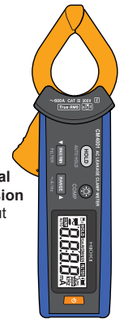
HIOKI

# CM4001

## AC LEAKAGE CLAMP METER

## Instruction Manual

EN



**Instruction Manual Downloadable Version**
(Excel® direct input function)

https://www.hioki.com/global/support/download

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HIOKI

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### Warranty

Malfunctions occurring under conditions of normal use in conformity with the Instruction Manual and Product Precautionary Markings will be repaired free of charge. This warranty is valid for a period of three (3) years from the date of purchase. Please contact the distributor from which you purchased the product for further information on warranty provisions.

# Introduction

Thank you for choosing the Hioki CM4001 AC Leakage Clamp Meter. To ensure your ability to get the most out of this instrument over the long term, please read this manual carefully and keep it available for future reference. Familiarize yourself with the separate document entitled “Operating Precautions” before using the instrument.

### Intended audience

This manual has been written for use by individuals who use the product or provide information about how to use the product.
In explaining how to use the product, it assumes electrical knowledge (equivalent of the knowledge possessed by a graduate of an electrical program at a technical high school).

## Notations

In this document, the severity levels of risk and hazard are classified as follows.

| | |
|---|---|
| ⚠ DANGER | Indicates an imminently hazardous situation that will result in death of or serious injury to the operator. |
| ⚠ WARNING | Indicates a potentially hazardous situation that may result in death of or serious injury to the operator. |
| ⚠ CAUTION | Indicates a potentially hazardous situation that may result in minor or moderate injury to the operator or damage to the instrument or malfunction. |
| ⃠ | Indicates an action that must not be performed. |
| ❗ | Indicates an action that must be performed. |
| ⚠ | Indicates the need for caution or the presence of danger. For more information about locations where this symbol appears on instrument components, see the “Usage Notes” section, warning messages listed at the beginning of operating instructions, and accompanying the document entitled “Operating Precautions”. |
| ⚡ | Indicates that the instrument may be connected to or disconnected from a live conductor. |
| **Bold** | Operation keys are printed in bold. |

The instrument screen displays the alphanumeric characters as follows.

# Overview

The instrument is an AC leakage clamp meter capable of true RMS value measurement of current ranging from 0.60 mA to 600.0 A using a compact, low-profile sensor. It also provides a comparator function to facilitate instantaneous pass/fail judgments.

# Usage Notes

**⚠ CAUTION**

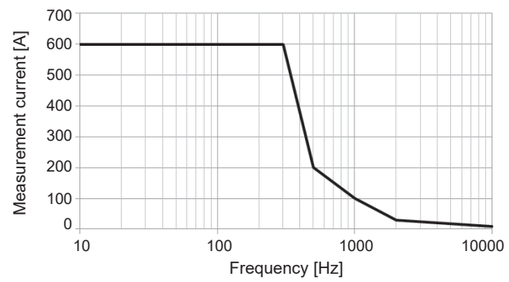
⃠
- Avoid dropping or jarring the instrument which could damage the jaw, adversely affecting measurement.
- Do not place any foreign object between the jaws or insert any foreign object into the gap of the sensor head. Doing so may worsen the performance of the sensor or the opening-closing operation of the sensor head.

❗
- After touching any metallic part, such as a doorknob, to eliminate static electricity from your body, connect/disconnect the Z3210. Failure to do so could cause static electricity to damage the Z3210.

- Displayed values can frequently fluctuate due to induction potential even when no voltage is applied. This, however, is not a malfunction.
- The 6 A and below ranges have different sensor characteristics than the 60 A and above ranges. As a result, use of different ranges may yield different indicated values. Such differences do not represent a problem with the instrument.
- Use of the instrument should confirm not only to its specifications, but also to the specifications of all accessories, options, battery, and other equipment in use.

# Specifications

| | |
|---|---|
| **Operating environment** | Indoors, Pollution Degree 2, altitude up to 2000 m (6562 ft.) |
| **Operating temperature and humidity range** | Temperature: −10°C to 65°C (14°F to 149°F)<br>Humidity:<br>−10°C to 40°C (14°F to 104°F), 80% RH or less<br>40°C to 45°C (104°F to 113°F), 60% RH or less<br>45°C to 65°C (113°F to 149°F), 50% RH or less<br>(non-condensing) |
| **Storage temperature and humidity range** | Temperature: −10°C to 65°C (14°F to 149°F)<br>Humidity 80% RH or less (non-condensing) |
| **Standards** | Safety EN 61010<br>EMC EN 61326 |
| **Power supply** | LR03 alkaline battery × 1<br>Rated power voltage: 1.5 VDC<br>Maximum rated power: 450 mVA<br>Rated power: 60 mVA+20% or less (supply voltage 1.5 V, ACA measurement, LCD backlight off) |
| **Continuous operating time** | • Approx. 32 hours (without Z3210)<br>• Approx. 16 hours (with Z3210, wireless communication)<br>• Other conditions: LCD backlight off, no input |
| **Dimensions** | Approx. 37W × 160H × 27D mm<br>(1.46”W × 6.3”H × 1.06”D)<br>(excluding the protruding parts, operation grip, and jaw) |
| **Jaw dimensions** | Approx. 44W × 18D mm (1.73”W × 0.71”D) |
| **Jaw cross-sectional minimum dimension** | Approx. 9.5 mm |
| **Maximum measurable conductor diameter** | ϕ24 mm |
| **Mass** | Approx. 115 g (4.1 oz.) |
| **Product warranty period** | 3 years<br>(number of jaw open/close cycles: 10000) |
| **Accessories** | LR03 Alkaline battery × 1, Carrying case, Instruction Manual, Operating Precautions (0990A909), Strap |
| **Option** | Z3210 Wireless Adapter<br>Option is subject to change. Check Hioki’s website for the latest information. |
| **Measurement items** | AC Current (~ A), Frequency (Hz) |
| **Maximum rated terminal-to-ground voltage** | 300 V AC (Measurement Category III)<br>Anticipated transient overvoltage: 4000 V |
| **Measurement method** | True RMS value measurement |
| **Display update rate** | Measured value:<br>5 times/s (after range fixed, excluding frequency)<br>1 time to 2 times/s (frequency)<br>Defined within the measurement range (does not include range change time) |
| **Zero-display range** | 5 counts or less |
| **Crest factor** | For the 60.00 mA range/ 600.0 mA range/ 6.000 A range/ 60.00 A range/600.0 A range<br>4.5 (4000 counts or less)<br>3 (more than 4000 counts, 6000 counts or less) |
| **Maximum input current** | As per frequency derating (within 5 min.) |




## Accuracy Specifications

rdg.: The value currently being measured and indicated on the measuring instrument.

| | |
|---|---|
| **Accuracy guarantee conditions** | Accuracy guarantee period: 1 year<br>Accuracy guarantee temperature and humidity range:<br>23°C±5°C (73°F±9°F), 80% RH or less (non-condensing)<br>Number of jaw open/close cycles: 10000 or less |
| **Accuracy guarantee input conditions** | Sine wave input |
| **Effect of external magnetic field** | In a magnetic field of 400 A AC/m<br>Max. 7.0 mA (6.000 A range and below)<br>Max. 4.0 A (60.00 A range and above) |
| **Effects of conductor position** | Within±0.1% (6.000 A range and below)<br>Within ±5.0% (60.00 A range and above)<br>Specified with 11 mm cable<br>(At any positions, based on the center of sensor) |
| **Temperature coefficient** | Add “measurement accuracy × 0.1/°C”<br>(excluding 23°C±5°C [ 73°F±9°F ]). |

### AC current RMS value measurement (ACA/ACA MAX/ACA MIN/ACA AVG)

| Range (Display range) | Resolution (Accuracy guarantee range) | Accuracy guarantee frequency range | Measurement accuracy | |
|---|---|---|---|---|
| | | | Filter off | Filter on |
| 60.00 mA (0.00 mA to 60.00 mA) | 0.01 mA (0.60 mA rms to 60.00 mA rms) | 45 Hz ≤ f ≤ 66 Hz | ±1.5% rdg ±0.05 mA | ±1.5% rdg ±0.05 mA |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±2.5% rdg ±0.05 mA | – |
| 600.0 mA (0.0 mA to 600.0 mA) | 0.1 mA (6.0 mA rms to 600.0 mA rms) | 45 Hz ≤ f ≤ 66 Hz | ±1.5% rdg ±0.5 mA | ±1.5% rdg ±0.5 mA |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±2.5% rdg ±0.5 mA | – |
| 6.000 A (0.000 A to 6.000 A) | 0.001 A (0.060 A rms to 6.000 A rms) | 45 Hz ≤ f ≤ 66 Hz | ±1.5% rdg ±0.005 A | ±1.5% rdg ±0.005 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±2.5% rdg ±0.005 A | – |
| 60.00 A (0.00 A to 60.00 A) | 0.01 A (0.60 A rms to 60.00 A rms) | 45 Hz ≤ f ≤ 66 Hz | ±2.5% rdg ±0.05 A | ±2.5% rdg ±0.05 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±5.0% rdg ±0.05 A | – |
| 600.0 A (0.0 A to 600.0 A) | 0.1 A (6.0 A rms to 600.0 A rms) | 45 Hz ≤ f ≤ 66 Hz | ±2.5% rdg ±0.5 A | ±2.5% rdg ±0.5 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±5.0% rdg ±0.5 A | – |

### AC current peak measurement (ACA PEAK MAX/ACA PEAK MIN)

PEAK detection time width: 2 ms or more (Filter off)

| Range (Display range) | Resolution (Accuracy guarantee range) | Accuracy guarantee frequency range | Measurement accuracy | |
|---|---|---|---|---|
| | | | Filter off | Filter on |
| 60.00 mA (0.0 mA to ±180.0 mA) | 0.1 mA (±1.8 mA to ±180.0 mA) | 45 Hz ≤ f ≤ 66 Hz | ±2.5% rdg ±0.7 mA | ±2.5% rdg ±0.7 mA |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±3.5% rdg ±0.7 mA | – |
| 600.0 mA (0 mA to ±1800 mA) | 1 mA (±18 mA to ±1800 mA) | 45 Hz ≤ f ≤ 66 Hz | ±2.0% rdg ±7 mA | ±2.0% rdg ±7 mA |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1k Hz | ±3.0% rdg ±7 mA | – |
| 6.000 A (0.00 A to ±18.00 A) | 0.01 A (±0.18 A to ±18.00 A) | 45 Hz ≤ f ≤ 66 Hz | ±2.0% rdg ±0.07 A | ±2.0% rdg ±0.07 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±3.0% rdg ±0.07 A | – |
| 60.00 A (0.0 A to ±180.0 A) | 0.1 A (±1.8 A to ±180.0 A) | 45 Hz ≤ f ≤ 66 Hz | ±3.0% rdg ±0.7 A | ±3.0% rdg ±0.7 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±6.0% rdg ±0.7 A | – |
| 600.0 A (0 A to ±1800 A) | 1 A (±18 A to ±1800 A) | 45 Hz ≤ f ≤ 66 Hz | ±3.0% rdg ±7 A | ±3.0% rdg ±7 A |
| | | 40 Hz ≤ f < 45 Hz<br>66 Hz < f ≤ 1 kHz | ±6.0% rdg ±7 A | – |

### AC inrush current measurement (ACA INRUSH)

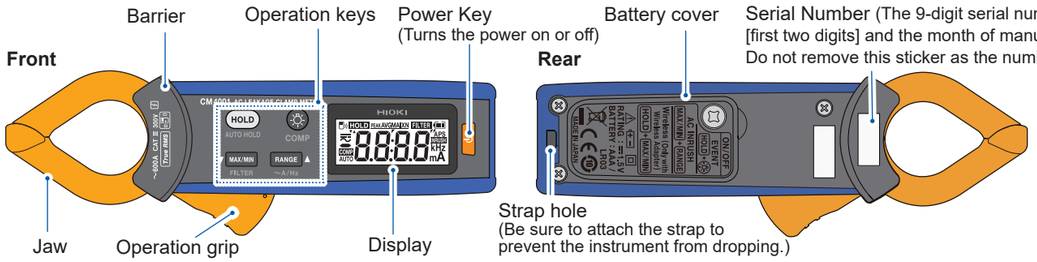
| Range (Display range) | Resolution (Accuracy guarantee range) | Accuracy guarantee frequency range | Trigger threshold value (PEAK value) | Measurement accuracy |
|---|---|---|---|---|
| | | | | Filter off |
| 600.0 mA (0.0 mA to 600.0 mA) | 0.1 mA (60.0 mA rms to 600.0 mA rms) | 40 Hz ≤ f ≤ 1 kHz | +60.0 mA or more or −60.0 mA or less | ±6.0% rdg ±1.0 mA |
| 6.000 A (0.000 A to 6.000 A) | 0.001 A (0.600 A rms to 6.000 A rms) | 40 Hz ≤ f ≤ 1 kHz | +0.600 A or more or −0.600 A or less | ±6.0% rdg ±0.010 A |
| 60.00 A (0.00 A to 60.00 A) | 0.01 A (6.00 A rms to 60.00 A rms) | 40 Hz ≤ f ≤ 1 kHz | +2.00 A or more or −2.00 A or less | ±10.0% rdg ±0.10 A |
| 600.0 A (0.0 A to 600.0 A) | 0.1 A (60.0 A rms to 600.0 A rms) | 40 Hz ≤ f ≤ 1 kHz | +20.0 A or more or −20.0 A or less | ±10.0% rdg ±1.0 A |

### Frequency measurement (Current)

Minimum current sensitivity: 1.80 mA

| Range (Display range) | Resolution (Accuracy guarantee range) | Measurement accuracy |
|---|---|---|
| 999.9 Hz (40.0 Hz to 999.9 Hz) | 0.1 Hz (40.0 Hz to 999.9 Hz) | ±1.5% rdg ±0.1 Hz |

# Part Names and Functions




### Operation keys

| Key | Press once | Press for 1 s or more |
|---|---|---|
| HOLD AUTO HOLD | Retains measured value (HOLD lights up) (Cancel: Press the **HOLD** key), saves measured value when using the GENNECT Cross. | Turns the auto hold function on or off. (HOLD flashes) |
| COMP | Turns the display backlight on and off. Automatically deactivates the backlight when the instrument is not in use for 40 s. | Turns the comparator function on or off. (COMP lights up) |
| MAX/MIN FILTER | Turns the statistics function on. Switches to the statistical value describing the period from the time the statistics function was enabled to the current time. Display content: maximum value (MAX), minimum value (MIN), average value (AVG), maximum peak value (PEAK MAX), minimum peak value (PEAK MIN), and current value (___). Locks the current range until the statistics function is disabled. | If the statistics function is set to On: Cancels the statistic function. Off: Turns the filter function on or off. (FILTER lights up) |
| RANGE ~A/Hz | Switches measurement ranges | Switches frequency measurement and current measurement. |

### Power-on Option (Turns the power on while pressing operation keys)

| Key | Function | Default value | Setting retained? |
|---|---|---|---|
| HOLD + ⏻ | Cancels the auto power save function (APS) off. | On | No |
| ☼ + ⏻ | Automatic backlight deactivation (on or off) | On | Yes |
| MAX/MIN + ⏻ | Turns the filter function on or off when the instrument is powered on. | Off | Yes |
| RANGE + ⏻ | Beep (on or off) | On | Yes |
| HOLD + ☼ + ⏻ | Simple event logging function (on or off) | Off | – |
| HOLD + MAX/MIN + ⏻ | Displays Serial Number | – | – |
| MAX/MIN + RANGE + ⏻ | Displays model number, version of software, and all indicators. | – | – |

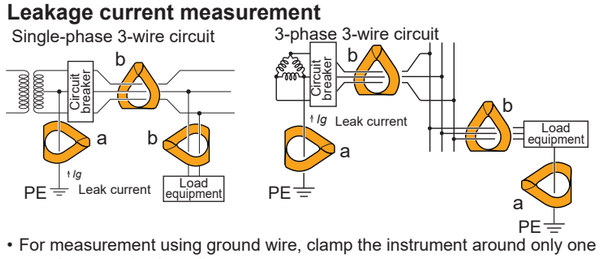
# Making Measurements

To ensure that the instrument is properly operating, conduct an inspection and check instrument operation before using instrument to ensure that no damage has occurred during storage or transport. Verify that the tips of the jaws are free of damage and cracking. If there is any damage to the instrument, contact your authorized Hioki distributor or reseller for repair.

**⚠ DANGER**

- **To prevent an electric shock, do not touch any areas beyond the barrier while the instrument is in use.**
- **The maximum measurement current varies with the frequency, and the current that can be measured continuously is limited. Operating the instrument at less than this limitation is referred to as derating. Do not measure currents in excess of the derating curve. Damage to the instrument or overheating can malfunction, a fire, or burn.**

### Leakage current measurement




- For measurement using ground wire, clamp the instrument around only one wire (see a in the figure).
- For measurement of zero-phase current, clamp around the entire wires together in a bundle (see b in the figure).
- To measure a single-phase 2-wire circuit, clamp around two wires together in a bundle.
- To measure a 3-phase 4-wire circuit, clamp four wires together in a bundle. If this is not possible, carry out the measurement on the equipment's ground wire.
- Measurement may not be accurate in the cases below.
  (1) If there is large current flowing through a nearby electric line.
  (2) If you use the instrument to measure the waveforms on the secondary side of an inverter, or other special waveforms.
- The instrument can momentarily display large readouts when you open and close the jaws; however, this is not an error. It may take some time for the display to return to zero. However, starting measurement before the display returns to zero will not affect measurement.

### AC current measurement, frequency measurement

- Clamp the instrument on one wire only.
- Put the conductor perpendicular to the sensor.
- Correct measurement may be impossible for the case of rush current or significantly fluctuating current.
- At a low temperature, there are cases when the reading may not be around zero without any input signal. But it does not affect measurement.
- Press **RANGE** key for 1 s or more to switch frequency measurement and current measurement.
- In accordance with the magnitude of the input current, a sound may be generated from the jaws due to resonance, but it does not affect the measurement.

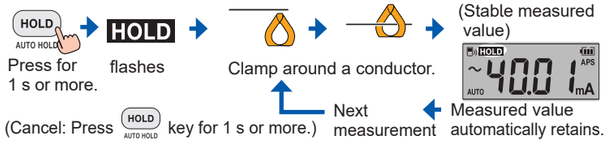
**Over-input warning** (Red backlight or flashing red backlight + beep)

The measured value is beyond the measurable range of current measurement. Halt measurement as the instrument is in an over-input state.
The backlight will also turn red if the comparator or event logging function threshold is exceeded.

# Useful Functionality

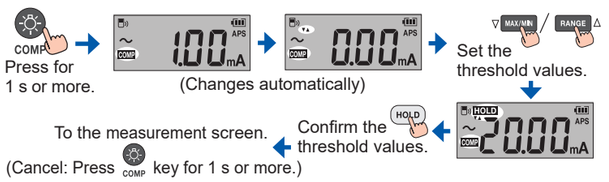
### Auto hold function

When the measured value stabilizes, the value automatically retains.




### Comparator function

If the present threshold value is exceeded, the instrument will sound an intermittent beep, and the display will turn red.

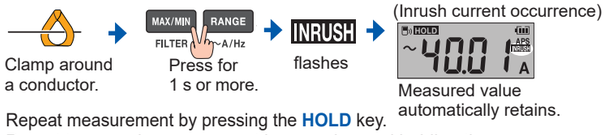



### Filter function

The effects of noise can be reduced by the low-pass filter.
The passband is −3 dB at 180 Hz ±30 Hz. Turn off the filter function when performing measurement of current frequencies in excess of 180 Hz. When the filter function is enabled, the indicated value may be lower than the actual value. If the instrument indicates different measured values depending on the range selected manually, trust the one measured using the upper range.

### AC Inrush function (Inrush current measurement)

The measured value (RMS value) is retained when an inrush current is detected.




Repeat measurement by pressing the **HOLD** key.
Revert to normal measurement by pressing and holding the **MAX/MIN** key and **RANGE** key simultaneously for 1 s or more.
The inrush range is fixed at the range during current measurement. Specifically, the inrush range is fixed to the 600.0 A range when using the auto range for current measurement and to the 600.0 mA range when using the 60 mA range for current measurement.

### Auto power save (APS) function

The instrument will turn off if there is no input and no operation for about 10 min.

### Event logging function

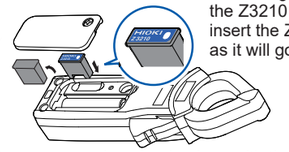
The event logging function logs the data when measured values exceed a desired threshold value, which can be set with GENNECT Cross. For details, see the **Help** function in the GENNECT Cross.
The number of logged events can be checked using the instrument.

### Wireless function (GENNECT Cross)

When the wireless function is enabled, you can review measurement data and create measurement reports on mobile devices. For more information about this functionality, see the **Help** function in the GENNECT Cross (application software, free of charge).

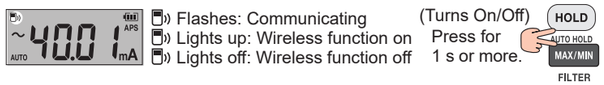
**1 Connect the Z3210 Wireless Adapter (option) to the instrument.**

1. Turn off the power and disconnect the clamp from the object under measurement.
2. Remove the battery cover by turning screws.
3. Remove the protective cap.
4. Exercising care to orient the Z3210 correctly, insert the Z3210 as far as it will go.
5. Replace the battery cover and secure in place with the screw.




**2 Install the GENNECT Cross on your mobile device.**

**3 Turn on the power and confirm that the wireless function is enabled.**




**4 Launch the GENNECT Cross and pair it with the instrument.**

**5 Select the measurement function (such as General Measurement and Waveform Graph function) and start measurement.**

- The communication distance is approx. 10 m (line of sight). The distance over which data can be sent and received varies greatly depending on whether there are any obstructions between the paired instruments (for example, walls, metal barriers, etc.) and on the distance between the instrument and the floor (or ground). To ensure stable communication, verify adequate signal strength.
- Although the GENNECT Cross is provided free of charge, downloading or using the application software may incur internet connection charges. Such charges are the sole responsibility of the user.
- The GENNECT Cross is not guaranteed to operate on all mobile devices.

### Simple event logging function

When the maximum value exceeds the set threshold value, the backlight flashes in red to warn.

1. Turn the power on while pressing the **HOLD** key and ☼ key simultaneously.
2. Set the threshold value. (Press ▼/▲ keys to change the value and then press the **HOLD** key to confirm.)
3. Set the filter function to be on or off. (Press the ▼/▲ keys or the **MAX/MIN** key for 1 s or more to switch and then press the **HOLD** key to confirm.)
4. Press the **HOLD** key to start logging.
5. Press the ▼/▲ keys to switch to the "Stop logging & Check Values" screen.*
6. Press the **HOLD** key to stop logging, and return to the "Start Logging" screen.*

*: The display will return to the "Logging in Progress" screen if no key is operated for about 4 seconds.

# Maintenance and Service

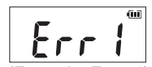
If the instrument seems to be malfunctioning, confirm that the battery is not discharged before contacting your authorized Hioki distributor or reseller.
During shipment of the instrument, handle it carefully so that it is not damaged due to a vibration or shock.

### Cleaning

If the instrument becomes dirty, wipe the instrument clean with a soft cloth slightly moistened with water or a neutral detergent.

### Error display

If an error is displayed when turning on the instrument, repair is necessary. Please contact your authorized Hioki distributor or reseller.

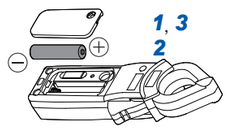



(Example: Error 1)

### Replacing battery

**⚠ WARNING**

**To avoid electric shock, turn off the power switch and disconnect the clamp from the object under measurement before replacing the battery.**




1. **Remove the battery cover by turning screws.**
2. **Replace the battery.**
3. **Replace the battery cover and secure in place with the screw.**