

25-Seven Systems

# PRECISION DELAY



## Operator's Manual

Version 1.2



THE TELOS ALLIANCE

**It's About Time™**

[www.25-seven.com](http://www.25-seven.com)    888.257.2578    24-hour tech support 216.622.0247

## Warnings and Service Information



### CAUTION

TO PREVENT RISKS OF ELECTRIC SHOCK,  
DO NOT ATTEMPT TO SERVICE THIS UNIT.



**DANGER:** There are hazardous voltages in this unit. Do not attempt to repair it.

**WARNING:** To reduce the risk of electrical shock, do not expose the chassis to rain or moisture.



There are no user-serviceable parts in the Precision Delay. If repairs are necessary, contact Customer Service at 888-257-2578 (toll-free), or write to [info@25-seven.com](mailto:info@25-seven.com).

**USA CLASS A COMPUTING DEVICE INFORMATION TO USER. WARNING:** This equipment generates, uses, and can radiate radio-frequency energy. If it is not installed and used as directed by this manual, it may cause interference to radio communication. This equipment complies with the limits for a Class A computing device, as specified by FCC Rules, Part 15, Subpart J, which are designed to provide reasonable protection against such interference when this type of equipment is operated in a commercial environment. Operation of this equipment in a residential area may cause interference. If it does, the user will be required to eliminate the interference at the user's expense. **NOTE:** Objectionable interference to TV or radio reception can occur if other devices are connected to this device without the use of shielded interconnect cables. FCC rules require the use of only shielded cables.

© 2013, 25-Seven Systems, A Telos Alliance Company. All rights reserved.

We are constantly working to improve our products. Specifications and features are subject to change without notice.

THE TELOS ALLIANCE™



1241 Superior Avenue Cleveland, OH 44114 USA | +1.216.241.7225 | [TelosAlliance.com](http://TelosAlliance.com)

## Table of Contents

About this Manual	4
Precision Delay at a Glance	4
Basic Operation	5
Building and Build Speed	7
PD and PPM	7
About the Display	9
How PD Processes Delays	14
Front Panel	16
Detailed Operating Instructions	17
Start-up Behavior	17
Front Panel Menus	19
Web Remote Control and Log-in	30
Serial / Parallel Remote control	35
Installation	40
Rear Panel	41
Software Updates and Service	45
Specifications	46
For More Information	46
Warranty	46



### *Close-ups*

Some parts of this manual explain how Precision Delay works “under the hood”. We’ve set these in a san-serif face.

You don’t need to read these sections to operate or install the unit... but they *will* help you use the system better.

---

## About this Manual

This document helps you get the most out of 25-Seven's Precision Delay for radio broadcasting (PD).

- The first few pages describe PD's basic operation. PD can do a lot more for your station's sound and operation than traditional delay units. This section will guide you through its functions.
- The next pages detail PD's menus and controls
- The rest of the booklet is full instructions for setup and installation.

---

## Precision Delay at a Glance

25-Seven's Precision Delay unit is designed to be a permanent part of your air chain.

- It can align analog and digital signals for HD broadcast with extremely high precision.
- It can be easily connected and calibrated to popular modulation monitors, for trouble-free synchronization.
- It can change its delay *while on the air*, without annoying jumps, glitches, or pitch shifting. Programming still sounds perfectly normal, even while you're increasing or reducing the delay.
- It lets you turn off your HD compensating delay for real-time events like ball games, and restore the delay after the event ends, without disrupting programming or needing filler material. Most listeners never even know it's been activated!
- It's friendly to your embedded data:
  - Program-related text and serial data stay synchronized with content.
  - PPM identification codes are preserved, even while delay time is changing. Ratings points don't get lost because of PD's processing.
  - Network cues and contact closures can be automatically delayed to match program audio.
- It can be used for delays as short as 10 milliseconds, or as long as 4 hours, with very high precision.
- It's designed to be installed and forgotten about. There's no hard drive to wear out. The only moving part is a small vent fan.

*And of course, the flexibility and smart design you expect from 25-Seven:*

- Glitch-free time manipulation using technologies developed for 25-Seven's ground-breaking Audio Time Manager®.
- Stereo processing with CD quality, even during time manipulation. It's clean enough that you can change the delay during live music programs and other events.
- Internal audio is kept as linear PCM: there's no audio data compression, anywhere; no compromising of your signal; no conflicts with compressed transmission standards.
- You can change setup and parameters any time, even while on the air, as your needs change.
- Flexible front-panel LCD dashboard with controls for time readout, audio level display, and quick parameter changes without a computer.
- Built-in graphic user interface and Web server. Complete, easy to use, password-protected configuration and control from any computer on your local or wide area data network.
- Easy command and control via RS-232 or IP.
- Automatic delay of program data, via RS-232 or IP, to stay in sync with audio.
- Full user-assignable GPIO: activate functions using buttons, relays, or logic levels; send cues and status to automation systems or remote indicators.
- Future-proof audio capability: connect using balanced analog, AES/EBU digital, or Livewire IP Audio<sup>1</sup>. Change configuration without having to buy new hardware.
- Automatic clock synchronization using Network Time Protocol (NTP).

For more details on what PD does and its special features, read the rest of this manual.

---

## Basic Operation

PD's flexibility doesn't get in the way of easy operation.



### *To Delay Programming...*

...press the green BUILD button.

The button will flash, and the delay will start slowly building to a Target length that you've specified.

---

<sup>1</sup> IP Audio capability is currently undergoing testing; consult factory for status.

PD approaches the Target delay length subtly. It won't disrupt your programming. It does this by speeding up or slowing down your audio, with no pitch change or unusual pauses: most listeners won't even notice it's being used.

- Building can take a few moments; see discussion on page 7.
- If you want to jump to the Target delay length immediately, press the BUILD button twice. See page 9 of this manual for details.

During normal Build, the LCD will look like this:

```
Delay:      0:00.21310
Target:     0:10.00000
Done in:    0:02:30<
Building   7%↑↓ MENU√
```

*This is the current delay, in minutes:seconds.decimal seconds.*  
*This is the Target delay length. PD subtly varies audio pacing to reach this value.*  
*This is how long PD will take to reach the Target at the current Build speed.*  
*This indicates the Build speed. You can change it by using the arrow buttons..*

The ↑, ↓, √ or × icons on PD's LCD display show how its front-panel buttons (▲, ▼, ◆ or ⊗) will control the system.

In the above screen:

- The < means "press ◀ on the front panel to toggle this line of the display." This toggles the display between:

**Done in:** (how many minutes:seconds PD needs to reach the Target),  
and

**Done at:** (what time the Target will be reached).

These times change, depending on the current Build speed (shown as a percentage on the bottom line). Build speeds are discussed on the next page.

- The ↑ and ↓ mean press ▲ or ▼ to raise or lower the Build speed.

**MENU√** appears on many screens. It means press ◆ to reach PD's menu system, where you can make other changes. The menu structure is described starting on page 19.

The Target is the desired ultimate delay length. When it's reached, PD reverts to its main screen:

```
Delay:      0:10.00000
           AirChain1
           1:05:32p
Delay Full  MENU√
```

*This is the current delay.*  
*This is the name you've set for this particular PD system<sup>1</sup>.*  
*This is the present time of day.*



<sup>1</sup> Setting names is optional (see page 33), but can be handy if you're controlling more than one unit over a network.

The message **Delay Full** means a PD is now delaying audio by the *target amount* you specified, unless the system is in BYPASS mode. It doesn't mean all of PD's delay capacity is being used; there might be plenty left for longer delays.



## ***Building and Build Speed***

How long PD takes to reach a target depends both on the length of the target delay, and what you've selected as *build speed*: that is, how quickly you want PD to speed up or slow down your audio.

You can adjust the build speed any time the Build or Exit screen is showing, by using the  or  buttons.

PD builds and exits its delay by subtly slowing down or speeding up the incoming program material. There's no need for filler material or pre-roll, and no long silence. Listeners usually aren't aware of the change at all. We use proprietary algorithms we developed specifically for radio:

- There's no distortion or repeating of content.
- There's no pitch shift.
- Pauses continue to sound natural.

When you want to remove a delay, PD catches up with real-time the same way. Again: sound remains natural, nothing is lost or skipped, musical keys aren't changed, and watermarking frequencies aren't pitch shifted.

The build speed is adjustable. Higher speed settings can reach the target delay length more quickly; lower settings are less likely to be noticed. *For best results in preserving PPM encoding, use speeds of 4% or less and enable Watermark Safe Mode.* Watermark Safe is discussed on page 8, and can be enabled on the Web configuration screen (page 33).



## ***Using PD with PPM***

Building in and out of delays while broadcasting the codes for *Arbitron's PPM*<sup>1</sup> [also known as "Portable People Meter"] can be challenging. Pitch shifting an encoded signal—something we don't do at all—makes PPM decoding fail, while prolonged continuous time manipulation can interrupt some of the redundancy PPM includes in its system.

---

<sup>1</sup> Arbitron® and PPM® are registered trademarks of Arbitron Inc.

Precision Delay addresses these technical challenges with a superior processing algorithm, and includes user features designed specifically to accommodate the PPM system.

Our algorithms retain all original frequencies. They add or subtract individual waves as needed, but never change the pitch. So even though PPM depends on exact frequencies, our processing never gets in its way. PPM signals are also highly redundant. This protects against individual datums being lost to environmental noise, dropouts, or other interruptions; under some circumstances, they can be disturbed by the wave manipulations in our algorithms. If your station relies on PPM, we recommend a conservative setting for PD's Build Speed, to preserve as much of this redundancy as possible. We also recommend enabling Watermark Safe Mode (see below). These two features help protect your station's ratings.

Unlike standard profanity delays, where you want to get back to a full delay as quickly as possible, *subtle* is the best guideline when using Precision Delay on PPM signals. Waiting a few extra moments to reach your target delay may pay off in more accurate audience measurement.

We suggest you start with a speed setting of 4% or less for functions like synchronizing analog and HD radio signals. This will provide good protection for PPM's redundancy, even when PD's time expansion or compression is changing the amount of delay.

PD's Build speed can be set much higher when PPM codes aren't being passed through our processor.

Additionally, our Watermark Safe Mode helps accommodate the time-based structure inherent in PPM encoding. This mode cyclically modifies PD's time manipulations during delay build or exit, making sure there are times when complete PPM message sets can be transmitted. Watermark Safe Mode lengthens to the build and exit process for a given speed. It can be particularly helpful if you're using PD to synchronize analog and HD audio for live events (often called "ballgame mode").

We recommend using Watermark Safe Mode in conjunction with a conservative build speed setting. Both can be controlled from the Configuration Page of our Web interface (page 33).

Ultimately, the best approach is to consider the desired result, then audition various Build speeds with your own programming.

When you've found a speed you like, you can make it the default (see page 19). You'll still be able to change it from the Build or Exit screen when needed.



As a general guide:

Speed setting	Approximate minutes:seconds to build or collapse 8-second delay	
	Watermark Safe OFF	Watermark Safe ON
1%	13:20	23:00
2%	6:35	11:40
4%	3:30	5:55
5%	2:45	4:45
10%	1:30	2:30
15%	1:00	1:45

↑  
Better protection

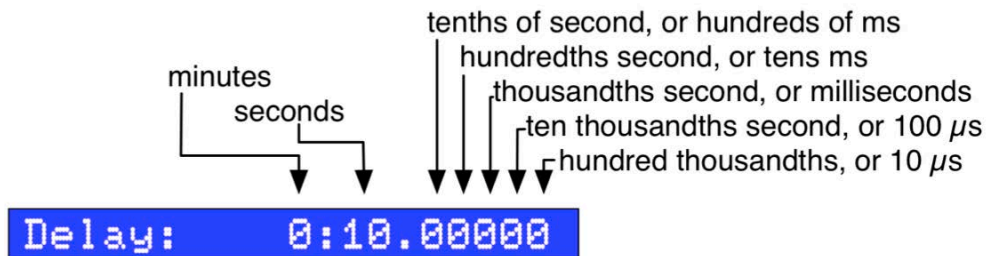
↓  
Faster transitions



### About the Decimal Display

We're not kidding when we say PD is "precision". It can set and display delay times to 2/100,000 second... that is, to twenty *microseconds*. This is less than a *single sample* at 44.1 kHz<sup>1</sup>.

You can think of the display like this:



Of course you can set whole seconds, tenths, or any other convenient decimal fraction... simply by leaving the lesser digits as zero. See item 3 on page 12 for how to set specific digits.

There's more about delay precision and clock accuracy, and how to translate microseconds to digital samples, on page 22.

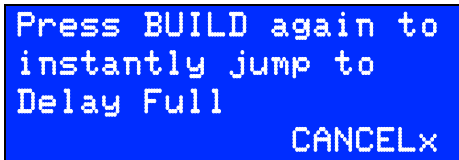


### To Delay Instantly, Without Changing Speed...


...tap the green BUILD button a second time. The button will start flashing, and the LCD will show a confirmation screen.

<sup>1</sup> That's because we round off to the nearest 10 μs to make the display readable. It doesn't affect accuracy, just what's showing on the LCD.

For what it's worth, a single sample at 44.1 kHz equals 22.676 μs.



```
Press BUILD again to
instantly jump to
Delay Full
CANCELx
```

Press the  button to return to normal building.

Building continues while this screen is showing. But if you tap the BUILD button *again*, PD instantly applies the full delay you've set. The main screen returns, with the message **Delay Full**.

Instant Build is handy when you don't need to build delays on the air, or need a very long delay and normal Build mode takes too long.

But be aware: if you just turned PD on, there may not be a full Target's worth of signal in memory. It will output silence at first, to make up the difference. This can happen even while PD's input meter indicates incoming audio.

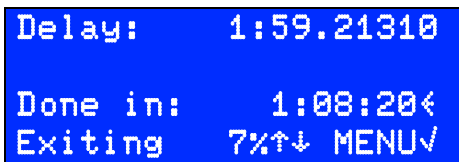
**If you don't press BUILD again within six seconds, the screen is cancelled.** This is a safety feature. Building continues as normal and the previous screen returns.



### To Exit a Delay...

...press the yellow EXIT button.





The button will flash and the LCD will look like this:



```
Delay:      1:59.21310
Done in:    1:08:20<
Exiting     7%↑↓ MENU√
```

It works just like *building a delay* above, except the target is assumed to be zero (that is, real-time). The EXIT button flashes, while processing smoothly speeds up the program to reduce the delay.

When building is finished, PD passes the audio unchanged.

As with Build mode,  or  let you change the Build speed,  toggles the **Done in:** display, and  enters the menus.



### To return to Real-Time Instantly ...

...tap the yellow EXIT button a second time. The button will start flashing, and the LCD will show you a confirmation screen similar to the one for instant Build.

```
Press EXIT again to
instantly jump to
Delay Empty
CANCELx
```

Press the ⊗ button to return to normal building.

Building to zero continues while this screen is showing. But if you tap the EXIT button a third time, PD instantly empties the buffer and passes real-time audio. The main screen returns, with the message **Delay Empty**.

Instant Exit can disrupt program audio. Audio that's working through the delay line and hasn't yet been played will be skipped.

**If you don't press EXIT again within six seconds, the screen is cancelled.** This is a safety feature. Building continues as normal and the previous screen returns.

Once the Delay is empty, you'll see this screen:

```
Delay:      0:00.00500
Target:     0:08.00000
           1:05:32p
Delay Empty  MENU√
```

When empty, PD has a fixed latency of 5 ms.

This is the target delay that will be used when you press BUILD.

Time of day.

After PD exits its delay, it leaves an inherent 5 ms processing latency inside the system. This keeps the hardware buffers filled, and should be undetectable to the ear.

Pressing BYPASS removes the delay from the signal chain completely. The resulting 5 ms jump is so small that you can safely switch between Delay Empty and Bypass, assuming PD's audio level controls have been properly set.

## **MENU** To Set or Change Delay Time...

You can adjust the target delay time whenever you want, even while PD is building or delaying audio.

- 1) Verify that the lower right corner of the LCD says **MENU√**. This is PD's usual mode. If the lower right corner says something else, press the ⊗ button until **MENU√** appears.
- 2) Press the ⬠ button *twice* to get the Delay Menu. The LCD will now look like this:

```
Target:     0:10.00000
Change:     0:09.00000
Delay:      0:01.00000
↑↓↔ Change  DONE√
```

This is where you set the desired delay, in minutes and seconds.



This is how much time PD needs to add or subtract to reach target.




This is the current delay.


Use the cursor keys to change the delay (see below). Press ⬠ when done.

This screen is active: if you make a change in the Target and the BUILD button is lit, PD will start building to the new Target, and the new Target gets saved for the next use.

The **Delay** and **Change** numbers constantly update during building, to reflect how much closer PD is getting to the Target value.

- 3) When you first see the display, seconds and fractional seconds on the top line will be flashing. You can press  or  to raise or lower the target delay in whole seconds.



If you want to make more precise adjustments, press  until just the digits to the right of the decimal flash.  or  now adjust the most significant flashing digit.

You can press  multiple times for finer settings. For example<sup>1</sup>:

**Target: 0:10.00000** means  or  change the target in seconds.

**Target: 0:10.00000** means they change it in 1/100 second.



**Target: 0:10.00000** means they change it in tens of seconds.

You can use  or  to select any digit, making it easy to enter the desired Target length quickly.

**4a)** If you're in Delay mode (the green BUILD button is flashing or lit), PD will start building to the new value as it's being entered.

**4b)** If you're in Delay mode and want to jump to the new value instantly, press the green BUILD button *two more times*.

**4c)** If you're in Standby mode (no large buttons are lit), the new value is stored for use as soon as you press the BUILD button.

- 5) Press  to confirm your change, and then  to return to the main screen.

You can also set a target delay from our Graphical User Interface on any networked computer, or tell PD to retrieve a delay value from your modulation monitor. Instructions start on page 30 .

The minimum target is .01000 second (10 ms). The maximum target delay is just over 4 hours<sup>2</sup>. Long delays may be used for rollovers and extended program delays (including program associated (PAD) data across time zones, without the need for spinning hard drives or additional equipment. Your preferred target setting can be saved as a default.

If you have a long delay target already stored in PD and enter a shorter one, Building smoothly reverses direction. Then it starts heading for the shorter length.

---

<sup>1</sup> Assume the bright digits in the following sample lines are flashing. We couldn't make them actually flash in this manual.

<sup>2</sup> It's 241 minutes, to be precise. Note that delays are always displayed as minutes:seconds on the LCD. For example, if you want a 3 hour delay, set a target of 180:00.00000.



## To Bypass PD Entirely...

...press the gray BYPASS button.

The rear-panel output jacks get fed directly by their matching inputs, and signal is passed unchanged. (Signal still gets stored internally; see next section.)

Normally, all outputs get the same processed signal: for example, if you've set PD's input to analog, the delayed analog signal appears at analog *and digital* outputs. Similarly, if a digital input is selected, the processed digital signal also appears at the analog outputs. You can use this feature for monitoring or to feed multiple destinations.

But turning on Bypass temporarily disables this feature. It uses relay contacts to connect the outputs directly to their matching inputs: AES/EBU digital input goes to the AES/EBU output jack. Analog left and right signals go to their respective output jacks.

PD automatically goes into Bypass mode when power is removed, for safety. It also stays in Bypass when first powered up, during the automatic self-test and initialization.

You can select how PD's Bypass behaves immediately after startup:

- It can stay in Bypass mode after power-up, and wait for user (or automation system) instructions.
- It can leave Bypass mode and start processing audio.

You can also preset *how* it will process audio immediately after power-up. These choices are found under Startup Behavior, page 17.



## Instant Exit or Bypass?

Both modes pass audio transparently, without any delay. For many purposes they're equivalent. But there are a few differences:

- When PD displays **Delay Empty** and Bypass is turned off (i.e., the BYPASS button is not lit), audio passes through our processor and is sent to the outputs<sup>1</sup>. At the same time, it's recorded into delay memory... just in case you want to use the delay function later.
- When Bypass is On (BYPASS button is lit), the outputs are internally connected directly to the inputs. There's no processing at all. But incoming audio is still being recorded into delay memory.

In other words, PD is *always* recording audio... even if you're not using it for a delay function at the time. If your unit has been powered up for several hours with an active input fed to it, you can expect this audio will stay in PD's delay buffer for up to 4 hours.

---

<sup>1</sup> There's a tiny latency during processing: 5/1000 second.

- If you turn Bypass Off and jump instantly to a Target, earlier audio may still be working through the delay line. Depending on the timing, you may hear content that was already broadcast while the system was in Bypass.

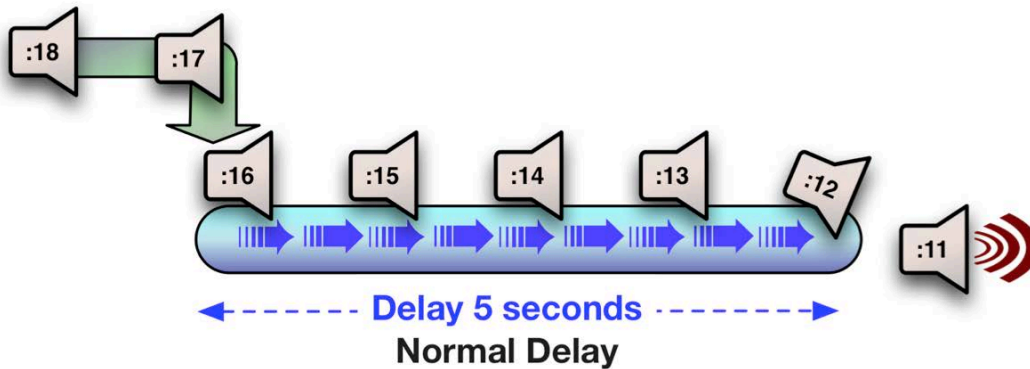
The bottom line: PD gives you a lot of flexibility for signal and delay. This is discussed further under Startup Behavior, page 17.



## *What's Really Happening Inside PD*

Broadcasters have been using various types of delay for decades, and traditional delay lines — either analog or digital — are well understood. We've developed a better architecture.

You can think of a standard delay line as a conveyor belt. Individual moments of audio come in one end, work their way down the belt, and come out on the other end some time later.



The picture above is self-explanatory: it's a five-second delay line, with audio going in one end and coming out the other.

The problem arises when a broadcaster wants to go from non-delayed programming into delayed, or back again. If we simply bypass the delay in the drawing above, the signal will jump from second :11 directly to second :16. Five seconds of programming will be lost!

Similarly, if we switched directly from bypassed to delay output, five seconds would be repeated.

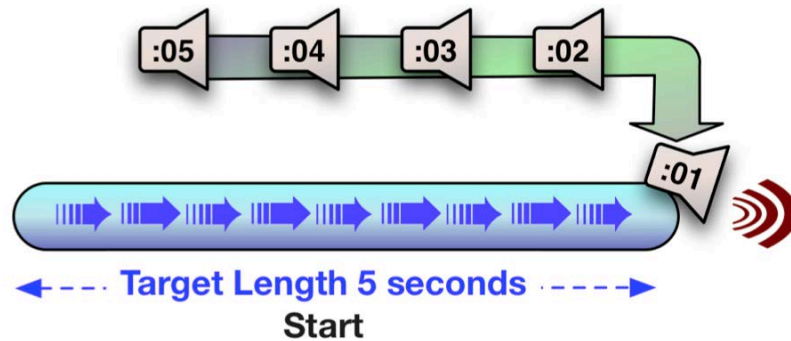
Of course there are ways around this. You can have talent pause for five seconds in the middle of a sentence, so no real content gets lost. You can play a five-second jingle to cover a delayed obscenity. Or you can use an elegant, flexible system like 25-Seven's PDM<sup>1</sup>.

---

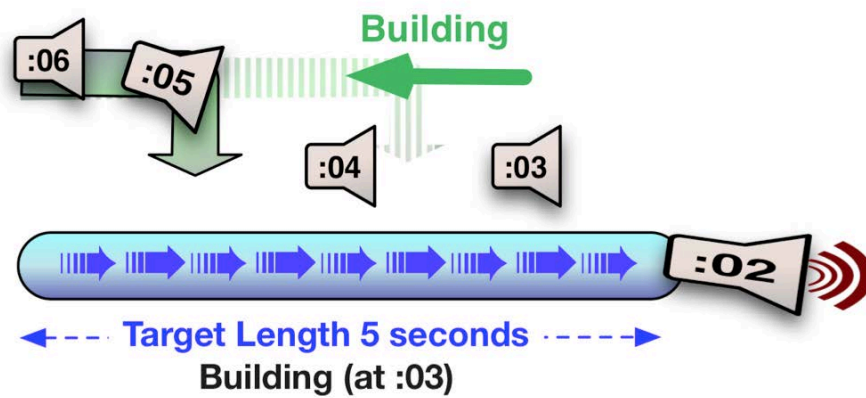
<sup>1</sup> 25-Seven's Program Delay Manager™ is designed to seamlessly delete (aka *Dump*) inappropriate content during live shows. It rebuilds delays by subtly stretching the material that follows a deletion. It also keeps an internal database of exactly what got deleted, automatically e-mails "before" and "after"

Things get more difficult when you need absolute precision, such as syncing analog and HD Radio signals, or using very long times for program delay. That's why we've added the concepts of a Target Delay and Building.

If you set PD for a five second delay, that's the Target: it sets aside a 5-second delay line... but starts by injecting audio at the *end* of that line. Second :01 goes in, and comes out almost immediately.



Then the injection point starts moving earlier, making the delay longer. To avoid gaps or interruptions, it stretches each moment of audio a tiny bit, as they are leaving the conveyor belt!



We made the time-stretching obvious in this drawing, so you could understand PD's signal flow. But our proprietary methods of stretching or compressing audio don't affect pitch, don't change the relative pacing of pauses, and don't mangle music. In most cases listeners aren't even aware they're in use<sup>1</sup>.

When the injection point reaches the target length, audio is fully delayed. There's no more need for stretching or compressing. At this point PD behaves like a conventional digital delay...

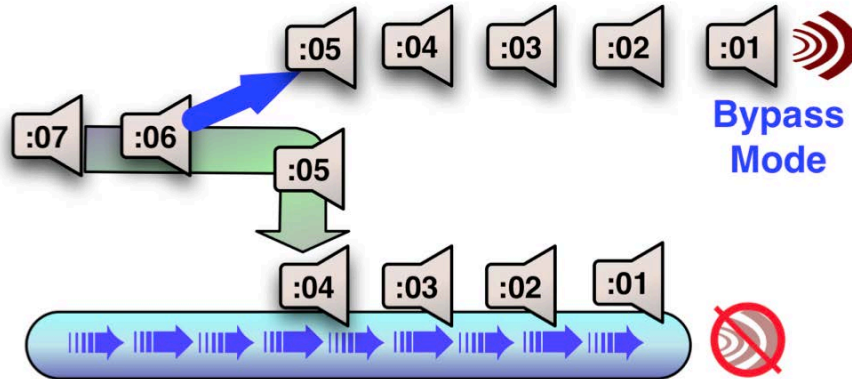
---

audio clips to the Program Director or other concerned personnel, and does a lot more. Your dealer will be glad to give you details.

<sup>1</sup> There's more about our time manipulation algorithms at [25-Seven.com](http://25-Seven.com).

Until you press EXIT. Then Building starts in the other direction. The injection point moves later in the delay line, audio is subtly sped up, and the delay shrinks until it reaches zero.

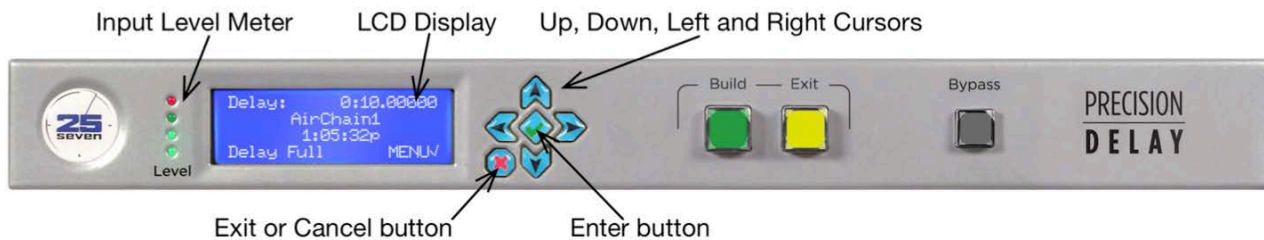
One other important consideration: PD is *always* recording signal to the delay line... even when the system is in Bypass. That's shown in the next drawing:



You can also Build from zero when Bypass is turned off.



## Front Panel

Details of the rear panel appear in the Installation section, page 41.



The Input Level Meter monitors the signal going in to PD's processing circuit. At least one of its LEDs should be flashing whenever there's audio at any reasonable level. More details on this meter appear below.

The Cursor Control buttons let you navigate around the LCD display. In this manual, they're shown as , , , and  for Up, Down, Left and Right.

The Enter button (shown as ) is used to open menus and confirm choices. The Cancel button () exits the current menu without making any changes.

The green BUILD and yellow EXIT buttons are discussed starting on page 5.

The gray BYPASS button is used for emergencies or when you want to take PD out of the signal chain<sup>1</sup>. It connects PD's analog and digital inputs to its outputs, with no

<sup>1</sup> Occasionally, you may need to do software updates or other system-level maintenance (page 45). Put the unit in Bypass mode, or remove it from the signal chain, before beginning these operations.



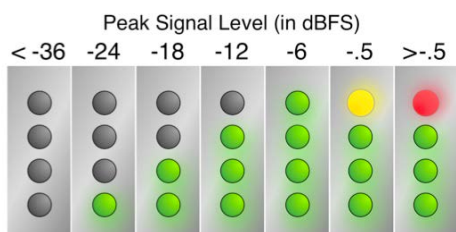
processing or delay. Audio continues to be written to PD's internal delay memory, so you can use it as soon as you exit this mode.

PD also goes into Bypass when power is removed. Analog inputs are passed to their respective analog output; AES/EBU input is passed directly to the AES/EBU output. This is totally passive and no level adjustment or analog/digital conversion takes place.

You can select whether PD stays in Bypass when power is restored and self-initialization is finished, or whether it automatically starts Building a delay. Full instructions are on page 24.

## Input Level Meter

PD's four color-coded LEDs indicate audio input level at the processor.



- If all four LEDs are dark, the input signal is below -36 dBFS. This usually represents normal studio background noise, with no talking or music.
- As the peak input signal increases between -36 dBFS and Full Scale, successive LEDs light up.

All four LEDs will light yellow if PD is expecting a Livewire input but not seeing a valid signal. This is usually a configuration problem. All four LEDs will also light yellow or red in the unlikely event of an internal error.

PD's input meter shows instantaneous peaks as a diagnostic aid. It doesn't display RMS voltage or time-integrated level, and isn't a replacement for the sophisticated loudness meters found in a modern broadcast facility.

---

## Detailed Operating Instructions

### Start-up Behavior

When PD is first powered up, transport buttons will briefly light, and the unit will be in Bypass mode. After about 10 seconds, the LCD displays this initialization screen for a few moments:

```
Welcome to the
25-Seven Systems
Precision Delay
Please wait...
```

Once the hardware is successfully initialized, the screen will update; the level meters will show activity if there is a valid audio input.

What happens next depends on how you've set the System menus. Bypass may remain enabled, or turn itself off and revert to normal output. The Delay system may start a

normal Build, instantly go to Delay Full, or instantly go to Delay Empty. Full instructions for setting these options are on page 24.

Whichever options you've chosen, the system will then display the appropriate screen.

## General Menu Procedures

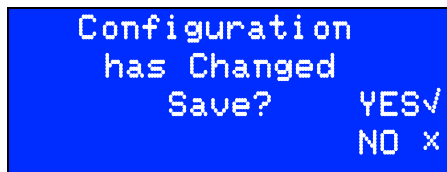
Many of PD's operating screens say **MENU✓** in their lower right corner. When it's showing, you can press the blue **◇** button (in between the four cursor buttons) to enter the Menu system.

A few elements are common to most PD menus:

- **↑↓ Change** or **Chg Value** means use **▲** or **▼** to change the flashing or highlighted value on the screen.
- **↔** may appear when a field has more than one digit. Use **◀** or **▶** to select which digit in the field will be changed. Then you can increment the digit's value using the **▲** or **▼** buttons.
- **More↑** and **More↓** mean there are more menu options in this category. Use **▲** or **▼** to see them.
- **OK✓** means press **◇** to apply or preview a parameter change, and return to the next higher menu. It won't be saved permanently until you confirm it, as described below.
- **CNCL×** means press **⊗** to return to the next higher menu without making any additional changes. If you're on the Master menu, pressing **⊗** exits the menu system and takes you to either the Main operating screen or the Confirmation screen.

## Confirming Changes

If you've made any parameter changes while in the menu system, you'll see a Confirmation screen like this before you return to the Master menu<sup>1</sup>:



Press **◇** to permanently save these changes

Press **⊗** to erase these changes and restore PD's former settings

If you don't press either button, the Confirmation screen times out after three minutes. Any changes you just made in the menu system are cancelled, and PD returns to its normal operating screen.

---

<sup>1</sup> Depending on which menu you're in, you may need to press **⊗** a few times to see the Confirmation screen.



## PD's Front Panel Menus

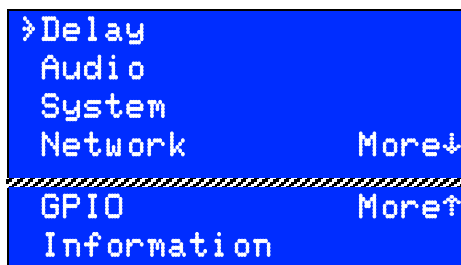
These menus can be activated from PD's front panel, or via its secure Web interface.




The Web interface uses convenient configuration pages that group all of the settings for a particular operation. They're a fast way to configure and document<sup>1</sup> the system. Some options appear only on the Web interface; see page 33 for details.


The Web interface also includes a graphic, interactive version of PD's front panel (page 31) for remote operation. In most cases, it works the same as the actual front panel. However, network address settings must be made from PD's front panel, to avoid inadvertently locking yourself out. See page 25.


### Master Menu

If you press  while **MENU** is displayed, the screen changes to the Master Menu. Here you can choose to adjust:

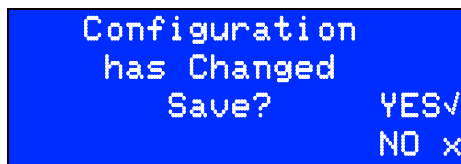




The arrow on the left means press  to enter the selected menu...  
...or use  and  to select one of the other menus.



There are more options than would fit on the screen; press  to see them.

Press  to see previous options.

Most of PD's menus are "live": if you make a change, it's immediately reflected in the output. Most changes require confirmation when leaving the menu system: you'll see a screen like this:



Press  to save the change,  to cancel and keep the previous settings.

- Press  to save the settings; they'll become your new defaults.
- Press  to immediately cancel and return to the main screen. If you don't do anything for one minute, the system will time out, discard your changes, and return to the main screen.

---

<sup>1</sup> Want notes showing exactly how you set up the system? It's easy: just pull a screenshot from your browser!

## Delay Menu

```
Target: 1:00.00000
Change: +0:00.00000
Delay: 0:00.50000
↑↓↔ Change DONE✓
```

*This menu is fully described on page 11.*

Note that changes on the Delay Menu are “live”: they change the system immediately, and don’t wait for a confirmation screen.

## Audio Menu

```
→Build Speed
Audio Input
Input Sens.
Output Level More↓
-----
Sample Rate More↑
```

*Lets you select a default Build Speed for building (page 34).*

*Lets you select analog or digital inputs. See below.*

*Adjusts the analog input level to match your studio’s “0 VU”*

*Adjusts the analog output level to match studio’s “0 VU.”*

*Selects default sample rate when no digital input is connected (page 22).*

### Audio Input selection

Choose AES/EBU, analog, or Livewire<sup>1</sup> input for the audio signal PD will process. During normal operation, all outputs carry the processed signal from this input. You can use this feature for analog monitoring in an all-digital chain<sup>2</sup>.

PD’s internal clock locks to any valid AES/EBU signal that’s connected, even if you’ve chosen an analog input. This lets you keep signals synchronized to your facility’s master audio clock. There’s more about sample clock accuracy on page 22.

---

<sup>1</sup> Under development; contact factory for more information.

<sup>2</sup> When Bypass is enabled, output jacks are relay-connected directly to the matching input jacks. AES/EBU input goes to AES/EBU output, and Left or Right analog inputs go to their respective analog outputs. In other words: when Bypass is On, you *can’t* use the “analog monitoring of a digital chain” trick.

Because of the latency in serial digital audio words, PD’s analog and digital outputs will never be precisely time-aligned; there will always be few samples of difference. The amount depends on the sample rate and signal path, but it’s never enough to make a difference in monitoring situations. For a complete discussion, see page 41.

## Input Sensitivity and Output Level

These two menus calibrate PD's internal and output level for best performance, when using Analog inputs. They're active only when the Analog inputs are selected, since Digital and Livewire signals are self-calibrating. If you've selected a Digital input, the analog output level reverts to a factory setting.

Analog Input Sens: +14dBu=0dBFS ↑↓ Chg value      OK✓ L:-70 R:-70      CNCLx	Analog Output Level: +14dBu=0dBFS ↑↓ Chg value      OK✓ L:-70 R:-70      CNCLx
---	---

The second line in each of these menus is critical. On the input side, it determines what voltage (in dBu) will result in 0 dBFS, or Full Scale, within PD's processor. On the output side, it determines what analog voltage PD delivers when the processor hits 0 dBFS. The analog outputs are always active, even when a digital input has been selected.

The two adjustments are usually set to matching values, giving PD unity gain. But you can vary them if you need additional analog gain or loss in your setup.

Factory default for both adjustments is **+14dBu=0dBFS**. We recommend this for most installations. It provides 10 dB of headroom above 0 VU on most analog equipment meters, and 84 dB signal/noise ratio below 0 VU.

The last line on each of these menus is a stereo, instant-reading level meter. It's connected at the processor as an aid for calibration when using constant tones.



### ***Don't Confuse Analog dBu with Digital dBFS!***

Analog dBu is a comparison to an arbitrary voltage (.775 v), and signals can be much hotter. A console's output is typically +4 dBu (1.228 v) when the meter reads 0 VU, but that's for a sinewave test signal. Peaks in voice waveforms, in real-world broadcasting, can sometimes be considerably above that... even though properly-calibrated VU meters are deliberately too slow to register them. Analog is very forgiving of these momentary peaks.

However, in the digital world, 0 dBFS (decibels referred to Full Scale) is an absolute ceiling. Some devices distort horribly or crackle when an input attempts to pass this value. PD handles overloads differently, applying serious limiting to gracefully protect your signal (and listeners).

If your facility uses the +4 dBu standard of modern broadcast equipment, our recommended setting of +14dBu= 0dBFS provides 10 dB of headroom for protection while still maintaining an 84 dB signal-to-noise ratio. With this setup, it's unlikely that PD will ever go into distortion or audible limiting.

If you're dealing with heavily-processed feeds you can use a lower setting; for seriously dynamic performances it may need to be higher. PD has 94 dB dynamic range at all settings, within 2 dB of the theoretical limit for 16-bit sound.

## Sample Rate and Clock Accuracy

When PD is used with Analog inputs and nothing is connected to the AES/EBU input jack, it generates its own internal clock. Use this menu page to choose an audio sample rate of **32 kHz**, **44.1 kHz**, or **48 kHz**; this is also the rate that appears on the digital output. The factory default is 44.1 kHz; feel free to change it to match your studio setup.

Changing the sample rate causes PD to reset its hardware and dump its delay memory. **This will disrupt any signal flowing through the unit.** We've provided a special warning and confirmation screen that appears only during sample-rate changes.

```
Changing sample rate
will dump the buffer
*** and restart! ***
CANCEL<                OK>
```

Press **▶** to confirm the change. *Don't do this while on-air: it will disrupt audio.*

Press **◀** to cancel the change, keeping the current sample rate and not interrupting audio.

If a valid AES/EBU signal is applied to the Digital inputs, that signal's clock takes precedence. Its incoming sample rate is used for internal processing and digital output, **even when an analog input is selected.** We did this to eliminate clicking, dropouts, and the other problems of asynchronous digital signals in a complicated broadcast plant.

This arrangement has two important implications:

1. **PD's audio will be disrupted when you connect a new AES/EBU signal.** This happens as PD synchronizes to the signal's digital clock, and is unavoidable... even if you're using an analog input. If the AES/EBU signal is intermittent or damaged, PD's output will continue to be unusable. **Make sure PD is turned off or Bypassed before changing the AES/EBU input connection.**

2. PD's internal delay measurement is necessarily locked to the audio sample rate. We use a high-precision crystal, calibrated at the factory. However, some installations may require absolute tracking with other clocks in the facility. If that's the case, you can use an AES/EBU input signal derived from your master sync system, GPS receiver, or other source. PD will automatically lock to it for both its delay timing and its audio sample rate.

PD's display is calibrated in tens of microseconds. If you need to compute delays in samples, it's a simple matter of dividing by the nominal sample rate. Rounded to nanoseconds:

Sample rate	32 kHz	44.1 kHz	48 kHz
Length of one sample	31.25 $\mu$ s	22.6757 $\mu$ s	20.8333 $\mu$ s

Or as a rule-of-thumb: at standard audio sample rates, a single sample is about 20  $\mu$ s long.

For best results when using a digital input, we recommend you set the internal sample rate to match the rate of the AES digital input. This will protect against clocking anomalies in the event of an AES signal dropout.

### *Input Choice, Delay Calibration, and Output Synchronization*

We designed PD to be inserted into an analog or digital program line, and we calibrated our Delay settings for that purpose. Since PD itself is a digital device—its sophisticated processing would be impossible in the analog domain—we have to convert analog signals when they enter or leave the unit. That conversion takes a tiny amount of time.

To keep the Delay display accurate, we compensate for the conversion internally when using Analog inputs. This compensation is adjusted when you change the internal sample rate, and turned off when you've selected Digital inputs. The process is transparent to the user: whichever kind of wiring you're using, and whichever sample rate you choose, the display will be accurate for the input you've chosen.

However, you might want to use Digital and Analog *outputs* simultaneously... perhaps to feed a monitoring chain separate from your air chain. Because of the extra conversion, the Analog output will always be slightly behind the Digital output by about half a millisecond. This is insignificant for most purposes.

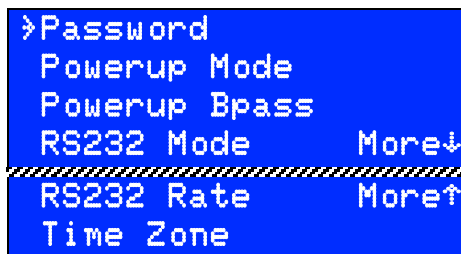
- The difference between the two outputs will be 0.521 ms at 48 kHz sample rate, 0.567 ms at 44.1 kHz sample rate, and 0.781 ms in those few installations that use 32 kHz sample rate.

Also, we can't compensate the display for both outputs at the same time. We assume the input you've selected—*analog or digital*—is the main signal chain, and adjust the display to be accurate for the matching output.

- If you've selected Analog input, the front panel delay calibration will be accurate for Analog outputs. The Digital output delay will be what's displayed on the front panel, less the fraction of a millisecond indicated above.
- If you've selected Digital inputs, the calibration will be accurate for Digital outputs. The Analog output delay will be that fraction of a millisecond larger.

Why do we explain this in such detail? Because when 25-Seven says our products are "precise", we mean *PRECISE*.

### *System Menu*



Enter or verify password for this unit. It's used during Web access (page 30).

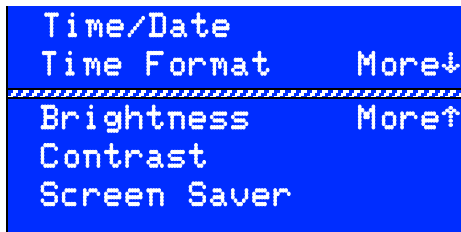
Sets system behavior on power up.

Sets whether PD powers up in bypass or active delay.

Choose Disabled, Control, or Delay Data (page 39).

Select a serial Baud rate between 1200 and 115200.

Select a US time zone, or any offset from Greenwich Mean Time.



Sets PD's internal clock.

Choose 12 or 24 hour.

Brightness and Contrast control the front panel LCD. If you accidentally set the LCD too dark, you can restore its settings via Web interface.

Sets how long PD's front panel must be inactive before the LCD's backlighting automatically turns off. Select 1 – 100 minutes, or Never.

### About the Powerup options

These determine what PD does when you first turn it on, after it's performed a self-test and initialized.

#### Powerup Mode

Select how PD behaves after it's initialized. It can:

- **Ramp to Target** Build to reach the Target delay. Audio output will start immediately, but will be subtly slowed down until the Target is reached.
- **Delay Empty** Go instantly into Delay Empty. Audio will pass through with no delay. The system waits for a command to start Building a new delay.
- **Delay Full** Go instantly into Delay Full mode (audio signal is delayed by the Target length)<sup>1</sup>.

#### Powerup Bypass

PD is automatically Bypassed while the power is off and during the system initialization. Then, depending on your selection:

- **Enabled** Keeps Bypass enabled after powering up, so the output is connected directly to the input, or
- **Disabled** Bypass gets Disabled as soon as the system is ready, and PD provides its Normal output.

These behaviors are separately settable in any combination. For example:

- **Bypass: Disabled** and **Mode: Ramp to Target** smoothly rebuilds your normal delay automatically after a power failure<sup>2</sup>.
- **Bypass: Enabled** and **Mode: Delay Full** will go immediately into Delay Full mode, while still passing signal instantly through the Bypass relay. When you then Disable Bypass, you'll hear the output of the delay.

### Network Menu



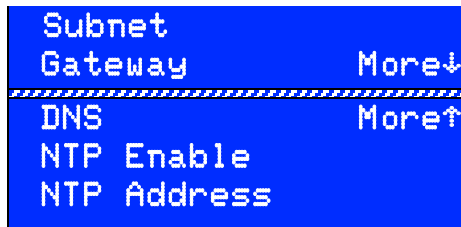
Enable or Disable.

These next four lines appear only if DHCP is disabled.

<sup>1</sup> Obviously, if you've just turned PD on and Bypass is Disabled, there won't be any audio output in this mode until the Target is reached.



<sup>2</sup> We strongly recommend using a UPS to provide blackout-free power for any mission-critical processors.







"  
"  
"  
*Enables or disables NTP.*  
*NTP Address appears only if NTP has been enabled.*

### About the Network Menu

- **DHCP** DHCP is a standard protocol that lets PD get network configuration details automatically from your system's router. It provides IP, Subnet, DNS Server, and Gateway addresses.
  - Disabling, pressing , then re-enabling and pressing  will tell your system's router to reset PD's network address. It may take a few moments before a new address is registered.
  - After you enable and confirm DHCP, with some routers you may need to power cycle PD to get an address.
  - PD responds to pings<sup>1</sup> across your network. You can use this to determine if an address is valid and the network is working properly.

Fields in the following menus "roll over" between their limits of 0 and 255. If the zero is showing, press  to jump to 255. If 255 is showing, press  for zero.

- If DHCP is **Disabled** you must set the next options manually:
  - **IP Address** Network address of this PD, in standard IP form.
  - **Subnet mask** In most cases, this should be set to 255.255.255.0.
  - **DNS Server** Domain Name Server, needed for NTP, support features and Web.
  - **Gateway** Provides access outside your local area network.
- **NTP** When enabled, PD can set its internal clock automatically from a Network Time Protocol server<sup>2</sup> (see below). When disabled, you can set the clock manually in the System menu page. To insure accurately time-stamped system logs and "Done at" delay calculations, we recommend you enable NTP.
  - **NTP Server** Enter the IP address of the time server. This entry appears only if NTP is enabled. If you've found the time server from a list that doesn't specify numeric IP addresses, use the Ping utility in a networked computer. When you ping its named address, it should respond with the IP address.

---

<sup>1</sup> A standard diagnostic utility, provided with most computers.

<sup>2</sup> NTP works fastest if the system clock is already fairly close to the current time. We recommend you set the Time/Date and Time Zone manually before enabling this feature.

## **Network Troubleshooting**

PD's Internet services (such as status e-mails, Network Time Protocol, and Web remote control) require proper Internet Protocol addressing. In many installations this is provided automatically by your station's data router, when you choose DHCP (page 24).

If your **Information** screen shows **0.0.0.0** for the IP address and DHCP has been enabled, your local network's router probably isn't supplying a valid address. Power cycling PD may solve the problem. In some cases you might need to power cycle or reset the router as well... but be aware this can temporarily disrupt the entire data network.

Some data networks don't support DHCP, and many companies prefer to use static IP addresses for specialized equipment such as PD. If that is the case, you will have to manually enter the IP Address, Subnet Mask, Gateway, and DNS numbers. You can get these numbers from your ISP or IT department if needed; tell them that the router sees PD as a standard computer on the network.

PD's Network Time Protocol system will also report potential network issues while it is establishing a connection with the time server. These messages appear on the information screen, and are described on page 35.



### **About NTP**

Network Time Protocol servers supply accurate time-of-day and other data over the Internet. PD can use one to automatically set its internal clock. Your facility might also have its own NTP server.

NTP servers are often identified by a domain name—a familiar-sounding “.com” or “.gov” URL—rather than their numeric IP address. PD requires numeric IP addresses.

You'll find a list of US servers, with both their domain names and their IP addresses, at the National Institute of Standards and Technology's website<sup>1</sup>. International time server domain names are listed at [www.ntp.org](http://www.ntp.org). Please respect the access policies listed by the server provider and IT department. PD users should never select a Primary server for NTP updating; use Pool or Secondary servers instead.

The best way we have found to test whether NTP services are working is to manually offset your PD clock by a couple of minutes, then enable NTP. If your network connections are working and your NTP address is valid, the system clock should quickly acquire the correct time.

---

<sup>1</sup> The list itself is currently at <http://tf.nist.gov/tf-cgi/servers.cgi>. If NIST has moved it from that location, use the search box on their home page, [www.nist.gov](http://www.nist.gov), to find “Internet Time Service”.

## GPIO Menu (General Purpose Input/Output)

```
➤GPIO Enable
GPIO Inputs
GPIO Outputs
GPIO Test
```

This menu lets you program PD's rear panel parallel connections for remote control. Select **Enabled** to activate this control system; you can use **Disabled** if you have a remote plugged into the DB-25 jack but want to turn it off.

Our GPIO system doesn't use noisy relays and won't be tripped by normal static impulses. You can leave it Enabled even if nothing is plugged in. GPIO wiring details are covered on page 44.

### Programming GPIO Inputs and Outputs

The GPIO system has to be configured, so PD knows which functions you want on the pins of the rear-panel jack. Select **GPIO Inputs** or **GPIO Outputs** and press **◆**.

You'll see screens like this:

```
GPIO Inputs:      GPIO Outputs:
In1=Build         In1=Build
↑↓ Chg Value      ↑↓ Chg Value      OK✓
↔ Chg Field       ↔ Chg Field       CNCLx
```

Each of the 8 Inputs or outputs (e.g., In1, In2, Out1, Out2, etc) can be assigned to a PD function, as listed on the following chart. The same function can be assigned to multiple inputs or outputs, if you require two or more isolated circuits for it.

GPIO FUNCTION	INPUT SETTING*	OUTPUT SETTING†
Nothing Assigned	<b>None</b>	<b>None</b>
Build Button	<b>Build</b>	<b>BuildLamp</b>
Build by ramping to target	<b>BuildRamp</b>	<b>Building</b>
Instant Build	<b>BuildNow</b>	
Exit Button	<b>Exit</b>	<b>ExitLamp</b>
Exit by ramping to no delay	<b>ExitRamp</b>	<b>Exiting</b>
Instant Exit	<b>ExitNow</b>	
Build command received		<b>BuildTrig</b>
Pulse when delay target is reached		<b>FullTrig</b>
Pulse when delay reaches zero		<b>EmptyTrig</b>
Delay Full (target has been reached)		<b>DelayFull</b>

Delay Empty (zero delay)		<b>DelayEmpty</b>
Bypass	<b>Bypass</b>	<b>Bypass</b>
Cue point #1 <sup>¶</sup>	<b>Cue1</b>	<b>Cue1</b>
...etc (up to 8 Cue points)	<b>Cue2...</b>	<b>Cue2...</b>
Flag point #1 <sup>¶</sup>	<b>Flag1</b>	<b>Flag1</b>
...etc (up to 8 Flag points)	<b>Flag2...</b>	<b>Flag2...</b>

**Important notes about the table:**

\* — Where an input function has the same name as a front-panel button, the input behaves just like that button.

For example, a momentary pulse on a GPIO **Build** input will start the delay Building, just as if you'd tapped the BUILD button.

A second pulse on **Build** shows the Instant Build confirmation screen; a third pulse confirms it, setting delay to its full Target value.

† — Some PD functions have multiple outputs for flexibility.

- If an output setting ends with **Trig**, PD generates a single 250 ms output pulse when that state is reached. This can be handy for interfacing with automation systems.
- If an output setting ends with **Lamp**, PD's GPIO output mimics the front panel button's lamp. It stays low when the lamp is on, high when the lamp is off, and cycles when the lamp is flashing. This can be handy for building custom remotes.
- **Building** and **Exiting** indicate PD's current operational state, and are held low for as long as these states exist.

¶ — “Cue” and “Flag” points let you automatically delay the signals from satellites, automation systems, and producers' control panels. They keep the signals in sync with appropriate program audio at all times.

Connect an appropriate contact closure or logic pulse to any GPIO input that you've set for Cue or Flag: when its signal is received, it gets recorded along with the incoming audio sample. It stays with this specific sample, no matter how much delay is applied. You can then pass the mark to other devices with an appropriate GPIO output.

- **Cue** marks generate a 250 ms trigger when they're reached. This can be handy when interfacing with automation systems.
- **Flag** marks store and output continuous logic levels, as with on/off switches.

## Testing GPIO

The **GPIO Test** screen lets you verify that GPIO connections and external remotes are properly wired.

```
12345678
Ins: 11111111
Outs: 00000000
↑↓↔ Change      CNCLX
```

These change from 0 to 1 while PD is receiving a trigger on the DB-25 input (1-8) identified in the line above.

Use **↔** and **↔** to select an output. Then use **↑** or **↓** to change that output's state between 1 (on) and 0 (off).

When you leave the GPIO test screen, the DB-25 outputs are all reset to 0.

## Information

Choosing **Information** from the Master Menu lets you scroll through screens showing the input selection, analog sensitivity and output level, time/date, NTP status, Network addresses, machine identification (MAC and module number), software versions, and internal temperature. More detailed information is available on the Graphical User Interface (page 35).

The NTP status may show one of three messages:

- **Search** PD is seeking a path to the remote NTP server. If this message persists, it may indicate that the NTP server address you entered isn't valid, or the network is down.
- **Query** PD has contacted the remote server and calibrating its internal clock to match. This may take a few minutes depending on the connection and how much adjustment is required.
- **Sync** PD's clock is now synchronized with the remote server's.

As a general guideline, PD should run within 20° Fahrenheit of ambient room temperature<sup>1</sup>.

---

<sup>1</sup> There's more about heat control in the section on Installation, page 40.

---

## Graphical User Interface and Web Remote Control

PD includes a built-in Web server for remote control and diagnostics. You can access it from a browser in any computer on the data network, if you have the proper password.

### Logging in to PD from a Connected Computer

- Launch any standard Web browser, on any Windows, Macintosh, or Linux computer on your network<sup>1</sup>.
- Set the browser to `http://nnn.nn.n.nn`, where the n's are PD's IP address. You can read that address from the **Information** menu on PD's front panel.
- When it connects, you'll be asked for a User Name and Password

Use `pdweb` as the user name, and `pdwebDnnn` as the initial password. (*Dnnn* is the unique Module Code, which you'll find on the last page of the Information screen. You can change or view the password from the front panel System menu's Password page. Passwords are case sensitive.

If it doesn't connect, you may have a problem with your network connections, the version of Flash installed in your browser, or your system's configuration<sup>2</sup>.

After successfully connecting and checking your browser's plug-in, PD draws its Graphical User Interface on your computer screen.

### Port Forwarding & GUI Communication

PD's web server connects at `http port 80`. Once you log in and the front panel or configuration pages are loaded, embedded Adobe Flash movies in our GUI let your browser control the PD via `port 5444`. Both these ports must be open and available for the GUI to function.

If you are trying to connect to your PD over a Wide Area Network or across the Internet, you will need to use a NAT router<sup>3</sup> to send ports 80 and 5444 to your PD's local IP address.

If your facility has multiple air chains, you may want to control two or more PDs on the same network using a single external IP address. You can do this with your NAT router along with PD's built-in port offset feature. The key is to forward *pairs* of port numbers.

---

<sup>1</sup> Web-based control relies on Adobe Flash being installed in your browser. Flash communicates with PD over port 5444. If this port is blocked by your firewall, Web-based control will not function.

<sup>2</sup> This may be a setup issue in PD's menus or your local computer, a network wiring or configuration problem, or even something as simple as entering the IP address wrong in your browser. PD responds to ping commands as an aid for debugging.

<sup>3</sup> Network Address Translation Router. Most routers have the ability to forward port requests from specific IP addresses. Some routers call this feature Virtual Servers. See your router's instruction manual for details.

For example, say you have two PD units, named *PD-A* and *PD-B*:

- At your router, configure the ports so inbound browser traffic on port 81 forwards to port 80 on PD-A, while port 5445 forwards to port 5444 on PD-A. Users seeking access to PD-A from the outside, for example, could use the IP address plus port number, and enter 10.11.12.100:81 in their browser.
- For your second unit, configure inbound browser traffic on port 82 to forward to port 80 on PD-B, while port 5446 forwards to port 5444 on PD-B. Users seeking access to PD-B from the outside would use the IP address and that port number, such as 10.11.12.100:82.

You should see a pattern here: Ports 80 and 5444 are paired. When the web page is fetched from port  $x$ , the Flash movie will automatically connect to the control port at  $x - 80 + 5444$ . You don't need to specify Flash ports, just which port your router uses to talk to PD: if you set that and associated firewall permissions properly at the router, our software does the rest. If you can see the front panel web page, but the Flash front panel interactive image can not connect, you likely have a problem with control port routing.

### Selecting GUI Page

PD's GUI is organized by pages, to make it easier for you to find particular functions.

The top of each page displays this particular PD's Machine Name<sup>1</sup>, and has a row of tabs. Click a tab to select which page you'd like to work on.



### Front Panel GUI Page

After connecting and authentication, your browser will change to look like this.

---







<sup>1</sup> You can change the Machine Name from the CONFIGURATION tab.



Click [here](#) to open a mini front panel window.

Access this page any time by clicking the **FRONT PANEL** tab on the GUI.

This page is fully interactive. On-screen buttons can be clicked with your mouse; the text displays whatever is on PD's LCD at the time; LEDs and buttons flash as they would on the front panel.

You can also use your computer's keyboard as buttons. Tap the **B** key to BUILD, the **E** key for EXIT, **ENTER** for , **ESC** for , and     for the cursor arrows.

### ***Mini Front Panel***

If you click the link below the Build button, a smaller Front Panel will pop up in your browser. It can be dragged anywhere on your screen, and is resizable by dragging its window's lower right corner. It is fully functional, and works even if the main window is a different page or is closed.



## Configuration page

Click on **CONFIGURATION** tab at the top of the GUI. It will gather information, and after a moment look like this:

Identification	
PD name:	PD2
Module number:	000
Control	
Delay target:	10 seconds
Initial build/exit speed:	7 %
Watermark Safe Mode:	<input checked="" type="checkbox"/> Enabled
Mode on Power-up:	Delay Full
Bypass on Power-up:	<input checked="" type="checkbox"/> Enabled
Synchronization	
Remote device type:	None
Address:	
Port:	0 (0 - default port)
Channel:	0 (0 - default channel)
Location of Precision Delay:	Analog chain
Test Sync Device:	<input type="button" value="Test"/> (attempts to contact remote device)
Hardware GPIO	
Hardware GPIO:	<input checked="" type="checkbox"/> Enabled
Inputs:	In 1 Build In 2 BuildRamp In 3 BuildNow In 4 Exit In 5 ExitRamp In 6 ExitNow In 7 Bypass In 8 Cue1
Outputs:	Out 1 BuildTrig Out 2 FullTrig Out 3 EmptyTrig Out 4 Cue1 Out 5 Cue2 Out 6 Cue3 Out 7 Cue4 Out 8 Cue5
Other I/O	
Network control port 5443:	<input checked="" type="checkbox"/> Enabled
Network delayed data ports:	<input checked="" type="checkbox"/> 5445 -> 5446 enabled <input checked="" type="checkbox"/> 5447 -> 5448 enabled
RS232 port mode:	Control
RS232 rate:	57600 baud
RS485A port mode:	Disabled
Clock offset:	0 seconds ahead
Front Panel	
Screen saver:	3 minutes
Brightness:	75
Contrast:	40
Save Changes	
<input type="button" value="Save"/>	<input type="button" value="Revert"/>

You can enter data directly into the fields on this page.

- After you enter new data for a particular field, its descriptive name becomes boldface. This is a reminder that you still have to *save* the changes.
- If you enter an illegal value, its field turns red. It'll turn white again when you make a valid entry in the field.
- Changes that you enter on this page don't take effect until you press the Save button. If you open another tab and then come back to this page, the changes are lost.

- If someone makes changes at PD's front panel or through the Mini Front Panel, they won't show on this page until it's redrawn. Use your browser's Refresh feature, or click the **CONFIGURATION** tab again.

Identification shows the hardware and module number of this PD. You can set a PD name for easy identification of this unit. This name will also be used if PD sends an e-mail<sup>1</sup>.

- Names can be up to 19 numbers or upper/lower case letters. Spaces and special characters may not be used.

Control and Hardware GPIO let you view and change settings that are also on PD's front panel menus. See the functional descriptions under Menus, page 19.

Watermark Safe Mode uses a specially designed process to protect data you've embedded in your audio signal, such as with Arbitron's PPM system. It's discussed more fully on page 8. Turn it on or off with the Enable check box. You can't control it from PD's front panel.

Synchronization lets PD get its Target delay from Belar FMHD1 or Audemat Golden Eagle HD Radio modulation monitors. You'll have to enter an IP address for the monitor, along with appropriate channel and port identification numbers as described in the monitor's instructions.

Other I/O lets you:

- Enable bi-directional serial commands over network port 5443.
- Enable data delays over port pairs 5445/5446 and 5447/5448.
- Configure the rear panel RS-232/RS-485 port to serve as either a data delay or a bi-directional serial control. You may also disable the port from this menu.
- Set the baud rate for the rear panel RS-232 serial lines.
- Set parameters for an external slave clock output over RS-485.

PD's serial command language and data delay capability is described on page 35.

Front Panel mimics the front panel menu settings on PD's menu.

Save Changes The Save button changes PD's internal settings to match whatever you've entered on this page. Revert cancels your unsaved entries, replacing them with whatever had been previously set in PD.

---

<sup>1</sup> E-mail capability is currently being developed; contact factory for status.

## Information Page

Click the **INFORMATION** tab to view information about the connected hardware. This read-only page shows the current system settings that appear in the **Information** menu, along with data that will be helpful if you need to contact the factory for service.

Audio	
Audio Input	Analog
Sample Rate	48 kHz
Analog input sensitivity	0 dBu = 0 dBFS
Analog output level	0 dBFS = 6 dBu
Network	
MAC address	00:30:18:a8:d5:03
DHCP	disabled
IP address	192.168.1.12
Network mask	255.255.255.0
Gateway	192.168.1.1
DNS server	192.168.1.1
NTP	enabled
NTP server	71.162.115.13

NTP server	71.162.115.13
NTP status	synchronized
System	
Time zone	EST/EDT
Time format	12 hour
Internal temperature	96°F 35°C
Firmware versions	
PD	1.2-Feb25b
IOB	1.2.1
LSP	3.2
WEB	2.25b.7
ACD	1.0.6.1
UTIL	1.2

*Shown in two pieces to save space.*

This page is not updated automatically. If you change system settings or believe the system status has changed, Refresh the page in your browser or click the **INFORMATION** tab again.

## Serial / Parallel Remote control

In addition to IP based remote control, PD supports traditional control systems for maximum flexibility. All control options — including from the front panel — can be used simultaneously.

### *Parallel (GPIO or “Contact Closure”) Control*

There are eight inputs and eight outputs for remote control, on a rear panel female DB-25 connector. Each can be assigned to PD functions through a configuration screen, described on page 27. Multiple inputs or outputs can be assigned to the same function if you need isolated circuits. Inputs and outputs are opto-isolated, active low; wiring details are on page 35.

### *Serial Control*

PD’s serial control options let you build custom interfaces, such as for an on-air or logging system. You can access PD’s internal control language via RS-232 serial, a networked terminal program, or both at the same time.

The comprehensive language uses abbreviations to query delay length and internal temperature, access all GPIO functions, and continuously report PD's operating status.

### ***Standard serial or IP-based connections***

Data and control lines appear on a male DB-25 connector in RS-232 format.

Enable RS-232 and set its protocols in the Web interface's **CONFIGURATION** screen (page 33). You can wire a custom cable or use a standard DB-25 to DB-9 adapter and a null modem.

Commands and queries can also be transmitted as IP packets over network port 5443, if you enable this function on the Configuration screen.

- Once port 5443 is enabled, it remains accessible to the entire network until specifically closed. There is no further password checking. Use a firewall, or keep your PD on a dedicated (closed) network, for protection.

### ***Serial language structure***

PD's serial remote control language is designed to be easily implemented from any terminal program, macros in most automation systems, or computer programming language. Requests and responses are standard ASCII characters, based on plain English, using familiar PD "front panel" designations whenever possible.

*Requests*, or messages from the controller to PD, consist of a number of words, followed by a Line Feed character<sup>1</sup> <LF>. Requests are case-sensitive.

*Responses* are replies from PD back to the controller. They consist of a single `Result` character, any appropriate message, and then <LF>. The Result character may be:

- ! Indicates command has been received and acted upon
- ? Indicates command isn't understood, or can't be acted upon

*Output Events* can be sent by PD whenever there's a change in status, such as memory being filled or buttons being pressed. They're provided so you can design custom serial interfaces to other equipment. Send a request with the `enable` command to specify which events will generate a message.

### **Request syntax**

Requests consist of a *command* (something for PD to do), usually followed by *arguments* (what it should act on), and then the <LF>.

*Commands* include:

- `down` Start a flag event described by <argument>
- `up` End a flag event described by <argument>

---

<sup>1</sup> ASCII 10 (decimal) or 0x0A (hex). Note that Carriage Return (ASCII 13) is ignored by the system.

**trigger** Momentary activation of <argument>, same as tapping a button.  
**get** Returns status of <variable>  
**help** Returns hints about PD's serial language  
**enable** Turns on Output Event reporting for a specific PD condition  
**disable** Turns off reporting for a specific condition

Commands are case-sensitive and must be all lower-case.

*Arguments* include:

**Build**, **Exit**, **Bypass**, **Cue1 through Cue8**, **Flag1 through Flag8**

Arguments for **up**, **down**, and **trigger** match GPIO inputs.

Arguments for **enable** or **disable** match GPIO outputs, and determine which conditions will generate a serial message.

A complete list of GPIO inputs and outputs, with their appropriate serial names, starts on page 27.

Arguments are also case-sensitive. They use internal capital letters, and must be sent exactly as shown in this manual.

*Variables* include:

**Depth:** current audio delay length in seconds and tenths

**PeakInput:** peak input level in dBFS

**PeakOutput:** peak output level in dBFS

**TemperatureC** or **TemperatureF:** current internal temperature in whole degrees Celsius or Fahrenheit, depending on the request.

Output Event messages sent by PD take the form @NameOfEvent[=1 or =0], followed by <LF>.

**NameOfEvent** can be any event reported by the GPIO. If an event is momentary (such as a button press) the Boolean does not appear.

**=1 or =0** These Boolean values appear only if the event is an ongoing state, such as whether the system is currently in Bypass Mode. These numbers do not appear for momentary events, such as button presses or Cues.

A typical Output Event might look like:

@BuildLamp=1<LF> Means the lamp in the BUILD button is now on.

If the lamp is flashing, PD will report 1 or 0 for each change of state.

## Examples

Note that requests are case sensitive.

REMOTE REQUEST	PDM RESPONSE	NOTES
down Build<LF>	!<LF>	<i>PD starts building the delay</i>
trigger Bypass<LF>	!<LF>	<i>PD toggles the Bypass state</i>
help<LF>	!down up(etc)<LF>	<i>Returns a list of valid commands</i>
help <command><LF>	!(text)<LF>	<i>Returns help for the specified command.</i>
get Depth<LF>	!Depth=7.5	<i>Current delay is 7.5 seconds</i>
get PeakInput<LF>	!PeakInput= -19	<i>Current audio input peak level is -19 dBFS</i>
	@DelayFull=1	<i>*Delay has been fully built</i>
	@Bypass=0	<i>*PD removed from Bypass mode</i>
Ballgame<LF>	?unknown command Ballgame<LF>	<i>PD doesn't understand this instruction, so no action is taken</i>

\* — Output Event Messages (preceded by @) appear only after they've been specifically enabled for a type of event. See next section.

## Output Event Messages

You can use PD's *Output Event messages* to build elaborate custom remote controls. Any event that can trigger a GPIO output can also be sent serially.

Each type of output event must be specifically enabled before PD will report it. This way, you can tell PDM to report only those events that are important to your installation.

Messages are sent via RS-232 and over Ethernet. When PD first boots, or when a socket connection is made to port 5443, a *System Active* message is sent:

@Welcome to PD xxxx<sup>1</sup><LF>. You can use this as a handshake, or as a signal to start your own routine for enabling those Output Events you want reported.

Events are enabled or disabled on a per-connection basis. You must send enable messages each time you establish a new connection. Otherwise, PD defaults to having all of its event messages disabled.

---

<sup>1</sup> xxxx is the serial number of that specific PD. You can use this to verify the proper system is being accessed in facilities with multiple units.

### ***enable***

This command turns on PD's ability to report specific events. Use the form `enable EventName<LF>`, where `EventName` is a change in PD's current status. For example, `enable EmptyTrig<LF>` tells PD to send a message whenever empty has been reached.

- You can put two or more `EventNames` in the same `enable` command. Separate them by spaces. For example, `enable DelayFull Cue1<LF>` tells PD to report any time either Delay Full is reached or Cue 1 goes by.
- Note that `BuildLamp` and `ExitLamp` generate a message each time the lamp turns on or off. If the lamp is flashing, it can result in a lot of messages.
- You can use `All` for `EventName` as a shortcut, when you want to enable messaging for every PD event.
- When PD receives any valid `enable` command, it responds `!<LF>`.
- If a function is active when you enable its message, PD reports its state immediately. It then sends an updated report when the state changes.

For example, if you send `enable Bypass<LF>` and PDM is already Bypassed, PDM immediately responds `@Bypass=1`. Then, when Bypass is disabled, PD will send `@Bypass=0`.

### ***disable***

This command turns off reporting of one or more output events. It follows similar syntax.

- `disable Cue1<LF>` tells PD to stop reporting when Cue 1 is passed.
- `disable BuildTrig FullTrig<LF>` turns off reporting for both functions.
- `disable ALL<LF>` turns off any message reporting.
- PD responds to valid `disable` commands with `!<LF>`.

`disable` affects only the serial messages. Parallel GPIO functions on the DB-25 aren't changed, and stay as you set them on the front panel or via Web interface.

## ***Data Delay***

PD can delay serial streams such as PAD (Program Associated Data) in sync with audio. This way, you can make sure "now playing" or other information on receivers or web streams lines up with program audio. When this feature is turned on, incoming data is stored for exactly the same amount of time that PD is delaying audio, and then sent out.

The data can be carried via RS-232 or IP for maximum flexibility. Both data streams work independently, so you can set RS-232 to delay one kind of data while IP is handling a different kind.

During Building, the data delay is automatically compensated to match.

### ***Data Delay over RS-232***

To use RS-232 for delayed data, open the **CONFIGURATION** page and set RS-232 port mode to delayed data (this can also be done from the front panel). Delayed data gets sent on the same RS-232 connector as it's received on, so if you have one device generating data and another one listening, you'll need a Y cable to split the TX and RX signals.

### ***Data Delay over IP***

Two pairs of ports, 5445/5446 and 5447/5448, provide independent IP data delays. This gives you maximum flexibility for on-air systems and AOIP systems. To set this function, open **CONFIGURATION** and check the appropriate Network delayed data port box.

The lower number of each pair (5445 or 5447) is the input port, while the higher number (5446 or 5448) is the output port. Only one input can feed data at a time, but multiple devices can be listening to delayed data on the outputs.

---

## **Installation**

PD fits a standard 19" equipment rack, 1 unit high by 12" deep (allow additional depth for the connectors).

While PD doesn't generate much heat, we recommend at least one unit of blank or perforated rack panel separating it from any heat-generating devices above or below it. Do not block the fan or intake vents on the rear of the unit.

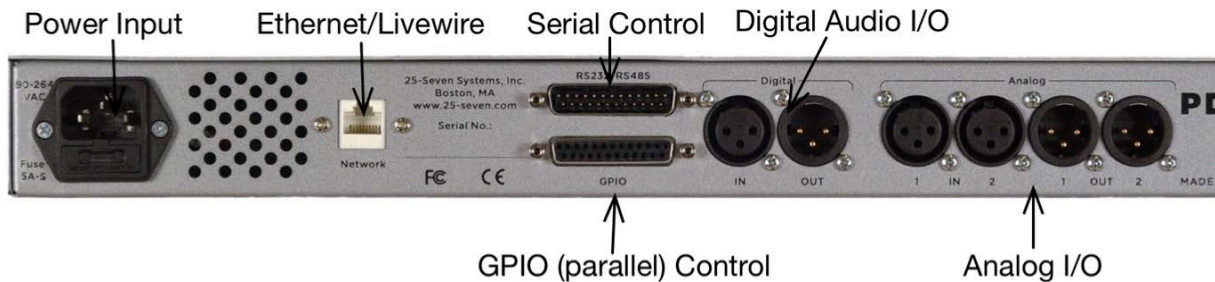
- You can check PD's internal temperature using front panel menus (page 22), or via web interface (page 35). As a general guideline, PD should stay within 20° Fahrenheit (about 7° C) of ambient room temperature
- PD's cooling fan is its only moving part, and must move freely to keep PD in normal operating range. If temperature readings appear high, check the fan and air intake vent immediately.
- We recommend you check the cooling fan annually, to make sure it's moving freely and that dust hasn't built up.

The internal power supply will self-adapt to any voltage between 100 – 240 v 50/60 Hz. It consumes 1.8 A maximum; typical draw is about 32 watt @ 120VAC.

We recommend that PD be connected to a UPS (uninterruptible power supply), to prevent loss of audio in case of a power disruption. This is good advice for any mission-critical electrical device.



## Rear Panel



### Power Input

Standard IEC configuration self-adapts to any voltage between 100 – 240 volts AC, 50 or 60 Hz.

### Ethernet / Livewire

Connect to a standard 10/100Base-T network connection. PD uses this port for remote control via web browser, e-mail, serial remote control over IP, Livewire audio input and output, and synchronization to a modulation monitor or network time server. If connected to the Internet, it should be behind a hardware firewall or on a VPN.

### Digital Input

This input conforms to IEC 958 Professional (5v p-p, 110Ω balanced, usually known as AES/EBU) on XLR connectors.

**Warning:** PD will lock to any valid signal at this connector, even if you're using analog audio inputs. This lets you keep PD's internal clocks compatible with other equipment. But locking to a new signal can disrupt audio. **Do not connect, remove, or change a digital input signal while PD is on the air.**

If using the digital input, you should configure the PD's Sample Rate to match the rate of the digital audio signal, even if you are using the Analog input. This will reduce the potential for problems if the digital input has a dropout.

Under extreme circumstances, an intermittent digital input can cause erratic audio behavior. If this happens, power-cycle the PD.

### Digital Output

This output conforms to IEC 958 Professional (AES/EBU) on XLR connectors. Output is 16-bit PCM linear. The digital output is always active, no matter what PD is using for an input.

If there is no signal on the digital input jack, PD provides its own low-jitter clock, at the sample rate you've set in the menu. When there is a valid signal at the digital input jack—even if analog inputs are selected—the internal clock and digital output are

locked to it. Use this feature to make sure PD's output works smoothly with your routers and other equipment. But see the warning about digital clocking above.

## Analog Inputs

Information about input and output levels is on page 20. Unbalanced operation is not recommended.

These are electronically balanced XLR female, pin 2 hot, with a load of 20k $\Omega$ : this makes them compatible with all modern electronically-balanced outputs. If fed from a transformer-balanced output, we recommend bridging a 680 $\Omega$  resistor between pins 2 and 3.

## Analog Outputs

These are electronically balanced XLR male, pin 2 hot, designed to feed a load of 600 $\Omega$  or greater.

PD uses advanced algorithms to process signals in true stereo, with no smearing or variation in the stereo field during Building. So while the analog outputs (and analog inputs) are labeled 1 and 2 on the back panel, we assume you'll be using them for the left and right channels of a stereo pair and that's how we've written this documentation.

However, you can also use PD for dual, identical processing of two mono signals. There's no cross-talk.

## Bypass Relays

Analog and digital XLR inputs and outputs are wired to bypass relays. In the event of a power failure, incoming audio is connected directly to the outputs. PD powers up in bypass.

**Always use Bypass mode when installing software updates.** You can trigger this mode with the front panel BYPASS button or the web interface.

If you're using PD to distribute a single input to both analog and digital outputs, remember this feature is defeated by the Bypass relays. If you want both sets of outputs to be live during Bypass, you'll have to provide two sets of inputs.

## GPIO

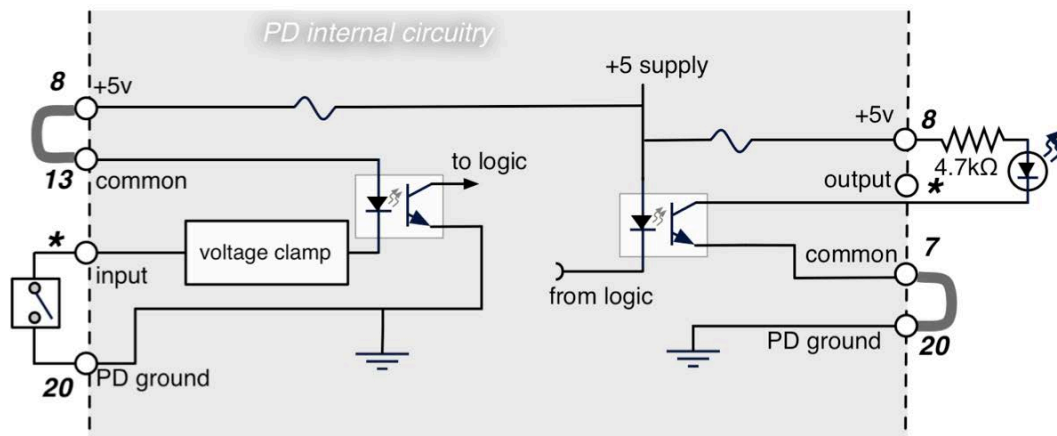
Eight parallel control inputs and eight parallel control outputs appear on the female DB-25 connector, with pinouts detailed below. Input and output functions are assigned through the **GPIO** menu or web configuration page.

Inputs and outputs are opto-isolated for easy interface to other equipment. A +5v supply and ground are also brought out to the DB-25 for simple remote controls using pushbuttons and LED status readouts. Output pulse length is 250ms<sup>1</sup>.

The +5v supply can provide 200 mA, more than adequate for 8 LEDs and 8 logic inputs. Total draw should not exceed this value. This supply is protected by an internal, self-resetting thermal circuit breaker. If this breaker should trip, power off and allow several minutes for it to reset.

### Basic remote control

- 1) Use the connections shown on the left side of the schematic below. At the DB-25, jump pin 13 (input common) to pin 8 (+5v).
- 2) Connect one side of an SPST NO pushbutton to pin 20 (ground); connect the other side to pin 25 (Input 1).
- 3) Add up to 7 more pushbuttons as needed, connecting one side of all to pin 13 as common, and connecting their other sides to the individual inputs in the chart below.



Typical remote input (left) and output (right) circuits. Use the jumpers shown in gray for simple pushbutton / LED remote. Or use just the opto-isolator connections without pins 8 and 20 for interface to other equipment. DB-25 pinouts shown in bold. \* indicates individual DB-25 pins for separate GPIO inputs and outputs; see chart below.

### Basic remote readout

- 1) Use the connections shown on the right side of the schematic. At the DB-25, connect pin 7 (output common) to pin 20 (PD ground).
- 2) Connect a 4.7 kΩ 1/4 watt resistor between pin 8 (+5 V) and the anode or + lead of an LED; connect the cathode or – lead of the LED to pin 19 (output 1).
- 3) Add up to 7 more resistor-and-LED combinations as needed, using pin 8 as the common voltage supply and connecting the LEDs cathodes to individual outputs in the chart below.

<sup>1</sup> Other pulse lengths may be available; contact customer support.

## Connecting to external logic or relay circuits:

PD's GPIO inputs and outputs are isolated from its power supply and ground, and can be connected to external logic circuits or the power supplies in remote equipment:

- Inputs require at least 6 mA flowing from the input common (pin 1) and the individual input circuit pin.
- Outputs can carry up to 50 mA, up to 30 V DC per channel, between the individual output circuit pin and output common (pin 7).

### *GPIO Pinouts*

PIN	SIGNAL	PIN	SIGNAL
1	NC	14	NC
2	Ground	15	NC
3	Output 8	16	Output 7
4	Output 6	17	Output 5
5	Output 4	18	Output 3
6	Output 2	19	Output 1
7	Output Common	20	Ground
8	+5 VDC	21	NC
9	Input 8	22	Input 7
10	Input 6	23	Input 5
11	Input 4	24	Input 3
12	Input 2	25	Input 1
13	Input Common	NC — No internal connection	

## Serial Port

### *RS-232*

The RS-232 pins are configured as a computer DTE port, similar to the Comm 1 jack on desktop computers.

If you want to send serial commands from a computer or dumb terminal, you'll need a DB-25 null modem or a cable that reverses pins 2 and 3 (data), and reverses pins 4 and 5 (flow control). Since PD uses standard pin configurations, you should be able to use an easily available DB-25 to DB-9 adapter to connect more common 9 pin cables.

### *RS-485*

There are also two independent RS-485 differential data lines on this connector. Each is independently controlled and programmable as input, output, or bi-directional.

### Serial Pinouts on DB-25

PIN	SIGNAL	
1	NC	
2	RS-232 TX	<i>Output from PD</i>
3	RS-232 RX	<i>Input to PD</i>
4	RS-232 RTS	<i>Do not use</i>
5	RS-232 CTS	<i>Do not use</i>
6	NC	
7	Ground	
8	RS-485 Port 1 +	<i>Differential pair. Bi-directional for slave clock display</i>
9	RS-485 Port 1 -	
10	NC	
11	RS-485 Port 2 +	<i>For future expansion</i>
12	RS-485 Port 2 -	
13 - 25	NC	NC — No internal connection

---

## Software Updates and Service

25-Seven Systems is constantly working to improve our products. Please check in with us for the latest software release information. Software updates can be sent via email, and installed using a simple web page from a connected computer. Instructions will be included by 25-Seven tech support.

Make sure PD is in Bypass mode before beginning any software update. Power cycle your unit after installing new software.

PD has comprehensive diagnostics running in the background at all times, creating a log of important events and conditions. We may ask you to download and send us your log file in case of a problem, or to help us gather data in other ways.

In extreme situations, our software engineers can remotely test your PD via our unique Remote Access system. **But you have to specifically set this up before we can start, and it applies for just that session.** Afterward, your system is secure again. We absolutely can't get into your PD unless you let us.

If you think remote access may be appropriate, contact us by phone or e-mail. We'll set up a time, and give you instructions for enabling the session.

---

## Audio Specifications<sup>1</sup>

S/N = 84 dB with 10 dB headroom (94 dB dynamic range), A-weighted

THD @ 1 kHz = .025%; IMD (IHF) = .05%

Frequency response =  $\pm 5$  dB 20 Hz – 20 kHz

---

## For more Information

25-Seven Systems

1085 Commonwealth Avenue, #360, Boston, MA 02215

888/257-2578 (toll free) fax 617/904-1670

web: [www.25-seven.com](http://www.25-seven.com) email: [info@25-seven.com](mailto:info@25-seven.com)

---

## Warranty

25-Seven Systems, a Telos Alliance company, (hereinafter “25-Seven” and “we” or “us”) warrants Precision Delay (“PD” and “the unit”) to be free from defects in material and workmanship for a period of one year from the date of receipt by the end-user.

This warranty is void if the unit is subject to Acts of God including (without limitation) lightning; improper installation or misuse including (without limitation) power line surges; accident; neglect or damage.

EXCEPT FOR THE ABOVE-STATED WARRANTY, 25-SEVEN MAKES NO WARRANTIES, EXPRESS OR IMPLIED (INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE).

In no event will 25-Seven, its employees, agents or authorized dealers be liable for incidental or consequential damages, or for loss, damage, or expense directly or indirectly arising from the use of PD or the inability to use PD either separately or in combination with other equipment or materials, or from any other cause.

In order to invoke this Warranty, notice of a warranty claim must be received by 25-Seven within the above-stated warranty period and warranty coverage must be authorized by us. If we authorize the performance of warranty service, we will supply a shipping address and return authorization number: the defective unit must be delivered to that address, shipping prepaid and with that authorization number clearly marked.

We at our option will either repair or replace the unit and such action shall be the full extent of 25-Seven’s obligation under this Warranty. After the unit is repaired or replaced, we will return it to the party that sent the unit and will pay the cost of ground shipping.

25-Seven’s authorized dealers are not authorized to assume for us any additional obligations or liabilities in connection with the dealers’ sale of the unit.

---

<sup>1</sup> Specifications are for all modes, including time compression or expansion during build and exit. We used analog i/o for our measurements; expect even better results when using digital i/o.