Keithley Instruments
ExceLINX-3A
ExceLINX software for the Model 2000
Release Note for Version C02

3/26/2015

IMPORTANT: To work properly with ExceLINX, your instrument must have a compatible version of firmware. Refer to section 2 (System Requirements) below for specific details regarding the required firmware version for your instrument. Visit Keithley.com for upgrade instructions if your instrument's firmware is not a compatible version. The instrument's firmware version is shown on the display when the instrument is first powered up, immediately to the right of the model number.

This document provides additional information for the installation and use of ExceLINX for the 2000 Digital Multimeter (DMM). Please review the contents of this file before installing or using the software.

For the purpose of brevity, ExceLINX for the 2000 DMM is referred to simply as "ExceLINX" in the remainder of this document. Keithley offers versions of ExceLINX that support other instruments and Data Acquisition Products. Visit www.keithley.com for details.

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1 Introduction

1.1 Included in this release

All the components described below are provided as part of the release of
ExceLINX-3A. This software package includes:

   (1) ExceLINX-3A software
   (2) Keithley 2000 IVI Driver
   (3) Keithley I/O Layer

1.1.1 ExceLINX-3A Software

ExceLINX is a Microsoft Excel add-in for the Model 2000 DMM. Within minutes of
installing ExceLINX on a PC, users can acquire data dynamically within Excel, and
then employ the familiar Excel graphics, charting, and analysis capabilities. No
Programming is required to use ExceLINX - a few mouse clicks are all it takes to
configure the instrument and collect data.

Note: ExceLINX does not support the use of the optional scanner card.

1.1.2 KE2000 IVI Driver

ExceLINX uses the KE2000 IVI driver and the Keithley I/O layer (VISA) to communicate with your instrument. IVI (Interchangeable Virtual Instruments) and VISA (Virtual Instrument Software Architecture) provide a common foundation for application development across multiple communication buses and multiple instrument vendors. This software driver supports many Application Development Environments under Windows, such as Visual Basic, C/C++, LabView, LabWindows CVI, and TestPoint. The KE2000 IVI driver supports the Model 2000 only.

Numerous examples and an on-line help utility are provided to help programmers build their custom applications. A shortcut for the driver help is added to the Keithley Instruments folder on your Start Menu.

1.1.3 Keithley I/O Layer

The Keithley I/O Layer software is an installer that contains many subcomponents used to configure IVI drivers and manage the communications between Keithley instrument drivers and software applications and the instrument itself.

1.1.3.1 Keithley Configuration Panel and Wizard

The Keithley Configuration Panel is provided to allow you to setup or modify the communications between the driver and your instrument.

For an IVI driver to be truly interchangeable you need to create a virtual instrument configuration which points to the VISA resource to use, the name of the DLL to use and the prefix for the function calls in the DLL. The Configuration Panel and Wizard allow you to do this.

The installation pre-configures instruments for Serial ports COM1 and COM2, and for a GPIB instrument at GPIB address 16. If you are using one of these, you may skip the configuration panel. Otherwise, you must create a new instrument configuration using the Keithley Configuration Panel and Wizard. See instructions below.

1.1.3.2 VISA Runtime

VISA (Virtual Instrument Software Architecture) software actually performs the communications with the instruments. The Keithley Configuration Panel configures VISA to work with your instruments, and the Keithley Communicator, instrument drivers, and applications use VISA to perform instrument communications.

1.1.3.3 Keithley SCPI-based Instrument Driver

The Keithley SCPI-based Instrument IVI-C Driver is used to support the Keithley Configuration Panel Wizard and Keithley Communicator functionality. It contains simple functions for opening, configuring, taking measurements from, and closing the instrument.

1.1.3.4 IVI Compliance Package (ICP)

The NI IVI Compliance Package is a software package that contains IVI class drivers and support libraries necessary for the development and use of applications that leverage IVI instrument interchangeability. The IVI Compliance Package also is based on and is compliant with the latest version of the instrument programming specifications defined by the IVI Foundation.

1.2 New Features in this Release

1.2.1 New Features in ExceLINX C02
ExceLINX C02 has the following new features:

- Initial release

2 System Requirements

Pentium-class PC.

2000 firmware release B01 or later.

Supported GPIB controller (see section 3.1), or RS-232 Serial port for communications with the instrument.

NOTE: It is strongly recommended that your computer and instrument be powered by an Uninterruptible Power Supply (UPS) when running a critical application. If a computer running Excel loses power, all your data may be lost.

2.1 Supported Operating Systems and System Software

Microsoft Windows 7 Professional (32-bit & 64-bit) service pack 1 or later
Microsoft Windows Vista Business & Enterprise & Ultimate (32-bit & 64-bit) service pack 2 or later

Microsoft Windows XP Professional service pack 3 or later (32-bit only)

NOTE: Microsoft Windows 95, Windows 98, Windows ME, Windows NT, Windows 2000, Windows XP (64-bit) operating systems are not supported

Excel 2010 (32-bit & 64-bit) service pack 1 or later
Excel 2007 service pack 2 or later
Excel 2003 service pack 1 or later
Excel 2002 (XP) service pack 2 or later
Excel 2000 service pack 3 or later
Excel 97 service release 1 or later

ExceLINX has been tested with a variety of International versions of Microsoft Windows and Excel, including Chinese (Simplified and Traditional), Japanese, German, and French. Note that Microsoft Windows 95, Windows 98, Windows ME, Windows NT, Windows 2000, and Windows XP (64-bit) are not supported in any language.

3 Installation

3.1 GPIB Controller Installation

If you will be using GPIB to communicate with your instrument, you must have a compatible GPIB controller card and associated software driver installed in your computer before installing ExceLINX

ExceLINX is compatible with the following GPIB controller cards:

> Keithley Instruments GPIB cards (ISA, PCI, and USB)

> CEC GPIB cards (ISA, PCI)

> National Instruments GPIB cards (ISA, PCI, PCMCIA and USB)

Follow the manufacturer's instructions for installing the controller card and software, and for verifying correct operation of the card and software driver.

3.1.1 Keithley GPIB Cards and USB-to-GPIB Interfaces

Model	Driver Name	Minimum Version	Operating Systems Supported
KPCI-488	CEC-488	6.0	2000, XP
KPCI-488A	GPIB-488	9.3	2000, XP, Vista (32, 64), 7 (32, 64)
KUSB-488	GPIB-488	9.0	2000, XP, Vista (32, 64)
KUSB-488A	GPIB-488	9.3	2000, XP, Vista (32, 64), 7 (32, 64)
KPCI-488LP	KI-488	3.12	2000, XP, Vista (32, 64), 7 (32, 64)

| KPCI-488LPA KI-488 | 3.12 | 2000, XP, Vista (32, 64), 7 (32, 64) |
| KUSB-488B KI-488 | 3.12 | 2000, XP, Vista (32, 64), 7 (32, 64) |

The Keithley I/O Layer software supports the above listed GPIB controllers. Versions of these drivers may be downloaded from the Keithley Web site, www.Keithley.com/support by entering the appropriate model number and selecting Software Driver.

3.2 Connecting your Computer to your Instrument

Connect your instrument to your computer using a standard GPIB interface cable or a "straight through" (not null-modem) serial RS-232 cable.

3.3 ExceLINX Installation

Important note: When installing the software the logged-in user must have administrator privileges. If a reboot is requested, please log in as the same user to finish installation.

3.3.1 Installing ExceLINX from the Web

Download the software from the Keithley Web site, www.keithley.com/support . The software is a single compressed file and should be downloaded to a temporary directory.

Run the downloaded file from the temporary directory.

Follow the instructions on the screen to install the software.

Reboot your computer during installation if so instructed by the installation utility.

3.4 Uninstalling ExceLINX

Important Note: If you have ExceLINX for another instrument also installed on your computer (e.g. ExceLINX-1A for 2700 or ExceLINX-2A for 6485 or ExceLINX for Data Acquisition Cards), you should answer "no" when prompted to remove shared components during the uninstallation. Otherwise, answer "yes" when prompted to remove shared components. You may receive this prompt more than one time; answer the same way each time.

Using the Add/Remove Programs Wizard in Control Panel, uninstall the following components:

- Keithley ExceLINX-3A

- Keithley ke2000 IVI Instrument Driver
- Keithley I/O Layer
- Keithley SCPI IVI Instrument Driver

The following components are installed or upgraded by the Keithley I/O Layer software but maybe used by other software or drivers on you system so be careful about uninstalling them:

- IVI Shared Components
- Under the National Instruments Software entry there will be:
  - NI-VISA x.x.x Runtime (x.x.x will be the VISA version)
  - NI IVI Compliance Package xxx (xxx will be the version number)

Reboot your computer.

4 Configuring Instrument Communications

4.1 Virtual Instruments

Before ExceLINX can communicate with your instrument, a virtual instrument configuration must exist in the VISA software. ExceLINX pre-configures instruments for Serial ports 1 and 2, and for a GPIB instrument at GPIB address 16. If you are using one of these, you may skip the rest of this step. Otherwise, you must create a new instrument configuration using the Keithley Configuration Wizard. Open the Wizard by selecting Start>Programs>Keithley Instruments>Keithley Configuration Panel, and wait for the Wizard to start. Follow the Wizard instructions to create a new virtual instrument configuration or modify an existing one. After making changes in the Keithley Configuration Panel, you must restart Excel so that ExceLINX recognizes the changes.

4.2 Specifying a Virtual Instrument

When you use ExceLINX, you must specify which virtual instrument ExceLINX should use to communicate with your instrument. This is done by selecting a virtual instrument in the "Device" field of the ExceLINX configuration task. You must also select the appropriate instrument in the "Model" field.

If you created or modified a virtual instrument configuration in step 4.1 above, you would select that virtual instrument in the "Device Field". Otherwise, select one of the default virtual instruments according to the following guidelines:

Note: The default virtual instruments all have KE2000 as part of the name. If you prefer, you may change the default name using the configuration panel and wizard.

If your instrument is at GPIB address 16 and you are using a National Instruments GPIB card, select KE2000_GPIB16 as your device. If KE2000_GPIB16 does not appear in the "Device" field list, then select KE2000ExampleInstr. KE2000ExampleInst is a logical name equivalent to KE2000_GPIB16 by default.

If your instrument is at GPIB address 16 and you are using a Keithley Instruments or CEC ISA or PCI GPIB card, select KE2000_GPIB1_16 as your device.

If your instrument is at GPIB address 16 and you are using a Keithley Instrument or INES PCMCIA GPIB card, select KE2000_GPIB2_16 as your device.

If you are using COM Port 1, select KE2000_COM1 as your device.

If you are using COM Port 2, select KE2000_COM2 as your device.

5 Running the software

Refer to ExceLINX help if necessary to perform the following tasks. ExceLINX help may be accessed via the ExceLINX menu in Excel.

A) Start Excel. If you are using Excel 2007 or later you will have to click on the Add-Ins Tab to display the ExceLINX toolbar.

B) Create a new KE 2000 Config task and a new KE2000 Scan task.

C) On the Config Task page, in the Device field, select the device corresponding to your instrument. Use KE2000_COM1 if your instrument is connected to the first serial port or KE2000_COM2 for the second serial port. There are three default device configurations for GPIB. All three are for an instrument at GPIB address 16, if your instrument is not at address 16, you will need to create a new or modify one of the default configurations as described above.

If you are using a National Instruments GPIB card, select KE2000_GPIB16 (or
KE2000_GPIB0_16) as your device.

If you are using a Keithley Instruments or CEC ISA or PCI GPIB card, select

KE2000_GPIB1_16 as your device.

If you are using a Keithley Instrument or INES PCMCIA GPIB card, select KE2000_GPIB2_16 as your device.

D) From the ExceLINX menu, select KE2000 Config and then Detect Device. If your communications connection is properly configured and working, ExceLINX will display Task stopped successfully. You are now ready to begin using ExceLINX.

5.1 Status and error messages

When you run an ExceLINX task, the status of the command and any error messages that are returned are displayed in the Status/Cmds field of each ExceLINX task spreadsheet. If the message is truncated because of the limited size of the Status/Cmds field, click on the field to select it. The entire text of the message may now be viewed in the Excel edit bar at the top of the spreadsheet. Error messages are displayed in red, while normal status messages are displayed in black.

If you enter an invalid value into an ExceLINX field, ExceLINX will change the invalid value's color to red. Invalid entries do not prevent the task from executing, but the invalid value is not sent to the instrument. To rectify an invalid value, change the value to a valid value, and click on any other cell to trigger the validation logic.

Note, because some values are related or interact, it is possible for a value in one cell to cause other cells to be marked invalid. If cells marked in red appear to be correct, examine other related cells for correct values. (PR16035, 15612, 15933, 19201, 15516)

5.2 Using the ExceLINX toolbar

ExceLINX provides a toolbar for executing commonly used functions. If you are using Excel 2007 or later you will have to click on the Add-Ins Tab to display the ExceLINX toolbar. The toolbar may be left floating or docked similar to any other Excel toolbar. Refer to Excel help for details on displaying, hiding, docking or un-docking the toolbar.

When using the toolbar, you must first select an ExceLINX task in the list box on the left end of the toolbar. Once you have selected a task in the list, the applicable toolbar buttons will be enabled. All commands issued using the toolbar apply only to the task selected in the list box.

5.3 ExceLINX and front panel interaction

When using ExceLINX to configure and operate your instrument, you should not use the instrument's front panel to view or modify configuration. ExceLINX does not determine when changes have been made on the front panel, and incorrect operation can result.

Furthermore, ExceLINX does not send all configuration information to the instrument every time a configuration task is executed. Only items that have been changed within ExceLINX since the last time the configuration task was run are written to the instrument. This means that if the instrument is turned off or settings are changed from the front panel while ExceLINX is in use, the instrument may become configured incorrectly. To avoid this problem, avoid turning the instrument off or using the front panel while ExceLINX is in use. (PR15996)

To make it easier to prevent inadvertent changes via the front panel, ExceLINX can optionally lock out the front panel when ExceLINX is using the instrument. This is controlled using the Front Panel Lockout field on the Configuration task. By default, Front Panel Lockout is set to on, meaning the front panel is locked out while ExceLINX is using the instrument.

When Front Panel Lockout is set to on, the front panel will be locked out the first time ExceLINX access the instrument. To release the front panel lockout, close Excel.

5.4 Scan and Config tasks

The first time a scan task is executed, it automatically executes the associated config task. If no config data is changed, the config task may not be executed on subsequent runs of the scan task. The config task can always be run by itself to configure the instrument without executing any measurements. See also the note in the known issues section of this document regarding config data caching.

5.4 Recommended data location

Although, for convenience, ExceLINX allows you to display data on the scan or read task work sheets, it is recommended that you configure the tasks to place the data on a separate spreadsheet. Because the ExceLINX cells are protected from revisions and format changes, and because Excel protects the entire column not just certain cells, you cannot alter the format of cells on the task worksheets. This means that date information can be displayed in an undesired format. Furthermore, when cells are first used to display one type of information, such as a date, and then a different type of data, such as a reading, the format will be incorrect, and the protection prevents altering it to the desired setting.

By always placing data on a separate work sheet, all these problems are avoided. (PR15733)

6 Examples

The following sections show two examples of using ExceLINX to configure and operate your 2000. The examples assume you are using one of the default virtual instrument configurations described in the previous section. If you are using a custom virtual instrument configuration, select it in place of one of the standard configurations called for in the examples.

6.1 Simple Scan Example

This example demonstrates using ExceLINX to configure and operate the instrument to take 10 readings using all the default settings.

A. Launch Microsoft Excel:

   Select Excel from the Start programs menu.

B. Create a new blank workbook:

   Select the File >> New menu entry.

C. Create a new ExceLINX Configure Keithley 2000 DMM Worksheet:

   Select the ExceLINX >> Create >> Configure Keithley 2000 DMM Worksheet menu entry.

D. Configure the Instrument device:

   In the Instrument section, click the Device pull down arrow and choose the appropriate virtual instrument:

   KE2000_GPIB_16 or KE2000ExampleInstr -- if using a National Instruments GPIB card
   KE2000_GPIB1_16 -- if using a Keithley Instruments or CEC GPIB card
   KE2000_GPIB2_16 -- if using an INES GPIB card
   KE2000_COM1 -- if using a RS-232 COM Port 1
   KE2000_COM2 -- if using a RS-232 COM Port 2

E. From the ExceLINX menu, select KE2000 Config and then select Detect Device. If your communications connection is properly configured and working, ExceLINX will display Task stopped successfully. You are now ready to begin using ExceLINX.

F. Create a new ExceLINX Scan Keithley 2000 DMM Worksheet:

   Select the ExceLINX >> Create >> Scan Keithley 2000 DMM menu entry.

G. Set the Arm Trigger Count:

In the Arm Trigger section, click the Count field and type in the number of desired counts (e.g. 10). Click in a different field to ensure Excel accepts the value you entered.

H. Start the Scan:

Select the ExceLINX >> KE2000 Scan >> Start entry. The instrument should configure, collect data, and then display the data in the KE2000 Scan worksheet, Task Data section.

6.2 Fast Scan Example

This example demonstrates using ExceLINX to configure and operate the 2000 to take 10 readings with the instrument configured to take readings as fast as possible.

A. Launch Microsoft Excel:

Select Excel from the Start programs menu.

B. Create a new blank workbook:

Select the File >> New menu entry.

C. Create a new ExceLINX Configure Keithley 2000 DMM Worksheet:

Select the ExceLINX >> Create >> Configure Keithley 2000 DMM Worksheet menu entry.

D. Configure the Instrument device:

In the Instrument section, click the Device pull down arrow and choose the appropriate virtual instrument:

KE2000_GPIB_16 or KE2000ExampleInstr -- if using a National Instruments GPIB card
KE2000_GPIB1_16 -- if using a Keithley Instruments or CEC GPIB card
KE2000_GPIB2_16 -- if using an INES GPIB card
KE2000_COM1 -- if using a RS-232 COM Port 1
KE2000_COM2 -- if using a RS-232 COM Port 2

E. From the ExceLINX menu, select KE2000 Config and then select Detect Device. If your communications connection is properly configured and

working, ExceLINX will display Task stopped successfully. You are now ready to begin using ExceLINX.

F.   Set Auto Zero to Off:

In the Setup section, select the Autozero field. Click on the pull down arrow and change the value from On to Off.

G.   Set Display Digits to None (turns off the instrument front panel display):

In the Setup section, select the Display Digits field. Click on the pull down arrow and change the value from 6½ to None.

H.   Turn Auto-ranging Off:

In the Instrument Configuration section, select the Measurement Range field. Click on the pull down arrow and change the value from Auto to a fixed range value (e.g. 100 V)

I.   Set Sampling Rate to 0.01:

In the Instrument Configuration section, select the Sampling Rate field. Change the rate from Slow to 0.01 by typing in the new value and pressing the tab key.

J.   Create a new ExceLINX Scan Keithley 2000 DMM Worksheet:

Select the ExceLINX >> Create >> Scan Keithley 2000 DMM menu entry.

K.   Set the Arm Trigger Count:

In the Arm Trigger section, click the Count field and type in the number of desired counts (e.g. 10). Click in a different field to ensure Excel accepts the value you entered.

L.   Start the Scan:

Select the ExceLINX >> KE2000 Scan >> Start entry. The instrument should configure, collect data, and then display the data in the KE2000 Scan worksheet, Task Data section.

7   Known problems and issues

7.1 Instrument features that are not supported in ExceLINX

This release of ExceLINX does not support the optional scanner card.

7.2 Instrument not configured when out-of-range settings exist

In certain circumstances, when an out-of-range value is specified on the configuration task sheet, the instrument will not be configured properly. With a few exceptions described elsewhere in this document, ExceLINX marks out of range values by showing them in red. Correct any red settings before running an ExceLINX task. (PR19717, 16035)

7.3 Large data sets overflow sheet

All Excel worksheets, prior to version 2007, are limited to a maximum of 256 columns and 65536 rows. It is possible with certain combinations of settings for ExceLINX to overflow one or both of these limitations. The current version of ExceLINX may overwrite data or may not record some data points if these limits are exceeded. Make certain that the combination of settings you select for Scan list length, reading count, Display location, and Data organization, and auto wrap will allow all your data to fit on a single sheet. If you must collect more data than will fit on a single Excel worksheet, you may turn on logging to a file. When file logging is enabled, all data is written to the file, regardless of whether or not it fits on a worksheet. If more data is logged than can fit on the worksheet, the message "Not all data displayed" will appear in the status area.

In addition to the limits described above for spreadsheet size, Excel can run out of memory if you attempt to create a very large spreadsheet with all the cells containing data. Excel will run very slowly or generate error messages if it begins to run out of memory. The point at which this happens is dependent on the amount of primary and virtual memory available on your computer. (PR15897, 15991)

In Excel 2007, the worksheet size is 16,384 columns by 1,048,576 rows.

7.4 Data location reset when changes are made to tasks

ExceLINX maintains a data location pointer so it knows where to write the next data item read back from the instrument. When a task is executed for the first time, the pointer is set to the value specified in the Starting Row and Starting Column fields. After each data item is stored in the spreadsheet, the pointer is incremented one row or column depending as required by the Organize by rows or Organize by columns setting and other factors.

You can manually reset the pointer to the initial settings using the Reset Data Location function on the toolbar or ExceLINX menu.

However, changing any of the settings in the Data Location or Data Display sections of the Scan Task may reset the Data Location pointer to its initial value. This means

that the next time the scan task is run, it will begin writing data in the cell specified by the Starting Row and Starting Column parameters. This can overwrite any data that might have been previously written to that location. Changing the list of channels to be scanned by modifying the channel list in the configuration task can also cause this problem.

To avoid this problem, it is recommended that you use a trial run to make sure you have the proper channels configured and the Data Location and Data Display parameters adjusted to your desired settings. Then clear the trial run data using the ExceLINX erase function or Excel's clear contents function. Finally, reset the data location to its initial setting using the Reset Data Location function, you can now run the scan task to acquire data. (PR15988, 14738, 15898, 15764)

7.5 Change tracking not supported

ExceLINX will not work properly if you have change tracking enabled. Do not enable Excel Change Tracking when using the ExceLINX software. (PR18991)

7.6 Data not written to last row or last column

The current version of ExceLINX will not write data to column IV or row 65536. Adjust data location settings to avoid writing data into those cells. (PR16105)

7.7 Configuration values are cached

ExceLINX attempts to maximize performance by only sending configuration values to the instrument when they have been changed. For example, when a configuration task is run for the first time, all configuration values are sent to the instrument. If the task is run again without changing anything, most of the values will not be written again. This improves performance.

Caching of configuration values can cause problems if the instrument is turned off, or values are changed from the front panel instead of using ExceLINX. This can cause unexpected results. To avoid this problem, following a power interruption to the instrument, or manual alteration of settings from the front panel, you should close and re-open Excel, and then run the configuration or scan task. This will force ExceLINX to send all configuration data to the instrument. The optional local lockout setting allows you to configure ExceLINX to block access to the instruments front panel when ExceLINX is using the instrument. (PR15937)

7.8 Task allows invalid data location

Under certain unusual circumstances, the scan task will not flag an invalid Starting Row or Starting Column. Starting row should be 36 or greater when data will be placed on the scan task worksheet. (PR14739)

7.9 Adding new task after delete gives error

If a task sheet is deleted, and then a new task is created, ExceLINX incorrectly warns of a duplicate name. Clicking yes on the displayed dialog will force ExceLINX to use the name. (PR15904)

7.10 When logging to floppy, no disk full warning

When logging to a floppy disk, no warning is generated when the floppy becomes full. It is recommended that logging be to hard disk. The file can be transferred to floppy when required. (PR15967)

7.11 Quitting ExceLINX while task running causes error

Under Excel 97, quitting ExceLINX while a task is running will cause a run-time error. After the error occurs, ELXSDMMI.dll is left loaded and will prevent ExceLINX from functioning when it is restarted. Restart your computer, or use the Windows task manager to stop ELXSDMMI to recover. Stop any running tasks before quitting Excel. (PR16106)

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End of Release notes.