

PA5 Programmable Attenuator



Overview

The PA5 Programmable Attenuator is a precision device for controlling signal levels over a wide dynamic range, providing 0 to 120 dB of attenuation for signals up to 100 kHz in frequency. The device is fully programmable; however, simple manual operation is also available using front panel controls.

When used **programmatically**, the module may be controlled via TDT's ActiveX Controls, as well as any programming environment that supports ActiveX or programs that allow scripts for implementing ActiveX controls, such as Microsoft Access and Excel. For information about how to control the module programmatically, see the *ActiveX Reference Manual*.

When used in manual operation, the attenuation level is adjusted in two modes of operation:

- The *Atten* mode permits the user to adjust the attenuation level of the signal from 0 to 120 dB in increments of 0.1 dB.
- The *UserAtt* mode permits the user to adjust the attenuation level of the signal using user-programmed parameters. Before using the UserAtt mode, attenuation parameters must be set up using the UserOps menu.

Power and Interface

The PA5 Programmable Attenuator is powered via the System 3 zBus (ZB1PS) and requires an interface to the PC (Gigabit, Optibit, or USB). Ensure that the ZB1PS chassis housing the PA5 is connected in the interface loop according to the installation instructions for the interface in use.

Important! The chassis housing the PA5 must be powered and connected to a PC via the PC interface for BOTH manual and programmed operation.

Features

Display

Displays the current level of attenuation being applied to the signal or displays the manual operations menu. During manual operation it is used to set up user-defined attenuation parameters and to obtain descriptions for menu items. See “PA5 Display Icons” on page 14-12, for more information.

(ESC) Button

Exits the manual operations menu items without accepting changes.

SELECT (ENTER) Knob

During manual operation, allows the user to adjust the attenuation applied to the signal. In addition, it allows the user to scroll through the manual operation menus, set up user-defined attenuation parameters, and access descriptions of menu item.

Turn the Select knob to adjust attenuation or view menus. Press and release the knob to make a selection. The module must be in Attn or UserAtt mode to manually adjust attenuation. See “PA5 Manual Operation ” on page 14-4, for more information.

INPUT BNC

Source signal input. The maximum input voltage is +/- 10 V peak.

OUTPUT BNC

Attenuated signal output.

PA5 Manual Operation

Important! The PA5 is powered via the zBus and must be connected to the PC via an interface module during manual operation.

In manual operation, the PA5 is operated using front panel controls. The menu options are viewed by turning the Select knob and entered by pressing and releasing the knob. The module must first be set to Attn or UserAtt mode to manually adjust attenuation.

To access a menu:

- Turn the knob until the name of the desired menu appears on the display, then press and release the knob. The module has two levels of menus.

Top-level menu items are indicated by a single filled box in the upper left corner of the menu display, and sub-menus are indicated with an additional indicator box for each level. Only the UserOps menu item has sub-menu items. See “PA5 Display Icons” on page 14-12, for more information.

For a definition of each menu item:

- Turn the **Select** knob until the name of the menu appears on the display, then press and hold down the **Select** knob. A description of the menu function will scroll across the display.

To exit a menu without changing settings:

- Press and release the **ESC** button.

Operation in *Atten* Mode

In *Atten* mode, the user sets the desired level of attenuation with the Select knob. When the unit is powered on, it defaults to the *Atten* mode with 0.0 dB of attenuation.

To use *Atten* mode:

- Turn the **Select** knob until *Atten* appears on the display, then press and release the **Select** knob.

A small letter "A" appears in the upper left corner of the display, indicating the unit is in *Atten* mode, and a decibel reading appears on the right side of the display. See "PA5 Display Icons" on page 14-12, for more information.

- Turn the **Select** knob to adjust attenuation in 0.1 dB increments.

Operation in *UserAtt* Mode

In *UserAtt* mode, the user can adjust the attenuation level of the signal using user-programmed parameters available in the *UserOps* menu. Users can also save common parameter configurations in the PA5's nonvolatile memory. See "Using Preset Configurations" on page 14-10, for more information.

To use *UserAtt* mode:

1. Turn the **Select** knob until *UserAtt* appears on the display, then press and release the **Select** knob.

A small letter "U" appears in the upper left corner of the display, indicating the unit is in *UserAtten* mode, and a decibel reading appears on the right side of the display. See "PA5 Display Icons" on page 14-12, for more information.

2. Turn the **Select** knob to adjust attenuation according the current user programmable parameters (available in the *UserOps* menu). The default settings include a step size of 3.0 dB and dynamic update mode.

Note: When the Update attenuation parameter is set to Manual, the intensity of the display will dim as the user turns the knob—this indicates that the changes have not been applied to the output signal. The user must press and release the Select knob to apply attenuation changes to the output signal.

To access the *UserOps* menu:

1. Turn the **Select** knob until *UserOps* appears on the display.
2. Press and release the **Select** knob.
3. Set the *UserOps* parameters as desired.

To set parameters such as step size (*StpSize*), update mode (*Update*), minimum attenuation (*AbsMin*), base attenuation (*BaseAtt*), and reference value (*Refrnce*); turn the Select knob to the desired value and then press and release to save changes.

4. To exit any menu without saving parameter changes, press and release the **ESC** button before the settings are saved.

About UserAtten Mode Parameters

In *UserAtten* Mode, the user may set parameters such as step size (*StpSize*), update mode (*Update*), and minimum attenuation (*AbsMin*). The scale can be adjusted using the base attenuation (*BaseAtt*) and reference value (*Refrnce*) parameters. Both base attenuation and reference can be used simultaneously, producing an actual attenuation equal to ($Refrnce + BaseAtt$ - dial setting). See “PA5 Manual Operation ” on page 14-4, for more information.

BaseAtt--Base Attenuation

Adds a fixed attenuation value, shifting the scale down and allowing attenuation to be displayed relative to this base level (useful for calibrating signals played over varying transducers). See “Setting Base Attenuation” on page 14-8, for more information.

StpSize--Step Size

Sets the increments in which attenuation is applied to the signal when using the Select knob.

Refrnce—Reference

Sets a reference value used to “flip” the scale of the display (useful for displaying actual signal level on the front panel of the PA5). May be used only when the intensity of the input signal is known. See “Setting a Reference Value ” on page 14-10, for more information.

Update—Update

Determines whether attenuation changes dynamically as the selector knob is turned or only after pressing enter to select the current value.

AbsMin--Minimum Attenuation

Sets the minimum level of attenuation the user can apply to the signal (to avoid accidentally presenting excessively loud signals).

PA5 Manual Operation Menus

To access a menu:

- Turn the knob until the name of the desired menu appears on the display, then press and release the knob. The module has two levels of menus.

Top-level menu items are indicated by a single filled box in the upper left corner of the menu display, and sub-menus are indicated with an additional indicator box for each level. Only the UserOps menu item has sub-menu items.

For a definition of each menu item:

- Turn the Select knob until the name of the menu appears on the display, then press and hold down the Select knob. A description of the menu function will scroll across the display.

To exit a menu without changing settings:

- Press and release the **ESC** button.

PA5 Top Level Menu

Command	Description
Atten	Sets attenuation from 0.0 to 120.0 dB in 0.1 dB increments. The default setting is 0.0 dB. When Atten is in use, the letter "A" appears on the left side of the display, while the attenuation level appears on the right side of the display.
UserAtt	Sets attenuation based on UserOps settings. Before use, attenuation parameters must be set up via the UserOps sub-menus (see below). The default setting is 0.0 dB. When UserAtt is in use, the letter "U" appears on the left side of the display, while the attenuation level appears on the right side of the display.
UserOps	<p>Access UserOps submenu UserOps Sub-menu:</p> <p>BaseAtt Sets a fixed level of attenuation as a reference. The default setting is 0.0 dB and the range is 0 to 100.0 dB. When BaseAtt is set, a "+" symbol appears on the left side of the display. When used, the attenuation level displayed is relative to BaseAtt. For example, with BaseAtt set to 60.0 dB, the attenuation level will be display from -60.0 dB to 60.0 dB.</p> <p>StpSize Sets the increments of attenuation. The default setting is 3.0 dB, and the range is 0.1 to 60.0dB.</p> <p>Refrnce Changes the display so it shows the output signal intensity rather than the attenuation level. This function may be used only when the input signal strength is known. When Refrnce is set, the letter "R" appears on the left side of the display. The default setting is 0.0, and the range is ± 300.0. For example, when Refrnce is set to 136 and the attenuation level set to 0.0 dB, the display shows 136.0. When the attenuation level is adjusted to 30.0 the display shows 106.</p> <p>Update Determines when attenuation is applied to the signal. When set to Dynamic, attenuation is applied as the Select knob is turned. When set to Manual, attenuation is applied after the Select knob is pressed and released. The default setting is Dynamic.</p> <p>Note that when Update is set to Manual, the attenuation level on the display changes as the Select knob is turned, but the attenuation is not applied to the signal until the Select knob is pressed and released. In this mode, the intensity of the display dims to indicate that the attenuation has not been applied to the signal.</p> <p>MinAttn Sets the minimum attenuation level for the UserAtt mode. This is used to avoid signals that are too loud for the subject or equipment. The default value is 0.0 dB and its range is 0.0 to 100.0 dB.</p> <p>Note that setting this parameter limits the range of possible attenuation levels. For example, when it is set to 30.0 dB, the range of attenuation is 30 db to 120 dB.</p>

PA5 Top Level Menu

Command	Description
Load PS	Loads one of four preset UserAtt configurations from non-volatile memory. See Save PS (Below). The default is 1 and its range is 1 to 4.
Save PS	<p>Saves the current UserAtt configuration in one of four non-volatile memory buffers. This permits the user to save commonly used UserAtt configurations. The default is 1 and its range is 1 to 4.</p> <p>To save a configuration, first ensure that all UserAtt parameters are set as desired then turn the Select knob until the desired memory location is displayed, and press the Select knob. Saving appears on the display. The preset is ready of use.</p>
Reset	<p>Resets all menu items, including presets, to their default conditions.</p> <p>Confirm The user must confirm the reset by pressing and releasing the Select knob. While the module is resetting, Resetting appears on the display. The user must confirm the reset by pressing and releasing the Select knob. While the module is resetting, Resetting appears on the display.</p> <p>To exit without resetting, turn the Select knob until Cancel appears on the display and then press and release the Select knob, or press the Esc button.</p> <p>Cancel Cancels the reset.</p>

Setting Base Attenuation

When operating the PA5 manually in User Attenuation (UserAtt) mode, the Base Attenuation (BaseAtt) parameter can be used to apply a fixed attenuation level to the signal. Any additional attenuation to the signal is displayed relative to this base level within a range of 0 to 120 dB. For example: if the BaseAtt is set to 6 dB, when the user sets the attenuation to 3 dB the actual attenuation applied is 9 dB. This feature can be used to calibrate a number of different experimental setups, attenuating each by a different base attenuation so as to provide identical signal levels when each is set to 0.0 dB UserAtt.

When this feature is in use, a “+” symbol is displayed on the left side of the display. Note that the Base Attenuation and Reference parameters can be used simultaneously. When both of these features are in use, the letter “R” and a “+” symbol are displayed on the left side of the display. See “PA5 Display Icons” on page 14-12, for more information.

To set the base attenuation:

1. Access the *UserAtt* mode, by turning the **Select** knob until *UserAtt* appears on the display, then pressing and releasing the knob.
2. Access the *UserOps* menu, and turn the **Select** knob until *BaseAtt* appears on the display.
3. Press and release the **Select** knob. *0.0 dB* appears on the display.
4. Turn the **Select** knob until the display shows the desired level of attenuation.
5. Press and release the **Select** knob. The level is saved and *BaseAtt* appears on the display.

6. To exit the *UserOps* menu, press and release the **ESC** button again.

Example 1: Adding Speaker Calibration Attenuation

A user wishes to equilibrate the level of stimuli applied to two different loudspeakers. Speaker #2 is 7.3 dB louder at the frequency of interest than speaker #1. This example requires the use of two PA5 programmable attenuators.

To more directly compare thresholds measured with both loudspeakers, set the BaseAtt parameter for speaker #1 to *0.0 dB* and set the *BaseAtt* parameter for speaker #2 to 7.3 dB, so that the signal level delivered for a given *UserAtt* is the same for both loudspeakers. Actual attenuation versus displayed levels is shown in the following table.

Speaker 1: BaseAtt=0		Speaker 2: BaseAtt = 7.3	
<i>UserAtt</i> Display Value	Actual Attenuation	<i>UserAtt</i> Display Value	Actual Attenuation
0	0	-7.3	0
120	120	0	7.3
		112.7	120

Example 2: Multiple Signals of Varying Levels

The base attenuation feature is also useful when working with multiple signals of varying levels. BaseAtt can be configured so the intensity of each signal input is identical at 0.0 dB. When working with three signals 30, 34, and 36 dB SPL, the BaseAtt parameters are set and the actual versus displayed value of attenuation are shown in the table below.

This example requires three PA5 programmable attenuators.

Input Signal	BaseAtt	Displayed Value	Actual Attenuation
36 dB SPL	6.0 db	0	6
		4	10
		6	12
		8	14
34 dB SPL	4.0 dB	0	4
		4	8
		6	10
		8	12
30 dB SPL	0.0 dB	0	0
		4	4
		6	6
		8	8

Setting a Reference Value

The Reference parameter is used to display the intensity of the output signal. This parameter can be used only when the strength of the input signal is known. This serves to “flip” the scale, displaying larger numbers for smaller attenuation values.

When in use, a letter “R” is displayed on the left side of the display. Note that the Base Attenuation and Reference parameters can be used simultaneously. When both of these features are in use, the letter “R” and a “+” symbol are displayed on the left side of the display. See “PA5 Display Icons” on page 14-12, for more information.

To set the Reference parameter:

1. Access the *UserOps* menu, and turn the **Select** knob until *Refrnce* appears on the display.
2. Press and release the **Select** knob. *0.0 dB* appears on the display.
3. Turn the **Select** knob until the display shows the desired level.
4. Press and release the **Select** knob. The reference is saved.
5. To exit the *UserOps* menu, press and release the **ESC** button.

Example 1: Displaying Signal Level in SPL

A user wishes to use the PA5 to display the signal level in dB Sound Pressure Level (SPL) for the frequency of interest. Measurements with a sound level meter show a sound level of 96.4 dB SPL with 0.0 dB of attenuation in the PA5. The user sets the Refrnce parameter to 96.4.

The actual attenuation versus the displayed value is as follows:

Display Value (in dB SPL)	Attenuation
0	96.4
50	46.4
96.4	0

Example 2: Combining Reference and Base Attenuation

When the Reference parameter is set to 110 dB and the Base Attenuation parameter is set to 6.0 dB, the actual attenuation versus displayed value is as follows:

Display Value (in dB SPL)	Attenuation
0	116
50	66
110	6

Using Preset Configurations

The PA5 Programmable Attenuator allows users to save four unique User Operation configurations that may be used in UserAttn mode. These configurations may include any of the UserOps parameters (such as step size, base attenuation, and minimum attenuation). Before a configuration can be loaded, it must be set up via the UserOps menu and saved via the SavePS menu.

Saving Preset Configurations



WARNING: This procedure overwrites the contents of the selected preset location. Be certain that the existing configuration is not needed before continuing.

Before a configuration can be saved, it must be set up via the *UserOps* menu. Once the configuration is set up as desired, save the configuration by performing the following:

1. At any top-level menu, turn the **Select** knob until *SavePS* appears on the display.
2. Press and release the **Select** knob. *Preset-1* appears on the display.
3. Turn the **Select** knob until the desired preset location is displayed and then press and release the **Select** knob.

Saving appears on the display and then *Atten* appears on the display.

The configuration is saved.

Loading Preset Configurations

When a configuration has been set up via the *UserOps* menu and saved via the *SavePS* menu, load the configuration by performing the following:

1. Turn the **Select** knob until *LoadPS* appears on the display.
2. Press and release the **Select** knob. *Preset-1* appears on the display.
3. Turn the **Select** knob until the desired preset location is displayed, and then press and release the **Select** knob.

Loading appears on the display and then *Attn* appears on the display.

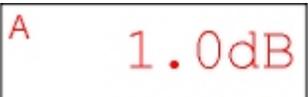
The configuration is loaded.

PA5 Display Icons

Menu Level Icons

Display	Description
	Single Box: indicates a top-level menu.
	Double Box: indicates a second-level menu.

Attenuation Mode Icons

Display	Description
	A: Normal Attenuation Mode
	U: User Attenuation Mode
	U+: User Attenuation Mode. Base attenuation value set.
	R: User Attenuation Mode. Reference level set.
	R+: User Attenuation Mode. Base attenuation value and reference level set.

PA5 Technical Specifications

Input Signal Range	±10V peak
Frequency Range	– 200 kHz
Attenuation Range	0.0 to 120.0 dB
Attenuation Resolution	0.1 dB
Attenuation Accuracy	0.05 dB
Spectral Variation	< 0.04 dB (20Hz to 80 kHz)
Offset	< 10 mV
Signal/Noise	113 dB (20 Hz to 80 kHz at 9.9 V)
Noise Floor	16 μ V rms (20 Hz to 80 kHz)
THD	< 0.003% (1kHz tone +/- 7V peak, 0 dB attenuation)
Attenuation Settling Time	5 ms
Switching Transient	< 8 mV (0 Hz to 80 kHz)
Input Impedance	10 kOhm
Output Impedance	10 Ohm

