

## MILLIOHM METER

### MODEL 16502

#### Key Features :

- Basic accuracy: 0.05%
- Pulsed test current output mode is used to reduce thermal EMFs affection on milliohm measurement.
- **DC test current output mode** is used to fasten measurement speed for inductive DUT
- **Dry-circuit test current output mode** is used to measure such contact resistances where the maximum open-circuit voltage must be limited to 20mV.
- 0.001mΩ~1.9999MΩ wide
- Measurement range with 4 1/2 digits resolution
- Temperature correction (Temperature correction function) without regard to material or temperature.
- Helpful Temperature Conversion Function for Motor / Coil Evaluation.
- Standard RS232 interface.
- Optional GPIB & Handler interface
- Comparator and Pass/Fail alarming beeper function.
- Large LCD display (240 x 64 dot-matrix)
- Friendly user interface.



## MILLIOHM METER MODEL 16502

The Chroma 16502 Milliohm Meter is Chroma's newest digital Milliohm Meter. With a basic accuracy of 0.05% the instrument offers a 0.001mΩ~1.9999MΩ wide measurement range. It provides measurement range with 4 ½ digits resolution. The fast measurement time is 65 ms. It suits component evaluation on production line.

The Chroma 16502 Milliohm Meter provides three kinds of mode for different type material application. Pulsed test current output mode is used to reduce thermal EMFs affection on milliohm measurement. DC test current output mode is used to fasten measurement speed for inductive DUT. Dry-circuit test current output mode is used to measure such contact resistances where the maximum open-circuit voltage must be limited to 20mV. DC, Pulsed, and Dry-circuit test current driving modes, enable the Chroma 16502 can be properly used in DC resistance measurement for various inductive components (coil, choke, and transformer winding etc.), cable, metallic contact (connector, relay switch etc.) and conduction materials.

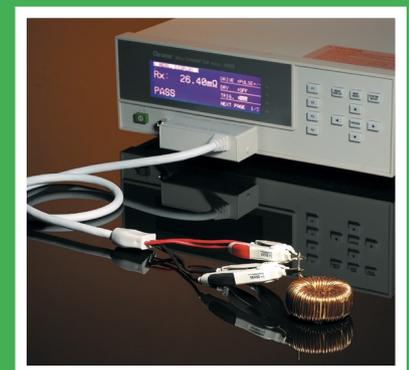
The Chroma 16502 provide temperature correction function. Temperature correction (Temperature correction function) without regard to material or temperature. Users usually get different resistance value with different ambient temperature. Conventional units have temperature correction using a copper wire at 20°C only, but the 16502 provides converted values regardless of material or temperature.

The Chroma 16502 offers temperature conversion function. It is a helpful temperature conversion function for motor / coil evaluation. Users usually cannot get the motor / coil temperature through touch the surface directly. The temperature conversion function displays the temperature (t) or increase in temperature (t) of motor / coil, deriving the values from the measured resistance of the motor / coil and the ambient temperature. It is helpful for user temperature evaluation of motor / coil.

The Chroma 16502 provide menu type front panel with LCD Display, and the programming assures that low resistance measurements can be made quick and easy. Provides a programmable Hi/Lo comparator function in absolute value or %, as well as 8 sorting bins for categorization of components.

For measurement integrity, contact to the test device is made via a 4-terminal Kelvin connection that incorporates an automatic zeroing function to compensate for lead errors.

Standard RS232 interface, optional GPIB & Handler interface, high speed and stable measurement capabilities enable the Chroma 16502 can be used for both component evaluation on the production line and milliohm measurement for bench-top applications.



**Chroma**



## Test Modes

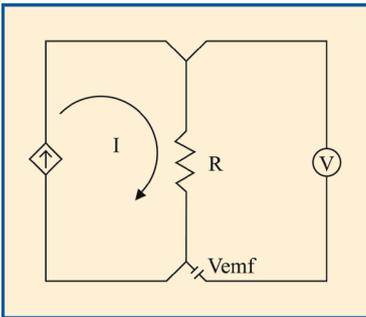
### DC Mode

Only one DC level of test current is output in this mode. This mode is proper to be used for inductive DUT measurement which is faster because of just one level measurement.

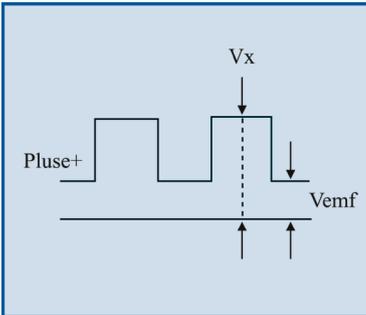
### Pulse Mode

Some contain medium or junctions between wires of different metals act like thermocouples generating small electric potentials called thermoelectric EMFs. Unless rejected in some way, the thermoelectric EMFs can interfere with the measurement.

A pulsed mode selecting in the Chroma 16502 includes pulsed+, pulsed-, and pulsed±. This mode is used to eliminate the affection of thermoelectric EMFs, and is proper to be used for low resistance measurement and conduction materials thermal characteristic analysis.



■  $V_{emf}$  = Thermoelectric EMFs



■  $V_x - V_{emf} = IR$

$V_{emf}$  = Thermoelectric EMFs

### Dry Circuit

Dry circuit test limits open-circuit voltage level to avoid any damage on contact junction while initial of contact for contact resistance measurement. The Chroma 16502 limits this open-circuit voltage level to be lower than 20mV.

## Test Modes

### NULL

Eliminates the measurement error caused by leakage current of outside test jigs and offset voltage of inside circuit.

### COMPARE

Selection of comparator function ON and OFF. The limit can be set to single Upper or Lower, and both, depends on test requirement. For example, for general insulation material and capacitor, lower than the upper limit of leakage current is Pass. However, for anti-static electric materials, upper than the lower limit of leakage current or between the upper and lower limits is pass.

## System Config

### AVERAGE NO

Setting of the average number of tested value. The number of measurements to take then average can be set from 01 to 10. The instrument default setting is 01.

### BEEPER

A beeper volume selection. The Chroma 11200 beeps for Pass/Fail judge and key-pressed echo.

### KEY LOCK

The Key Lock function is designed to avoid the setup information is changed and the keypad is touched by mistake.

### CONTRAST

LCD contrast adjustment.

### SOUND MODE

A selection of beeper sound output for Pass/Fail judge. The Chroma 11200 provides CONTINUOUS and PULSE selections.

### ALARM MODE

A selection of Pass or Fail alarm.

### TRIG. DELAY

Delay time between the test start and the external trigger. Generally used for automatic equipment timing adjustment or delay time for waiting a real leakage current.

### TRIG. EDGE

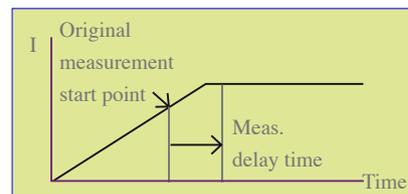
The Chroma 11200 provides RISING and FALLING edge trigger selections for automation.

### HANDLER MODE

There are two selections of Handler I/O output result during the test period. One is HOLD mode, the output signal (PASS or FAIL) of tested result will remain until the next test result comes otherwise. Another is CLEAR mode, force the output signals to FAIL indications until the next test result comes otherwise.

### MEAS. DELAY

Delay time between the test signal start output and the measurement. Generally used for DUT need more time for charge. For some large inductance component testing, trigger delay time must be set to delay the measurement start point till test current is ready.



■ Measurement delay

### LINE FREQUENCY

The measurement of micro current is easily interfered by power noise. The Chroma 16502 used advanced power noise filtering technology to filter the selected line frequency noise accordingly for accurate measurement.

### GPIB ADDRESS

From 00 to 30.

### RS232 BAUDRATE

RS232 transmission baud rate selection. There are 600, 1200, 4800, 9600, 19200 and 28800 for selecting.

### CORREC. TEMP.

It is corrected temperature. It sets the specified temperature value that you want to convert in temperature correction function.

### THERM. COEFF

It sets the thermal coefficient in temperature correction function.

### DWELLTEMP. PROBE

It sets the type of probe for measuring temperature. There are two types of PT100 and PT500.

## Applications

- Production Testing of Contact Resistance of Switches, Relays, Connectors, Cables, and Other Low Resistance Devices
- Production Testing of various inductive components (coil, choke, and transformer winding etc.),
- Testing of Low Value Resistors, Fuses, Squibs, and Heating Elements
- Winding Resistance of Motors, Transformers, Solenoids, and Ballasts
- Conductivity Evaluation in Product Design
- Incoming Inspection and Quality Assurance Testing

## Key Features

### Temperature Correction (Temperature Correction Function) without Regard to Material or Temperature.

Using the Chroma A165015 temperature probe with temperature function interface card (A165013/A165014), Chroma 16502 is possible to correct the displayed resistance value to the required temperature by any thermal coefficient. A lot of material 's resistance will be different value by the different ambient temperature. This function avoid users complex calculation and calculation error. Conventional units have temperature correction using a copper wire at 20 oC, but the 16502 provides converted values regardless of material or temperature. Chroma 16502 supports two common types of temperature probe, PT100 and PT 500. Users just plug the temperature probe in the interface card with temperature function at back panel. Users also can key in the ambient temperature without the temperature probe to get temperature correction.t

### Setting

For example, if the ambient temperature is 30 °C, and a resistance of 100 Ω of a copper wire is to be converted to the value at 20 °C, then this correction can be obtained by making settings as shown below for the corrected temperature and the thermal coefficient (when the conductivity is close to 1, for copper this is 3930 ppm).

Formula for converting 100 Ω resistance of copper to 20 °C at an ambient temperature 30 °C :

$$Rt0 = Rt / \{1 + \alpha t0 \times (t - t0)\} = 100 / \{1 + (3930 \times 10^{-6}) \times (30 - 20)\} 96.21 \Omega$$

Rt0 : corrected resistance value / Rt : measured resistance value / α t0: thermal coefficient of resistance

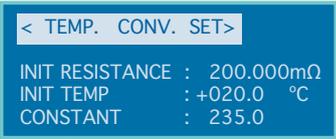
t (°C) : ambient temperature / t0 (°C): temperature of corrected value



1 — CORREC. TEMP. : +20.0 °C  
2 — THERM. COEFF. : 3930 PRM

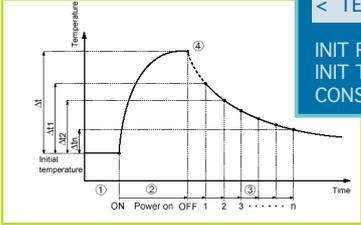
**Temperature correction setting mode**

1. Corrected temperature setup value
2. Thermal coefficient of resistance setup value
3. Temperature sensor probe type



**Temperature conversion setup mode**

INIT RESISTANCE : 200.000mΩ  
INIT TEMP : +020.0 °C  
CONSTANT : 235.0



### Helpful Temperature Conversion Function for Motor / Coil Evaluation

Using the Chroma A165015 temperature probe with temperature function interface card (A165013/A165014), Chroma 16502 is possible to display the temperature (t) or increase in temperature (.t) of an object, deriving the values from the measured resistance of the object and the ambient temperature.

Chroma 16502 supports two common types of temperature probe, PT100 and PT 500. Users just plug the temperature probe in the interface card with temperature function at back panel.

This function display the temperature (t) or increase in temperature (.t) of an object, deriving the values from the measured resistance of the object and the ambient temperature. It is also possible to use the calculated value for making comparisons. When evaluating motors and coils, it is necessary to confirm the maximum temperature increase that will occur while power is applied to the component. this function makes it easy to estimate the maximum temperature.

The temperature conversion function can not be used at the same time as the temperature compensation function. Allow the motor or coil to reach room temperature, and then measure the resistance (r0) and ambient temperature (t0) before supplying power to the motor or coil. . Turn on the power, and then turn the power off once you think that the increased temperature of the motor or coil has reached a plateau. . After the power is turned off, the device measures the change in temperature (.t1 to .tn) at fixed intervals on the basis of the resistance (rt) and the ambient temperature (t)..

### Setting

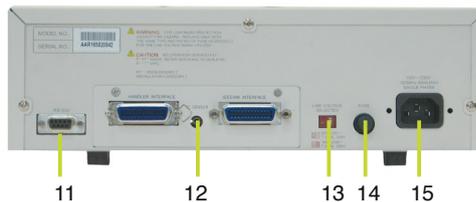
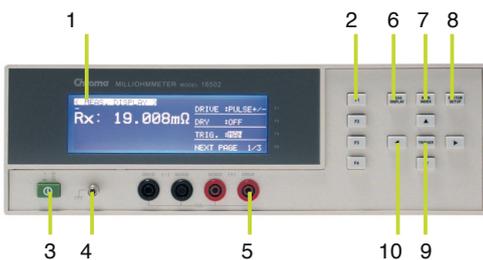
For example, with a copper wire at an initial temperature (t0) of 20°C and a resistance (r0) of 200 mΩ, assume that the nth measurement values were 25°C for the ambient temperature (t) and 210 mΩ for the resistance (rt). The device then calculates and displays the increase in temperature (.tn) at that point according to the following formula:

$$\begin{aligned} .tn &= rt / r0 (T + t0) - (T + t) * T \text{ is a constant. (copper: 235; aluminum:230)} \\ &= (210 \times 10^{-3}) / (200 \times 10^{-3}) \times (235 + 20) - (235 + 25) = 7.75^\circ\text{C} \end{aligned}$$

## Specification

<b>Model</b>	<b>16502</b>	
<b>Range Basic Measurement Accuracy(Note 1);Test Current</b>		
20mΩ	±(0.1% of reading+0.03% of range); 1A typical	
200mΩ	±(0.05% of reading+0.03% of range); 100mA typical	
2Ω	±(0.05% of reading+0.03% of range); 10mA typical	
20Ω	±(0.05% of reading+0.03% of range); 1mA typical	
200Ω	±(0.05% of reading+0.02% of range); 1mA typical	
2kΩ	±(0.05% of reading+0.01% of range); 1mA typical	
20kΩ	±(0.1% of reading+0.01% of range); 100uA typical	
200kΩ	±(0.2% of reading+0.01% of range); 10uA typical	
2MΩ	±(0.3% of reading+0.01% of range); 1uA typical	
<b>Test Signal</b>		
Drive Mode	DC+, DC-, Pulsed+, Pulsed-, Pulsed+/-, Stand by	
Dry Circuit	Open Circuit Voltage less than 20mV; For 200mΩ, 2Ω, 20Ω ranges only	
<b>Measurement Time (Note 2)</b>		
Fast	65mS	
Medium	150mS	
Slow	650mS	
<b>Temp. Correction / Conversion Function</b>		
Temp. Measurement Accuracy	-10.0°C ~39.9°C	±(0.3% of reading+0.5°C) (Note 3)
	40.0°C ~99.9°C	±(0.3% of reading+1.0°C) (Note 3)
Temp. Sensor Type (Option)	PT100/ PT500	
<b>Interface &amp; I/O</b>		
Interface	RS-232(Standard), GPIB & Handler (Optional)	
Output Signal	Bin-sorting & Pass/Fail judge	
Comparator	Upper/Lower Limits in value	
Trigger Delay	0-9999mS	
<b>Trigger</b>	Internal, Manual, External, Bus	
<b>Display</b>	240*64 dot-matrix LCD display	
<b>Correction Function</b>	Zeroing	
<b>General</b>		
Operation Environment	Temperature: 100C-400C, Humidity: <90% R.H.	
Power Consumption	150VA	
Power Requirement	90-125Vac or 190-250Vac, 48Hz-62Hz	
Weight	Approx. 5.5Kg	
Size (W*H*D)	320*115*350mm	

## Panel Description



- 1.LCD Display
- 2.Function Keys
- 3.Power Switch
4. Ground Terminal
- 5.Unknown Test Terminal
- 6.MEAS DISPLAY Key
- 7.MAIN INDEX Key
- 8.SYSTEM SETUP Key
9. TRIGGER Key
- 10.Cursor Keys
- 11.RS232 Interface
12. GPIB and Handler Interface with Temperature Compensation (A165013ption)
13. Line Voltage Selector
14. Fuse
15. AC Line Input

## Ordering Information

**16502** : Milliohm Meter  
**A110235** : GPIB & HANDLER Interface  
**A165013** : GPIB and Handler Interface with Temperature Compensation

**A165014** : Temperature Compensation Card  
**A165015** : PT100 Temperature Probe  
**A165022** : Four terminal test cable with Clips

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