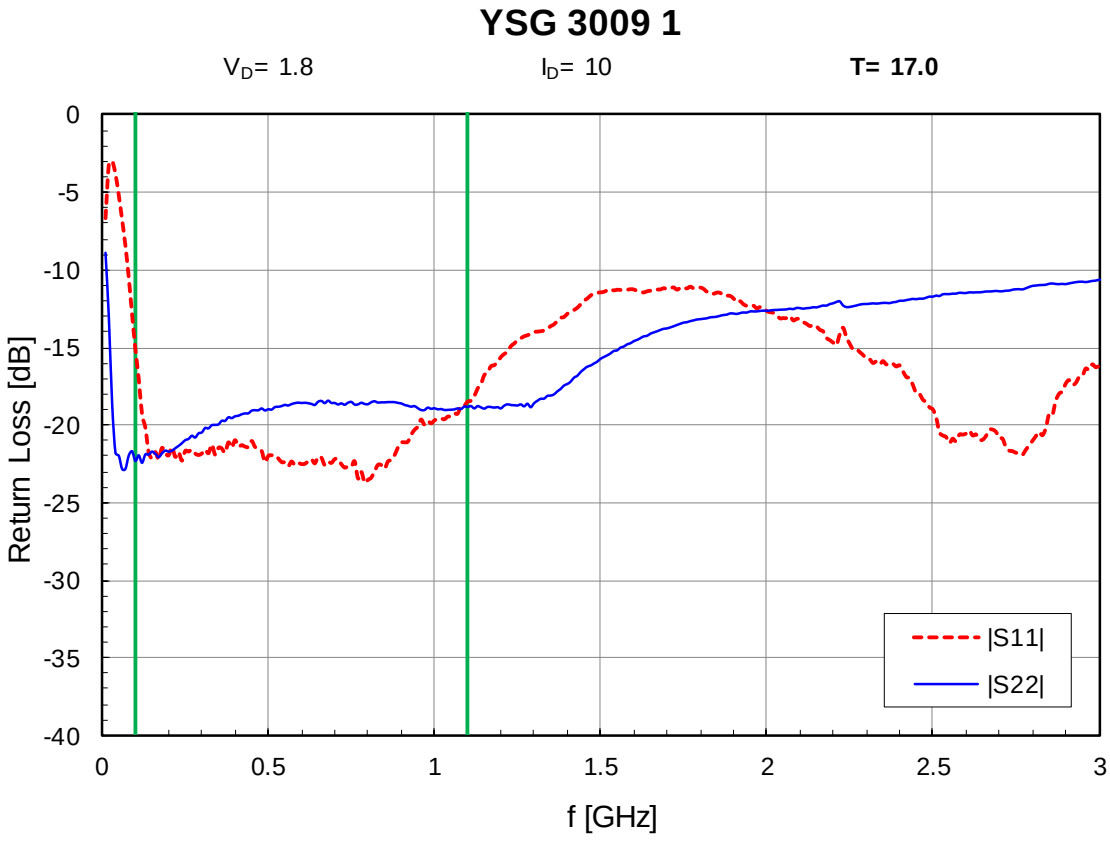

YSG 3009 1
V_D= 2
I_D= 16
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

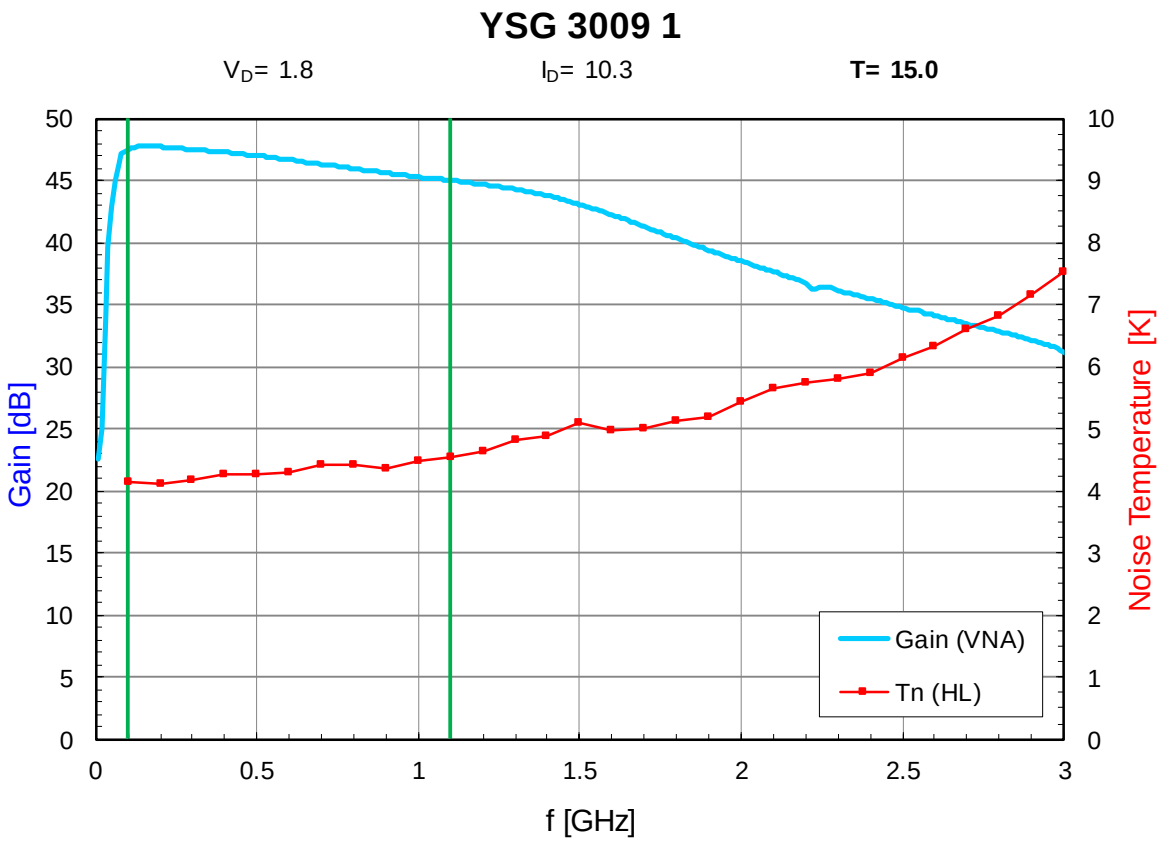

YSG 3009 1
V_D= 2
I_D= 15.6
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3009 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3009 1
V_D= 1.6
I_D= 7.4
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3009 1
V_D= 1.8
I_D= 10.3
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3009 1
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3009 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

OBSERVATORIO DE YEBES

CENTRO DE DESARROLLOS TECNOLÓGICOS – **IGN**

Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3010

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	16	32	**1.6**	7.7	**12.3**
Bias #2				**1.8**	10.3	**18.5**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	52.5	3.9	3.8	4.2
	min. - max.	49.2 - 58.9	3.8 - 4.1	3.6 - 4.1	4 - 4.4
Gain	**average**	40.7	44.9	46.4	46.4
	flatness	3.1	2.2	2.6	2.6

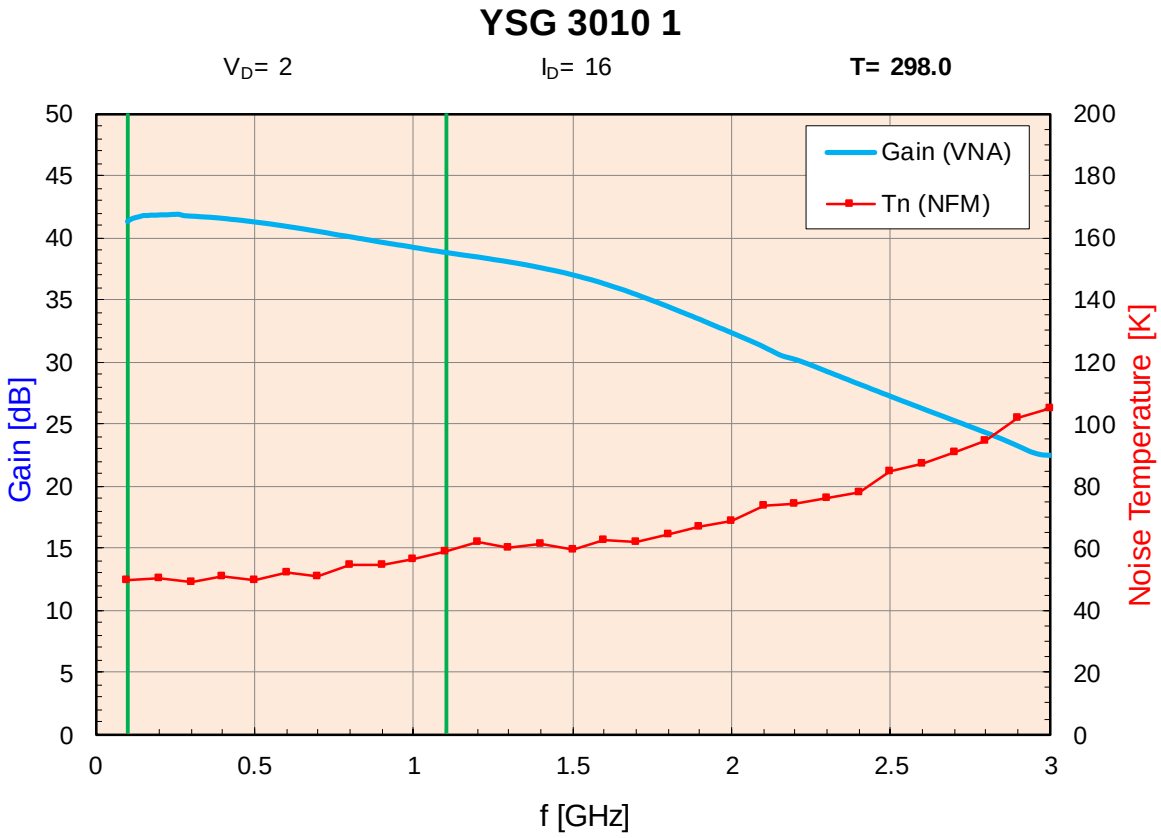
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-11.1	-14.6	-14.1	-14.1
	max. (95%)	-14.3	-15.3	-19.9	-19.9
ORL	**max.**	-16.5	-20.2	-18.8	-18.8
	max. (95%)	-19.2	-21.2	-19.8	-19.8

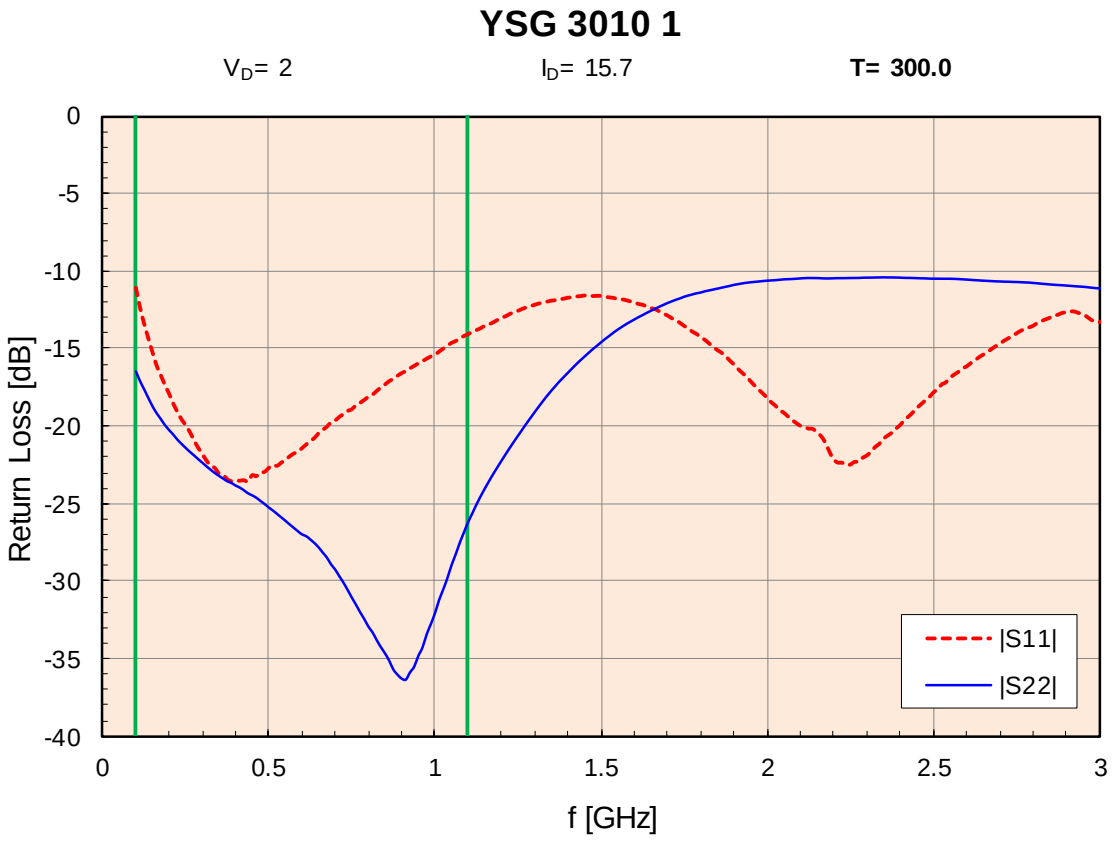
Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	2.1	2.0	2.0

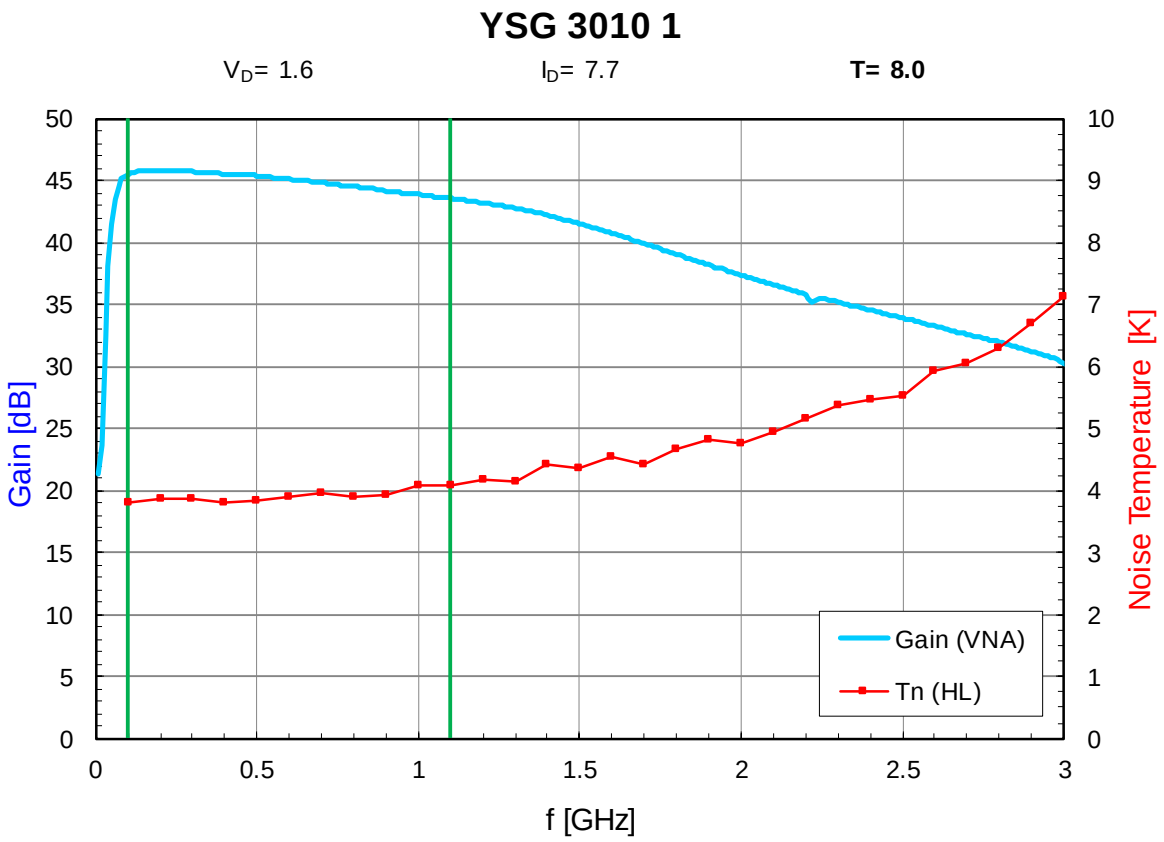
Remarks:

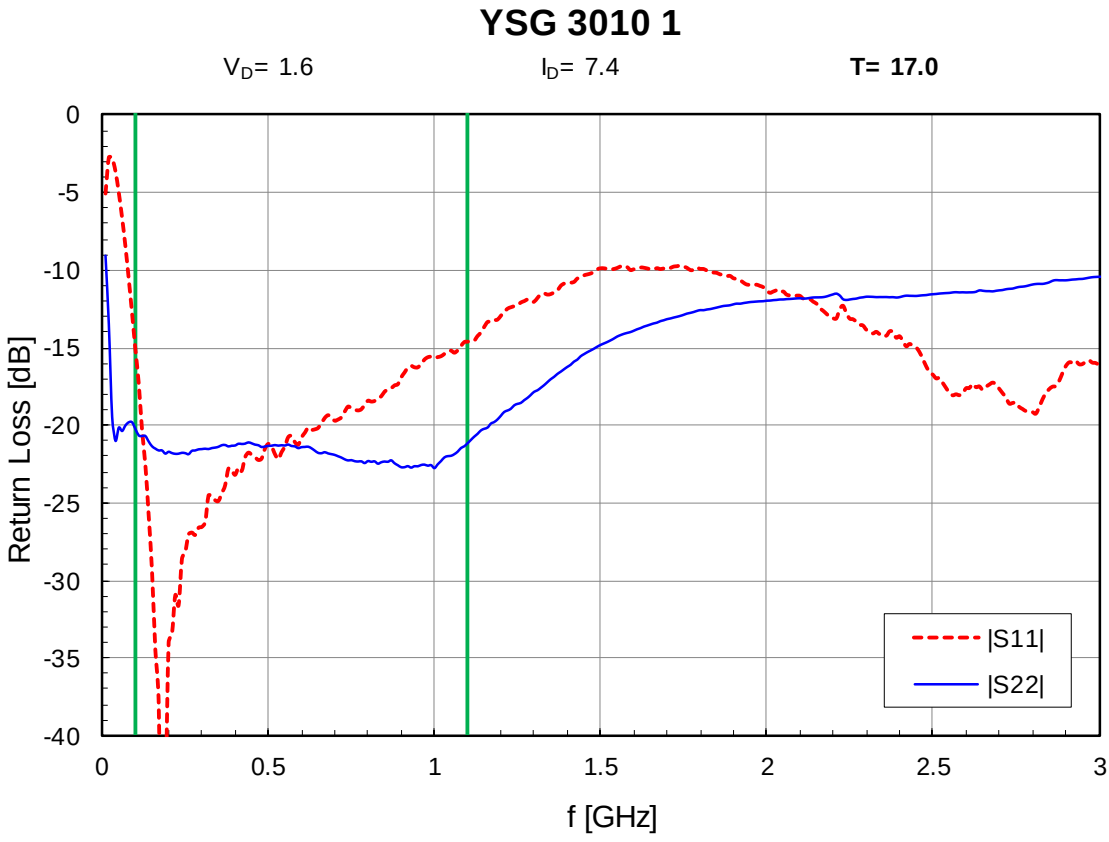
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

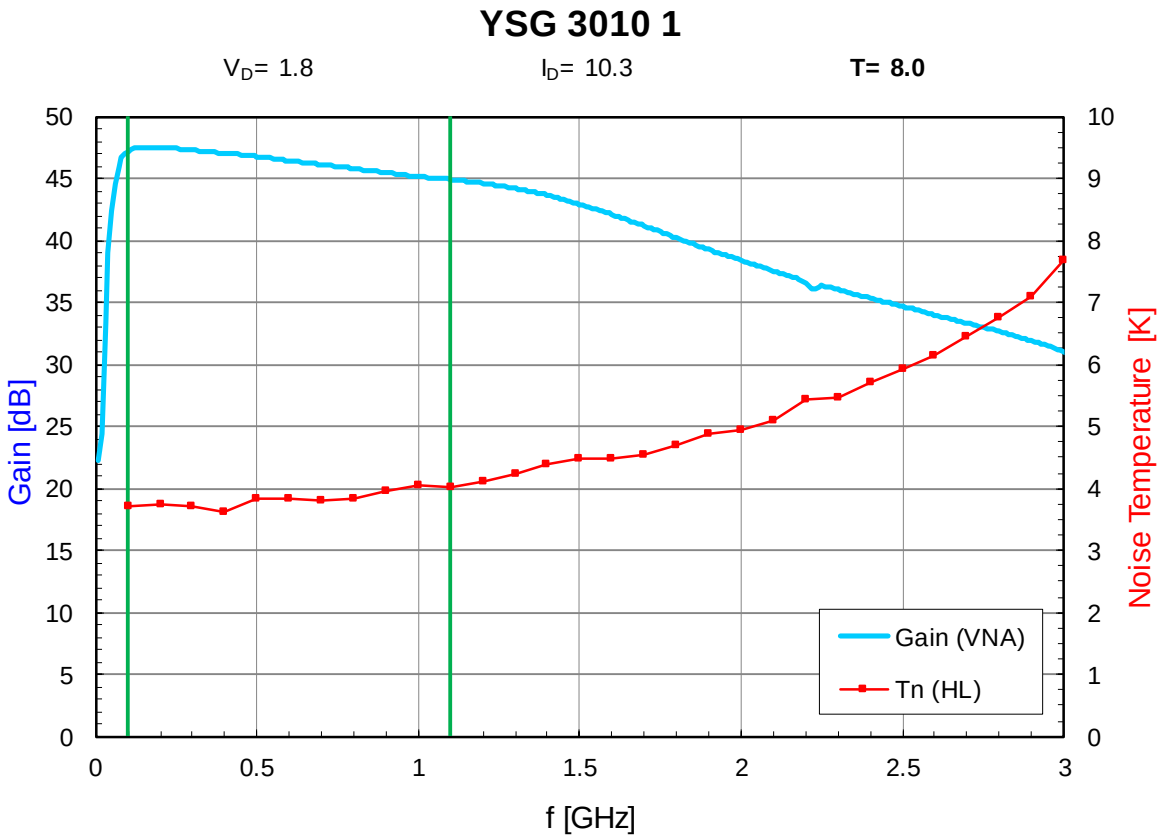
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

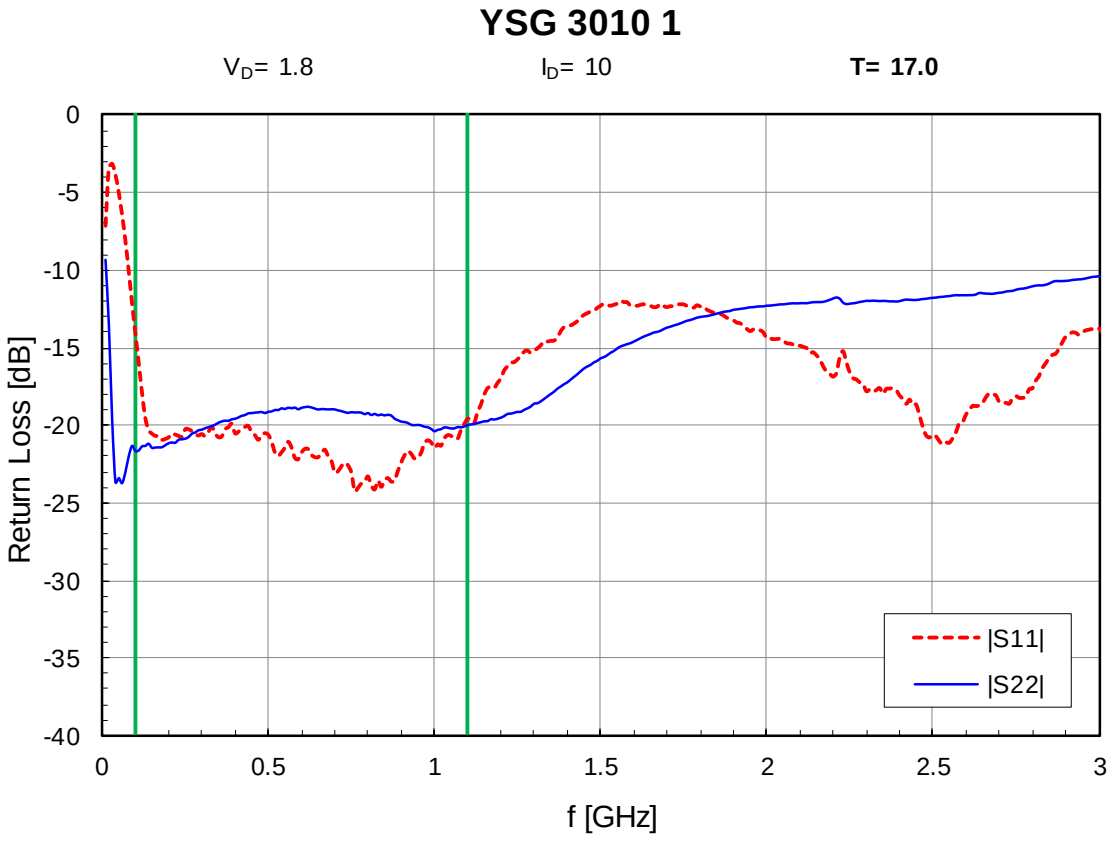

YSG 3010 1
V_D= 2
I_D= 16
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

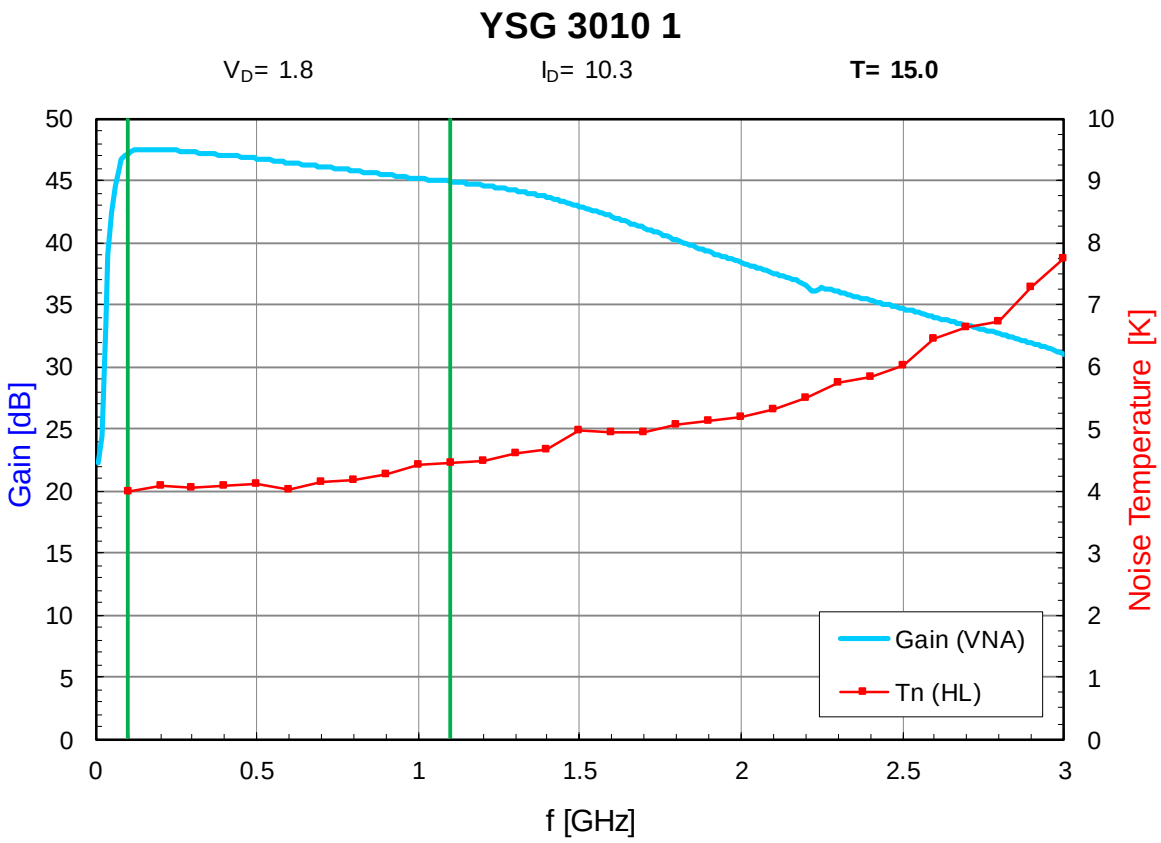

YSG 3010 1
V_D= 2
I_D= 15.7
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3010 1
V_D= 1.6
I_D= 7.7
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3010 1
V_D= 1.6
I_D= 7.4
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3010 1
V_D= 1.8
I_D= 10.3
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3010 1
V_D= 1.8
I_D= 10
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3010 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3

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Apartado 148
19080 Guadalajara, SPAIN

Phone: +34 949 29 03 11
e-mail: i.lopez@oan.es

CRYOGENIC LNA DATA SHEET

YSG 3011

Date: 30/07/2021

Nominal Band: **0.1 - 1.1 GHz**

TRT reference: ST1: SiGe HBT Infineon ST2: SiGe HBT NXP

Bias:

	Room temperature			Cryogenic		
	V_d	(I_d)	Power	V_d	(I_d)	Power
Bias #1	**2**	15.9	31.8	**1.6**	7.6	**12.2**
Bias #2				**1.8**	10.2	**18.4**

Performance:

		T = 298	T = 8		T = 15
Bias #		**1**	**1**	**2**	**2**
Noise	**average**	54.0	5.2	4.9	5.2
	min. - max.	48.5 - 61.4	5 - 5.3	4.8 - 5.1	5 - 5.4
Gain	**average**	40.7	44.6	46.1	46.1
	flatness	3.1	2.0	2.2	2.2

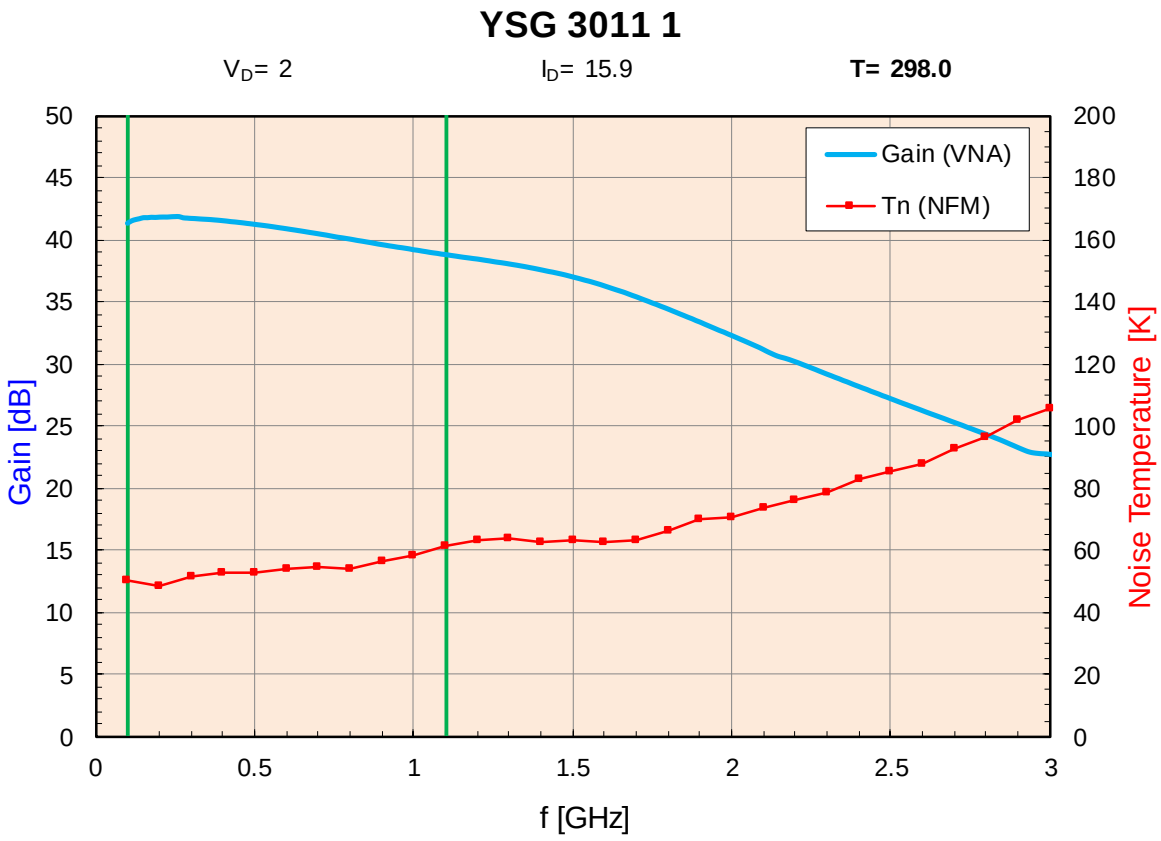
Bias #		**1**	**1**	**2**	**2**
IRL	**max.**	-11.2	-15.9	-15.4	-15.4
	max. (95%)	-14.9	-16.1	-15.7	-15.7
ORL	**max.**	-16.6	-20.7	-18.4	-18.4
	max. (95%)	-19.4	-20.9	-19.6	-19.6

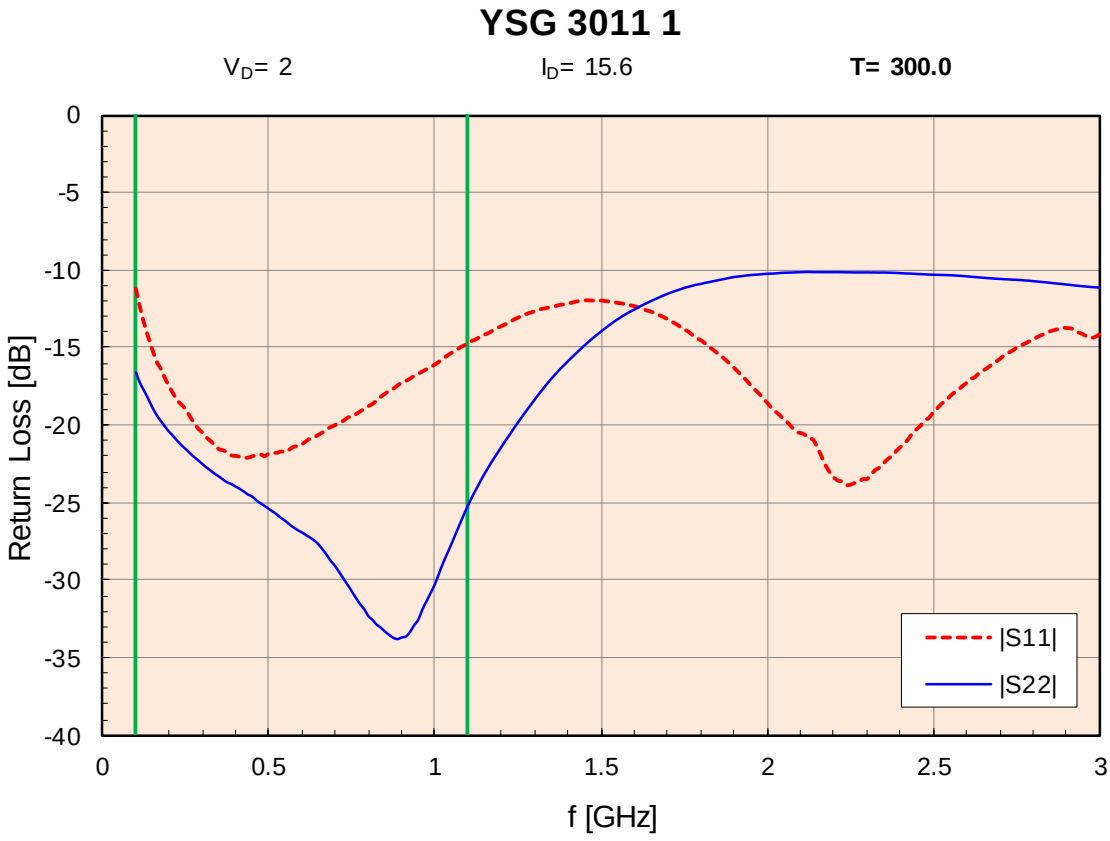
Bias #		**1**	**2**	**2**
Stability	**K factor min. 0-26.5 GHz**	2.1	1.9	1.9

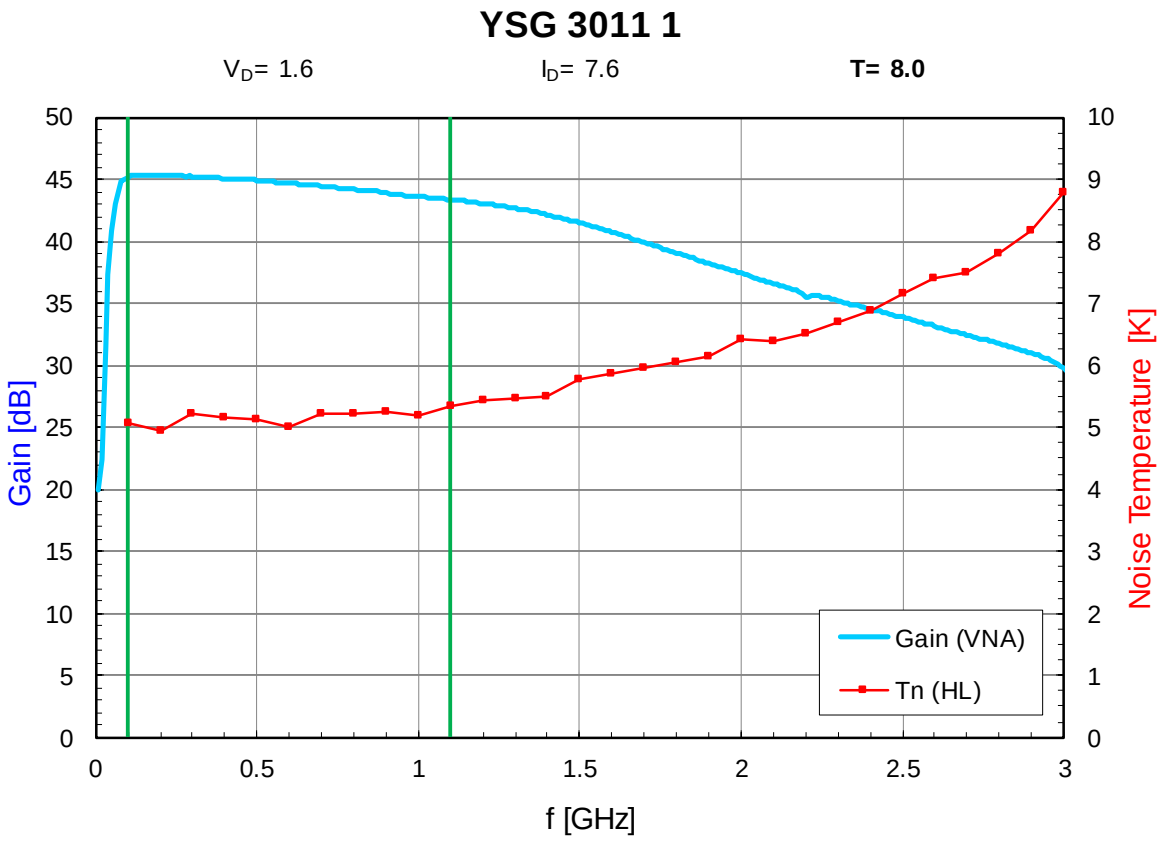
Remarks:

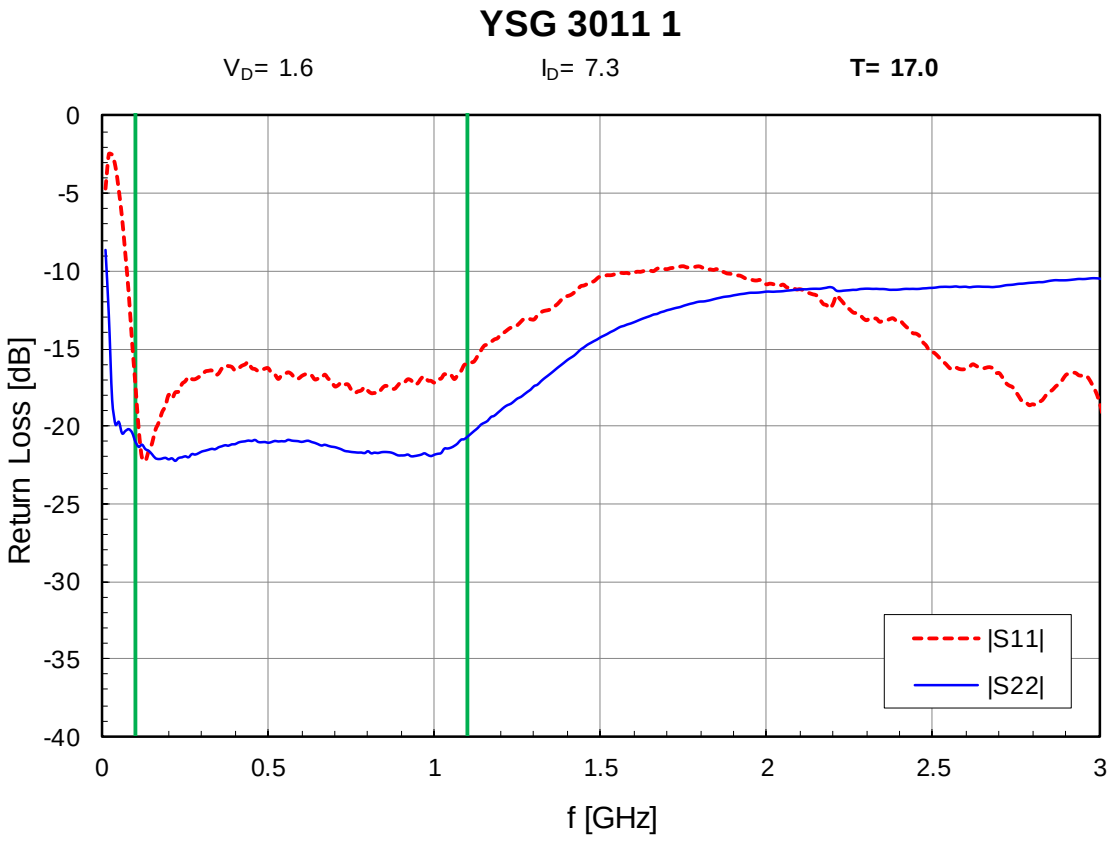
- Noise measurements using the controlled temperature load method
- Gain data from VNA measurements
- Gain and RL data measured around 15 K - Negligible variation at 8 K
- 95% indicates parameter values not exceeded in 95% of the measurement frequency band

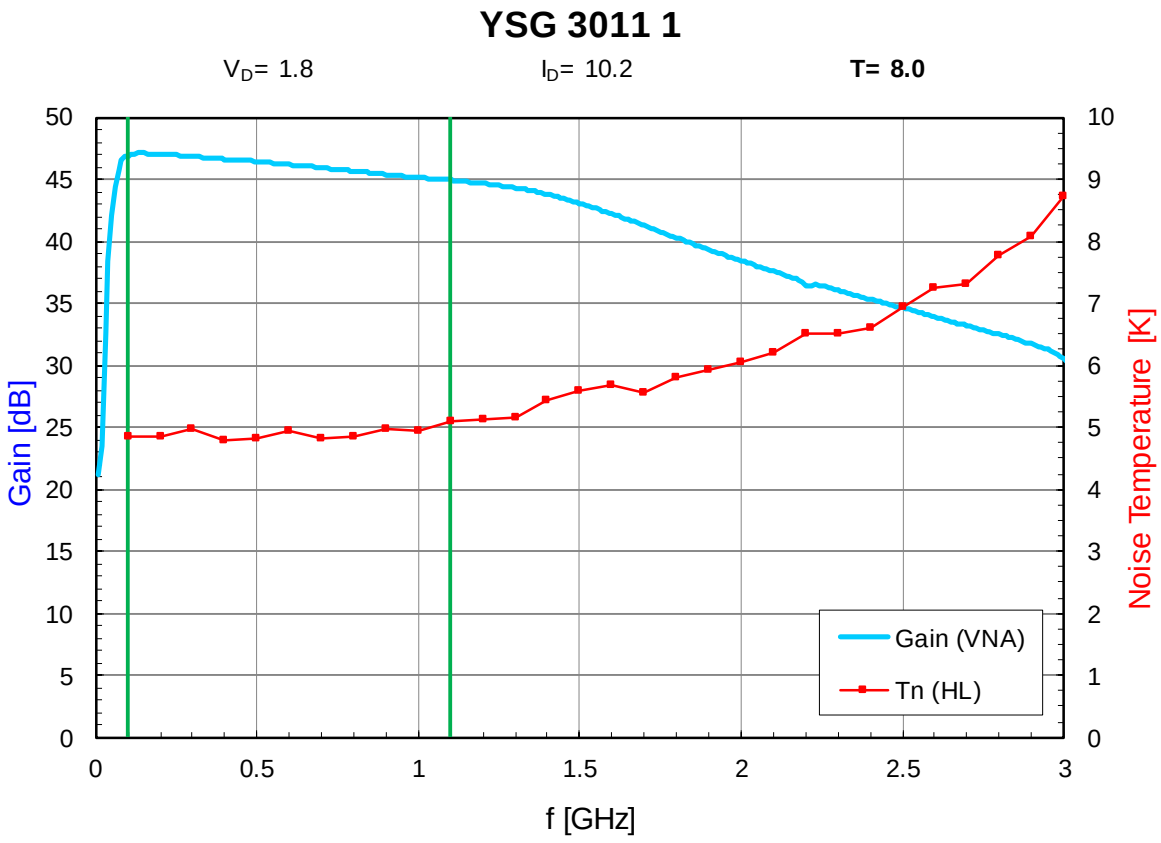
Vd, Vg in Volts, Id in mA, Power in mW, Noise temperature in K, Gain and Return loss in dB, Compression in dBm, Frequency in GHz

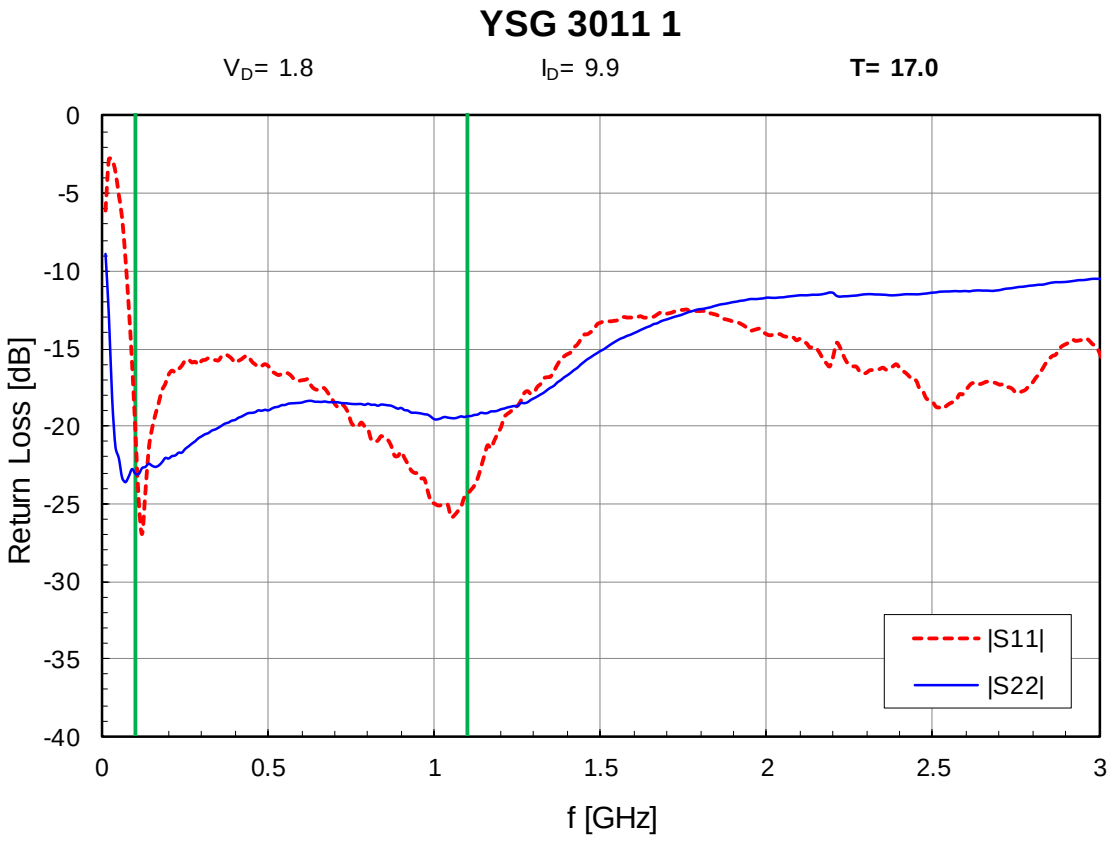

YSG 3011 1
V_D= 2
I_D= 15.9
T= 298.0
Gain (VNA)
Tn (NFM)
Gain [dB]
Noise Temperature [K]
f [GHz]

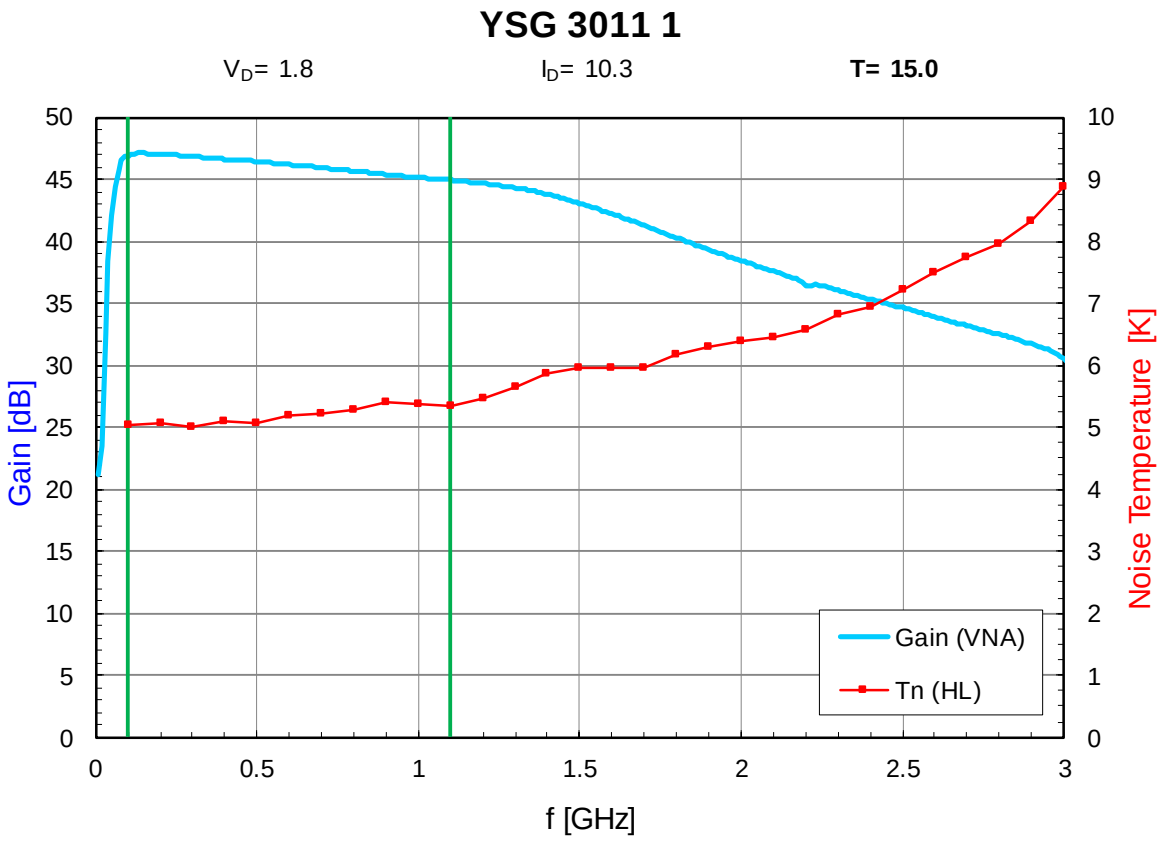

YSG 3011 1
V_D= 2
I_D= 15.6
T= 300.0
|S11|
|S22|
Return Loss [dB]
f [GHz]


YSG 3011 1
V_D= 1.6
I_D= 7.6
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3011 1
V_D= 1.6
I_D= 7.3
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3011 1
V_D= 1.8
I_D= 10.2
T= 8.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)


YSG 3011 1
V_D= 1.8
I_D= 9.9
T= 17.0
Return Loss [dB]
f [GHz]
|S11|
|S22|


YSG 3011 1
V_D= 1.8
I_D= 10.3
T= 15.0
Gain [dB]
Noise Temperature [K]
f [GHz]
Gain (VNA)
Tn (HL)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
0
0.5
1
1.5
2
2.5
3