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PN3048 Phase Noise Software v1.417 Preliminary

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WHAT'S NEW

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 one of several HP spectrum analyzers such as the HP3585A.

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

Test Type Range	Graph
Instrument Parameters	Loaded Files
Cal Process	Parameter Summary
Source Control	Measurement

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

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 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 your 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.
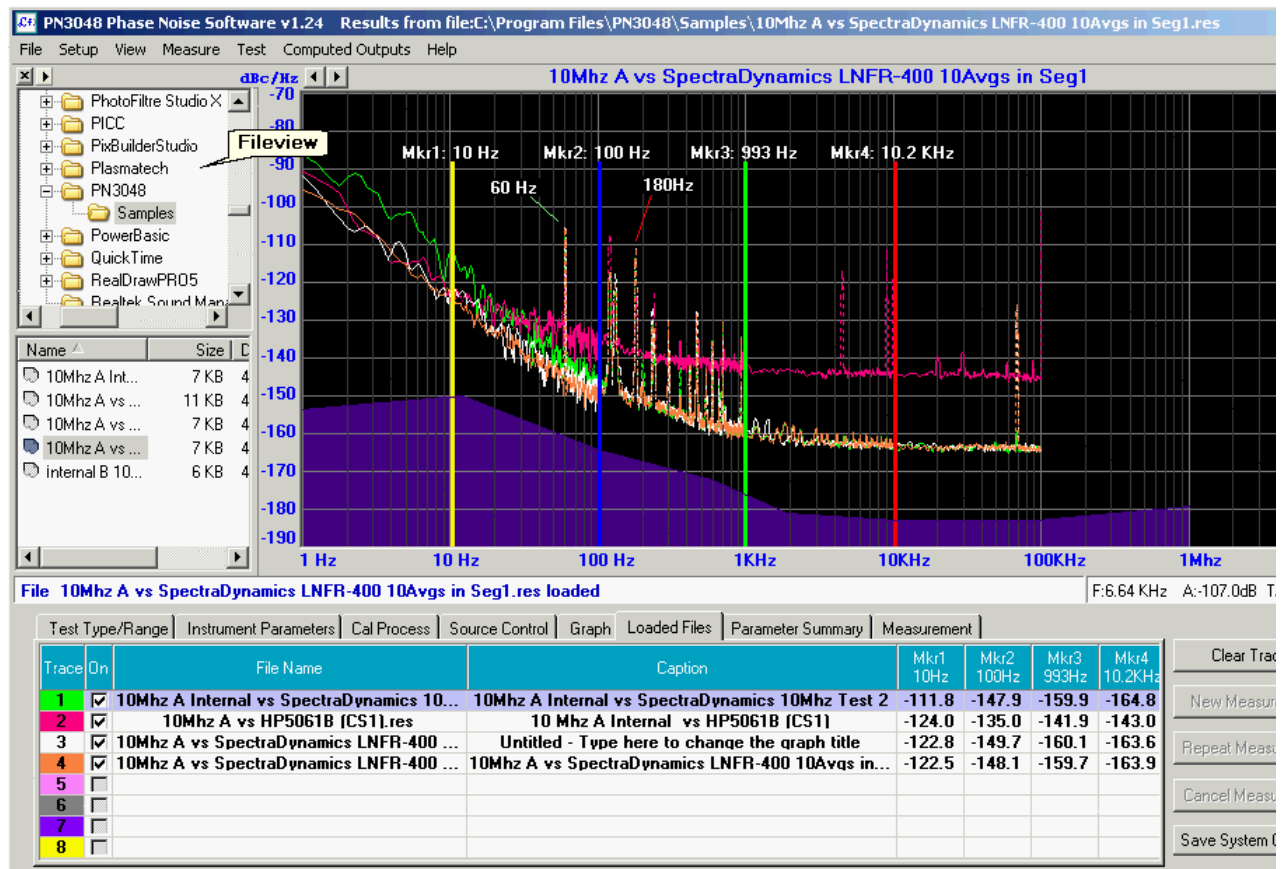
Save System Configuration Button
Saves the current program settings to the default configuration file PN3048.ini. PN3048.ini is loaded when the program is first run, establishing the me
environment. You may load and save other configuration files with different names from the file menu items "Load Configuration..." and "Save Configu
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
~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 ca
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 pa
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 allows
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 determin
type (normal or reversed byte ordering) automatically. The program writes the results of measurements in the same BDAT format, but with PC byte o
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

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 can 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 differen 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

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

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement

Phase Detector Constant
○ Use the current Detector Constant `0.628` V/Rad 950.E-6 to 1.E+3
⦿ Measure the current Detector Constant

VCO Tuning Constant
○ Use the current Tuning Constant `14 Hz/Volt`
⦿ Measure the VCO Tuning Constant
○ Compute from expected Tuning Constant `1E+15 Hz/Volt`

☑ Verify Loop Suppression

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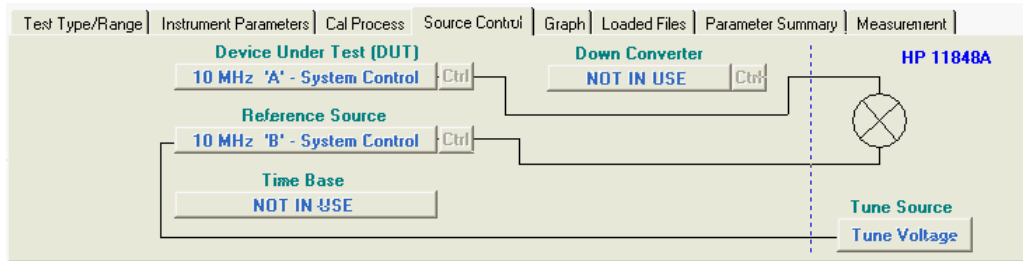Use Current Detector Constant
Measure the Current

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)
10 MHz 'A' - System Control Ctrl

Down Converter
NOT IN USE Ctrl

HP 11848A

Reference Source
10 MHz 'B' - System Control Ctrl

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:

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement

Phase Shifter DUT **HP 11848A**

Source
10 MHz 'B' - System Control Ctrl

DUT

Quadrature will be established by adjusting the source frequency.

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

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement

Phase Shifter **HP 11848A**

DUT Source
10 MHz 'B' - System Control Ctrl

Quadrature will be established by adjusting the source frequency.
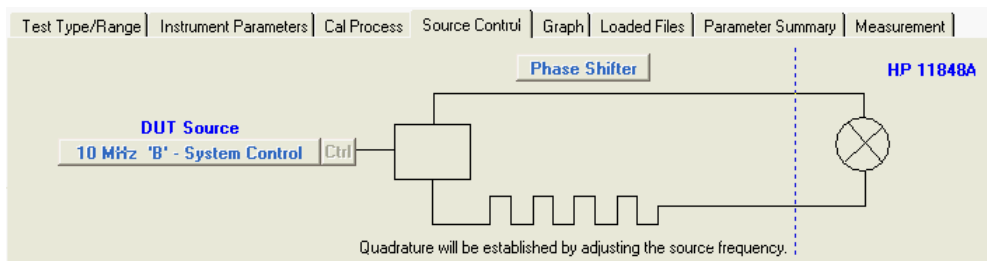
For Test Type AM Noise, the Source Control Tab looks like this:

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement |

AM DETECTOR

HP 11848A

DUT Source   **AM Detector**
10 MHz 'B' - System Control |Ctrl|——— USER'S DEV. |Ctrl|

Noise
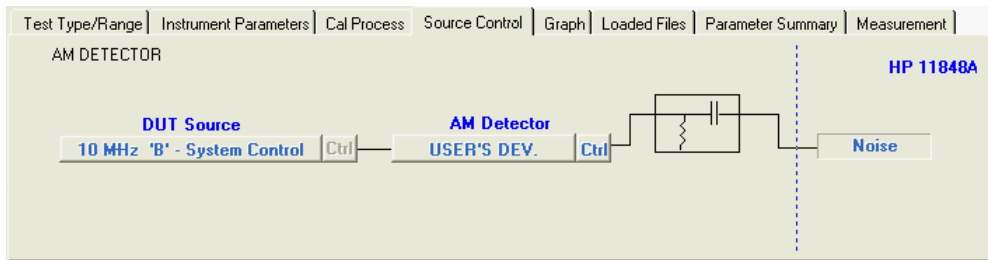
Graph Tab

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 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 | Source Control | Graph | Loaded Files | Parameter Summary | Measurement |

Graph Type

- ● Single Sideband Phase Noise (dBc/Hz)
- ○ Phase Modulation Spectral Density (dB/Hz)
- ○ FM Spectral Density (1/SQR(Hz))
- ○ Spectral Density of Frac. Freq Fluctuations (1/SQR(Hz))
- ○ Noise Figure for 2-Port Devices

☐ DSC FLR   ☐ Small Angle

Graph Parameters

Minimum X Coordinate	1.000	Hz Range: .001Hz to 10Ghz
Maximum X Coordinate	10,000,000	Hz Range: .001Hz to 10Ghz
Minimum Y Coordinate	-170	Range: -300 to 300
Maximum Y Coordinate	0	Range: -300 to 300

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)

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement |

Trace	On	File Name	Caption	Mkr1 10Hz	Mkr2 100Hz	Mkr3 993Hz	Mkr4 10.2KHz
1	☑	10Mhz A Internal vs SpectraDynamics 10...	10Mhz A Internal vs SpectraDynamics 10Mhz Test 2	-111.8	-147.9	-159.9	-164.8
2	☑	10Mhz A vs HP5061B (CS1).res	10 Mhz A Internal vs HP5061B (CS1)	-124.0	-135.0	-141.9	-143.0
3	☑	10Mhz A vs SpectraDynamics LNFR-400 ...	Untitled - Type here to change the graph title	-122.8	-149.7	-160.1	-163.6
4	☑	10Mhz A vs SpectraDynamics LNFR-400 ...	18Mhz A vs SpectraDynamics LNFR-400 10Avgs in...	-122.5	-148.1	-159.7	-163.9
5	☐						
6	☐						
7	☐						
8	☐						

Clear Traces

New Measureme

Repeat Measureme

Cancel Measurem

Save System Con

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 me selected and other settings.

Test Type/Range | Instrument Parameters | Cal Process | Source Control | Graph | Loaded Files | Parameter Summary | Measurement |

Measurement Type: Phase Locked	**Entered Kvco:** 10 Hz/Volt	**Loop Suppression:** VERIFIED
Start Frequency: 1 Hz	**Center Voltage:** 0 Hz/Volt	**Closed PLL BW:** 28 Hz
Stop Frequency: 1.E+6 Hz	**Tune Range +/-:** 4 Hz/Volt	**Peak Tune Range:** 56 Hz
Minimum Averages: 4		**Assumed Pole:** 40.E+2 Hz
Carrier Frequency: 10.E+6 Hz	**Kvco Method:** MEASURED	**DUT:** USER'S SRCE, SYS
Detector In Freq: 10.E+6 Hz	**Kvco:** 14 Hz/Volt	**Reference Source:** 10 MHz 'A', SYS, VCO
Phase Detector: 5 TO 1600 MHz		**External Timebase:** NOT IN USE
11848A LNA: OUT	**Kphi Method:** MEASURED	**Down Converter:** NOT IN USE
	Kphi: 629.E-3 V/Rad	

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 V 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-3 V/Rad
VCO Constant: 14 Hz/V

Approx internal noise floor: -170 dBc/Hz
[LNA in, Offsets > 10 kHz]

3561A

11848A

VCO Center Voltage
0.35

Inc/Dec Span
100,000

LNA On

Continue

FORMS

Display Setup

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

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 the
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

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

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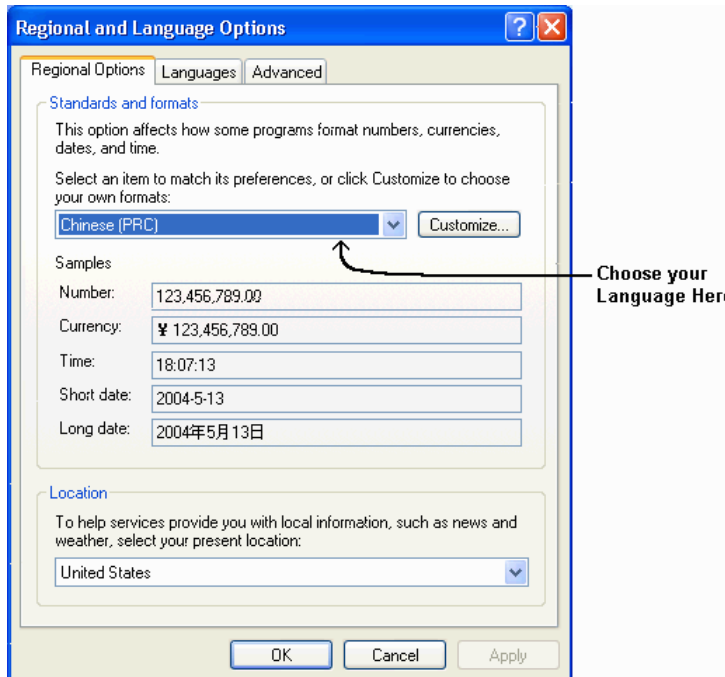
Windows XP
Follow these steps to set Windows Regional settings for Windows XP.

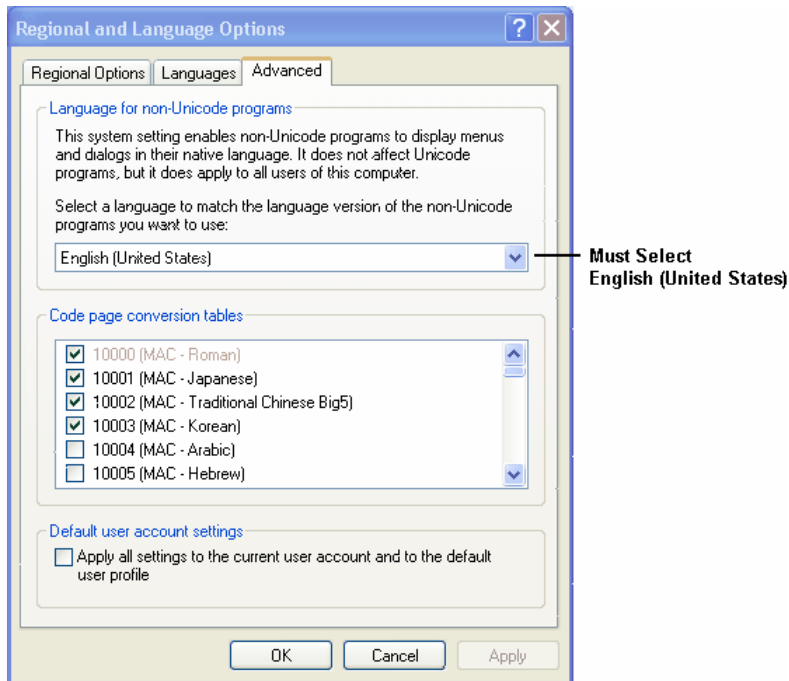Go to the Control panel by clicking on Start/Settings/Control Panel.

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.

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

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.
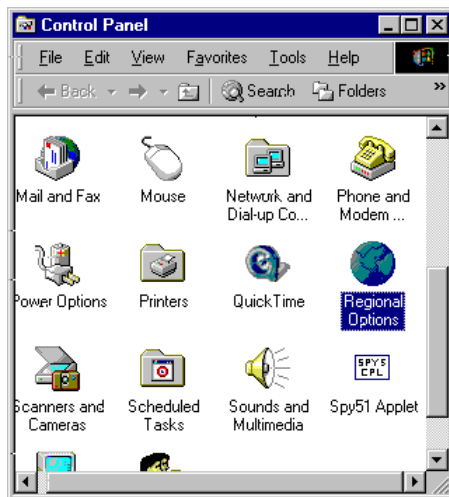
Find the Regional Options icon and double click. This will bring up the Regional Options form with the General tab showing Your Locale (location) settin
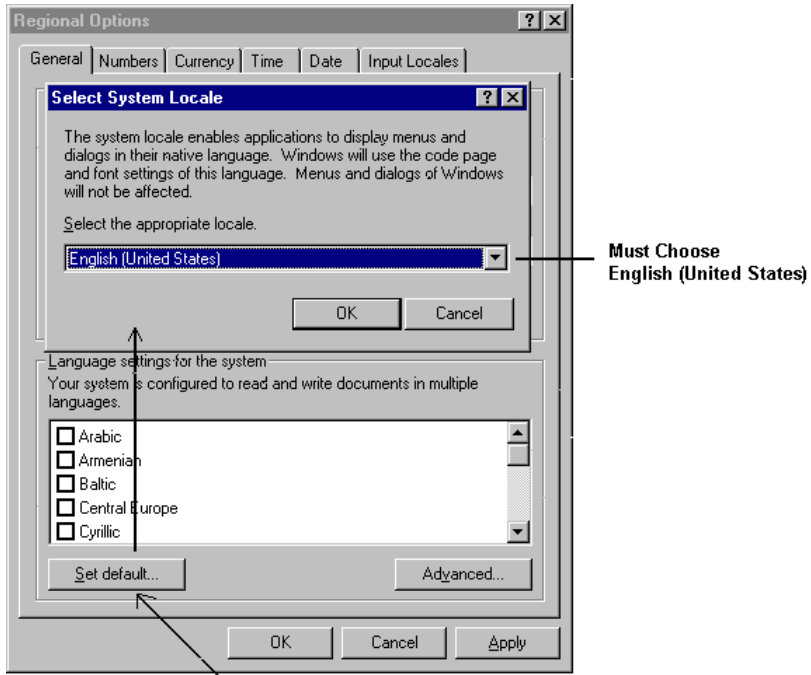shown below. Enter your language here. This affects the way dates, times and numbers are presented by Windows.
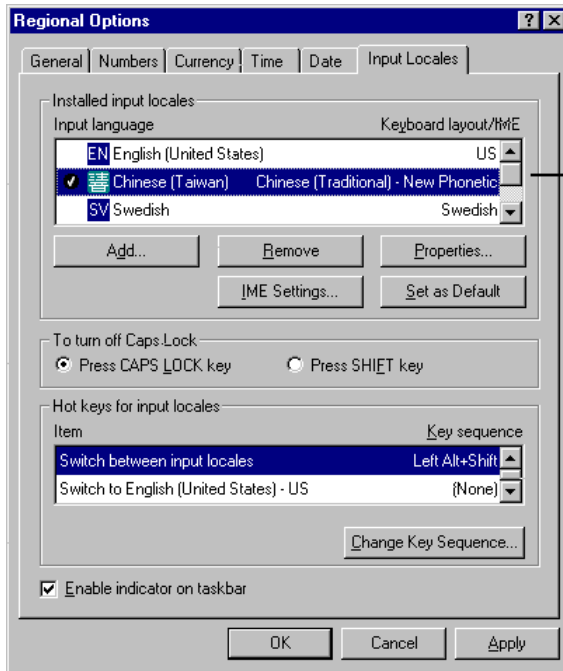
Click on the Input Locales tab and enter your language at Input Language. This affects the way the keyboard operates.
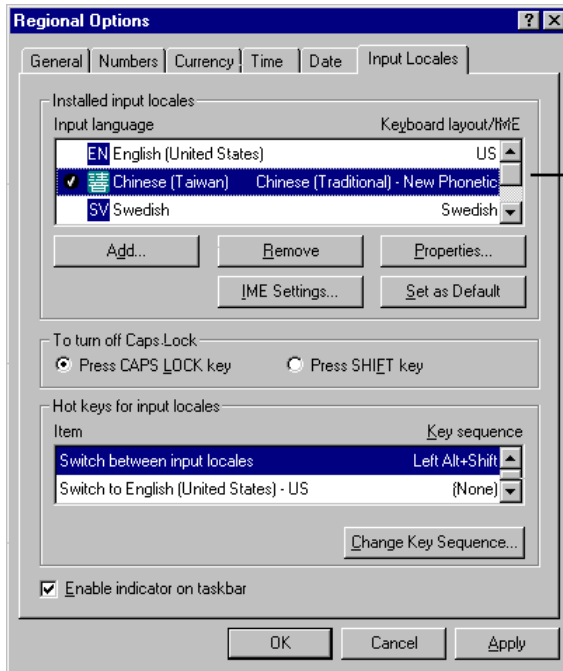
Click on the General tab and then click on the Set Default... button which will open the Select System Locale form and below the label Select the Appro locale choose English (United States).

Must Choose English (United States)

Click Set Default... button to bring up the Select System Locale form

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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