

## **INSTRUCTION MANUAL**

**2304-20**

**PULSE MODULE**

**HIOKI E. E. CORPORATION**

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## Introduction

Thank you for purchasing the HIOKI "Model 2304-20 PULSE MODULE". To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

## Inspection

When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

### Accessories

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## Safety Notes






This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using it, be sure to carefully read the following safety precautions.

### Safety Symbols



In the manual, the  symbol indicates particularly important information that the user should read before using the instrument.

The  symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the ) before using the relevant function.



Indicates a grounding terminal.






Indicates DC (Direct Current).



Indicates AC (Alternating Current).

The following symbols in this manual indicate the relative importance of cautions and warnings

 <b><u>DANGER</u></b>	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
 <b><u>WARNING</u></b>	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
 <b><u>CAUTION</u></b>	Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument.
<b><u>NOTE</u></b>	Indicates advisory items related to performance or correct operation of the instrument.

## Other Symbols



Indicates the prohibited action.



Indicates the location of reference information.

## Measurement categories (Overvoltage categories)

This instrument complies with CAT I safety requirements. To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called measurement categories. These are defined as follows.

**CAT I** Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.

**CAT II** Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)

**CAT III** Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.

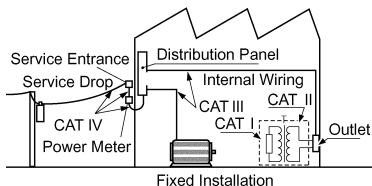
**CAT IV** The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).

Higher-numbered categories correspond to electrical environments with greater momentary energy. So a measurement device designed for CAT III environments can endure greater momentary energy than a device designed for CAT II.

Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.

Never use a CAT I measuring instrument in CAT II, III, or IV environments.

The measurement categories comply with the Overvoltage Categories of the IEC60664 Standards.





## Notes on Use



Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

### **CAUTION**

Do not allow the instrument to get wet.



### **Operation and Installation environment.**

This instrument should be installed and operated indoors only, between 0 and 50°C and 80% RH or less.

**Do not allow the instrument to get wet, and do not take measurements with wet hands.**

This may cause an electric shock.



Corrosive or combustible gases

**Do not use the instrument where it may be exposed to corrosive or combustible gases.**

The instrument may be damaged.



Electromagnetic radiation or highly electrically charged object

**Do not use the instrument near a source of strong electromagnetic radiation, or near a highly electrically charged object.**

These may cause a malfunction.



Temperature or humidity

**This instrument is not designed to be entirely water- or dust-proof.**

Do not use it in an especially dusty environment, nor where it might be splashed with liquid. This may cause damage.

When the module is used in a dusty environment, place it in a dustproof case and take measures to ensure heat dissipation.



Dust  
Direct sunlight

**Do not store or use the instrument where it could be exposed to direct sunlight, high temperature or humidity, or condensation.**

Under such conditions, the instrument may be damaged and insulation may deteriorate so that it no longer meets specifications.

**CAUTION**

To avoid damage to the instrument, protect it from physical shock when transporting and handling.

Be especially careful to avoid physical shock from dropping.

**Do not obstruct the ventilation holes.**

Ventilation holes for heat radiation are provided on the top and rear panels of the instrument. Leave sufficient space around the ventilation holes and install the instrument with the holes unobstructed. Installation of the instrument with the ventilation holes obstructed may cause a malfunction or fire.

**When using the instrument in the case, drill ventilation holes.**

Drill ventilation holes or install a ventilation fan to prevent heat buildup.

**NOTE**

Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.

## Wiring

### **WARNING**

- A qualified electrician shall perform the wiring to prevent electric shock.
- Avoid live-line electrical work to prevent electric shock and accidents due to short-circuiting.
- When tightening the screws, confirm that all screws are securely tightened. A loose screw may result in module errors, fire, or electric shock.
- Tighten the screws within the specified torque. Excessive torque may damage the terminals. Inadequate torque may result in module errors, fire, or electric shock.
- Ensure that the power supply module and input are OFF until all wiring work is finished. This will prevent module trouble and electric shock.
- Ensure that the power supply module and input are OFF when connecting or disconnecting the module to the system. This will prevent electric shock, errors, and malfunction.
- Avoid using an unused terminal for relaying or any other purpose to prevent electric shock, errors, and malfunction.
- The core end of the clamp sensor is not insulated. To prevent injury, avoid short-circuiting a charged part of the object to be measured with the core.

**CAUTION**

- Connect the module to a power source that matches the rating in order to prevent fire.
- Ensure that the power supply, input, and output are correctly wired according to the wiring diagram. (See the chapter on "Preparations" in the instructions manual for each module.) This will prevent fire, malfunction, and errors.
- Use cables of the proper sizes for the rated current. This will prevent entire system errors and fire resulting from broken wire.
- Use crimp connectors suitable for the cable sizes. This will prevent module errors and fire due to broken wires.
- If power supply noise poses a problem, use of a noise filter is recommended.
- When the power and signal lines may be subject to a lightning-induced surge, install a lightning arrester between another device or module connected to this module and line to protect the system.
- Use the specified clamp sensor for this module only. Do not connect any other current sensor directly to the module. Use of other sensors may result in excessive input and damage the module.
- Be careful to avoid dropping the clamps or otherwise subjecting them to mechanical shock, which could damage the mating surfaces of the core and adversely affect measurement.
- Measurements are degraded by dirt on the mating surfaces of the clamp-on sensor, so keep the surfaces clean by gently wiping with a soft cloth.
- Avoid stepping on or pinching cables, which could damage the cable insulation.

**⚠ CAUTION**

- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

## Preliminary Checks

**⚠ WARNING**

Before using the instrument, make sure that the insulation on the cables is undamaged and that no bare conductors are improperly exposed. Using the product in such conditions could cause an electric shock, so contact your dealer or Hioki representative for repair.

Before using the instrument the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.



# Overview

# Chapter 1

## 1.1 Product Overview

The 2304-20 PULSE MODULE is a measurement module of the Hioki "Smart Site" (remote measurement system). This module measures and records current pulses, voltage pulses and no-voltage contact output at regular intervals. For example, the 2304-20 can be used to measure pulse output from a watt-hour meter or flowmeter.

The 2304-20 is used with the power supply module, communications module, and module base.

Usable current sensor	9766 CLAMP ON SENSOR
Number of measurement channels	1 channel for voltage/contact pulse+1 channel for current pulse
Measurement range	16,000 k pulse/interval
Input pulse	4 kHz max. (voltage/contact ) 40 Hz max. (current)



(Conceptual image)

## 1.2 Major Features

- ◆ The recording interval is selectable from 1 second to 60 minutes.
- ◆ The totals of measurements made during a recording interval can be recorded (with sampling once a second).
- ◆ The module has an alarm output terminal.
- ◆ The specified clamp sensor also makes it possible to count the current pulses output from the watt-hour meter without disconnecting the cables.



## Rough Estimate of Storable Data Quantity and Time

Action at memory full:  
Continue recording (Endless)

	Recording Mode
	Instantaneous Value
Quantity of storable data	26000
Recording interval	
1 sec.	7.5 hours
2 sec.	14.5 hours
5 sec.	1.5 days
10 sec.	3 days
15 sec.	4.5 days
20 sec.	6 days
30 sec.	9 days
1 min.	18 days
2 min.	36 days
5 min.	92 days
10 min.	184 days
15 min.	277 days
20 min.	369 days
30 min.	554 days
60 min.	1109 days

### **NOTE**

When the alarm log is ON, the higher the number of alarms generated, the smaller the recording period.

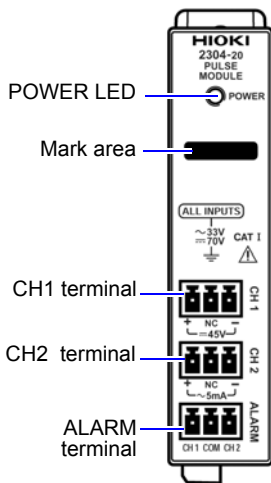
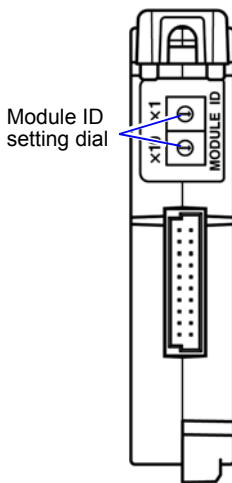
Action at memory full:  
stop recording (Memory full stop)

	Recording Mode
	Instantaneous Value
Quantity of storable data	30000
Recording interval	
1 sec.	8.5 hours
2 sec.	17 hours
5 sec.	1.5 days
10 sec.	3.5 days
15 sec.	5 days
20 sec.	7 days
30 sec.	10 days
1 min.	21 days
2 min.	42 days
5 min.	106 days
10 min.	213 days
15 min.	319 days
20 min.	426 days
30 min.	639 days
60 min.	1279 days

**NOTE**

When the alarm log is ON, the higher the number of alarms generated, the smaller the recording period.

## 1.3 Name and Function of the Parts

**Front****Back**

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**POWER LED** Goes on or flashes when power is supplied to the module.  
Remains on, flashes, or changes to another color according to the state of the module.

**POWER LED indication**

Lit in green : Data being recorded.

Flashing in green : Standing by.

Lit in yellow : Alarm output.

Lit in red : Non-recoverable error occurred. \*1

Flashing in red : Recoverable error occurred. \*2

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**Mark area** Use this area to make a note of the object to measure or the module ID.  
Use an ink pen, since pencil lead may rub off.

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**CH1 terminal** Connect the voltage pulse signal or contact pulse signal to this terminal (channel 1).

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**CH2 terminal** Connect the current sensor for current pulse signal input (9766 CLAMP ON SENSOR) to this terminal (channel 2).

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**ALARM terminal** Connect alarm output to this terminal.  
This terminal is electrically insulated from CH1 and CH2 terminals.

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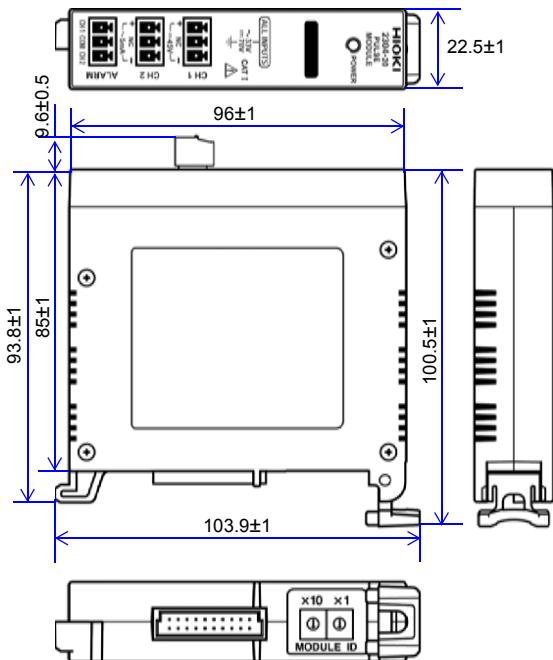
**Module ID setting dial** Use the dial to set the module's identification No.

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\*1: The module needs repair. Contact your dealer or Hioki representative.

\*2: The same module ID may be used by another module.

## 1.4 Dimension Diagrams



(Unit: mm)



# Settings

# Chapter 2

## 2.1 Setting the Module ID

You can connect up to 63 measurement modules to one communications module.

### Setting Procedure

Use the module ID setting dial to set the ID No. of the module to a number from 01 and to 63. (You cannot set a number other than the above.)

#### **NOTE**

- Ensure that the set ID is not used for any other module connected to the same communications module.
- The ID numbers of modules need not be consecutive.
- Setting the ID to 99, then turning on the power resets all internal settings to the defaults.
- The module ID and COM ID are not related and can be set independently.





# Preparations

# Chapter 3

## 3.1 Installing the Module

### 3.1.1 Installing the Module Base

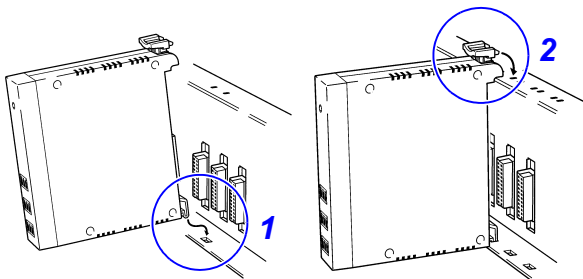


**CAUTION** Do not mount the module base on the ceiling where it may fall off.

Fasten the module base to a DIN rail or the wall according to the procedure described in the 2391 or 2392 series MODULE BASE instruction manual.

### 3.1.2 Mounting a Module on the Module Base

Mount a module on the module base as shown below. Ensure that the lever clicks.



## 3.2 Connecting Input/Output Cables

### Recommended Cable

Single-wire: 0.14 to 1.5 mm<sup>2</sup>

Stranded-wire: 0.14 to 1.0 mm<sup>2</sup>

AWG: 26 to 16

Cable strip length: 5 mm

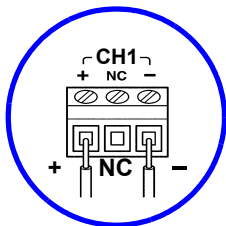


### 3.2.1 Connecting to CH1 Terminal (voltage/contact pulse signals input)

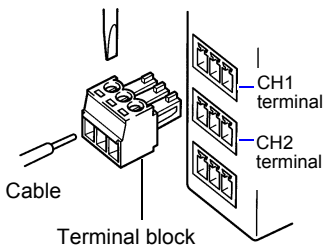
#### CAUTION

- The CH1 and CH2 terminals are not insulated from each other. Avoid short-circuiting.
- Note that the instrument may be damaged if the applied voltage exceeds the measurement range.

1. Use a flat head screwdriver to loosen the screws on the supplied terminal block.
2. Insert the cable for voltage or contact pulse signal input into the terminal block, then tighten the screws into the terminal block (at tightening torque of 0.25 N•m).
3. Connect the terminal block to the CH1 or CH2 terminal.



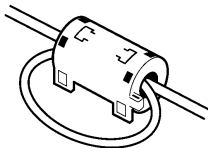
Terminal block



Terminal block

**NOTE**

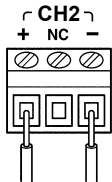
- In case of external noise, wind the cable around the ferrite clamp supplied as an accessory as shown below.



- Note that measurement may be adversely affected by external noise or the electromagnetic environment when using a cable longer than 3 meters.

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### 3.2.2 Connecting to CH2 Terminal (9766 CLAMP ON SENSOR)



Connect the extension cable from the 9766 CLAMP ON SENSOR to the CH2 terminal.

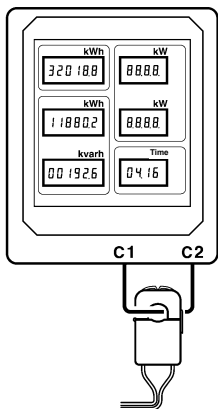
- ❖ 3.2.1, "Connecting to CH1 Terminal (voltage/contact pulse signals input)" (page 22)

9766 CLAMP ON SENSOR

**NOTE**

- Use only the 9766 CLAMP ON SENSOR for current pulse input.
- The clamp sensor connection is irrespective of polarity.
- Attach the clamp around only one conductor. Single-phase (2-wire) or three-phase (3-wire) cables clamped together will not produce any reading.

## Connecting the Energy Meter and 9766



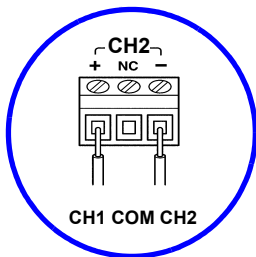
- 9766 CLAMP ON SENSOR
1. Connect the supplied connection cables to the C1 and C2 terminals of the energy meter. For more information on the cable connection, see the operating manual for the composite power utility meter.
  2. Connect the extension cable to the 9766.
  3. Connect the other end of the extension cable to this module.
  4. Open the clamp core of the 9766 and clamp the connection cable. Be sure to lock the clamp. The clamp does not have a spring.
  5. Make sure the clamp core end is closed tightly.

### **NOTE**

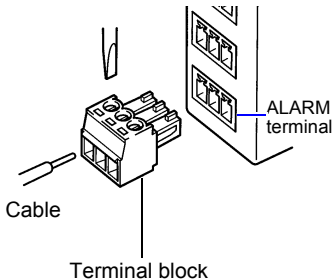
This module detects very small pulse currents. Excessive static electricity near the measuring terminal or the 9766 CLAMP ON SENSOR or use of the module in a strong magnetic field may result in pulse detection errors.

### 3.2.3 Connecting Cables to the ALARM Terminal (Alarm output)

1. Use a flat head screwdriver to loosen the screws on the supplied terminal block.
2. Insert the cable for alarm output into the terminal block, then tighten the screws (at tightening torque of 0.25 N•m).
3. Connect the terminal block to the ALARM terminal.

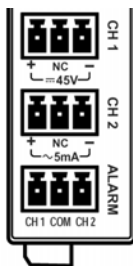


Terminal block



Connect the cable for CH1 output to CH1 and COM; connect the cable for CH2 output to CH2 and COM.

### 3.2.4 Connection Locations of Input/output Cables



CH1 terminal (input)	+	<b>NC</b>	-
	Voltage/ contact input (+)	Not in use	Voltage/ contact input (-)
CH2 terminal (input)	+	<b>NC</b>	-
	9766 input (+)	Not in use	9766 input (-)
ALARM terminal (output)	<b>CH1</b>	<b>COM</b>	<b>CH2</b>
	Alarm output	Common	Alarm output

## 4.1 Alarm Output



### 4.1.1 Output Rating

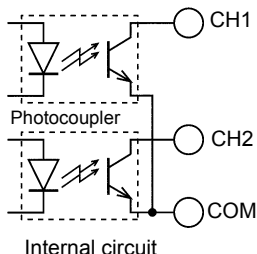


Ensure that the input does not exceed the maximum input voltage or current to avoid module damage, short-circuiting and electric shock resulting from heat building.

Output method	Open collector
Maximum input voltage / current	30 V, 20 mA max.
Signal logic	Enabled: ON Disabled: OFF

### 4.1.2 Internal Circuit

The alarm output circuit is configured as shown below.

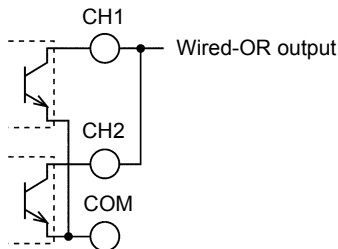
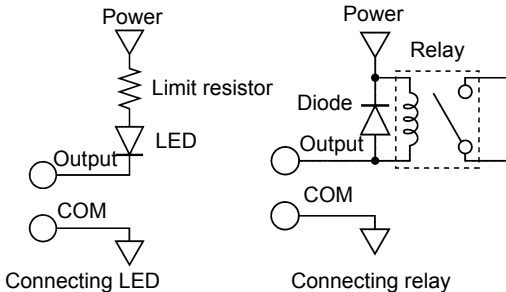


#### **NOTE**

- Signal logic indicates the signal state in which a signal's function is enabled.
- The output transistor works as a switch between signal output and ground in the module. When output becomes enabled, the switch is turned on and current flows from the output signal to COM in the module. Therefore, a relay or LED lamp can be connected directly to the output terminal (page 29).



## Circuit diagram



Using on Wired-OR Logic

### **NOTE**

- When connecting a relay or LED lamp, ensure that the relay or lamp operates at up to 30 V and 20 mA. When connecting a relay, be sure to use a diode to absorb counterelectromotive force.
- Open collector output operates on wired-OR logic by short-circuiting CH1 and CH2. Moreover, it enables the signal if an alarm occurs in either channel.

## 4.2 Insulation of Internal Circuit

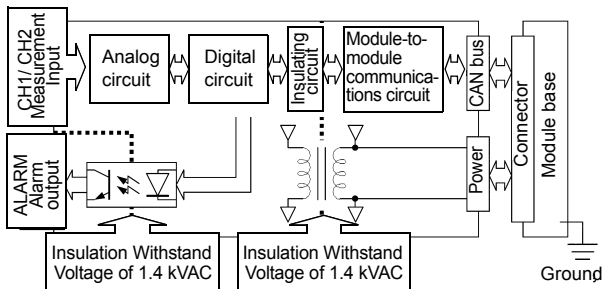


### CAUTION

The CH1 and CH2 terminals are not insulated from each other.

When measuring two measurement points having a potential difference, equalize the ground level potential of these two points, or use another 2304-20 Module, since measurements may be adversely affected.

In the 2304-20, the input circuit and alarm output are insulated from the CAN bus as shown in the block diagram below. (Withstand voltage: 1.4 kVAC, 50/60 Hz, Response current: 5 mA, 1 minute)



### NOTE

The COM terminal of the alarm output terminal is used for both CH1 and CH2.

## Specifications

## Chapter 5

## 5.1 Basic Specifications

Number of inputs	<p>Voltage/contact pulse input × 1 channel          Simultaneous detection on 2 channels is also possible.          Clamp-type current pulse input × 1CH          (Detected using externally connected 9766 CLAMP ON SENSOR.)</p>
Measurement range	<p>Voltage/contact pulse up to 4 kHz</p> <ul style="list-style-type: none"> <li>• Voltage pulse              A pulse is counted when the voltage level changes from L to H.              L: +0.0 to +0.2 V              H: +1.5 to +45 V              (Logic in the range from +0.2 to +1.5V is indefinite.)</li> <li>• Contact pulse:              A pulse is counted when the circuit between the terminals changes from a short circuit to an open circuit.</li> <li>• Current pulse              Detected current range 10 to 20 mA<sub>p-p</sub>              Pulse width                    12.5 ms or more              Pulse interval                25 ms or more, 40 Hz max.              Rise/fall speed                0.8 ms or less              With the 9766 CLAMP ON SENSOR, in a magnetic field of 50 A/m AC or less</li> </ul>
Filter	<p>Effective for voltage/contact pulse input (set by a command).</p> <ul style="list-style-type: none"> <li>• For mechanical contact              Pulse width: 20 ms or more              Pulse separation: 40 ms or more              (Frequency: 25 Hz or less)              No filter for current pulse input</li> </ul>

Measurement accuracy	±100 ppm rdg. ±1 dgt. Recording interval accuracy: ±2 ms Display range: Total of each channel at every interval (16,000,000 max.)
Guaranteed accuracy period	1 year
Sampling	1 time / sec.
Input terminal	3 Input terminal block × 2

## 5.2 Function Specifications

Actual time management	Time management using PC application
Recording start/end	Recording is started and ended by a command. (Immediate start, timed start, or timed end)
Recording Method	Interval recording (Total number of pulse are recorded at a set recording interval.)
Recorded data	One data set contains time, temperature, and humidity (At every interval).
Recording mode	Instantaneous value recording mode (Total during the interval)
Recording end condition	Memory full stop or indefinite Set the mode before the start of recording.
Quantity of recorded data	512 KB Flash memory Instantaneous value recording mode (Total during the interval) 30,000 data × 2 CH
Data acquisition method	All logging data, data before, at, and after the specified time, or the current instantaneous value (monitored value)
Recording interval	1/2/5/10/15/20/30 sec. 1/2/5/10/15/20/30/60 min.

Alarm	<p>Criterion threshold can be set to either Hi or Lo.</p> <p>Hi : The total at every sampling is judged within the interval.</p> <p>Lo : The total is judged at every interval.</p>
Alarm output	<p>Alarm output × 2 CH (Open collector: 30 VDC, 20 mAmax.)</p> <p>Output is turned ON when an alarm (Hi or Lo) occurs.</p> <p>Whether to hold the alarm output can be selected. The reset switch or a command can be used to reset alarms.</p>
Data deletion	<p>All items of data are deleted by a command. New data will be added to the previous data at the start of recording.</p>
Power outage protection	<p>After recovering from a power outage, the 2304-20 automatically returns to the state held before the outage.</p>

## 5.3 General Specifications

Clock accuracy	±100 ppm (Reference value at temperature from 0 to 50°C without the communications module)
Backup	<p>Recorded data (saved in flash memory)</p> <p>Data loss for up to 2 minutes before and after a power outage may occur.</p>
Communication interface	CAN bus
Maximum rated voltage to earth	33 Vrms, 70 VDC
Maximum input voltage	Voltage/contact side 45 VDC
Rated supply voltage	5 VDC±0.3 V

Maximum rated power	1.4 W
Dielectric strength	1.4 kVAC (Between input and alarm output, Input/Output and CAN bus) (50/60 Hz, Response current 5 mA, one minutes)
Dimensions	Approx. 22.5W × 96H × 85D mm (sans protrusions) (0.89"W × 3.78"H × 3.35"D)
Mass	Approx. 120 g (4.2 oz.)
Accessories	Instruction manual ..... 1 Ferrite clamp ..... 2 Terminal block ..... 3
Option	9766 CLAMP ON SENSOR (For current pulse detection)
Operating temperature and humidity	0 to 50°C (32 to 122°F), 80%RH or less (non-condensating)
Storage temperature and humidity	-10 to 50°C (14 to 122°F), 80%RH or less (non-condensating)
Operating environment	Indoors, altitude up to 2000 m (6562-ft.)
Applicable standards	Safety EN61010-1:2001 Pollution degree 2 Measurement Category I, (anticipated transient overvoltage 330 V) EMC EN61326:1997+A1:1998+A2:2001 Class A

# Maintenance and Service

## Chapter 6

### 6.1 Cleaning

To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.

### 6.2 Servicing



Never modify the instrument. Only Hioki service engineers should disassemble or repair the instrument. Failure to observe these precautions may result in fire, electric shock, or injury.

- If the instrument seems to be malfunctioning, confirm that the cables are not open circuited before contacting your dealer or Hioki representative.
- When sending the instrument for repair, remove the batteries and pack carefully to prevent damage in transit. Include cushioning material so the instrument cannot move within the package. Be sure to include details of the problem. Hioki cannot be responsible for damage that occurs during shipment.
- When transporting the 2304-20 Module or a system containing this module, tape the front of the module or take similar measures to avoid losing internal components.



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