Портативный калибратор электрических сигналов Yokogawa CA100

Портативный калибратор Yokogawa CA100 предназначен для тестирования цепей питания датчиков, калибровки полевого оборудования, цифровых мультиметров, регистраторов и другого измерительного оборудования. Он одинаково полезен как при обслуживании полевых приборов, так и при лабораторной настройке электронного оборудования. Калибратор Yokogawa CA100 имеет небольшой вес (1,2 кг) и габариты (237 x 137 x 63 мм).

Основные функции

- одновременное и независимое воспроизведение и измерение постоянного напряжения и тока, сопротивления, температуры (измерение и имитация сигналов с термопары или термометра сопротивления)
- генерирование прямоугольных импульсов
- выход 24 В постоянного тока для питания полевого датчика
- функция имитации полевого датчика (имитация устройства с заданным током потребления)
- функция пошагового изменения сигнала (до 15 шагов)
- интерфейс RS232C для программирования, обмена данными с компьютером и печати
- возможность программирования цикла операций
- автономная работа с питанием от батарей типа АА и NiCd

Технические характеристики

Характеристики		Диапазон	Разрешение	Погрешность ± (% показания + % диапазона)
Измеряемые сигналы	Напряжение	± 500 мВ	0,01 мВ	± (0,02 + 0,01)
		± 5 В	0,0001 В	± (0,02 + 0,01)
		± 35 В	0,001 В	± (0,02 + 0,015)
	Ток	± 20 мА	0,001 мА	± (0,025 + 0,02)
		± 100 мА	0,01 мА	± (0,04 + 0,03)
	Сопротивление	0 ÷ 500 Ом	0,01 Ом	± (0,055 + 0,015)
		0 ÷ 5 кОм	0,0001 кОм	± (0,055 + 0,015)
		0 ÷ 50 кОм	0,001 кОм	± (0,055 + 0,02)
Воспроизводимые сигналы	Напряжение	0 ÷ 10 мВ	0,001 мВ	± (0,02 + 0,01)
		0 ÷ 1 В	0,00001 В	± (0,02 + 0,005)
		0 ÷ 10В	0,0001 В	± (0,02 + 0,005)
	Ток	0 ÷ 20 мА	0,001 мА	± (0,025 + 0,015)
		0 ÷ -20 мА	0,001 мА	± (0,025 + 0,03)
	Сопротивление	0 ÷ 500 Ом	0,01 Ом	± (0,02 + 0,02)
		0 ÷ 5 кОм	0,0001 кОм	± (0,05 + 0,03)
		0 ÷ 50 кОм	0,001 кОм	± (0,1+ 0,1)
	RTD (PT100)	-200°C ÷ +850°C	0,1°C	± 0,3°C (в диапазоне -200°C ÷ 0°C) ± 0,5°C (в диапазоне 0°C ÷400°C) ± 0,8°C (в диапазоне 400°C ÷ 850°C)
	Термопара	-250°C ÷ +1820°C	0,1°C; 1°C	± 0,2°C (типы K, E, J, T) ÷ ± 2°C (тип B)
	Частота	1 Гц ÷ 50 кГц	0,1 ÷ 100 Гц	1 единица разрешения

MODEL CA100 "COMPACT CAL" CALIBRATOR

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We have developed Model CA100 "Compact CAL," a portable calibrator, having 0.02% accuracy and the resistance generator function. The design objectives were excellent accuracy, the support of essential functions, and easy operation. The calibrator is ideal for maintaining the accuracy of such equipment as converters at an optimum level. In order to calibrate such equipment in the field, we have provided the compact, economical calibrator with the generator function, measurement function and 24-V DC output function.

This paper introduces the functional overview of the CA100 calibrator.

INTRODUCTION

In all kinds of industrial plants, physical quantities such as temperature, flowrate and pressure are changed to required electrical signals through converters to use them for monitoring, control or other purposes. The industry-standard accuracy of these converters, which was 0.25%, has been changed to 0.1% recently. Consequently, it has become a requirement for measuring instruments used to inspect or calibrate converters, receiving meters, and so on to also have higher accuracies.

The recently developed CA100 calibrator is a portable, highly accurate measuring instrument having an accuracy high enough to support the inspection and calibration of converters with a 0.1%-order accuracy in the field. In addition, CA100 is provided with the function for generating pseudo resistance temperature detector (RTD) signals, the DMM function used to measure the output signals of a converter, and the 24-V DC output function used to supply power separately to a converter, all of which were only available previously using a separate instrument.

Figure 1 is the external view of the CA100 calibrator.

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DESIGN CONCEPTS

As trends in the latest measuring instruments, we often notice such products that are equipped with a variety of advanced functions to highlight the superiority in cost-performance. In contrast, users are hoping for a simple measuring instrument that has only necessary functions with required accuracies and does not mislead the operator during use. This requirement is all the more strong for the excellently portable CA100 calibrator in order to avoid accidents due to erroneous operation in the field. Users who make a business of engineering tend to implement their own know-how in the form of programs for a personal computer and

Figure 1 External View of CA100

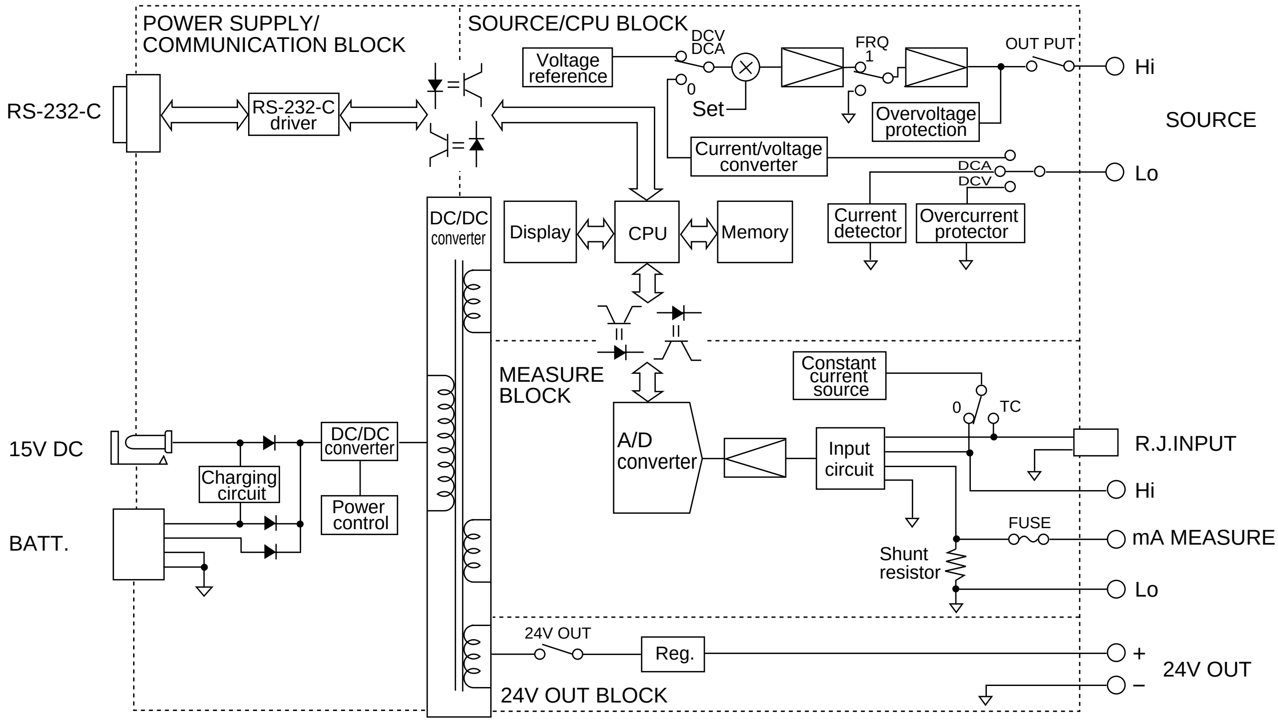


Figure 2 Block Diagram of CA100

Table 1 Typical Examples of Accuracies of the Basic Functions

Function Category	Function	Range	Accuracy (%)
Generation	DC voltage	1V	±(0.02% of setting + 0.005% of range)
	DC current	20mA	±(0.025% of setting + 0.015% of range)
	Resistance	500Ω	±(0.02% of setting + 0.02% of range)
Measurement	DC voltage	5V	±(0.02% of setting + 0.01% of range)
	DC current	20mA	±(0.025% of setting + 0.02% of range)

connect a measuring instrument to the computer to efficiently inspect equipment and make reports. Earlier advanced functions are being absorbed in such computer programs. The result is a demand that measuring instruments have the communication function, in addition to their essential functions and high accuracy, so they serve as I/O units for personal computers.

In the design of CA100, efforts were concentrated on high accuracy and the enhancement of basic functions, as voiced by users. For a human-machine interface, operability was considered first; therefore, multiple definitions of keys and their degree of multilayer structure were minimized and the number of keys was reduced in order to achieve the principle of “one key-one-action” with the minimum number of required keys. Advanced functions that would make operation complex were removed by equipping the calibrator with the communication interface to enable online control. All these efforts led to the precision measuring instrument that can be used like a common, commercially available hand-held tester.

FUNCTIONAL OVERVIEW AND FEATURES

The generator function covers DC voltage, DC current, resistance, thermocouple (TC) signals, resistance temperature detector (RTD) signals, frequency and pulses to support different types of input to a converter. The measurement function is designed to support DC voltage, DC current and resistance with the aim of measuring 1-5 V and 4-20 mA signals. The accuracies have been made as high as possible, as shown in Table 1. In other areas of functionality, the calibrator supports not only the source mode but also the sink mode for DC current generation, enabling inspection of receiving meters. For resistance generation, the calibrator is provided with a 500Ω range so the single range covers up to 332.66Ω which corresponds to 650°C for a Pt100 RTD. The response time has also been improved (10 ms), considering signal generation for scan-mode input devices. For TC signal generation, the function is made switchable taking into consideration a case where equipment being measured is a combination of earlier and later versions of JIS-standard products. The calibrator is provided with the 24-V DC power supply output function, in addition to the generator and measurement functions. The display (as wide as 35% the area of the operation panel) is located in the upper-middle of the operation panel for better visibility. Integral, silicone-rubber flat keys are employed to make the key panel dustproof. To protect against a possible failure due to aging, mechanical switches are placed on the circuit board so each rubber keytop pushes down

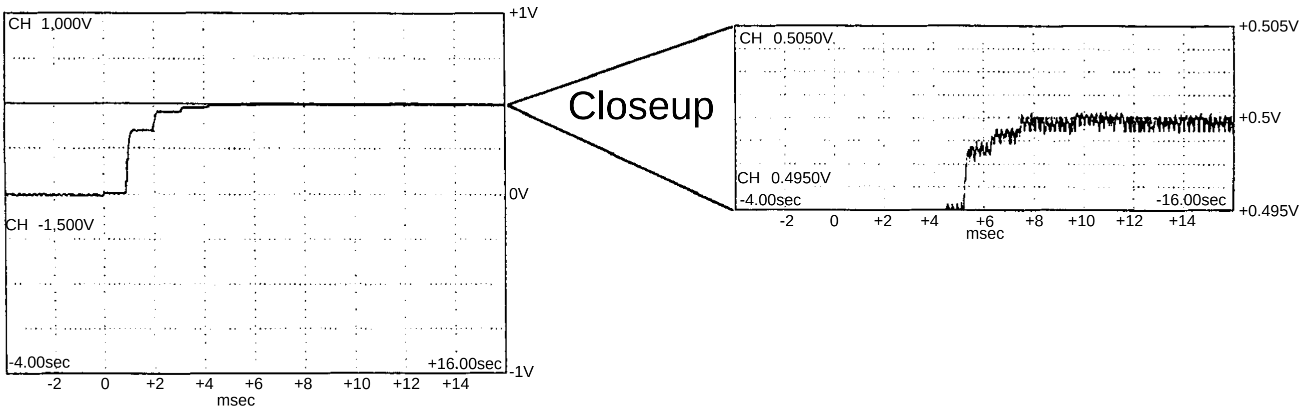


Figure 3 Response Waveform during Resistance Generation

the underneath mechanical switch. This arrangement gives the operator a click feeling each time, ensuring that the key has been pressed securely. As a main source of power to the calibrator, we have selected an AA-size battery, among other batteries, which is available almost anywhere and even when the calibrator is used unexpectedly. In addition to the battery, dedicated Ni-Cd battery packs and AC adapters are available. The Ni-Cd battery pack is rechargeable through the calibrator using the AC adapter. For communication, the calibrator is provided with the serial communication function based on start-stop synchronization, as standard, so generator-function settings and measured values can be printed by connecting a printer externally. CA100 is compact and lightweight, having an outline nearly the size of an A5 paper—237 (W) × 137 (H) × 63 (D) (mm)—and weighing only 1.2 kg (including batteries).

CONFIGURATION

Figure 2 illustrates the block diagram of the CA100 calibrator. The diagram can roughly be divided into four blocks: the power supply/communication block, generator block, measurement block and 24-V power supply block. To enable these four blocks to be used separately, they are electrically isolated from each other. The MPU, which controls the entire calibrator, is located in the generator block. Control of the respective blocks is done through photocouplers. The communication section, which is connected to an external device, is located in the power supply section and isolated from other blocks. The 24-V power supply block for converters being calibrated is isolated using a transformer and outputs power through a three-terminal voltage regulator. Details on the power supply, generator and measurement blocks are given in the following paragraphs.

1. Power Supply Block

Since CA100 is a portable calibrator, the power supply block needs to be highly efficient and emit less noise to support prolonged operation on batteries and higher accuracy. The block first regulates input voltage from such unstable, varying types of power sources as an AC adapter, a Ni-Cd battery pack or dry cells using a DC/DC converter; then using a transformer-based switching regulator, the block generates and supplies electrically isolated power to other blocks. The power is further processed through a three-terminal voltage regulator to produce a stable source of power. Each winding of the transformer is shielded to prevent switching noise from mixing into the secondary stage. Each switching regulator is as efficient as no less than 90% and the three-terminal voltage regulator has a saturation voltage as excellent as approximately 0.2 V. The generator block can deliver an output voltage of up to 28 V (for generation of -22 mA); therefore, a switching regulator is used as the power source to the output amplifier to control the power supply voltage by means of the output voltage. This strategy achieves low power consumption when the output voltage is low. All these features have made it possible to produce a power supply that is extremely immune to voltage variations in the power source, far less noisy and highly efficient.

2. Generator Block

The generator block consists of a voltage reference, a multiplier, amplifiers, output selector contacts, a current/voltage converter and protection circuits. For voltage generation, the output of the voltage reference is varied by the multiplier to produce a desired voltage through the output amplifier. For current generation, the output amplifier works as a voltage/ current converter. In the case of resistance generation, the block does not actually generate resistance. Rather, the block uses a means known as the "active impedance method" that generates a voltage consistent with the resistance being generated when a current is applied externally. A current entering through the Lo terminal is transduced to a voltage by the current/voltage converter, the voltage is varied by the multiplier, and then a desired voltage is outputted across the Hi and Lo terminals. This strategy enables free generation of a desired voltage consistent with the preset resistance for an incoming current simply by changing the setpoint of the multiplier. This means the desired

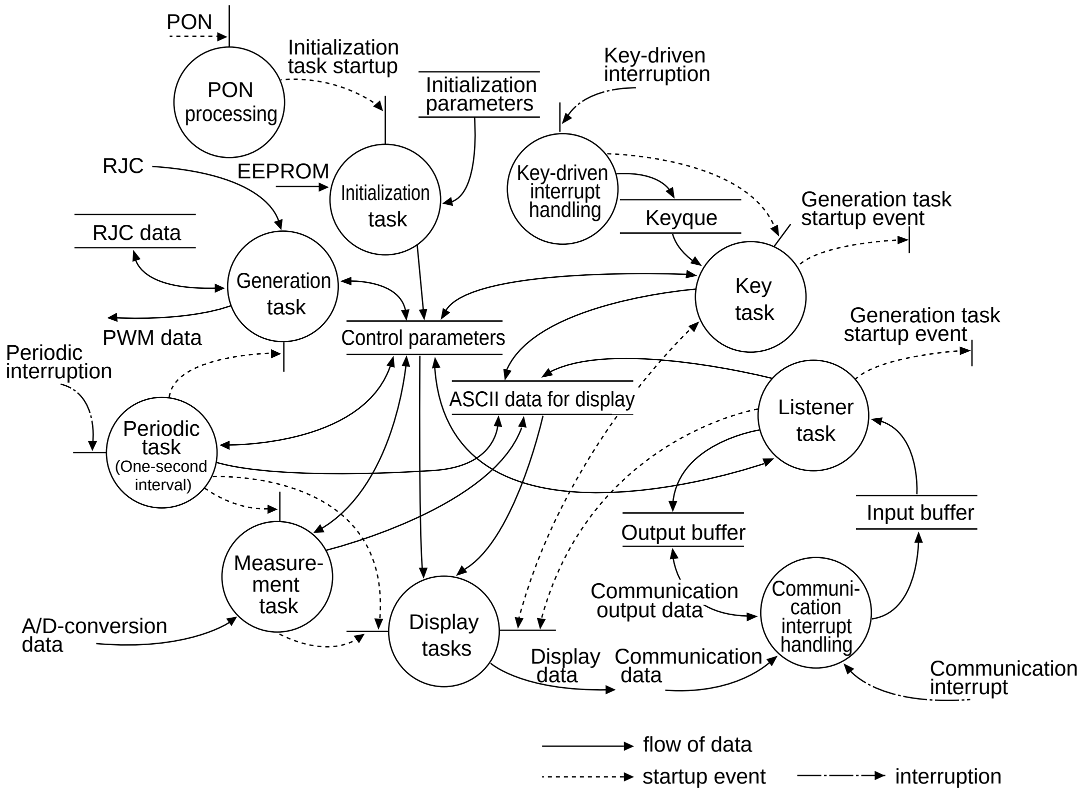


Figure 4 Configuration of Software

resistance has been generated artificially. The method is useful for a resistance meter using the voltage-drop measurement method based on a constant current source. The multiplier, which must be "varied" at high accuracy and with high stability, is especially important for the generator block.

The recently developed CA100 calibrator employs a PWM multiplier based on the interval integration method that multiplies a pulse width given by the CPU by an input voltage. The multiplier operates fast and has excellent linearity, enabling highly accurate calculation. These features make it possible for CA100 to calibrate even a scanned RTD thermometer that requires fast response. The calibrator also features 0.02% high accuracy for $5\frac{1}{2}$-digit resolution. Figure 3 shows a response waveform during resistance generation. There are two protection circuits in this block: one for output overvoltage and one for overcurrent that works only during voltage generation. If these circuits detect a failure resulting from overload or erroneous operation, they shut down the output using a relay to protect the internal circuitry.

3. Measurement Block

The measurement block can measure the DC voltage, DC current and resistance and gives $4\frac{1}{2}$-digit readings. The block uses auto-zeroing as its method of measurement in which it measures voltages on both sides of the input terminal, finds the voltage appearing in the absence of input, and corrects the offset voltage.

The DC voltage measurement mode has three ranges: 500 mV, 5 V and 35 V. The 500-mV range has high input resistance (equal to or greater than 1 GΩ) since the block directly receives signals at a preamplifier. For the 5- and 35-V ranges, the block receives signals at an approximately 1-MΩ voltage-dividing resistor, divides the input voltage into a tenth and a hundredth magnitude, respectively, and then feed the signal to the preamplifier. The DC current measurement mode has two ranges: 20 mA and 100 mA. A current being measured is introduced to a resistor with known resistance (shunt resistor), whereby the current's value is determined from the voltage developed across the resistor. The resistance measurement mode, which is based on the two-wire method, has three ranges: 500 Ω, 5 kΩ and 50 kΩ. A known current from the constant current source is introduced to the resistor being measured so the voltage developed across the resistor is measured to determine the resistance.

When in the TC output mode, the block also measures temperature using an RJC sensor (thermistor) to support the internal reference junction compensation of the instrument being calibrated. Using the resistance measurement function noted above, CA100 measures the resistance of the thermistor and converts it to a temperature value internally to use it as the compensation data for the TC output mode.

As the A/D converter, CA100 employs a delta-sigma-conversion CMOS LSI having 20-bit resolution. The block performs averaging on measured data within an interval between display updates to reduce effects due to output noise, thus suppressing instability in readings.

OVERVIEW OF FIRMWARE

The internal firmware consists of three types of interruption and eight tasks (Figure 4). It undertakes different types of hardware control such as processing for generation, processing for measurement, measurement for RJC, processing for communication, control of the keys and LCD display, power monitoring and automatic power-on/off. Our conventional precision instruments would use MPU's of different types and from different manufacturers in different ways. Beginning with the newly developed products, however, we will use the 32 bit-MPU models in the SH series. This approach is a first step toward the unification of development environments (use of µ ITRON, an OS that supports the SH series and development tools, such as a compiler, linker and debugger, from Greenhills) and the sharing of resources for a reduction in development work processes.

CONCLUDING REMARKS

In this paper, we have discussed the functions, features and internal circuits of CA100. Because of the instrument's high accuracy, wealth of basic functions and simple operation, we expect it to win backing from a wide range of user classes in the on-site inspection of various converters and receiving meters. The resistance (RTD-signal) generator function, among other functions, has been designed in pursuit of high speeds and, therefore, is outstanding and unrivaled. We are confident the function will be useful in a wide variety of applications. ◆

Specifications

General conditions: These specifications apply to the CA100 calibrator under the following conditions: ambient temperature of 23 ±5°C, auto-zeroing has been executed, the EL backlight is turned off, no battery charging is in progress, and it is one year since the calibrator was calibrated.

■ Specifications of Generation Functions

● DC Voltage/Current and Resistance Generation

Function	Range	Range with Guaranteed Accuracy	Display Resolution	Setting Range	Accuracy ±(% of setting + % of range)		Temperature Coefficient*1 ±(% of setting + % of range)/°C		Remarks
					% of setting	% of range	% of setting/°C	% of range/°C	
DC voltage generation	100 mV	0 to 100.000 mV	1 µV	-10 to 110.000 mV	0.02	0.01	0.003	0.002	Output resistance: approx. 6.5 Ω
	1 V	0 to 1.00000 V	10µV	-0.1 to 1.10000 V	0.02	0.005	0.002	0.001	Maximum output: 10 mA Output resistance: approx. 30 mΩ
	10 V	0 to 10.0000 V	100µV	-1 to 11.0000 V	0.02	0.005	0.002	0.001	Maximum output: 10 mA Output resistance: approx. 30 mΩ
DC current generation	20 mA	0 to 20.000 mA	1µA	0 to 22.000 mA	0.025	0.015	0.003	0.003	Maximum output: 24 V
	-20 mA*2	0 to -20.000 mA	1µA	0 to -22.000 mA	0.025	0.03	0.003	0.003	Maximum output: 28 V
Resistance generation*3	500 Ω	0 to 500.00 Ω	10 mΩ	0 to 550.00 Ω	0.02*4	0.02*4	0.002	0.01	*5
	5 kΩ	0 to 5.0000 kΩ	100 mΩ	0 to 5.5000 kΩ	0.05*4	0.03*4	0.002	0.01	*6
	50 kΩ	0 to 50.000 kΩ	1Ω	0 to 55.000 kΩ	0.1*4	0.1*4	0.002	0.03	*7

*1) Temperature conditions of temperature coefficient: 5°C or greater but less than 18°C, and greater than 28°C but no greater than 40°C
*2) DC-mA sink: A function which draws a current of the specified intensity in the direction from an external voltage generation source to the positive terminal.
*3) Resistance is generated by generating an equivalent resistance based on detection of the resistance-measuring current and generation of a voltage drop.
The specifications are valid over the ranges of measuring current and output voltage shown in the Remarks column.
*4) Does not include the resistance effects of the leads provided.
*5) Effective for measuring-current range of 1 to 5 mA, and for output voltage of no greater than 2 V
*6) Effective for measuring-current range of 0.1 to 1 mA, and for output voltage of no greater than 2 V
*7) Effective for measuring-current range of 0.01 to 0.1 mA, and for output voltage of no greater than 2 V

● Frequency and Resistance Generation

Function	Range (Range with Guaranteed Accuracy)	Display Resolution	Range of Generation/Reading	Accuracy	Maximum Output	Remarks
Frequency generation	1 to 100 Hz	100.0 Hz	1 to 110 Hz	±1 digits	10 mA	Waveform: Rectangular, with approx. 50% of duty ratio Output level: 0 to 10 V Accuracy of output level: ±10%
	100 to 1000 Hz	1000 Hz	90 to 1100 Hz			
	1 to 10 kHz	10.0 kHz	0.9 to 11.0 kHz			
	10 to 50 kHz	50 kHz	9 to 50 kHz			
Pulse generation*8	1 to 100 Hz	60,000 cycles	1 to 60000 cycles	±1 digits	10 mA	
	100 to 1000 Hz					
	1 to 10 kHz					
	10 to 50 kHz					

*8) The pulse generation generates as many rectangular waves as the specified number of cycles, where the single period of a rectangular wave is defined as a cycle.

● Generation of Equivalent Resistance-temperature-detector Temperature

Range	Generation Range (°C)	Display Resolution (°C)	Accuracy*10 (°C)	Temperature Coefficient*11 (°C/°C)
PT100	-200.0 to 0	0.1	0.3	0.04
	0 to 400.0	0.1	0.5	0.04
	400.0 to 850.0	0.1	0.8	0.04

*10) The accuracy is specified for measurement currents from 1 to 5 mA, excluding the resistance effects of the leads provided.
*11) Temperature conditions of temperature coefficient: 5°C or greater but less than 18°C, and greater than 28°C but no greater than 40°C
The specifications are compatible with both IEC 751-1983 and IEC 751-1995.

● General Specifications of Signal Generation Functions

- The equivalent RTD temperature is generated by generating an equivalent resistance based on detection of the resistance-measuring current and generation of a voltage drop.
- Response time of generation function:
  - DC V generation with 1-V or 10-V range: 10 ms (time taken from when the output begins changing to when it falls within the given accuracy)
  - Resistance generation with 500-Ω range (including RTD output): 10 ms (time taken from when the specified current is applied to when the output falls within the given accuracy)
  - Generation functions for ranges other than noted above: 300 ms
- Maximum load capacitance: 0.01 µF (for DC voltage, resistance, thermocouple EMF, RTD, frequency, and pulse generations)
- Maximum load inductance: 100 µF (for DC current generations)
- DC V generation limiter: Active for load voltages equal to or greater than 28.5 V (recovered manually)
- DC A generation limiter: Active for load currents equal to or greater than 12 mA (DC voltage, frequency and pulse generation functions only. Recovered manually.)
- Temperature Unit:°C, °F

● Generation of Thermocouple EMF

Range	Generation Range (°C)	Display Resolution (°C)	Accuracy (°C)	Temperature Coefficient*9 (°C/°C)
K	-200.0 to -100.0	0.1	0.6	0.05
	-100.0 to 400.0	0.1	0.5	0.05
	400.0 to 1200.0	0.1	0.7	0.05
	1200.0 to 1372.0	0.1	0.9	0.05
E	-250.0 to -200.0	0.1	1.2	0.1
	-200.0 to -100.0	0.1	0.6	0.05
	-100.0 to 600.0	0.1	0.5	0.05
	600.0 to 1000.0	0.1	0.6	0.05
J	-210.0 to -100.0	0.1	0.6	0.05
	-100.0 to 800.0	0.1	0.5	0.05
	800.0 to 1200.0	0.1	0.7	0.05
T	-250.0 to -200.0	0.1	1.5	0.2
	-200.0 to 400.0	0.1	0.5	0.05
N	-200.0 to -100.0	0.1	1.0	0.1
	-100.0 to 900.0	0.1	0.7	0.05
	900.0 to 1300.0	0.1	0.8	0.05
B	400 to 600	1	2.0	0.2
	600 to 800	1	1.5	0.2
	800 to 1820	1	1.1	0.2
R	-40 to 100	1	1.5	0.2
	100 to 1767	1	1.2	0.2
S	-40 to 100	1	1.5	0.2
	100 to 1767	1	1.5	0.2

*9) Temperature conditions of temperature coefficient: 5°C or greater but less than 18°C, and greater than 28°C but no greater than 40°C
- The specifications are compatible with both IEC 584-1-1989 and IEC 584-1-1995.
- The internal resistance for thermocouple output is approximately 6.5 Ω.
- The accuracy does not include the accuracy of reference junction compensation. Reference junction compensation is done by the optional RJC sensor. When performing output correction using the reference junction temperature, add the sensor accuracy. The output is corrected about every 10 seconds.
- Specifications of RJC sensor:
  Measurement range: -10 to 50°C
  Accuracy: ±0.5°C for a range of 18 to 28°C (when combined with the main unit)
  ±1°C for ranges of -10 to 18°C and 28 to 50°C (when combined with the main unit)
  Cord length: approx. 1.5 m
- Temperature Unit:°C, °F

● Step Output Function

Output = setting value ✕ n /m
where,
m = integer (1 to 15); n = integer (1 to m)

■ 24-V DC Power Supply to Transmitter

- Output voltage: 24 ±1 V
- Maximum output current: 22 mA
- Output protection: Output shutdown over 30 mA

■ Specifications of Measurement Functions

Function	Range	Range with Guaranteed Accuracy	Display Resolution	Reading Range	Accuracy ±(% of reading + % of range)		Temperature Coefficient*12 ±(% of reading + % of range)/°C		Remarks
					% of reading	% of range	(% of reading)/°C	(% of range)/°C	
DC voltage measurement	500 mV	-500.00 to 500.00 mV	10µV	-599.99 to 599.99 mV	0.02	0.01	0.002	0.001	Input resistance: more than 1 GΩ
	5 V	-5.0000 to 5.0000 V	100µV	-5.9999 to 5.9999 V	0.02	0.01	0.002	0.001	Input resistance: approx. 1 MΩ
	35 V	-35.000 to 35.000 V	1 mV	-41.999 to 41.999 V	0.02	0.015	0.002	0.001	
DC current measurement	20 mA	-20.000 to 20.000 mA	1µA	-23.999 to 23.999 mA	0.025	0.02	0.002	0.001	Input resistance: no more than 20 Ω
	100 mA	-100.00 to 100.00 mA	10µA	-119.99 to 119.99 mA	0.04	0.03	0.002	0.001	
Resistance measurement	500 Ω	0 to 500.00Ω	10mΩ	0 to 599.99 Ω	0.055*13	0.015*13	0.005	0.02	Measurement current: approx. 1 mA
	5 kΩ	0 to 5.0000kΩ	100mΩ	0 to 5.9999k Ω	0.055*13	0.015*13	0.005	0.02	Measurement current: approx. 100 µA
	50 kΩ	0 to 50 000kΩ	1Ω	0 to 59.999 kΩ	0.55*13	0.02*13	0.005	0.02	Measurement current: approx. 10 µA

*12) Temperature conditions of temperature coefficient: 5°C or greater but less than 18°C, and greater than 28°C but no more than 40°C
*13) The accuracy does not include the resistance effects of the measurement leads provided.
- Display update period of measured value: 1 sec
- Maximum voltage/current to measurement input terminals:
  Voltage input terminal: 42 Vpeak
  Current input terminal: 120 mA
- Current input terminal protection: Fuse (250 V, 125 mA)
- Open-circuit voltage during resistance measurement: 4.5 V maximum
- Moving average for measured value: Based on 5 sampled data values

General Specifications

- Complying Safety Standard:
  General safety:EN61010
  • Overvoltage category II (CAT II)
  • Pollution Degree 2

  EMC:IEC1326-1:1997 DRAFT, IEC1326-10:1996 DRAFT
  • Except, use a double shielded cable for the RS-232-C cable and separate the RS-232-C cable and the measurring lead by 50 mm or more.
  • The cable layout during the emission test was as follows. The output lead of the generation section was bent perpendicularly to the left at 20 cm from the terminal section. The output lead of 24V, OUT was bent perpendicularly to the right at 20 cm from the terminal section. The cord from the AC adapter was bent prependiculary towards the front at 5 cm from the connector. The measuring laed, RJC sensor cable and the RS-232-C cable was positioned perpendicular to the terminal section and the connector in a straight line.
  • The output voltage range of the AC adapter is 15 V DC ±0.75 V
  The influence under the immunity environment is as follows:

Function	Test Condition		
	Range	Setting Value	Accuracy
Generation	1V 20mA 50kΩ	0.5V 10mA 10kΩ	± 5% of range ± 5% of range ± 5% of range
Measurement	5V 20mA 50kΩ	1V 0mA 10kΩ	±20% of range ±30% of range ±20% of range

- Power Supply: AA-size batteries, dedicated Ni-Cd battery pack, or dedicated AC adapter
  • AA-size batteries: Eight cells (model A1070EB)
  Approximate service life assuming continuous use (and alkaline cells):
  5-V DC (10-mA load current) generation with active measurement function: 10 hours
  20mA DC generation with active measurement function, active 24-V DC power supply to transmitter, and lit EL backlight: 2 hours
  • Ni-Cd battery pack: Optional (model B9914PS)
  1200mAh, 9.6-V battery pack for repeated use with service life of approximately two years (depending on usage conditions)
  Approximate service life assuming continuous use:
  5-V DC (10-mA load current) generation with active measurement function: 7.5 hours
  20-mA DC generation with active measurement function, active 24-V DC power supply to transmitter, and lit EL backlight: 2.5 hours
  Charging: Timer-operated charging using the main unit (10 hours of charging, requiring AC adapter)
  • AC adapter: Optional (model 366969)
  Input: 100-120 or 220-240 V AC, 50/60 Hz, 40-55 VA
  Maximum range of input voltage: 90-264 V AC
  Maximum range of input frequency: 48-62 Hz
  • Automatic power-off: 30 minutes (Condition: If there is no key input or data exchange via communication while the instrument is running on batteries)
- Communication: RS-232-C (9-pin D-Sub connector)
  • Transmission: Asynchronous
  • Transmission rate: 150, 300, 600, 1200, 2400, 4800 or 9600 bits/sec
  • Modes: Allows selection between talk-only and normal modes and selection of handshaking mode and data format
  • Printer using ESC/P command:Possible
- Display: Segmented LCD with built-in backlight; 5 digits for generated value and 4.5 digits for measured value
- Warm-up Time: 5 minutes
- Power Consumption: 55 VA maximum (when using the dedicated AC adapter)
- Insulation Resistance: 20 MΩ or greater at 500 V DC for 1 minute applied between respective terminals and between each terminal and the power line of the AC adapter
- Withstanding Voltage: 350 V AC, 1 minute (between respective terminals); 1,500 V AC, 1 minute (between each terminal and the power line of the AC adapter)
- Operating Temperature and Humidity Range:
  5 to 40°C, 20 to 80% RH (no condensation), during generation and/or measurement (in normal operation) or while charging when neither generation nor measurement is taking place
- Storage Temperature and Humidity Range:
  -20 to 45°C, 90% RH maximum (no condensation)
- I/O Terminals: Maximum applied voltage is less than 42 Vpeak and CAT II between terminals/each terminal and ground. Expert, negative 24 V OUT terminal is 18 Vpeak or less.
- Operating Altitude: Max. 2000m
- Dimensions and Weight: Approx. 237 (W) × 137 (H) × 63 (D) mm (excluding protrusions); 9.3" (W) × 5.4" (H) × 2.5" (D) approx. 1.2 kg(f) / 2.64ℓ6
- Accessories: Generation/measurement leads (with resistance of approx. 0.08 Ω, model B9409LA): Two sets
  Ferrite cores for generation/measurement leads (model A1194MN):Two
  AA-size alkaline batteries (model A1070EB): Eight
  Battery holder (model B9914CV): One
  Carrying case (model B9914LC): One
  Fuse: One
  Instruction manual: One

Model and Suffix Codes

Product Name	Model code	Suffix code	Description
Compact Cal	255701	· · · · · · · ·	CA100
Engineering unit for temperature		-U3	°C, °F

Accessories (optional)

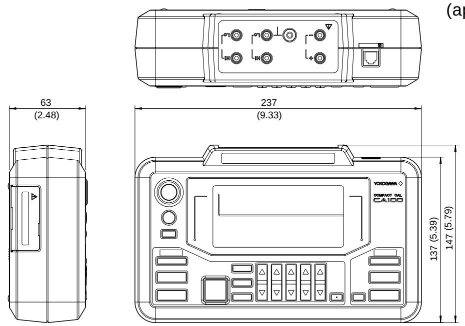
Product Name	Model Code	Suffix Code	Description	Application A	B	C	D	E	Min. Order Q'ty
AC power supply kit*1	366969	-D	UL/CSA standard	✔	✔				1
		-F	VDE standard						
		-R	SAA standard						
		-Q	BS standard						
Ni-Cd battery pack	B9914PS	—	—		✔				1
RJC sensor	B9638CR	—	—			✔			1
Lead cable	B9409LA	—	—				✔		1
Ferrite core (for RJC sensor)	A1193MN	—	—			✔			1
Ferrite core (for lead cable)	A1194MN	—	—				✔		2
Input terminal adapter*2	751512	—	—					✔	1

*1) Includes an AC adapter (model A1437UP), UL/CSA-standard power cable (model A1006WD) or VDE-standard power cable (model A1009WD), or SAA-standard power cable (model A1024WD), or BS-standard power cable (model A1054WD).
*2) Guard terminal-to-binding post conversion adapter

Application:
A: Driven by an AC power supply
B: Driven by the Ni-Cd battery pack
C: Calibrating a thermometer having built-in RJC compensation
D: Using the 24-V DC power supply to transmitter/transducer
E: Calibrating a three-wire RTD

Dimensions

Unit:mm
(approx,inch)



If not specified, the tolerance is ±3%. However, in cases of less than 10 mm, the tolerance is ±0.3 mm.