REPEATER SENSITIVITY / DE-SENSE TESTS

TESTING RX SENSITIVITY DEGRADATION CAUSED BY:

- **ANTENNA NOISE PICK-UP**
- **TX SIGNAL FEEDING BACK INTO RX**

BUILDING A USEFUL SAMPLER – WITH MEASURED RESPONSE

GE MASTER II FRONT END HELICAL FILTER RESPONSE

GE MASTER II PREAMPLIFIER NOISE FIGURE TESTS

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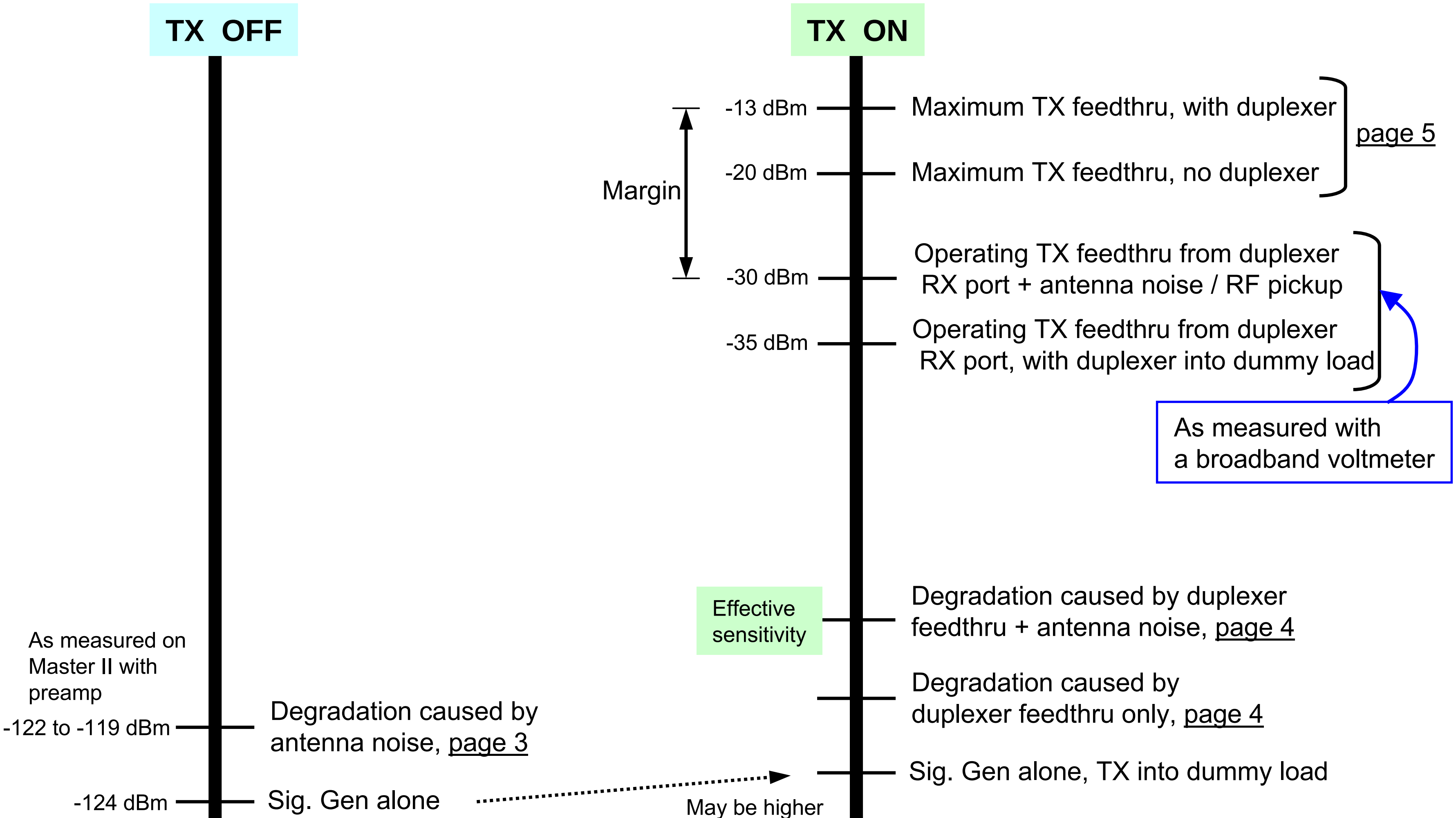
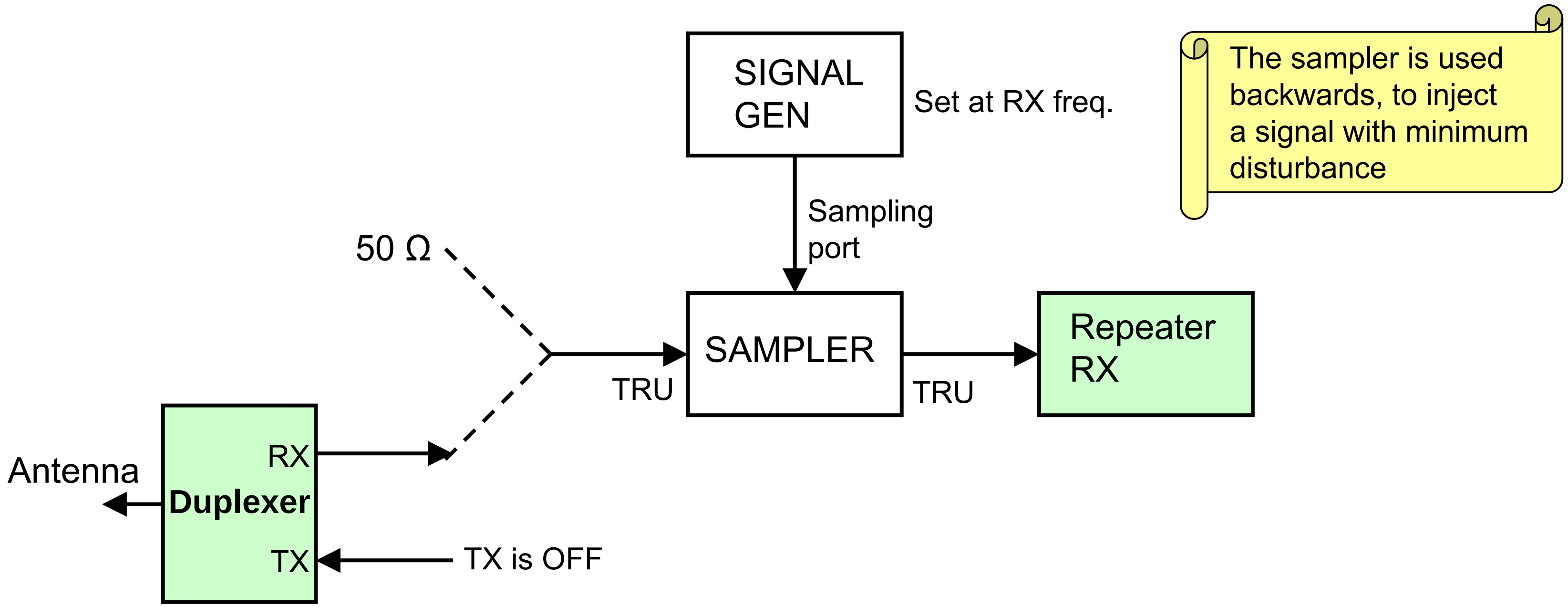
SUMMARY OF SENSITIVITY / DE-SENSE TESTS



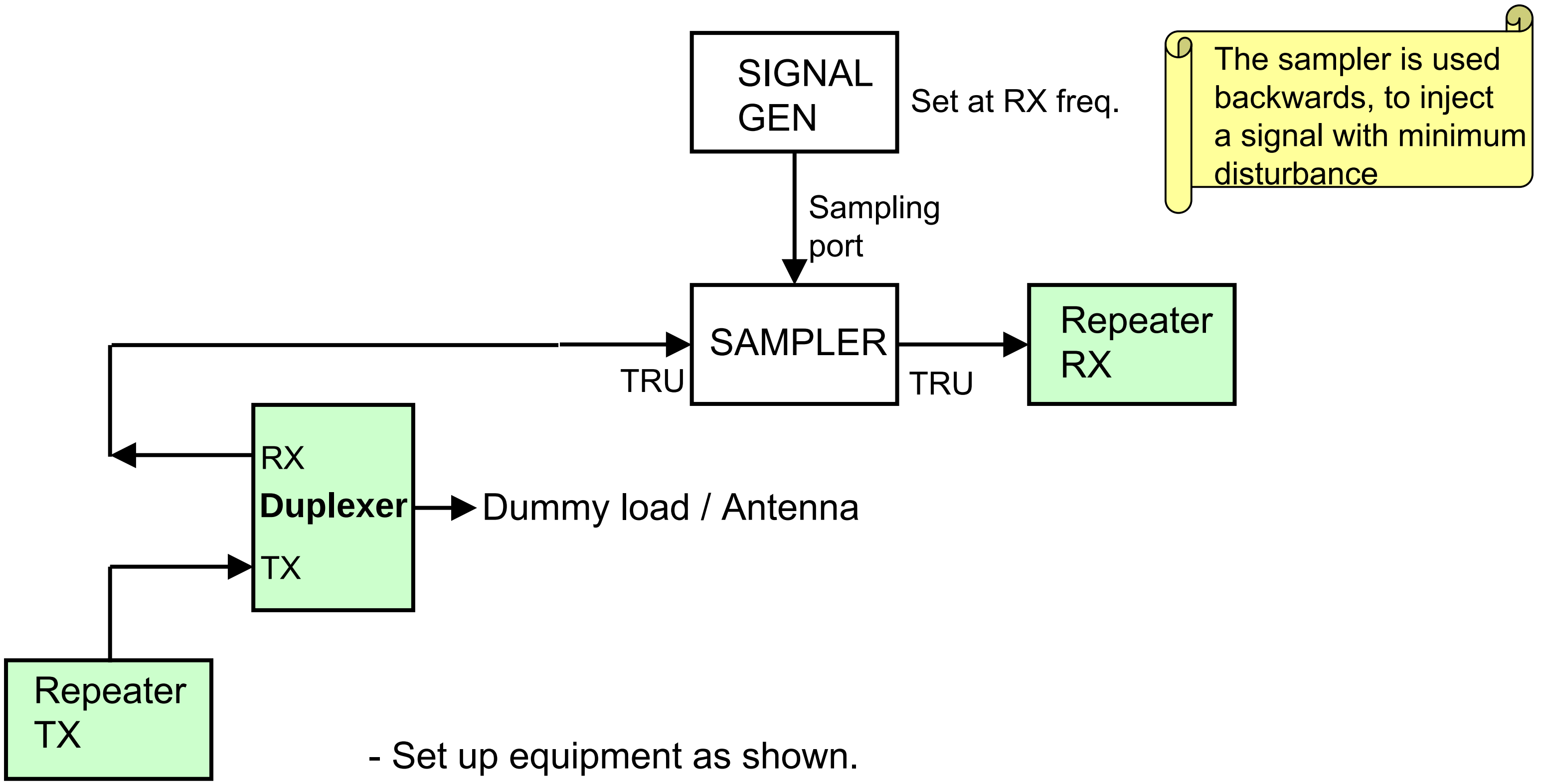
TESTING RX SENSITIVITY DEGRADATION CAUSED BY: ANTENNA NOISE PICK-UP



Adjust Sig Gen to check sensitivity with 50 Ω term connected.
Repeat sensitivity test with Antenna connected (Connect to duplexer RX port)
With the antenna, the sensitivity is degraded by the antenna noise present. Note the reduction.

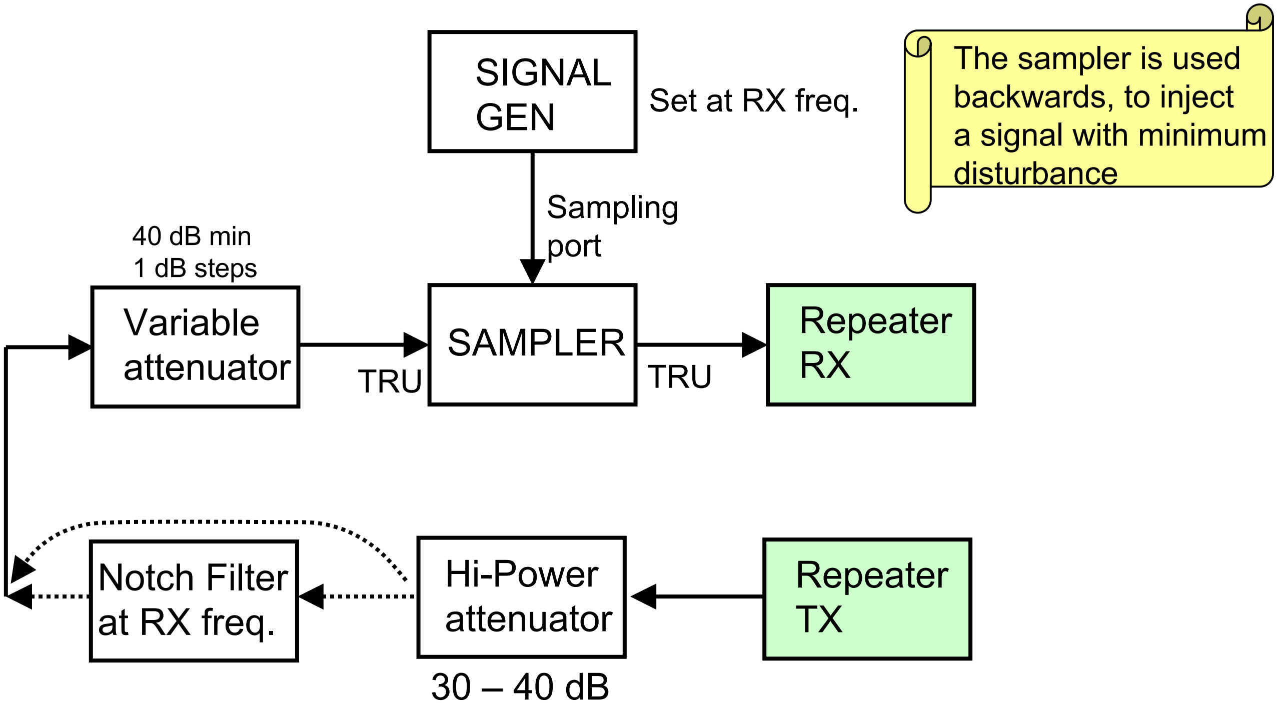
On Master II: measured 2 to 5 dB reduction with 2m antenna at QTH
The preamp is good enough even with 4.7 dB noise figure !

TESTING RX SENSITIVITY DEGRADATION CAUSED BY: TX SIGNAL FEEDING BACK INTO RX



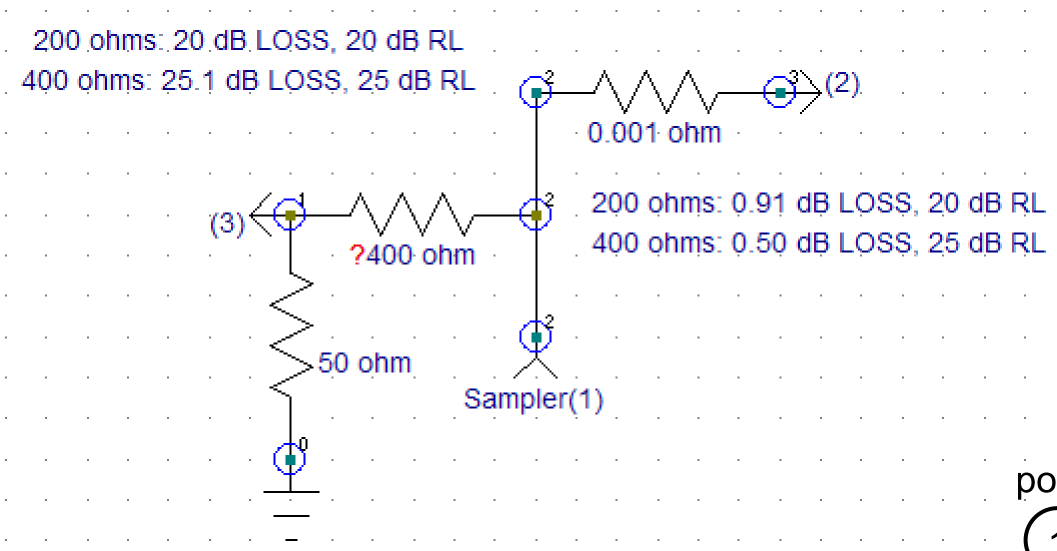
- Set up equipment as shown.
- With TX OFF, set Sig Gen just above the squelch trigger level.
-Turn ON TX with duplexer connected to dummy load: The repeater RX sensitivity should remain the same. (1 or 2 dB de-sense is OK).
- Repeat above test with the antenna connected. This shows the combined effect of the TX de-sense and the antenna noise.

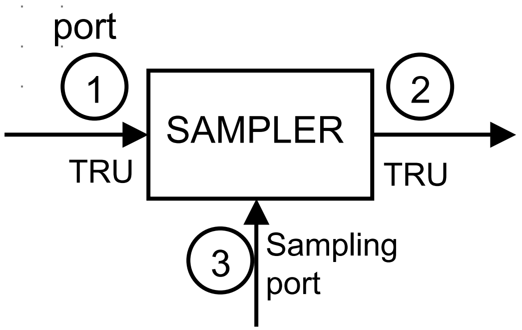
TESTING TX MAXIMUM FEEDTHRU INTO RX
– Check without / with notch filter



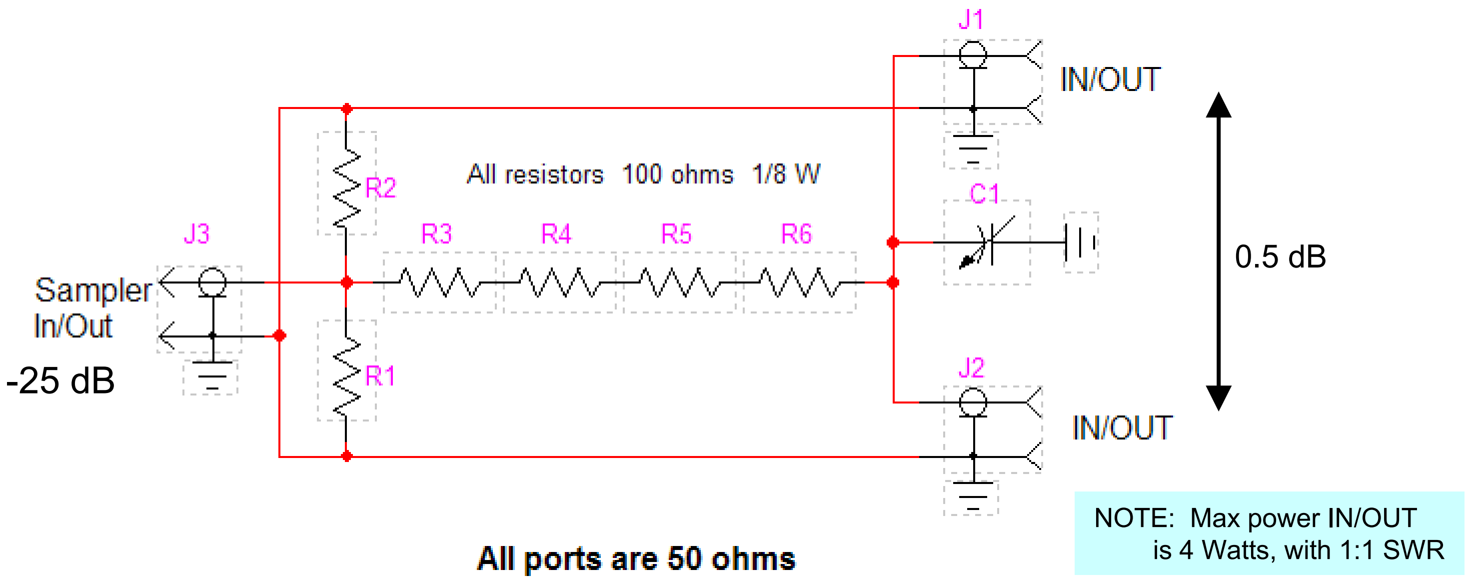
Set up equipment as shown.
With TX OFF, set Sig Gen 2 - 5 dB above the squelch trigger level. (I used 3 dB).
Set Variable atten to max atten. Turn ON TX: The repeater RX sensitivity should remain the same.
Decrease attenuation in 1 dB steps until the RX squelch turns off the received carrier + noise.
Measure TX power at the sampler output. This is the worst case RX overload point. (-20 dBm on Master II)
With a duplexer, the RX overload point should be higher since filtering of the TX phase noise occurs.
(Measured –13 dBm on Master II, with a 27 dB notch at the RX freq. and added between the Hi-Power atten and Variable attenuator. The same value was obtained with a low noise signal generator).
With a duplexer, the RX overload point should be compared to the TX power measured at the RX port of the duplexer. (Approx – 30 dBm). This shows a good margin.

SAMPLER DESIGN and SIMULATIONS

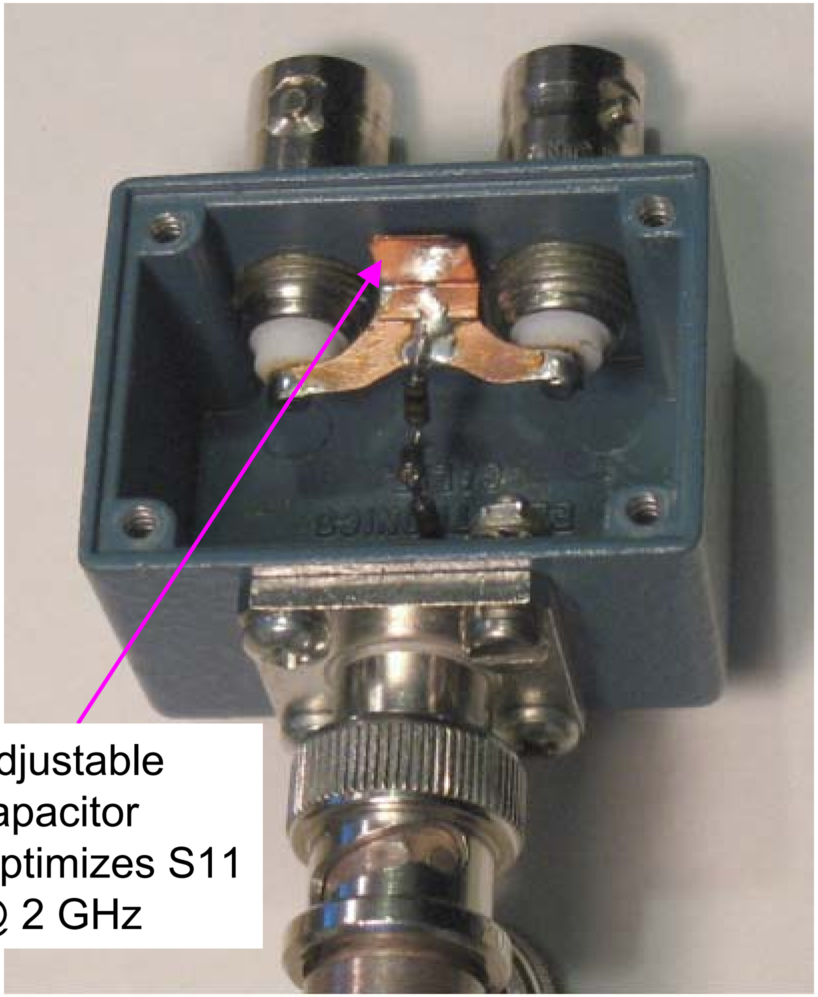




SAMPLER SCHEMATIC

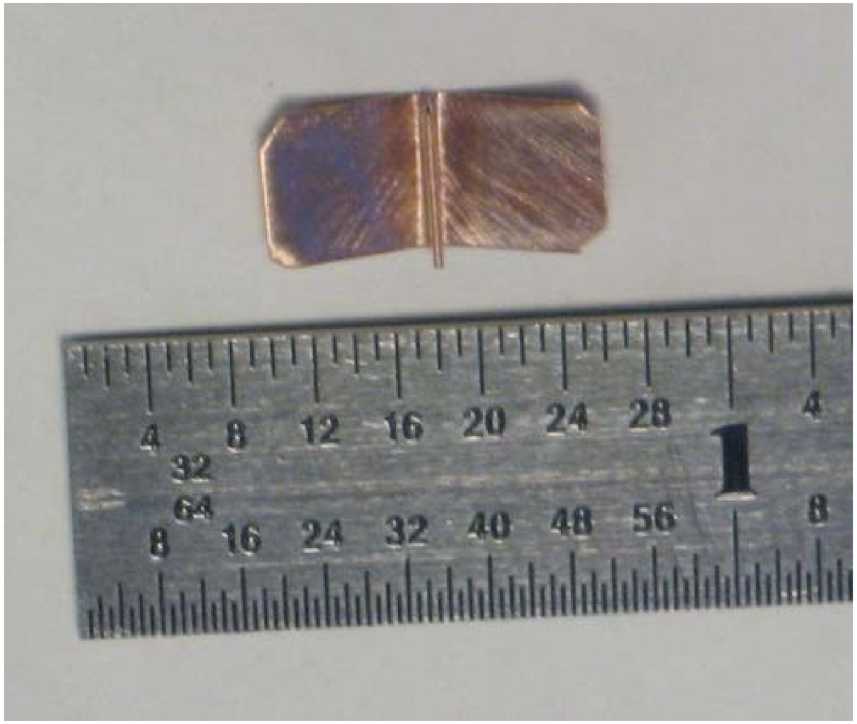


SAMPLER PICTURES

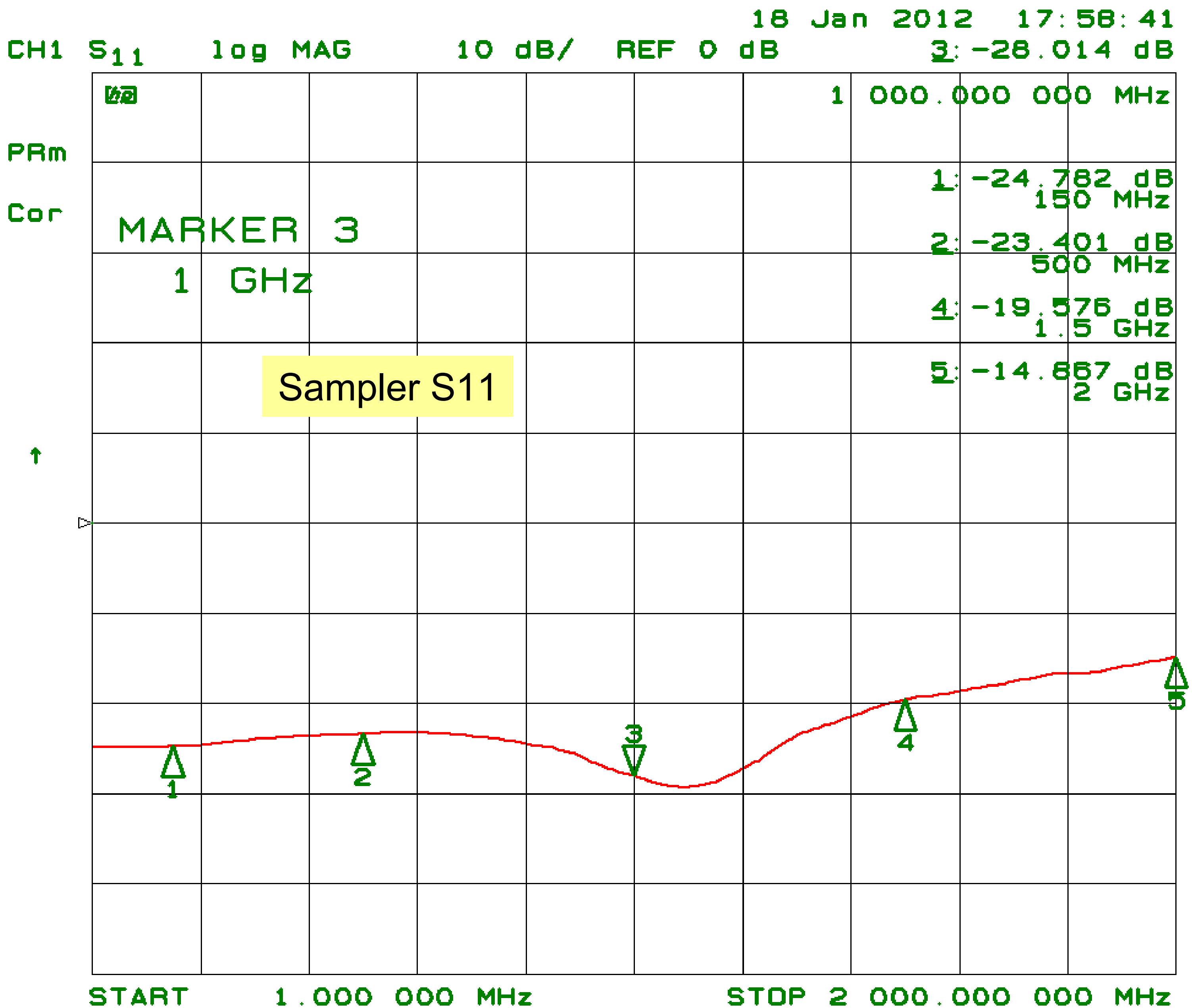


SAMPLER PICTURES

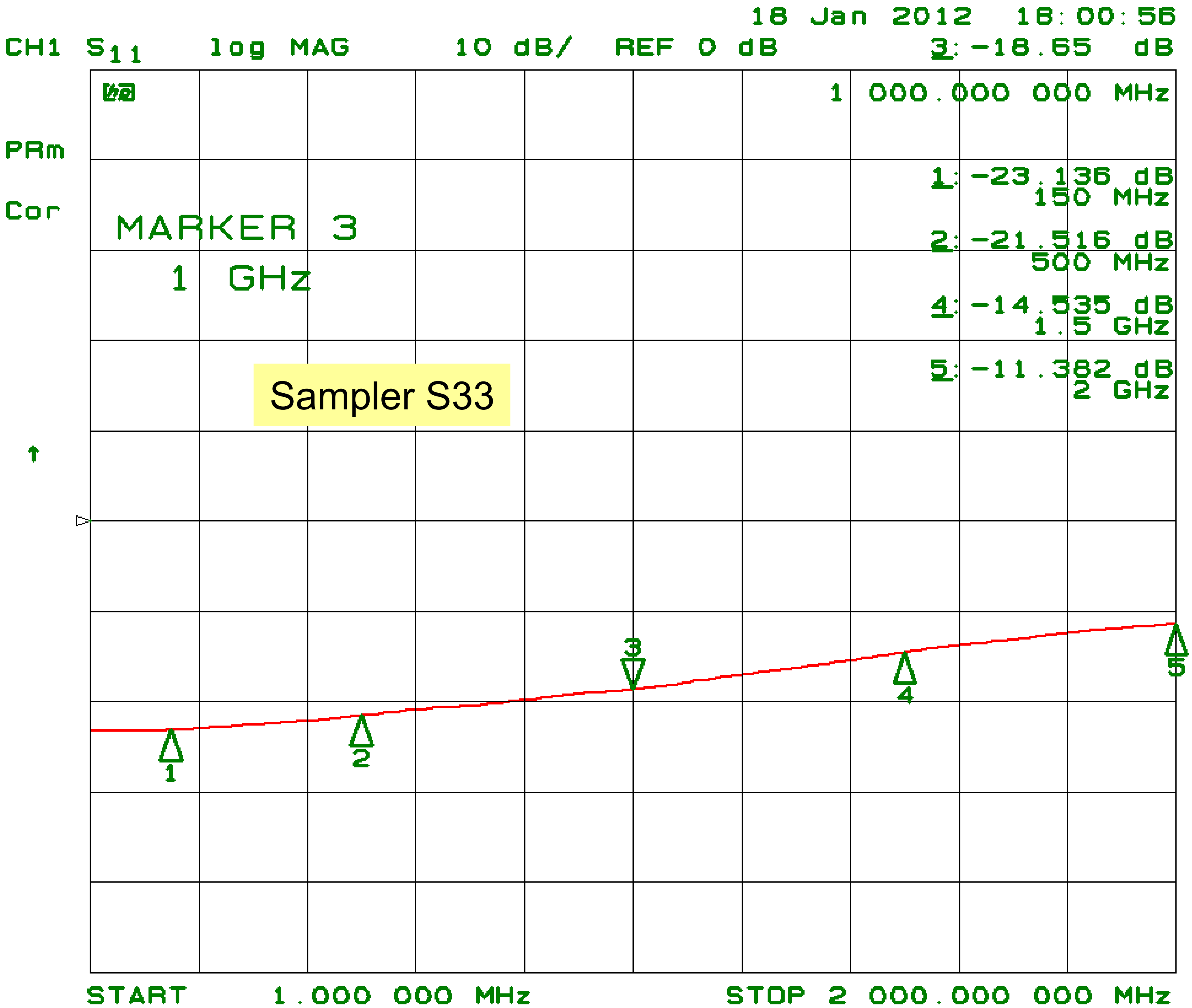
Adjustable capacitor before soldering

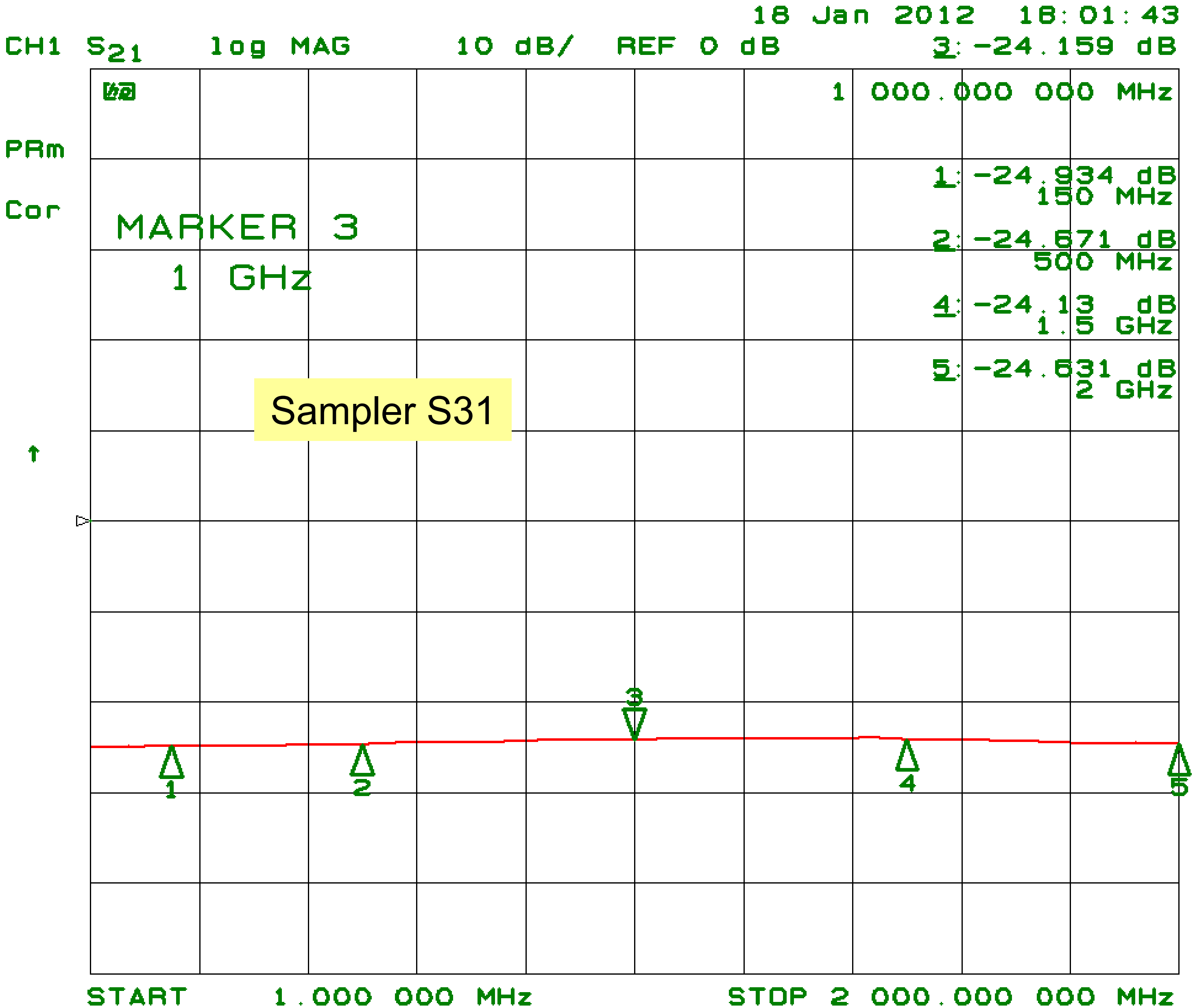


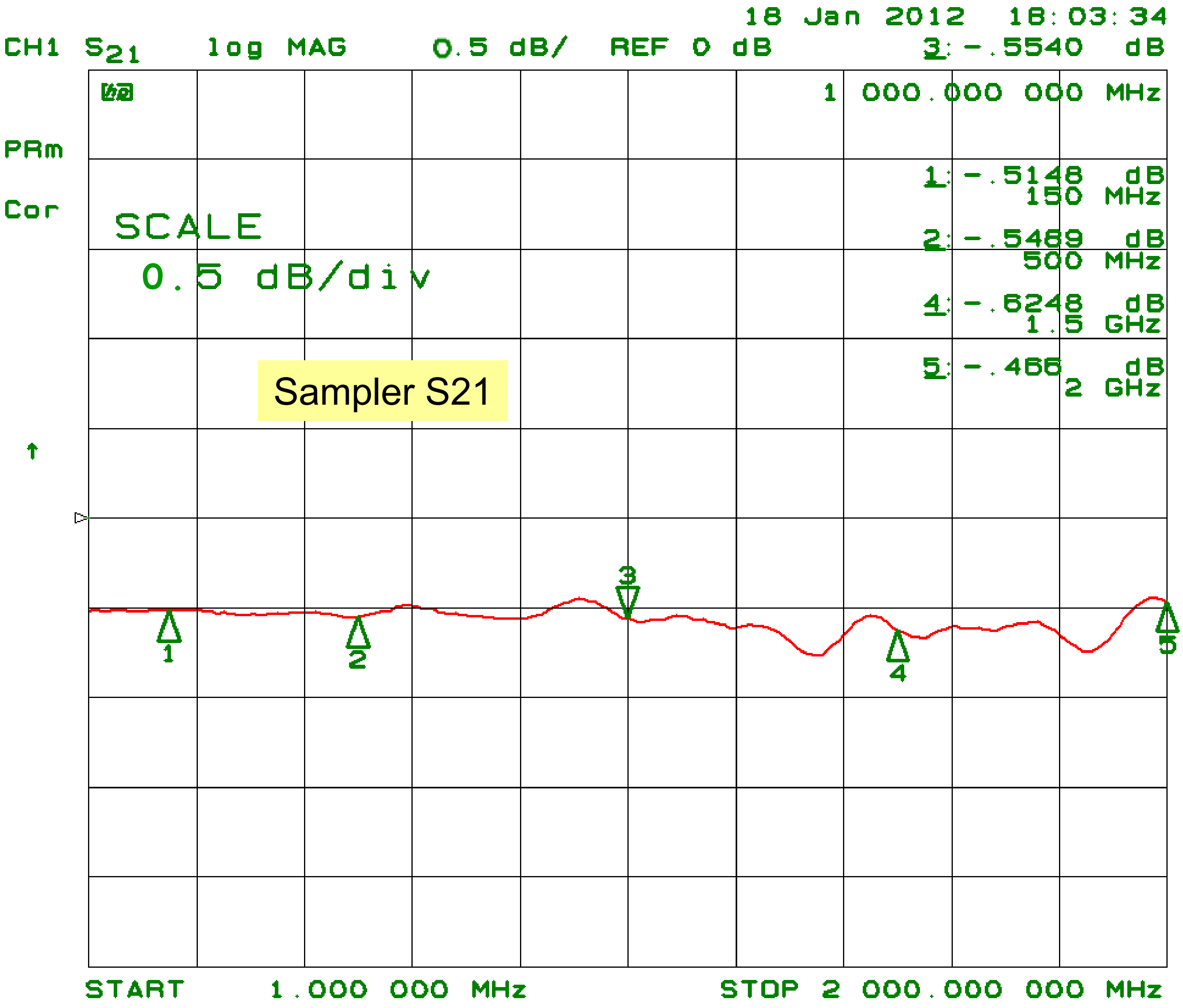
Note: Only required on
wideband 2 GHz version
Omit if sampler is only used at VHF



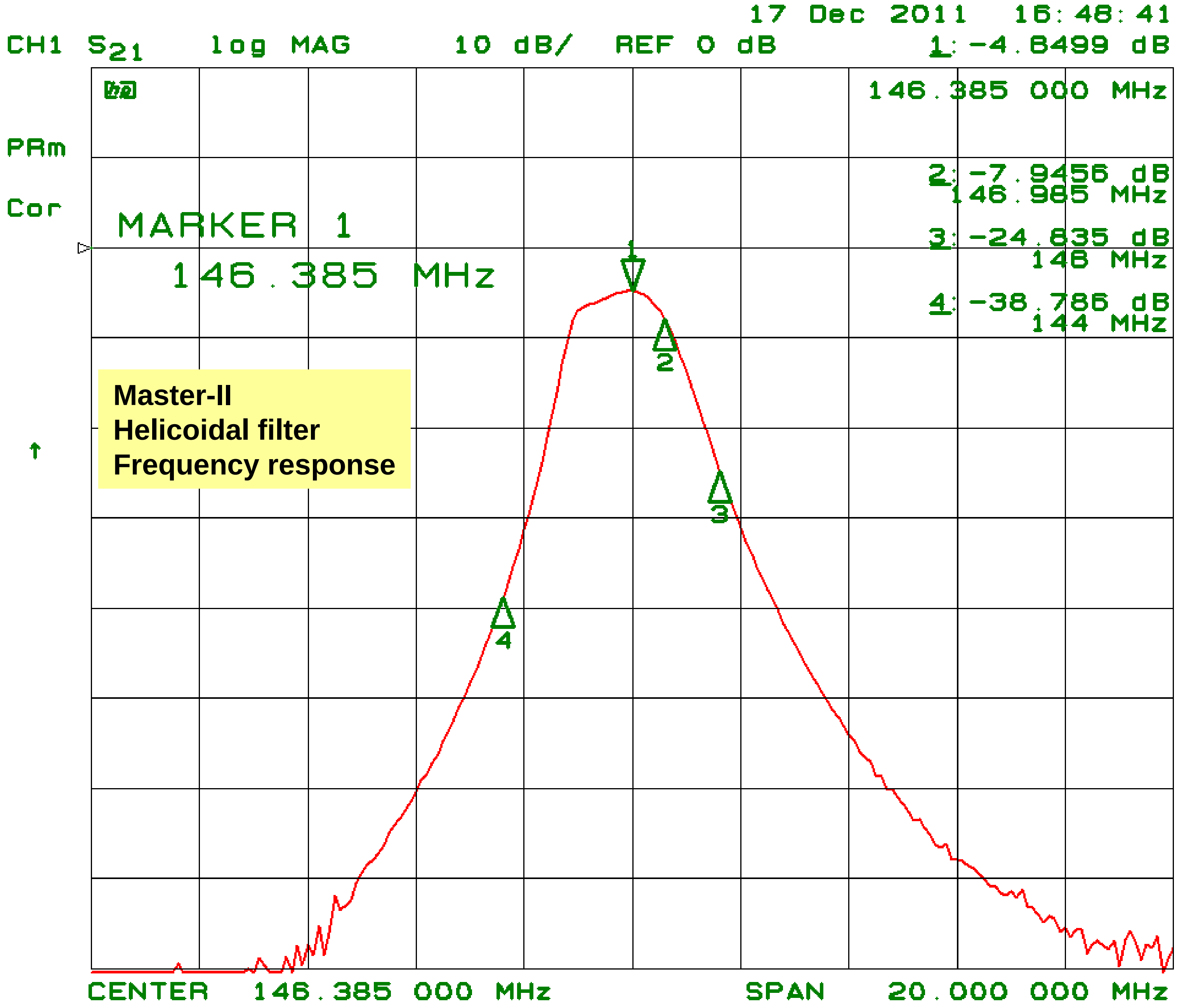
18 Jan 2012 17:58:41
CH1 S11 log MAG 10 dB/ REF 0 dB 3: -28.014 dB
1 000.000 000 MHz
PRm
Cor
MARKER 3
1 GHz
1: -24.782 dB
150 MHz
2: -23.401 dB
500 MHz
4: -19.576 dB
1.5 GHz
5: -14.867 dB
2 GHz
Sampler S11
START 1.000 000 MHz
STOP 2 000.000 000 MHz

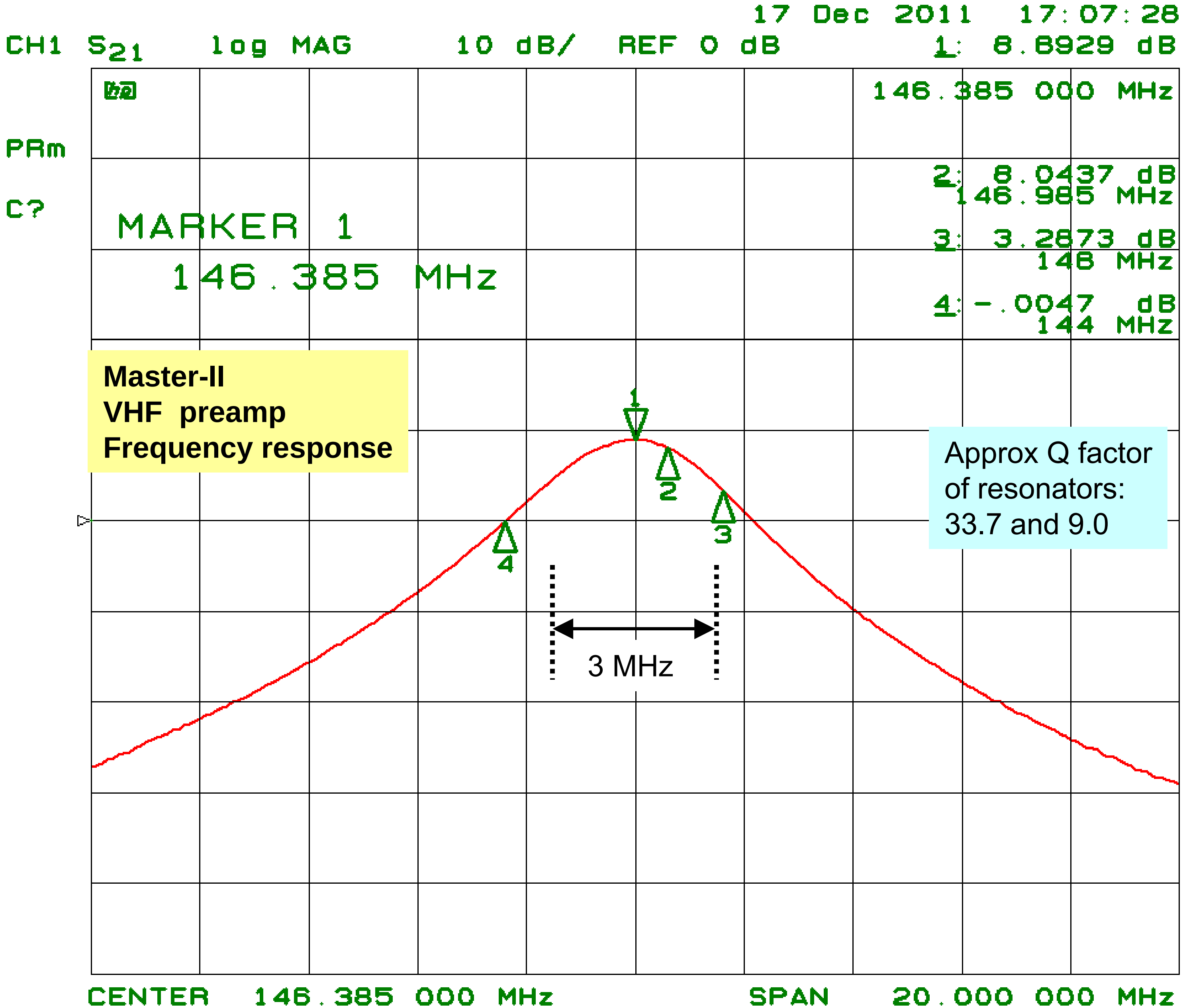

18 Jan 2012 18:00:56
CH1 S11 log MAG 10 dB/ REF 0 dB 3: -18.65 dB
1 000.000 000 MHz
PRm
Cor
MARKER 3
1 GHz
1: -23.136 dB
150 MHz
2: -21.516 dB
500 MHz
4: -14.535 dB
1.5 GHz
5: -11.382 dB
2 GHz
Sampler S33
START 1.000 000 MHz
STOP 2 000.000 000 MHz


18 Jan 2012 18:01:43
CH1 S21 log MAG 10 dB/ REF 0 dB 3: -24.159 dB
1 000.000 000 MHz
PRm
Cor
MARKER 3
1 GHz
1: -24.934 dB
150 MHz
2: -24.671 dB
500 MHz
4: -24.13 dB
1.5 GHz
5: -24.631 dB
2 GHz
Sampler S31
START 1.000 000 MHz
STOP 2 000.000 000 MHz



18 Jan 2012 18:03:34
CH1 S21 log MAG 0.5 dB/ REF 0 dB 3: -.5540 dB
1 000.000 000 MHz
PRm
Cor
SCALE
0.5 dB/div
1: -.5148 dB
150 MHz
2: -.5469 dB
500 MHz
4: -.6248 dB
1.5 GHz
5: -.466 dB
2 GHz
Sampler S21
START 1.000 000 MHz
STOP 2 000.000 000 MHz


17 Dec 2011 16:48:41
CH1 S21 log MAG 10 dB/ REF 0 dB 1: -4.8499 dB
146.385 000 MHz
PRm
Cor
2: -7.9456 dB
146.985 MHz
3: -24.835 dB
148 MHz
4: -38.786 dB
144 MHz
MARKER 1
146.385 MHz
Master-II
Helicoidal filter
Frequency response
CENTER 146.385 000 MHz SPAN 20.000 000 MHz


17 Dec 2011 17:07:28
CH1 S21 log MAG 10 dB/ REF 0 dB 1: 8.8929 dB
146.385 000 MHz
PRm
C?
MARKER 1
146.385 MHz
2: 8.0437 dB
146.985 MHz
3: 3.2873 dB
148 MHz
4: -.0047 dB
144 MHz
Master-II
VHF preamp
Frequency response
Approx Q factor
of resonators:
33.7 and 9.0
3 MHz
CENTER 146.385 000 MHz SPAN 20.000 000 MHz

MASTER II VHF Preamp

Noise Figure Tests

SA set at 3 MHz BW
(This is the BW used by
the Spectrum Analyzer
to measure noise)

Source ENR dB	**Tambiant deg. C**			
5.63	22			= req
(ref 290K)				
Noise source calibration from SA measurements in dBm/Hz				
Noise OFF	**Noise ON**			
-133.4	-129.59			
Noise source + UUT from SA measurements in dBm/Hz				
Noise OFF	**Noise ON**			
-125.69	-122.52			
Intermediate calculations				
Noise Source ENR Correction			5.609	
Noise Source Hot temp in deg. K			1350.22	
System Y Factor			2.404	
System noise temp			456.13	
System Y factor with UUT connected			2.075	
Overall noise temp with UUT connected			686.39	
	RESULTS			
UUT Linear Gain			**4.517**	
UUT Gain in dB			**6.55**	
True noise temp of UUT (deg. K)			**585.423**	
UUT Noise Figure in dB (ref 290K)			**4.80**	

3 MHz measurement BW
yields too low gain since
the gain is not constant
over 3 MHz as shown
on page 3

Ref: http://ve2azx.net/technical/NoiseFigMeasure.xls

MASTER II VHF Preamp

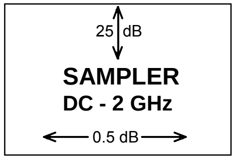
Noise Figure Tests

SA at 1 MHz BW

Now yields correct gain !

Source ENR dB	**Tambiant deg. C**			
5.63	22			= req
(ref 290K)				
Noise source calibration from SA measurements in dBm/Hz				
Noise OFF	**Noise ON**			
-133.47	-129.85			
Noise source + UUT from SA measurements in dBm/Hz				
Noise OFF	**Noise ON**			
-124.8	-121.52			
Intermediate calculations				
Noise Source ENR Correction			5.609	
Noise Source Hot temp in deg. K			1350.22	
System Y Factor			2.301	
System noise temp			515.55	
System Y factor with UUT connected			2.128	
Overall noise temp with UUT connected			640.08	
	RESULTS			
UUT Linear Gain			**6.382**	
UUT Gain in dB			**8.05**	
True noise temp of UUT (deg. K)			**559.300**	
UUT Noise Figure in dB (ref 290K)			**4.67**	

But Noise Figure
is still poor !
Probably caused by the
loss in preamp BP filters



Sampler Label