

PN3048 Phase Noise Software



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WHAT

The main interface for the program consists of a series of eight tabs.

one of several HP spectrum analyzers such as the HP3585A.

	Test Type Range	<u>Graph</u>
	Instrument Parameters	Loaded Files
S NEW	Cal Process	Parameter Summary
	Source Control	<u>Measurement</u>

There are four main dialog boxes for choosing display colors and labeling, specifying attached instruments and GPIB addresses, specifying segments, n controlling the 11848A, and testing the system.

PN3048 is a Windows program for measuring the phase noise of signal sources and two port devices using the HP11848A Phase Noise Interface and HP

Spectrum Analyzer. With these basic instruments, phase noise may be measured at offsets from the carrier of .01Hz to 100Khz and to 40Mhz with the



Display Setup Instrument Configuration Edit Segment Tables 11848 Control 3048 Test

Program Installation

To install the PN3048 program, run setup.exe. The installation program will create a new folder in the Program Files folder named PN3048 where the r executable program file and a few support files are placed. Two PN3048 icons will be created. One will be placed on the Start Menu and the other on y desktop. A list of the installed files is included at the end of this file.



IMPORTANT

For various Asian and European users it will be necessary to change the Regional Settings on your computer to deal with the placement of the decimal commas in the input fields and also the unicode encoding used in some languages. You must choose "English United States" in the Windows Regional O the Advanced tab as shown below under the topic Regional Settings.



Uninstalling the Program

To uninstall the PN3048 System Software, double-click the icon Add/Remove Programs in the Control Panel. Find the PN3048 program in the list of pro Install/Uninstall and click the Add/Remove... button. Windows will automatically remove the PN3048 program.

Main Window

The PN3048 Main window is where phase noise files are loaded, measurement options selected and measurements run.



Save System Configuration Button

Saves the current program settings to the default configuration file PN3048.ini. PN3048.ini is loaded when the program is first run, establishing the me environment. You may load and save other configuration files with different names from the file menu items "Load Configuration..." and "Save Config. As..." These files have the same structure as the PN3048.ini file, however, they are given the extension "*.cfg" to distinguish them from the default PN file.

Clear Traces Button

Clears measurement data or a loaded file (or files) from memory. When a file is loaded, the state of the software is saved to a temporary file named \sim PN3048.ini. When the Clear Trace button is clicked, the graph is cleared and the state of the software is restored using this temporary file.

Cancel Button

Allows a measurement in progress to be canceled. You are prompted before the program quits the current measurement.

New Measurement Button

Initiates a new measurement. The VCO and Phase Detector tuning constants are determined before beginning the actual phase noise measurement pr This takes much longer but is more accurate than using existing constants.

Also, if a file is loaded, the software will prompt you to use the VCO and Phase Detector constants from the loaded file in the measurement. This will c software to skip the determination of these two constants resulting in a faster measurement cycle.

Repeat Measurement Button

The Repeat Measurement button uses VCO and Phase Detector tuning constants that were determined from initially running a "New Measurement". Th in a much faster measurement cycle.

Fileview

Fileview, located on the left side of the main window, is an explorer style view of the file system with the directory structure displayed in the upper par files displayed in the lower pane. The relative size of the panes can be adjusted by dragging the splitter bar that divides them. At the top of the directory pane, the [PICTURE FileViewBtn.gif] button provides several options that control the behavior of Fileview. For example, the action for clicking on a file in the file pane is to immediately load that file. This may be changed from single-click load to double-click load, which allow: be renamed and deleted without being loaded.

Files

The program reads both the original HP BDAT file format generated by HP 9000 series computers and also the PC byte ordered file format. It determine type (normal or reversed byte ordering) automatically. The program writes the results of measurements in the same BDAT format, but with PC byte or The files the software uses are:

*.res

Result file. Contains plot data and instrument parameters. These files are in the same format as the original HP RESU_ files.

PN30448.ini

Default parameters for the program. This loads on startup

*.cfg

Same structure as the PN3048.ini, intended for saving different setups. These are saved using the menu item "SaveConfigurationn As..." and recalled I

menu item "File | Load Configuration ... "

*.seg

Segment definition file. The default segments are stored in PN3048.ini and are loaded when the program is first run. Additional segment definitions car created and saved using the Save Segment As... button in the Edit Segment form and are saved using the .seg extension.

CalDataLo.ini

Calibration data for the low frequency bands

CalDataHi.ini

Calibration data for the high frequency bands

*.ds

Display Setup file. This file is used to save different display setups with varying line, label, and marker positions and colors. A dispay setup file is gener when the button "Save Dispay Setup" in the Display form is clicked. To load a previously saved dispay setup, click on "Load Display Setup" button.

*.nf

Noise floor file. This file contains the X & Y data used to generate a noise floor curve. Noise floor curves can be loaded and saved from the Display Setu the Noise Floor group.

System Requirements

The software has only been tested under Windows XP and may not run under Windows Vista or Windows 7. At a minimum, the software expects to see HP11848A and a 3561A and a National Instruments compatible GPIB controller. The following HP instruments can be used with the software for differe measurement scenarios:

RF Spectrum			
Analyzers	RF Sources	Counters	Miscellaneous
HP3585A/B	HP8662A HP8644A	HP5384A	HP3325A
HP8561/2/3 A/B/E	HP8663A HP8654A	HP5385A	HP3478A
HP8566A/B	HP8665A HP8654B	HP5386A	11729C
HP8567A	HP8640A HP8656B	HP5343A	
HP8568A/B	HP8642A HP8657A	HP5316A	
HP71000	HP8642B HP8657B	HP5316B	

TABS

Type/Range Tab

The Offset Start and Stop Frequencies are entered here as well as the minimum number of averages, which can be over-ridden by the averaging settin Segment definitions.

At present, two "Measurement Types" have been tested: "Phase Noise Using Phase Locked Loop" and "Phase Noise without Using a PLL". The other fou available have not been tested and most likely will not work.



Instrument Parameters Tab

Specify the Phase Detector type, carrier frequency and VCO tuning parameters. All elements except External Phase/AM Detector in the have been test

Test Type/Range	Instrument Parameters	Cal Pro	cess	Source Control	Graph Loa	aded F	iles Parameter	Summary	Measurement
Phase Detecto	Phase Detector VCO / Carrier Frequency								
Internal Pha	se Detector: 5Mbz to 160	0Mbz		Ca	arrier frequenc	зу 🦳	10,900,000.0	Hz	Range: 1Hz to 110Ghz
C Internal Pha	se Detector: 1.2Ghz to 18	Ghz		Detector/Discrim i	nput frequenc	у 🕅	10,000,000.0	Hz	Range: 5Mhz to 18Ghz
C External Pha	ase/AM Detector			VCO T	uning Constar	nt 🔽	10.00	Hz/Volt	Range: .01 to 1E6
			Cer	nter voltage of VCC) Tuning curv	re 🔽	0.00	Volts	Range: -10 to 10
			1	Voltage tuning rang	ge of VCO +,	/- 🕅	4.00	Volts	Range: 0 - 10
				VCU tune port in	nput resistanc	:e	1,000,000.0	Ohms	Range: .1 to 1E6

Cal Process Tab

Determines the procedure used to establish the VCO and Phase Detector tuning constants.

Test Type/Range Instrument Pa	rameters Cal Process	Source Control	Graph	n Loaded Files Parameter Summary Meas	surement
Phase Detector Constant C Use the current Detector Cons G Measure the current Detector	tant 0.628 V/Rad Constant	950.E-6 to 1.E+3	3	VCO Tuning Constant C Use the current Tuning Constant C Measure the VCO Tuning Constant C Compute from expected Tuning Constant	14 Hz/Volt t 1E+15 Hz/Volt
		🔽 Verify	Loop S	uppression	

Only the first two Phase Detector Constant methods have been verified: Use Current Detector Constant Measure the Current

Note: Other methods appear in the Phase Detector group when a non-PLL controlled measurement is made, but these have not been tested yet.

Under VCO Tuning Constant, two have been tested. Use Current Tuning Constant Measure the VCO Tuning Constant

Source Control Tab

Displays a connection diagram of the various sources/components under test. There are four possible Source Control displays corresponding to the fou types of noise measurements. Clicking on the various elements in the connection diagram causes the connections to change. Only two connection arra have been tested Phase Noise Using Phase Locked Loop and Phase Noise Without a Phase Locked Loop. Most of the connection types should work but r combinations have been tested.

For Test Type Phase Noise Using Phase Locked Loop the Source Control Tab looks like this:

Test Type/Range Instrument Parameters Cal Process Source Control Graph Loaded	Files Parameter Summary Measurement
Device Under Test (DUT) Down Co	nverter HP 11848A
10 MHz 'A' - System Control Ctrl NOT IN	USE Ctrl
Reference Source	
10 MHz 'B' - System Control Ctrl	$ \forall \rangle$
Time Base	
NOT IN USE	Tune Source
	Tune Voltage

For Test Type Phase Noise Without a Phase Locked Loop, the Source Control Tab looks like this:



For Test Type Phase Noise Using an FM Discriminator, the Source Control Tab looks like this:



For Test Type AM Noise, the Source Control Tab looks like this:

Test Type/Hange Instrument Parameters Cal Process	Source Control Graph Loaded Files Parameter Summary Measurement
AM DETECTOR	HP 11848A
DUT Source 10 HHz 'B' - System Control Ctrl	AM Detector

Graph Tab

Here you may choose the type of graph to display, the X and Y coordinates and colors. Checking "Display Multiple Result Files", allows multiple phase I measurements to be loaded for comparison.

The only graph type that has been coded is the Single Sideband Phase Noise (dBc/Hz).

Test Type/Range Instrument Parameters Cal Process Sc	ource Control Graph Loaded Files Parameter Summary Measurement
Graph Type	Graph Parameters
Single Sideband Phase Noise (dBc/Hz)	Minimum X Coordinate 1.000 Hz Range: .001Hz to 10Ghz
C Phase Modulation Spectral Density (dB/Hz)	Maximum X Coordinate 10,000,000 Hz Range: .001Hz to 10Ghz
C FM Spectral Density (1/SQR(Hz))	Minimum Y Coordinate -170 Range: -300 to 300
Spectral Density of Frac. Freq Fluctuations (1/SQR(Hz)) Noise Figure for 2-Port Devices	Maximum Y Coordinate 0 Range: -300 to 300
DSC FLR Small Angle	Colors Display Multiple Result Files

Loaded Files Tab

This tab displays the filenames, titles of files and the ranges of the measurement, when more than one file is loaded (must check "Display Multiple Res on the Graph tab to display more than one file)

ſ	Test	Туре	e/Range Instrument Parameters Cal Process Sc	urce Control Graph Loaded Files Parameter Summary M	easuremei	nt			
	Trace	On	File Name	Caption	Mkr1 10Hz	Mkr2 100Hz	Mkr3 993Hz	Mkr4 10.2KHz	Clear Traces
	1		10Mhz A Internal vs SpectraDynamics 10	10Mhz A Internal vs SpectraDynamics 10Mhz Test 2	-111.8	-147.9	-159.9	-164.8	New Measurem
	2		10Mhz A vs HP5061B (CS1).res	10 Mhz A Internal vs HP5061B (CS1)	-124.0	-135.0	-141.9	-143.0	
	3		10Minz A vs SpectraDynamics LNFR-400	Untitled - Type here to change the graph title	-122.8	-149.7	-160.1	-163.6	Beneat Measurer
	4	₽	10Mhz A vs SpectraDynamics LNFR-400	18Mhz A vs SpectraDynamics LNFR-400 10Avgs in	-122.5	-148.1	-159.7	-163.9	
	5								e 14
	6								Lancel Measuren
10	7								
	8								Save System Con
14					1	1	1		

Parameter Summary Tab

This tab displays a summary of all the various parameters for each type of measurement. The fields displayed here vary depending on the type of measurement. The fields displayed here vary depending on the type of measurement.

Test Type/Range Instrument Parameters Ca	Process Source-Control Graph Loaded I	Files Parameter Summary Measurement
Measurement Type: Phase Locked Start Frequency: 1 Hz Stop Frequency: 1.E+6 Hz Minimum Averages: 4	Entered Kvco: 10 Hz/Volt Center Voltage: 0 Hz/Volt Tune Range +/-: 4 Hz/Volt	Loop Suppression: VERIFIED Closed PLL BW: 28 Hz Peak Tune Range: 56 Hz Assumed Pole: 40.E+2 Hz
Carrier Frequency: 10.E+6 Hz	Kxco Method: MEASURED	DUT: USER'S SRCE, SYS
Detector In Freq: 10.E+6 Hz	Kyco: 14 Hz/Volt	Reference Source: 10 MHz 'A', SYS, VCO
Phase Detector: 5 TO 1680 MHz	Kphi Method: MEASURED	External Timebase: NOT IN USE
11848A LNA: OUT	Kphi: 629.E-3 V/Rad	Down Converter: NOT IN USE

Measurement Tab

The measurement tab displays information about the current running measurement. Also, if a measurement fails to find a beat note, the VCO Center \ control and the Inc/Dec Span control on this tab will be enabled allowing you to adjust the VCO Center frequency, which will change the tuning voltage hence the beat frequency. The span setting of the 3561A may then be adjusted to get the best view of the beat note.

Test Type/Range Instrument Parameters Cal	Process Source Control Graph Loaded Files Parameter Summary	Measurement
PLL Gain Change: 268.E-15 dB Closed PLL BW: 35 Hz Peak Tune Range: 72 Hz Assumed Pole: 702 Hz Max Error: 5 dB Detector Constant: 608.E-3V/Rad	3561A	VCO Center Voltage 0.35 × Inc/Dec Span 100,000 ×
VCO Constant: 14 Hz/V Approx internal noise floor: -170 dBc/Hz (LNA in, Offsets > 10 kHz)	11848A	LNA On Continue

FORMS

Display Setup

💐 Display Setup		×
Trace Color/Background	V Lines	Labels
Trace 1 Trace 5 Trace 2 Trace 6 Trace 3 Trace 7 Trace 4 Trace 8 Background Major Grid Black Background White Background Cyan Background	Line 1 Line 2 Line 2 Line 3 Line 4 Line 5 Line 6 Line 7 Line 8 Line 9 Line 10 Reset Lines All On All Off	Label 1 ▼ 60 Hz Label 2 ▼ 180Hz Label 3 □ □ Label 4 □ □ Label 5 □ □ Label 6 □ □ Label 7 □ □ Label 8 □ □ Label 9 □ □
Noise Floor Color • Thin Fill • Thick Load Save Save Display Setup Load	Marker 1 V Marker 2 V Marker 3 V Marker 4 V d Display Setup	Clear Labels All On All Off Filename -> Labels Text Color File Caption -> Labels Background Ok (Cancel) Help

Display Setup is available by right clicking the display area and choosing "Display Setup" or selecting the menu item View | Display Setup... The Displa form allows the trace and background colors to be changed. In addition, the Lines, Labels, Markers and Noise Floor may be turned on and off, colors cl and individual Lines and Labels enabled or disabled.

The markers and labels can be selected by left clicking and dragging into position using the mouse. To position the Lines, move the mouse pointer ove point until the mouse pointer changes to a four-headed arrow, and then left click and drag the endpoint into position.

The text in the Labels can be edited by double-clicking on them or, alternatively, they can be edited in the Display Setup form.

Edit Segment Tables

🖏 Ed	lit Segment	Tables							
1	FFT Segment Table								
Seg #	Plotted Range Low	Plotted Range High	Measurement Range Low	Measurement Range High	Minimum Averages	Bandwidth	Time Record _ Length		
1	1	100	1	100	4	0.955	4		
2	100	1000	100	1000	30	9.486	0.4		
3	1000	10000	1000	10000	100	95.86	0.04		
4							-		
5									
6									
7									
8									
9									
			RF Se	gment Table					
Seg #	Plotted Range Low	Plotted Range High	Measurement Range Low	Measurement Range High	Minimum Averages	Bandwidth	Time Record		
1									
2									
3									
4							-		
5									
5									
6									
9									
9									
9	Load Segmer	nts		Insert Row		elete Row			
9 	Load Segmer ave Segment:	nts s As	01	Insert Row	Cancel	elete Row	lelp		

The Edit Segment Tables form allows the current segment definition to be edited, and new definitions to created and saved. It is fully functional, but th very little checking for correctness. For example, if you delete a row this will cause problems. The program currently expects the entries to be ascendi frequency order, and for the specified segments to begin and end without gaps. I plan to add more robust error checking to prevent inadvertent errors can cause a measurement to fail for mysterious reasons.

Instrument Configuration

🗟 Instrument Configuration					
S. Instrument Configure Basic Instruments Addr 3561A 11 11848A 20 GPIB Adapters Board 1 C	Analyzer Addr No RF Analyzer Addr 3585A/B 13 8561/2/3 A/B/E 0 8566A/B 18 8567A 0 8568A/B 18 8568A/B 18 8568A/B 18 8568A/B 18 8568A/B 18 8568A/B 18	RF Source Addr No RF Source Addr 8662A 19 8663A 0 8665A 0 8665A 0 8665A 0 8640B 0 8642A 0	Addr 8644A C 0 8645A C 0 8645B C 0 8656B C 0 8656B C 0	Counter Addr 5384A 0 5385A 0 5386A 0	Miscellaneous Func Gen Addr 3325A 17 Voltmeter 3478A 3478A 23 Downconverter 11729C
Test GPIB Co	71000 C 0	0k	86578 C 0	53168 C 0	Configure 11729C

The Instrument Configuration form is used to specify which instruments are connected to the system. It is fully functional, and allows all of the original instruments HP specified for operation with the 3048A to be selected. However, at present, only the basic boxes have been tested - the HP11848A and HP3561A. If you select any of the other instruments the software will address them (i.e., the 3585A or the 8662A) but if a measurement is specified th them, it is likely to fail (very likely)

11848 Control



The 11848 Control form allows manual control of the 11848A Interface box. On entry, the current state of the 11848A is reported. You may change the any relay or switch in the 11848A here. This form may be invoked while a test is in progress to take a look at the state of the 11848A while a test is ru optionally modify the state of the 11848A. The test will resume from where it was interrupted.

3048 Test

🗟, 3048A Test	×
Functional Tests PerformanceTests Calibrate System Internal Adjustments	Test Internal DACs
3048A Functional Tests	Paths-
Fun All Tests Test 1 DC Offset Test Test 2 A3/A4 Signal Paths Transfer Function Test Test 3 PLL Paths Transfer Function Test Test 3 PLL Paths Transfer Function Test Test 4 Lag/Lead Transfer Function Test Test 5 100Khz Calibrator, Search Osc & Out Of Lock F/F Test Test 5 100Khz Calibrator, Bearnote Test Test 6 RF Phase Detector Beatrinote Test Test 7 DAC 1,2 & 3 Beatnote Pull Test Test 9 Rear Panel Tune Voltage Output Test Test 10 Front Panel Tune Voltage Output Test	All GoMhz LPF C HPF 1KHz ZMhz LPF C HPF 100Hz LNA 50 0hm C HPF 10Hz LNA 50 0hm Low Freq) C HPF 1Hz LNA 1K C Adaptive Coupler=AC Switched Gain x2 C Adaptive Coupler=DC Switched Gain x1 C LPF 10KHz Switched Gain x1 C LPF 10Hz Switched Gain x1 C LPF 10Hz HPF 10KHz C LPF 11Hz
View 11848 State Continue Pause after setting up 11848A Run Test	Cancel Test
Save Test Log	Exit Help

Provides a variety of tests for verifying the function and performance of the system and for adjusting various internal circuits. The Calibrate tab allows calibration constants to be generated.

The Functional Tests tab, Internal Adjustments tab and Test Internal DACs tab are now functional. The Performance Tests tab and Calibrate System ta functional.

Regional Settings

If you are an international user using either Windows Vista, Windows XP or Windows 2000, the code page Windows uses for language translation must English (United States) for the PN3048 program to run properly. If the regional settings are set incorrectly, the PN3048 software will run erratically an not be able to load and view the sample result files or control the HP3048 hardware. Follow the instructions below to view or change the regional settin your version of Windows.

Windows XP

Follow these steps to set Windows Regional settings for Windows XP.

Go to the Control panel by clicking on Start/Settings/Control Panel.



Find the Regional and Language Options icon and double click. This will bring up the Regional and Language Options form shown below with the Region tab showing the current regional setting. Enter your language here.

Regional and L	anguage Options 🛛 ? 🔀	
Regional Options	Languages Advanced	
Standards and	d formats	
This option al dates, and tin	ffects how some programs format numbers, currencies, ne.	
Select an iter your own form	n to match its preferences, or click Customize to choose nats:	
Chinese (PR	C) Customize	
Samples	<u> </u>	Choose your
Number:	123,456,789.09	Language Here
Currency:	¥ 123,456,789.00	
Time:	18:07:13	
Short date:	2004-5-13	
Long date:	2004年5月13日	
Location To help servi weather, sele United State	ces provide you with local information, such as news and ct your present location:	
	OK Cancel Apply	

Next click on the Advanced tab and choose English (United States) as shown below.

Regional and Language Options	
Regional Options Languages Advanced	
Language for non-Unicode programs	
This system setting enables non-Unicode programs to display menus and dialogs in their native language. It does not affect Unicode programs, but it does apply to all users of this computer.	
Select a language to match the language version of the non-Unicode programs you want to use:	
English (United States)	- Must Select English (United States)
Code page conversion tables	
✓ 10000 (MAC - Roman) ✓ 10001 (MAC - Jananese)	
 10002 (MAC - Traditional Chinese Big5) 	
10003 (MAC - Korean)	
🔲 10004 (MAC - Arabic)	
10005 (MAC - Hebrew)	
Default user account settings	
Apply all settings to the current user account and to the default user profile	
OK Cancel Apply	

Click OK to accept the new settings and then click OK in the Regional Options form. Windows will prompt you to restart the computer. Choose Yes to re

Windows 2000

Follow these steps to set Windows Regional settings for Windows 2000.

Go to the Control panel by clicking on Start/Settings/Control Panel.



Find the Regional Options icon and double click. This will bring up the Regional Options form with the General tab showing Your Locale (location) setting shown below. Enter your language here. This affects the way dates, times and numbers are presented by Windows.

Regional Options		?	×	
General Numbers Currer	ncy Time Date	Input Locales		
Installed input locales			1	
Input language		Keyboard layout/liviE		
EN English (United	States)	US 📥		CI.
🗸 📑 Chinese (Taiwa	n) Chinese (Traditio	onal) - New Phonetic 🔜 '		 Choose your Langester horo
SV Swedish		Swedish 👻		also
Add	<u>R</u> emove	Properties		
	IME Settings	<u>S</u> et as Default		
To turn off Caps Lock — • Press CAPS LOCK k	ey O Press Si	HI <u>E</u> T key		
Hot keys for input locale	s		1	
Item		<u>K</u> ey sequence		
Switch between input lo	ocales	Left Alt+Shift 📥		
Switch to English (United States) - US (None)				
	Ū	hange Key Sequence		
Enable indicator on tas	kbar			
	OK	Cancel Apply		

Click on the Input Locales tab and enter your language at Input Language. This affects the way the keyboard operates.

Regional Options ? 🗙	
General Numbers Currency Time Date Input Locales	
Installed input locales	
Input language Keyboard layout/lfi/fE	
EN English (United States) US 🛋	
🔮 🐺 Chinese (Taiwan) 🛛 Chinese (Traditional) - New Phonetic	- Choose your
Swedish Swedish	also
Add <u>R</u> emove <u>Properties</u>	
IME Settings Set as Default	
To turn off Caps-Lock Press CAPS LOCK key Press SHIET key	
Hot keys for input locales	
Item <u>K</u> ey sequence	
Switch between input locales Left Alt+Shift 📥	
Switch to English (United States) - US (None)	
Change Key Sequence	
Enable indicator on taskbar	
OK Cancel <u>Apply</u>	

Click on the General tab and then click on the Set Default... button which will open the Select System Locale form and below the label Select the Approlocale choose English (United States).

Regional Options	
General Numbers Currency Time Date Input Locales	
Select System Locale	
The system locale enables applications to display menus and dialogs in their native language. Windows will use the code page and font settings of this language. Menus and dialogs of Windows will not be affected.	
Select the appropriate locale.	
English (United States)	Must Choose English (United States)
OK Cancel	
Language settings for the system Your system is configured to read and write documents in multiple languages.	
Arabic Armenian Baltic	
Central Europe	
Set default	
OK Cancel Apply	
Click Set Default button to brixg up the Select System Locale ferm	

Click OK to accept the new settings and then click OK in the Regional Options form. Windows will prompt you to restart the computer. Choose Yes to re

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