

TuneLab for Smartphones

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Installing TuneLab on your Windows Mobile Smartphone

There are two general ways to install TuneLab on your Smartphone. One method uses TuneLab supplied in a Windows installation program. The other method uses TuneLab supplied in a “CAB” file.

TuneLab in a Windows Installation Program

TuneLab in this format may be downloaded from the web or supplied on a CD. The name of the file is **tunelab_sp_setup.exe**. If you are downloading this file from the Internet, do not run it immediately. Instead just download it as a file and save it somewhere where you can find it. Using a CD, diskette, or USB memory stick, you can copy this file to some other computer that may not be connected to the Internet to do the actual installation. Do not run this installation program until the ActiveSync connection with your Smartphone has been verified, as described next.

On the computer where you intend to run the installation program, make sure that Microsoft ActiveSync has first been installed on that computer. ActiveSync is a program that is supplied on a CD along with your Smartphone. If you do not have a CD with ActiveSync, you can download the latest ActiveSync software for free from the Microsoft Windows Mobile website:

<http://microsoft.com/windowsmobile>

Now connect your Smartphone to your computer using the USB cable provided with the phone. You should see an ActiveSync window showing the “connected” status. Now run the TuneLab installation program on that computer. The on-screen prompts will guide you through the rest of the process.

TuneLab in a “CAB” File

The less-common format in which TuneLab can be packaged is as a “CAB” file, which is named **tunelab3sp.cab**. This file is understood directly by your Smartphone, which can unpack the file and perform the installation of TuneLab - provided you can get the CAB file into the phone in the first place. There are several ways you might do that. If you have a Macintosh computer, you may get a Macintosh equivalent of ActiveSync. One such product is “Missing Sync”. Another way is by direct download from the web into your Smartphone, if your Smartphone is set up to browse the web. Another way is by infra-red beaming, provided you can get the CAB file into some other device that has the capability of beaming a file, like a Pocket PC. One last method is by getting the CAB file onto a memory card and then inserting that card into your phone. After the CAB file has been moved into your phone's file memory, you need to locate that file using a File Manager program, which is supplied by some Smartphone vendors. If you can navigate to that CAB file, you can launch it and cause it to perform the installation using that File Manager.

Running TuneLab

After TuneLab is installed, you can find it among the programs on your phone from the **Start** menu on the **Home** screen. After running it once, you will find TuneLab among the shortcuts to recent programs at the top of your **Home** screen.

What is TuneLab for Smartphones ?

TuneLab is software that helps you to tune pianos. This form of the software runs on cellphones known as “Smartphones” which are based on the Microsoft Windows Mobile operating system and use menu keys rather than a touchscreen. If your phone has a touchscreen, see TuneLab Pocket instead. There are other manuals to describe the forms of TuneLab that run on other platforms.

Visual Tuning

TuneLab is a software program that turns a Smartphone into an Electronic Tuning Device, which provides a piano tuner with real-time guidance during tuning. The sound of a note as it is played is picked up by a microphone and analyzed. The results of the analysis are displayed in a visual pattern. TuneLab displays two main visual patterns - the **phase display** and the **spectrum display**. Both of these displays indicate if the pitch of a note should be raised or lowered, but each display has its own unique advantages. Having both displays visible simultaneously gives the piano tuner the best of both worlds.

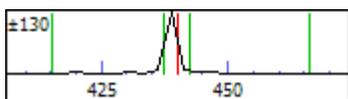
Phase Display



The phase display is the horizontal band shown here. This display is used for fine tuning. The black squares move to the left if the note is flat and to the right if the note is sharp. The closer you get to the correct tuning, the slower the black squares will move. The goal is to make the black squares come as much to a stop as possible. If the piano string has any false beats then the black squares may appear to move in an irregular fashion, sometimes moving back and forth. When there is no note playing, or when the note being played is far from the correct pitch, the black squares will disappear or move randomly.

This display is called a phase display because it displays the phase of the sound from the microphone as compared to the phase of an internally generated reference pitch. The movement of the squares can be compared to listening to beats between a tuning fork and a note on the piano. For the bass and midrange, when a square makes one complete trip around the display, that corresponds to one complete beat that you would hear when comparing two tones. For higher notes the display is artificially slowed down in order to keep the speed of the display in a reasonable range.

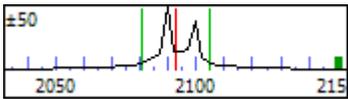
Spectrum Display



The spectrum display is the graph shown here with the zoom set to ± 130 cents around the desired pitch. There are four different zoom levels available: “wide”, ± 260 cents, ± 130 cents, and ± 50 cents. Using the **Edit Options** menu, you can choose to make the traces thicker for easier visibility, at the cost of some

loss of resolution. This display shows how the sound energy is distributed across the frequency spectrum. If TuneLab is listening to a pure tone, then the spectrum graph will show a single peak. The example seen here was made from an A-440 tuning fork that was actually a little flat. The red line in the center of the display marks the correct pitch. The green lines nearest the center mark the points that are 10 cents above and below the correct pitch. The green lines far from the center mark the points that are 100 cents above and below the correct pitch, i.e. the previous note and the next note. The object in tuning with the spectrum display is to tune the note until the peak of the graph is centered on the red line.

The spectrum display has several advantages over the phase display. One is that it shows where the pitch of the piano is, even when that pitch is far from the correct pitch. The other advantage is that the spectrum display can show several peaks at once. The picture here shows is what you would get when playing a poorly tuned unison. Here the piano note C7 is being played with one string tuned nine cents higher than the other two strings. In this display the zoom has been set to its most zoomed-in level, ± 50 cents. By looking at individual peaks it is possible to tune notes in the high treble without mutes! You simply tune one of the strings and watch which peak moves. You can move that peak to the central red line and then that string will be at the correct pitch. However, tuning this way is not as accurate as tuning by sounding one string at a time, because the multiple peaks tend to become blurred as they merge into one another.



One advantage of the phase display is that it generally provides more resolution than the spectrum display, except in the highest octave where the resolutions of the two displays are about the same. For this reason the spectrum display is used for rough tuning and the phase display is used for fine tuning. False beats can confuse the phase display, though. So the spectrum display is preferred even for fine tuning in the high treble. In any case, both displays are available; so you can use whichever display seems to be giving the clearest indication.

Menus

TuneLab uses the soft-menus available at the bottom of the screen. The menus change depending on the context. The menus are accessed by pressing one of the two soft-menu keys associated with the two menu fields at the bottom of the display screen. After one of these menus is selected, you can choose among the items in the menu using the **up** and **down** keys in the 5-way navigation pad and then confirm your choice by pressing the **action** key in the center of that pad. But the fastest way to choose menu items is to press the digit key (**1-9**) on the keypad associated with the menu item that you want to select. If you do not want to select any item, press the **back** key.

On the main tuning screen, the soft-menus are labeled **Alt** and **Menu**. The **Alt** menu contains the items that you are likely to need to use more often. The **Menu** menu contains everything else. See the complete list of menu items at the end of this manual.

System Keys

Some of the keys have special meaning to the Windows Mobile operating system. The **back** key normally means that the system should switch to the previous screen. In the main tuning screen, this means returning to whatever was on the screen before you started TuneLab. Note that this is not the same as closing TuneLab. The **back** key only puts TuneLab in the background while it continues to run. If you open any menu and

decide not to select any of the menu items listed, then you can use the **back** key to exit from that menu without doing anything. But when any screen is displayed that contains an edit field - that is, an entry box in which you can enter numbers or characters, then the **back** key functions as a backspace when entering data in that box. The **home** key will take you back to the cellphone's home screen. This also does not close TuneLab - it just leaves it running in the background. To close TuneLab, use the Close menu item on the right side menu.

Entering Text

When entering text on your cellphone, the numeric keypad can be used to enter text and special characters as well as numbers. You can read more about this capability in documentation that came with your cellphone. In normal text mode, pressing any digit key repeatedly will cycle through all the characters associated with that key. For example, quickly pressing the **2** key twice produce a letter “**b**”. The **1** key has many special characters associated with it. If you want to enter just numbers, then you can switch to the numbers-only mode by pressing and holding the ***** key until the 123 mode symbol appears at the top of your screen. Just pressing the ***** key will cycle through the modes **abc**, **Abc**, and **ABC**, which are lower-case, shift, and shift-lock. When entering text, the right and left arrow keys will move the cursor, and the **back** key will act like a backspace and erase the character before the cursor. The **#** key acts like a space bar. See Chapter 8, **Working with Files**, to see how entering text allows you to specify the file name of a tuning file that you want to save.

Main Tuning Screen Keypad Functions

When the main tuning screen is displayed, the keys on the keypad have the functions shown here. Using the **2** and **3** keys, any octave may be selected. Using the **5** and **6** keys, you can move one note at a time. You can also move one note at a time by pressing the right or left arrow keys in the 5-way navigation pad. Using the **8** and **9** keys, you can raise or lower the partial for the current note. The **7** key turns on locking mode. Pressing it again triggers the locking mode into action. The **0** key switches to the tuning curve editor for viewing and adjusting the tuning curve. The **#** key begins an inharmonicity measurement, except when over-pull mode is enabled. In that case the **#** key re-measures the current note for over-pull. Each time you press the **#** key in over-pull mode, the most recent measurement in the over-pull history list is removed. The ***** key is used in general to stop various modes of operation. When locking mode is enabled, the ***** key will turn locking mode off. When an inharmonicity measurement is in progress, the ***** key will cancel the measurement. When timed note switching is in effect, pressing the ***** key will pause the timer that switches notes. Pressing the ***** key again will resume timed note switching.

1	2 octave down	3 octave up
4	5 note down	6 note up
7 locking mode	8 partial lower	9 partial higher
* ESC key (see text)	0 edit tuning curve	# measure IH or over-pull

The 5-way navigation pad serves several functions in TuneLab. The **right** and **left** keys provide an alternate means to select notes, one note at a time. The action of the **up** and **down** keys depend on

context. In over-pull mode, the **up** and **down** keys will change the over-pull percentage by 1%. Holding these keys will cause the over-pull percentage to change quickly. When over-pull mode is not enabled, then the **up** and **down** buttons may be used to change the offset. To prevent an accidental offset from being entered, this action is enabled only if you first invoke the menu item **Allow Offset Jog** in the **Offsets** sub-menu under the **Alt** menu. Invoking **Allow Offset Jog** enables the offset jog operation for 30 seconds. If you do jog the offset with the **up** and **down** arrow keys, the use of this function remains enabled until you stop using it for at least 30 seconds. The **action** key in the center of the 5-way navigation pad has a special function for the tuning exam mode. In this mode the **action** key causes the current offset to be transferred to the custom stretch for the current note. This makes it easy to quickly record a tuning for the exam.

Current Settings Displays

In the middle of the main TuneLab display screen in large letters there is a display of the currently selected note. At the top of the screen is a display of various current settings. Most of these fields are usually blank; but here is an example with all the fields shown:

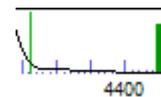
MyKawai	Offset 3.73
Werkmeister III	Cust -1.28
OverPull: 25 %	TCurve 2.46
Fundamental	Temper 7.80
788.11 Hz	AutoUP Basic 2.40

Here is a description of each of these fields, reading down the left column and then the right column:

- Tuning File Name** (*MyKawai*) - the name of the tuning file currently in use
- Temperament Name** (*Werkmeister III*) - the name of the un-equal temperament file (if one is selected)
- Over-pull Percentage** (*25%*) - the current over-pull percentage (if over-pull mode is selected)
- Tuning Partial** (*Fundamental*) - which partial (or fundamental) is used for tuning the current note
- Frequency** (*788.11 Hz*) - the calculated frequency, taking into account all offsets
- Offset** (*3.73*) - the temporary offset (or the offset due to over-pull in over-pull mode)
- Custom Stretch** (*-1.28*) - the offset (if any) manually programmed for the current note
- Tuning Curve Stretch** (*2.46*) - the offset calculated from the tuning curve
- Temperament Offset** (*7.80*) - the offset from the optional un-equal temperament in effect
- Basic Offset** (*2.40*) - the offset (if any) applied to all notes uniformly
- Note Switching** (*AutoUP*) - tells which form of note switching is in effect

Microphone Level Indicator

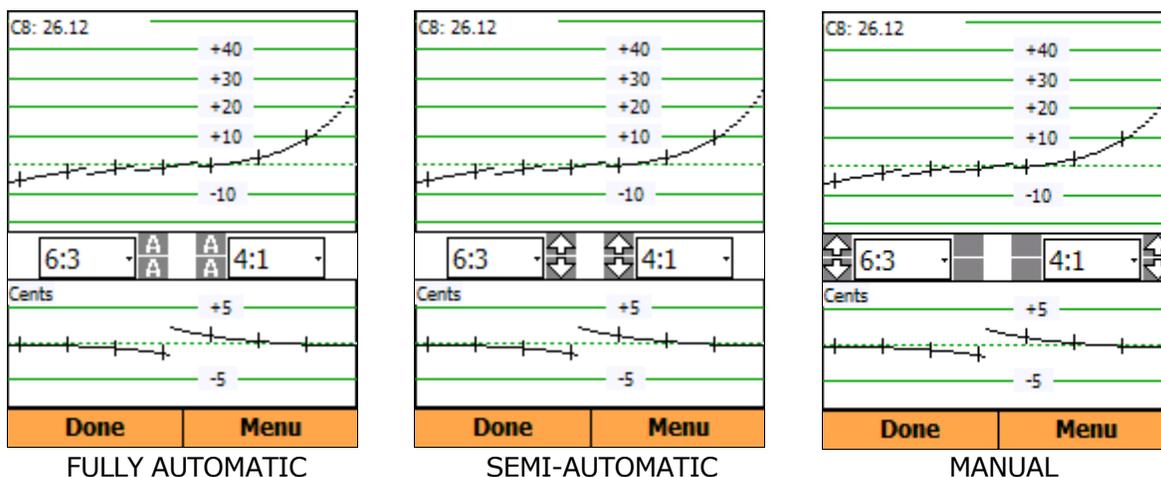
To help verify that your microphone is working properly, and to help you control how loud sounds appear to TuneLab, there is a microphone level bar graph indicator at the right edge of the spectrum display as shown here. When the green vertical bar reaches the top of the spectrum display and then turns red, that corresponds to a mic level of 100%. When all is quiet, the level should be below 1%. Normal talking into the microphone should produce a level of at least 50%. If the



reported level is nowhere near these levels, then you may have a problem with your microphone or its settings. Some phones have automatic gain control, which can also affect the microphone level received by TuneLab.

Tuning Curve Adjustment

There are three modes of operation for the tuning curve adjuster. We recommend the fully automatic mode:



You can change between these modes by pressing the **0** key. The tuning curve display contains two different graphs. The upper graph is called the **tuning curve** and the lower graph is called the **deviation curve**. The small vertical lines mark the C notes. For each note from A0 to C8 the tuning curve shows the calculated stretch in cents. It is this calculated stretch that appears in the current settings display under the name **TCurve**.

In the **automatic** mode just press the **3** key and the tuning curve adjustment is complete. In the **semi-automatic** mode (also called **Auto-A0-C8**), you use the four adjuster arrows, which map to the **1**, **3**, **4**, and **6** keys, to adjust the shape of the bass and treble portions of the tuning curve. The overall stretch at A0 and C8 is adjusted automatically. In the **manual** mode, you have eight adjuster arrows, which map to the same four keys. You switch between the inner (shape) adjustments and the outer (stretch) adjustments using the **2** and **5** keys.

The lower graph is called the **deviation curve**. It displays information about the two intervals that are selected in the selection boxes just above the graph. As shown we have selected 6:3 octaves for the bass and 4:1 double octaves for the treble. Other intervals may be selected, depending on the kind of tuning you want to achieve. The left half of the deviation curve is based on the interval selected for the bass (6:3 octaves in this case) and the right half is based on the interval selected for the treble (4:1 double octaves in this case). The deviation curve shows how wide or narrow these selected intervals are given the current tuning curve. Where the deviation curve shows zero, the selected interval is beatless. Where the deviation curve shows a positive number of cents, the selected interval is wide by that many cents. Where the deviation curve shows a negative number of cents, the selected interval is narrow by that many cents. When you use the adjuster arrows to adjust the tuning curve, you are directly affecting the tuning curve. As a consequence of your adjustment of the tuning curve, the deviation curve will also change. Therefore, even though you are directly adjusting the tuning curve, you make your adjustments based on the effect on the deviation curve. The procedure for making these adjustments is described in detail in Chapter 2.

In the tuning curve adjuster, the keys on the keypad take on different functions, as shown here. The **2** and **5** keys are used to select between the inner and outer set of adjuster arrows in manual mode. Selecting the outer set of adjuster arrows implicitly enables the manual adjustment mode. Pressing the **0** key will cycle through the three adjustment modes. Whichever set of adjuster arrows is selected, pressing the **1**, **3**, **4**, or **6** key is the same as pressing the corresponding adjuster arrow. The **8** key is used to zoom the graphs so that the vertical scaling will just contain the data. Pressing the **8** key again will return the graphical scaling to its original state. The **7** and **9** keys are used to open the bass or treble interval selection. This will cause the list to expand to show all possible intervals. When the list of intervals is expanded, then you can use the **up** and **down** keys in the 5-way navigation pad to change the selection. Use the **action** key in the center to confirm your new selection. If you do not wish to change the selection, the press the **back** key to close the list. The **right** and **left** arrow keys change which note will have its total stretch reported in the upper left corner of the tuning curve graph.

1 upper left arrow ↑	2 use inner (shape) arrows	3 upper right arrow ↑
4 lower left arrow ↓	5 use outer (stretch) arrows	6 lower right arrow ↓
7 change bass interval	8 zoom graphs	9 change treble interval
*	0 Auto/Manual/ Semi-Auto adjust mode	#

Partials

Each note is tuned according to its fundamental pitch or the pitch of one of its partials. The current settings box shows which partial is being used for the current note. The selection of partials comes from a table of partials. This table may be modified from the screen shown on the right. The table shows the partial number for each note from A0 to B6. (C7 through C8 are assumed to be using the fundamental.)

8
partial
lower

9
partial
higher

0
duplicate to
next note

Using the **left** and **right** arrow keys you can move the green highlight (shown here on A0) to the partial for any note listed. Once the highlight has been moved to the partial that you wish to change, use the **8** or **9** key to lower or raise that partial (the same keys as you would use on the main tuning screen). Once a particular partial has been set to the desired value, you may want to use that same partial in some following notes. Press the **0** key to duplicate the partial value into the next note. In this manner you can quickly set an entire section of notes to the same partial.

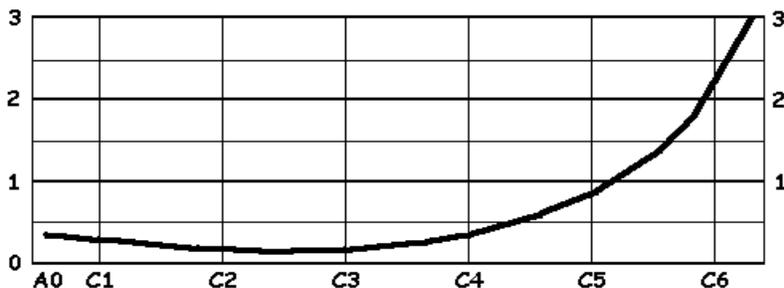
Partials							
	0	1	2	3	4	5	6
C		6	6	4	2	1	1
C#		6	6	4	2	1	1
D		6	6	4	2	1	1
D#		6	6	4	2	1	1
E		6	6	4	2	1	1
F		6	4	2	2	1	1
F#		6	4	2	2	1	1
G		6	4	2	2	1	1
G#		6	4	2	2	1	1
A	6	6	4	2	1	1	1
A#	6	6	4	2	1	1	1
B	6	6	4	2	1	1	1
Done		Edit					

The table of partials is stored along with the tuning curve in the tuning file when you save a tuning. So it is possible to customize the table of partials for each piano that you tune. Whenever you begin a new tuning, the

table of partials is initialized from the special tuning file, **DEFAULT**, which is installed when you install TuneLab. If you want to make a change to the table of partials that will apply to all new tuning files that you create, then you can explicitly load **DEFAULT** as a tuning file, edit the table of partials, then save the modified **DEFAULT**, which will replace the original **DEFAULT**. Partial numbers can also be changed while tuning using the **8** and **9** keys as described above. These on-the-fly changes are not stored in the table of partials and are canceled when a new note is selected, unless you have enabled **Persistent Partial Numbers** under **Edit Options**, in which case changes made on-the-fly are immediately incorporated into the current tuning file.

Inharmonicity

Inharmonicity is the phenomenon whereby the partials of a piano string are not whole-number multiples of a fundamental frequency. TuneLab assumes that the partials are offset from their exact whole-number multiples of the fundamental by an amount that increases with the square of the partial number and is proportional to the inharmonicity constant. When TuneLab measures inharmonicity for a string, the pitches of all the partials of that string are analyzed and an inharmonicity constant is generated for that string. The inharmonicity constants are stored in the tuning file when a tuning is saved. You don't need to be concerned with the actual values of the inharmonicity constants that you measure; but you can see and selectively delete them from the **Menu** using the screen shown on the right. Use the **up** and **down** arrow keys to select an inharmonicity reading. Then use the **Delete** menu item from the right-side **Menu** to delete the selected reading. In a well-scaled piano you can expect to see the lowest inharmonicity constants somewhere in octave 2. From there the inharmonicity constants increase slightly as you move down to A0 and they increase substantially as you move up to C8, as shown in the graph below. TuneLab uses the specific samples that you collect to find a best-fit inharmonicity model for the entire scale. Using this model, TuneLab makes all the calculations regarding how partials relate to one another.



Typical Inharmonicity Values for a 6' 8" Kawai Grand

Inharmonics		abc
A0	0.227	
A1	0.060	
A2	0.073	
A3	0.240	
A4	0.647	
A5	1.920	
A6	5.453	

1 Delete

Done Menu

Over-pull Mode

When raising or lowering the overall pitch of a piano by a significant amount, you will find that the notes that you tune first will not stay where you put them by the time you are done tuning. This is due to the interaction of the string tensions, primarily through the bridge and soundboard and the flexing of the plate. When an entire section of notes is raised in pitch, the result is that the notes that were tuned first will tend to drop in pitch after you tune them. Even the notes that you tuned last will drop somewhat due to the delayed settling of tension in the wire.

Over-pull tuning mode compensates for this change by setting tuning targets that are a calculated amount beyond the desired pitch. In this way the change that occurs will leave the notes right where you want them. In many cases using just one pass with over-pull tuning can take the place of tuning the piano twice. Over-pull mode accomplishes this goal by making a quick one-second pitch measurement before you start tuning each note. The collection of these measurements is called the “over-pull history”. The most recent portion of the history list is displayed to the left of the selected note as shown below.

Recent	-34	A#3	Over-pull
	-34		was -34
	-34		

The main purpose in displaying this list is to provide verification that the over-pull calculations are based on valid measurements. Sometimes during a pitch raise extraneous noise can trigger a false reading which will then be added to the history list. The false reading can be corrected by re-measuring the current note. When in over-pull mode, the field normally used for the temporary offset is used to display the over-pull offset as shown earlier in the current settings. Temporary offsets are not permitted in over-pull mode (although you can use the basic offset for the same purpose). When over-pull mode is first entered you have an opportunity to adjust some parameters that affect how over-pull is calculated. The parameter that is most often changed is the over-pull percentage, and this can be done quickly while you are tuning by pressing the **up** or **down** arrow keys. Each press changes the over-pull percentage by 1%. Holding the arrow keys will change the over-pull percentage by larger amounts.

Calibration

TuneLab should be calibrated before you trust its absolute pitch. Without calibration, TuneLab assumes a nominal crystal oscillator frequency in your phone's sound system and makes all pitch calculations from that assumption. By doing a calibration you are refining that nominal value based on a comparison to a trusted pitch source. You can do a rough calibration using a tuning fork, but your final calibration should be with some more precise source, such as the NIST phone service described later. The result of a calibration is a knowledge of the actual sample rate of the sound system, which is shown in the **About** screen (under the **Help** menu). Normally, calibration is done only once when TuneLab is first installed on your phone. See the chapter on calibration later in this manual for details on doing a calibration.

Hands-Free Note Switching

The first item in the **Alt** menu allows you to select what form of note switching you want to use. There is **auto note switching**, which listens for and switches to nearby notes when it hears them. There is **timed note switching**, which switches to the next note after a certain delay time. And there is **auto measure**, which switches notes to sequence through a pre-defined list of notes that you want to measure for inharmonicity when starting a new tuning file. When any of these forms of hands-free note switching is in effect, note switches are performed just as if they had been done manually. The current note switching status is shown in the bottom center of the Current Settings box. **Auto Measure** is initiated by starting a new tuning file. After the inharmonicity measurements are made, the note switching mode returns to whatever it was before. During a normal tuning it is most convenient to switch notes automatically using **auto note switching**. During an extreme pitch raise, it may be more useful to use **timed note switching**.

Auto note switching will switch up to three notes (300 cents) away from the current note. It can be enabled for up, down, or both directions. When over-pull mode is also enabled, or when higher treble notes are selected, auto note switching requires a “trigger”, which is a sudden rise in volume, such as you would get when playing a note after some silence. At other times, auto note switching is less demanding, and will switch when the pitch changes without a trigger event. If TuneLab doesn’t switch when you want it to, wait for some silence, and then play the note again.

Timed note switching is useful primarily for doing a quick first pass pitch-raise. You can set the delay time in Edit Options. If it is time to switch notes, but you are still playing the current note, then TuneLab will postpone doing the switch because it will not switch until it hears a brief period of silence. You can pause timed note switching by pressing the * key.

Auto measure is the mode that TuneLab uses when you start a new tuning file, provided you have previously set up your list of preferred notes to measure under Edit Options. After selecting **Measure Sequence** from **Edit Options** screen, press the **action** key in the center of the 5-way navigation pad to show the screen where you can specify which notes you want to sample for inharmonicity. This screen is similar to the table of partials shown earlier. Move the green highlight using the 5-way navigation pad, and enable or disable various notes for measurement using the **action** key. An 'm' is shown for the notes that will be measured. Typically only 5 or 6 notes are used. This mode is in effect only while you are measuring inharmonicity. After the last note in your list has been measured, auto measure mode is automatically canceled and the note switching mode returns to whatever it was before. After each note in your list is measured, TuneLab switches automatically to the next note in your list and starts the inharmonicity measurement for that note.

Un-Equal (Historical) Temperaments

By default, TuneLab assumes an equal-tempered scale. If you would like to tune in some un-equal temperament, you can select an historical temperament file to apply to your tuning. An historical temperament file contains a list of 12 offsets for each of the 12 notes of an octave. When an historical temperament is selected, one of these 12 offsets is used, depending on which note is selected. For any given note, the same offset is used in every octave. In addition, the temperament offset may be optionally normalized. This means that all 12 offsets will be shifted by the same amount before they are used. You can choose to have the offsets normalized so that the offset for A is always zero; you can choose to normalize so that the average offset is zero (to minimize the overall change from equal temperament); or you can choose to use the historical temperaments just as they are with no normalization. The temperament name and the temperament offset for the selected note appear in the Current Settings box shown previously. When you save a tuning the historical temperament values (and temperament name) are saved in the tuning file. See the chapter on special functions for information on making and using temperament files.

Tuning Files

A tuning file is a file made by TuneLab on your phone. It is stored under the folder where all your other documents are stored. It contains all the factors necessary to re-create a specific tuning. You can save the current tuning to a named file, or open an existing tuning file by using the **File** sub-menu under **Menu**. If you want to organize your tuning files into several folders (like “Churches” and “Homes” or “Grands” and

“Verticals”) under the one home folder, then you can create these other folders when you save the file. See Chapter 8, “**Working with Files**”, for more details.

Here is what a tuning file contains:

- The inharmonicity constants for all the notes that you measured.
- The tuning curve, just the way you adjusted it in the tuning curve editor.
- The name of the historical temperament (if any) and all 12 offsets from that temperament.
- The partial used for tuning and custom offset (if any) for each of the 88 notes.
- The selection of bass and treble intervals in the tuning curve editor.

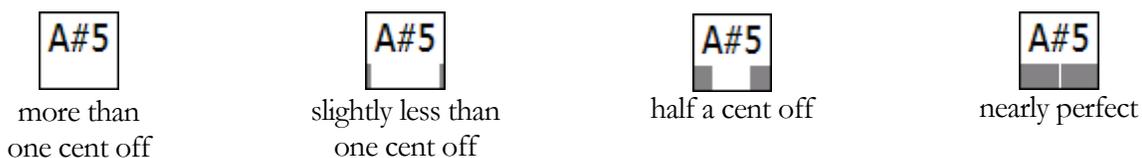
Sound Generation

Although the common use for TuneLab is in listening to notes and providing a visual tuning aid, you can also use TuneLab as a tone generator. When TuneLab is in sound generation mode, the spectrum display and phase display are disabled. The pitch of the sound generated in the speaker or headphones is the same as the pitch that would have indicated correct tuning in the listening mode. The pitch is generated for whichever partial is selected - not necessarily the fundamental. Sound generation using low pitches may not be audible due to the limitations in the frequency response of the speakers found in phones.

Sound generation is generally used to aid in stringing operations where precision is not as important as in normal tuning. If you intend to use sound generation for precise tuning in TuneLab, you should be aware of the fact that some phones use two separate crystal oscillators in their sound output and sound input operation. Therefore a separate calibration may be needed for the sound generation mode. If this is the case with your phone, you should do the separate output pitch calibration as described in the chapter on calibration. Even if your phone has only one sound crystal, it does not hurt to do the separate calibration for the tone generation mode. If you don't plan on using TuneLab to generate precise tones, then you don't need to do this special output calibration.

Tuning Closeness Indicator

The current note display has a region on the bottom that indicates how close your tuning is to the target pitch. Here are some examples:



As these examples show, the gray bars start appearing when the tuning is within one cent of the target pitch; they close down and meet in the center at zero cents off.

Normal Tuning Procedure

This chapter takes you step-by-step through an ordinary piano tuning (not a pitch-raise). We are also assuming that you have not tuned this piano before and saved a tuning file, because if you had, then you could skip the initial setup and just load that tuning file now and begin tuning.

Initial Setup

When TuneLab is started it will show a tuning file name such as “untitled-1”. If you have some other tuning file loaded as the current tuning (perhaps left-over from the previous tuning job) you should clear out that tuning and begin a new tuning file using the **File** menu. Select **New Tuning File**. This will clear out any old inharmonicity readings and reset the table of partials to the default settings. You are now ready to develop a new tuning. If you had previously specified the option of automatically sequencing through a set of notes for inharmonicity measurement, then TuneLab will now switch to the first of those notes and start the inharmonicity measurement automatically.

Measuring Inharmonicity

TuneLab needs to sample at least four notes for inharmonicity, and preferably five or six notes. If the piano is a type that has a large break in the inharmonicity, you may want to consider using the Split Scale mode, as described in the Chapter 6. For now, we will assume that the piano is a well-scaled instrument that does not require Split Scale mode. If the piano is a typical well-scaled instrument, you can measure, for example, the C notes from C1 to C6. If one of these notes is hard to measure accurately because of a serious false beat or lack of partials, then just measure some other nearby note instead. When you measure the inharmonicity of a note you should mute all but one string of the note. Measuring the inharmonicity of two or three strings sounding at once is not recommended.

To measure the inharmonicity of a note, make sure that note is selected as the current note in TuneLab. Now that TuneLab is showing the note that you want to measure, if the measurement has not already been initiated by the auto measure sequence, begin a measurement by pressing the **#** key on the keypad. This will cause a status box to appear showing “**Measuring.., (trigger?)**”. TuneLab will begin listening to the note as soon as you play it. The sudden rise in sound level is the trigger. If you do not play the note shortly after initiating a measurement it is quite likely that some extraneous noise may trigger the sampling period and you will get a false reading. If this happens, just wait for the calculation to finish and then discard the reading and start over.

When sampling inharmonicity you should play the note and watch the status box change from “**(trigger?)**” to “**(listening)**”. This listening period is about six seconds for low notes and progressively shorter for higher notes. After the listening period is over the status display will switch to “**(calculating)**”. At this time you can stop holding the note because TuneLab is no longer listening to it. After a short calculation time TuneLab will display the results of the measurement. In some problem notes, the partials are so weak that they cannot be

measured. In that case it may be useful to pluck the string near the termination point rather than playing it with the key. This is generally needed only on rare occasions or for high notes that may not need sampling.

The measurement results screen shows a lot of data, but the most important measurement is the inharmonicity constant. The graph in Chapter 1 shows the typical pattern of inharmonicity constants from a Kawai 6'8" grand. Other pianos may have more or less inharmonicity, but the pattern should be approximately the same. Knowing the typical inharmonicity pattern will help to eliminate obviously bad readings.

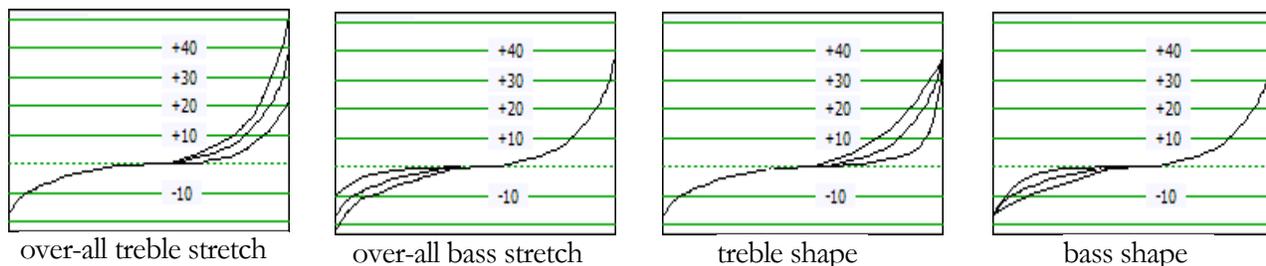
Measure Results:			
Partial	Offset	Amp.	Note:
Fund.	0.00	100.0	B3
2	-----	20.8	
3	4.88	96.7	
4	9.26	35.9	IH Con:
5	15.12	20.1	0.906
6	21.96	25.3	
7	30.14	87.2	avg= 0.90
8	-----	8.5	
9	-----	9.0	
10	-----	5.4	Sustain
11	-----	0.0	Time:
12	-----	10.3	27.5

When a measurement is complete, TuneLab displays a results screen like this. Here we see that pitches were detected for the fundamental and partials 3-7. The offset column shows the offset in cents for the individual partials as compared to what they would be if there were no inharmonicity. Generally there is more inharmonic offset the higher you go in the partial series. The amplitude column shows the relative strengths of the specific partials. TuneLab analyzes the pattern of partial offsets and calculates an inharmonicity constant for the string - in this case 0.906. If things look reasonable at this point then you could press the soft-menu button under **Save**, which will save the inharmonicity constant for the note B3. Or you can select **Save,+** from the **Menu** which will save the measurement and began another measurement of the same note to form an average. This is especially useful in the auto-measure sequence because it will allow you to take repeated measurements of the same note for averaging without interrupting the auto-measure sequence.

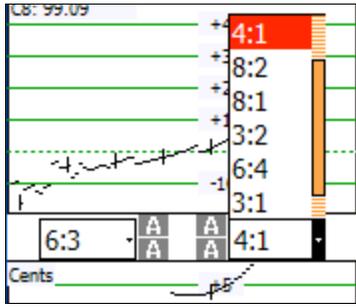
At this point you can also view the partial amplitudes in graphical form by selecting **Voicing** from the **Menu**. If you measure inharmonicity again for the same note, the inharmonicity readings will be averaged. To stop all measurement, select **Discard** from the **Menu** and then press the * key to cancel the subsequent measurement. Selecting **Discard** will discard the current reading, but it will also begin a new reading of the same note, so pressing the * key is necessary to completely stop all measurement of inharmonicity.

Adjusting the Tuning Curve

Now that the inharmonicity readings have been taken for several notes, TuneLab can form a model for the inharmonicity of all the notes of the scale, not just the notes that you measured. Using that model, TuneLab can predict how various intervals will sound. You can use that prediction to find an adjustment of the tuning curve that suits you. This tuning curve follows a four-parameter template, as illustrated here:



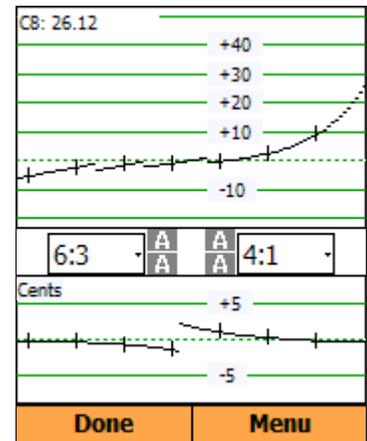
All four of these adjustments can be made automatically using the **automatic** mode in the tuning curve adjuster. In **semi-automatic** mode, the overall stretch parameters are adjusted automatically, and you adjust the two shape parameters manually. In **manual** mode you adjust all four parameters manually.



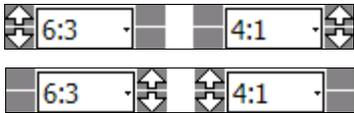
Regardless of which adjustment mode is used, you can affect the outcome of the adjustment by your selection of the bass and treble intervals in the tuning curve adjuster. Select these intervals in the selection boxes located around the adjuster arrows. Open these selection boxes by pressing the **7** key for the bass interval or the **9** key for the treble interval, as shown on the left. Scroll through the choices using the **up** and **down** keys on the 5-way navigation pad, then confirm your choice by pressing the **action** key in the center. We recommend that you select 6:3 in the left selection box and 4:1 in the right selection box, but you may experiment with other intervals to more closely

match your personal preference for a good tuning. Your selections will be stored along with your tuning curve adjustments in the tuning file for this piano. Each interval is described by the two coincident partials that make up that interval. For example, **6:3** designates the octave based on the 6th partial of the lower note and the 3rd partial of the upper note. And **4:1** designates the double octave based on the 4th partial of the lower note and the fundamental (1st partial) of the upper now.

Using **automatic** mode in the tuning curve adjuster, the screen appears as shown on the right. The letter 'A' appears in place of the inner adjuster arrows. In this mode, just press any one of the keys **1**, **3**, **4**, or **5**, and the tuning curve will be completely adjusted in all four aspects shown above, based on your selection of the bass and treble intervals. *If you are using only automatic mode, then you can skip ahead to **Saving the Tuning File**, because the rest of this section deals with the other two modes of operation.*



If you decide to use **manual** mode in the tuning curve adjuster, then the adjuster arrows will appear in one of the two forms show on the left. You can switch between these two forms using the **2** and **5** keys. When the outer arrows are selected,



then the keys **1**, **3**, **4**, and **6** act to adjust the overall stretch in the bass and the treble. When the inner arrows are selected, then those same four keys act to adjust the shape of the bass and treble portions of the tuning curve without affecting the overall stretch.

When the outer arrows are selected, then the keys **1**, **3**, **4**, and **6** act to adjust the overall stretch in the bass and the treble. When the inner arrows are selected, then those same four keys act to adjust the shape of the bass and treble portions of the tuning curve without affecting the overall stretch.

In **semi-automatic** mode (also called **Auto-A0-C8**), the adjuster arrows appear as shown here. You adjust only the shape of the tuning curve while the overall stretch (at A0 and C8) is adjusted automatically. The criteria for that automatic adjustment is to make the deviation curve go to zero at the extreme ends (at A0 and C8). This makes the selected intervals beatless at those extremes. Now that the overall stretch has been handled automatically, it is up to you to make the manual adjustments of the inner arrows to make the deviation curve remain close to zero as far as possible.



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Using the **0** key you can switch between these three modes of tuning curve adjustment. Regardless of which mode you use for tuning curve adjustment, the deviation curve shows how that adjustment affects the two selected intervals. If you want to practice manual or semi-automatic adjustment to see how it works, load the **practice.tun** tuning file, which already has some inharmonicity measurements, but is otherwise not adjusted.

When you activate an adjuster arrow, the arrow turns green on the display. If you hold any button down, the amount of tuning curve adjustment increases at an accelerating rate. If you change between up and down the amount of adjustment decreases. So if you want to make large adjustments, just hold down the desired button.

If you overshoot your goal, then just change to the opposite direction adjuster arrow. Doing so will reduce the size of the adjustment, so that you can adjust as finely as you want merely by changing directions. To become familiar with how this all works, now might be a good time to experiment. Try holding down one of the adjuster arrows until the adjustment reaches its limit and the adjuster arrows changes to this:  Then hold down the opposite direction arrow until the adjustment reaches the limit in that direction. Notice how a portion of the tuning curve moves as you make adjustments; and then the entire curve is drawn when you stop making adjustments. Now experiment with changing between an **up** and a **down** arrow. Change direction several times. Notice how the adjustment becomes finer with each change.

In the course of doing an adjustment you may find that a portion of the tuning curve goes off the scale. If this happens and you want to see the whole curve, press the **8** key. This will toggle the graphical limits between the original limits and the limits that exactly contain the current curves.

Now that you have become familiar with the mechanics of adjusting the tuning curve, it is time to adjust the



tuning to match your tuning criteria. Based on the intervals you have selected for the bass and the treble, the **deviation curve** (shown here) shows for each note (A0 to C8) how wide or narrow the selected interval will be in the current tuning. The notes in the left portion of the curve are the lower of the two notes of the selected bass interval. For example, the graph here shows -1.6 cents for C4. Therefore the 6:3 octave from C4 to C5 will be narrow by 1.6 cents. Conversely, the intervals in the right portion of the graph are identified by their upper note. For example, the graph also shows +0.3 cents for C6. Therefore the 4:1 double octave from C6 to C4 will be wide by 0.3 cents.

The goal in manual adjustment is to adjust the tuning curve until the deviation curve is as straight as possible at both ends. You will notice that the right-hand adjuster buttons in **semi-automatic** mode control the shape of the treble end of the tuning and hence the shape of the treble end of the deviation curve. If the deviation curve is bowed up in the middle, press the down adjuster arrow. If the deviation curve is bowed down in the middle, press the up adjuster arrow. If you have the default automatic adjustment of the endpoints of the tuning curve enabled, the ends of the deviation curve will always be at zero. Your goal in adjusting the shape is to get as much of the deviation curve as possible to lie close to zero.

When you adjust the shape of the bass end of the tuning curve you will notice that the deviation curve moves in the opposite direction as the tuning curve. This behavior is a consequence of the way the deviation curve is defined. If the bass end of the deviation curve is bowed up in the middle, press the up adjuster button. If the bass end of the deviation curve is bowed down in the middle, press the down adjuster button. If either the tuning curve or the deviation curve goes outside the bounds of the graph, use the **8** key as described earlier to revise the graphical scaling to just contain the graphs.

When you get the deviation curve to look something like the one shown above, then you are done. Notice that the deviation curve does not hold very close to zero at the transition in the middle. That is normal and expected. As you move from the bass to the treble, your criterion for a good tuning gradually changes from making 6:3 octaves beatless to making 4:1 double octaves beatless. Midway through that transition the 6:3 octaves will be a little narrow and the 4:1 double octaves will be a little wide. It is impossible to get both intervals to be beatless at once throughout the scale. You should find that in the vicinity of the transition you have other criteria for a good tuning (such as 4:2 single octaves) and those criteria will be satisfied quite well.

The criterion for a good tuning that we suggested here are just a starting point. Some TuneLab users report getting better results by selecting 4:2 octaves in the treble. Feel free to experiment to find the settings that most closely correspond to your tuning style.

Saving the Tuning File

After the tuning curve has been adjusted to your satisfaction, exit from the tuning curve adjuster by selecting the **Done** menu item. If you want to save this tuning file for later recall, now would be a good time to do so. Save the tuning file by using the **File** sub-menu under **Menu** as described in Chapter 8, **Working with Files**. Assign a name to the file that so that you can recognize it in a list of other tuning files. If you are tuning a lot of new pianos of the same make and model, you may decide to keep only one tuning file that you use for all pianos of that same make and model. If you have the time, it is best to measure inharmonicity and adjust a tuning curve for each piano. However new pianos of the same model do not vary that much; for all but the most critical uses, a generic tuning may be acceptable.

Beginning to Tune - the Tuning Sequence

Now that you have a custom tuning file for this piano and you have saved the tuning file in memory, you can turn your attention to actually doing the tuning. Because aural tuning always starts by setting a temperament, an aural tuning sequences starts in the middle of the scale and works downwards and upwards from there. When using a calculated TuneLab tuning, you need not conform to this sequence. You can tune in any order that you want. Although you may not be considering a pitch raise at this time, remember that you will get less interaction between notes if you tune from the low bass to the high treble in order. That is the recommended sequence. In any case, the decision on the tuning sequence is yours to make.

If tuning the bass first, select A0. Play the A0 on the piano and watch for a peak on the spectrum display. The bass requires some special consideration. Because you are tuning to a high partial, it is quite easy for a wrong partial to masquerade as the correct partial if the note is seriously mis-tuned. When in doubt, use aural methods to verify that the note is at least grossly at the correct pitch before trusting the spectrum display or the phase display. One way to confirm that you are tuning to the correct partial is temporarily to select a different partial. If several partials appear at the same relative position in the spectrum display, then you probably have the partials identified correctly. If you do not see a very prominent peak in the spectrum display, it is not necessarily a cause for concern. The phase display will work even with partials that are almost too small to see in the spectrum display. Especially in the bass, feel free to select a different partial on the fly if you are having trouble getting a reasonable indication on the current partial. You can change partials using the **8** and **9** keys. If you have enabled auto partial selection in Edit Options, then TuneLab will search for a stronger partial as you tune and switch partials automatically if one is found.

We recommend that for your very first tuning with TuneLab you leave auto note switching disabled. That way you will not be confused by unintentional note switches. Later on, you can enable auto note switching to speed up your tuning. For now you can manually switch notes by using the **2**, **3**, **5**, and **6** keys.

Using your Mutes - Tuning Unisons

When you finish the monochord section of the bass and come to the bichords, always mute one of the strings before tuning the other string in the unison. After one string is tuned, remove the mute and tune the unison aurally. There are times when machine tuning of the unisons is an advantage, but those instances are usually in the high treble. In the bass there are many partials that need to be balanced. Tuning these unisons aurally allows you to make the needed compromises to get the best-sounding unisons. Also, aural unison tuning is faster than using the machine.

Proceed up through the bi-chords and into the tri-chords. Here you can mute the outside two strings and tune the middle string. Then move the right mute over one note to expose the right-hand unison. Tune that unison aurally and then move the left-hand mute over one note. That will expose the left-hand unison and also re-mute the right-hand string. In case your right-hand unison was off at all, it is better to tune the left-hand unison to the middle string than to tune the left-hand unison to the combination of the middle and right-hand strings sounding at once. Also, having all three strings sound at once increases your chances of having to deal with false beats. So always tuning unison strings in pairs is recommended.

Tuning the High Treble

Continue tuning through the high treble. Here you may have some trouble with the phase display. Even though TuneLab has artificially slowed down the movement of the phase display in the high treble, false beats together with a short sustain can produce a confusing picture in the phase display. It is here that we recommend that you switch over to using the spectrum display. The resolution of the spectrum display is in terms of cycles per second, not in terms of cents. Therefore the cents-wise resolution of the spectrum display gets better and better the higher you go in frequency. You can see this by noting the coarse look of the spectrum display around A-440 in the picture in Chapter 1 as compare to the somewhat more precise look of the graph following that one which is based around C7 (at about 2100 Hz). Therefore, in the high treble we recommend just trying to get the peak to be centered on the central red line in the spectrum display.

Using Auto Note Switching

You can use auto note switching to make tuning easier. To enable this feature, use the **Note Switching** sub-menu under the **Alt** menu. When auto note switching is enabled, TuneLab will be constantly listening for nearby notes; and when it hears one, it will switch to it. Auto note switching can be enabled for switching up, down, or in both direction. The range of auto note switching is plus or minus 300 cents from the current note. If you use aural checks while tuning, be aware that auto note switching may occur while you are doing these checks. If an unintended auto note switch occurs, simply switch back to the correct note manually.

When over-pull mode is also enabled, or when higher treble notes are selected, auto note switching requires a “trigger”, which is a sudden rise in volume, such as you would get when playing a note after some silence. At other times, auto note switching is less demanding, and will switch when the pitch changes without a trigger event. If TuneLab doesn't switch when you want it to, wait for some silence, and then play the note again.

All About Offsets

TuneLab uses a variety of offsets. The offsets are specified in terms of cents. The offsets in effect are all displayed on the right side of the Current Settings box, as shown in Chapter 1. TuneLab combines them to calculate the desired pitch for each note. In normal tuning, only the tuning curve offset is used and the other offsets are all zero. These offsets can be entered numerically using the **Edit, Current Settings** menu item. Since it is difficult to generate a minus sign ('-') when entering offsets with the numeric keypad, the letter 'N' may be used in place of the minus sign to indicate a negative cents offset.

Temporary Offset (or Over-pull)

This is either the “temporary” offset (also just called the “Offset”), or the “over-pull” offset in over-pull (pitch-raise) mode. When not in over-pull mode, in addition to the numeric method described above, this offset can also be adjusted by using the **up** and **down** arrow keys in the 5-way navigation pad. Before this method can be used, you must first enable the function from the **Offsets** sub-menu under **Alt**. By selecting **Enable Offset Jog** you enable the function of the **up** and **down** arrow keys until you stop using that function for 30 seconds. This is to prevent accidental adjustment of the offset. The third way to change the offset is by using Locking Mode to lock on to an existing pitch, as described later in this chapter.

Also available under the **Offsets** sub-menu are functions for transferring the offset to the custom stretch for the current note, transferring the offset to the basic offset, or zeroing the offset entirely. In over-pull mode, this offset is not adjustable. Instead this field in the current settings box shows the calculated over-pull offset. In preparation for a Tuning Exam, this field shows the detuning offset when the detuning mode is selected. The temporary offset is not displayed if it is zero.

Custom Stretch

This is an optional note-by-note offset and it is stored in the tuning file. It is rarely used, except when recording an aural tuning for the Tuning Exam. It can be used to make note-by-note corrections to the tuning curve. But if you find yourself making many such corrections, then you should consider readjusting the whole tuning curve instead. This custom stretch can be set by a transfer from the temporary offset as described above. This offset is not displayed if it is zero.

Tuning Curve Stretch

This offset comes from the tuning curve. It is calculated based on the adjustment of the whole tuning curve, taking into account the partial that is selected and the inharmonicity. The only way it can be adjusted for any one note is to adjust the tuning curve as a whole.

Temperament Offset

This offset is shown only when a un-equal (historical) temperament is selected. In that case, this offset shows the temperament offset for the current note, which is the same for all other notes of the same name in different octaves. The 12 temperament offsets are stored in the tuning file when it is saved with an un-equal temperament selected.

Basic Offset

This offset used to offset the tuning as a whole. It is most commonly used to change to a non-standard pitch, such as A-442. Its effect is just like that of the temporary offset, except that it is not so easily changed. This offset can be zeroed from the **Offsets** sub-menu under the **Alt** menu.

Locking Mode

Locking mode is entered by pressing the **7** key. Then TuneLab shows a status box that says “(trigger?)”. A trigger is a sudden rise in volume as you would expect when a piano note is struck. If you want to activate Locking mode without a sound trigger (such as when calibrating to NIST tones), you can do so by pressing the **7** key again. To cancel locking mode, press the ***** key. When Locking mode is active, the offset is automatically adjusted by TuneLab to make the phase display come to a complete stop. The adjustment starts by making large rapid changes in the offset, which gradually reduce to a small slow changes after a few seconds. This behavior allows quick initial locking, followed by more precise offset trimming as the feedback is reduced. When the aggressiveness of the locking action is gradually reduced, the offset will not wander as much and a more accurate reading can be taken. At any time during the locking operation the aggressiveness of the offset adjustment can be reset to its initial maximum value by pressing the **7** key again.

Entering Offsets for a Specific Frequency

In the **Edit, Current Settings** screen, there are three offsets that are normally specified in terms of cents. These are the offset, the custom stretch for the current note, and the basic offset. When entering values in these fields, instead of entering a number in cents, you can enter a frequency in Hz in the following formats:

A=442 (for offset or basic offset)

F=524.35 (for offset, custom stretch, or basic offset)

In both of these formats, the ‘=’ sign is optional and may be omitted. Also the letter ‘**F**’ or ‘**A**’ may be entered as lower-case ‘**f**’ or ‘**a**’ as well. If the entry starts with letter ‘**A**’ then the number afterwards is interpreted as the desired pitch in Hz of the note A4 (instead of the standard 440). The offset being specified will be set in cents to whatever is needed to make A4 have the specified pitch. The effect of this entry is the same regardless of what note is currently selected on the main tuning screen. If the entry starts with the letter ‘**F**’ then the number afterwards is interpreted as the desired pitch of the currently selected note and partial. In the example above, we might be specifying the pitch of C5, provided that C5 is the note that is selected on the main tuning screen at the time that this entry is being made.

Over-pull (Pitch Raise) Tuning Procedure

Over-pull tuning is sometimes called pitch raising. When large overall changes are made to the tuning of a piano, the notes that you tune first tend to change as you tune later notes. Over-pull tuning mode compensates for this change by setting the pitch a calculated amount beyond the desired pitch. In this way the settling that occurs as later notes are tuned will leave the notes right where you want them. In many cases using just one pass with over-pull tuning can take the place of tuning the piano twice.

Measuring Inharmonicity Before an Over-pull

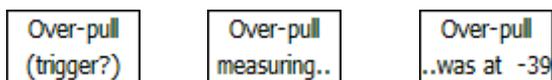
When over-pull mode is activated you cannot measure inharmonicity. Therefore if you want to create a custom tuning for the piano as described in the Chapter 2, you would have to measure the inharmonicity and adjust the tuning curve before enabling over-pull mode. For small to moderate pitch raises, the normal inharmonicity measurements will be sufficient. However, for extreme pitch raises, the act of pulling the string up to pitch will change the inharmonicity of the strings. For such pitch raises, you are not going to get away with doing a one-pass tuning anyway. So when you do the second pass, discard the old inharmonicity readings by starting over with a new tuning file, and take fresh inharmonicity readings. In fact, you would probably be better off skipping the inharmonicity readings on the first (extreme) pass and using a generic tuning file from a similar model piano for that pass. Then only the final pass needs to be customized.

Enabling Over-pull Mode

If your pre-tuning evaluation of the piano convinces you that the overall pitch change is large enough to need an over-pull, then you can enter over-pull mode by using the **Alt** menu. When over-pull is enabled, two status boxes appear on both sides of the current note display.

Beginning Tuning in Over-pull Mode

Before each note is tuned in over-pull mode, TuneLab can listen to the note for one second to get a rough measurement of its pitch. TuneLab keeps this information in a history list and uses this information to calculate the over-pull offset. You can follow your progress through the over-pull sequence by watching the status box that appears in over-pull mode. Here is what you would see as TuneLab waits for you to play the note, listens for one second, and then displays the results, at which time you can begin tuning the note:



Over-pull (trigger?) Over-pull measuring.. Over-pull ..was at -39

The first status box on the left is what you would see after changing to a new note or after requesting a re-measuring of the current note. When you play the note you will see the second status box followed briefly by

the third status box which will show what the measurement was for the current note. When you see the third status box you may then begin to tune the current note in the usual manner. If it appears that TuneLab does not always recognize when you play a note to be measured, remember that TuneLab is triggered by a sudden rise in volume. You should have a short break in the sound before striking the note so that TuneLab will see a clear difference between the silence and the sound of the note being struck. Then it will begin the measurement.

If the measurement shown in the third status box looks unreasonable, then perhaps an extraneous sound triggered the measurement before you actually played the note. If that is the case you can re-measure the current note by pressing the **#** key to re-measure that note. Every time you request a re-measuring of the current note, the most recent measurement is removed from the history list and TuneLab returns to waiting for you to play the note again. If you somehow get several bad readings in the history list, you can remove as many entries as you like by repeatedly requesting a new measurement without playing the note.

Faster Pitch Raising

To get the most accurate over-pull tuning, TuneLab normally measures every note automatically before it is tuned. One way to speed up the process is by measuring only occasionally, by unchecking the “Measure Every Note” option in the over-pull dialog box shown above. When automatic over-pull measurement is disabled in this way, you decide when a note should be measured by explicitly starting an over-pull measurement, using the **#** key as described above. For those notes that you don’t bother to measure, TuneLab will assume the same measurement for that note as for the previous note, and you can go directly to tuning as soon as you change notes.

Another way to do a very fast pitch-raise is to use timed note switching, as described in Chapter 1, and do a rough tuning only. Timed note switching will keep you from spending too much time on one note. You can tune without mutes and use the spectrum display, tuning roughly by moving the peaks for each string quickly to the red line in the middle. This will be close enough for a rough first pass. If you have the time delay set to 9 seconds, then you can complete the first pass tuning in about 13 minutes. If over-pull is used on this first pass, then perhaps the second pass can be done in normal mode.

How Over-pull is Calculated

You do not need to understand the exact formula for over-pull to take advantage of over-pull mode. TuneLab performs the calculation automatically based on the history list. The history list is the list of measurements taken before each note is tuned. The list is ordered from most recent to oldest. Only the most recent few measurements are displayed, but these recent measurements are the most important.

The over-pull amount is an offset in cents that is added to any other offset or stretch values. The over-pull amount is displayed in the upper right corner of the current settings box in the place normally used to display the temporary offset (if there is one). Note: The use of the temporary offset is not permitted in over-pull mode. If you must use an overall offset in over-pull mode, use the Basic Offset. The over-pull amount is calculated by starting with the most recent few measurements in the history list. How many are actually used in the calculation is determined by the number that you have selected in the **Over-pull Options** under the **Edit** sub-menu.. By default TuneLab uses the last seven notes. Assuming that seven measurements are used,

TuneLab takes a weighted average of these seven measurements using weightings that give the most weight to the most recent measurement and progressively less weight to the older measurements. Finally TuneLab multiplies the weighted average by the over-pull percentage and uses the opposite of that number as the over-pull in cents (subject to the safety limits, of course).

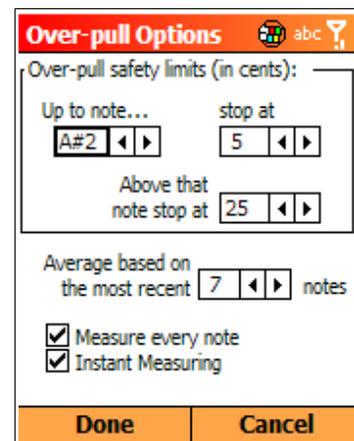
Changing Over-pull Percentage

The over-pull percentage may be changed as you tune in over-pull mode. Press the **up** and **down** arrow keys to change the over-pull percentage, as described earlier. The initial default over-pull percentage is 25%. The current over-pull percentage is always displayed in the current settings box when you are tuning in over-pull mode. For small to moderate pitch raises, simply use 12% when tuning in the bass bridge and 30% when tuning elsewhere. For more precise control of the tuning, use the following guidelines for over-pull percentage. These guidelines assume that you will tune unisons as you go up the scale from A0 to C8.

bass bridge	12%
tenor bridge to G5	29%
G5 to G6	29% increasing to 37%
G6 to C8	37% decreasing to 14%

Over-pull Options

There are some settings that you can change which affect how over-pull operates. These options are changed from the **Over-pull Options** menu item under the **Edit** sub-menu. This brings up the screen shown here on the right. The **up** and **down** arrow keys allow you to select which item you wish to change. The first group of fields sets safety limits for over-pull in cents. You can change these, or any other selection box values, by highlighting the selection box with the **up** and **down** keys, and they using the **right** and **left** keys to change the selection. Alternatively, you can open up and selection box once it is highlighted by pressing the **action** key. The purpose of these overriding safety limits is to reduce the likelihood of breaking strings in an extreme pitch raise. These limits do not come into play in small to moderate pitch raises. They define the maximum over-pull in cents for notes above and below a specified threshold, which is generally the break between wound and bare strings. If the calculated over-pull is higher than the limit shown here, then TuneLab will use the specified limit value and not the calculated value for over-pull.



Using Auto Note Switching with Over-pull Mode

There are some special considerations that need to be taken into account when using these two features together. If a pitch raise is more than 50 cents, the next note will sound closer to the current note, and TuneLab will not recognize it as the next note. In that case, consider using timed note switching, as described in Chapter 1. But assuming that auto note switching is feasible, it requires a “trigger” to switch, which is a

sudden rise in volume, such as you would get when playing a note after a brief period of silence. This is to reduce the chance of mistaken note switches in over-pull mode. If an unintended note-up switch does occur, and if you correct it by manually switching back down to the previous note, then TuneLab will automatically remove any over-pull measurements that may have been entered into the history list after the mistaken auto note switch. Also, there is an option called “Instant Measuring” in the over-pull options screen. If you check Instant Measuring, then the sound that triggers an auto note switch will also be measured automatically for the over-pull calculation. If you do not check Instant Measuring, then you will need to play the note once to switch notes and again to measure it. Then you can start tuning the note.

Saving the Entire History List

After tuning a piano in over-pull mode, the entire collection of over-pull pitch measurements made before each note was tuned may be saved to a file for later off-line study. From the **Files** sub-menu, select **Save Over-pull Measurements**. You will be prompted to enter a file name. The entire history list will be written in text format to the file that you specify.

When to Tune Unisons in a Pitch Raise

There are two schools of thought when it comes to this issue. You can tune unisons as you go, or you can use a strip mute and postpone the tuning of unisons until the end. Aside from any general considerations that may enter into your decision of which way to choose, there are special considerations relating to Over-pull mode.

Over-pull works by estimating how far the pitch of a string will fall as the rest of the piano is tuned. The current note is then tuned sharp by that same amount. If you tune unisons as you go, the notes below the current note will all have been tuned and the notes above it will not have been tuned yet. Therefore the current note will be affected only by the subsequent tuning of the notes above it. On the other hand, if you use a strip mute and postpone tuning unisons, the outer strings of the notes below the current note will not have been tuned yet. Therefore the current note will be affected both by the tuning of notes that lie above the current note and by the tuning of the unisons of the notes that lie below the current note. This subjects the current note to the almost twice as much pitch-fall after it is tuned. To compensate for this extra expected drop in pitch, you would have to use a higher over-pull percentage.

The guidelines shown for over-pull percentage are based on the assumption that you will tune unisons as you go. If you want to use a strip mute and tune unisons later, then plan on using a somewhat higher over-pull percentage. Warning! This may increase the chance of breaking strings on extreme pitch raises. Use the over-pull safety limits to prevent extreme over-pull.

Calibration Procedure

Chapter 1 described the need for calibration. This chapter takes you through the process of actually doing a calibration. Normally you need to do a calibration only once when you first install TuneLab on your phone. The results of the calibration are stored permanently on your phone and used every time you run TuneLab.

A Trusted Source of Pitch

To do a calibration you need to have a trusted source of pitch. The most accurate source of pitch that you can get is the National Institute of Standards and Technology (NIST). This agency of the U.S. government has a telephone service and shortwave radio service that disseminate standard time and frequency. The telephone service is free of charge (but the call is not toll-free), and the shortwave radio service may be heard on 2.5, 5, 10, 15, and 20 MHz. Another source of accurate pitch is a Sanderson Accu-Fork or Accu-Tuner. In most areas of the USA, the telephone dial tone contains an A-440 that might be used for calibration, but this frequency is not certified by the phone companies and may be in error. The procedure described here involves the use of the NIST standard frequency service.

NIST Broadcast (and Telephone) Schedule

The NIST standard frequency service is broadcast on shortwave radio station WWV on the frequencies listed above. The audio from this broadcast is also available by telephone by calling (303) 499-7111 in Colorado. This is a very popular number. NIST reports that they get over two million calls per year. In order to use these services effectively, you need to know something about the schedule for WWV. The following schedule is followed each hour. It shows what tones are present during each minute of the hour. When a tone is present, it is present for the first 45 seconds of the minute and it is silent for the last 15 seconds.

0: ---	10: ---	20: 500	30: ---	40: 500	50: ---
1: 600	11: 600	21: 600	31: 600	41: 600	51: ---
2: 440	12: 500	22: 500	32: 500	42: 500	52: 500
3: ---	13: 600	23: 600	33: 600	43: ---	53: 600
4: ---	14: ---	24: 500	34: 500	44: ---	54: 500
5: 600	15: ---	25: 600	35: 600	45: ---	55: 600
6: 500	16: ---	26: 500	36: 500	46: ---	56: 500
7: 600	17: 600	27: 600	37: 600	47: ---	57: 600
8: ---	18: ---	28: 500	38: 500	48: ---	58: 500
9: ---	19: 600	29: ---	39: 600	49: ---	59: ---

Although the 440 Hz tone in minute #2 is tempting, do not try to use it. That pitch is only present for 45 seconds each hour. The difficulty in calling at just the right time and the shortness of the tone make this choice inadvisable. Instead you can use the 500 Hz and 600 Hz tones. The telephone service will disconnect you after

three minutes, so make sure that when you call you have everything set up and time your call so that you will be assured of at least three minutes of 500 Hz or 600 Hz tones. If you happen to be closer to Hawaii than to Colorado, you can receive WWVH by shortwave radio or by calling (808) 335-4363 in Hawaii. For more information on both of these sources, see the website:

www.boulder.nist.gov/timefreq/stations/iform.html

Do not try to make the call to the NIST with the same phone that you are trying to calibrate with TuneLab. Most phones do not provide a means to feed the phone call audio in on the microphone circuit where TuneLab can hear it. Instead, make the call to the NIST using a different phone and position the TuneLab phone so that its microphone is right over the speaker of the second phone.

Special NIST Tuning File for Calibration

To use the NIST standard frequency service to do a calibration, start by opening the tuning file **NIST-303-499-7111-C5-D5** which was installed on your phone with TuneLab. This tuning file contains special custom stretch offsets for the notes C5 and D5 so that they come out to 500 Hz and 600 Hz respectively. The name of the tuning file also contains the Colorado phone number for the NIST service as a reminder. If you select C5 and then D5 you can see the frequency reported as 500 Hz and 600 Hz to correspond with the tones from NIST. Do not make any changes to this tuning file, and of course do not try to tune a piano when it is loaded!

When TuneLab begins listening to an NIST tone, your goal is to trim the offset of TuneLab so that the phase display is perfectly stopped. There are two ways to do this - manually and automatically. The manual method may be slightly more accurate but the automatic method may be quicker to use. In either case, you will have to select C5 or D5 depending on which tone is coming from NIST. Don't bother trying to figure out which tone is present from the broadcast schedule. Just use trial and error. Select C5. If the spectrum display doesn't show a peak near the central red line then you probably have the wrong note, so switch to D5. If you run out of tone before you can get the phase display stopped, then switch to the other note because the 500 Hz and 600 Hz tones alternate each minute. If you get the offset trimmed for 500 Hz, that same offset will be correct for 600 Hz.

Manual Locking onto NIST

Trim the Offset as described in the Chapter 3 ("All About Offsets"). While TuneLab is listening to the NIST tones from the telephone, the goal is to make the phase display be absolutely stopped by adjusting the offset to within a small fraction of a cent. Adjusting the offset by .01 cents will produce a change so small that you will not be able to tell that anything has changed unless you observe the phase display for more than 15 seconds, so don't worry about getting that last hundredths place right unless .01 cent absolute tuning accuracy is really that important to you. For most purposes, .05 cents is close enough. If the phase display is moving to the right, then you should make the offset higher (press the **up** key). If it is moving to the left, then make the offset lower (press the **down** key). The slower the phase display moves the finer the adjustment that is needed. When the phase display is as stopped as you can make it, you are done with the adjustment (but not with the calibration). You may hang up the phone at this point and go to **Completing the Calibration** on the next page.

Automatic Locking

As an alternative to the manual adjustment of offset that was just described, you can use the Locking mode in TuneLab, as described in Chapter 3, “**All About Offsets**”. When this mode is active, TuneLab listens to the sound coming in and automatically adjusts the offset to make the phase display come to a complete stop. The process is somewhat sensitive to noise; but the automatic locking mode may be easier and faster. When locking to a tone on the telephone, there may not be a rise in volume sufficient to be detected as a trigger. You can force Locking mode to become active without a trigger by pressing the **7** key again.

When Locking mode is active (as indicated by the Locking status box) the adjustments to the Offset will proceed continuously, and you should see the results of that adjustment in the upper right of the Current Settings box. If the sound that TuneLab is supposed to lock to is interrupted, TuneLab will continue to attempt to lock onto whatever sound it hears. If it hears just normal background noise, the offset will seem to change randomly. Therefore it is important to disable Locking mode before removing the tone. In the case of the NIST tones, if the tone stops before you have achieved a satisfactory lock, then you should disable Locking mode as soon as possible (by pressing the ***** key) and wait for another tone to begin. Since the NIST tones alternate between 500 Hz and 600 Hz, you should take this opportunity to switch between C5 and D5.

If the phase display appears to have stopped completely, then turn off Locking mode. This is done by pressing the ***** key. If you have time, make one final check of your Offset adjustment after turning off the locking mode. If the phase display is still stopped, then you are done listening to the NIST tone and you can hang up the phone and proceed with **Completing the Calibration**.

Completing the Calibration

At this point you should have a temporary offset showing in the Current Settings box. This is the offset that made it possible for the phase display to come to a complete stop when TuneLab was listening to the NIST tones. You should also have a frequency showing in the current settings box. If you were locked onto one of the NIST tones, this frequency will be very close to either 500 Hz or 600 Hz, but it will probably not be exactly 500 Hz or 600 Hz unless the Offset that stopped the phase display just happened to be zero. The reason for this difference is that TuneLab has not been calibrated yet; so what it thinks is 500 Hz is not necessarily exactly 500 Hz. Do not change notes or anything else until the following procedure has been completed.

From the **Tools** sub-menu, select **Calibrate..** A box will appear with a field labeled “actual frequency”. If this is a NIST calibration, then TuneLab will fill in this box with a suggested value of 500.00 or 600.00 depending on which note was last selected. If the selected note is A4, then TuneLab will suggest exactly 440.00. Otherwise TuneLab will suggest the frequency that appeared in the current settings box, rounded to the nearest 1 Hz. This may be exactly what you need if the calibration error was small. If not, you may need to enter the correct frequency. If the calibration tone came from NIST, then the correct actual frequency should be 500.000 or 600.000, depending on which tone TuneLab was listening to last. Make sure that the correct exact frequency is entered and then press **Done**. You may need to review “Entering Text” from Chapter 1. The calibration is now done. At this point TuneLab will automatically zero out any offset that you may have had prior to the calibration, because it is no longer needed, now that the new calibration is in effect.

NIST Calibration Checklist

- (1) **NIST-303-499-7111-C5-D5** tuning file is loaded.
- (2) **C5** is selected with 500 Hz showing.
- (3) Spectrum display zoom set to +/- 260 cents (so you can see both C5 and D5 at once)
- (4) Telephone sound can be heard by the microphone.
- (5) NIST schedule shows tones are available for the next few minutes.
- (6) Place the call to NIST.

Before calling NIST, make sure you can situate the telephone so that TuneLab can hear the tones. You can use the dial tone just to verify that it will work. Try to situate the telephone receiver directly over the microphone in your computer so that you are not holding it in your hands, because movement of the receiver will create noise that could interfere with the sounds TuneLab is trying to hear. When the call is answered, listen for a tone. Remember that the last 15 seconds of every minute has no tone, so you may have to wait up to 15 seconds. When a tone is heard, determine if it is 500 Hz or 600 Hz by selecting C5 or D5 until you see an indication in the phase display or the spectrum display. As soon as you find out which tone is being heard, use the Locking mode or manually adjust the offset in order to make the phase display stop. Remember that NIST will disconnect you after three minutes, so plan your usage accordingly. Finish the calibration as described above.

Verifying Calibration

After a calibration is complete, you may wonder if it completed properly. You can check this in several ways. From the **Help** menu, select **About TuneLab**. A box will appear that shows, among other things, the actual sample rate. This is the actual end product of doing a calibration. The actual sample rate is stored in your computer to be used every time you start up TuneLab. If you are curious as to how far off TuneLab would have been without calibration, compare the actual sample rate shown in the About box with the nominal sample, which is 22,050. Now that you have done a calibration, it will not matter that the actual sample rate is different from the nominal rate because TuneLab knows about the difference, and is taking it into account in all its calculations. Another way to check calibration is to go back to NIST or some other trusted source of known pitch. Select the note and offset that makes the phase display stand still. If TuneLab is properly calibrated, the frequency display in the current settings box should be absolutely accurate and it should agree with the frequency of the trusted source.

Special Functions

Split Scale Mode (Spinets)

Most spinets (and some small grands, like the Yamaha GH-1) are difficult to tune because they have a large jump in their inharmonicity - usually at the point where the scale makes the transition between wound strings and plain strings. TuneLab has a special facility just for such pianos. This facility is called the "Split Scale".

If you want to use the Split Scale, then do this:

1. Take inharmonicity measurements of the two consecutive notes at the transition. If the inharmonicity constants from these two measurements differ by more than a 2 : 1 ratio, then this piano is a good candidate for Split Scale tuning. If you decide that the inharmonicity constants are not different enough to justify Split Scale tuning, then discard one of the two inharmonicity readings and do not use Split Scale mode.
2. Measure three other notes below the transition.
3. Measure three other notes above the transition.

This pattern of inharmonicity measurements tells TuneLab to use the Split Scale tuning curve, and it also tells TuneLab exactly where the transition is.

An alternative way to start a Split Scale tuning file is from the **File** sub-menu. Select **“New Split Scale”**. TuneLab will then ask you for the location of the break where you expect the inharmonicity to jump (typically the break between wound strings and plain strings). Once TuneLab knows this, it will figure out which notes you should measure and sequence through those measurements automatically.

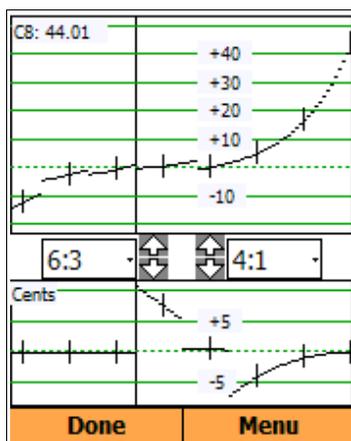
After you have measured inharmonicity as described above, you can invoke the tuning curve adjuster. The tuning curve adjuster shows when TuneLab is in Split Scale mode by placing a vertical line on the tuning curve and the deviation curve, as shown in the picture below. This vertical line shows the location of the break between the two parts of the split scale. If you do not see this vertical line in the tuning curve adjuster, then TuneLab is not in Split Scale mode. If you expected to see Split Scale mode, then review your list of inharmonicity readings. You will probably find that you have either:

1. less than four total inharmonicity readings below the break, or
2. less than four total inharmonicity readings above the break, or
3. more than one pair of consecutive inharmonicity readings.

If any of these conditions are true, then TuneLab will not go into Split Scale mode. For example, if you are tuning a Baldwin Acrosonic spinet, which has a break at F#3/G3, then you could invoke Split Scale mode by measuring inharmonicity at:

B0 G1 E2 F#3 G3 C4 A4 G5

We recommend the fully automatic adjustment mode for the tuning curve. But if you want to use some form of manual adjustment, be aware that when TuneLab is in Split Scale mode, the tuning curve adjuster buttons have a direct effect only on the portion of the tuning curve above the transition. We recommend that you select 4:1 double octaves in the treble side of the tuning curve adjuster, and 6:3 single octaves in the bass side.



This is what TuneLab does in Split Scale mode. The usual continuous model for the inharmonicity of the whole piano is broken up into two separate models - one for the portion of the scale below the transition and one for the portion above the transition. When you adjust the tuning curve, you will be directly adjusting only the portion of the tuning curve above the transition. The portion of the tuning curve below the transition will be automatically adjusted to give perfect 6:3 single octaves, if 6:3 octaves are what you selected for the bass. If you selected something else for the bass, then TuneLab will adjust the bass for 6:3 single octaves at the top of the bass and whatever you selected at the bottom of the bass. TuneLab will blend smoothly between these two intervals as you move down the scale in the bass. If you select 6:3 single octaves for the bass, then the deviation curve will show exactly zero cents for the entire left half of the curve.

When manually adjusting the tuning curve in Split Scale mode, the adjuster buttons for the left half of the curve do not actually change the left half. Instead they change the portion of the treble tuning curve as it would be if it were extended into the bass. Nevertheless, it may still be useful to make these adjustments because the interaction with the treble side can improve the length of the flat portion of the deviation curve at the treble end. The image shown above is what a good tuning curve and deviation curve might look like in Split Scale mode for a Baldwin Acrosonic Spinet. Note the vertical line which indicates Split Scale mode.

The large deviations in the middle of the deviation graph are to be expected. Pianos that need Split Scale mode tend to have high inharmonicity just above the break. Although 4:1 double octaves in this region may be quite wide, 4:2 single octaves will be just about right. You can check the condition of 4:2 single octaves by temporarily switching to 4:2 in the treble. Make sure you switch back to 4:1 double octaves before making any further adjustments. After you have adjusted the tuning curve so that the deviation curve looks something like the one above, focusing mostly on the far right end of the curve and how it sticks close to zero, then exit from the tuning curve adjuster and tune the piano as usual.

Tuning Exam Mode

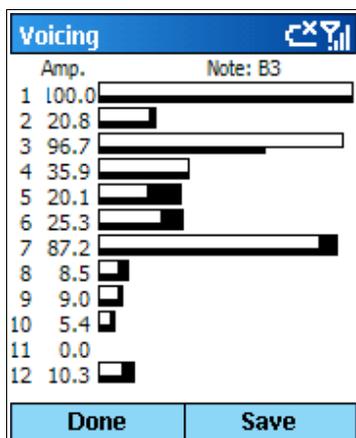
From the **View** sub-menu you can enter or leave Tuning Exam Mode using **Exam Mode Enable** or **Stop Exam Mode**. When this mode is active, the status box on the right side of the current note display is used to display the total offset, rounded to the nearest 0.1 cents, in keeping with the requirements of the PTG Tuning

Exam. This display may be used to gather tuning offsets manually. Pressing the **action** key will transfer this offset to the custom stretch for the current note so that a complete set of these offsets may be recorded in a tuning file. Tuning Exam Mode also forces the use of the proper partials, as specified by the PTG Tuning Exam. In addition, there is a grading facility for comparing an examinee's tuning with a master tuning. See the separate document on using TuneLab in the Tuning Exam for details.

Making Temperament Files

Historical temperaments were described in Chapter 1. They are opened and attached to the current tuning using the **Tools** sub-menu menu. If you want to use a temperament that was not provided with TuneLab, you can create your own new temperament files using **New Temperament** from the **File** menu. All you need to know is the 12 offsets that define the temperament. After you enter the 12 offsets, you will be prompted to enter a file name for the new or modified temperament. When you make a new temperament file, you can then select it into any tuning curve just like the original temperament files.

Measuring Voicing



As a by-product of measuring inharmonicity, TuneLab creates a picture of the relative amplitudes of the various partials that were measured. All the partial amplitudes are rated in proportion to the strongest partial, which is rated at 100. The voicing display shown to the left is available by selecting the **Voicing** menu when an inharmonicity result is being displayed. Notice there are two sets of horizontal bar graphs - one white and the other black. The white bars show the amplitudes for the current measurement. The black bars show the amplitudes for a previously-saved measurement (using the **Save** menu item). In example shown, the previous measurement was made with a forté blow, and the current measurement was made with a softer blow. This resulted in different relative amplitudes, especially for the second partial. Keep in mind the limitations in the use of this voicing measurement. The exact pattern of amplitudes depends greatly on the quality and the placement of the microphone, and on the strength of the hammer blow.

Measuring Sustain Time

Another by-product of an inharmonicity measurement is the sustain time, which is described as the length of time that a note sounds before fading so much that it cannot be heard. Although this definition is imprecise and subjective, piano rebuilders often need some measure of sustain time to evaluate the quality of the bridge and soundboard. The calculated sustain time is shown along with the results of the inharmonicity measurement. To measure sustain time, follow the normal instructions for measuring inharmonicity. However, there are several precautions regarding measuring sustain time.

One precaution is to turn off automatic gain control on the microphone, if your phone offers such an option. Normally, automatic gain control would be a good thing because it brings up the level of the sound as the note decays, thus giving TuneLab more signal to work with. But automatic gain control will make the notes appear to sustain much longer than they really do, so the calculation of sustain time will be invalid. If you do change

automatic gain control settings, you will have to switch temporarily to sound generating mode and back to listening mode for the change to take effect

Another precaution is to be aware of the sound level as you strike the note. If the level reaches 100% for too much of the sample time of an inharmonicity measurement, then no sustain time will be reported. Use the microphone overload indicator, as described in Chapter 1, to avoid too loud of a sound. Learn how hard you must strike the note to achieve an initial 100% level, or thereabouts. A brief period of 100% level is OK as long as the level drops below 100% shortly thereafter.

Finally, make sure that the correct note is selected when you measure sustain time. Although the sustain calculation is not pitch-sensitive, the total sampling time does depend on which note is selected. TuneLab assumes a shorter sustain for higher notes, as you can see by noting the differences in the inharmonicity sampling times.

Auto Partial Selection

As stated in Chapter 1, the selection of which partial is used for each note can be modified by editing the table of partials as a whole, or by making individual on-the-fly changes. Sometimes individual bass strings are found to be weak in the pre-selected partial, making it difficult to tune them. You could manually try different partials, or you can let TuneLab change to a different partial by enabling the option for automatic partial selection. This option can be found under **Edit Options**. You specify a note below which automatic partial selection may occur, and how high a partial you will allow to be selected automatically. The default is to disable automatic partial selection completely. If you select a higher limiting note in your Options, then the lower notes will have automatic partial selection enabled.

When automatic partial selection is enabled for a note, then the partial selection may change during the first few seconds after you switch to that note. TuneLab will not change partials unless it finds a qualified partial that is at least twice as strong as the currently selected partial. TuneLab will only change partials once for each note switch. If an automatic partial change does occur, that change is treated exactly the same as if you had made the change on the fly manually. In particular, if the Persistent Partial option is enabled, the change is immediately incorporated into the current tuning file.

Menu Items and Options

Here is an item-by-item list for the menus in TuneLab for Smartphones.

Alt menu - the left-hand soft-menu available on the main tuning screen

1 Note Switching

- 1 Manual** - allow only manual note switching
- 2 Auto Up** - enables auto note switching in the upward direction
- 3 Auto Down** - enables auto note switching in the downward direction
- 4 Auto Both** - enables auto note switching in either direction
- 5 Timed Up** - enables timed note switching to the next higher note
- 6 Timed Down** - enables timed note switching to the next lower note
- 7 Auto Measure** - sequences through pre-defined list of notes to measure for inharmonicity.

2 Zoom Out (-) - changes to a wider view in the Spectrum Display

3 Zoom In (+) - changes to a narrower view in the Spectrum Display

4 Offsets

- 1 Zero Offset** - sets the temporary offset to zero
- 2 Offset to Basic** - transfer the offset to the basic offset
- 3 Offset to Custom Str.** - transfers the offset to the custom stretch for the current note
- 4 Zero Custom Stretch** - sets the custom stretch for the current note to zero
- 5 Zero Basic Offset** - sets the basic offset to zero
- 6 Allow Offset Jog** - enabled **up** and **down** keys to change offset for 30 seconds
- 5 Start Over-pull** - Enable over-pull mode. If over-pull is already enabled, this menu item changes to *Stop Over-pull*.
- 6 Begin Tone Gen** - Switches to generating a tone rather than listening to the microphone. If the tone-generation is already enabled, this menu item changes to *Stop Tone Gen*.

“Menu” menu - the right-hand soft-menu available on the main tuning screen

1 File

- 1 New Tuning File** - clear out any existing tuning file data and loads from DEFAULT tuning file.
- 2 New Split-Scale** - ask for location of break, then start new tuning file.
- 3 New Temperament** - allows you to change the 12 offsets of a historical temperament, or to enter a completely new temperament and save it to a file
- 4 Open Tuning File** - show a list of previously saved tuning files from which you choose
- 5 Save Tuning** - ask for a file name and maybe a new folder name where tuning file will be saved

2 Edit

- 1 Current Settings** - allows you to enter exact values for offset, custom stretch for the current note, basic offset, and over-pull percentage.
- 2 Edit Inharmonicity** - review and possibly delete the inharmonicity constants that resulted from inharmonicity measurements.
- 3 Edit Partial**s - allows you to review and possibly change the table of partials currently in use. This table will be saved with the current tuning if you save the tuning file.
- 4 Zero All Custom Str.** - Use this function to remove all Custom Stretch values from the current tuning. This will not affect the template tuning curve or the historical temperament (if any).
- 5 Options (general)** - allows the setting of various options, listed later
- 6 Over-pull Options** - allows the setting of over-pull safety limits, how many readings are averaged, whether or not all notes are measured and the notes are measured at the same time auto note switching switches notes.

3 View

- 1 Spectrum Wide** - shows many partials at once
- 2 Spectrum 260 cents** - shows 260 cents around the current note and partial
- 3 Spectrum 130 cents** - shows 130 cents around the current note and partial
- 4 Spectrum 50 cents** - shows 50 cents around the current note and partial
- 5 Exam Mode Enable** - selects correct partials for RPT tuning exam and displays offset rounded to the nearest 0.1 cents for recording master tunings and examinees' tunings
- 6 Exam Detuning Enable** - prepares a piano for the tuning exam by using specific offsets
- 7 Exam Scoring** - compares the current examinee's tuning with a previously recorded master tuning

4 Tools

- 1 Pick Temperament** - lets you choose an existing unequal temperament file
- 2 Cancel Temperament** - returns the current tuning to equal temperament
- 3 Save Overpull Readings** - saves all the measurements to a file for off-line analysis
- 4 Calibrate** - Choose this item **after** you have matched TuneLab to an external frequency source of pitch, such as NIST tones.

5 Help

- 1 About TuneLab** - version information and calibration data
- 2 Register** - Enter license data to switch from trial version to paid version.
- 6 Close** - Stops and closes TuneLab. TuneLab will prompt you if you need to save a tuning file first.

Tuning curve editor (Menu)

1 View

- 1 Cents** - selects the cents display mode for the deviation curve
- 2 Beats** - selects the beats display mode for the deviation curve

2 Edit

- 1 Undo Changes** - returns the tuning curve adjustment to the way it was when the tuning curve editor was entered
- 2 Freeze Custom Offset** - enables or disables the mode whereby the effect of custom offsets remains fixed when the template tuning curve is adjusted. The setting of this mode does not matter unless you are adjusting a tuning after establishing some Custom Stretch values.

Edit Inharmonicity List

Done - returns to main screen

Menu

1 Delete - deletes the inharmonicity sample that is highlighted

Edit Partial

Done - returns to main screen

Edit

1 Revert to Defaults - returns the partials to those in **DEFAULT.TUN**

Results of an Inharmonicity Measurement

Save - saves this inharmonicity measurement and perhaps goes on to next note in measure sequence

Menu

1 Save+ - saves this inharmonicity measurement and begins another measurement on same note

2 Discard - discards this inharmonicity measurement and begins another measurement on same note

3 Erase Previous - erases all readings for the current note, but continues to show this measurement

4 Voicing - switches to the bar graph display of partial amplitudes

Voicing Graph Display

Done - returns to the inharmonicity measurement display screen

Save - saves the current set of amplitudes (in “white” bars) for later comparison (in “black” bars)

Saving a File

Cancel - aborts this file save operation

Menu

1 Enter File Name - presents box where user can enter name of file where data will be saved

2 New Folder - presents box where user can enter name of new folder to be created here

Options (general, in Edit Options screen)

Use wide traces in graphs - makes traces three pixels wide instead of one pixel in the spectrum display and in the tuning curve editor.

Make partial changes persistent - remembers in the tuning file any changes made to the selected partial using the partial-changing keys or by the action of **auto partial selection**. Otherwise all such changes are temporary, and the partial selections in the tuning file stay as they are.

Auto Partial Selection - specifies which notes, if any, should use automatic partial selection, and which partials should be allowed to be selected automatically. This option is for the lowest bass notes. See Chapter 6 for details. The default is for no auto partial selection.

Timed note switching time - sets the time in seconds at which TuneLab will switch to the next note if timed note switching is enabled.

Normalize Historical Temperaments - allows the selection of three types of normalization: none (as is), normalize so that $A=0$, and normalize so that the average offset=0. The normalization shifts all 12 offsets for tuning, but does not change the original offsets in the tuning file or the temperament file.

Measure Sequence Button - Pressing this button brings up a screen where the user can specify which notes will be measured for inharmonicity when starting a new tuning file.

Over-pull Options

Low note threshold and cents limit - specifies what note is considered the threshold for observing the first safety limit on over-pull offset in cents. Generally this is this highest note that might ever be a wound string. The cents limit ensures that over-pull calculations will be limited to at most this value.

Cents limit for remainder - specifies the safety limit on over-pull offset in cents for all notes above the threshold note described above

Number of history values in average - specifies how far back in history TuneLab should look in forming the running average of over-pull measurements. By default TuneLab considers that most recent seven notes when forming over-pull offsets.

Measure every note - specifies that TuneLab should automatically measure every note before it is tuned

Instant measuring - specifies that TuneLab should use the same sound that caused an auto note switch to make an over-pull measurement on the new note before it is tuned.

Phase Display Options

Speed Factor - scales the speed of the phase display for all notes.

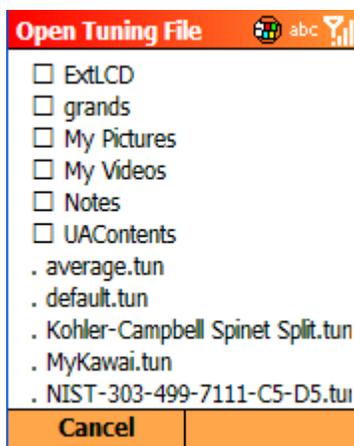
Switch to Cents at... - specifies the note at which the speed of the phase display switches to cents. Below this note, the speed of the phase display is based on beats. One beat of pitch error means one complete cycle of the phase display (if Speed Factor is set to 1). Above the specified note, the phase display speed represents the pitch error in cents. The higher you put this changeover point, the faster the phase display will be for the higher notes.

Working with Files

Files stored on your phone are used to store tunings, temperaments, and text reports.

When you select an existing file or create a new file, you will be using the TuneLab file dialog. This is a custom screen that allows you to navigate through different folders, make selections, and define new folders and files.

Open Tuning or Temperament Files

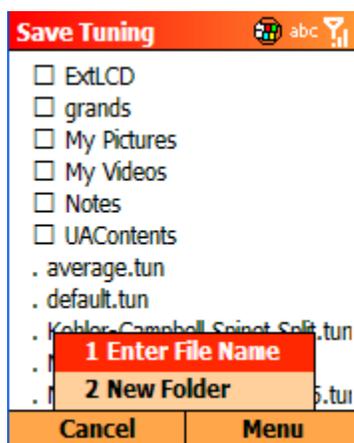


The most common file operation is opening an existing tuning file. This process is started from the **File** sub-menu. The screen on the left is what you see when you ask to open a tuning file. What you see is a list of folders and files under the storage folder where your phone keeps all your documents. The names are arranged alphabetically, with the folder names listed first. The folder names are preceded by a box () and the tuning file names are preceded by a dot (.). You can use the **up** and **down** arrow keys in the 5-way navigation pad to move a selector highlight through the list, which will scroll if necessary. When the highlight reaches the file that you want to open, press the **action** key in the center of the 5-way navigation pad to confirm the selection. If you want to enter a folder, then press the **action** key when the folder name is highlighted. Note that when you enter a folder, the folder does *not* appear to remind you where you are. If you forget what folder you are in, you can press the **back** key to return up one level where the folder name will be highlighted.

You can have any reasonable number of levels of folders. It is a good idea to use folders to organize the tuning files that you will collect because that will limit the total number of files in any one folder, and scrolling through a huge number of files can be quite bothersome. Note that not all the folders that appear in the initial list have anything to do with TuneLab. In fact, TuneLab does not create any folders when it is installed. The folders that you see listed are probably created by other programs on your cellphone. The only TuneLab-related folders will be folders that you decide to create later, such as the “grands” folder shown in the example above. All the tuning and temperament files supplied with TuneLab are initially installed in the top-level documents folder. If you decide not open any tuning file, then use the **Cancel** menu button.

A very similar display is shown when you elect to pick an un-equal temperament file. But instead of showing you files that end in “.tun”, the list will contain the files that end in “.tem”. About 11 historical temperament files are automatically installed when you install TuneLab on your phone.

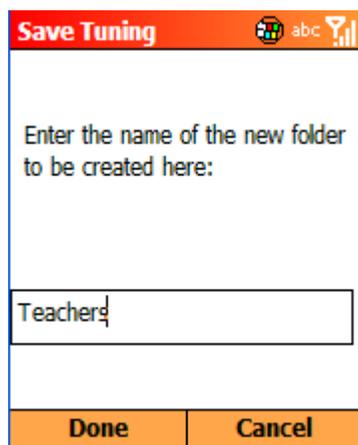
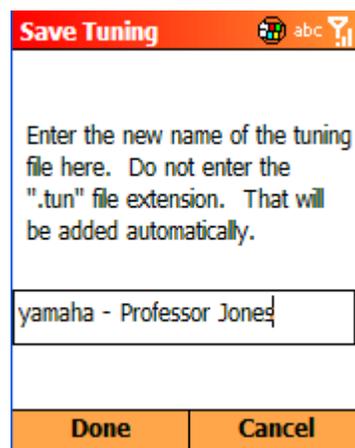
Saving Files



When you ask TuneLab to save a tuning file, the screen appears as shown on the screen to the left. The display is very similar to the one for opening a tuning file. You can still navigate to different folders and select files, just as if you were opening a file as shown previously. If you do select an existing file as the target of your save, then TuneLab will warn you that you are about to overwrite an existing file. If you confirm that that is indeed what you want to do, then TuneLab will do it. Otherwise the save will not happen.

More typically, you will want to create a new file when you do a save. For that you can use the **Menu** as shown in this example. In that menu you can select either **Enter File Name** or **New Folder**. If you select **Enter File Name** then you be asked to enter the name of

a file that will be created in the folder whose contents was being displayed. In the case of tuning files, the screen looks like the one to the right. Use the numeric keypad as described in Chapter 1 to enter a new name, like the “yamaha - Professor Jones” shown here. Note that pressing the * key will cycle through various entry modes, as shown in the caption bar at the top of the screen. These modes are abc, Abc, and ABC. If you hold the * key you can get 123. These modes have to do with capitalization and alphabetic vs. numeric characters. As the instructions advise, do not enter the “.tun” extension because that will be added automatically by the software.



If you wish to create a new folder while saving a tuning file, then select **New Folder**. This will bring up the screen shown here on the left. This screen is similar to the one for entering a new file name. The prompt text is different, since it reminds you that you are entering folder name instead of a file name. Also, there are no automatic filename extensions since a folder name can be anything you like, as in “Teachers” shown here. After you create a new folder, you will be returned to the previous screen showing a list of folders and files. But now your newly-created folder will appear in the list of folders that you can select. It will not be selected automatically. You still have to select it if you want to store your new tuning file in that folder.

Although this example showed how to save a tuning file, the same interface is used to save a temperament file when you create a new un-equal temperament. It is also used to save text files if you want to save a set of over-pull measurements, or save a tuning exam report that was generated in scoring the RPT tuning exam.

There is no means inside of TuneLab to delete or move files. However you can do that with your desktop ActiveSync connection by using the **Explore** function in ActiveSync when your phone is connected to your desktop computer.

Motorola Q Phone and Similar Phones

There are two major differences between the ordinary Smartphone and the Motorola Q Phone. One is that the Q Phone has a screen that is wider than it is high. The other is that the Q Phone has a full keyboard including letters - not just numbers. When TuneLab for Smartphones is installed on such a phone, TuneLab changes some display formats and takes advantage of the expanded keyboard. The most obvious advantage is that entering file names is easier with a separate button for every letter. The current settings box on the main tuning display is condensed to just three lines:

MyKawai	Kirnberger III	Offset 8.91
25%OP	Cust 2.54	TCurve 0.74
554.63 Hz par: 1	AutoUP	Basic -12.36

Tuning File Name (*MyKawai*) - the name of the tuning file currently in use

Temperament Name (*Werkmeister III*) - the name of the un-equal temperament file (if one is selected)

Over-pull Percentage (*25%OP*) - the current over-pull percentage (if over-pull mode is selected)

Tuning Partial (*par: 1*) - which partial is used for tuning the current note. 1 = fundamental.

Frequency (*554.63 Hz*) - the calculated frequency, taking into account all offsets

Offset (*8.91*) - the temporary offset (or the offset due to over-pull in over-pull mode)

Custom Stretch (*2.54*) - the offset (if any) manually programmed for the current note

Tuning Curve Stretch (*0.74*) - the offset calculated from the tuning curve

Temperament Offset (not shown) - the offset from the optional un-equal temperament in effect

Basic Offset (*-12.36*) - the offset (if any) applied to all notes uniformly

Note Switching (*AutoUP*) - tells which form of note switching is in effect

Use of Menus

On a regular Smartphone, each menu selection appears with a number (1-9) in front of it, as in the menu **4 Tools**. That is to signify that you can select that menu item by pressing the indicated digit key (4). But on the Q Phone the menu text does not appear with a number in front of it. The Tools menu appears as **T**ools. That is because this menu item can be selected by pressing the **T** key when the menu is showing. Often the letter key is the first letter of the item, as in **F**ile. But sometimes a different letter is designated. Look for the underline of the designated letter to determine which letter key can be used to make the selection, as in the menu item **A**uto **U**p, which is selected by pressing the **U** key. To use letters to make menu selections you cannot have the **ALT** (numeric) shift in effect. Of course menu items can also be selected with the 5-way navigation pad if you don't want to use the designated letter method.

Alternate Keystrokes for Main Tuning Display

The keys with numbers on them behave just as with a regular smartphone, as shown in Chapter 1, regardless of which keyboard shift mode is in effect. But when the keyboard shift mode is **abc** or **ABC** (non-numeric), then the following keys are also effective:

- L - turns locking mode on (like the **7** key)
- M - starts a measurement of inharmonicity or over-pull (like the **#** key on a regular Smartphone)
- T - switches to the tuning curve adjuster (like the **0** key)
- O - zooms the spectrum display out (like the **ALT** menu)
- I - zooms the spectrum display in (like the **ALT** menu)
- '(space) - pauses or escapes from various modes (like the ***** key on a regular Smartphone)

Keystrokes for the Tuning Curve Adjuster

No special considerations are needed in the tuning curve adjuster. Regardless of the keyboard shift mode in effect, the keys with numbers on them behave as described in Chapter 1.