Instrument Control Toolbox 2

Control and communicate with test and measurement instruments

The Instrument Control Toolbox lets you communicate with instruments, such as oscilloscopes, function generators, and analytical instruments, directly from MATLAB®. With the toolbox, you can generate data in MATLAB to send out to an instrument, or read data into MATLAB for analysis and visualization.

The toolbox provides a consistent interface to all devices independent of hardware manufacturer, protocol, or driver. The toolbox supports IVI, VXI*plug&play*, and MATLAB instrument drivers. Support is also provided for GPIB, VISA, TCP/IP, and UDP communication protocols.

Working with the Instrument Control Toolbox

The Instrument Control Toolbox provides a variety of ways to communicate with instruments, including:

- Instrument drivers
- Communication protocols
- Graphical user interface (TMTool)

The Instrument Control Toolbox is based on MATLAB object technology. The toolbox includes functions for creating objects that contain properties related to your instrument and to your instrument control session.

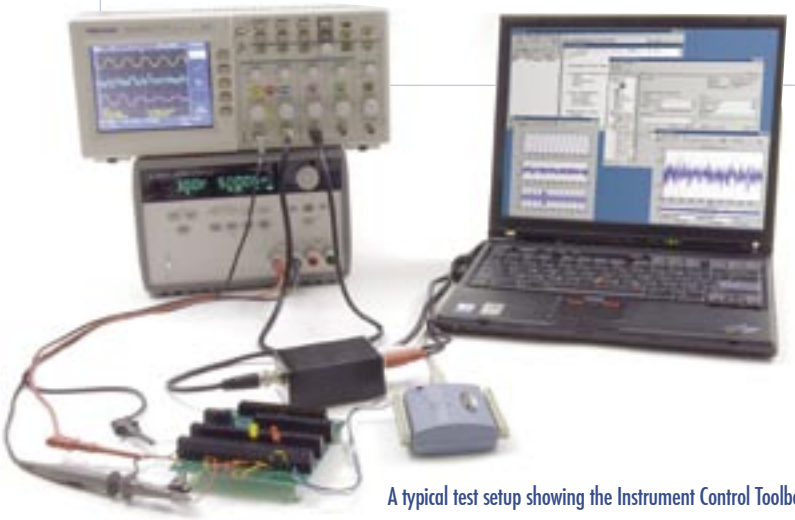
Instrument Drivers

Instrument drivers let you communicate with an instrument independent of device protocol. As a result, you can use common MATLAB terminology to communicate with instruments without learning instrument-specific commands, such as Standard Commands for Programmable Instruments (SCPI).

The toolbox lets you work with VXI*plug&play*, IVI, and MATLAB instrument drivers. VXI*plug&play* and IVI instrument drivers often ship with your instrument and are also available from the instrument manufacturers' Web sites. You can also create MATLAB instrument drivers with driver development tools provided in the Instrument Control Toolbox.

KEY FEATURES

- Instrument driver support for IVI, VXI*plug&play*, and MATLAB instrument drivers
- Support for GPIB and VISA standard protocols (GPIB, GPIB-VXI, VXI, USB, TCP/IP, serial)
- Support for networked instruments using the TCP/IP and UDP protocols
- Graphical user interface for identifying, configuring, and communicating with instruments
- Hardware availability, management, and configuration tools
- Instrument driver development and testing tools
- Functions for reading and writing binary and text (ASCII) data
- Synchronous and asynchronous (blocking and nonblocking) read-and-write operations
- Event handling for time-out, bytes read, data written, and other events
- Recording of data transferred to and from instruments



A typical test setup showing the Instrument Control Toolbox controlling and communicating with a power supply and oscilloscope. Resulting data is read into MATLAB for analysis and visualization.

Communication Protocols

The Instrument Control Toolbox supports communication protocols, including GPIB, serial, TCP/IP, and UDP, for directly communicating with instruments. You can also communicate with instruments using VISA over GPIB, VXI, USB, TCP/IP, and serial buses. The toolbox provides a set of M-file functions for creating and working with instruments. These functions let you write commands to your instrument or read data from your instrument for use in MATLAB.

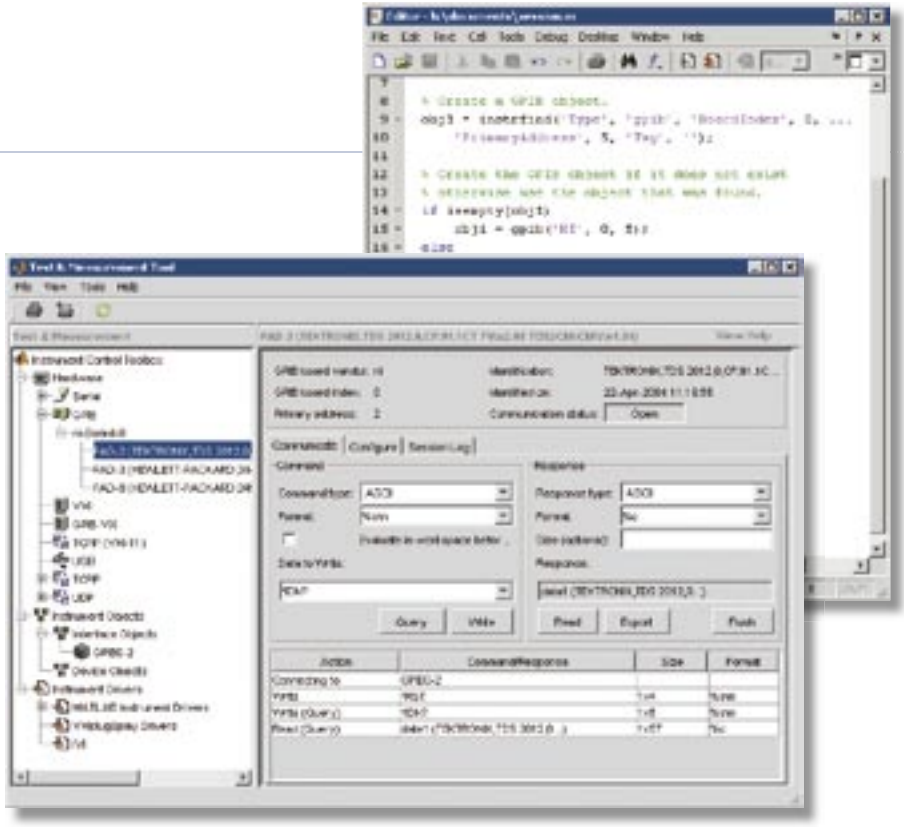
The toolbox supports the text commands used by your instrument, such as SCPI. The transferred data can be binary or ASCII.

TMTool

You can communicate with and configure your instruments without writing code using TMTool, a GUI that enables programmers and nonprogrammers to:

- Search for available hardware
- Connect to an instrument
- Configure instrument settings
- Write data to an instrument
- Read data from an instrument

TMTool automatically generates M-code from your instrument control session. By saving this code to an M-file, you can execute the same commands programmatically.



TMTool, a graphical user interface, lets you search for available hardware and drivers and communicate with and control instruments without writing code. TMTool can automatically generate M-code from your session.

Managing Your Instrument Control Session

Hardware Detection, Management, and Configuration

The Instrument Control Toolbox provides a set of utility functions that enable you to easily determine hardware availability for your test setup. Using the provided functions, the toolbox will scan for all available hardware connected to your system.

The toolbox also lets you configure IVI Configuration store information for your IVI drivers. You can add and remove hardware assets and logical names and display available IVI driver information.

You can access these management and configuration functions using M-file functions or TMTool.

Support for Synchronous and Asynchronous Modes

The Instrument Control Toolbox supports both synchronous and asynchronous read-and-write operations. A synchronous operation blocks access to the command line until the read or write is completed. An asynchronous operation lets you issue additional MATLAB commands while the read or write operation executes.

Event Handling

An event, which occurs at a particular time after a condition is met, may execute a specified function, known as a callback. The Instrument Control Toolbox lets you use events and callbacks to analyze data as it is received from the instrument or to display a message to the MATLAB workspace when all the data has been written to the instrument. The toolbox supports many event conditions, such as:

- Errors
- Timers
- Bytes available
- Output buffer empty

Data Recording

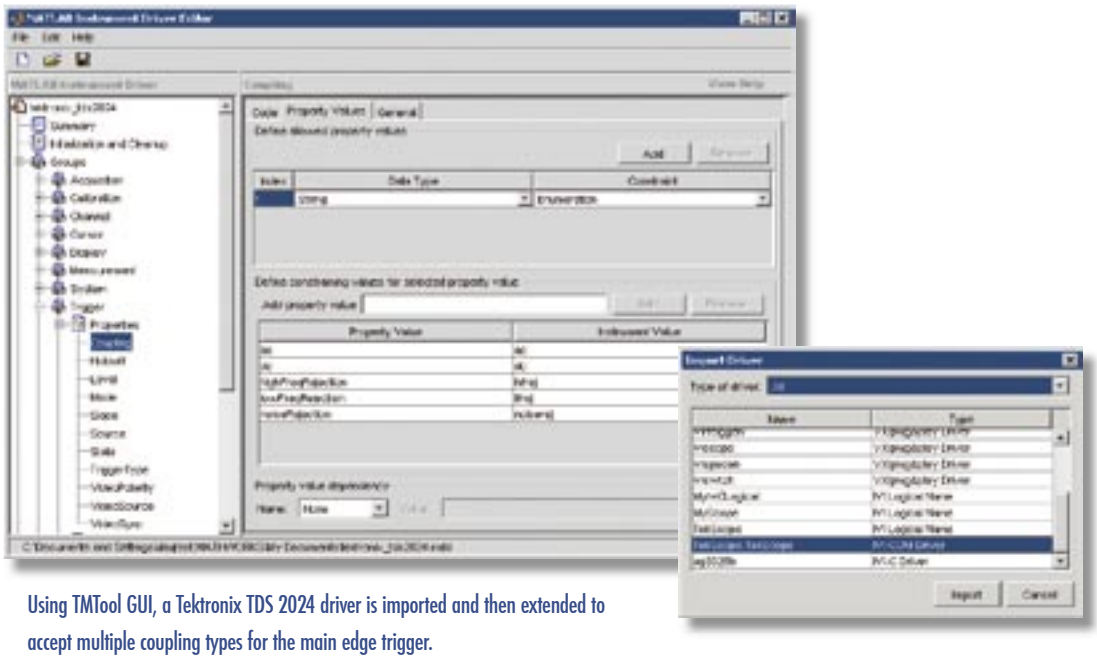
The Instrument Control Toolbox includes functions for recording your instrument control session to disk files. You can record:

- Data written to instruments
- Data read from instruments
- Event information

Developing and Modifying Instrument Drivers

Creating and Testing Instrument Drivers

The Instrument Control Toolbox provides a set of graphical tools for creating and testing MATLAB instrument drivers and for working with IVI and VXI*plug&play* drivers.



Using TMTool GUI, a Tektronix TDS 2024 driver is imported and then extended to accept multiple coupling types for the main edge trigger.

To work with VXI*plug&play* and IVI instrument drivers, a MATLAB instrument driver wrapper is required for the underlying driver. You can create these drivers using the provided tools. You can also download preconfigured wrappers and MATLAB instrument drivers from the MathWorks Web site.

The MATLAB Instrument Driver Editor Tool lets you create MATLAB instrument drivers and wrappers for VXI*plug&play* and IVI instrument drivers. The MATLAB Instrument Driver Editor Tool also lets you:

- Import existing drivers for editing and modification
- Configure and define instrument-specific properties
- Document properties and functions
- Customize the behavior of your instrument

The MATLAB Instrument Driver Testing Tool provides a graphical environment for creating a test to verify the functionality of a MATLAB instrument driver. It also lets you:

- Verify property behavior
- Verify function behavior
- Save the test as M-code
- Export the test results to the MATLAB workspace, a figure window, a MAT-file, or the MATLAB Array Editor
- Save test results as an HTML page

Adding Analysis Capabilities to Instrument Drivers

The Instrument Control Toolbox lets you modify instrument drivers to call MATLAB analysis functions. As a result, you can configure the instrument to perform tasks that return results as text or numeric data. VXI*plug&play*, IVI, and MATLAB instrument drivers can be extended to incorporate a single command to the instrument or a sequence of instrument commands.

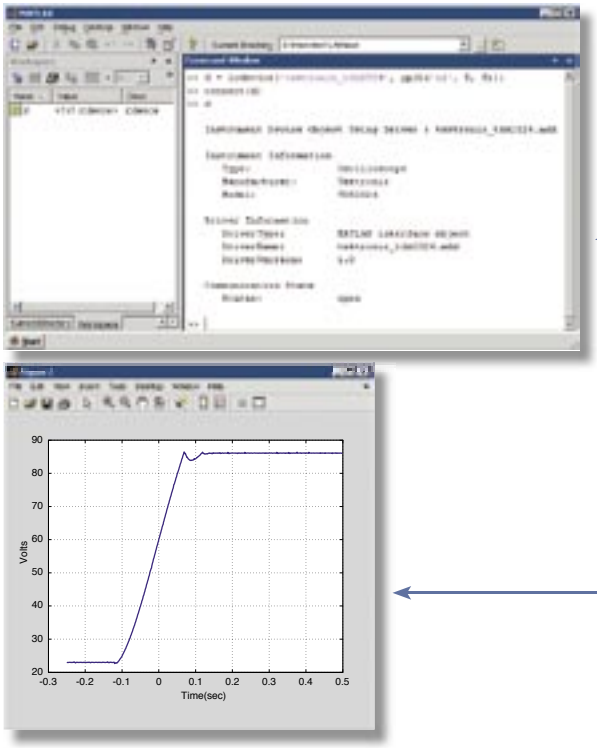
You can also include MATLAB code to determine which commands are sent to the instrument or to perform analysis on data returned from the instrument. For example, you can request that a meter run its self-calibration and return the status as a result. You can also read a meter's scaling, request a measurement, adjust the measured data according to the scale reading, and then return the result.

Supported Drivers and Interfaces

The Instrument Control Toolbox supports IVI, VXI*plug&play*, and MATLAB instrument drivers.

The toolbox also lets you communicate with instruments using the following protocols:

- GPIB (HPIB, IEEE-488) interfaces from Agilent Technologies, Capital Equipment Corporation (CEC), CONTEC, ICS Electronics, IOTech, Keithley, Measurement Computing Corp. (formerly ComputerBoards), and National Instruments




```
% Create a device object to communicate with the instrument
d = icdevice('tektronix_tds2024', gpib('ni',0, 1));

% Connect to the instrument
connect(d);

% Get information about the instrument
d

% Configure the trigger slope to be falling
set(d, 'TriggerSlope', 'falling');

% Get information about the waveform and the device object
waveform_1 = get(d, 'Waveform');

% Get the waveform data from channel 1 of the oscilloscope
[y, x] = invoke(waveform_1, 'getWaveform', 'Channel1');

% Generate a plot of the waveform
plot(x, y);
xlabel('Time(sec)'); ylabel('Volts')
```

A script illustrating the basic steps of connecting to a device with the Instrument Control Toolbox: creation, configuration, and communication. A few lines of code let you acquire test data from an oscilloscope and plot the data in MATLAB.

- VISA standard, including interfaces for GPIB, VXI, GPIB-VXI, USB, and TCP/IP, and serial from Agilent Technologies, National Instruments, Rohde & Schwarz, and Tektronix
- TCP/IP and UDP interfaces for connecting to networked instruments

MATLAB provides serial port support. The Instrument Control Toolbox provides additional features and tools for working with serial devices.

You can also download freely available instrument driver wrappers and preconfigured MATLAB instrument drivers from the MathWorks Web site.

Required Products

MATLAB

Related Products

Data Acquisition Toolbox. Acquire and send out data from plug-in data acquisition boards

Image Acquisition Toolbox. Acquire images and video from industry-standard hardware

MATLAB Compiler. Convert MATLAB applications into stand-alone applications and software components

MATLAB Report Generator. Automatically generate documentation for MATLAB applications and data

Signal Processing Toolbox. Perform signal processing, analysis, and algorithm development

For more information on related products, visit *www.mathworks.com/products/instrument*

Platform and System Requirements

For platform and system requirements, visit *www.mathworks.com/products/instrument* ■

For demos, application examples, tutorials, user stories, and pricing:

- Visit **www.mathworks.com**
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