PA Tests

Search Measurements

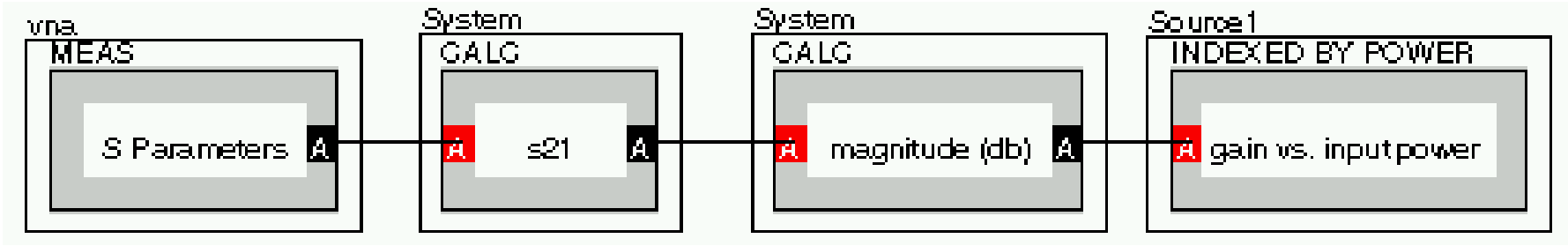
- Dependent and Independent Variable
- Collect appropriate data
- Curve fit
- Find desired dependent condition
- Retrieve associated independent stimulus

P1dB, Step 1 and 2

- Measure the small signal gain, in this case 10 dB
- Subtract 1 from the value to establish the "target compression gain" in this case 9 dB

P1dB Step 3

- Measure gain at a number of Source 1 input power levels, saving the measured gains, indexed by Source 1 Power.



P1dB Step 3 (Continued)

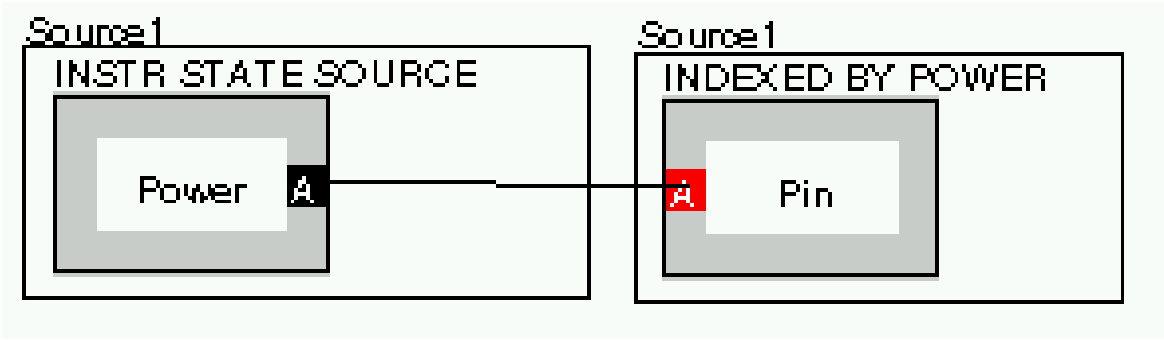
- The index value is actually not the Source 1 power value, It is the "N" as in the Nth value of the Source 1 power used

Index, Gain
1, 10
2, 10
3, 10
4, 10
5, 10
6, 9.7
7, 9.2
8, 8.4
9, 7.5
10, 6.5
11, 5.5

P1dB Step 4

- Save the second array, Source 1 power, also indexed by Source 1 Power

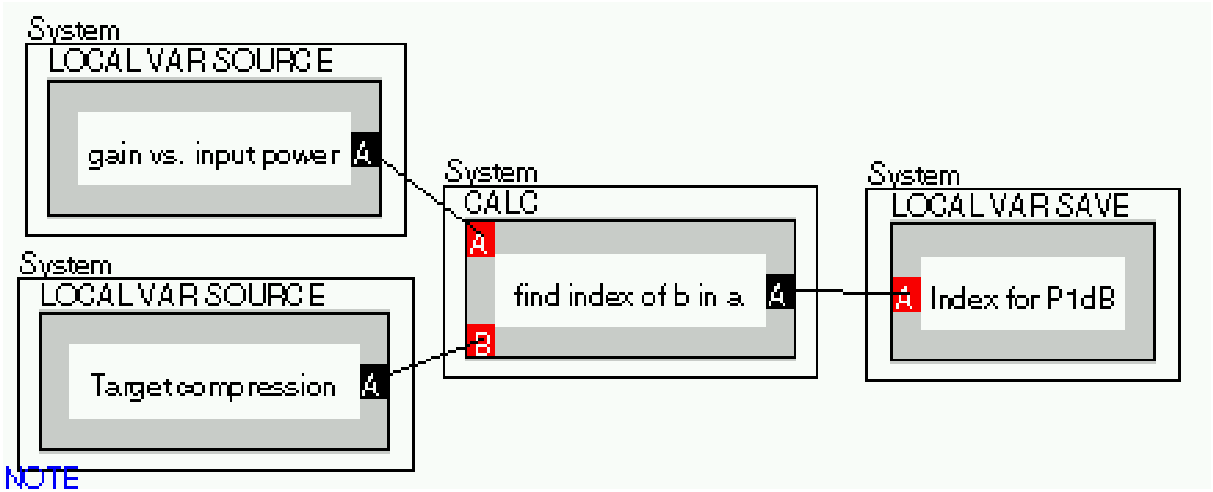
Index	Pin
1	−30
2	−29
3	−28
4	−27
5	−26
6	−25
7	−24
8	−23
9	−22
10	−21
11	−20



P1dB Step 5

- Find fractional index for P1dB (9 dB)
- This is an index of approximately 7.2

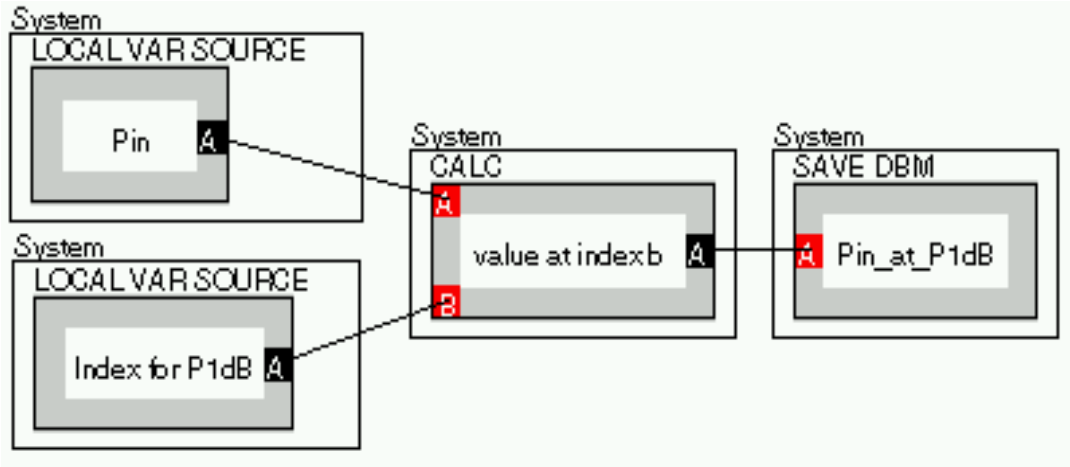
Index, Gain
1, 10
2, 10
3, 10
4, 10
5, 10
6, 9.7
7, 9.2
8, 8.4
9, 7.5
10, 6.5
11, 5.5



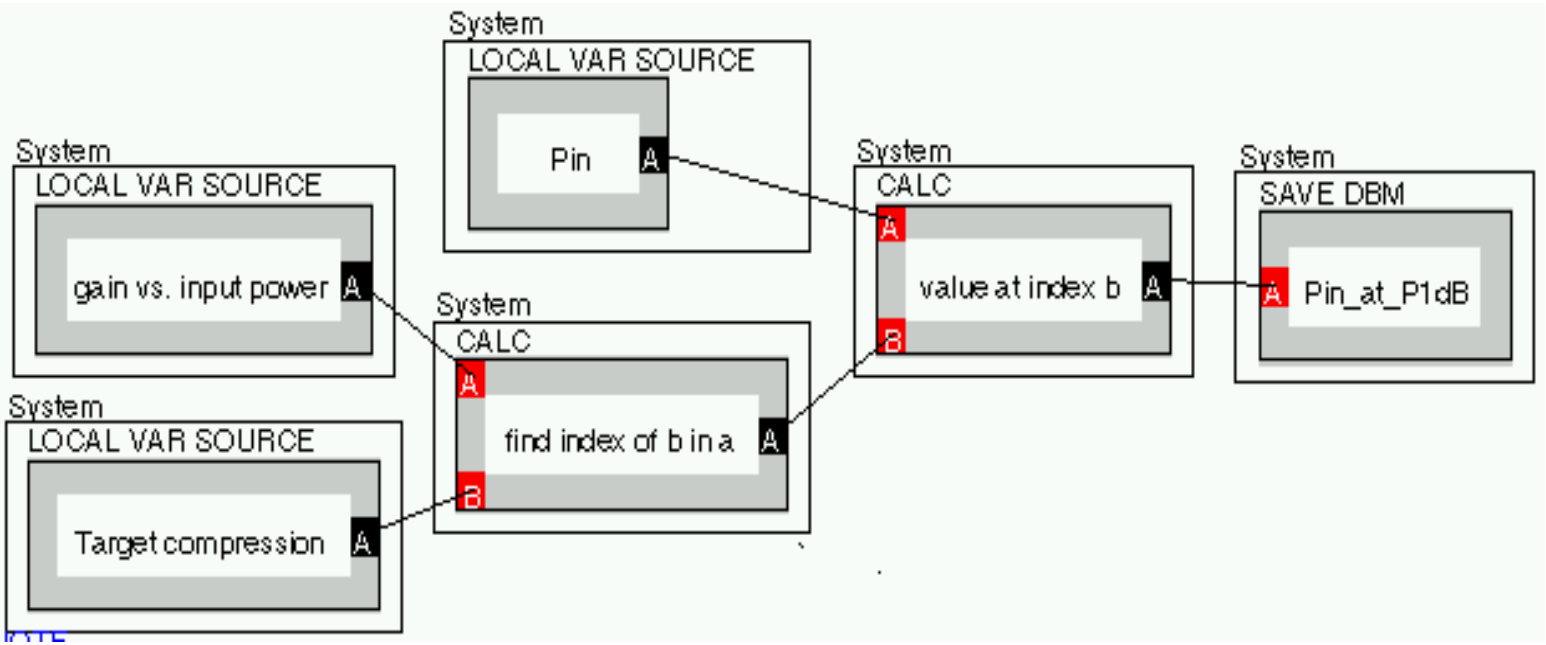
P1dB Step 6

- Extract Pin for that index. (~ -23.8 dBm)

Index	Pin
1	−30
2	−29
3	−28
4	−27
5	−26
6	−25
7	−24
8	−23
9	−22
10	−21
11	−20



P1db Calculation



Examples

- P1dB
- Transistor Bias
- Power Transistor Efficiency
- Fixed Output Power

PA Test Plan Measurements

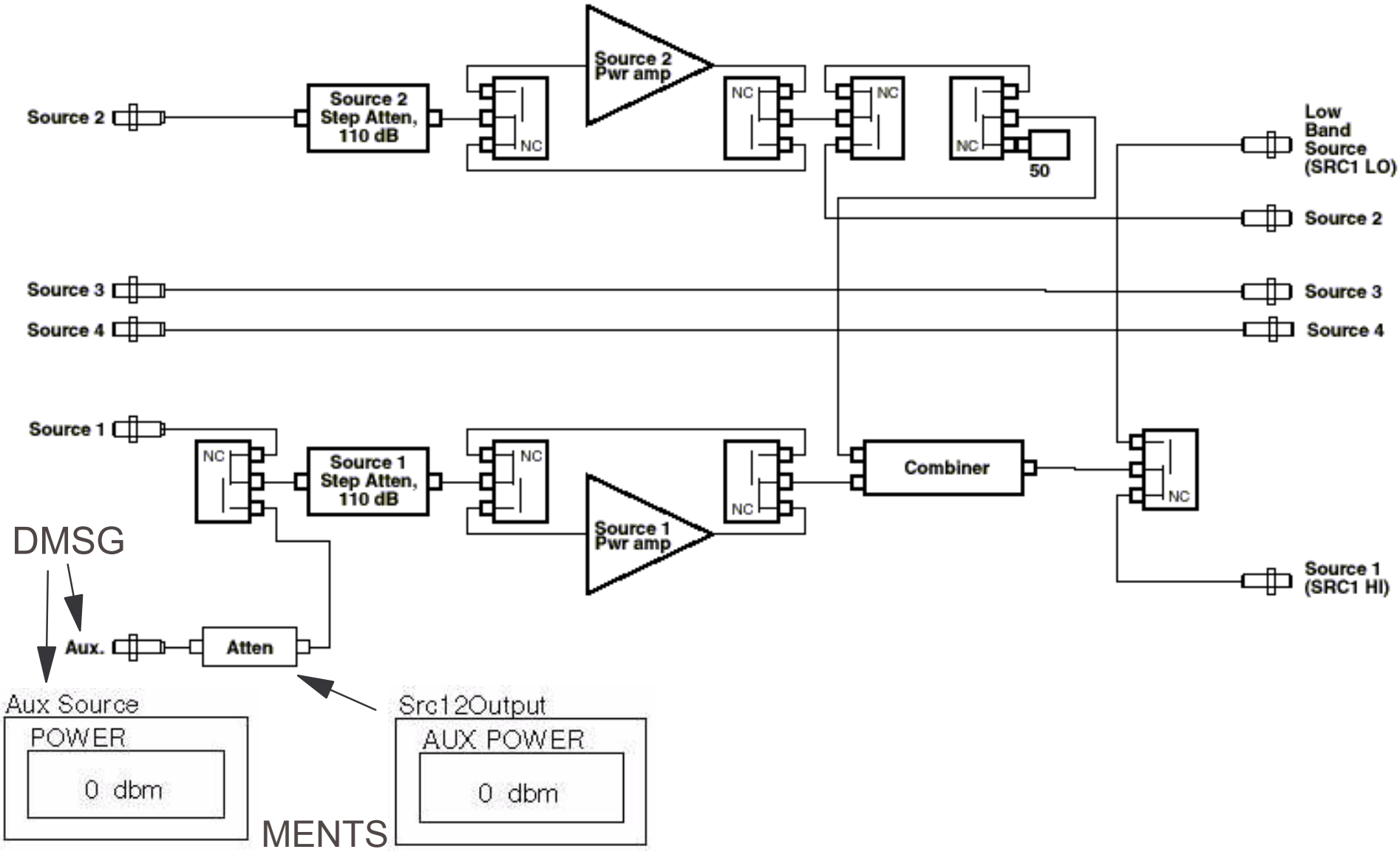
- Gain
- P1dB
- Fixed Pout
- IM3
- Leakage Current
- ACPR/ACLR
- Efficiency

PA Test Measurement Notes

PA Test Considerations

- Set Up DMSG in Global Defaults
- Use SRC12/Aux Pwr not Aux SRC/Pwr for sweep
- SRC12/Aux Pwr is Actually Attenuation
- Use RMS Power for Modulated Tones
- Characterize Noise BW of IF Filters for Modulation Type
- Use DB Line for Leakage Current Measurement

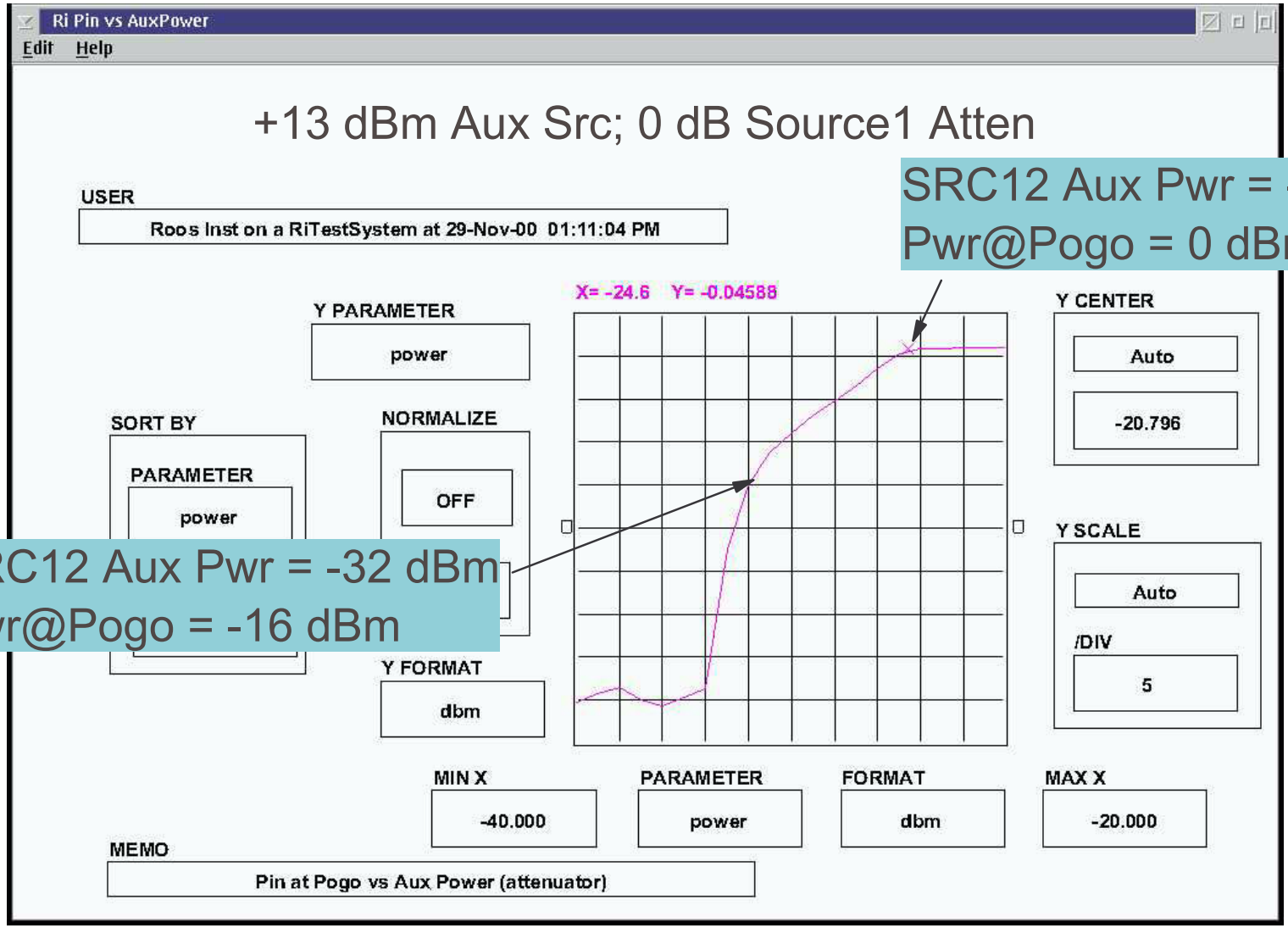
Aux Attenuator Path



Src12 Aux Pwr

- Attenuator not Power
- Logarithmic Attenuation
- Approximately 13 dB Path Loss in 0 dB Attenuation State (DMSG to Pogo Ring)
- Effective Settings: SRC12/AuxPwr
  - -24 dBm = 13 dB path loss = 0 dB atten
  - -32 dBm = 29 dB path loss = 16 dB atten

Pavailable vs. Src12/AuxPower



Aux Source Capabilites

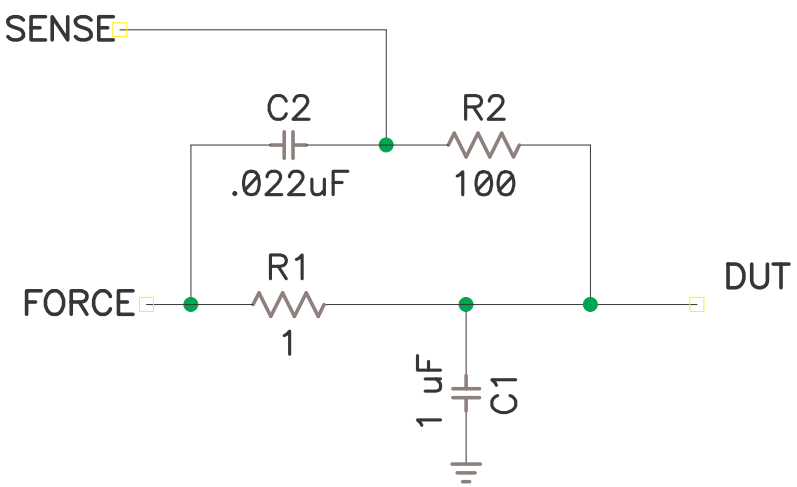
- Anritsu MG3671B; +13 dBm max.
- Aux Src Only: 0 dBm @ Pogo
- With SRC1 Amp: Approximately +20 dBm @ Pogo
- CDMA,TDMA,PDC,GSM,TETRA,DECT

VI Loading

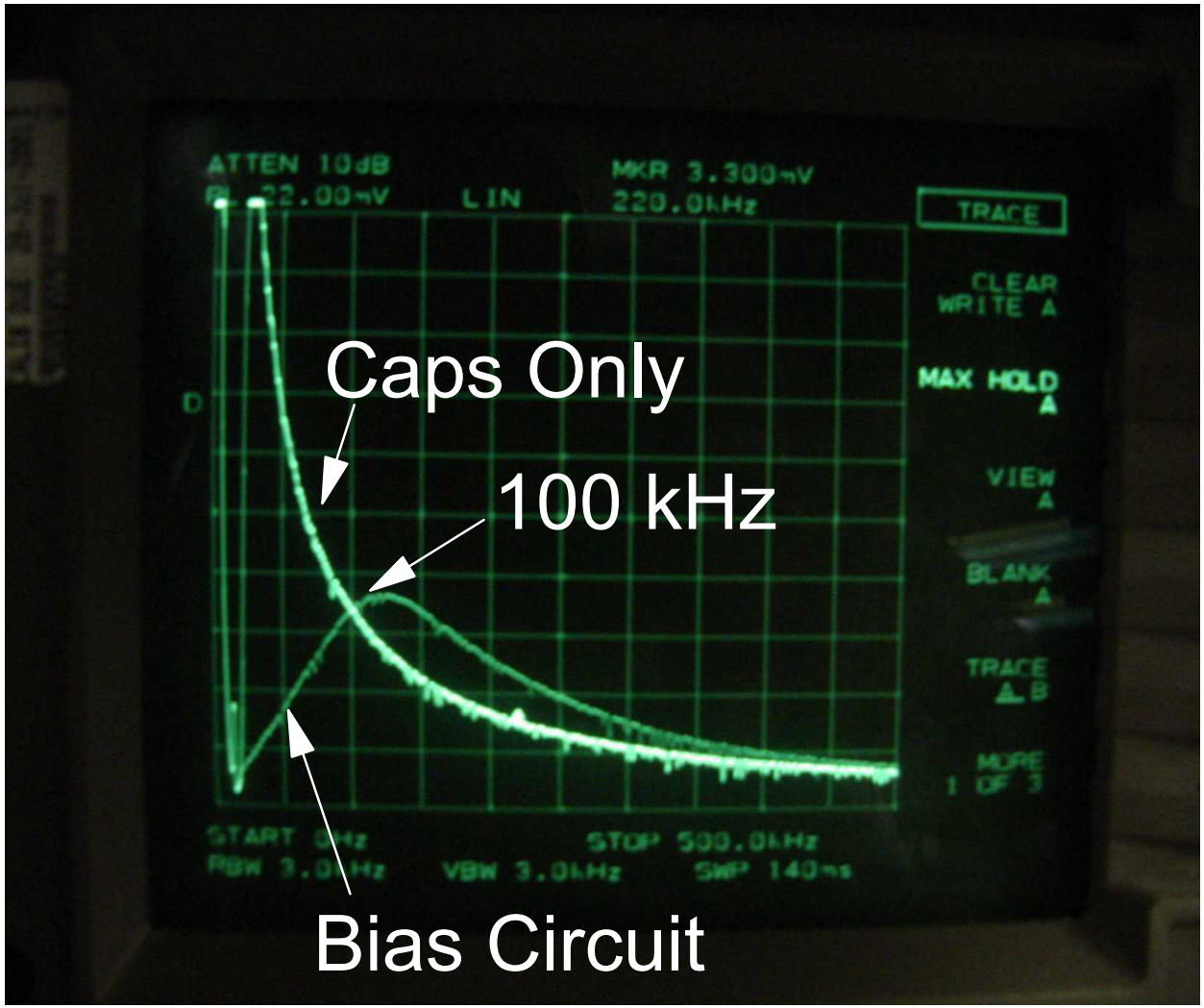
- Power VIs designed for <0.1uF
- 3 uSec settling, Faster than bench
- Some PA eval boards have higher values
- Design Dut boards appropriately
- If Dut must have >1uF cap use following method

Loading Circuit

- C1 must be Ceramic (low R)
- R1, high watt; isolates Cap from VI

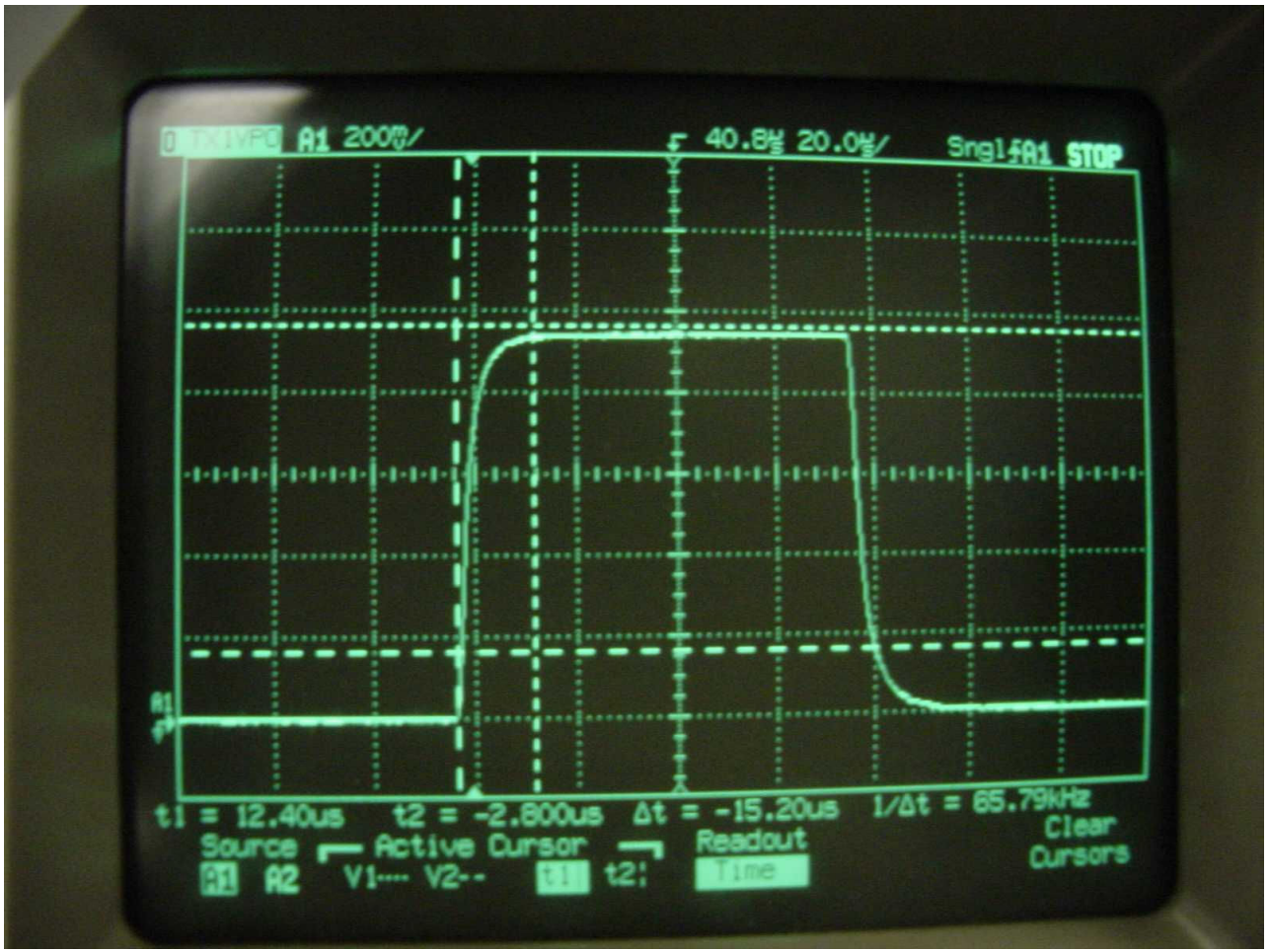


Circuit Frequency Response



Circuit Time Response

- 15 uSec Settling



PA Test Plan ACPR Test

- Use Aux Source
- Measure Leakage
- Search and Fix Pout
- Measure CDMA ACPr
  - 1.23 MHz Channel
  - 885 kHz, 1980 kHz Offset; 30 kHz BW

PA Test Plan Lab: NADC ACPR

- Create NADC Measurement
  - 25 kHz Ch.; 30 kHz Offset 25 kHz BW
- Channel is Flat
- Significant Power exists outside the channel
- Pout Does Not Equal Channel Power

Mixer Testing

- Mixer Test Plan
  - Measurements
  - Things to Remember
  - Lab: Develop Image Rejection Test

Mixer Test Plan
Measurement Notes

- LO Feed Through
  - LP Filter on IF Output
- SSB Noise Figure
  - Must Filter Noise Stimulus for SSB NF
- LO S/N to NF Conversion
  - Pad or Filter LO
- IF VSWR/NF Test Head Set-Up
  - Use "Back Door"

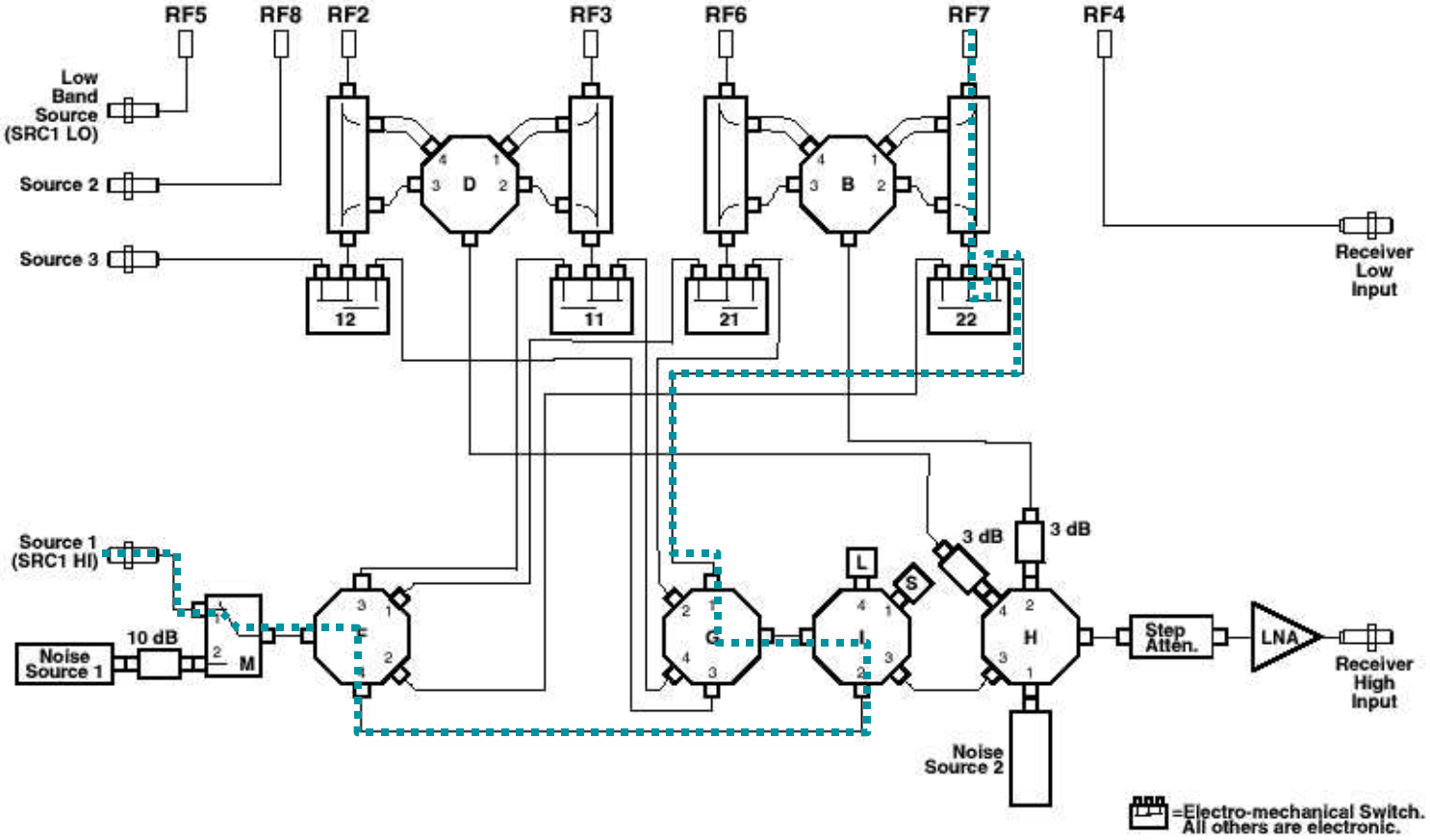
Mixers IF VSWR

- Different Frequencies at Ports
- Conventional "12-term" Error Correction Unusable
- Use S_{11} only VNA button
- Uses 8-term, 1-port model
- If Tester Port is "Receive" (IF port of mixer when testing NF) use "Back Door"

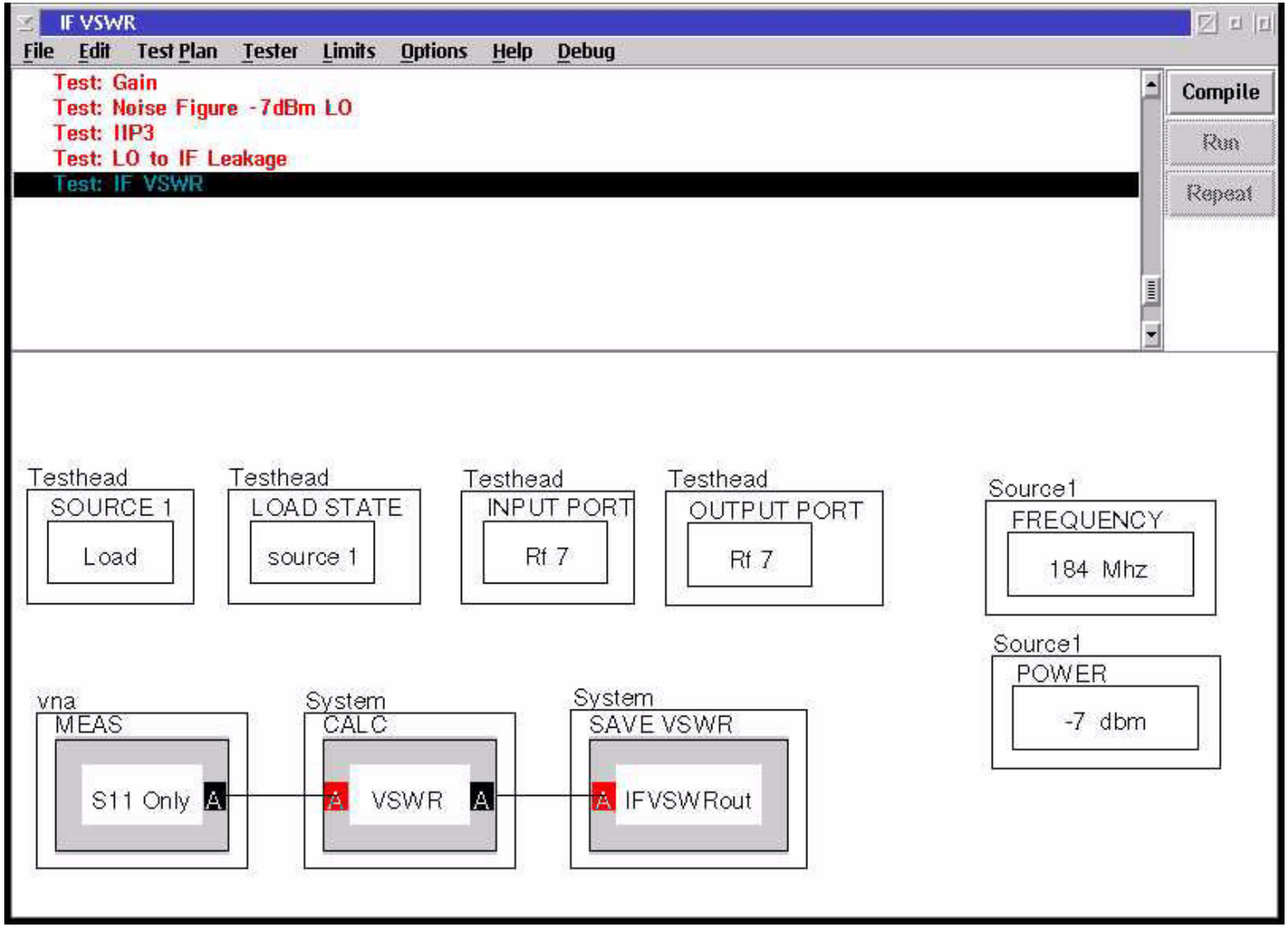
Back Door Path

- Allows SRC1 Access to Ports Configured for Receive
- Eliminates Mechanical Relay Switching
- Not Calibrated for Absolute Power (~3 dB low)
- Automatic for Bi-directional Mode (Bi-directional not Available for S11 Only)

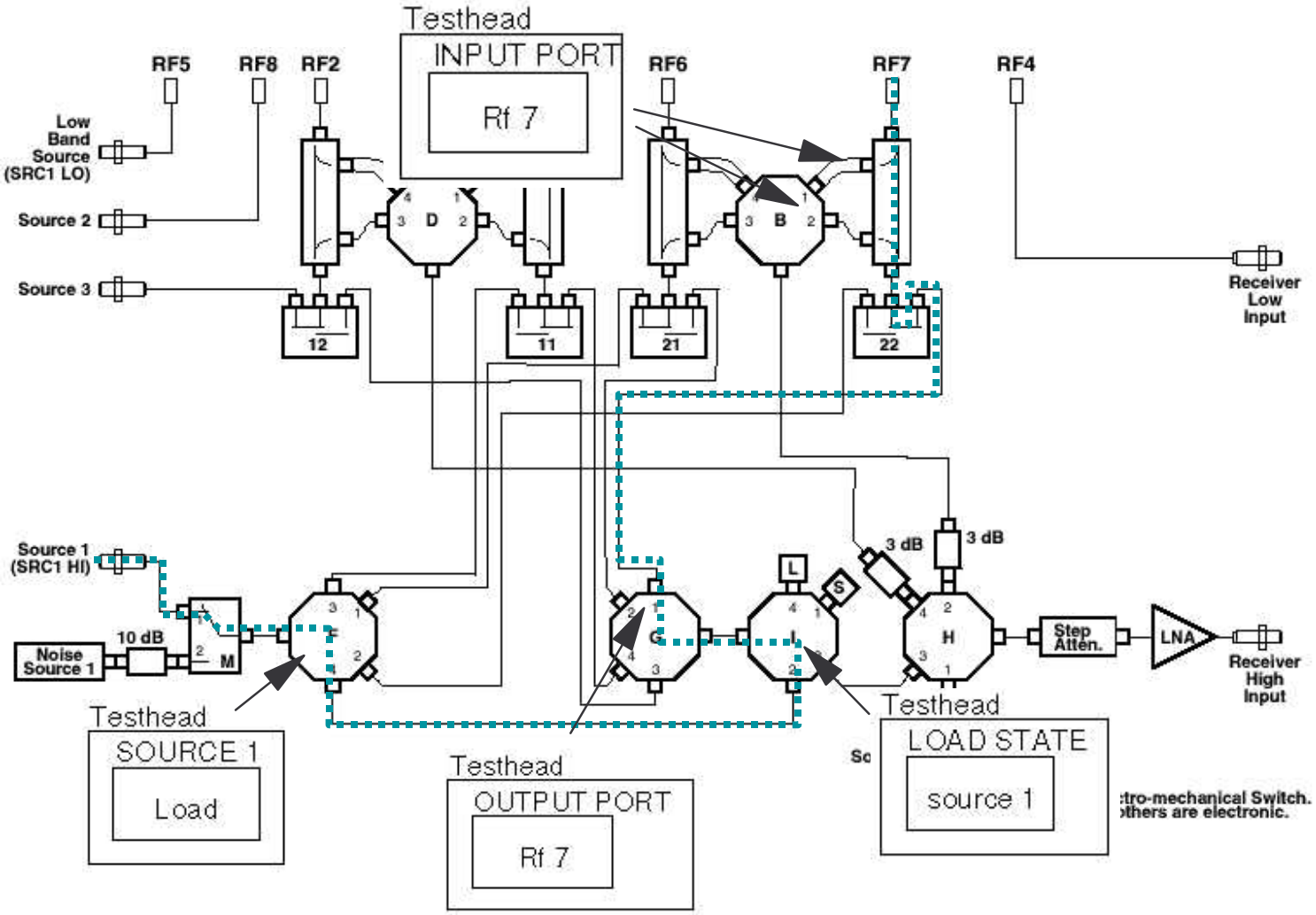
Back Door Path



Test Plan


IF VSWR
File Edit Test Plan Tester Limits Options Help Debug
Test: Gain
Test: Noise Figure -7dBm LO
Test: IIP3
Test: LO to IF Leakage
Test: IF VSWR
Compile
Run
Repeat
Testhead
SOURCE 1
Load
Testhead
LOAD STATE
source 1
Testhead
INPUT PORT
Rf 7
Testhead
OUTPUT PORT
Rf 7
Source1
FREQUENCY
184 Mhz
Source1
POWER
-7 dbm
vna
MEAS
S11 Only
A
System
CALC
A
VSWR
A
System
SAVE VSWR
A
IFVSWRout

Back Door Path



Mixer Test Plan Lab: Develop Image Rejection Test

- RF Level = -5 dBm
- IF Frequency = 184 MHz
- RF Frequency = 1960 MHz
- LO Frequency = 2144 MHz
- Image Frequency = _____ MHz
- Calculate Image Rejection in dBs

Mixer Test Plan
Measurement Results

'Dwn_Converter_lab_revD' Statistics (Limits: None)

View Inspect Help

	Mean	Std. Dev.	%SD	Min	Max	Total
IDDRx	29.861e-6	16.981e-6	56.867	239.54e-9	62.997e-6	25
Mixer_Gain	-5.9160	17.988e-3	304.05e-3	-5.9445	-5.8817	25
Mixer_in_RL	-6.5829	27.882e-3	423.55e-3	-6.6404	-6.5309	25
Mixer_in_VSWR	2.7641	10.660e-3	385.65e-3	2.7423	2.7841	25
MixerIIP3	9.7830	108.80e-3	1.1122	9.5919	10.010	25
MixerOIP3	3.8475	135.84e-3	3.5305	3.6473	4.0808	25
Mixer_IIP2	32.014	362.76e-3	1.1332	31.414	32.697	25
RF_to_LOin_Isolation	26.238	19.211e-3	73.218e-3	26.199	26.273	25
RF_to_IF_Isolation	20.515	19.695e-3	96.001e-3	20.457	20.546	25
LO_to_RFin_Leakage	-22.509	6.7937e-3	30.182e-3	-22.522	-22.496	25
LO_to_IF_Leakage	-9.4557	7.9040e-3	83.590e-3	-9.4707	-9.4418	25
LOin_RL	-11.833	19.519e-3	164.95e-3	-11.871	-11.775	25
LOin_VSWR	1.6884	2.0818e-3	123.30e-3	1.6843	1.6946	25
IF_RL	-21.533	45.038e-3	209.16e-3	-21.665	-21.472	25
IF_VSWR	1.1830	1.0319e-3	87.230e-3	1.1800	1.1844	25
Image_Rejection	-225.82e-6	25.907e-3	11.472e3	-51.703e-3	48.694e-3	25

Day 3: IQ Mod & Demod Testing

- Modulator Test Plan
  - Measurements
  - Things to Remember
  - Lab: Develop IQ Sweep Test
- Demodulator Test Plan
  - Measurements
  - Things to Remember

IQ Modulator Test Plan Measurement Notes

ROOS INSTRUMENTS

IQ Modulator Test Plan Lab: Find Minimum Image Rejection Pt.

- Sweep I Phase +/-2 Degrees
- Find Phase which Minimizes LO-IF
- Save Phase as Local Variable:
  Phase_for_min_image2
- Sweep I Amplitude +/- 0.1 Volt peak
- Find Amplitude which Minimizes LO-IF
- Save Amplitude as Local Variable:
  Amp_for_min_image2

IQ Modulator Test Plan Measurement Results

'IQ_Mod_example_revD' Statistics (Limits: None)

View Inspect Help

	Mean	Std. Dev.	%SD	Min	Max
gsm_I_optimum_offset	-3.0231e-3	73.113e-6	2.4185	-3.1434e-3	-2.9018e-3
gsm_Q_optimum_o	8.2333e-3	75.099e-6	912.14e-3	8.0892e-3	8.4073e-3
GSM Phase Min Im	89.852	9.9367e-3	11.059e-3	89.831	89.873
GSM Amp Min Ima	346.06e-3	57.229e-6	16.537e-3	345.96e-3	346.17e-3
gsm_LO-IF_dBs	-67.713	1.3272	1.9600	-70.435	-64.737
gsm_LO_Rejection_Nominal_dB	-54.527	971.59e-3	1.7819	-56.271	-52.998
gsm_LO_Rejection_Nominal_lin	1.8695e-3	208.44e-6	11.031	1.5361e-3	2.2393e-3
gsm_LO_Rejection_Vavg_dBs	-66.623	4.8622	7.2981	-81.576	-59.048
gsm_LO_Rejection_Vavg_lin	529.66e-6	235.10e-6	44.387	83.407e-6	1.1158e-3
gsm_LO+IF	-9.9822	8.5894e-3	86.047e-3	-10.002	-9.9676
gsm_LO-3IF_dBs	-43.124	83.966e-3	194.71e-3	-43.322	-42.965
gsm_3LO-IF_dBs	-49.224	122.98e-3	249.84e-3	-49.541	-48.987

IQ Demodulator Test Plan Measurement Notes

ROOS INSTRUMENTS

IQ Demodulator Test Plan Measurement Results

'IQ_Demod_example_revB' Statistics (Limits: None)

View Inspect Help

	Mean	Std. Dev.	%SD	Min	Max	Total
Idd_RX	86.083e-6	22.108e-6	25.682	38.558e-6	119.43e-6	25
Phase_match_rx	-395.56e-3	96.862e-3	24.487	-532.35e-3	-190.92e-3	25
phase_match_old_tech	-1.2647	1.7565	138.88	-5.4003	208.99e-3	25
Gain_rxi	-21.616	9.0417e-3	41.828e-3	-21.641	-21.596	25
Gain_rxq	-21.448	13.040e-3	60.800e-3	-21.467	-21.405	25
Amplitude_match_rx	-168.59e-3	14.900e-3	8.8378	-201.04e-3	-147.16e-3	25
Gain_delta_min_max_Vcc	2.3909e-3	7.3480e-3	307.33	-7.8674e-3	22.549e-3	25
Compression_rxi_P1dB	-29.036e-3	10.944e-3	37.692	-51.745e-3	-7.4669e-3	25
Compression_rxq_P1dB	-37.844e-3	10.261e-3	27.114	-59.028e-3	-16.989e-3	25
V_offset_rxi	4.1683e-3	21.748e-3	521.74	-1.0176e-3	109.15e-3	25
V_offset_rxq	-994.07e-6	21.811e-6	2.1941	-1.0227e-3	-951.65e-6	25
Blocking_rxi	7.6115e-3	10.167e-3	133.57	-8.0542e-3	31.945e-3	25
Blocking_rxq	4.5322e-3	5.7783e-3	127.49	-5.8940e-3	12.698e-3	25
LO_Isolation	-56.986	123.39e-3	216.53e-3	-57.199	-56.680	25