Pro 2 OS 1.4 Manual Addendum

Pro 2 OS version 1.4 adds a number of new features not covered in the main Operation Manual. These features are described in the following addendum in the order shown below.

New Features in OS 1.4

- Linear frequency modulation for classic DX-style FM.

- Arpeggiator Beat Sync. This Global parameter quantizes keyboard performance of the arpeggiator so that notes are triggered precisely on the beat.

- Sequencer Direction parameter, which provides new options for sequencer playback direction: forward, reverse, ping-pong, and random.

- Rest/tie note input during step recording on track 1 of the Sequencer.

- Lock sequence, which allows you to continuously run the same sequence while changing presets/programs.

- MIDI CC output from the Pro 2 sequencer.

- Trigger/Gate CV output, which gives you the ability to send a per-step gate signal from the CV output of the Pro 2 Sequencer.

- Alternate Tunings. The Pro 2 now ships with 16 preset alternative tunings ranging from Equal temperament to Indonesian Gamelan tunings. Other tuning sets can be downloaded if desired.

Checking Your Operating System Version

If you've just purchased your Pro 2 new, OS 1.4 may already be installed. If not, and you want to use the new features just described, you'll need to update your OS to version 1.4 or later.

To update your Pro 2 OS, you'll need a computer and a USB cable, or a MIDI cable and MIDI interface. To download the latest version of the Pro 2 OS along with instructions on how to perform a system update, visit the Sequential website at:

https://www.sequential.com/download-latest-pro-2-os/

To check your OS version:

1. Press the GLOBAL button. The screen displays the OS version.

2. If your OS is out of date, download the latest version from the URL above and update your instrument using the instructions included with the download.
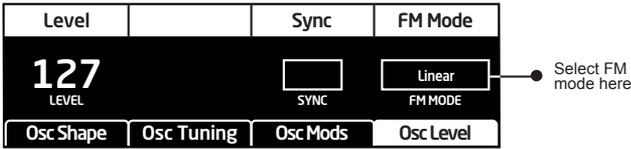
Because OS 1.4 adds new commands to Globals menu, after installing the OS update, you must refresh the Pro 2's Global parameters using the RESET GLOBALS command in the Globals menu.

Linear FM

The Pro 2 now provides a choice between its original *exponential* method of FM (frequency modulation), and *linear* FM, which is the type found on the classic Yamaha DX-series of synthesizers. Exponential FM is selected by default. To choose linear FM, you'll need to use the menus in the Pro 2 display.

To choose linear FM:

1. Press the front panel OSCILLATOR 1 selector to show the oscillator controls in the display.

2. Press soft button 4 (OSC LEVEL).

3. Use soft knob 4 (FM MODE) to set the FM mode to LINEAR. This sets the FM mode to linear for all oscillators.

Level		Sync	FM Mode
127 LEVEL		☐ SYNC	Linear FM MODE
Osc Shape	Osc Tuning	Osc Mods	Osc Level

Select FM mode here

Choosing Linear FM

Creating Sounds with Linear FM

To create sounds with FM you'll use one oscillator (the *modulator*) to modulate the frequency of another oscillator (the *carrier*). This creates a new waveform that has additional harmonics known as *sidebands*. The complexity of the sidebands created depends on the tuning relationship between the modulator and the carrier. If both are tuned to the same note or a multiple of the same note (for example, carrier = C2, modulator = C3) then the harmonics created will be harmonically related and "in tune."

However, if the modulator is tuned to a note that is not the same as the carrier or is not a multiple of it (for example, carrier = C2, modulator = D#2) the sidebands won't be harmonically related and the resulting sound will be clangorous. This is why FM synthesis is often used to create metallic, bell-like timbres.

The amount of sidebands created is directly related to the amount of modulation applied (the FM AMOUNT parameter) and also the waveform of the modulator. The greater the FM AMOUNT setting, the more sidebands produced, and the "brighter" the sound will become.

A modulator with a large number of harmonics, (a sawtooth wave, for example), will create many more sidebands than a modulator with a no harmonics (a sine wave, for example).

The original DX-7 synthesizer provided only sine waves for its oscillators (called *operators* in DX-7 terms). The Prophet 2, however, supplies a much broader range of waveshape choices. Experiment with different waveshapes for both the carrier and modulator to see how this changes the harmonic content of a sound.

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The Default Carrier/Modulator Relationship

The Pro 2 has a default carrier/modulator relationship between its oscillators. The following table shows this.

Carrier	Modulator
Oscillator 1	Oscillator 2
Oscillator 2	Oscillator 3
Oscillator 3	Oscillator 4
Oscillator 4	Oscillator 1

Turning up the FM parameter on oscillator 1 causes it to be modulated by oscillator 2, turning up the FM parameter on oscillator 2 causes it to be modulated by oscillator 3, and so on.

Though the chart above shows the default oscillator relationships for performing FM, you can actually route any oscillator to another oscillator using the modulation matrix. This will also allow you to modulate the same carrier oscillator with more than one modulator oscillator. When doing so, set the WAVE RESET parameter (in the OSC TUNING tab) to ON for the various oscillators to avoid phase cancellation.

When creating a typical linear FM sound, you'll usually want to turn up the output level of the *carrier* oscillator so that you can hear it, but turn down the output level of the *modulator* oscillator so that you don't hear it.

To create a basic linear FM sound:

1. Press the GLOBAL button, then turn soft knob 1 and select BASIC PROGRAM.

2. Press soft button 1 (WRITE NOW). Then press the GLOBAL button again to exit the Global menu.

3. Press the front panel OSCILLATOR 1 selector to show the oscillator controls in the display, then press soft button 4 (OSC LEVEL).

4. Use soft knob 4 (FM MODE) to set the FM mode to LINEAR. (Setting any oscillator to linear FM sets all oscillators to linear FM.)

5. Turn soft knob 1 to set the oscillator 1 LEVEL to 127.

6. Turn the SHAPE/NOISE knob and select SINE as the waveshape.

7. Turn the FM knob to 150.

8. Press the Oscillator 2 selector on the front panel, then turn the SHAPE/NOISE knob and select SINE as the waveshape.

9. Turn the PITCH knob for Oscillator 2 and listen to the effect on the tone of Oscillator 1.

10. Repeat steps 5-7 for Oscillator 3 and Oscillator 4. By default, oscillator 3 is the carrier and Oscillator 4 is the modulator.

11. Remember to leave the output LEVEL at zero for the modulators (oscillators 2 and 4) so that you don't hear them. It's only necessary to hear the carriers (oscillators 1 and 3).

Adjust the Pitch (note) value of Oscillators 2 and 4 (the modulators) to hear how this changes the timbre of your sound. For metallic, bell-like sounds, tune the pitch of Oscillator 2 and 4 to something other than C.

For evolving timbres, try routing Auxiliary Envelope 3 or 4 to the FM Amount parameter of Oscillator 1 and/or 3. The envelope causes the FM amount to change over time, thus changing the resulting waveform either subtly or drastically, depending on the envelope shape.

Arpeggiator Beat Sync

This option, found in the Global menu, quantizes keyboard performance of the arpeggiator so that notes are triggered precisely on the beat. Previously, changing notes or chords on the keyboard during arpeggiator playback would retrigger notes whether or not the note was played precisely on the beat. With this option enabled, arpeggiator note playback occurs only on the beat — regardless of when you press a key on the keyboard.

To enable Arpeggiator Beat Sync:

1. Press the GLOBAL button, then turn soft knob 1 and select ARP BEAT SYNC.

2. Turn soft knob 3 to set ARP BEAT SYNC to ON.

3. Press the GLOBAL button again to exit the Global menu.

Sequencer Playback Direction

The Pro 2 Sequences provides new options for playback direction. These include: forward, reverse, ping-pong, and random.

- Forward: This is the standard, default playback direction. The sequence plays forward in the order that it was recorded.

- Reverse: The sequence plays in reverse, beginning with the final note of the sequence.

- Ping-Pong: The sequence plays forward in its entirety, then backward in its entirety.

- Random: The sequence plays in continuously varying random order.

To set the direction of Sequencer playback:

1. Press the front panel SEQUENCER button to show the sequencer's controls in the display.

2. Press soft button 4 (SEQ MISC).

3. Use soft knob 4 (DIRECTION) to select the playback direction that you want.

Rest/Tie Input During Sequencer Track 1 Step Recording

The Pro 2 Sequencer now gives you the ability to add ties and rests while you are recording notes on Track 1.

To add rests during step recording:

1. Press the SEQUENCER button to activate the Sequencer.

2. Press the RECORD button and play some notes on the keyboard.

3. At the step where you want to add a rest, press the step button (1-16) for that step.

4. To add multiple rests (i.e. a longer rest), press the step button (1-16) that corresponds to the last step of the rest.

5. Continue creating the sequence by playing notes on the keyboard. Add additional rests where desired.

To add ties during step recording:

1. Press the SEQUENCER button to activate the Sequencer.

2. Press the RECORD button and play some notes on the keyboard.

3. At the step where you want to start the tie, play the note to be tied, then press and hold the step button (1-16) for that step. Then press the step button (1-16) that corresponds to the last step in the tie.

4. Continue creating the sequence by playing notes on the keyboard. Add additional ties where desired.

Sequence Lock

The Sequence Lock feature, which appears as an option in the main display, allows you to continuously run the same sequence while changing programs.

To lock a sequence:

1. Use the BANK SELECT and PROGRAM SELECT knobs to choose a program that has a sequence.

2. In the main display, press soft button 4 (SEQ LOCK OFF) to toggle Sequence Lock on.

3. Press the PLAY/STOP button to activate Sequencer playback.

4. Use the BANK SELECT and/or PROGRAM SELECT knobs to switch to a different program. The sequence continues to play.
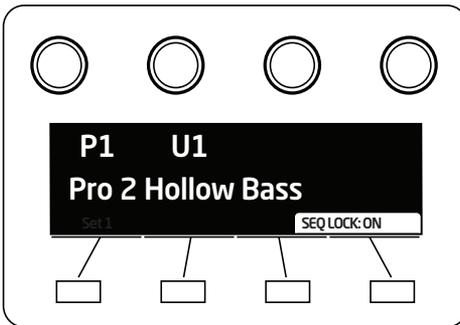
Sequencer Lock

Sequencer Output of MIDI Continuous Controller Data

You can now record a sequencer track and set its Destination to a specific MIDI Continuous Controller. This sequencer data is then output via the USB and/or MIDI Output 1 or MIDI Output 2 connectors on the rear of the Pro 2.

This allows you to use the Pro 2 sequencer to automate corresponding Continuous Controller functions on another synthesizer or DAW.

Available choices are MIDI continuous controllers 02, 04, 11, 14-25, or 74. Continuous Controllers 02, 04, and 74 are usually fixed to Breath, Foot Controller, and Brightness (filter cutoff) respectively on external devices. The other Continuous Controllers are unspecified.

To select a MIDI Continuous Controller as a sequencer track destination:

1. Hold down the SEQUENCER button and turn Soft Knob 1 (SELECT TRACK) to select the sequencer track from which you want to send MIDI Continuous Controller data.

2. Turn soft knob 4 (DEST) and select a destination for the track. Available Continuous Controller destinations are CC 02, 04, 11, 14-25, or 74, on MIDI Output 1 or MIDI Output 2 on the Pro 2.

3. Make the appropriate connections to the external synthesizer or DAW, including selecting the parameter that you want the Pro 2 sequencer's MIDI Continuous Controller track output to affect.

4. To listen to the sequence, make sure the SEQUENCER button is on, then press PLAY/STOP.

Sequencer Output of CV Trigger Data

You can now record a sequencer track and set its Destination to send a control voltage trigger from one of the control voltage outputs on the rear of the Pro 2. This then sends out a short trigger pulse for each step in that track. This is useful for triggering external drum or sample modules, or outputting a sequenced clock signal for other external gear.

To output a sequencer track as a control voltage trigger:

1. Hold down the SEQUENCER button and turn Soft Knob 1 (SELECT TRACK) to select the sequencer track from which you want to send the trigger signal.

2. Turn soft knob 4 (DEST) and select CV1 Trig, CV2 Trig, CV3 Trig, or CV4 Trig, depending on which Pro 2 rear-panel control voltage output you want to send the signal from.

3. Turn soft knob 2 (TRK VAL) to set the output voltage of the trigger pulse.

4. Make the appropriate connections to the drum machine or other external device with control voltage inputs. For example, if the Pro 2 sequencer track is set to CV1 Trig, connect Pro 2 CV Out 1 to whatever input on the external device accepts a trigger.

5. To listen to the trigger sequence, make sure the Pro 2's SEQUENCER button is on, then press PLAY/STOP.

Alternate Tunings

By default, the Pro 2 is set to standard, equal-temperament, chromatic western tuning. Additionally, it now supports up to 16 additional alternate tunings, which you can access using the ALT TUNING SCALE setting in the GLOBAL menu.

Pro 2 OS version 1.4 and later ships with 16 preset, alternate tunings. These range from Equal temperament to Indonesian Gamelan tunings. They are described in detail at the end of this section.

If your Pro 2 has an older version of the operating system and you want to use these tunings, update your OS to version 1.2 or later and download the alternate tunings from the Pro 2 Support section of the Sequential website. Then install the tunings using the instructions included with the download.

To use an alternate tuning:

1. Press the GLOBAL button, then turn soft knob 1 and select SCALE (ALT TUNING).

2. Turn soft knob 3 (SCALE) and select one of the available tunings. The EQUAL TEMPERMENT setting is standard western tuning. For information on the others, see the list that follows.

3. Press the GLOBAL button again to exit the Global menu.

Provided Alternate Tunings

1. 12-Tone Equal Temperament (non-erasable)

The default Western tuning, based on the twelfth root of two.

2. Harmonic Series

MIDI notes 36-95 reflect harmonics 2 through 60 based on the fundamental of A = 27.5 Hz. The low C on a standard 5 octave keyboard acts as the root note (55Hz), and the harmonics play upwards from there. The remaining keys above and below the 5 octave range are filled with the same intervals as Carlos' Harmonic 12 Tone that follows.

3. Carlos Harmonic Twelve Tone

Wendy Carlos' twelve note scale based on octave-repeating harmonics. A = 1/1 (440 Hz). 1/1 17/16 9/8 19/16 5/4 21/16 11/8 3/2 13/8 27/16 7/4 15/8

4. Meantone Temperament

An early tempered tuning, with better thirds than 12ET. Sounds best in the key of C. Use this to add an authentic touch to performances of early Baroque music. C=1/1 (260 Hz)

5. 1/4-Tone Equal Temperament

24 notes per octave, equally spaced 24root2 intervals. Mexican composer Julian Carillo used this for custom-built pianos in the early 20th century.

6. 19-Tone Equal Temperament

19 notes per octave (19root2) offering better thirds than 12 ET, a better overall compromise if you can figure out the keyboard patterns.

7. 31-Tone Equal Temperament

Many people consider 31root2 to offer the best compromise towards just intonation in an equal temperament, but it can get very tricky to keep track of the intervals.

8. Pythagorean C

One of the earliest tuning systems known from history, the Pythagorean scale is constructed from an upward series of pure fifths (3/2) transposed down into a single octave. The tuning works well for monophonic melodies against fifth drones, but has a very narrow palate of good chords to choose from. C=1/1 (261.625 Hz)

1/1 256/243 9/8 32/27 81/64 4/3 729/512 3/2 128/81 27/16 16/9 243/128

9. Just Intonation in A with 7-limit Tritone at D#

A rather vanilla 5-limit small interval just-intonation, except for a single 7/5 tritone at D#, which offers some nice possibilities for rotating around bluesy sevenths. A=1/1 (440 Hz) 1/1 16/15 9/8 6/5 5/4 7/5 3/2 8/5 5/3 9/5 15/8

10. 3-5 Lattice in A

A pure 3 and 5-limit tuning which resolves to very symmetrical derived relationships between notes. A=1/1 (440 Hz)

1/1 16/15 10/9 6/5 5/4 4/3 64/45 3/2 8/5 5/3 16/9 15/8

11. 3-7 Lattice in A

A pure 3 and 7-limit tuning which resolves to very symmetrical derived relationships between notes. Some of the intervals are very close together, offering several choices for the same nominal chords. A=1/1 (440 Hz)

1/1 9/8 8/7 7/6 9/7 21/16 4/3 3/2 32/21 12/7 7/4 63/32

12. Other Music 7-Limit Black Keys in C

Created by the group Other Music for their homemade gamelan, this offers a wide range of interesting chords and modes. C=1/1 (261.625 Hz)

1/1 15/14 9/8 7/6 5/4 4/3 7/5 3/2 14/9 5/3 7/4 15/8

13. Dan Schmidt Pelog/Slendro

Created for the Berkeley Gamelan group, this tuning fits an Indonesian-style hepta-tonic Pelog on the white keys and pentatonic Slendro on the black keys, with B and Bb acting as 1/1 for their respective modes. Note that some of the notes will have the same frequency. By tuning the 1/1 to 60 Hz, Dan found a creative way to incorporate the inevitable line hum into his scale. Bb, B = 1/1 (60 Hz)

1/1 1/1 9/8 7/6 5/4 4/3 11/8 3/2 3/2 7/4 7/4 15/8

14. Yamaha Just Major C

When Yamaha decided to put preset microtunings into their FM synth product line, they selected this and the following tuning as representative just intonations. As such, they became the de-facto introduction to JI for many people. Just Major gives preferential treatment to major thirds on the sharps, and a good fourth relative to the second. C= 1/1 (261.625)

1/1 16/15 9/8 6/5 5/4 4/3 45/32 3/2 8/5 5/3 16/9 15/8

15. Yamaha Just Minor C

Similar to Yamaha's preset Just Major, the Just Minor gives preferential treat-ment to minor thirds on the sharps, and has a good fifth relative to the second. C= 1/1 (261.625) 1/1 25/24 10/9 6/5 5/4 4/3 45/32 3/2 8/5 5/3 16/9 15/8

16. Harry Partch 11-limit 43 Note Just Intonation

One of the pioneers of modern microtonal composition, Partch built a unique orchestra with this tuning during the first half of the 20th century, to perform his own compositions. The large number of intervals in this very dense scale offers a full vocabulary of expressive chords and complex key changes. The narrow spac-ing also allows fixed-pitched instruments like marimbas and organs to perform glissando-like passages. G = 1/1 (392 Hz, MIDI note 67)

1/1 81/80 33/32 21/20 16/15 12/11 11/10 10/9 9/8 8/7 7/6 32/27 6/5 11/9 5/4 14/11 9/7 21/16 4/3 27/20 11/8 7/5 10/7 16/11 40/27 3/2 32/21 14/9 11/7 8/5 18/11 5/3 27/16 12/7 7/4 16/9 9/5 20/11 11/6 15/8 40/21 64/33 160/81

17. Arabic 12-Tone

A 12-tone approximation of an Arabic scale, which appears in some electronic keyboards designed for use with Arabic music. Not a just-intonation scale, nor equal tempered. These are the intervals in Cents relative to C:

60 = Cents 0.

61 = Cents +151.

62 = Cents +204.

63 = Cents +294.

64 = Cents +355.

65 = Cents +498.

66 = Cents +649.

67 = Cents +702.

68 = Cents +853.

69 = Cents +906.

70 = Cents +996.

71 = Cents +1057.

72 = Cents +1200