



## HIGHLIGHTS

- Automated LCR bridge calibration
- Calibration data from 20 Hz to 1 MHz
- Four-terminal pair, 4W and 2W configurations
- Open, Short and Load compensation

## DESCRIPTION

Model M550 Impedance calibrator is designed for calibration of LCR meters. The calibrator contains stable and temperature independent resistance standards, partial capacitance standards and partial inductance standards simulated by RC T-type passive network. Open and Short reference positions are available to eliminate influence of test cables.

Calibration values of both complex parameters of partial standards are displayed on large LCD screen in preselected pairs of parameters as well as voltage, current and frequency readouts from built-in test signal meter.

Philosophy of M550 is based on remote control and automated calibration. For this reason, the calibrator is equipped with RS-232 and GPIB interfaces and supported in CALIBER/WinQbase automated calibration software.

## SPECIFICATION

Specifications below describe 1-year absolute uncertainty at a confidence interval of 95%, including long-term stability, linearity, load and line regulation and reference standard measurement uncertainty as well as ambient conditions within specified limits.

### Resistance

|                           |                                                                                            |
|---------------------------|--------------------------------------------------------------------------------------------|
| Resistance range summary  | 0.1 $\Omega$ – 100 M $\Omega$ in 4TP and 4W mode,<br>1 $\Omega$ – 10 M $\Omega$ in 2W mode |
| Frequency range           | 20 Hz – 1 MHz                                                                              |
| Available parameter pairs | Z/e, Y/e, Rs/Ls, Rs/Cs, Rp/Cp, Rp/Lp, R/X, G/B                                             |

### Series resistance (Rs) parameter overview

| Nominal value  | Calibration uncertainty at 1 kHz |                     |       | 1 year typical stability | Tolerance at 1 kHz |                     | Temperature coefficient | Max. voltage / current |        |
|----------------|----------------------------------|---------------------|-------|--------------------------|--------------------|---------------------|-------------------------|------------------------|--------|
|                | 4TP                              | 4W                  | 2W    |                          | 4TP                | 4W                  |                         | 4TP                    | 4W, 2W |
| 100 m $\Omega$ | 0.20 %                           | 0.50 %              | -     | 0.001 %                  | 2.0 %              | 2.0 %               | 50 ppm/K                | 200 mA                 | 200 mA |
| 1 $\Omega$     | 0.10 %                           | 0.10 %              | 5.0 % | 0.001 %                  | 1.0 %              | 1.5 %               | 2 ppm/K                 | 100 mA                 | 200 mA |
| 10 $\Omega$    | 0.05 %                           | 0.05 %              | 0.5 % | 0.001 %                  | 0.5 %              | 1.0 %               | 2 ppm/K                 | 50 mA                  | 150 mA |
| 100 $\Omega$   | 0.02 %                           | 0.05 %              | 0.1 % | 0.001 %                  | 0.1 %              | 1.0 %               | 2 ppm/K                 | 15 mA                  | 50 mA  |
| 1 k $\Omega$   | 0.02 %                           | 0.02 %              | 0.1 % | 0.001 %                  | 0.1 %              | 1.0 %               | 2 ppm/K                 | 5 V                    | 10 V   |
| 10 k $\Omega$  | 0.02 %                           | 0.02 %              | 0.1 % | 0.001 %                  | 0.1 %              | 1.0 %               | 2 ppm/K                 | 15 V                   | 30 V   |
| 100 k $\Omega$ | 0.02 %                           | 0.05 %              | 0.1 % | 0.001 %                  | 0.1 %              | 1.0 %               | 2 ppm/K                 | 30 V                   | 50 V   |
| 1 M $\Omega$   | 0.03 %                           | 0.20 %              | 0.2 % | 0.003 %                  | 0.1 %              | 1.0 %               | 2 ppm/K                 | 30 V                   | 50 V   |
| 10 M $\Omega$  | 0.05 %                           | 0.20 % <sup>1</sup> | 0.5 % | 0.010 %                  | 0.2 %              | 2.0 % <sup>1</sup>  | 10 ppm/K                | 30 V                   | 50 V   |
| 100 M $\Omega$ | 0.50 %                           | 1.00 % <sup>1</sup> | -     | 0.010 %                  | 1.0 %              | 10.0 % <sup>1</sup> | 25 ppm/K <sup>2</sup>   | 30 V                   | 50 V   |

<sup>1</sup> At 100 Hz.

<sup>2</sup> 50 ppm/K in 4TP mode.

### Capacitance

|                           |                                                                    |
|---------------------------|--------------------------------------------------------------------|
| Capacitance range summary | 10 pF – 100 $\mu$ F in 4TP mode,<br>100 pF – 100 $\mu$ F otherwise |
| Frequency range           | 20 Hz – 1 MHz                                                      |
| Tolerance at 1 kHz        | 5 % in 4TP mode, 10 % otherwise                                    |
| Available parameter pairs | Z/e, Y/e, Cs/D, Cs/Rs, Cp/D, Cp/Rp, Cp/G                           |

### Parallel capacitance (Cp) parameter overview

| Nominal value | Calibration uncertainty at 1 kHz |        |       | 1 year typical stability |         | Temperature coefficient |            | Max. voltage / current | Dissipation factor at 1kHz (4TP, typical) |
|---------------|----------------------------------|--------|-------|--------------------------|---------|-------------------------|------------|------------------------|-------------------------------------------|
|               | 4TP                              | 4W     | 2W    | 4TP                      | 4W, 2W  | 4TP                     | 4W, 2W     |                        |                                           |
| 10 pF         | 1.00 %                           | -      | -     | 0.010 %                  | -       | 50 ppm/K                | -          | 30 V                   | < 0.0020                                  |
| 100 pF        | 0.10 %                           | 1.0 %  | 5.0 % | 0.010 %                  | 0.015 % | 50 ppm/K                | 500 ppm/K  | 30 V                   | < 0.0010                                  |
| 1 nF          | 0.05 %                           | 0.10 % | 1.0 % | 0.010 %                  | 0.010 % | 50 ppm/K                | 500 ppm/K  | 30 V                   | < 0.0005                                  |
| 10 nF         | 0.05 %                           | 0.05 % | 0.2 % | 0.010 %                  | 0.010 % | 50 ppm/K                | 500 ppm/K  | 30 V                   | < 0.0005                                  |
| 100 nF        | 0.05 %                           | 0.05 % | 0.2 % | 0.010 %                  | 0.010 % | 50 ppm/K                | 500 ppm/K  | 20 V                   | < 0.0005                                  |
| 1 $\mu$ F     | 0.05 %                           | 0.05 % | 0.2 % | 0.010 %                  | 0.010 % | 250 ppm/K               | 500 ppm/K  | 10 V                   | < 0.0010                                  |
| 10 $\mu$ F    | 0.10 %                           | 0.10 % | 0.5 % | 0.015 %                  | 0.015 % | 250 ppm/K               | 1000 ppm/K | 100 mA                 | < 0.0050                                  |
| 100 $\mu$ F   | 0.10 %                           | 0.20 % | 1.0 % | 0.015 %                  | 0.150 % | 250 ppm/K               | 1000 ppm/K | 200 mA                 | < 0.0200                                  |

## Inductance <sup>3</sup>

|                           |                               |
|---------------------------|-------------------------------|
| Inductance range summary  | 10 $\mu$ H – 10 H in 4TP mode |
| Frequency range           | 20 Hz – 100 kHz               |
| Tolerance at 1 kHz        | 15 %                          |
| Typical 1-year stability  | 0.01 %                        |
| Temperature coefficient   | 50 ppm/K                      |
| Available parameter pairs | Z/e, Y/e, Ls/Q, Ls/Rs         |

### Series inductance (Ls) parameter overview

| Nominal value | Calibration uncertainty at 1 kHz | Max. voltage / current | Typical series resistance Rs |
|---------------|----------------------------------|------------------------|------------------------------|
| 10 $\mu$ H    | 0.3 %                            | 50 mA                  | 66 $\Omega$                  |
| 100 $\mu$ H   | 0.2 %                            | 30 mA                  | 200 $\Omega$                 |
| 1 mH          | 0.1 %                            | 5 V / 20 mA            | 660 $\Omega$                 |
| 10 mH         | 0.1 %                            | 5 V / 10 mA            | 660 $\Omega$                 |
| 100 mH        | 0.1 %                            | 10 V                   | 2 k $\Omega$                 |
| 1 H           | 0.1 %                            | 10 V                   | 20 k $\Omega$                |
| 10 H          | 0.1 %                            | 10 V                   | 20 k $\Omega$                |

<sup>3</sup> Inductance is simulated in 4TP mode using T-network RC circuit

## Test level meter

|                       |                                                                    |
|-----------------------|--------------------------------------------------------------------|
| Frequency measurement | 20 Hz – 100 kHz<br>accuracy: 0.01 % + 1 mHz                        |
| Voltage measurement   | 0.2 – 10 V <sub>rms</sub><br>accuracy: 2 % above 1V, 5 % otherwise |
| Current indication    | 1 nA – 500 mA                                                      |

## GENERAL DATA

|                        |                                                               |
|------------------------|---------------------------------------------------------------|
| Warm-up time           | 15 minutes                                                    |
| Reference temperature  | +21 °C – +25 °C                                               |
| Operating temperature  | +15 °C – +30 °C                                               |
| Storage temperature    | -10 °C – +40 °C                                               |
| Output terminals       | 4TP mode: 4 BNC connectors<br>4W & 2W modes: 4 banana sockets |
| Max relative humidity  | 80 %                                                          |
| Power supply           | 115/230V - 50/60 Hz, 35 VA max                                |
| Dimensions (W x H x D) | 450 x 150 x 430 mm                                            |
| Weight                 | 12 kg                                                         |
| Interfaces             | RS232, IEEE488                                                |

## LCR bridge calibration (application)

