

PA5 Programmable Attenuator

Hardware Reference



Updated 2025-02-27

© 2016-2025 Tucker-Davis Technologies, Inc. (TDT). All rights reserved.

Tucker-Davis Technologies
11930 Research Circle
Alachua, FL 32615 USA
Phone: +1.386.462.9622
Fax: +1.386.462.5365

Notices

The information contained in this document is provided "as is," and is subject to being changed, without notice. TDT shall not be liable for errors or damages in connection with the furnishing, use, or performance of this document or of any information contained herein.

The latest versions of TDT documents are always online at <https://www.tdt.com/docs/>

Table of Contents

PA5 Programmable Attenuator

Overview	4
Power and Interface	5
Features	5
Display	5
(ESC) Button	5
SELECT (ENTER) Knob	5
INPUT BNC	6
OUTPUT BNC	6
PA5 Manual Operation	6
Operation in Atten Mode	7
Operation in UserAtt Mode	7
About UserAtten Mode Parameters	8
PA5 Manual Operation Menus	9
PA5 Top Level Menu	10
Setting Base Attenuation	12
Setting a Reference Value	13
Using Preset Configurations	13
Saving Preset Configurations	14
Loading Preset Configurations	14
PA5 Display Icons	15
Menu Level Icons	15
Attenuation Mode Icons	15
PA5 Technical Specifications	16
PA5 Frequency Response	16
PA5 Frequency Response with 50 dB Attenuation	17
PA5 Total Harmonic Distortion	17

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 in any programming environment that supports ActiveX controls, such as MATLAB, Python, or LabVIEW. 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:

- In **Atten** mode, the attenuation level of the signal can be adjusted from 0 to 120 dB in increments of 0.1 dB.
- **UserAtt** mode applies user-programmed parameters to adjust the attenuation level. 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](#) 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 Atten or UserAtt mode to manually adjust attenuation. See [PA5 Manual Operation](#) 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](#) 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:

1. 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](#) for more information.

2. 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](#) 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](#) 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](#) 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](#), 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](#) 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

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

Access UserOps submenu:

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.

StpSize

Sets the increments of attenuation. The default setting is 3.0 dB, and the range is 0.1 to 60.0 dB.

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.

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.

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.

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.

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. Access UserOps submenu.

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

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.

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.

Reset

Resets all menu items, including presets, to their default conditions.

Confirm

The user must confirm the reset by pressing and releasing the Select knob. While the module is resetting, Resetting appears on the display.

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.

Cancel

Cancels the reset.

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](#) 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.

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](#) for more information.

To set the Reference parameter:

1. Access the **UserOps** menu, and turn the **Select** knob until **Refnrnce** 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.

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 **Atten** 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.

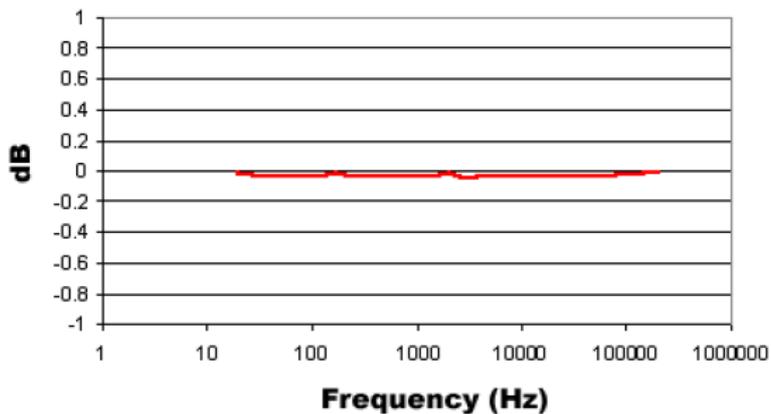
Attenuation Mode Icons

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.

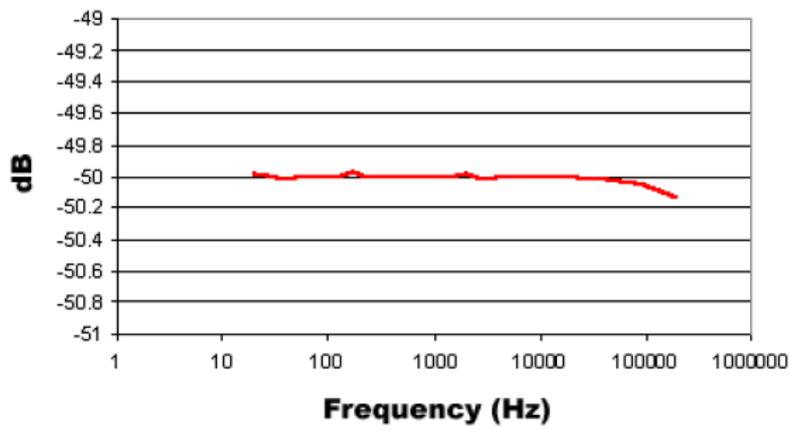
PA5 Technical Specifications

Input Signal Range	± 10 V peak
Frequency Range	DC - 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 (20 Hz to 80 kHz)
Offset	<10 mV
Signal/Noise	113 dB (20 Hz to 80 kHz at 9.9 V)
Noise Floor	16 μ Vrms (20 Hz to 80 kHz)
THD	<0.003% (1 kHz tone ± 7 V 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

PA5 Frequency Response



PA5 Frequency Response with 50 dB Attenuation



PA5 Total Harmonic Distortion

