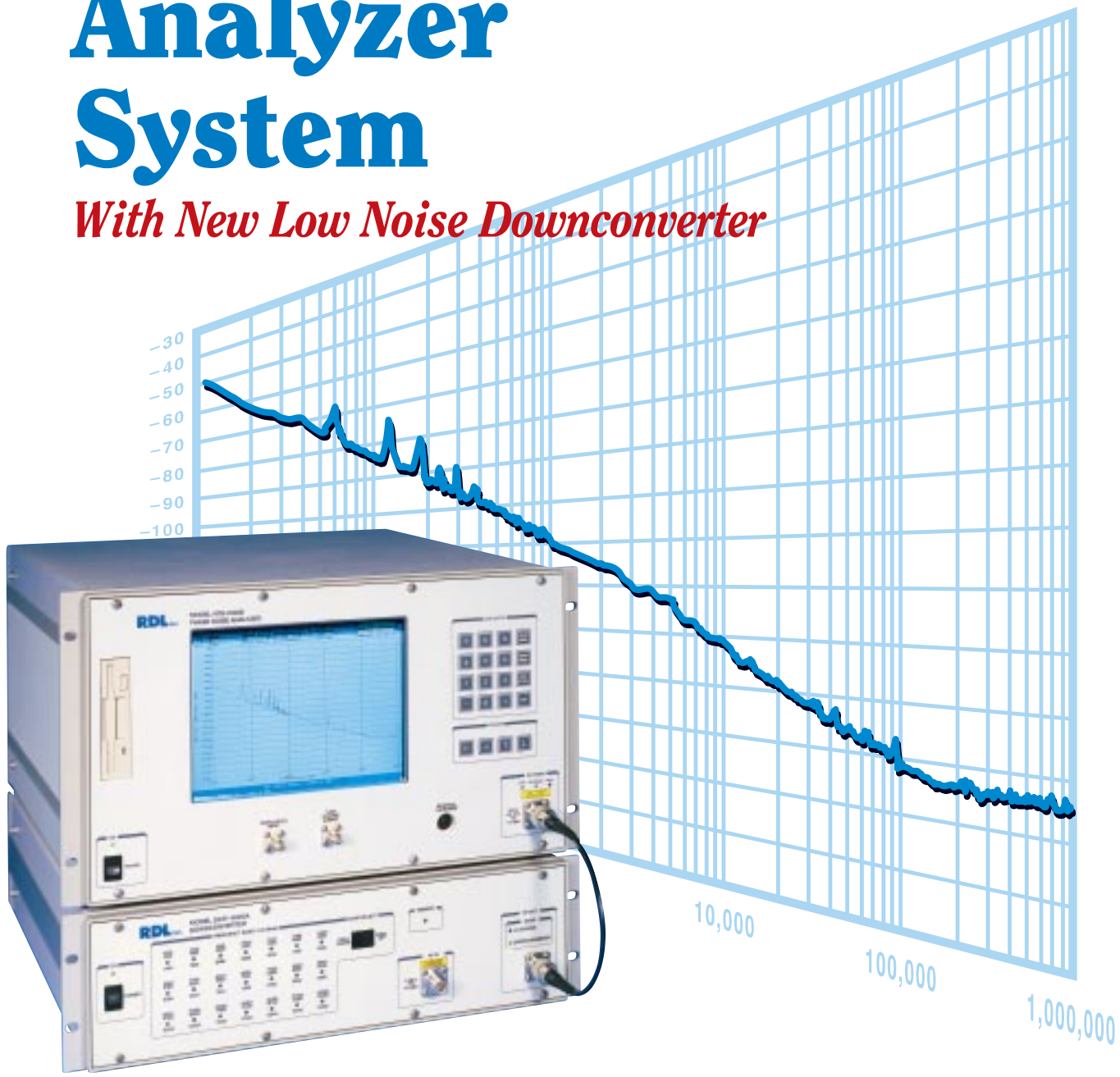
Phase Noise Analyzer System

With New Low Noise Downconverter



Automated Phase Noise Measurements . . . In Seconds

RDL INC.
Frequency Generation and Noise Measurement for Critical Applications
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2005K

NTS-1000B Phase Noise Analyzer

Proven Measurement Technique

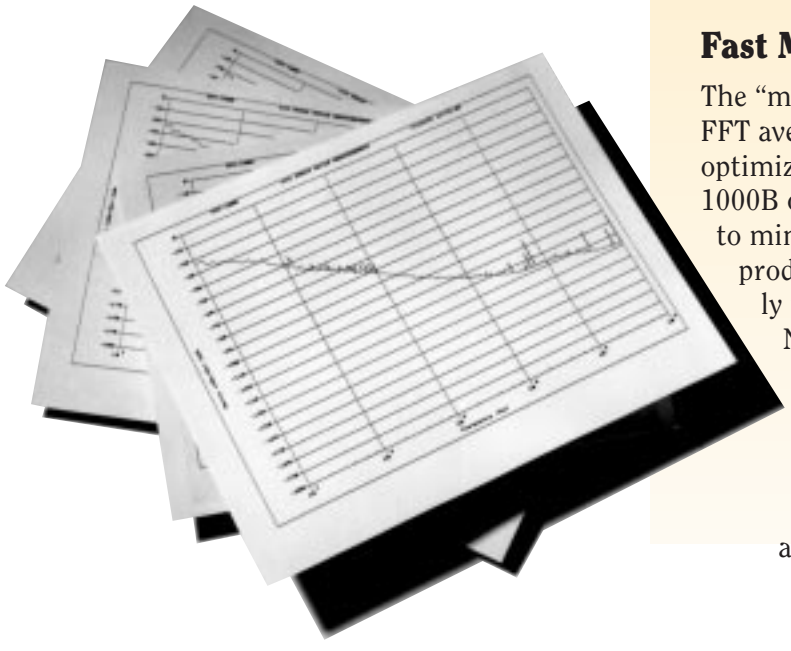
The NTS-1000B Phase Noise Analyzer uses the proven "delay-line discriminator" measurement technique to accurately measure Phase Noise at offsets between 10 Hz and 1 MHz. The NTS-1000B performs a precise calibration at the measured frequency before every measurement to insure measurement accuracy.

Self Contained

The RDL Model NTS-1000B Phase Noise Analyzer is a unique instrument that, for the first time, allows phase noise testing of every part. An FFT digital signal processor and vibration-hardened delay line are contained inside the unit. No external signal generator or outside computer are required.

Easy To Use

Measurements are made by simply pushing the "start measurement" button or sending an IEEE bus command. No special training or skills are required to operate the RDL Model NTS-1000B. Phase locking is not required. Automatic "pass/fail" analysis of phase noise levels and spurious levels is provided. These levels are user defined and the results can be reported over the IEEE-488 bus.



Fast Measurements

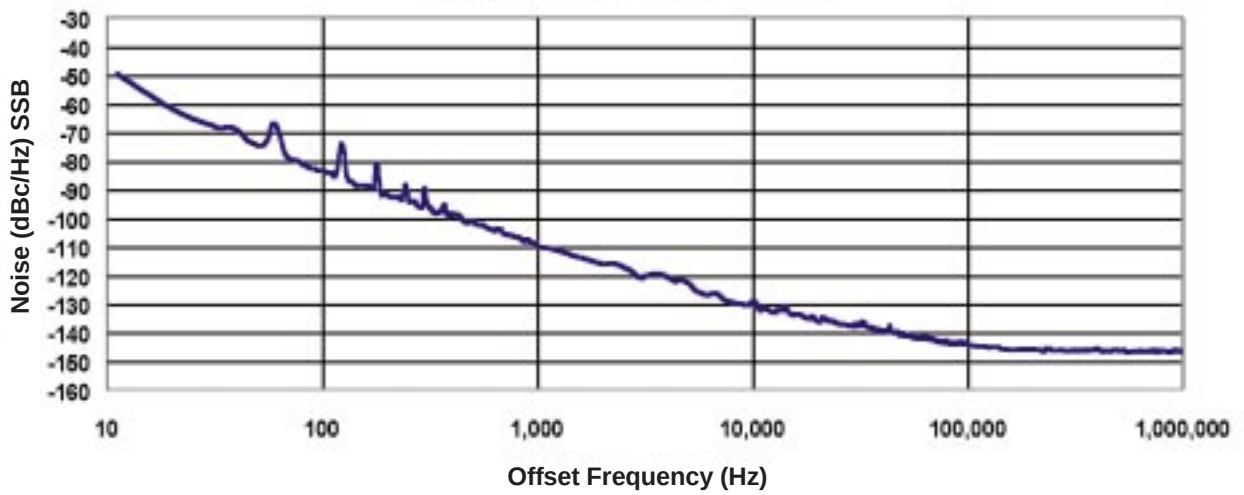
The "measurement range" and "number of FFT averages" are selectable by the user to optimize measurement time. The NTS-1000B only measures in the selected range to minimize the measurement time. In production applications, where extremely fast measurements are needed, the NTS-1000B can measure and report the results in less than 2 seconds. Typical measurement time for a full range measurement, 10 Hz to 1 MHz, with 100 FFT averages, is only 30 seconds, including an automatic calibration.

NTS–1000B and DCR–14000A-03

The latest microwave synthesizers and the YIG and DRO oscillators used in these sub-systems now have phase noise levels that are lower than even the most sophisticated military requirements of the past. The new "Low Noise Option" for the DCR-14000A, the –03 Option, lowers the noise floor levels of the RDL Phase Noise Analyzer System to easily measure to these new levels. The fact that "phase locking" is not required and the "10 second measurement speed" makes this measurement routine. Getting near instantaneous test results allows in-process adjustment to obtain optimum phase noise performance. These devices can now be subject to SPC and variations in the manufacturing process can be monitored, on line, and corrected before shipments are impacted. The table shows the phase noise performance of the DCR-14000A-03.

Typical Noise Floor dBc/Hz				
Offset Band		10 kHz	100 kHz	1 MHz
1.00 to 1.38		-147	-159	-160
1.38 to 1.86		-145	-158	-159
1.86 to 2.50		-144	-157	-158
2.50 to 3.14		-141	-155	-156
3.14 to 3.78		-140	-154	-155
3.78 to 4.42		-138	-151	-152
4.42 to 5.06		-135	-150	-151
5.06 to 5.70		-135	-150	-151
5.70 to 6.34		-135	-149	-150
6.34 to 6.98		-133	-149	-150
6.98 to 7.62		-133	-147	-148
7.62 to 8.26		-133	-146	-147
8.26 to 8.90		-131	-146	-147
8.90 to 9.54		-131	-144	-145
9.54 to 10.18		-131	-144	-145
10.18 to 10.82		-129	-143	-144
10.82 to 11.46		-129	-143	-144
11.46 to 12.10		-129	-140	-141
12.10 to 12.74		-128	-140	-141
12.74 to 13.38		-128	-140	-141
13.38 to 14.70		-128	-140	-141
14.70 to 18.50	Option-01	-128	-140	-141
18.50 to 24.94	Option-01	-127	-140	-141

Typical Noise Floor
NTS-1000B and DCR-14000A-03
RF Input Frequency 10,200.5 MHz



NTS–1000B and DCR–2500A

The new PCS applications have placed high demands on the designer and manufacturer. The constant push to better utilize the available spectrum has made phase noise one of the most important parameters. Phase synchronous modulation has placed further demands on this critical parameter. Since every dB is critical and costly, accurate measurement is now a requirement, not a luxury.

The RDL Phase Noise Analyzer System that consists of the NTS-1000B and DCR-2500A provides unique measurement capabilities that are not available from other suppliers. The ability of the NTS-1000B to measure unlocked sources, in seconds, combined with the very low phase noise in the DCR-2500A Downconverter extends the measurement of phase noise from the lab into the factory.

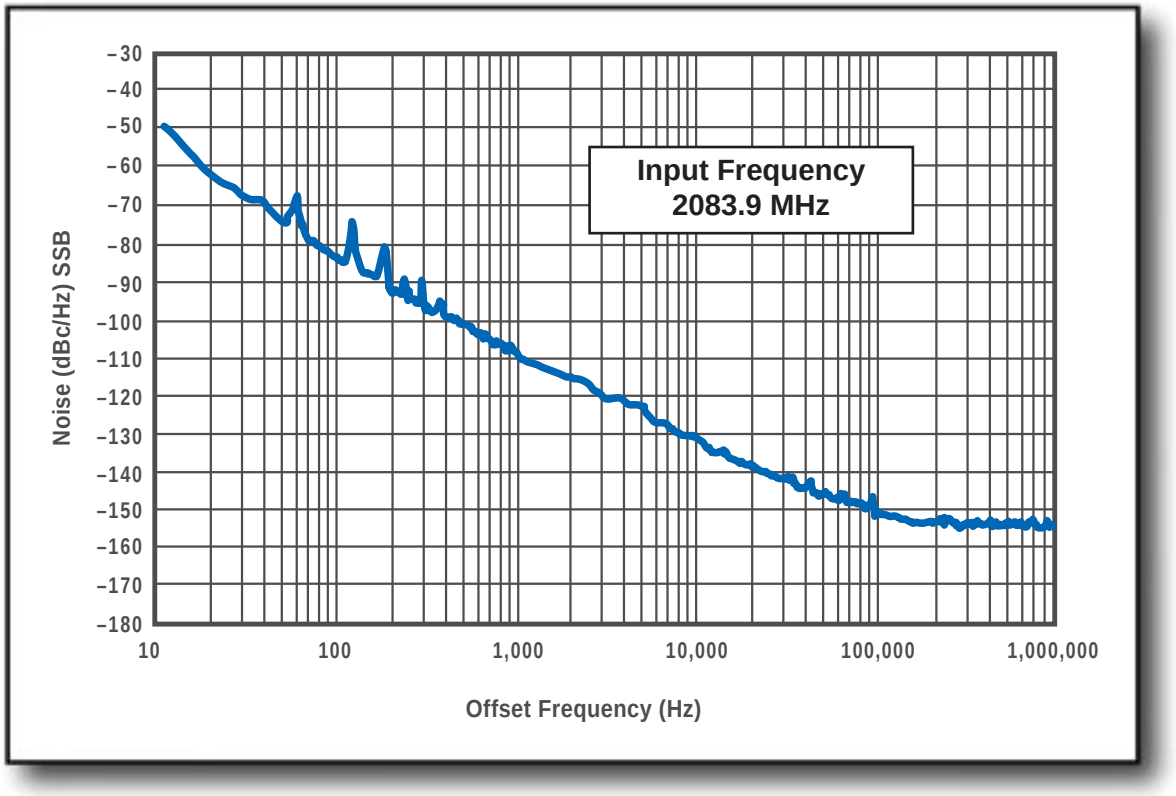
In the past phase noise measurements have been confined to the laboratory due to the complexity of the measurement techniques and the time consuming tools that have been available. The RDL System makes this a push-button measurement that can be made by non-technical personnel or under IEEE bus control. The built-in printer port and easy data manipulation makes documenting phase noise measurements a snap, and for the first time, makes statistical process control of this critical parameter feasible.

The low noise floor of the RDL System opens up the possibility of really measuring what is going on in a synthesizer's design. Now the noise of the PLL can be separated from the noise of the VCO and real design improvements can be analyzed and implemented.

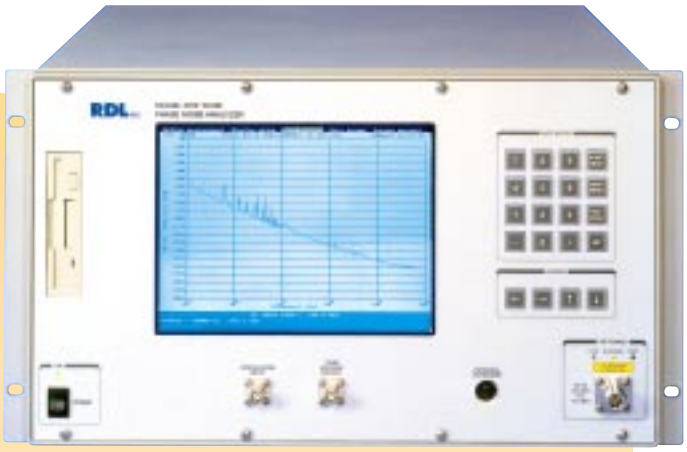
Now you don't have to specify an over-designed VCO and pay for performance you can not confirm or use. The RDL System is so simple and fast that, for the first time, you can consider testing every product in production.

Typical Noise Floor NTS-1000B and DCR-2500A

(Corrected for Source Noise)



NTS-1000B Specifications



Frequency Range:	50 to 1100 MHz
Frequency counter resolution:	100 kHz
RF Input Level:	−20 to +10 dBm
Spectral Analysis:	FFT; Hanning
Measurement Accuracy:	±2 dB
Calibration:	Automatic, before every measurement.
Analysis Range:	10 Hz to 1 MHz in 3 bands
Measurement Speed, includes calibration:	
10 Averages:	~10 sec. (full analysis range)
100 Averages:	~30 sec. (full analysis range)
Under remote control:	<1.2 sec. (1 kHz to 100 kHz analysis range)
Input Frequency Stability:	±20 kHz during measurement
(measurement time is a function of which analysis band(s) are selected and number of FFT averages selected)	
Averaging:	Selectable 1, 5, 10, 15, 20, 25, 50, 100 averages
Pass/Fail Analysis:	User defined limits for noise analysis.
Spurious Identification & Analysis:	User defined limits and analysis criteria.
Integrated Noise Analysis:	Computes integrated noise (dBc SSB) over user defined range(s).
Front & Rear Panel Input:	Type N
Printer Port:	Centronix parallel port (LPT1)
VCO Tune Voltage:	
Range:	±30 Volts
Resolution:	0.1 Volt
Noise:	~13 nV/√Hz 5 kHz

Modulation Input:	Used to apply modulation signal to the VCO tune voltage.

Typical Noise Floor dBc/Hz SSB Input > +6 dBm

Offset	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Input Frequency						
80 MHz	−49	−81	−107	−130	−151	−160
160 MHz	−49	−81	−107	−130	−150	−159
320 MHz	−48	−80	−107	−130	−150	−158
640 MHz	−48	−80	−107	−130	−150	−158
960 MHz	−45	−78	−104	−130	−150	−158

General Data:	
Remote Control:	IEEE-488.2
AC Power:	99-121 and 198-242 Volts, 47-63 Hz
EMC:	Meets the requirements of CE and FCC Part 15.
Size:	22 x 17.5 x 10.5 inch (D x W x H)
Weight:	85lbs. net, 120lbs. shipping

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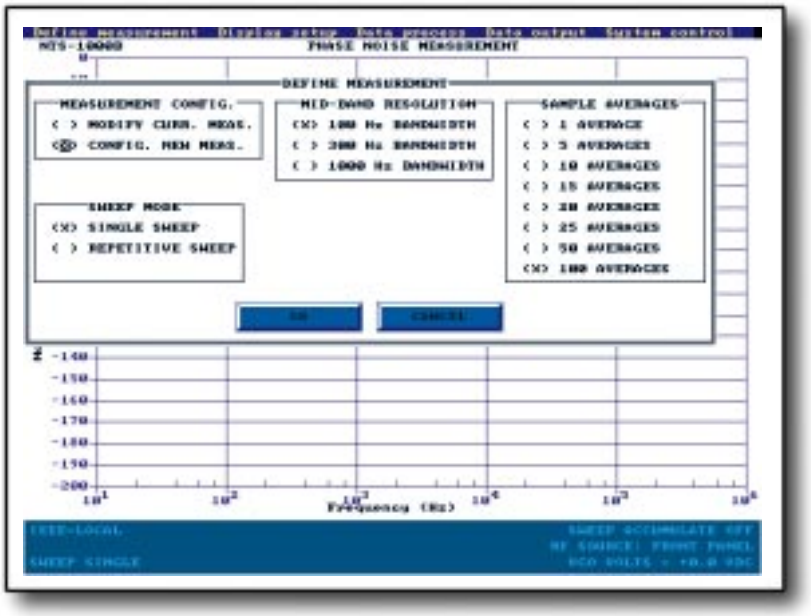
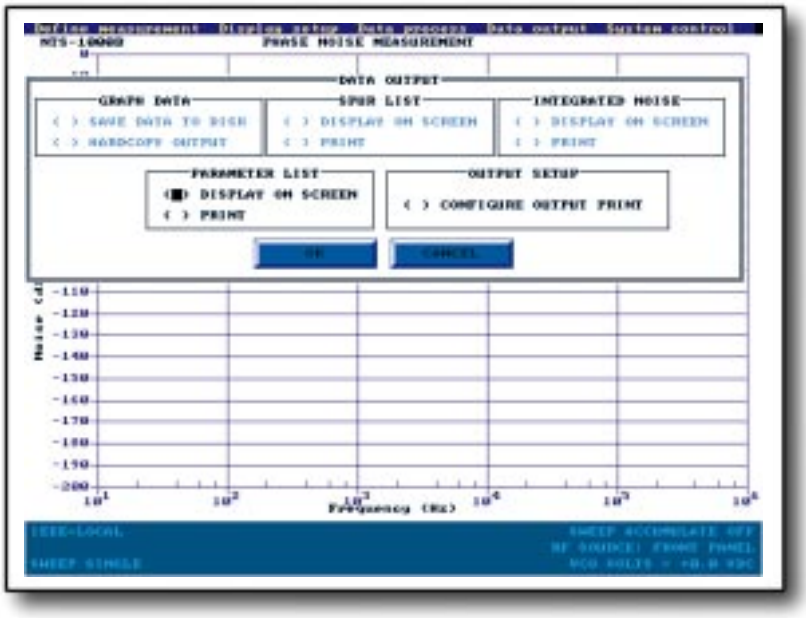
Specifications subject to change without notice.



Define Measurement

The user can set the "Number of Averages" and "Mid-band resolution" bandwidth to optimize measurement time. "Repetitive Mode" may be selected to further speed the measurement.

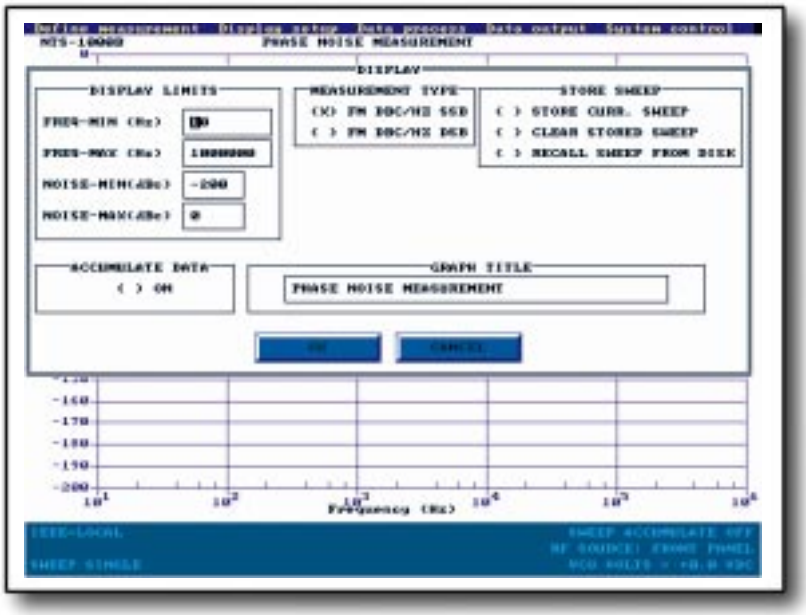


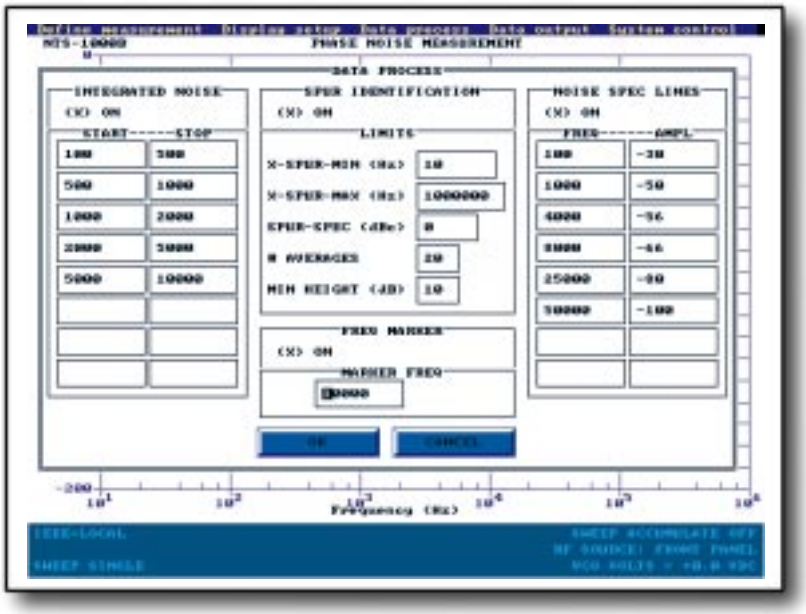
Data Output

Measurement results can be saved to the integral 3.5" disk drive or output to the integral printer port(s). The results of the "Integrated Noise" and "Spur List" can also be output. Virtually every measurement result and control is available over the integral IEEE-488 Bus.

Display Setup

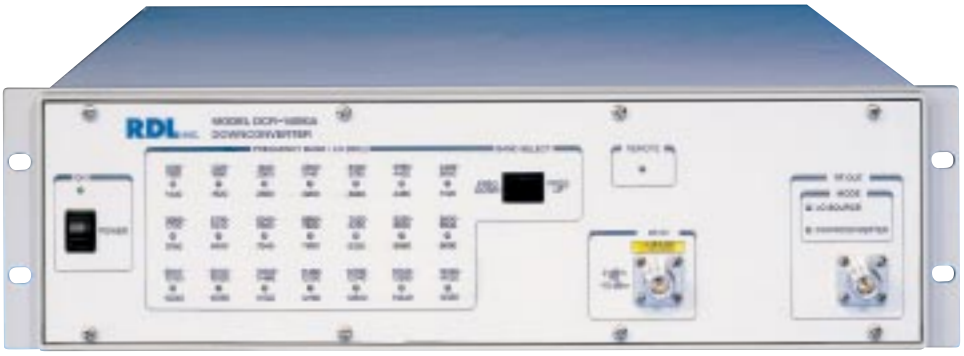
Menus define the measurement range, "Display Limits," and "Measurement Type." The "Graph Title" can be input, using a standard PC keyboard, so that printer plots contain identifying nomenclature. The "Accumulate Data" mode can be selected so that multiple measurements can be displayed and compared. The "Store Sweep" modes provide means to "screen save" an existing measurement or a "disk stored" measurement can be transferred to the display screen.





Data Processing

Definition of the frequency limits for calculating "Integrated Noise" is user defined along with the range and thresholds for"Spur Identification" and "Noise Spec Lines". The starting frequency of the "Moveable Marker" is also available.



DCR–14000A Downconverter

The RDL Model DCR-14000A Downconverter utilizes technology that RDL developed for military radar systems. The LOs are based on seven very low noise sources that are based on an 80 MHz crystal oscillator. These are mixed and matched to create 21 separate bands, each with very low phase noise. The output conversion gain is nominally 3 dB and the input required is only 0 dBm. You won't need to find a low-noise microwave amplifier to make your signal big enough to measure. The output is band limited to 60-700 MHz. The basic unit covers the frequency range of 1 to 14.7 GHz. There is continuous frequency coverage, no holes around each LO, and the phase noise levels are state-of-the-art.

The frequency range of the DCR-14000A can be extended to 25 GHz with Option 01. The 10.24 GHz LO that is available full time inside the DCR-1400A is made available on the rear panel for mixing from higher frequencies. The phase noise performance of the DCR-14000A at these higher frequencies is virtually the same as at the lower bands because this LO's noise is correlated with the noise of the other LOs. The 10.24 GHz signal is +10 dBm to accomodate a wide range of mixers.

The DCR-14000A can also be configured as a source. Option 02 is available where the individual LOs of the DCR-14000A can be output. Applications such as measuring the phase noise of a block downconverter is easy. The DCR-14000A's LOs can be the input and the output of the converter, usually within the frequency range of the NTS-1000B, can be measured directly, without locking, and you will know that the noise you are measuring is the noise of the DUT, not the noise of the source.

DCR-14000A Specifications

Frequency Range: 1 to 14.7 GHz, 21 bands

Output Frequency Range: 60 to 700 MHz

Input Level Range −10 to 0 dBm

Output Conversion Gain: 3 db; ± 3 dB

Typical Noise Floor dBc/Hz SSB @ 0 dBm input level

Frequency Range GHz	Offset Bands	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
1.00 – 2.50	3	−106	−136	−143	−144	−145
2.50 – 4.42	3	−101	−131	−138	−140	−141
4.42 – 6.34	3	−98	−128	−135	−137	−138
6.34 – 8.26	3	−96	−126	−133	−135	−136
8.26 – 10.18	3	−94	−124	−131	−133	−134
10.18 – 12.10	3	−92	−122	−129	−131	−132
12.10 – 14.78	3	−91	−121	−128	−130	−131

Option 01 Frequency Extension:

10.24 GHz LO for external mixing from 25 GHz

Output: Rear Panel; +9 dBm ± 1 dB; Type N connector.

Typical Noise Floor dBc/Hz SSB

Offset	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
10.24 GHz	−93	−121	−130	−133	−134

Option 02 Source Option:

There are 21 selectable output frequencies from 1.44 GHz to 14.08 GHz.

Output: ; +9 dBm ±3 dB; Type N connector

Typical Noise Floor dBc/Hz SSB

Offset Output Frequencies	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
1.44, 1.92 & 2.56 GHz	−106	−136	−143	−145	−146
3.20, 3.84 & 4.48 GHz	−101	−131	−138	−140	−141
5.12, 5.76 & 6.40 GHz	−98	−128	−135	−137	−138
7.04, 7.68 & 8.32 GHz	−96	−126	−133	−135	−136
8.96, 9.60 & 10.24 GHz	−94	−124	−131	−133	−134
10.88, 11.52 & 12.16 GHz	−92	−122	−129	−131	−132
12.80, 13.44 & 14.08 GHz	−91	−121	−128	−130	−131

Option 03 Low Noise Option:

See page 3 for performance specifications.

General Data:

Remote Control:	IEEE-488.2
AC Power:	99-121 and 198-242 Volts, 47-63 Hz
EMC:	Meets the requirements of CE and FCC Part 15.
Size:	20 x 17.5 x 5.25 inch (D x W x H)
Weight:	37lbs. net, 47lbs. shipping

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DCR–2500A Downconverter

The requirement for phase noise levels in the new PCS applications is unprecedented. The DCR-2500A has the lowest noise available and the levels are low enough, when combined with the NTS-1000B, to measure these extremely low levels.

The RDL Model DCR-2500A is a unique downconverter in that the LOs inside have extremely low phase noise. There are three overlapping bands in the DCR-2500A that provide continuous frequency coverage between 1 GHz and 3.26 GHz. The output frequency range is bandpass filter limited to between 60 and 700 MHz.

This unit requires only a 0 dBm input level. RDL puts the gain inside the DCR-2500A so that an external low-noise amplifier is not required. Conversion gain is a nominal +3 dB and the DCR-2500A output is sufficient to drive the Model NTS-1000B Phase Noise Analyzer.

The DCR-2500A operates under IEEE-488.2 external control. The user can select a band or just send a frequency and the DCR-2500A will automatically select the correct band. The NTS-1000B has an input screen, also available over the IEEE-488 bus, that inputs the downconverter's LO frequency. This allows the NTS-1000B to properly interpret its input to display the correct measured frequency. The DCR-2500A extends the measurement speed and convenience of the NTS-1000B into the PCS frequency bands.

DCR-2500A Specifications

Frequency Range:	1 to 3.26 GHz
Input Level Range	0 to −10 dBm
Output Frequency Range	60 to 700 MHz
Output Conversion Gain:	3 dB; ± 3 dB

Typical Noise Floor dBc/Hz SSB @ 0 dBm input level

Offset	**100 Hz**	**1 kHz**	**10 kHz**	**100 kHz**	**300kHz**	**1 MHz**
Bands						
1.00-1.38 GHz	−106	−134	−145	−154	−154	−155
1.38-1.86 GHz	−105	−132	−143	−153	−154	−154
1.86-3.26 GHz	−103	−130	−140	−151	−153	−154

General Data:

Remote Control:	IEEE-488.2
AC Power:	99-121 and 198-242 Volts, 47-63 Hz
EMC:	Meets the requirements of CE and FCC Part 15.
Size:	20 x 17.5 x 5.25 inch (D x W x H)
Weight:	32lbs. net, 42lbs. shipping

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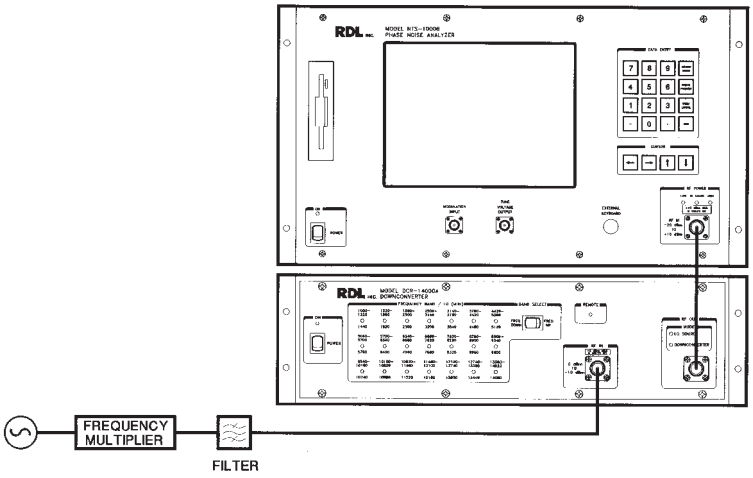
Specifications subject to change without notice.

Applications

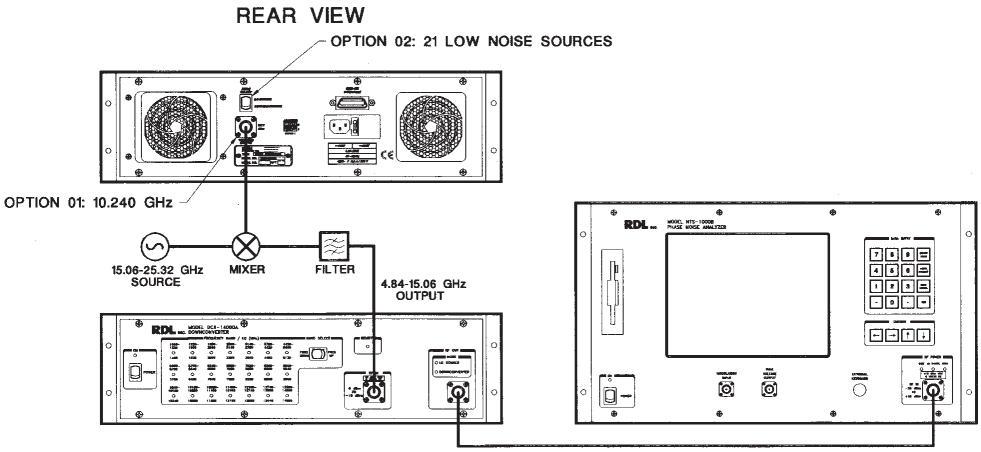
Measuring Crystal Oscillator Phase Noise

Multiplying increases the phase noise by 6 dB for every doubling. Multiplying by x16 would increase the phase noise by 24 dB and increase (improve) the apparent noise floor of the NTS/DCR to –129 dBc at 1 kHz offset and –154 dBc at 10 kHz offset.



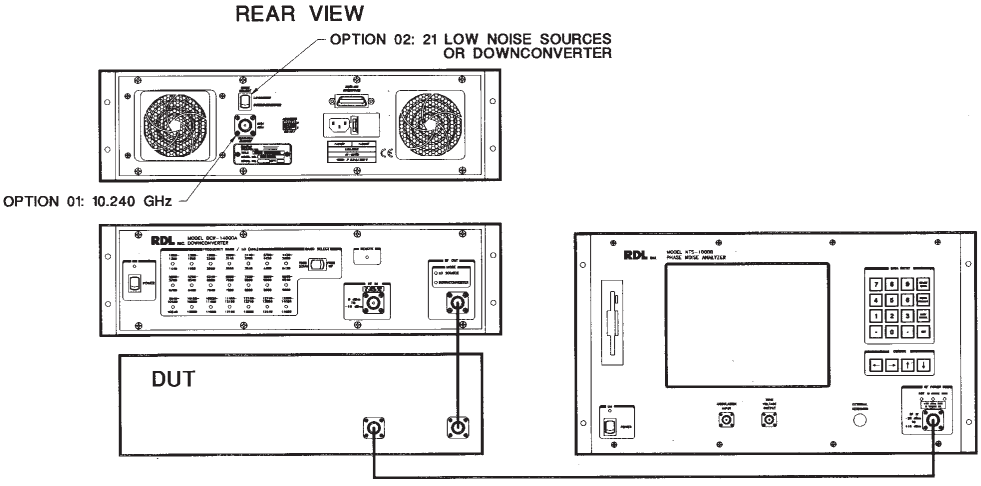
Measuring Signals Above 14 GHz

Option 01 provides a very low noise source for mixing down from higher frequencies. The user can mix down signals as high as 25 GHz to within the range of the DCR-14000A using this option.



Measuring Additive Phase Noise

The DCR-14000A with Option 02 can be a microwave source that has extremely low phase noise. In “Source” mode the internal LOs are made available to drive a microwave downconverter or microwave amplifier so that the phase noise of the output can be measured directly by the NTS-1000B or another DCR-14000A/ NTS-1000B.



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