

Vaunix Technology Corporation
Lab Brick® Family of Digital Attenuators

API User
Manual



Revision A1

NOTICE

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1.0 OVERVIEW

The LabBrick Programmable Attenuator Win32 SDK supports developers who want to control LabBrick programmable attenuators from Windows programs, or who want to control the attenuators from LabVIEW¹ or other National Instruments programming environments. The SDK includes a dll which provides a Win32 API to find, initialize, and control the attenuators, along with header files and an example Win32 C program which demonstrates the use of the API.

¹ LabView is a trademark of National Instruments

2.0 USING THE SDK

The SDK consists of a dll, named VNX_atten.dll, along with this documentation, a C style header file, a library file for linking to the dll, and a VC 6 example program. Unzip the SDK into a convenient place on your hard disk, and then copy the dll and library file into the directory of the executable program you are creating. Add the header file (VNX_atten.h) to your project, and include it with the other header files in your program. Make sure that the linker directives include the path of the library file.

3.0 PROGRAMMING

3.1 Overall Strategy and API Achitecture

The API provides functions for identifying how many and what type of LabBrick attenuators are connected to the system, initializing attenuators so that you can send them commands and read their state, functions to control the operation of the attenuators, and finally a function to close the software connection to the attenuator when you no longer need to communicate with it.

The API can be operated in a test mode, where the functions will simulate normal operation but will not actually communicate with the hardware devices. This feature is provided as a convenience to software developers who may not have a LabBrick attenuator with them, but still want to be able to work on an applications program that uses the LabBrick. Of course it is important to make sure that the API is in its normal mode in order to access the actual hardware!

Be sure to call `fnLDA_SetTestMode(FALSE)`, unless of course you want the API to operate in its test mode. In test mode there will be 2 devices, an LDA-102 and an LDA-602.

The first step is to identify the attenuators connected to the system. Call the function `fnLDA_GetNumDevices()` to get the number of attenuators attached to the system. Note that USB devices can be attached and detached by users at any time. If you are writing a program which needs to handle the situation where devices are attached or detached while the program is operating, you should periodically call `fnLDA_GetNumDevices()` to see if any new devices have been attached.²

Allocate an array big enough to hold the device ids for the number of devices present. While you should use the `DEVID` type declared in `VNX_atten.h` it's just an array of uints at this point. You may want to just allocate an array large enough to hold `MAXDEVICES` device ids, so that you do not have to handle the case where the number of attenuators increases.

Call `fnLDA_GetDevInfo(DEVID *ActiveDevices)`, which will fill in the array with the device ids for each connected attenuator. The function returns an integer, which is the number of devices present on the machine.

The next step is to call `fnLDA_GetModelName(DEVID deviceID, char *ModelName)` with a null `ModelName` pointer to get the length of the model name, or just use a buffer that can hold `MAX_MODELNAME` chars. You can use the model name to identify the type of attenuator. Call

² Usually it is a good idea to call `fnLDA_GetNumDevices()` at around 1 second intervals. While a short interval reduces the chances, it is still possible that the user will remove one device and replace it with another however, so to completely handle all the cases which can result from users hot plugging devices your application needs to check to see not only if the number of devices is different, but if they are different devices.

`fnLDA_GetSerialNumber(DEVID deviceID)` to get the serial number of the attenuator. Based on that information, your program can determine which device to open.

Once you have identified the attenuator you want to send commands to, call `fnLDA_InitDevice(DEVID deviceID)` to actually open the device and get its various parameters like attenuation setting, attenuation ramp parameters, etc. After the `fnLDA_InitDevice` function has completed you can use any of the get functions to read the settings of the attenuator.

To change one of the settings of the attenuator, use the corresponding set function. For example, to set the attenuation level, call `fnLDA_SetAttenuation(DEVID deviceID, int attenuation)`. The first argument is the device id of the attenuator, the second is the value of the attenuation you want to set the attenuator to. Attenuation is specified in .25 db units, so 10 db of attenuation is represented as 40, 6 db of attenuation is represented as 24, and .5 db, the minimum attenuation increment, is represented as 2.

When you are done with the device, call `fnLDA_CloseDevice(DEVID deviceID)`.

3.2 Status Codes

All of the set functions return a status code indicating whether an error occurred. The get functions normally return an integer value, but in the event of an error they will return an error code. The error codes can be distinguished from normal data by their numeric value, since all error codes have their high bit set, and they are outside of the range of normal data.

A separate function, `fnLDA_GetDeviceStatus(DEVID deviceID)` provides access to a set of status bits describing the operating state of the attenuator. This function can be used to check if a device is currently connected or open.

The values of the status codes are defined in the `VNX_atten` header file.

3.3 Functions – Selecting the Device

VNX_ATTEN_API void fnLDA_SetTestMode(bool testmode)

Set testmode to FALSE for normal operation. If testmode is TRUE the dll does not communicate with the actual hardware, but simulates the basic operation of the dll functions. It does not simulate the operation of attenuation ramps generated by the actual hardware, but it does simulate the behavior of the functions used to set the parameters for the ramps.

VNX_ATTEN_API int fnLDA_GetNumDevices()

This function returns a count of the number of connected attenuators.

VNX_ATTEN_API int fnLDA_GetDevInfo(DEVID *ActiveDevices)

This function fills in the ActiveDevices array with the device ids for the connected attenuators. Note that the array must be large enough to hold a device id for the number of devices returned by fnLDA_GetNumDevices. The function also returns the number of active devices, which can, under some circumstances, be less than the number of devices returned in the previous call to fnLDA_GetNumDevices.

The device ids are used to identify each device, and are used in the rest of the functions to select the device. Note that while the device ids may be small integers, and may, in some circumstances appear to be numerically related to the devices present, they should only be used as opaque handles.

VNX_ATTEN_API int fnLDA_GetModelName(DEVID deviceID, char *ModelName)

This function is used to get the model name of the attenuator. If the function is called with a null pointer, it returns just the length of the model name string. If the function is called with a non-null string pointer it copies the model name into the string and returns the length of the string. The string length will never be greater than the constant MAX_MODELNAME which is defined in VNX_atten.h This function can be used regardless of whether or not the attenuator has been initialized with the fnLDA_InitDevice function.

VNX_ATTEN_API int fnLDA_GetSerialNumber(DEVID deviceID)

This function is used to get the serial number of the attenuator. It can be called regardless of whether or not the attenuator has been initialized with the fnLDA_InitDevice function. If your system has multiple attenuators, your software should use each device's serial number to keep track of each specific device. Do not rely upon the order in which the devices appear in the table of active devices. On a typical system the individual attenuators will typically be found in the same order, but there is no guarantee that this will occur.

VNX_ATTEN_API int fnLDA_GetDeviceStatus(DEVID deviceID)

This function can be used to obtain information about the status of a device, even before the device is initialized. (Note that information on the sweep or ramp activity of the device is not guaranteed to be available before the device is initialized.)

VNX_ATTEN_API int fnLDA_InitDevice(DEVID deviceID)

This function is used to open the device interface to the attenuator and initialize the dll's copy of the device's settings. If the fnLDA_InitDevice function succeeds, then you can use the various fnLDA_Get* functions to read the attenuator's settings. This function will fail, and return an error code if the attenuator has already been opened by another program.

VNX_ATTEN_API int fnLDA_CloseDevice(DEVID deviceID)

This function closes the device interface to the attenuator. It should be called when your program is done using the attenuator.

3.4 Functions – Setting parameters on the Attenuator

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuation(DEVID deviceID, int attenuation)

This function is used to set the attenuation level of the programmable attenuator. The attenuation setting is encoded as an integer where each increment represents .25db of attenuation. The encoding is:

$$\text{attenuation} * .25\text{db} = \text{Attenuation in db}$$

For example, attenuation = 40 for 10db of attenuation and 2 for .5db of attenuation.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampStart(DEVID deviceID, int rampstart)

This function sets the attenuation level at the beginning of an attenuation ramp or sweep. The encoding of rampstart is the same as the fnLDA_SetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampEnd(DEVID deviceID, int rampstop)

This function sets the attenuation level at the end of an attenuation ramp or sweep. The encoding of rampstop, the attenuation level, is the same as the fnLDA_SetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationStep(DEVID deviceID, int attenuationstep)

This function sets the size of the attenuation step that will be used to generate the attenuation ramp or sweep. The encoding of attenuationstep, is the same as the fnLDA_SetAttenuation function. The smallest attenuation step size is 2 or .5 db.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationStepTwo(DEVID deviceID, int attenuationstep2)

This function sets the size of the attenuation step that will be used to generate the attenuation for the second phase of a ramp. The encoding of attenuation step, is the same as the fnLDA_SetAttenuation function. The smallest attenuation step size is 2 or .5 db.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetChannel(DEVID deviceID, int channel)

This function sets the active channel of a quad channel device. Valid channels are 1 to 4.

VNX_ATTEN_API LVSTATUS fnLDA_SetDwellTime(DEVID deviceID, int dwelltime)

This function sets the length of time that the attenuator will dwell on each attenuation step while it is generating the attenuation ramp. The dwelltime variable is encoded as the number of milliseconds to dwell at each level. The minimum dwell time is 1 millisecond.

VNX_ATTEN_API LVSTATUS fnLDA_SetDwellTimeTwo(DEVID deviceID, int dwelltime2);

This function sets the dwell time for each step on the second phase of an attenuation ramp. The dwelltime2 variable is encoded as the number of milliseconds to dwell at each level. The minimum dwell time is 1 millisecond.

VNX_ATTEN_API LVSTATUS fnLDA_SetHoldTime(DEVID deviceID, int holdtime)

This function sets the time delay between the first and second phases of a ramp. The holdtime variable is encoded as the number of milliseconds. The minimum hold time is 0 milliseconds.

VNX_ATTEN_API LVSTATUS fnLDA_SetIdleTime(DEVID deviceID, int idletime)

This function sets the length of time that the attenuator will wait at the end of an attenuation ramp before beginning the ramp again when the ramp mode is set to SWP_REPEAT. The idletime variable is encoded as the number of milliseconds to idle at each level. The minimum idle time is 0 milliseconds.

VNX_ATTEN_API LVSTATUS fnLDA_SetRFOn(DEVID deviceID, bool on)

This function allows rapid switching of the attenuator from its set value “on” (on = TRUE) to its maximum attenuation (on = FALSE).

VNX_ATTEN_API LVSTATUS fnLDA_SetRampDirection(DEVID deviceID, bool up)

This function is used to set the direction of the attenuation ramp. To create a ramp with increasing attenuation, set up = TRUE. Note that the ramp start attenuation value must be less than the ramp end attenuation value for a ramp with increasing attenuation. For a ramp with decreasing attenuation the ramp start value must be greater than the ramp end value.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampMode(DEVID deviceID, bool mode)

This function is used to select either a single ramp or sweep of attenuation values, or a repeating series of ramps. If mode = TRUE then the ramp will be repeated, if mode = FALSE the ramp will only happen once.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampBidirectional(DEVID deviceID, bool bidir_enable)

This function selects bidirectional ramps. For a bidirectional ramp the attenuation changes from the start to end value in the first phase, and then back to the start value in the second phase.

VNX_ATTEN_API LVSTATUS fnLDA_StartRamp(DEVID deviceID, bool go)

This function is used to start and stop the attenuation ramps. If go = TRUE the attenuator will begin sweeping, FALSE stops the sweep.

VNX_ATTEN_API LVSTATUS fnLDA_SaveSettings(DEVID deviceID)

The LabBrick attenuators can save their settings, and then resume operating with the saved settings when they are powered up. Set the desired parameters, then use this function to save the settings.

VNX_ATTEN_API LVSTATUS fnLDA_SetProfileElement(DEVID deviceID, int index, int attenuation)

This function sets the value of a profile element. The index runs from zero to the maximum profile length minus 1. PROFILE_MAX is currently 100. The encoding of attenuation step, is the same as the fnLDA_SetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetProfileCount(DEVID deviceID, int profilecount)

This function sets the number of elements in the profile that will be used. It must be greater than zero and less than PROFILE_MAX, the maximum profile length.

VNX_ATTEN_API LVSTATUS fnLDA_SetProfileIdleTime(DEVID deviceID, int idletime)

This function sets the idle time after a profile is played before the profile is played again in repeating profile mode.

VNX_ATTEN_API LVSTATUS fnLDA_SetProfileDwellTime(DEVID deviceID, int dwelltime)

This function sets the time duration of each element in the profile during playback. The dwelltime is specified in milliseconds.

VNX_ATTEN_API LVSTATUS fnLDA_StartProfile(DEVID deviceID, int mode)

This function starts the playback of a profile. A mode value of 1 plays the profile once, a mode value of 2 plays the profile repeatedly.

High resolution specific functions:

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationHR(DEVID deviceID, int attenuation)

This function is used to set the attenuation level of the programmable attenuator. The attenuation setting is encoded as an integer where each increment represents .05db of attenuation. The encoding is:

$$\text{attenuation} * .05\text{db} = \text{Attenuation in db}$$

For example, attenuation = 200 for 10db of attenuation and 10 for .5db of attenuation.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationHRQ(DEVID deviceID, int attenuation, int channel)

This function is used to set the channel and attenuation level of the quad programmable attenuator. The attenuation encoding is the same as fnLDA_SetAttenuationHR and valid channels are 1 to 4.

VNX_ATTEN_API LVSTATUS fnLDA_SetWorkingFrequency(DEVID deviceID, int frequency)

This function sets the frequency to use when setting the attenuation, this increases the accuracy of the attenuation. The frequency setting is in 100KHz steps therefore 200MHz would be represented by 2000.

NOTE: The LabView VI works in MHz and therefore 200MHz would be represented by 200.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampStartHR(DEVID deviceID, int rampstart)

This function sets the attenuation level at the beginning of an attenuation ramp or sweep. The encoding of rampstart is the same as the fnLDA_SetAttenuationHR function.

VNX_ATTEN_API LVSTATUS fnLDA_SetRampEndHR(DEVID deviceID, int rampstop)

This function sets the attenuation level at the end of an attenuation ramp or sweep. The encoding of rampstop, the attenuation level, is the same as the fnLDA_SetAttenuationHR function.

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationStepHR(DEVID deviceID, int attenuationstep)

This function sets the size of the attenuation step that will be used to generate the attenuation ramp or sweep. The encoding of attenuation step, is the same as the fnLDA_SetAttenuationHR function.

VNX_ATTEN_API LVSTATUS fnLDA_SetAttenuationStepTwoHR(DEVID deviceID, int attenuationstep2)

This function sets the size of the attenuation step that will be used to generate the attenuation for the second phase of a ramp. The encoding of attenuation step, is the same as the fnLDA_SetAttenuationHR function.

VNX_ATTEN_API LVSTATUS fnLDA_SetProfileElementHR(DEVID deviceID, int index, int attenuation)

This function sets the value of a profile element. The index runs from zero to the maximum profile length minus 1. PROFILE_MAX is currently 100. The encoding of attenuation step, is the same as the fnLDA_SetAttenuationHR function.

3.5 Functions – Reading parameters from the Attenuator

VNX_ATTEN_API int fnLDA_GetDLLVersion()

This function returns the version of the DLL, encoded as Major.Minor version in the lower 16 bits. LDA_DLLVERSION 0x00000200 // Version 2.0

VNX_ATTEN_API int fnLDA_GetFeatures(DEVID deviceID);

This function returns a bit vector with bits set to indicate the available features. See VNX_LDA_api.h for definitions. Legacy devices have a zero value for the feature vector.

VNX_ATTEN_API int fnLDA_GetAttenuation(DEVID deviceID)

This function returns the current attenuation setting of the selected device. When an attenuation ramp is active this value will change dynamically to reflect the current setting of the device. The attenuation is encoded as an integer where each increment represents .25db of attenuation. The encoding is:

$$\text{attenuation} * .25\text{db} = \text{Attenuation in db}$$

For example, returned attenuation = 40 for 10db of attenuation and 2 for .5db of attenuation.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetRampStart(DEVID deviceID)

This function returns the current attenuation ramp start value setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetRampEnd(DEVID deviceID)

This function returns the current attenuation ramp end setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetAttenuationStep(DEVID deviceID)

This function returns the current attenuation step size setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetAttenuationStepTwo(DEVID deviceID)

This function returns the current attenuation step size setting of the selected device for the second phase of a ramp. The return value encoding is the same as the fnLDA_GetAttenuation function.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetDwellTime(DEVID deviceID)

This function returns the current dwell time for each step on the attenuation ramp in milliseconds. A one second dwell time, for example, would be returned as 1000.

VNX_ATTEN_API int fnLDA_GetDwellTimeTwo(DEVID deviceID)

This function returns the current dwell time for each step on the attenuation ramp in milliseconds for the second phase of a ramp. A one second dwell time, for example, would be returned as 1000.

VNX_ATTEN_API int fnLDA_GetIdleTime(DEVID deviceID)

This function returns the idle time, which is the delay between attenuation ramps when the device is in the repeating ramp mode, in milliseconds.

VNX_ATTEN_API int fnLDA_GetRF_On(DEVID deviceID)

This function returns an integer value which is 1 when the attenuator is “on”, or 0 when the attenuator has been set “off” by the fnLDA_SetRFOn function. Note that the function does not attempt to interpret attenuation settings as either “on” or “off”, so if you set the attenuation level to 63 db, (attenuation = 252) the output signal level would be the same as if you had used the fnLDA_SetRFOn function with the on = FALSE, but this function would not return 0.

VNX_ATTEN_API int fnLDA_GetMaxAttenuation(DEVID deviceID)

This function returns the maximum attenuation value that the device can provide. The return value encoding is the same as the fnLDA_GetAttenuation function. Since future products may have different maximum attenuation capabilities your software should use this function to obtain the maximum attenuation possible.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetMinAttenuation(DEVID deviceID)

This function returns the minimum attenuation value that the device can provide. The return value encoding is the same as the fnLDA_GetAttenuation function. Since future products may have different minimum attenuation capabilities your software should use this function to obtain the minimum attenuation possible.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

VNX_ATTEN_API int fnLDA_GetAttenuationHR(DEVID deviceID)

This function returns the current attenuation setting of the selected device. When an attenuation ramp is active this value will change dynamically to reflect the current setting of the device. The attenuation is encoded as an integer where each increment represents .05db of attenuation. The encoding is:

$$\text{attenuation} * .05\text{db} = \text{Attenuation in db}$$

For example, returned attenuation = 200 for 10db of attenuation and 10 for .5db of attenuation.

NOTE: The LabView VI does the above conversion internally therefore the units are in dB.

High resolution specific functions:

VNX_ATTEN_API int fnLDA_GetAttenuationHR(DEVID deviceID)

This function returns the current attenuation setting of the selected device. When an attenuation ramp is active this value will change dynamically to reflect the current setting of the device. The attenuation is encoded as an integer where each increment represents .05db of attenuation. The encoding is:

$$\text{attenuation} * .05\text{db} = \text{Attenuation in db}$$

For example, returned attenuation = 200 for 10db of attenuation and 10 for .5db of attenuation.

VNX_ATTEN_API int fnLDA_GetWorkingFrequencyHR(DEVID deviceID)

This function returns the current attenuation ramp start value setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuationHR function.

VNX_ATTEN_API int fnLDA_GetRampStartHR(DEVID deviceID)

This function returns the current attenuation ramp start value setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuationHR function.

VNX_ATTEN_API int fnLDA_GetRampEndHR(DEVID deviceID)

This function returns the current attenuation ramp end setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuation function.

VNX_ATTEN_API int fnLDA_GetAttenuationStepHR(DEVID deviceID)

This function returns the current attenuation step size setting of the selected device. The return value encoding is the same as the fnLDA_GetAttenuationHR function.

VNX_ATTEN_API int fnLDA_GetAttenuationStepTwoHR(DEVID deviceID)

This function returns the current attenuation step size setting of the selected device for the second phase of a ramp. The return value encoding is the same as the fnLDA_GetAttenuationHR function.

VNX_ATTEN_API int fnLDA_GetMaxAttenuationHR(DEVID deviceID)

This function returns the maximum attenuation value that the device can provide. The return value encoding is the same as the fnLDA_GetAttenuationHR function. Since future products may have different maximum attenuation capabilities your software should use this function to obtain the maximum attenuation possible.

VNX_ATTEN_API int fnLDA_GetMinAttenuationHR(DEVID deviceID)

This function returns the minimum attenuation value that the device can provide. The return value encoding is the same as the fnLDA_GetAttenuationHR function. Since future products may have

different minimum attenuation capabilities your software should use this function to obtain the minimum attenuation possible.

NOTE: The LabView VI does all the above conversions internally therefore the units are in engineering units.

4.0 PROGRAMMING SUPPORT

Lab Brick programming support is available from Vaunix Technology Corporation. Please contact our technical support group by email - LabBrickSupport@Vaunix.com.

Vaunix Technology also offers custom programming solutions. Send us your requirements to receive a fixed rate project quotation.

Thank you for using our Lab Brick products.