KEITHLEY

Model 5909 Calibration Sources

Instruction Manual

A GREATER MEASURE OF CONFIDENCE

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Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, rechargeable batteries, diskettes, and documentation.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

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This warranty does not apply to defects resulting from product modification without Keithley's express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

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Model 5909 Calibration Sources Instruction Manual

Test Instrumentation Group

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SAFETY PRECAUTIONS

The following safety precautions should be noted before using the Model 5909 calibration sources.

These sources are intended for use by qualified personnel who recognize possible shock hazards and are familiar with the safety precautions necessary to avoid possible injury. Carefully read over the manual supplied with the instrument being calibrated before operation.

Excercise extreme caution when a shock hazard is present in the circuit. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS (42.4V peak) are present. A good safety practice is to assume that hazardous voltages are present in any unknown circuit before measurement.

Do not exceed 30V RMS (42.4V peak) between instrument analog common and earth ground.

Inspect test leads or connecting cables before each use. Replace defective cables with those of equivalent voltage rating.

For maximum safety, do not touch exposed test leads or the instrument while power is applied to the circuit under test. Turn off the power and discharge all capacitors before connecting or disconnecting the instrument.

Do not touch any object which could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

Do not exceed the instrument's maximum allowable input as defined in the instruction manual for the unit.

KEITHLEY Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If ⏚ or ⏚ is present, connect it to safety earth ground using the wire recommended in the user documentation.

The ⚠ symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The ⚡ symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

SPECIFICATIONS

	ACCURACY, 23° ±2°C			
	24 HOURS		90 DAYS*	
VALUE	DC - 100 kHz	1 MHz	DC - 100 kHz	1 MHz
1.8 nF	465 ppm	645 ppm	640 ppm	820 ppm
470 pF	375 ppm	420 ppm	550 ppm	595 ppm
180 pF	375 ppm	390 ppm	550 ppm	565 ppm
47 pF	375 ppm	380 ppm	550 ppm	555 ppm

*ACCURACY: Typical accuracies for >90 days from calibration:
Add 350ppm × $\sqrt{years}$ to 24 hour capacitance specifications.
Add 150ppm × $\sqrt{years}$ to 24 hour conductance specifications.

Specifications subject to change without notice.

GENERAL

CAPACITANCE FROM EITHER TERMINAL TO CASE: 3.5pF maximum.

TEMPERATURE COEFFICIENT OF DIRECT CAPACITANCE (0°-50°C): +140ppm/°C typical.

MAXIMUM VOLTAGE: ±300V.

INSULATION RESISTANCE (terminal to terminal or case):
$10^{13}\Omega$ minimum (1.8nF, 470pF)
$10^{14}\Omega$ minimum (180pF or less).

TERMINALS: Two male BNC push-on connectors spaced on 1-inch centers.

OPERATING ENVIRONMENT: 0° to 50°C; 0% to 70% relative humidity up to 35°C.

STORAGE ENVIRONMENT: −25°C to +65°C.

DIMENSIONS, WEIGHTS: Each calibration source is 35mm × 57mm × 44mm (1.38 in. × 2.25 in. × 1.75 in.). Carrying case with calibration sources is 248mm × 165mm × 73mm (9.75 in. × 6.50 in. × 2.88 in.). Net weight 1.3kg (2 lbs. 14 oz.).

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SECTION 1
General Information

1.1 INTRODUCTION

This section contains general information concerning the Model 5909 Calibration Sources. The Model 5909 is intended to cable correct the Package 82 Simultaneous CV System.

1.2 WARRANTY INFORMATION

Warranty information may be found on the inside front cover of this manual. Should you require warranty service, contact the Keithley representative or authorized repair facility in your area for further information.

1.3 MANUAL ADDENDA

Any improvements or changes concerning the sources or this manual will be explained on an addendum included with the sources. Please be sure to note these changes and incorporate them into the manual before using the sources.

1.4 SAFETY SYMBOLS AND TERMS

The following safety symbols and terms may be found on the instrument or used in this manual.

The symbol ⚡ on an instrument shows that high voltage may be present on the terminal(s). Use standard safety practices to avoid personal contact with these voltages.

The symbol ⚠ on the instrument indicates that the user should refer to the operating instructions.

The **WARNING** heading used in this manual explains hazards the might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading used in this manual explains hazards that could damage the unit. Such damage may void the warranty.

1.5 SPECIFICATIONS

Detailed specifications for the Model 5909 sources may be found at the front of this manual.

1.6 UNPACKING AND INSPECTION

Upon receiving the Calibration Sources carefully unpack them from their shipping carton and inspect all sources for any obvious signs of physical damage. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment.

The following items are included with every order:

- Model 5909 Calibration Sources (see Table 1-1).
- Supplied accessories (Table 1-1).
- A copy of this instruction manual.
- Additional accessories as ordered.

If an additional instruction manual is required, order the manual package (Keithley Part Number 5909-901-00). The manual package includes an instruction manual and any applicable addenda.

1.7 REPACKING FOR SHIPMENT

Should it become necessary to return the sources, carefully pack them in the original packing carton or its equivalent. Be sure to include the following:

- Advise as to the warranty status.
- Write ATTENTION REPAIR DEPARTMENT on the shipping label.
- Fill out and include the service form at the back of this manual.

1.8 USING THE SOURCES

The Model 5909 Sources are intended for use in cable correcting the Package 82 Simultaneous CV System. Refer to Section 3 of the Package 82 Instruction Manual for information on using the Sources.

Table 1-1. Supplied Items

Quantity	Description
1	47pF Capacitance Source
1	180pF Capacitance Source
1	470pF Capacitance Source
1	1.8nF Capacitance Source
2	BNC, female-to-female adapters
1	Case, calibration set
2	Capacitance calibration label set

SECTION 2
Design Considerations

2.1 INTRODUCTION

This section discusses important mechanical and electrical design considerations and calibration methods for the calibration sources.

2.2 MECHANICAL DESIGN CONSIDERATIONS

2.2.1 Dielectric

Glass dielectric capacitors are used for the sources because of several desirable characteristics when compared to other dielectric types. Key important characteristics of the glass capacitor include:

- No noticable frequency-dependent dielectric constant changes.
- Better time stability than all other dielectrics with the possible exception of air capacitors.
- Dissipation factor sufficiently low to allow use with the Model 590.
- Stable and repeatable temperature coefficient.
- High DC insulation resistance allowing use with the Model 595.

2.2.2 Connectors

The BNC connectors were chosen to allow quick and easy connection of the source to the front panel of the Model 590. The connectors have Teflon® insulation for high leakage resistance, and they are specified for use at frequencies as high as 4GHz. The 4GHz specification indicates that both the shunt capacitance and the series inductance are carefully controlled during the manufacturing process, resulting in low SWR for optimum high-frequency operation.

2.2.3 Case Construction

The capacitor is internally mounted between the two BNC connectors, as shown in Figure 2-1. To minimize the capacitance to guard (the metal case acts as the guard), the capacitor is suspended as far as possible from the sides of the case. For the larger capacitor values only, the capacitor is glued to a glass standoff so that impacts and vibration will not cause the capacitor to move, thus preventing changes in shunt capacitance. The standoff has sufficient length and small enough cross sectional area so that it does not contribute to the shunt capacitance, and it also results in a very high DC resistance to ground. To further improve DC resistance to ground, care is taken during assembly not to get a pathway of adhesive, either between the two capacitor terminals, or between either terminal and guard.

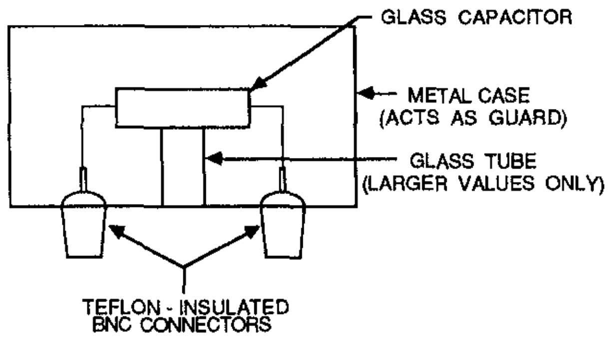

Figure 2-1. Capacitance Source Construction

2.2.4 Series Inductance

The series inductance is the principle error term, and it is minimized by placing the capacitor directly between the ends of the BNC connectors. The lead length, and thus the series inductance, is made as small as possible.

2.3 CAPACITANCE SOURCE CALIBRATION

The capacitance sources are designed to be characterizable at frequencies up to 1MHz. However, since no direct measurement method known provides the required measurement accuracy to 1MHz, the method discussed in the following paragraphs was developed to transfer a traceable calibration of these sources at 1kHz to higher frequencies by analyzing any effects which could alter the capacitance reading at higher frequencies. This method is similar to the method described in the reference[1] at the end of this section.

2.3.1 High Frequency Circuit Model

As shown in Figure 2-2, the capacitor in the metal box can be modeled as an ideal capacitor (C_1) whose value is the measured 1kHz value in series with an inductor (L) representing the inductance of the capacitor, capacitor leads, and BNC connectors. Any shunt capacitance between this network and guard is ignored by the capacitance meter, which makes a guarded measurement.

To obtain the effective capacitance at a given high frequency, the value of the reactance of C_1 and L are computed at that frequency and then added together (keeping in mind that capacitance reactance is negative, and inductive reactance is positive). The resulting reactance is then converted back to an equivalent capacitance at the 100kHz or 1MHz frequency of interest.

The value for L includes the inductance in the BNC connectors up to some reference point on the BNC connector pins. If a different point on the connector pins is chosen, the effective capacitance will be different because L will have a different value.

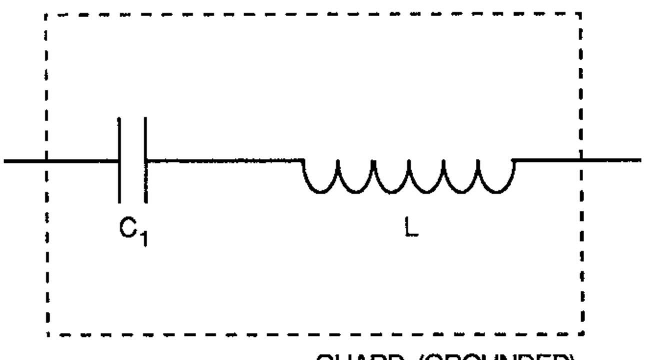

Figure 2-2. High Frequency Model

2.3.2 Calibration Method

The two measurements necessary to calibrate each capacitance source include the 1kHz capacitance, and the series inductance.

1kHz Capacitance Measurement

The 1kHz capacitance is measured in a conventional manner by a precision capacitance bridge utilizing a 3-terminal guarded measurement. Temperature of the capacitance source is accurately monitored during the measurement so that an accurate determination of the temperature can be made. This temperature measurement is necessary because the capacitor has a sufficiently high temperature coefficient to degrade the accuracy of the ultimate user's measurements unless correction is made for changes in capacitance due to temperature variations. Any uncertainty in temperature at the time of source calibration enters into the total uncertainty of the capacitance value.

Series Inductance Measurement

The series inductance is somewhat more difficult to measure than the 1kHz capacitance. The method consists of making a resonant circuit of the capacitor and its series inductance by shorting the external terminals together, as shown in Figure 2-3. Assuming that the 1kHz capacitance value is the same as the capacitance at the resonant frequency, the series inductance can then be calculated from those two factors.

For optimum accuracy, it is necessary to subtract the inductance of the shorting bar from the series inductance of the resonant circuit to obtain the true series inductance of the capacitance source. For that reason, a precision shorting bar is used. This bar has a known inductance, and it also contacts the connecting terminals at the same point each time it is attached minimizing variations.

The resonant frequency is measured by placing a coupling coil close to the shorting bar and looking for a dip in the impedance across the coupling coil with a network analyzer. The dip indicates that the resonant circuit is extracting energy from the coupling coil at the point of resonance.

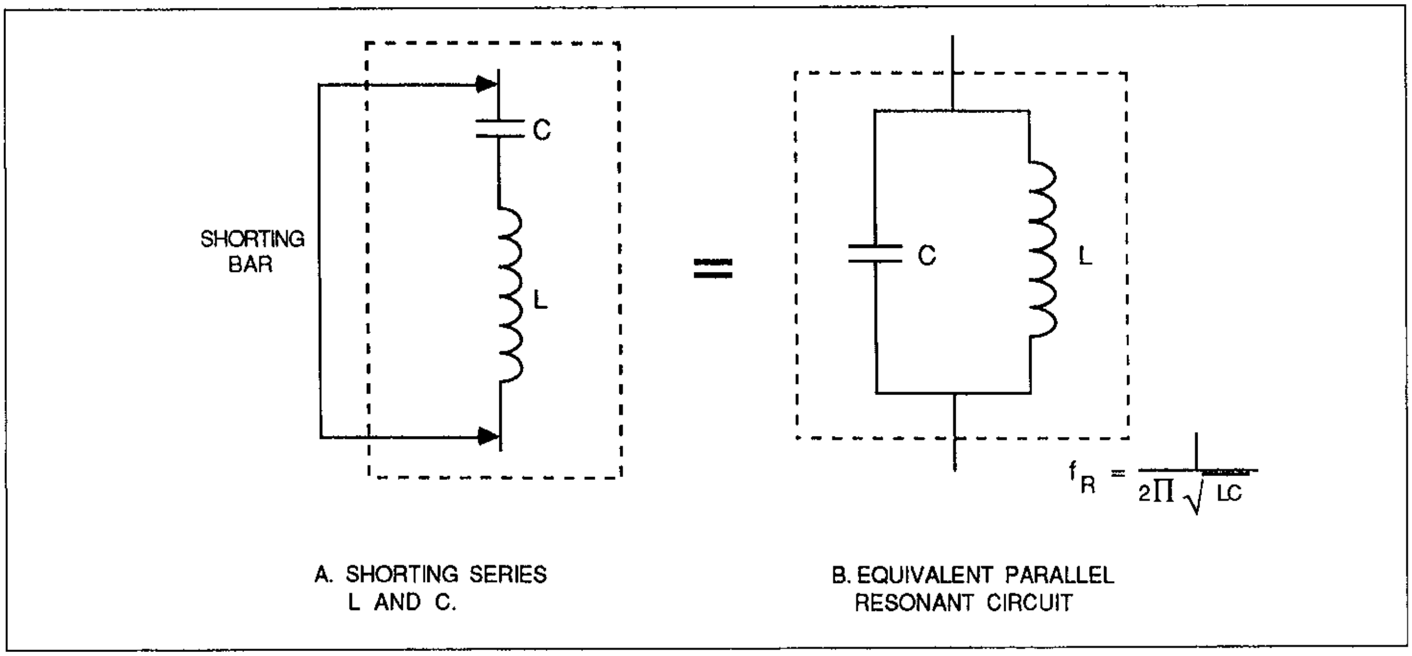

Figure 2-3. Shorting L and C Form Parallel Resonant Circuit

References

1 Jones, R.N., Evaluation of Three-Terminal and Four-Terminal Pair Capacitors at High Frequencies, Nat. Bur. Stand. (U.S.) Tech Note 1024, 15 pages (Sept. 1980)

SECTION 3
Characterization

3.1 INTRODUCTION

This section contains procedures for characterizing the Model 5909 capacitance sources. Recommended equipment and environmental conditions are also discussed.

3.2 RECOMMENDED EQUIPMENT

Table 3-1 summarizes the equipment recommended to characterize the sources to the accuracy given in the specifications at the front of this manual. In order to maintain that accuracy, the specifications for any substitute equipment must be at least as good as those given in Table 3-1. Also, it is important that the test equipment be calibrated to NBS traceable standards.

3.3 ENVIRONMENTAL CONDITIONS

Source characterization should be done under laboratory conditions with an ambient temperature of 23° ±1°C and at a relative humidity of less than 70%.

3.4 TEMPERATURE STABILIZATION

Before characterization, allow the sources to stabilize in a free air environment at the ambient temperature for at least four hours.

NOTE

Do not handle a source for more than one minute at any any given time to avoid inaccurate characterization caused by temperature rise. Typically, it takes 20 minutes for a source to stabilize to rated accuracy after being handled for several minutes.

3.5 WARM UP PERIOD

Before characterization, turn on the test equipment and allow it to warm up for the period stated in the instruction manual for that equipment.

Table 3-1. Recommended Characterization Equipment

Description	Specifications	Manufacturer and Model	Application
1kHz Capacitance Bridge	10ppm (0.001%) accuracy, 0.02ppm/°C stability	Andeen-Hagerling Model 2500	Measure 1kHz capacitance of C source
DMM (RTD temperature)	0.16°C accuracy (temperature)	Keithley Model 193A	Measure source temperature (probe required below)
4-wire RTD temperature probe	100Ω ±0.1Ω platinum RTD, DIN43760, alpha 0.00385 or 0.00392	Omega PR-11-3-100	Measure ambient temperature with Model 193A

3.6 CAPACITANCE SOURCE CHARACTERIZATION

The following paragraphs discuss the procedure for measuring the 1kHz values of the capacitance sources. The factory calibration value for series inductance is used to calculate the 100kHz and 1MHz values. The series inductance measurement discussed in paragraph 2.3.2 is not required for characterization because the value of inductance does not significantly drift during the life of the sources. Before performing these procedures, the test equipment and sources must be temperature stabilized as discussed in the preceding paragraphs.

3.6.1 Connections

Where possible, the source being characterized should be connected directly to the 1kHz capacitance bridge. If connections must be made through cables, use the type and maximum length specified by the manufacturer of the capacitance bridge.

3.6.2 1kHz Capacitance Measurement

Measure the 1kHz capacitance of each source as follows:

1. Connect the source being characterized to the capacitance bridge.
2. Allow the source to temperature stabilize for at least 10 minutes after handling. Measure the ambient temperature to within 0.1°C.
3. Measure the 1kHz capacitance and record the value in Table 3-2.
4. Repeats steps 1 through 3 for the remaining capacitance sources.

3.6.3 100kHz Capacitance Calculation

Use the 1kHz measured value and the inductance marked on each source to calculate the 100kHz value at 23°C as follows:

$$C_{100k} = C_{1k}\,[(T_A-23)(0.00014)+1]\left[1+\frac{\omega^2 L\, C_{1k}}{1-\omega^2 L\, C_{1k}}\right]$$

Where: C_{100k} = capacitance at 100kHz
C_{1k} = capacitance at 1kHz (measured)
L = series inductance (marked on each source)
$\omega^2 = (2\pi f)^2 = 3.9478417 \times 10^{11}$
T_A = Ambient temperature during 1kHz measurement (°C)

After calculating each 100kHz value, record it in the appropriate space in Table 3-2.

Example: Assume that the measured 1kHz value of a nominal 180pF source is 181pF, and that the marked series inductance is 0.0492µH. The 100kHz capacitance at 25°C is:

$$C_{100k}=(181\times10^{-12})\,[(25-23)(0.00014)+1]$$

$$\left[1+\frac{(3.9478417\times10^{11})(0.0492\times10^{-6})(181\times10^{-12})}{1-((3.9478417\times10^{11})(0.0492\times10^{-6})(181\times10^{-12}))}\right]$$

$$C_{100k} = 181.05131 \times 10^{-12}$$

$$C_{100k} = 181.05131\text{pF}$$

Table 3-2. Model 5909 Capacitance Characterization

Nominal Value	Measured 1kHz Capacitance	Calculated 100kHz Capacitance*	Calculated 1MHz Capacitance*
47 pF	________	________	________
180 pF	________	________	________
470 pF	________	________	________
1.8nF	________	________	________

*Calculated as follows:

$$C_E = C_{1k}\,[(T_A - 23)(0.00014) + 1]\left(1 + \frac{\omega^2 L\, C_{1k}}{1 - \omega^2 L\, C_{1k}}\right)$$

Where: C_E = Extrapolated 100kHz or 1MHz value.
C_{1k} = Measured 1kHz capacitance.
$\omega^2 = (2\pi f)^2 = 3.9478417 \times 10^{11}$ (100kHz) or 3.9478417×10^{13} (1MHz)
L = Series inductance marked on source
T_A = Ambient temperature during 1kHz measurement (°C)

3.6.4 1MHz Capacitance Calculation

The 1MHz capacitance value at 23°C can be determined in the same manner as the 100kHz value as follows:

$$C_{1M} = C_{1k}\,[(T_A - 23)(0.00014) + 1]\left[1 + \frac{\omega^2 L\, C_{1k}}{1 - \omega^2 L C_{1k}}\right]$$

Where: C_{1M} = capacitance at 1MHz (calculated)
C_{1k} = capacitance at 1kHz (measured)
L = series inductance (marked on each source)
$\omega^2 = (2\pi f)^2 = 3.9478417 \times 10^{13}$
T_A = Ambient temperature during 1kHz measurement (°C)

After calculating each 1MHz value, record it in Table 3-2.

Example: Assume the same 180pF (nominal) source is used. With a measured 1kHz capacitance of 181pF and a marked series inductance of 0.0492µH, the 1MHz capacitance at 25°C is:

$$C_{1M} = (181 \times 10^{-12})\,[(25-23)(0.00014) + 1]$$

$$\left[1 + \frac{(3.9478417\times10^{13})(0.0492\times10^{-6})(181\times10^{-12})}{1-((3.9478417\times10^{13})(0.0492\times10^{-6})(181\times10^{-12}))}\right]$$

$$C_{1M} = 181.1144 \times 10^{-12}$$

$$C_{1M} = 181.1144\text{pF}$$

3.6.5 Capacitance Source Calibration Labels

After the 1kHz, 100kHz, and 1MHz capacitance values have been determined, write the values on the calibration labels (supplied). Also include other pertinent information such as due date, and place the labels on the source over the existing labels.

SECTION 4
Replaceable Parts

4.1 INTRODUCTION

This section contains information on replaceable parts for the Model 5909.

4.2 PARTS LIST

Parts for the Model 5909 are listed in Table 4-1. The capacitance values listed in the table are nominal. Also note that the part numbers listed for the capacitance sources are for factory calibrated units.

4.3 ORDERING INFORMATION

To place a parts order, or to obtain information concerning replacement parts, contact your Keithley representative or the factory (see the inside front cover for addresses). When ordering parts, be sure to include the following information:

1. Model number (5909).
2. Serial number (where applicable).
3. Part description.
4. Keithley part number.

Table 4-1. Model 5909 Parts List

Quantity	Description*	Keithley Part Number**
1	Capacitance Source, 47pF	5900-301-5
1	Capacitance Source, 180pF	5900-301-6
1	Capacitance Source, 470pF	5900-301-7
1	Capacitance Source, 1.8nF	5900-301-8
2	BNC, female-to-female adapter	CS-565
1	Case, calibration set, small	5900-316
2	Capacitance calibration label set, replaceable	MC-444

*Source values shown are nominal.
**Capacitance source part numbers are for calibrated units.

KEITHLEY

Service Form

Model No. ____________ **Serial No.** ____________ **Date** ____________

Name and Telephone No. ____________________________

Company ____________________________

List all control settings, describe problem and check boxes that apply to problem. ____________________________

- ❑ Intermittent
- ❑ IEEE failure
- ❑ Front panel operational
- ❑ Analog output follows display
- ❑ Obvious problem on power-up
- ❑ All ranges or functions are bad
- ❑ Particular range or function bad; specify ____________
- ❑ Batteries and fuses are OK
- ❑ Checked all cables

Display or output (check one)

- ❑ Drifts
- ❑ Unstable
- ❑ Overload
- ❑ Unable to zero
- ❑ Will not read applied input

- ❑ Calibration only
- ❑ Data required
- ❑ Certificate of calibration required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

____

What power line voltage is used? ____________ Ambient temperature? ____________°F

Relative humidity? ____________ Other? ____________

Any additional information. (If special modifications have been made by the user, please describe.)

____

Be sure to include your name and phone number on this service form.

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