total solutions in calibration

To our readers: *as you know, we have reduced the number of pages in the printed* Total Solutions in Calibration *newsletter. Our online newsletter, however, is not restricted by length, so occasionally you will find longer articles, or "bonus" articles that do not appear in the printed newsletter. Visit the online version of* Total Solutions in Calibration *at www.fluke.com/TCALnl to read the additional content, or to subscribe and receive e-mail notification of newly published issues.*

Fluke Calibration Training: Global News

Europe: 2005 training includes temperature calibration in Norwich lab

A full schedule of training at the Fluke facility in Norwich, United Kingdom includes these courses:

- Temperature Metrology
- Metrology for Technicians
- Calibration Laboratory Management
- Preparing for Accreditation
- MET/CAL® *Plus* Procedure Writing – Basic
- MET/CAL® *Plus* Procedure Writing – Advanced
- MET/CAL® *Plus* Report Writing

On-site training is available for most of these courses.

More information about Fluke training opportunities is available on the web at www.fluke.com/2005caltraining. You will find detailed information about courses in the United States as well as links to training offered in Europe and Singapore.

Fluke Factory Services in Europe for calibrators and standards

Fluke in Europe runs three ISO 17025 accredited Competence Centers for calibration and repair for Fluke, Wavetek/Datron and Hart products. These Competence Centers are located in Kassel/Germany, Eindhoven/The Netherlands and Norwich/United Kingdom. In most of the other European countries, this service is offered and handled by a Fluke Authorized Service Partner.

The Fluke CalNet Competence Centers offer you the complete spectrum of factory and accredited temperature/electrical calibrations from industrial to primary levels with superior uncertainties. They ensure that your instrument is calibrated in one of the three Fluke Calibration facilities closest to you and at the required uncertainties.

	Norwich – UKAS			Kassel – DKD			Eindhoven – RvA		
	Repair	Calibration		Repair	Calibration		Repair	Calibration	
		CalNet	UKAS		CalNet	DKD		CalNet	RvA
Fluke									
5500A + options	–	x	x	x	x	x	x	x	x
5520A + options	–	x	x	x	x	x	x	x	x
5520A+options+PQ	–	–	–	x	x	x1	x	x	x1
5700A + option	–	x1	x1	x	x	x1	x	x	x1
5720A + option	–	x1	x1	x	x	x1	x	x	x1
5725A + option	–	x	x	x	x	x	x	x	x
5790A + option	–	–	–	x	x	x1	–	–	–
732A/B	–	x	x	x	x	x	x	x	x
742A	Exch	x	x	Exch.	X	x	Exch.	X	x
792A	–	–	–	x	x	x	–	–	–
A40 shunts	–	–	–	x	x	x	–	–	–
8508A	x	x	x	–	x	x	–	–	–
Wavetek / Datron									
9100 + options	x	x	x	–	x	x	–	–	–
9500 + options	x	x	x	–	x	x	–	–	–
9510/20/30/50/60	x	x	x1	–	x	x1	–	–	–
Temperature									
Thermometers by fixed-point	x	x	x	–	–	–	–	–	–
Thermometers by comparison	x	x	x	–	–	–	x	x	x
Thermometer readouts	x	x	x	–	–	–	x	x	x
Fluid baths	–	–	–	–	–	–	x	x	x
Industrial temperature calibrators	–	–	–	–	–	–	x	x	x

x1 = Limited. Calibration

Results of calibration may show different measurement uncertainties from country to country. Standard turnaround time is approx. 5 to 10 working days for calibration and/or repair.

All Fluke facilities work in accordance to the Fluke CalNet© Standard. MetCal® is primarily used to control the process of calibration, whereas MetTrack® is used for Asset Management.

All Fluke service facilities have a local parts store that enables only them to perform product related upgrades (PCN) on Fluke test equipment.

For access to these services please contact your local Fluke Authorized Service Partner or one of the Fluke Competence Centers in Norwich, Kassel or Eindhoven.

total solutions in calibration

FLUKE®

Now available: MET/CAL® *Plus* Version 7.1

Fluke has recently released version 7.1 of its MET/CAL *Plus* Calibration Management Software. The new release represents many new improvements, in addition to the significant changes included in version 7.

Version 7 ushered in a completely redesigned, easy-to-use MET/TRACK®, the asset management part of MET/CAL *Plus*. Version 7.1 adds many MET/CAL features, including:

- Procedure language enhancements, including more programming constructs for decision making and color coded statements that make procedures easier to read
- Support for several foreign languages including Spanish, German, French, and Italian, plus limited support for Japanese reports
- Enhanced RF calibration capabilities with expanded reference drivers and support for new instruments
- New tools for guardbanding and calculating measurement uncertainty
- New utility programs including QuickSort, a documenting procedure manager, plus an all new AutoPro for writing procedures
- And much more

First-time MET/CAL *Plus* users find dramatic productivity improvements when they automate instead of doing calibrations manually. For example, complex calibrations that normally take three to four hours when done manually, often can be done unattended in 30 minutes or less with MET/CAL.

A new data sheet provides detailed information about the new MET/CAL *Plus* 7.1. To get your free copy, simply circle the appropriate number on the enclosed reply form. Or visit Fluke on the web at www.fluke.com/metcal.

Fluke takes the risk out of purchasing used equipment

To qualify as Fluke Certified, an instrument must undergo a rigorous refurbishing process:

- All engineering updates for safety, software, and firmware are performed
- The instrument is fully tested
- The instrument is calibrated and furnished with a certificate of calibration
- The instrument is cleaned and cosmetic repairs are performed
- Required accessories and manual are included
- The full manufacturer's warranty is included

This process is performed by Fluke's qualified personnel, giving confidence and great value to used equipment purchased from Fluke. And each Fluke Certified purchase is fully guaranteed within the terms of the Fluke warranty.

Contact your local Fluke representative and ask about the availability of the instrument you need, or send an email to certified.equipment@fluke.com to determine availability and price of Fluke certified equipment. More information about Fluke Certified equipment is also available on our web site at www.fluke.com/certified.

inside

Calibration News

18 Issue 18
Volume 5

Oscilloscope calibration

This article describes calibration techniques for the vertical deflection portions of an oscilloscope. It is an excerpt from a Fluke application note titled "A Guide to Oscilloscope Calibration Using Dedicated or Multiproduct Calibrators."

Calibrating the accuracy of vertical deflection using dedicated or multi-product calibrators

Amplitude

The Y-axis is used, almost exclusively, for displaying the amplitude of incoming signals. These are processed through "channel" amplifiers (mainly two channels, though often four or more).

Basic setup features include:

- Zero alignment to graticule (offset)
- Vertical amplifier balance
- Vertical channel switching
- Operation of alternate/chopped presentations

Multiple traces are created using alternate-sweep switching or "chopped" high-speed switching. In alternate-sweep switching, the trace completes before switching to the next. With "chopped" high-speed switching, usually used for low frequency signals, inputs are sampled alternately at high speed and steered into separate channels. Digital storage oscilloscopes (DSOs) use different forms of switching to achieve similar effects. Whichever system is in use, there will be a series of alternative channel amplifiers and attenuators whose gain characteristics are the major influence on vertical accuracy.

There are five main parameters to be checked in calibrating each vertical amplifier system: offset, gain, linearity, bandwidth and pulse response. These parameters are crucial to achieve accurate representation of the signal. For effective comparisons between signals applied through different channels, their channel parameters must be equalized.

Measurement of a channel amplifier's gain is usually performed by injecting a standard signal and measuring its presentation against the display graticule. Because the amplifier coupling may be switched between ac/dc and often switching termination resistance between 50 Ω/100 MΩ, it will be necessary to inject signals which test the operation of each of these forms of coupling and termination resistances.

Two standard signals for measuring an amplifier's gain are usually employed:

1. With dc coupling, either a dc signal (figure 1) or a square wave (figure 2) is injected, and the channel's response is measured against graticule divisions or cursor readings.

   All Fluke oscilloscope calibrators provide dc voltage and 1 kHz square wave outputs for testing the gain and offset of dc coupled amplifiers.

2. With ac coupling, a square wave signal is injected at 1 kHz, and again the channel's response is measured against graticule divisions or cursor readings.

   Using a low-frequency pulse can also provide a rough check of the gross low-frequency and high-frequency response (figure 3). This is only a rough test of gross distortion. A result which looks square must still be checked for pulse response and bandwidth.

   All Fluke oscilloscope calibrators provide a 1 kHz square wave for testing the low-frequency gain of ac-coupled amplifiers.

   Channel amplifiers' linearity can be tested by injecting either a dc or a square wave signal, varying the amplitude and checking the changes against the graticule or cursor readings.

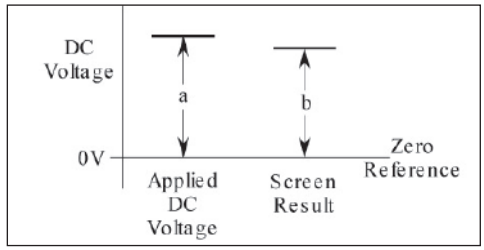


Figure 1. DC voltage – gain (includes offset)

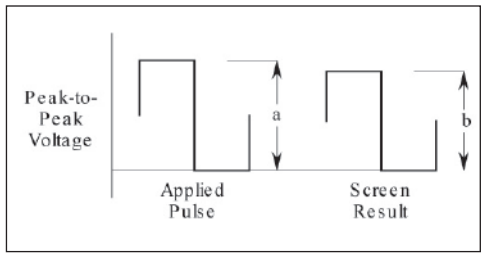


Figure 2. Low frequency square wave – gain (can be manipulated to remove the offset).

The peak-to-peak value shown on the screen (b) is compared with the known value (a):
b ÷ a – = Gain at 1 kKHz

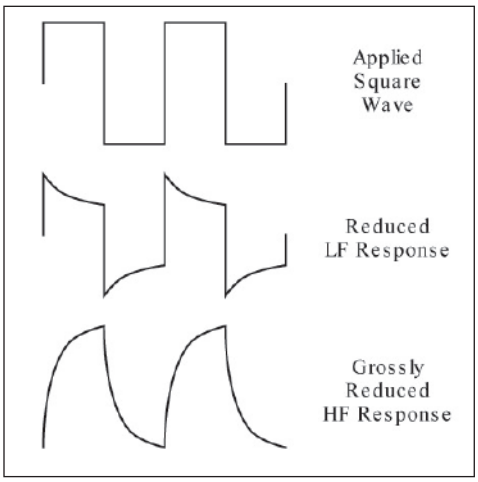


Figure 3. LF square wave-distortions

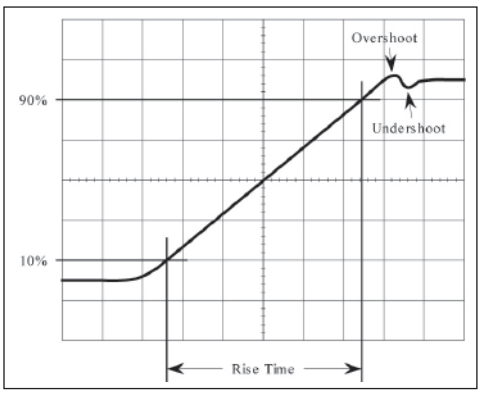


Figure 4. Measurement of rise time

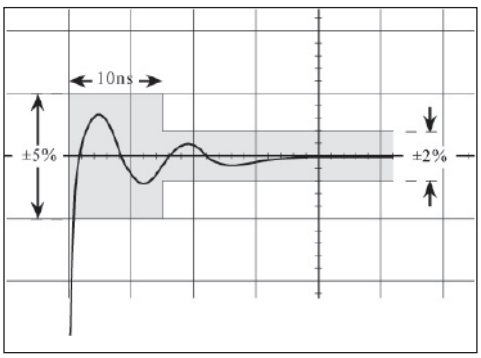


Figure 5. Leading-edge aberration

Pulse response

Viewing the rise time of pulse fast edges is one of two complementary methods of measuring the response of the vertical channel to pulsed inputs (the amplifier's bandwidth should also be measured).

Response to fast edges depends on the input impedance of the oscilloscope to be tested. Two standard input impedances are generally in use: 50 Ω and 1 MΩ (typically) 15 pF. 1 MΩ is the industry standard input generally used with passive probes. Where the 50 Ω input is provided, it gives optimal matching to high-frequency signals.

To measure the rise time, the pulse signal is injected into the channel to be tested; the trigger and time base are adjusted to present a measurable screen image; and the rise/fall time is measured against the graticule or cursor readings. The observed rise/fall time has a component for the applied signal and a second component for the channel under test. They are combined as the root of the sum of squares, so to calculate the time for the unit under test (UUT) channel, a formula must be used:

UUT rise/fall time = square root [(observed time) 2 – (applied signal time) 2]

In some oscilloscopes, the vertical graticule is specially marked with 0 %, 10 %, 90 % and 100 % to make it easy to line up the pulse amplitude against the 0 %/100 % marks, then measure the 10 %/90 % crossing points against marks on the center horizontal graticule line.

Measurement

In all Fluke oscilloscope calibrators, two different types of pulses are used:

- Low edge function: a low voltage amplitude pulse matched into 50 Ω with a rise/fall time less than or equal to 1 ns. When using the formula to calculate the UUT rise/fall time, the applied signal rise time must be that certified at the most-recent calibration of the calibrator, closest to the amplitude of the applied pulse.
- High-edge function: a high-voltage amplitude pulse matched into 1 MΩ with a rise time less than or equal to 100 ns. This function is used mainly to calibrate the response of the oscilloscope's channel attenuators.

Leading-edge aberration

In figure 4, some leading-edge aberrations (overshoot and undershoot) are shown at the top end of the edge, before the voltage settles at its final value (the value defined at 100 %).

Where scope specifications include aberrations, the specification limits can be expressed as shown in the shaded area of the magnified figure 5.

When aberrations are displayed for measurement, they should be within the specification limits, although where the oscilloscope's aberration specification approaches that of the calibrator, other methods must be used.

continued on inside back wrapper

FLUKE®

New warranted MET/CAL® procedures now available for LeCroy® WaveRunner®

Fifteen new MET/CAL procedures covering five of the latest LeCroy WaveRunner models have been added to the MET/SUPPORT℠ web site. All procedures require an optional IEEE port available from LeCroy.

Availability

These procedures are available on the MET/SUPPORT community site. After you log in, click on "Library," then click on MET/CAL Procedures.

Customers with active MET/SUPPORT Gold contracts can view "MET/CAL Calibration Procedure Download – Gold Edition" to find the files you need and download them for free. Other MET/CAL users can view "MET/CAL Calibration Procedure Download – Silver Edition" to find the files and purchase them online.

To become a member of the MET/SUPPORT extranet:

1. Go to http://support.fluke.com
2. Select your preferred language from the pull-down box.
3. In the field next to "Name of the site where you want to go" choose met-support and click the Register button.
4. Fill out and submit the registration form.
5. You will receive an email from the site administrator when your registration has been approved.
6. To logon once you have become a member, just follow steps 1 through 3, clicking the Logon button instead of the Register button. You'll be asked to type in your user name and password.

New 5624 Platinum Resistance Thermometer

Temperature range of 0 °C to 1000 °C

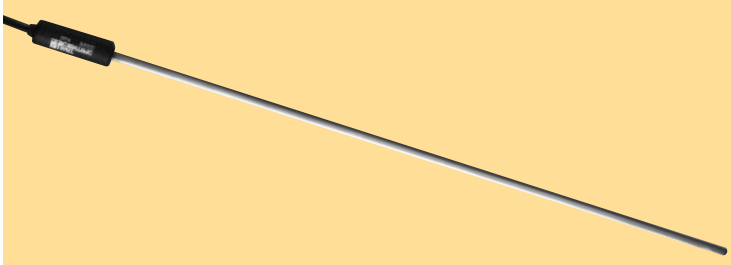
Ideal for use as a reference thermometer in high-temperature furnaces, the 5624 can reach a temperature of 1000 °C with long-term drift at 0 °C of 10 mK and accuracy (including short-term stability and calibration uncertainty over the full range) of 55 mK. This PRT has short-term stability of 5 mK, and an immersion requirement of less than 153 mm (6 inches) at 700 °C.

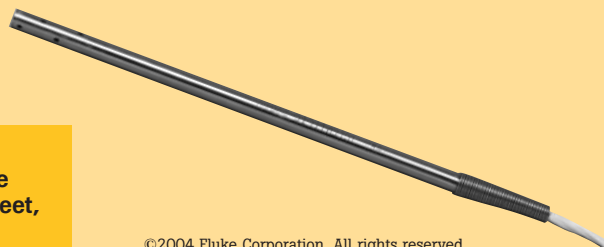
The 5624 is assembled in an alumina sheath that is 508 mm (20 inches) long and 6.35 mm (0.25 inches) in diameter. Several termination configurations can be selected to match different thermometer readouts. Each 5624 comes with a NIST-traceable, NVLAP-accredited fixed-point calibration from 0 °C to 962 °C. The 5624 also comes in a protective carrying case.

New 5623A Precision RTD Freezer Probe

Temperature range of -200 °C to 156 °C

For precision measurement at low temperatures, the new 5623A precision "freezer probe" is now available from Hart Scientific, a Fluke Company. The 5623A is specially sealed from the sensing element to the end of the probe cable, preventing ingress of moisture when exposed to temperatures as low as –200 °C. The entire assembly withstands temperatures over its full range (–200 °C to 156 °C), which is ideal for verification of freezers or autoclaves where a thermo-well isn't available. The 5623A assembly can be fully immersed in fluids when the application may require use in a liquid bath. The 5623A is available in a 6.35 mm (0.25 inch) diameter x 125 mm (5 inches) long Inconel™ sheath. With accuracy (that includes calibration uncertainty and short-term drift) of ±0.05 °C over its full range, the 5623A is just right as a secondary standard for calibration of process sensors.





Detailed information about the 5624 Platinum Resistance Thermometer and the 5623A RTD Freezer Probe is available on the web at www.hartscientific.com. To receive a data sheet, circle the appropriate number on the enclosed reply card.

Oscilloscope calibration *continued*

Channel bandwidth
As well as determining the pulse response by viewing a specimen pulse on the screen, this should be supported by measuring the amplifier's bandwidth using a "leveled sine wave." This is done at an input impedance of 50 Ω, to maintain the integrity of the 50 Ω source and transmission system. For high-input impedance oscilloscopes, an in-line 50 Ω terminator is used to match the line at the oscilloscope input. The in-line 50 Ω could take the form of a separate 50 Ω terminator or be incorporated within an Active Head – the latter gives the benefit of full automation and requires no additional calibration.

First the displayed amplitude of the input sinusoidal wave is measured at a reference frequency (usually 50 kHz), then the frequency is increased, at the same amplitude, to the specified 3 dB frequency of the channel. The displayed amplitude is measured again.

The bandwidth is correct if the observed 3 dB point amplitude is equal or greater than 70 % of the value at the reference frequency.

If it is needed to establish the actual 3 dB point, the frequency should be increased until the peak-to-peak amplitude is 70 % of the value at the reference frequency, then this frequency is close to the 3 dB point.

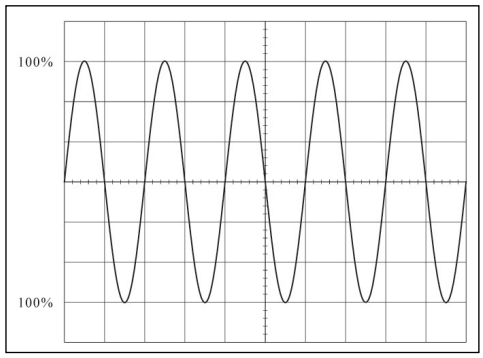


Figure 6. Setting the amplitude at the reference frequency

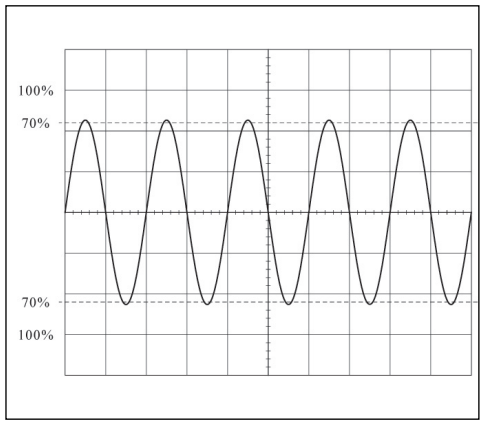


Figure 7. Measuring the amplitude at the 3 dB point frequency

The complete application note, "A Guide to Oscilloscope Calibration Using Dedicated or Multiproduct Calibrators," is available on www.fluke.com/scopeapp. To have information sent to you, just circle the appropriate box on the enclosed reply form.

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