

Introducing the LXI Interface

APPLICATION NOTE

Summary

LXI is the latest industry standard for LAN connectivity to instruments and modular systems.

Beginning with firmware release 5.7.2.1, several series of LeCroy oscilloscopes include a new remote control option: **LXI**, or LAN eXtensions for Instrumentation. LXI is the latest industry standard for LAN connectivity to instruments and modular systems. LXI-compliant LeCroy oscilloscopes include standard LXI features such as a LAN interface, VXI11 discovery, a web server and IVI-C & IVI-COM drivers. Each of these items is described below, along with examples for using the LXI interface. To configure the scope for LXI connectivity, go to Utilities > Utilities Setup, select the Remote tab as shown below, and press the LXI (VXI11) button as shown in Figure 1 below.

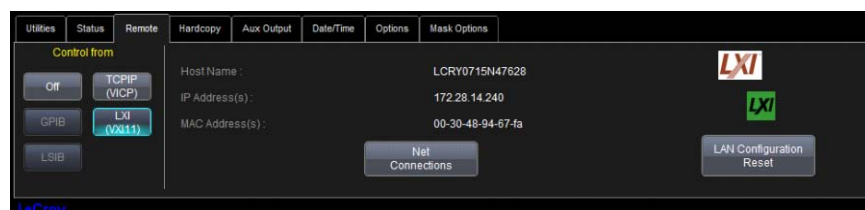


Figure 1 - Dialog for setting up the remote control interface.

The LXI standard goes well beyond specifying a LAN interface on a stand-alone instrument; it is intended both to replace the aging GPIB interface as the industry standard for connecting Test & Measurement equipment and to specify a complete modular standard with requirements for size, cooling, multi-device synchronization, triggering, etc. The full specification for LXI can be found at <http://www.lxistandard.org>. The specification describes three LXI classes that must adhere to some subset of the full LXI specification; LeCroy oscilloscopes are Class C LXI instruments.

Primary LXI Features

LAN Interface

The physical LAN interface on LXI-compliant oscilloscopes is no different than in other LeCroy oscilloscopes that offer LAN connectivity. All compliant oscilloscopes include a standard RJ45 connector to connect the oscilloscope to your network or to another host PC via a crossover network cable. The LXI LAN interface uses the VXI11 protocol on top of the TCP/IP stack.

LeCroy oscilloscopes (with a few exceptions) have included a LAN interface standard since 2001, and optionally since the late 1990's. This interface option remains in place and continues to be referred to as the "TCPIP" option, as shown in figure 1 above, and uses LeCroy's VICP protocol.

VXI11 Discovery

The LXI standard requires that instruments support VXI11 Discovery to automatically detect LXI instruments on your network. The LXI spec requires only that enough of the VXI-11 protocol be implemented to allow discovery, and for execution of simple *IDN? queries. After that, manufacturers may choose to switch to their own proprietary protocol for further communications with the instrument. LeCroy has decided to go one step further, implementing a full-featured VXI-11 stack that allows any command or query to be sent using the VXI-11 protocol, instead of requiring LeCroy's proprietary VICP protocol to be used.

National Instruments' Measurement & Automation Explorer software includes the ability to automatically find LXI instruments on a network. See the section ***Automatically Find Instruments and Create Aliases*** for more details. VXI11 is a protocol created back in the mid 1990's, originally for use with VXIbus instruments.

IVI Driver

In order to be LXI compliant, manufacturers must provide an **IVI driver**. IVI, or *Interchangeable Virtual Instrument* is a driver technology that provides a standard API for communications with instruments, allowing users to potentially interchange instruments without changing their source code. The IVI Foundation manages the IVI specification; see <http://www.ivifoundation.org> for more information. In order to become LXI compliant, a new IVI driver (**LeCroyScope**) was developed. The driver strictly adheres to the Ivi-Scope instrument class specification, and includes both IVI-C and IVI-COM drivers. For detailed information about how the driver works and the functions it includes, see the help information that installs with the driver. A shortcut to the help file can be found in Start > All Programs > LeCroy > LeCroyScope > Documentation.

It is important to note that IVI drivers use **VISA** (*Virtual Instrument Software Architecture*). Users of drivers that employ a VISA interface layer typically avoid the need to deal with the low-level details of the communications bus. For this reason, it is recommended to use drivers such as the LeCroyScope IVI driver or, for LabVIEW users, the **lcwave** or **LeCroy_Wave_Series** LabVIEW drivers. See the sections regarding using LabVIEW and VisualStudio for examples.

Web Interface

The LXI specification requires that compliant instruments should include a web server that responds to a standard http request to its IP address. Several of the webpages are shown in the figures below. Note the LAN Configuration page in Figure 3. Via this page, users can change the oscilloscope's IP address and remote control mode. **It is highly recommended that users modify the password for the LAN Configuration.** The password can be reset to the default value by pressing the LAN Configuration Reset button on the **Remote** tab of the **Utilities** dialog, as shown in Figure 1. The default username is **lxi.lecroyuser**; the default password is **lxi**.

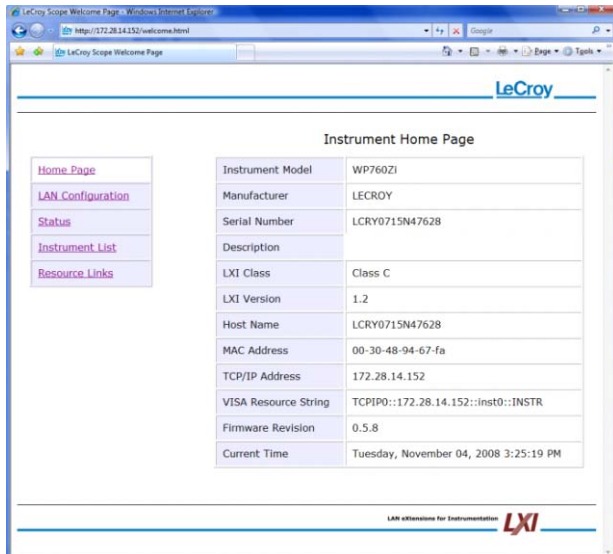


Figure 2 - Web interface homepage

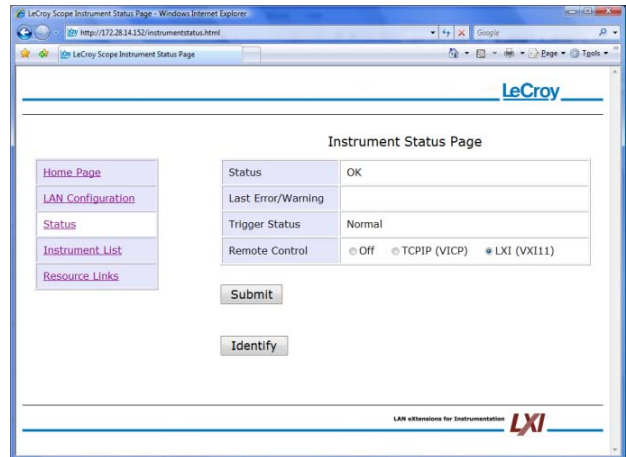


Figure 4 - Instrument Status page

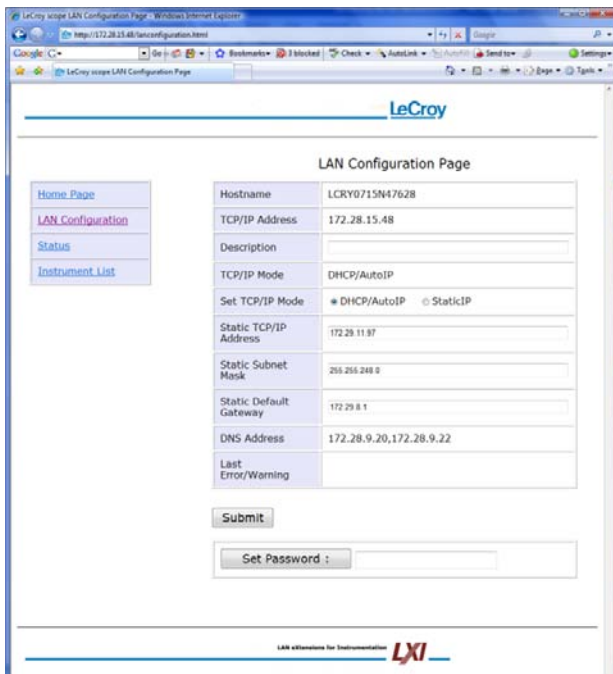


Figure 3 – LAN Configuration Page

Using LXI Features

Automatically Find Instruments and Create Aliases

National Instruments' Measurement & Automation Explorer (MAX) includes the ability to automatically find LeCroy oscilloscopes and to create a VISA alias. The following screenshots show how to create a resource in MAX, and to use VXI discovery to automatically find oscilloscopes on the network and create aliases to them. See the next section on how to use the aliases in LabVIEW and Visual Studio. Using an alias is a powerful way to make your application more flexible.

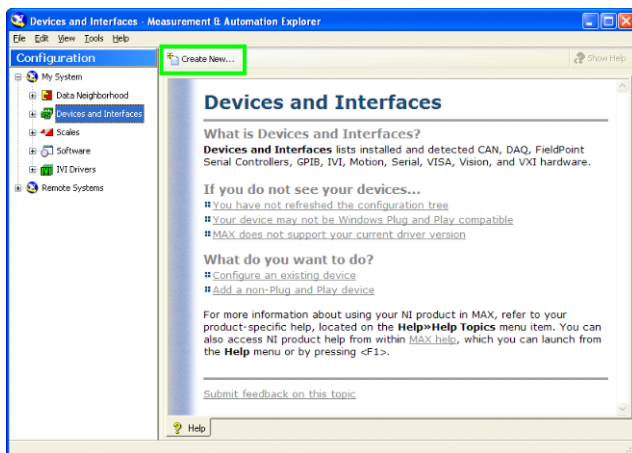


Figure 5 - Click Create New to start the wizard to create a new device or interface

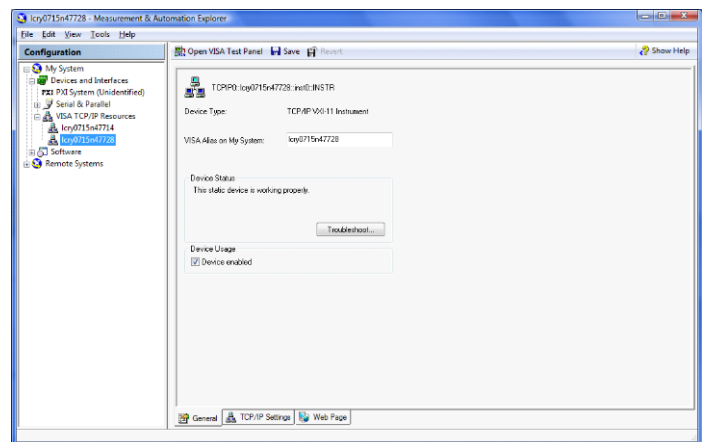


Figure 7 - When the wizard is complete, a new device and alias are created. The alias can be changed if desired on this screen.

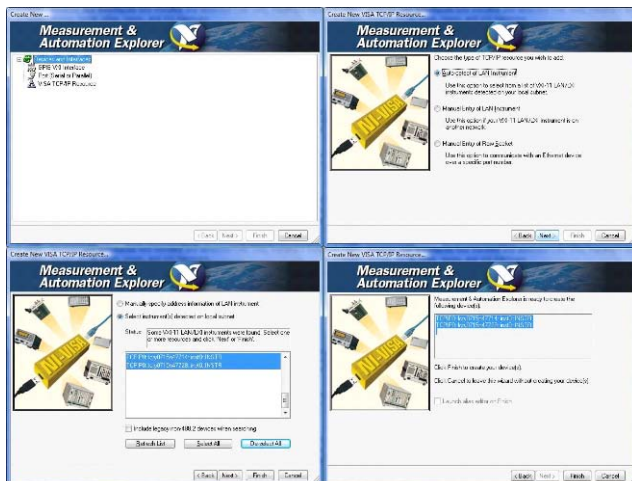


Figure 6 - Step through the wizard. In the first screen, select VISA TCP/IP Resource. Subsequent screens select whether or not to auto-detect all instruments, and to select the instruments for which a new device is created

LXI Connections using the IVI Driver

When using the LeCroyScope IVI driver, LXI connections are established by using either the oscilloscope's LXI VISA resource string or an alias when opening a connection. This is done via either the IVI driver's Initialize or InitializeWithOptions functions. (When initializing the connection, the IVI driver passes the VISA Resource Name or alias to a "VISA Open" call. The VISA handler determines the connection type to be LXI, and passes the request to open a connection (and subsequent requests to Read or Write data) to the VISA passport that handles the LXI interface.) Figure 8 shows an example application written in Visual Basic 2005, using the complete VISA resource name (left side) and using an alias (right side). The code for this example is available by emailing technical.support@lecroy.com.

Note that when using the IVI driver, the lower-level details of LXI (or VXI11) programming are hidden from the user; the details of the VXI11 protocol are handled by the VISA passport. Also note that since VISA is employed, no mention of the interface bus appears in program, which facilitates upgrading from GPIB to LXI (or back).

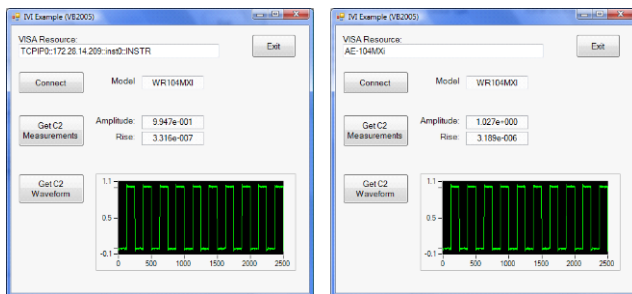


Figure 8- Visual Basic 2005 application GUI that shows how to address the scope using both the explicit VISA resource name for an LXI instrument at IP address 172.28.14.209, and using its alia “AE-104MXi”

IVI-C vs IVI-COM

The LeCroyScope IVI driver includes both IVI-C and IVI-COM drivers. The IVI-C driver is a DLL that uses C-based entry points for its functions. The IVI-COM driver is based on Microsoft’s Component Object Model technology. LabWindows/CVI users should use the IVI-C driver, which includes an function panel file for selecting driver functions as is standard in LabWindows. Developers working in .NET environments will typically use the IVI-COM driver. See the help file that installs with the driver for more information.

LXI Communications in LabView Using the Icwave and LeCroy_Wave_Series Drivers

LabVIEW drivers are available for use with LXI-enabled oscilloscopes from LeCroy, and can be downloaded from National Instruments’ Instrument Driver Network. These are VISA-based LabVIEW drivers that adhere to National Instruments driver development guidelines, and are not IVI drivers. When using LabVIEW, and when interchangeability between instruments of different manufacturers is not required, using one of these drivers is often preferred to using the LeCroyScope IVI driver. LabVIEW drivers are easier to modify since they do not require creating a DLL as is required for IVI drivers. (To use the LeCroyScope IVI driver in LabVIEW, see the LeCroyScope documentation that installs with the driver.)

The two LabVIEW drivers are called **Icwave** and **LeCroy_Wave_Series**. Their code is equivalent, but they differ in that LeCroy_Wave_Series is a project-style driver for use in LabVIEW 8.0 and higher. Since both of the LabVIEW drivers are VISA-based they can be used for LXI connections without any modification to the code. The drivers can also be used for GPIB and VICP communications simply by using the appropriate VISA resource name. (Note that VICP users should have the **VICP Passport** for NI-VISA installed on their PC.) For users changing to LXI connectivity from GPIB or VICP all that is required is to use the VISA Resource String or an alias defined in Measurement & Automation Explorer. (See the **Web Interface** and **Automatically Find Instruments and Create Aliases** sections of this document.)

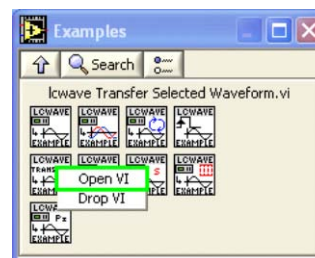


Figure 9 - “Examples” function palette for the Icwave driver

The following screenshots show the **Icwave Transfer Selected Waveform** example that can be found in the Icwave driver’s **Examples** function palette (see figure 9). To open this example, simply right-click on its icon and select open.

Figure 10 below shows the full VISA Resource String; figure 11 shows the use of an alias defined in Measurement & Automation Explorer.

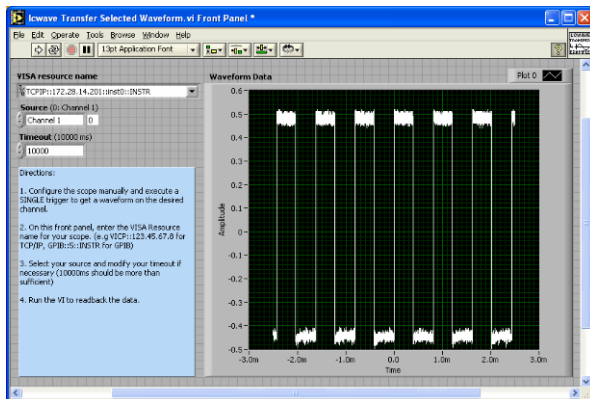


Figure 10 – Example showing use of the full VISA resource name, addressing an oscilloscope at IP address 172.28.14.201

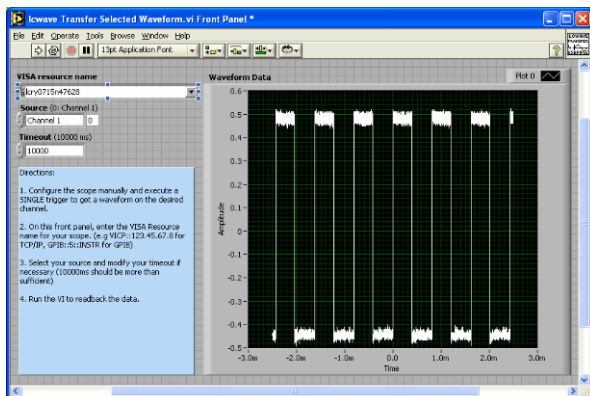


Figure 11 - The user has opted to use an alias for the VISA Resource Name.

Conclusion

The addition of an LXI interface simplifies remote control operation. Users can locate their instruments more quickly via VXI-11 discovery, address them more easily using an alias, and interact via industry standard IVI drivers or via National Instruments certified LabVIEW drivers.