

# Oscilloscopes CS-5400 SERIES

100MHz 3-Channel Oscilloscope (With Digital Readout / Cursor)

## CS-5400

100MHz 3-Channel Oscilloscope

## CS-5405

50MHz 3-Channel Oscilloscope (With Digital Readout / Cursor)

## CS-5450

50MHz 3-Channel Oscilloscope

## CS-5455

setup functions enabling to measure AC voltage (Vp-p), DC voltage, frequency and period. All of these models are provided with full features including  $\pm 2\%$  high-accuracy measurement, delay sweep function, automatic triggering and high intensity, high-resolution CRT. The CS-5400 Series with high-performance will surely assist you in many kinds of field activities.

### CS-5400/5450 FEATURES

#### Parameter Auto Measurement Function



It is possible to measure the voltage, frequency and period automatically just input the signal. Especially for voltage measurement, measurement mode is automatically selected according to the input selector. For example, when the AC input is selected, "Peak-to-Peak" voltage is automatically measured, and when the DC input is selected, DC voltage is measured automatically.

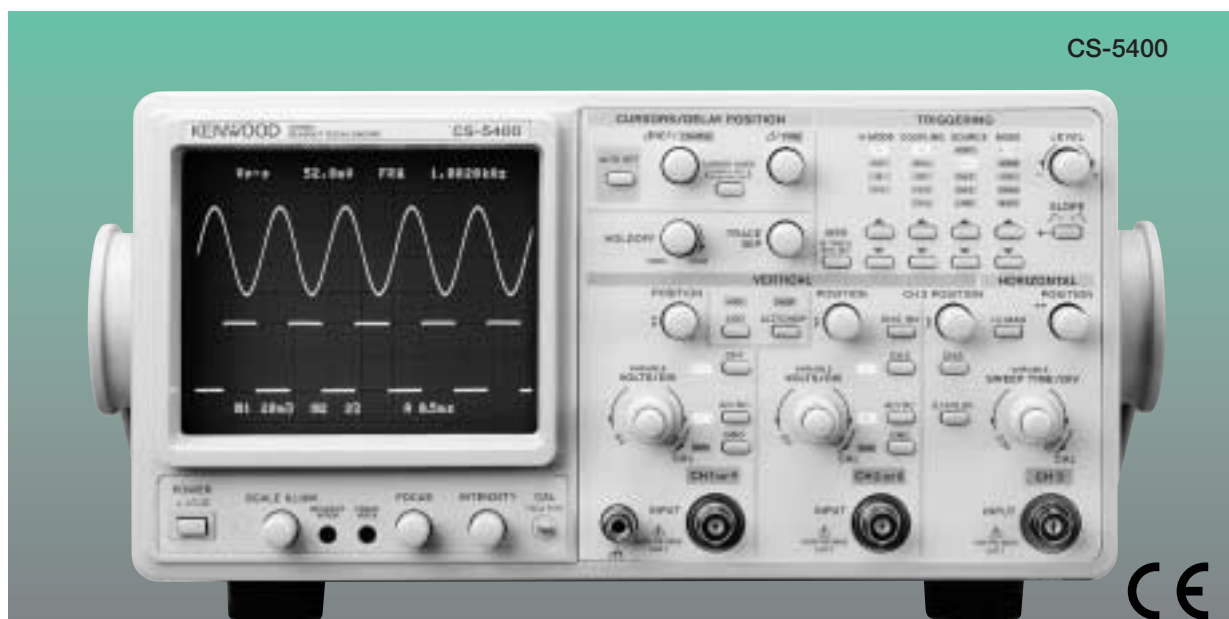
### OUTLINE

The CS-5400 Series are 3-channel oscilloscopes developed with concepts of high level design, high accuracy and easy operation. The panel layout never diminishes the intuitive and high-speed response provide fatigue free operation even after long-hours of use. These models incorporating readout function (with CS-5400 / 5450) offer you parameter measurement and auto

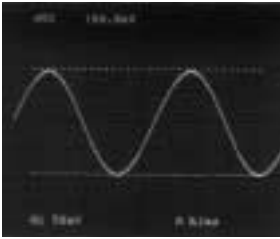
#### Auto Setup Function



By pressing the AUTO SET key, the voltage range and time range are selected automatically.



### Cursor Measurement Function



The cursor measurement function allows a high accuracy measurement of signal values. When the probes are used, its attenuation ratio can be converted automatically. It is also possible to measure the voltage value and phase differences. When the delay

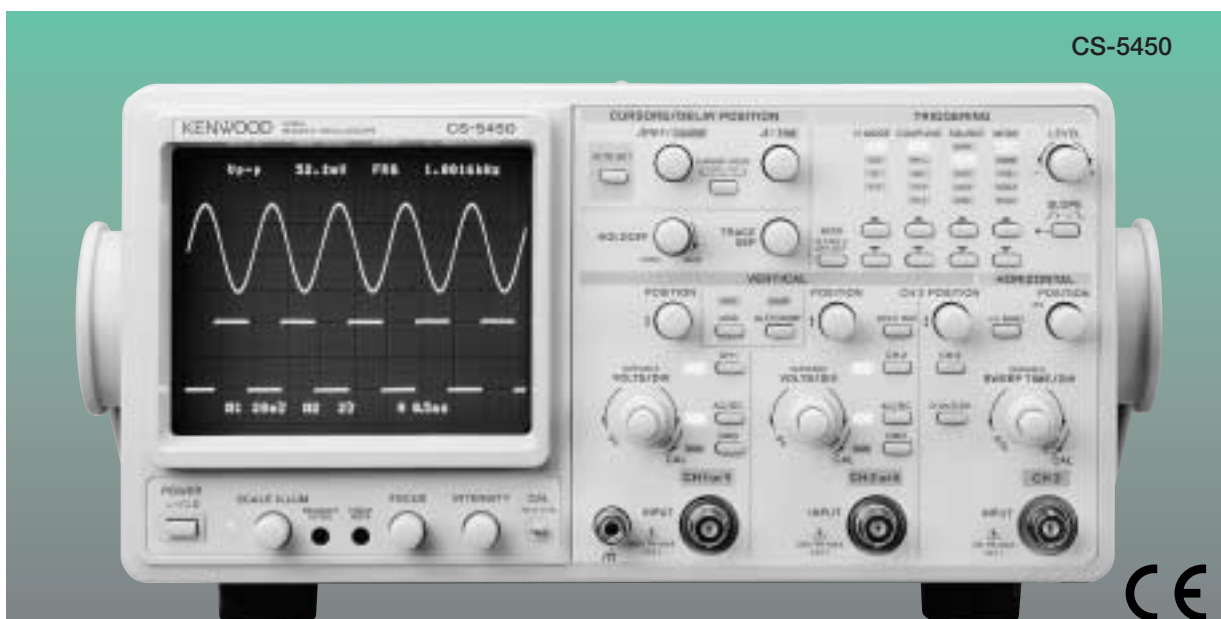
sweep is used, the delay time is also displayed, enabling an accurate measurement results without any errors due to visual checks in conventional systems.

### Peak to Peak Voltage Measurement

Parameter automatic measurement function enables automatic AC peak to peak voltage measurement up to 5MHz.

### Variable Lock

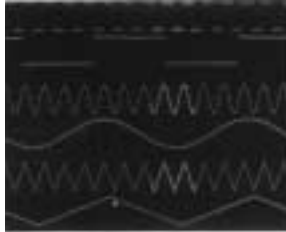
ON/OFF the vertical and horizontal variable functions can be set when pressing the ALT/CHOP knob more than 1-second. When OFF is selected, it becomes CAL level. When the function is ON, it returns to prior value.



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## CS-5400 SERIES COMMON FEATURES

### 3-Channel 8-Trace Waveform Display



CS-5400 series enable the display of CH3 input in addition to CH1 and CH2. These three input signals to CH1, CH2 and CH3 can be displayed at the same time as the main (A) sweep waveform.

Furthermore, an alternated delay sweep function displayed as the delayed (B) sweep waveforms of each signal.

### High-Sensitivity Design with Vertical Axis of 1 mV/div

The vertical axis sensitivity can be varied continuously from 1 mV/div. to 5 V/div. using the 1-2-5 step attenuator. The 1 mV/div. position is very useful to measure low-level and complicated signals. (Frequency response at 1 mV/div. and 2mV/div are DC to 20 MHz (-3 dB)).

### Automatic Sync (FIX) Function

With this function, the synchronization level is automatically controlled by tracking the amplitude of the waveform to maintain the sync lock status. This function eliminates annoying and complicated synchronization operations.

### Easy Operation Panel Layout

The CS-5400 and CS-5450 used touch switches and LEDs. The CS-5405 and CS-5455 used push switches and lever switches for easy operation.

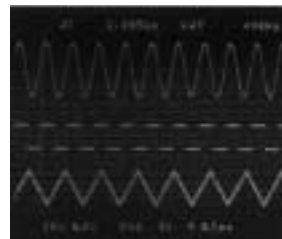
### Delayed Sweep with Waveform Partial Magnification Capability



This is a real alternate delayed sweep.

The main (A) sweep waveform in which the magnified section is brightened by intensity modulation and the delayed (B) sweep waveform which shows only the magnified section can be observed simultaneously.

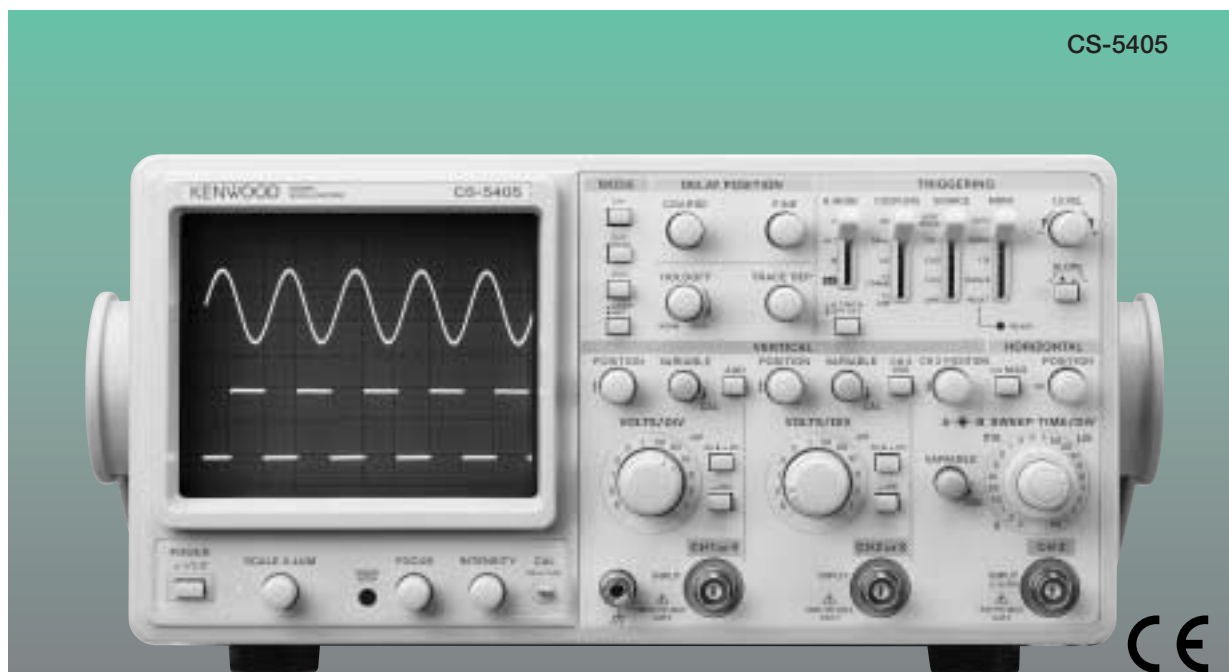
### V Mode Sync for Stable Display of 3 Signals



Even when the CH1, CH2 and CH3 input signal frequencies are different, each signal can be synchronized securely and its waveform can be displayed stably.

### High-Accuracy $\pm 2\%$ Design for More Precision Measurement

In order to obtain highly reliable measurement results, the vertical axis sensitivity and sweep time for the main circuit is maintained within  $\pm 2\%$  precision. Other specifications also guarantees the rated values (under temperature conditions of 10 to 35°C, humidity of 85% or less).

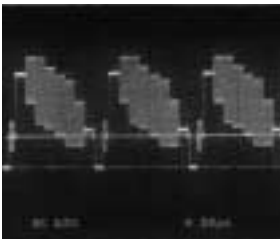


**Maximum Sweep Rate of 5 ns/div (x10 MAG)**

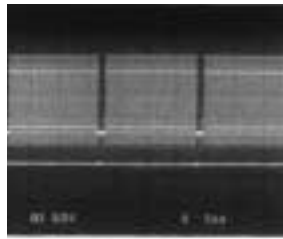
The sweep rate can be varied continually from 0.5 s/div to 50 ns/div. The signal delay line is installed so that the positive rise of high-speed signals and high-frequency signals can be measured accurately.

**Wide Dynamic Range and Distortion-Free Accurate Waveform Display**

Its wide dynamic range having greater margins assures the linearity of the waveforms displayed on the CRT, providing highly accurate waveform displays without any distortion up to the upper frequency limits.

**Built in Video Clamp Circuit for Easy Operation**

● Horizontal TV signal



● Vertical TV signal

Built in Video Clamp function which enables observation of the frame and line TV signals at the touch of a button, while high-stability synchronization is obtained without performing annoying synchronizing operations.

**Square-Type 150 mm CRT with Self-Illuminated Light and Inside Scale (12 kV)**

A large-sized, square, dome-mesh type CRT with accelerator is employed. It features both high intensity and high resolution while providing accurate measurements without parallax view. The auto focus circuit is also incorporated to display sharp waveforms at all times.

**Single Sweep for Observations of Single-shot Channel**

The single sweep function is powerful in measurement of single-shot or sudden channel. Waveform photography using a camera is as easy as ordinary, visual observations. It is easy not only for observations during normal visual inspections but also for camera shots of the waveforms.

**Variable Hold-off Allowing Observation of Waveforms with Complicated Cycle**

Signals which are hard to be synchronized due to complicated repetition cycles, for example digital signals and video bursts signal, can be synchronized stably by converting them into the hold-off time.

**High-Accuracy Calibration Signals**

A calibration signal output is provided to output the highly accurate frequency of  $\pm 0.1\%$  and voltage accuracy of  $\pm 1\%$ , enabling checking of the measurement precision at any required time.

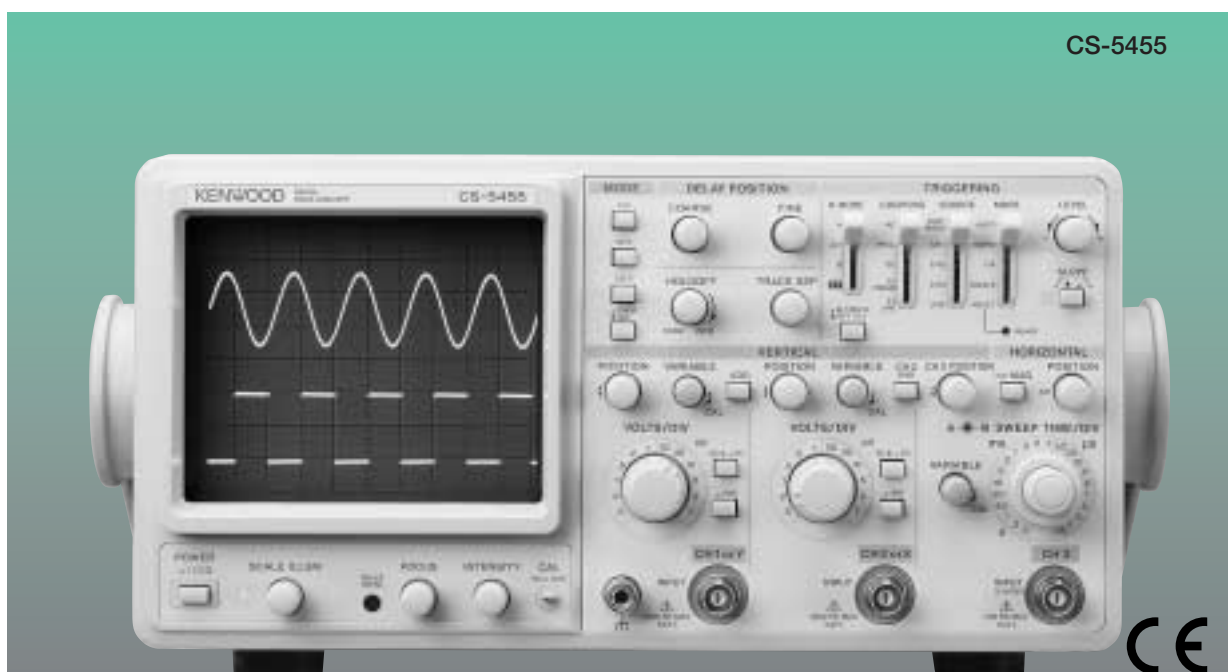
**CH1 Signal Output Connector**

The CH1 signal output is obtained by branching the input signal in the middle of the signal line. As this connector outputs the input signal at a rate of 50 mV/div, connecting a frequency counter makes it possible to measure the frequency of a very low signal while observing its waveform.

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### Other Features

- All position knobs and controls are provided on the front panel.
- A High-sensitivity X-Y function is convenient for the measurement of phase differences between two input signals.
- A Trace Rotation function allows an easy correction of the inclination of the trace line due to earth magnetism.
- LINE Synchronization is provided
- A Trace Separation function shifts the B sweep waveform upward or downward by 4 div. from A sweep waveform.
- The waveform to which the brightness modulation is applied can also be observed.
- Added or extracted waveforms using ADD and CH2 INV functions can also be observed.
- Scale illumination convenient for taking photographs or observation in dark areas is provided.
- CRT scale also provides 0, 10, 90 and 100% indications; convenient for measurement of rising time, etc.
- A 10-times sweep waveform magnification function (X10 MAG) is provided.



**CS-5400 SERIES**

**SPECIFICATIONS**

CS-5400 SERIES

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Model		CS-5400	CS-5405	CS-5450	CS-5455		
<b>CRT Type/accelerating voltage</b>		150 mm rectangular with internal graticule 8 × 10 div. (1 div.=10mm) /approx. 12 kV					
<b>Vertical Axis (CH1, CH2)</b>							
Sensitivity	5 mV to 5 V/div.	± 2%					
	1 mV, 2 mV/div.	± 5%					
Attenuator		1-2-5 step, 12 ranges, fine adjustable within the selected range					
Input Impedance		1 MK ± 1%, approx. 20 pF					
Frequency Response	5 mV to 5 V/div	DC: DC to 100 MHz (within -3 dB) AC: 5 Hz to 100 MHz (within -3 dB)		DC: DC to 50 MHz (within -3 dB) AC: 5 Hz to 50 MHz (within -3 dB)			
	1 mV, 2 mV/div	DC: DC to 20 MHz (within -3 dB) AC: 5 Hz to 20 MHz (within -3 dB)					
Rising Time	5 mV to 5 V/div.	approx. 3.5 ns		approx. 7 ns			
	1 mV, 2 mV/div.:	approx. 17.5 ns					
Signal Delay Time		Leading edge can be confirmed using a square wave that has a rising time of less than this unit					
Crosstalk		-40 dB (at 1 kHz)					
Max. Input Voltage		800 Vp-p or 400 V (DC + AC peak, 1 kHz)					
<b>Vertical Axis (CH3)</b>							
Sensitivity		0.1 V, 0.5 V/div. ± 2%					
Attenuator		0.1 V, 0.5 V/div.	0.1 V/div.	0.1 V, 0.5 V/div.	0.1 V/div.		
Input Impedance		1 MK ± 1%, approx. 20 pF					
Frequency Response		DC to 100 MHz (within -3 dB)		DC to 50 MHz (within -3 dB)			
Rising Time		Approx. 3.5 ns		Approx. 7 ns			
Signal Delay Time		Leading edge can be confirmed using a square wave that has a rising time of less than this unit					
Max. Input Voltage		100 Vp-p or 50 V (DC + AC peak, 1 kHz)					
<b>Vertical Axis</b>							
Operation Mode		CH1, CH2, CH3, ADD, ALT, CHOP					
Chopping Frequency		Approx. 250 kHz					
Polarity Inversion		CH2 only					
<b>Horizontal (CH2 Input, except × 10 MAG)</b>							
Sensitivity	5 mV to 5 V/div.	± 3%					
	1 mV, 2 mV/div.	± 5%					
Input Impedance		Same as vertical axis (CH2)					
Frequency Response	DC	DC to 1 MHz (-3 dB)					
	AC	5 Hz to 1 MHz (-3 dB)					
X-Y Phase Difference		Less than 3° at 100 kHz					
Operation Mode		Switchable to X-Y mode with H.MODE key (CH1: Y axis, CH2: X axis)					
Max. Input Voltage		Same as vertical axis (CH2)					
<b>Sweep</b>							
Sweep Mode		A, ALT, B, X-Y					
Sweep Time	A Sweep	0.5 s to 50 ns/div. ± 2%, 1-2-5 step, 22 ranges, fine adjustable within the selected range					
	B Sweep	50 ms to 50 ns/div. ± 2%, 1-2-5 step, 19 ranges					
Sweep Magnification		× 10 ± 5%, (± 8% at 0.5 μs, 0.1 μs and 50 ns/div. )					
Linearity		± 3% (± 5% at × 10 MAG mode)					
Hold Off		A Sweep, continuously variable from NORM position					
Trace Separation		B Sweep is continuously variable ± 4 div. with respect to A sweep.					
Delay Sweep Mode	AFT'D	Continuous delay (After Delay)					
	B TRG'D	Synchronous delay (B TRIG'D): Synchronized with trigger signal					
Delay Time		Continuously variable from 0.2 div. to 10 div. (0.5s/div. to 50ns/div.)					
Delay Time Error		± (3% of setting value + 1% of full scale) + (0 to 300 ns) : CS-5400, CS-5450 ± 4% of reading value : CS-5405, CS5455					
Delay Jitter		20000 (10 times of A Sweep setting value) : 1 (at A Sweep 1 ms/div, B Sweep 1 μs/div)					
<b>Triggering Mode</b>							
Trigger Mode		AUTO, NORM, FIX, SINGLE, RESET					
Trigger Sources		VERT, CH1, CH2, CH3, LINE					
Trigger Coupling		AC, HF-REJ, DC, TV-F, TV-L					
Trigger Sensitivity (NORM MODE)	Coupling	Frequency	NORM	FIX*	Frequency	NORM	FIX*
		AC	10Hz to 50MHz	1.0 div	1.5 div	10Hz to 20MHz	1.0 div
	HF-REJ	50MHz to 100MHz	1.5 div	2.0 div	20MHz to 50MHz	1.5 div	2.0 div
		10Hz to 10kHz	1.0 div	1.5 div	10Hz to 10kHz	1.0 div	1.5 div
	DC	10 kHz or more	> min	> min	10 kHz or more	> min	> min
		DC to 50MHz	1.0 div	1.5 div	DC to 20MHz	1.0 div	1.5 div
TV-F, TV-L	50MHz to 100MHz	1.5 div	2.0 div	20MHz to 50MHz	1.5 div	2.0 div	
TV-F, TV-L		Composite video signal		Composite video signal		1.5 div	
(Above values are obtained with the signal input of: AUTO: 40 Hz or more, FIX: 50 Hz or more Internal sensitivity indicated as the amplitude on the CRT. Sensitivity in HF-Rej mode ">min" denotes the amplitude required for synchronization will increase.)							

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Model	CS-5400	CS-5405	CS-5450	CS-5455
<b>Calibration Signal</b>				
Waveform	Square wave			
Polarity	Positive			
Amplitude	1 Vp-p ± 1%			
Frequency	1 kHz ± 0.1%			
<b>Intensity Modulation</b>				
Input Voltage	Dims at TTL high level (+5V)			
Input Impedance	Approx. 10 kK			
Frequency Response	DC to 5 MHz			
Max. Input Voltage	84 Vp-p or 42 V (DC + AC peak, 1 kHz)			
<b>CH1 Signal Output (50K Load)</b>				
Output Voltage	Approx. 50 mVp-p/div.			
Output Impedance	Approx. 50K			
Frequency Response	5 mV to 5 V/div. 1 mV, 2 mV/div.	100 Hz to 100 MHz (-3 dB)	100 Hz to 50 MHz (-3 dB)	
Trace Rotation	Enables trace rotation adjustment by semi-fixed controller on the panel.			
<b>Power Requirements</b>				
Input Voltage	AC 100/120/220/230 V (±10%)			
Frequency	50 Hz / 60 Hz			
Power Consumption	Max. 56 W, Max. 69 VA	Max. 45 W, Max. 58 VAA	Max. 55 W, Max. 68 VA	Max. 44 W, Max. 57 VA
Insulator Voltage	AC 1.5 kV, 1 minute			
Insulator Resistance	More than 100MK at DC 500 V			
<b>Dimensions/Weight</b>				
Dimensions (W × H × D)	305 × 150 × 400 mm / (344 × 165 × 459 mm, Maximum dimensions)			
Weight	Approx. 9.3 kg	Approx. 8.8 kg	Approx. 9.3 kg	Approx. 8.8 kg
<b>Operating Environment (limited as indoor use)</b>				
Altitude	Below 2000 m			
Overvoltage Category	II			
Pollution	2			
Operating Temperature & Humidity	0 to +40°C, 85% or less (with no condensation)			
Storage Temperature & Humidity	-20 to +70°C, 85% or less (with no condensation)			
<b>Accessories</b>				
Probe	PC-51 (2)	PC-59 (2)	PC-53 (2)	PC-54 (2)
	Operation Manual (1)/Adjusting Screwdriver (1)/Power Cable (1)/Replacement (1)			

## CS-5400 SERIES

## Readout Section (CS-5400, CS-5450 only)

Panel Setup Value	CH1, CH2 scale factor (with probe detection), CH3 scale factor, V-UNCAL, ADD, INV, A/B Sweep scale factor (MAG conversion, "M" is displayed in MAG mode), X-Y, Sweep UNCAL, DELAY, TIME, B TRIG'D
Cursor Measurement OV1 only in X-Y mode (Measures between OREF and cursor except the parameter automatic measurement)	OV1: Voltage display by converting CH1 scale factor OV2: Voltage display by converting CH2 scale factor OV3: Voltage display by converting CH3 (0.1V/div. or 0.5V/div.) scale factor OT : Time display by converting A Sweep scale factor OI/T: Frequency display by converting Sweep scale factor
DCV, Vp-p, FRQ, PER	Display the parameter measurement value by automatic measurement function
VARIABLE or A VARIABLE at UNCAL	RATIO: Voltage ratio, time ratio display with 5 div. on the CRT as 100% PHASE: Phase difference display with 5 div. on the CRT as 360° DCV >, Vp-p >: Display ">" and inform that the input signal is larger than measurement value on CRT
Resolution/Measurement Error	10 bits/± 4%
Measuring Range	Vertical: More than ± 3.6 div. from the center of CRT Horizontal: More than ± 4.6 div. from the center of CRT
Parameter auto setting function	Each parameter is measured and displayed for the signal selected as the trigger signal source from CH1 or CH2
Frequency (FRQ)	Mode selectable in Cursor mode. Measured with internal counter to be displayed
Frequency Range	CS-5400: 2 Hz to 100 MHz CS-5450: 2 Hz to 50 MHz
Effective Digits/Accuracy	5 digits/0.01% ± 1 digit
Measurement Sensitivity	Same as trigger sensitivity
Period (PER)	Mode selectable in Cursor mode. Measured with internal counter to be displayed
Measurement Range	CS-5400: 0.5 s to 10 ns CS-5450: 0.5 s to 20 ns
Effective Digits/Accuracy	5 digits/0.01% ± 1 digit
Measurement Sensitivity	Same as trigger sensitivity
AC Voltage (Vp-p)	Mode selectable in Cursor mode. Peak-to-peak voltage is measured and displayed
Measurement Range	10 Hz to 1MHz: 0.5 div. to Effective CRT area 1MHz to 5MHz: 2.0 div. to Effective CRT area
Frequency Range	10 Hz to 5 MHz
Effective Digits	3 digits
Accuracy	10 Hz to 40 Hz: ± {8% + attenuator setup value (V/div) × 0.04 div} 40 Hz to 1 MHz: ± {3% + attenuator setup value (V/div) × 0.04 div} 1 MHz to 5 MHz: ± {5% + attenuator setup value (V/div) × 0.04 div}
DC Voltage (DCV)	Mode selectable in Cursor mode. Average DC voltage is measured and displayed
Sensitivity	0.5 div. to Effective CRT area
Effective Digits	3 digits
Accuracy	± {3% + attenuator setup value (V/div) × 0.04 div}
Auto Setup	For CH1, CH2, Vertical axis attenuator, Sweep range, Vertical position, Horizontal position are automatically setup
Period	1.5 to 5 periods (H.Variable.; CAL mode, for input signal up to 10 MHz)
Amplitude	Within effective CRT area (within 1/2 of effective CRT area in dual-trace mode)
Frequency (Sine wave)	CS-5400: 50 Hz to 100 MHz, CS- 5450: 50 Hz to 50 MHz
Position	Vertical axis: 1 channel ; almost center of CRT, 2 channel ; CH1 approx. +2 div., CH2 approx. -2 div. from the center of CRT Horizontal axis: starts from left edge of CRT scale
Backup	Panel setup values are backed up by built-in battery. Battery service life approx. 30,000 hours (with room temperature)