

# T3LCR1002, T3LCR1100, T3LCR1300

## Precision LCR Meters

# User Manual



This manual contains proprietary information, which is protected by copyright. All rights are reserved. No part of this manual may be photocopied, reproduced or translated to another language without prior written consent of the Teledyne LeCroy company.

The information in this manual was correct at the time of printing. However, Teledyne LeCroy continues to improve products and reserves the right to change specifications, equipment, and maintenance procedures at any time without notice.

## Safety Summary



When you notice any of the unusual conditions listed below, immediately terminate operation and disconnect the power cable.

Please contact the TELEDYNE service center representative for repair of the instrument. If you continue to operate without repairing the instrument, there is a potential fire or shock hazard for operators.

The instrument is operating abnormally if:

- The instrument emits abnormal noise, smell, smoke, or a spark-like light during the operation.
- The instrument generates high temperature or electrical shock during operation.
- The power cable, plug, or receptacle on the instrument is damaged.
- Foreign substances or liquid has fallen into the instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

### Disclaimer

TELEDYNE assumes no liability for the customer's failure to comply with these requirements.

### Ground The Instrument

To avoid electric shock hazards, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

### DO NOT Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of inflammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

|                                              |                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Keep Away From Live Circuits                 | Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable is removed. To avoid injuries, always disconnect the power and discharge the circuits before touching them. |
| DO NOT Service Or Adjust Alone               | Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.                                                                                                                                                                                                                                                                            |
| DO NOT Substitute Parts Or Modify Instrument | Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to a TELEDYNE authorized service center for service and repair to ensure that safety features are maintained.                                                                                                                         |

## Table of Contents

|                                            |           |
|--------------------------------------------|-----------|
| <b>1. UNPACKING AND PREPERATION .....</b>  | <b>10</b> |
| 1.1 Incoming Inspection.....               | 10        |
| 1.2 Environmental Requirements .....       | 11        |
| 1.3 Cleaning .....                         | 11        |
| 1.4 How to Remove the Handle.....          | 12        |
| <b>2. OVERVIEW.....</b>                    | <b>13</b> |
| 2.1 Introduction .....                     | 13        |
| 2.2 Main Specifications and Features ..... | 14        |
| 2.2.1 Test Function.....                   | 14        |
| 2.2.2 Equivalent Circuit .....             | 14        |
| 2.2.3 Ranging.....                         | 14        |
| 2.2.4 Measurement Speed .....              | 14        |
| 2.2.5 Trigger Mode.....                    | 15        |
| 2.2.6 Basic Accuracy .....                 | 15        |
| 2.2.7 Display Range.....                   | 15        |
| 2.3 Test Signal.....                       | 15        |
| 2.3.1 Test Signal Frequency .....          | 15        |
| 2.3.2 Test Signal Level.....               | 16        |
| 2.3.3 Output impedance.....                | 16        |
| 2.4 Main Functions.....                    | 16        |
| 2.4.1 Correction Function .....            | 16        |
| 2.4.2 Comparator Function (Sorting).....   | 16        |
| 2.4.3 List Sweep .....                     | 17        |
| 2.5 Measurement Assistance Functions ..... | 17        |
| 2.5.1 Files .....                          | 17        |
| 2.5.2 Key Lock .....                       | 17        |
| 2.5.3 RS-232/USB.....                      | 17        |
| 2.6 Options .....                          | 17        |
| 2.6.1 USB host port.....                   | 17        |
| 2.6.2 DC Bias Voltage.....                 | 19        |

|                                                       |           |
|-------------------------------------------------------|-----------|
| <b>3. STARTUP.....</b>                                | <b>20</b> |
| 3.1 Front panel .....                                 | 20        |
| 3.2 Rear Panel.....                                   | 21        |
| 3.3 Power On/Off.....                                 | 21        |
| 3.3.1 Power On.....                                   | 21        |
| 3.3.2 Power Off.....                                  | 21        |
| 3.4 Warm-up Time.....                                 | 22        |
| 3.5 Connect to the Device Under Test (DUT) .....      | 22        |
| <b>4. MEASURE KEY.....</b>                            | <b>23</b> |
| 4.1 [MEAS DISPLAY] Page .....                         | 23        |
| 4.1.1 Measurement Function [FUNC].....                | 24        |
| 4.1.2 Impedance Range [RANGE] .....                   | 26        |
| 4.1.3 Test Frequency [FREQ].....                      | 28        |
| 4.1.4 Trigger Mode [TRIG].....                        | 29        |
| 4.1.5 Test Signal Voltage/Current Level [LEVEL] ..... | 30        |
| 4.1.6 Measurement Speed [SPEED] .....                 | 31        |
| 4.1.7 Measurement log [LOG].....                      | 32        |
| 4.2 [OPEN/SHORT] Page.....                            | 34        |
| 4.2.1 Open Correction [OPEN] .....                    | 35        |
| 4.2.2 Short Correction [SHORT] .....                  | 36        |
| 4.2.3 SPOT Correction.....                            | 37        |
| 4.3 [LIST SETUP] Page .....                           | 39        |
| 4.3.1 Measurement Function [FUNC].....                | 40        |
| 4.3.2 Test Mode [MODE].....                           | 40        |
| 4.3.3 List Measurement Parameters .....               | 41        |
| 4.3.4 List Point and Limit Modes.....                 | 42        |
| 4.4 [LIST MEAS] Page.....                             | 43        |
| 4.4.1 Trigger Mode [TRIG].....                        | 43        |
| 4.4.2 Test Mode [MODE].....                           | 44        |
| 4.4.3 Range Mode [RANGE].....                         | 45        |
| 4.4.4 Measurement log [LOG].....                      | 45        |
| 4.5 [ENLARGE DISPLAY ] Page.....                      | 47        |

|           |                                                      |           |
|-----------|------------------------------------------------------|-----------|
| 4.5.1     | Enlarge Display .....                                | 47        |
| 4.5.2     | Direct Comparison Function .....                     | 48        |
| <b>5.</b> | <b>SETUP KEY.....</b>                                | <b>49</b> |
| 5.1       | [MEAS SETUP] Page.....                               | 49        |
| 5.1.1     | Source Output Impedance [SRC RES] .....              | 50        |
| 5.1.2     | Averaging Factor [AVG].....                          | 51        |
| 5.1.3     | DC Bias Voltage [BIAS].....                          | 51        |
| 5.1.4     | Auto LCZ Function [AUTO LCZ] .....                   | 52        |
| 5.1.5     | Monitor 1 and Monitor 2 [MON 1][MON 2] .....         | 52        |
| 5.1.6     | Measurement Delay [DELAY].....                       | 53        |
| 5.1.7     | AUTO LEVEL CONTROL [ALC].....                        | 53        |
| 5.1.8     | Nominal Value [NOMINAL].....                         | 54        |
| 5.2       | [BIN SETUP] Page.....                                | 55        |
| 5.2.1     | Measurement Function [FUNC].....                     | 56        |
| 5.2.2     | Comparator Function ON/OFF .....                     | 56        |
| 5.2.3     | Auxiliary Bin [AUX] .....                            | 58        |
| 5.2.4     | Primary Parameter Comparator limit mode [MODE] ..... | 58        |
| 5.2.5     | Nominal value for tolerance mode .....               | 61        |
| 5.2.6     | Beep feature .....                                   | 61        |
| 5.2.7     | Total Number of Bins [#-BINS] .....                  | 61        |
| 5.2.8     | Lower and Upper Limits.....                          | 62        |
| 5.3       | [BIN MEAS] Page .....                                | 62        |
| 5.3.1     | Comparator Function ON/OFF .....                     | 63        |
| 5.3.2     | Auxiliary Bin [AUX] .....                            | 64        |
| 5.4       | [BIN COUNT] Page .....                               | 64        |
| 5.4.1     | Counter Function [COUNT] .....                       | 65        |
| <b>6.</b> | <b>SYSTEM CONFIGURATIONS.....</b>                    | <b>66</b> |
| 6.1       | [SYSTEM CONFIG] Page .....                           | 66        |
| 6.1.1     | Setting the system date and time.....                | 67        |
| 6.1.2     | Account Setting.....                                 | 68        |
| 6.1.3     | KEY BEEP Setting .....                               | 69        |
| 6.1.4     | Baud rate .....                                      | 69        |

|            |                                              |           |
|------------|----------------------------------------------|-----------|
| 6.1.5      | Remote control interface.....                | 70        |
| 6.1.6      | TERMINATOR.....                              | 70        |
| 6.1.7      | Hand Shake.....                              | 71        |
| 6.1.8      | Error Code.....                              | 71        |
| 6.1.9      | Result.....                                  | 73        |
| 6.1.10     | DATA BUFFER.....                             | 73        |
| 6.1.11     | DEFAULT SET .....                            | 74        |
| 6.2        | [SYSTEM INFO] Page .....                     | 75        |
| <b>7.</b>  | <b>FILE OPERATION .....</b>                  | <b>76</b> |
| 7.1        | [FILE] Page.....                             | 76        |
| 7.1.1      | [MEDIA].....                                 | 77        |
| 7.1.2      | Recall a File at Startup [AUTO RECALL] ..... | 77        |
| 7.1.3      | Auto save data to last file [AUTO SAVE]..... | 78        |
| 7.1.4      | File operation.....                          | 78        |
| <b>8.</b>  | <b>HANDLER INTERFACE.....</b>                | <b>79</b> |
| 8.1        | Pin Assignment .....                         | 80        |
| 8.2        | Connection .....                             | 82        |
| 8.3        | Timing Chart for Handler Interface .....     | 83        |
| <b>9.</b>  | <b>EXAMPLES.....</b>                         | <b>84</b> |
| 9.1        | Basic Measurement Procedure.....             | 84        |
| 9.2        | Example .....                                | 85        |
| <b>10</b>  | <b>REMOTE CONTROL.....</b>                   | <b>89</b> |
| 10.1       | RS-232 Interface .....                       | 89        |
| 10.2       | USB Interface.....                           | 90        |
| 10.3       | Install USB Driver .....                     | 92        |
| <b>11.</b> | <b>COMMAND REFERENCE.....</b>                | <b>95</b> |
| 11.1       | Terminator.....                              | 95        |
| 11.2       | Notation Conventions and Definitions .....   | 95        |
| 11.3       | Command Structure .....                      | 95        |
| 11.4       | Header and Parameters .....                  | 98        |
| 11.5       | Command Reference.....                       | 99        |
| 11.6       | DISPlay Subsystem.....                       | 100       |



|         |                                                 |     |
|---------|-------------------------------------------------|-----|
| 11.6.1  | DISP:LINE.....                                  | 100 |
| 11.6.2  | DISP:PAGE .....                                 | 100 |
| 11.7    | FUNCTION Subsystem .....                        | 102 |
| 11.7.1  | FUNCTION.....                                   | 102 |
| 11.7.2  | FUNCTION:IMPedance:AUTO.....                    | 103 |
| 11.7.3  | FUNCTION:IMPedance:RANGe.....                   | 103 |
| 11.7.4  | FUNCTION:DCR:RANGe .....                        | 103 |
| 11.7.5  | FUNCTION:RANGe:AUTO.....                        | 104 |
| 11.7.6  | FUNCTION:MONitor 1 /2.....                      | 104 |
| 11.8    | LEVEL Subsystem.....                            | 106 |
| 11.8.1  | LEVEL:VOLTage (=VOLTage[:LEVEL]).....           | 106 |
| 11.8.2  | LEVEL:CURREnt (=CURREnt[:LEVEL]).....           | 107 |
| 11.8.3  | LEVEL:SRESistance (= VOLTage:SRESistance) ..... | 107 |
| 11.8.4  | LEVEL:ALC (=AMPLitude:ALC).....                 | 108 |
| 11.8.5  | LEVEL:MODE? .....                               | 108 |
| 11.9    | APERture Subsystem.....                         | 109 |
| 11.9.1  | APERture:RATE?.....                             | 109 |
| 11.9.2  | APERture:AVG?.....                              | 109 |
| 11.10   | FETCH Subsystem.....                            | 110 |
| 11.10.1 | FETCH? .....                                    | 110 |
| 11.10.2 | FETCH:IMPedance? .....                          | 111 |
| 11.10.3 | FETCH:MAIN? .....                               | 111 |
| 11.10.4 | FETCH:MONitor1? /2? .....                       | 111 |
| 11.10.5 | FETCH:MONitor? .....                            | 111 |
| 11.10.6 | FETCH:LIST? .....                               | 112 |
| 11.11   | COMPARATOR Subsystem .....                      | 113 |
| 11.11.1 | COMPARATOR:STATe.....                           | 113 |
| 11.11.2 | COMPARATOR:MODE.....                            | 114 |
| 11.11.3 | COMPARATOR:AUX.....                             | 114 |
| 11.11.4 | COMPARATOR:BINS .....                           | 114 |
| 11.11.5 | COMPARATOR:TOLerance:NOMinal.....               | 115 |
| 11.11.6 | COMPARATOR:TOLerance:BIN.....                   | 115 |

|          |                                 |     |
|----------|---------------------------------|-----|
| 11.11.7  | COMParator:SLIM .....           | 115 |
| 11.11.8  | COMParator:BEEP .....           | 116 |
| 11.11.9  | COMParator:OPEN.....            | 116 |
| 11.12    | LIST Subsystem .....            | 117 |
| 11.12.1  | LIST:PARAMeter.....             | 117 |
| 11.12.2  | LIST:STAT .....                 | 117 |
| 11.12.3  | LIST:BAND .....                 | 118 |
| 11.13    | CORRection Subsystem .....      | 119 |
| 11.13.1  | CORRection:OPEN .....           | 119 |
| 11.13.2  | CORRection:OPEN:STATe.....      | 120 |
| 11.13.3  | CORRection:OPEN:LCR.....        | 120 |
| 11.13.4  | CORRection:OPEN:DCR .....       | 120 |
| 11.13.5  | CORRection:SHORT .....          | 120 |
| 11.13.6  | CORRection:SHORT:STATe.....     | 121 |
| 11.13.7  | CORRection:SHORT:LCR .....      | 121 |
| 11.13.8  | CORRection:SHORT:DCR .....      | 121 |
| 11.13.9  | CORRection:SPOT:STATe .....     | 121 |
| 11.13.10 | CORRection:SPOT:FREQuency ..... | 122 |
| 11.13.11 | CORRection:SPOT:OPEN .....      | 122 |
| 11.13.12 | CORRection:SPOT:SHORT.....      | 122 |
| 11.14    | TRIGger Subsystem .....         | 123 |
| 11.14.1  | TRIGger[:IMMediate].....        | 123 |
| 11.14.2  | TRIGger:SOURce.....             | 123 |
| 11.14.3  | TRIGger:DELAY .....             | 123 |
| 11.15    | BIAS Subsystem.....             | 124 |
| 11.16    | FILE Subsystem .....            | 125 |
| 11.16.1  | FILE?.....                      | 125 |
| 11.16.2  | FILE:SAVE .....                 | 125 |
| 11.16.3  | FILE:LOAD .....                 | 125 |
| 11.16.4  | FILE:DELeTe.....                | 126 |
| 11.17    | ERRor Subsystem.....            | 126 |
| 11.17.1  | ERRor? .....                    | 126 |

|            |                                                          |            |
|------------|----------------------------------------------------------|------------|
| 11.18      | SYSTEM Subsystem .....                                   | 126        |
| 11.18.1    | SYSTem:SHAKehand.....                                    | 126        |
| 11.18.2    | SYSTem:CODE .....                                        | 126        |
| 11.18.3    | SYSTem:KEYLock.....                                      | 127        |
| 11.18.4    | SYSTem:REsult.....                                       | 127        |
| 11.19      | Common Commands.....                                     | 127        |
| 11.19.1    | *IDN? .....                                              | 127        |
| 11.19.2    | *TRG .....                                               | 127        |
| 11.19.3    | *SAV .....                                               | 128        |
| 11.19.4    | *RCL .....                                               | 128        |
| <b>12.</b> | <b>SPECIFICATION .....</b>                               | <b>129</b> |
| 12.1       | General Specification.....                               | 129        |
| 12.2       | Dimensions.....                                          | 133        |
| <b>13.</b> | <b>ACCURACY .....</b>                                    | <b>134</b> |
| 13.1       | Accuracy.....                                            | 135        |
| 13.1.1     | L, C, R   Z   Measurement Accuracy .....                 | 135        |
| 13.1.2     | Accuracy for D.....                                      | 135        |
| 13.1.3     | Accuracy for Q.....                                      | 136        |
| 13.1.4     | Accuracy for $\theta$ .....                              | 136        |
| 13.1.5     | Accuracy for Rp .....                                    | 136        |
| 13.1.6     | Accuracy for Rs.....                                     | 137        |
| 13.2       | Correction factors that affect measurement accuracy..... | 137        |
|            | Certifications .....                                     | 141        |
|            | EMC Compliance.....                                      | 141        |
|            | Safety Compliance.....                                   | 143        |
|            | Environmental Compliance .....                           | 143        |
|            | RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS) .....         | 144        |

# 1. UNPACKING AND PREPERATION

---

This chapter describes how to set up and start the T3LCR Series LCR Meter.

- Incoming Inspection
  - Environmental Requirements
  - Cleaning
  - How to Remove the Handle
- 

## 1.1 Incoming Inspection

After you receive the instrument, perform the following checks during unpacking according to the following procedure:

---



**WARNING**

If the external face of the instrument (such as the cover, front/rear panel, VFD screen, power switch, and port connectors) appears to have been damaged during transport, do not turn on the power switch. Otherwise, you may get an electrical shock.

---

Make sure that the packing box or shock-absorbing material used to package the instrument has not been damaged.

Check that all packaged items supplied with the meter have been provided as specified:

LCR  
Test Lead  
Power Cord  
D-sub

---

**Note**

If an abnormality is detected, contact the company and transport the meter to your nearest TELEDYNE sales or service office. Save the packing box, shock-absorbing material, and packaged items as you received them in case you need to mail the instrument to an authorized TELEDYNE distributor or service center.

---

## 1.2 Environmental Requirements

Set up the T3LCR Series where the following environmental requirements are satisfied.

### Operating Environment

Ensure that the operating environment meets the following requirements:

Temperature: 0°C to 50°C

Temperature range at calibration:  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$  (<1°C deviation from the temperature when performing calibration)

Humidity: <70% at wet bulb temperature  $\leq 40^{\circ}\text{C}$  (non-condensation)

Altitude: 0 to 2000m

## 1.3 Cleaning

To prevent electrical shock, disconnect the T3LCR Series power cable from the receptacle before cleaning. Use a dry cloth or a cloth slightly dipped in water to clean the casing. Do not attempt to clean the T3LCR Series internally.

---

**WARNING**

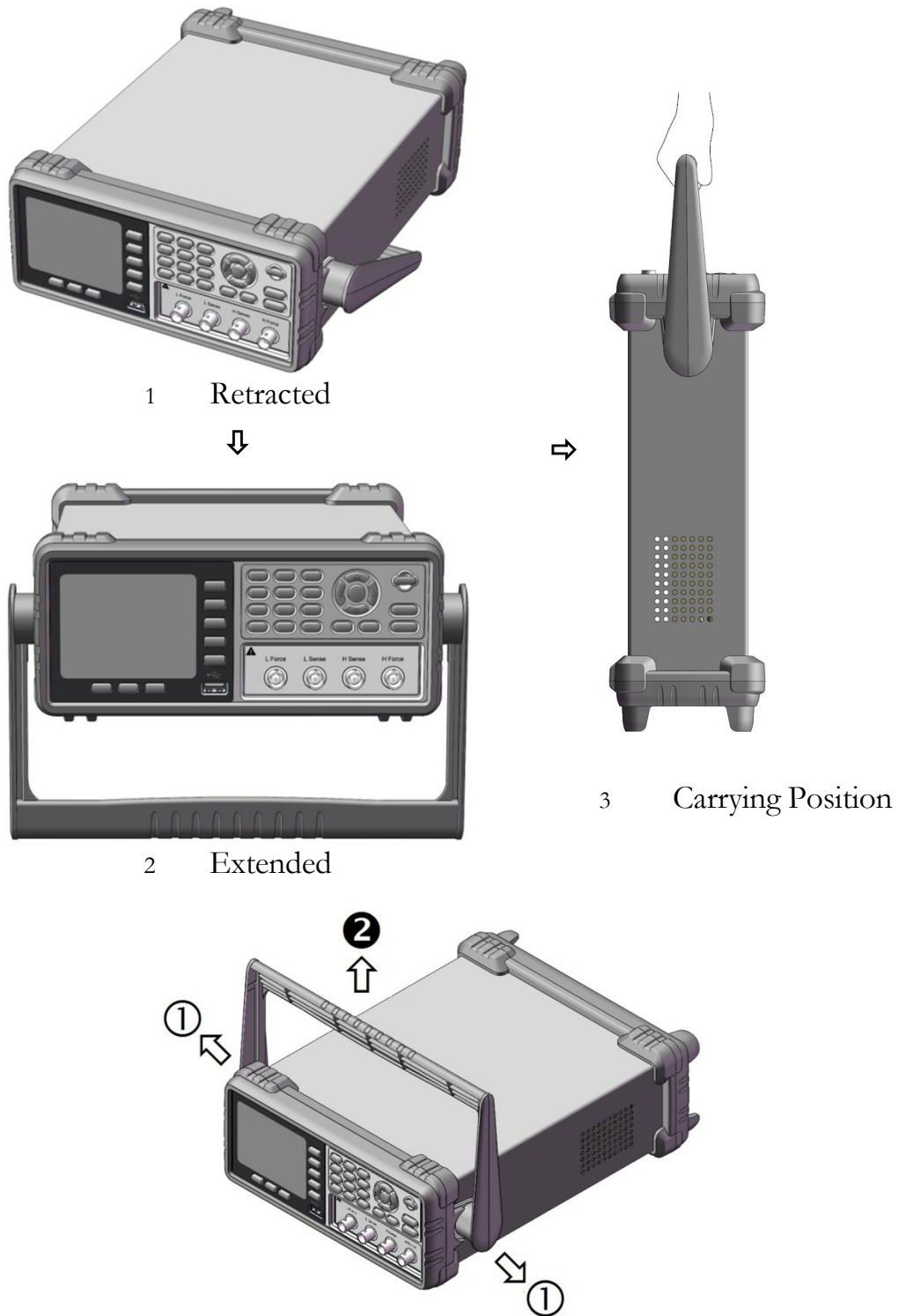
Don't Use Organic Solvents (such as alcohol or gasoline) to clean the Instrument.

---

## 1.4 How to Remove the Handle

A handle kit is attached to the T3LCR Series:

Figure 1-1 How to remove the handle



Remove Handle

*(Lift the handle perpendicular to the unit while pulling it in the direction of 1.)*

## 2. OVERVIEW

---

This chapter contains general information about T3LCR Series .The information is organized as follows.

- Introduction
  - Main Specifications
  - Feature overview
- 

### 2.1 Introduction

Thank you for purchasing an T3LCR Series LCR meter.

The TELEDYNE T3LCR Series is a general-purpose LCR meter for incoming inspection of components, quality control, and laboratory use.

The T3LCR Series is used for evaluating LCR components, materials, and semiconductor devices over a wide range of frequencies (10 Hz to 300 kHz) and test signal levels (10.00mV to 2.00V & 100.0uA to 20.00mA).

With its built-in comparator, the T3LCR Series can output comparison/decision results for sorting components into a maximum of ten bins. Furthermore, by using the handler interface, the T3LCR Series can be easily combined with a component handler, and a system controller to fully automate component testing, sorting, and quality-control data processing.

The list measure function permits entry of up to 10 frequencies or test signal levels points to be automatically measured.

## 2.2 Main Specifications and Features

### 2.2.1 Test Function

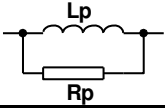
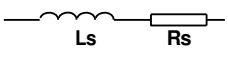
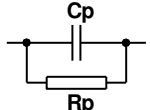
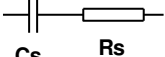
Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, Rs-Q, Rp-Q, R-X, DCR, Z- $\theta_r$ , Z- $\theta_d$ , Z-D, Z-Q

### 2.2.2 Equivalent Circuit

#### Serial and Parallel

Table 2-1

Equivalent Circuit

| Circuit |                                                                                     | Dissipation Factor          | Conversion                                |
|---------|-------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------|
| L       |    | $D=2\pi$<br>$FL_p/R_p=1/Q$  | $L_s=L_p/(1+D^2)$<br>$R_s=R_pD^2/(1+D^2)$ |
|         |    | $D=R_s/2\pi$<br>$FL_s=1/Q$  | $L_p=(1+D^2)L_s$<br>$R_p=(1+D^2)R_s/D^2$  |
| C       |  | $D=1/2\pi$<br>$FC_pR_p=1/Q$ | $C_s=(1+D^2)C_p$<br>$R_s=R_pD^2/(1+D^2)$  |
|         |  | $D=2\pi$<br>$FC_sR_s=1/Q$   | $C_p=C_s/(1+D^2)$<br>$R_p=R_s(1+D^2)/D^2$ |

$$Q=X_s/R_s, D=R_s/X_s, X_s=1/2\pi FC_s=2\pi FL_s$$

### 2.2.3 Ranging

Auto, Hold and Nominal range. Total 9 Ranges.

About Nominal ranges: The T3LCR Series will automatically select the best range according to the nominal value.

### 2.2.4 Measurement Speed

Fast: 40 readings per second; 25ms/per reading<sup>\*1</sup>

Medium: 10 readings per second; 100ms/per reading<sup>\*1</sup>

Slow: 3 readings per second; 333ms/per reading<sup>\*1</sup>

You can also specify the averaging factor within the range of 1 to 256 in steps of 1 to improve performance.

NOTE

\*1. Measurement speed in 300kHz, typical.



## 2.2.5 Trigger Mode

Includes Internal, Manual, External and Bus Trigger.

## 2.2.6 Basic Accuracy

0.05%@SLOW/MED

0.1%@FAST

## 2.2.7 Display Range

Table 2-2

Display Range

| Parameter  | Display Range       |
|------------|---------------------|
| L          | 0.00001uH-9999.99H  |
| C          | 0.00001pF-9999.99mF |
| R, X,  Z   | 0.00001Ω-99.9999MΩ  |
| G, B,  Y   | 0.01nS-999.999S     |
| D          | 0.00001-9.99999     |
| Q          | 0.00001-99999.9     |
| $\theta_d$ | -179.999°-179.999°  |
| $\theta_r$ | -3.14159-3.14159    |
| DCR        | 0.00001Ω-99.9999MΩ  |
| $\Delta\%$ | -999999%-999999%    |

## 2.3 Test Signal

### 2.3.1 Test Signal Frequency

T3LCR1300: 10Hz-300kHz

T3LCR1100: 10Hz-100kHz

T3LCR1002: 10Hz-2kHz

Frequency Accuracy:  $\pm 0.01\%$

## 2.3.2 Test Signal Level

AC: 10.00mV-2.00V ( $\pm 10\%$ )  
CV mode: 10.00mV-2.00V ( $\pm 6\%$ )  
100.0uA-20.00mA ( $\pm 10\%$ )  
CC mode: 100.0uA-20.00mA ( $\pm 6\%$ ) @2VMax  
DCR: +2V, 0.066A(Max.), Output impedance fixed  
30 $\Omega$

## 2.3.3 Output impedance

30 $\Omega$ , 50 $\Omega$  and 100 $\Omega$

## 2.4 Main Functions

### 2.4.1 Correction Function

#### **OPEN/SHORT correction:**

Eliminates measurement errors due to stray parasitic impedance in the test fixtures.

### 2.4.2 Comparator Function (Sorting)

#### **Bin sort**

The primary parameter can be sorted into BIN1-BIN9, AUX, OUT and HI/IN/LO for each of the primary measurement parameters.

The sequential mode or tolerance mode can be selected as the sorting mode.

#### **Limit Setup**

Absolute value, deviation value, and % deviation value can be used for setup.

#### **BIN count**

Countable from 0 to 999999

## 2.4.3 List Sweep

### **Points**

There is a maximum of 10 points.

### **Sweep parameters**

Test frequency, test voltage, test current.

### **Comparator function of list sweep**

The comparator function enables you to set one pair of lower and upper limits for each measurement point.

You can select from:

Judge with the first sweep parameter/Judge with the second parameter/Not used for each pair of limits.

## 2.5 Measurement Assistance Functions

### 2.5.1 Files

Up to 10 setup conditions can be written to/read from the built-in non-volatile memory.

### 2.5.2 Key Lock

The front panel keys can be locked.

### 2.5.3 RS-232/USB

Complies with SCPI.

## 2.6 Options

### 2.6.1 USB host port

Universal serial bus jack, type-A (4 contact positions, contact 1 is on your left); female; for connection to USB memory devices only.

USB disk type: Flash disk only.

Format: FAT / FAT32 / exFAT.

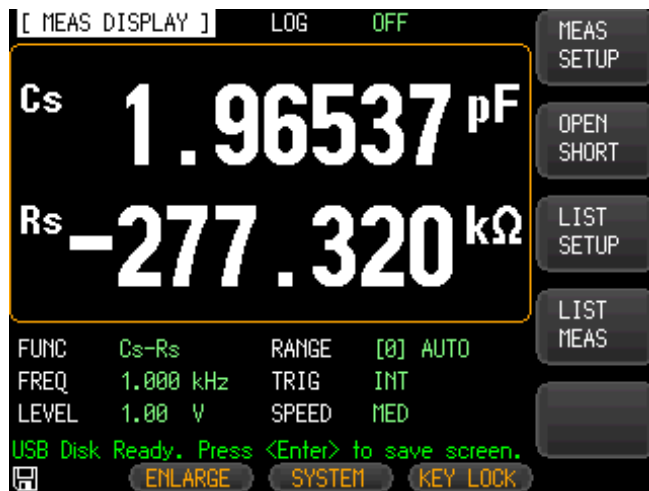
Max memory size: 128GB.

## Save Screen

After a USB disk has been inserted into the USB host port of the LCR meter and if the meter detects that the USB disk is usable, the meter will show “USB Disk Ready. Press <Enter> to save screen.” on the lower part of the LCD screen.

Figure 2-1

### Disk Ready

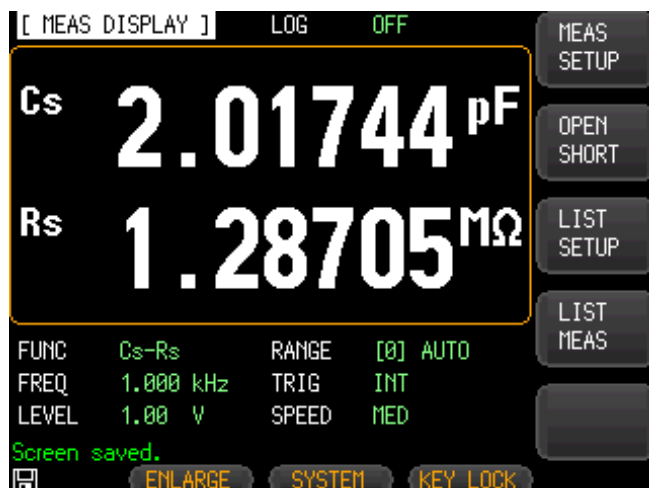


If the keypad is not needed to enter a numeric value, a screenshot of the meter's LCD display can be captured and saved to the USB disk by depressing the Enter key. If the screen shot is saved successfully, “Screen saved.” will be shown in the message area at the bottom of the screen. The location and name of the screenshot will also be shown, for example:

F:\T3LCR1300\Screen\ScreenShot001.bmp.

Figure 2-2

### Screen Saved



## 2.6.2 DC Bias Voltage

0V-±2.5V

Accuracy:  $\pm 0.5\% + 0.005\text{V}$

## 3. STARTUP

This chapter describes names and functions of the front panel, rear panel, and screen display and provides the basic procedures for operating the T3LCR Series.

- Front panel summary
- Rear panel summary
- Power On/Off
- Connect to Device under test

### 3.1 Front panel

Figure 3-1 Front panel

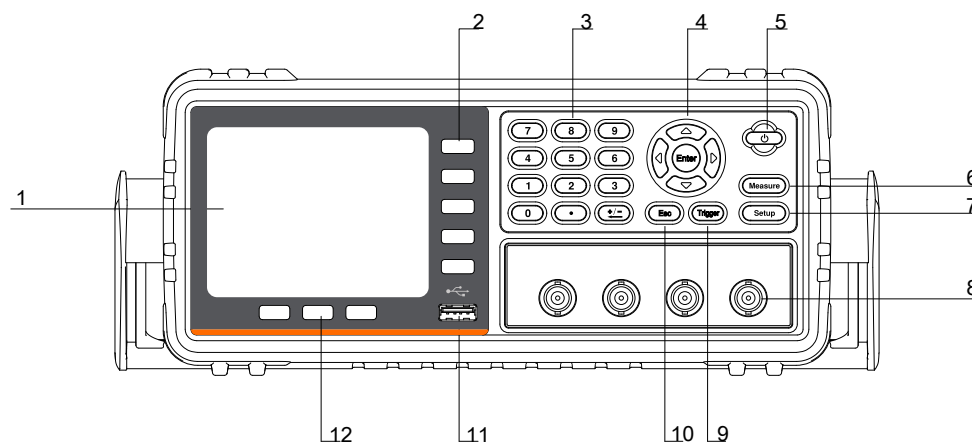


Table 3-1

Front panel description

| No. | Description  |
|-----|--------------|
| 1   | LCD Display  |
| 2   | Soft-key     |
| 3   | Number Key   |
| 4   | Cursor Key   |
| 5   | Power Switch |
| 6   | Measure key  |
| 7   | Setup Key    |
| 8   | BNC Terminal |

|    |                          |
|----|--------------------------|
| 9  | Trigger Key              |
| 10 | ESC Key                  |
| 11 | USB Disk Port (USB-Host) |
| 12 | System Soft-key          |

## 3.2 Rear Panel

Figure 3-2 Rear Panel

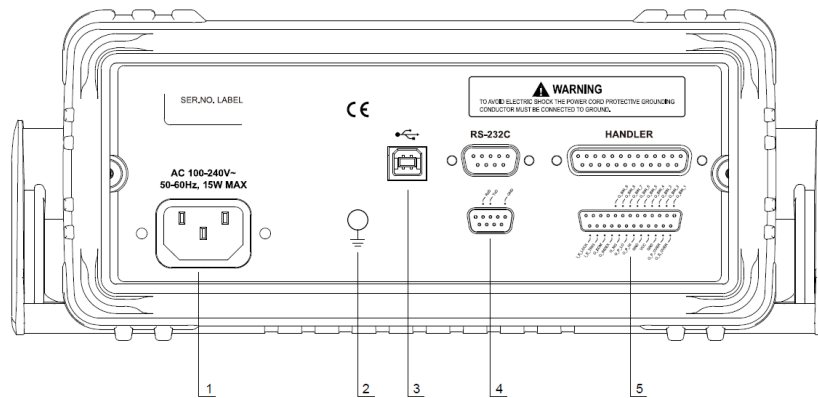


Table 3-2 Rear panel description

| No. | Description                    |
|-----|--------------------------------|
| 1   | Power Cable Receptacle(Outlet) |
| 2   | Frame Terminal                 |
| 3   | USB Interface(Type B)          |
| 4   | RS-232 Interface               |
| 5   | Handler Interface              |

## 3.3 Power On/Off

### 3.3.1 Power On

Press the power key for at least 1 second. Release power key when the POWER LED turns green.

### 3.3.2 Power Off

Press the power key at least 1 second. T3LCR Series will shut down when you release the power key after the POWERLED turns red.

If the AUTOSAVE option of the File Operation menu is set to ON (see page 76), the POWER LED will flash twice and the AUTOSAVE function will be executed during the power-off sequence.

## 3.4 Warm-up Time

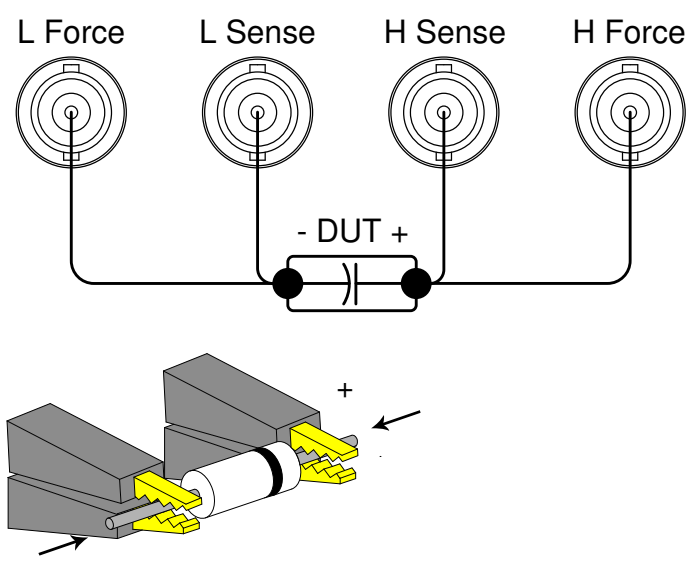
T3LCR Series is ready to be used as soon as the power-up sequence has completed. However, to achieve the specification accuracy, first warm up the instrument for 30 minutes.

## 3.5 Connect to the Device Under Test (DUT)

The T3LCR Series uses a four terminal measurement configuration that provides easy, accurate and stable measurements and avoids mutual inductance, interference from measurement signals, noise and other factors inherent with other types of connections.

Figure 3-3

Connect to DUT



WARNING

Do not apply DC voltage or current to the UNKNOWN terminals. Applying a DC voltage or current may lead to device failure. Connect the measurement sample (DUT) to the test port (or the test fixture, cables, etc.) after the DUT has been completely discharged.



## 4. MEASURE KEY

---

This section includes the following information:

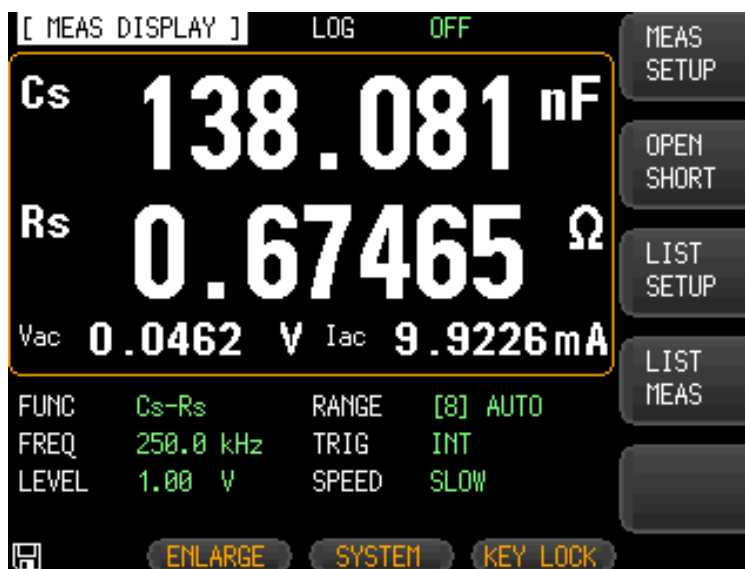
- MEAS DISPLAY page
  - OPEN/SHORT page
  - LIST SETUP page
  - LIST MEAS page
- 

### 4.1 [MEAS DISPLAY] Page

When the [Measure] key is pressed, the [MEAS DISPLAY] page appears. The following measurement controls can be set.

- FUNC – Measurement Function
- RANGE – Impedance range
- FREQ – Test Frequency
- TRIG – Trigger Mode
- LEVEL – Test Signal Level
- SPEED – Measurement Speed

Figure 4-1 [MEAS DISPLAY] Page



### 4.1.1 Measurement Function [FUNC]

The T3LCR Series simultaneously measures four components of complex impedance (parameters) in a measurement cycle. These include a primary parameter, a secondary parameter and two monitor parameters.

**NOTE** The monitor parameters can be set in the [SETUP] page. The monitor parameters are initially set to OFF.

#### Types of measurement parameters

Table 4-1

Measurement parameter combinations

|       |      |       |      |
|-------|------|-------|------|
| Cs-Rs | Cs-D | Cp-Rp | Cp-D |
| Lp-Rp | Lp-Q | Ls-Rs | Ls-Q |
| Rs-Q  | Rp-Q | R-X   | DCR  |
| Z-θr  | Z-θd | Z-D   | Z-Q  |

#### Monitor parameters

Table 4-2

Monitor parameters

|     |     |   |    |
|-----|-----|---|----|
| Z   | D   | Q |    |
| Vac | Iac | Δ | Δ% |
| θr  | θd  | R | X  |
| G   | B   | Y |    |

Table 4-3

## Measurement and Monitor parameter descriptions

| Parameter  | Description                                                                           |
|------------|---------------------------------------------------------------------------------------|
| Cs         | Capacitance value measured using the series equivalent circuit model                  |
| Cp         | Capacitance value measured using the parallel equivalent circuit model                |
| Is         | Inductance value measured using the series equivalent circuit model                   |
| Ip         | Inductance value measured using the parallel equivalent circuit model                 |
| Rs         | Equivalent series resistance measured using the series equivalent circuit model (ESR) |
| Rp         | Equivalent parallel resistance measured using the parallel equivalent circuit model   |
| Z          | Absolute value of impedance                                                           |
| Y          | Absolute value of admittance                                                          |
| G          | Conductance                                                                           |
| B          | Susceptance                                                                           |
| R          | Resistance (=Rs)                                                                      |
| X          | Reactance                                                                             |
| D          | Dissipation factor                                                                    |
| Q          | Quality factor(=1/D)                                                                  |
| $\theta_r$ | Phase radian                                                                          |
| $\theta_d$ | Phase angle                                                                           |
| Vac        | Test signal Voltage                                                                   |
| Iac        | Test signal Current                                                                   |
| $\Delta$   | Absolute deviation value                                                              |
| $\Delta\%$ | Relative deviation value                                                              |
| DCR        | Direct Current Resistance                                                             |

### Procedure for setting the measurement function [FUNC]

- Step 1. Press the [Measure] key.
- Step 2. Press the [MEAS DISPLAY] soft-key if [MEAS DISPLAY] is not already the active mode.
- Step 3. Use the cursor key to select [FUNC] field.
- Step 4. Use the soft-keys to select measurement function.

## 4.1.2 Impedance Range [RANGE]

### Impedance range mode

To achieve the best measurement result, it is recommended to set the impedance range mode to “Auto range”. When using “Hold range”, errors in measurement results may occur if the measured value exceeds the full scale of the selected range.

Table 4-4

### Impedance range mode

| Mode          | Function overview                                                          | Advantage                                                   | Disadvantage                                                         |
|---------------|----------------------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------|
| Auto Range    | T3LCR Series sets the optimum impedance range for the impedance of the DUT | You don't need to select range                              | The measurement time is longer due to the ranging time               |
| Hold Range    | Measurement                                                                | No ranging time is required                                 | You need to select a proper range depending on the value of the DUT. |
| Nominal Range | T3LCR Series sets the optimum range depending on the nominal value         | You don't need to select range. No ranging time is required | Valid only in the sorting mode                                       |

### Available impedance range

The hold range has nine impedance ranges: 10, 30, 100, 300, 1k, 3k, 10k, 30k and 100k.

The impedance range is selected according to the DUT's impedance even if the measurement parameter is capacitance or inductance.

Table 4-5 Effective measurement range for the impedance range when in HOLD state.

| Range | Impedance | Effective measurement range                                             |
|-------|-----------|-------------------------------------------------------------------------|
| 8     | 10Ω       | 0-10Ω                                                                   |
| 7     | 30Ω       | 10Ω-100Ω                                                                |
| 6     | 100Ω      | 100Ω-316Ω                                                               |
| 5     | 300Ω      | 316Ω-1kΩ                                                                |
| 4     | 1kΩ       | 1kΩ-3.16kΩ                                                              |
| 3     | 3kΩ       | 3.16kΩ-10kΩ                                                             |
| 2     | 10kΩ      | 10kΩ-31.6kΩ                                                             |
| 1     | 30kΩ      | 31.6kΩ-100kΩ (∞)                                                        |
| 0     | 100kΩ     | 100kΩ-∞ (This range is available only when the test frequency < 20kHz.) |

Table 4-6 DCR FUNC best measurement range for the impedance range when in HOLD state.

When the measured value exceeds 150% of the full scale for the selected range, "OVERLOAD" will be displayed.

| Range No. | Impedance range | Best measurement range | Overload |
|-----------|-----------------|------------------------|----------|
| 7         | 100mΩ           | 0Ω-0.33Ω               | 0.495Ω   |
| 6         | 1Ω              | 0.32Ω-3.3Ω             | 4.95Ω    |
| 5         | 10Ω             | 3.2Ω-99Ω               | 148.5Ω   |
| 4         | 100Ω            | 90Ω-990Ω               | 1.485kΩ  |
| 3         | 1kΩ             | 900Ω-9.9kΩ             | 14.85kΩ  |
| 2         | 10kΩ            | 9kΩ-33kΩ               | 49.5kΩ   |
| 1         | 100kΩ           | 32kΩ-990kΩ             | 1.485MΩ  |
| 0         | 1MΩ             | 900kΩ-10MΩ             | 100MΩ    |

DCR accuracy:  $\pm 0.05\%$  with 0.1Ω-312kΩ measurement range.

### Procedure for setting the impedance range [RANGE]

- Step 1. Press the [Measure] key.
- Step 2. Use the cursor key to select the [RANGE] field.
- Step 3. Use the soft-keys to select the impedance range mode or impedance range.

| Soft-key      | Function                                        |
|---------------|-------------------------------------------------|
| AUTO RANGE    | Sets to AUTO range                              |
| HOLD RANGE    | Sets to HOLD range                              |
| NOMINAL RANGE | Sets to NOMINAL range                           |
| INCR +        | Increments the impedance range in the HOLD mode |
| DECR -        | Decrements the impedance range in the HOLD mode |

### 4.1.3 Test Frequency [FREQ]

T3LCR1300: 10Hz~300kHz

T3LCR1100: 10Hz~100kHz

T3LCR1002: 10Hz~2kHz

Table 4-7

#### Frequency range and resolution

| Frequency range(F)                            | Resolution |
|-----------------------------------------------|------------|
| $10.00\text{Hz} \leq F \leq 99.99\text{Hz}$   | 0.01Hz     |
| $100.0\text{Hz} \leq F \leq 999.9\text{Hz}$   | 0.1Hz      |
| $1.000\text{kHz} \leq F \leq 9.999\text{kHz}$ | 1Hz        |
| $10.00\text{kHz} \leq F \leq 99.99\text{kHz}$ | 10Hz       |
| $100.0\text{kHz} \leq F \leq 300.0\text{kHz}$ | 100Hz      |

Frequency Accuracy:  $\pm 0.01\%$  with 4-digit resolution

### Procedure for setting test frequency [FREQ]

- Step 1. Press the [Measure] key.
- Step 2. Use the cursor key to select the [FREQ] field.
- Step 3. Use the soft-keys or numeric entry keys to enter the test frequency.

When data is entered with the numeric keys, the soft-keys change to unit labels (Hz, kHz).

| Soft-key | Function                                                    |
|----------|-------------------------------------------------------------|
| INCR +   | Be used to select between predefined measuring frequencies. |
| DECR -   |                                                             |

Table 4-8 T3LCR1300's predefined test frequencies that can be selected by using INCR+/DECR-

| INCR+/DECR- |        |        |        |        |
|-------------|--------|--------|--------|--------|
| 10Hz        | 50Hz   | 60Hz   | 100Hz  | 120Hz  |
| 1kHz        | 2kHz   | 10kHz  | 20kHz  | 40kHz  |
| 50kHz       | 100kHz | 200kHz | 250kHz | 300kHz |

Table 4-9 T3LCR1100's predefined test frequencies that can be selected by using INCR+/DECR-

| INCR+/DECR- |        |       |       |       |
|-------------|--------|-------|-------|-------|
| 10Hz        | 50Hz   | 60Hz  | 100Hz | 120Hz |
| 1kHz        | 2kHz   | 10kHz | 20kHz | 40kHz |
| 50kHz       | 100kHz |       |       |       |

Table 4-10 T3LCR1002's predefined test frequencies that can be selected by using INCR+/DECR-

| INCR+/DECR- |      |      |       |       |
|-------------|------|------|-------|-------|
| 10Hz        | 50Hz | 60Hz | 100Hz | 120Hz |
| 1kHz        | 2kHz |      |       |       |

#### 4.1.4 Trigger Mode [TRIG]

T3LCR Series supports four trigger modes: INT (internal), EXT (external), MAN (manual) and BUS (RS-232/USB).

| Trigger | Description                                                                                                                                   |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| INT     | T3LCR Series continuously repeats the measurement cycle.                                                                                      |
| MAN     | T3LCR Series performs one cycle of measurement each time you press the [Trig] key.                                                            |
| EXT     | T3LCR Series performs one cycle of measurement each time a rising pulse is input to the handler external trigger input pin on the rear panel. |
| BUS     | T3LCR Series performs one cycle of measurement each time it receives a trigger command sent via RS-232/USB.                                   |

##### Procedure for choosing trigger mode [TRIG]

- Step 1. Press the [Measure] key.
- Step 2. Use the cursor key to select the [TRIG] field.
- Step 3. Use the soft-keys to select desired trigger mode.

| Soft-key | Function              |
|----------|-----------------------|
| INT      | Internal Trigger Mode |
| MAN      | Manual Trigger Mode   |
| EXT      | External Trigger Mode |
| BUS      | BUS Trigger Mode      |

### 4.1.5 Test Signal Voltage/Current Level [LEVEL]

The T3LCR Series' test signal voltage/current level can be set as the effective value (RMS value) of a sine wave of the test frequency from the unit's internal oscillator.

When a constant voltage or current level measurement is performed, an asterisk mark (\*) appears at the end of the LEVEL display.

#### Test signal level setting procedure

- Step 1. Press the [Measure] key
- Step 2. Use the cursor key to select [LEVEL] field
- Step 3. Use the soft-keys or numeric entry keys to enter the test signal voltage/current level.

| Soft-key | Function               |
|----------|------------------------|
| INCR +   | Refer to Table 4-11    |
| DECR -   |                        |
| ALC ON   | Auto Level Control ON  |
| ALC OFF  | Auto Level Control OFF |

Table 4-11

Test voltage/current level that can be selected with INCR+/DECR-

| INCR+/DECR- |         |         |         |         |         |
|-------------|---------|---------|---------|---------|---------|
| 10.00mV     | 100.0mV | 300.0mV | 500.0mV |         |         |
| 1.00V       | 1.50V   | 2.00V   |         |         |         |
| INCR+/DECR- |         |         |         |         |         |
| 100.0uA     | 500.0uA | 1.00mA  | 5.00mA  | 10.00mA | 20.00mA |

| Voltage range                                          | Resolution |
|--------------------------------------------------------|------------|
| $10.00\text{mV} \leq \text{LEVEL} \leq 99.99\text{mV}$ | 0.01mV     |
| $100.0\text{mV} \leq \text{LEVEL} \leq 999.9\text{mV}$ | 0.1mV      |
| $1.00\text{V} \leq \text{LEVEL} \leq 2.00\text{V}$     | 0.01V      |

| Current range                                          | Resolution |
|--------------------------------------------------------|------------|
| $100.0\text{uA} \leq \text{LEVEL} \leq 999.9\text{uA}$ | 0.1uA      |
| $1.00\text{mA} \leq \text{LEVEL} \leq 20.00\text{mA}$  | 0.01mA     |



## 4.1.6 Measurement Speed [SPEED]

SLOW, MED and FAST can be selected for T3LCR Series.

SLOW mode will result in more stable and accurate measurement results.

### Procedure for setting measurement speed mode

- Step 1. Press the [Measure] key.  
 Step 2. Use the cursor key to select the [SPEED] field.  
 Step 3. Use the soft-keys to set measurement speed.

| Soft-key | Function                   |
|----------|----------------------------|
| FAST     | 40 times/sec <sup>*1</sup> |
| MED      | 10 times/sec <sup>*1</sup> |
| SLOW     | 3 times/sec <sup>*1</sup>  |

### NOTE

\*1. Measurement speed in 300kHz, typical. The Measurement Speed time is the trigger to the end of measurement (EOM) output on the Handler.

Display: [BIN MEAS] Page

[RANGE]: HOLD RANGE

[AVG]: 1

[BIAS]: OFF

[AUTO LCZ]: OFF

[MON 1] [MON 2]: OFF

[DELAY]: 0 ms

[ALC]: OFF

Measurement speed [ms]

|                    | Speed |      |      |
|--------------------|-------|------|------|
| Test Frequency(Hz) | SLOW  | MED  | FAST |
| 10                 | 1600  | 1600 | 1600 |
| 20                 | 800   | 800  | 800  |
| 100                | 483   | 160  | 160  |

|      |     |      |      |
|------|-----|------|------|
| 1k   | 342 | 94   | 30   |
| 2k   | 336 | 91   | 26.5 |
| 10k  | 332 | 88.5 | 24.5 |
| 100k | 332 | 88.5 | 24.5 |
| 300k | 332 | 88.5 | 24.5 |
| DCR  | 333 | 171  | 48   |

### 4.1.7 Measurement log [LOG]

The T3LCR has an internal data buffer that record up to 10000 measurement readings. These readings can be saved to an external USB drive in a .csv file format. These readings can then be opened on a PC using software such as Windows Excel. When the LOG function is active, the display is fixed to the [MEAS DISPLAY] screen. The [FUNC], [FREQ] and [LEVEL] settings are also fixed and cannot be changed.

#### Procedure for setting Log

- Step 1. Press the [Measure] key.
- Step 2. Use the left/right cursor keys to select the LOG status field.
- Step 3. Use the [START LOG] soft-keys to start a new log.

| Soft-key  | Function                        |
|-----------|---------------------------------|
| START LOG | To start a new measurement log. |

- Step 4. After a new log has started, the measurement readings will be recorded into the meter's internal buffer. The options in the following table are available during this recording process:

| Soft-key | Function                                                                                                                                                                                                                                                 |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STOP     | Stops the recording and temporarily saves the logs into the buffer. An exclamation mark will be added after the record counts (in the [LOG] status field) to remind you that there are recorded readings in the buffer that have not yet been processed. |

|              |                                                                                                                                                                                                                                                                           |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SAVE TO USB  | Saves the recorded readings in the buffer to an external USB flash drive. The internal buffer is cleared after this operation.                                                                                                                                            |
| CLEAR BUFFER | Clears the internal buffer.                                                                                                                                                                                                                                               |
|              |                                                                                                                                                                                                                                                                           |
| SAVE & STOP  | Stops the recording and saves the recorded readings in the internal buffer to an external USB flash drive. The internal buffer will be cleared after the save operation. If an external USB flash drive is not plugged in, the meter will not stop the ongoing recording. |
| CLEAR & STOP | Stop recording and clears the internal buffer.                                                                                                                                                                                                                            |

Step 5. When the internal buffer is full, “!FULL” will be added after the number of recorded counts(in the [LOG] status field). The following two operations are available in this situation:

| Soft-key     | Function                                                                                                                       |
|--------------|--------------------------------------------------------------------------------------------------------------------------------|
| SAVE TO USB  | Saves the recorded readings in the buffer to an external USB flash drive. The internal buffer is cleared after this operation. |
| CLEAR BUFFER | Clears the internal buffer.                                                                                                    |

Before saving the recorded readings in the internal buffer to the external USB flash drive, remember to plug the external USB drive into the USB port on the front panel.

The recorded readings will be saved in a subdirectory named MEAS DATA, whose parent directory will have the same name as the T3LCR model being used. See the example in below:

Example:

F:\T3LCR1300\MEAS DATE\ MEAS0000.CSV

Up to 9999 recording files can be saved, with their file names from 0001.csv-9999.csv.

The size of the internal buffer can be adjusted in SYSTEM→SYSTEM CONFIG→DATA BUFFER setting field. The maximum data buffer size is 10000.

## 4.2 [OPEN/SHORT] Page

When you press the [Measure] key and the [OPEN SHORT] soft-key, the [ OPEN SHORT ] page appears.

In this page, the OPEN/SHORT/SPOT correction for correcting the stray admittance and residual impedances can be performed.

The OPEN and SHORT function performs open or short correction over a range of fixed trimming points. The correction for all other frequencies are interpolated from those fixed trimming points. Please refer to the 12.1 Specification page to see what the trimming frequency points are for each T3LCR model.

The SPOT function will perform open, or short correction at a user-defined “spot” frequency.

In the [ OPEN SHORT] page, you can configure each of the following controls with the cursor placed in the corresponding field:

- Open correction [OPEN]
- Short correction [SHORT]
- SPOT correction [SPOT]

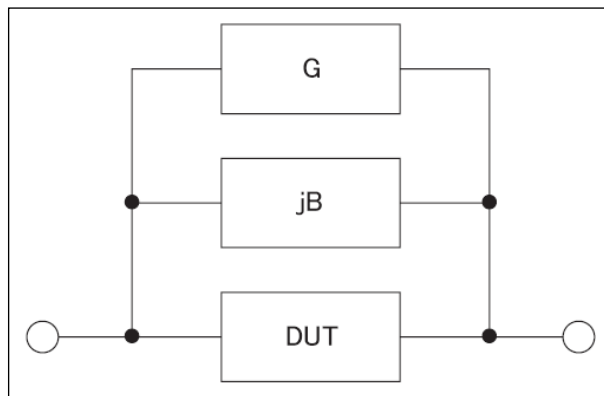
Figure 4-2 [OPEN/SHORT] Page



### 4.2.1 Open Correction [OPEN]

The T3LCR Series' OPEN correction capability cancels errors due to the stray admittance (G, B) in parallel with the device under test (Refer to Figure 4-3).

Figure 4-3 Stray Admittance



The OPEN correction data is taken at all preset frequency points, independent of the test frequency you set. Refer to the tables on page 130 for the trimming frequency point lists for each model.

#### To perform open correction

- Step 1. Press the [Measure] key.
- Step 2. Press the [OPEN SHORT] soft-key.
- Step 3. Use the cursor key to select the [OPEN] field.

| Soft-key | Function                 |
|----------|--------------------------|
| ON       | Enables open correction. |

|           |                              |
|-----------|------------------------------|
| OFF       | Disables open correction.    |
| MEAS OPEN | Starts open correction (AC). |
| DCR OPEN  | Starts open correction (DC). |

- Step 4. Press the [MEAS OPEN] or [DCR OPEN] soft-key. A dialog message, “Open-circuit the test terminals” will appear.
- Step 5. Connect the test fixture to the BNC terminals. Do not connect the DUT to the fixture.
- Step 6. Press the [OK] soft-key. The T3LCR will then measure the open admittances (capacitance and conductance) at the all test frequency points.

During the measurement, an “LCR OPEN measurement in progress” dialog message is shown on the display.

When the measurement has finished, “Correction finished” is displayed. During the measurement, you can press the [ABORT] soft-key to abort the OPEN correction.

- Step 7. After the OPEN measurement has finished, the meter will enable OPEN correction automatically. You can, however, still choose to manually enable or disable OPEN correction by depressing the ON or OFF soft-keys.

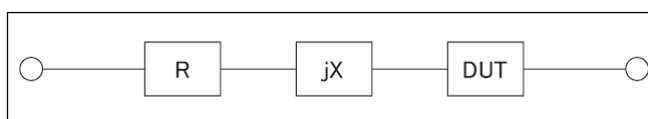
## 4.2.2 Short Correction [SHORT]

The short correction feature of the T3LCR Series compensates for any residual impedances (R,X) that may exist outside of calibration, such as the impedance of the cables and the DUT connection points.

See Figure 4-4 Residual Impedances.

Figure 4-4

Residual Impedances



### To perform short correction

- Step 1. Press the [Measure] key.
- Step 2. Press the [OPEN SHORT] soft-key.
- Step 3. Use the cursor key to select the [SHORT] field.

| Soft-key   | Function                      |
|------------|-------------------------------|
| ON         | Enables short correction.     |
| OFF        | Disables short correction.    |
| MEAS SHORT | Starts short correction (AC). |
| DCR SHORT  | Starts short correction (DC). |

- Step 4. Press the [MEAS SHORT] or [DCR SHORT] soft-key, a dialog message, “Short-circuit the test terminals”, will appear.
- Step 5. Connect the test fixture to the BNC terminals and short-circuit the test terminals.
- Step 6. Press the [OK] soft-key. The T3LCR measures the short impedances (inductances and resistance) at the all test frequency points. During the measurement, an “LCR SHORT measurement in progress” dialog message is shown on the display. When the measurement has finished, “Correction finished” is displayed. During the measurement, you can press the [ABORT] soft-key to abort the SHORT correction.
- Step 7. After the SHORT measurement has finished, the meter will enable SHORT correction automatically. You can, however, still choose to manually enable or disable SHORT correction by depressing the ON or OFF soft-keys.

### 4.2.3 SPOT Correction

The spot correction function involves performing open/short correction at user-specified frequency points. You can specify 1 frequency point.

## To specify frequency points and perform open correction

- Step 1. Press the [Measure] key.
- Step 3. Press the [OPEN SHORT] soft-key.
- Step 3. Use the cursor key to select the [SPOT] field.
- Step 4. Enter the frequency using the numeric entry keys.

| Soft-key     | Function                |
|--------------|-------------------------|
| ON           | Enable this point.      |
| OFF          | Disables this point.    |
| CURRENT FREQ | Use current frequency   |
| MEAS OPEN    | Starts open correction. |
| MEAS SHORT   | Starts short correction |

- Step 4. Press the [MEAS OPEN] soft-key. A dialog message, “Open-circuit the test terminals”, will appear.
- Step 5. Connect the test fixture to the BNC terminals. Do not connect the DUT to the test fixture.
- Step 6. Press the [OK] soft-key. The T3LCR measures the open admittances (capacitance and conductance) at this frequency point.  
During the measurement, an “OPEN measurement in progress” dialog message will be shown on the display.  
When the measurement has finished, “Correction finished”, will be displayed.  
During the measurement, you can press the [ABORT] soft-key to abort open correction.



### To specify frequency points and perform short correction

- Step 1. Press the [MEAS SHORT] soft key, a dialog message, “Short-circuit the test terminals”, will be displayed.
- Step 2. Connect the test fixture to the BNC terminals and short-circuit the test terminals.
- Step 3. Press the [OK] soft-key. The T3LCR measures the short impedances (inductances and resistance) at this frequency point.  
During the measurement, a “SHORT measurement in progress” dialog message will be shown on the display.  
When the measurement has finished, “Correction finished” is displayed on the screen. During the measurement, you can press the [ABORT] soft-key to abort short correction.

## 4.3 [LIST SETUP] Page

Press the [Measure] key and press the [LIST SETUP] soft-key to open the [LIST SETUP] page. The List Measure feature can perform automatic sweep measurements by sweeping the frequency or signal level through a maximum 10 list points.

Before using the List Measure feature, you have to configure the list setup.

In the [LIST SETUP] page, you can configure each of the following list measurement controls with the cursor placed in the corresponding field.

- Function mode [FUNC]
- Test mode [MODE]
- Parameter selection [FREQ[Hz], VOLT[V], CURR[A]]
- Limit parameter selection [LMT]
- Lower and upper limits [LOWER] [UPPER]

Figure 4-5 [LIST SETUP] Page

| No. | FREQ[Hz] | LMT | LOWER      | UPPER      |
|-----|----------|-----|------------|------------|
| 1   | 1.000 k  | A   | 50.0000 μF | 80.0000 μF |
| 2   | 2.000 k  | A   | 50.0000 μF | 80.0000 μF |
| 3   | 3.000 k  | A   | 50.0000 μF | 80.0000 μF |
| 4   | 5.000 k  | A   | 1000.000mF | 1000.000mF |
| 5   | 10.00 k  | A   | 1000.000mF | 1000.000mF |
| 6   | 50.00 k  | A   | 1000.000mF | 1000.000mF |
| 7   | 150.0 k  | A   | 1000.000mF | 1000.000mF |
| 8   | 200.0 k  | A   | 1000.000mF | 1000.000mF |
| 9   | 250.0 k  | B   | 800.000 Ω  | 900.000 Ω  |
| 10  | 300.0 k  | B   | 0.01000 Ω  | 1.00000 Ω  |

### 4.3.1 Measurement Function [FUNC]

Select the primary and the secondary measurement here.

### 4.3.2 Test Mode [MODE]

The [LIST MEAS] page will execute a list of up to 10 swept frequency or amplitude tests.

When [MODE] is set to SEQ and [TRIG] is set to MAN, the [LIST MEAS] function will automatically execute each test step on the list in sequence until the last step is executed. The meter will then wait for the trigger button to be depressed before repeating the process.

When [MODE] is set to STEP and [TRIG] is set to MAN, the [LIST MEAS] function will automatically execute the first test step. The meter will then wait for the trigger button to be depressed before executing the next step. This process is repeated for each step on the list.

| Soft-key | Function                                  |
|----------|-------------------------------------------|
| SEQ      | Sequence measure all step by one trigger. |
| STEP     | Measure one step by one trigger.          |

There are 4 available trigger modes in the [LIST MEAS] page.

| Trigger Mode | Function                                                                 |
|--------------|--------------------------------------------------------------------------|
| INT          | Trigger by the meter's internal trigger source.                          |
| MAN          | Trigger by pressing the trigger button.                                  |
| EXT          | Trigger by sending a signal to the trigger pin on the handler interface. |
| BUS          | Trigger by the RS-232/USB port.                                          |

### 4.3.3 List Measurement Parameters

The list parameter used for the list measurement can be the measurement frequency or the signal level [V/A]. Use the list point field to specify the list measurement parameter.

#### To specify the list sweep measurement parameter

- Step 1. Press the [Measure] key.
- Step 2. Press the [LIST SETUP] soft-key.
- Step 3. Use the cursor key to select FREQ or VOLT or CURR field.
- Step 4. Use the soft-keys to select list measurement parameter.

| Soft-key | Function                                         |
|----------|--------------------------------------------------|
| FREQ     | Uses frequency as the list measurement parameter |
| VOLT     | Uses voltage as the list measurement parameter   |
| CURR     | Uses current as the list measurement parameter   |

### 4.3.4 List Point and Limit Modes

The List measurement feature supports up to 10 list points as well as measurement limit values. Each list point can be turned on or off.

#### To configure the list points:

- Step 1. Press the [Measure] key.
- Step 2. Press the [LIST SETUP] soft-key.
- Step 3. Use the cursor key to select one of the list point field (1 through 10)
- Step 4. Use the soft-keys to turn on/off the current point.

| Soft-key | Function               |
|----------|------------------------|
| ON       | Turn on current point  |
| OFF      | Turn off current point |

- Step 5. Enter the list point value (maybe the frequency value or the signal level voltage/current value). When you enter the frequency value, the soft-key labels change to unit labels (Hz, kHz). When you enter the signal level voltage value, you don't need to enter units. When you enter the signal level current value, the soft-key labels change to unit labels (uA, mA).
- Step 6. Using the cursor keys, select the LMT field.
- Step 7. Configure the limit parameter by pressing the appropriate soft-key.

| Soft-key  | Function                                             |
|-----------|------------------------------------------------------|
| PRIMARY A | Uses the primary parameter as the limit parameter.   |
| 2NDARY B  | Uses the secondary parameter as the limit parameter. |
| OFF       | Turns OFF the limit feature.                         |

- Step 8. Using the cursor keys, select the LOWER field.
- Step 9. Enter the lower limit value.
- Step 10. Using the cursor keys, select the UPPER field and enter the higher limit value.
- Step 11. Repeat Step 4 to Step 10.

## 4.4 [LIST MEAS] Page

The [LIST MEAS] page will appear when you press the [Measure] key and then the [LIST MEAS] soft-key.

Figure 4-6

[LIST MEAS] Page

| No. | FREQ[Hz] | Cs         | RANGE | Rs        | CMP |
|-----|----------|------------|-------|-----------|-----|
| 1   | 1.000 k  | 151.044 nF |       | 4.38137 Ω | L   |
| 2   | 2.000 k  | 150.767 nF |       | 3.00416 Ω | L   |
| 3   | 3.000 k  | 150.584 nF |       | 2.43871 Ω | L   |
| 4   | 5.000 k  | 150.343 nF |       | 1.89876 Ω | L   |
| 5   | 10.00 k  | 149.885 nF |       | 1.42362 Ω | L   |
| 6   | 50.00 k  | 148.033 nF |       | 0.83988 Ω | L   |
| 7   | 150.0 k  | 143.530 nF |       | 0.70858 Ω | L   |
| 8   | 200.0 k  | 140.600 nF |       | 0.69086 Ω | L   |
| 9   | 250.0 k  | 137.163 nF |       | 0.67574 Ω | L   |
| 10  | 300.0 k  | 133.081 nF |       | 0.66532 Ω | P   |

On the [LIST MEAS] page, the list points are swept and the measurement results are compared to the limits. During a sweep, an asterisk mark (\*) will appear on the left side of the list point currently being measured.

This page provides the following information:

- Trigger mode [TRIG].
- Test mode [MODE].
- Range mode [RANGE].
- Measurement recording [LOG].

These conditions can be set from [MEAS DISPLAY] page and [SETUP] page.

### 4.4.1 Trigger Mode [TRIG]

Select the trigger mode for LIST MEAS here; manual trigger is generally used for LIST MEAS.

When entering the LIST MEAS function, the default trigger mode is the manual trigger mode.

You can use the cursor button to highlight the TRIG source field and select the other available trigger sources.

### Trigger mode

When entering LIST MEAS for the first time, the system will set Trig Mode to MAN.

| Trig Mode | Function                                                                                                                  |
|-----------|---------------------------------------------------------------------------------------------------------------------------|
| INT       | Internal Trigger. All ten list points are swept continuous.                                                               |
| MAN       | Manual Trigger. Each time the instrument is triggered by [Trig] key, the list points are swept one by one.                |
| EXT       | External Trigger. Each time the instrument is triggered by the handler trigger pin, the list points are swept one by one. |
| BUS       | BUS Trigger. Each time the instrument is triggered by SCPI command, the list points are swept one by one.                 |

## 4.4.2 Test Mode [MODE]

The [LIST MEAS] page will execute a list of up to 10 swept frequency or amplitude tests.

When [MODE] is set to SEQ and [TRIG] is set to MAN, the [LIST MEAS] function will automatically execute each test step on the list in sequence until the last step is executed. The meter will then wait for the trigger button to be depressed before repeating the process.

When [MODE] is set to STEP and [TRIG] is set to MAN, the [LIST MEAS] function will automatically execute the first test step. The meter will then wait for the trigger button to be depressed before executing the next step. This process is repeated for each step on the list.

### Test Mode

| Soft-key | Function                                  |
|----------|-------------------------------------------|
| SEQ      | Sequence measure all step by one trigger. |
| STEP     | Measure one step by one trigger.          |

There are 4 available trigger modes in the [LIST MEAS] page.

| Trigger Modes | Function                                                                 |
|---------------|--------------------------------------------------------------------------|
| INT           | Trigger by the meter's internal trigger source.                          |
| MAN           | Trigger by pressing the trigger button.                                  |
| EXT           | Trigger by sending a signal to the trigger pin on the handler interface. |
| BUS           | Trigger by the RS-232/USB port.                                          |

### 4.4.3 Range Mode [RANGE]

Displays the selected measurement range for each measurement step; this field is here only for display, its content can't be changed here. If you need to change the measurement range; it can be done in the [MEAS DISPLAY] or [MEAS SETUP] function.

### 4.4.4 Measurement log [LOG]

The T3LCR has an internal data buffer that record up to 10000 measurement readings. These readings can be saved to an external USB drive in a .csv file format. These readings can then be opened on a PC using software such as Windows Excel. When the LOG function is active, the display is fixed to the [MEAS DISPLAY] screen. The [FUNC], [FREQ] and [LEVEL] settings are also fixed and cannot be changed.

#### Procedure for setting Log

- Step 1. Press the [LIST MEAS] soft-key.
- Step 2. Use the cursor keys to select the [LOG] status field.
- Step 3. Use the [START LOG] soft-keys to start a new log.

| Soft-key  | Function                        |
|-----------|---------------------------------|
| START LOG | To start a new measurement log. |

- Step 4. After a new log has started, the measurement readings will be recorded into the meter's internal buffer. The options in the following table are available during this recording process:

| Soft-key     | Function                                                                                                                                                                                                                                                                  |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SAVE & STOP  | Stops the recording and saves the recorded readings in the internal buffer to an external USB flash drive. The internal buffer will be cleared after the save operation. If an external USB flash drive is not plugged in, the meter will not stop the ongoing recording. |
| CLEAR & STOP | Stop recording and clears the internal buffer.                                                                                                                                                                                                                            |

Step 5. When the internal buffer is full, “!FULL” will be added after the number of recorded counts(in the [LOG] status field). The following two operations are available in this situation:

| Soft-key     | Function                                                                                                                       |
|--------------|--------------------------------------------------------------------------------------------------------------------------------|
| SAVE TO USB  | Saves the recorded readings in the buffer to an external USB flash drive. The internal buffer is cleared after this operation. |
| CLEAR BUFFER | Clears the internal buffer.                                                                                                    |

Before saving the recorded readings in the internal buffer to the external USB flash drive, remember to plug the external USB drive into the USB port on the front panel.

The recorded readings will be saved in a subdirectory named LIST DATA, whose parent directory will have the same name as the T3LCR model being used. See the example in below:

Example: F:\T3LCR1300\LIST DATE\LIST0000.CSV

Up to 9999 recording files can be saved, with their file names from 0001.csv-9999.csv.

The size of the internal buffer can be adjusted in SYSTEM→SYSTEM CONFIG→DATA BUFFER setting field. The maximum data buffer size is 10000.



## 4.5 [ENLARGE DISPLAY] Page

Only four measurement values will be shown in this simplified display mode: The primary measurement parameters, the secondary measurement parameters and two monitored parameters such as  $\Delta$ ,  $\Delta\%$ , Iac or Vac, etc.

### 4.5.1 Enlarge Display

Press the ENLARGE soft-key in the [MEAS DISPLAY] to enter the [ENLARGE DISPLAY] mode (simplified display mode); on the contrary, press the NORMAL soft-key in the [ENLARGE DISPLAY] mode to quit the [ENLARGE DISPLAY] mode and return to the regular [MEAS DISPLAY] mode.

Two biggest readings you see in the upper part of the [ENLARGE DISPLAY] mode are the primary and the secondary measurement parameters while the two other smaller readings in the lower part of the display are the monitored parameters you chose to be displayed. The PASS/FAIL result of the Direct Comparison function (see 4.5.2 Direct Comparison Function) for the DUT currently being measured will be displayed in the bottom right corner of the enlarged display.

The Direct Comparison function allows you to see whether the currently measured DUT is within the acceptable tolerance range without the complexity of the BIN sorting function.

Figure 4-7 [ENLARGE DISPLAY] Page



## 4.5.2 Direct Comparison Function

The Direct Comparison function can be turned on in the [BIN SETUP] page. When the number of bins is set to 1 in the [BIN SETUP] page, the Direct Comparison function will be activated for the [ENLARGE DISPLAY] mode. To activate Direct Comparison, choose “1-BINS” in the [BIN SETUP] page. Please refer to the Total Number of Bins [#-BINS] chapter on page 61 on how to choose “1-BINS”.

Figure 4-8 Direct Comparison setting



# 5. SETUP KEY

This section includes the following information:

- MEAS SETUP page
- BIN SETUP page
- BIN MEAS page
- BIN COUNT page

Every time or everywhere you can press the [Setup] key to open the [MEAS SETUP] page.

## 5.1 [MEAS SETUP] Page

**NOTE** In [MEAS SETUP] page, the Instrument does not display test result and sorting result, but testing still in progress.

Figure 5-1 [MEAS SETUP] Page



In the [MEAS SETUP] Page, you can configure each of the following measurement controls with the cursor placed in the corresponding field.

- Measurement Function [FUNC] <sup>\*1</sup>
- Impedance range [RANGE] <sup>\*1</sup>
- Test Frequency [FREQ] <sup>\*1</sup>
- Trigger Mode [TRIG] <sup>\*1</sup>
- Test Signal Voltage Level [LEVEL] <sup>\*1</sup>
- Measurement Speed [SPEED] <sup>\*1</sup>
- Source Output Impedance [SRC RES]
- Averaging Factor [AVG]
- DC Bias Voltage [BIAS]
- Auto LCZ Function [AUTO LCZ]
- Monitor 1 and Monitor 2 Parameter Select [MON 1]  
[MON 2]
- Measurement Delay Time [DELAY]
- Auto Level Control [ALC]

#### NOTE

\*1. These six settings can be set in the [MEAS DISPLAY] page and the [BIN COUNT] page. Please refer to section 4.1 [MEAS DISPLAY] Page on page 23 for details.

### 5.1.1 Source Output Impedance [SRC RES]

The Source output impedance can be set to 30Ω, 50Ω or 100Ω.

If you use T3LCR Series to test a smaller inductor, please use 30Ω.

If you need to compare test results with Keysight E4980A, select 100Ω.

#### Procedure for setting source output impedance

- Step 1. Press the [Setup] key.
- Step 2. Use the cursor key to select the [SRC RES] field.
- Step 3. Use the soft-keys to set the source output impedance.

| Soft-key | Function |
|----------|----------|
| 30Ω      | 30Ω      |
| 50Ω      | 50Ω      |
| 100Ω     | 100Ω     |

### 5.1.2 Averaging Factor [AVG]

The averaging feature allows you to obtain moving average values of successive measurement results.

You can specify the averaging factor from integer 1 to integer 256.

#### To set up the averaging factor

- Step 1. Press the [Setup] key.
- Step 2. Use the cursor key to select [AVG] field.
- Step 3. Use the soft-keys or number keys to enter averaging factor.

| Soft-key | Function                                                                         |
|----------|----------------------------------------------------------------------------------|
| INCR +   | Increments the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256. |
| DECR -   | Decrements the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256. |

### 5.1.3 DC Bias Voltage [BIAS]

This function will apply a DC bias voltage onto the DUT while LCR meter is performing its AC measurement on the DUT. The settable DC bias voltage range is from -2.5V-2.5V.

#### Procedure for setting DC bias voltage

- Step 1. Press the [Setup] key.
- Step 2. Use the cursor key to select [BIAS] field.
- Step 3. Use the soft-keys to select DC bias voltage.

| Soft-key | Function                                           |
|----------|----------------------------------------------------|
| OFF      | Turn off the DC bias voltage                       |
| 2V       | 2V voltage is applied to the device under test.    |
| 1.5V     | 1.5V voltage is applied to the device under test.  |
| -1.5V    | -1.5V voltage is applied to the device under test. |
| -2V      | -2V voltage is applied to the device under test.   |

| Bias Voltage range                                     | Resolution |
|--------------------------------------------------------|------------|
| $0.01\text{V} \leq \text{DC BIAS} \leq 2.50\text{V}$   | 0.01V      |
| $-2.50\text{V} \leq \text{DC BIAS} \leq -0.01\text{V}$ | 0.01V      |

### 5.1.4 Auto LCZ Function [AUTO LCZ]

Auto LCZ Function can help you to select a proper measurement parameter.

#### NOTE

Auto LCZ Function cannot judge complex components, please do not rely entirely on this function to measure.

#### To set up the Auto LCZ Function

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [AUTO LCZ] field
- Step 3. Use the soft-keys to turn on/off the Auto LCZ Function.

| Soft-key | Function                                                                                                        |
|----------|-----------------------------------------------------------------------------------------------------------------|
| OFF      | Turn off the Auto LCZ Function                                                                                  |
| ON       | Turn on the Auto LCZ Function.<br>When Auto LCZ Function is set to ON, "AUTO-LCZ" will display on [FUNC] field. |

#### NOTE

The Auto LCZ Function will be turned off after you set the measurement function.

### 5.1.5 Monitor 1 and Monitor 2 [MON 1][MON 2]

The T3LCR Series can monitor the other two parameters.

#### NOTE

Additional monitoring parameters **do not** increase the instrument measurement time. Monitor parameter display in [MEAS DISPLAY] page and [ENLARGE] page.

### Procedure for setting monitor parameters (monitor 1 and monitor 2)

- Step 1. Press the [Setup] key.
- Step 2. Use the cursor key to select [MON 1] or [MON 2] field.
- Step 3. Use the soft-keys to select DC bias voltage.

| Soft-key   | Function                     |
|------------|------------------------------|
| OFF        | Turn off the monitor         |
| Z          | Absolute value of impedance  |
| D          | Dissipation factor           |
| Q          | Quality factor(=1/D)         |
| Vac        | Test signal Voltage          |
| Iac        | Test signal Current          |
| $\Delta$   | Absolute deviation value     |
| $\Delta\%$ | Relative deviation value     |
| $\theta_r$ | Phase radian                 |
| $\theta_d$ | Phase angle                  |
| R          | Resistance (=Rs)             |
| X          | Reactance                    |
| G          | Conductance                  |
| B          | Sustenance                   |
| Y          | Absolute value of admittance |

### 5.1.6 Measurement Delay [DELAY]

This setting decides how long the meter will wait to commence a measurement after the trigger signal is received. Settable range: 0ms to 60s.

### 5.1.7 AUTO LEVEL CONTROL [ALC]

The automatic level control (ALC) feature adjusts the voltage across the DUT or the current through the DUT to match the voltage/current level setting. Using this feature, you can try to ensure a constant signal level (voltage or current) is applied to the DUT.

---

**NOTE** In situations when the actual measuring Vac or Iac goes beyond the extent that the ALC can regulate, a warning message, “Failed! ALC can’t regulate!”, will be shown at the bottom of the screen to indicate to the operator that the ALC can no longer regulate Vac/Iac.

An asterisk will be shown beside the LEVEL V or A unit when the ALC is turned on.

---

| Soft-key | Function                                 |
|----------|------------------------------------------|
| OFF      | Turn off the Auto Level Control Function |
| ON       | Turn on the Auto Level Control Function  |

### 5.1.8 Nominal Value [NOMINAL]

The Nominal Value parameter becomes displayed and settable only when MON1 and MON2 are set in either  $\Delta$  or  $\Delta\%$  modes. The Nominal Value and the measured main parameter will then be used to perform the  $\Delta$  or  $\Delta\%$  calculations.



## 5.2 [BIN SETUP] Page

Press [Setup] key and press the [BIN SETUP] soft-key to open [BIN SETUP] page.

This page allows you to configure the T3LCR Series' built-in comparator. The built-in comparator can sort DUTs into a maximum of 10 levels (BIN1 through BIN9 and OUT) using up to nine sets of primary parameter limits along with one set of secondary parameter limits.

In addition, DUTs that fall within the primary parameter limits but are out of the secondary parameter limits can be sorted into an auxiliary bin.

To take full advantage of the comparator, T3LCR Series is equipped with a handler interface for use in conjunction with the comparator. All 10 bin signals can output to your PLC via the handler interface.

In the [BIN SETUP] page, you can configure each of the following controls with the cursor placed in the corresponding field.

- Measurement Function [FUNC]
- Comparator ON/OFF [COMP] <sup>\*1</sup>
- Auxiliary bin ON/OFF [AUX] <sup>\*1</sup>
- Nominal value [NOM]
- Primary parameter comparator limit mode [MODE]
- Beep feature [BEEP]
- Primary parameter total bins [BINS]

---

### NOTE

\*1. These two settings can also be set in the [BIN MEAS] page.

---

Figure 5-2 [BIN SETUP] Page



## 5.2.1 Measurement Function [FUNC]

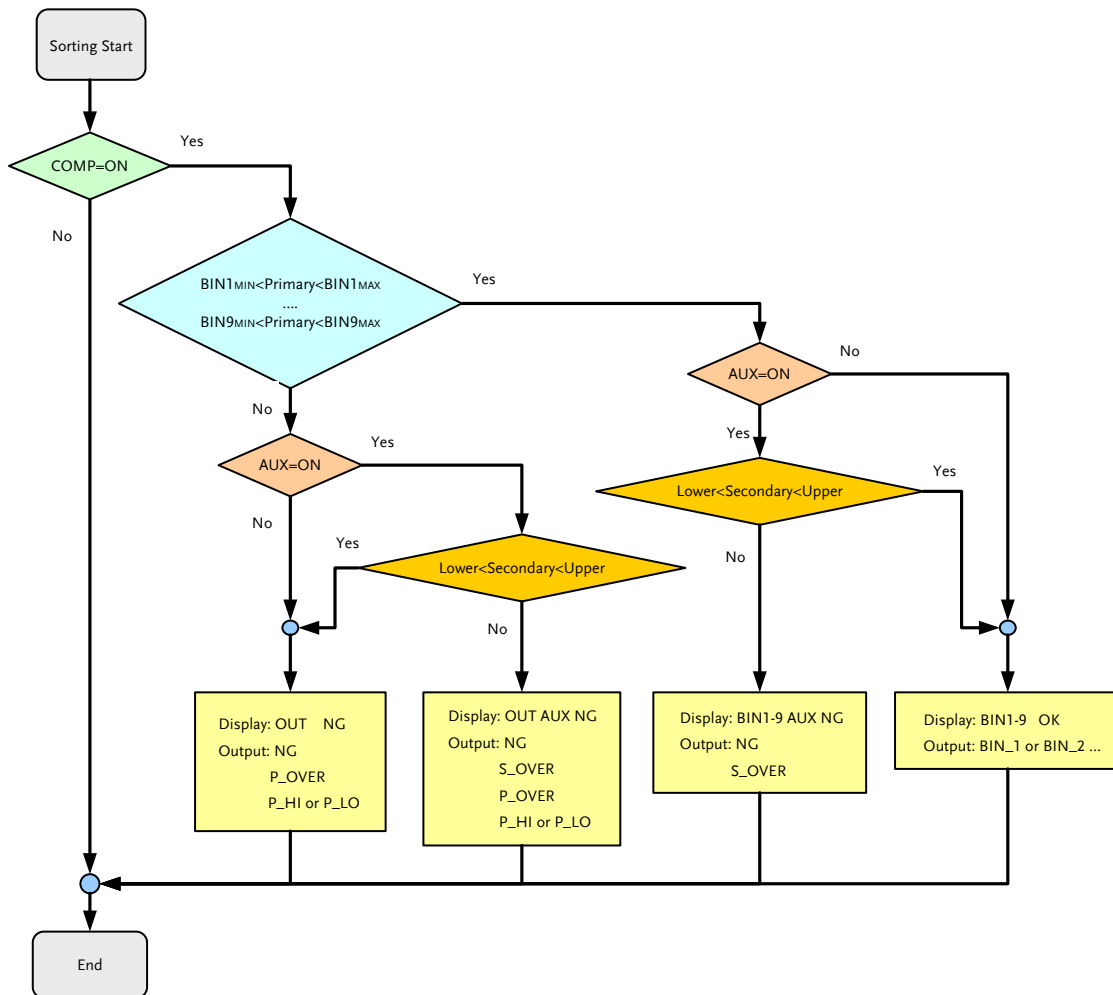
The T3LCR Series simultaneously measures four components of the complex impedance (parameters) in a measurement cycle. These include primary parameter, secondary parameter and two monitor parameters. Please refer to the 4.1 [MEAS DISPLAY] Page section on 23 for details.

## 5.2.2 Comparator Function ON/OFF

T3LCR Series' built-in comparator can sort DUT's into a maximum of 10 bins (BIN1 to BIN9 and OUT), using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits.

A DUT can be sorted into the auxiliary BIN (AUX) when the primary parameter is within the limits but the secondary parameter is not.

Figure 5-3 Page Comparator Workflow



### Procedure for setting the comparator function [COMP]

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [COMP] field.
- Step 4. Use the soft-keys to turn on/off the comparator.

| Soft-key | Function                    |
|----------|-----------------------------|
| OFF      | Turns OFF the COMP function |
| ON       | Turns ON the COMP function  |

### 5.2.3 Auxiliary Bin [AUX]

After AUX is turned on, DUTs that do not fall within the primary parameter limit values are sorted as OUT. In addition, DUTs that fall within the primary parameter limits but are out of the secondary parameter limits are sorted into the auxiliary (AUX) bin.

Procedure for turning ON/OFF the auxiliary bin [AUX]

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [AUX] field.
- Step 4. Use the soft-keys to turn on/off the auxiliary bin.

| Soft-key | Function                    |
|----------|-----------------------------|
| ON       | Turns ON the auxiliary bin  |
| OFF      | Turns OFF the auxiliary bin |

### 5.2.4 Primary Parameter Comparator limit mode [MODE]

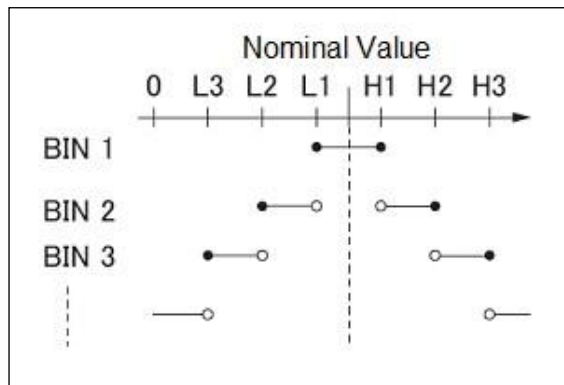
You can specify the primary parameter limit values in one of the following 3 ways:

- Tolerance mode [%][Δ]  
In tolerance mode, the comparison limit values are based on the deviations from the specified nominal value, which can be specified in the [NOM] field. You configure the tolerance mode limit values as a deviation percentage (%) or absolute (Δ) parameter value.
- Sequential mode [SEQ]  
In sequential mode, the comparison limit values are based on the absolute value of the measurement. When you configure these limit values, you have to first define the minimum value and then the maximum value.
- Nominal Value [NOM]  
Sets the nominal value (reference value) for the ABS and PER compare modes. Use the number keys to enter the value and the unit.

### Absolute mode[ABS]

Absolute value ( $\Delta$ ) = UNKNOWN value – nominal value

Figure 5-4 Absolute mode

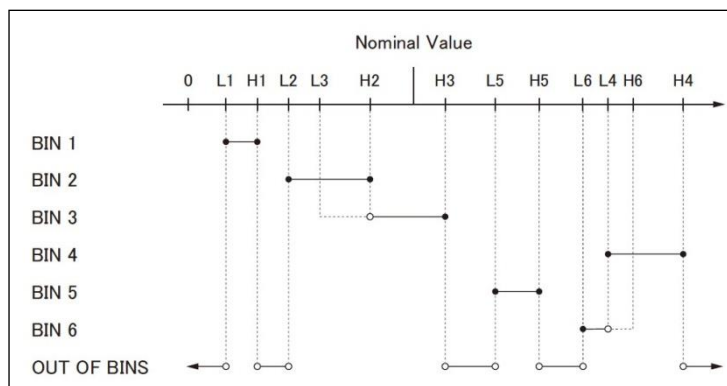


- Includes the point
- Excludes the point

### Percentage mode [PER]

Deviation percentages (%) = Absolute value ( $\Delta$ )/nominal value  $\times$  100%

Figure 5-5 Percentage mode

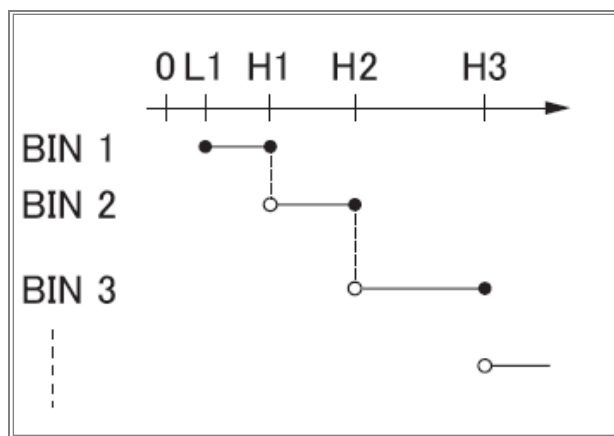


- Includes the point
- Excludes the point

## Sequential mode[SEQ]

Figure 5-6

### Sequential mode



- Includes the point
- Excludes the point

In Sequential mode, the comparison limit values are based on the absolute value of the measurement. The nominal value does not need to participate in operation.

### To set up the comparator limit mode

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [MODE] field.
- Step 4. Use the soft-keys to select comparator mode.

| Soft-key | Function                  |
|----------|---------------------------|
| ABS      | Absolute parameter values |
| PER      | Deviation percentages     |
| SEQ      | Sequential mode           |

## 5.2.5 Nominal value for tolerance mode

You must configure the nominal value when you use tolerance mode as the limit mode for the primary parameter.

In sequential mode the nominal value does not affect sorting. In sequential mode, you do not need to configure the nominal value.

### To enter the nominal value

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [NOM] field.
- Step 4. Enter the nominal value using the entry keys.  
Use the soft-key to select the unit.

## 5.2.6 Beep feature

The beep feature behaves differently depending on which beep mode is in effect.

### To set up the beep feature

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [BEEP] field.
- Step 4. Use the soft-keys to set beep feature.

| Soft-key | Function                                      |
|----------|-----------------------------------------------|
| OFF      | Turns the beep feature off                    |
| PASS     | Beep when the comparator sorting result is OK |
| FAIL     | Beep when the comparator sorting result is NG |

## 5.2.7 Total Number of Bins [#- BINS]

T3LCR series specify nine bins (1-BINS to 9-BINS).

### To choose total number of the bins

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [#-BINS] field.
- Step 4. Use the soft-keys to select beep tone.

| Soft-key | Function      |
|----------|---------------|
| 1-BINS   | Set to 1 bin  |
| 2-BINS   | Set to 2 bins |
| 3-BINS   | Set to 3 bins |
| 4-BINS   | Set to 4 bins |
| 5-BINS   | Set to 5 bins |
| 6-BINS   | Set to 6 bins |
| 7-BINS   | Set to 7 bins |
| 8-BINS   | Set to 8 bins |
| 9-BINS   | Set to 9 bins |

## 5.2.8 Lower and Upper Limits

T3LCR Series built-in comparator can sort DUTs into a maximum 10 levels (Bin1 through Bin9 and OUT) using up to nine sets of primary parameter limits along with one set of secondary parameter limits.

### To enter the limit values for tolerance mode

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN SETUP] soft-key.
- Step 3. Use the cursor key to select [BIN 1 LOWER] field
- Step 4. Enter the limit value using the entry keys.  
When in the ABS and SEQ mode, please enter the unit using the soft-keys. When in the PER mode, the unit is %.
- Step 5. Repeat Step 4 using the cursor keys until you have entered all limit values.
- Step 6. Use the cursor key to select [2nd LOWER] field and enter the lower limit value for the secondary parameter.
- Step 7. Select [2nd UPPER] field to enter the upper limit value.

## 5.3 [BIN MEAS] Page

When the [Setup] key and the [BIN MEAS] soft-key is pressed, the [BIN MEAS] page appears. The bin sorting results are displayed in larger characters while the measurement results are shown in normal characters.



Figure 5-7

[BIN MEAS] Page



This page provides the following information:

- FUNC, RANGE, FREQ, LEVEL, TRIG, LEVEL, SPEED: These conditions can be set from [MEAS DISPLAY] page.
- Comparator function ON/OFF [COMP].
- Auxiliary bin ON/OFF [AUX].

### 5.3.1 Comparator Function ON/OFF

T3LCR built-in comparator can sort DUTs into a maximum of 10 bins (BIN1 to BIN9 and OUT) using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits.

A DUT which has the primary parameter within the limits, but secondary parameter is not, can be sorted into an auxiliary BIN (AUX).

See Figure 5-3 on page 57 for the Comparator Workflow.

#### Procedure for setting the comparator function [COMP]

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN MEAS] soft-key.
- Step 3. Use the cursor key to select [COMP] field.
- Step 4. Use the soft-keys to turn on/off the comparator.

| Soft-key | Function                    |
|----------|-----------------------------|
| OFF      | Turns OFF the COMP function |
| ON       | Turns ON the COMP function  |

### 5.3.2 Auxiliary Bin [AUX]

After AUX is turned on, DUTs that do not fall within the primary parameter limit values are sorted as OUT. In addition, DUTs that fall within the primary parameter limits but out of the secondary parameter limits are sorted into the auxiliary (AUX) bin.

#### Procedure for turning ON/OFF the auxiliary bin [AUX]

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN MEAS] soft-key.
- Step 3. Use the cursor key to select [AUX] field.
- Step 4. Use the soft-keys to turn on/off the auxiliary bin.

| Soft-key | Function                    |
|----------|-----------------------------|
| ON       | Turns ON the auxiliary bin  |
| OFF      | Turns OFF the auxiliary bin |

## 5.4 [BIN COUNT] Page

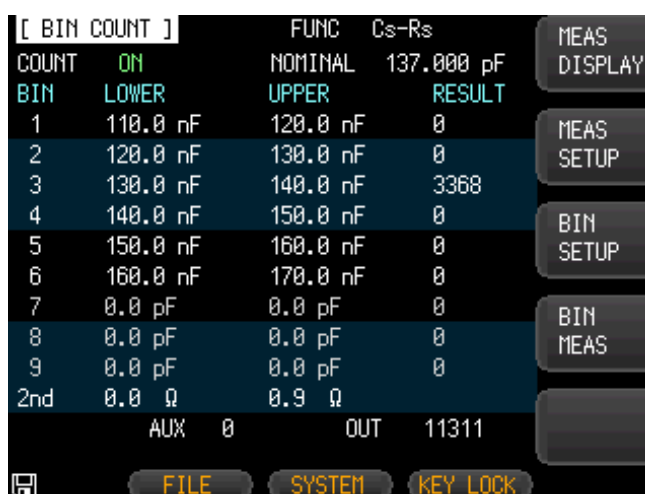
When the [Setup] key and the [BIN COUNT] soft-key is pressed, the [BIN COUNT] page appears.

This page provides the following information:

- Counter function [COUNT]

Figure 5-8

[BIN COUNT] Page



## 5.4.1 Counter Function [COUNT]

The number of DUTs sorted into each bin is counted while the unit sorts the DUTs into the appropriate bins using the comparator function.

When the maximum count of 99999999 is reached, the counting operation stops and the overflow message “-----” appears.

### Set the Counter:

- Step 1. Press the [Setup] key.
- Step 2. Press the [BIN COUNT] soft-key.
- Step 3. Use the cursor key to select [COUNT] field.
- Step 4. Use the soft-keys to set counter function.

| Soft-key    | Function                                    |
|-------------|---------------------------------------------|
| COUNT ON    | Turns the counter function on               |
| COUNT OFF   | Turns the counter function off              |
| RESET COUNT | The counter is reset when this key pressed. |

# 6. SYSTEM CONFIGURATIONS

---

This section includes the following information:

- SYSTEM CONFIG page
  - SYSTEM INFO page
  - SYSTEM SERVICE page
- 

## 6.1 [SYSTEM CONFIG] Page

When the [Measure] or [Setup] key is pressed, followed by the [SYSTEM] bottom soft-key, the [SYSTEM CONFIG] page appears.

The following information can be configured in the [SYSTEM CONFIG] page.

- System Information
- System date and time configuration [DATE/TIME]
- Account settings [ACCOUNT]
- Key Beep setting [KEY BEEP]
- Baud rate setting [BAUD]
- Remote control interface [REMOTE]
- [HAND SHAKE]
- [ERROR CODE]
- [RESULT]
- [DATA BUFFER]
- [DEFAULT SET]

Figure 6-1

## [SYSTEM CONFIG] Page



### 6.1.1 Setting the system date and time

T3LCR Series features a built-in 24-hour clock.

#### To change the date

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select date field.
- Step 4. Use the soft-keys to edit date.

| Soft-key    | Function                           |
|-------------|------------------------------------|
| YEAR INCR+  | Increases the year in steps of 1.  |
| YEAR DECR-  | Decreases the year in steps of 1.  |
| MONTH INCR+ | Increases the month in steps of 1. |
| DAY INCR+   | Increases the day in steps of 1.   |
| DAY DECR-   | Decreases the day in steps of 1.   |

#### To change the time

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select time field.
- Step 4. Use the soft-keys to edit time.

| Soft-key     | Function                            |
|--------------|-------------------------------------|
| HOUR INCR+   | Increases the hour in steps of 1.   |
| HOUR DECR-   | Decreases the hour in steps of 1.   |
| MINUTE INCR+ | Increases the minute in steps of 1. |
| MINUTE INCR- | Decreases the minute in steps of 1. |
| SECOND DECR+ | Increases the second in steps of 1. |
| SECOND DECR- | Decreases the second in steps of 1. |

## 6.1.2 Account Setting

The T3LCR Series has two accounts, administrator and user.

Administrator: All functions can be configured by the administrator except [SYSTEM SERVICE] page.

User: All functions can be configured by user except the [SYSTEM SERVICE] page and the [FILE] page.

### To Change Account

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select ACCOUNT field.
- Step 4. Use the soft-keys to change account.

| Soft-key | Function      |
|----------|---------------|
| ADMIN    | Administrator |
| USER     | User          |

Switch user mode to administrator mode, you must input a correct password.

### To Change Administrator's Password

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select [ADMINISTRATOR] field. When the ACCOUNT field is [USER], you should change to [ADMINISTRATOR].
- Step 4. Use the soft-keys to change the password or delete the password.

| Soft-key           | Function                              |
|--------------------|---------------------------------------|
| CHANGE<br>PASSWORD | Input password (less than 9 numbers). |
| DELETE<br>PASSWORD | The password will be removed.         |

**NOTE**

If you forget your password, please contact your local  
TELEDYNE distributor or TELEDYNE  
<http://teledynelecroy.com>.

### 6.1.3 KEY BEEP Setting

Key tone settings.

#### To set up the beep feature

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [KEY BEEP] field.
- Step 4. Use the soft-keys to set the beep settings.

| Soft-key | Function                       |
|----------|--------------------------------|
| ON       | Turn on the key beep feature.  |
| OFF      | Turn off the key beep feature. |

### 6.1.4 Baud rate

Before you can control the T3LCR Series remotely via the built-in RS-232/USB controller, you have to configure the RS-232 RS-232/USB baud rate.

The T3LCR built-in RS-232/USB interface uses the SCPI language.

RS-232/USB configuration is as follows:

Data bits: 8-bit

Stop bits: 1-bit

Parity: none

#### To set up the baud rate

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [BAUD] field.
- Step 4. Use the soft-keys to select the baud rate.

| Soft-key | Function                      |
|----------|-------------------------------|
| 1200     | Sets the baud rate to 1200.   |
| 9600     | Sets the baud rate to 9600.   |
| 38400    | Sets the baud rate to 38400.  |
| 57600    | Sets the baud rate to 57600.  |
| 115200   | Sets the baud rate to 115200. |

## 6.1.5 Remote control interface

Selection the interface for PC/PLC remote control.

| Soft-key | Function                             |
|----------|--------------------------------------|
| RS232    | Select RS-232 port as remote control |
| USB      | Select USB port as remote control    |



Note

Only one mode is supported. Before selecting either a remote control mode, please connect its corresponding cable to appropriate port on the rear panel of the device.

For other setting items about remote control mode, please refer to chapter “Remote control” on page 89.

After the device detects the signal change on RS-232 or USB interface, the device will immediately communicate with the host at the setting serial transmission rate, and the keyboard will be locked as well.

In order to be able to communicate correctly, please confirm whether the setting serial transmission rate and stop bit are set correctly. Otherwise the device won't be able to communicate with host computer correctly.

## 6.1.6 TERMINATOR

The command terminator EOL uses the ASCII Line Feed character by default. (LF, Decimal 10, Hex 0x0A, or ASCII '\n')

The EOL of the command and the EOL of the command return data are the same.

The terminator (EOL) can change the three types:

1. LF (Line feed, Hex 0x0A).
2. CR (Carriage Return, Hex 0x0D).
3. CR+LF.

The T3LCR PC software only supports LF types.



| Soft-key | Function                         |
|----------|----------------------------------|
| LF       | Set up the EOL to LF(0Ah).       |
| CR       | Set up the EOL to CR(0Dh).       |
| CR+LF    | Set up the EOL to CR+LF(0D 0Ah). |

## 6.1.7 Hand Shake

If handshaking is turned on, the meter will return the commands it received from the PC first before returning the result string of the command.

Example: PC sends idn?

The meter returns:

idn? T3LCR1300 RevC1.0

### To set up the Hand Shake feature

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [HAND SHAKE] field.
- Step 4. Use the soft-keys to set the handshake setting.

| Soft-key | Function                         |
|----------|----------------------------------|
| OFF      | Turn off the Hand Shake feature. |
| ON       | Turn on the Hand Shake feature.  |

## 6.1.8 Error Code

If the error code setting is set to on, the meter will return error codes if the wrong command or an invalid command is received to help you to debug your control program.

```

"*E00", //No error
"*E01", //"Bad command",
"*E02", //"Parameter error",
"*E03", //"Missing parameter",
"*E04", //"buffer overrun",
"*E05", //"Syntax error",
"*E06", //"Invalid separator",
"*E07", //"Invalid multiplier",
"*E08", //"Numeric data error",

```

"\*E09", // "Value too long",  
"\*E10", // "Invalid command"  
"\*E11", // "Unknown error"

### **To set up the Error Code feature**

- Step 1. Press the [Measure] or [Setup] key.  
Step 2. Press the [SYSTEM] bottom soft-key.  
Step 3. Use the cursor key to select the  
[ERROR CODE] field.  
Step 4. Use the soft-keys to set the error code setting.

| Soft-key | Function                         |
|----------|----------------------------------|
| OFF      | Turn off the Error Code feature. |
| ON       | Turn on the Error Code feature.  |

## 6.1.9 Result

If the Result setting is set to Auto, the meter will automatically send out the measurement results each time a test is finished; this setting is convenient especially when the meter is working with a sorting machine. The meter will start a test after receiving the trigger signal and then returns the test result to the sorting machine without the need to receive a 'fetch?' command from either the sorting machine or the control PC.

### To set up the Result feature

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [RESULT] field.
- Step 4. Use the soft-keys to set.

| Soft-key | Function                                                    |
|----------|-------------------------------------------------------------|
| FETCH    | The meter will not send out the test result after the test. |
| AUTO     | The meter will send out the test result after the test.     |

## 6.1.10 DATA BUFFER

The data buffer setting sets the maximum number of record counts that the internal buffers can store; Settable range 1-10000.

### To set up the Data Buffer feature

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [DATA BUFFER] field.
- Step 4. Enter the number of sets using the entry keys or use the soft-key to select the maximum number of sets.

| Soft-key | Function                                             |
|----------|------------------------------------------------------|
| MAX      | Sets the maximum record counts to be 10000 directly. |

## 6.1.11 DEFAULT SET

To reset setting values (MEAS SETUP) and offset values (OPEN SHORT) to factory default, use the DEFAULT SET setting. The device can be quickly restored to its factory settings.

Default settings:

(MEAS SETUP):

FUNC: Cp-D  
 FREQ: 1kHz  
 LEVEL: 1V  
 RANGE: AUTO  
 TRIG: INT  
 SPEED: SLOW  
 SRC RES: 100Ω  
 BIAS: OFF  
 AUTO LCZ: OFF  
 DELAY: 0ms  
 ALC: OFF  
 AVG: 1  
 MON1: OFF  
 MON2: OFF

(OPEN SHORT):

OPEN TEST: ON  
 SHORT TEST: ON  
 SPOT: OFF

### To reset setting values to factory default:

- Step 1. Press the [Measure] or [Setup] key.
- Step 2. Press the [SYSTEM] bottom soft-key.
- Step 3. Use the cursor key to select the [DEFAULT SET] field.
- Step 4. Use the soft-keys to set.

| Soft-key | Function                             |
|----------|--------------------------------------|
| ON       | To reset to default factory settings |
| OFF      | No reset to factory default settings |

## 6.2 [SYSTEM INFO] Page

When the [Measure] or [Setup] key is pressed followed by [SYSTEM] bottom soft-key, and then the [SYSTEM INFO] soft-key, the [SYSTEM INFO] page appears.

There are no configurable options in the [SYSTEM INFO] page.

Figure 6-2

### [SYSTEM INFO] Page



# 7. FILE OPERATION

This chapter provides information on the file operation of the T3LCR Series.

You can save up to 10 files into the internal non-volatile memory.

## 7.1 [FILE] Page

When the [Setup] key is pressed followed by the [FILE] bottom soft-key, the [FILE] page appears.

Figure 7-1

[FILE] Page



In this page, you can configure each of the following controls with the cursor placed in the corresponding field.

- Recall a file when the instrument starts up [AUTO RECALL].
- Automatically save a file when the instrument shuts down [AUTO SAVE].

## 7.1.1 [MEDIA]

The Media field is used to select the media source from either the meter's internal memory or an external USB flash drive. A maximum of up to 10 files can be accessed from either source.

- Step 1. Press the [Setup] key.
- Step 2. Press the [FILE] bottom soft-key.
- Step 3. Use the cursor key to select the [MEDIA] field.
- Step 4. Use the soft-keys to select the source.

| Soft-key        | Function                                           |
|-----------------|----------------------------------------------------|
| INTERNAL MEMORY | To access files from the meter's internal memory.  |
| USB MEMORY      | To access files from the external USB flash drive. |

## 7.1.2 Recall a File at Startup [AUTO RECALL]

You can recall file0 or the current file when the instrument starts up.

### To select auto recall file

- Step 1. Press the [Setup] key.
- Step 2. Press the [FILE] bottom soft-key.
- Step 3. Use the cursor key to select the [AUTO RECALL] field.
- Step 4. Use the soft-keys to select the recall option.

| Soft-key  | Function                                            |
|-----------|-----------------------------------------------------|
| LAST FILE | Last used file will be recalled at next startup.    |
| FILE 0    | File 0 will be recalled at next instrument startup. |

### 7.1.3 Auto save data to last file [AUTO SAVE]

You can save the modified data into the last used file when the instrument power key is pressed.

#### To turn on/off the AUTO SAVE function

- Step 1. Press the [Setup] key.
- Step 2. Press the [FILE] bottom soft-key.
- Step 3. Use the cursor key to select the [AUTO SAVE] field.
- Step 4. Use the soft-keys to select the save option.

| Soft-key | Function                            |
|----------|-------------------------------------|
| ON       | Auto save function will be enabled. |
| OFF      | Turn off the auto save function.    |

### 7.1.4 File operation

#### To choose a file to operate

- Step 1. Press the [Setup] key.
- Step 2. Press the [FILE] bottom soft-key.
- Step 3. Use the cursor keys to select a file (File name from 0 to 9).
- Step 4. Use the soft-keys to perform an operation.

| Soft-key   | Function                                                                                               |
|------------|--------------------------------------------------------------------------------------------------------|
| SAVE       | Save user configuration data into currently selected file.                                             |
| RECALL     | Recall configuration data from currently selected file.                                                |
| ERASE      | Erase the selected file. The user configuration data will be reset to the default at the next startup. |
| MODIFY DES | Modify the file description.                                                                           |



# 8. HANDLER INTERFACE

---

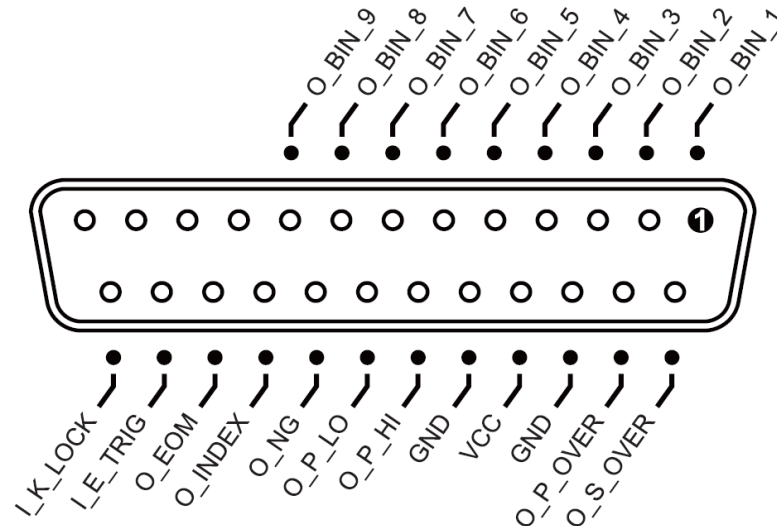
This chapter provides information about the T3LCR Series' built-in handler interface. It includes:

- Pin Assignment
  - Circuit Diagram
  - Timing Chart
- 

The T3LCR Series' built-in handler interface outputs signals that indicate the end of a measurement cycle, the result of bin sorting by the comparator. In addition, the instrument accepts input of external trigger. You can use these signals to easily integrate the T3LCR Series with a component handler or system controller. This means that you can fully automate such tasks as component inspection, component sorting, and processing of quality management data for higher manufacturing efficiency.

## 8.1 Pin Assignment

Figure 8-1 Pin Assignment



### Output Pins

Table 8-1 Handler Interface Signals-Output Pins

| Pin | Pin names | Signal descriptions                               |
|-----|-----------|---------------------------------------------------|
| 1   | O_BIN_1   | The sorting result is within bin1.<br>Active low. |
| 2   | O_BIN_2   | The sorting result is within bin2.<br>Active low. |
| 3   | O_BIN_3   | The sorting result is within bin3.<br>Active low. |
| 4   | O_BIN_4   | The sorting result is within bin4.<br>Active low. |
| 5   | O_BIN_5   | The sorting result is within bin5.<br>Active low. |
| 6   | O_BIN_6   | The sorting result is within bin6.<br>Active low. |
| 7   | O_BIN_7   | The sorting result is within bin7.<br>Active low. |
| 8   | O_BIN_8   | The sorting result is within bin8.<br>Active low. |
| 9   | O_BIN_9   | The sorting result is within bin9.<br>Active low. |
| 10  |           | NC                                                |
| 11  |           | NC                                                |
| 12  |           | NC                                                |

|    |          |                                                                                                                                         |
|----|----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 13 |          | NC                                                                                                                                      |
| 14 | O_S_OVER | Over fail occurs on the secondary measurement parameter. Active low. (The signal on this pin is available only after AUX is turned on.) |
| 15 | O_P_OVER | Over fail occurs on the primary measurement parameter. Active low. The logic state of this pin = O_P_HI OR O_P_LO.                      |
| 19 | O_P_HI   | Hi fail occurs on the primary measurement parameter. Active low.                                                                        |
| 20 | O_P_LO   | Low fail occurs on the primary measurement parameter. Active low.                                                                       |
| 21 | O_NG     | The overall test result is an over fail. Active low. The logic state of this pin = O_S_OVER OR O_P_OVER.                                |
| 22 | O_INDEX  | This pin indicates that AD conversion is still ongoing. It is not yet finished when it is low.                                          |
| 23 | O_EOM    | A low level on this pin indicates that the test is still ongoing and not yet finished.                                                  |

### Input Pins

Table 8-2

Handler Interface Signals-Input Pins

| Pin | Pin names | Signal descriptions                                                                                                           |
|-----|-----------|-------------------------------------------------------------------------------------------------------------------------------|
| 24  | I_E_TRIG  | External trigger input, Active on a rising edge.                                                                              |
| 25  | I_K_LOCK  | Key pad lock signal. Low on this pin locks the key pad on the front panel while a high level on this pin unlocks the key pad. |

### Power Pins

Table 8-3

Handler Interface Signals-Power Pins

| Pin   | Pin names | Signal descriptions              |
|-------|-----------|----------------------------------|
| 16,18 | GND       | GND pin for external power input |
| 17    | VCC       | VCC pin for external power input |

## 8.2 Connection

### Electrical parameters

Interface power requirements: +12.4V-36VDC, 0.2A(Min).

Output circuit: Built-in pull-up resistors are internally connected to the collector pin of the output transistors. The output pins are isolated by photocouplers.

Input pins: Isolated by photocouplers.



**Warning:** To avoid damaging the interface, ensure the external power does not exceed the +12.4-36V input range.

To avoid damaging the interface, turn off the meter before making any wired connections to this interface.

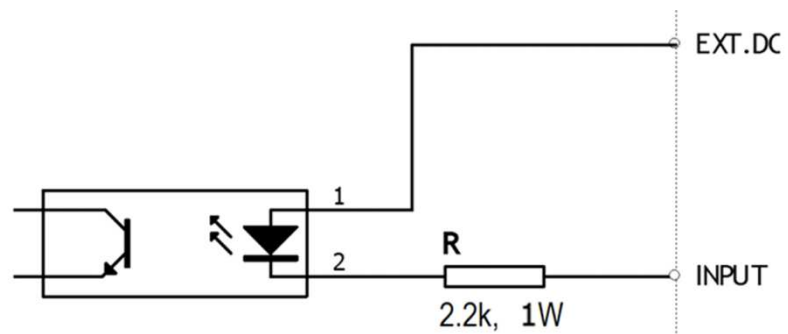
If users need to use the output pins of this interface to drive external relays, do use only small signal relays. Because the output pins of this interface are driven by photocouplers, the fan-out current is not sufficient to drive big relays; external transistors need to be used when users want to use the signals on these output pins to control big relays. The coil of the external relays must be in parallel with a flyback diode.

### Circuit of input pins

Figure 8-2

Circuit of input pins

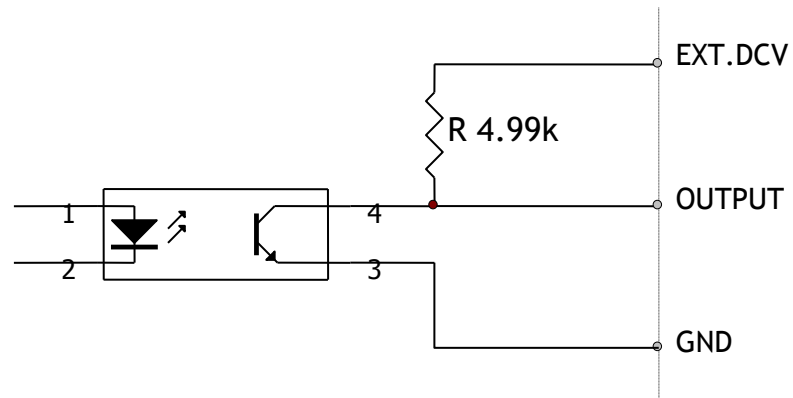
Sink Current: 5-50mA.



### Circuit of output pins

Figure 8-3

Circuit of output pins (Bin sorting, Index, EOM)



Maximum sourcing current: 5mA.

Maximum sinking current: 50mA

## 8.3 Timing Chart for Handler Interface

Figure 8-4

Timing chart

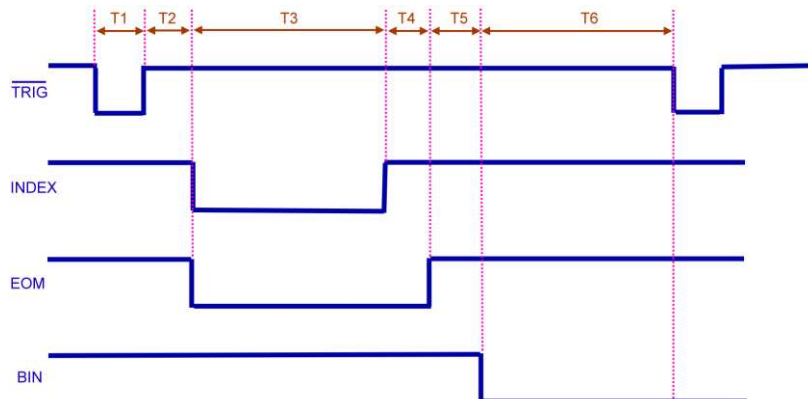


Table 8-4

Timing Definitions

| Time segment |                                    |                         | Minimum value       |
|--------------|------------------------------------|-------------------------|---------------------|
| T1           | Trigger pulse width                |                         | 1msec               |
| T2           | Measurement circle                 | Trigger delay time      | < 10usec            |
| T3           |                                    | Analog Measurement time | Depends on settings |
| T4           |                                    | Digital math time       | 1msec               |
| T5           |                                    | Bin output delay time   | 200usec             |
| T6           | Trigger wait time after the output |                         | 0sec                |

# 9. EXAMPLES

---

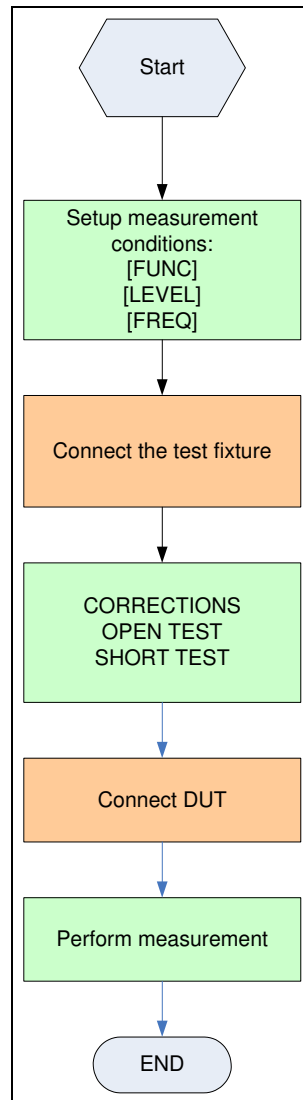
This chapter covers basic measurement procedures as well as basic L, C, and R measurement theory. It also offers various measurement hints. After the descriptions of basic measurement procedures, practical measurement examples are shown using T3LCR Series.

---

## 9.1 Basic Measurement Procedure

The following flow chart shows the basic procedures used to measure the impedance of capacitors, inductors, resistors, and other components. Follow the procedures to perform impedance measurements while referring to the items noted to the right side of each step.

Figure 9-1 Basic Measurement Procedure



## 9.2 Example

This paragraph describes a practical example of measuring a ceramic capacitor.

The basic procedure flow to perform this measurement is the same as the Basic Measurement Procedure described previously. In this example, a ceramic capacitor is measured under the following conditions.

Sample (DUT) Ceramic capacitor Measurement Conditions:

- Function: Cs-D
- Test Frequency: 1 kHz
- Test Signal Level: 1V

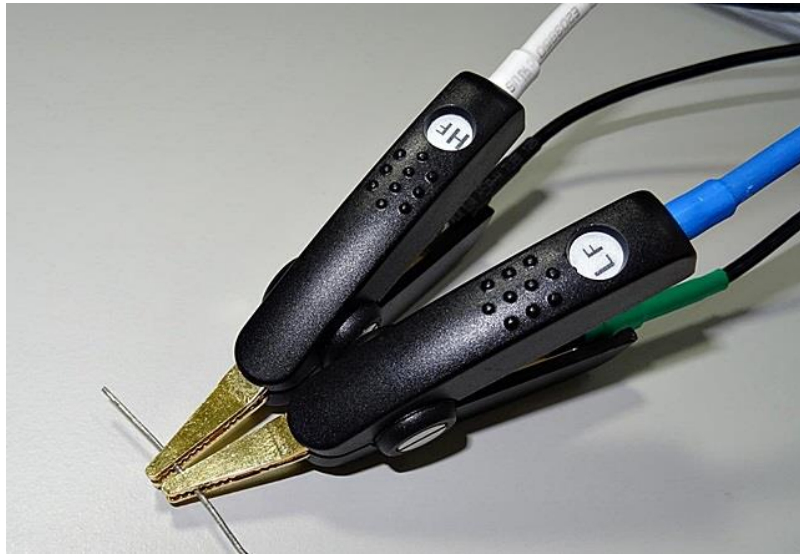
- Step 1. Turn the T3LCR Series ON.
- Step 2. Set up the measurement conditions by filling in the fields on the MEAS DISPLAY page.
- Move to the FUNC field using the cursor keys and choose Cs-D.
  - Move to the FREQ field using the cursor keys and input 1 kHz.
  - Move to the LEVEL field using the cursor keys and input 1 V
- Step 3. Connect the test fixture to the T3LCR Series.
- Step 4. To compensate for the test fixture, a user correction is required.  
Don't connect any DUT to the unit, as shown below:
1. Press the [Measure] key and the [OPEN SHORT] soft-key.
  2. Move to the OPEN TEST or SPOT field using the cursor keys.
  3. Don't connect the clips to anything, as shown here:



4. Press the [MEAS OPEN] soft-key and then the [OK] soft-key. Wait until the "Correction finished" message is displayed.
5. Press the [ON] soft-key if the OPEN field is set to OFF.
6. Move to the SHORT TEST or SPOT

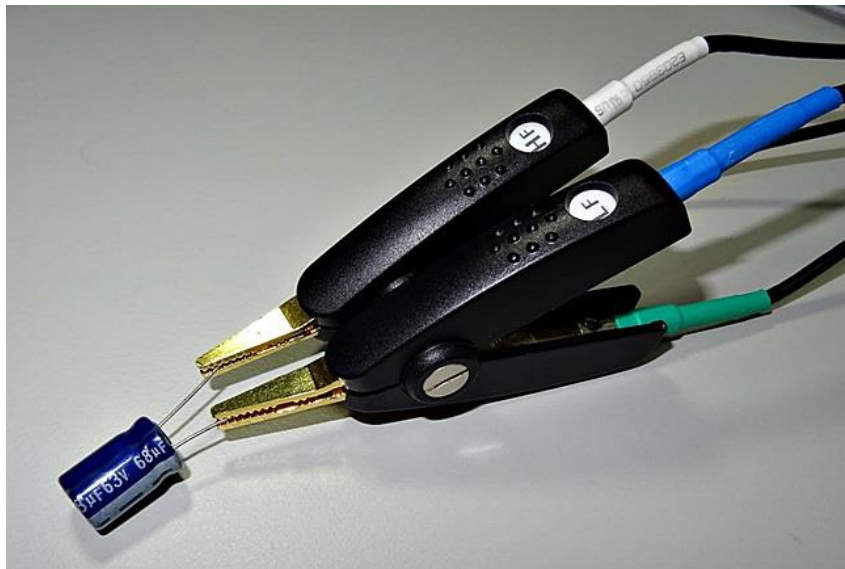


- field using the cursor keys.
7. Connect the clips to a shorting bar as shown below:



8. Press the [MEAS SHORT] soft-key and then the [OK] soft-key. Wait until the "Correction finished" message is displayed.
9. Press the [ON] soft-key if the SHORT field is set to OFF.

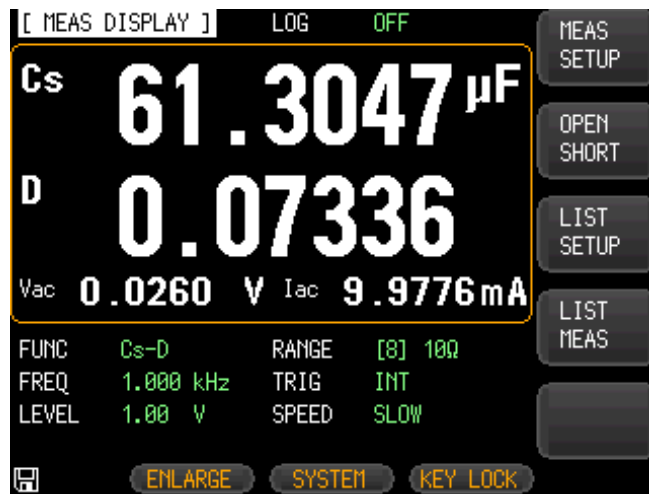
Step 5. Connect the DUT to the test fixture as shown below:



- Step 6. Press the [Measure] key. Measurements are performed continuously by the internal trigger, and the measured Cs and D values of

the capacitors are displayed as shown below:

Figure 9-2 Measurement results



# 10. REMOTE CONTROL

---

This chapter provides the following information to remotely control the T3LCR Series via the RS-232 or USB:

- RS-232 Interface
  - USB Interface
  - Install USB Driver
- 

The device uses the RS-232 interface or USB interface to communicate with the computer to complete all device's functions. With standard SCPI commands, users can easily create various acquisition system which are suitable for themselves.

---

## 10.1 RS-232 Interface

You can connect a controller (i.e. PC and PLC) to the RS-232 interface using a TELEDYNE RS-232 DB-9 cable. The serial port uses the transmit (TXD), receive (RXD) and signal ground (GND) lines of the RS-232 standard. It does not use the hardware handshaking lines CTS and RTS.

---



NOTE:

Only use a TELEDYNE (null modem) DB-9 cable.

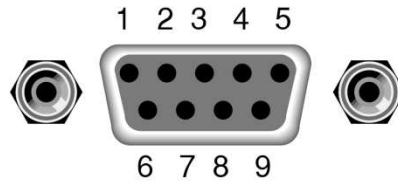
Cable length should not exceed 2m.

To avoid electrical shock, turn off the power when plugging and unplugging the DB-9 cable.

---

Figure 10-1

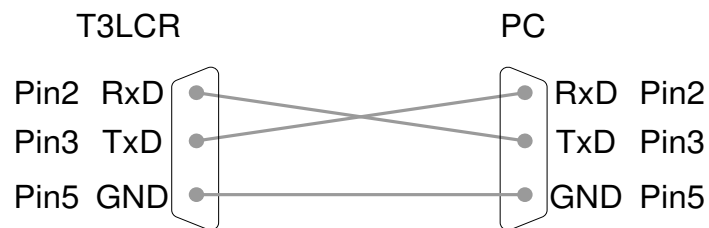
The RS-232 connector on the real panel



Pin 2: RxD  
 Pin 3: TxD  
 Pin 5: GND  
 Pin 1, 4, 6-9: No Connection

Figure 10-2

PC to T3LCR Series connection uses a null modem connection



- Make sure the controller you connect to T3LCR Series also uses these settings. The RS-232 interface transfers data using:  
 Data bits: 8 bits  
 Stop bits: 1 bit  
 Parity: none  
 Baud rate: 1200-115200bps

## 10.2 USB Interface

You can connect a controller (i.e. PC and PLC) to the USB interface using a type A-B USB cable.

This virtual port can perform the same functions as RS232 and use the same settings as the RS232 port. It supports USB2.0 and below version.

The USB device port on the rear panel is used for remote control. The USB port is configured as CDC interface.

When configured to CDC, the USB port on the T3LCR series will appear as a virtual COM port to a connected PC. Any terminal program that can communicate via a serial port can be used for remote control. Before the T3LCR series can be used for remote control using the

CDC USB class, install the appropriate CDC USB driver.

---



NOTE:

Only use a type A-B USB cable.

Cable length should not exceed 2m.

To avoid electrical shock, turn off the power when plugging and unplugging the USB cable.

---

- Make sure the controller you connect to T3LCR Series also uses these settings. The USB interface transfers data using:

PC connector: Type A, host

T3LCR series connector: Rear panel Type B, slave

Speed: 1.1/2.0 (full speed/high speed)

USB Class: CDC (Communications device class)

Hardware flow control: Off

Data bits: 8-bit

Stop bits: 1-bit

Parity: none

Baud rate: 1200-115200 bps

## 10.3 Install USB Driver

The USB driver needs to be installed when using the USB port for remote control. The USB interface creates a virtual COM port when connected to a PC.

Configure the interface to USB in  
SYSTEM>CONFIG>REMOTE item.

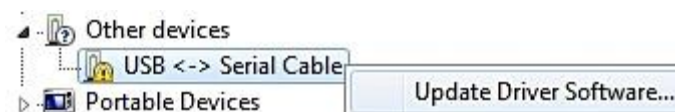
Connect the Type A-B USB cable to the rear panel USB B port on the T3LCR. Connect the other end to the Type A port on the PC.

Go to the Windows Device Manager.

For Windows 7 go to:

Start Menu > Control Panel > Hardware and Sound > Device Manager

The T3LCR will appear as an unknown LCR Meter Virtual Com Port under “Other Devices”.



Right-click Other Devices and select “Update Driver Software”.

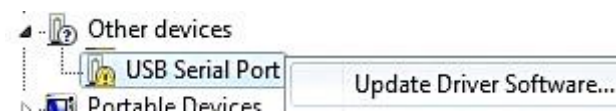
Select “Browse my computer for driver software” and select the USB VCP Drivers.



The T3LCR and the converter that it is assigned to will now appear in under the Controller (Universal Serial Bus Controller) node.



The T3LCR will appear as an unknown USB Serial Port under “Other Devices”.

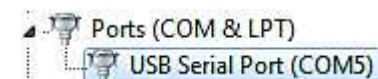


Right-click Other Devices and select “Update Driver Software”.

Select “Browse my computer for driver software” and select the USB VCP Drivers.



The T3LCR and the COM port that it is assigned to will now appear in under the Ports (COM & LPT) node.



NOTE:

- To avoid electrical shock, turn off the power when plugging and unplugging the DB9 cable.
- If the driver installation is completed correctly, the number of USB serial port will be displayed.
- You need to remember this port number because you will use it when programming.

- SCPI commands can be operated through RS-232C or USB port.



# 11. COMMAND REFERENCE

## 11.1 Terminator

The EOI line is asserted by New Line or ASCII Line Feed character.  
(Decimal 10, Hex 0x0A, or ASCII ‘\n’)

## 11.2 Notation Conventions and Definitions

The following conventions and definitions are used in this chapter to describe RS-232 operation.

< > Angular brackets enclose words or characters that are used to symbolize a program code parameter or an RS-232 command.

[] A square bracket indicates that the enclosed items are optional.

\n Command Terminator

## 11.3 Command Structure

The T3LCR commands are divided into two types: Common commands and SCPI commands.

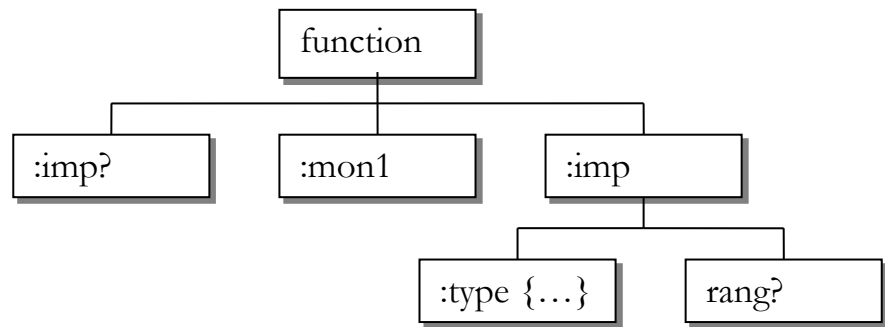
The common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. The SCPI commands are used to control all of the T3LCR's functions.

The SCPI commands are tree structured, three levels deep. The highest level commands are called the subsystem commands in this manual. So the lower level commands are legal only when the subsystem commands have been selected.

A colon (:) is used to separate the higher level commands and the lower level commands.

Semicolon (;) A semicolon does not change the current path but separates two commands in the same message.

Figure 11-1 Command Tree Example



Example:

`function:imp:type Cp-D`

function    Subsystem Command

imp            Level 2

type           Level 3

Cp-D           Parameter

**The basic rules of the command tree are as follows.**

- Letter case (upper and lower) is ignored.  
For example,  
**FUNCTION: IMPEDANCE=**  
**function:impedance**
- Spaces ( \_ used to indicate a space) must not be placed before and/or after the colon (:).  
For example,  
**❌ func \_ : \_ imp      →    ✅ func:imp**
- The command can be completely spelled out or in abbreviated form. (The rules for command abbreviation are described later in this section)  
For example,  
**function: impedance=func:imp**  
.
- The command header should be followed by a question mark (?) to generate a query for that command.  
For example,  
**function:imp?**
- Command abbreviations:

- Every command and character parameter has at least two forms, a short form and a long form. In some cases they will be the same. The short form is obtained using the following rules.

A) If the long form has four characters or less, the long form and short form are the same.

B) If the long form has more than 4 characters:

(a) If the 4th character is a vowel, the short form is the first 3 characters of the long form.

For example:

|            |                     |
|------------|---------------------|
| comparator | abbreviated to comp |
| current    | abbreviated to curr |
| range      | abbreviated to rang |

(b) If the 4th character is not a vowel, the short form is the first 4 characters.

For example:

|            |                    |
|------------|--------------------|
| resistance | abbreviated to res |
| volume     | abbreviated to vol |

- If the long form mnemonic is defined as a phrase rather than a single word, then the long form mnemonic is the first character of the first word(s) followed by the entire last word. The above rules, when the long form mnemonic is a single word, are then applied to the resulting long form mnemonic to obtain the short form.

For example:

PercentTolerance abbreviated to ptol

## 11.4 Header and Parameters

The commands consist of a command header and parameters. (See the following.)

Example: `comp:nom 100.0e3`

Header      Parameter

Headers can be of the long form or the short form. The long form allows easier understanding of the program code and the short form allows more efficient use of the computer.

Parameters may be of two types as follows.

(A) Character Data and String Data Character data consists of ASCII characters. The abbreviation rules are the same as the rules for command headers.

(B) Numeric Data

- (a) **NR1** integer: For example, 1,+123,-123
- (b) **NR2** fix float: For example, 1.23,+1.23,-1.23
- (c) **NR3** floating point: For example, 1.23e3, 5.67e-3, 123k, 1.23M, 2.34G,

The available range for numeric data is 9.9E37. When numeric data is used as a parameter, the suffix multiplier mnemonics and suffix units (The suffix multiplier must be used with the suffix unit.) can be used for some commands as follows.

Table 11-1

Multiplier Mnemonics

| Definition    | Mnemonic |
|---------------|----------|
| 1E18 (EXA)    | EX       |
| 1E15 (PETA)   | PE       |
| 1E12 (TERA)   | T        |
| 1E9 (GIGA)    | G        |
| 1E6 (MEGA)    | MA       |
| 1E3 (KILO)    | K        |
| 1E-3 (MILLI)  | M        |
| 1E-6 (MICRO)  | U        |
| 1E-9 (NANO)   | N        |
| 1E-12 (PICO)  | P        |
| 1E-15 (PEMTO) | F        |
| 1E-18 (ATTO)  | A        |

## 11.5 Command Reference

All commands in this reference are fully explained and listed in the following functional command order.

- DISPlay Subsystem
- FUNCTion Subsystem
- FREQuency Subsystem
- VOLTage Subsystem
- APERture Subsystem
- FETCh Subsystem
- COMParator Subsystem
- LIST Subsystem
- CORRection Subsystem
- TRIGger Subsystem
- BIAS Subsystem
- FILE Subsystem
- ERRor Subsystem
- Common Command:
- \*TRG
- \*IDN?
- \*SAV
- \*RCL

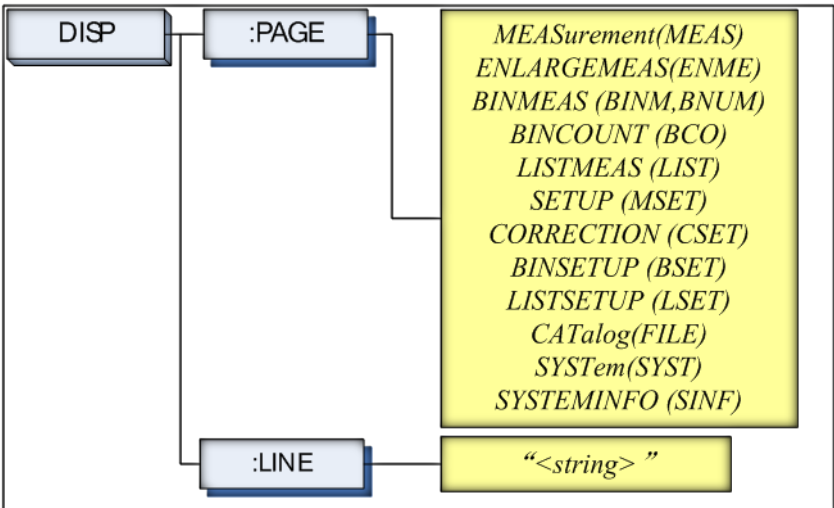
The explanation of each subsystem command is patterned as follows.

1. Subsystem command name
2. Command Tree (Subsystem command only)
3. Compound Command Name
4. Command Description
5. Command Syntax
6. Example Using the Above Command Syntax
7. Query Syntax
8. Query Response
9. Example Using the Above Query Syntax
10. Constraints

# 11.6 DISPlay Subsystem

The DISP Subsystem command group sets the display page.

Figure 11-2 Command Tree Example



## 11.6.1 DISP:LINE

The :LINE command enters an arbitrary comment line of up to 30 ASCII characters in the comment field.

|                |                                                                 |
|----------------|-----------------------------------------------------------------|
| Command Syntax | DISP:LINE "<string>"                                            |
| Parameter      | Where, <string> is ASCII character string (30 ASCII characters) |
| Example        | SEND> DISP:LINE "This is a comment."                            |

## 11.6.2 DISP:PAGE

The :PAGE command sets the display page.

The :PAGE? Query returns the abbreviated page name currently displayed on the LCD screen.

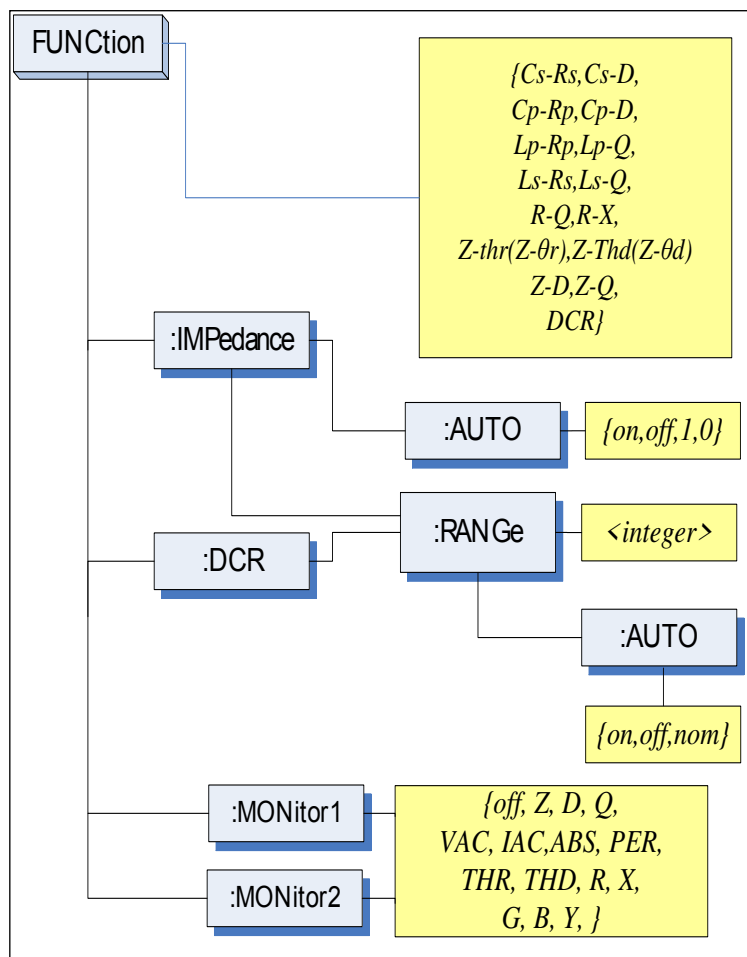
|                |                                                                                                                                                                                                                                                                |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | DISP:PAGE <page name>                                                                                                                                                                                                                                          |
| Parameter      | Where, <page name> is:<br>MEASurement [or MEAS] Sets the display page to MEAS DISPLAY.<br>ENLARGE[or ENLA] Sets the display page to ENLARGE DISPLAY.<br>BINMEAS [or BINM] Sets the display page to BIN MEAS.<br>BINCOUNT [or BCO] Sets the display page to BIN |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | <p>COUNT.</p> <p>LISTMEAS [or LIST] Sets the display page to LIST MEAS.</p> <p>SETUP [or MSET] Sets the display page to MEAS SETUP.</p> <p>CORRECTION [or CSET] Sets the display page to CORRECTION.</p> <p>BINSETUP [or BSET] Sets the display page to BIN SETUP.</p> <p>LISTSETUP [or LSET] Sets the display page to LIST SETUP.</p> <p>CATalog [ or CAT] Sets the display page to CATALOG</p> <p>SYSTem [or SYST] Sets the display page to SYSTEM CONFIG.</p> <p>SYSTEMINFO [or SINF] Sets the display page to SYSTEM INFORMATION.</p> |
| Example        | SEND> DISP:PAGE SYST<NL>//Set to the SYSEMT CONFIG.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Query Syntax   | DISP:PAGE?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Query Response | <page name><NL>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Example        | <p>SEND&gt; DISP:PAGE?&lt;NL&gt;</p> <p>RET&gt; SYST&lt;NL&gt;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Note           | <p>DISP:PAGE The command needs to be executed separately because of the long execution time to avoid the instrument ignoring the subsequent commands.</p> <p>SEND&gt; DISP:PAGE MEAS;FREQ 10k&lt;NL&gt;<br/>//Setting is wrong</p> <p>SEND&gt; DISP:PAGE MEAS&lt;NL&gt;//Setting is correct<br/>FREQ 10k &lt;NL&gt;</p>                                                                                                                                                                                                                   |

## 11.7 FUNCtion Subsystem

The FUNCtion subsystem command group sets the measurement function, the measurement range, monitors parameter control.

Figure 11-3      FUNCtion Subsystem Tree



### 11.7.1 FUNCtion

The FUNCtion command sets the measurement function.

|                |                                                                                                                                                                                                        |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | FUNC <function>                                                                                                                                                                                        |
| Parameter      | Where, <function> is:<br>Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, Rs-Q, Rp-Q, R-X, DCR, Z- $\theta$ r (or Z-thr)*1, Z- $\theta$ d (Z-thd)*1, Z-D, Z--Q.<br>(*1: $\theta$ is ASCII Hex 0xE9) |
| Example        | SEND> FUNC Cp-D<NL> //Set measurement function to Cp-D                                                                                                                                                 |
| Query Syntax   | FUNC?                                                                                                                                                                                                  |



|                |                                  |
|----------------|----------------------------------|
| Query Response | <function>                       |
| Example        | SEND> FUNC?<NL><br>RET> Cp-D<NL> |

### 11.7.2 FUNCtion:IMPedance:AUTO

The FUNCtion:IMPedance:AUTO command sets the impedance's LCZ Automatic selection.

|                |                                          |
|----------------|------------------------------------------|
| Command Syntax | FUNC:IMPedance:AUTO {ON,OFF, 0,1}        |
| Example        | SEND> FUNC:IMP:AUTO ON<NL>               |
| Query Syntax   | FUNC:IMPedance:AUTO?                     |
| Query Response | {on,off}<NL>                             |
| Example        | SEND> FUNC:IMP:AUTO?<NL><br>RET> off<NL> |

### 11.7.3 FUNCtion:IMPedance:RANGe

The FUNCtion:IMPedance:RANGe command sets the impedance's measurement range.

|                |                                                                                                      |
|----------------|------------------------------------------------------------------------------------------------------|
| Command Syntax | FUNC:IMPedance:RANGe <0-8,MIN,MAX>                                                                   |
| Parameter      | Where, <0-8,MIN, MAX> is:<br>0-8        The range number<br>MIN       =Range 0<br>MAX       =Range 8 |
| Example        | SEND> FUNC:IMP:RANG 2<NL> //Set measurement range to [2] 10k $\Omega$ .                              |
| Query Syntax   | FUNC:IMPedance:RANGe?                                                                                |
| Query Response | <0-8><NL>                                                                                            |
| Example        | SEND> FUNC:IMP:RANG?<NL><br>RET> 0<NL>                                                               |

### 11.7.4 FUNCtion:DCR:RANGe

The FUNCtion:DCR:RANGe command sets the DCR's measurement range.

|                |                                                                                                      |
|----------------|------------------------------------------------------------------------------------------------------|
| Command Syntax | FUNC:DCR:RANGe <0-8,MIN,MAX>                                                                         |
| Parameter      | Where, <0-8,MIN, MAX> is:<br>0-8        The range number<br>MIN       =Range 0<br>MAX       =Range 8 |
| Example        | SEND> FUNC:DCR:RANG 2<NL> //Set DCR range to [2] 10k $\Omega$ .                                      |
| Query Syntax   | FUNC:DCR:RANGe?                                                                                      |

|                |                                        |
|----------------|----------------------------------------|
| Query Response | <0-8><NL>                              |
| Example        | SEND> FUNC:DCR:RANG?<NL><br>RET> 0<NL> |

## 11.7.5 FUNcTION:RANGe:AUTO

The FUNcTION:RANGe:AUTO command sets the auto range to ON or OFF.

|                |                                                                                                                                                                |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | FUNC:RANGe:AUTO {off(hold),on(auto),NOMinal}                                                                                                                   |
| Parameter      | Where, {off(hold),on(auto),NOMinal} is:<br>off(or hold): Sets the auto range to off.<br>on(or auto): Sets the auto range to on.<br>NOMinal: Sets the range No. |
| Example        | SEND> FUNC:RANG:AUTO AUTO<NL> //Sets to auto range.<br>SEND> FUNC:RANG:AUTO off<NL> //Sets auto range to off.                                                  |
| Query Syntax   | FUNC:RANGe:AUTO?                                                                                                                                               |
| Query Response | {HOLD,AUTO,NOM}                                                                                                                                                |
| Example        | SEND> FUNC:RANG:AUTO?<NL><br>RET> auto<NL>                                                                                                                     |

## 11.7.6 FUNcTION:MONitor 1 /2

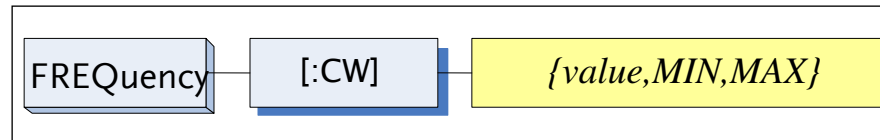
The FUNcTION:MONitor1 and FUNcTION:MONitor2 commands set the two monitor parameter.

|                |                                                                                                                                                      |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | FUNC:MONitor1 {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC}<br>FUNC:MONitor2 {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC} |
| Parameter      | Where, {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC}                                                                                    |
| Example        | SEND> FUNC:MON1 Z<NL>                                                                                                                                |
| Query Syntax   | FUNC:MON1?<br>FUNC:MON2?                                                                                                                             |
| Query Response | {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC}                                                                                           |
| Example        | SEND> FUNC:MON1?<NL><br>RET> off<NL>                                                                                                                 |

## FREQuency Subsystem

The FREQuency command sets the oscillator frequency. The FREQuency? query returns the current test frequency setting.

Figure 11-4      FREQ Subsystem Command Tree

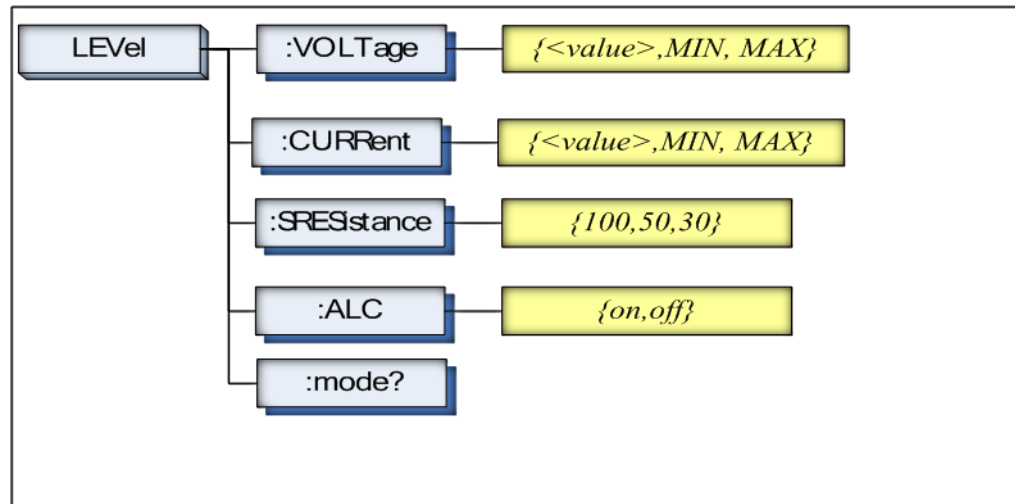


|                |                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | FREQ[:CW] {<value>,MIN,MAX}                                                                                                                                                       |
| Parameter      | Where,<br><value> Is the numeric data (NR1 integer, NR2fix float or NR3 floating point).<br>MIN Sets to the minimum value<br>MAX Sets to the maximum value                        |
| Example        | SEND> FREQ 1K<NL> //Set to 1kHz,the Hz cannot be added.                                                                                                                           |
| Query Syntax   | FREQ[:CW]?                                                                                                                                                                        |
| Query Response | <NR3><NL><br>NR3 floating point                                                                                                                                                   |
| Example        | SEND> FREQ?<NL><br>RET> 1.000000E+03<NL>                                                                                                                                          |
| Note           | A suffix multiplier (k) can be used with this command.<br>But the suffix unit Hz can't be used.<br>This command CANNOT be used in LIST SWEEP<br>DISPLAY page and CORRECTION page. |

## 11.8 LEVel Subsystem

The Level subsystem sets the oscillator's output voltage/current level and source output impedance.

Figure 11-5 LEVel Subsystem Command Tree



### 11.8.1 LEVel:VOLTage (=VOLTage[:LEVel])

The LEVel:VOLTage or VOLTage[:LEVel] command sets the oscillator's output voltage level.

|                |                                                                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LEVel:VOLTage {<value>,MIN,MAX}<br>or VOLTage:LEVel {<value>,MIN,MAX}                                                                              |
| Parameter      | Where,<br><value> Is the numeric data (NR1, NR2 or NR3).<br>MIN Sets to the minimum value of voltage.<br>MAX Sets to the maximum value of voltage. |
| Example        | SEND> LEV:VOLT 0.3<NL> //Set to 0.3V, V unit suffix cannot be used.                                                                                |
| Query Syntax   | LEVel:VOLTage?<br>or VOLTage:LEVel?                                                                                                                |
| Query Response | <NR3><br>NR3 floating point                                                                                                                        |
| Example        | SEND> VOLT?<NL><br>RET> 1.000e+00<NL>                                                                                                              |
| Note           | The V unit suffix can't be used.<br>This command CANNOT be used in LIST MEAS page and CORRECTION page.                                             |

### 11.8.2 LEVel:CURRent (=CURRent[:LEVel])

The LEVel:CURRent or CURRent[:LEVel] command sets the oscillator's output current level.

|                |                                                                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LEVel:CURRent {<value>,MIN,MAX}<br>or CURRent:LEVel {<value>,MIN,MAX}                                                                              |
| Parameter      | Where,<br><value> Is the numeric data (NR1, NR2 or NR3).<br>MIN Sets to the minimum value of current.<br>MAX Sets to the maximum value of current. |
| Example        | SEND> LEV:CURR 1m<NL> //Set to 1mA. The A unit suffix cannot be used.                                                                              |
| Query Syntax   | LEVel:CURRent?<br>or CURRent:LEVel?                                                                                                                |
| Query Response | <NR3><br>NR3 floating point                                                                                                                        |
| Example        | SEND> CURR?<NL><br>RET> 1.000e+00<NL>                                                                                                              |
| Note           | The A unit suffix cannot be used.<br>This command CANNOT be used in LIST MEAS page and CORRECTION page.                                            |

### 11.8.3 LEVel:SRESistance (= VOLTage:SRESistance)

The LEVel:SRESistance or VOLTage:SRESistance command sets the source output impedance.

|                |                                                                                                                                                                      |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LEVel:SRESistance {30,50,100}<br>VOLTage:SRESistance {30,50,100}                                                                                                     |
| Parameter      | {30,50,100}<br>Where,<br>30 Sets the output impedance to 30 $\Omega$<br>50 Sets the output impedance to 50 $\Omega$<br>100 Sets the output impedance to 100 $\Omega$ |
| Example        | SEND> LEV:SRES 30<NL> //Set to 30 $\Omega$ , the unit $\Omega$ cannot be added.                                                                                      |
| Query Syntax   | VOLTage:SRES?<br>or LEVel:SRES?                                                                                                                                      |
| Query Response | <NR1><br>NR1 integer                                                                                                                                                 |
| Example        | SEND> LEV:SRES?<NL><br>RET> 30<NL>                                                                                                                                   |

|      |                                                                                                                                              |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Note | The suffix unit $\Omega$ can't be used with this command.<br>This command CANNOT be used in LIST SWEEP.<br>DISPLAY page and CORRECTION page. |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|

### 11.8.4 LEVel:ALC (=AMPlitude:ALC)

The LEVel:ALC or AMPlitude:ALC command enables the Automatic Level Control (ALC).

|                |                                                                                  |
|----------------|----------------------------------------------------------------------------------|
| Command Syntax | LEVel:ALC {on,1,off,0}<br>AMPlitude:ALC {on,1,off,0}                             |
| Parameter      | {on,1,off,0}<br>Where,<br>on (1)     Enable ALC<br>off(0)     Turn off the ALC.  |
| Example        | SEND> LEV:ALC on<NL>                                                             |
| Query Syntax   | LEV:ALC?<br>or AMP:ALC?                                                          |
| Query Response | {on,off}                                                                         |
| Example        | SEND> LEV:ALC?<NL><br>RET>     off<NL>                                           |
| Note           | This command CANNOT be used in LIST MEAS page ,<br>CORRECTION page and DCR mode. |

### 11.8.5 LEVel:MODE?

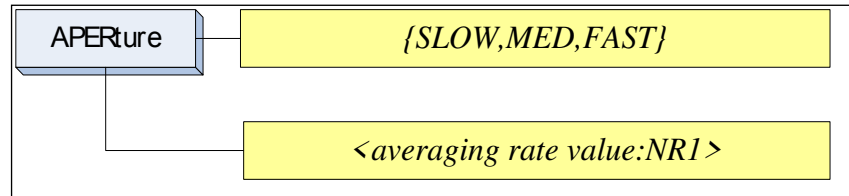
The LEVel:MODE? query returns the level mode.

|                |                                      |
|----------------|--------------------------------------|
| Query Syntax   | LEVel:MODE?                          |
| Query Response | {volt, curr}                         |
| Example        | SEND> LEV:MODE?<NL><br>RET>     volt |

## 11.9 APERture Subsystem

The APERture subsystem command sets the integration time of the ADC and the averaging rate.

Figure 11-6 APERture Subsystem Command Tree



|                |                                                                                                                                                         |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | APERture {SLOW,MED,FAST}<br>APERture <value><br>SPEED(spdc) {SLOW,MED,FAST}<br>SPEED(spdc) <value>                                                      |
| Parameter      | Where,<br>SLOW Set test speed to slow<br>MED Set test speed to medium<br>FAST Set test speed to fast<br><value> NR1(0 to 256): Averaging rate (0=OFF=1) |
| Example        | SEND> APER FAST<NL><br>SEND> APER 10<NL>                                                                                                                |
| Query Syntax   | APER?                                                                                                                                                   |
| Query Response | {SLOW,MED,FAST},<avg value>                                                                                                                             |
| Example        | SEND> APER?<NL><br>RET> slow,0<NL>                                                                                                                      |

### 11.9.1 APERture:RATE?

The APERture:RATE? query returns the current integration time.

|                |                                       |
|----------------|---------------------------------------|
| Query Syntax   | APER:RATE?                            |
| Query Response | SLOW                                  |
| Example        | SEND> APER:RATE?<NL><br>RET> slow<NL> |

### 11.9.2 APERture:AVG?

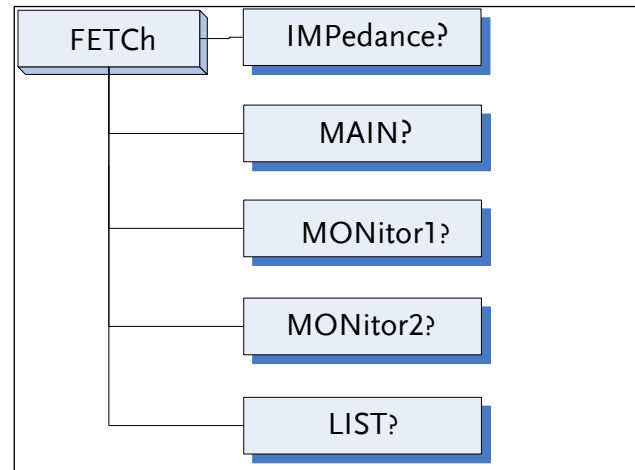
The APERture:AVG? query returns the averaging rate settings.

|                |                                   |
|----------------|-----------------------------------|
| Query Syntax   | APER:AVG?                         |
| Query Response | <NR1><br>Integer (0 to 256)       |
| Example        | SEND> APER:AVG?<NL><br>RET> 0<NL> |

## 11.10 FETCh Subsystem

The FETCh subsystem command group is a sensor-only command which retrieves the measurement data taken by measurement(s) initiated by a trigger, and places the data into the output buffer.

Figure 11-7 FETCh Subsystem Command Tree



### 11.10.1 FETCh?

The FETCh? query sets the latest measurement data of the primary, secondary parameters and comparator result into the output buffer.

|                |                                                                                                                          |
|----------------|--------------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh?                                                                                                                   |
| Query Response | <NR3:primary value>,<NR3:secondary value>,<comparator result>                                                            |
| Example        | SEND> FETC?<NL><br>RET> +2.61788e-11,+5.45442e-01,BIN1,AUX-OK,OK <NL><br>RET> +1.23434e+05,OUT ,NG <NL> //DCR & Comp on. |

When in the [LIST MEAS] page view, the following description for the FETCh query is applicable:

The FETCh? query sets the latest LIST measurement data of the primary parameters, secondary parameters and comparator results into the output buffer.

|                |                                                                                                                     |
|----------------|---------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh?                                                                                                              |
| Query Response | <NR3:primary value>,<NR3:secondary value>,<CMP result>                                                              |
| Example        | SEND> FETC?<NL><br>RET> -2.98524e-12,+3.27673e+00,L <NL><br>RET> -1.00000e+20,-1.00000e+20,- <NL> //The STEP is OFF |



## 11.10.2 FETCh:IMPedance?

The FETCh:IMPedance? query sets the latest measurement data of the primary parameter, secondary parameter, monitor1 and monitor2 results into the output buffer.

|                |                                                                                                                                                                                              |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh:IMPedance?                                                                                                                                                                             |
| Query Response | <NR3:primary value>,<NR3:secondary value>,<NR3:monitor1>,<NR3:monitor2>,<comparator result>                                                                                                  |
| Example        | <pre>SEND&gt; FETC:IMP?&lt;NL&gt; RET&gt;  +2.61788e-11,+5.45442e-01,+3.88651e+05, +0.00000e+00,BIN1,AUX-OK, OK&lt;NL&gt; RET&gt;  +1.23434e+05,BIN1,OK&lt;NL&gt; //DCR &amp; Comp on.</pre> |

## 11.10.3 FETCh:MAIN?

The FETCh:MAIN? query sets the latest measurement data of the primary and secondary parameters.

|                |                                                                                                                                                     |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh:MAIN?                                                                                                                                         |
| Query Response | <NR3:primary value>,<NR3:secondary value>                                                                                                           |
| Example        | <pre>SEND&gt; FETC:MAIN?&lt;NL&gt; RET&gt;  +2.02100e-11,+1.64422e-01&lt;NL&gt; //LCR Primary,Secondary RET&gt;  +1.23434e+05&lt;NL&gt; //DCR</pre> |

## 11.10.4 FETCh:MONitor1? /2?

The FETCh:MONitor1? and FETCh:MONitor2 set the latest measurement data of the monitor1 and monitor2 parameters into the output buffer.

|                |                                                                                                                                    |
|----------------|------------------------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh:MONitor1? and FETCh:MONitor2?                                                                                                |
| Query Response | <NR3: monitor1/2 value>                                                                                                            |
| Example        | <pre>SEND&gt; FETC:MON1?&lt;NL&gt; RET&gt;  +3.88651e+05&lt;NL&gt; RET&gt;  +0.00000e+00&lt;NL&gt; //0: The monitor 1 is OFF</pre> |

## 11.10.5 FETCh:MONitor?

The FETCh:MONitor? sets the latest measurement data of the monitor1 and monitor2 parameters into the output buffer.

|                |                                                                                                                |
|----------------|----------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh:MONitor?                                                                                                 |
| Query Response | <NR3: monitor1/2 value>                                                                                        |
| Example        | <pre>SEND&gt; FETC:MON?&lt;NL&gt; RET&gt;  +3.88651e+05,+0.00000e+00&lt;NL&gt; (0: The monitor 2 is OFF)</pre> |

## 11.10.6 FETCh:LIST?

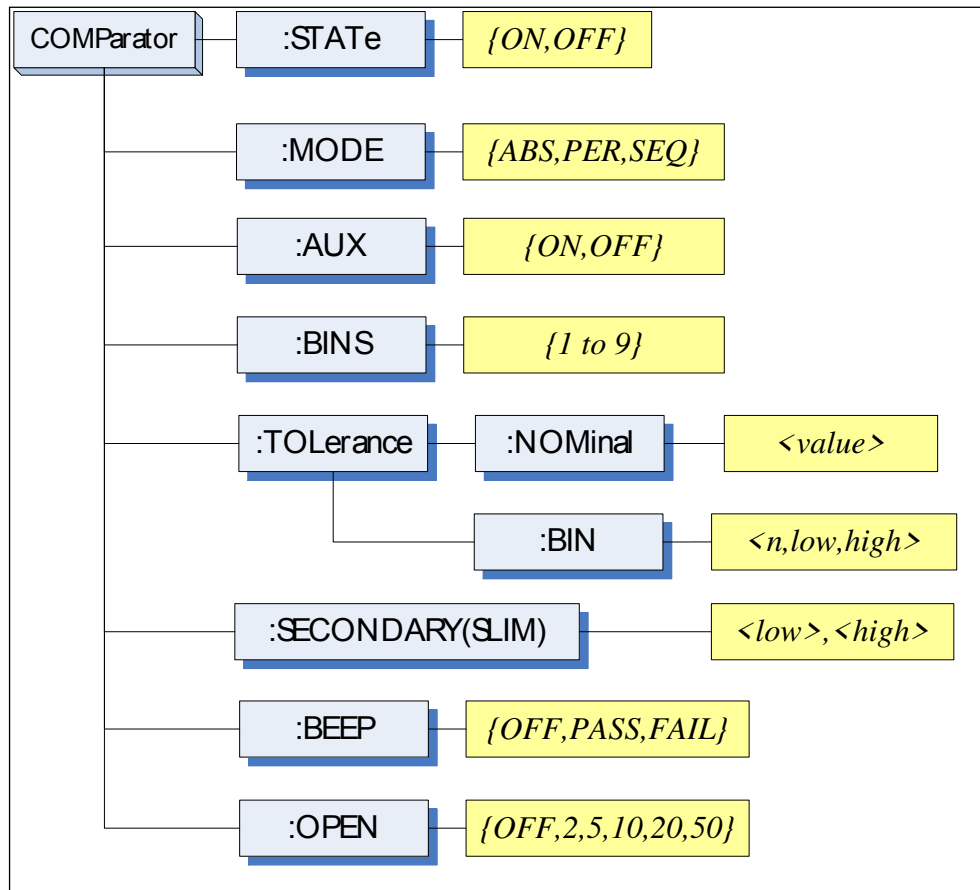
The FETCh:LIST? query sets the latest LIST measurement data of the primary parameters, secondary parameters and comparator results into the output buffer. Only applicable when in the [LIST MEAS] page view.

|                |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Query Syntax   | FETCh:LIST?                                                                                                                                                                                                                                                                                                                                                                                                              |
| Query Response | <spot no>,<NR3:primary value>,<NR3:secondary value>,<CMP result> // spot no:01-10                                                                                                                                                                                                                                                                                                                                        |
| Example        | <pre>SEND&gt; FETCh:LIST?&lt;NL&gt; RET&gt; 01,-2.98524e- 12,+3.27673e+00,L,02,+7.11030e-12,+3.48450e- 01,P,03,+7.11322e-12,+5.14944e-02,H,04,- 1.00000e+20,-1.00000e+20,-,05,-1.00000e+20,- 1.00000e+20,-,06,-1.00000e+20,-1.00000e+20,-,07,- 1.00000e+20,-1.00000e+20,-,08,-1.00000e+20,- 1.00000e+20,-,09,-1.00000e+20,-1.00000e+20,-,10,- 1.00000e+20,-1.00000e+20,-&lt;NL&gt; (-1.00000e+20: The STEP is OFF)</pre> |
| Query Syntax   | FETCh:LIST? <spot no>                                                                                                                                                                                                                                                                                                                                                                                                    |
| Query Response | <spot no>,<NR3:primary value>,<NR3:secondary value>,<CMP result>                                                                                                                                                                                                                                                                                                                                                         |
| Example        | <pre>SEND&gt; FETCh:LIST? 2&lt;NL&gt; RET&gt; 02,+7.11030e-12,+3.48450e-01,P&lt;NL&gt; (-1.00000e+20: The STEP is OFF)</pre>                                                                                                                                                                                                                                                                                             |

## 11.11 COMParator Subsystem

The COMParator subsystem command group sets the comparator function, including its ON/OFF setting, limit mode, and limit values.

Figure 11-8 COMParator Subsystem Command Tree



### 11.11.1 COMParator:STATe

The COMParator:STATe command sets the comparator function to ON or OFF.

|                |                                                                                    |
|----------------|------------------------------------------------------------------------------------|
| Command Syntax | COMParator:STATe {ON,OFF,1,0}                                                      |
| Parameter      | Where,<br>ON or 1 Sets the comparator to ON<br>OFF or 0 Sets the comparator to OFF |
| Example        | SEND> COMP:STAT OFF<NL>                                                            |
| Query Syntax   | COMParator:STATe?                                                                  |
| Query Response | {on,off}                                                                           |
| Example        | SEND> COMP:STAT?<NL><br>RET> on<NL>                                                |

## 11.11.2 COMParator:MODE

The :COMParator:MODE command sets the limit mode of the comparator function.

|                |                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:MODE {ABS,PER,SEQ}                                                                                |
| Parameter      | Where, {ABS,PER,SEQ} is:<br>ABS Absolute tolerance mode<br>PER Percent tolerance mode<br>SEQ Sequential mode |
| Example        | SEND> COMP:MODE PER<NL>                                                                                      |
| Query Syntax   | COMParator:MODE?                                                                                             |
| Query Response | {abs,per,seq}                                                                                                |
| Example        | SEND> COMP:MODE?<NL><br>RET> abs<NL>                                                                         |

## 11.11.3 COMParator:AUX

The COMParator:AUX command sets the auxiliary BIN counting function of the comparator to ON or OFF.

|                |                                                                                             |
|----------------|---------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:AUX {ON,OFF,1,0}                                                                 |
| Parameter      | Where, {ON,OFF,1,0} is:<br>ON or 1 Set the AUX BIN to ON<br>OFF or 0 Set the AUX BIN to OFF |
| Example        | SEND> COMP:AUX OFF<NL>                                                                      |
| Query Syntax   | COMParator:AUX?                                                                             |
| Query Response | {on,off}                                                                                    |
| Example        | SEND> COMP:AUX?<NL><br>RET> on<NL>                                                          |

## 11.11.4 COMParator:BINs

The COMParator:BINs command sets the total number of bins.

|                |                                    |
|----------------|------------------------------------|
| Command Syntax | COMParator:BINs <value>            |
| Parameter      | Where, {value} is:<br>NR1 (1 to 9) |
| Example        | SEND> COMP:BINs 3<NL>              |
| Query Syntax   | COMParator:BINs?                   |
| Query Response | <NR1> (1 to 9)                     |
| Example        | SEND> COMP:BINs?<NL><br>RET> 3<NL> |

### 11.11.5 COMParator:TOLerance:NOMinal

The COMParator:TOLerance:NOMinal command sets the nominal value for the tolerance mode of the comparator function.

|                |                                                                                                                                              |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:TOLerance:NOMinal <value>                                                                                                         |
| Parameter      | Where,<value> is:<br>NR1, NR2 or NR3<br>A suffix multiplier can be used with this command. But the suffix unit F/ $\Omega$ /H can't be used. |
| Example        | SEND> COMP:TOL:NOM 100N<NL><br>SEND> COMP:TOL:NOM 1E-6<NL>                                                                                   |
| Query Syntax   | COMParator:TOLerance:NOMinal?                                                                                                                |
| Query Response | <NR3>                                                                                                                                        |
| Example        | SEND> COMP:TOL:NOM?<NL><br>RET> 1.00000e-06<NL>                                                                                              |

### 11.11.6 COMParator:TOLerance:BIN

The COMParator:TOLerance:BIN command sets the low/high limit values of each BIN for the comparator function tolerance mode.

|                |                                                                                                                                                                  |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:TOLerance:BIN <n>,<low limit>,<high limit>                                                                                                            |
| Parameter      | Where,<n>,<low limit>,<high limit> is:<br>n NR1 (1 to 9): Bin number<br>low limit NR1,NR2 or NR3: low limit value<br>high limit NR1,NR2 or NR3: high limit value |
| Example        | SEND> COMP:TOL:BIN 1,100P,200P<NL><br>SEND> COMP:TOL:BIN 2,200E-6,300E-6<NL>                                                                                     |
| Query Syntax   | COMParator:TOLerance:BIN? <n>                                                                                                                                    |
| Parameter      | Where,<n> is:<br>NR1 (1 to 9): Bin number                                                                                                                        |
| Query Response | <NR3:low limit>,<NR3:high limit>                                                                                                                                 |
| Example        | SEND> COMP:TOL:BIN? 2<NL><br>RET> 1.00000e-06,2.00000E-6<NL>                                                                                                     |

### 11.11.7 COMParator:SLIM

The COMParator:SLIM or COMParator:secondary command sets the LOW/HIGH limit values for the secondary parameter.

|                |                                                                                                                                     |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:SLIM <low value>,<high value><br>COMParator:secondary <low value>,<high value>                                           |
| Parameter      | Where, <low value>,<high value> is:<br><low value> NR1,NR2 or NR3: low limit value<br><high value> NR1,NR2 or NR3: high limit value |

|                |                                                          |
|----------------|----------------------------------------------------------|
|                | A suffix multiplier can be used with this command.       |
| Example        | SEND> COMP:SLIM 0.0001,0.0010<NL>                        |
| Query Syntax   | COMParator:SLIM?<br>COMParator:secondary?                |
| Query Response | <NR3:low limit>,<NR3:high limit>                         |
| Example        | SEND> COMP:SLIM?<NL><br>RET> 1.00000e-04,1.00000e-03<NL> |

## 11.11.8 COMParator:BEEP

The :COMParator:BEEP command sets beep mode of the comparator function.

|                |                                                                                                                                                     |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | COMParator:BEEP {OFF,PASS,FAIL}                                                                                                                     |
| Parameter      | Where,<br>OFF Turns the beeper off.<br>PASS Sounds a beep when the test is passed (BIN1-BIN9).<br>FAIL Sounds a beep when the test is failed (OUT). |
| Example        | SEND> COMP:BEEP PASS<NL>                                                                                                                            |
| Query Syntax   | COMParator:BEEP?                                                                                                                                    |
| Query Response | {OFF,PASS,FAIL}                                                                                                                                     |
| Example        | SEND> COMP:BEEP?<NL><br>RET> OFF<NL>                                                                                                                |

## 11.11.9 COMParator:OPEN

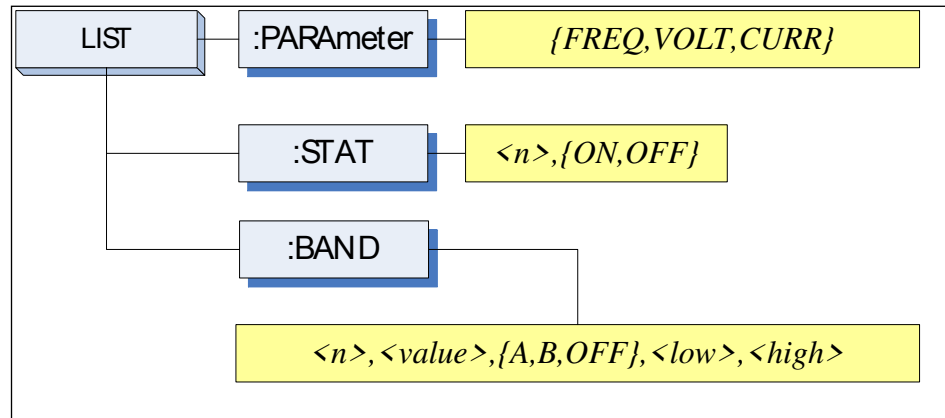
The :COMParator:OPEN command selects the open condition for main parameter.

|                |                                                                             |
|----------------|-----------------------------------------------------------------------------|
| Command Syntax | COMParator:OPEN {OFF,2,5,10,20,50}                                          |
| Parameter      | Where,<br>OFF Turns the beeper off.<br>2,5,10,20,50 The percent range value |
| Example        | SEND> COMP:OPEN 2<NL>                                                       |
| Query Syntax   | COMParator:OPEN?                                                            |
| Query Response | {OFF,2,5,10,20,50}                                                          |
| Example        | SEND> COMP:OPEN?<NL><br>RET> OFF<NL>                                        |

## 11.12 LIST Subsystem

The LIST or SWEEP Subsystem command group sets the List Sweep measurement function, including the sweep point setting and limit values for the limit function.

Figure 11-9 LIST Subsystem Command Tree



### 11.12.1 LIST:PARAMeter

The LIST:PARAMeter command sets the list sweep parameter.

|                |                                                                                                                                                                           |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LIST:PARAMeter {FREQ,VOLT,CURR}                                                                                                                                           |
| Parameter      | Where, {FREQ,LEVEL} is:<br>FREQ Sets the sweep parameter to frequency<br>VOLT Sets the sweep parameter to voltage level<br>CURR Sets the sweep parameter to current level |
| Example        | SEND> LIST:PARA VOLT<NL>                                                                                                                                                  |
| Query Syntax   | LIST:PARAMeter?                                                                                                                                                           |
| Query Response | {FREQ,VOLT,CURR}                                                                                                                                                          |
| Example        | SEND> LIST:PARA?<NL><br>RET> FREQ<NL>                                                                                                                                     |

### 11.12.2 LIST:STAT

The LIST:STAT command turns on/off the specified sweep point.

|                |                                                                                                                     |
|----------------|---------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LIST:STAT <n>,{ON,OFF,1,0}                                                                                          |
| Parameter      | Where,<n> is:<br>n NR1(1 to 10): List sweep point<br>ON or 1 Set this point to ON<br>OFF or 0 Set this point to OFF |
| Example        | SEND> LIST:STAT 1,ON<NL>                                                                                            |
| Query Syntax   | LIST:STAT? <n>                                                                                                      |

|                |                                                   |
|----------------|---------------------------------------------------|
| Parameter      | Where,<n> is:<br>n NR1(1 to 10): List sweep point |
| Query Response | {on,off}                                          |
| Example        | SEND> LIST:STAT? 1<NL><br>RET> on<NL>             |

### 11.12.3 LIST:BAND

The LIST:BAND command sets the List Sweep point value, limit mode and low/high limit values.

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | LIST:BAND <n>,<point value>,{A,B,OFF},<low>,<high>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Parameter      | Where, <n>,<point value>,{A,B,OFF},<low>,<high> is:<br>n NR1(1 to 10): List sweep point<br><point value> Sweep point value (frequency value or signal level voltage value)<br>A Uses the primary parameter as the limit parameter.<br>B Uses the secondary parameter as the limit parameter.<br>OFF Turn off the List Sweep's comparator function<br><low> NR1,NR2 or NR3: low limit value<br><high> NR1,NR2 or NR3: high limit value<br>Note: The suffix multipliers can be used with this command. But the suffix units CANNOT be added. |
| Example        | SEND> LIST:BAND 1,1k,A,1n,2n<NL><br>SEND> LIST:BAND 2,10k,A,1E-9,2E-9<NL>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Query Syntax   | LIST:BAND? <n>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Parameter      | Where,<n> is:<br>n NR1(1 to 10): List sweep point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Query Response | {on,off},<point value>,{A,B,-},<NR3:low>,<NR4:high>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Example        | SEND> LIST:BAND? 1<NL><br>RET> on,1.00000e+03,A,1.000000E-9,2.000000E-9<NL>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

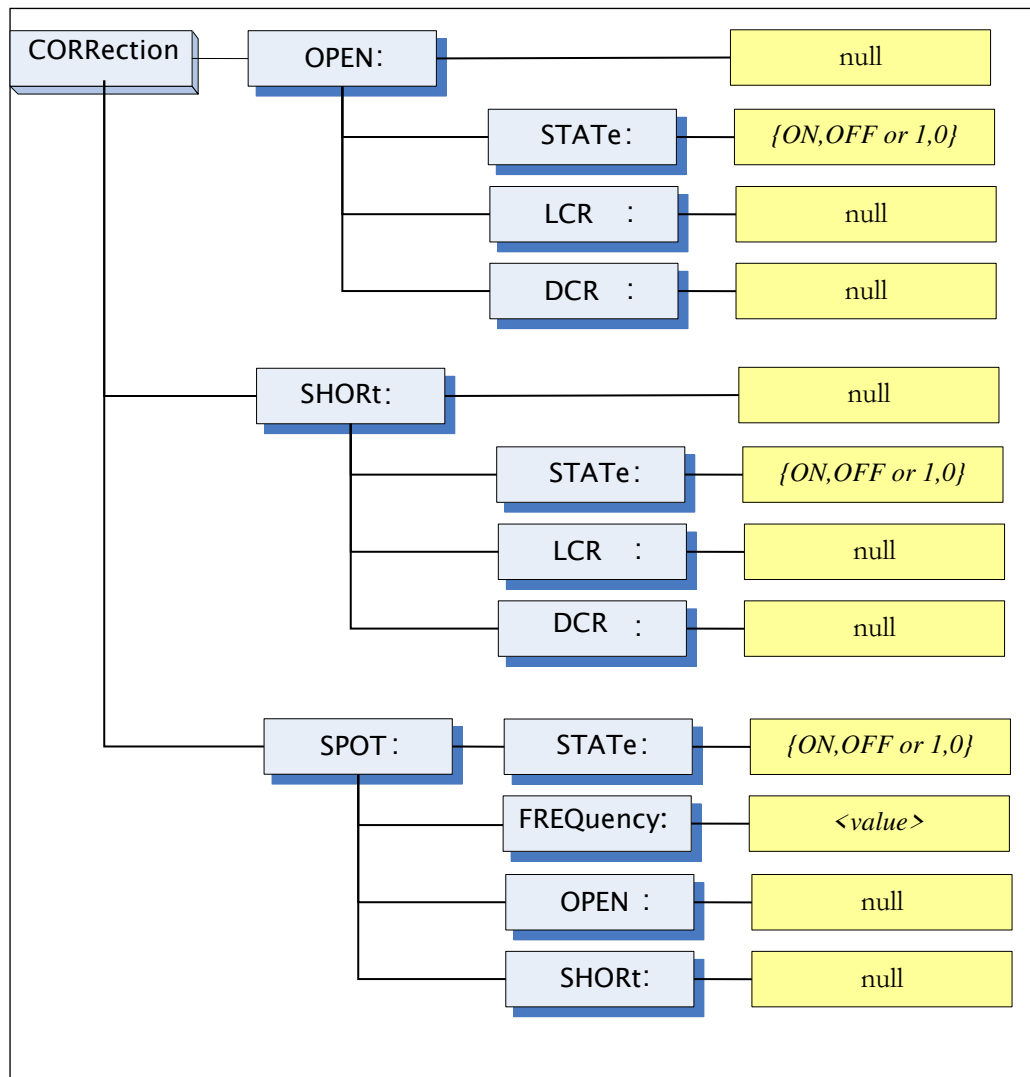


## 11.13 CORRection Subsystem

The CORRection subsystem command group sets the correction function, including the OPEN, SHORT and SPOT correction settings.

**Note** The CORRection subsystem CANNOT work in [LIST MEAS] page.

Figure 11-10 CORRection Subsystem Command Tree



### 11.13.1 CORRection:OPEN

The CORRection:OPEN command execute all preset OPEN correction data measurement points.

|                |                                                                                       |
|----------------|---------------------------------------------------------------------------------------|
| Command Syntax | CORRection:OPEN                                                                       |
| Example        | SEND> CORRection:OPEN<NL><br>RET> open<NL> // Run<br>pass/fail<NL> //Finish or Undone |

### 11.13.2 CORRection:OPEN:STATe

The CORRection:OPEN:STATe command sets the OPEN correction function to ON or OFF.

|                |                                                                            |
|----------------|----------------------------------------------------------------------------|
| Command Syntax | CORRection:OPEN:STATe {ON,OFF or 1,0}                                      |
| Parameter      | ON, 1    Set up the function is ON<br>OFF, 0    Set up the function is OFF |
| Example        | SEND> CORR:OPEN:STATe ON<NL><br>RET>    null                               |
| Query Syntax   | CORRection:OPEN:STATe?                                                     |
| Query Response | {on,off}                                                                   |
| Example        | SEND> CORR:OPEN:STATe?<NL><br>RET>    on<NL>                               |

### 11.13.3 CORRection:OPEN:LCR

The CORRection:OPEN:LCR command execute all preset OPEN correction data measurement points (AC).

|                |                                                                                                  |
|----------------|--------------------------------------------------------------------------------------------------|
| Command Syntax | CORRection:OPEN:LCR                                                                              |
| Example        | SEND> CORRection:OPEN:LCR<NL><br>RET>    LCR open<NL> // Run<br>pass/fail<NL> //Finish or Undone |

### 11.13.4 CORRection:OPEN:DCR

The CORRection:OPEN:DCR command execute all preset OPEN correction data measurement points (DC).

|                |                                                                                                  |
|----------------|--------------------------------------------------------------------------------------------------|
| Command Syntax | CORRection:OPEN:DCR                                                                              |
| Example        | SEND> CORRection:OPEN:DCR<NL><br>RET>    DCR open<NL> // Run<br>pass/fail<NL> //Finish or Undone |

### 11.13.5 CORRection:SHORT

The CORRection:SHORT command execute all preset SHORT correction data measurement points.

|                |                                                |
|----------------|------------------------------------------------|
| Command Syntax | CORRection:SHORT                               |
| Example        | SEND> CORRection:SHOR<NL><br>RET>    short<NL> |

### 11.13.6 CORRection:SHORt:STATe

The CORRection:SHORt:STATe command sets the SHORt correction function to ON or OFF.

|                |                                                                            |
|----------------|----------------------------------------------------------------------------|
| Command Syntax | CORRection:SHORt:STATe {ON,OFF or 1,0}                                     |
| Parameter      | ON, 1    Set up the function is ON<br>OFF, 0    Set up the function is OFF |
| Example        | SEND> CORR:SHOR:STATe ON<NL><br>RET>    null                               |
| Query Syntax   | CORRection:SHOR:STATe?                                                     |
| Query Response | {on,off}                                                                   |
| Example        | SEND> CORR:SHOR:STATe?<NL><br>RET>    on<NL>                               |

### 11.13.7 CORRection:SHORt:LCR

The CORRection:SHORt:LCR command execute all preset SHORt correction data measurement points (AC).

|                |                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------|
| Command Syntax | CORRection:SHORt:LCR                                                                               |
| Example        | SEND> CORRection:SHORt:LCR<NL><br>RET>    LCR short<NL> // Run<br>pass/fail<NL> //Finish or Undone |

### 11.13.8 CORRection:SHORt:DCR

The CORRection:SHORt:DCR command execute all preset SHORt correction data measurement points (DC).

|                |                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------|
| Command Syntax | CORRection:SHORt:DCR                                                                               |
| Example        | SEND> CORRection:SHORt:DCR<NL><br>RET>    DCR short<NL> // Run<br>pass/fail<NL> //Finish or Undone |

### 11.13.9 CORRection:SPOT:STATe

The CORRection:SPOT:STATe command sets the SOPT correction function to ON or OFF.

|                |                                                                            |
|----------------|----------------------------------------------------------------------------|
| Command Syntax | CORRection:SOPT:STATe {ON,OFF or 1,0}                                      |
| Parameter      | ON, 1    Set up the function is ON<br>OFF, 0    Set up the function is OFF |
| Example        | SEND> CORR:SPOT:STATe ON<NL><br>RET>    null                               |

|                |                                           |
|----------------|-------------------------------------------|
| Query Syntax   | CORRection:SPOT:STATe?                    |
| Query Response | {on,off}                                  |
| Example        | SEND> CORR:SPOT:STATe?<NL><br>RET> on<NL> |

### 11.13.10 CORRection:SPOT:FREQuency

The CORRection:SPOT:FREQuency command sets the frequency point for the specified frequency point correction.

|                |                                                                                                                                 |
|----------------|---------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | CORRection:SPOT:FREQuendy <value>                                                                                               |
| Parameter      | value NR1,NR2 or NR3:Frequecnny value.<br>A suffix multiplier can be used with this command. But the unit “Hz” cannot be added. |
| Example        | SEND> CORR:SPOT:FREQ 100<NL><br>SEND> CORR:SPOT:FREQ 10k<NL>                                                                    |
| Query Syntax   | CORRection:SPOT:FREQuency?                                                                                                      |
| Query Response | <NR3>                                                                                                                           |
| Example        | SEND> CORR:SPOT:FREQ?<NL><br>RET> 1.000000e+03<NL>                                                                              |

### 11.13.11 CORRection:SPOT:OPEN

This command executes the OPEN correction data measure for the specified frequency correction.

|                |                                                                   |
|----------------|-------------------------------------------------------------------|
| Command Syntax | CORRection:SPOT:OPEN                                              |
| Example        | SEND> CORR:SPOT:OPEN<NL><br>RET> pass/fail<NL> //Finish or Undone |

### 11.13.12 CORRection:SPOT:SHORt

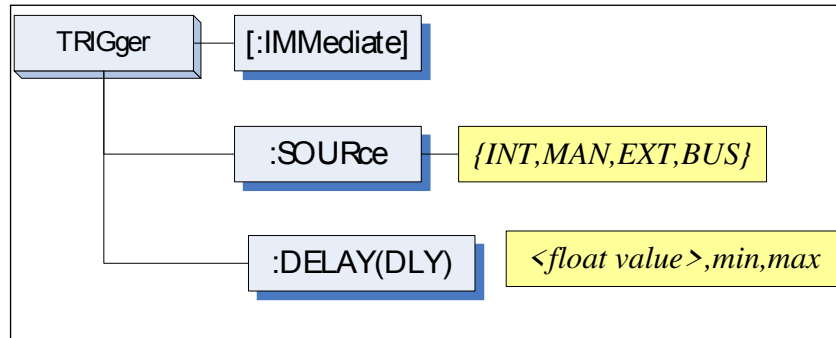
This command executes the SHORT correction data measure for the specified frequency correction.

|                |                                                                   |
|----------------|-------------------------------------------------------------------|
| Command Syntax | CORRection:SPOT:SHORt                                             |
| Example        | SEND> CORR:SPOT:SHOR<NL><br>RET> pass/fail<NL> //Finish or Undone |

## 11.14 TRIGger Subsystem

The TRIGger subsystem command group is used to enable a measurement or a sweep measurement, and to set the trigger mode.

Figure 11-11 TRIGger Subsystem Command Tree



### 11.14.1 TRIGger[:IMMediate]

The TRIGger:IMMediate command causes the trigger to execute a measurement or a sweep measurement, regardless of the trigger state.

|                |                                                    |
|----------------|----------------------------------------------------|
| Command Syntax | TRIGger[:IMMediate]                                |
| Example        | SEND> TRIG<NL>                                     |
| Note           | This command can be ONLY used in BUS trigger mode. |

### 11.14.2 TRIGger:SOURce

The TRIGger:SOURce command sets the trigger mode.

|                |                                                                                                                                                           |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | TRIGger:SOURce {INT,MAN,EXT,BUS}                                                                                                                          |
| Parameter      | Where, {INT,MAN,EXT,BUS} is<br>INT      Internal Trigger Mode<br>MAN     Manual Trigger Mode<br>EXT     External Trigger Mode<br>BUS     BUS Trigger Mode |
| Example        | SEND> TRIG:SOUR BUS<NL>                                                                                                                                   |
| Query Syntax   | TRIGger:SOURce?                                                                                                                                           |
| Query Response | {INT,MAN,EXT,BUS}                                                                                                                                         |
| Example        | SEND> TRIG:SOUR?<NL><br>RET> INT<NL>                                                                                                                      |

### 11.14.3 TRIGger:DELAY

The TRIGger:DELAY command sets the trigger delay time.

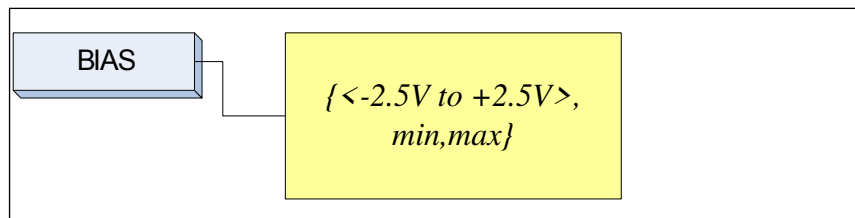
|                |                                                                  |
|----------------|------------------------------------------------------------------|
| Command Syntax | TRIGger:DELAY {<float>,min,max}<br>TRIGger:DLY {<float>,min,max} |
|----------------|------------------------------------------------------------------|

|                |                                                                                       |
|----------------|---------------------------------------------------------------------------------------|
| Parameter      | Where, is<br>float value:from 1ms to 60.00s<br>min:       =0ms<br>max:       =60.000s |
| Example        | SEND> TRIG:DLY 1<NL> //1.000s                                                         |
| Query Syntax   | TRIGger:DELAY?<br>TRIGger:DLY?                                                        |
| Query Response | {0.000s-60.00s}                                                                       |
| Example        | SEND> TRIG:DLY?<NL><br>RET>   1.000s<NL>                                              |

## 11.15 BIAS Subsystem

The BIAS subsystem command group sets the DC BIAS switch to ON or OFF, and sets the DC bias voltage value.

Figure 11-12       BIAS Subsystem Command Tree

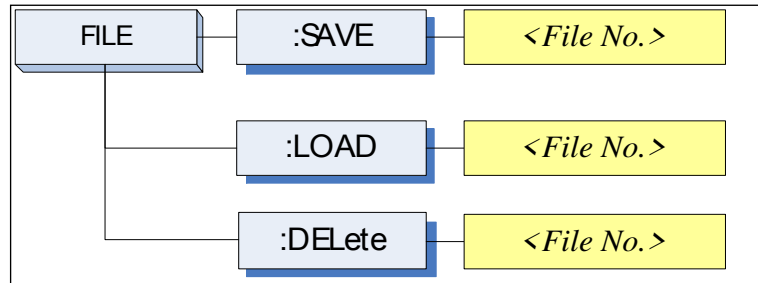


|                |                                        |
|----------------|----------------------------------------|
| Command Syntax | BIAS {OFF,<-2.5 to +2.5V>,min,max}     |
| Example        | SEND> BIAS OFF<NL><br>SEND> BIAS 2<NL> |
| Query Syntax   | BIAS?                                  |
| Query Response | <-2.50V-+2.50V>                        |
| Example        | SEND> BIAS?<NL><br>RET>   OFF<NL>      |

## 11.16 FILE Subsystem

The FILE subsystem command group executes the file operation.

Figure 11-13 FILE Subsystem Command Tree



### 11.16.1 FILE?

The FILE? query returns the file number used by the system.

|                |                               |
|----------------|-------------------------------|
| Query Syntax   | FILE?                         |
| Query Response | <NR1(0 TO 9): File number>    |
| Example        | SEND> FILE?<NL><br>RET> 0<NL> |

### 11.16.2 FILE:SAVE

The FILE:SAVE command saves all user settings into the currently used file.

|                |                     |
|----------------|---------------------|
| Command Syntax | FILE:SAVE           |
| Example        | SEND> FILE:SAVE<NL> |

The FILE:SAVE <n> command saves all user settings into the specified file.

|                |                                       |
|----------------|---------------------------------------|
| Command Syntax | FILE:SAVE <File No.>                  |
| Parameter      | Where, <File No.> is:<br>NR1 (0 to 9) |
| Example        | SEND> FILE:SAVE 0<NL>                 |

### 11.16.3 FILE:LOAD

The FILE:LOAD command recalls all user settings from the currently used file.

|                |                     |
|----------------|---------------------|
| Command Syntax | FILE:LOAD           |
| Example        | SEND> FILE:LOAD<NL> |

The FILE:LOAD <n> command recalls all user settings from specified file.

|                |                                       |
|----------------|---------------------------------------|
| Command Syntax | FILE:LOAD <File No.>                  |
| Parameter      | Where, <File No.> is:<br>NR1 (0 to 9) |
| Example        | SEND> FILE:LOAD 0<NL>                 |

## 11.16.4 FILE:DELeTe

|                |                                       |
|----------------|---------------------------------------|
| Command Syntax | FILE:DELeTe <File No.>                |
| Parameter      | Where, <File No.> is:<br>NR1 (0 to 9) |
| Example        | SEND> FILE:DELeTe<NL>                 |

## 11.17 ERRor Subsystem

### 11.17.1 ERRor?

The ERRor? retrieves the last error information.

|                |                                      |
|----------------|--------------------------------------|
| Query Syntax   | ERRor?                               |
| Query Response | Error string                         |
| Example        | SEND> ERR?<NL><br>RET> no error.<NL> |

## 11.18 SYSTEM Subsystem

### 11.18.1 SYSTem:SHAKehand

The SYSTem:SHAKehand command feeds back the sent commands.

|                |                                      |
|----------------|--------------------------------------|
| Command Syntax | SYSTem:SHAKehand {on,off}            |
| Example        | SEND> SYST:SHAK ON<NL>               |
| Query Syntax   | SYSTem:SHAKehand?                    |
| Query Response | {on,off}                             |
| Example        | SEND> SYST:SHAK?<NL><br>RET> OFF<NL> |

### 11.18.2 SYSTem:CODE

The SYSTem:CODE command feeds back error codes for each sent command.

|                |                        |
|----------------|------------------------|
| Command Syntax | SYSTem:CODE {on,off}   |
| Example        | SEND> SYST:CODE ON<NL> |



|                |                                      |
|----------------|--------------------------------------|
| Query Syntax   | SYSTem:CODE?                         |
| Query Response | {on,off}                             |
| Example        | SEND> SYST:CODE?<NL><br>RET> OFF<NL> |

### 11.18.3 SYSTem:KEYLock

SYSTem:KEYLock command unlocks the keypad.

|                |                                     |
|----------------|-------------------------------------|
| Command Syntax | SYST:KEYLOCK OFF<br>or UNLOCK(UNLK) |
| Example        | SEND> UNLOCK<NL>                    |

### 11.18.4 SYSTem:RESult

SYSTem:RESult command selects the test results send mode.

|                |                                                                                                                            |
|----------------|----------------------------------------------------------------------------------------------------------------------------|
| Command Syntax | SYSTem:RESult {fetch,auto}                                                                                                 |
| Example        | SEND> SYST:RES fetch<NL>                                                                                                   |
| Parameter      | Where,<br>fetch The test results will be sent back by command “fetch?”.<br>auto The results will be sent back by one trig. |
| Query Syntax   | SYSTem:RESult?                                                                                                             |
| Query Response | {FETCH,AUTO}                                                                                                               |
| Example        | SEND> SYST:RES? <NL><br>RET> fetch<NL>                                                                                     |

## 11.19 Common Commands

### 11.19.1 \*IDN?

The \*IDN? query returns the instrument ID.

|                |                                                |
|----------------|------------------------------------------------|
| Query Syntax   | IDN? Or *IDN?                                  |
| Query Response | <model>,<firmware>,<serial no.>,<manufacturer> |

### 11.19.2 \*TRG

The \*TRG command (trigger command) performs the same function as the Group Execute Trigger command.

|                |                                                       |
|----------------|-------------------------------------------------------|
| Command Syntax | *TRG                                                  |
| Query Response | <primary value>,<secondary value>,<comparator result> |
| Example        | SEND> *TRG<br>RET> +5.56675e-11,+7.25470e-01,OUT      |

|      |                                                                     |
|------|---------------------------------------------------------------------|
| Note | This command can be used in BUS trigger mode.<br>*TRG = TRIG;;FETC? |
|------|---------------------------------------------------------------------|

### 11.19.3 \*SAV

\*SAV = FILE:SAVE

The \*SAV command saves all user settings into the currently used file.

|                |                |
|----------------|----------------|
| Command Syntax | *SAV           |
| Example        | SEND> *SAV<NL> |

### 11.19.4 \*RCL

\*RCL = FILE:LOAD

The \*RCL command recalls all user settings from the currently used file.

|                |                |
|----------------|----------------|
| Command Syntax | *RCL           |
| Example        | SEND> *RCL<NL> |

# 12. SPECIFICATION

This chapter describes the specifications and supplemental performance characteristics of the T3LCR Series:

- Specifications
- Dimensions

Accuracy is defined as meeting all of the following conditions:

Temperature:  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$

Humidity:  $<70\%$  R.H.

Zeroing: Open and Short Correction Warm up time is 30 min or more.

1-year calibration cycle.

Basic Accuracy:  $0.05\%$ (Slow/Med),  $0.1\%$ (Fast)

## 12.1 General Specification

Display: RGB color TFT-LCD, Size: 3.5" (320x240)

Test Function: Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, Rs-Q, Rp-Q, R-X, DCR, Z- $\theta_r$ , Z- $\theta_d$ , Z-D, Z-Q

Monitor Parameter: Z, D, Q, Vac, Iac,  $\Delta$ ,  $\Delta\%$ ,  $\theta_r$ ,  $\theta_d$ , R, X, G, B, Y (2 Parameter)

Measurement Speed: 40 times/s, 10 times/s, 3 times/s

Test Frequency  
 T3LCR1300: 10Hz~300kHz  
 T3LCR1100: 10Hz~100kHz  
 T3LCR1002: 10Hz~2kHz

**Frequency range and resolution**

| Frequency range(F)                            | Resolution |
|-----------------------------------------------|------------|
| $10.00\text{Hz} \leq F \leq 99.99\text{Hz}$   | 0.01Hz     |
| $100.0\text{Hz} \leq F \leq 999.9\text{Hz}$   | 0.1Hz      |
| $1.000\text{kHz} \leq F \leq 9.999\text{kHz}$ | 1Hz        |
| $10.00\text{kHz} \leq F \leq 99.99\text{kHz}$ | 10Hz       |
| $100.0\text{kHz} \leq F \leq 300.0\text{kHz}$ | 100Hz      |

Frequency Accuracy:  $\pm 0.01\%$  4 digit resolution

**T3LCR1300's open/short trimming frequency point list**

|      |      |      |      |      |      |     |     |     |     |
|------|------|------|------|------|------|-----|-----|-----|-----|
| 10   | 12   | 15   | 20   | 25   | 30   | 40  | 50  | 60  | 80  |
| 100  | 120  | 150  | 200  | 250  | 300  | 400 | 500 | 600 | 800 |
| 1k   | 1.2k | 1.5k | 2k   | 2.5k | 3k   | 4k  | 5k  | 6k  | 8k  |
| 10k  | 12k  | 15k  | 20k  | 25k  | 30k  | 40k | 50k | 60k | 80k |
| 100k | 120k | 150k | 200k | 250k | 300k |     |     |     |     |

**T3LCR1100's open/short trimming frequency point list**

|      |      |      |     |      |     |     |     |     |     |
|------|------|------|-----|------|-----|-----|-----|-----|-----|
| 10   | 12   | 15   | 20  | 25   | 30  | 40  | 50  | 60  | 80  |
| 100  | 120  | 150  | 200 | 250  | 300 | 400 | 500 | 600 | 800 |
| 1k   | 1.2k | 1.5k | 2k  | 2.5k | 3k  | 4k  | 5k  | 6k  | 8k  |
| 10k  | 12k  | 15k  | 20k | 25k  | 30k | 40k | 50k | 60k | 80k |
| 100k |      |      |     |      |     |     |     |     |     |

**T3LCR1002's open/short trimming frequency point list**

|     |      |      |     |     |     |     |     |     |     |
|-----|------|------|-----|-----|-----|-----|-----|-----|-----|
| 10  | 12   | 15   | 20  | 25  | 30  | 40  | 50  | 60  | 80  |
| 100 | 120  | 150  | 200 | 250 | 300 | 400 | 500 | 600 | 800 |
| 1k  | 1.2k | 1.5k | 2k  |     |     |     |     |     |     |

**Display Range**

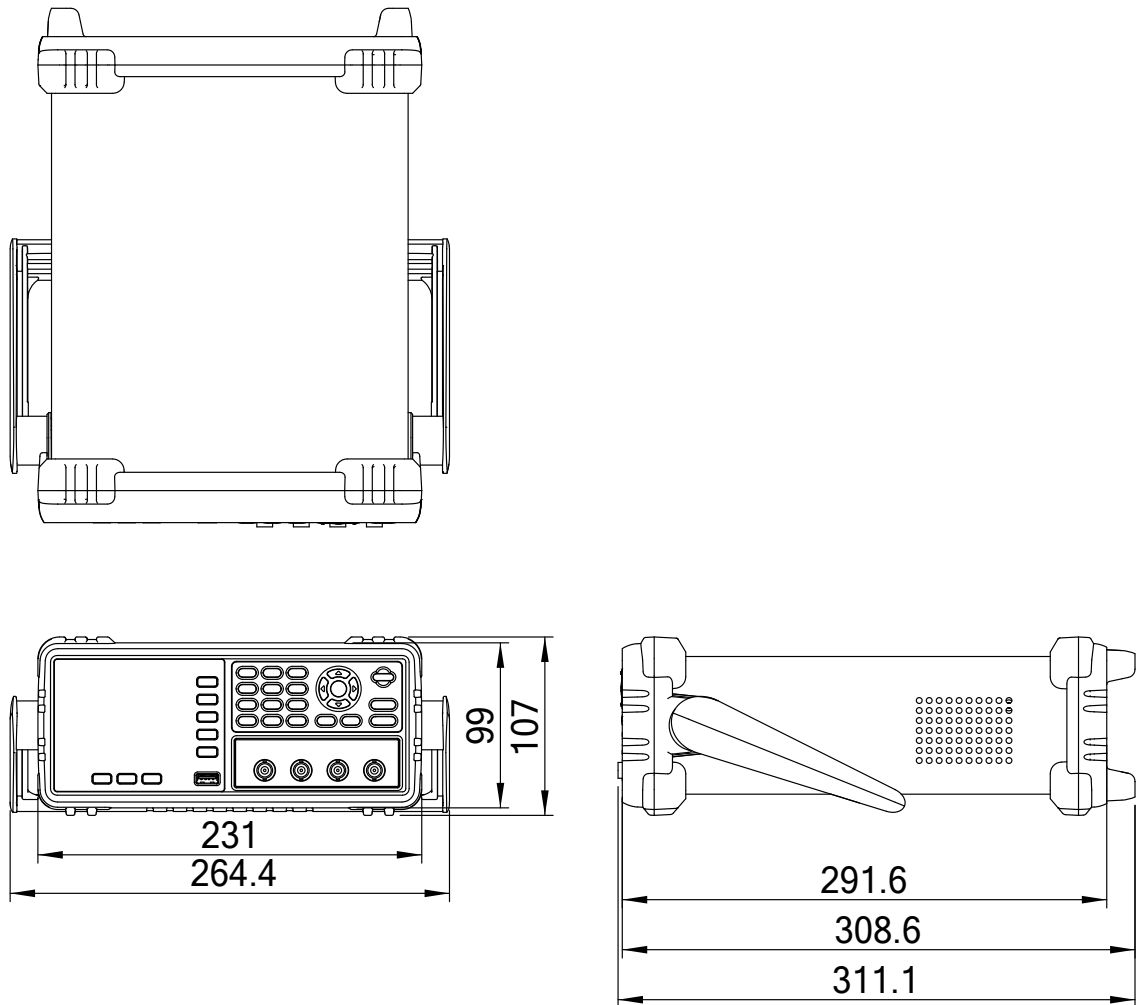
| Parameter  | Display Range       |
|------------|---------------------|
| L          | 0.00001uH-9999.99H  |
| C          | 0.00001pF-9999.99mF |
| R, X,  Z   | 0.00001Ω-99.9999MΩ  |
| G, B,  Y   | 0.01nS-999.999S     |
| D          | 0.00001-9.99999     |
| Q          | 0.00001-99999.9     |
| $\theta_d$ | -179.999°-179.999°  |
| $\theta_r$ | -3.14159-3.14159    |
| DCR        | 0.00001Ω-99.9999MΩ  |
| $\Delta\%$ | -999999%-999999%    |

|                        |                                                                                                                                                      |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Test signal level:  | 10.00mV- 2.00V ( $\pm 10\%$ )<br>CV: 10.00mV- 2.00V( $\pm 6\%$ )<br>100.0uA- 20.00mA ( $\pm 10\%$ )<br>CC: 100.0uA- 20.00mA( $\pm 6\%$ )<br>(@2VMax) |
| DCR Test signal level: | +2V, 0.066A(Max.), Output<br>impedance fixed $30\Omega$                                                                                              |
| DC Bias: Internal:     | $\pm 2.5V$ ( $0.5\%+0.005V$ )                                                                                                                        |
| List Test:             | 10Step<br>(Frequency/Voltage/Current)                                                                                                                |
| Output impedance:      | $30\Omega$ , $50\Omega$ and $100\Omega$                                                                                                              |
| Ranging:               | Auto, Hold and Nominal range.<br>Total 9 Ranges.                                                                                                     |
| Equivalent Circuit:    | Serial and Parallel                                                                                                                                  |
| OPEN/SHORT Test :      | OPEN/SHORT Zeroing<br>(ALL,SPOT)                                                                                                                     |
| Files:                 | built-in 10 files and USB Disk<br>10 files, 9999 Log File, 999<br>Picture File, 10000 Data (.csv)                                                    |
| Beep Feature:          | OFF/PASS/FAIL                                                                                                                                        |
| Trigger Mode:          | Internal, Manual, External and<br>Bus Trigger.                                                                                                       |
| Interface:             | Handler interface and<br>RS232/USB interface.                                                                                                        |

|                     |                           |                                                                                         |
|---------------------|---------------------------|-----------------------------------------------------------------------------------------|
| <b>Environment:</b> | Specification Conditions: | Temperature: 23°C±5°C,<br>Relative Humidity: <70%RH                                     |
|                     | Operating Environment:    | Temperature: 0-50°C, Relative Humidity: <70%RH (Indoor use only, Altitude: 2000 meters) |
|                     | Storage Conditions:       | Temperature: -10-70°C, Relative Humidity: <80%RH                                        |
|                     | AC Input Power:           | AC 100V-240V, 50Hz-60Hz                                                                 |
|                     | Fuse:                     | 2A Slow-Blow                                                                            |
|                     | Maximum rated power:      | 15W                                                                                     |
|                     | Weight:                   | 3kg, net                                                                                |

## 12.2 Dimensions

Figure 12-1 Dimensions



# 13. ACCURACY

---

This section will explain the meter's accuracy, measurement tolerance and how to test the meter's performance. It includes:

- Accuracy
  - Factors that decide accuracy
- 

The meters' accuracy is affected by the tolerances from measurement stability, temperature variation, circuit linearity and the measurement repeatability.

The meter's accuracy verification needs to be done under the following circumstances:

Warming up time:  $\geq 30$  minutes.

Perform Open/Short calibration correctly after warming up.

Set the meter to auto-ranging mode.



## 13.1 Accuracy

### 13.1.1 L, C, R |Z| Measurement Accuracy

The accuracies of L, C, R, |Z| is equal to  $A_e$ , which is defined by:

$$A_e = \pm [A \times A_r + (K_a + K_b + K_f) \times 100 + K_L] \times K_c \quad [\%]$$

A: Basic measurement accuracy

$A_r$ : Basic accuracy correction factor

$K_a$ : Impedance factor a

$K_b$ : Impedance factor b

$K_c$ : Temperature factor

$K_f$ : Open/short trimming factor

$K_L$ : 'Test leads' length factor

The method to calculate the accuracy of L and C depends on whether  $D_x$  ( $D$  measurement value) is  $\leq 0.1$  or not.

The method to calculate the accuracy of R depends on whether  $Q_x$  ( $Q$  measurement value) is  $\leq 0.1$  or not.

When  $D_x > 0.1$ , L and C's accuracy factors,  $A_e$ , should be multiplied by  $\sqrt{1 + D_x^2}$ .

When  $Q_x > 0.1$ , R's accuracy factor,  $A_e$ , should be multiplied by  $\sqrt{1 + Q_x^2}$ .

### 13.1.2 Accuracy for D

D's accuracy is defined below:

$$D_e = \pm \frac{A_e}{100} \quad (\text{when } D_x \leq 0.1)$$

When  $D_x > 0.1$ ,  $D_e$  should be multiplied by  $(1 + D_x)$

### 13.1.3 Accuracy for Q

Q's accuracy is defined below:

$$Q_e = \pm \frac{Q_x^2 \times D_e}{1 \mp Q_x \times D_e} \text{ (when } Q_x \times D_e < 1)$$

Where:

$Q_x$  is the measured Q value.

$D_e$  is D's accuracy.

### 13.1.4 Accuracy for $\theta$

$\theta$ 's accuracy is defined below:

$$\theta_e = \frac{180}{\pi} \times \frac{A_e}{100} \quad [\text{deg}]$$

### 13.1.5 Accuracy for $R_p$

When  $D_x$  (the measured D value)  $\leq 0.1$ ,  $R_p$ 's accuracy is defined as:

$$R_p = \pm \frac{R_{px} \times D_e}{D_x \mp D_e} \quad [\Omega]$$

Where:

$R_{px}$  is the measured  $R_p$  value  $[\Omega]$ .

$D_x$  is the measured D value.

$D_e$  is D's accuracy.

### 13.1.6 Accuracy for Rs

When  $D_x$  (measured D value)  $\leq 0.1$

The accuracy of  $R_s$  is defined as:

$$R_{se} = X_x \times D_e \quad [\Omega]$$

$$X_x = 2\pi f L_x = \frac{1}{2\pi f C_x}$$

Where:

$X_x$  is the measured X value[ $\Omega$ ].

$C_x$  is the measured C value[F].

$L_x$  is the measured L value[H].

$D_e$  is D's accuracy.

F is the measuring frequency.

## 13.2 Correction factors that affect measurement accuracy

The following will show how to decide the basic accuracy, A:

A is 0.05:

When the measuring signal is  $0.4V_{rms} \leq V_s \leq 1.2V_{rms}$   
and the measurement speed is slow or medium.

A is 0.1:

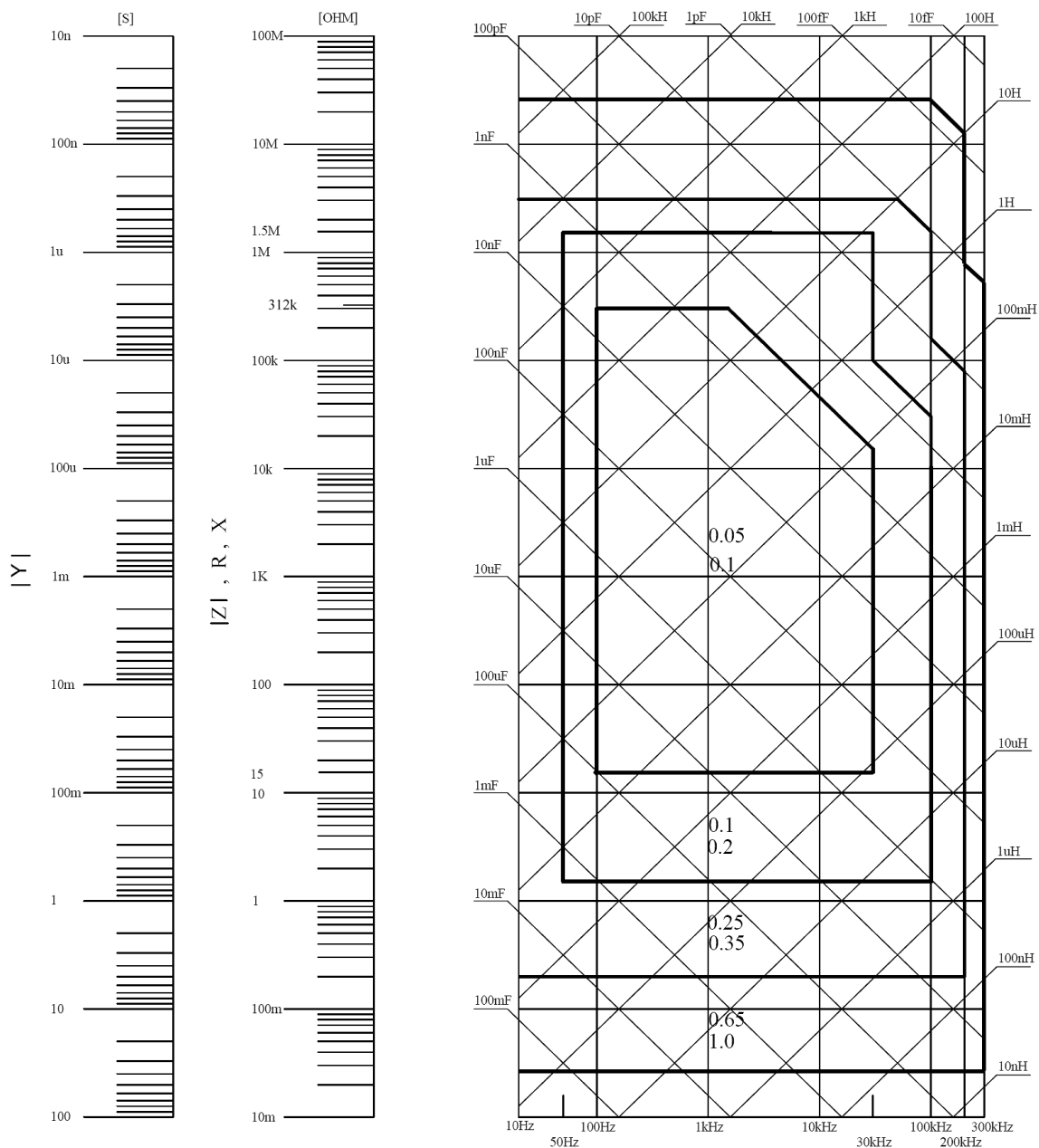
When the measuring signal is  $0.4V_{rms} \leq V_s \leq 1.2V_{rms}$   
and the measurement speed is fast.

When the measuring signal is  $V_s < 0.4V_{rms}$  or  $V_s > 1.2V_{rms}$   
the basic accuracy, A, should be calculated according to the following description:

Write down the basic accuracy, A, for the measurement speed currently being used and then write down the correction factor,  $A_r$ , according to the amplitude of the measuring signal being currently used (see Figure 13-2). Let A be multiplied by  $A_r$  to get the actual basic accuracy, A, for that moment.  $V_s$  represents the amplitude of the measuring signal.

Figure 13-1

## The basic measurement accuracy A



If the accuracy for the spot you are searching for falls right on the line, e.g. the horizontal thick line between values 0.25 and 0.65, then use the smaller value, 0.25, for the basic accuracy of the spot you are searching for.

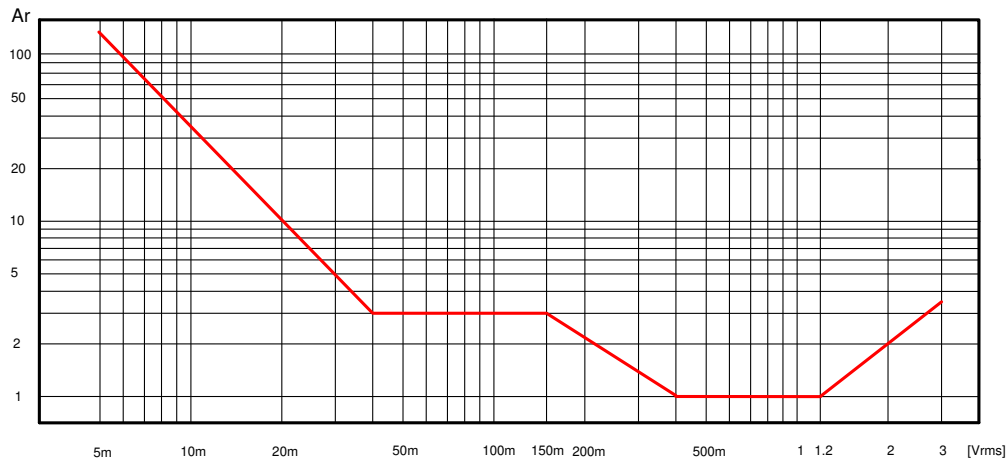
Figure 13-2 Table for basic accuracy correction factor  $A_r$ 

Table 13-1 Impedance correction factors

| Measurement speed | Measuring frequency                        | $K_a$                                                                                 | $K_b$                                                                      |
|-------------------|--------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Slow<br>Medium    | $f_m < 100\text{Hz}$                       | $(\frac{1 \times 10^{-3}}{ Z_m })(1 + \frac{200}{V_s})(1 + \sqrt{\frac{100}{f_m}})$   | $ Z_m (1 \times 10^{-9})(1 + \frac{70}{V_s})(1 + \sqrt{\frac{100}{f_m}})$  |
|                   | $100\text{Hz} \leq f_m \leq 100\text{kHz}$ | $(\frac{1 \times 10^{-3}}{ Z_m })(1 + \frac{200}{V_s})$                               | $ Z_m (1 \times 10^{-9})(1 + \frac{70}{V_s})$                              |
|                   | $f_m > 100\text{kHz}$                      | $(\frac{1 \times 10^{-3}}{ Z_m })(2 + \frac{200}{V_s})$                               | $ Z_m (3 \times 10^{-9})(1 + \frac{70}{V_s})$                              |
| Fast              | $f_m < 100\text{Hz}$                       | $(\frac{2.5 \times 10^{-3}}{ Z_m })(1 + \frac{400}{V_s})(1 + \sqrt{\frac{100}{f_m}})$ | $ Z_m (2 \times 10^{-9})(1 + \frac{100}{V_s})(1 + \sqrt{\frac{100}{f_m}})$ |
|                   | $100\text{Hz} \leq f_m \leq 100\text{kHz}$ | $(\frac{2.5 \times 10^{-3}}{ Z_m })(1 + \frac{400}{V_s})$                             | $ Z_m (2 \times 10^{-9})(1 + \frac{100}{V_s})$                             |
|                   | $f_m > 100\text{kHz}$                      | $(\frac{2.5 \times 10^{-3}}{ Z_m })(2 + \frac{400}{V_s})$                             | $ Z_m (6 \times 10^{-9})(1 + \frac{100}{V_s})$                             |

$f_m$ : Measuring frequency [Hz]

$Z_m$ : The impedance of the DUT [ $\Omega$ ]

$V_s$ : The amplitude of the measuring signal [mVrms]

When the impedance is less than  $500\Omega$  then use  $K_a$ ;  $K_b$  can be ignored.

When the impedance is larger than  $500\Omega$  then use  $K_b$ ;  $K_a$  can be ignored.

Table 13-2 Temperature correction factor  $K_c$ 

| Temp (°C)      | 5 |  | 8 |  | 18 |  | 28 |  | 38 |  |   |
|----------------|---|--|---|--|----|--|----|--|----|--|---|
| K <sub>c</sub> | 6 |  | 4 |  | 2  |  | 1  |  | 2  |  | 4 |

Table 13-3 Correction factor for interpolated open/short trimming  $K_f$ 

| Test frequency                                                        | $K_f$  |
|-----------------------------------------------------------------------|--------|
| When test frequency equals to the open/short trimming frequency       | 0      |
| When test frequency is not equal to the open/short trimming frequency | 0.0003 |

Please refer to 12.1 general specification section for what the open/short trimming frequency points are for each T3LCR models.

Table 13-4 Correction factors for the cable length of test leads  $K_L$ 

| Amplitude of the test signal | Cable length of the test leads |                                |                              |
|------------------------------|--------------------------------|--------------------------------|------------------------------|
|                              | 0m                             | 1m                             | 2m                           |
| $\leq 1.5V_{rms}$            | 0                              | $2.5 \times 10^{-2}(1+0.5f_m)$ | $5 \times 10^{-2}(1+0.5f_m)$ |
| $> 1.5V_{rms}$               | 0                              | $2.5 \times 10^{-2}(1+0.9f_m)$ | $5 \times 10^{-2}(1+1.1f_m)$ |

In above table,  $f_m$  represents the frequency of the measuring signal [kHz].

# Certifications

Teledyne LeCroy certifies compliance to the following standards as of the time of publication. Please see the EC Declaration of Conformity document shipped with your product for current certifications.

## EMC Compliance

### EC DECLARATION OF CONFORMITY - EMC

The instrument meets intent of EC Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications listed in the Official Journal of the European Communities:

EN 61326-1:2013, EN 61326-2-1:2013 EMC requirements for electrical equipment for measurement, control, and laboratory use.<sup>\*1</sup>

#### Electromagnetic Emissions:

EN 55011:2016+A1:2017, Radiated and Conducted Emissions Group 1, Class A<sup>\*2\*3</sup>

EN 61000-3-2:2014 Harmonic Current Emissions, Class A

EN 61000-3-3:2013 Voltage Fluctuations and Flickers, Pst = 1

#### Electromagnetic Immunity:

EN 61000-4-2:2009 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes<sup>\*4</sup>

EN 61000-4-3:2006+ A2:2010 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz-2 GHz; 1 V/m, 2 GHz-2.7 GHz

EN 61000-4-4:2012 Electrical Fast Transient/Burst, 1 kV on power supply lines, 0.5 kV on I/O signal data and control lines<sup>\*4</sup>

EN 61000-4-5:2014+A1:2017 Power Line Surge, 1 kV AC Mains, L-N, L-PE, N-PE<sup>\*4</sup>

EN 61000-4-6:2014 RF Conducted Electromagnetic Field, 3 Vrms, 0.15 MHz - 80 MHz

EN 61000-4-11:2004+A1:2017 Mains Dips and Interruptions, 0%/1 cycle, 70%/25 cycles, 0%/250 cycles<sup>\*4\*5</sup>

<sup>\*1</sup> To ensure compliance with all applicable EMC standards, use high-quality shielded interface cables.

<sup>\*2</sup> Emissions which exceed the levels required by this standard may occur when the instrument is connected to a test object.

<sup>\*3</sup> This product is intended for use in nonresidential areas only. Use in residential areas may

cause electromagnetic interference.

<sup>\*4</sup> Meets Performance Criteria “B” limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

<sup>\*5</sup> Performance Criteria “C” applied for 70%/25 cycle voltage dips and for 0%/250 cycle voltage interruption test levels per EN61000-4-11.

### **European Contact:\***

Teledyne GmbH, European Division

Im Breitspiel 11c

D-69126 Heidelberg

Germany

Tel: + 49 6221 82700

### **AUSTRALIA & NEW ZEALAND DECLARATION OF CONFORMITY – EMC**

The instrument complies with the EMC provision of the Radio Communications Act per the following standards, in accordance with requirements imposed by Australian Communication and Media Authority (ACMA):

AS/NZS CISPR 11:2015 Radiated and Conducted Emissions, Group 1, Class A.

### **Australia / New Zealand Contacts:\***

RS Components Pty Ltd.

Suite 326 The Parade West

Kent Town, South Australia 5067

RS Components Ltd.

Units 30 & 31 Warehouse World

761 Great South Road

Penrose, Auckland, New Zealand

\* Visit [teledynelecroy.com/support/contact](http://teledynelecroy.com/support/contact) for the latest contact information.



## Safety Compliance

### EC DECLARATION OF CONFORMITY – LOW VOLTAGE

The instrument meets intent of EC Directive 2014/35/EU for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use -

Part 1: General requirements

EN 61010-2:030:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use -

Part 2-030: Particular requirements for testing and measuring circuits

The design of the instrument has been verified to conform to the following limits put forth by these standards:

- Mains Supply Connector: Overvoltage Category II, instrument intended to be supplied from the building wiring at utilization points (socket outlets and similar).
- Measuring Circuit Terminals: No rated measurement category. Terminals not intended to be connected directly to the mains supply.
- Unit: Pollution Degree 2, operating environment where normally only dry, non-conductive pollution occurs. Temporary conductivity caused by condensation should be expected.

## Environmental Compliance

### END-OF-LIFE HANDLING



The instrument is marked with this symbol to indicate that it complies with the applicable European Union requirements of Directives 2012/19/EU and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

The instrument is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit [teledynelecroy.com/recycle](http://teledynelecroy.com/recycle).

# RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)

## EC DECLARATION OF CONFORMITY – RoHS

Unless otherwise specified, all the materials and processes are compliant with RoHS Directive 2011/65/EU in its entirety, inclusive of any further amendments or modifications of said Directive.

## CHINA RoHS 2

Unless otherwise specified, all the materials and processes are compliant with the latest requirements of China RoHS 2. The hazardous substances contained in the instrument are disclosed in accordance with the standards SJ/T 11364-2014 (Marking for the restricted use of hazardous substances in electronic and electrical products) and GB/T 26572-2011 (Requirements on concentration limits for certain restricted substances in electrical and electronic products). The instrument is marked with an appropriate Environmental Friendly Use Period (EFUP) symbol. The packaging materials include the appropriate recycling labels. The below substance disclosure tables (in Chinese and English languages) provide the required compliance information.

| 部件名称                                                      | 有毒有害物质和元素 |           |           |               |               |                 |
|-----------------------------------------------------------|-----------|-----------|-----------|---------------|---------------|-----------------|
|                                                           | 铅<br>(Pb) | 汞<br>(Hg) | 镉<br>(Cd) | 六价铬<br>(Cr6+) | 多溴联苯<br>(PBB) | 多溴二苯醚<br>(PBDE) |
| PCBAs                                                     | X         | O         | O         | O             | O             | O               |
| 机械硬件                                                      | O         | O         | O         | O             | O             | O               |
| 金属片                                                       | O         | O         | O         | O             | O             | O               |
| 塑料部件                                                      | O         | O         | O         | O             | O             | O               |
| 电缆组件                                                      | X         | O         | O         | O             | O             | O               |
| 显示器                                                       | O         | O         | O         | O             | O             | O               |
| 电源                                                        | O         | O         | O         | O             | O             | O               |
| 风扇                                                        | O         | O         | O         | O             | O             | O               |
| 电池                                                        | O         | O         | O         | O             | O             | O               |
| 电源线                                                       | O         | O         | O         | O             | O             | O               |
| 外部电源(如有)                                                  | X         | O         | O         | O             | O             | O               |
| 探头(如有)                                                    | X         | O         | O         | O             | O             | O               |
| 熔丝(如有)                                                    | O         | O         | O         | O             | O             | O               |
| 产品外壳(如有)                                                  | O         | O         | O         | O             | O             | O               |
| 适配器/模块(如有)                                                | O         | O         | O         | O             | O             | O               |
| 鼠标(如有)                                                    | O         | O         | O         | O             | O             | O               |
| O: 表明该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11364-2014 标准规定的限量要求之下。  |           |           |           |               |               |                 |
| X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11364-2014 标准规定的限量要求。 |           |           |           |               |               |                 |

EFUP (对环境友好的使用时间): 30 年。

使用条件: 参阅用户手册“环境条件”部分的规定。

探头 EFUP: 10 年。

| Part Name                                                                                                                                                                                | Toxic or Hazardous Substances and Elements |              |              |                            |                                |                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------|--------------|----------------------------|--------------------------------|---------------------------------------|
|                                                                                                                                                                                          | Lead (Pb)                                  | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr6+) | Polybrominated Biphenyls (PBB) | Polybrominated Diphenyl Ethers (PBDE) |
| PCBAs                                                                                                                                                                                    | X                                          | O            | O            | O                          | O                              | O                                     |
| Mechanical Hardware                                                                                                                                                                      | O                                          | O            | O            | O                          | O                              | O                                     |
| Sheet Metal                                                                                                                                                                              | O                                          | O            | O            | O                          | O                              | O                                     |
| Plastic Parts                                                                                                                                                                            | O                                          | O            | O            | O                          | O                              | O                                     |
| Cable Assemblies                                                                                                                                                                         | X                                          | O            | O            | O                          | O                              | O                                     |
| Display                                                                                                                                                                                  | O                                          | O            | O            | O                          | O                              | O                                     |
| Power Supply                                                                                                                                                                             | O                                          | O            | O            | O                          | O                              | O                                     |
| Fans                                                                                                                                                                                     | O                                          | O            | O            | O                          | O                              | O                                     |
| Batteries                                                                                                                                                                                | O                                          | O            | O            | O                          | O                              | O                                     |
| Power Cord                                                                                                                                                                               | O                                          | O            | O            | O                          | O                              | O                                     |
| Ext Power Supply (if present)                                                                                                                                                            | X                                          | O            | O            | O                          | O                              | O                                     |
| Probes (if present)                                                                                                                                                                      | X                                          | O            | O            | O                          | O                              | O                                     |
| Fuse (if present)                                                                                                                                                                        | O                                          | O            | O            | O                          | O                              | O                                     |
| Product Case (if present)                                                                                                                                                                | O                                          | O            | O            | O                          | O                              | O                                     |
| Adapters/Modules (if present)                                                                                                                                                            | O                                          | O            | O            | O                          | O                              | O                                     |
| Mouse (if present)                                                                                                                                                                       | O                                          | O            | O            | O                          | O                              | O                                     |
| O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement specified in SJ/T11364-2014.              |                                            |              |              |                            |                                |                                       |
| X: Indicates that this toxic or hazardous substance contained in at least one of the homogenous materials used for this part is above the limit requirement specified in SJ/T11364-2014. |                                            |              |              |                            |                                |                                       |

EFUP (Environmental Friendly Use Period): 30 years.

Use Conditions: Refer to the environmental conditions stated in the User Manual.

EFUP for Probes: 10 years.

# ABOUT TELEDYNE TEST TOOLS



## Company Profile

Teledyne LeCroy is a leading provider of oscilloscopes, protocol analyzers and related test and measurement solutions that enable companies across a wide range of industries to design and test electronic devices of all types. Since our founding in 1964, we have focused on creating products that improve productivity by helping engineers resolve design issues faster and more effectively. Oscilloscopes are tools used by designers and engineers to measure and analyze complex electronic signals in order to develop high-performance systems and to validate electronic designs in order to improve time to market.

The Teledyne Test Tools brand extends the Teledyne LeCroy product portfolio with a comprehensive range of test equipment solutions. This new range of products delivers a broad range of quality test solutions that enable engineers to rapidly validate product and design and reduce time-to-market. Designers, engineers and educators rely on Teledyne Test Tools solutions to meet their most challenging needs for testing, education and electronics validation.

## Location and Facilities

Headquartered in Chestnut Ridge, New York, Teledyne Test Tools and Teledyne LeCroy has sales, service and development subsidiaries in the US and throughout Europe and Asia. Teledyne Test Tools and Teledyne LeCroy products are employed across a wide variety of industries, including semiconductor, computer, consumer electronics, education, military/aerospace, automotive/industrial, and telecommunications.

Distributed by:

## Teledyne LeCroy (US Headquarters)

700 Chestnut Ridge Road  
Chestnut Ridge, NY, USA 10977-6499

Phone: 800-553-2769 or 845-425-2000  
Fax Sales: 845-578-5985  
Phone Support: 1-800-553-2769  
Email Sales: [contact.corp@teledynelecroy.com](mailto:contact.corp@teledynelecroy.com)  
Email Support: [support@teledynelecroy.com](mailto:support@teledynelecroy.com)  
Web Site: <http://teledynelecroy.com/>

## Teledyne LeCroy (European Headquarters)

Teledyne LeCroy GmbH  
Im Breitspiel 11c  
D-69126 Heidelberg, Germany

Phone: + 49 6221 82700  
Fax: +49 6221 834655  
Fax Sales: +49 6221 834655  
Fax Service: +41 22 719 22 99  
Email Sales: [contact.gmbh@teledynelecroy.com](mailto:contact.gmbh@teledynelecroy.com)  
Email Service: [service.gmbh@teledynelecroy.com](mailto:service.gmbh@teledynelecroy.com)  
Email Support: [applicatons.de@teledynelecroy.com](mailto:applicatons.de@teledynelecroy.com)  
Web Site: <http://teledynelecroy.com/germany>  
Phone Service: +49 6221 8270 85  
Phone Support: +49 6221 8270 28

World wide support contacts can be found at:  
<https://teledynelecroy.com/support/contact>

[teledynelecroy.com](http://teledynelecroy.com)



© 2020 Teledyne Test Tools is a brand and trademark of Teledyne LeCroy Inc. All rights reserved. Specifications, prices, availability and delivery subject to change without notice. Product brand or brand names are trademarks or requested trademarks of their respective holders.

T3 stands for Teledyne Test Tools

[www.valuetronics.com](http://www.valuetronics.com)

933531 Rev1