

Digital Storage Oscilloscope

# DCS-9000 SERIES

100MS/s 4 Acquisition 100MHz 4-Channel

## DCS-9300

100MS/s 2 Acquisition 100MHz 4-Channel

## DCS-9320

40MS/s 4 Acquisition 100MHz 4-Channel

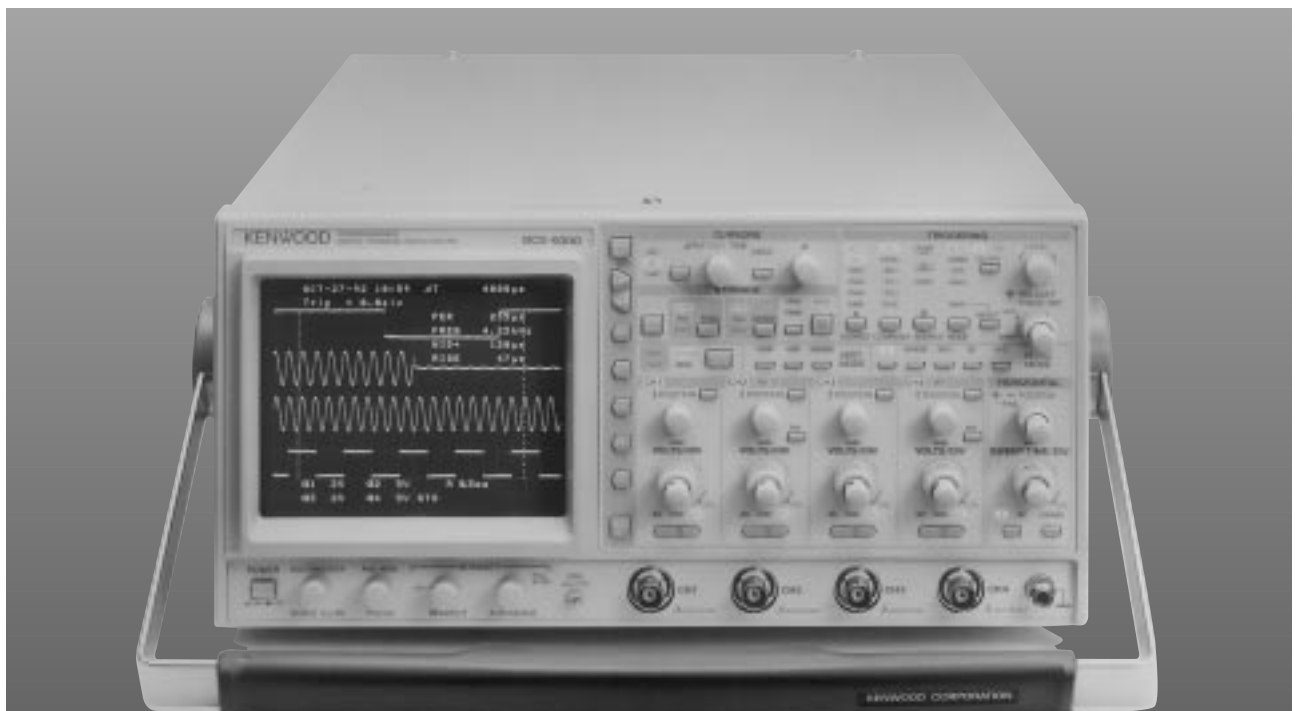
## DCS-9100

40MS/s 2 Acquisition 100MHz 4-Channel

## DCS-9120

### OUTLINE

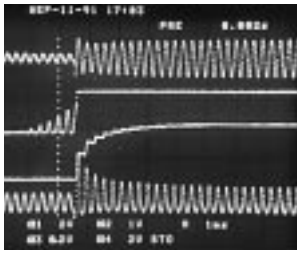
The DCS-9000 Series includes a complete 4-channel, high-performance model incorporating independent 100 MS/s A-D converters for the 4 channels and 100 MHz/4-channel real-time oscilloscope (DCS-9300). The 4-channel models are capable of 4-channel simultaneous sampling for easy observation of the waveforms of single-shot phenomena in fast, multiple phenomena, transient phenomena and sudden phenomena. The memory is provided with a margin and implemented with a complete 4-channel configuration (DCS-9300, DCS-9100). Each channel has a 16K-word data memory for waveform storage and a reference memory for storing reference waveforms so that the memory setup can be made easily and with a margin for every kind of observation. In addition, a quick response capability using digital technology lets these models offer excellent operability.



# DCS-9000 SERIES

## FEATURES

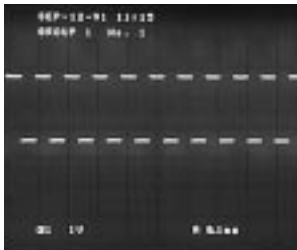
### 100 MS/s (10 ns/word), 4-channel simultaneous sampling



The 4-channel simultaneous sampling at the maximum sampling rate of 100 MS/s (10 ns/word) makes it easy to observe the waveforms of single-shot phenomena in fast, multiple phenomena, transient phenomena and sudden phenomena (this is applicable

to the DCS-9300. The DCS-9320 is capable of 100 MS/s 2-channel simultaneous sampling, the DCS-9100 of 40 MS/s 4-channel simultaneous sampling and the DCS-9120 of 40 MS/s 2-channel simultaneous sampling). This makes it easy to measure the write/read timing of a dynamic RAM, etc.

### 100-step programming



Step 1



Step 2

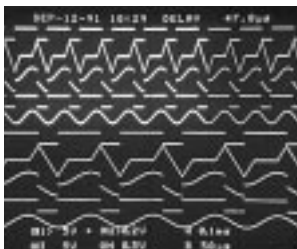


Step 3

Observation conditions can be stored in 100 steps (20 steps x 5) which can be set by the user. This allows you to reproduce the settings according to the measurement fields quickly and without mistake, and is convenient for repeated, routine measurements. By using this function during the GP-IB

controlled operation, thousands of command transfer operations can be omitted and observation conditions can be set instantaneously on the panel.

### DC to 100 MHz/4-channel, 12 traces



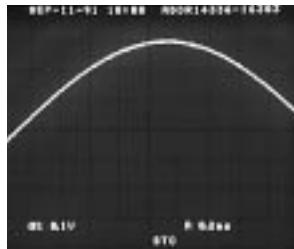
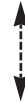
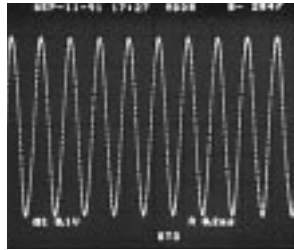
All of the 4 channels have full-range attenuators (1 mV/div to 5 V/div, 1-2-5 step, 12 ranges). The 4 channels have the identical performances, which proves to be powerful in 4-channel simultaneous observations.

### Direct control and menu operation for an enhanced operability



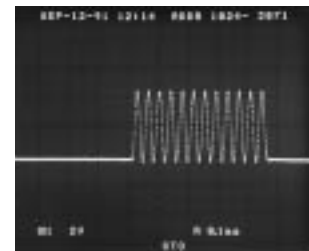
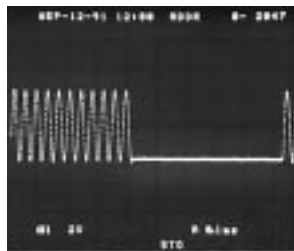
Direct control is provided for frequently used functions and other functions can also be operated efficiently using menu screens and function keys. Special consideration has been made to allow previous settings of functions using menu screens whenever possible so as to facilitate the operations of the functions.

### Margin in memory length, memory division capability



Each channel has a 16K-word data memory for waveform storage and a reference memory for reference waveform storage. The data memory can be set to 2-K-word or 2-K word x 8 (memory division). The reference memory of each of the 4 channels can save 8 to 32 kinds of waveforms. Each memory can be optimally set according to the required observation.

### Display scrolling for referring to all data



When the data memory is set to 16K-word/CH or 2K-word x 8 CHs, all of the stored data can be observed easily by changing the display position (memory address) on the CRT (2K-word/CH).

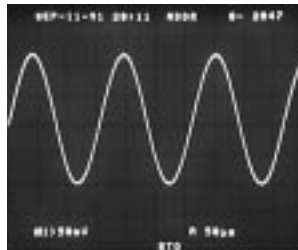
DCS-9000 SERIES DIGITAL STORAGE OSCILLOSCOPES

# DIGITAL STORAGE OSCILLOSCOPES

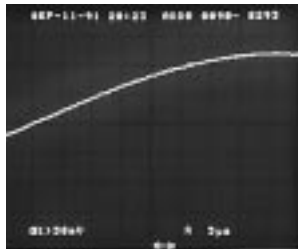
## Data compression, data magnification



Compressed



Normal



Expanded

By varying the sweep rate while the data is held, data can be compressed to 1/10 (when the memory is set to 16K-word) or magnified to x100. This widens the range of observation of the stored data.

From high-speed phenomena to ultra low-speed phenomena The sampling rate for digital storage can be set in a very wide range from 2  $\mu$ s/div to 500 s/div (5  $\mu$ s/div to 500 s/div with the DCS-9100 and DCS-9120), making it possible to observe from very high-speed to ultra low-speed phenomena. Sampling is also possible during delayed sweep so complicated waveforms can be observed easily.

## 80-div pre-triggering, 10,000-div post-triggering

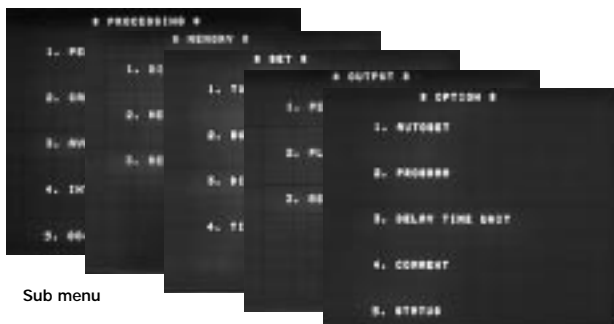
Wide range of triggering during storage can be set, including the 80-division pre-triggering and 10,000-division post-triggering as well as the normal triggering and delayed-sweep triggering. This has made it possible to observe phenomena which used to be impossible to observe.

## Digital storage with simple operation



Main menu

The real-time oscilloscope function and the digital storage oscilloscope function can be switched simply by using the mode switch. The storage function can be set with an almost identical feel to the real-time oscilloscope setting so the handling of the digital storage function is easy.



Sub menu

## Setup display



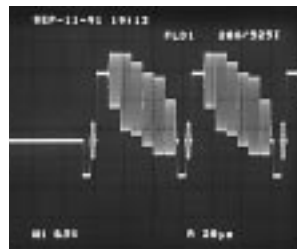
The current setup can be displayed as a list on the CRT.

## Convenient auto-setup



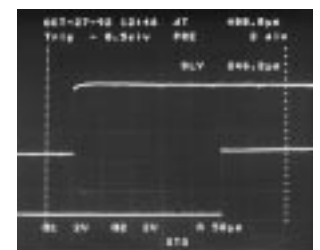
The auto-setup function is capable of specifying the number of waveform peaks and the amplitude displayed on the CRT so the measurement condition can be set quickly according to the target of observation.

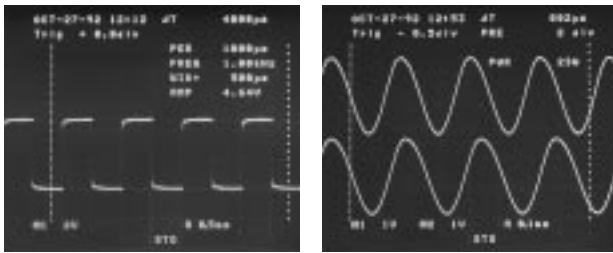
## TV line selector



The TV line selector function enables detailed observations of the horizontal signals in a video signal.

## Parameter function (automatic computation)





(1) The menu screen allows to select arbitrarily the desired 4 items among the 14 items.

(2) The results of computations of the selected 4 items are displayed on the CRT.

**【Period】** Measures the period of the waveform inside the cursor area.

**【Frequency】** Measures the frequency of the waveform inside the cursor area.

**【Pulse duration】** Measures the duration of the first pulse (in either the positive direction or negative direction) seen from the left cursor in the cursor area.

**【Rise time】** Measures the first rise time seen from the left cursor in the cursor area.

**【Fall time】** Measures the first fall time seen from the left cursor in the cursor area.

**【Delay time】** Measures the time difference of the selected waveform in the cursor area.

**【Overshoot】** Measures the overshoot in the cursor area and displays the overshoot value in percentage.

**【Undershoot】** Measures the undershoot in the cursor area and displays the undershoot value in percentage.

**【Peak to peak】** Measures difference between maximum value and minimum value between the cursors.

**【RMS value】** Measures the RMS voltage in the cursor area.

**【Top level】** Measures the flatness point level above the center.

**【Base level】** Measures the flatness point level below the center.

**【Amplitude】** Measures the difference between the top level and base level in the cursor area.

**【Power】** Measures the average power in the cursor area.

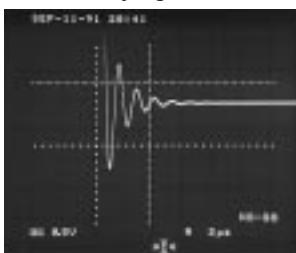
#### Trigger counter



to the clock, etc.

The trigger counter is a powerful function for observation of waveforms including logical waveforms. The possibility of delayed sweep by counting an arbitrarily selected trigger point for the main sweep makes it possible to observe the timing of a digital circuit with respect

#### GO/NO-GO judgment

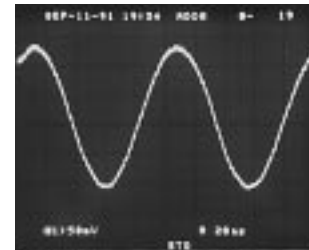


The GO/NO-GO judgment can be applied to a set range and the TTL-level external output and the built-in buzzer are driven according to the result.

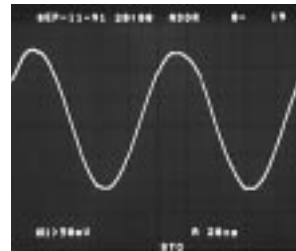
#### Variety of interpolation functions



No interpolation



Sign interpolation



Spline interpolation

The data interpolation functions provides the selection of the linear, sine and spline interpolation functions so that the waveform reproducibility during magnification can be assured.

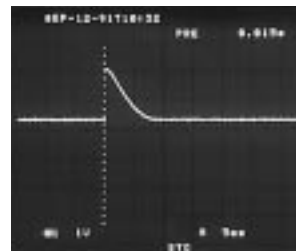
#### Four arithmetic computations of data

The waveforms of CH1 and CH2 or CH3 and CH4 can be computed with the  $+$ ,  $-$ ,  $\times$  and  $\div$  arithmetic operations and the results can be displayed in the form of waveforms. In doing this, by saving the CH1 and CH2 or CH3 and CH4 waveforms in the reference memory, it is also possible to display both the original waveforms and computed waveforms on the CRT.

#### Glitch detection

With the peak detection function, abnormal power spikes can be monitored.

#### Time stamping



In the single-sweep mode, the single-shot phenomenon after waiting can be recorded together with the time it is swept, thereby making possible unattended observations of irregular signals.

#### Comment display

The comment editor function allows you to write desired characters on the CRT screen. It is also possible to write and recall 10 kinds of statements.

#### Storage of high-speed, repetitive phenomena

The equivalent time sampling based on random sampling with pre-triggering capability enables storage of high-speed, repetitive phenomena.

# DIGITAL STORAGE OSCILLOSCOPES

## X-Y mode with X-axis input selection possibility



In both the real-time oscilloscope and digital storage oscilloscope modes, the X axis of the X-Y mode can be selected by the user.

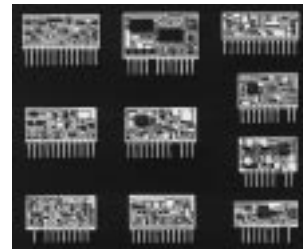
## GP-IB and RS-232C provided as standard

The GP-IB interface which allows the panel control as well as data transfer and the RS-232C interface in compliance with the HP-GL for the plotter are provided as standard.

## High $\pm 2\%$ accuracy for more correct measurements

To allow reliable measurements, accuracy of  $\pm 2\%$  is guaranteed for the major specifications including the vertical axis sensitivity and sweep rate under environments with a temperature from 10 to 35(°)C and humidity of below 85%. Other specifications are also guaranteed at the rated values.

## KENWOOD-developed ICs for drastic improvement in reliability



## Pen output provided as standard

The X-axis and Y-axis outputs for a pen recorder are provided as standard.

## High-performance CPU deserving the high functionality

## SPECIFICATIONS

The DCS-9320 and DCS-9120 have 2-channel storage.

Figures inside [ ] are the values for the DCS-9320 and DCS-9120; all other values are common.

### [Real-time section]

#### CRT

Type ..... 150mm rectangular, with internal graticule

Accelerating voltage ..... Approx. 17kV

Effective area ..... 8div.  $\times$  10div. (1div = 10mm)

Vertical axis (Common for CH1,CH2,CH3 & CH4)

Operating modes ..... CH1, CH2, CH3, CH4, ADD, ALT, CHOP

Sensitivity ..... 5mV/div to 5V/div  $\pm 2\%$

1mV/div to 2mV/div  $\pm 4\%$

Attenuator ..... 1mV/div to 5V/div, 1-2-5 step, (fine adjustment)

Input impedance ..... 1M  $\pm 1\%$ , 23pF  $\pm 3pF$

#### Frequency response

DC ..... DC to 100MHz (-3dB), (5mV/div to 5V/div)  
DC to 20MHz (-3dB), (1mV/div, 2mV/div)

AC ..... 5Hz to 100MHz (-3dB), (5mV/div to 5V/div)  
5Hz to 20MHz (-3dB), (1mV/div, 2mV/div)

Rise time ..... Approx. 3.5ns (5mV/div to 5V/div)

Approx. 17.5ns (1mV/div, 2mV/div)

Signal delay time ..... Over 10ns (display delay)

Crosstalk ..... Below -40dB (at 1kHz sine wave)

Polarity inversion ..... CH2, CH4

Frequency response limit ..... Approx. 20MHz, -3dB

Chopping frequency ..... Approx. 500kHz

CH to CH delay difference ..... CH1 to CH4 : 0.5ns max.

Maximum undistorted amplitude ..... 8div min (DC to 100MHz)

Maximum input voltage ..... 800Vp-p or 400V (DC + ACpeak)

#### Horizontal axis

Operating modes ..... Horizontal mode set to X - Y ,

Y axis : CH1 to CH4 and ADD

X axis : Select by trigger sources

(CH1 to CH4)

Sensitivity ..... Same as vertical axis

Input impedance ..... Same as vertical axis

#### Frequency response

DC ..... DC to 2MHz, within -3dB

AC ..... 5Hz to 2MHz, within -3dB

X-Y phase difference ..... Below 3 degrees at 100kHz

Maximum input voltage ..... Same as vertical axis

#### Sweep

Sweep modes ..... A sweep, B sweep

#### Sweep time

A ..... 20ns/div to 0.5s/div  $\pm 2\%$ , in 1-2-5 steps, 23 ranges and fine adjustment

B ..... 20ns/div. to 50ms/div.  $\pm 2\%$ , in 1-2-5 steps, 20ranges

Magnified sweep .....  $\times 10 \pm 5\%$  (A and B)

Linearity .....  $\pm 3\%$  (at  $\times 10MAG$ ,  $\pm 5\%$ )

Delay method ..... Continuous delay, Synced delay and trigger count

Delay time accuracy ..... Continuous delay, Synced delay

0.2 to 10 times of A SWEEP

TIME/DIV (5,000 counts f.s.)

Delay time accuracy .....  $\pm (2\% \text{ of set value} + 1\% \text{ of f.s.}) + (0 \text{ to } 100\text{ns})$

Delay jitter ..... 20,000 : 1

Hold off ..... A sweep : Continuously variable from NORM

## DCS-9000 SERIES

- Trace separation ..... B separation from A is continuously adjustable to approx.  $\pm 4$  div.
- Trigger count ..... 1 to 2,000 counts,  
maximum frequency : 10MHz
- Triggering
- Trigger sources ..... V.MODE, CH1, CH2, CH3, CH4, LINE
- A-Trigger modes ..... AUTO, NORM, SINGLE, FIX
- Trigger coupling ..... AC, HFrej, DC, TV-F1, TV-F2, TV-LINE
- Trigger sources ..... B STARTS AFTER DELAY TIME  
B TRIG ' D AFTER DELAY TIME  
Trigger count

## Trigger sensitivity

Sync instruction	Synced frequency range	Min. triggering amplitude
DC	DC to 50MHz	1 div.
	DC to 100MHz	1.5 div.
AC	20Hz to 50MHz	1 div.
	20Hz to 100MHz	1.5 div.
HFrej	Minimum triggering amplitude increases above 10kHz.	
TV	1.0 div.	

AUTO : The above specifications apply at 50Hz & above.

FIX : The above specifications apply at 40Hz & above.

- Jitter ..... 0.5ns or less ( 100MHz sine wave ,2ns/div )
- Calibration voltage ..... 1Vp-p  $\pm 1\%$  (positive polarity, 1kHz  $\pm 3\%$ , square wave)
- Intensity modulation
- Input voltage ..... TTL level (2Vp-p or more) (goes off as positive polarity)
- Input impedance ..... Approx.10k
- Frequency response ..... DC to 10MHz
- Maximum input voltage ..... 50V (DC + AC peak)
- Trace rotation ..... Enables trace rotation adjustment by the knob.

## [Storage section]

- Vertical axis (common to CH1, CH2, CH3 and CH4)
- Vertical resolution ..... 8bit (25dots/div.)
- Dynamic range .....  $\pm 5$ div.
- Effective storage frequency range (sine interpolation)
- DC ..... DC to 40MHz [16MHz] (5mV/div to 5V/div.)  
DC to 20MHz [16MHz] (1mV/div, 2mV/div.)
- AC ..... 5Hz to 40 MHz [16MHz] (5mV/div to 5V/div.)  
5Hz to 20 MHz [16MHz] (1mV/div, 2mV/div.)
- Equivalent sampling
- DC ..... DC to 100MHz, within - 3dB (5mV/div to 5V/div.)  
DC to 20MHz, within - 3dB (1mV/div, 2mV/div.)
- AC ..... 5Hz to 100MHz, within - 3dB (5mV/div to 5V/div.)  
5Hz to 20MHz, within - 3dB (1mV/div, 2mV/div.)
- Rise time ..... Effective rise time : below 16ns  
[40ns] (With linear interpolation)  
At equivalent sampling : approx. 3.5ns

## Memory capacity

- NORM sampling
- Display memory (data) ..... 2KW/CH ( 200dot/div. )
- Display memory (REF) ..... 2KW/CH
- Acquisition memory ..... 16KW/CH
- REF memory ..... 16KW/CH

- Equivalent sampling
- Display memory (data) ..... 2KW/CH ( 200 dot/div. )
- Display memory (REF) ..... 2KW/CH
- Acquisition memory ..... 2KW/CH
- REF memory ..... 2KW/CH
- Roll mode
- Display memory (data) ..... 2KW/CH (200 dot/div.)
- Display memory (REF) ..... 2KW/CH
- Acquisition memory ..... 16KW/CH
- REF memory ..... 16KW/CH
- Memory backup ..... Battery backed up for approx. 30,000 hrs.  
(at normal temperature)
- REF memory ..... 16KW/CH
- Sweep time • Display mode
- NORM sampling ..... 20ns [50ns]/div. to 500s/div. (20ns [50ns]/div. to 1 $\mu$ s [2 $\mu$ s]/div. in the MAG range)  
(Maximum sampling rate : 100MS/s [40MS/s])
- Peak detector ..... 10 $\mu$ s/div. to 500s/div.
- Equivalent sampling ..... 20ns/div. to 1 $\mu$ s [ 2 $\mu$ s ] /div.
- Roll mode ..... 0.2s/div. to 500s/div.
- Storage mode
- AUTO ..... Same operation as NORM for the same period, free-running data updating in other cases.
- NORM ..... Data updated each time a trigger is received.
- SINGLE ..... Data is held after storage
- AVG (Averaging) ..... Average of 2, 4, 8, 16, 32, 64, 128, 256 times
- SMT (Smoothing) ..... Eliminates noise by computation at one-time fetching of waveform  
Expansion
- PEAK DETECTOR ..... Detection of glitches as short as 50 ns.
- ROLL ..... Continuous display and updating of data on the CRT.
- Equivalent sampling ..... Random type
- Memory split ..... 2Kword  $\times$  8/CH
- Magnification, Compression
- Magnification ..... Data (up to 100 times around screen's center point) by setting a sweep time for SWEEP TIME/DIV faster than the current sweep time under Hold conditions.
- Compression ..... Compressed data (down to 1/10 size in screen's start direction up to screen 8div.) by setting a sweep time for SWEEP TIME/DIV slower than the current sweep time under Hold conditions.
- Interpolation ..... Linear interpolation, sign interpolation, and spline interpolation
- Trigger
- Pre-trigger ..... 0 to 80div (time or div display for each 1div. setting) (0 to 10div. when setting memory 2kw)
- Post-trigger ..... 0 to 10,000div (time or div display for each 1div setting)
- Usage of B triggering ..... B STARTS AFTER DELAY TIME  
B TRIG'D AFTER DELAY TIME  
Trigger count : 1 ~ 2,000 counts

# DIGITAL STORAGE OSCILLOSCOPES

## X - Y

Effective storage frequency range (sine interpolation)

DC	DC to 40MHz [16MHz] (5mV/div to 5V/div.)
AC	DC to 20MHz [16MHz] (1mV/div, 2mV/div.) 5Hz to 40MHz [16MHz] (5mV/div to 5V/div.) 5Hz to 20MHz [16MHz] (1mV/div, 2mV/div.)

Adjustable sampling speed for the SWEEP TIME /DIV.

Equivalent sampling frequency range

DC	DC to 100MHz, within - 3dB(5mV/div to 5V/div.) DC to 20MHz, within - 3dB (1mV/div, 2mV/div.)
AC	5Hz to 100MHz, within - 3dB (5mV/div to 5V/div.) 5Hz to 20MHz, within - 3dB(1mV/div, 2mV/div.)

## Other

Waveform calculation ..... +, -, x, ÷ (calculated between CH1 & CH2 and CH3 & CH4)

GO/NO - GO ..... Determined in the range of conditions set with the cursor (output terminal on rear panel)

Decision accuracy ..... Within ± 0.5 div of range of conditions set with the cursor

AUTO SET ..... Autorange setting according to input waveform (operates also in real time)

Operating modes ..... Vertical only; horizontal only; both vertical and horizontal

Operating range ..... 2mVp-p ~ 40Vp-p 50Hz ~ 5MHz (at FIX period available range)

PEN OUT (display hard copy)

Y-axis output ..... - 0.5V/div ± 5%

X-axis output ..... - 0.5V/div ± 5%

PEN LIFT ..... TTL level, "L" at PEN DOWN

Output impedance ..... X-axis, Y-axis : approx. 2kΩ  
PEN LIFT : approx. 100Ω

Read out speed ..... 10ms, 50ms, 100ms, 500ms/word

PLOT OUT (display hard copy)

Usage of RS-232C

Output ..... RS-232C HP-GL command (compatible with A3-size or smaller HP-GL command plotter); data transmission only

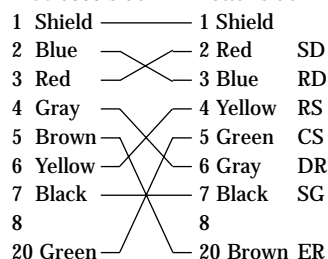
Baud rate ..... 9600/4800/2400/1200 bps

Transfer type ..... Data length = 7/8bit, Settable parity, stop bit = 2bit fixed, hardware handshake

## Signal

FG( Frame Ground )	Frame ground	
SD( Send Data )	Send data	Plotter
RD( Receive Data )	Receive data	Plotter
RS( Request to Send )	Request to send	Plotter
CS( Clear to Send )	Clear to send	Plotter
DR( Data Set Ready )	Data set ready	Plotter
ER( Data Terminal Ready )	Data terminal ready	Plotter
SG( Signal Ground )	Signal ground	

Connections ..... DCS-9000 side Plotter side



## Usage of GP-IB

Output ..... HP-GL Command (Compatible with HP-GL command plotter made by Epson Co., Ltd.)

## [Readout section]

Calendar

Display ..... Year / month / day / hour / minute

Clock accuracy ..... ± 2 minutes/month

Battery life ..... Approx. 30,000 hours (at room temperature)

Trigger time stamp ..... Time display at trigger input in storage mode (during single sweep)

## Setting values

Vertical axis related items ..... CH1 to CH4 scale factors (with probe detector), GND, AD/DC, V-UNCAL, ADD, INVERT, BW

Horizontal axis related items ..... (A, B) sweep scale factor (MAG conversion), SWEEP VARIABLE, UNCAL X-Y (displays CH selected by trigger source)

Trigger-related items ..... Delay time, trigger count, trigger level, TV line number

Storage related items ..... Sampling speed during X-Y display  
Waveform calculation (+, -, x, ÷), calculated CH designation (CH1 to CH4)

Display scroll, average number of times setting

Trigger point (pre-trigger, post-trigger) display

Equivalent sampling, roll, REF MEMORY setting conditions

Other ..... Autostep display, trigger time stamp display, SRQ, comment display (10-screen portion)

## Cursor measurement

Cursor modes ..... ΔV1, ΔV2, ΔV3, ΔV4, ΔT, 1/ΔT, RATIO, PHASE

Tracking ..... Δcursor is engaged in ΔREF cursor operation

Measuring resolution ..... 10bit

Measuring accuracy ..... ± 3%

Measurement range

Vertical direction ..... ± 3.6div or more from center of CRT

Horizontal direction ..... ± 4.6div or more from center of CRT

## [Other functions]

Program

Range ..... All panel switches and volumes except focus, astig scale illumination, rotation.

Step operation ..... With front panel SET switch and rear panel program step terminal

Number of step ..... 100 steps

## [Power source section]

Line voltage ..... AC90V to 250V (two steps), 48 to 440Hz

Power consumption ..... Max. 130W

## 【Other】

### Dimensions and Weight

Case dimensions ..... 310(W) × 150(H) × 460(D) mm

Maximum dimensions ..... 350(W) × 163(H) × 515(D) mm

Weight ..... Approx. 9kg

## DCS-9000 SERIES

## Temperature/humidity for operation

Temperature/humidity for ..... 10 to 35 , 85% or less (without characteristics in spec. condensation)

Temperature/humidity for ..... 0 to 50 , 85% or less (without operation condensation)

## Accessories

Probe ..... PC-51 (4) (Readout capability)

Power cable ..... (1)

Instruction manual ..... (1)

## [Interface]

GP-IB (complies with IEEE-488-1978)

Operation ..... Waveform data input/output, plotter output, panel data output and control

Command ..... 69 types

## Data control

Waveform data ..... 8bit (Same as storage section)

Cursor data ..... 10bit (Same as readout section)

Analog control data .....  $\pm 0.5$  div ("div." display section) (% display part not stipulated)

RS-232C EIA Standard (plot out only; refer to PLOT OUT items)

## [External trigger (factory option)]

Input level ..... TTL level, 50Hz to 100MHz

DCS-9300/9320/[9100]/[9120] common (but storage part of DCS-9320/9120 is 2 channels)

Ratings may change without prior notice, subject to technical developments.

Since this product comes under military materials (or duties) as determined in the Foreign Exchange and Foreign Trade Control Act, an export license based on the same Act is required for export of the product.