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# User Guide CAL5000S Surge Calibration Verification System

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This guide is intended to assist professionals in the operation of the CAL5000S Surge Calibration.

The CAL5000S is supplied with the following materials, verify you have received them:

## Items Required to deploy CAL5000S

Qty 1: #100-2-003 CAL5000S Surge Calibration & Readout: Calibration for surge testers, measuring reflective voltage spikes on VFD motors applications, or detecting shaft voltages

Qty 1: #95-1-027A Tektronics Passive High Voltage Probe, 75 MHz, 20kV DC40kV Peak with Ground Lead & Alligator Clip

Qty 1: #95-1-028 Fluke VPS410-II-R Probe, Active 10:1, 500MHz, 1kV



Figure 1 CAL5000S Surge Calibration Verification Device

## : Primary intended use

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Calibration verification of most of the commercial surge and impulse generators available on the market today. This is typically done/required on a periodic, or yearly basis and may be done as part of in process quality control and/or other procedures. The device uses non differential measurement of high frequency conducted signals, at voltages up to +/- 15kv impulse. The rise time/fall time of such impulses which fall between 100 nano-seconds to about 10 milli-seconds. The portion of the signal which is detected is the highest peak voltage. RMS values are not indicated, wave shapes are not indicated, and frequency is not indicated. If these are criteria that must be determined in your application, we recommend you purchase an oscilloscope and a high voltage oscilloscope probe.

## : Secondary intended use

Non differential measurement of AC “peak” voltages at 50-400 cycles of up to 10kv RMS are able to be measured. The device can be used to sample the peak voltages developed by current limited voltage generators, impulse generators, surge generators, transient over voltages in power supplies, power delivery systems, such as the output voltages developed by PWM (pulse width modulation) or even ASD (adjustable speed drive) circuits.

The output measured is then signal conditioned, and resulting +/- peak voltage in relation to earth ground is supplied to a dual banana jack for connection to a digital multi-meter. The resulting display operation makes for very rapid, easy to understand detection of peak voltages, in applications where frequency/period/wave shape are not critical, only the peak voltage.

A probe comprised of non-conducting material, with provision for BNC plug output, and a clamp for ground reference are necessary. A suitable, calibrated, digital multi-meter or oscilloscope (for display purposes) can be supplied separately or at the time of purchase.

## : Considerations for alternatives uses

For example, it may be desirable or necessary to measure the instantaneous voltage between two circuit elements, not in reference to earth ground (PE). Such an application requires generally requires special

precautions and EDE Application Engineering should be consulted for recommended practices.

## : Environmental considerations

The probe and its application is intended to be in a workshop or calibration laboratory type environment. It requires the presence of earth ground to provide a measurement with small degree of error. It is not to be used in the presence of condensing humidity. It is characterized for operation between 0 degrees C to 40 degrees C. Operation outside these guidelines may result in erroneous measurements, or malfunction. The probe is not to be used in any type of contaminated or explosive atmosphere. Suitable safety precautions, such as high voltage gloves, safety interlocks or light curtains for operator safety are reasonable and encouraged.

## :Deploying the CAL5000S

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Read this user guide before attempting to deploy the CAL5000S. It is important to understand the procedures, and requirements for safe operation.

It is important to determine the presence of earth ground at the test station/area tests and measurements are going to be gathered. Earth ground also known as (PE) protective earth. Earth ground is a required to meet electrical code in most countries. The earth provides a path of least resistance to electrical currents, should there be any type of equipment flaw or insulation break down - electricity will take the path the protective earth. This is for operator and equipment safety, allowing proper operation of safety circuits, etcetera.

This check can be as simple as determining the presence of a 3 prong NEMA grounded receptacle at the test bench, or can require special connection to building ground with heavy braided conductors. In most typical applications, a NEMA 3 prong grounded receptacle in good service condition is suitable.

A trained electronics technician, or plant electrician should have knowledge about how to determine the presence of this requirement. It is beyond the scope of this operator's manual to determine all possible configurations and or possibilities. Consult EDE Application Engineering or other authorized staff.

## Determine what type of device you will verify

Surge testers and impulse generators used in the electric coil/electric motor/electric generator industry come in many form factors. They are devices used by O.E.M.'s and electrical apparatus service shops to provide quality control of the wire insulation used in the electric coils, motors or generators. These devices are also used in the field by electrical maintenance departments to determine suitability for service of the same apparatus. These testers generally contain relatively large and heavy power supplies which are difficult to transport and/or ship to calibration laboratories for periodic calibration verification. CAL5000S helps you avoid this concern, and can provide return on the investment in a relatively short period of time.

Surge and impulse generators deliver either a (+) positive polarity impulse/surge, or a (-) negative polarity impulse/surge, or bi-polar (+/-) impulse surge. In other words, the leading edge of the electrical pulse appears as a positive or negative pulse, in relation to earth ground. For this reason, the CAL5000S includes provision for both positive and negative pulses. By default, the CAL5000S is for (-) polarity testers such as those manufactured by "Baker".

Note: Bi-polar/non-symmetric surge/impulse generators could require you to take both a (+) and (-) measurements. You may need to sum the readings, or take other steps to correlate them to the specific device you are measuring!

(Some manufacturer's testers are selectable + provide all 3 types, some only 1 or 2 types. Some manufacturers provide this information in their user guides, some do not)

## Steps to connect the ST CAL5000 and take a measurement

Observe the BNC port on the CAL5000S: This is where you will plug in your P6015A or equivalent 1000:1 voltage divider. Plug it in first. Also, make sure you have installed fresh 9V batteries in the CAL5000S.

1. Power down the surge tester or impulse tester. The CAL5000S is only to be connected to a de-energized circuit, and the voltage increased from 0 volts. This is important for operator safety, as well as preventing arcs/electric discharging or other types of unnecessary phenomena.
2. Land the G ground lead of the CAL5000S on a known earth ground, ideally the return from the high voltage surge generator. This becomes more important if the coils or test objects are low impedance, and draw high currents from the surge impulse generator. The high currents are responsible for significant voltage drops in the test leads. Landing at the return can cancel much of this effect, and provide you information regarding the voltage across those circuit nodes.
3. Land the probe tip of the CAL5000S on the surge test lead of the tester you will be verifying. It is important to consider the effects of proximity. For example, if the probe tip is laid flat on a floor or table top, capacitive or other coupling effects can contribute to measurement errors.
4. Energize the CAL5000S measurement circuit. It is enabled with a toggle switch on the front panel of the CAL5000S. (On/Off)
5. You should see a display appear on the CAL5000S. Typically some small signal like 0.001V will be indicated. If some stray voltage is indicated let it decay toward .001 for a few seconds.
6. Select a reasonable test voltage on your surge impulse tester. A good starting point is 500 volts. If you have configured your device(s) properly, you will immediately see deflection on your

digital multi-meter display that is analogous to the voltage reported by the surge tester. The CAL5000S is calibrated to provide a 1000:1 voltage divider ratio. Therefore, you will see indication on the CAL5000S display meter of .5 volts when 500 volts is applied.

7. If a strange reading such as .250 volts appears when 500 volts is applied, you may have a positive polarity surge tester, for example. Return the voltage to 0 volts, and reverse the polarity. Test for effect. It is probable you will see a different indication.
8. Even after step 8, If it is not reading within specification, several possibilities exist, such as:
  - A) The unit being verified is grossly out of calibration; check the vendor's surge tester specification sheet for its rated accuracy, or contact EDE Application Engineering.
  - B) The surge generator may apply pulses with rise times faster than the CAL5000S can resolve. This could result in a lower voltage being indicated. Some vendors provide detailed specifications of the rise times, some do not. Consult EDE Application Engineering or the vendor of the surge generator.
  - C) Surge Generator may have 1 or more broken test leads, creating a connection problem resulting in erroneous measurement. This problem tends to affect older testers which have had very heavy use. Inspect the test leads and connections, both visually and electrically. Make repairs if necessary.
9. Typical Surge testers have several ranges of operation, for example, there may be a 0-500V, 1000-3000V scale or similar. It is important to check a more than one voltage. A commercial 6kV surge tester should be checked at 50% output (for example) and correlation of the tester indicated voltage versus the CAL5000S measured voltage reviewed. Other data points may be gathered depending on the manufacturer's specification sheet.



## : Maintenance of the CAL5000S

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The CAL5000S device contains a battery circuit which provides for the signal conditioning circuitry. Before use, verify the batteries are present and have sufficient freshness to provide service. The batteries are located behind a small hatch. If the batteries are allowed to deplete, replace them, or re-charge them. Otherwise, measurement errors are possible. Accuracy of reported results can be reasonably assured if the batteries are operating within 6-10% of their nominal rating. i.e. > 8.1VDC for 9V batteries. Replace the batteries promptly if their voltage drops below this limit. Never attempt to change batteries while making measurements of any circuit!

## : Periodic verification

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It is simple and easy to periodically verify the performance of the CAL5000S using readily available test voltages. For example, a 500V or 1000V megger can be used to apply DC voltage. This DC voltage can serve as a voltage source to cross verify the performance of the CAL5000S. Keep in mind that meggers may actually apply (-) or (+) voltages some checks will need to be done to determine the operation.