50MHz PXI Instrumentation Amplifier

MODEL 4040A

Instruction Manual
PN# 4040A-901-01
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REV. A

This owner's manual was as current as possible when this product was manufactured. However, products are constantly being updated and improved. Because of this, some differences may occur between the description in this manual and the product you received.

Intended Application

The 4040A is a single channel, differential input amplifier capable of high gain and equally high attenuation values with a bandwidth from DC-50MHz. The Model 4040A is capable of operating with gains of x1, x10, and x100 in conjunction with attenuation by factors of: ÷1, ÷10, and ÷100. These levels of gain and attenuation may be used in combination to condition a differential input signal so that it matches the needed input of a low-level device such as a digitizer or oscilloscope. There is a more in depth explanation contained in the specification section. In addition, the 4040A provides programmable offset, anti-aliasing filters, input impedance and input coupling. Figure one is a block diagram of the 4040A. The 4040A has been specifically designed to take two signals and make a valid differential measurement by inverting one of the signals and adding the difference, this allows the user to measure signals not referenced to local ground without compromising safety.

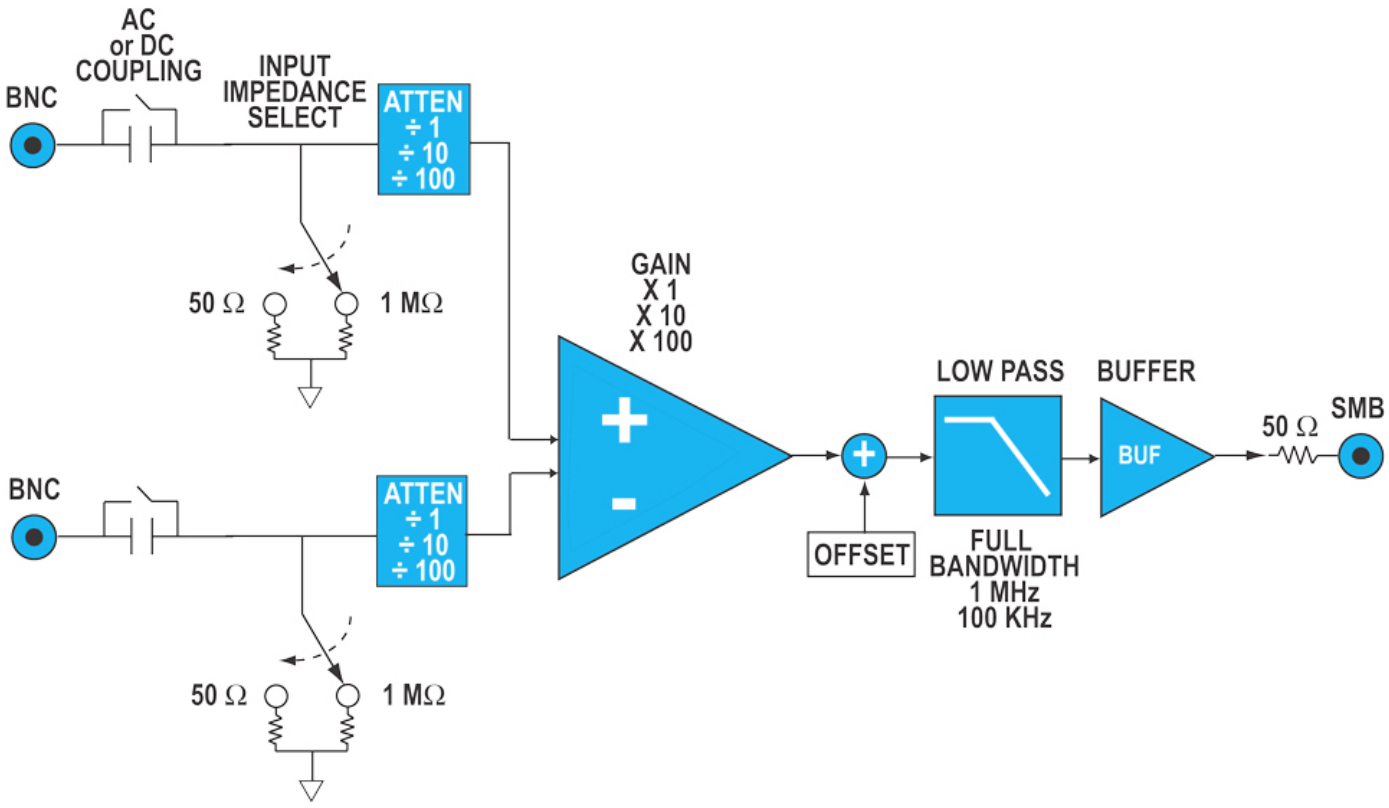

Figure 1

Explanation

The multiple gain and attenuation settings of the 4040A interact to affect the performance in terms of bandwidth and noise. Figure 2 shows the various combinations and how these settings modify what can be expected

Peak Amplitude Input Range	Total Gain	Input Attenuation	Internal Amplifier Gain	Voltage Range [a,b,c]	Noise, referred to input	Bandwidth, DC Coupling
100 V	÷100	÷100	1	100 V	990 nV/√Hz	20MHz
10 V	÷10	÷100	10	100 V	990 nV/√Hz	50MHz
10 V	÷10	÷10	1	40 V	99 nV/√Hz	20MHz
1 V	x1	÷100	100	100 V	990 nV/√Hz	20MHz
1 V	x1	÷10	10	40 V	99 nV/√Hz	50MHz
100 mV	x10	÷10	100	40 V	99 nV/√Hz	20MHz
100 mV	x10	÷1	10	4 V	9 nV/√Hz	50MHz
10 mV	x100	÷1	100	4 V	9 nV/√Hz	20MHz

a. DC Coupled, 1MΩ input
b. AC Coupled, 1MΩ input: DC + Peak AC not to exceed 100 V; Peak AC component not to exceed table
c. 10 V max into 50Ω

Figure 2

from the 4040A. As an example, a total system gain of X10 can be achieved in multiple ways depending on the signal requirements through attenuating and amplifying by different amounts. Choosing the best combination involves trade offs in bandwidth and signal to noise ratio. Noise increases with higher levels of attenuation because the noise specification is referred to the input. In relative terms the signal to noise ratio is basically constant.

Input Specifications	Value	Clarification
Channels	Single Channel	Differential Input
Gains	100, 10, 1, 0.1, 0.01	
Maximum Voltage Range	±100 V	DC + Peak AC
Coupling	AC-10 Hz, DC	
Input Impedance	1 M Ω | | 20 pF 50Ω	Selectable
Input Voltage Range	±100 V ±10 V ±1 V	For Gain 1, 0.1 and 0.01 @ 1 MΩ Input Impedance For Gain 10, 1 and 0.1 For Gain 100, 10 and 1
CMRR	77 dB at 60 Hz	> 50 dB at 1 MHz
Total Harmonic Distortion	<-60 dB @ 1 MHz	Output 1 Vp-p into 50Ω
DC Gain Accuracy	±(0.1% input + 100 µV)	Offset set to 0
AC Gain Accuracy	1%	10 kHz Sine Wave, Calibrated
Over-voltage Protection (In Any Range)	±100 V	DC + Peak AC
Offset Range (Referred to Input)	0-Full Scale	All Gain Ranges
Offset Resolution	40uV	65,535 steps
Offset Accuracy	±(0.5% of Setting + 300 uV)	Referenced to 1 V Range
Temperature Stability	±(0.01% of rdg + 40 uV)/°C	All Gain Ranges
Noise	9nV / √Hz	CMR=±1 V, Gain 10 and 100 Referred to Input for Frequencies >100 Hz
Rise Time	≤3.5 ns	

Output Specifications	Value	Clarifications
Type	Single Ended 2 Vp-p	
Output Resistance	50Ω	
Bandwidth	See Range Table fig. 2	See Range Table fig. 2
Passband Ripple	±0.25 dB	DC to 10MHz Referred to 10 kHz
LP Filter, Cutoff Frequency	100 kHz, 1 MHz	Single Pole Filter

Unpacking & Inspection:

Each TEGAM Model 4040A is put through a series of electrical and mechanical inspections before shipment to the customer. Upon receipt of your instrument unpack all of the items from the shipping carton and inspect for any damage that may have occurred during transit. Report any damaged items to the shipping agent. Retain and use the original packing material for reshipment if necessary.

Upon Receipt, inspect the carton for the following items:

(1) Model 4040A Fast PXI Instrumentation Amplifier
(1) CD including Model 4040 User's Manual, P/N 4040-901-01A and Software Drivers, P/N 1000019

Safety Information & Precautions:

The following safety information applies to both operation and service personnel. Safety precautions and warnings may be found throughout this instruction manual and the equipment. These warnings may be in the form of a symbol or a written statement. Below is a summary of these precautions.

Terms in This Manual:

CAUTION statements identify conditions or practices that could result in damage to the equipment, or other property.

WARNING statements apply conditions or practices that could result in personal injury or loss of life.

	This symbol denotes where precautionary information may be found.

	Attention – Please refer to the instruction manual.

Terms as Marked on Equipment:

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

⚠ Precaution

Grounding the Model 4040A

The Model 4040A is grounded through the grounding conductor of the PXI chassis power cord. The proper grounding of the chassis is essential for safety and for the optimization of the Model 4040A's operation.

WARNING
To avoid electrical shock or other potential safety hazards, plug the PXI chassis power cord into a properly wired receptacle before using this instrument.

Use A Common Ground for All Instruments
It is very important that all instruments being used, both internal modules as well as external instruments share a common ground. If a common ground connection is lost then improper instrumentation readings may result, also see warning above.

Danger Arising from Loss of Ground
If the connection to ground through the PXI chassis is lost or compromised, a floating potential could develop in the Model 4040A module. Under these conditions all accessible parts, including insulating parts such as the front panel could develop a hazardous voltage and put the user at risk.

⚠

Do Not Use in Explosive Environments
WARNING: The Model 4040A is not designed for operation in explosive environments.

Do not Operate Unless the 4040A Module is Properly Installed
WARNING: The Model 4040A should be properly seated within an appropriate PXI chassis before use. All PXI chassis covers and service panels should be in place before operation. Operation with empty module slots, or removed covers could result in personal injury.

PXI Chassis:
WARNING: The power supply should be plugged in (to establish ground) but switched off before installing the Model 4040A or any PXI module.

FOR QUALIFIED SERVICE PERSONNEL ONLY

⚠ Servicing Safety Summary:

Use Care When Servicing with Power On
Dangerous voltages may exist at several points within the PXI chassis. To avoid personal injury or damage, avoid touching exposed connections or components while the power is on. Assure that the power is off and any cables are disconnected when removing or servicing the 4040A amplifier.

Power Source
The Model 4040A is designed to connect to a PXI Chassis and receive all operational power from the backplane of the chassis. The Model 4040A draws 3.3 volts and 5 volts from the PXI Chassis backplane. 3.3 DC volts are used for all TTL level functions and 5 VDC operate onboard analog circuitry. Be aware that higher voltages exist within the PXI Chassis and it is essential that the chassis be powered off and all cables disconnected when installing or uninstalling any PXI card. A protective chassis ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Important Safety Information:

The Model 4040A PXI module is grounded via an internal connection within the PXI chassis. The connection shields of all the connectors are also grounded. This is for your safety.

WARNING:
DO NOT MODIFIY any configurations or connections from their original state otherwise safe operation of this equipment may be compromised.

WARNING:
Always remember to shut off the power and wait at least 15 seconds before disconnecting or connecting any cables to or from the Model 4040A. Ignoring this warning could result in electric shock.

PXI Installation

Use the steps below to install the Model 4040A Fast PXI Instrumentation Amplifier.

1. Make sure the power is off or turn off the power of the PXI chassis.
2. Read the manual supplied with the PXI chassis to determine which slot is available for standard PXI modules such as the Model 4040A. Slot 1 is usually reserved for use as a hardware controller for the overall system, or other modular device to enable PXI control.
3. Install the 4040A by inserting the module into a PXI chassis empty slot by placing the card edges into the front module guides, guides are located on both the top and bottom of the chassis entry location.
4. Gently apply pressure to further insert the card and finally use the injector/ejector handle on the 4040A to fully insert the card into the chassis.
5. Secure the 4040A to the chassis with the captured screw in the top of the face plate.

Figure 1: Installation of the 4040A into a typical multi-slot PXI chassis containing an embedded system controller and support for six peripheral modules.

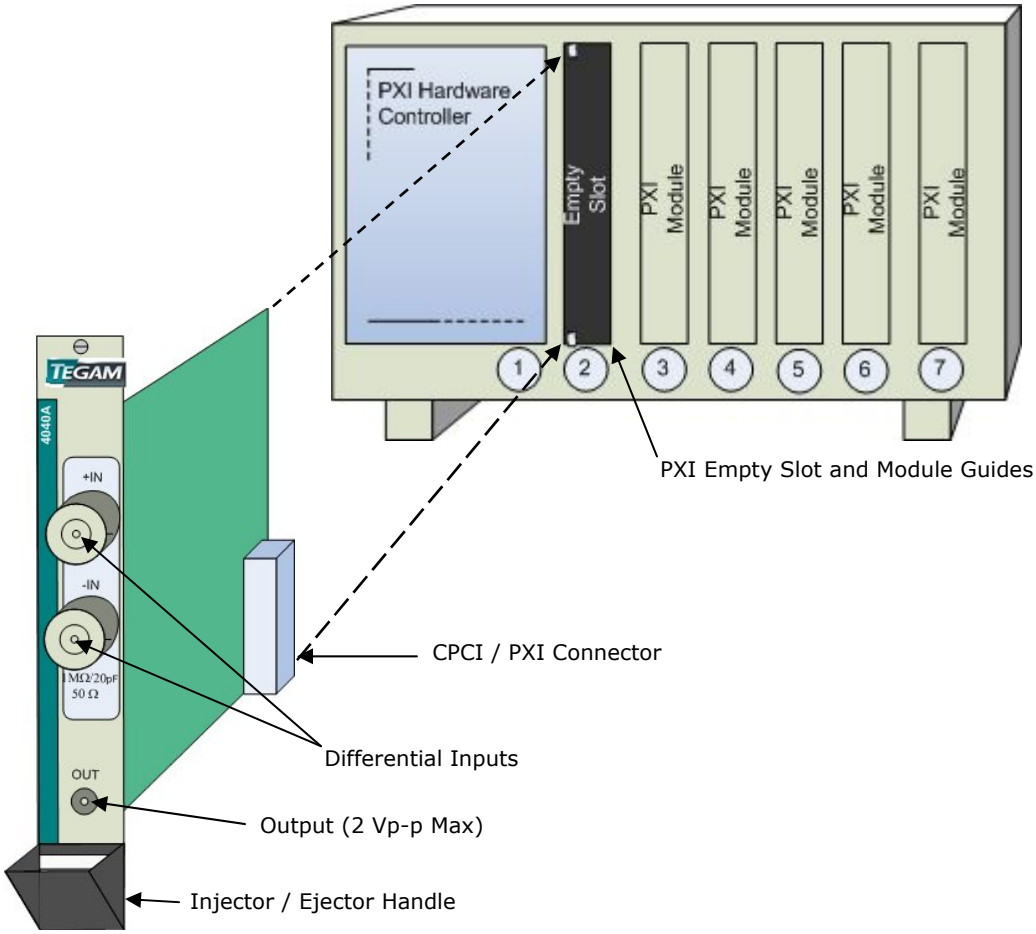

Figure 3

Connection

Both of the amplifier's inputs require standard BNC connections and have an impedance of 50Ω. The 4040A is compatible with all signals from DC to 50MHz and 0 to ±100V. The output is an SMB male connector specified as 50Ω. For proper performance, TEGAM recommends interconnection cables made of RG316-DS. RG316-DS accessory cables are available from TEGAM in various lengths to suit your application or your may purchase them from standard cable vendors.

Both input BNC shields are grounded to a common ground inside the Model 4040A. The BNC shield is at the same potential as the PXI chassis ground. Figure 2 represents a typical connection from the 4040A to a system under test.

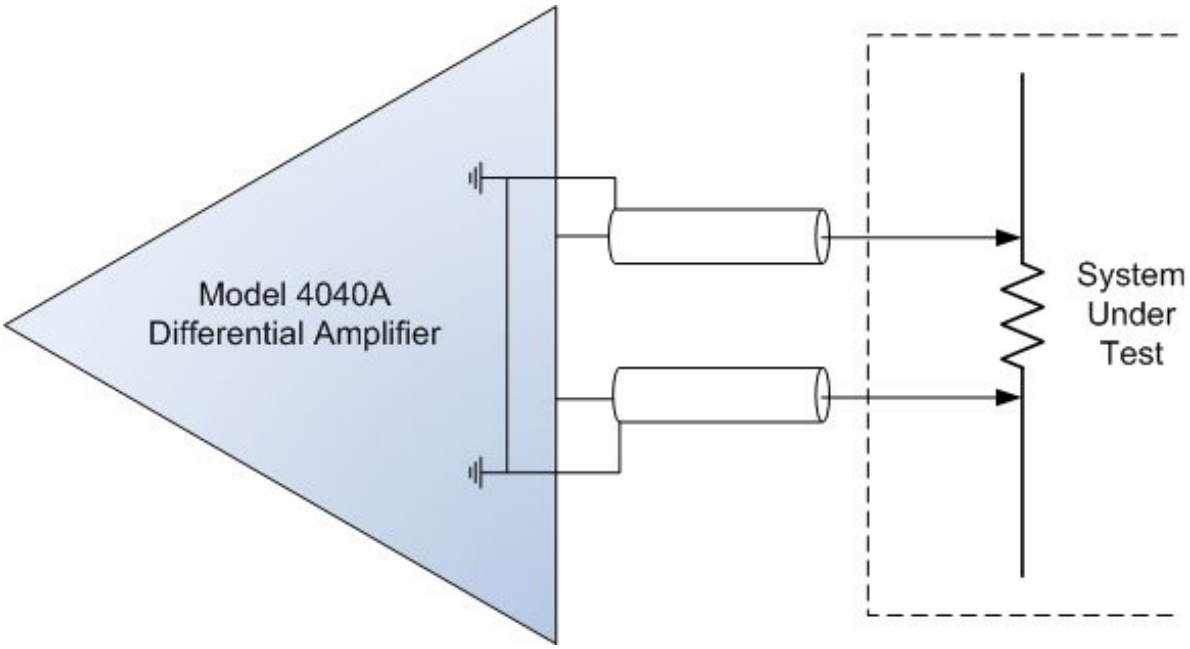

Figure 4: Typical connection

Voltage & Current Limitations

In general, the maximum input voltage of the 4040A should not exceed ±100V (200Vp-p) when the input terminator is set to 1MΩ. However, some settings will produce incorrect results at lower voltages. This occurs when the input signal or gain setting is too high and causes the output amplifier to clip the signal. An example of this would be measuring a 10V signal with the gain set to x100. Mathematically this results in a 1000 V signal which clearly exceeds the 2 Vp-p rating of the output amplifier. See figure 2 for a table of appropriate input voltages for given combinations of gain and attenuation. No damage would occur to the 4040A or to a digitizer connected to it if the input range was exceeded, but the signal would be distorted. A signal in excess of 100V would cause the onboard voltage limiting circuitry to activate and also create distortion.

There are other considerations when the 4040A is configured with the 50 Ohm input termination. The input voltage is limited to a maximum of +/-10V. This is due to the power limitations of the terminator which is 2W. To preserve the signal integrity and bandwidth of the amplifier the 50 Ohm terminator is protected with surface mount single use fuses. **Important:** Exceeding the rating of the input in this case requires the 4040A to be returned to the factory for service.

Frequency Characteristics

The 4040A is capable of amplifying millivolt level signals with a bandwidth from DC to 50MHz. Some combinations of gain and attenuation will limit the bandwidth to 20MHz. See figure 2 for a complete list of settings and the expected bandwidth. In addition, AC coupling rolls of the low frequencies at 10Hz.

Two anti-aliasing low pass filters are included and tuned for 100 KHz and 1 MHz. These are first order filters that roll off at 20dB per decade.

Offset Adjustment

The 4040A includes a programmable offset adjustment that operates on the signal after the gain stage. The resolution of the adjustment is 40uV and can offset the signal +/-1V which is the entire range of the output amplifier. It is not able to effectively offset a signal that exceeds the input range of a given gain and attenuation setting.

Selecting Gains and Ranges

The amplitude of the signal being measured is the primary consideration when selecting the appropriate gain and attenuation settings. As an example: A 100 mV signal that is riding on 42 V can be effectively measured with an attenuation setting of ÷1 and a gain setting of x10. This is because the differential operation of the 4040A rejects the 42 V common mode signal and only amplifies the difference producing an output signal of 1 V. If the signal of interest was the 42 V itself the 4040A should be configured with an attenuation of ÷100 and a gain of x1 producing an output signal of 0.42 V. The 4040A attenuates the signal prior to amplification.

Software

VISA compliant drivers are available for LabView8.20, C++ and Visual Basic. Installation instructions are contained in the Readme.txt file on the CD that is included with the 4040A. A simple front panel LabView8 VI is included that provides control of all of the 4040A's settings.

Parts Replacement

The Model 4040A has no user-serviceable parts. All onboard parts besides the connectors are surface mount based (SMT). The 4040A contains multiple levels of failsafe circuitry. As a last resort, four SMT fuses have been installed which may blow if the 4040A is used outside of its rated operating constraints. Since all onboard fuses are SMT devices, it is not suggested that they be replaced by the user. If you suspect that the unit has failed, please contact Tegam Inc. for an RMA number.

Preparation for Repair or Calibration Service:

Once you have verified that the cause for 4040A malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA, (Returned Material Authorization), number. You can contact TEGAM customer service via the TEGAM website, www.tegam.com or by calling 440.466.6100 (*All Locations*) OR 800.666.1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify your instrument and to address the particular service request by you which is assigned to that RMA number. Of even greater importance is a detailed written description of the problem that should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or of a detailed description of the problem.

This description should include information such as is the problem intermittent?, when is the problem most frequent?, has anything changed since the last time the instrument was used?, Etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use the form provided on the next page.

Once this information is prepared and sent with the instrument and RMA number to our service department, we will do our part in making sure that you receive the best possible customer serviced and turnaround time possible.

Expedite Repair & Calibration Form

Use this form to provide additional repair information and service instructions. The Completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

Repair Instructions:

☐ Evaluation ☐ Calibration Only ☐ Repair Only ☐ Repair & Calibration ☐ Z540 (Extra Charge)

Detailed Symptoms:

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent?, Has anything changed with the application since the last time the instrument was used?, etc.

Warranty:

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

TEGAM, Inc. warrants the calibration of this product for a period of 6 months from date of shipment. During this period, TEGAM, Inc. will recalibrate any product, which does not conform to the published accuracy specifications.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever period is longer.

Warranty Limitations:

The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.

Statement of Calibration:

This instrument has been inspected and tested in accordance with specifications published by TEGAM Inc. The accuracy and calibration of this instrument are traceable to the National Institute of Standards and Technology through equipment, which is calibrated at planned intervals by comparison to certified standards maintained in the laboratories of TEGAM Inc.

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