sanwa

DCL31DR

DIGITAL CLAMP METER

INSTRUCTION MANUAL

SANWA ELECTRIC INSTRUMENT CO., LTD.
Dempa Bldg., 4-4 Sotokanda 2-Chome
Chiyoda-ku, Tokyo, Japan

CE

PRINTED WITH SOY INK This manual emplys soy ink.

01-1507 2040 6011

[1] SAFETY PRECAUTIONS

Before use, read the following safety precautions
This instruction manual explains how to safely use your new DCL31DR digital clamp meter. Before use, please read this manual thoroughly. After reading it, keep it together with the product so you can refer to it when necessary. If this product is not used as specified in this manual, its protection function may be compromised.
To avoid accidental burns or electric shock, always follow any instructions with "⚠WARNING" or "⚠CAUTION" headings.

1-1 Explanation of Warning Symbols

The meanings of the symbols used in this manual and on the product are explained below.

⚠ **: Very important instructions for safe use.**
- Warning messages are intended to prevent accidents to operating personnel such as burn and electric shock.
- Caution messages are intended to prevent damage to the instrument.

The meanings of the symbols used exclusively on the product are explained below.

⚠ : Symbol requesting reference to the instruction manual before use
⚡ : Potential of connection to a power line in live status
⧈ : Double in sulation or reinforced insulation
⏻ : Power switch ☼ : Backlight

1-2 Warning Instructions for Safe Use

⚠ WARNING

To avoid physical injury such as burns or electric shock, be sure to observe the following instructions when using this instrument.
1. This instrument is a digital clamp meter for low voltages. It should be used on power lines with a voltage to ground of 300 Vrms or less.
2. Pay special attention when measuring voltages of AC 33 Vrms (46.7 V peak) or DC 70 V or more to avoid injury. Also use insulating protective equipment as required.
3. Never use the instrument on power lines that exceed the maximum rated input current (see 1-3).
4. Do not use the instrument if the main unit is damaged or broken.
5. Do not use the instrument with the case or battery compartment cover removed.
6. Do not hold the measurement clip at any point beyond the barrier.
7. Before performing measurement, make sure that the function is properly set.
8. Do not use the instrument when it or your hand is wet.
9. Do not attempt to repair or modify the instrument except to replace the batteries.
10. Be sure to check the instrument before each use and inspect it at least once a year.
11. Always use the instrument indoors.
12. To avoid compromising the protection function of this instrument, do not use it in any way other than instructed in this manual.

* Voltage to ground of 300 Vrms or less: When the Y-connection voltage is 415 V, the voltage to ground is equal to 415 / $\sqrt{3}$ ≒ 240 V.

1-3 Overload Protection Input Values

Input	Max. rated input current	Max. overload protection input
Clamp sensor	AC/DC 420 A	AC/DC 450 A

[2] APPLICATIONS AND FEATURES

2-1 Applications

This instrument is an AC/DC clamp meter with RMS response that allows you to measure the current range specified in IEC 61010-1 CAT. III 300 V. It is suitable for measuring the current of low-voltage power lines and electrical appliances, etc.

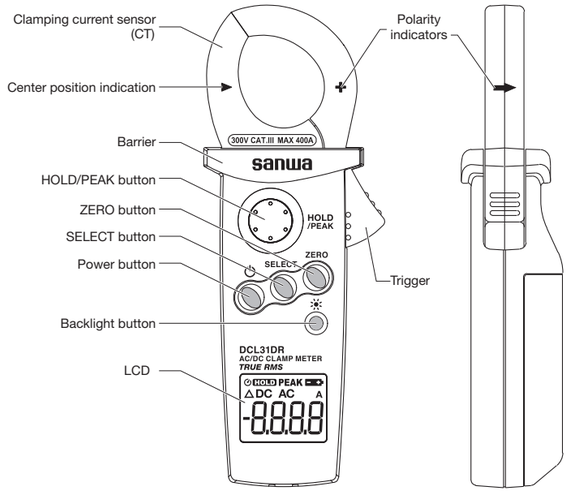
2-2 Features

- Safety design that complies with IEC61010-1 CAT. III 300 V
- Compact pocket size
- AC/DC compatible clamp meter
- DC+AC (True RMS) function
- Auto power OFF (approx. 15 min.) (Disabling also possible)
- Backlight

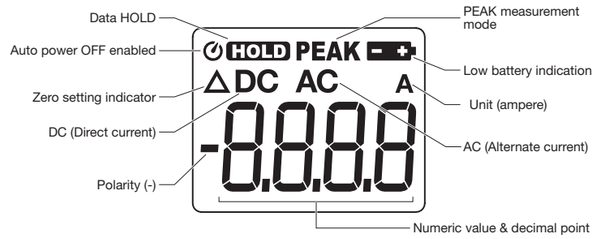
Measurement Category (Overvoltage Category)
Equipment of CAT II :
Primary cable runs of power-consuming equipment from a wall socket.
Equipment of CAT III :
Primary cable runs of equipment directly connected to a distribution board and cable runs from a distribution board to wall sockets.
Equipment of CAT IV :
Cable runs from an incoming line to a distribution board.

[3] NAME OF COMPONENT UNITS

3-1 Main unit



3-2 Display



[4] DESCRIPTION OF FUNCTIONS

4-1 Power button: ⏻ button
Press the button to switch the power ON and OFF.

4-2 Auto power OFF function
The instrument incorporates the auto power OFF function that turns the instrument OFF in about 15 minutes after the last operation. This function can be disabled by switching the instrument ON while holding the ☼ button. The ⏻ indicator on the display panel is extinguished when the auto power OFF functions is disabled.

4-3 Low battery indication
The ▬+ indicator lights on the display when the batteries have discharged down to a supply voltage of about 2.3 V or less. Replace the batteries when this indicator lights up.

4-4 Data hold: HOLD/PEAK button
Press the HOLD button shortly. The HOLD indicator lights on the display and the value displayed at that time is held and will not change even if the measurement data varies. Pressing the button shortly again extinguishes the HOLD indicator and the measurement data is no longer held.
* The held data is cleared when the function is switched by pressing the **SELECT** button.

4-5 Function switching: SELECT button
Each press of this button switches the measurement function in sequence of AC → DC → DC AC → AC → …

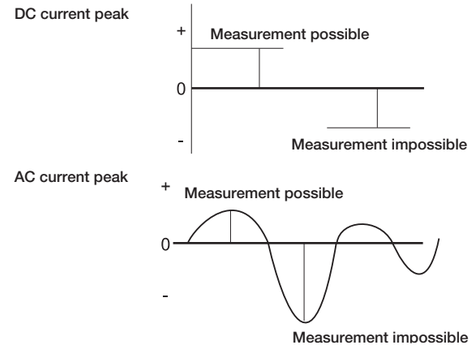
4-6 Zero setting: ZERO button
When the **ZERO** button is pressed while the **DC** or **DC+AC** function is selected, the △ indicator lights on the display and the current input value is displayed as zero. Pressing the ZERO button again cancels the zero setting.
* This button is disabled while the AC function is selected.

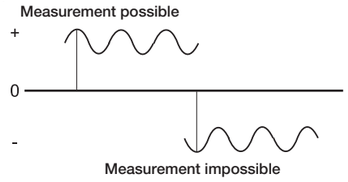
4-7 Backlight function: ☼ button
Press this button to light the backlight of the display. Pressing the button again extinguishes the backlight. The backlight is also extinguished automatically in about 10 seconds after it is lit.

4-8 Peak hold: HOLD/PEAK button
When the **HOLD/PEAK** button is held depressed (for more than 1 sec.) during the voltage or current measurement, the **PEAK** indicator lights on the display and the Peak Hold mode fixed at the 400.0 A range is started. Holding the button depressed again cancels the Peak Hold mode. In the Peak Hold mode, the peak value of input waveform is held at intervals of 1 msec. The held value is updated whenever a higher value is input but not updated at lower values. For instance, when the input is a 100 A sine wave AC, the peak value is about 141 A ($\sqrt{2}$ times the rated value).

- Almost the same values are displayed with both the AC and DC functions.
- Peak Hold does not work with the negative (-) input with both the AC and DC functions.
- When the **HOLD/PEAK** button is pressed in the Peak Hold mode, the **PEAK** and HOLD indicators light and the value displayed at that moment is held. Even when the displayed value is held, the peak value continues to be updated internally so, when the **HOLD/PEAK** button is pressed again to release the held value, the latest updated peak value is displayed.
- The Peak Hold mode is canceled when the function switch is switched.

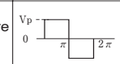
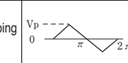
Examples of peak hold measurement:
* The peak value of the negative (-) current is not held.





4-9 AC Detection method
This meter employs the root-mean-square value method and indicates the magnitude of AC as the same amount of work as DC. Root-mean-square values of sinusoidal waves and such non-sinusoidal waves as square waves and chopping waves can be measured by the true RMS (Root Mean Square) circuit. (The input signal measurement value is used as the scale of the actual input signal power. It is therefore measured as a more effective value than the value obtained by average detection.)

4-10 Crest factor
The CF (crest factor) indicates the peak value of a signal by dividing it by its root-mean-square value. With most common waveforms such as sinusoidal wave and chopping wave, the crest factor is low. With low duty cycle pulse waveforms, the crest factor is high. For the voltages and crest factors for typical waveforms, see the table below.

	Input Waveform	0 to PEAK Vp	Root Mean Square Value Vrms	Average Value Vavg	Crest Factor Vp/Vrms	Form Factor Vrms/Vavg
Sinusoidal wave		Vp	$\frac{Vp}{\sqrt{2}}$ =0.707 Vp	$\frac{2\,Vp}{\pi}$ =0.637 Vp	$\sqrt{2}$ =1.414	$\frac{\pi}{2\sqrt{2}}$ =1.111
Square wave		Vp	Vp	Vp	1	1
Chopping wave		Vp	$\frac{Vp}{\sqrt{3}}$ =0.577 Vp	$\frac{Vp}{2}$ =0.5 Vp	$\sqrt{3}$ =1.732	$\frac{2}{\sqrt{3}}$ =1.155
Pulse		Vp	$\sqrt{\frac{\tau}{2\pi}}\cdot Vp$	$\frac{\tau}{2\pi}\cdot Vp$	$\sqrt{\frac{2\pi}{\tau}}$	$\sqrt{\frac{2\pi}{\tau}}$

Voltages of Various Waveforms

[5] MEASURING PROCEDURE

⚠ WARNING

1. Do not apply an input voltage exceeding the maximum rated current.
2. During measurement, do not hold the measurement clip at any point beyond the barrier.

5-1 Start-up inspection
Perform the following pre-operational check for safety.
- Check the external appearance. Check that the main unit is free of abnormality or damage due to dropping, etc.
- Check that the test leads are free of irregularity such as wire disconnection or crack.
- Check that the ▬+ indicator is not lit. If it is lit, replace the batteries with new ones.
- Make sure your hands and the instrument are not wet.

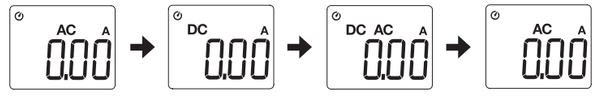
*If nothing is displayed on the LCD, the batteries might have been totally discharged.

5-2 Current measurements

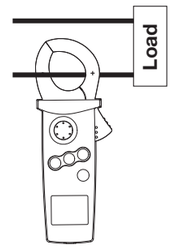
⚠ CAUTION

1. To improve the measuring accuracy, position the conductor at the center of the clamp sensor.
2. Always clamp only one wire at a time. Accurate measurement is impossible if two or more wires, a cable with multiple conductors or a parallel cord is clamped.
3. Accurate measurement is impossible if the clamp sensor is not closed completely.
4. Accurate measurement is sometimes impossible near a source of strong magnetic field such as a transformer or high-current line, near a source of electromagnetic waves such as radio equipment or near a charged object.
5. The CT may generate an oscillating sound when a high current is applied. This is not malfunction.
6. During measurement with the DC current (DCA) function, the reading may vary by a few counts when the orientation (effect of the terrestrial magnetism) or the ambient temperature of this instrument is changed significantly.

* Perform measurements using the clamp sensor. Each press of the button switches the measurement function in sequence of **AC** → **DC** → **DC AC** → **AC** → …

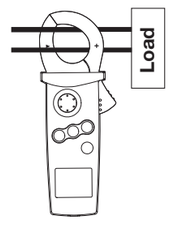


Correct ○

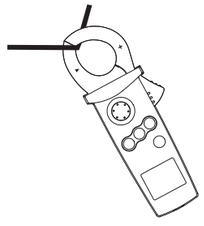


Clamping single conductor on the center of clamp sensor.

Incorrect ×



Clamping multiple conductors.



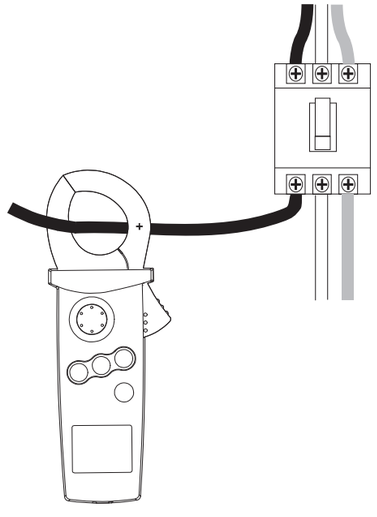
Force applied to the tip of clamp sensor.

5-2-1 Measuring the AC current (ACA measurement)

Function	Input	Ranges
AC	0.01 ～ 400.0	60.00/400.0 A

* The accuracy-guaranteed frequencies of this measurement are from 40 to 400 Hz.

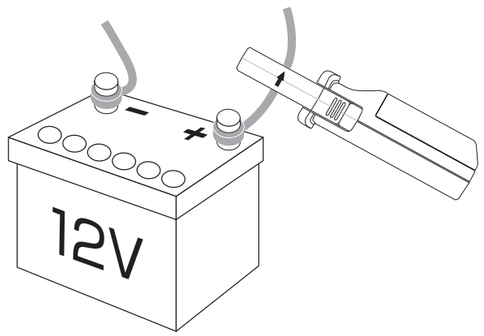
① Press the **SELECT** button so that **AC** lights.
② Open the clamp sensor, position the wire to be measured and close the clamp sensor completely.
③ Read the displayed value.



5-2-2 Measuring the DC current (DCA measurement)

Function	Input	Ranges
DC	± 0.01 ～ 400.0	60.00/400.0 A

① Press the **SELECT** button so that **DC** lights.
② Wait until the display stabilizes, then press the **ZERO** button to perform the zero adjustment. (△ lights on the LCD display.)
③ Open the clamp sensor, position the wire to be measured and close the clamp sensor completely.
④ Read the displayed value
* Align the orientation of the arrow on the side of the clamp sensor with the orientation of the measured current. If they are not aligned, the displayed polarity becomes – (negative).



5-2-3 Measuring the DC + AC current (DCA+ACA measurement)

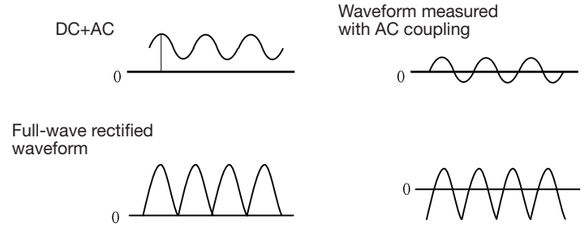
This function measures the RMS value of a total-wave/half-wave rectified waveform or a DC wave on which AC wave is superimposed.

Function	Input	Ranges
DC AC	0.1 ～ 400.0	400.0 A

① Press the **SELECT** button so that both **DC** and **AC** light.
② Wait until the display stabilizes, then press the **ZERO** button to perform the zero adjustment. (△ lights on the LCD display.)
③ Open the clamp sensor, position the wire to be measured and close the clamp sensor completely.
④ Read the displayed value.
* DCA+ACA is internally calculated as $\sqrt{(DC)^2 + (AC)^2}$. The polarity of the DC component is not displayed.
* Note the input frequencies and the crest factor.

Remark:

In general, AC measurements use AC coupling.
If an AC signal includes DC offset, only the AC component is measured by cutting the DC component.
A waveform having the amplitude on only one side, such as the full-wave rectified wave, is regarded as an AC waveform with which the 0 position is moved to the midpoint in terms of area.



[6] MAINTENANCE

⚠ WARNING

1. This section is very important for safety. Read and understand the following instructions fully and maintain your instrument properly.
2. To maintain safety and accuracy, calibrate and inspect the instrument at least every year.

6-1 Maintenance and Inspection

Before use, check the instrument to confirm that there is no abnormality and that the CT can be opened and close smoothly. If anything is abnormal, do not use the instrument and return it to your authorized Sanwa agent or distributor for repair.

6-2 Calibration

For more information, please contact Sanwa's authorized agent / distribute service provider, listed in our website. See section 7-3.

6-3 Cleaning and Storage

⚠ CAUTION

1. The panel and case are not resistant to volatile solvent and must not be cleaned with thinner or alcohol. If the instrument gets dirty, wipe with a soft cloth moistened with a small amount of water.
2. The panel and case are not resistant to heat. Do not place the instrument near heat-generating devices (such as a soldering iron).
3. Do not store the instrument anywhere it may be subject to vibrations or could fall.
4. When storing the instrument, avoid hot, cold or humid locations, locations exposed to direct sunlight, or locations where condensation is anticipated.
5. When the instrument is not going to be used for an extended time, be sure to remove the batteries.

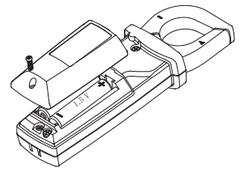
6-4 Battery replacement

• Batteries shipped with the instrument

The batteries loaded at the factory are monitor batteries, so their service life may be shorter than that of brand-new batteries. Monitor batteries are a type of battery used to check the functions and performance of a product.

⚠ WARNING

1. To avoid electric shock, do not remove the battery compartment cover while an input is applied to the clamp sensor or the instrument is measuring something.
2. Make sure that this instrument is set to OFF before proceeding to the battery replacement.



① Using a Phillips screwdriver, remove the fixing screw (x 1) from the battery compartment cover.
② Remove the battery compartment cover.
③ Replace both of the batteries in the battery holder with new ones by observing the correct polarity.
④ Place the battery compartment cover and tighten the fixing screw in the original position.

[7] AFTER-SALE SERVICE

7-1 Warranty and provision

Sanwa offers comprehensive warranty services to its end-users and to its product resellers. Under Sanwa's general warranty policy, each instrument is warranted to be free from defects in workmanship or material under normal use for the period of one (1) year from the date of purchase.
This warranty policy is valid within the country of purchase only, and applied only to the product purchased from Sanwa authorized agent or distributor.
Sanwa reserves the right to inspect all warranty claims to determine the extent to which the warranty policy shall apply. This warranty shall not apply to disposables batteries, or any product or parts, which have been subject to one of the following causes:

1. A failure due to improper handling or use that deviates from the instruction manual.
2. A failure due to inadequate repair or modification by people other than Sanwa service personnel.
3. A failure due to causes not attributable to this product such as fire, flood and other natural disaster.
4. Non-operation due to a discharged battery.
5. A failure or damage due to transportation, relocation or dropping after the purchase.

7-2 Repair

Customers are asked to provide the following information when requesting services:

1. Customer name, address, and contact information
2. Description of the problem
3. Description of the product configuration
4. Model Number
5. Product Serial Number
6. Proof of Date-of-Purchase
7. Where you purchased the product

Please contact Sanwa authorized agent / distributor / service provider, listed in our website, in your country with above information. An instrument sent to Sanwa / agent / distributor without above information will be returned to the customer.

Note:
1) Prior to requesting repair, please check the following:
Capacity of the built-in battery, polarity of installation and discontinuity of the test leads.
2) Repair during the warranty period:
The failed instrument will be repaired in accordance with the conditions stipulated in 7-1 Warranty and provision.
3) Repair after the warranty period has expired:
• If it is expected that servicing can restore the original functioning of the product, we will service it for a price upon request of the user.
• The service charge or transport freight could sometimes become higher than the product price. Please consult us before asking for servicing.
• The minimum retention period of the servicing performance parts of this product is six (6) years after the discontinuation of production. This period is equal to the servicing available period. However, the retention period of a part may be reduced if it becomes unavailable due to discontinuation of production of the part manufacturer, etc.
4) Precautions when sending the product to be repaired:
To ensure the safety of the product during transportation, place the product in a box that is larger than the product 5 times or more in volume and fill cushion materials fully and then clearly mark "Repair Product Enclosed" on the box surface. The cost of sending and returning the product shall be borne by the customer.

7-3 SANWA web site

http://www.sanwa-meter.co.jp
E-mail: exp_sales@sanwa-meter.co.jp

[8] SPECIFICATIONS

8-1 General specifications

Operation method	Δ- Σ method
AC detection method	True RMS method (AC coupling)

Display	6000 count
Sampling rate	Approx. 2 times / sec. Approx. 1 time/sec. with DC+AC function
Overload display	"OL" on the numeric display
Range selection	Auto range
Low battery indication	When the batteries are discharged down to 2.3 V or less, the ▭ indicator lights on the display.
Current measurement method	Clamping current sensor (CT)
aperture diameter	Max. approx. dia. ϕ 25 mm
Operation environment	Altitude max. 2000 m, indoor use, environmental pollution degree II.
Operating temperature/ humidity	Temperature 5 to 40 °C, Relative humidity max. 80 % RH at 5-31 °C and decreases linearly through 80 % RH to 50 % RH at 31-40 °C (without condensation)
Storage temperature/ humidity	-10 to 40°C: Max. 80 % RH (without condensation) 40 to 50°C: Max. 70 % RH (without condensation) (Remove the internal batteries when the instrument is not to be used for long time.)
Temperature coefficient	At below 18 °C or above 28 °C, multiply accuracy by x 0.15 per 1 °C
Power supply	"AAA"-size alkaline battery LR03 x 2
Auto power OFF	Power OFF in approx. 15 min. after last operation
Power consumption / Battery life	Approx. 25 mA / Approx. 35 hours (backlight extinguished)
Dimensions and mass	145 (*H*) x 54 (*W*) x 31 (*D*) mm, approx. 120 g (including batteries)
Safety standards	IEC61010-1, IEC61010-2-030 CAT. III 300 V, IEC61010-2-32
EMC directive	IEC61326-1
Accessories	Instruction manual, carrying pouch (C-DCL10)

8-2 Measuring ranges and accuracies

Accuracy-guaranteed temperature/humidity range: 23 ±5 °C, max. 80 % RH (without condensation).
rdg: Reading. dgt: digits (lowest digit)
Accuracy-guaranteed range: 1 % to 100 % of measurement range
Crest factor CF: Full-scale CF < 1.6, half scale CF < 3.2

ACA measurement RMS response, AC coupling (sine wave alternate current)

Range	Resolution	Accuracy: 50/60 Hz	Accuracy: 45-400 Hz
60.00 A	0.01 A	±(2.0 %rdg + 5 dgt)	±(3.0 %rdg + 10 dgt)
400.0 A	0.1 A		

DCA measurement

Range	Resolution	Accuracy
60.00 A	0.01 A	± (2.0 %rdg + 5 dgt)
400.0 A	0.1 A	

Note: Accuracy after the zero point is set by pressing the **ZERO** button.

DCA+ACA measurement

Range	Resolution	Accuracy: 50/60 Hz	Accuracy: 45-400 Hz
400.0 A	0.1 A	± (2.5 %rdg + 10 dgt)	± (3.5 %rdg + 15 dgt)

Note: Accuracy after the zero point is set by pressing the **ZERO** button. The polarity of the DC component is not displayed. * DCA+ACA is internally calculated as $\sqrt{DC^2 + AC^2}$.

Peak hold

Range	Resolution	Accuracy
400.0 A	0.1 A	± (3.0 %rdg + 10 dgt)

* With a waveform having a level of 4.0 A or more and width of 2 msec, or more.

Accuracy measurement method

(Example) ACA measurement
Reading: 10.00 A
Range accuracy: 60.00 A range = ±(2 %rdg + 5 dgt)
Error: ±(10.00 A x 2.0 % + 0.01 A + 5) = ±0.25 A
True value: 10.00 A ±0.25 A (in the range from 9.75 to 10.25 A)

* 3 dgt in the 60.00 A range is equivalent to 0.03 A.
* 3 dgt in the 300.00 A range is equivalent to 0.3 A.

Specifications and external appearance of the product described above may be revised or modified without prior notice.