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

TX OFF

-124 dBm
Sig. Gen alone

Degradation caused by antenna noise, page 3

-122 to -119 dBm

As measured on Master II with preamp

TX ON

-13 dBm
Maximum TX feedthru, with duplexer

-20 dBm
Maximum TX feedthru, no duplexer

-30 dBm
Operating TX feedthru from duplexer RX port + antenna noise / RF pickup

-35 dBm
Operating TX feedthru from duplexer RX port, with duplexer into dummy load

Marg

Effective sensitivity

Degradation caused by duplexer feedthru + antenna noise, page 4

Degradation caused by duplexer feedthru only, page 4

As measured with a broadband voltmeter

-35 dBm
Effi
cen

-124 dBm
Sig. Gen alone

May be higher

-35 dBm
Efficiency

Degradation caused by duplexer feedthru + antenna noise, page 4

Degradation caused by duplexer feedthru only, page 4

Sig. Gen alone, TX into dummy load
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

200 ohms: 20 dB LOSS, 20 dB RL
400 ohms: 25.1 dB LOSS, 25 dB RL

0.001 ohm

200 ohms: 0.91 dB LOSS, 20 dB RL
400 ohms: 0.50 dB LOSS, 25 dB RL

Sampler(1)

port 1
TRU

2
TRU

Sampling port

3

1

2

3

SAMPLER
SAMPLER SCHEMATIC

All ports are 50 ohms

NOTE: Max power IN/OUT is 4 Watts, with 1:1 SWR
Adjustable capacitor Optimizes S11 @ 2 GHz
SAMPLER PICTURES

Adjustable capacitor before soldering

Note: Only required on wideband 2 GHz version
Omit if sampler is only used at VHF
CH1 S21  log MAG  0.5 dB/ REF 0 dB

PRm

Cor

SCALE

0.5 dB/div

Sampler S21

18 Jan 2012  18:03:34

1: -5148 dB  150 MHz
2: -5469 dB  500 MHz
3: -6248 dB  1.5 GHz
4: -466 dB  2 GHz

START  1.000 000 MHz  STOP  2 000.000 000 MHz
Master-II Helicoidal filter Frequency response
Master-II VHF preamp
Frequency response

Approx Q factor of resonators: 33.7 and 9.0
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)

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

Noise Figure Tests

SA at 1 MHz BW

Now yields correct gain!

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

<table>
<thead>
<tr>
<th>Source ENR (dB)</th>
<th>Tambiant (deg. C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.63</td>
<td>22</td>
</tr>
</tbody>
</table>

(ref 290K)

Noise source calibration from SA measurements in dBm/Hz

<table>
<thead>
<tr>
<th>Noise OFF</th>
<th>Noise ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>-133.47</td>
<td>-129.85</td>
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</tbody>
</table>

Noise source + UUT from SA measurements in dBm/Hz

<table>
<thead>
<tr>
<th>Noise OFF</th>
<th>Noise ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>-124.8</td>
<td>-121.52</td>
</tr>
</tbody>
</table>

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
Sampler Label