



NAT-SNA

Network Analyzer Terminal -Scalar Network Analyzer



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Ozarkcon 2015 April 10-11





George Heron – N2APB







What can YOU do with a Scalar Network Analyzer?

Test Filters ... Low Pass, Band Pass, Receiver IF stages

Match Crystals ... Frequency, Pass Band, Motional Parameters

Analyze Antennas ... SWR, Return Loss

Generate RF Signals ... Stable reference frequencies

Measure QRP Power Levels... Current, Average, Peak

Measure Coax Cables ... Integrity, length, shorts

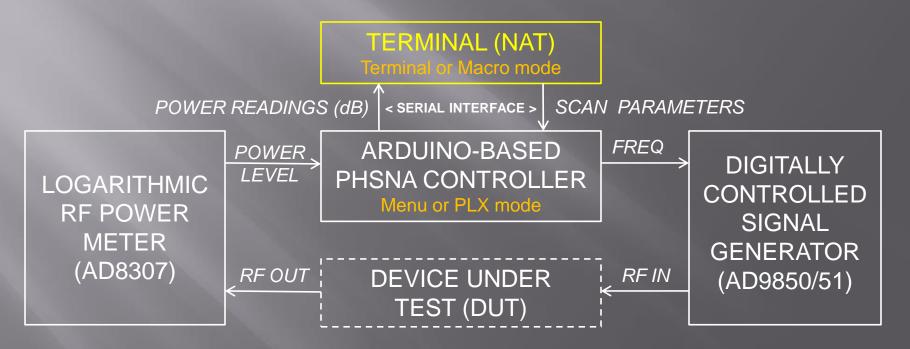
Measure Inductors, Capacitors ... and more!





Poor Ham's Scalar Network Analyzer (PHSNA)

With Network Analyzer Terminal (NAT) replacing the PC



https://groups.yahoo.com/neo/groups/PHSNA/info







General NAT Specifications

PCB: 4.47" x 3.31"

Enclosure: 4.82" x 3.77" x 1.39"

Display: 3.2" QVGA, 64K color depth

Serial data rate: 1.2 to 38.4 kbaud

Keyboard: PS2 US and UK

Power: 8-12V DC @ 120 ma (typ.)

Weight: 7 oz. (approx.)

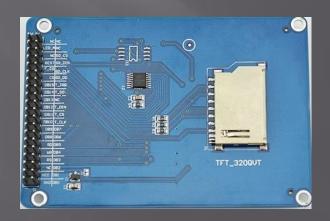




Display module:

- 240 x 320 Pixel (QVGA), 16-bit color, 3.2" LCD
- SSD1289 display controller
- Resistive touch screen with ADS7843 controller
- SD Card socket
- Pads and interconnect for serial (SPI) EEPROM
- Single, 40-pin interface connector
- Under \$20 on eBay!



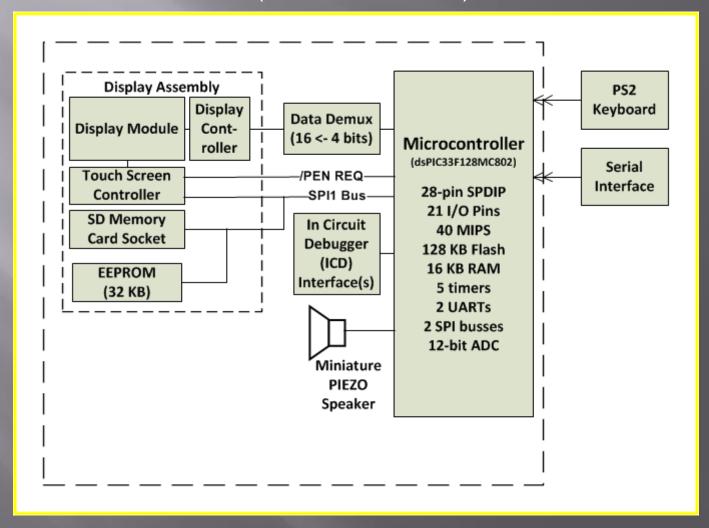






Basic NAT Block Diagram

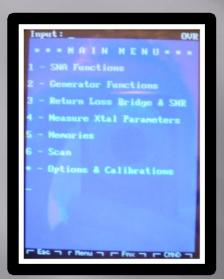
(Versions 1 and 2)





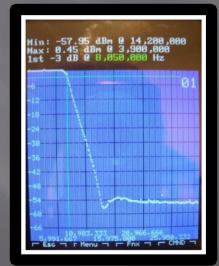


Menu Mode screen shots















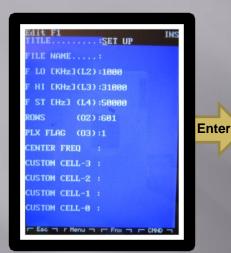


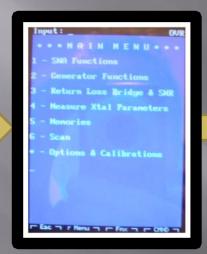


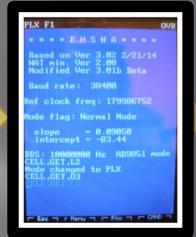
Macro Mode screen shots

F1

SPACE









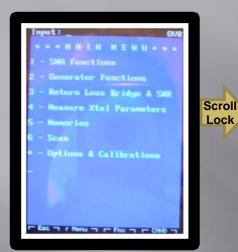


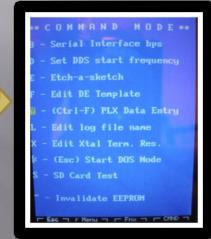






DOS Mode screen shots

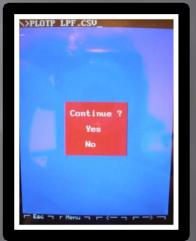




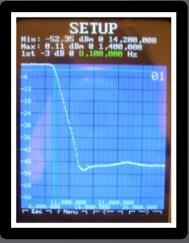












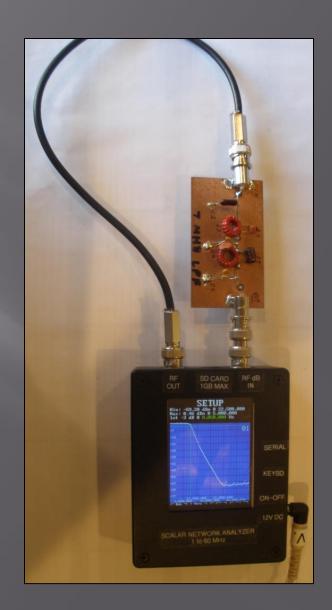




Midnight Scalar Network Analyzer (MSNA) Version 4

Optional PC Application

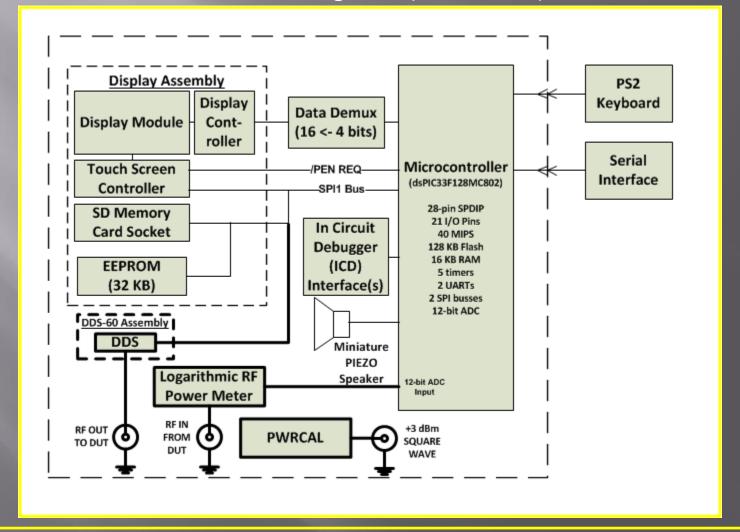
SERIAL INTERFACE >
Midnight Scalar
Network Analyzer
(MSNA)
DEVICE UNDER
TEST (DUT)







NAT-SNA: NAT-Scalar Network Analyzer Block Diagram (Version 4)





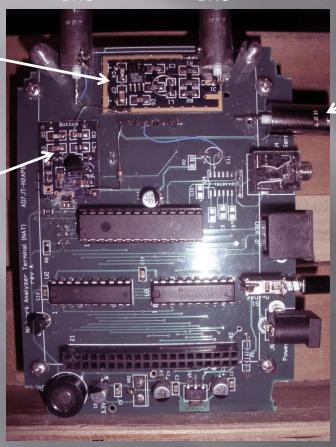


RF OUT BNC RF IN BNC

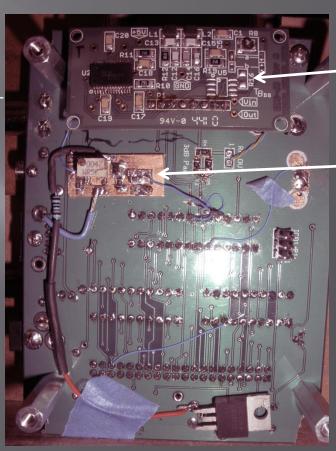
NAT to MSNA conversion

RF Power Meter PCBA

Separate
5 Volt Regulator
PCBA



PWRCAL ► BNC



DDS-60 Plug-in PCBA

PWRCAL CCBA

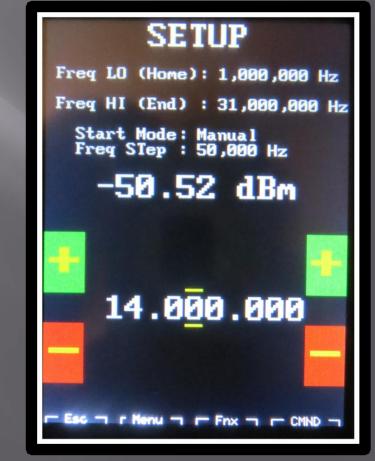
RF Power Meter by Dick Faust, K9IVB http://www.k9ivb.net/RF_Power_Meter/





- SIGNAL GENERATOR MODE
 - Manual frequency control (1 MHz to 60+ MHz)
 - Manual and automatic power readings

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DELAY(ms):
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     Vswr plot
overWrite existing file
      Signal generator mode
     Power Meter Calibration
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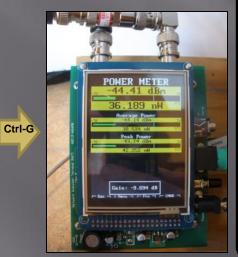




- QRP RF Power Meter
 - Power reading taken about 200 times/second (every 5 ms)
 - ~97 dBm range: -80 dBm to +20 dBm (approx.)
 - Use attenuators to shift the range
 - DDS used only for calibration
- Three Power Meters Displayed
 - Current power reading (10-point RA)
 - Average Power (200-point RA)
 - Peak Power (updated every 200 samples)





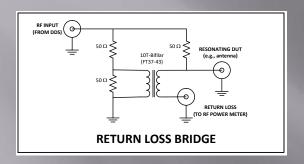


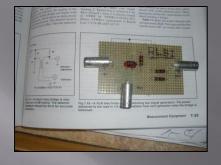






Antenna analysis with Return Loss Bridge (RLB)









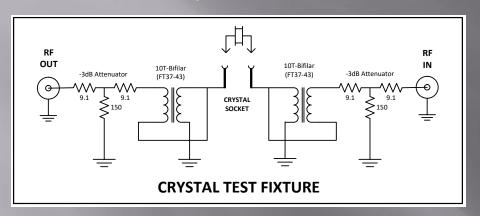


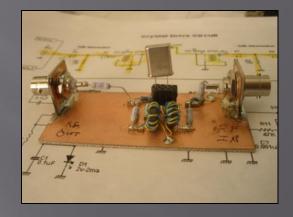


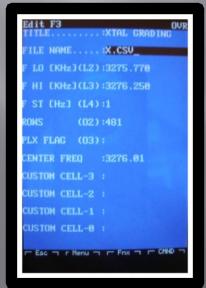




Crystal Characterization & Matching







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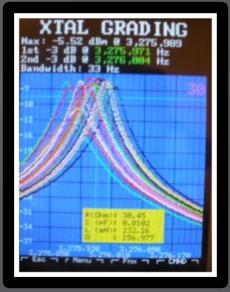
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W(4) overWrite existing file
S(5) Signal generator mode
E(6) External SNA Controller
P(7) Power Meter Calibration
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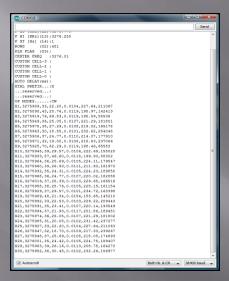




Crystal Characterization & Matching (cont.)



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30	X27,327	5948,37,25.6	9,0.0108,21	8.05,17469	3					
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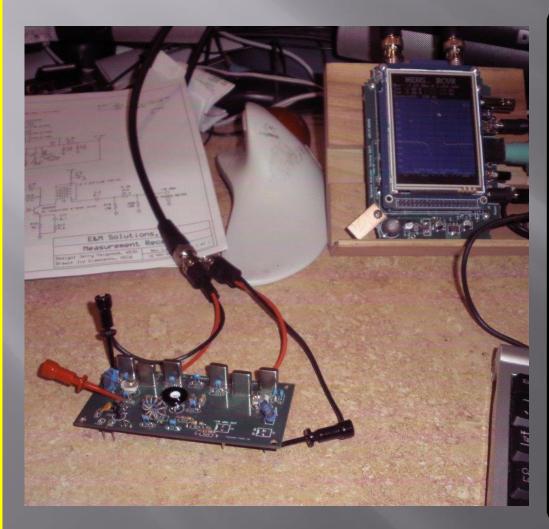
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7	X4	3,275,949	36	25.05	0.0107	221.29	181,801		
8	X5	3,275,978	38	27.29	0.0108	219.02	165,178		
9	X6	3,275,963	30	18.85	0.0101	232.62	254,048		
10	X7	3,275,906	37	24.77	0.0110	214.07	177,910		
11	X8	3,275,971	32	19.00	0.0108	218.83	237,086		
12	X9	3,275,925	70	62.29	0.0119	198.46	65,583		
13	X10	3,275,945	39	29.57	0.0106	222.69	155,020		
14	X11	3,275,933	57	46.60	0.0118	199.93	88,302		
15	X12	3,275,964	36	25.69	0.0105	224.11	179,547		
16	X13	3,275,960	39	26.93	0.0111	211.93	161,970		
17	X14	3,275,932	35	24.31	0.0105	224.23	189,850		
18	X15	3,275,968	36	24.77	0.0107	220.02	182,855		
19	X16	3,276,019	37	28.39	0.0103	229.65	166,516		
20	X17	3,275,958	38	28.76	0.0105	225.15	161,154		
21	X18	3,275,929	37	29.57	0.0101	234.72	163,398		
22	X19	3,275,969	48	21.34	0.0154	153.65	148,210		
23	X20	3,275,992	33	22.53	0.0103	229.22	209,443		
24	X21	3,275,891	35	23.41	0.0107	220.14	193,549		
25	X22	3,275,994	37	21.93	0.0117	201.86	189,481		
26	X23	3,275,974	36	25.05	0.0107	221.29	181,802		
27	X24	3,275,985	31	20.08	0.0102	231.42	237,277		_
28	X25	3,275,927	33	22.20	0.0104	227.64	211,063		
29	X26	3,275,947	32	18.70	0.0109	217.33	239,267		
30	X27	3,275,948	37	25.69	0.0108	218.05	174,693		
31	X28	3,276,001	35	24.42	0.0105	224.75	189,407		
32	X29	3,275,963	39	26.16	0.0113	208.78	164,270		_
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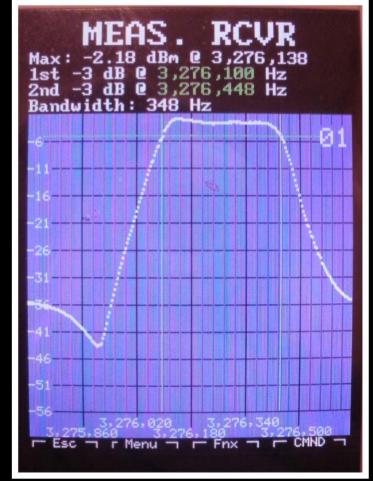
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Crystal Characterization & Matching (cont.)











Feature Summary

- Handheld instrument for making "scalar measurements"
 ... incident, reflected & transmitted signal magnitudes
 are measured to determining results.
- Useful for:
 - Testing and evaluating filters
 - Measuring crystal parameters
 - Return Loss Measurement
 - VSWR and antenna tuning
 - Measuring QRP transmit power
- Provides 0 dBm signal reference output
- QRP Power Meter functions
 - Current power
 - Peak power
 - Average power
- User calibration achieved with just a DVM
- Continuous/repeated operation options
- 3.2", 240 x 320, 16-bit color graphic LCD display
- Touch panel & Keyboard as input devices
- Field upgradable firmware
- Serial port connection to other devices
- EEPROM for storing settings & options
- SD Card storage up to 1 GB provides:
 - Data spooling and playback
 - Calibration data storage and reloading
 - Direct data exchange with Windows and Linux apps
- DOS-like commands to manage and playback data files





References:

- http://www.midnightdesignsolutions.com/nat
- https://groups.yahoo.com/neo/groups/NAT-SNA/info
- https://groups.yahoo.com/neo/groups/PHSNA/info

Contacts:

- Dave ad7jt@dnbrealty.com
- George n2apb@midnightdesignsolutions.com

QUESTIONS?

COMMENTS?

CRITIQUES?





Time for a little math

- Gain ratio = P_{out}/P_{in}
- Gain (dB) = $10 \log(P_{out}/P_{in})$
- Gain (dBm) = $10 \log(P_{out}/.001) = 10 \log(P_{out} \times 1000)$ = $10 (\log(P_{out}) + \log(1000)) = 10 \log(P_{out}) + 30$
- Short circuit gain = $10 \log(P_{in}/P_{in}) = 10 \log(1) = 0$ for any P_{in}
- Gain (dBm) = 10 log(P_{in}) d where:
 P_{in} = power meter reading in mw d = short circuit gain reading in mw
- DDS output level varies with frequency (due to sin(x)/x sampling effect) therefore d is a function of frequency: d(f)

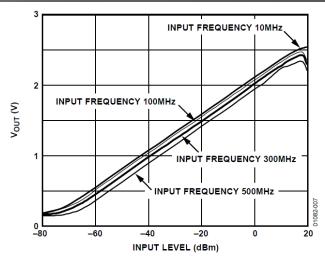


Figure 7. V_{OUT} vs. Input Level (dBm) at Various Frequencies