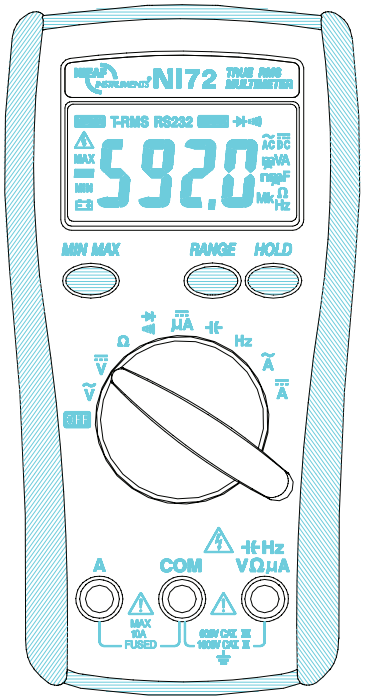
NI 71/72
Multimeter

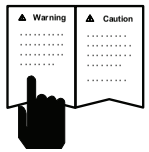
NIEAF INSTRUMENTS™
A Nieaf-Smitt activity

CE



Manual

Safety Alert Symbol : ⚠



READ and **UNDERSTAND** all ***safety alert symbols :*** ⚠ in this manual.
Failure to read and understand safety instructions can result in **INJURY** or **DEATH**

Limited Warranty

This meter is warranted to the original purchaser against defects in material and workmanship for 6 months from the date of purchase. During this warranty period, Nieaf Instruments will, at its option, replace or repair the defective unit, subject to verification of the defect or malfunction. This warranty does not cover fuses, disposable batteries, or damage from abuse, neglect, accident, unauthorized repair, alteration, contamination or abnormal conditions of operation or handling.

Any implied warranties arising out of the sale of this product, including but not limited to implied warranties of merchant-ability and fitness for a particular purpose, are limited to the above. The Nieaf Instruments shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim or claims for such damage, expense or economic loss. Some states or countries laws vary, so the above limitations or exclusions may not apply to you.

Nieaf Instruments
www.nieaf-instruments.com

Safety

"⚠Warning" and "⚠Caution" Alert Symbol Statement :

⚠ Warning" Alert Symbol

A "**⚠Warning**" Statement identifies hazardous conditions and actions that could cause **BODILY HARM** or **DEATH.**

"⚠ Caution" Alert Symbol

A " **⚠Caution**" Statement: identifies conditions and actions that could **DAMAGE** the Meter or the equipment under test.

"⚠ Warnings" and "⚠ Cautions" :

⚠ Warnings

- When using test leads or probes, keep your fingers behind the finger guards.
- Remove test lead from Meter before opening the battery door or Meter case.

- Use the Meter only as specified in this manual or the protection by the Meter might be impaired.
- Always use proper terminals, switch position and range for measurements.
- Never attempt a voltage measurement with the test lead inserted into the A input terminal.
- Verify the Meter's operation by measuring a known voltage. If in doubt, have the Meter serviced.
- Do not apply more than the rated voltage, as marked on the Meter, between terminals or between any terminal and earth ground.
- Do not attempt a current measurement when the open voltage is above the fuse protection rating. Suspected open circuit voltage can be checked with voltage function.
- Only replace the blown fuse with the proper rating as specified in this manual.
- Use caution with voltages above 30 Vac rms, 42 Vac peak or 60 Vdc. These voltages pose a shock hazard.
- To avoid false readings that can lead to electric shock and injury, replace battery as soon as low battery indicator 🔋 appears.
- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Do not use Meter around explosive gas or vapor.
- To reduce the risk of fire or electric shock do not expose this product to rain or moisture.

⚠ Cautions

- Disconnect the test leads from the test points before changing the position of the function rotary switch.
- Never connect a source of voltage with the function rotary switch in Ω/ •))/⎓ ∼A /⊣⊢/Hz position.
- Do not expose Meter to extremes in temperature or high humidity.
- Never set the meter in ⎓ ∼A function to measure the voltage of a power supply circuit in equipment that could result in damage the meter and the equipment under test.

Symbols as Marked on The Meter :

∼ : AC (Alternating Current)

⎓ : DC (Direct Current)

⚠ : Caution, **Risk of Electric shock.** To alert you to the presence of a potentially hazardous voltage.

⚠ : Caution, **Risk of Danger.** Refer to ⚠Warnings and ⚠ Cautions in the manual.

⧈ : **Double Insulation** protection against electric shock.

CE : Conforms to **European** Union directives.

Symbols and Terms in The Manual

Symbols :

⚠ **: Caution, Risk of Danger.**

⚠ **Warning :** Identifies hazardous conditions and actions that could cause **BODILY HARM** or **DEATH**

⚠ **Caution :** Identifies conditions and actions that could **DAMAGE** the meter or equipment under test.

: Fuse.

Terms :

CAT Level **:** Over Voltage Category Level, indicates measurement can be performed at which measuring circuit level. The different level measuring circuit has different high transient stresses voltage.

PER IEC 1010 OVERVOLTAGE INSTALLATION CATEGORY

OVERVOLTAGE CATEGORY Ⅰ

Equipment of **OVERVOLTAGE CATEGORY Ⅰ** is equipment for connection to circuits in which measurements are taken to limit the transient overvoltage to an appropriate low level. Note examples include protected electronic circuits.

OVERVOLTAGE CATEGORY Ⅱ

Equipment of **OVERVOLTAGE CATEGORY Ⅱ** is energy consuming equipment to be supplied from this fixed installation.

OVERVOLTAGE CATEGORY Ⅲ

Equipment of **OVERVOLTAGE CATEGORY Ⅲ** is equipment in fixed installations. Note examples include switches in this fixed installation and some equipment for industrial use with permanent connection to the fixed installation.

OVERVOLTAGE CATEGORY Ⅳ

Equipment of **OVERVOLTAGE CATRGORY Ⅳ** is for use at the origin of the installations. Note examples include electricity meters and primary overcurrent protection equipment.

PER IEC1010 Pollution degree
POLLUTION
Addition of foreign matter, solid, liquid or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity.

POLLUTION degree
For the purpose of evaluating spacing of this product, the following degrees of POLLUTION in the micro environment are defined.

POLLUTION DEGREE 1
No POLLUTION or only dry, non-conductive POLLUTION occurs. The POLLUTION has no influence.

POLLUTION DEGREE 2
Normal POLLUTION only non-conductive POLLUTION occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

POLLUTION DEGREE 3
Conductive POLLUTION occurs, or dry, non-conductive POLLUTION occurs which becomes conductive due to condensation, which is expected.

NOTE : *In such conditions equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.*

Safety Compliance And Certification

Safety compliance

The Meter conform to CENELEC **LVD (Low-Voltage Directive)**
73/23/EEC and EMC **(Electromagnetic Compatibility directive)** 89/336/EEC

The Meter meets the requirements to IEC 61010-1 (2001) , EN 61010-1 (2001), UL 3111-1 (Jan.1994)
CSA C22.2 NO.1010-1-92 +A2: Feb. 1997

Safety Certification : CE

Introduction

Unpacking and Inspection

Upon removing your new digital multimeter from its packing, you should have the following items.

1. Digital multimeter.
2. Test lead set (one black, one red)
3. User manual.
4. Protective holster.

Environmental Conditions

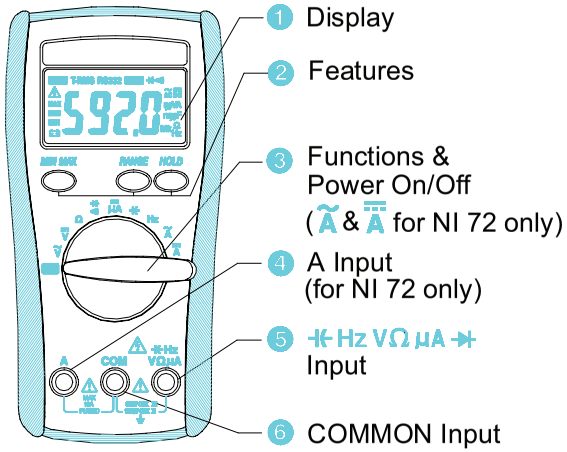
This product is safe at least under the following conditions:

1. Indoor Use
2. Altitude up to 2000 Meter
3. Operating Temperature and Relative Humidity :
   Non-condensing ≦10°C ,11°C ~ 30°C (≦80% R.H)
   31°C ~ 40°C (≦75% R.H), 41°C ~ 50°C (≦45% R.H),
4. Storage Temperature and Relative Humidity : -20°C ~ 60°C (0 ~ 80% R.H) when battery removed from Meter.
5. Pollution degree 2
6. Installation category :
   The standard 70 series models meet the requirements for double insulation to IEC 61010-(2001), EN61010 (2001), UL3111-1(6.1994), CSA C22.2 NO.1010-1-92 to terminals:
   V/Ω: CAT II 1000V - CAT III 600V
7. Shock Vibration : Sinusoidal vibration per Mil-T-28800E (5 ~55 Hz, 3g maximum).
8. Droop Protection : 4 feet droop to hardwood on concrete floor.

The Meter Description

Front Panel Illustration

1. 6000 counts LCD display.
2. Push-buttons for features.
3. Rotary switch to turn the Power On or Off and to select a function.
4. Input Terminal for current A function. (For NI 72 only)
5. Input Terminal for all functions EXCEPT current (A) functions.
6. Common (Ground reference) Input Terminal for all functions.

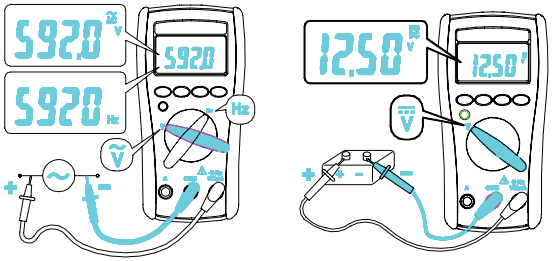


Basic Measurements

> *Preparation and Caution Before Measurement*
> ⚠ : **Observe the rules** of
> ⚠ *Warnings* and ⚠ *Cautions*.

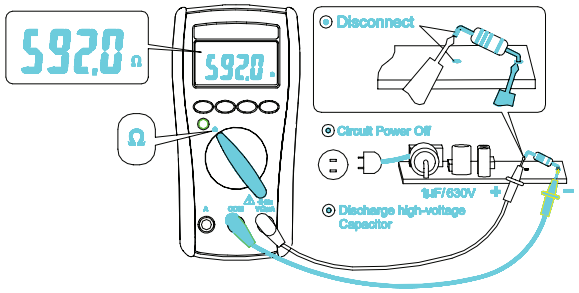
When connecting the test leads to the **DUT** (**D**evice **U**nder **T**est) ***connect the common (COM) test lead before connecting the live lead ; when removing the test leads removing the test live lead before removing the common test lead.***
The figures on the following pages show how to make basic measurements.

Measuring AC/DC Voltage And Frequency



The non-zero display reading is normal when the meter test leads are open, which will not affect actural measurement accuracy. The meter will show zero or close to reading when the test leads are shorted. In reading AC voltage or current, reading-settling time increases to several seconds at the low end of AC voltage and current ranges in rms models.

Measuring Resistance



⚠ Caution

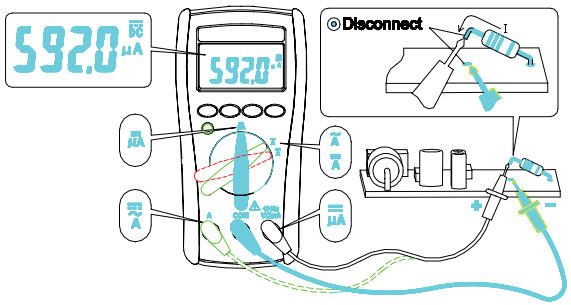
To avoid possible damage to the Meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring resistance.

Note – The Meter provides an open voltage ≦–1.5V to the circuit under test that causes the diode, transistor junction to conduct so *it is better to disconnect the resistance from the circuit to get a correct measurement*.
The resistance of test leads is about 0.1Ω ~ 0.2Ω. To test the leads resistance, touch the probe tips together, for accuracy measurement in low resistance.

$$R_{UNKNOWN} = R_{MEASUREMENT} - R_{TEST\ LEAD}$$

Measuring DC µA, DC A, AC A Current

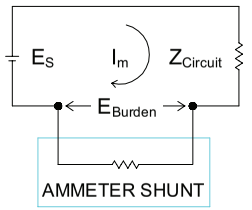
(DCA, ACA for NI 72 only)



⚠ *Warning*

Never attempt an in–circuit measurement where the open–circuit potential to earth potential is greater than 500V for example a 3-phase system measurement, you may damage the Meter or be injured.

To avoid possible damage to the Meter or to the equipment under test, check the Meter's fuses before measuring current. *Use the proper terminals, function and range for your measurement.*
Never place the probes across (in parallel with) any circuit or component when the leads are plugged into the current terminals.
When measuring current, the Meter acts like an impedance such as 0.01Ω at AC/DC A (approximately 1.5KΩ at DC μA) in series with the circuit.
This loading effect of the Meter can cause measurement errors, ***loading effect error***, especially in low impedance circuits.
For example : To measure a 1Ω impedance circuit will cause a –1% measuring error. The ***error percentage of the loading effect*** of the Meter is expressed as following :



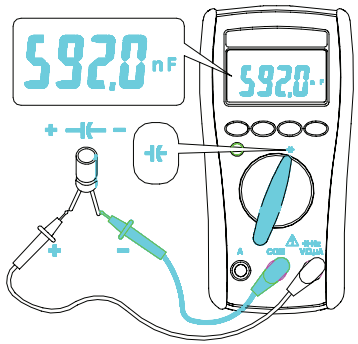
$$100 \times \frac{-0.01\Omega}{Zcircuit + 0.01} \%$$

or

$$100 \times \frac{-E_{Burden}}{E_S} \%$$

DC μA input terminal is protected by a 1.5K PTC (600V rating) resistance.

Measuring Capacitance



⚠ Caution

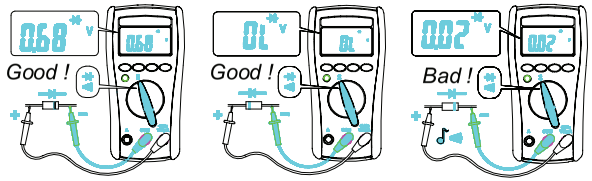
To avoid possible damage to the meter or to the equipment under test, disconnect icrcuit power and discharge all high-voltage capacitors before measuring capacitance. Use the DC voltage function to confirm that the capacitor is discharged.

Note– To improve the measurement accuracy of small value capacitor, record the reading with the test leads open then substract the residual capacitance of the Meter and leads from measurement.

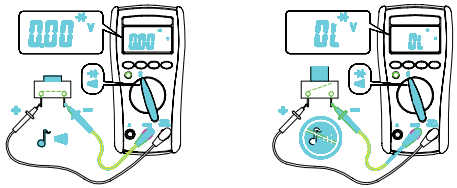
$$C_{UNKNOWN} = C_{MEASUREMENT} - C_{RESIDUAL}$$

Testing for Diode and Continuity

Diode :



Continuity :



⚠ Caution

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring diode and continuity.

Note – Use the diode test to check the semiconductor junction is good or bad. The Meter sends a current through the semiconductor junction to measure the voltage drop across the junction. A good junction drops between 0.4 V to 0.9 V.

Features

Feature Description

The Meter has Features :

Display Hold – Freezes the display.

Min Max Hold – Record the Max or Min reading of the display.

Range – Selects the manual ranging mode. The default mode is Automatic Range.

APO (Auto Power Off) (Battery Saver) –

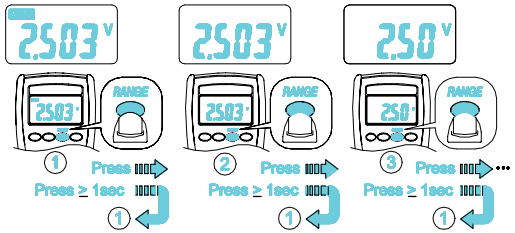
The Meter automatically enters "Sleep Mode" and blanks the display if the Meter is not used for 10 minutes. Press any of the feature buttons or change the rotary switch position to reset the time of APO.

Features Available vs Functions

	~V	⎓V	Ω	•))	⎓µA	⊣⊢	Hz	~A	⎓A
HOLD	O	O	O	O	O	O	O	O	O
MIN MAX HOLD	O	O	O	O	O	O	O	O	O
RANGE	O	O	O	X	O	O	O	O	O
APO	O	O	O	O	O	O	O	O	O

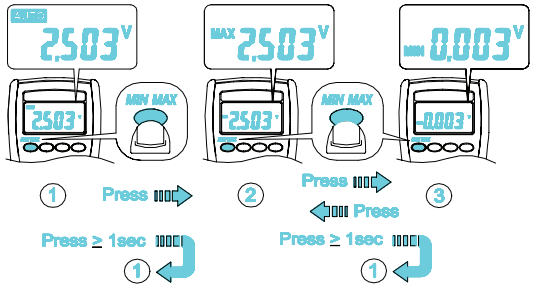
Using The Features

Manual Ranging and Auto Ranging



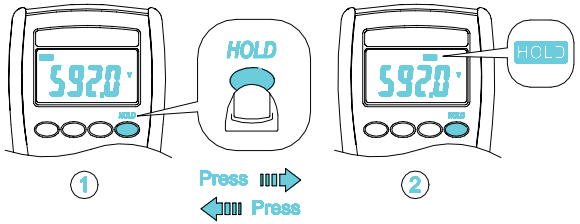
Note - The Range button is pressed to select manual ranging and to change ranges. When the Range button is pressed once, the AUTO indicator turns off. Press Range button to select the appropriate range for measurement you want to make. Press Range button and hold for 1 second to return to Autorange.

MIN MAX Record



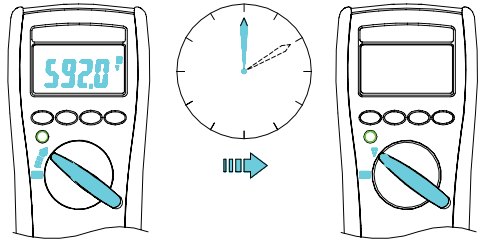
Note – Press ***HOLD*** button in ***MIN MAX*** mode to make the Meter stop updating the maximum and minimum value. When display ***Hold*** mode is nested in ***MIN MAX*** mode, the ***MIN MAX*** mode must be released before the display Hold.

Display Hold



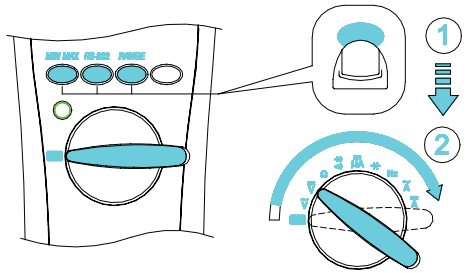
Note – Press the ***Hold*** button to toggle in and out of the display Hold mode. The ***MAX / MIN*** feature is unavailable when display Hold is active.

Auto Power Off (Battery Saver)



Note – If the Meter idles for more than 10 minutes, the Meter automatically turns the power off. When this happens, the LCD displaying-state of the Meter is saved. The Meter can be turned back on by pushing any button, the LCD displays the saved state. Pushing ***Hold*** button to disables the hold state. Any button pressed or rotary change resets the time of Auto Power-OFF.

Disable Auto Power Off



Press one of the buttons (except the Hold button) while the instrument is switched on. The Auto Power OFf function is disabled

Maintenance

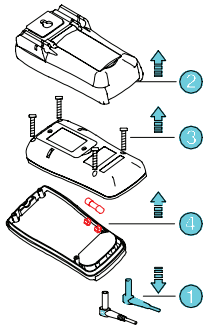
- ***Do not attempt to repair this meter. It contains no user serviceable parts. Repair or servicing should only be performed by qualified personal.***
- ***Failure to observe this precaution can result in injury and can damage the meter.***

Cleaning and storage

Periodically wipe the housing with a damp cloth and mild detergent. Dirt or moisture in the terminals can affect readings. If the Meter is not to be used for a long period, more than 60 days, ***remove the battery and store it separately.***

Fuse Replacement (For NI 72 only)

Refer to the following figure to replace fuse :

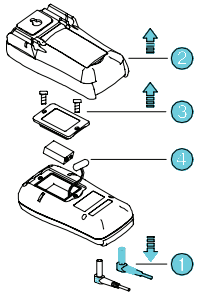


⚠ Caution

- Use ONLY a fuse with the amperage, interrupt, voltage, and speed rating specified.
- Fuse rating : 10A, 500V

Battery Replacement

Refer to the following figure to replace the battery :



⚠ Caution

- Replace the battery as soon as the low battery indicator "🔋" appears, to avoid false reading.
- **NI 71 :** Battery 1.5V x 2
  NI 72 : Battery 9V

TROUBLE SHOOTING

Do not attempt to repair your Meter unless you are qualified to do so and have the relevant calibration, performance test and service information.

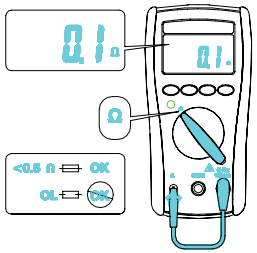
Basic Trouble Shooting

If the Meter fails, first check the battery, the battery connection, fuse, test leads, and replace as necessary.
Review this manual to make sure that you are operating the Meter correctly.

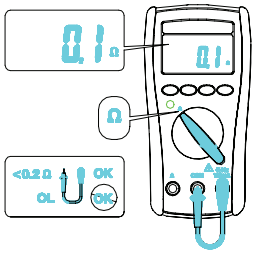
Testing the Fuse and Test Leads

Testing the fuse and test leads as shown below.

Testing the Fuse



Testing the Test Leads



Specification

General Specifications

Display : 6000 counts updates 1.5/sec.

Polarity Indication : Automatic, positive implied, negative indicated.

Overrange Indication : “OL” or “-OL”

Low Battery Indication : “” is displayed when the battery voltage drops below operating voltage.

Auto Power Off : Approx 10 minutes.

Operating Ambient :
Non-condensing ≦10°C,11°C ~ 30°C (≦80% R.H)
31°C ~ 40°C (≦75% R.H), 41°C ~ 50°C (≦45% R.H),

Storage Temperature : -20ºC to 60ºC , 0 to 80% R.H. when battery removed from Meter.

Temperature Coefficient :
0.15 x (Spec.Acc’y) / ºC , <18ºC or > 28ºC .

Power Requirements :
1.5V x 2 IEC LR03, AM4 or AAA size (for NI 71)
Standard 9V battery NEDA 1604, IEC6F22, JIS006P.
(for NI 72)

Battery Life : Alkaline 300 hours.

Dimensions (W x H x D) :
76mm x 158mm x 38mm , without holster.
82mm x 164mm x 44mm , with holster.

Accessories : Battery (installed), Test leads and User manual.

Electrical Specifications

Accuracy is ± (% reading + number of digits) at 23ºC ± 5ºC , less than 80% R.H.

(1) DC / AC Volts

Range	DC Accuracy	AC Accuracy
600.0mV	±(0.5% + 2dgt)	50Hz / 60Hz sine wave only for 600.0mV range, ±(0.9% + 5dgt) 50Hz ~ 500Hz *1
6.000V		
60.00V		
600.0V		
DC1000V / AC750V		

Over voltage protection : DC1000 V or AC 750 Vrms.

Input Impedance : 10MΩ // less than 100pF.

CMRR / NMRR : (Common Mode Rejection Ratio)
(Normal Mode Rejection Ratio)

V_{AC} : CMRR > 60dB at DC, 50Hz / 60Hz
V_{DC} : CMRR > 100dB at DC, 50Hz / 60Hz
NMRR > 50dB at DC, 50Hz / 60Hz

AC Conversion Type :
NI 71 : Average sensing rms indication.
NI 72 : AC conversions are ac-coupled true rms responding, calibrated to the sine wave input.

*1 The basic accuracy is specified for a sine wave below 4000 counts. Over 4000 counts, add 0.6% to the accuracy. For a non-sine waves below 2000 counts, refer to the following for accuracy :
±1.5% addition error for C.F. from 1.4 to 3
Crest Factor : C.F.=Peak/RMS

(2) DC / AC Current

Range	DC Accuracy	AC Accuracy	Voltage Burden
600.0µA	±(1.0% + 2 dgt)	N/A	<4mV / µA
6000µA			
6.000A *2		±(1.5% + 5 dgt) 50Hz ~ 500Hz *1	2V max
10.00A *2			

Overload Protection :
A input : 10A (500V) fast blow fuse
µA input : 600V rms.

*** 1 AC Conversion Type :** Conversion type and additional specification are same as DC/AC Voltage.

* 2 (For NI 72 only)

(3) Resistance

Range	Accuracy	Overload protection
600.0Ω *2	±(0.7% + 2 dgt)	600V rms
6.000KΩ		
60.00KΩ		
600.0KΩ		
6.000MΩ	±(1.0% + 2 dgt)	
60.00MΩ *1	±(1.5% + 2 dgt)	

Open circuit Voltage : -1.3V approx.
* 1 < 100 dgt rolling.
* 2 < 10 dgt rolling.

(4) Diode Check and Continuity

Range	Resolution	Accuracy
	10 mV	±(1.5% + 5 dgt)*

* For 0.4V ~ 0.8V

Max.Test Current : 1.5mA

Max. Open Circuit Voltage : 3V

Overload Protection : 600V rms.
Continuity : Built-in buzzer sounds when resistance is less than approximately 500Ω. Response time is approximately 100 msec.

(5) Frequency

Range	Sensitivity	Accuracy
6000Hz	100mV rms *	Frequency : 0.1%±1digit
60.00KHz		
600.0KHz		
6.000MHz	250mV rms	
60.00MHz	1V rms	

Overload Protection : 600V rms.

* Less than 20Hz, the sensitivity is 1.5V rms.

(6) Capacitance

Range	Accuracy
6.000nF	±(1.9% + 8 dgt)
60.00nF	
600.0nF	
6.000µF	
60.00µF	
600.0µF	
6.000mF *	

Overload Protection : 600V rms.
* < 100 dgt of reading rolling.

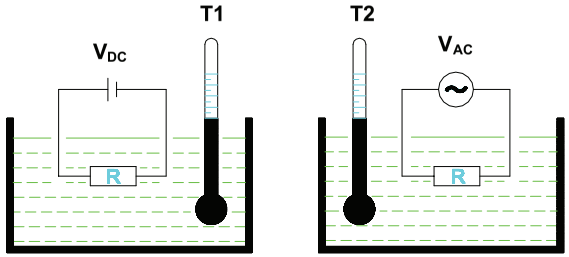
(7) Auto Power Off (APO)

If the Meter idles for more than 10 minutes, the Meter automatically turns the power off.

Terms In The Specification

RMS :

The physical meaning of **RMS** (**R**oot ← **M**ean ← **S**quare) **:**
If the heat energy, temperature, in a resistor produced by a AC signal during the periodic time T is the same as produced by a DC signal during the same time T then we know ***"** The DC signal value is the RMS value of the AC signal**"***

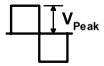


When T1 = T2,
The V_{DC} value is the V_{RMS} value of a V_{AC} signal

According to the definition of physical meaning we can derive the mathematic operation procedure to get a RMS value of a signal as following :

"**R**oot ← **M**ean ← **S**quare the signal"

Average sensing RMS calibrated technical :
Most digital multimeters use an average sensing RMS calibrated technique of an electrical average circuit to measure RMS value of AC signals. This technique is scaling the output average value of the average sensing circuit by the ratio of RMS value to average value, for sine wave the ratio is 1.11. Unfortunately, ***this ratio varies widely as a function of the wave form***, it will give grossly incorrect results in many cases. The table shows a few representative examples comparing RMS to average.

Waveform Type 1 Volt Peak Amplitude	Crest Factor (V_{PEAK} / V rms)	True rms Value	Average Responding Circuit Calibrated rms Value of Sine Waves Will Read	**% of Reading Error* Using Average Responding Circuit**
	1.414	0.707V	0.707V	**0%**
	1.00	1.00V	1.11V	**+11.0%**
	1.73	0.577V	0.555V	**-3.8%**
Rectangular Pulse Train 2 10		0.5V 0.1V	0.278V 0.011V	**-44%** **-89%**

*** % of Reading Error =**

$$\frac{\textbf{Average Responding Value - True rms Value}}{\textbf{True rms Value}} \textbf{ x 100\%}$$

True RMS technical :

The true RMS technique multimeter use the RMS mathematic operation procedures in the electric circuit to obtain the true RMS value. ***So the true RMS measurement is independent of the wave form of the signal under test normally.***
The applications for true RMS measurement, for example, is the measurement of the energy content of SCR waveforms at differing firing angles and measurement of noise and measurement of distorted waveforms with the presence of harmonics. The harmonics in the main circuit may cause circuit breakers to trip prematurely and transformers to overheat motors to burn out, fuses to blow faster than normal and BUS bars and electrical panels to vibrate, and neutrals of three phase system to overheat.

AC / AC+DC coupling true RMS :

AC coupling true RMS : Measures the energy of the AC component only in a signal. For example, measures the noise energy on a DC signal.

AC+DC coupling true RMS : Measures the total energy in a signal. For example, measures the dissipative energy on a SCR thyristor used to control the brightness of a bulb.
A voltage signal with AC component and DC component can be expressed as :

$$V_{RMS\ (AC+DC)} = \sqrt{V^2_{RMS\ (AC)} + V^2_{DC}}$$

Crest Factor :

The definition of Crest Factor (CF) **:**

$$CF = V_{PEAK} / V_{RMS}$$

A wave form with higher order harmonics has a big CF value. Normally the CF value implies the ability of a true RMS multimeter to test the sharp wave form or distorted wave form.

CMRR (Common Mode Rejection Ratio) :

The CMRR is the ability of a multimeter to reject the Common Mode Voltage **Vcm** (The voltage present on both the **COM** and **VOLTAGE** *input terminal* with respect to earth ground). The Vcm normally comes from the electromagnetic interference of high voltage power source line or generators.

NMRR (Normal Mode Rejection Ratio) :

The NMRR is the ability of a multimeter to reject the unwanted AC noise, V_{NM}, in DC measurement.

Burden Voltage :

Burden Voltage (V_{BURDEN}) is voltage present on the **CURRENT** *input terminal* and **COM** *terminal* of a multimeter. The presence of the Burden Voltage on the current under test flows through the impedance of the current sensing circuit of the multimeter. The Burden Voltage will cause the measuring value to be less than the actual value. For accurate measurements use the approxi-mation described in the operation of Measuring Current.

Nieaf-Smitt B.V.
Vrieslantlaan 6, 3526 AA, Utrecht
P.O. Box 7023, 3502 KA, Utrecht,
The Netherlands
Tel.: +31 (0) 30 288 13 11
Fax: +31 (0) 30 289 88 16
E-mail: sales@nieaf-smitt.nl
Internet:
http://www.nieaf-smitt.nl
http://www.nieaf-instruments.com