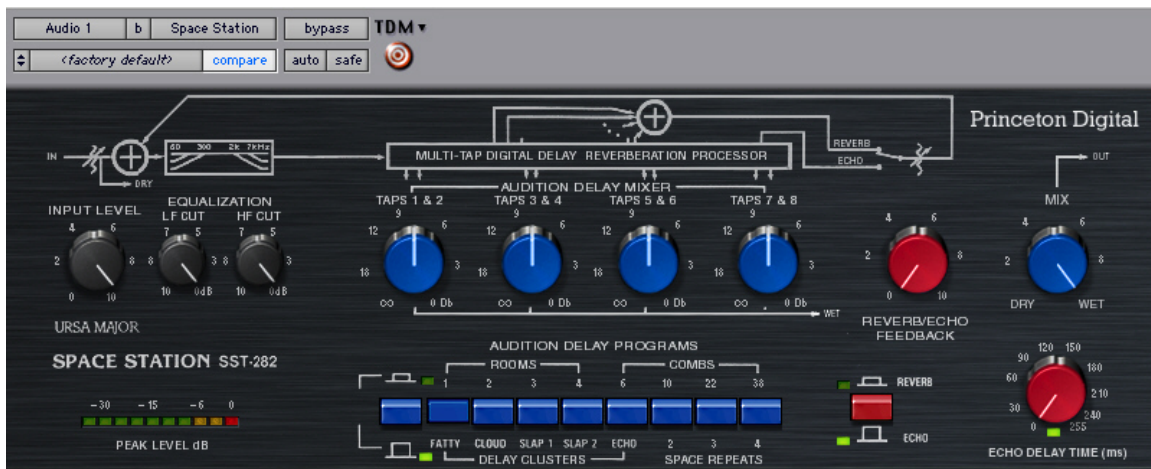# Princeton Digital
Space Station SST-282
User Guide

Preliminary

For DigiDesign ProTools 6.0 or greater
HD or Accel Hardware Required
Mac OS X 10.2 or later

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Introduction

In 1981 a small company called Ursa Major in Belmont, MA (USA) introduced what this writer recalls as a very strange signal processor called the SST-282. It became a much loved effects device, and in 2003 this 5.25" rack-mount unit was recreated in a small, tabletop form factor with digital I/O for studio use. We here at Princeton Digital took some of the software code from the new unit and the retro user interface from the original unit and voila, we present to you the Space Station SST-282 plug-in for Pro Tools. It's a multitap delay whose output delays are modulated (swept) to provide some really unique effects.

The plug-ins require Pro Tools 6.0 (or newer) on a Macintosh OS X 10.2 Operating System (or newer). HD or Accel hardware is also required. Installation is performed by running the installer found on the distribution media or the Internet download.

The plug-ins are protected by the same Ilok hardware dongle that's provided with your Pro Tools TDM system and will not run without it. All installs are initially set up with a 30-day demo evaluation. The demo authorization must be obtained from iLok.com. If you have not actually purchased the plug-ins this gives you a chance to try it out. It's not possible to extend the demo period by reinstalling the plug-ins or obtaining additional demo authorizations.

Regardless of whether you are running a demo version or a fully-authorized version, please go to iLok.com and retrieve your authorization before you run Pro Tools. If you launch Pro Tools without the authorization you will be presented with a series of dialog boxes that may make it appear that you can run the plug-in; but you can't. An artifact of the Pace iLok copy protection may cause a challenge-response dialog to appear: but we here at Princeton Digital don't support that method of authorization. Nevertheless we can't remove that panel.

If you've purchased the software you'll be able to authorize a more permanent installation via ilok.com. Check our website for more information about this feature.

There's more information about the iLok in the documentation that came along with your Pro Tools system or check out www.ilok.com.

We assume that you're familiar with Pro Tools, how to insert a plugin into a track, and how to save plugin setups using the top toolbar of a plugin. If this isn't the case then you can discover how to do this by reading the manuals that came with the system.

The SST-282 will work with both the HD and Accel DSP boards. We provide both mono and stereo I/O formats for use with different types of tracks

What is it?

The Space Station is a signal processor that uses time delay techniques. It's different than just a plain digital delay - those usually have one or perhaps 2 taps. The Space Station has eight taps just for listening: These are called "Audition Delay Taps." There are a number of others used to synthesize reverb and echo.

You can think of the Space Station like a multi-head tape recorder, operating with a loop of tape 255 milliseconds long. The tape is like the Space Station audio memory and the multiple playback heads are akin to the Space Station's multiple taps.

The eight Audition Delay Taps are placed along this imaginary piece of tape with a resolution of 1 millisecond, and can be repositioned at will to any of 16 pre-programmed patterns.

You also have continuous control over another tap, the Echo tap (active in Echo mode), which can be set from 1 to 255 milliseconds and can be fed back to the input to create the traditional effects of tape loops.

A Reverb mode is also available. Proprietary internal programming randomizes these taps so that they can be stably fed back to produce reverberation. The equalized sum of these taps appears at a pot (Reverb/Echo Feedback) where the level of this sum can be adjusted to create any decay time from zero to about 3.5 seconds.

An important part of the Space Station's fundamental concept is contained in two groups of delay taps, one for auditioning (output) and the other for reverberation. They operate independently of each other; that is, the Audition Delay Taps set up a way of hearing the contents of memory, while the Reverberation or Echo taps, when fed back, determine the type of reverberant sound existing in the memory.

Each acts independently so that endless varieties of sound can be created. For example, a sound approximating normal room reverberation may be set up by feedback, and then auditioned with any of the 16 programs to sound like rooms, like a slap, an echo, or even a reverberating comb filter. Or, a comb-like reverberation effect can be set up by feedback and then auditioned in a room, another comb, or as echo, slap, etc.

Even more versatility derives from the built-in mixer, where Audition Taps may be mixed in any desired ratio to emphasize earlier reflections, to delay the onset of reverb, etc. The possibilities are endless yet the front panel is intuitive, due in part to the flow chart displayed on the background graphic of the plug-in.

You'll find that you will be able to create a wide variety of effects on a wide range of input sources with the Space Station.

Inserting Into a Mono track

The plug-in supports insertion into mono or stereo tracks. When you insert into a mono track you have the option of choosing mono/mono or mono/stereo. If you choose the mono/mono insert then the right channel of the Space Station's output is discarded.

Controls
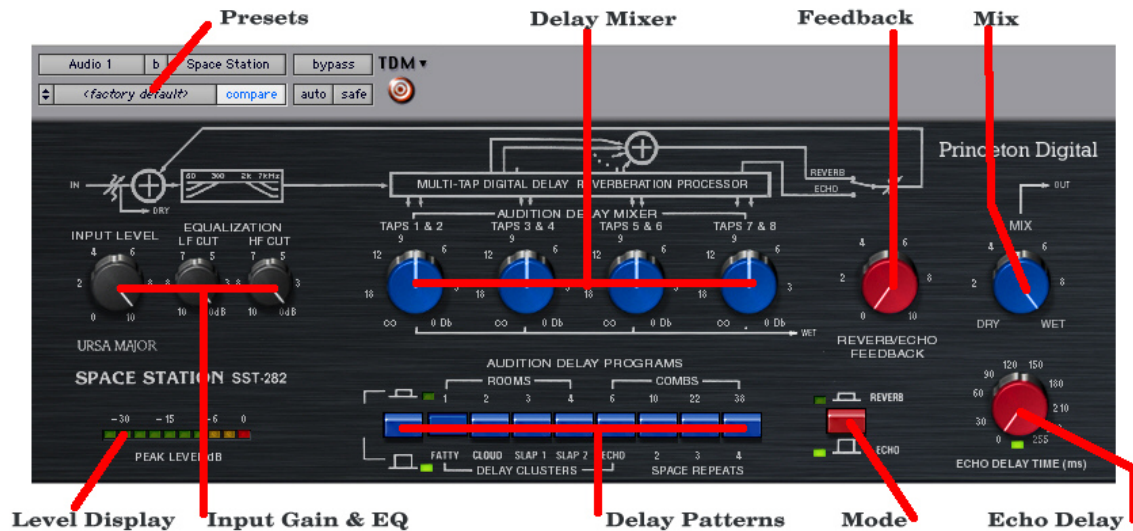
The image above is an annotated version of the Space Station. If you're not familiar with rotary knobs on a plug-in, they're easy to use: You just click a knob and drag up-down to change a knob's setting. You don't need to try to turn them in a circle.

Like all Pro Tools controls, you can hold down the "Apple key" prior to click-dragging the knob to make the knob turn more slowly and have a finer degree of control over the parameter.

You might notice that the block diagram of the unit is shown on the background graphic. There are no lines between the 'Dry' source (near the top left) and the 'Wet' source (under the Delay Mixer pots) to avoid too much clutter. The Dry and Wet merge at the Mix control. The output of the Mix control is the plug-in's output.

The Space Station is capable of a range of effects so broad that the best that can be done in a manual is to indicate the basic types and explain the controls and range of settings pertinent to them. The three basic effects are Pure Delay (no feedback), Reverb, and Echo. Within each of these basic types, the variation in sound modification can be so great as to produce completely different subjective effects, but the operating principles are the same.

First, let's familiarize you with the controls!

Presets and Bypass

The **Preset** list box is a standard Pro Tools function that allows you to save your current control settings to a named file. It's a handy way of saving a particularly nice environment. We provide a number of presets for you to start using the SST-282.

The **Bypass** control completely bypasses the SST-282 as far as Pro Tools is concerned. However, the plug-in's inputs are still driven and all controls are still operational. This is important so that audible artifacts are not created when you remove the bypass.

Level Display

This 10-light display shows a display of the signal levels. If internal clipping occurs then all of the lights will illuminate and hold that state for about ½ second.

Mode

The **Mode** control (near the lower right) selects the major operation mode of the Space Station. When this button is clicked **in**, then the plug-in is in Reverb mode; when clicked **out** the plug-in is in Echo mode. LEDs are provided so that you can easily tell the difference.

If you look at the block diagram that's on the plug-in's background graphic you can easily see the difference. See the switch that's near the Princeton Digital logo? That switch is up in Reverb mode and down in Echo mode.

In Echo mode, the delay line tap is set with the Echo Delay knob (at the lower right) from 0 – 255 milliseconds. The tap's output audio data is recirculated back to the input of the filters with the Reverb/Echo Feedback pot controlling the amount of feedback.

Likewise, in Reverb mode, there are a bunch of randomized delay taps (seen coming out of the top of the delay line in the block diagram). These are summed and sent to the Reverb/Echo feedback pot. More on this later.

It's important to understand that the Audition Delay Programs buttons ***do not*** affect the reverb or echo outputs of the delay line; i.e., the input to the Reverb/Echo Feedback pot. They ***only*** affect the signals going to the Audition Delay Mixer pots. This is also discussed more fully later in this document.

Echo Delay

When using Echo mode, the Echo Delay control can be used to set the single output tap of the delay line. Note that this control is inactive in Reverb mode. For your convenience, a LED is set underneath this control so that you can tell when it's active.

Input Gain and EQ, Feedback

The **Input Level** control adjusts the gain from the digital source to the algorithm inputs so that the source level can be reduced for those cases where the decay time is high and signal builds up within the delay line. Changes to this control don't upset the mixing ratios. The output of the input level control is the 'dry' input to the **Mix** control. Note that if two channels are input to the Space Station then they are mixed into one channel before being input to the EQ (i.e., after the big '+' sign in the diagram). However, the two channels are separate when they are sent as the 'dry' input to the **Mix** control.

Whether you select Reverb or Echo mode (as discussed above), you will often choose to feedback or recirculate the delay-line output(s) to extend the time span of the effect. Turning

the **Feedback** control varies the decay time from a minimum value related to basic delay paths from input to output, to a maximum of several minutes.

A Bit O' Theory

The Space Station uses special dedicated taps just for fed-back effects such as reverb, echo, or resonance. These signals are not accessible for auditioning directly, but their effect is heard when they are fed back to the input mixer and revealed by the Audition Taps. Recirculating these taps creates effects from smooth reverberation with decay times from 0 to 3.5 seconds, to long, repeating echoes lasting over eight seconds, to resonance effects of very short duration but high-Q filter spectral characteristics.

In Reverb mode, a large number of specially randomized taps are summed and equalized before being fed back via the **Feedback** control. Echo requires only a single tap for feedback, and this tap is selected for feedback when the Echo mode has been selected. Use the **Echo Delay Time** control to set the time delay of the echo tap.

Regardless of the mode chosen (Echo or Reverb), the **Feedback** control determines the decay time continuously from zero to a maximum.

Equalizers are placed in the algorithms so that high and/or low frequencies applied to the processor from the source, or from feedback, can be attenuated to modify the decay time at low and high frequencies.

This helps you achieve the optimum decay time for different kinds of spaces, such as rooms with more absorbent walls or rooms with higher bass absorption. The two equalizer controls, **HF Cut** and **LF Cut**, act on any signal going into the reverberator (but not on the source signal mixed to the output by the **Mix** control). With the Feedback control set to 0, no signals are fed-back and any sound going into and through the Digital Processor is simply equalized once, but with feedback each successive pass through the unit is re-equalized.

Delay Mixer, Mix

The Delay Processor has one input, fed from a mixer where direct and fed-back signals are combined, but it has many outputs, or taps. Eight of these taps are called ***Audition Delay Taps*** because their sole function is for mixing audio to create the final signal that is the plug-in's output. These eight taps are never recirculated (as you can see from the block diagram) and have no role in reverberation or echo feedback effects: thus they can be adjusted independently from any feedback adjustments. The taps are set to various time delays by the Audition Delay Programs, discussed below.

The eight taps are paired, and each pair (1 & 2, 3 & 4, etc.) has a level control. The output of the odd number taps' level controls are mixed together and sent to the left input of the **Mix** control, while the output of the even number taps' level controls go to the right input of the **Mix** control.

In addition, the dry signal is fed to the **Mix** control, which adjusts the level of the signal appearing in the L and R mixes. By balancing the relative setting of the **Mix** control and the four Audition delay mixer controls (*1 & 2*, *3 & 4*, *5 & 6*, *7 & 8*), you can obtain any ratio from completely dry to completely "wet". Note that if you have **Mix** set fully clockwise (100% wet)

and the Delay Mixer controls are all set fully counterclockwise (Off) then there will be no output from the plug-in.

Audition Delay Programs

The Audition Delay Taps are set to various time delays by the nine buttons of the **Audition Delay Programs** block. The leftmost button is a 'bank switch' button that selects the setting on top of (button in) or below (button out) the remaining eight buttons. There are 'LEDs' that illuminate to show which bank is active. Only one of the eight 'Programs' buttons may be clicked in at a time.

The patterns are arranged into families, including rooms, combs, delay clusters, and space repeats. Within each family, there are three to five patterns similar in effect and application. In virtually all patterns, the lower number taps have the shorter delay times, and the times increase progressively from Taps 1 to 8.

There is always a delay differential between odd and even taps of a given pair, sometimes left shorter, sometimes right shorter. These differentials and the exact times have been carefully chosen to yield the best sounds and most powerful effects. Altogether, this control gives instant access to 16 patterns.

It's important to understand that these settings *do not* affect the reverb or echo outputs of the delay line; i.e., the input to the Reverb/Echo Feedback pot. They *only* affect the signals going to the Audition Delay Mixer pots.

Rooms 1, 2, 3, & 4
These four patterns use semi-randomly chosen delays spaced to sound like the early reflections of rooms. The maximum delay time in each pattern appears at the last taps, 7 and 8, and ranges from about 70ms in room 1 to 255ms in room 4. In the smaller rooms, the taps are closely spaced so that when all are auditioned equally, the gaps are filled in well and no disturbing echo is heard, as would occur with a single tap at the longest delay time. Like all the Audition Delay Patterns, rooms can also be used without feedback to modify sounds by simply adding pure delay, or multiple delays. This is a good set of patterns for general enhancement, or for creating multiple, abrupt-ending echoes. Mix all four tap pairs at the same level in rooms 1 and 2, but feel free to taper the longer delays down in level when in Rooms 3 and 4 to reduce discrete echoes.

Combs 6, 10, 22, and 38
The four Comb patterns are for special effect signal modification by non-recursive (no feedback) comb filtering. Comb filters are created when a signal and one or more delayed versions of itself are combined. The result is called a comb because there are periodic nulls and peaks spread across the spectrum, placed at frequencies related to the reciprocal of the delay time.

Because the delay times and tap gains are precise in the Space Station, the nulls produced are very deep; and, because there are four taps plus the dry signal to combine for each output channel, the complexity of the resultant sound is much greater than with traditional delay lines. Furthermore, the left and right delays are interlaced so that they may be externally summed to yield combs of closer spacing and still more complex and varied sound. When the Echo mode is used to create fed-back comb effects, they can be auditioned through one of the Comb patterns to make things even more interesting.

Comb filters make good sci -fi machine-like voices, or tune percussive sounds, or place a sharp bite and edge on instruments such as guitars and harps. Mix all four tap pairs at the same level to optimize the effect.

Delay clusters fatty, cloud, slap 1, slap 2, and echo
As with other aspects of the Space Station, these effects are so new, we had to invent names for them. This family of patterns uses delay taps spaced closely together, in clusters on the time axis. The clusters occur at progressively later times as you move from fatty to echo. Fatty, with all its taps placed under about 40ms, has no audible separation from the source, but is an excellent loudness enhancing effect that's great with almost any source. Comb filtering isn't a problem with these patterns due to the choice of random times; moreover, the 7kHz frequency response reduces any tendency to comb at higher frequencies. In cloud, the cluster is later, almost with a gap, while slap 1 and slap 2 are delayed enough to be heard as real slap echo–except, of course, with eight delay taps for greater fatness and loudness intensification. Echo produces a single repeat of the source at about 250ms, again with eight delays for more punch. Mix all four tap pairs at the same level to optimize the effect.

Space repeats 2, 3, and 4
These three patterns provide for 2, 3, or 4 repetitions of a sound, with even spacing in time from 0 to 255ms, and with L-R, L-center-R, or L-R-L-R motion, respectively. All eight taps are used, even with the two-repeat pattern to provide extra punch at each hit. Space Repeats are excellent with percussive sound or sharp transients, since these tend to reveal the spatial movement of time and syncopation best. Of course, Space Repeats may be used with any echo or reverberant effect to cause the decaying signal to ricochet in stereo space as it dies out. Mix all four tap pairs at the same level to optimize the effect.

Using the Space Station

As said earlier, the Space Station is capable of a really broad range of effects. In this section we discuss the various types of things that you can do - but this is only a starting point.

Pure delay effects

In this family of effects, we are simply adding delayed versions of the input signal to itself. We have choice over the time delay settings, the number of discrete delayed versions added, and the relative amplitude of the delay signals and the source. We can also equalize the delayed signals (as a group, not individually) using **LF Cut** and **HF Cut**. Much of what is said here about mixing the Audition Taps, and the characteristics of the various Audition Delay Patterns, is common to all effects, and can be referred to later. Just remember that the Audition settings determine the way we hear the contents of the memory, while the *decay time* control determines the decay of the signal in memory with time.

The Audition Delay Taps are set to times from as short as 6ms to as long as 255 ms. The delay times used in each pattern of a particular family increase, in general, from left to right. Thus in room 1, Taps I&2 have the shortest delay times and 7 & 8 the longest; and in room 4 the delay times are still the shortest at Taps 1 & 2, but all eight time delays are longer than the corresponding times of room 1, 2, or 3. This distribution of delay times within the taps and families is also true in Combs and Delay Clusters.

In the Space Repeat family, the delay times range from about 64 ms to 256 ms in each pattern, but are chosen to repeat the source evenly in time and space and do not increase from Tap 1 through Tap 8 in a simple manner.

Rooms can be used as pure delay patterns for doubling when a semi random spread of delay times is desired. The larger Rooms, 3 and 4, have long enough time delays to disturb intelligibility when used with vocals, but will be fine with other sources such as harp, piano, guitar, synthesizer, etc., where the later discrete delays can provide an interesting syncopation, beat fill-in, or spatial shift. Attenuate the longer taps more than the early ones for a more natural sound with the reverb patterns, and for greater intelligibility with vocals. Try using greatest gain with the longest Taps in Room 4, and progressively less gain down to Taps 1 & 2, to get an effect like backwards tape–pseudo time-reversal.

Combs are special effect delay patterns that evenly space the four delay times in each channel at a constant time delay (6, 10, 22, and 38mS apart). Mix all taps together at equal level to get the deepest nulls and sharpest peaks in these Comb filter patterns. The effect of the Comb filters is most audible on sources with a broad spectral content, such as percussion instruments, transients, noise, spoken voice, etc. Like flanging, Comb filtering tends to get lost on pure, single-line voices or instruments.

Delay Clusters are primarily for doubling, slap, and echo effects. All these effects can be done with one or two taps chosen from the Room patterns, but with the Delay Cluster patterns, all eight taps are bunched so close together that the sound is perceived as a new, fatter, louder event, stretched out and with added body.

Fatty places all the delays below the Haas fusion limit so that no separation is heard from the original source, but the sound is perceived as louder and richer. Careful selection of delay

times minimizes comb filter effects in these closely spaced clusters, so that they may even be used with vocals.

In Cloud, the cluster is a little more delayed, so that the time delay is just audible with transients, but not with more fluid sources.

Space Repeats are a special family of three patterns which give even repetitions of the source 2, 3, or 4 times, all between zero and 255 ms time delay. If all eight taps are mixed together at equal level, a spatial bouncing occurs due to time delay (not amplitude) difference using the Haas effect. In Space Repeat 2, the dry signal will appear panned center, the first repeat left, and the second repeat right. In Space Repeat 3, the movement would be center, left, right, left; while in Space Repeat 4 the movement is center, left, right, left, and right. Use Space Repeats with percussive sounds, plucked instruments, and transients.

Reverberation Effects

Select the Reverb mode. Natural room-like reverberation calls for auditioning via one of the room patterns to achieve a smooth, random pattern of early arrivals and reverberant decay. For Rooms 3 and 4, be sure to use progressively less gain at the later taps. This reduces the confusion that would result from long, late-arriving reflections. For the largest room, set the **Feedback** control fully clockwise. The **LF/HF Cut** controls may be used to shorten the high frequency decay time, as in cathedrals or rooms with absorbent walls, while the low frequency decay time can be shortened to simulate hard-walled rooms, plate reverberators, etc.

Small rooms call for a choice of Room l or 2 and a lower setting of the *decay time* control. Tiny rooms can be created with Cloud or Fatty and low settings of the *decay time* control.

For special effect reverberation, try the Comb Audition Delay Patterns: although the same reverberant process is going on in the Digital Processor, listening to it with comb filter ears results in a completely new and different form of reverberation. Other unique forms of reverb result from auditioning with a Delay Cluster pattern, such as Slap 2 or Echo.

While not strictly reverberation (so called "hard-reverb", as created with few taps), an interesting reverberant effect can be attained using the Echo mode and a 255ms *echo delay* setting. With the *decay time* control at full clockwise, this will yield a very long decay time, and will sound surprisingly smooth if auditioned through Room 4 or Space Repeat 4. Use it for special cases where the longest decay time is needed. Rolling off both *lf decay* and *hf decay* results in a progressively telephone-like quality as the sound decays.

Special Effects

Select the Echo mode. Here the term "echo" really describes a mode of operation that results from feeding back only one tap, not from the perception of a decaying "hello, hello, hello...." kind of echo (although that can be created, too). This family of effects includes feedback of short time delays that give resonant filter frequency responses with high Q factors.

Delay times less than about 30 ms result in filters as opposed to echo effects, and a smooth transition occurs from one to the other as the **Echo Delay Time** control is advanced from about 20 ms to 255 ms. The Echo mode provides an interesting example of the interplay of feedback and audition parameters.

Consider feedback of the single Echo tap set to less than 30 mS delay time. This results in a cardboard tube filter effect beginning almost immediately after the dry signal enters memory. If this is auditioned with the later Delay Cluster or with the Space Repeats patterns, there will be a delay long enough to produce an echo: there's a delay and then the cardboard tube effect is heard (once, fattened in echo; 2, 3, or 4 times in Space Repeats).

The inverse occurs if a long delay time is set on the Echo tap and fed back, and then auditioned by a Comb pattern. The Comb pattern produces a comb filter using very short Audition Delay Taps, whereas the single, long, fed-back delay produces the discrete decaying echoes, each of which is heard through the comb filter.