

# **BK PRECISION<sup>®</sup>**

Models: TL89T1

## Transformer Test Fixture

USER MANUAL



# 1. Introduction

The 894 & 895 LCR meters provide measurement functions for basic parameter testing of transformers (see Figure 1). Along with the use of test fixture TL89T1, the 894 and 895 can test the primary and secondary inductance ( $L_{2A}$ ,  $L_{2B}$ ), turn ratio ( $N$ ,  $1/N$ ), mutual inductance ( $M$ ), primary and secondary direct-current resistance ( $R_2$ ) of a transformer directly. Additionally, 894 and 895 can indirectly test two other common parameters of the transformer: winding equivalent capacitance  $C_o$ , and leakage inductance  $L_k$ .

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**NOTE:** "2" in  $L_{2A}$ ,  $L_{2B}$ , and  $R_2$  indicates two terminal measurement method to differentiate from four-terminal measurement.

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The LCR meters are designed to provide simple transformer measurement methods that are limited by the two-wire test terminal method. While using the built-in bias voltage source, bias tests can be made for transformer windings.

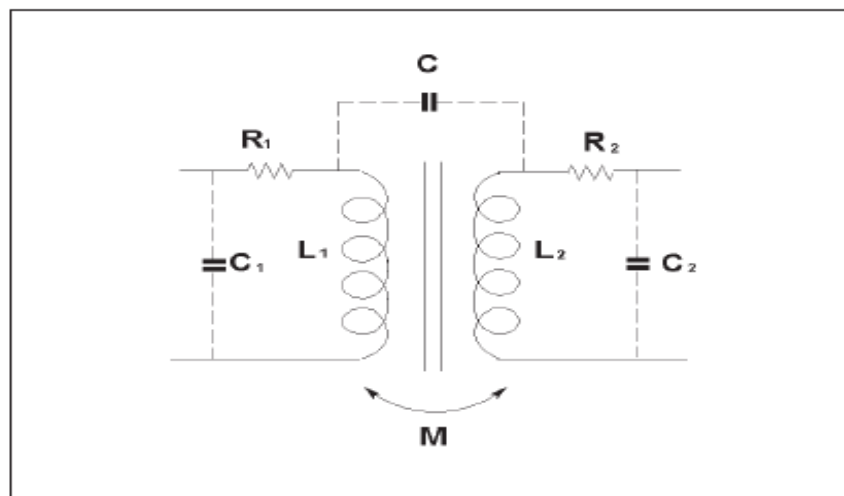


Figure 1 - Transformer Parameters

It is not recommended to replace the test fixture of TL89T1 with other third party connectors or test accessory.

## 2. Direction Transformer Tests

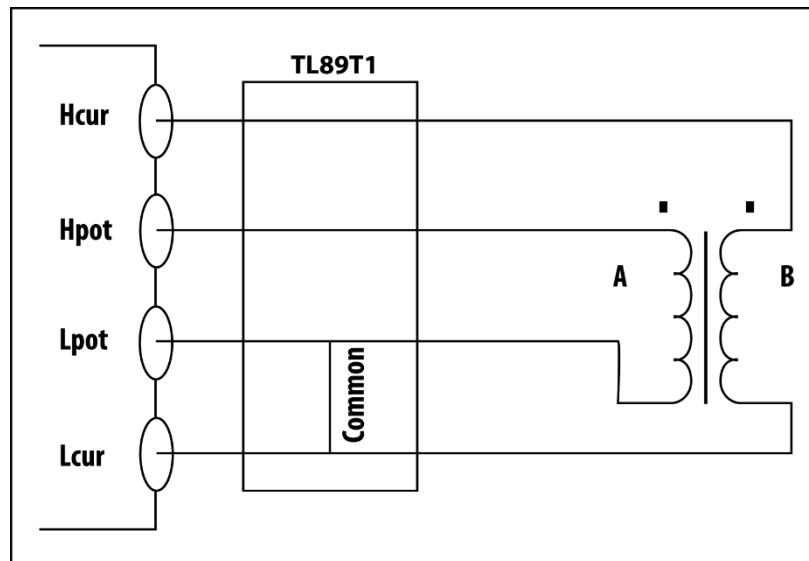


Figure 2 - Transformer Test Connection

In Figure 2, the winding connected to the Hpot terminal is defined as the primary (winding A) and the winding connected to the Hcur terminal is defined as the secondary (winding B). Before performing a transformer test, the appropriate test level and test frequency should be selected.

After selecting the parameter and connecting the transformer test fixture, perform an open and short correction. For short correction, if the primary parameter is L2A, short the Hpot terminal and the low terminal. If the primary parameter is L2B, short the Hcur terminal and the low terminal.

### 2.1.1 Correction process

To remove the inherent stray capacitance of the TL89T1 that increases measurement error, first perform an Open correction, then a Short correction. Figure 3 and Figure 4 shown below illustrates the proper lead connections for either correction. In the case of an Open correction, connect the clips from "A" to "B" together and connect the two common clips together (see Figure 3). In the case of a Short correction connect all for clips together (see Figure 4). Once the leads have been connected properly, follow the correction procedure in the 894/895 user manual.

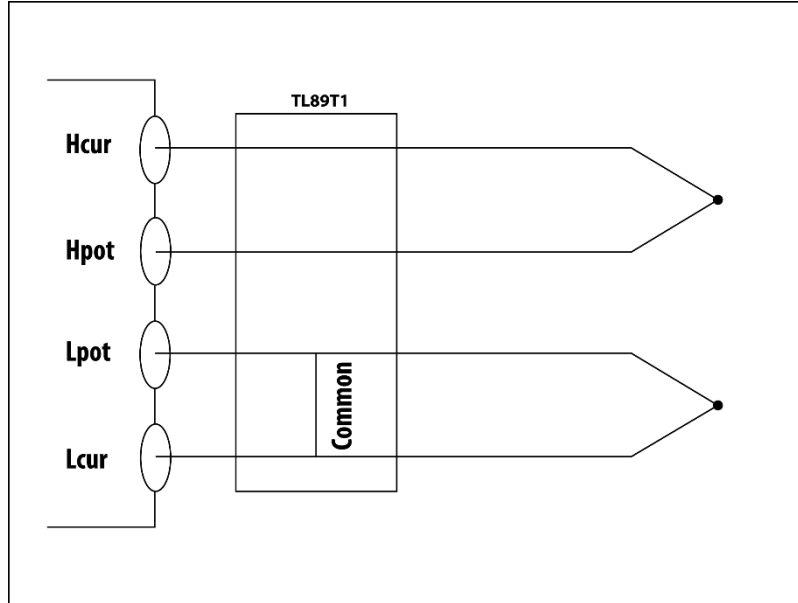


Figure 3 - Open Correction

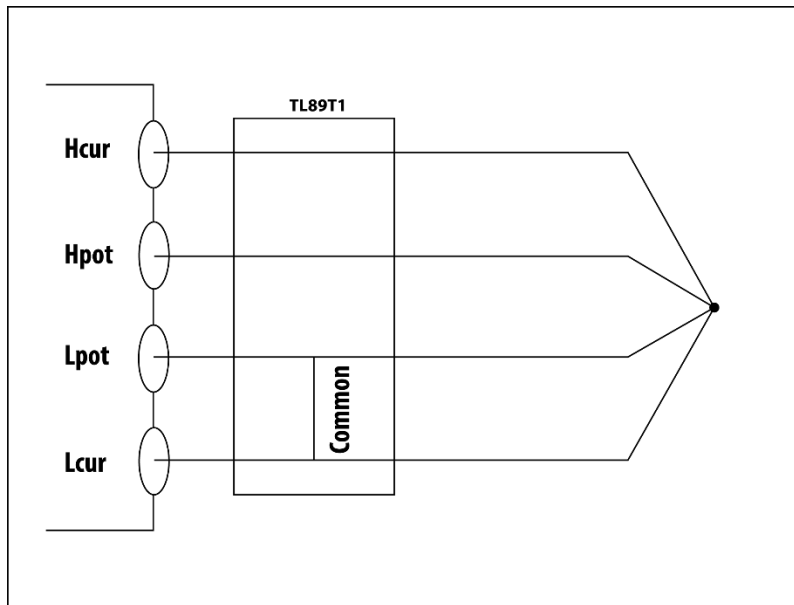


Figure 4 - Short Correction

### 2.1.2 Primary and secondary inductance L2A, L2B

After connecting the test fixture and the transformer according to Figure 2 and performing the correction process, primary inductance can be measured if the primary parameter L2A is selected. The secondary inductance can be measured if the primary parameter L2B is selected.

With L2A selected, the signal source exists in the transformer primary polarity. With L2B selected, the signal source exists in the transformer secondary polarity.

### 2.1.3 Turn ratio and polarity measurement N, 1/N

The 894 & 895 adopts the method of voltage ratio to measure the turn ratio directly. When the secondary parameter selects N or 1/N, it can measure the turn ratio.

When N or 1/N appears to be negative, this indicates that it the non-dotted terminal of the transformer connected to the Hcur and Hpot terminal.

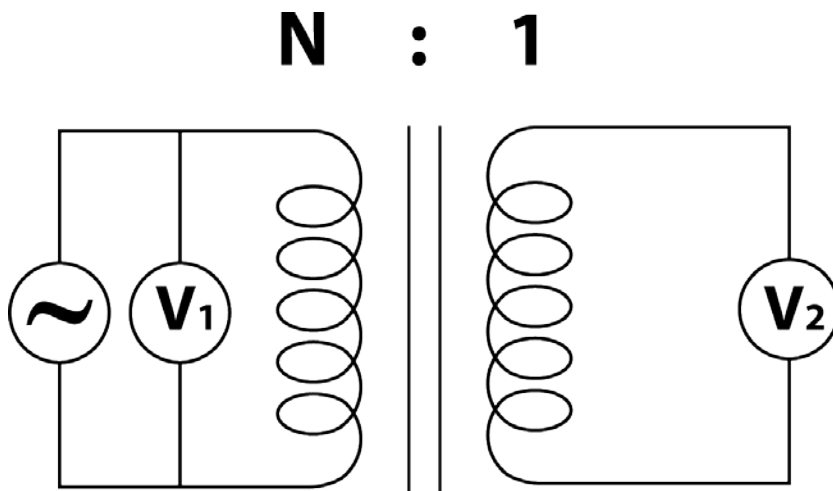


Figure 5 - Direct measurement of turn ratio by voltage ratio method

When the measurement parameter is L2A-N, N is the turn ratio of primary to secondary.

When the measurement parameter is L2B-N, N is the turn ratio of secondary to primary.

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**NOTE:** The 894 & 895 are suitable for the measurement of the turn ratio when  $N \geq 1$ . If  $N < 1$ , it may result in measurement error due to large amplitude of the sampled signal. Therefore, select L2A or L2B correctly before measurement.

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In general, if the turn of winding A is larger than winding B, select L2A-N. Otherwise, select L2B-N.

#### 2.1.4 Mutual inductance

Mutual inductance (M) adopts a direct measurement method. After connecting the transformer according to Figure 6, mutual inductance can be measured when the secondary parameter is selected as M.

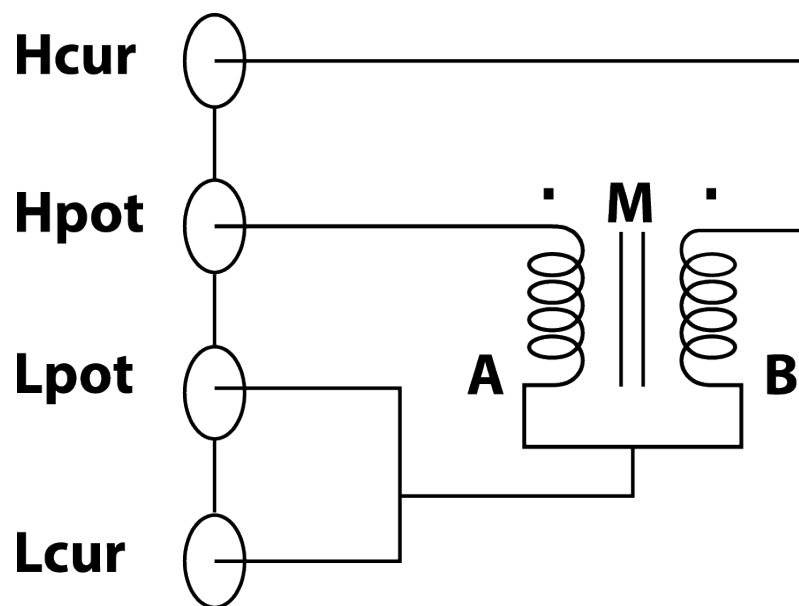


Figure 6 - Direct measurement method of mutual inductance

Similar to the measurement of the turn ratio, if the turn of winding A is larger than winding B, select L2A-M. Otherwise, select L2B-M.

### 2.1.5 Direct current resistance measurement

Select L2A-R2 to measure the primary inductance and primary direct current resistance.

In the LCR function menu, select Ls-DCR to measure the inductance and direct current resistance for some winding of the transformer with a four-wire terminal setup. After selecting Ls-DCR, press **PARA A** again to turn off the AC test and enter into the DCR independent test status.

Whether it is L2A-R2, L2B-R2 or Ls-DCR, measurements are alternated between AC/DC.

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**NOTE:** When measuring high resistance, especially large inductive components, unsteady measurements or test errors may result due to long unstable period of the signal.

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## 3. Indirect Transformer Tests

### 3.1.1 Leakage inductance $L_k$

The Ls measurement function of the LCR meter can be used to test the leakage inductance, as shown in Figure 7.

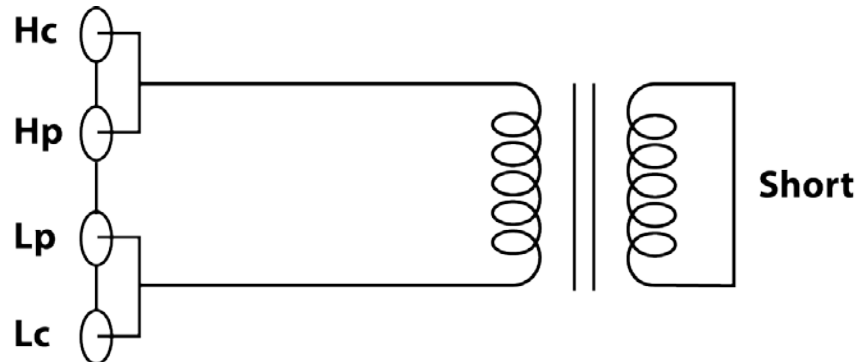


Figure 7 - Leakage inductance measurement of transformer

In transformer measurement mode, disconnect Hcur terminal and connect with the secondary polarity in short circuit to measure the primary  $L_k$  with L2A. Disconnect Hpot terminal and connect with the primary polarity in short circuit to measure the secondary  $L_k$  with L2B.

### 3.1.2 Winding capacitance $C_0$

The equivalent capacitance of the transformer winding can be measured using the  $C_p$  measurement function of the LCR meter.

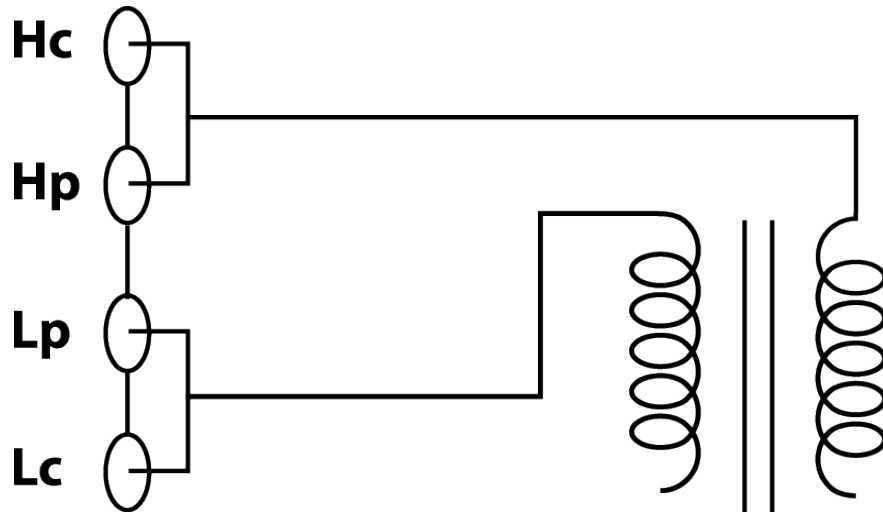


Figure 8 - Capacitance measurement of transformer winding

## 4. Specifications

Measurement parameters: L, M, N, & DCR

Frequency range: DC to 100 kHz

Max. DC Bias:  $\pm 42$  V

Weight: 240 g

Operating temperature: 0 °C to 40 °C

Storage temperature: -10 °C to 70 °C





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