

## **LXI – The Future of Calibration**

Test and measurement applications involve the test and analysis of a wide array of products such as satellites, rocket engines, automotive engines, medical devices, and in most cases measurement integrity is of the utmost importance. Countless dollars and man hours go into the design of these products, and accurate testing is essential. Poor measurement quality can be devastating resulting in schedule setbacks, substantial monetary losses, and endangerment of human safety. It is critical that test engineers are able to confidently rely on their measurement devices, and the integrity of the data they produce.

Measurement integrity or confidence is achieved through instrument calibration and traceable verification standards. A traceable source is used by the instrument undergoing calibration to both adjust and verify the quality of measurement. This has been viewed as a painful but necessary process involving station disassembly and downtime. Test engineers are required to disassemble test stations, and send each individual product to their respective vendor's factory for calibration. Some costly workarounds to this problem include ordering spare instruments for each test station, hiring an outside calibration service, or construction of an in-house calibration laboratory. Reducing these costs and alleviating the downtime associated with the calibration process ultimately benefits all test and measurement applications.

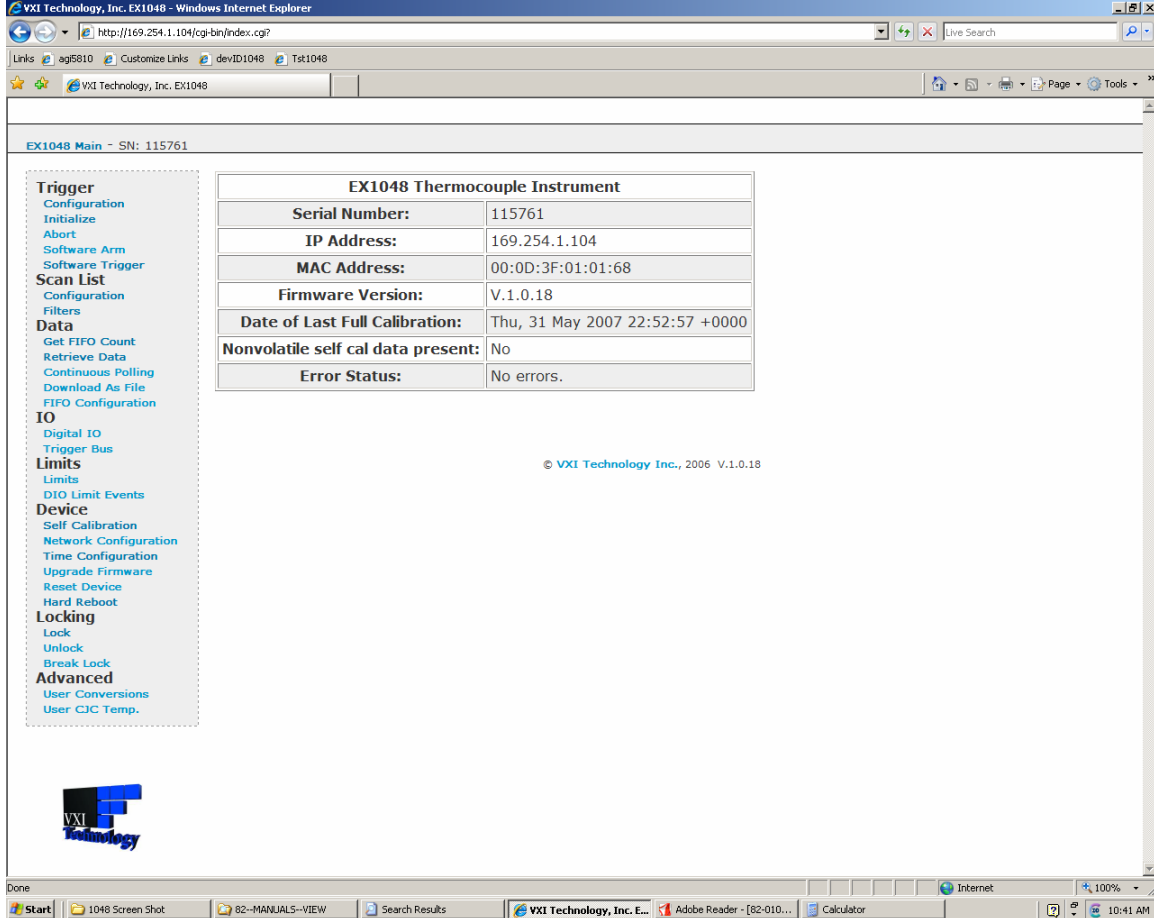
VTI has invested significant engineering resources into simplifying the calibration process for customers, and adding features that guarantee measurement accuracy. This is achieved by taking advantage of the benefits of the next generation measurement platform:

### **Key Benefits of the LXI Instrumentation Platform:**

- **Industry standards for triggering devices via LAN and hardwire trigger bus**
- Peer to peer device communication
- Widely distributed test systems

With respect to improving calibration the notable break through is that LXI class A compliant products are capable of peer to peer device communication independent of a host controller. Taking advantage of this and designing instruments with on-board precision voltage references provides the means for making the calibration process more convenient and more reliable than ever. Now vendors can embed an easy-to-use calibration process directly into the product's firmware, allowing the end user to execute a complete calibration in minutes, at the click of a button. The precision voltage source extends the calibration capabilities by also offering a "self-calibration" routine which the users can initiate at any time. This on-board procedure guarantees users the most precise measurements, regardless of changes in surrounding environmental conditions.

## A Practical Application - Temperature Measurement



EX1048 Thermocouple Instrument	
Serial Number:	115761
IP Address:	169.254.1.104
MAC Address:	00:0D:3F:01:01:68
Firmware Version:	V.1.0.18
Date of Last Full Calibration:	Thu, 31 May 2007 22:52:57 +0000
Nonvolatile self cal data present:	No
Error Status:	No errors.

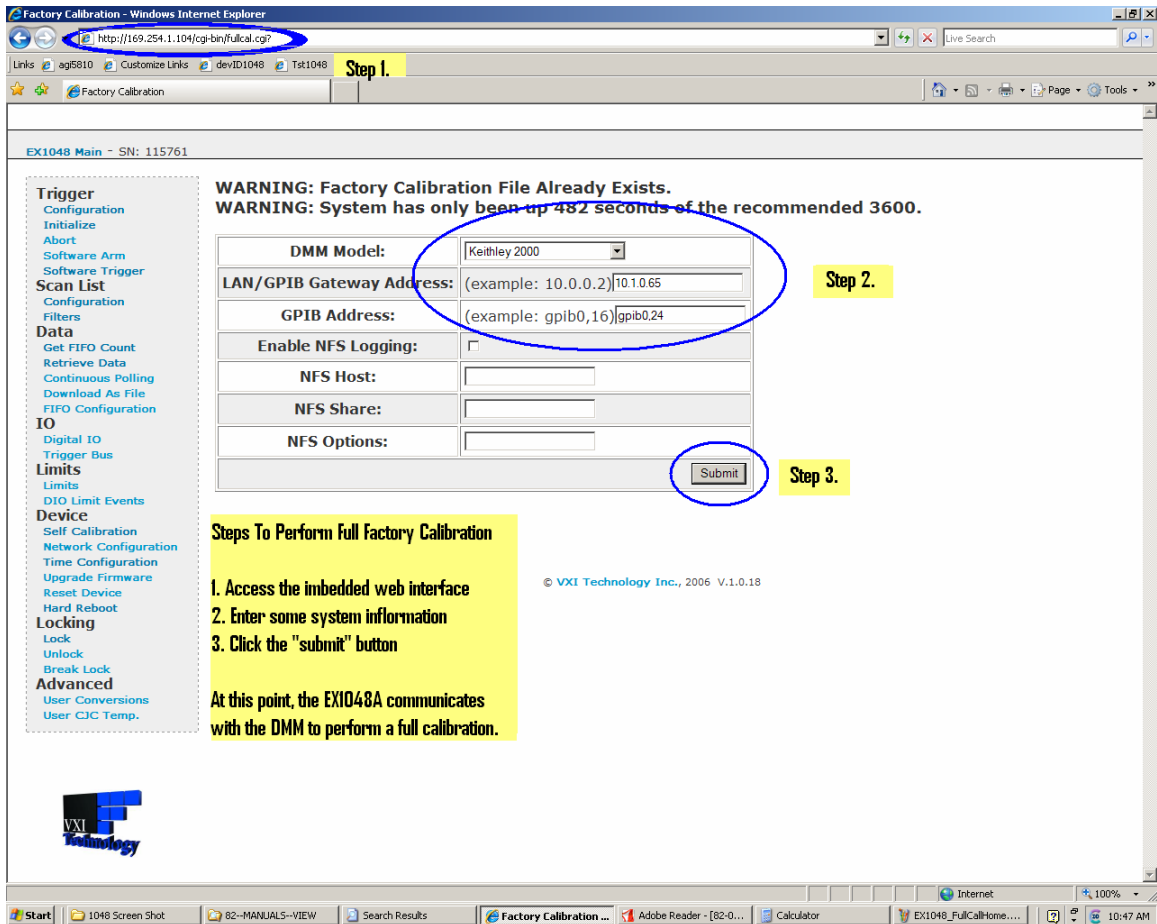
The EX1048A is a 48-channel precision thermocouple instrument which takes advantage of the fact that LXI class A products can do peer to peer device communication and trigger measurements via its LAN interface. The fully integrated web interface required in LXI products streamlines the calibration process, making it truly turnkey. This easy to use interface combined with a built-in internal voltage reference, makes calibration in any location convenient and cost effective

### Required Hardware For Full NIST Traceable Calibration:

- Host Computer
- Precision Voltmeter (EX1266)
- EX1048 (Unit to be calibrated).

### Procedure for Initiating Calibration:

1. Connect all the required equipment through LAN hub or switch
2. Access the EX1048A's web interface via internet browser
3. Enter the IP address of the voltmeter
4. Click a button to initiate calibration



**Step 1.**

EX1048 Main - SN: 115761

**Trigger**  
 Configuration  
 Initialize  
 Abort  
 Software Arm  
 Software Trigger  
**Scan List**  
 Configuration  
 Filters  
**Data**  
 Get FIFO Count  
 Retrieve Data  
 Continuous Polling  
 Download As File  
 FIFO Configuration  
**IO**  
 Digital IO  
 Trigger Bus  
**Limits**  
 Limits  
 DIO Limit Events  
**Device**  
 Self Calibration  
 Network Configuration  
 Time Configuration  
 Upgrade Firmware  
 Reset Device  
 Hard Reboot  
**Locking**  
 Lock  
 Unlock  
 Break Lock  
**Advanced**  
 User Conversions  
 User CJC Temp.

**WARNING: Factory Calibration File Already Exists.**  
**WARNING: System has only been up 482 seconds of the recommended 3600.**

**Step 2.**

DMM Model: Keithley 2000  
 LAN/GPIB Gateway Address: (example: 10.0.0.2) 10.1.0.65  
 GPIB Address: (example: gpi0,16) gpi0,16  
 Enable NFS Logging:   
 NFS Host:   
 NFS Share:   
 NFS Options:

**Step 3.**

**Submit**

**Steps To Perform Full Factory Calibration**

1. Access the imbedded web interface
2. Enter some system information
3. Click the "submit" button

At this point, the EX1048A communicates with the DMM to perform a full calibration.

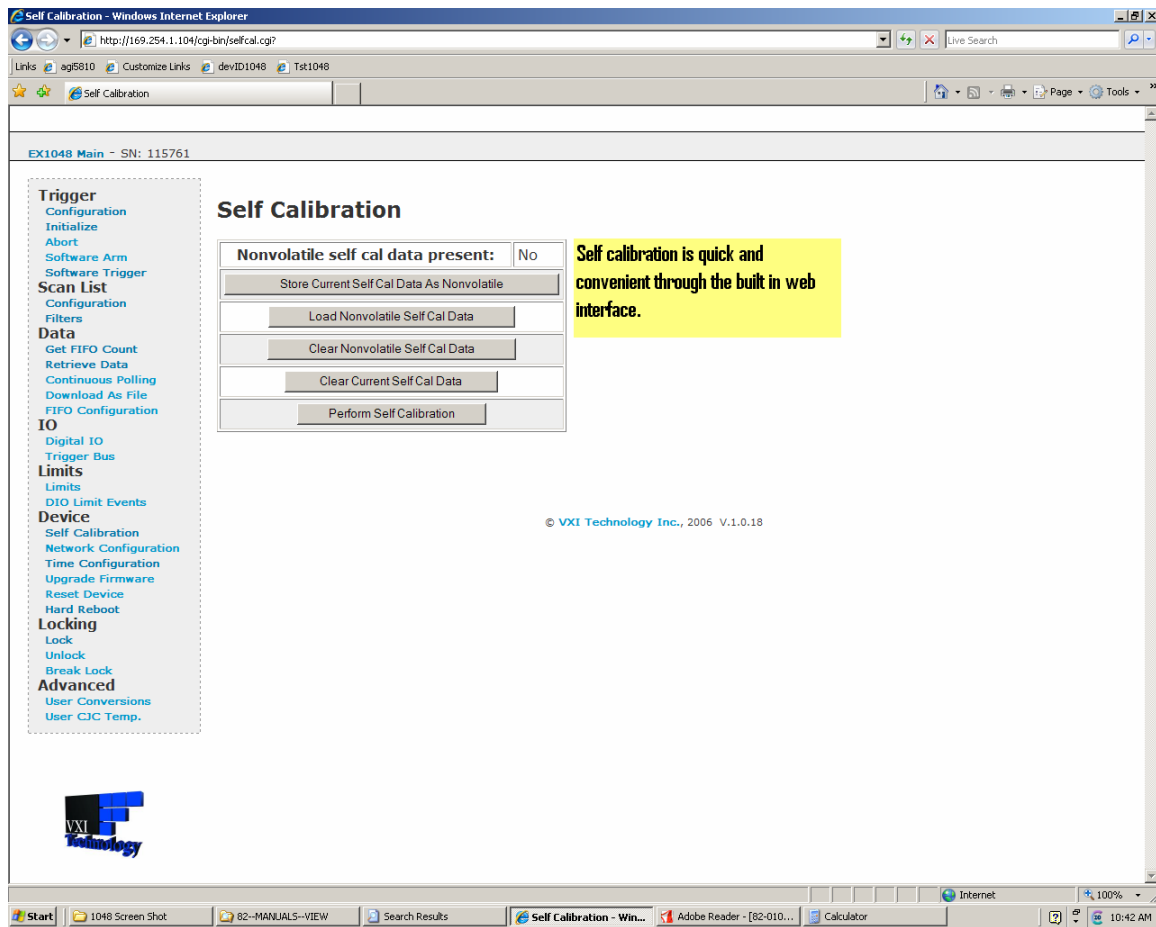
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With LXI being the only instrumentation standard that provides for peer to peer instrument communication, the EX1048A's firmware recognizes and communicates with a number of different voltmeters, including the most commonly used instruments, to measure the on-board precision voltage source. Storing this value, the EX1048A can now route that source back through the input signal paths and reliably perform internal adjustments. When compared to other approaches, this takes little user interaction, and no calibration software development investment. The simplified equipment setup enables the process to be executed almost anywhere.

However, there will continue to be the need for factory calibration services, even in light of these advances in automated calibration utilities. Therefore VTI also offers a complete zero down time calibration service specifically intended to maximize test stand availability when factory calibration is needed. VTI's 24/48 Zero Down Time Calibration service will manage the calibration cycle by providing calibrated hardware that can be substituted into your test stand while your instrumentation is returned for calibration. This service ensures system availability even during factory calibration cycles.

## Confidence in Data with Routine Self-Calibrations

In addition to a turn-key full calibration procedure, the EX1048A guarantees the highest level of measurement accuracy before each data acquisition sequence. The EX1048A is designed with a self-calibration procedure that is executed directly from the instrument driver APIs or the web interface. Before any measurement is initiated, users can initiate a self-calibration sequence which routes the precision source back through the input signal paths of the EX1048A. This process makes minor gain and offset adjustments to the signal path. Whenever the device undergoes any changes in its surrounding thermal environment, this process can be executed to ensure the highest degree of measurement quality.





The following table quantifies the benefits of having a routine self-calibration procedure built in to your instrumentation. Using a precision thermocouple simulator as a source, the EX1048A was configured to take Type-E thermocouple measurements. It is clear from the data that the quality of the measurement is improved significantly after the quick self-calibration is performed.

<b>Accuracy Analysis of EX1048A Before Self-Calibration</b>							
Precision Source	-100° C	0° C	100° C	300° C	500° C	700° C	900° C
EX1048A Measurement 1	-100.60° C	-0.50° C	99.58° C	299.62° C	499.41° C	699.33° C	899.25° C
EX1048A Measurement 2	-100.61° C	-0.51° C	99.59° C	299.63° C	499.40° C	699.34° C	899.26° C
EX1048A Measurement 3	-100.62° C	-0.52° C	99.57° C	299.59° C	499.42° C	699.35° C	899.25° C
EX1048A Measurement 4	-100.61° C	-0.50° C	99.58° C	299.60° C	499.41° C	699.33° C	899.24° C
EX1048A Measurement 5	-100.60° C	-0.51° C	99.58° C	299.61° C	499.41° C	699.34° C	899.24° C

<b>Accuracy Analysis of EX1048A After Self-Calibration</b>							
Precision Source	-100° C	0° C	100° C	300° C	500° C	700° C	900° C
EX1048A Measurement 1	-100.17° C	-0.17° C	99.82° C	299.84° C	499.83° C	699.84° C	899.80° C
EX1048A Measurement 2	-100.16° C	-0.14° C	99.84° C	299.83° C	499.84° C	699.82° C	899.81° C
EX1048A Measurement 3	-100.17° C	-0.15° C	99.83° C	299.83° C	499.84° C	699.83° C	899.80° C
EX1048A Measurement 4	-100.18° C	-0.15° C	99.84° C	299.83° C	499.83° C	699.84° C	899.81° C
EX1048A Measurement 5	-100.17° C	-0.17° C	99.85° C	299.82° C	499.83° C	699.84° C	899.80° C

VTI has taken measures to ensure these benefits and advantages in calibration and associated measurement integrity are an integral part of all of its next generation products. Look for these exciting features on the EX1048A precision thermocouple device, EX1629 static strain measurement device, VT1432B dynamic data acquisition device, and all future LXI products.