

**1730**  
**LCR Digibridge**  
**Instruction Manual**  
Form 150683/A2

©QuadTech, Inc., 2002  
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The material in this manual is for informational purposes only and is subject to change, without notice. QuadTech assumes no responsibility for any error or for consequential damages that may result from the misinterpretation of any procedures in this publication.

**CAUTION**

Voltage may be present on front and rear panel terminals. Follow all warnings in this manual when operating or servicing this instrument. Substantial levels of energy may be stored in capacitive devices tested by this unit.



Product will be marked with this symbol (ISO#3864) when it is necessary for the user to refer to the instruction manual in order to prevent injury or equipment damage.



Product marked with this symbol (IEC417) indicates presence of direct current.



Product will be marked with this symbol (ISO#3864) when voltages in excess of 1000V are present.



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## Warranty

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QuadTech warrants that Products are free from defects in material and workmanship and, when properly used, will perform in accordance with QuadTech's applicable published specifications. If within one (1) year after original shipment it is found not to meet this standard, it will be repaired, or at the option of QuadTech, replaced at no charge when returned to a QuadTech service facility.

**Changes in the Product not approved by QuadTech shall void this warranty.**

**QuadTech shall not be liable for any indirect, special or consequential damages, even if notice has been given of the possibility of such damages.**

**This warranty is in lieu of all other warranties, expressed or implied, including, but not limited to any implied warranty or merchantability of fitness for a particular purpose.**

### **SERVICE POLICY**

QuadTech's service policy is to maintain product repair capability for a period of at least five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.



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# Specifications

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## LCR Features

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<b>Primary Parameters:</b>	Ls, Lp, Cs, Cp, Rs, Rp and $ Z $ Ls, Lp: 0.001 $\mu$ H – 99.999kH Cs, Cp: 0.001pF – 9.9999F Rs, Rp: 0.01m $\Omega$ – 99.99M $\Omega$ $ Z $ : 0.01m $\Omega$ – 99.99M $\Omega$
<b>Secondary Parameters:</b>	D, Q, ESR, Xs and $\theta$ D: 0.0001 – 9999 Q: 0.0001 – 9999 ESR: 0.01m $\Omega$ – 99.99M $\Omega$ Xs: 0.01m $\Omega$ – 99.99M $\Omega$ $\theta$ : -180.00° – 180.00°
<b>Measurement Accuracy:</b>	Basic LCR: 0.1%      Basic DQ: $\pm$ 0.001
<b>Measurement Rate:</b>	Fast: 62 measurements/second Medium: 19 measurements/second Slow: 3 measurements/second
<b>Measurement Mode:</b>	Continuous or Trigger (INT, EXT or Manual)
<b>Measurement Delay:</b>	0 – 10 seconds in 1ms increments
<b>Averaging:</b>	1-256 measurements
<b>Ranging:</b>	Automatic or User Selectable
<b>Equivalent Circuit:</b>	Series or Parallel
<b>Test Voltage:</b>	10mV to 1.0V programmable in 10mV steps
<b>Test Frequency:</b>	7 User Selectable Test Frequencies 100Hz, 120Hz, 1kHz, 10kHz, 20kHz, 50kHz and 100kHz Accuracy: $\pm$ (0.01% $\pm$ 0.01Hz)
<b>Source Impedance:</b>	100/25 $\Omega$ (instrument auto-selects based on DUT impedance), 100 $\Omega$ , 25 $\Omega$ , 10 $\Omega$ c.c. (constant current)

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## Specifications (Continued)

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### General Features

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<b>Bias Voltage:</b>	Internal: ( $R_{BIAS}$ ) 0-5V DC, External: Programmable 0-5V DC				
<b>Bias Current:</b>	Internal: ( $R_{BIAS}$ ) 0-200mA				
<b>Display:</b>	240 x 64 LCD Graphic display				
<b>Results Format:</b>	• Value      • Deviation      • %Deviation      • Bin Number				
<b>Indication:</b>	Audible alarm programmable HI, LOW or OFF for Pass or Fail				
<b>Setup Storage:</b>	50 Memory Locations				
<b>Standard Interfaces:</b>	• IEEE-488      • Handler				
<b>Connectors:</b>	Front Connection: 4 BNC Sockets ( $L_{CUR}$ , $L_{POT}$ , $H_{POT}$ , $H_{CUR}$ ) Rear Connection: EXT Bias Terminal Strip, 1 BNC Connector GUARD: Banana Socket (Front & Rear connection)				
<b>Front Panel Lockout:</b>	Key Lock with or without setup recall Back Lit Display: <span style="border: 1px solid black; padding: 2px;">LOCK</span>				
<b>Mechanical:</b>	Bench Mount Dimensions:(w x h x d): 12.50 x 4.00 x 13.50 inches 312.5 x 100.0 x 337.5 mm				
<b>Weight:</b>	12.4 lbs (5.7 kg) net, 17 lbs (7.8 kg) shipping				
<b>Environmental:</b>	Operating:    10°C to + 40°C, 10-90% RH Storage:      0°C to + 50°C, 10-90% RH Pollution Degree 2 Installation Category II				
<b>Power:</b>	• 90-125VAC      • 190-250VAC      • 50 or 60Hz      • 65W max				
<b>Supplied:</b>	• Instruction Manual                      • Power Cable • Calibration Certificate				
<b>Ordering Information:</b>	<table style="width: 100%;"><thead><tr><th style="text-align: left;"><u>Description</u></th><th style="text-align: right;"><u>Catalog No.</u></th></tr></thead><tbody><tr><td>LCR Digibridge</td><td style="text-align: right;">1730</td></tr></tbody></table>	<u>Description</u>	<u>Catalog No.</u>	LCR Digibridge	1730
<u>Description</u>	<u>Catalog No.</u>				
LCR Digibridge	1730				



# Accessories

## Accessories Included

Item	Quantity	QuadTech P/N
AC Power Cord	1	4200-0300
Power Line Fuse 1A 250V SB	1	520026
Power Line Fuse 0.5A 250V SB	1	520138
Instruction Manual	1	150683
Calibration Certificate	1	N/A

## Accessories/Options Available

Item	Quantity	QuadTech P/N
Axial/Radial Component Test Fixture	1	1700-01
Axial/Radial Remote Test Fixture	1	1700-02
Lead Set: 4 BNC Connectors to 2 Kelvin Clips	1	1700-03
BNC to BNC Cable Lead Set (1m)	1	7000-01
BNC to BNC Cable Lead Set (2m)	1	7000-02
Lead Set: 4 BNC Connectors to Chip Component Tweezers	1	7000-05
Low Voltage Chip Component Test Fixture	1	7000-07
50-pin micro-ribbon plug (for Handler)	1	329210

**NOTE:**

For proper operation, the  $H_{CUR}/H_{POT}/I_{CUR}/I_{POT}$  cable shields must be connected together at the DUT. This connection is already made using the 1730 recommended accessory leads.

If the shields are not tied together, then at higher frequencies a resonance may occur which could cause erroneous capacitance readings.



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## Safety Precautions

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### CAUTION

The 1730 LCR Digibridge can provide an external bias output voltage of 5V DC to the device under test (DUT). Although the 1730 Digibridge unit is a low voltage instrument, some devices tested (especially capacitors) can store charge and may cause serious hazards if not discharged properly. Follow these safety instructions.

1. Operate the 1730 unit with its chassis connected to earth ground. The instrument is shipped with a three-prong power cord to provide this connection to ground. This power cord should only be plugged in to a receptacle that provides earth ground. Serious injury can result if the 1730 unit is not connected to earth ground.
2. Tightly connect BNC cables to the silver output terminals: **H<sub>POT</sub>**, **H<sub>CUR</sub>**, **L<sub>POT</sub>**, and **L<sub>CUR</sub>**. If this is not done, the DUT's casing can be charged to the high voltage test level and injury or electrical shock hazards could result if the DUT is touched.
3. Never touch the test leads, test fixture or DUT in any manner (this includes insulation on all wires and clips) when the bias voltage is applied and the **BIAS** backlight is **ON**.
4. Before turning on the 1730 Digibridge unit, make sure there is no device (DUT) or fixture connected to the test leads.
5. When the **BIAS** backlight is **ON**, NEVER touch the device under test, the lead wires or the output terminals.
6. Before touching the test lead wires or output terminals make sure:
  - a) Make sure any capacitive device has been discharged fully.
  - b) The **BIAS** backlight is **OFF**.
7. **In the case of an emergency**, turn OFF the POWER switch using a "hot stick" and disconnect the AC power cord from the wall. Do not touch the 1730 instrument.
8. Be wary when the 1730 Digibridge instrument is used in remote control mode. The bias voltage output is being turned on and off with an external signal.



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# Condensed Operating Instructions

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## General Information

The 1730 Digibridge is an instrument for measuring the passive component primary parameters of inductance (L), capacitance (C), resistance (R) and impedance (Z). Secondary parameters measured are dissipation factor (D), quality factor (Q), equivalent series resistance (ESR), reactance (X), and phase angle ( $\theta$ ). Any two of twelve parameters can be measured simultaneously and the results formatted as value, deviation from nominal, %deviation from nominal or by bin number. Connection to device under test is through 4-BNC terminals on the front panel.

## Start-Up

The 1730 Digibridge unit can be operated from a power source between 90-125V or 190-250V AC at a power line frequency of 50 or 60Hz. The standard 1730 unit is shipped from QuadTech with a 1A fuse in place for AC 90-125V operation. (A 0.5A fuse is included for AC 190-250V operation). The 1730 unit is shipped with the line voltage selector set for 115V. Refer to paragraph 1.4.3 for instructions on changing the fuse or line voltage selector.

Connect the 1730 Digibridge unit AC power cord to the source of proper voltage. Operate the 1730 instrument with its chassis connected to earth ground. The 1730 instrument is shipped with a three-prong power cord to provide this connection to ground. This power cord should only be plugged into a receptacle that provides earth ground. Serious injury may result if the 1730 instrument is not connected to earth ground.

To turn the 1730 instrument ON, press the power button on the front panel. To switch the power OFF, press the button again or if measurements are to be made proceed with the Test Parameter Setup in Table COI-1. The 1730 instrument should warm up for 15 minutes prior to use.

### NOTE

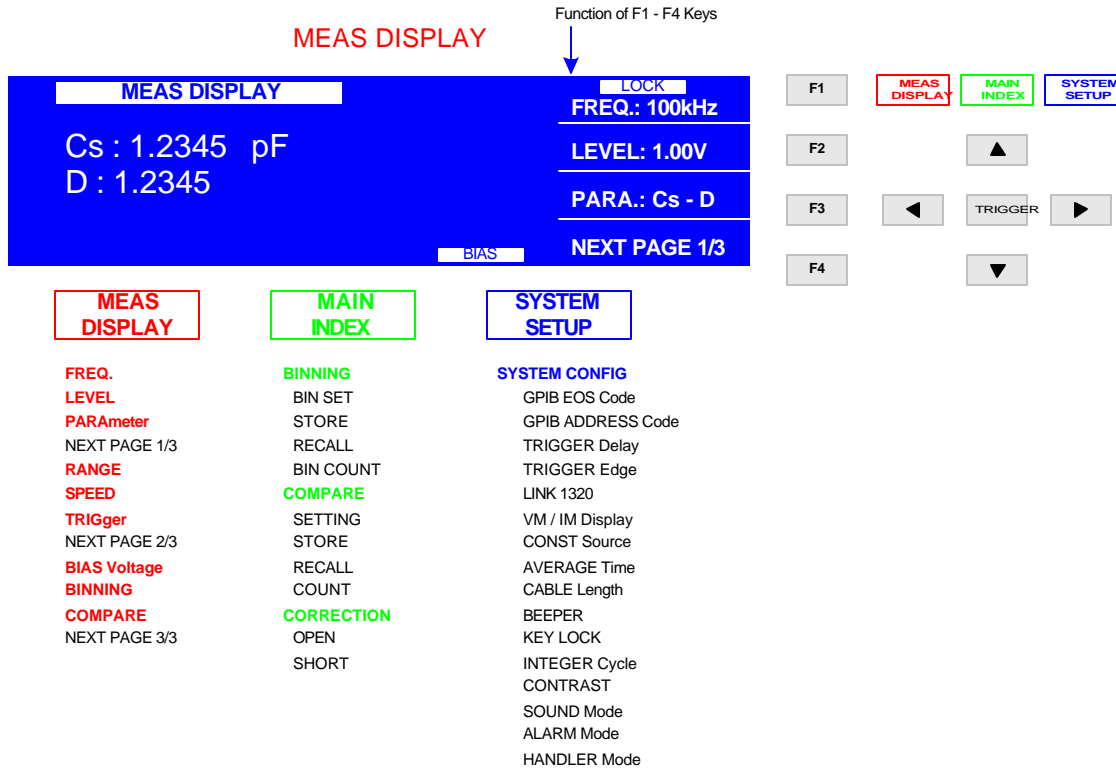
**Please read this instruction manual in its entirety before operating this instrument. These condensed operating instructions are not a substitute for all the information provided in the remainder of this manual.**

### NOTE

**Refer to paragraphs 2.3 through 2.4 for a full description of programming test parameters and instruction on how to store the test setup. Test parameters must be set before the 1730 instrument can be zeroed.**

## Condensed Operating Instructions (Continued)

There are three main menus within the 1730 Digibridge instrument software. Familiarize yourself with these menus prior to programming a test. Figure COI-1 illustrates the MEAS DISPLAY screen and lists the functions that can be accessed by pressing the [MAIN INDEX] and [SYSTEM SETUP] keys.



**Figure COI-1: 1730 Instrument Menus**

NOTE:

The function keys [F1 – F4] are used to select the parameter to change and in some menus to change the value of that selected parameter.

The function of UP/DOWN depends on the menu. In some menus, the LEFT/RIGHT keys are used to select a digit by moving the underscored cursor left or right.

# Condensed Operating Instructions (Continued)

## 1. Set Test Parameters

- Press [POWER] ON.
- Allow the instrument to warm up for 15 minutes.
- Press [MEAS DISPLAY]
- Set test parameters (frequency, voltage, parameters) using the function & arrow keys.

## 2. Correction (Zero)

After setting your test parameters, use the correction function of the 1730 Digibridge instrument to zero the test leads. With no device connected, connect the appropriate cable to the front panel BNC connectors. Refer to paragraph 2.6 for cable connections.

With the instrument in MEAS DISPLAY status:

1. Press [MAIN INDEX]
2. Press [CORRECTION]
3. Press [F2] = OPEN (or [F3] = SHORT) to select zero function.
4. Press [F2] = MULTI to select frequency.
5. Follow instructions on display: i.e.: “Open circuit test leads”.
6. Press [TRIGGER] button.
7. Wait while instrument gets CORRECTION value.
8. Press [ANY KEY] to return to MEAS DISPLAY status.
9. Repeat steps 3-8 for SHORT correction.

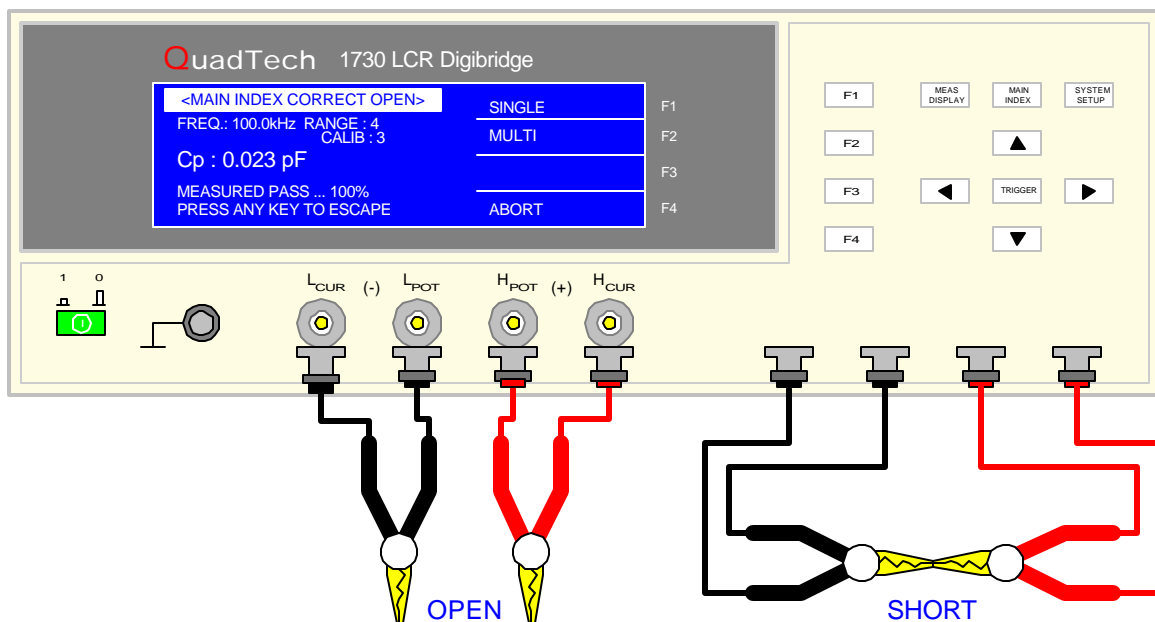
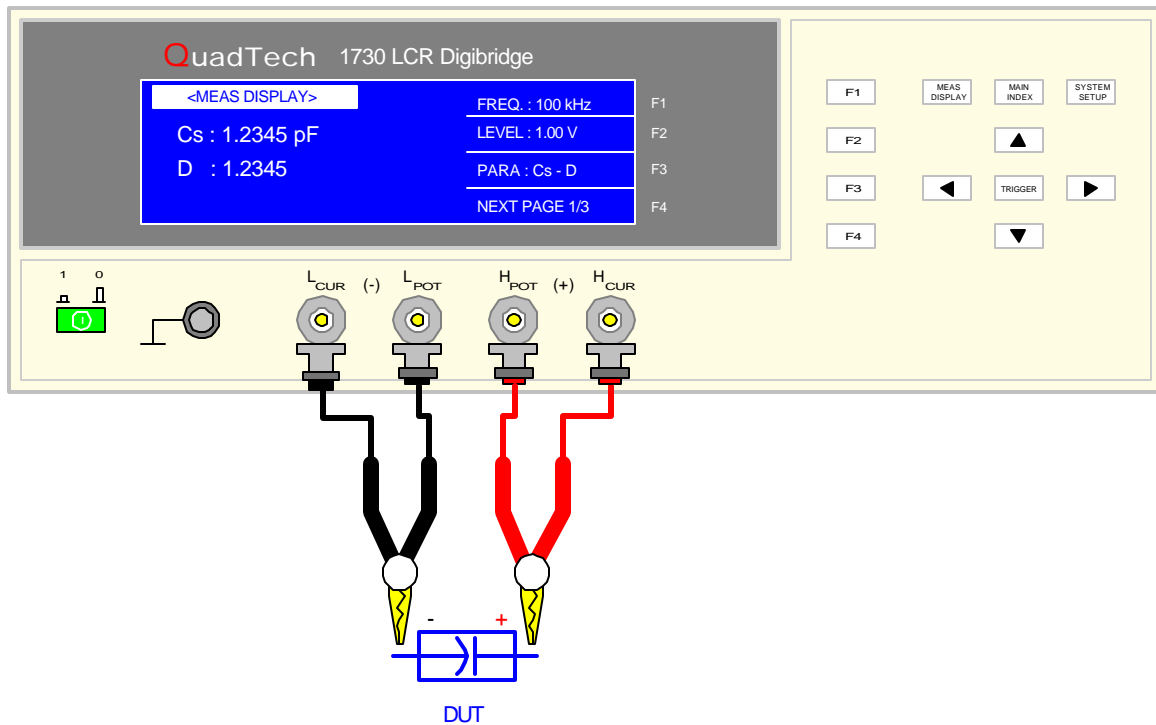


Figure COI-2: Correction OPEN & SHORT Configurations

## Condensed Operating Instructions (Continued)

### 3. Connection to Device under Test (DUT)

Figure COI-3 illustrates the connection of the 1730 Digibridge unit to a single DUT using the 1700-03 4-BNC to Kelvin Clips cable lead set. The silver BNC connectors are connected to the front panel BNC terminals on the 1730 unit: red to  $H_{CUR}/H_{POT}$  and black to  $L_{CUR}/L_{POT}$ . The red Kelvin clip is connected to the high side of the DUT and the black Kelvin clip to the low side of the DUT.



COI-3: Connection to Device under Test

### 4. Make a Measurement

1. Press [MEAS DISPLAY]
2. Connect device under test (DUT) to test leads.
3. Press [TRIGGER].
4. Record measurement.

#### NOTE:

For proper operation, the  $H_{CUR}/H_{POT}/I_{CUR}/I_{POT}$  cable shields must be connected together at the DUT. This connection is already made using the 1730 recommended accessory leads. If the shields are not tied together, then at higher frequencies a resonance may occur which could cause erroneous capacitance readings.



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# Section 1: Introduction

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## 1.1 Unpacking and Inspection

Inspect the shipping carton before opening. If damaged, contact the carrier agent immediately. Inspect the 1730 Digibridge instrument for any damage. If the instrument appears damaged or fails to meet specifications notify QuadTech (refer to instruction manual front cover) or its local representative. Retain the original shipping carton and packing material for future use such as returning the instrument for recalibration or service.

## 1.2 Product Overview

The 1730 Digibridge instrument is a compact yet powerful LCR meter for production or laboratory testing of inductors, capacitors, resistors and other passive components. The 1730 instrument measures 12 parameters:  $L_s$ ,  $L_p$ ,  $C_s$ ,  $C_p$ ,  $R_s$ ,  $R_p$ ,  $D$ ,  $Q$ , ESR,  $|Z|$ ,  $X_s$  and  $\theta$  and displays two simultaneously. Basic accuracy is  $\pm 0.1\%$  for LCR and  $\pm 0.001$  for DQ measurements. Ranging is automatic or user selectable. Measurement rate is also selectable (Slow, Medium or Fast) with rates up to 62 measurements per second. Measurements can be made continuously or triggered with a programmable delay time up to 10 seconds. The IEEE-488 and Handler interfaces are standard equipment on the 1730 instrument. External bias voltage measurements are made via connection to the rear panel terminal strip and levels of 0-5V DC are possible. Internal bias voltage from 0-5V is attainable using an  $R_{BIAS}$  resistor across the rear panel terminal strip. Voltage across and current through the DUT can be monitored using the test signal. Zero the effects of stray admittance/residual impedance in the test leads with the open/short correction function. The source impedance of the 1730 instrument is selectable as  $100\Omega$ ,  $100/25\Omega$ ,  $25\Omega$ , or  $10\Omega$  constant current. Seven test frequencies are selectable from 100Hz to 100kHz. The 1730 instrument is equipped with 8 Pass/Fail bins and 50 Store/Recall memory locations. Test results can be formatted as nominal value, deviation from nominal value or %deviation from nominal value. Bin number or Pass/Fail can be displayed as well. Connection to the device under test is through 4 BNC terminals on the front panel.

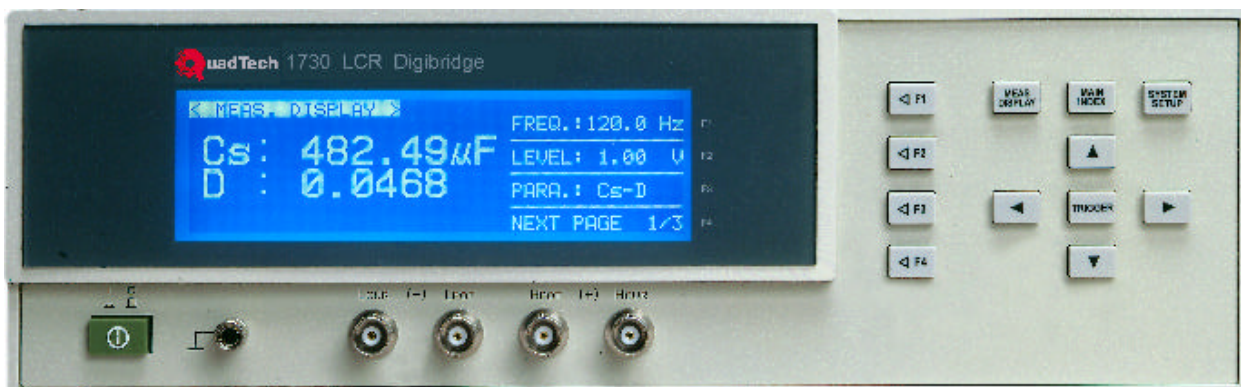
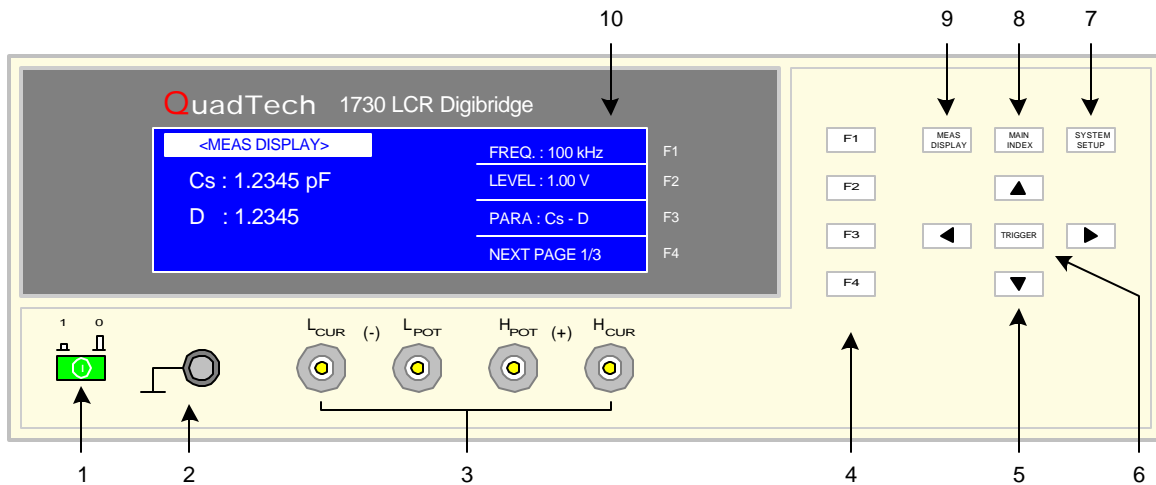


Figure 1-1: 1730 LCR Digibridge

## 1.3 Controls and Indicators

### 1.3.1 Front Panel Controls and Indicators

Figure 1-2 illustrates the controls and indicators on the front panel of the 1730 Digibridge instrument. Table 1-1 identifies them with description and function.



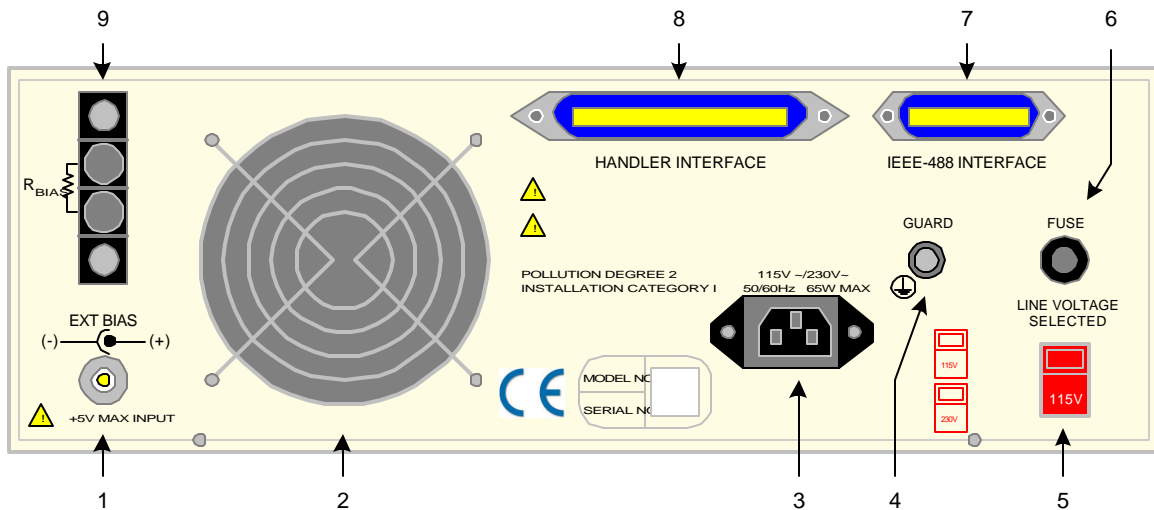
**Figure 1-2: 1730 Front Panel Controls & Indicators**

**Table 1-1: 1730 Front Panel Controls & Indicators**

Reference # Figure 1-2	Name	Type	Function
1		Green Push Button	Apply AC POWER: 1=ON, 0=OFF
2		Silver Banana Jack	Chassis ground connection
3	L <sub>CUR</sub> L <sub>POT</sub> H <sub>POT</sub> H <sub>CUR</sub>	4 silver BNC terminals	Current Drive Terminal, Low (-) Voltage Sense Terminal, Low (-) Voltage Sense Terminal, High (+) Current Drive Terminal, High (+)
4	F1, F2, F3 and F4	4 gray push buttons	Select Instrument Functions Keys perform different functions under different menus. Right side of display shows corresponding key function.
5	, , ,	4 gray push buttons	Move backlit box around display to choose parameter Change parameter value (increase/decrease)
6	TRIGGER	Gray push button	Initiate measurement
7	SYSTEM SETUP	Gray push button	View, Select or Change System Parameters: GPIB, Trigger, Handler, Constant source, VM/IM display, Average, Beeper, Sound, Alarm, Contrast, Integer, Cable Length, Key Lock & Link 1320
8	MAIN INDEX	Gray push button	View, Select or Change Setup & Result Parameters: Binning, Compare, Correction & Store & Recall
9	MEAS DISPLAY	Gray push button	View, Select or Change Measurement Parameters: Frequency, Voltage, Parameter (Pri/Sec), Range, Speed, Trigger, Bias Voltage, Binning and Compare
10		240 x 64 LCD display	Show measurement results as value, deviation, %deviation, bin number or pass/fail. Show programming instructions

### 1.3.2 Rear Panel Controls and Connectors

Figure 1-3 illustrates the controls and connectors on the rear panel of the 1730 Digibridge instrument. Table 1-2 identifies them with description and function.



**Figure 1-3: Rear Panel 1730 Instrument**

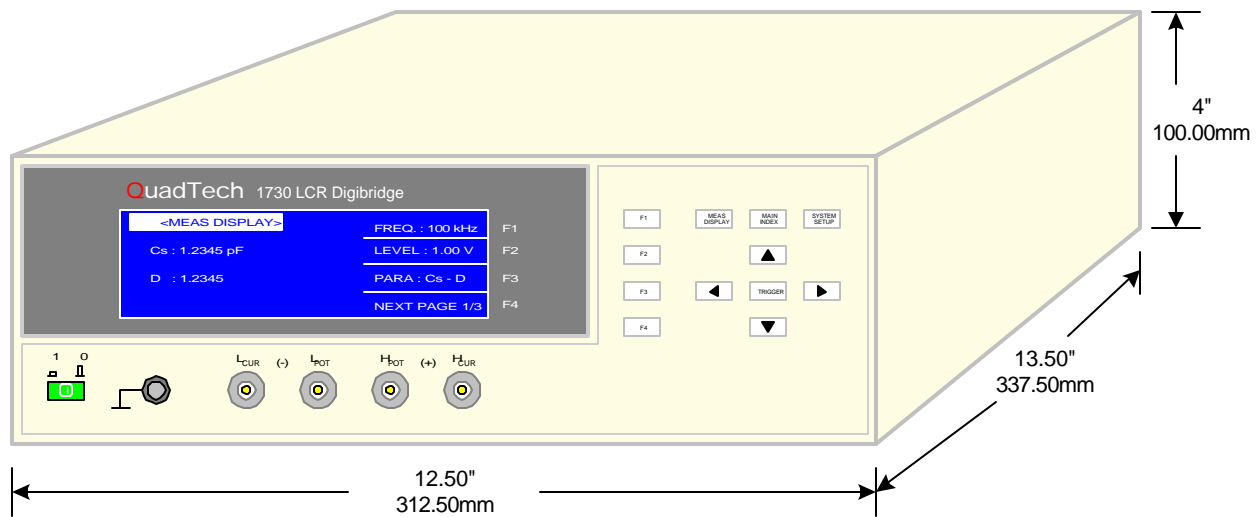
**Table 1-2: 1730 Rear Panel Controls & Connectors**

Reference # Figure 1-3	Name	Type	Function
1	EXT BIAS	Silver BNC terminal	External Bias Voltage output connection to DUT
2	FAN	SF11580AT 115V 50/60Hz 0.10A	Cool Unit: T≥50°C = ON, T<45°C = OFF
3	AC Line Input	Black 3-wire inlet module	Connection to AC power source
4	GUARD	Silver banana jack	Chassis ground connection
5	LINE VOLTAGE SELECTED	2 Red 2-position Slide Switches	Select Voltage Level corresponding to AC Source 90V – 125V: T1.0A 250V fuse 190V – 250V: T 0.5A 250V fuse
6	FUSE	Black screw cap fuse holder	Short circuit protection T 1.0A 250V fuse for 115V operation T 0.5A 250V fuse for 230V operation
7	IEEE-488 INTERFACE	Blue 24-pin connector	IEEE-488 Interface connector for data transfer
8	HANDLER INTERFACE	Blue 50-pin connector	Handler Interface connector for remote operation
9	R <sub>BIAS</sub>	Black 4-screw terminal strip	Remote connection: resistor for internal bias voltage (0-5V) and bias current (0-200mA)

## 1.4 Installation

### 1.4.1 Dimensions

The 1730 Digibridge unit is supplied in a bench configuration, i.e., in a cabinet with resilient feet for placement on a table. A bail is provided under the front feet so that the 1730 instrument can be tilted up for convenient operator viewing.



**Figure 1-4: 1730 Instrument Dimensions**

### 1.4.2 Instrument Positioning

The 1730 instrument contains one (1) graphic display for direct readout of measured parameters. The optimum angle for viewing is slightly down and about 10 degrees either side of center. For bench operation the front flip feet should always be used to angle the instrument up. In bench or rack mount applications the instrument should be positioned with consideration for ample air flow around the rear panel fan ventilation hole. An open space of at least 3 inches (75mm) is recommended behind the rear panel. Testing should be performed on a non-conductive surface. An ESD mat is not a recommended test platform.

### 1.4.3 Power Requirements

The 1730 can be operated from a power source of 90 to 125V AC or 190 to 250V AC. Power connection is via the rear panel through a standard receptacle. Before connecting the 3-wire power cord between the unit and AC power source, make sure the voltage selection switches on the rear panel (Figure 1-5) are in accordance with the power source being used. For a 90-125V source, use a 1A 250V fuse. For a 190-250V source, use a 0.5A 250V fuse. Always use an outlet that has a properly connected protection ground.

## CAUTION

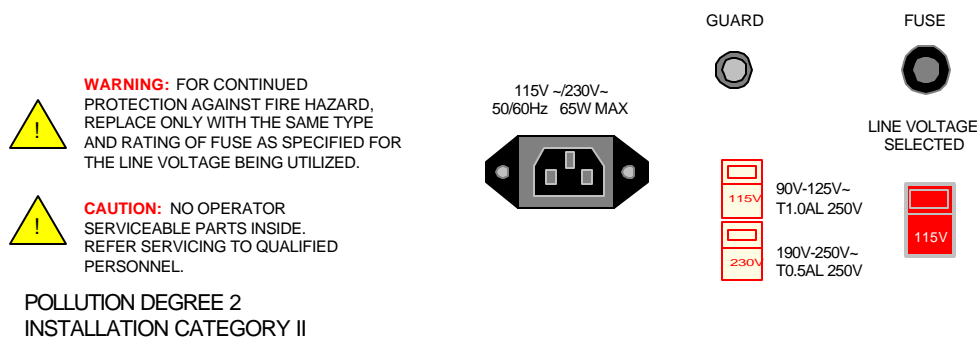
**Make sure the unit has been disconnected from its AC power source for at least five minutes before proceeding.**

### Procedure For Changing A 1730 Instrument Fuse

**Unscrew the fuse cap on the rear panel of the 1730 and pull fuse holder outward.**

Once the fuse holder has been removed from the instrument snap the fuse from the holder and replace. Make sure the new fuse is of the proper rating.

Install the fuse back into the cap holder by pushing in until it locks securely in place.



**Figure 1-5: Close-Up of 1730 Rear Panel**

#### 1.4.4 Safety Inspection

Before operating the instrument inspect the fuse holder on the rear of the 1730 instrument to ensure that the properly rated fuse is in place, otherwise damage to the unit is possible. Make sure that the voltage selector switches are set in accordance with the power source in use. Refer to paragraph 1.4.3 and Figure 1-5.

The 1730 instrument is shipped with a standard U.S. power cord, QuadTech P/N 4200-0300 (with Belden SPH-386 socket or equivalent, and a 3-wire plug conforming to IEC 320). Make sure the instrument is only used with these cables (or other approved international cord set) to ensure that the instrument is provided with connection to protective earth ground.

The surrounding environment should be free from excessive dust to prevent contamination of electronic circuits. The surrounding environment should also be free from excessive vibration. Do not expose the 1730 instrument to direct sunlight, extreme temperature or humidity variations, or corrosive chemicals.



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## Section 2: Operation

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### 2.1 Terms and Conventions

**Table 2-1: Measurement Unit Prefixes**

<u>Multiple</u>	<u>Scientific</u>	<u>Engineering</u>	<u>Symbol</u>
1000000000000000	10 <sup>15</sup>	Peta	P
1000000000000	10 <sup>12</sup>	Tera	T
1000000000	10 <sup>9</sup>	Giga	G
1000000	10 <sup>6</sup>	Mega	M
1000	10 <sup>3</sup>	Kilo	k
.001	10 <sup>-3</sup>	milli	m
.000001	10 <sup>-6</sup>	micro	μ
.000000001	10 <sup>-9</sup>	nano	n
.000000000001	10 <sup>-12</sup>	pico	p
.000000000000001	10 <sup>-15</sup>	femto	f

**Accuracy:** The difference between the measured value or reading and the true or accepted value. The accuracy of an LCR meter is typically given as a  $\pm$  percentage of the measured value for primary parameters and  $\pm$  an absolute value for secondary value. For example:  $\pm 0.05\%$  for L, C & R and  $\pm 0.0005$  for Df.

**Basic Accuracy:** Basic accuracy is specified at optimum test signal, frequencies, highest accuracy setting or slowest measurement speed and impedance of the DUT. As a general rule this means 1VAC RMS signal level, 1kHz frequency, high accuracy which equates to 1 measurement/second, and a DUT impedance between 10Ω and 100kΩ.

**Binning:** Procedure for sorting components into bins using sequential limits or nested limits.

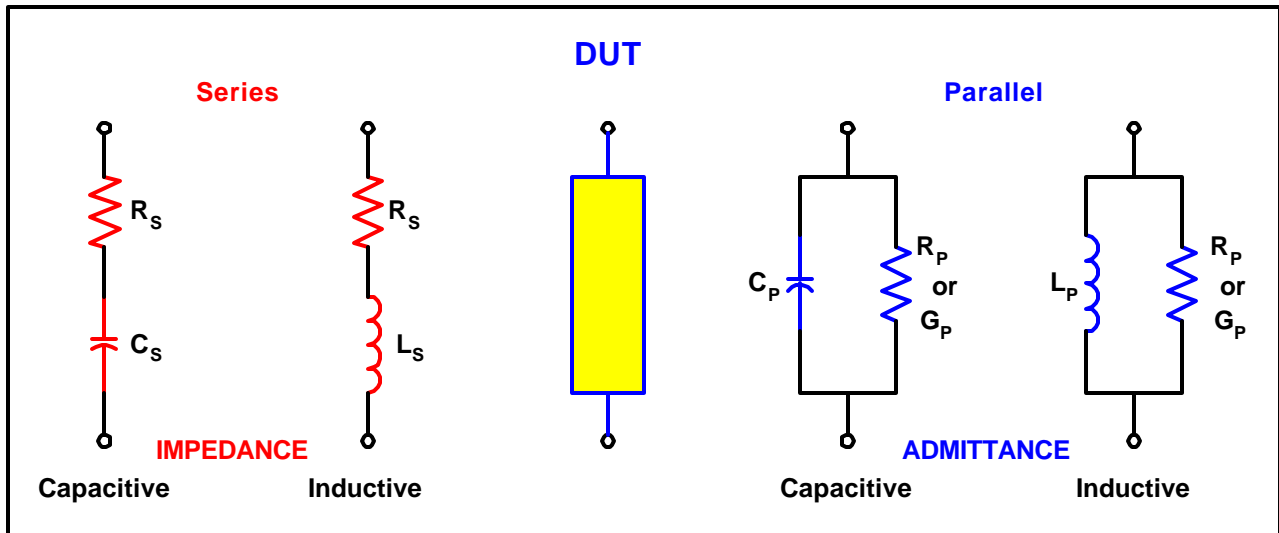
**Capacitor:** Abbreviated C (as in LCR). A capacitor is passive component comprised of two conductors separated by a dielectric. A capacitor stores charge blocks DC flow and allows AC flow based on frequency and capacitor design.

Capacitance:	The measure of the ratio of charge on either plate of a capacitor to the potential difference (voltage) across the plates. Unit of measure is the Farad (F).
Capacitive Reactance:	A measurement of the actual AC resistance of a capacitor. How effective a capacitor allows AC to flow depends upon its capacitance and the frequency used. $X_C = 1 / 2\pi fC$ .
Compare:	Procedure for sorting components by comparing the measured value against a known standard.
<b>Current:</b>	
AC:	Alternating Current. AC is an electrical current that has one polarity during part of the cycle and the opposing polarity during the other part of the cycle. Residential electricity is AC.
DC:	Direct Current. Non-reversing polarity. The movement of charge is in one direction. Used to describe both current and voltage. Batteries supply direct current (DC).
Dielectric:	A material which is an electrical insulator or in which an electric field can be sustained with a minimum dissipation of power.
Dielectric Constant:	Abbreviated K, relative dielectric constant. The dielectric constant of a material is the ratio of the capacitance of a capacitor filled with a given dielectric to that same capacitor having only a vacuum as a dielectric.
Discharge:	The act of draining off an electrical charge to ground. Devices that retain charge should be discharged after an IR test or DC hipot test.
DUT:	Device Under Test. (i.e. the product being tested).



Equivalent Circuit:

The configuration of the device under test. Is it a series or parallel equivalent circuit?



Frequency:

The rate at which current or voltage reverses polarity and then back again completing a full cycle, measured in Hertz (Hz) or cycles/second. AC Line Frequency = 50/60 Hz.

Ground:

The base reference from which voltages are measured, nominally the same potential as the earth. Ground is also the side of a circuit that is at the same potential as the base reference.

Impedance:

The AC resistance of the DUT. Impedance ( $Z$ ) is a vector summation of resistance  $R$  and reactance  $X$ .

For capacitors reactance is defined as  $X_C = 1/j\omega C$

For inductors reactance is defined as  $X_L = j\omega L$

For resistors resistance is defined as  $R$

Impedance is defined as  $Z = \sqrt{X^2 + R^2}$

Inductor:

Abbreviated  $L$  (as in LCR). An inductor is a coil of wire. It is used to create electromagnetic induction in a circuit.

Inductance:

The property of a coil to oppose any change in current through it. If the turns (coils) of the wire are stretched out, the field intensity will be less and the inductance will be less. Unit of measure is the Henry (H).

Inductive Reactance:

A measure of how much the counter electro-magnetic force (emf) of the coil will oppose current variation through the coil. The amount of reactance is directly proportional to the current variation:  $X_L = 2\pi fL$ .

**Interface:**

Handler:	Device for remote control of test instrument in component handling operations.
IEEE-488:	General Purpose Interface Bus (GPIB). GPIB is an industry standard definition of a Parallel bus connection for the purpose of communicating data between devices.
RS232:	An industry standard definition for a Serial line communication link or port.
Scanner:	An electronic device designed to switch or matrix signals.
Level:	The test signal level is the programmed RMS voltage of the generator in an LCR meter. The actual test voltage across the DUT is always less than the programmed level. Refer to VM/IM feature to view actual signal across DUT.

**Limits:**

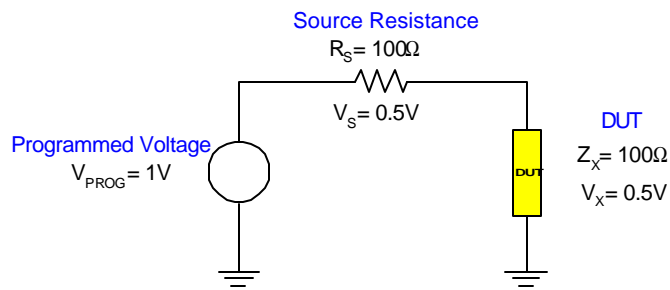
High Limit:	The high limit is the upper value for a test to be considered a pass. If the measured value is higher than the high limit the test is considered a fail.
Low Limit:	The low limit is the lower value for a test to be considered a pass. If the measured value is lower than the low limit the test is considered a fail.
Parameter:	Electrical property being tested. The primary parameter (L, C, R) is the first property characterized of the device under test. The secondary parameter (D, Q, $\theta$ ) is the second property characterized of the device under test.
Permittivity:	Abbreviated $\epsilon$ . The dielectric constant multiplied by the dielectric constant of empty space ( $\epsilon_0$ ), where the permittivity of empty space ( $\epsilon_0$ ) is a constant in Coulomb's Law, equal to a value of 1 in centimeter-gram-second units and to $8.854 \times 10^{-12}$ farads/meter in rationalized meter-kilogram-second units.
Range:	The resistance ranges the instrument uses for reference in making the measurement.

Repeatability: The difference between successive measurements with no changes in the test setup or test conditions.

Reproducibility: Similar to repeatability but adds the element of what could be expected under real life conditions. Reproducibility would take into account the variability in thing like fixturing where the DUT being tested is removed from the fixture and then inserted again.

Resolution: The smallest value that can be shown on the display in a digital instrument. LCR meters typically specify a measurement range that is the largest and smallest value that can be shown on the display.

Source Impedance: A constant source resistance of the measuring instrument used to level the voltage across the DUT to a constant voltage.



Speed: The rate at which the instrument makes a measurement in measurements per second. Speed is inversely proportional to accuracy.

**Trigger:** The device for initiating the test (applying the voltage or current).

External: The test is initiated via an external source such as a computer with an IEEE-488 or Handler interface. One measurement is made each time the external trigger is asserted on the handler.

Internal: The instrument continuously makes measurements.

Manual: The operator initiates the test by pressing the [START] button. One measurement is made each time the trigger is pressed.

## 2.2 Startup

Check to make sure the red Line Voltage Selector switch on the rear panel agrees with the power source available. Depending on the power source the switch position should be in the up or down position as shown in Figure 1-5 (Close-Up of 1730 Rear Panel).

**CAUTION**  
USE ALL PRECAUTIONS NECESSARY TO **AVOID TOUCHING THE DEVICE UNDER TEST** WHEN  
THE **BIAS BACKLIGHT IS ON**.

Connect the instrument power cord to the source of proper voltage. **The instrument is to be used only with three-wire grounded outlets.**

Power is applied to the 1730 instrument by pressing the green power switch on the front panel to the ON (1 position). The 1730 unit should warm up for a period of at least 15 minutes prior to measurements being made.

## 2.3 SYSTEM SETUP/CONFIG

Prior to programming a test or measuring a device, set up the system controls of the 1730 instrument. To access the system controls, press [SYSTEM SETUP] then press [SYSTEM CONFIG]. Table 2-2 lists the contents of SYSTEM CONFIG.

**Table 2-2: SYSTEM CONFIG**

Parameter	Function	Range
VM/IM Display	Display output voltage and current	OFF/ON
CONSTant Source	Set constant source impedance	100/25Ω, 100Ω, 25Ω, 10Ωc.c.
AVERAGE Time	Set measurement average	0 – 256
CABLE Length	Set test cable length	0M, 1M, 2M or 4M
BEEPER	Set beeper loudness	OFF, LOW or HIGH
KEY LOCK	Lock out front panel programming	OFF/ON
INTEG Cycle	Set analog averaging cycle (time)	01 – 08
CONTRAST	Set display contrast	00 – 13 (dark to bright)
SOUND Mode	Set when the buzzer to sounds	PASS/FAIL
ALARM Mode	Set type of alarm signal	PULSE/CONTINUOUS
HANDLER Mode	Set handler interface mode	CLEAR/HOLD
GPIB EOS Code	Set End of String code	0Dh, 0Ah, 0Dh 0Ah
GPIB ADDRESS Code	Set interface address	00 – 30
TRIGGER Delay	Set external trigger time	0000 – 9999 ms
TRIGGER Edge	Set trigger mode	FALLING/RISING
LINK 1320	Link 1730 to 1320 bias source	OFF/ON

### 2.3.1 VM/IM Display

The voltage across the DUT and the current through the DUT can be displayed along with the measured value when VM/IM is set to ON. VM/IM can be selected OFF/ON. The instrument default setting is OFF. To change the VM/IM Display press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow  $\downarrow$  until the box next to VM/IM DISPLAY is highlighted, then press [F1] = ON to display the current and voltage across the DUT, or [F2] = OFF.

The screenshot shows the SYSTEM CONFIG menu with the following settings:

<b>&lt;SYSTEM CONFIG&gt;</b>		<b>ON</b>
VM / IM DISPLAY:	OFF	<b>OFF</b>
CONST Rsource:	100/25 OHM	
AVERAGE TIME:	001	
CABLE LENGTH:	0M	
BEEPER:	LOW	
KEY LOCK:	OFF	

Navigation options on the left: non-operational (up arrow), Go to CONST Rsource (down arrow). Function keys on the right: F1 Select Voltage & Current Display ON, F2 Select Voltage & Current Display OFF, F3 Default: OFF.

### 2.3.2 CONST Rsource

The constant source impedance of the 1730 instrument can be set to 100/25 $\Omega$ , 100 $\Omega$ , 25 $\Omega$ , or 10 $\Omega$ c.c. (constant current). The instrument default setting is 100/25 $\Omega$ .

The 100/25 $\Omega$  setting allows the instrument to automatically select its impedance based on the impedance of the DUT ( $Z_{DUT}$ ). If  $Z_{DUT}$  is <10 $\Omega$ , then the 1730 CONST Rsource = 25 $\Omega$ . If  $Z_{DUT}$  is  $\geq$ 10 $\Omega$ , then the 1730 CONST Rsource = 100 $\Omega$ .

The 10 $\Omega$ c.c. setting puts a constant current equal to 100mA across the DUT when the test voltage is set to 1V. If  $Z_{DUT}$  is  $\geq$ 10 $\Omega$ , then the 1730 instrument CONST Rsource = 10 $\Omega$ .

To change the source resistance press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow  $\downarrow$  until the box next to CONST Rsource is highlighted, then press [F1] =100/25 $\Omega$ , [F2] =100 $\Omega$ , [F3] = 10 $\Omega$ c.c. or [F4] = Next Page. On next page [F1] = 25 $\Omega$ .

The screenshot shows the SYSTEM CONFIG menu with the following settings:

<b>&lt;SYSTEM CONFIG&gt;</b>		<b>100/25 OHM</b>
VM / IM DISPLAY:	OFF	
CONST Rsource:	100/25 OHM	<b>100 OHM</b>
AVERAGE TIME:	001	
CABLE LENGTH:	0M	<b>10 OHM/C.C.</b>
BEEPER:	LOW	
KEY LOCK:	OFF	<b>NEXT P. 1/2</b>

Navigation options on the left: Go to VM / IM Display (up arrow), Go to AVERAGE Time (down arrow). Function keys on the right: F1 100/25 OHM, F2 100 OHM, F3 10 OHM/C.C. (constant current), F4  $\rightarrow$  F1 = 25 OHM. Default: OFF.

### 2.3.3 AVERAGE Time

The 1730 instrument can make many measurements then display the average based on what average number was selected. The range is 001 – 256 and the instrument default setting is 001. To change the number to average press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to AVERAGE TIME is highlighted, then press [F1] = DIGIT UP to increase then number of measurements to take before displaying the average or [F2] = DIGIT DOWN to decrease the number.

Go to CONST Rsource <input type="button" value="▲"/> Go to CABLE Length <input type="button" value="▼"/>	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center; border-bottom: 1px solid white;"><b>&lt;SYSTEM CONFIG&gt;</b></td> <td style="text-align: right; border-bottom: 1px solid white;"><b>DIGIT UP</b></td> </tr> <tr> <td style="padding: 2px;">VM / IM DISPLAY:</td> <td style="padding: 2px;">OFF</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>DIGIT DOWN</b></td> </tr> <tr> <td style="padding: 2px;">CONST Rsource:</td> <td style="padding: 2px;">100 OHM</td> <td></td> </tr> <tr> <td style="padding: 2px;">AVERAGE TIME:</td> <td style="padding: 2px; border: 1px solid white;">001</td> <td></td> </tr> <tr> <td style="padding: 2px;">CABLE LENGTH:</td> <td style="padding: 2px;">0M</td> <td></td> </tr> <tr> <td style="padding: 2px;">BEEPER :</td> <td style="padding: 2px;">OFF</td> <td></td> </tr> <tr> <td style="padding: 2px;">KEY LOCK:</td> <td style="padding: 2px;">OFF</td> <td></td> </tr> </table>	<b>&lt;SYSTEM CONFIG&gt;</b>		<b>DIGIT UP</b>	VM / IM DISPLAY:	OFF	<b>DIGIT DOWN</b>	CONST Rsource:	100 OHM		AVERAGE TIME:	001		CABLE LENGTH:	0M		BEEPER :	OFF		KEY LOCK:	OFF		<table border="0"> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F1</b></td> <td style="padding: 2px;">Increase # of measurements to average</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F2</b></td> <td style="padding: 2px;">Decrease # of measurements to average</td> </tr> <tr> <td colspan="2" style="padding: 5px 0 0 20px;">Default: 001</td> </tr> </table>	<b>F1</b>	Increase # of measurements to average	<b>F2</b>	Decrease # of measurements to average	Default: 001	
<b>&lt;SYSTEM CONFIG&gt;</b>		<b>DIGIT UP</b>																											
VM / IM DISPLAY:	OFF	<b>DIGIT DOWN</b>																											
CONST Rsource:	100 OHM																												
AVERAGE TIME:	001																												
CABLE LENGTH:	0M																												
BEEPER :	OFF																												
KEY LOCK:	OFF																												
<b>F1</b>	Increase # of measurements to average																												
<b>F2</b>	Decrease # of measurements to average																												
Default: 001																													

### 2.3.4 CABLE Length

Selected cable length should match length of test cables being used to minimize phase errors. The test cable length can be set as 0M, 1M, 2M or 4M. “M” denotes the length in meters. The instrument default setting is 0M. To change the cable length press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to CABLE LENGTH is highlighted, then press [F1] = 0M, [F2] = 1M, [F3] = 2M or [F4] = 4M whichever corresponds to the test cable length. After changing the cable length, run the open/short correction to obtain more accurate measurements.

Go to AVERAGE Time <input type="button" value="▲"/> Go to BEEPER <input type="button" value="▼"/>	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center; border-bottom: 1px solid white;"><b>&lt;SYSTEM CONFIG&gt;</b></td> <td style="text-align: right; border-bottom: 1px solid white;"><b>0M</b></td> </tr> <tr> <td style="padding: 2px;">VM / IM DISPLAY:</td> <td style="padding: 2px;">OFF</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>1M</b></td> </tr> <tr> <td style="padding: 2px;">CONST Rsource:</td> <td style="padding: 2px;">100 OHM</td> <td></td> </tr> <tr> <td style="padding: 2px;">AVERAGE TIME:</td> <td style="padding: 2px;">003</td> <td></td> </tr> <tr> <td style="padding: 2px;">CABLE LENGTH:</td> <td style="padding: 2px; border: 1px solid white;">0M</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>2M</b></td> </tr> <tr> <td style="padding: 2px;">BEEPER:</td> <td style="padding: 2px;">OFF</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>4M</b></td> </tr> <tr> <td style="padding: 2px;">KEY LOCK:</td> <td style="padding: 2px;">OFF</td> <td></td> </tr> </table>	<b>&lt;SYSTEM CONFIG&gt;</b>		<b>0M</b>	VM / IM DISPLAY:	OFF	<b>1M</b>	CONST Rsource:	100 OHM		AVERAGE TIME:	003		CABLE LENGTH:	0M	<b>2M</b>	BEEPER:	OFF	<b>4M</b>	KEY LOCK:	OFF		<table border="0"> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F1</b></td> <td style="padding: 2px;">Select test cable = 0 meters</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F2</b></td> <td style="padding: 2px;">Select test cable = 1 meter</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F3</b></td> <td style="padding: 2px;">Select test cable = 2 meters</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F4</b></td> <td style="padding: 2px;">Select test cable = 4 meters</td> </tr> <tr> <td colspan="2" style="padding: 5px 0 0 20px;">Default: 0M</td> </tr> </table>	<b>F1</b>	Select test cable = 0 meters	<b>F2</b>	Select test cable = 1 meter	<b>F3</b>	Select test cable = 2 meters	<b>F4</b>	Select test cable = 4 meters	Default: 0M	
<b>&lt;SYSTEM CONFIG&gt;</b>		<b>0M</b>																															
VM / IM DISPLAY:	OFF	<b>1M</b>																															
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<b>F3</b>	Select test cable = 2 meters																																
<b>F4</b>	Select test cable = 4 meters																																
Default: 0M																																	

### 2.3.5 BEEPER

The loudness of the beeper or audible alarm can be set to OFF, LOW or HIGH. The instrument default setting is LOW. To change the beeper loudness press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to BEEPER is highlighted, then press [F1] = OFF, [F2] = LOW or [F3] = HIGH.

Go to CABLE Length <input type="button" value="▲"/> Go to KEY LOCK <input type="button" value="▼"/>	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center; border-bottom: 1px solid white;"><b>&lt;SYSTEM CONFIG&gt;</b></td> <td style="text-align: right; border-bottom: 1px solid white;"><b>OFF</b></td> </tr> <tr> <td style="padding: 2px;">VM / IM DISPLAY:</td> <td style="padding: 2px;">OFF</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>LOW</b></td> </tr> <tr> <td style="padding: 2px;">CONST Rsource:</td> <td style="padding: 2px;">100 OHM</td> <td></td> </tr> <tr> <td style="padding: 2px;">AVERAGE TIME:</td> <td style="padding: 2px;">003</td> <td></td> </tr> <tr> <td style="padding: 2px;">CABLE LENGTH:</td> <td style="padding: 2px;">1M</td> <td style="border-bottom: 1px solid white; text-align: right;"><b>HIGH</b></td> </tr> <tr> <td style="padding: 2px;">BEEPER :</td> <td style="padding: 2px; border: 1px solid white;">OFF</td> <td></td> </tr> <tr> <td style="padding: 2px;">KEY LOCK:</td> <td style="padding: 2px;">OFF</td> <td></td> </tr> </table>	<b>&lt;SYSTEM CONFIG&gt;</b>		<b>OFF</b>	VM / IM DISPLAY:	OFF	<b>LOW</b>	CONST Rsource:	100 OHM		AVERAGE TIME:	003		CABLE LENGTH:	1M	<b>HIGH</b>	BEEPER :	OFF		KEY LOCK:	OFF		<table border="0"> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F1</b></td> <td style="padding: 2px;">Select beeper volume = OFF</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F2</b></td> <td style="padding: 2px;">Select beeper volume = Low</td> </tr> <tr> <td style="border: 1px solid gray; padding: 2px; width: 30px; text-align: center;"><b>F3</b></td> <td style="padding: 2px;">Select beeper volume = High</td> </tr> <tr> <td colspan="2" style="padding: 5px 0 0 20px;">Default: LOW</td> </tr> </table>	<b>F1</b>	Select beeper volume = OFF	<b>F2</b>	Select beeper volume = Low	<b>F3</b>	Select beeper volume = High	Default: LOW	
<b>&lt;SYSTEM CONFIG&gt;</b>		<b>OFF</b>																													
VM / IM DISPLAY:	OFF	<b>LOW</b>																													
CONST Rsource:	100 OHM																														
AVERAGE TIME:	003																														
CABLE LENGTH:	1M	<b>HIGH</b>																													
BEEPER :	OFF																														
KEY LOCK:	OFF																														
<b>F1</b>	Select beeper volume = OFF																														
<b>F2</b>	Select beeper volume = Low																														
<b>F3</b>	Select beeper volume = High																														
Default: LOW																															

### 2.3.6 KEY LOCK

To lock out the front panel operations with the exception of the [TRIGGER] key, set the key lock function to ON. Press [SYSTEM SETUP], [SYSTEM CONFIG], [↓] until **OFF** is highlighted next to KEY LOCK, then press [F1] = ON. The backlit **LOCK** block will appear on the measure display. To turn the key lock function OFF: press [F1], [F4] and then [SYSTEM SETUP]. Key lock can be set ON or OFF. The instrument default setting is OFF.

Go to BEEPER ▲

Go to INTEG. Cycle ▼

<SYSTEM CONFIG>		ON
VM / IM DISPLAY:	OFF	OFF
CONST Rsource:	100 OHM	
AVERAGE TIME:	003	
CABLE LENGTH:	1M	
BEEPER:	ON	
KEY LOCK:	OFF	

F1 Select key lock = ON

F2 Select key lock = OFF

Default: OFF

**IF** F1 is pressed (Key Lock = ON) the Meas Display will show **LOCK** in upper right hand corner

Press MEAS DISPLAY to view LOCK symbol

MEAS DISPLAY	LOCK
Cs : 1.2345 pF	FREQ.: 1.0 kHz
D : 1.2345	LEVEL: 1.00 V
	PARA.: Cs - D
	NEXT PAGE 1/3

### 2.3.7 INTEGer CYCLE

This determines the number of cycles of a sine wave integrated together during a measurement. An integration cycle of 1 will result in the fastest possible measurement but the least accurate. The integer cycle can be set from 01 to 08. The instrument default setting is 04. To change the integer cycle press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to INTEG CYCLE is highlighted, then press [F1] = DIGIT UP to increase then number or [F2] = DIGIT DOWN to decrease the number.

Go to KEY LOCK ▲

Go to CONTRAST ▼

<SYSTEM CONFIG>		DIGIT UP
INTEG. CYCLE:	04	DIGIT DOWN
CONTRAST:	07	
SOUND MODE:	FAIL	
ALARM MODE:	PULSE	
HANDLER MODE:	CLEAR	

F1 Increase # of integer cycles

F2 Decrease # of integer cycles

Range: 00 - 08, Default: 04

### 2.3.8 CONTRAST

The display contrast can be set from 00 to 13. The instrument default setting is 07. The darkest contrast is 00 the brightest is 13. To change the display contrast press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to CONTRAST is highlighted, then press [F1] = DIGIT UP to brighten the contrast or [F2] = DIGIT DOWN to darken the contrast.

Go to INTEG. Cycle ▲

Go to SOUND Mode ▼

<SYSTEM CONFIG>		DIGIT UP
INTEG. CYCLE:	04	DIGIT DOWN
CONTRAST:	07	
SOUND MODE:	FAIL	
ALARM MODE:	PULSE	
HANDLER MODE:	CLEAR	

F1 Brighten Contrast

F2 Darken Contrast

Range: 00 - 13, Default: 07

### 2.3.9 SOUND Mode

The audible alarm can be set to sound on PASS or to sound on FAIL under high or low limit judgment in the measure display. The instrument default setting is FAIL. To change the sound mode press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to SOUND MODE is highlighted, then press [F1] = PASS for the alarm to sound on a pass result or [F2] = FAIL for the alarm to sound on a fail result.

Go to CONTRAST ▲

Go to ALARM Mode ▼

<SYSTEM CONFIG>		PASS
INTEG. CYCLE:	04	FAIL
CONTRAST:	07	
SOUND MODE:	FAIL	
ALARM MODE:	PULSE	
HANDLER MODE :	CLEAR	

F1 Select alarm to sound on PASS

F2 Select alarm to sound on FAIL

Default: FAIL



### 2.3.10 ALARM Mode

The type of audible alarm can be set to PULSE or CONTINUOUS during judgment in the measure display. The instrument default setting is PULSE. To change the alarm mode press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to ALARM MODE is highlighted, then press [F1] = PULSE for the alarm to sound in a pulse tone or [F2] = CONTINUOUS for the alarm to sound continuously.

Go to SOUND Mode ▲

Go to HANDLER Mode ▼

<SYSTEM CONFIG>		PULSE
INTEG. CYCLE:	04	
CONTRAST:	07	
SOUND MODE:	FAIL	
ALARM MODE:	PULSE	
HANDLER MODE:	CLEAR	
		CONTINUOUS

F1 Select alarm to sound as a PULSE

F2 Select alarm to sound CONTINUOUSLY

Default: PULSE

### 2.3.11 HANDLER Mode

The handler interface mode can be set to CLEAR or HOLD. The instrument default setting is CLEAR. When set to CLEAR, the handler interface will clear the last test result prior to each subsequent measurement. When set to HOLD, the handler interface will hold the last test result until the next measurement is made and displayed. To change the handler mode press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to HANDLER MODE is highlighted, then press [F1] = CLEAR or [F2] = HOLD.

Go to ALARM Mode ▲

Go to GPIB EOS Code ▼

<SYSTEM CONFIG>		CLEAR
INTEG. CYCLE:	04	
CONTRAST:	07	
SOUND MODE:	FAIL	
ALARM MODE:	PULSE	
HANDLER MODE:	CLEAR	
		HOLD

F1 Select handler to CLEAR result

F2 Select handler to HOLD result

Default: CLEAR

### 2.3.12 GPIB EOS Code

The End of String code for the IEEE-488 interface is set as “0Dh”, “0Ah” or “0Dh, 0Ah”. The instrument default setting is “0Dh”. To change the GPIB EOS code press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to GPIB EOS code is highlighted, then press [F1] = 0Dh, [F2] = 0Ah or [F3] = 0Dh, 0Ah.

Go to HANDLER Mode ▲

Go to GPIB ADDRESS ▼

<SYSTEM CONFIG>		0Dh
GPIB EOS CODE:	0Ah	
GPIB ADDRESS:	17	
TRIGGER DELAY:	0000mS	
TRIGGER EDGE:	FALLING	
LINK 1320:	OFF	
		0Ah
		0Dh, 0Ah

F1 Select end of string code = 0Dh

F2 Select end of string code = 0Ah

F3 Select end of string code = 0Dh, 0Ah

Default: 0Dh

### 2.3.13 GPIB Address Code

The IEEE-488 interface address can be programmed from 00 to 30. The instrument default setting is 17. To change the GPIB ADDRESS press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to GPIB ADDRESS is highlighted, then press [F1] = DIGIT UP to increase the address, or [F2] = DIGIT DOWN to decrease the address.

Go to EOS Code ▲

Go to TRIGGER Delay ▼

**<SYSTEM CONFIG>**

GPIB EOS CODE: 0Ah

GPIB ADDRESS: 17

TRIGGER DELAY: 0000mS

TRIGGER EDGE: FALLING

LINK 1320: OFF

DIGIT UP

DIGIT DOWN

F1 Increase IEEE-488 address

F2 Decrease IEEE-488 address

Address: 00 - 30, Default: 17

### 2.3.14 TRIGGER Delay

The trigger delay is the amount of time between the activation of a trigger (via IEEE, Handler or front panel) and the 1730 making the measurement. The delay time can be programmed from 0000 to 9999 milliseconds. The instrument default value is 0000 milliseconds. To change the TRIGGER DELAY press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to TRIGGER DELAY is highlighted, then press [F1] = DIGIT UP to increase the delay time, [F2] = DIGIT DOWN to decrease the delay time or [F3] = DIGIT to move over a decimal place.

Go to GPIB ADDRESS ▲

Go to TRIGGER Edge ▼

**<SYSTEM CONFIG>**

GPIB EOS CODE: 0Ah

GPIB ADDRESS: 17

TRIGGER DELAY: 0000mS

TRIGGER EDGE: FALLING

LINK 1320 : OFF

DIGIT UP

DIGIT DOWN

DIGIT

F1 Increase delay time

F2 Decrease delay time

Delay: 0000 - 9999ms, Default: 0000ms

### 2.3.15 TRIGGER Edge

Select on which edge the measurement is triggered: FALLING or RISING. The instrument default setting is FALLING. To change the TRIGGER EDGE press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to TRIGGER EDGE is highlighted, then press [F1] = FALLING or [F2] = RISING.

Go to TRIGGER Delay ▲

Go to LINK 1320 ▼

**<SYSTEM CONFIG>**

GPIB EOS CODE: 0Ah

GPIB ADDRESS: 17

TRIGGER DELAY: 0000mS

TRIGGER EDGE: FALLING

LINK 1320: OFF

FALLING

RISING

F1 Select FALLING edge

F2 Select RISING edge

Default: FALLING

### 2.3.16 LINK 1320

It is possible to link the 1730 instrument to the QuadTech 1320 Bias Current Source. The 1320 instrument is capable of producing 20A DC bias current. The 1730 instrument default setting is OFF. To change the LINK 1320 press [SYSTEM SETUP], [SYSTEM CONFIG] and the down arrow [↓] until the box next to LINK 1320 is highlighted, then press [F1] = ON or [F2] = OFF.

The image shows two screenshots of the SYSTEM CONFIG menu. The first screenshot shows the LINK 1320 setting, which is currently OFF. The second screenshot shows the OHM setting, which is currently 100/25 OHM. Both screenshots show the menu structure and the corresponding function key actions.

**First Screenshot: LINK 1320 Setting**

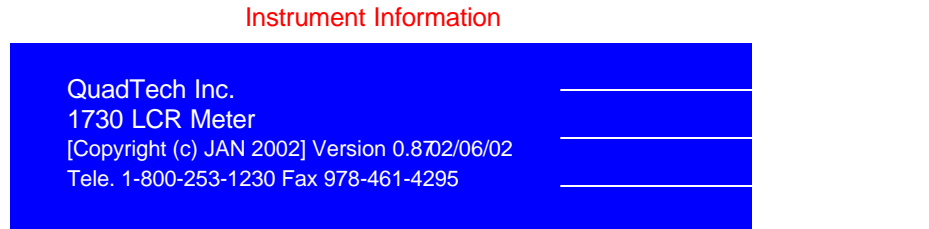
- Navigation: Go to TRIGGER Edge (▲), Go to VM / IM Display (▼)
- Menu: <SYSTEM CONFIG>
- Parameters: GPIB EOS CODE: 0Ah, GPIB ADDRESS: 17, TRIGGER DELAY: 0000mS, TRIGGER EDGE: FALLING, LINK 1320: OFF
- Options: ON, OFF
- Function Keys: F1 (Select link to 1320 ON), F2 (Select link to 1320 OFF), Default: OFF

**Second Screenshot: OHM Setting**

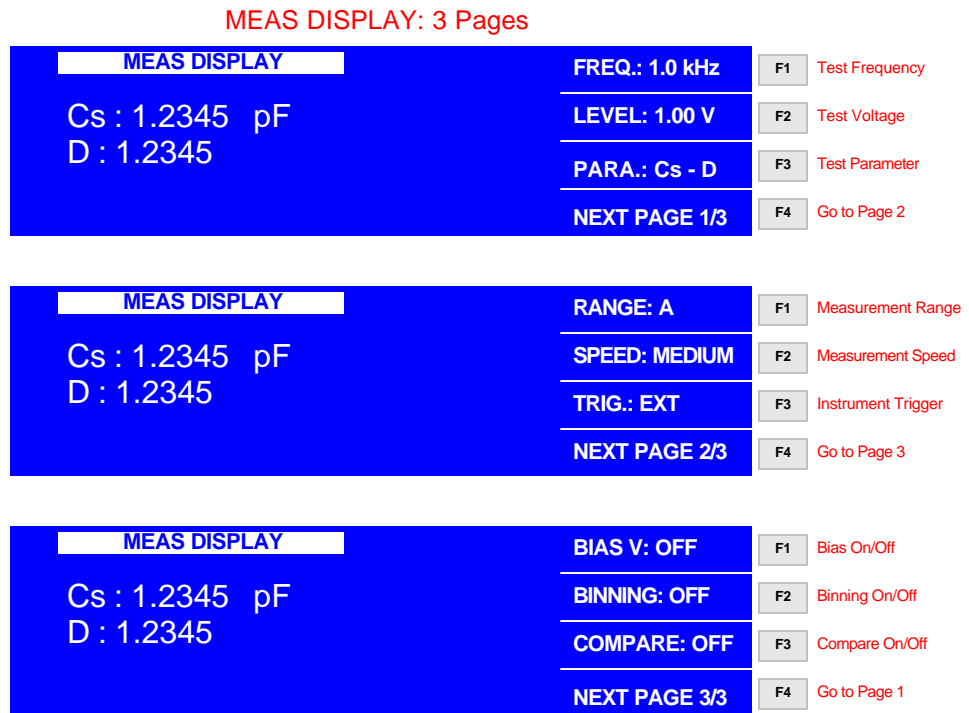
- Navigation: Go to VM / IM Display (▲), Go to AVERAGE Time (▼)
- Menu: <SYSTEM CONFIG>
- Parameters: VM / IM DISPLAY: OFF, CONST Rsource: 100/25 OHM, AVERAGE TIME: 001, CABLE LENGTH: 0M, BEEPER: LOW, KEY LOCK: OFF
- Options: 100/25 OHM, 100 OHM, 10 OHM/C.C., NEXT P. 1/2
- Function Keys: F1 (100/25 OHM), F2 (100 OHM), F3 (10 OHM/C.C. (constant current)), F4 (→ F1 = 25 OHM), Default: OFF

## 2.4 MEAS DISPLAY

The 1730 instrument's stand-by display is the MEAS DISPLAY. After power has been applied to the instrument and it cycles quickly through the information screen, the instrument reverts to the MEAS DISPLAY. To view the instrument information screen as illustrated in Figure 2.1, press [SYSTEM SETUP] then [←].



**Figure 2.1: Instrument Information Screen**



**Figure 2.2: MEAS DISPLAY**

Figure 2.2 illustrates the three pages of parameters that can be programmed within the MEAS DISPLAY. The binning and comparison functions are enabled/disabled in MEAS DISPLAY and programmed in MAIN INDEX. The bias voltage function is enabled/disabled in MEAS DISPLAY and programmed in SYSTEM SETUP. Paragraphs 2.4.1 through 2.4.9 explain each parameter in detail.

## 2.4.14 FREQuency

The 1730 instrument provides seven test frequencies in the 100Hz to 100kHz range including 100Hz, 120Hz, 1kHz, 10kHz, 20kHz, 50kHz and 100kHz. In MEAS DISPLAY press [F1] so that the **1.0** kHz box is highlighted. Use the up arrow [ $\uparrow$ ] key to increase the frequency value or use the down arrow [ $\downarrow$ ] key to decrease the frequency value. The instrument default setting is 1.0kHz.

The screenshot shows the MEAS DISPLAY screen with the following parameters: Cs: 1.2345 pF, D: 1.2345, FREQ.: 1.0 kHz, LEVEL: 1.00 V, PARA.: Cs - D, and NEXT PAGE 1/3. To the right, the F1 key is labeled 'Select test frequency parameter'. It has two arrow keys: an up arrow for '10kHz, 20kHz, 50kHz, 100kHz' and a down arrow for '120Hz, 100Hz'.

## 2.4.2 LEVEL

The test voltage can be programmed in 10mV increments from 0.01V to 1.00V. In MEAS DISPLAY press [F2] so that the **1.00** V box is highlighted. Use the up arrow [ $\uparrow$ ] key to increase the voltage value or use the down arrow [ $\downarrow$ ] key to decrease the voltage value in 10mV increments. The instrument default setting is 1.00V.

The screenshot shows the MEAS DISPLAY screen with the following parameters: Cs: 1.2345 pF, D: 1.2345, FREQ.: 1.0 kHz, LEVEL: 1.00 V, PARA.: Cs - D, and NEXT PAGE 1/3. To the right, the F2 key is labeled 'Select test voltage parameter'. It has two arrow keys: an up arrow for 'Increase V in 0.01V increments' and a down arrow for 'Decrease V in 0.01V increments'.

## 2.4.3 PARAMeter

The 1730 instrument can measure 12 different LCR parameters and display two (primary and secondary) simultaneously. In MEAS DISPLAY press [F3] so that the **C** sD box is highlighted. Use the down arrow [ $\downarrow$ ] key to change/select the primary parameter. Use the right arrow [ $\Rightarrow$ ] key to move the highlighted box to **s** and use the [ $\uparrow$ ] key to select the equivalent circuit equal to series or parallel. Use the right arrow [ $\Rightarrow$ ] key to move the highlighted box to **D** and use the down arrow [ $\downarrow$ ] key to select the secondary parameter. The instrument default setting is CsD.

The screenshot shows the MEAS DISPLAY screen with the following parameters: Cs: 1.2345 pF, D: 1.2345, FREQ.: 1.0 kHz, LEVEL: 1.00 V, PARA.: C s D, and NEXT PAGE 1/3. To the right, the F3 key is labeled 'Select Primary & Secondary parameter'. It has three arrow keys: a down arrow for 'Select Primary parameter C, R, Z, L', a right arrow for 'Move highlighted box right Select Series or Parallel', and another right arrow for 'Move highlighted box right Select Secondary parameter D, ESR,  $\theta$ , X, Q'. Annotations with colored arrows point to the 'C', 's', and 'D' boxes in the PARA. field: a green arrow for 'Primary Measurement Parameter' (C), a red arrow for 'Equivalent Circuit' (s), and a pink arrow for 'Secondary Measurement Parameter' (D).

The programming of parameter may at first seem a little confusing but remember the highlighted box is what is selected then pressing the down arrow [↓] key will toggle through the choices. Use the right arrow [⇒] key to move the highlighted box and select the next parameter then press the down arrow [↓] key to toggle through the choices. Table 2-3 lists the primary and secondary parameters in common pair configuration that are measurable by the 1730 instrument.

**Table 2-3: 1730 Measurement Parameters**

Primary		Secondary	
Cs, Cp	Capacitance	D	Dissipation Factor
Rs, Rp	Resistance	Xs	Series Reactance
Zs	Impedance	θ	Phase Angle
Ls, Lp	Inductance	Q	Quality Factor
		ESR	Equivalent Series Resistance

#### 2.4.4 RANGE

The 1730 instrument's measurement range can be selected as AUTO or HOLD. The instrument measurement ranges are 1MΩ, 300kΩ, 100kΩ, 30kΩ, 10kΩ, 3kΩ, 1kΩ, 300Ω, 100Ω, 10Ω, 1Ω, and 100mΩ depending on the test frequency and selected constant source impedance. In MEAS DISPLAY (Pg 2/3) press [F1] so that the **A** box is highlighted\*. Use the up arrow [↑] key to increase the range value or use the down arrow [↓] key to decrease the range value. The instrument default setting is A (Auto Range).

The screenshot shows the MEAS DISPLAY screen with the following information:

- MEAS DISPLAY
- Cs : 1.2345 pF
- D : 1.2345
- RANGE.: **A** 100 ▾
- SPEED: SLOW
- TRIG.: INT
- NEXT PAGE 2/3

The legend for the F1 function keys is as follows:

- F1** Select measurement range
- ▲ Toggle between A and H mode
- ▶ Move highlighted box to value
- ▲ Increase range value: 300 Ω, 1kΩ, 3kΩ, 10k Ω, 30kΩ, 100k Ω, 300kΩ 1M Ω
- ▼ Decrease range value: 100 Ω, 10Ω, 1 Ω, 100m Ω

**Note:** When CONST Rsource is OFF, 300kΩ, 30kΩ, 3kΩ and 300Ω are disabled. When Test Frequency is set to 100Hz or 120Hz, 0.1Ω is disabled.

\* Use the up arrow [↑] key to toggle between A (Auto) and H (Hold). Use the right arrow [⇒] key to move the range value.

## 2.4.5 SPEED/Accuracy

Trading accuracy for speed, program the measurement speed of the 1730 instrument to Slow (3 measurements/second), Medium (22 measurements/second) or Fast (66 measurements/second). The basic LCR accuracy (0.1%) and D accuracy (0.001) are specified for the slow measurement speed. In MEAS DISPLAY (Pg 2/3) press [F2] so that the **MEDIUM** box is highlighted. Use the up arrow [↑] key to increase the speed or use the down arrow [↓] key to decrease the speed. The instrument default setting is MEDIUM (22 meas/second).

The screenshot shows the MEAS DISPLAY screen with the following information:

- MEAS DISPLAY** (Title)
- RANGE: A 100W**
- SPEED: SLOW** (highlighted)
- TRIG.: INT**
- NEXT PAGE 2/3**
- Cs : 1.2345 pF**
- D : 1.2345**

Below the screen, a legend for the F2 key is provided:

- F2** Select measurement speed
- ▲** Increase speed: Slow/Medium/Fast (3 meas/sec, 22 meas/sec, 66 meas/sec)
- ▼** Decrease speed: Fast/Medium/Slow (66 meas/sec, 22 meas/sec, 3 meas/sec)

The accuracy of the 1730 instrument depends on the speed of the measurement. Basic Accuracy for LCR is  $\pm 0.1\%$  and basic accuracy for DQ is  $\pm 0.001$ . Basic accuracy is specified for the speed equal to 3 measurements/second, temperature =  $23^\circ\text{C} \pm 5^\circ\text{C}$ , relative humidity (RH)  $\leq 90\%$ .

Table 2-4 lists the basic accuracy for  $|Z| - \theta$ . For measurements made in fast mode double the accuracy listed in Table 2-4.

**Table 2-4:  $\frac{1}{2}Z\frac{1}{2} - \theta$  Accuracy**

Impedance	Frequency (Hz)						
	100	120	1k	10k	20k	50k	100k
<b>10M</b>	0.48%	0.4%	0.35%				
<b>1M</b>	0.5°	0.45°	0.4°				
<b>1M</b>	0.24%	0.20%	0.16%	0.5%	1.5%	2%	2%
<b>100k</b>	0.33°	0.3°	0.08°	0.12°	0.12°	0.24°	0.4°
<b>100k</b>	0.2%	0.2%	0.12%	0.5%	1.5%	1.8%	2%
<b>10k</b>	0.24°	0.24°	0.06°	0.08°	0.09°	0.24°	0.3°
<b>10k</b>	0.2%	0.2%	0.1%	0.45%	0.5%	0.6%	0.7%
<b>1k</b>	0.2°	0.2°	0.05°	0.07°	0.08°	0.08°	0.2°
<b>1k</b>	0.2%	0.2%	0.1%	0.2%	0.36%	0.4%	0.45%
<b>100</b>	0.2°	0.2°	0.05°	0.07°	0.08°	0.08°	0.2°
<b>100</b>	0.25%	0.25%	0.24%	0.26%	0.36%	0.4%	0.5%
<b>10</b>	0.2°	0.2°	0.09°	0.09°	0.15°	0.17°	0.2°
<b>10</b>	0.45%	0.4%	0.32%	0.35%	0.4%	0.5%	0.6%
<b>1</b>	0.22°	0.22°	0.09°	0.15°	0.15°	0.17°	0.2°
<b>1</b>	0.7%	0.5%	0.35%	0.35%	0.4%	0.7%	0.9%
<b>0.1</b>	0.24°	0.24°	0.15°	0.15°	0.2°	0.26°	0.6°

If the impedance ( $|Z|$ ) is in the range  $0.1\Omega$  to  $0.01\Omega$ , then the following accuracy formula applies.

**$Z < 0.1W$ :**

$$|Z| \text{ Accuracy} = Z_e (\%) = A + B \times \left[ \frac{100m\Omega}{|Z|} \right] + \left[ \frac{C}{|Z|} \right]$$

$$\theta \text{ Accuracy} = \theta_e = \frac{180^\circ}{\pi} \times [Z_e]$$

Values for parameters A, B and C are listed in Table 2-4a

**Table 2-4a:  $\frac{1}{2}Z\frac{1}{2}$  - q Accuracy for Z: 0.1W - 0.01W**

Frequency		100Hz	120Hz	1kHz	10kHz	20kHz	50kHz	100kHz
<b>Parameter A</b>		0.6	0.4	0.3	0.3	0.4	0.6	0.8
<b>Parameter B</b>		0.12	0.12	0.08	0.08	0.09	0.01	0.12
<b>Parameter C</b> (Cable length)	0M	0.001 $\Omega$	0.0012 $\Omega$	0.002 $\Omega$	0.02 $\Omega$	0.04 $\Omega$	0.1 $\Omega$	0.2 $\Omega$
	1M	0.008 $\Omega$	0.009 $\Omega$	0.012 $\Omega$	0.07 $\Omega$	0.14 $\Omega$	0.35 $\Omega$	0.7 $\Omega$
	2M	0.015 $\Omega$	0.017 $\Omega$	0.022 $\Omega$	0.12 $\Omega$	0.24 $\Omega$	0.6 $\Omega$	-

Multiply the  $|Z|$  and  $\theta$  accuracy by the parameter D when the test signal level is not set to 1V. The values for D are listed in Table 2-4b. The test signal voltage is abbreviated  $V_{\text{SIGNAL}}$  and  $V_s$  in Table 2-4b.

**Table 2-4b: D Value when  $V_{\text{SIGNAL}}$  is < 1V**

Level	$1V > V_s \text{ £ } 0.5V$	$0.5V > V_s \text{ £ } 0.25V$	$0.25V > V_s \text{ £ } 0.01V$
<b>Parameter D</b>	1	2	$\frac{0.5V}{V_s}$



## More 1730 Accuracy Formulas

### L, C & R Accuracy

For  $Q \geq 10$  and  $(D \leq 1)$ ,  $|Z| =$

$$|Z_L| = |2\pi fL|$$

$$|Z_C| = |1/(2\pi fC)|$$

For  $Q < 10$  and  $(D > 0.1)$ ,

Multiply L accuracy by  $(1 + 1/Q)$

Multiply C accuracy by  $(1 + D)$

### D & Q Accuracy

For all D values:

$$\text{DF Accuracy} = \frac{\text{Accuracy (\%)}}{100} + \frac{\text{DF}}{50} \left[ 1 + \sqrt{\frac{\text{FREQ}}{50000}} \right]$$

For all values of Q:

$$\text{Q Accuracy} = \frac{\text{Accuracy (\%)}}{100} + \left[ |Q| \left( 0.02 + \frac{\text{Accuracy (\%)}}{100} \right) \right] + \left[ Q^2 \left( \frac{\text{Accuracy (\%)}}{200} \right) \right]$$

### R (ESR, EPR) Accuracy

For  $Q \leq 0.1$ :

$$\text{Accuracy of R} = \text{Accuracy of } |Z|$$

For  $Q \geq 0.1$ :

Multiply accuracy R by  $(1 + Q)$

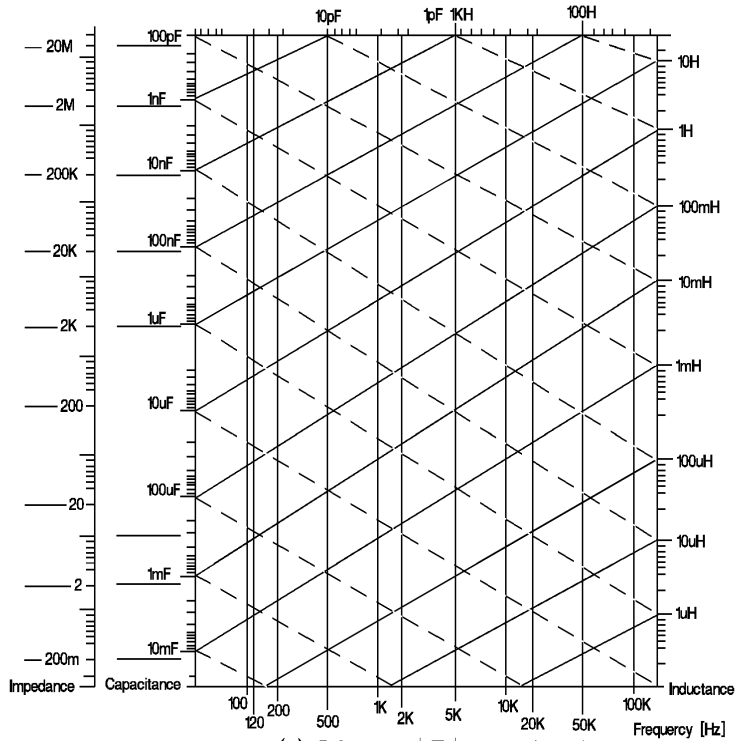
Figure 2-3 illustrates the frequency conversion charts for LC to Z, C to Z and L to Z.

### Voltage Accuracy

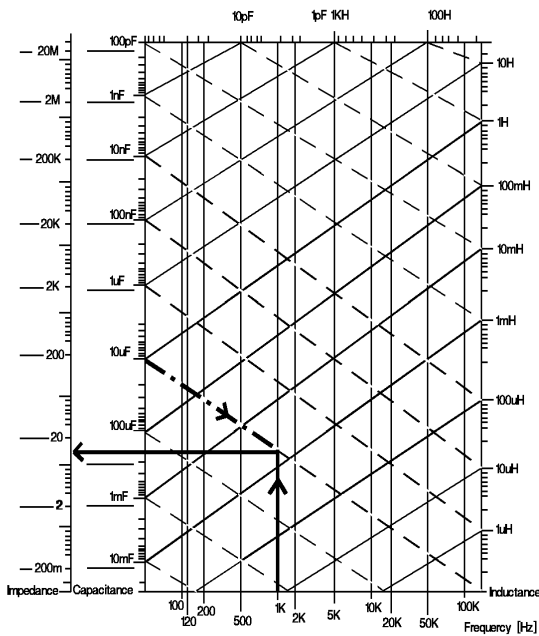
For voltages less than 1V an additional error applies. Multiply the accuracy (LCRDQ) by:  $[0.8 + (0.2/V_{\text{source}})]$ .

# 1730 Accuracy Conversion Charts

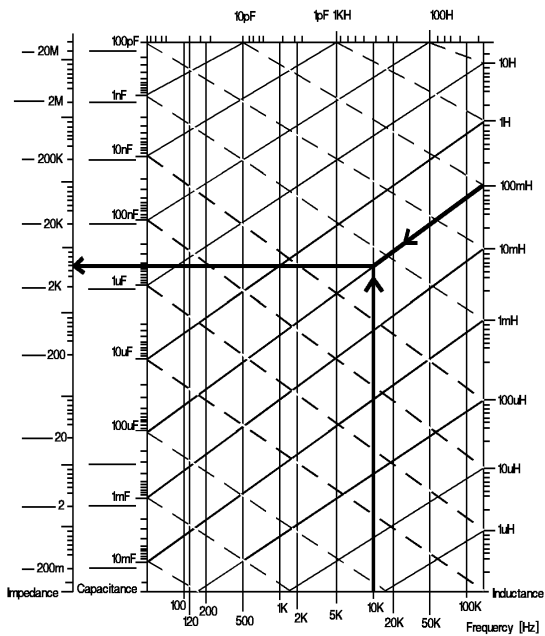
Figure 2-1 LC  $\leftrightarrow$  |Z| conversion



(a). LC  $\leftrightarrow$  |Z| conversion chart



(b). C  $\rightarrow$  |Z| conversion chart



(c). L  $\rightarrow$  |Z| conversion chart

Figure 2-3: 1730 Accuracy Formula Conversion Charts

## 2.4.6 TRIGger

The 1730 instrument can be triggered manually, internally or externally. In MEAS DISPLAY (Pg 2/3) press [F3] so that the **INT** box is highlighted. Use the up arrow [↑] key to change the trigger or use the down arrow [↓] key to change the trigger. The instrument default setting is INT (internal trigger). When MANUAL trigger is selected, one measurement will be made each time the trigger is pressed. When EXTERNAL trigger is selected, one measurement will be made each time the external trigger is asserted by the handler. When INTERNAL trigger is selected, measurements are performed continuously when in [MEAS DISPLAY].

The screenshot shows the MEAS DISPLAY screen with the following settings: RANGE: A 100W, SPEED: MEDIUM, TRIG.: EXT, and NEXT PAGE 2/3. The Cs and D values are 1.2345 pF. To the right, a diagram shows the F3 key being pressed, with arrows pointing to the 'Select measurement trigger' label and two buttons labeled 'Select trigger: INT, MAN, EXT'.

## 2.4.7 BIAS Voltage

The 1730 instrument is capable of generating 0-5V external DC bias voltage to the device under test. When the Bias Voltage is ON, voltage can be supplied from an internal voltage supply using the  $R_{BIAS}$  resistor, or from an external supply when the external bias connector is used. To enable/disable the bias voltage function, in MEAS DISPLAY (Pg 2/3) press [F1] so that the **OFF** box is highlighted. Use the up arrow [↑] or down arrow [↓] keys or [F1] to switch the bias voltage function ON/OFF. The instrument default setting is OFF. Setting the bias voltage level is done externally.

The screenshot shows the MEAS DISPLAY screen with the following settings: BIAS V: OFF, BINNING: OFF, COMPARE: OFF, and NEXT PAGE 3/3. The Cs and D values are 1.2345 pF. To the right, a diagram shows the F1 key being pressed, with arrows pointing to the 'Enable/Disable bias voltage function' label and two buttons labeled 'Enable/Disable bias voltage function'.




The screenshot shows the MEAS DISPLAY screen with the following settings: BIAS V: ON, BINNING: OFF, COMPARE: OFF, and NEXT PAGE 3/3. The Cs and D values are 1.2345 pF. The BIAS box is highlighted. To the right, a diagram shows the F1 key being pressed, with arrows pointing to the 'Enable/Disable bias voltage function' label and two buttons labeled 'Enable/Disable bias voltage function'.

This box will also be shown PAGE 1/3 when BIAS is selected ON.




Refer to paragraph 3.3 for a description of the bias voltage feature.

## 2.4.8 BINNING

The 1730 instrument has 8 pass/fail bins for sorting components by test result. To enable/disable the binning function, in MEAS DISPLAY (Pg 3/3) press [F2] so that the **OFF** box is highlighted. Use the up arrow [↑] key or down arrow [↓] key to switch the binning function ON/OFF. The instrument default setting is OFF. Setting the bin values is done within the MAIN INDEX menu. Refer to paragraph 2.5.1 for instructions on setup of Binning.




<b>MEAS DISPLAY</b>	<b>BIAS V: OFF</b>	 Enable/Disable binning function  Enable/Disable binning function  Enable/Disable binning function
Cs : 1.2345 pF	BINNING: <b>OFF</b>	
D : 1.2345	COMPARE: OFF	
NEXT PAGE 3/3		








<b>MEAS DISPLAY</b>	<b>BIAS V: OFF</b>	 Enable/Disable binning function  Enable/Disable binning function  Enable/Disable binning function
Cs : 1.2345 pF	BINNING: <b>ON</b>	
D : 1.2345	COMPARE: OFF	
BIN: 0	NEXT PAGE 3/3	

## 2.4.9 COMPARE

The 1730 instrument has 8 pass/fail bins for sorting components by test result. To enable/disable the compare function, in MEAS DISPLAY (Pg 3/3) press [F3] so that the **OFF** box is highlighted. Use the up arrow [↑] key or down arrow [↓] key to switch the compare function ON/OFF\*. The instrument default setting is OFF. Setting the comparison values is done within the MAIN INDEX menu. Refer to paragraph 2.5.4 for instructions on setup of Compare.

<b>MEAS DISPLAY</b>	<b>BIAS V: OFF</b>	 Enable/Disable compare function  Enable/Disable compare function  Enable/Disable compare function
Cs : 1.2345 pF	BINNING: OFF	
D : 1.2345	COMPARE: <b>OFF</b>	
NEXT PAGE 3/3		

<b>MEAS DISPLAY</b>	<b>BIAS V: OFF</b>	 Enable/Disable compare function  Enable/Disable compare function  Enable/Disable compare function  Absolute Value  Delta Absolute Value  Delta Percent Absolute Value  Compare Function: OFF
Cs : 0.0000 pF	BINNING: OFF	
D : 0.5002	COMPARE: <b>ON-VAL</b>	
Cs: <b>GO</b> D: <b>GO</b>	NEXT PAGE 3/3	

\* Refer to “Notes on Compare Settings” on next page.

### Notes on Compare Settings:

Setting COMPARE =  $\overline{\text{ON-VAL}}$  will display the primary and secondary readings in addition to a  $\overline{\text{GO}}$  (PASS). A  $\overline{\text{LO}}$  reading is lower than the set nominal value and a  $\overline{\text{HI}}$  reading is higher than the set nominal value.

Setting COMPARE =  $\overline{\text{ON-}\Delta}$  will display the difference between the measured value and the set nominal value. A  $\overline{\text{GO}}$ ,  $\overline{\text{LO}}$ , or  $\overline{\text{HI}}$  judgment is also displayed.

Setting COMPARE =  $\overline{\text{ON-}\Delta\%}$  will display the percent difference between the measured value and the set nominal value. A  $\overline{\text{GO}}$ ,  $\overline{\text{LO}}$ , or  $\overline{\text{HI}}$  judgment is also displayed.

## 2.5 MAIN INDEX

Within the 1730 instrument's MAIN INDEX are the Binning, Compare and Correction functions. To access these functions press [MAIN INDEX] and the display should look as shown in Figure 2-4.

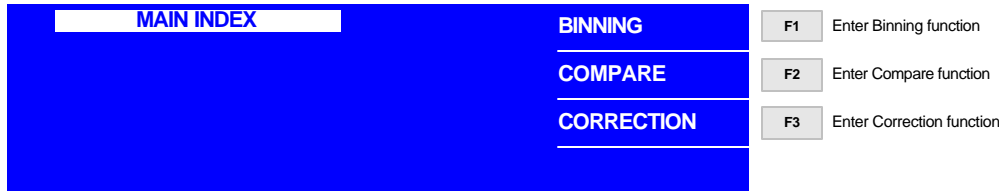
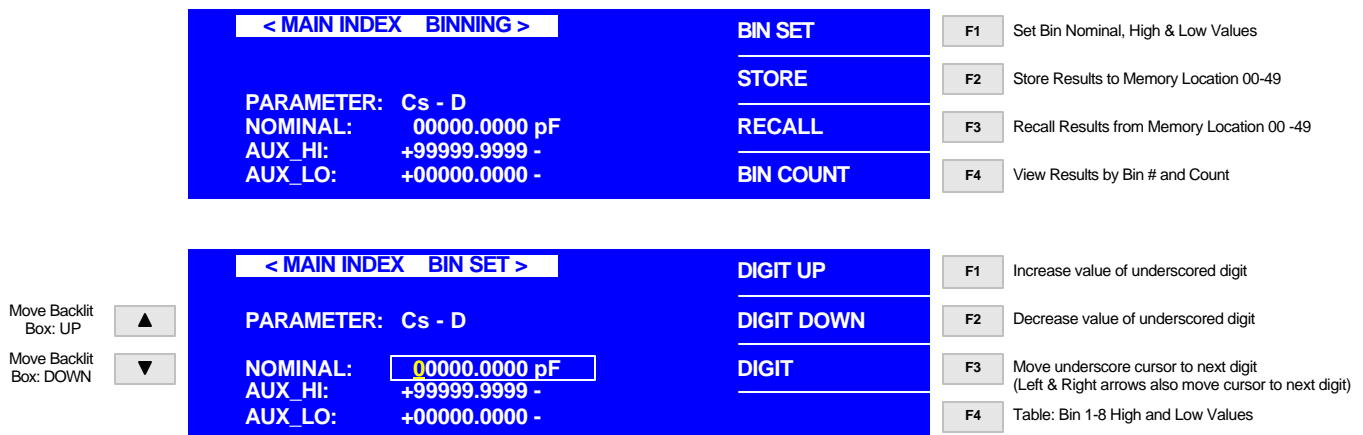


Figure 2-4: MAIN INDEX

### 2.5.1 BINNING

To set the bin functions for the 1730 instrument, press [MAIN INDEX] then [F1] = BINNING.



- Press [F1] = BIN SET and to enter the BIN SET Display and set the nominal, high and low values for the primary parameter.
- To select the nominal, high or low value, move the backlit box UP using the up arrow [↑] or to move it down using the down arrow [↓].
- Press [F1] = DIGIT UP to increase the value of the underscored digit.
- Press [F2] = DIGIT DOWN to decrease the value of the underscored digit.
- Press [F3] = DIGIT to move the underscored digit right. The left [←] and right [→] arrow keys also move the underscored digit left or right on a single line.
- The units of the values can be selected using the DIGIT UP and DIGIT DOWN when the underscore cursor is in the right most position.

When the nominal, auxiliary high and auxiliary low values are set, use the down [↓] arrow key to move the backlit box AUX\_LO: -00000.0000 down to view bins 1-8 high and low percent settings.

## BIN Set and BIN Count

After setting the AUX\_LO: -00000.0000 value, press the down [↓] arrow key to view bins 1-4.  
Press the down [↓] arrow key again to view bins 5-8.

Press the [MAIN INDEX] key to return to the MAIN INDEX BINNING screen.

Press the [F4] = BIN COUNT to view the bin count for bins 1-8 and the OUT bin.

**NOTE:**  
All bins can be viewed by pressing [F4] at anytime in [MAIN INDEX\_BIN SET]

Move Backlit  
Box: DOWN ▼

< MAIN INDEX BIN SET >			DIGIT UP	F1
BIN	HI	LO	DIGIT DOWN	F2
1	+000.00%	-000.00%	DIGIT	F3
2	+000.00%	-000.00%		F4
3	+000.00%	-000.00%		
4	+000.00%	-000.00%		

F1 Increase value of underscored digit  
F2 Decrease value of underscored digit  
F3 Move underscore cursor to next digit  
F4 Table: Bin 1-8 High and Low Values

Move Backlit  
Box: DOWN ▼

< MAIN INDEX BIN SET >			DIGIT UP	F1
BIN	HI	LO	DIGIT DOWN	F2
5	+000.00%	-000.00%	DIGIT	F3
6	+000.00%	-000.00%		F4
7	+000.00%	-000.00%		
8	+000.00%	-000.00%		

F1 Increase value of underscored digit  
F2 Decrease value of underscored digit  
F3 Move underscore cursor to next digit  
F4 Table: Bin 1-8 High and Low Values

PRESS MAIN INDEX      PRESS F4 = BIN COUNT

BIN	COUNT	BIN	COUNT	SPEED: M	F1
0	127	5	0	TRIG.: MAN	F2
1	0	6	0	RANGE: AUTO	F3
2	0	7	0	RESET	F4
3	0	8	0		
4	0	OUT	11		
TOTAL:			138		

F1 Change measurement speed: S/M/F  
F2 Change trigger: MAN/INT/EXT  
F3 Change range: HOLD/AUTO  
F4 Reset bin counts to 0.

### In the BIN COUNT screen:

Press [F1] = SPEED to change the measurement speed equal to Fast, Medium or Slow.

Press [F2] = TRIG to change the measurement trigger equal to MANual, INTernal or EXTernal.

Press [F3] = RANGE to change the measurement range equal to Hold or Auto.

Press [F4] = RESET to clear the contents of the bins.

Press [MAIN INDEX] when finished.

BIN	COUNT	BIN	COUNT	YES	F1
0	127	5	0	NO	F2
1	0	6	0		F3
2	0	7	0		F4
3	0	8	0		
4	0	OUT	11		
TOTAL:			138		

F2 Clear the Counts in all bins  
F3 Do not clear the counts in all bins  
F4

Two of the most common methods of sorting results into bins are using nested limits or sequential limits.

### Nested Limits

Nested limits are a natural choice for sorting components by % tolerance around a single nominal value with the lower bins narrower than the higher numbered bins. Nested limits for three bins are illustrated in Figure 2-5. Note that the limits do not have to be symmetrical (Bin 3 is  $-7\%$  and  $+10\%$ ).

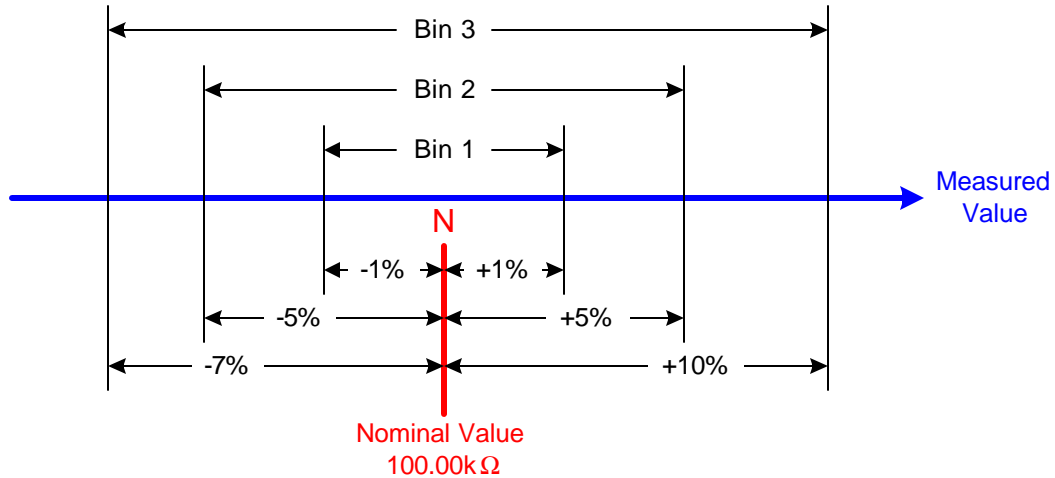


Figure 2-5: Nested Limits

### Sequential Limits

Sequential limits are a natural choice when sorting components by absolute value. Figure 2-6 illustrates the use of sequential limits for a total of three bins. Sequential bins do not have to be adjacent. Their limits can overlap or have gaps depending upon the specified limit. Any component that falls into an overlap between bins would be assigned to the lower numbered bin and any component that falls into a gap between bins would be assigned to the overall fail bin.

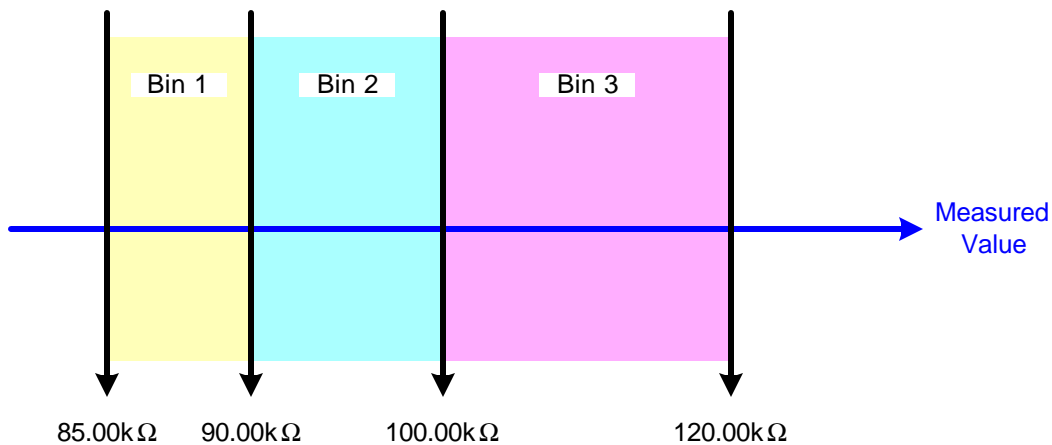


Figure 2-6: Sequential Limits



## 2.5.2 STORE

The 1730 instrument's STORE and RECALL functions are within the MAIN INDEX menu. Press [MAIN INDEX], press [F1] = BINNING (or [F2] = COMPARE) then press [F2] = STORE to access the store function.

<div style="background-color: #0000FF; color: white; padding: 5px;"> <span style="float: left;">&lt; MAIN INDEX &gt;</span> <div style="float: right; text-align: right;"> <p><u>BINNING</u></p> <p>COMPARE</p> <p>CORRECTION</p> </div> </div>		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F1</div> Enter Binning function
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F2</div> Enter Compare function
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F3</div> Enter Correction function

<div style="background-color: #0000FF; color: white; padding: 5px;"> <span style="float: left;">&lt; MAIN INDEX BINNING &gt;</span> <div style="float: right; text-align: right;"> <p><u>BIN SET</u></p> <p>STORE</p> <p>RECALL</p> <p>BIN COUNT</p> </div> </div>		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F1</div> Set Bin Nominal, High & Low Values
PARAMETER: Cs - D NOMINAL: 00000.0000 pF AUX_HI: +99999.9999 - AUX_LO: +00000.0000 -		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F2</div> Store Results to Memory Location 00-49
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F3</div> Recall Results from Memory Location 00 -49
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F4</div> View Results by Bin # and Count

Go UP in memory location <span style="border: 1px solid #ccc; padding: 2px;">▲</span> Go DOWN in memory location <span style="border: 1px solid #ccc; padding: 2px;">▼</span>	<div style="background-color: #0000FF; color: white; padding: 5px;"> <span style="float: left;">&lt; MAIN INDEX BINNING &gt;</span> <div style="float: right; text-align: right;"> <p><u>DIGIT UP</u></p> <p>DIGIT DOWN</p> <p>DIGIT</p> </div> </div>	<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F1</div> Increase value of underscored digit
	ENTER STORE NUMBER: <u>00</u> PARAMETER: Cs - D NOMINAL: 00000.0000 pF AUX_HI: +99999.9999 - AUX_LO: +00000.0000 -	<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F2</div> Decrease value of underscored digit
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F3</div> Move underscore cursor to next digit <small>(Left &amp; Right arrows also move cursor to next digit)</small>
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F4</div>

TRIGGER

**Press TRIGGER to store setup**

If there is already data stored in the location chosen, this message will be displayed:

<div style="background-color: #0000FF; color: white; padding: 5px;"> <span style="float: left;">&lt; MAIN INDEX BINNING &gt;</span> <div style="float: right; text-align: right;"> <p><u>DIGIT UP</u></p> <p>DIGIT DOWN</p> <p>DIGIT</p> </div> </div>		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F1</div> Increase value of underscored digit
ENTER STORE NUMBER: <u>02</u> THIS NUMBER HAS DATA PRESS TRIGGER TO RECOVER! PRESS OTHER KEY TO ESCAPE		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F2</div> Decrease value of underscored digit
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F3</div> Move underscore cursor to next digit
		<div style="border: 1px solid #ccc; padding: 2px; width: 40px; text-align: center;">F4</div> Table: Bin 1-8 High and Low Values

When performing the STORE and RECALL functions, the 1730 instrument stores the following information:

- Frequency
- Speed
- Level
- Parameter
- Range
- All Bin setting values (excluding the Bin Counter)
- All Compare setting values (excluding the Compare Counter)

There are 50 storage locations (00 – 49) in the 1730 instrument memory.

### 2.5.3 RECALL

The 1730 instrument's STORE and RECALL functions are within the MAIN INDEX menu. Press [MAIN INDEX], press [F1] = BINNING (or [F2] = COMPARE) then press [F3] = RECALL to access the recall function.

<div style="display: flex; justify-content: space-between;"> <span>&lt; MAIN INDEX &gt;</span> </div>	BINNING <hr/> COMPARE <hr/> CORRECTION	<table border="0"> <tr><td style="border: 1px solid gray; padding: 2px;">F1</td><td>Enter Binning function</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F2</td><td>Enter Compare function</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F3</td><td>Enter Correction function</td></tr> </table>	F1	Enter Binning function	F2	Enter Compare function	F3	Enter Correction function
F1	Enter Binning function							
F2	Enter Compare function							
F3	Enter Correction function							

<div style="display: flex; justify-content: space-between;"> <span>&lt; MAIN INDEX BINNING &gt;</span> </div>	BIN SET <hr/> STORE <hr/> RECALL <hr/> BIN COUNT	<table border="0"> <tr><td style="border: 1px solid gray; padding: 2px;">F1</td><td>Set Bin Nominal, High &amp; Low Values</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F2</td><td>Store Results to Memory Location 00-49</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F3</td><td>Recall Results from Memory Location 00 -49</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F4</td><td>View Results by Bin # and Count</td></tr> </table>	F1	Set Bin Nominal, High & Low Values	F2	Store Results to Memory Location 00-49	F3	Recall Results from Memory Location 00 -49	F4	View Results by Bin # and Count
F1	Set Bin Nominal, High & Low Values									
F2	Store Results to Memory Location 00-49									
F3	Recall Results from Memory Location 00 -49									
F4	View Results by Bin # and Count									

<div style="display: flex; justify-content: space-between;"> <span>&lt; MAIN INDEX BINNING &gt;</span> </div>	ENTER RECALL NUMBER: <u>00</u> PRESS TRIG TO RECALL PARAMETER: Cs - D NOMINAL: 00000.0000 pF AUX_HI: +99999.9999 - AUX_LO: +00000.0000 -	DIGIT UP <hr/> DIGIT DOWN <hr/> DIGIT	<table border="0"> <tr><td style="border: 1px solid gray; padding: 2px;">F1</td><td>Increase value of underscored digit</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F2</td><td>Decrease value of underscored digit</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F3</td><td>Move underscore cursor to next digit (Left &amp; Right arrows also move cursor to next digit)</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F4</td><td></td></tr> </table>	F1	Increase value of underscored digit	F2	Decrease value of underscored digit	F3	Move underscore cursor to next digit (Left & Right arrows also move cursor to next digit)	F4	
F1	Increase value of underscored digit										
F2	Decrease value of underscored digit										
F3	Move underscore cursor to next digit (Left & Right arrows also move cursor to next digit)										
F4											

Go UP in memory location ▲  
Go DOWN in memory location ▼

TRIGGER

**Press TRIGGER to recall setup**

If there is no data stored in the location chosen, this message will be displayed:

<div style="display: flex; justify-content: space-between;"> <span>&lt; MAIN INDEX BINNING &gt;</span> </div>	ENTER RECALL NUMBER: <u>07</u> ERROR... NO DATA PARAMETER: Cs - D NOMINAL: 00000.0000 pF AUX_HI: +99999.9999 - AUX_LO: +00000.0000 -	DIGIT UP <hr/> DIGIT DOWN <hr/> DIGIT	<table border="0"> <tr><td style="border: 1px solid gray; padding: 2px;">F1</td><td>Increase value of underscored digit</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F2</td><td>Decrease value of underscored digit</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F3</td><td>Move underscore cursor to next digit</td></tr> <tr><td style="border: 1px solid gray; padding: 2px;">F4</td><td></td></tr> </table>	F1	Increase value of underscored digit	F2	Decrease value of underscored digit	F3	Move underscore cursor to next digit	F4	
F1	Increase value of underscored digit										
F2	Decrease value of underscored digit										
F3	Move underscore cursor to next digit										
F4											

When performing the STORE and RECALL functions, the 1730 instrument stores the following information:

- Frequency
- Speed
- Level
- Parameter
- Range
- All Bin setting values (excluding the Bin Counter)
- All Compare setting values (excluding the Compare Counter)

There are 50 storage locations (00 – 49) in the 1730 instrument memory.

## 2.5.4 COMPARE

To set up a comparison test, use the COMPARE function. To access the COMPARE function, press [MAIN INDEX] then press [F2] = COMPARE. Press [F1] = SETTING to set the primary nominal high and low judgment values. Press [F2] = STORE to store the current COMPARE setup or press [F3] = RECALL to recall a stored COMPARE setup. Press [F4] = COUNT to view the COMPARE results and counts.

		<div style="border: 1px solid white; display: inline-block; padding: 2px;">&lt; MAIN INDEX &gt;</div>	BINNING <hr/> COMPARE <hr/> CORRECTION	<div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F1</div> Enter Binning function <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F2</div> Enter Compare function <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F3</div> Enter Correction function																			
		<div style="border: 1px solid white; display: inline-block; padding: 2px;">&lt; MAIN INDEX COMPARE &gt;</div>	SETTING <hr/> STORE <hr/> RECALL <hr/> COUNT	<div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F1</div> Set Primary and Secondary Nominal, High and Low Values <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F2</div> Store Compare settings <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F3</div> Recall Compare settings <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F4</div> View Compare results & counts																			
Move backlit box: UP <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">▲</div> Move backlit box: DOWN <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">▼</div>	<div style="border: 1px solid white; display: inline-block; padding: 2px;">&lt; COMPARE SET &gt;</div>		PARAMETER: Cs - D PRI_NOMINAL: <span style="border: 1px solid white; padding: 1px;">+00000.0000pF</span> SEC_NOMINAL: +00000.0000 PRI_HI_NOMINAL: +00999.9000pF PRI_LO_NOMINAL: - 00999.9000pF SEC_HI_NOMINAL: +00999.9000 SEC_LO_NOMINAL: - 00999.9000	DIGIT UP <hr/> DIGIT DOWN <hr/> DIGIT <hr/> MODE: ABS	<div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F1</div> Increase underscored digit <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F2</div> Decrease underscored digit <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F3</div> Move underscored digit left on a single line (Left and right arrows also move underscored digit) <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F4</div> Select Absolute or Percent (%) Value																		
<div style="border: 1px solid gray; padding: 2px; width: 60px; margin: 0 auto;">MAIN INDEX</div>		<b>When finished SETTING Comparison values</b>																					
<div style="border: 1px solid gray; padding: 2px; width: 60px; margin: 0 auto;">F4</div>		<b>= COUNT to view the COMPARE results and counts</b>																					
		<div style="border: 1px solid white; display: inline-block; padding: 2px;">&lt; COMPARE COUNT &gt;</div>	SPEED: F <hr/> TRIG.: MAN <hr/> RANGE: AUTO <hr/> RESET	<div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F1</div> Select measurement speed = Fast, Medium or Slow <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F2</div> Select trigger = MAN, INT or EXT <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F3</div> Select measurement range = Auto or Hold <div style="border: 1px solid gray; padding: 2px; width: 20px; text-align: center;">F4</div> Clear COMPARE count																			
		<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>PRIMARY</th> <th>COUNT</th> <th>SECOND</th> <th>COUNT</th> </tr> </thead> <tbody> <tr> <td>GO:</td> <td>198</td> <td>GO:</td> <td>198</td> </tr> <tr> <td>HI:</td> <td>0</td> <td>HI:</td> <td>0</td> </tr> <tr> <td>LO:</td> <td>0</td> <td>LO:</td> <td>0</td> </tr> <tr style="border-top: 2px solid white;"> <td>TOTAL:</td> <td></td> <td></td> <td>198</td> </tr> </tbody> </table>	PRIMARY	COUNT	SECOND	COUNT	GO:	198	GO:	198	HI:	0	HI:	0	LO:	0	LO:	0	TOTAL:			198	
PRIMARY	COUNT	SECOND	COUNT																				
GO:	198	GO:	198																				
HI:	0	HI:	0																				
LO:	0	LO:	0																				
TOTAL:			198																				

### Notes on Compare Settings:

Setting COMPARE = ON-VAL will display the primary and secondary readings in addition to a GO (PASS). A LO reading is lower than the set nominal value and a HI reading is higher than the set nominal value.

Setting COMPARE = ON-Δ will display the difference between the measured value and the set nominal value. A GO, LO, or HI judgment is also displayed.

Setting COMPARE = ON-Δ% will display the percent difference between the measured value and the set nominal value. A GO, LO, or HI judgment is also displayed.

## 2.5.5 CORRECTION

The 1730 instrument provides automatic offset for lead and/or fixture effects. During the offset process a correction is made (subtracted out) as the result of lead leakage current and stored in instrument memory to be applied to ongoing measurements. For maximum measurement accuracy it is recommended that the CORRECTION function be performed on the 1730 instrument after power up, any time the test parameters are changed and any time the test leads or fixture is changed.

Prior to performing the CORRECTION function:

- Allow the instrument to warm up for 15 minutes.
- Connect the Test cables (or fixture) to the output connectors (BNC terminals).
- Program the test steps.

With the instrument in STAND-BY status (MEAS DISPLAY shown on display):

- Press [MAIN INDEX]
- Press [F3] = CORRECTION
- Press [F2] = OPEN (or [F3] = SHORT) to select zero function.
- Press [F1] = SINGLE or [F2] = MULTI to select frequency.
- Follow instructions on display: i.e.: “Open circuit test leads”.
- Press [TRIGGER] button.
- Wait while instrument gets CORRECTION value.
- Press [ANY KEY] to return to MEAS DISPLAY status.

### NOTE:

When SINGLE is selected, the 1730 instrument performs an open/short at the programmed test frequency.  
When MULTI is selected, the 1730 instrument performs the open/short at all 7 test frequencies.

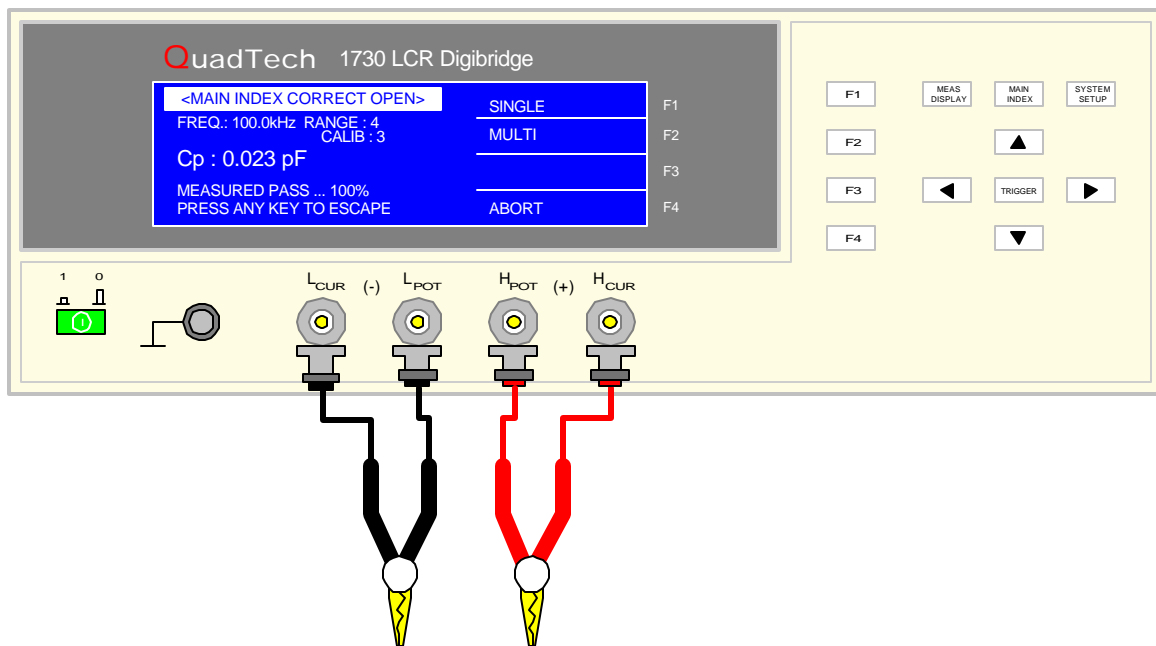
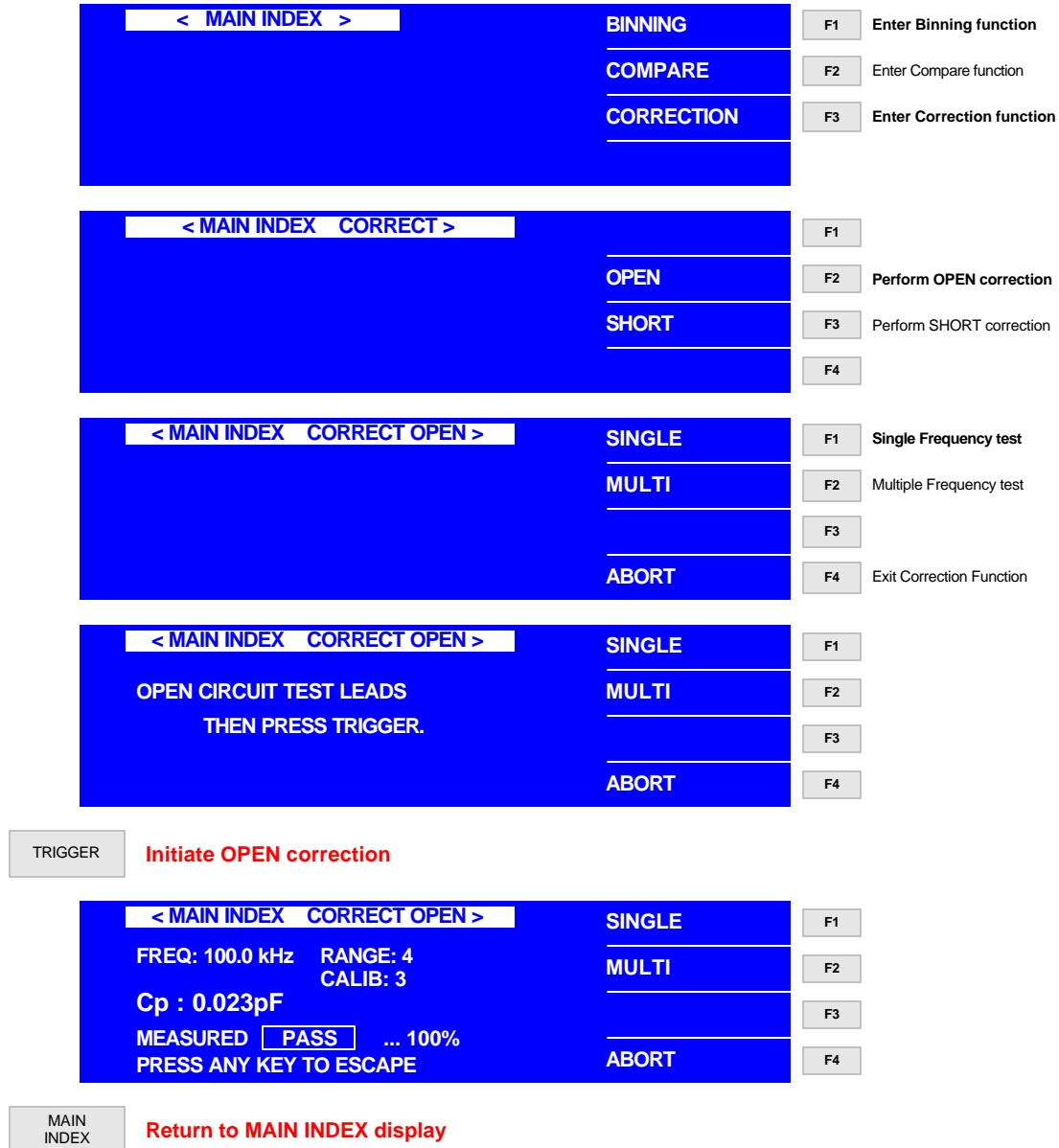


Figure 2-7: OPEN Configuration using Kelvin Clip Test Leads

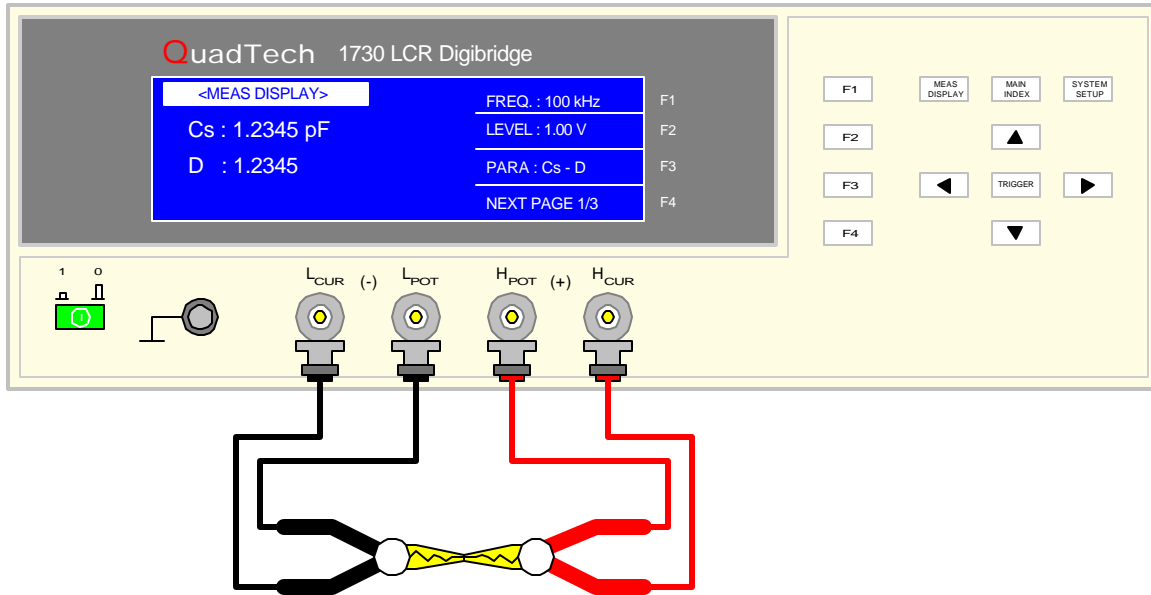
## CORRECTION: OPEN

Figure 2-7 illustrates the connection of the Kelvin Clip test leads for an open correction. The MAIN INDEX display menus corresponding to the OPEN operation are illustrated below.



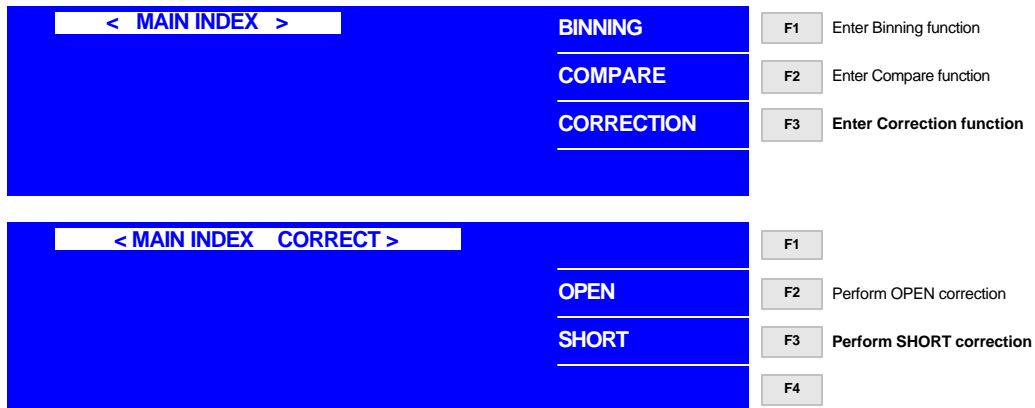
## CORRECTION: SHORT

Figure 2-8 illustrates the connection of the Kelvin Clip test leads for a short correction. The MAIN INDEX display menus corresponding to the SHORT operation are illustrated below.



**Figure 2-8: SHORT Configuration using Kelvin Clip Test Leads**

To access the SHORT correction operation, press [MAIN INDEX] then [F3] = CORRECTION.



## CORRECTION: SHORT - continued

Press [F3] = SHORT to select the SHORT configuration. Short test leads together then press [TRIGGER] to initiate short correction measurement.

<b>&lt; MAIN INDEX CORRECT SHORT &gt;</b>		<b>SINGLE</b>	F1 Single Frequency test
		<b>MULTI</b>	F2 Multiple Frequency test
			F3
		<b>ABORT</b>	F4 Exit Correction Function

<b>&lt; MAIN INDEX CORRECT SHORT &gt;</b>		<b>SINGLE</b>	F1
<b>SHORT CIRCUIT TEST LEADS</b>		<b>MULTI</b>	F2
<b>THEN PRESS TRIGGER.</b>			F3
		<b>ABORT</b>	F4

TRIGGER **Initiate SHORT correction**

<b>&lt; MAIN INDEX CORRECT SHORT &gt;</b>		<b>SINGLE</b>	F1
FREQ: 100.0 kHz RANGE: 10		<b>MULTI</b>	F2
CALIB: 1			F3
Rs : 1.05 kW		<b>ABORT</b>	F4
MEASURED <b>FAIL</b> ... 0%			
PRESS ANY KEY TO ESCAPE			

MAIN INDEX **Return to MAIN INDEX display**

### NOTE

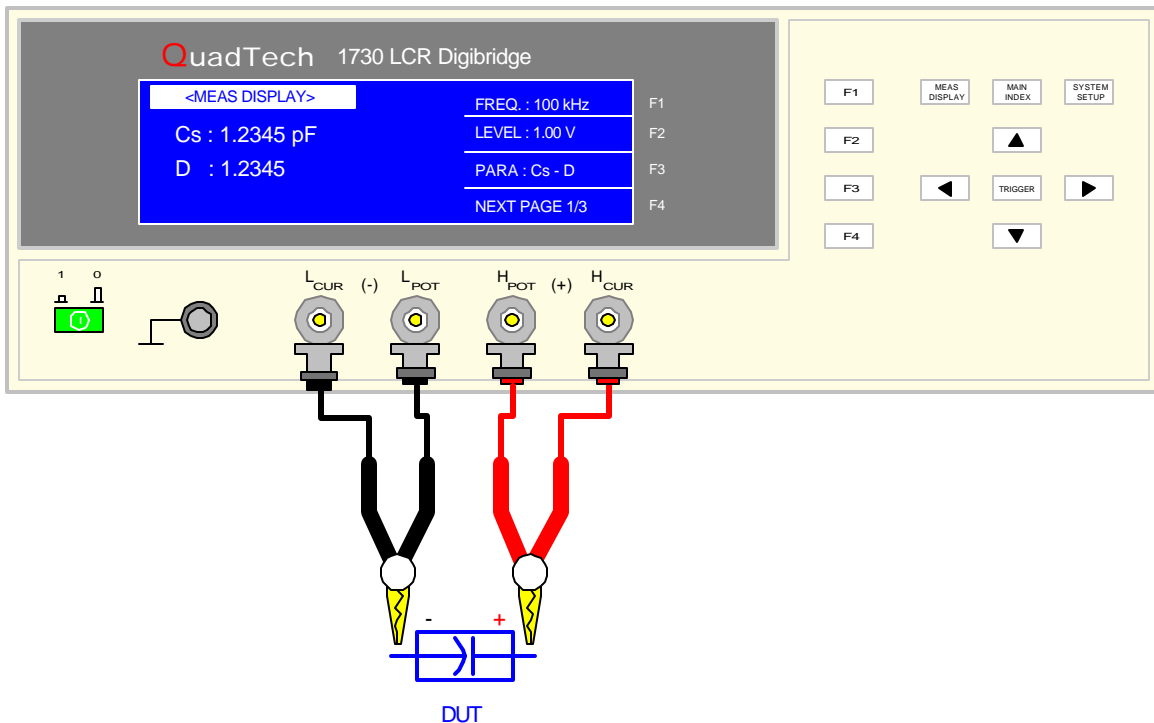
Perform the CORRECTION functions any time the test leads or test fixtures are changed or any time the test parameters (especially constant source impedance, CONST Rsource) are changed.

### NOTE:

When SINGLE is selected, the 1730 instrument performs an open/short at the programmed test frequency. When MULTI is selected, the 1730 instrument performs the open/short at all 7 test frequencies.

## 2.6 Connection to Device under Test

Figure 2-9 illustrates the connection of the 1730 LCR to a single DUT using the 1700-03 Kelvin Clip Cable lead set. The red Kelvin clip/BNCs are connected between the  $H_{POT}$  and  $H_{CUR}$  (+) terminals on the 1730 unit and the high side of the device under test. The black Kelvin clip/BNCs are connected between the  $L_{POT}$  and  $L_{CUR}$  (-) terminals on the 1730 unit to the low side of the DUT.



**Figure 2-9: 1700-03 Kelvin Clip Test Leads**

There are a variety of test leads and fixtures available for the 1730 LCR Meter as listed in Table 2-5 and illustrated in Figure 2-9 through 2-14.

**Table 2-5: 1730 LCR Meter Test Leads & Fixtures**

Description	QuadTech P/N	Figure
Axial/Radial Component Test Fixture	1700-01	2-10
Axial/Radial Remote Test Fixture	1700-02	2-11
Lead Set: 4 BNC Connectors to 2 Kelvin Clips	1700-03	2-9
Lead Set: 4 BNC Connectors to Chip Component Tweezers	7000-05	2-12
BNC to BNC Cable Lead Set (1m)	7000-01	2-13
BNC to BNC Cable Lead Set (2m)	7000-02	2-13
Low Voltage Chip Component Test Fixture	7000-07	2-14

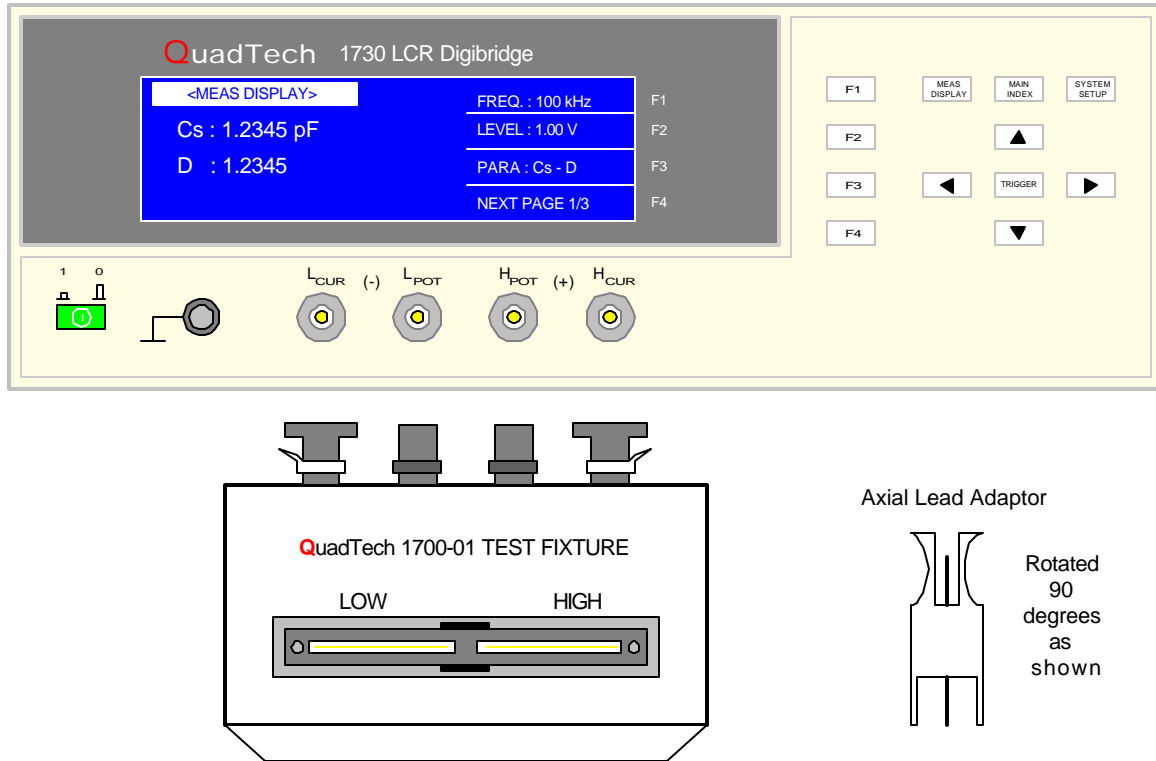
**NOTE:**

For proper operation, the  $H_{CUR}/H_{POT}/L_{CUR}/L_{POT}$  cable shields must be connected together at the DUT. This connection is already made using the 1730 recommended accessory leads. If the shields are not tied together, then at higher frequencies a resonance may occur which could cause erroneous capacitance readings.



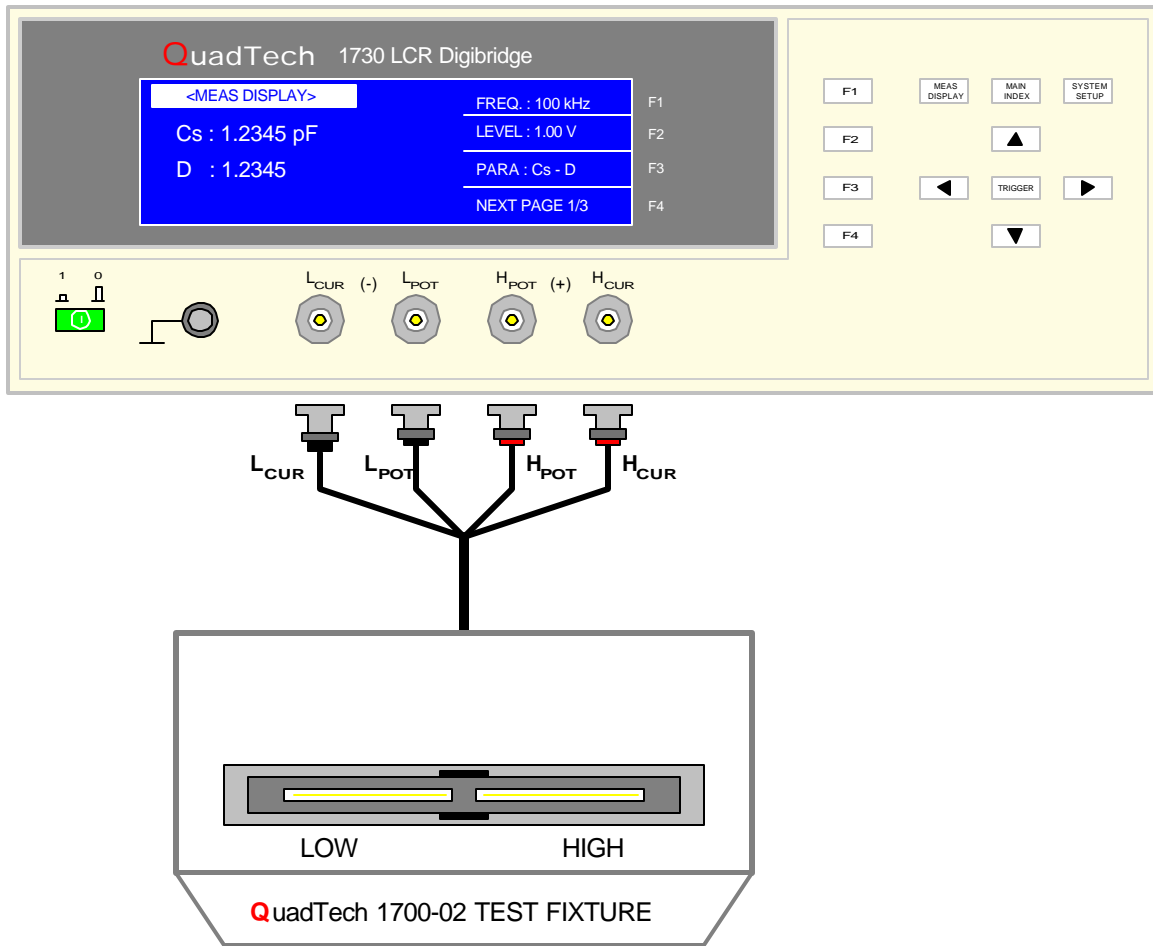
## Connection to Device under Test – continued

Figure 2-10 illustrates the connection of the 1700-01 axial/radial component test fixture to the 1730 LCR meter.



**Figure 2-10: 1700-01 Axial/Radial Component Test Fixture**

Figure 2-11 illustrates the connection of the 1700-02 axial/radial remote test fixture to the 1730 LCR meter.



**Figure 2-11: 1700-02 Axial/Radial Remote Test Fixture**

Figure 2-12 illustrates the connection of the 7000-05 Component Tweezers cable lead set to the 1730 LCR meter. This provides a 4-terminal connection to even the smallest of devices.

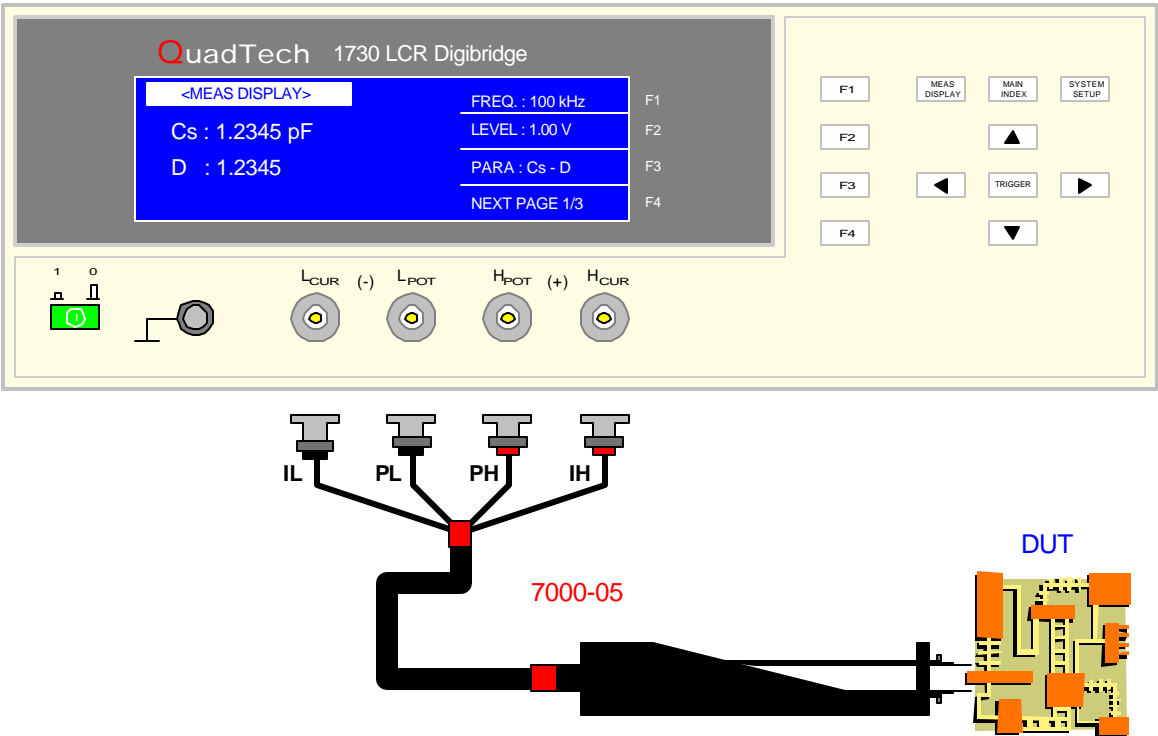
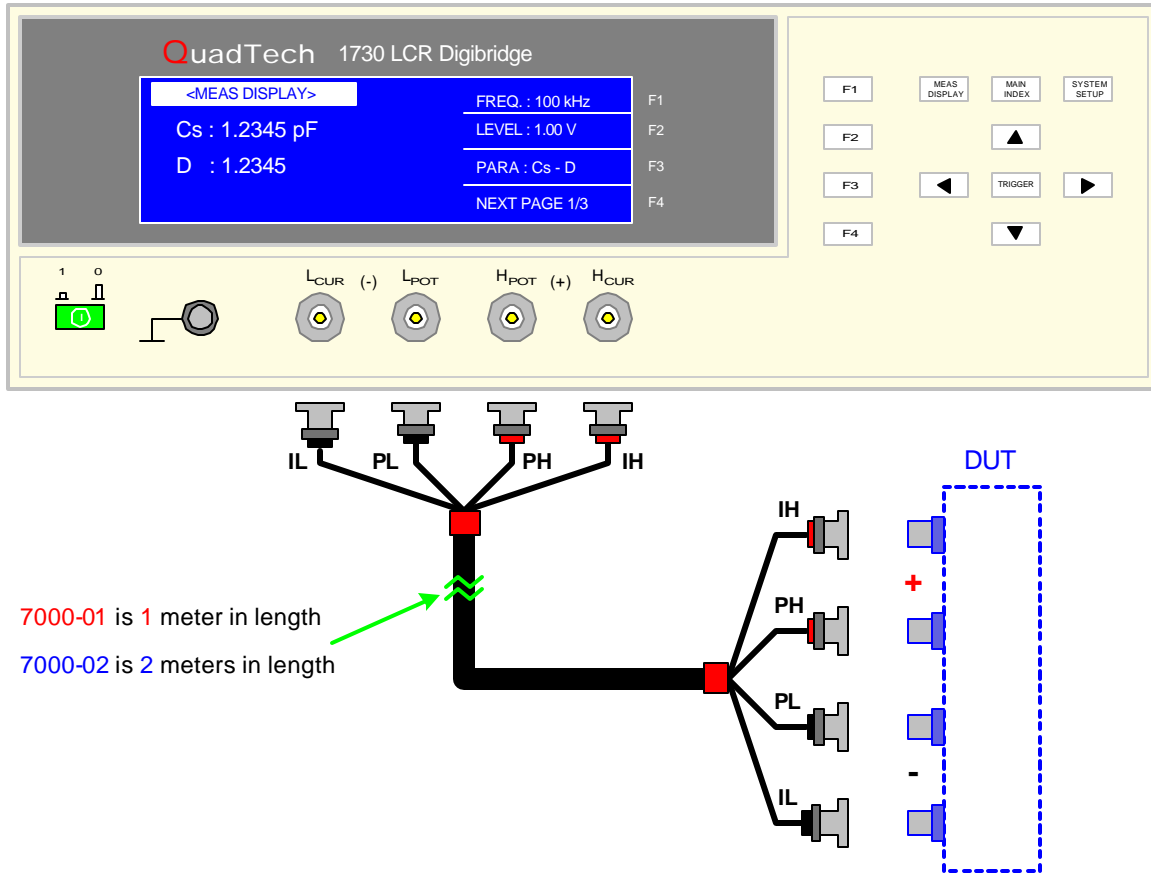


Figure 2-12: 1700-05 BNC to Chip Component Tweezers Cable Lead Set

Figure 2-13 illustrates the two 7000 Series BNC to BNC test cable lead sets available for the 1730 LCR Meter. The 7000-01 is one meter in length and the 7000-02 is two meters in length. The 1730 instrument permits the input of the test cable length for better measurement accuracy. Refer to paragraph 2.3.9, Cable Length for programming instruction. As always, each time the test cable is changed the 1730 instrument should be re-zeroed.



**Figure 2-13: 7000-01 & -02 Cables for the 1730 LCR Meter**



**Figure 2-14: 7000-07 Low Voltage Chip Component Test Fixture**

## 2.7 Measurement Procedure

Before a measurement is made verify the following:

1. 1730 instrument [POWER] ON.
2. 15-minute warm-up.
3. Test parameters programmed and shown on MEAS DISPLAY.
4. Test cables or fixture connected.
5. CORRECTION function initiated.
6. Device under test connected.

The operator has the option of performing a test at power-up conditions (test conditions at which the instrument was last powered down) or recalling one of 50 stored test setups. Refer to paragraphs 2.4 – 2.5 for test programming and storage/recall instructions.

### To initiate a test:

- Press [TRIGGER].
- The test voltage is shut **off** when all test steps are completed,
- **OR** when a test result is judged a FAIL per programmed test limits.
- The test result is displayed on MEAS DISPLAY

The 1730 instrument judges the measurement value based on the BINNING and COMPARE functions set up previously. Refer to paragraphs 2.5.1 and 2.5.4 for instructions on setting these judgment parameters. Upon completion of the test the output voltage is terminated and the display shows the test result.



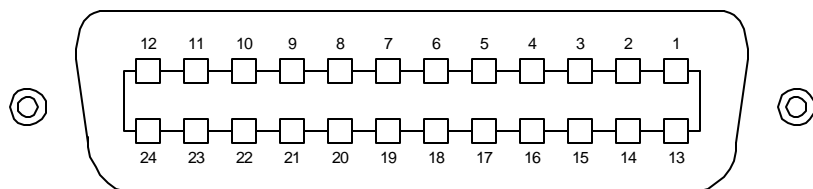
## Section 3: Interface

### 3.1 IEEE-488 Interface

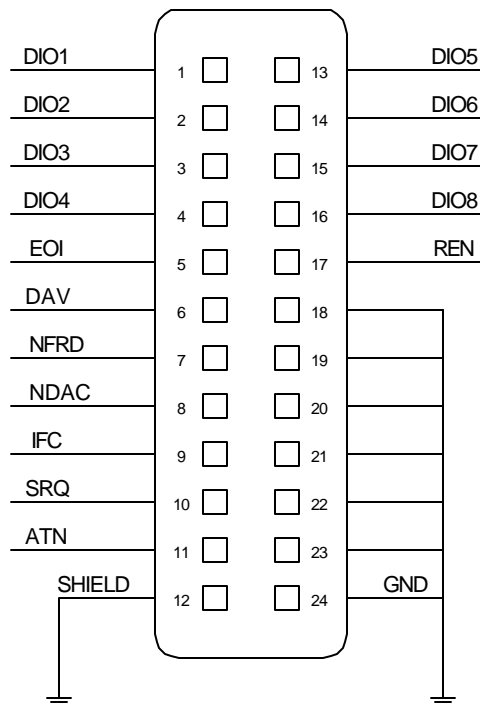
#### 3.1.1 Pin Configuration

The 1730 instrument comes standard with an IEEE-488 interface as illustrated in Figure 3-1. Connection is through the blue 24-pin connector labeled 'IEEE-488 INTERFACE' on the rear panel of the 1730 instrument. This interface can be used to connect a system containing a number of instruments and a controller in which each meets IEEE Standard 488.2 (Standard Digital Interface for Programmable Instrumentation).

1730 IEEE-488 Interface PIN Configuration: Rear Panel View



1730 IEEE-488 Interface  
PIN Designation



**Figure 3-1: IEEE-488 Interface Pin Configuration**

Table 3-1 lists the IEEE-488 Interface pin designations by pin number, signal name and pin function. Bus and driver information is also listed.

**Table 3-1: IEEE-488 Interface Pin Designations**

Bus	Driver	Signal Name	Pin Number	Function
<b>Handshake</b>	3 States	DAV	6	Low State: "Data is Available" and valid on DI01 through DI08
	Open Collector	NRFD	7	Low State: At least one Listener on the bus is "Not Ready For Data"
	Open Collector	NDAC	8	Low State: At least one Listener on the bus is "Not Accepting Data"
<b>Control</b>	3 States	ATN	11	"Attention" specifies 1 of 2 uses for the DI01 through DI08 lines: Low State: Controller command messages High State: Data bytes from the Talker device
	3 States	IFC	9	"Interface Clear" Low State: Returns portion of interface system to a known quiescent state
	Open Collector	SRQ	10	"Service Request" Low State: A Talker or Listener signals (to the controller) need for attention in the midst of the current sequence of events.
	3 States	REN	17	"Remote Enable" Low State: Enables each device to enter remote mode when addressed to listen. High State: All devices revert to Local control.
	3 States	EOI	5	"End of Identify" If ATN is in HIGH state, then EOI LOW state indicates the end of a multiple-byte data transfer sequence. If ATN is in LOW state, then EOI LOW state indicates a parallel poll.
<b>Data</b>	Open Collector	DI01	1	The 8-Line Data Bus.  If ATN is in LOW state, then the bus conveys interface messages. If ATN is in HIGH state, then the bus conveys device-dependent messages. (Example: carries remote control commands from the controller or from a talker device)
		DI02	2	
		DI03	3	
		DI04	4	
		DI05	13	
		DI06	14	
		DI07	15	
		DI08	16	



### 3.1.2 IEEE-488 Interface Function Codes and Messages

The IEEE-488 (GPIB) address is defined under the SYSTEM SETUP in the SYSTEM CONFIG menu. Press [SYSTEM SETUP], then the numerical key [F3] to enter the SYSTEM CONFIG menu. Press down arrow [↓] to enter the GPIB ADDRESS code. To select a new IEEE-488 address, use the function keys. Refer to paragraph 2.3.2 for more information. The default setting for the IEEE address is 17.

Table 3-2 defines the IEEE-488 interface codes and their function. Table 3-3 defines the IEEE-488 interface messages the 1730 instrument responds to and their function.

**Table 3-2: IEEE-488 Interface Functions**

Code	Function
SH1	Source Handshake (Talker)
AH1	Acceptor Handshake (Listener)
T6	Basic Talker Function
	Serial Poll Function
	Listener-specified Talker Release Function
	No TALK-ONLY Function
L4	Basic Listener Function
	Talker-specified Listener Release Function
SR1	Service Request Function
RL1	All Remote/Local Functions
PP0	No Parallel Poll Function
DC1	Device Clear Function
DT1	Device Trigger Function
C0	No Controller Functions

**Table 3-3: IEEE-488 Interface Messages**

Interface Message	Function	Description
GTL	Go To Local	Only addressed devices that receive this command are set to local mode. Cancels the remote control mode, making the front panel switches operative.

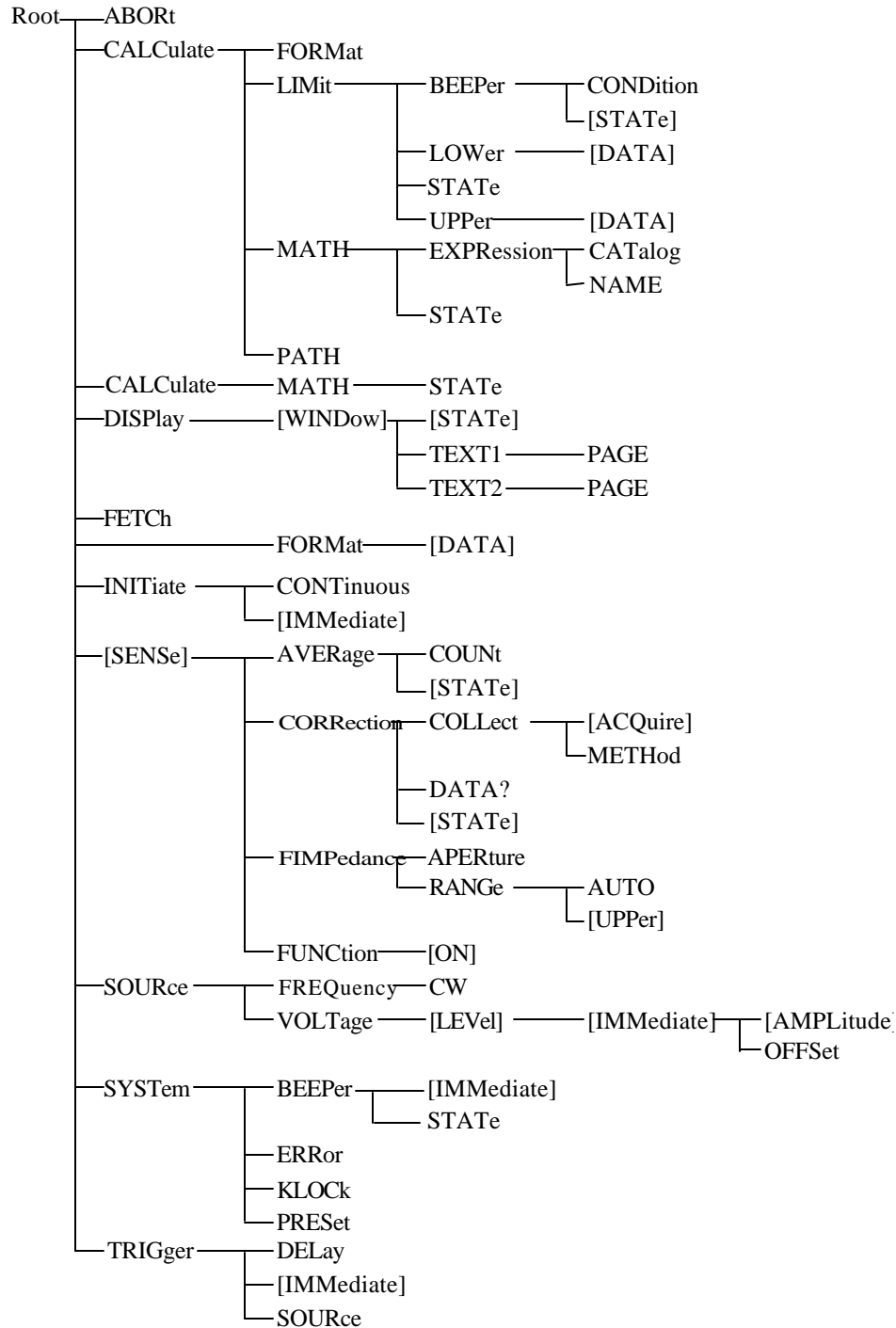
Table 3-4 lists the IEEE-488 interface commands the 1730 instrument accepts to set or query a parameter value. Paragraphs 3.1.3 through 3.1.5 detail command function, format, return value and description.

**Table 3-4: IEEE-488 Commands**

<b>Command</b>	<b>Name</b>	<b>Function</b>	<b>Output Format</b>
*CLS	Clear Status	Clear standard event status register. Clear status bit group register except for bit 4 (MAV)	
*ESE	Event Status Enable	Enable standard event status register value.	0 – 255
*ESE?	Event Status Enable	Query standard event status of device enable register	0 – 255
*ESR?	Event Status Register	Query standard event register value of device. After this command, the standard register is cleared to 0.	0 – 255
*IDN?	Identification	Query/Read basic device data. (A comma separates the identification fields.)	4 ID: Manufacturer, Device Model, Serial Number, Firmware Version
*OPC	Operation Complete	Operation is complete.	0
*OPC?	Operation Complete	Query operation complete.	1
*RST	Reset	Reset Device.	
*SRE	Service Request Enable	Enable service request register value.	0 – 255
*SRE?	Service Request Enable	Query/Read service request register value.	0 – 255
*TRG	Trigger Bus	Trigger the 1730 instrument	
*TST?	Self Test	Perform self test & report error	0 = no error
*SAV	Save	Save current status to memory.	1 – 50
*RCL	Recall	Recall saved status from memory.	1 – 50

### 3.1.3 IEEE-488 Commands

Figure 3-2 illustrates the programming commands accepted by the IEEE-488 interface of the 1730 instrument. The commands are written in tabular format as a single reference to view all the commands. The command format and examples are detailed in paragraphs 3.1.4 – 3.1.5.



**Figure 3-2: IEEE-488 Commands**

### 3.1.4 IEEE-488 Command Format

The IEEE-488 commands are configured in Root format. There are six levels of the instruction from top to bottom. Follow the specific path (as illustrated in Figure 3.2) to configure a specific command. The colon at the beginning of each line denotes that all line signals are root. Use a colon (:) to separate levels. Use the semicolon (;) to separate two commands on the same line.

For example, to format the command for the NAME function, use this path:

```
:CALCulate:MATH:EXPRession:NAME
```

To format the NAME and CATalog function, use two single commands:

```
:CALCulate:MATH:EXPRession:NAME  
:CALCulate:MATH:EXPRession:CATalog
```

or use the single command:

```
:CALCulate:MATH:EXPRession:NAME;CATalog
```

If the command is a setting, then put the parameter after the instruction. If the command is an inquiry, then put a question mark (?) after the instruction.

For example, to set the frequency to 1kHz:

```
:SOURce:FREQUency[:CW]1kHz
```

To inquire what the frequency is set to:

```
:SOURce:FREQUency[:CW]?
```

The lowercase letters and portion in parenthesis can be omitted so the above instruction can be rewritten as:

```
:SOUR:FREQ;
```

The Ending Code can be any type in Table 3-5.

**Table 3-5: IEEE-488 Interface Ending Codes**

Ending Code
[CR] (0Dh)
[LF] (0Ah)
[CR] (0Dh) + [LF] (0Ah)

### 3.1.5 IEEE-488 Commands - Detailed

The IEEE commands listed in Figure 3-2 are detailed in paragraphs 3.5.1.1 – 3.1.5.39 including command, parameter, return value, function, and description. **Note:** Numerical data is transferred via one of three methods: integer format, fixed decimal format or floating point decimal format. Refer to Figure 3-3.

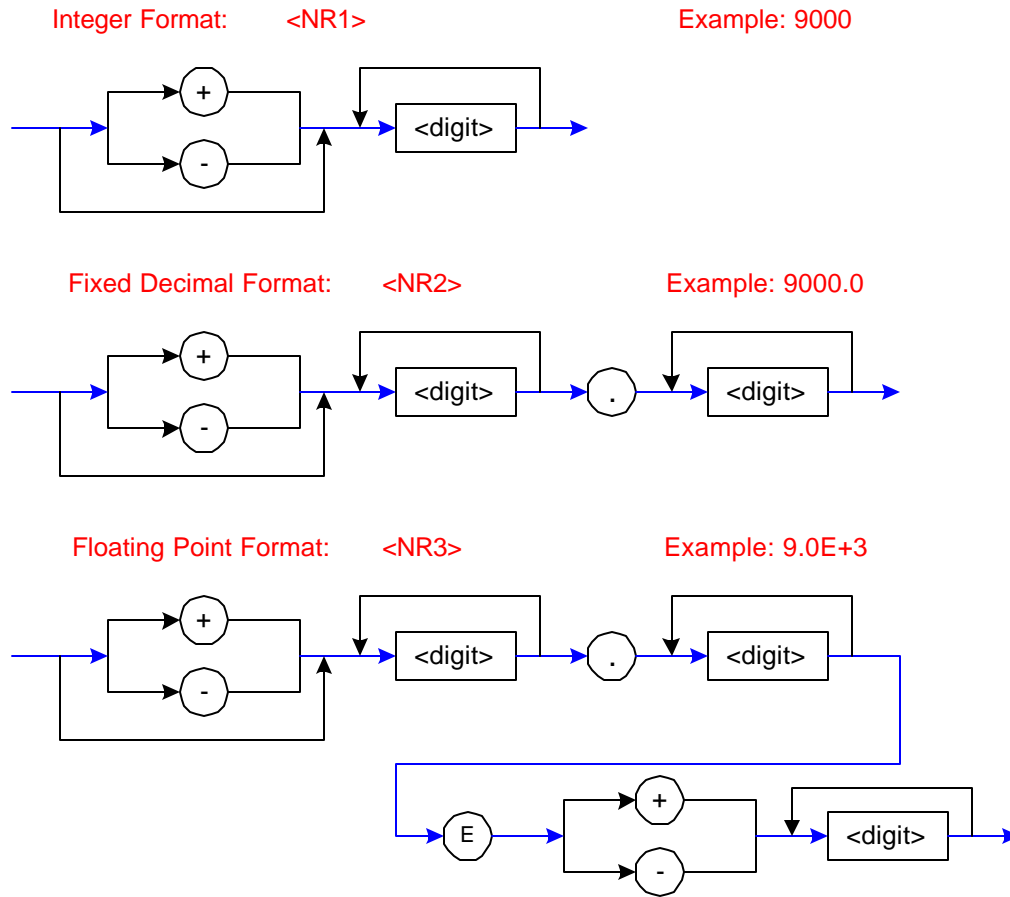


Figure 3-3: Numerical Data Transfer

#### 3.1.5.1 ABORt

Instruction: ABORt  
Parameter: None  
Return Value: None  
Function: Terminate Trigger in process. Reset Trigger.

### 3.1.5.2 CALCulate1:FORMat

Instruction: CALCulate1:FORMat  
Parameter: {REAL | MLINear | CP | CS | LP | LS | ZS | RS | RP}  
Return Value: {REAL | MLINear | CP | CS | LP | LS | ZS | RS | RP}  
Function: Set or Query the primary measurement parameter.  
Description: REAL Impedance, Real  
MLINear Impedance, absolute value  
CP Equivalent parallel capacitance  
CS Equivalent series capacitance  
LP Equivalent parallel inductance  
LS Equivalent series inductance  
ZS Equivalent series impedance  
RS Equivalent series resistance  
RP Equivalent parallel resistance

### 3.1.5.3 CALCulate2:FORMat

Instruction: CALCulate2:FORMat  
Parameter: {IMAGinary | PHASe | D | Q | REAL | RS | XS}  
Return Value: {IMAGinary | PHASe | D | Q | REAL | RS | XS}  
Function: Set or Query the secondary measurement parameter.  
Description: IMAGinary Impedance, Imaginary  
PHASe Phase angle  
D Dissipation factor  
Q Quality factor  
REAL Impedance, Real  
RS Equivalent series resistance  
XS Equivalent series reactance (imaginary)

### 3.1.5.4 CALCulate{1|2}:LIMit:BEEPer:CONDition

Instruction: CALCulate{1 | 2}:LIMit:BEEPer:CONDition  
Parameter: {FAIL | PASS}  
Return Value: None  
Function: Set condition upon which Beeper sounds.  
Description: FAIL Beeper sounds when comparison result is a FAIL  
PASS Beeper sounds when comparison result is a PASS

### 3.1.5.5 CALCulate{1|2}:LIMit:BEEPer

Instruction: CALCulate{1 | 2}:LIMit:BEEPer  
Parameter: {OFF (0) | LOW (1) | HIGH (2)}  
Return Value: {0 | 1 | 2}  
Function: Set or query if beeper is ON or OFF.  
Description: (0) Turn off Beeper  
(1) Turn on Beeper (LOW)  
(2) Turn on Beeper (HIGH)

### 3.1.5.6 CALCulate{1|2}:LIMit:LOWer[:DATA]

Instruction: CALCulate{1 | 2}:LIMit:LOWer[:DATA]  
Parameter: {The lower limit value | MAXimum | MINimum}  
Return Value: The lower limit value, the format is <NR3> (Floating point)  
Function: Set or query the lower limit value.  
Description: MINimum -9.999E14  
MAXimum 9.999E14

### 3.1.5.7 CALCulate{1|2}:LIMit:STATe

Instruction: CALCulate{1 | 2}:LIMit:STATe  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if the Compare function is ON or OFF.  
Description: ON (1) Turn on Compare function  
OFF (0) Turn off Compare function

### 3.1.5.8 CALCulate{1|2}:LIMit:UPPer[:DATA]

Instruction: CALCulate{1 | 2}:LIMit:UPPer[:DATA]  
Parameter: {The upper limit value | MAXimum | MINimum}  
Return Value: The upper limit value, the format is <NR3> (Floating point)  
Function: Set or query the upper limit value.  
Description: MINimum -9.999E14  
MAXimum 9.999E14

### 3.1.5.9 CALCulate{1|2}:MATH:EXPRession:CATalog

Instruction: CALCulate{1 | 2}:MATH:EXPRession:CATalog  
Parameter: None  
Return Value: Bias absolute value (DEV) or percent value (PCNT)  
Function: Send back the parameter to use with  
CALCulate{1 | 2}:MATH:EXPRession:NAME

### 3.1.5.10 CALCulate{1|2}:MATH:EXPRession:NAME

Instruction: CALCulate{1 | 2}: MATH:EXPRession:NAME  
Parameter: {DEV | PCNT}  
Return Value: {DEV | PCNT}  
Function: Set the Compare function value to deviation or percent deviation.

### 3.1.5.11 CALCulate{1|2}:MATH:STATe

Instruction: CALCulate{1 | 2}:MATH:STATe  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if CALCulate{1 | 2}: MATH:EXPRession:NAME is ON or OFF.  
Description: ON (1) Turn on CALCulate{1 | 2}: MATH:EXPRession:NAME  
OFF (0) Turn off CALCulate{1 | 2}: MATH:EXPRession:NAME

### 3.1.5.12 CALCulate{1|2}: PATH?

Instruction: CALCulate{1 | 2}: PATH?  
Parameter: None  
Return Value: FORM, MATH, LIM  
Function: Send back CALCulate subsystem according to performance sequence of CALCulate subsystem.

### 3.1.5.13 CALCulate{3|4}:MATH:STATe

Instruction: CALCulate{3 | 4}:MATH:STATe  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if VM/IM function is ON or OFF.  
Description: CALCulate3 Set current value (IM)  
CALCulate4 Set voltage value (VM)  
ON (1) Turn on VM/IM function  
OFF (0) Turn off VM/IM

### 3.1.5.14 CALibration:CABLe

Instruction: CALibration:CABLe  
Parameter: {0 – 4 meters}  
Return Value: {0 | 1 | 2 | 4}  
Function: Set the test cable length.

**NOTE:**

CALC1 refers to primary parameter, CALC2 to secondary parameter.



### 3.1.5.15 :DATA[:DATA]

Instruction: :DATA[:DATA]  
Parameter: {REF1 | REF2}  
Return Value: The nominal value in <NR3> format (-9.999E14 to 9.999E14)  
Function: Set the Primary or Secondary nominal value.  
Description: REF1 Nominal value of primary parameter  
REF2 Nominal value of secondary parameter

### 3.1.5.16 DISPlay[:WINDow][:STATe]

Instruction: DISPlay[:WINDow][:STATe]  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if the LCD display is ON or OFF.

### 3.1.5.17 DISPlay[:WINDow] :TEXT1:PAGE

Instruction: DISPlay[:WINDow]:TEXT1:PAGE  
Parameter: {1 | 2}  
Return Value: {1 | 2}  
Function: Set or query which screen is shown.  
Description: 1 Measuring screen  
2 Comparison screen

### 3.1.5.18 DISPlay[:WINDow]:TEXT2:PAGE

Instruction: DISPlay[:WINDow]:TEXT2:PAGE  
Parameter: {1 | 2 | 3}  
Return Value: {1 | 2 | 3}  
Function: Set or query which page of MEAS DISPLAY is shown.  
Description: 1 Page 1 of MEAS DISPLAY (Freq, Level, Parameter)  
2 Page 2 of MEAS DISPLAY (Range, Speed, Trigger)  
3 Page 3 of MEAS DISPLAY (Bias, Binning, Compare)

### 3.1.5.19 FETCh?

Instruction: FETCh?  
Parameter: None  
Return Value: <STATE>, <DAT1>, <DAT2>, <CMP1>, <CMP2>  
Function: Get the result from the INITiate function.  
Description: <STATE> Measuring status  
1 Normal  
2 Overload  
3 DUT disconnected  
<DAT1> test value of primary parameter  
<DAT2> test value of secondary parameter  
When the Compare function is enabled, results are:  
<CMP1> comparison value of primary parameter  
<CMP2> comparison value of secondary parameter  
0 No secondary parameter  
1 Test value in range  
2 Test value too high  
4 Test value too low  
8 DUT disconnected

**NOTE:**

Use the \*TRG command to initiate a measurement and get the data back in a single command.

### 3.1.5.20 FORMat[:DATA]

Instruction: FORMat[:DATA]  
Parameter: {ASCII}  
Return Value: ASK  
Function: Set or query the format of the numerical data being transferred.

### 3.1.5.21 INITiate[:IMMEDIATE]

Instruction: INITiate[:IMMEDIATE]  
Parameter: None  
Return Value: None  
Function: Immediately initiate all sequences.

### 3.1.5.22 INITiate:CONTInuous

Instruction: INITiate:CONTInuous  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if the Trigger is ON or OFF.  
Description: ON (1) Turn on Trigger  
OFF (0) Turn off Trigger

### 3.1.5.23 [SENSe]:AVERAge:COUNT

Instruction: [SENSe]:AVERAge:COUNT  
Parameter: {1 ~ 256}  
Return Value: {1 ~ 256}  
Function: Set or query the averaging number.

### 3.1.5.24 [SENSe]:CORRection:COLLect[:ACQuire]:STANdard

Instruction: [SENSe]:CORRection:COLLect[:ACQuire]:STANdard  
Parameter: {1 | 2}  
Return Value: None  
Function: Perform OPEN or SHORT correction procedure.  
Description: 1 Perform OPEN correction procedure  
2 Perform SHORT correction procedure  
Open Example: SENSe:CORR:COLL:STAN1

### 3.1.5.25 [SENSe]:CORRection:COLLect:METhod

Instruction: [SENSe]:CORRection:COLLect:METhod  
Parameter: {REFL2}  
Return Value: {REFL2}  
Function: Set or query the measured tolerance's correction procedure.  
Description: REFL2 OPEN/SHORT correction procedure

### 3.1.5.26 [SENSe]:CORRection:DATA?STANdard

Instruction: [SENSe]:CORRection:DATA?STANdard  
Parameter: {1 | 2}  
Return Value: Two numerical correction values in <NR3> format  
Function: Query the numerical correction value.  
Description: STANdard 1 OPEN correction value: G, B  
STANdard 2 SHORT correction value: R, X

### 3.1.5.27 [SENSe]:FIMPedance:APERature

Instruction: [SENSe]:FIMPedance:APERature  
Parameter: 0.025 (Fast), 0.065 (Medium), 0.500 (Slow)  
Return Value: 0.025 (Fast), 0.065 (Medium), 0.500 (Slow)  
Function: Set or query the measurement speed.

### 3.1.5.28 [:SENSe]:FIMPedance:RANGe:AUTO

Instruction: [:SENSe]:FIMPedance:RANGe:AUTO  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if the Auto Range is ON or OFF.  
Description: ON (1) Turn on Auto Range  
OFF (0) Turn off Auto Range

### 3.1.5.29 [:SENSe]:FIMPedance:RANGe[:UPPer]

Instruction: [:SENSe]:FIMPedance:RANGe[:UPPer]  
Parameter: {Measured value range | UP | DOWN}  
Unit: [MOHM | KOHM | OHM | MOHM], default is OHM  
Return Value: {Measured value range} in <NR3> format  
Function: Set or query which Measurement Range is enabled.  
Description: UP Go to previous range  
DOWN Go to next range  
Range Values: 1M $\Omega$ , 300k $\Omega$ , 100k $\Omega$ , 30k $\Omega$ , 10k $\Omega$ , 3k $\Omega$ , 1k $\Omega$ , 300 $\Omega$ , 100 $\Omega$ , 10 $\Omega$ , 1 $\Omega$ , 0.1 $\Omega$ .

Note: When CONST Rsource is OFF, 300k $\Omega$ , 30k $\Omega$ , 3k $\Omega$  and 300 $\Omega$  are disabled.  
When Test Frequency is set to 100Hz or 120Hz, 0.1 $\Omega$  is disabled.

### 3.1.5.30 [:SENSe]:FUNCTION[:ON]

Instruction: [:SENSe]:FUNCTION[:ON]  
Parameter: {FIMPedance | FADMITTANCE}  
Return Value: {FIMPedance | FADMITTANCE}  
Function: Set or query the equivalent circuit measurement mode.  
Description: FIMPedance Series equivalent circuit  
FADMittance Parallel equivalent circuit

### 3.1.5.31 SOURce:FREQuency[:CW]

Instruction: SOURce:FREQuency[:CW]  
Parameter: Test Frequency  
Unit: [Hz | kHz], default is Hz  
Return Value: {Test Frequency} in <NR3> format  
Function: Set or query the test frequency.  
Range Values: 100Hz, 120Hz, 1kHz, 10kHz, 20kHz, 50kHz and 100kHz

### 3.1.5.32 SOURce:VOLTage[:LEVel][:IMMediate][AMPLitude]

Instruction: SOURce:VOLTage[:LEVel][:IMMediate][AMPLitude]  
Parameter: Test Voltage  
Return Value: {Test Voltage} in <NR3> format  
Function: Set or query the test voltage.  
Range Values: 0.02 ~ 1Vrms, Resolution is 10mV

### 3.1.5.33 SOURce:VOLTage[:LEVel][:IMMediate]:OFFSet:STATe

Instruction: SOURce:VOLTage[:LEVel][:IMMediate]:OFFSet:STATe  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Enable/Disable the DC bias voltage function.  
Description: ON (1) Enable bias voltage  
OFF (0) Disable bias voltage

### 3.1.5.34 SYSTem:ALARm

Instruction: SYSTem:ALARm  
Parameter: {PULSe | CONTInuous}  
Return Value: {PULSe | CONTInuous}  
Function: Set the mode the alarm will sound in.

### 3.1.5.35 SYSTem:BEEPer:STATe

Instruction: SYSTem:BEEPer:STATe  
Parameter: {OFF (0) | ON, LOW (1) | ON, HIGH (2)}  
Return Value: {0 | 1 | 2}  
Function: Set the loudness of the beeper.

### 3.1.5.36 SYSTem:CONSt

Instruction: SYSTem:CONSt  
Parameter: Constant Source Resistance  
Return Value: {100/25 | 100 | 25 | 10c}  
Function: Set the constant source resistance.

### 3.1.5.37 SYSTem:ERRor?

Instruction: SYSTem:ERRor?  
Parameter: None  
Return Value: Error message  
Function: Query if there are any system errors.

### 3.1.5.38 SYSTem:HANDler

Instruction: SYSTem:HANDler  
Parameter: {CLEAR | HOLD}  
Return Value: {CLEAR | HOLD}  
Function: Set the Handler to clear result or hold result for each test.

### 3.1.5.39 SYSTem:INTEgration

Instruction: SYSTem:INTEgration  
Parameter: {0 - 8}  
Return Value: {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8}  
Function: Set the integer cycle (# of sine waves integrated together per measurement).

### 3.1.5.40 SYSTem:KLOCK

Instruction: SYSTem:KLOCK  
Parameter: {ON (1) | OFF (0)}  
Return Value: {1 | 0}  
Function: Set or query if the Key Lock function is ON or OFF.  
Description: ON (1) Turn on Key Lock  
OFF (0) Turn off Key Lock

### 3.1.5.41 SYSTem:PRESet

Instruction: SYSTem:PRESet  
Parameter: None  
Return Value: None  
Function: Set the instrument to initial default values.

### 3.1.5.42 YSTem:VERSion

Instruction: YSTem:VERSion  
Parameter: None  
Return Value: None  
Function: Set the instrument software version and date.

### 3.1.5.43 TRIGer:DELay

Instruction: TRIGer:DELay  
Parameter: Trigger Delay Time  
Unit: [MS | S], default is S  
Return Value: {Trigger Delay Time} in <NR3> format  
Function: Set or query the trigger delay time.  
Range Values: 0 ~ 9999ms

### 3.1.5.44 TRIGger:[IMMediate]

Instruction: TRIGger:[IMMediate]  
Parameter: None  
Return Value: None  
Function: Set the instrument to trigger immediately.

### 3.1.5.45 TRIGger:SOURce

Instruction: TRIGger:SOURce  
Parameter: {BUS | EXTernal | INTernal | MANual}  
Return Value: {BUS | EXTernal | INTernal | MANual}  
Function: Set or query the trigger mode.  
Description: BUS Bus trigger  
EXTernal External trigger  
INTernal Internal trigger  
MANual Manual trigger

### 3.1.6 Binning Example

Here is an example to program the bin limits for a binning operation. In this example Bin1 has a high/low limit of  $\pm 1.2\%$ . Bin2 has a high/low limit of  $\pm 2.2\%$ . Both nested around the nominal value of  $100\text{m}\Omega$ .

**Note:**

The Bin function is turned on **after** the bin limits are set.

:BINning:NOMInal 100e3;	Sets the nominal value to 100m
:BINning:UPPer:AUX 1;	Sets the AUX-HI limit value to 1
:BINning:LOWer:AUX 0;	Sets the AUX_LO limit value to 0
:BINning:UPPer:BIN1,+1.2;	Sets the Bin1 HI limit value to +1.2%
:BINning:LOWer:BIN1,-1.2;	Sets the Bin1 LO limit value to -1.2%
:BINning:UPPer:BIN2,+2.2;	Sets the Bin2 HI limit value to +2.2%
:BINning:LOWer:BIN2,-2.2;	Sets the Bin2 LO limit value to -2.2%
:BINning:STATe ON;	Enables Binning function
:BINning:RESUlt?	Query the Binning result

### Results

+0	Binning result is Bin0 = Secondary parameter failed
+1 - +8	Binning result is Bin1 to Bin8 = Primary and secondary parameters pass (within the limits set for bins 1-8).
+9	Binning result is Bin9 = Secondary pass, primary fail

### 3.1.7 Compare Example

Here is an example to program the nominal, high and low limits for a compare operation. In this example the 1730 instrument is programmed with the primary parameter Rs and the secondary parameter Q at 1kHz and 1V. The auto range is OFF and the 100Ω Range is selected. The primary nominal value is set to 24.9Ω, the primary low limit is set to 20Ω and the primary high limit is set to 30Ω. The Compare display selected is “ON-VAL”. **Note:** the Compare function is turned on **after** the limits are set.

```
NI = 0
datakeep$ = "no"
passall$ = "yes"
If NI = 1 Then
Open "gpib0" For Output As #1
Open "gpib0" For Input As #2
Print #1, "ABORT"
Print #1, "RESET"
Print #1, "gpibeos lf"
Else
Open "\dev\ieeeeout" For Output As #1
IOCTL #1, "BREAK"
Print #1, "RESET"
Open "\dev\ieeeein" For Input As #2
Print #1, "TERM LF"
End If
K2 = 1000
fr = 100000
cmdl$ = "C"

Print #1, "output 17; TRIG:SOUR ext"
For G = 1 To k2: Next G
Print #1, "output 17; :SOUR:FREQ "; 1000
For G = 1 To k2: Next G
Print #1, "output 17; :SENS:FIMP:APER 0.500"
For G = 1 To k2: Next G
Print #1, "output 17; :SOUR:VOLT 1e0"
For G = 1 To k2: Next G
Print #1, "output 17; :CAL:CABL 1"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC2:FORM Q"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC1:FORM RS"
For G = 1 To k2: Next G
Rem now for bin limits
Print #1, "output 17; :data ref1,24.9;"
For G = 1 To k2: Next G
Print #1, "output 17; :sens:fimp:rang:auto off"
For G = 1 To k2: Next G
Print #1, "output 17; :sens:fimp:rang 100"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC1:lim:lower 20"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC1:lim:upper 30"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC1:lim:state on"
For G = 1 To k2: Next G
Print #1, "output 17; :CALC1:math:state on"
For G = 1 To k2: Next G
Print #1, "output 17; :disp:wind:text1:page2"
For G = 1 To k2: Next G
```



### 3.1.8 Sample IEEE-488 Basic Program

Included herein is a sample Basic program.

**NOTE:**

Refer to: <http://www.quadtech.com> for the latest sample programs that may be available.

```
NI = 0
IF NI = 1 THEN
OPEN "gpib0" FOR OUTPUT AS #1
OPEN "gpib0" FOR INPUT AS #2
PRINT #1, "ABORT"
PRINT #1, "RESET"
PRINT #1, "gpibeos lf"
ELSE
OPEN "\dev\ieeeeout" FOR OUTPUT AS #1
IOCTL #1, "BREAK"
PRINT #1, "RESET"
OPEN "\dev\ieeeein" FOR INPUT AS #2
PRINT #1, "TERM LF"
END IF

k2 = 1000
fr = 100000
cmdl$ = "C"

Print "Configuring the 1730"

PRINT #1, "output 17; TRIG:SOUR BUS"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :SOUR:FREQ "; fr
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :SENS:FIMP:APER 0.500"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :SOUR:VOLT 1e0"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :CAL:CABL 1"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :FIMP:RANG:AUTO ON"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :CALC1:FORM REAL"
FOR g = 1 TO k2: NEXT g
PRINT #1, "output 17; :CALC2:FORM IMAG"
FOR g = 1 TO k2: NEXT g

IF cmdl$ = "C" THEN
PRINT #1, "output 17; :CALC2:FORM D"
PRINT #1, "output 17; :CALC1:FORM CP"
ELSEIF cmdl$ = "R" THEN
PRINT #1, "output 17; :CALC2:FORM Q"
PRINT #1, "output 17; :CALC1:FORM RS"
ELSEIF cmdl$ = "L" THEN
PRINT #1, "output 17; :CALC1:FORM LS"
PRINT #1, "output 17; :CALC2:FORM Q"
END IF

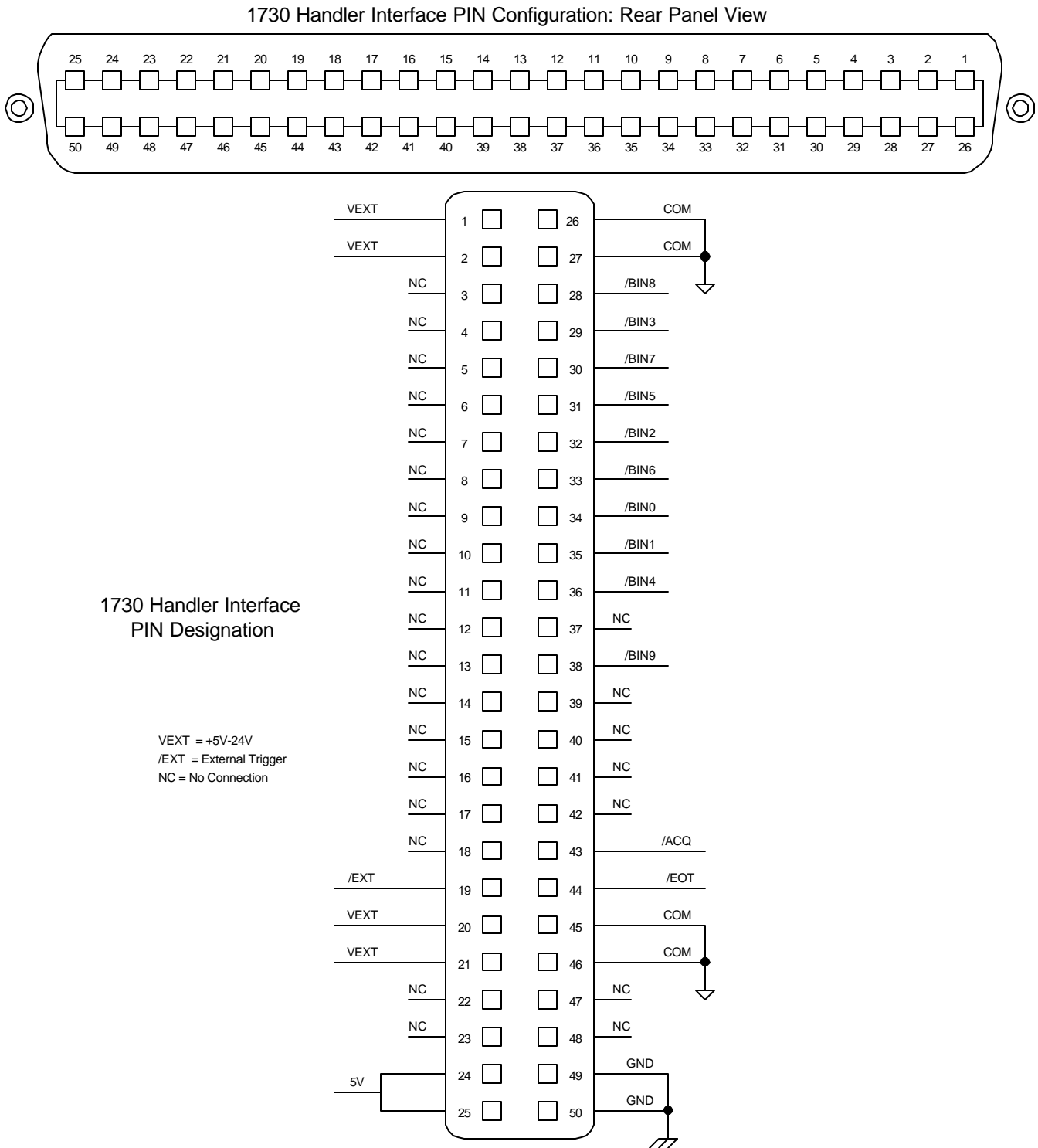
PRINT #1, "output 17;*TRG"
FOR g = 1 TO k2: NEXT g
PRINT #1, "enter 17"
REM get and parse return data

INPUT #2, s1$
INPUT #2, f3$
INPUT #2, f6$

PRINT "Data is:",s1$,f3$,f6$
```

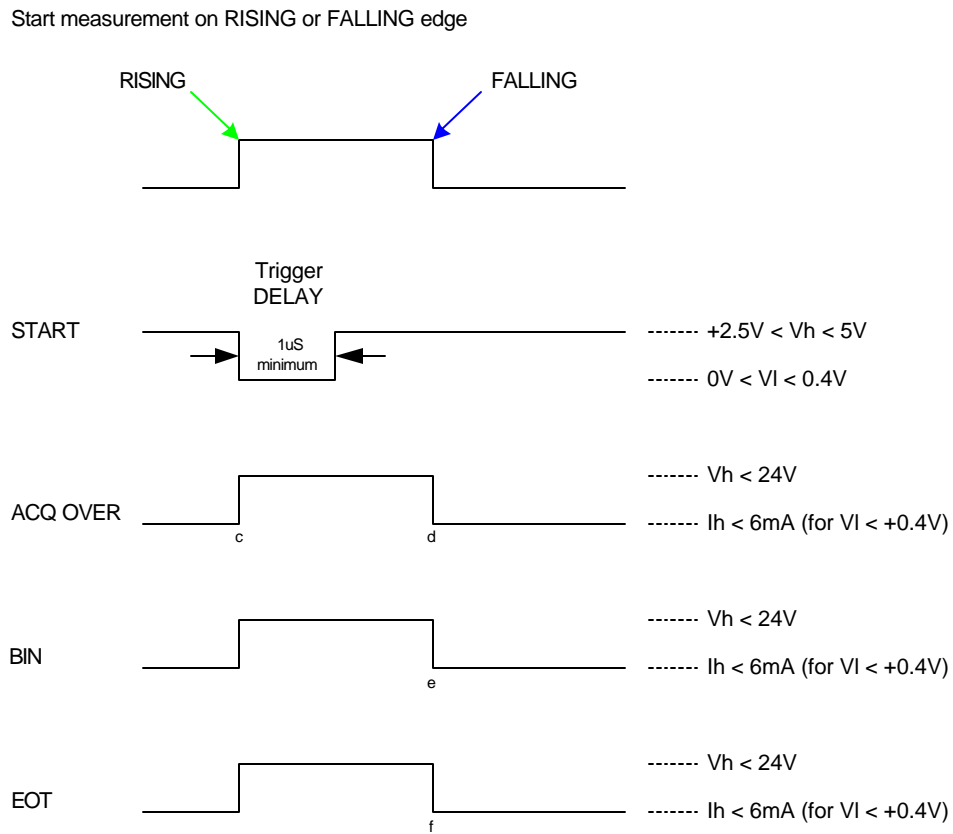
### 3.2 Handler Interface

The 1730 instrument comes standard with a Handler interface as illustrated in Figure 3-4. Connection is through the blue 50-pin connector on the rear panel of the 1730 instrument.



**Figure 3-4: Handler Interface Pin Configuration**

Paragraph 2.3.16 contains the instructions for changing the Handler mode. Paragraphs 2.3.3 and 2.3.4 contain instructions for setting the Trigger Delay time and selecting the Trigger Edge. Figure 3-5 illustrates the Trigger function.

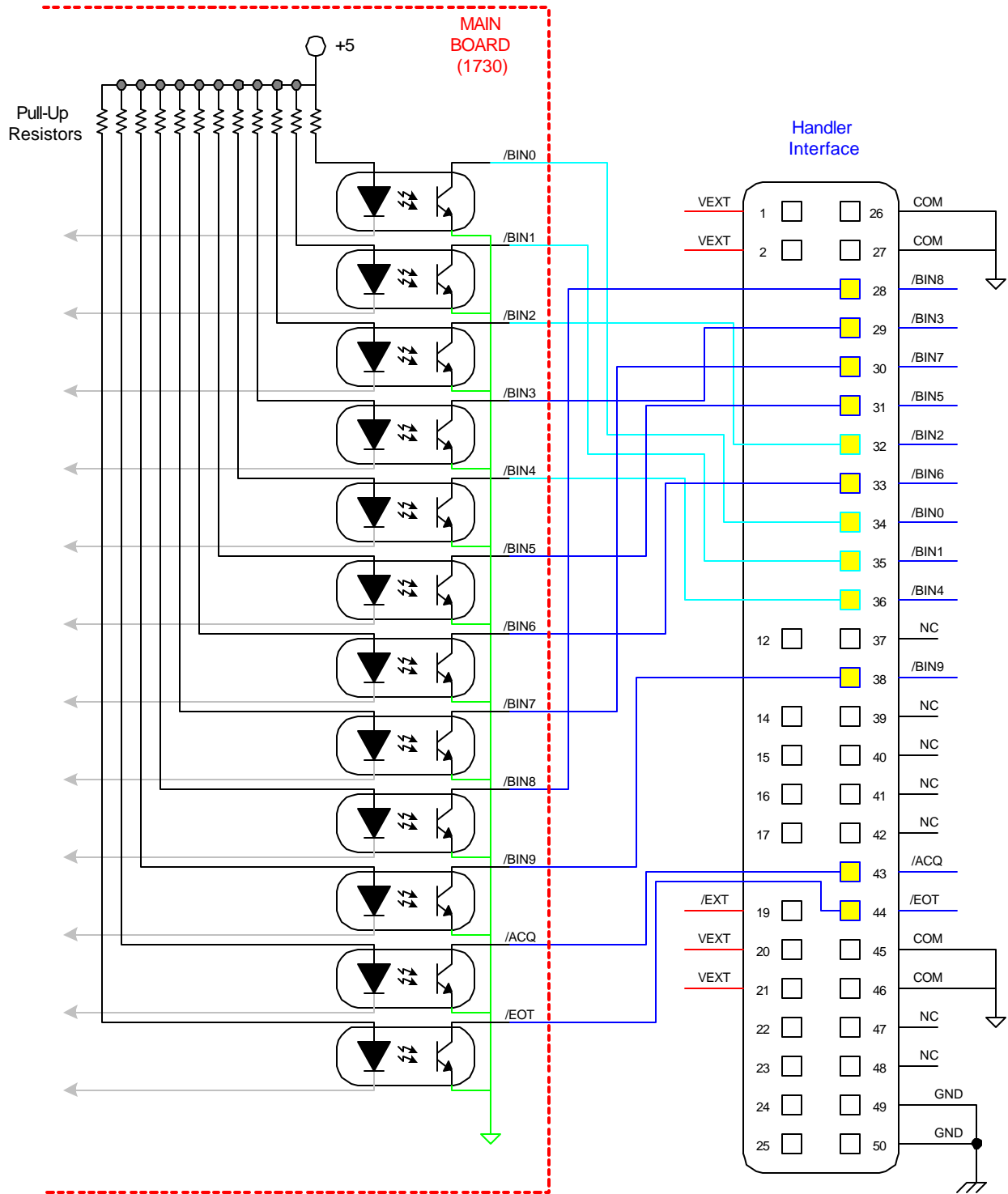


**Figure 3-5: Trigger**

## Output Signals

The output lines of the 1730 Handler interface are open collector drivers that pull each signal line to a low voltage, signal ground when the signal is active (true). Each external line should be pulled up (with a resistor) to a positive voltage between 5V and 24V. The pull-up resistor must limit the current to < 6mA for a signal of a comparison function and to < 5mA for a control signal (EOT).

Figure 3-6 illustrates the connection of the handler interface to the main board on the 1730.



**Figure 3-6: Connection of 1730 Handler Interface to Main Board**

## Input Signal

The input signal to the 1730 Handler interface is active low and requires a positive external voltage to pull the signal down below 0.4V, ground. The connection of pin 19 (/EXT), the external trigger input signal, is illustrated in Figure 3-7.

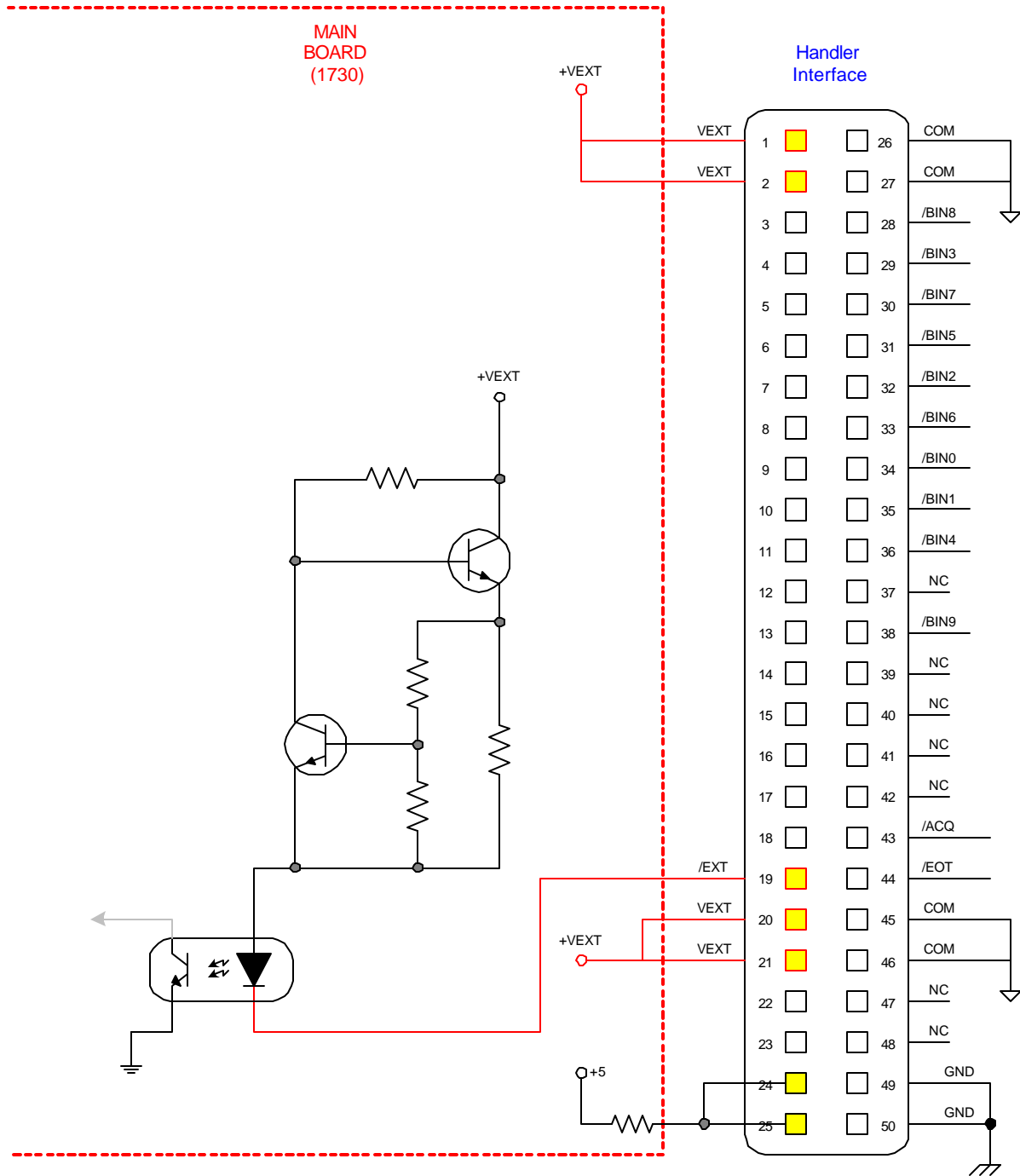
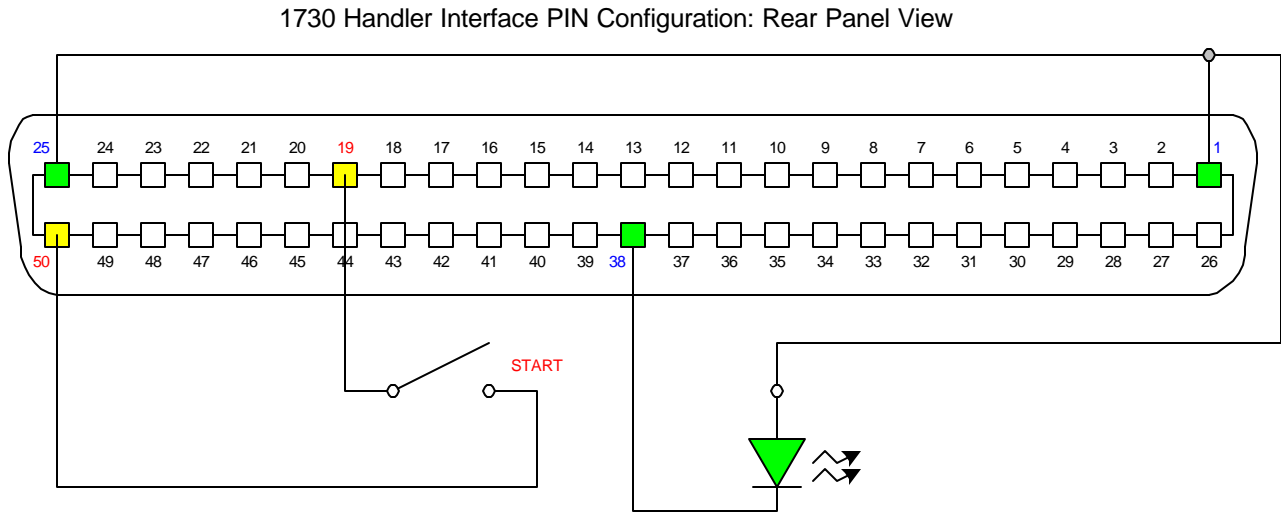


Figure 3-7: Input Signals

A basic example of an external trigger (START) connection is illustrated in Figure 3-8. A switch is inserted between pins 19 and 50. A green LED is connected between pins 1, 25 and 38.



**Figure 3-8: Sample External Trigger Connection**

### 3.2.1 Handler Pin Assignments for Binning Operation

Table 3-6 lists the pin assignments when the handler interface on the 1730 instrument is performing a Binning operation. The device under test is sorted by test value. The test limits can be set as absolute value or percent value.

**Table 3-6: Handler Pin Assignments for Binning**

<b>Pin</b>	<b>Name</b>	<b>Description</b>
1 – 2	VEXT	External DC voltage: 5V ~ 24V
3 – 18	X	No connection
19	/EXT	External trigger
20 – 21	VEXT	External DC voltage: 5V ~ 24V
22 – 25	X	No connection
26 – 27	COM	Common Ground
28	BIN 8	Primary parameter pass (within Bin 8 limits)
29	BIN 3	Primary parameter pass (within Bin 3 limits)
30	BIN 7	Primary parameter pass (within Bin 7 limits)
31	BIN 5	Primary parameter pass (within Bin 5 limits)
32	BIN 2	Primary parameter pass (within Bin 2 limits)
33	BIN 6	Primary parameter pass (within Bin 6 limits)
34	BIN 0	Secondary parameter fail
35	BIN 1	Primary parameter pass (within Bin 1 limits)
36	BIN 4	Primary parameter pass (within Bin 4 limits)
37	X	No connection
38	BIN 9	Primary parameter pass
39 – 42	X	No connection
43	ACQ	Received data, ready to accept next
44	EOT	End of Test
45 – 46	COM	Common Ground
47 – 48	X	No connection
49 – 50	GND	Chassis Ground

### 3.2.2 Handler Pin Assignments for Compare Operation

Table 3-7 lists the pin assignments when the handler interface on the 1730 instrument is performing a Compare operation. The device under test is being compared against a standard of known value. High and low limits can be defined as absolute value or percent value.

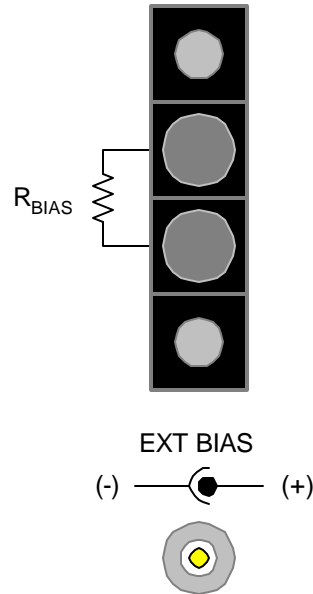
**Table 3-7: Handler Pin Assignments for Compare**

<b>Pin</b>	<b>Name</b>	<b>Description</b>
1 – 2	VEXT	External DC voltage: 5V ~ 24V
3 – 18	X	No connection
19	/EXT	External trigger
20 – 21	VEXT	External DC voltage: 5V ~ 24V
22 – 25	X	No connection
26 – 27	COM	Common Ground
28	A HI	Primary parameter fail high (test value above high limit)
29	A GO	Primary parameter pass (test value within limits)
30	A LO	Primary parameter fail low (test value below low limit)
31	B HI	Secondary parameter fail high (test value above high limit)
32	B GO	Secondary parameter pass (test value within limits)
33	B LO	Secondary parameter fail low (test value below low limit)
34	B NG	Secondary parameter fail (No Good)
35	GO	
36 – 37	X	No connection
38	A NG	Primary parameter fail (No Good)
39 – 42	X	No connection
43	ACQ	Received data, ready to accept next
44	EOT	End of Test
45 – 46	COM	Common Ground
47 – 48	X	No connection
49 – 50	GND	Chassis Ground



### 3.3 Bias Voltage

Figure 3-9 illustrates the two connectors on the rear panel of the 1730 instrument used for bias voltage (or current) applications. The  $R_{BIAS}$  connector is a black 4-screw terminal strip with two screws active. The EXT BIAS connector is a silver BNC terminal.



**Figure 3-9: Bias Voltage Connectors**

A fixed resistor or potentiometer can be connected to  $R_{BIAS}$  to provide an internal bias voltage or current to the device under test (DUT). In [MEAS DISPLAY] select Bias Voltage = ON. The value of the resistor placed across the  $R_{BIAS}$  terminals determines the bias voltage output. The  $R_{BIAS}$  output can range from 0V – 5V. The polarity is always positive.

The bias voltage output is determined by the formula:

$$\text{BIAS Voltage} = \frac{5.0V}{[R_{BIAS} (\text{k}\Omega)] + 1}$$

For example, a fixed resistor value of 4k $\Omega$  would provide a 1.0V bias voltage output.

$$\text{BIAS Voltage} = \frac{5.0V}{[4.0 (\text{k}\Omega)] + 1} = 1.0V$$

$R_{BIAS}$  can also be used as a bias current source. The output current is determined by the resistor value and the selected source impedance value with a maximum bias current equal to 200mA and a compliance voltage of 5.0V.

Use the EXT BIAS BNC connector if an external power supply is to be used rather than  $R_{BIAS}$ .

**NOTE:**

To prevent damage to the 1730 instrument, do **not** use the  $R_{BIAS}$  resistor if the EXT BIAS connector is used.



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## Section 4: Service & Calibration

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### 4.1 General

Our warranty (at the front of this manual) attests to the quality of materials and workmanship in our products. If malfunction should be suspected, or other information desired, applications engineers are available for technical assistance. Applications assistance is available in the U.S. by calling (978) 461-2100 and asking for Applications Support. For support outside of the United States please contact your local QuadTech Distributor.

### 4.2 Instrument Return

Before returning an instrument to QuadTech for service please call our **Customer Care Center (CCC)** at **800-253-1230** for Return Material Authorization (RMA). It will be necessary to include a Purchase Order Number to insure expedient processing, although units found to be in warranty will be repaired at no-charge. For any questions on repair costs or shipping instructions please contact our CCC Department at the afore-mentioned number. To safeguard an instrument during storage and shipping, please use packaging that is adequate to protect it from damage, i.e. equivalent to the original packaging, and mark the box "Delicate Electronic Instrument". Return material should be sent freight prepaid to:

**QuadTech, Inc.**  
**5 Clock Tower Place, 210 East**  
**Maynard, Massachusetts 01754**

**Attention: RMA#**

**Shipments sent collect cannot be accepted.**

### 4.3 Calibration

Calibration of the 1730 LCR Digibridge instruments is completed at the factory and includes a NIST calibration certificate. Verification of instrument operation and accuracy is recommended on an annual basis. Accurate operation of the 1730 instrument is confirmed using the 1730-TP Verification Procedure.

### 4.3.1 1730 Verification Procedure

This section outlines the relevant information to verify performance of the 1730 LCR Meter. It is recommended that performance be performed at least once a year using this outline procedure.

Instrument should be warmed up for a minimum of 15 minutes prior to verification. Verification should be performed under the following conditions: Temperature equal to  $23^{\circ}\text{C} \pm 1.2^{\circ}\text{C}$  and Relative Humidity (RH) between 35% and 55%.

Recommended standards are listed below. All standards should be traceable to a National Laboratory such as N.I.S.T. with calibrated values for primary and secondary parameters at the required test frequencies. QuadTech's verification conforms to ANSI Z540 and QuadTech recommends that the calibrated values for the primary and secondary standards have an uncertainty 4 times better than the primary and secondary accuracy specified in the Verification Data Sheet. If the calibrated values for the standards used do not have an uncertainty of 4 times better than the specified accuracy of the 1730 the uncertainty of the standard should be added to the specified accuracy of the 1730. For example: if the calibrated value of the  $500\text{m}\Omega$  standard is  $495.0\text{m}\Omega \pm 1\%$  at 100Hz, the expected reading on the 1730 would be  $495.0\text{ m}\Omega \pm 1.7\%$  (1% for the standard accuracy plus 0.7% for the 1730 accuracy). This also applies for secondary parameters as well.

Primary and secondary accuracy specifications given in the Verification Data Sheet are based upon the accuracy formulas in section 2.4.5 of this manual.

#### Measurement Standards

##### Inductance Standards 4 Terminal

Inductor	10 $\mu\text{H}$ (nominal value)
Inductor	100 $\mu\text{H}$ (nominal value)
Inductor	1000 $\mu\text{H}$ (nominal value)

##### Standard Open and Short

##### Resistance Standards 4 Terminal

Resistor	95K ohm (nominal value)
Resistor	6K ohm (nominal value)
Resistor	374 ohm (nominal value)
Resistor	25 ohm (nominal value)
Resistor	5 ohm (nominal value)
Resistor	500m ohm (nominal value)

##### Capacitance Standards 2 or 4 Terminal

Capacitor	50pF (nominal value)
Capacitor	100pF (nominal value)
Capacitor	200pF (nominal value)
Capacitor	500pF (nominal value)
Capacitor	1000pF (nominal value)
Capacitor	0.1 $\mu\text{F}$ (nominal value)
Capacitor	0.05 $\mu\text{F}$ (nominal value)
Capacitor	0.02 $\mu\text{F}$ (nominal value)
Capacitor	0.01 $\mu\text{F}$ (nominal value)
Capacitor	0.005 $\mu\text{F}$ (nominal value)
Capacitor	0.002 $\mu\text{F}$ (nominal value)

## Measurement Procedure

The 1730 should be set to the following:

**[SYSTEM SETUP] [SYSTEM CONFIG]**

Integration Cycle = 4

Average = 1

Cable Length = 1M

Const Rsource = 25ohms

**[MEAS DISPLAY]**

Range: = Auto

Level: 1Volt

Speed: = Slow

Trigger = Manual

BiasV = Off

Binning = Off

Compare = Off

Connections to all standards should be via a 1-meter cable.

A multiple frequency open and short correct should be performed prior to any measurements. See paragraph 2.5.5 for information on performing an open and short correction.

Connect each standard listed in the Verification Data Sheet and select the test frequency in the [MEAS DISPLAY] menu of the 1730. Record the results in the Verification Data Sheet.

### 4.3.2 1730 Verification Data Sheet

#### R500M

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.70%	0.0070
1000			1			0.25%	0.0025
10000			1			0.30%	0.0030
100000			1			0.90%	0.0091

#### R25

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.25%	0.0035
1000			1			0.24%	0.0016
10000			1			0.26%	0.0016
100000			1			0.50%	0.0035

#### R374

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0035
1000			1			0.10%	0.0009
10000			1			0.20%	0.0012
100000			1			0.45%	0.0035

#### R6K

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0020
1000			1			0.10%	0.0010
10000			1			0.45%	0.0045
100000			1			0.70%	0.0071

#### R95.3K

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0020
1000			1			0.12%	0.0012
10000			1			0.50%	0.0051
100000			1			2.00%	0.0213

#### L10uH

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
1000			1			0.36%	0.1405
10000			1			0.30%	4.5965
100000			1			0.60%	70.4830

#### L100uH

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
1000			1			0.50%	0.0652
10000			1			0.35%	1.6276
20000			1			0.36%	5.4100
100000			1			0.50%	102.9650

**L1000uH**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			3.68%	0.0300
1000			1			0.41%	0.2781
10000			1			0.26%	8.9862
100000			1			0.45%	74.8312

**C50pF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
1000			1			0.35%	0.0040
10000			1			0.50%	0.0072
100000			1			2.00%	0.0483

**C100pF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
1000			1			0.35%	0.0040
10000			1			0.50%	0.0072
100000			1			2.00%	0.0483

**C200pF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.35%	0.0037
1000			1			0.16%	0.0018
10000			1			0.50%	0.0072
100000			1			0.70%	0.0169

**C500pF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.35%	0.0037
1000			1			0.16%	0.0018
10000			1			0.50%	0.0072
100000			1			0.70%	0.0169

**C1000pF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.35%	0.0037
1000			1			0.16%	0.0018
10000			1			0.50%	0.0072
100000			1			0.70%	0.0169

**C2nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.12%	0.0014
10000			1			0.45%	0.0065
100000			1			0.45%	0.0109

**C5nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.12%	0.0014
10000			1			0.45%	0.0065
100000			1			0.45%	0.0109

**C10nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.12%	0.0014
10000			1			0.45%	0.0065
100000			1			0.45%	0.0109

**C20nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.10%	0.0011
10000			1			0.20%	0.0029
100000			1			0.50%	0.0121

**C50nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.10%	0.0011
10000			1			0.20%	0.0029
100000			1			0.50%	0.0121

**C100nF**

Freq	Pri. Actual	Sec. Actual	Voltage	Primary Meas.	Sec. Meas.	Pspec	Sspec
100			1			0.20%	0.0021
1000			1			0.10%	0.0011
10000			1			0.20%	0.0029
100000			1			0.50%	0.0121