KENWOOD

PROGRAMMABLE DIGITAL
STORAGE OSCILLOSCOPE

DCS-9300
DCS-9100
DCS-9320
DCS-9120

INSTRUCTION MANUAL

KENWOOD CORPORATION

SAFETY

Simbol in This Manual
⚠ This symbol indicates where applicable cautionary or other imformation is to be found.

Power Source
This equipment operates from a power source that does not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product
This equipment is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the equipment input or output terminals.

Use the Proper Power Cord
Use only the power cord and connector specified for your product.

Use the Proper Fuse
To avoid fire hazard, use a fuse of the correct type.

Do not Operate in Explosive Atmospheres
To avoid explosion, do not operate this product in an explosive atmosphere.

Do not Remove Cover or Panel
To avoid personal injury, do not remove the cover or panel. Refer servicing to qualified personnel.

Voltage Conversion
If the power source is not applied to your product, contact your dealer. To avoid electrical shock, do not perform the voltage conversion.

＊ There are items in this manual that are indicated by a ⚠ mark.
   This mark is used to indicate items with which caution must be used to protect the safety of the customer
   using this instrument, and to prevent damage or destruction of the instrument.
   Please read the manual carefully, and use this instrument correctly.

ABOUT THE INSTRUCTION MANUAL

This instruction manual covers the four models, DCS-9300, DCS-9100, DCS-9320, and DCS-9120.
These models are same with the following exceptions:

	REAL	STORAGE		
	Channel display	Channel display	Sampling speed	Equivalent sampling range
DCS-9300	4CH	4CH simultaneous	100MS/s	20ns~1μs/div
DCS-9320	4CH	2CH simultaneous	100MS/s	20ns~1μs/div
DCS-9100	4CH	4CH simultaneous	40MS/s	50ns~2μs/div
DCS-9120	4CH	2CH simultaneous	40MS/s	50ns~2μs/div

This manual uses the following symbols:

① Descriptions in < > apply to the DCS-9320 and DCS-9120 in contrast to the DCS-9300 and DCS-9100.

② Descriptions in [ ] apply to the DCS-9100 and DCS-9120 in contrast to the DCS-9300 and DCS-9320.

Please read the descriptions that apply to your model.

CONTENTS

1. FEATURES

The DCS series are a 4-trace simultaneous sampling digital storage oscilloscope featuring the bandwidth of 100MHz, maximum sampling speed of 10ns per word [25ns per word], and storage capacity of 8bits×16000 words per channel.

It offers easy-to-use switch layout on the panel, menu-driven operations and free-setting 100-step programming for simple waveform storage and observation, which have been complicated.

As an ordinary oscilloscope, it has a wide bandwidth ranging from DC to 100MHz and full-range attenuators in 4 channels for furthered multi-trace observation efficiency.
The readout function displays switch settings and other various set data on the CRT. Thus, the user may check the operating conditions on the CRT at any time.
In addition, the DCS-9300 [DCS-9100] is capable of external control via the GP-IB interface and data output to a pen recorder and pen plotter.

1. The maximum sampling speed of 10ns per word [25ns per word] (4-channel simultaneous sampling) enables high-speed waveform observation of once-only events, transient events, sudden events, etc. in multi-traces. <The DCS-9320/9120 provide simultaneous sampling for two channels.>

2. The waveform storage has 16K-word data memory per channel. The reference waveform storage also has 16K-word memory per channel. Each memory may be used as a 2K-word memory or may be divided into eight 2K-word areas for memory setting ideal for applications.

3. The ordinary real-time oscilloscope may be switched into a digital storage oscilloscope with a mode selector switch easily. The storage oscilloscope functions may be used easily in the same manner as the real-time oscilloscope functions.

4. The digital storage sampling speed is variable between 10ns per word [25ns per word] and 2.5s per word (2μs/division [5μs/div.] to 500s/division) for a wide range of observations from high-speed to ultra-low-speed phenomena. Sampling is also possible during delayed sweep. Thus, complicated waveform may be measured easily.

5. Independent full-range attenuators provided for 4 channels enable true 4-channel trace observation free from voltage range restrictions, which have been placed on channels with external trigger signals.

6. The TV-LINE triggering line selector function allows precise measurement of horizontal video signals.

7. A wide range of triggering selection for storage operations; Normal triggering, delayed sweep triggering, pre-triggering of 80 divisions, and post-triggering of 10000 divisions. With this feature, phenomena which have been beyond measurement can be observed.

8. Pre-triggerable random equivalent sampling enables phenomena repeating at high speed to be stored.
   At low speed, the roll sweep function offers continuous waveform observation at all time.

9. The automatic range function allows to specify the number of wave crests and amplitude for speedy setting in accordance with measurement applications.

10. 100 steps (20×5) set by the user may be stored through panel operation. Setting suitable for measurement condition can be reproduced easily and accurately for convenience for periodical measurement sequences.

11. Menu-driven operations using function keys for efficient control of various functions. Preliminary settings may be handled on the menu to reduce troublesome startup procedures.

12. Digital storage data may be output to an analog pen recorder, digital plotter (compliant with the HP-GL) through the GP-IB or RS-232C, computer through the GP-IB, etc.

13. The GP-IB interface is provided as standard for external control.

14. The X-Y mode capable of X-axis selection may be used in both the real-time and storage operations.

15. With the peak hold function by detecting glitches of 50ns wide, abnormal spikes, etc. in the power supply may be monitored.

16. Triggering time storage display (TRIG. TIME STAMP) allows no-manned measurement of once-only events.

17. Any four of fourteen automatic waveform parameter measurement items such as the amplitude, rise time, fall time, effective voltage, average power, etc. may be selected and displayed on the screen. (In the storage mode)

18. GO/NO-GO judgment is possible in a preset range. (at storage mode operation)

19. Easy-to-operate cursor measurement using tracking and two knobs offers efficient waveform measurement.

20. The data interpolation secures high resolution for high-speed events. In addition, inter-channel operation allows power calculation, etc.

21. The display address function enables all the data in the memory to be observed. (Data display address is variable.)

22. In data holding, data may be contracted up to 1/10 or magnified up to 100 magnifications for wide range of analysis of measured data.

2. SPECIFICATIONS

【Real-Time Oscilloscope Section】

CRT	
Type Acceleration voltage Display area	150mm rectangular with internal graticule 17kV 8 div. ×10 div. (1 div. =10mm)

Vertical axis (CH1, CH2, CH3 & CH4)	
Sensitivity	5mV/div. to 5V/div. ±2% (10 to 35℃)
	1mV/div., 2mV/div. ±4% (10 to 35℃)
Attenuator	1mV/div. to 5V/div., 1-2-5 steps, 12 ranges, ranges fine-adjustable
Input impedance	1MΩ±1%, 23pF±3pF
Frequency response 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	3.5ns or less (5mV/div. to 5V/div.)
	17.5ns or less (1mV/div., 2mV/div.)
Signal delay time	10ns or more (Delay time on CRT screen)
Cross-talk	-40 dB or less (with 1kHz sine wave input)
Operation modes CH1 :	CH1 single-trace and 2- to 4-trace display combined with other channel (s)
CH2 :	CH2 single-trace and 2- to 4-trace display combined with other channel (s)
CH3 :	CH3 single-trace and 2- to 4-trace display combined with other channel (s)
CH4 :	CH4 single-trace and 2- to 4-trace display combined with other channel (s)
ADD :	CH1 + (±CH2) or CH3 + (±CH4) added waveform and 2- to 4-trace display combination with other channel (s)
ALT :	Alternate method signal display
CHOP:	Chop method signal display
Polarity reversal	Applicable to CH2 and CH4.
Bandwidth limiting	Approx. 20MHz -3dB
Chopping frequency	Approx. 500kHz
Inter-channel delay time difference	Between CH1 and CH4: 0.5ns or less
Max. undistorted amplitude	8div. or more (DC to 100MHz)
⚠Max. input withstand voltage	800Vp-p or 400V (DC+AC peak)

Horizontal axis	
Operation modes	X-Y mode is switched with HORIZONTAL MODE.
	Y-axis: CH1 to CH4 and ADD
	X-axis: Selectable with trigger source. (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	3° or less at 100kHz
⚠Max. input withstand voltage	Same as vertical axis.

Sweep	
Sweep method A	A sweep
A INT B	Simultaneous intensified B sweep during A sweep
ALT	Alternate A (A INT B) sweep and B sweep
B	B sweep
X-Y	X-Y oscilloscope operation
Sweep time A	20ns/div. to 0.5s/div. ±2% (10 to 35℃), 1-2-5 steps, 23 ranges, ranges fine-adjustable
B	20ns/div. to 50ms/div ±2% (10 to 35℃), 1-2-5 steps, 20 ranges
Sweep magnification	×10±5% (Common to A and B)
Linearity	20ns/div. to 0.5s/div. ±3% (×10MAG: ±5%)
Hold off	A sweep is continuously variable from NORM.
Trace separation	B sweep is continuously variable by approx. ±4 divisions with resp. to A sweep.
Delay method	Continuous delay, trigger delay and trigger count
Delay time	Continuous delay and trigger delay: 0.2 to 10 times as large as A SWEEP TIME/DIV. (Full scale at 5000 counts)
Trigger count	1 to 2000 counts, max. operating frequency: 10MHz
Delay accuracy	± (2% of set value+1% of full scale) + (0 to 100ns)
Delay jitter	20000: 1 or less

Triggering	
A trigger modes	AUTO, NORM, SINGLE & FIX
Trigger sources V MODE	Triggered by input signal of lowest-number channel selected for vertical axis mode.
CH1	Triggered by CH1 vertical axis input signal.
CH2	Triggered by CH2 vertical axis input signal.
CH3	Triggered by CH3 vertical axis input signal.
CH4	Triggered by CH4 vertical axis input signal.
LINE	Triggered by commercial supply frequency.
Trigger coupling	AC, HF$_{REF}$ DC, TV-F1, TV-F2, TV-LINE
Trigger level	Variable by ±90° with controller.
Polarity	Positive and negative
B trigger source	B starts after delay time
	B triggered after delay time

Trigger sensitivity	Trigger count	
coupling		
DC	Frequency range	Minimum sync amplitude
	DC to 50MHz	1 div.
	DC to 100MHz	1.5 div.
AC	20Hz to 50MHz	1 div.
	20Hz to 100MHz	1.5 div.
HF$_{REJ}$	Increased minimum sync amplitude for above 10kHz.	
TV F1	1.0 div.	
TV F2	1.0 div.	
TV LINE	1.0 div.	
	AUTO: Same as above specification for above 50Hz.	
	FIX : Same as above specification for above 40Hz.	
Jitter	0.5ns or less at 100MHz at 2ns/div. sweep rate (×10MAG on)	

Intensity modulation	

Input voltage	Disappears at TTL-level positive voltage (2Vp-p or more).
Input impedance	10kΩ or more
Frequency range	DC to 10MHz
⚠Max. input withstand voltage	50V (DC+AC peak)

Others	

Program	Program mode (Storing and executing on-panel set values)
Programming range	Switches and controllers on panel, excluding power switch and CRT-related controls (Except for the HOLD switch)
Number of steps	20 steps×5 (groups)
Step setting	With SET switch on front panel and program step terminals on rear panel
Trace rotation	Trace angle is adjustable with controller.
Calibration voltage	1Vp-p±1% (Positive polarity, 1 kHz±3%, square wave)

【Storage Section】

Vertical axes (CH1, CH2, CH3 & CH4) <For the DCS-9320/9120, storage channels are only CH1 and CH2.>		
Vertical resolution	8bits (25 dots/div.)	
Dynamic range	±5 div.	
Frequency response	DC	Effective storage frequency: DC to 40MHz [16MHz] (Sine interpolation)
	AC	Effective storage frequency: 5Hz to 40MHz [16MHz] (Sine interpolation)
Equivalent sampling	DC	DC to 100MHz, within -3dB (5mV/div. to 5V/div.)
		DC to 20MHz, within -3dB (1mV/div., 2mV/div.)
	AC	5 Hz to 100MHz, within -3dB (5mV/div. to 5V/div.)
		5 Hz to 20MHz, within -3dB (1mV/div., 2mV/div.)
Rise time		Effective rise time: 16ns [40ns] or less (Linear interpolation)

Memory capacity (Memory capacity used in each mode)	
NORM sampling	Display memory (for data) 2K words/channel (200 dots/div.) Display memory (for REF) 2K words/channel Acquisition memory 16K words/channel REF memory 16K words/channel
Equivalent sampling	Display memory (for data) 2K words/channel (200 dots/div.) Display memory (for REF) 2K words/channel Acquisition memory 2K words/channel REF memory 2K words/channel
Roll mode	Display memory (for data) 2K words/channel (200 dots/div.) Display memory (for REF) 2K words/channel Acquisition memory 16K words/channel REF memory 16K words/channel
Memory backup	Backed up by battery for approx. 30000 hours (at room temp.) REF memory 16K words/channel

Sweep time and display mode

NORM sampling	20ns/div. to 500s/div. (Magnification range: 20ns/div. 1ns [2ns]/div.) (Max. sampling speed: 100Ms/s [40Ms/s])
Peak detector	10μs/div to 500s/div
Equivalent sampling	20ns/div to 1μs [2μs]/div
Roll mode	0.2s/div to 500s/div

Storage method

NORM	Data is updated every time trigger is input.
SINGLE	Saves data after storage.
AVG	Average by adding 2, 4, 8, 16, 32, 64, 128 and 256 times
PEAK	Detects glitch of width up to 50ns.
ROLL	Records and updates data continuously on CRT.
Equivalent sampling	Random
Memory size	2K words/CH, 16K words/CH, 2K words×8/channel

Magnification and contraction

Magnification	Data is magnified by setting SWEEP TIME/DIV faster than current sweep time in hold state. (Magnified up to ×100 away from the screen center.)
Contraction	Data is contracted by setting SWEEP TIME/DIV slower than current sweep time in hold state. (Contracted down to 1/10, or 8 div on screen, toward the start point on the screen; down to 50 ms in B sweep.)
Interpolation	Linear interpolation, sine interpolation and spline interpolation

Triggering

Pre-trigger	0 to 80 div. (1-division-step setting, div. display or time display) 0 to 10 div. (when MEMORY SIZE menu is set to 2k)
Post-trigger	0 to 10000 div. (1-division-step setting, div. display or time display)

B trigger	B starts after delay time
	B triggered after delay time
	Trigger count: 1 to 2000 counts

| X-Y | |

| NORM | DC to 40MHz [16MHz] (Sampling speed is adjustable with SWEEP TIME/DIV.) |
| Equivalent sampling | DC to 100MHz |

| Others | |

Waveform operation	+, −, ×, ÷ (CH1-CH2 and CH3-CH4 operation)
GO/NO-GO	Judged in cursor-set condition range. (Output terminal on rear panel)
Judgment error	Cursor-set condition range within ±0.5 divisions
AUTO SET	Automatic range setting in accordance with input waveform. (Auto set operation is possible in the real-time mode)
Operation mode	Vertical only, horizontal only, and both vertical and horizontal
Set value	Vertical (peak value): 2 div (1 to 3 div), 4 div (2 to 4 div)
	Horizontal (cycle) : 2 div (1 to 3 cycles), 4 div (3 to 7 cycles)
Operation range	2mVp-p to 40Vp-p, 50Hz to 5MHz (Range where fix triggering is possible)

| PEN OUT (Hard copy of CRT screen) | |

Y-axis output voltage	0.5V/div ±5%
X-axis output voltage	0.5V/div ±5%
Pen lift	TTL-level; Low level during pen down motion
Output impedance	X- and Y-axis: Approx. 2kΩ
	Pen lift : TTL OUT
Readout speed	10ms, 50ms, 100ms & 500ms/word

| PLOT OUT (Hard copy of CRT screen) | |

Through RS-232C	
Output	Via RS-232C using HP-GL command, data transfer only,
	RS-232C/GP-IB selection is allowed (with the DIP switches on the rear panel.)
Baud rate	9600/4800/2400/1200 bps
Transmission format	Data length: 7/8 bits, parity setting is possible,
	stop bits: fixed to 2 bits, hardware hand shake
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
	(Request to send from plotter)
	ER (Data Terminal Ready) Data terminal ready → Plotter
	(Permission to send from plotter)
	SG (Signal Ground) Signal ground

Connection	DCS-9300 side Plotter side
	1 Shield ——————— Shield 1
	2 Blue ————⟍ ⟋—— Red 2 SD
	3 Red ——⟍ ⟍ ⟋ ⟋—— Blue 3 RD
	4 Gray —— ⟍ ⟋ ⟍ —— Yellow 4 RS
	5 Brown —⟋ ⟍ ⟋ ⟍— Green 5 CS
	6 Yellow⟋ ⟍ ⟋ ⟍— Gray 6 DR
	7 Black ——— ⟍ ⟋ ——— Black 7 SG
	8 – – 8
	20 Green —⟋ ⟍— Brown 20 ER
Through GP-IB Output	Via GP-IB using HP-GL command (applicable to HP-GL plotter made by EPSON), talk-only, RS-232C/GP-IB selection is allowed (with the DIP switches on the rear panel).

【Readout Section】

Calendar	
Display Clock accuracy Battery life Trigger time stamp	Year, month, day, o'clock, & minute ±2 minutes/month Approx. 30000 hours (at room temp.) Displays time when trigger is input in storage mode (single sweep).

Set value	
Vertical axis	CH1 to CH4 scale factors (with probe detection), GND, AC/DC, V-UNCAL, ADD, INVERT, BW
Horizontal axis	(A, B) sweep scale factors (magnification conversion), SWEEP VARIABLE UNCAL, X-Y (Channel selected as trigger source is displayed.)
Trigger	Delay time and trigger count
Storage	Sampling speed in X-Y display mode, waveform operation (+, −, ×, ÷), operation channel specification (CH1 to CH4) <For the DCS-9320/9120, storage channels are only CH1 and CH2>, display scroll, average number setting, trigger point display (pre-trigger, post-trigger), equivalent sampling, roll, REF memory set conditions
Others	Auto step display, trigger time stamp display, SRQ, comment display (for 10 screens), automatic waveform parameter measurement

Automatic waveform parameter measurement	
PERIOD	Automatic measurement of period of trigger source waveform
FREQUENCY	Automatic measurement of frequency of trigger source waveform
PULSE WIDTH	Automatic measurement of pulse width of trigger source waveform (Automatic positive/negative selection)
RISE TIME	Automatic measurement of rise time of trigger source waveform
FALL TIME	Automatic measurement of fall time of trigger source waveform
DELAY TIME	Automatic measurement of time difference between trigger source waveform and waveform in channel specified on menu

OVER SHOOT	Over-shoot of trigger source waveform is displayed in percentage based on amplitude
UNDER SHOOT	Under-shoot of trigger source waveform is displayed in percentage based on amplitude
PEAK TO PEAK	Automatic measurement of peak-to-peak voltage of trigger source waveform
VRMS	Automatic measurement of effective voltage of trigger source waveform
TOP LEVEL	Automatic measurement of top level of trigger source waveform
BASE LEVEL	Automatic measurement of base level of trigger source waveform
AMPLITUDE	Automatic measurement of amplitude of trigger source waveform
POWER	Automatic measurement of average power from trigger source voltage waveform and current waveform in channel specified on menu

Cursor measurement	

Cursor modes	ΔV1	Voltage measurement between ΔREF and Δcursor using CH1 scale factor
	ΔV2	Voltage measurement between ΔREF and Δcursor using CH2 scale factor
	ΔV3	Voltage measurement between ΔREF and Δcursor using CH3 scale factor
	ΔV4	Voltage measurement between ΔREF and Δcursor using CH4 scale factor
	ΔV12	Voltage measurement between ΔREF and Δcursor using CH1 or CH2 scale factor (when ADD key is ON state)
	ΔV34	Voltage measurement between ΔREF and Δcursor using CH3 or CH4 scale factor (when ADD key is ON state)
	ΔT	Time difference measurement between ΔREF and Δcursor using sweep scale factor
	1/ΔT	Frequency measurement between ΔREF and Δcursor using sweep scale factor
	RATIO	Voltage ratio and time ratio measurement between ΔREF and Δcursor based on 5 divisions on CRT as 100%
	PHASE	Phase difference measurement between ΔREF and Δcursor based on 5 divisions on CRT as 360°
Tracking		Δcursor links with ΔREF cursor operation.
Measurement resolution		10 bits
Measurement error		±3%
Measurement range		
Vertical		±3.6 divisions or more from CRT center
Horizontal		±4.6 divisions or more from CRT center

【Power Supply Section】

Supply voltage	90 to 250VAC (2 ranges), 48 to 440Hz
Power consumption	Max. approx. 130W

【Other Specifications】

Dimensions and weight (Values enclosed in parentheses include protrusions.)	
Width	310mm (350)
Height	150mm (163)
Depth	460mm (515)
Weight	Approx. 9kg

Operating temperature and humidity	
Within specification temperature	10 to 35℃
Within specification humidity	85% or less
Operating temp. and humid.	0 to 50℃, 85% or less (No dew condensation)

Accessories	

Probes
  Attenuation
  Input impedance
Power cord
Instruction manual
Replacement fuses
	PC-31 4 (Compatible with readout function)
	1/10
	10MΩ±1%, 14pF±10%
	1
	1 copy
	2

【Interface】

GP-IB (Compliant with IEEE-488 1978)	
Operation	Waveform input/output, panel data output and control, (TALK/LISTEN) Outputting data on screen to plotter (GP-IB/talk-only/RS-232C selection is allowed.)
Command	69 commands

Data accuracy
  Waveform data
  Cursor data
  Analog control data
	
	8 bits (Same as storage section.)
	10 bits (Same as readout section.)
	±0.5 div. (Div. display section) (% display section not specified)

RS-232C EIA Standard (Plot out only; Refer to the description on plot out.)

■ The specifications are subject to change without notice.

3. PRECAUTIONS

1. Check the supply voltage before using the DCS-9000 series.
   Two supply voltage ranges are available; 90 to 132V range and 180 to 250V range.
   Select the proper voltage range with the AC power selector switch on the rear panel.
   Improper voltage range selection may cause errors.
   After checking the supply voltage, connect the power cord to the wall socket.
   If the DCS-9000 series is to be used on different voltage, observe the maintenance instructions.

2. Do not use the DCS-9000 series in the following locations or conditions:
   ① Place exposed to the direct sunlight
   ② Hot and moist room
   ③ Room with much mechanical vibrations
   ④ Close to equipment generating strong magnetic force or impulse voltage
   ⑤ In or around a place where explosive gas is produced or stored

3. Do not apply voltage exceeding the maximum withstand voltage to any input terminal.
   ⚠ CH1, CH2, CH3 & CX4 input terminals: 800Vp-p or 400V (DC+AC peak)
   Z AXIS & PROG STEP input terminals: 50V (DC+AC peak)
   Do not apply voltage to any output terminal from outside.

4. Do not increase the intensity unnecessarily. Do not leave the trace line focused to a spot for long.

5. Do not place any object on the set or block the vent hole. Otherwise, inner temperature will increase, causing troubles.

6. High voltage is applied to some parts in the set. Refer to the maintenance instructions before removing the case.

7. Be sure to connect the GND terminal to the earth ground for safety before using this instrument.

8. The PC-31 probe supplied with this instrument has a Readout terminal. Do not use it for an instrument with no Readout terminal. Otherwise, the instrument may be damaged.

9. The calendar and clock have already been adjusted before shipment. If they should be incorrect at the time of purchase, readjust them. (Refer to the maintenance and adjustment instructions.)

10. The calendar, clock and stored data (in the reference memory only) are backed up by a built-in battery.
    If battery is almost dead, "BATT. DOWN" is displayed on the calendar and clock indicators. In addition, panel settings cannot be retained in the power off conditions and reset to the initial values (as shown below). In such a case, the battery should be replaced. For battery replacement, contact your dealer or our distributor.

11. Do not activate and deactivate the POWER switch repeatedly at an interval shorter than 5 seconds.
    Repeated activation and deactivation of the POWER switch may cause malfunctioning. Panel settings are subject to errors caused by disturbing noises. In such a case, deactivate the POWER switch, wait for approx. 5 seconds, then re-activate it. The initial or previous proper panel settings are restored.

Initial Settings

SCOPE MODE ㊱	⋯⋯⋯⋯⋯⋯⋯	Real-time mode
CH1 ㊺	⋯⋯⋯⋯⋯⋯⋯⋯⋯	ON
CH1 VOLTS/DIV ㊼	⋯⋯⋯⋯⋯⋯⋯	50mV/div.
CH1 POSITION ㊻	⋯⋯⋯⋯⋯⋯⋯	Center
CH1 AC/GND/DC ㊾	⋯⋯⋯⋯⋯⋯	AC
H-MODE ㊵	⋯⋯⋯⋯⋯⋯⋯⋯⋯	A
SWEEP TIME/DIV ㊉	⋯⋯⋯⋯⋯⋯	50μs/div.

×10 MAG ㊲	⋯⋯⋯⋯⋯⋯⋯⋯	OFF
TRIG MODE ㉚	⋯⋯⋯⋯⋯⋯⋯	AUTO
SLOPE ㉛	⋯⋯⋯⋯⋯⋯⋯⋯⋯	+
A TRIG COUPLING ㉘	⋯⋯⋯⋯⋯	AC
A TRIG SOURCE ㉗	⋯⋯⋯⋯⋯⋯	VERT (CH1)
CURSOR MODE ⑱	⋯⋯⋯⋯⋯⋯⋯	OFF

4. CONTROLS AND INDICATORS

[A] Front Panel
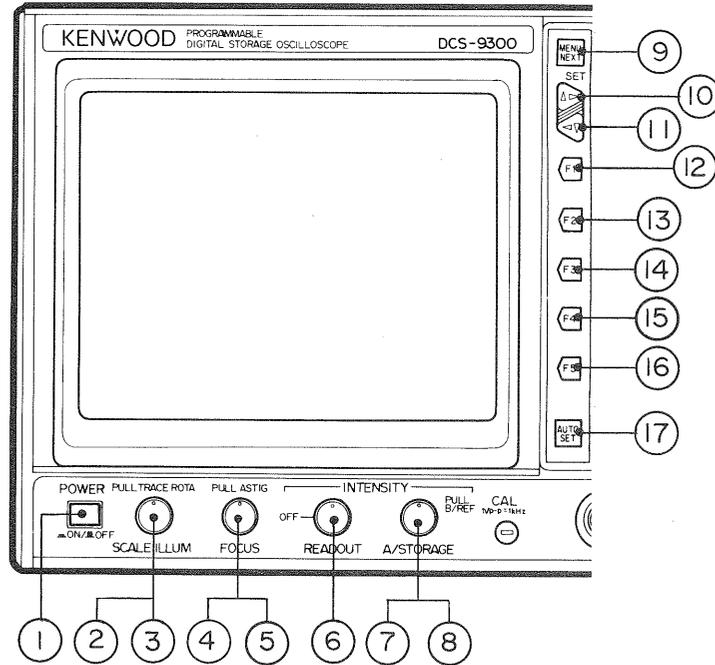
Fig. 1

① **POWER switch**

Press this switch to supply power to this instrument. Press it again to turn off power.
If power is turned on, the previous settings before turning off power are restored. However, if the backup battery has run down, "BATT. DOWN" is displayed and all values are initiate.

② **PULL TRACE ROTA control**

Controls rotation of the trace.
Clockwise rotation of the control turn the trace clockwise.

③ **SCALE ILLUM control**

Controls the scale intensity. Clockwise rotation of the control increases the intensity.

④ **PULL ASTIG control**

Controls the astigmatism.

⑤ **FOCUS control**

Controls the focus.

⑥ **READ OUT INTENSITY control**

Controls the intensity of readout characters.
Clockwise rotation of the control increases the intensity. Full counterclockwise rotation deactivates readout display.

13

⑦ A/STORAGE INTENSITY control

Controls A sweep, storage A sweep and storage B sweep waveform intensity.

Clockwise rotation increases the intensity.

⑧ PULL B/REF INTENSITY control

Controls B sweep, B sweep intensity modulation and storage reference waveform intensity.

Clockwise rotation increases the intensity.

⑨ MENU/NEXT key

Press this key to enter the Menu mode. Press it again to exit the Menu mode. On the menu, this key serves as the Next (or Enter or Return) key.

⑩ ↑→ SET key

Moves the data selection key on the menu.

Not in the cursor measurement mode, it functions as $\triangle$REF clockwise motion.

In cursor measurement, these keys are available for setting purposes in addition to cursor movement.

⑪ ←↓ SET key

Moves the data selection key on the menu.

Not in the cursor measurement mode, it functions as $\triangle$REF counterclockwise motion.

In cursor measurement, these keys are available for setting purposes in addition to cursor movement.

⑫ F1 key

A menu function key

⑬ F2 key

A menu function key

⑭ F3 key

A menu function key

⑮ F4 key

A menu function key

⑯ F5 key

A menu function key

In the hold mode, this key starts data output to the pen recorder and/or plotter.

⑰ AUTO SET button

Sets the vertical axis range and time axis range automatically based on the values set on the menu.
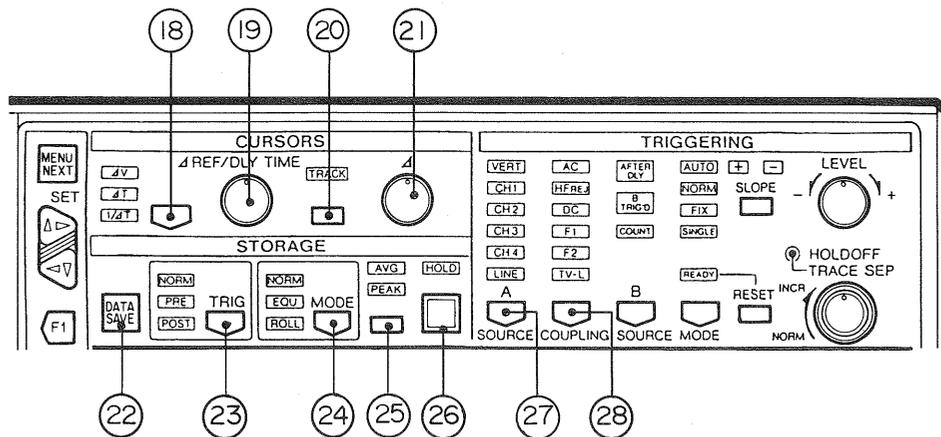
Fig. 2

⑱ **CURSOR MODE** selector

For mode setting, follow the procedure below.

In the REAL mode: OFF→ΔV1→ΔV2→ΔV3→ΔV4→ΔV12→ΔV34→ΔT→1/ΔT→OFF.

In the STORAGE mode: OFF→ΔV1→ΔV2→ΔV3→ΔV4→ΔT→1/ΔT→OFF. <For the DCS-9320/9120, ΔV3 and ΔV4 are not available in cursor mode.>

In the ADD state of the STORAGE mode: OFF→ΔV12→ΔV34→ΔT→1/ΔT→OFF. <For the DCS-9320/9120, ΔV34 is not available in cursor mode.>

(ΔVx may be selected for the channel (s) selected with the V-MODE.)

ΔVx : Potential difference in CH1 to CH4 is measured using two cursors.

A value of (Δcursor - ΔREF cursor) is displayed with the plus or minus sign on the CRT.

If the VOLTS/DIV range is set to UNCAL, ratio display is provided based on 5 divisions as 100%.

If ADD is specified, measured voltage is displayed only when both ranges are the same. If both ranges are different, a ratio is displayed. In the X-Y mode, the X-axis measurement cursor is displayed in the channel where the X-axis is selected.

ΔT : Time difference is measured using two cursors.

Time difference measurement is deactivated if the H-MODE is set to A-INT-B, ALT or X-Y.

A value of (Δcursor - ΔREF cursor) is displayed with the plus or minus sign on the CRT.

A value is converted if ×10MAG is selected.

If the sweep range is set to UNCAL, ratio display is provided based on 5 divisions as 100%.

1/ΔT : Frequency is measured using two cursor as a cycle.

Frequency measurement is deactivated if the H-MODE is set to A-INT-B, ALT or X-Y.

A value of (Δcursor - ΔREF cursor) is displayed with the plus or minus sign on the CRT.

A value is converted if ×10MAG is selected.

If the sweep range is set to UNCAL, phase display is provided based on 5 divisions as 360°.

⑲ ΔREF/DELAY TIME control

Clockwise rotation of the control causes increase, rightward or upward motion. Counterclockwise rotation causes decrease, leftward or downward motion. Normally, this control functions like the SET key.

Cursor ON   : Moves the ΔREF cursor.
B-AFTER DLY   : Sets a delay time position.
B-TRIG'D   : Sets a delay time position.
B-COUNT   : Sets a count value.
TV-TRIG   : Sets a count value.
Storage, DISP ADDR   : Sets a display address. (For display only)
Storage, PRE TRIG   : Sets the number of pre-trigger operations (or time).
Storage, POST TRIG   : Sets the number of post-trigger operations (or time).
DISPLAY OFFSET (MENU)   : Moves the X-axis on the R/O screen.
Automatic parameter
           measurement: Moves the ΔREF cursor.
GO/NO-GO   : Moves the ΔREF cursor.
COMMENT (MENU)   : Selects a comment characters.

> **Note**
>
> The ΔREF control allows setting functions common to all modes as described above. Thus, when setting functions for another mode while leaving the settings for the currently selected mode as they are, first switch to the new mode, and then start setting with the ΔREF control. The mode currently in effect should be verified on the on-screen readout so functions are set for the correct mode.

⑳ TRACK key

Every press of this button activates or deactivates Δ and ΔREF tracking operation.
If ΔREF is selected, two cursor move. If Δ is selected, normal operation is executed.

㉑ Δcontrol

Functions like the ΔREF control.
CURSOR ON   : Moves the Δ cursor.
DISPLAY OFFSET   : Moves the Y-axis on the R/O screen.
Automatic parameter
           measurement: Moves the ΔREF cursor.
GO/NO-GO   : Moves the Δ cursor.

㉒ DATA SAVE switch

Saves the waveform displayed in the hold mode in the REF memory as far as the memory capacity allows.
If the memory capacity is set to 2K words, 2K-word data are saved in the displayed data address.
If the memory capacity is set to 2K words×8, or 16K words, data are saved up to 16K words.

㉓ STORAGE TRIG selector

Changes the storage trigger modes in the order of NORM, PRE, POST and NORM.
Pre : The point set with the PRE TRIG before the trigger point is adjusted to the left end of the CRT.
        Waveform is displayed from the point.
        The pre-trigger point may be set with the ΔREF or SET key (between 0 and 80 divisions).
        If the memory capacity is set to 2K words, pre-trigger point may be set 0 to 10 divisions.
        The waveform is displayed in units of divisions or time, which is selected on the menu (DELAY TIME UNIT). Not functional in the Roll mode.
POST: The point set with the POST TRIG after the trigger point is adjusted to the left end of the CRT.
        Waveform is displayed from the point.

The post-trigger point may be set with the △REF or SET key (between 0 and 10000 divisions).
The waveform is displayed in units of divisions or time, which is selected on the menu (DELAY TIME UNIT). Not functional in the Roll mode.

㉔ **STORAGE MODE** selector
Changes the sampling modes in the order of NORM, EQU, ROLL and NORM.
    EQU : Selects the random equivalent sampling mode.
        The effective sweep range is from 1μs/div. [2μs/div.] to 20ns/div [50ns/div]. If data is out of this range, this mode is skipped without being selected. Readout display: EQU display on the CRT.
    ROLL: Selects the roll sampling mode.
        The effective sweep range is from 0.2s/div. to 500s/div. If data is out of this range, this mode is skipped without being selected. The PRE TRIG and POST TRIG of the storage trigger mode switches are deactivated automatically to select NORM TRIG. Although the memory size is already set to the 2K words or 2K words×8 mode, the 16K words mode is automatically established. Readout display: Rol display on the CRT.

㉕ **AVG/PEAK** selector
Changes the storage modes in the order of OFF, AVERAGE, PEAK DETECT and OFF.
    AVERAGE   : Displays an arithmetical mean of calculations performed for a preset number of times in the channel set on the Average menu.
               Readout display: Current number of times and specified number of times are displayed on the CRT.

> ─── Note ───
> If the memory capacity is set to 16K words and more than three channels are specified for averaging, the data in the reference memory are rewritten.

    PEAK DETECTOR : Detects the maximum and minimum values in the mode selected on the Peak Detect menu.
               The effective sweep range is from 10μs/div. to 500s/div.
               Readout display: MAX., MIN. or MAX/MIN is displayed on the CRT.

㉖ **HOLD** switch
Activates and deactivates the hold operation.
If the hold operation is activated, writing of storage waveform is discontinued the currently-displayed waveform data is saved. The waveform held at the vertical positions ㊻, ㉛, ㉝, and ㊷ may be moved vertically by adding the offset. Waveform may be contracted (in 16K-word mode only) or magnified based on the trigger point through sweep range operation. (The reference memory display cannot be contracted or magnified.) Contraction is possible up to 1/10 (i.e., 3 ranges). Magnification is possible up to 100 times as large (i.e., 6 ranges). The HOLD function is disabled when H-MODE is set to A INT B. If HOLD is selected with A INT B in effect, H-MODE changes to A.

㉗ **A TRIG SOURCE** selector
Changes the A trigger sources in the order of VERT, CH1, CH2, CH3, CH4, LINE and VERT.
    VERT   : Selects the smallest one of displayed channels (CH1 to CH4) as the trigger source.
           Cannot be selected for X-Y or GO/NO-GO operation.
    CH1~CH4: Selects the trigger source. (CH1 to CH4)
           Selects the X-axis in the X-Y mode.
           <For the DCS-9320/9120, CH3 or CH4 cannot be selected as a trigger source in storage mode.>
    LINE   : Uses the frequency of the commercial power supplied to this instrument as the trigger source.
           The trigger coupling is fixed to AC.
           Cannot be selected for X-Y or GO/NO-GO operation.
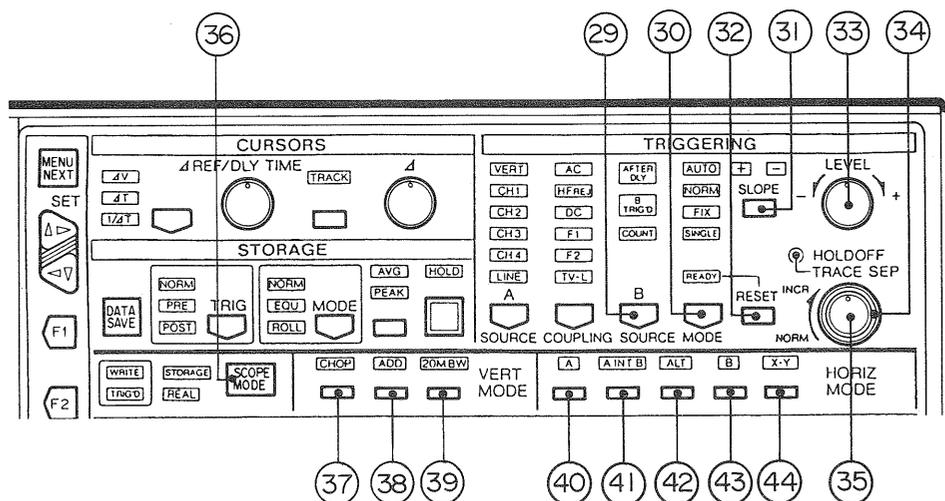
Fig. 3

㉘ **A TRIG COUPLING selector**

Changes the A trigger coupling in the order of AC, HF$_{REJ}$, DC, F1, F2, TV-L and AC.

AC/HF$_{REJ}$/DC

Selects the frequency filter for the trigger signal.

AC : Selects a high-pass filter having the cross-over frequency of 5Hz and slope of -3dB.

HF$_{REJ}$: Selects a low-pass filter having the cross-over frequency of 10kHz and slope of -3dB.

DC : Selects no filter.

TV-TRIGGER (F1, F2, TV-L)

Selects the video signal trigger.

F1 : Selects the video line selector function for the 1st video signal field.

F2 : Selects the video line selector function for the 2nd video signal field.

TV-L : Selects the horizontal trigger signal for video signals.

Use the MENU (: TV MODE) to select the type of the video signal (NTSC, PAL or AUTO) for line selector operation. A line count value may be set with the △REF key ⑲, and SET keys ⑩ and ⑪. It is displayed on the CRT.

㉙ **B TRIG SOURCE selector**

Changes the B trigger sources in the order of AFTER DLY, B TRIG'D, COUNT and AFTER DLY.

AFTER DLY : Initiates B sweep after the period of time set with the DTP (delay time position) from the A sweep start point. Functional when the H-MODE is set to A-INT-B, ALT or B.
The DTP time may be set with the △REF key ⑲ and SET keys ⑩ and ⑪ .

B TRIG'D : Initiates B sweep from the following trigger point after the period of time set with the DPT has passed from the A sweep start point. Functional when the H-MODE is set to A-INT-B, ALT or B. The DTP time may be set with the △REF key ⑲ and SET keys ⑩ and ⑪ .

COUNT : Initiates B sweep from the A sweep start point on completion of counting trigger signals whose number is set with the TRIG COUNT.
Functional when the H-MODE is set to A-INT-B, ALT or B.

18

㉚ **TRIG MODE selector**

Changes the trigger modes in the order of AUTO, NORM, FIX, SINGLE and AUTO.

AUTO : Detects a trigger signal. Executes triggered sweep if a trigger signal is detected. Or, executes auto free run if no signal is detected.

NORM : Executes triggered sweep.

FIX : Fixes the trigger point to the center of a signal and executes sweep operation, regardless of the setting of the TRIG LEVEL ㉝.
TRIG COUPLING ㉘ is fixed to AC.

SINGLE: Executes single sweep operation.

㉛ **SLOPE selector**

Every press of this switch alternates the trigger signal slope, positive or negative.

㉜ **RESET (SINGLE) switch**

Resets the single sweep mode into the trigger stand-by state.

㉝ **TRIG LEVEL control**

Controls the level of the trigger signal selected with the TRIG SOURCE.
Clockwise rotation of this control moves the trigger point in the positive direction along the vertical axis.

㉞ **HOLD OFF control**

Controls the hold off time.

㉟ **TRACE SEP control**

Controls the relative vertical position of A sweep and B sweep in the real-time mode.
Controls the relative vertical position of the acquisition data and reference data in the storage mode.
Clockwise rotation of this control moves the B sweep or reference data waveform upward.

> **NOTE**
>
> If this control is used in the storage mode to change the vertical position of reference waveform, the data obtained after PENOUT or PLOTOUT will show the waveform at a different position than the on-screen position.

㊱ **SCOPE MODE selector**

Alternates the real-time mode and storage mode.

㊲ **CHOP selector**

Selects a channel selection mode.
If the CHOP lamp is on, the channel is selected by the internal clock. If it is off, the ALT mode is selected and the channel is selected in each sweep operation.
Functional only in real-time multi-trace display operation. Not functional in the storage mode.

㊳ **ADD key**

Executes inter-channel operation. (Addition only in the real-time mode)
Calculated output is displayed in the mode and channel set with the MENU (: CALCULATION).
Added waveform and activation or deactivation of CH1 to CH4 may be set independently in the real-time mode.
In the storage mode, only calculation result is displayed. Multiplication and division are executed from the CRT center in units of divisions. (1div. × 1div. = 1div), (1div. ÷ 1div. = 1div.). Results of division using divisor 0 are apportioned to the maximum and minimum values in accordance with the signs.
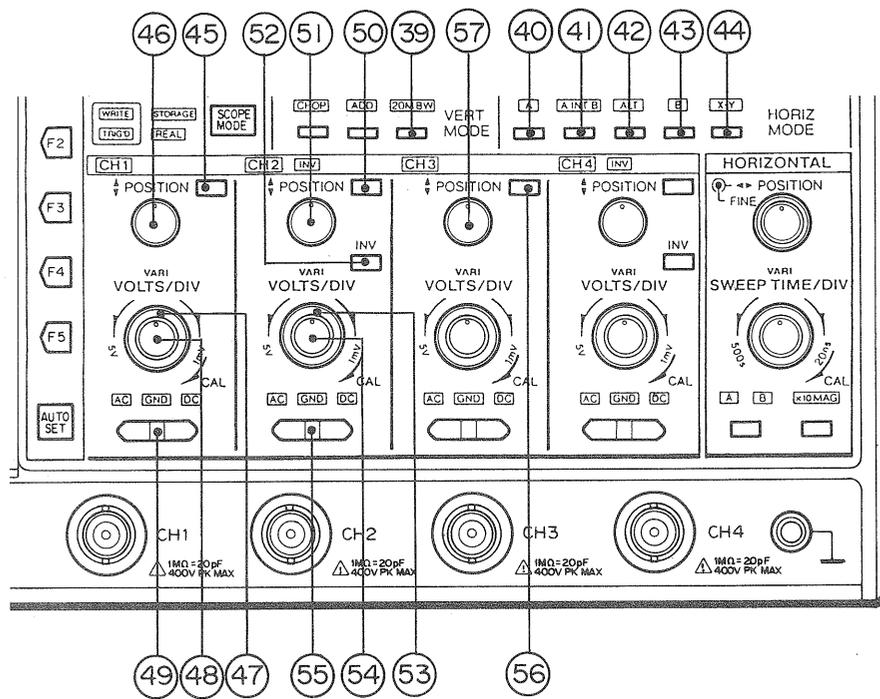
Fig. 4

㊱ 20MBW key

Turns on and off the bandpass filters (for 4 channels simultaneously).
In realtime mode, the 20MHz band-pass filter operates. In storage mode, smoothing operation takes place.

㊵ H-MODE A key

Displays A sweep waveform.

㊶ H-MODE A INT B key

Displays intensity-modulated waveform of delayed sweep.
Intensity modulation display is not produced when B-SOURCE is set to TRIG'D or COUNT in the storage mode.
The intensity modulation display indicates the value that is set when the sweep start point is aligned to the leftmost scale on the screen.

㊷ H-MODE ALT key

Alternates A INT B and B. Functional only in the real-time mode.

㊸ H-MODE B key

Displays delayed sweep.

㊹ H-MODE X-Y key

Displayed X-Y.
    X-axis: Channel selected with the A TRIG SOURCE.
    Y-axis: Vertical display channel
Select the X-axis with the TRIG SOURCE. (CH1 to CH4 only)
The X-axis is displayed in the Readout area.
The input switching time is displayed on the CRT in the real-time mode.
The data acquisition time is displayed on the CRT in the storage mode.
Data acquisition time = (sampling time for 200-word) × 10

20

㊺ CH1 key

Selects display of CH1 input signal.

㊻ CH1 POSITION control

Controls the offset of the acquisition data in the hold storage mode.
Clockwise rotation of this control moves the vertical position upward.

㊼ CH1 VOLTS/DIV selector

Changes the vertical axis range. It may be changed even if no channel is selected.
Clockwise rotation of the selector changes the range in the 1mV/div. direction.
Counterclockwise rotation changes it in the 5V/div. direction. Fixed in the hold storage mode.

㊽ CH VARI control

Controls the vertical gain continuously. Full clockwise rotation brings this instrument into the CAL
(calibration) state. In the Readout area, "〉" is displayed in the range display area on the CRT in the
UNCAL state. Not functional in the hold storage mode.

㊾ CH1 AC/GND/DC selector

DC→GND→AC

Changes the input signal coupling in the order of DC, GND and AC. Fixed in the hold storage mode.
This switch changes the coupling setting in one direction only. Each push on the left side (AC) of the
switch changes the setting in order of AC→GND→DC. Once DC is set, any further push will not change
the setting. Each push on the right side (DC) causes a change in order of DC→GND→AC. Once AC is set,
any further push will not change the setting.
Switching is possible even if no channel is selected. Any of the AC, GND and DC LED lights and its symbol
is displayed on the CRT.

㊿ CH2 key

Selects display of channel 2 input signal.

�51 CH2 POSITION control

Same as CH1.

㊾ CH2 INV key

Inverts the signal polarity. Every press alternates ON and OFF. Fixed in the hold storage mode.

㊾ CH2 VOLTS/DIV control

Same as CH1.

㊾ CH2 VARI control

Same as CH1.

㊾ CH2 AC/GND/DC switch

Same as CH1.

㊾ CH3 key <For the DCS-9320/9120, this key does not work in storage mode.>

Selects display of channel 3 input signal.

㊾ CH3 POSITION control
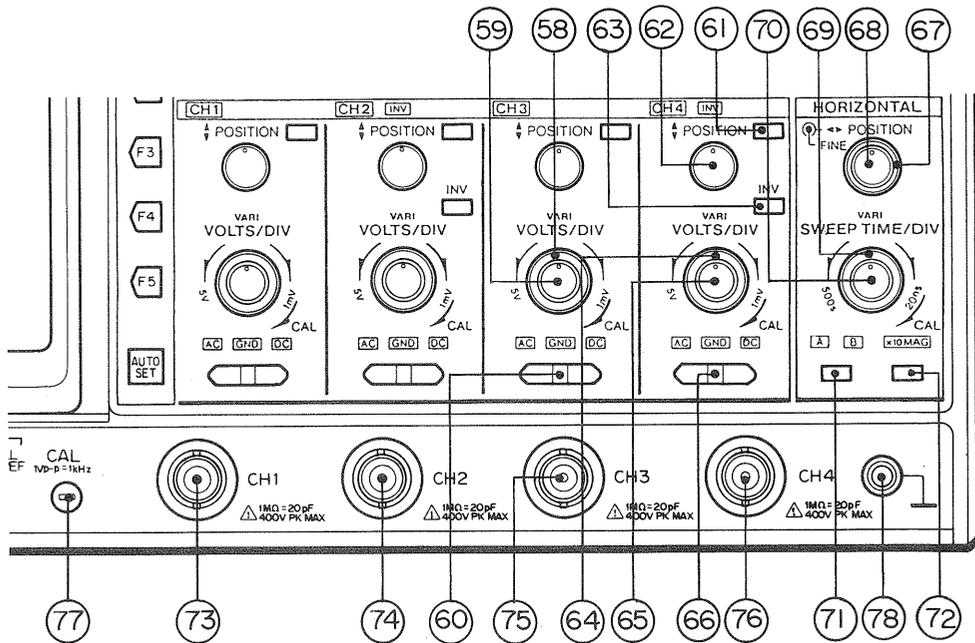
Same as CH1.

Fig. 5

㊳ **CH3 VOLTS/DIV control**
Same as CH1.

㊴ **CH3 VARI control**
Same as CH1.

㉠ **CH3 AC/GND/DC switch**
Same as CH1.

㉑ **CH4 key <For the DCS-9320/9120, this key does not work in storage mode.>**
Selects display of channel 4 input signal.

㉒ **CH4 POSITION control**
Same as CH1.

㉓ **CH4 INV key**
Same as CH2 INV.

㉔ **CH4 VOLTS/DIV control**
Same as CH1.

㉕ **CH4 VARI control**
Same as CH1.

㉖ **CH4 AC/GND/DC switch**
Same as CH1.

㉗ **H POSITION control**
Controls the horizontal position. Not functional in the X-Y operation in the real-time mode.

22

Causes fine operation only while in the storage mode. Clockwise rotation moves the waveform to the right.

⑱ H FINE control

Fine-controls the horizontal position. Not functional in the X-Y operation in the real-time mode.
Clockwise rotation moves the waveform to the right.

⑲ SWEEP TIME/DIV control

Use the A/B selector switch to select A or B sweep time. In real-time mode, A sweep may be set in the range of 20ns to 0.5 second and B sweep may be set in the range of 20ns to 50ms. In the storage mode, A sweep may be set in the range of 20ns to 500 seconds and B sweep may be set in the range of 20ns to 50ms. B sweep speed cannot be adjusted lower than the A sweep speed. Clockwise rotation changes the sweep time in the 20ns/div. direction. Counterclockwise rotation changes it in the 0.5s/div. direction.
In the hold storage mode, contraction is possible up to 1/10 only if the memory capacity is set to 16K words. Magnification is possible up to 100 magnifications. The X-axis range is displayed in the real-time X-Y mode. The data acquisition time for 200 words is displayed in the storage X-Y mode.

⑳ SWEEP TIME VARI control

Varies the A sweep time continuously up to 2.5 times. Full clockwise rotation brings this instrument into the CAL (calibration) state. Not functional in the storage mode.

㉑ A/B selector

Selects the sweep range, A or B. This selector toggles between A and B if A INT B, ALT or B is selected for H-MODE. When A is selected for H-MODE, it cannot be changed. If X-Y is selected, the selector has no effect.

㉒ ×10MAG key

Magnifies sweep 10 times as large from the CRT center. In the real-time A mode, A sweep is magnified 10 times as large. In the ALT or B mode, B sweep is magnified 10 times as large. Not functional in the A-INT-B, X-Y mode or storage mode. In the Readout area, the sweep range is converted and displayed automatically.

㉓ CH1 input terminal

Input vertical signal to this terminal.
The attenuation ratio of the readout probe (1:1 or 1:10) is detected.

㉔ CH2 input terminal

Input vertical signal to this terminal. (Same as CH1 input terminal)

㉕ CH3 input terminal

Input vertical signal to this terminal. (Same as CH1 input terminal)

㉖ CH4 input terminal

Input vertical signal to this terminal. (Same as CH1 input terminal)

㉗ CAL output terminal

Outputs 1 Vp-p, 1 kHz, 50% duty ratio, and positive square wave signals.

㉘ GND terminal

Connect this terminal to the earth ground.

[B] Rear Panel
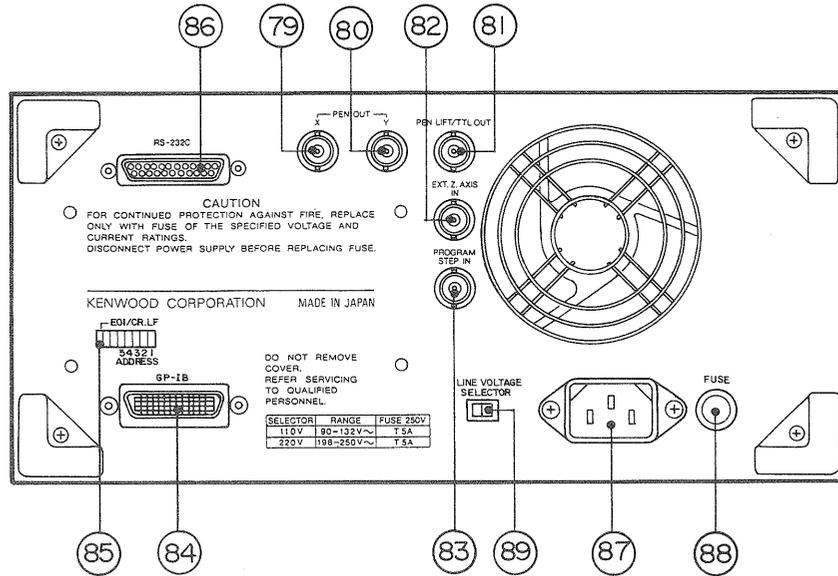
Fig. 6

⑦⑨ PENOUT X terminal

An X-axis pen output terminal

⑧⓪ PENOUT Y terminal

A Y-axis pen output terminal

⑧① PEN LIFT/TTL OUT terminal

A pen lift output or GO/NO-GO judgment signal output terminal

⑧② EXT.Z AXIS input terminal

An input terminal for external intensity modulation signal

⑧③ PROG. STEP IN terminal

A step increment input terminal for the program mode

⑧④ GPIB connector

A GP-IB connector

⑧⑤ GPIB switch

A switch for setting a GP-IB address and terminator. Selects the GP-IB or RS-232C for output to a digital plotter.

⑧⑥ RS-232C connector

An RS-232C connector

⑧⑦ AC-IN

AC power input

⑧⑧ FUSE

A fuse holder

⑧⑨ LINE VOLTAGE selector

A line voltage selector

[C] Readout

1 Readout setting display

```
┌─────────────────────────────────────────┐
│  ******1*******        *******2*******   │
│  *******3*******       *******4*******   │
│                        *17*####18####    │
│                        *19*####20####    │
│                        *21*####22####    │
│  Display setting on    *23*####24####    │
│  R/O screen                              │
│                                          │
│                                          │
│  *******16******            **5**        │
│  ***6***###7#####       *8  ##9### *10*  │
│  **11***###12####       *13 ##14## *15*  │
└─────────────────────────────────────────┘
```

1: **************
    JAN-25-91 22:57   Clock
    JAN-25-91T22:57   Trigger time
    BATT. DOWN   Battery down
    REF CH1 00mV 00ms   REF memory CH1
             >   Above voltage in UNCAL mode

2: ##############
    ADDR00000-00000   Address display
    △V1   -000.0mV   Voltage cursor V1, V2, V3, V4, V12, V34/mV, V
    △T   -000.0ms   Time cursor s, ms, μs, ns
    1/△T -00.0kHz   Frequency cursor GHz, MHz, kHz, Hz, mHz
    PHASE -000.0°   Phase cursor
    RATIO -000.0%   Ratio cursor
    REF CH2 00mV 00ms   REF memory CH2 display.
             >   Above voltage in UNCAL mode

3: **************
    GROUP 5 No. 20   When program stepping is used (Group No.=5, Step No.=20)
    REF CH3 00mV 00ms   REF memory CH3 display.
             >   Above voltage in UNCAL mode
    Trig + 0.0 div   Trigger level display

4: ##############
    DELAY   0000ms   Delay time position (after delay)
    DELAY?   0000ms   Delay time position (B triggered)
    COUNT   0000   Trigger count
    FLD1   620H/625P   In TV trigger mode (F2 PAL progressive signal display in 620 lines)
    PRE 0000div   If pre-trigger is used
    POST 0000div   If post-trigger is used
    REF CH4 00mV 00ms   REF memory CH4 display.
             >   Above voltage in UNCAL mode

5: *****
    OUT->   When setting plot out or pen out (F5); Flashes while outputting
    GO   If judged as GO in GO/NO-GO judgment
    NO-GO   If judged as NG in GO/NO-GO judgment
    REF->   If "GND-REF" shall be set for automatic parameter measurement

6: ******
    CH1 10mV   If CH1 is active
       >   ">": UNCAL
       ⏚   In case of coupling grounding

7: ########
    CH2 10mV   If CH2 is active
       >   ">": UNCAL
       ⏚   In case of coupling grounding
    +   In adding operation $+/-/\times/\div$
    ↓   When inverting

8: **
     BW   If 20 MHz filter is active (in real-time mode)
                         If smoothing function is active (in storage mode)

9: #####
    A 10ms   In A sweep s/ms/μs/ns
       >   '>':TIME/div UNCAL

10: ****
    000   Number of average counts
    Max   Max. peak hold value
    Min   Min. peak hold value
    M_X/M_N Max./min. peak hold value

11: ******
    CH3 10mV   If CH3 is active
       >   '>':UNCAL
       ⏚   In case of coupling grounding

12: ########
    CH4 10mV   If CH4 is active
       >   '>':UNCAL
       ⏚   In case of coupling grounding
    +   In adding operation $+/-/\times/\div$
    ↓   When inverting

26

13: ***

STO	Normal storage
EQU	In equivalent sampling
ROL	In roll mode
X-Y	In X-Y mode
◄─┤··├─►	Storage magnification
◄─┤─├─►	Storage contraction
◄─┼─├─►	In GO/NO-GO judgment

14: #####

B 10ms	In B sweep s/ms/μs/ns
X: CH1	In X-Y mode (X=CH1)

15: ***

256	Number of average set value

16: **************

SRQ LISTEN REN	GP-IB display
TALK	GP-IB display

17, 19, 21, 23:****

PER	For automatic period measurement
FREQ	For automatic frequency measurement
WID+	For automatic pulse width measurement in positive direction
WID-	For automatic pulse width measurement in negative direction
RISE	For automatic rise time measurement
FALL	For automatic fall time measurement
DLY	For automatic delay time measurement
OVRS	For automatic over-shoot measurement
UNDS	For automatic under-shoot measurement
P-P	For automatic peak-to-peak value measurement
Vrms	For automatic effective voltage measurement
AMP	For automatic amplitude measurement
TOP	For automatic top value measurement
BASE	For automatic base value measurement
PWR	For automatic average power measurement

18, 20, 22, 24:##########

>	'>':UNCAL
—	Indicate for negative
00000	Measurement value for atuomatic measurement
MHz	Unit: mV, V, ns, μs, ms, s, ks, μHz, mHz, Hz, kHz, MHz, GHz, μW, mW, W, kW

The DCS-9300 has the following tree-construction menus:

MAIN MENU ······ [1]

├ 1 PROCESSING MENU ············ [2]
│　　├ 1 PEAK DETECTION ······· [3]
│　　│　　├ 1 MINIMUM
│　　│　　├ 2 MAXIMUM
│　　│　　└ 3 MAX/MIN
│　　│
│　　├ 2 CALCULATION ·········· [4]
│　　│　　├ 1 REAL (CH1 CH2 ' '／＋)
│　　│　　├ 2 REAL (CH3 CH4 ' '／＋)
│　　│　　├ 3 STOR (CH1 CH2 ' '／＋／－／×／÷)
│　　│　　└ 4 STOR (CH3 CH4 ' '／＋／－／×／÷)
│　　│　　　　<For the DCS-9320/9120, the menu
│　　│　　　　does not include "4 STO".>
│　　│
│　　├ 3 AVERAGE ··············· [5]
│　　│　　├ 1 CH1 (ON/OFF)
│　　│　　├ 2 CH2 (ON/OFF)
│　　│　　├ 3 CH3 (ON/OFF)
│　　│　　├ 4 CH4 (ON/OFF)
│　　│　　└ 5 TIMES (2/4/8/16/32/64/128/256)
│　　│　　　　<For the DCS-9320/9120, the menu
│　　│　　　　does not include "3 CH3" and
│　　│　　　　"4 ch4".>
│　　│
│　　├ 4 INTERPOLATION ········ [6]
│　　│　　├ 1 NONE
│　　│　　├ 2 LINEAR
│　　│　　├ 3 SINE
│　　│　　└ 4 SPLINE
│　　│
│　　└ 5 GO/NO-GO ·············· [7]
│　　　　├ 1 MODE   (OFF/V/VH)
│　　　　├ 2 BUZZER (OFF/NO-GO/GO)
│　　　　├ 3 OUTPUT (OFF/ON)
│　　　　└ 4 HOLD   (OFF/NO-GO/GO)
│
└ 4 OUTPUT MENU ················· [20]
　　├ 1 PENOUT ················· [21]
　　│　　├ 1 OUTPUT (OFF/WAVE/+SCALE)
　　│　　├ 2 CAL   (OFF/ON)
　　│　　└ 3 SPEED (10/50/100/500 ms/word)

├ 2 MEMORY MENU ··················· [9]
│　　├ 1 DISPLAY ADDRESS ·········· [10]
│　　│　　├ 1 DISPLAY OFF
│　　│　　└ 2 DISPLAY ON
│　　│
│　　├ 2 MEMORY SIZE ············· [11]
│　　│　　├ 1 2K
│　　│　　├ 2 16K
│　　│　　└ 3 2K*8
│　　│
│　　└ 3 REFERENCE ··············· [12]
│　　　　├ 1 CH1 (OFF/ON)
│　　　　├ 2 CH2 (OFF/ON)
│　　　　├ 3 CH3 (OFF/ON)
│　　　　└ 4 CH4 (OFF/ON)
│　　　　　　<For the DCS-9320/9120, the menu
│　　　　　　does not include "3 CH3" and
│　　　　　　"4 ch4".>
│
├ 3 SET MENU ······················ [13]
　　├ 1 TV MODE ·················· [14]
　　│　　├ 1 AUTO (NTSC/PAL)
　　│　　├ 2 NTSC
　　│　　└ 3 PAL
　　│
　　├ 2 BUZZER ··················· [15]
　　│　　├ 1 OFF
　　│　　├ 2 ON KEYIN
　　│　　├ 3 ON ERROR
　　│　　└ 4 ALL
　　│
　　├ 3 DISPLAY OFFSET ··········· [16]
　　│
　　├ 4 TIME DISPLAY ············· [17]
　　　　├ 1 OFF
　　　　├ 2 ON-TIME
　　　　├ 3 TRIG-TIME
　　　　└ 4 TIME SET ··········· [18]
　　　　　　├ 1 YEAR
　　　　　　├ 2 MONTH
　　　　　　├ 3 DAY
　　　　　　├ 4 HOUR
　　　　　　└ 5 MIN

```
├ 2 PLOTOUT ·············· [22]              └ 5 DELAY TIME UNIT ········ [19]
│   ├ 1 OUTPUT (OFF/WAVE/+SCALE/+R/0/ALL)         ├ 1 sec MODE
│   └ 2 SETTING ········ [23]                      └ 2 div MODE
│        ├ 1 WAVE PEN  (SAME, /CH)      └ 5 OPTION MENU ················· [25]
│        ├ 2 SCALE PEN (1~8)                ├ 1 AUTO SET ··············· [26]
│        ├ 3 R/O PEN   (1~8)                │    ├ 1 MODE (V/H/VH)
│        ├ 4 PAPER     (A3/A4)              │    ├ 2 V (2/4)
│        └ 5 MODE      (1/1, 1/4, 2/4, 3/4, 4/4)  └ 3 H (2/4)
│
└ 3 RS-232C ·············· [24]             ├ 2 PROGRAM ················· [27]
     ├ 1 SPEED   (1200/2400/4800/9600)      │    ├ 1 MODE  (OFF/RUN/EDIT)
     ├ 2 PARITY  (NONE/ODD/EVEN)            │    ├ 2 GROUP (1~5)
     └ 3 BIT     (7/8)                      │    └ 3 REPEAT (02~20)
                                            │
                                            ├ 3 PARAMETER ·············· [29]
                                            │    ├ 1 PARAMETER
                                            │    └ 2 SUB-PARAMETER ···· [30]
                                            │         ├ 1 DELAY TO (CH1/CH2/CH3/CH4)
                                            │         ├ 2 DELAY MODE
                                            │         │   (↑↑/↑↓/↓↑/↓↓)
                                            │         ├ 3 CURRENT SOURCE
                                            │         │   (CH1/CH2/CH3/CH4)
                                            │         └ 4 CURRENT RANGE (1mA~50A)
                                            │          ⟨For the DCS-93000/9120, the
                                            │          menu does not include
                                            │          CH3/CH4.⟩
                                            │
                                            ├ 4 COMMENT ················· [31]
                                            │    ├ 1 DISPLAY (OFF/No.1~10)
                                            │    └ 2 COMMENT EDIT ····· [32]
                                            │
                                            └ 5 STATUS ················· [33]
```

[1]

```
┌─────────────────────────────────┐
│   1. PROCESSING                 │
│      Peak      Calc    Average  │
│      Interpolation     Go/No-Go │
│   2. MEMORY                     │
│      Address           Size     │
│      Reference                  │
│   3. SET                        │
│      TV        Buzzer  Offset   │
│      Time      Delay            │
│   4. OUTPUT                     │
│      PENout            PLOTout  │
│      RS232C                     │
│   5. OPTION                     │
│      Autoset   Program Parameter│
│      Comment   Status           │
└─────────────────────────────────┘
```

[2]

```
┌─────────────────────────────────┐
│         * PROCESSING *          │
│                                 │
│   1.  PEAK DETECT               │
│   2.  CALCULATION               │
│   3.  AVERAGE                   │
│   4.  INTERPOLATION             │
│   5.  GO/NO-GO                  │
│                                 │
└─────────────────────────────────┘
```

[3]

```
        * PEAK DETECTION *


   1.  MINIMUM
   2.  MAXIMUM
  >3.  MAX/MIN
```

[4]

```
         * CALCULATION *


   1.  REAL    CH1+CH2
   2.  REAL    CH3  CH4
   3.  STOR    CH1+CH2
   4.  STOR    CH3-CH4
```

+>->×>÷>□>+ •••
+ and □ only in real-time mode (□: space)
<For the DCS-9320/9120, the menu does not
 include "4 STOR".>

[5]

```
          * AVERAGE *


   1.  CH1   : ON
   2.  CH2   : OFF
   3.  CH3   : OFF
   4.  CH4   : OFF
   5.  TIMES : 256
```

TIMES : 2, 4, 8, 16, 32, 64, 128, 256
<For the DCS-9320/9120, the menu does not
 include "3 CH3" and "4 CH4".>

[6]

```
        * INTERPOLATION *


   1.  NONE
   2.  LINEAR
  >3.  SINE
   4.  SPLINE
```

[7]

```
        * GO/NO-GO MODE *


   1.  MODE   : V
   2.  BUZZER : GO
   3.  OUTPUT : ON
   4.  HOLD   : OFF
```

MODE   : OFF/V/VH
BUZZER : OFF/NO-GO/GO
OUTPUT : OFF/ON
HOLD   : OFF/NO-GO/GO

[8] GO/NO-GO operation menu

Range setting with cursor
V and T are switched with cursor switch
Cursor measurement disabled
T cursor disappears if Mode is V

30

[9]

```
              * MEMORY *

    1.  DISPLAY ADDRESS
    2.  MEMORY SIZE
    3.  REFERENCE
```

[10]

```
           * DISPLAY ADDRESS *

   >1.  DISPLAY OFF
    2.  DISPLAY ON
```

[11]

```
             * MEMORY SIZE *

    1.  2 K
    2.  16 K
   >3.  2K * 8
```

[12]

```
              * REFERENCE *

    1.  CH1 : ON
    2.  CH2 : OFF
    3.  CH3 : OFF
    4.  CH4 : OFF
```

<For the DCS-9320/9120, the menu does not
include "3 CH3" and "4 CH4".>

[13]

```
                 * SET *

    1.  TV MODE
    2.  BUZZER
    3.  DISPLAY OFFSET
    4.  TIME DISPLAY
    5.  DELAY TIME UNIT
```

[14]

```
               * TV MODE *

   >1.  AUTO (NTSC/PAL)
    2.  NTSC
    3.  PAL
```

[15]

```
               * BUZZER *

   >1.  OFF

    2.  ON KEYIN

    3.  ON ERROR

    4.  ALL
```

[16]

```
            *DISPLAY OFFSET*
   ------------------------------------
```

Cousor display

31

[17]

```
            * TIME DISPLAY *

    >1.   OFF
     2.   ON TIME
     3.   TRIG TIME
     4.   TIME SET
```

[18]

```
              * TIME SET *

     1.   YEAR
     2.   MONTH
                        92 - 08 - 18
     3.   DAY           ‾‾
     4.   HOUR          17 : 41
     5.   MIN
```

Item to be changed is displayed with cursor
Change with the SET key or △REF control
MENU key: To next item

[19]

```
          * DELAY TIME UNIT *

    >1.   sec MODE
     2.   div MODE
```

[20]

```
              * OUTPUT *

     1.   PENOUT
     2.   PLOTOUT
     3.   RS232C
```

[21]

```
             * PEN OUT *

     1.   OUTPUT    +SCALE
     2.   CAL       ON
     3.   SPEED     100ms/word
```

OUTPUT : OFF/WAVE/+SCALE
CAL   : ON/OFF
SPEED : 10/50/100/500ms/word

[22]

```
             * PLOT OUT *

     1.   OUTPUT OFF
     2.   SETTING
```

OUTPUT : OFF/WAVE/+SCALE/
             +READOUT/ALL

32

[23]

```
            * SETTING *

  1.   WAVE PEN    /CH
  2.   SCALE PEN   5
  3.   R/O PEN     6
  4.   PAPER       A4
  5.   MODE        1/1
```

WAVE PEN   : SAME, /CH
SCALE, READ OUT : 1〜8
PAPER   : A3, A4
MODE   : 1/1, 1/4, 2/4, 3/4, 4/4

[24]

```
            * RS 232C *

  1.   SPEED      1200 bps
  2.   PARITY     NONE
  3.   BIT        7
```

SPEED : 1200/2400/4800/9600
PARITY : NONE/ODD/EVEN
BIT   : 7/8

[25]

```
            * OPTION *

  1.   AUTOSET
  2.   PROGRAM
  3.   PARAMETER
  4.   COMMENT
  5.   STATUS
```

[26]

```
            * AUTO SET *

  1.   MODE : V
  2.   V    : 2
  3.   H    : 2
```

MODE : V/H/VH
V   : 2/4
H   : 2/4

[27]

```
            * PROGRAM *

  1.   MODE   : RUN
  2.   GROUP  : 5
  3.   REPEAT : 12
```

MODE   : OFF/RUN/EDIT
GROUP : 1〜5
REPEAT : 2〜20

[28] PROGRAM EDIT menu

```
###############        ################
GROUP 5 No. 20         ################
                            1.  Save
                            2.  Ins
                            3.  Del
                            4.  Call
###############        ###############
###############        ###############
```

Operation example

STEP No.	0	1	2	3	4
Current setting	X	A	(B)	C	D
1) SAVE	X	A	(X)	C	D
2) INS	X	A	(X)	B	C
3) DEL	X	A	(C)	D	D
4) CALL	Y	A	(B)	C	D
5) SET+	C	A	B	(C)	D
6) SET−	A	(A)	B	C	D

Y : Panel setting immediately before opening
    PROGRAM EDIT MENU
Step No.0 is buffer for setting.
Buffer indicated by step No. is enclosed
in parentheses.

[29]

```
            * PARAMETER *
 > OFF ························· 1  2  3  4
   PERIOD ·····················
   FREQUENCY ··················
   PULSE WIDTH ················
   RISE TIME ··················
   FALL TIME ··················
   DELAY ······················
   OVER SHOOT ·················
   UNDER SHOOT ················
   PEAK to PEAK ···············
   VOLT RMS ···················
   TOP LEVEL ··················
   BASE LEVEL ·················
   AMPLITUDE ··················
   POWER ······················
```

[30]

```
            * PARAMETER *

   1.  Delay to        CH1
   2.  Delay Mode      ↑ to ↑
   3.  Current Source  CH1
   4.  Current Range   50mA/div
```

Delay to   : CH1/CH2/CH3/CH4
Delay Mode   : ↑to↑, ↑to↓, ↓to↑, ↓to↓
Current Source : CH1/CH2/CH3/CH4
Current Range : 1mA～50A
〈For the DCS-9320/9120, the menu does not
 include "CH3/CH4"〉

[31]

```
            * COMMENT *

   1.  DISPLAY : No. 4
   2.  COMMENT EDIT
```

DISPLAY : OFF/No. 1～10

[32]

```
          * COMMENT EDIT *
             EDIT No. 4
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   ##############################
   [&]  F1:↑ F2:↓ F3:← F4:→
        Char:⇕  △REF F5:Char Set
```

Any data may be written in # positions.
Character to be set is displayed in & field.

[33]

```
              ✷ STATUS ✷

PEAK DETECT ················· MAX
CALC REAL      CH1+CH2  CH3  CH4
CALC STORAGE  CH1−CH2  CH3×CH4
AVERAGE CH1 CH2 CH3 CH4 TIMES 256
INTERPOLATION ··········· SPLINE
DISPLAY ADDRESS ··········· ON
MEMORY SIZE ··············· 2K
REFERENCE ······ CH1 CH2 CH3 CH4
TV MODE ················· AUTO
BUZZER ···················· ALL
TIME DISPLAY ·············· ON
PEN OUT ··················· OFF
PLOT OUT ······· A4 1/1 + SCALE
RS232C        1200bps NONE 7bit
AUTO SET ··········· VH V:2 H:4
```

MAX, MIN, Mₓ/Mɴ
‘ ’, ‘ ’, +
‘ ’, ‘ ’, +, −, ×, ÷
2〜256
NONE, LINEAR, SINE, SPLINE
OFF, ON
2K, 16K, 2K×8

AUTO, NTSC, PAL
OFF, KEY IN, ERROR, ALL
OFF, ON, TRIGGER
OFF, WAVE, +SCALE
A4, A3 1/1, 1/4〜4/4 OFF, +SCALE, +R/0, ALL
1200/2400/4800/9600 NONE/ODD/ENEN 7/8
V, H, VH V:2, 4 H:2, 4

〈The DCS-9320 and -9120 do not have CALC STORAGE CH3×CH4, AVERAGE, and REFERENCE CH3 and CH4.〉

5. OPERATING INSTRUCTIONS

Items

[A] Normal Oscilloscope Operations
    1 Normal Sweep Display
    2 Sweep Magnification
    3 X-Y Operation
    4 TV Signal Observation
    5 Single Sweep
    6 Delayed Sweep Magnification (B-Sweep)

[B] Readout Operations
    1 Set Data Readouts
    2 Cursor Measurement
    3 Menu Readout

[C] Digital Storage Oscilloscope Operations
    1 Normal Sampling
    2 Pre- and Post-Triggering
    3 Equivalent Sampling
    4 Roll Sweep
    5 Peak Hold
    6 Averaging
    7 Interpolation
    8 Reference Waveform Memory
    9 Operation Functions
    10 Others

[D] Programmable Oscilloscope Operations
    1 Writing & Reading Program
    2 GO/NO-GO Operation (Data judgment)

[E] Output to Pen Recorder and Plotter
    1 Output to Analog Pen Recorder
    2 Output to Digital Plotter

[F] Automatic Range Setting Operation (AUTO SET)
    1 Automatic Range Setting Operation (AUTO SET)

[G] External Control via GP-IB
    1 Control via GP-IB

Preparatory Operations

Before turning on power, set the controls as shown below. For the details of these controls, refer to the section "Controls and Indicators". If the probe is to be used, refer to the manual supplied with the probe and "Probe compensation" in the section "Maintenance and Adjustment".

```
ILLUM (ROTA) ③, ②  ····························· Full counterclockwise position (Push)
FOCUS (ASTIG) ⑤, ④  ····························· Center (Push)
R/O INTENSITY ⑥  ······························· Center
A INTENSITY (B INTENSITY) ⑦, ⑧  ··············· Center (Push)
VARI (Vertical, Sweep) ㊽, ㊾, ㊿, ㊿, ㊀······· Full clockwise rotation
TRIG LEVEL ㉝  ································· Center
HOLD OFF ㉞  ··································· Full counterclockwise rotation
TRACE SEP ㉟  ································· Center
H POSITION (COURSE, FINE) ㊼, ㊸  ·············· Center
```

[A] Normal Oscilloscope Operations

1 Normal Sweep Display

1) Power on setting

Press the POWER switch ①. Power is supplied to the instrument and some LED goes on. A trace is displayed in the CRT center.
If the trace is not displayed, set the controls and switches as shown below:

```
SCOPE MODE ㊱  ····························· Real-time mode
TRIG MODE ㉚  ······························· AUTO
CH1 ㊺  ··································· ON
CH1 POSITION ㊻  ························· Adjust.
CH1 AC/GND/CD ㊾  ······················· AC
×10MAG ㊼  ······························· OFF
H-MODE ㊵  ······························· A
SLOPE ㉛  ································· +
A TRIG COUPLING ㉘  ······················ AC
A TRIG SOURCE ㉗  ························· VERT (CH1)
```

Then, adjust the intensity with the A INTENSITY control ⑦. If necessary, use the FOCUS ⑤ and ASTIG ④ for easy-to-see observation.

2) Signal input

① Apply input signal to the CH1 INPUT terminal �73. Adjust the waveform to an appropriate size with the CH1 VOLTS/DIV control ㊼.

② If the CH2 ㊿ is pressed, two channels, CH1 and CH2, are displayed.
Likewise, the CH3 ㊋ or CH4 ㊬ switch is pressed, three or four channels are displayed.

③ If the ADD ㊳ of the V-MODE is selected, algebraic sum of CH1 and CH2 (CH1+CH2) or algebraic sum of CH3 and CH4 (CH3+CH4) or both of them are displayed on the CRT in accordance with the menu setting. If the CH2 INV switch ㊾ is activated in this condition, algebraic difference between CH1 and CH2 (CH1-CH2) is displayed. (The CH4 INV switch ㊿ functions likewise.)

The sensitivity of the add mode is set with the VOLTS/DIV if the same value is set for both channels.

```
┌─ NOTE ──────────────────────────────────────────────────────────────┐
│ For the add mode, specify the operation channels on menu ⑨.  For details, refer to section │
│ "3 Menu Readout".                                                    │
└──────────────────────────────────────────────────────────────────────┘
```


3) Triggering

a) Trigger source and coupling

Operate as shown below if the waveform to be observed is not triggered or the trigger point is to be moved:

① Select a trigger signal channel with the SOURCE ㉗.
If the SOURCE is set to VERT, the input signal of the smallest number of channel is used for triggering. Select CH1, CH2, CH3 or CH4 with the SOURCE ㉗. The signal of a selected channel is input to the trigger circuit.
If LINE is selected, the frequency of the supplied commercial power is used for triggering.

② Then, set the COUPLING ㉘ to any of the following:

(1) AC
The trigger signal is capacitive-coupled to eliminate DC components. Since only AC component is used, triggering is stable, regardless of the DC components.
The roll off frequency is 20Hz. In the frequency range lower than 20Hz, the trigger signal level is too low and triggering may fail in some cases. Thus, use the DC coupling.

(2) HF$_{REJ}$
The trigger signal is supplied via a low-pass filter. High-frequency components (over 10kHz) are cut, and only low-frequency components are used for triggering.

(3) DC
Input signal including DC components is supplied to the trigger circuit as the trigger signal.
The DC coupling is suitable for triggering using low frequency signal below 20Hz or ramping waveform oscillating slowly like DC.

(4) F1
Each horizontal line in the 1st field of the interlace mode video signal is used for triggering.
Triggering is stable, regardless of the setting of the LEVEL ㉝.
If the polarity of the trigger pulse is negative, set the SLOPE ㉛ to the "−" position. If it is positive, set the SLOPE to the "+" position. (This also applies to F2 or TV-LINE setting.)

(5) F2
Each horizontal line in the 2nd field of the interlace mode video signal is used for triggering.

(6) TV LINE
The horizontal line signal of the video signal is used for triggering.

b) Trigger level and trigger slope

Set the waveform trigger point with the TRIG LEVEL ㉝ and SLOPE ㉛.

c) Trigger mode

(1) AUTO

In this mode, sweep runs freely if no trigger signal is input. Thus, the GND level may be checked easily. If trigger signal is input, the trigger point may be set with the LEVEL and SLOPE for waveform observation like the normal triggering. If the trigger point gets out of the trigger range, sweep runs freely and waveform wavers.

> ── NOTE ──
> If the frequency of the input signal lowers below 50Hz in the automatic sweep mode, triggering is disabled. Use the normal mode in such a case.

(2) NORMAL

Sweep is activated only when trigger signal is input.
This mode is used to observe input signals lower than 50Hz or signals oscillating slowly.

> ── NOTE ──
> Sweep stops and no trace appears if the TRIG MODE is set to NORM and no trigger is input or the trigger point gets out of the trigger range.

(3) FIX

The trigger level is always adjusted to the approximate center of the CRT for triggering regardless of the level.

d) Hold off

If the pulses contained in the waveform are generated at different intervals through the waveform oscillates cyclically, triggering may be unstable.
In such a case, vary the sweep hold time with the HOLD-OFF ㉞ for stable triggering.

2 **Sweep Magnification**

If the sweep time is shortened while observing a part of the CRT by expanding along the time axis, the part to be observed may get out of the display area. In such a case, use the sweep magnification function. Move the part to be magnified to the CRT center with the POSITION ㉖. Then, press the ×10MAG switch ㉘; the part is magnified 10 times as large. In the Readout area, the magnification-converted sweep time is displayed.

> ── NOTE ──
> Sweep magnification is disabled if the H-MODE is set to A INT B ㊶ or X-Y ㊹.

3 **X-Y Operation**

In this mode, phase difference, etc. may be measured. Set the H-MODE to the X-Y ㊹ position. The channel selected with the TRIG SOURCE ㉗ is displayed along the horizontal (X-) axis. The channel selected with the V-MODE switch is displayed along the vertical (Y-) axis.

Position adjustment for Y-axis uses the ⬍ POSITION of the selected channel. Position adjustment for X-axis uses the ⬍ POSITION of the channel selected via TRIG SOURCE ㉗. The sensitivity of the X-Y operation depends on the settings of the VOLTS/DIV and VARIABLE in each channel.

> ┌─ Note ──
> In the real time mode of ADD, X-Y operation shows the ADD waveform along the Y-axis, while the X-axis displays the waveform of the channel selected with TRIG SOURCE.
> In the real time mode of four rules of arithmetic, X-Y operation shows the arithmetic waveforms along both X- and Y- axis. When CH1 or CH2 is selected for TRIG SOURCE, the X- axis displays the arithmetic waveforms for CH1 and CH2. When CH3 or CH4 is selected, the X-axis displays the arithmetic waveforms for CH3 and CH4. <Calculated waveforms for CH3 and CH4 can only be observed on the DCS-9300/9100.>

4　TV Signal Observation

Sweep may be started from any line in any field of TV signals.

1) Set the H-MODE to the A ㉚ position. Set the A-COUPLING to TV-F1 or TV-F2.

2) Input the TV signals to be observed. Adjust the SLOPE to fit the input signals.

3) Select a line number to be observed with the △REF or SET switches ⑩ and ⑪.

4) Select the TV signal field 1 or 2 with TV-F1/TV-F2.

5) Two modes may be selected on the menu: In one mode, the NTSC method signals and PAL method signals are discriminated automatically {525 (NTSC) and 625 (PAL)} , and in the other mode, these signals are fixed. In addition, the interlace signals and non-interlace signals are detected and a displayed line number is changed automatically.
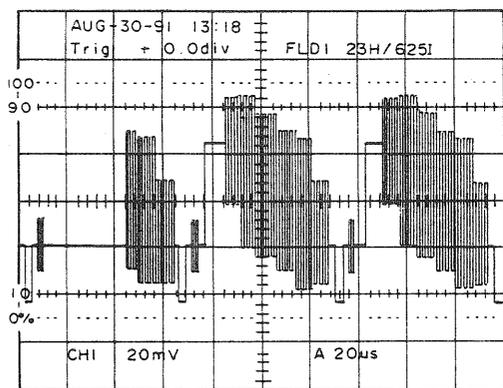
23th line in PAL field 1

Fig. 7

		Interlace signal	Non-interlace signal
NTSC	FLD1	1H/525I～263H/525I	1H/525P～262H/525P
	FLD2	1H/525I～263H/525I	1H/525P～262H/525P
PAL	FLD1	1H/625I～313H/625I	1H/625P～312H/625P
	FLD2	314H/625I～625H/625I	314H/625P～624H/625P

40

5 Single Sweep

Use the single sweep operation to observe non-cyclic signals.

1) Set the TRIG-MODE ㉚ to AUTO or NORM and adjust to the signal to be observed. Adjust the trigger level.
   Then, set the TRIG-MODE to SINGLE.

2) Press the RESET switch ㉜; the READY LED goes on, which indicates the instrument is ready for the
   trigger signal. This LED goes out when sweep is completed.

3) Input the signal to be observed.

   ┌─ NOTE ───┐
   │ If the V-MODE is set to ALT, 2 traces cannot be observed simultaneously. For 2-trace observation, │
   │ set the V-MODE to CHOP.   │
   └──┘

6 Delayed Sweep Magnification (B-Sweep)

If the trace to be observed is far from the trigger point and out of the display screen, it may be
observed by delaying sweep from the trigger point by specified time.
Operate as shown below for delayed sweep magnification in modes ①, ② and ③.

1) Select the waveform containing the trigger point with the A TRIG SOURCE ㉗. Then, use the TRIG LEVEL ㉝,
   etc. to trigger the waveform.

2) The A-sweep range should be selected for SWEEP TIME/DIV ㊹ so that the trace of interest is well
   included in the waveform.

3) Then, select the H-MODE ALT ㊷ or H-MODE B ㊸. Adjust the B sweep intensity with the B/REF INTENSITY ⑧.

4) Change the SWEEP TIME/DIV ㊹ into delayed sweep (B sweep) mode by A/B selector ㉘, if necessary. Set
   the B sweep range.

5) If the H-MODE is set to ALT, adjust the delayed sweep vertical position with the TRACE SEPARATION ㉟
   in order to separate the trace positions of the main sweep (A sweep) and delayed sweep (B sweep).

   ① Continuous delay (STARTS AFTER DELAY)
      Delayed sweep may be started at any point of A sweep.
      Select the AFTER DELAY of the B-SOURCE ㉙.
      Adjust the intensity-modulated part to the part to be observed with the △REF/DELAY TIME ⑲ or
      SET switches ⑩ and ⑪. The delay time is displayed in the upper right of the CRT.

      ┌─ NOTE ──┐
      │ Delayed sweep is invalid within 0.2 division from the A sweep start point. Delayed jitters │
      │ are generated at a high magnification in after delay operation. Use the following triggered │
      │ delay operation in such a case.   │
      └──┘

   ② Triggered delay (TRIG'D DELAY)
      B sweep is initiated by a trigger signal after preset delay time.
      Select the TRIG'D with the B-SOURCE ㉛.

In the triggered delay mode, time of the B sweep start point set with the △REF/DELAY TIME ⑲ or SET switches ⑩ and ⑪ is displayed for reference only.

③ Trigger count

B sweep starts after counting the number of pulses of digital signals, etc.

If the COUNT of the B-SOURCE ㉙ is selected, "COUNT" is displayed in the upper right of the CRT, and a count value is displayed following it.

Set a count value with the △REF/DELAY TIME ⑲ or SET switches ⑩ and ⑪.

> ── NOTE ──────────────────────────────
> One trigger count corresponds to the interval between the trigger point of A sweep and the trigger point of B sweep following the former.

> ── NOTE ──────────────────────────────
> The trigger count value may be set within the range between 1 and 2000 counts.
> If a count value exceeds the number of pulses displayed in A sweep waveform, B sweep is not displayed. Thus, set a count value less than the number of pulses in A sweep waveform.

> ── NOTE ──────────────────────────────
> When A INT B is active in the storage mode, the intensity modulation portion is independent of the horizontal position, so it generates error. Also, the correct position is not obtained in a magnified range greater than 1μs/div of A sweep.

[B] Readout Operations

1 Set Data Readouts

Rotate the R/O INTEN ⑥ clockwise; Set data are displayed on the CRT.

Control the intensity as necessary.

The set values shown in "Readout setting display" in the section "Controls and Indicators" are displayed.

> ── NOTE ──────────────────────────────
> The calendar and clock are not displayed on the CRT if they are deactivated.
> For their setting, refer to "Maintenance and Adjustment".
> If Readout function is activated, the real-time waveform may be intensity-modulated. In such a case, rotate the R/O INTENSITY ⑥ fully counterclockwise to the READOUT-OFF position. By this, intensity modulation of the real-time waveform may be avoided.

2 Cursor Measurement

To execute cursor measurement, the cursor mode may be activated or deactivated and the CURSOR MODE ⑱ may be changed as shown below:

OFF→△V1→△V2→△V3→△V4→△V12→△34→△T→1/△T→OFF

Non-selected vertical channels are skipped.

If the H-MODE is set to A INT B, ALT or X-Y, △T and 1/△T cursor measurements are disabled, and delay time and trigger count are displayed. If the H-MODE is set to B, the delay time and trigger count

are displayed once and the cursor mode is off.

Another cursor mode operation initiates the normal cursor measurement.

If the cursor mode is deactivated, the delay time and trigger count are displayed again.

1) Potential difference measurement

Set the cursor mode ΔV to an intended channel and use two horizontal cursors to measure potential difference.

A value (Δcursor-ΔREF cursor) is displayed on the CRT.

If the selected channel is in the UNCAL state, a voltage ratio based on 5 divisions as 100% is displayed.

If the H-MODE is set to X-Y and a channel set to X-axis with ΔV is selected, the cursors are displayed vertically and potential difference between them is displayed.

2) Time difference measurement

Set the cursor mode to the ΔT and use two vertical cursors to measure time difference. A value (Δ cursor-ΔREF cursor) is displayed on the CRT.

The $\times$10MAG switch is functional; If it is activated, a converted value is displayed.

If the sweep variable is in the UNCAL state, a time ratio based on 5 divisions as 100% is displayed.

3) Frequency measurement

To measure frequency, set the cursor mode to the $1/\Delta T$; the interval of the two vertical cursors represents 1 cycle. The values of the Δcursor and ΔREF cursor are converted into frequencies and displayed on the CRT screen. The $\times$10MAG switch is functional; If it is activated, a converted value is displayed. If the sweep variable is set to UNCAL, phase difference based on 5 divisions as 360° is displayed.

4) Tracking operation

In tracking operation, the Δcursor follows movement of the ΔREF cursor, which is convenient to compare data with the reference value. Activate or deactivate the ΔREF cursor tracking operation with the CURSOR TRACKING ⑳. The Δ control ㉑ moves independently.

5) Cursor operation

The ΔREF/DELAY TIME control ⑲ functions as follows depending on modes:

CURSOR ON	: Moves the ΔREF cursor.
B-AFTER DELAY	: Sets a delay time position.
B-TRIG'D	: Sets a delay time position.
B-COUNT	: Sets a count value.
TV-TRIG	: Sets a count value.
STORAGE, DISP ADDR	: Sets a display address. (When displaying only)
STORAGE, PRE TRIG	: Sets the number of pre-trigger divisions (time).
STORAGE, POST TRIG	: Sets the number of post-trigger divisions (time).
DISPLAY OFFSET	: Moves the X-axis on the readout area.
TIME SET	: Sets date and time.
GO/NO-GO	: Moves the ΔREF cursor.
Automatic parameter measurement	: Moves the ΔREF cursor.
COMMENT	: Selects a comment No. and comment characters.

The △control ㉑ functions as follows depending on modes:

CURSOR ON	: Moves the △cursor.
DISPLAY OFFSET	: Moves the Y-axis in the readout area.
GO/NO-GO	: Moves the △cursor.
Automatic parameter	
measurement	: Moves the △cursor.

Clockwise rotation of the △REF and △control causes increases, rightward and upward movements.

```
┌─ NOTE ──────────────────────────────────────────────────────────────────┐
│ If the △REF control ⑲ is used for setting, not for cursor operation, the SET switches ⑩ and │
│ ⑪ serve as the fine controls (i.e., fine-control values and vary the minimum values).      │
└──────────────────────────────────────────────────────────────────────────┘
```

3　Automatic Parameter Measurement

[29] Parameter Setting Menu

```
┌──────────────────────────────┐
│          * PARAMETER *        │
│                               │
│   OFF ·················· 1 2 3 4 │
│   PERIOD ···················· │
│ > FREQUENCY ················· │
│   PULSE WIDTH ··············· │
│   RISE TIME ················· │
│   FALL TIME ················· │
│   DELAY ····················· │
│   OVER SHOOT ················ │
│   UNDER SHOOT ··············· │
│   PEAK to PEAK ·············· │
│   VOLT RMS ·················· │
│   TOP LEVEL ················· │
│   BASE LEVEL ················ │
│   AMPLITUDE ················· │
│   POWER ····················· │
└──────────────────────────────┘
```

Display on R/O Screen

```
┌──────────────────────────────────────────┐
│ *******1*******        *******2*******    │
│ *******3*******        *******4*******    │
│                        *17*####18####     │
│                        *19*####20####     │
│                        *21*####22####     │
│                        *23*####24####     │
│                                           │
│                                           │
│ *******16******              **5**        │
│ ***6***###7#####        *8  ##9### *10*    │
│ **11***###12####        *13 ##14## *15*    │
└──────────────────────────────────────────┘
```

Any four of fourteen automatic waveform parameter measurement items may be selected and displayed on the screen in digital storage oscilloscope operation.

To execute automatic measurement, select the parameter setting menu [29], move the "＞" mark to an intended item with the ↑→ SET key ⑩ or ←↓ SET key ⑪, then press the F1⑫, F2⑬, F3⑭, or F4⑮ key. The F1, F2, F3F and F4 keys correspond to the numbers "1", "2", "3" and "4" on the parameter setting munu [29]. The numbers "1", "2", "3" and "4" correspond to positions (17-18), (19-20), (21-22) and (23-24) on the R/O screen.

On completion of setting on the menu, press the MENU/NEXT key ⑨ to re-display the waveform display screen.

Measured values are displayed at positions (17-18), (19-20), (21-22) and (23-24) on the R/O screen. These values are measured in the range of the vertical cursor.

If no cursor is displayed, measurement is performed all over the screen. The waveform in the channel serving as the trigger source is measured.

```
┌─ NOTE ──────────────────────────────────────────────────────────────────┐
│ If LINE is selected as the trigger source in REAL mode or X-Y measurement or in waveform │
│ computation, automatic parameter measurement is not executed.                            │
└──────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────┐
│ If automatic parameter measurement is selected in the GO/NO-GO mode, the GO/NO-GO mode is │
│ invalidated.                                                                             │
└──────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────┐
│ Set the vertical cursor for measurement range setting to a division more than 0.5 div.   │
└──────────────────────────────────────────────────────────────────────────┘
```

The following describes the measurement items.

$$Ycenter = \frac{MAX+MIN}{2}$$

$$FREQUENCY = \frac{1}{PERIOD}$$
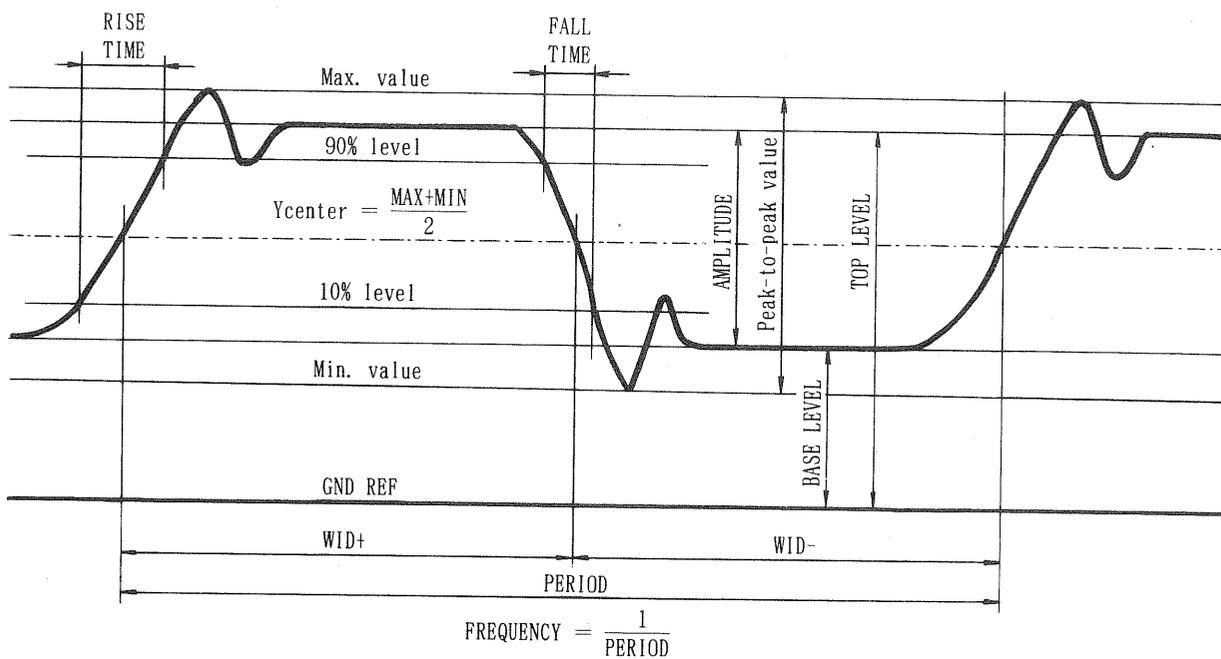
Fig. 8

1) PERIOD

The period of the first waveform from the left cursor within a preset cursor range is measured. Measurement applies to a channel selected as the trigger source. Carry out adjustment so that more than two periods of waves are within the cursor range. A measured value is displayed in the form of "PER ######s" on the screen.

2) FREQUENCY

The inverse number of the period shown above is found.
Carry out adjustment so that more than two periods of waves are within the cursor range. A measured value is displayed in the form of "FREQ ######Hz" on the screen.

3) PULSE WIDTH

The pulse width of the first waveform from the left cursor within a preset cursor range is measured. Measurement applies to a channel selected as the trigger source.
A pulse width in the positive direction (WID+) is measured if an applicable wave is rising.
A pulse width in the negative direction (WID−) is measured if an applicable wave is falling.
Accurate measurement is allowed if a single pulse is in the cursor range.
The width of a pulse in the positive direction is displayed in the form of "WID+#####s" on the screen. That of a pulse in the negative direction is displayed in the form of "WID−#####s."

4) RISE TIME

The rise time of the first waveform from the left cursor within a preset cursor range is measured. Measurement applies to a channel selected as the trigger source.
Carry out adjustment so that more than one period of waves are within the cursor range. A wave which rises to the peak within 0.1 division may not be measured accurately.
A measured value is displayed in the form of "RISE #####s" on the screen.

5) FALL TIME

The fall time of the first waveform from the left cursor within a preset cursor range is measured. Measurement applies to a channel selected as the trigger source. Carry out adjustment so that more than one period of waves are within the cursor range. A wave which falls to the bottom within 0.1 division may not be measured accurately. A measured value is displayed in the form of "FALL #####s" on the screen.

6) DELAY TIME
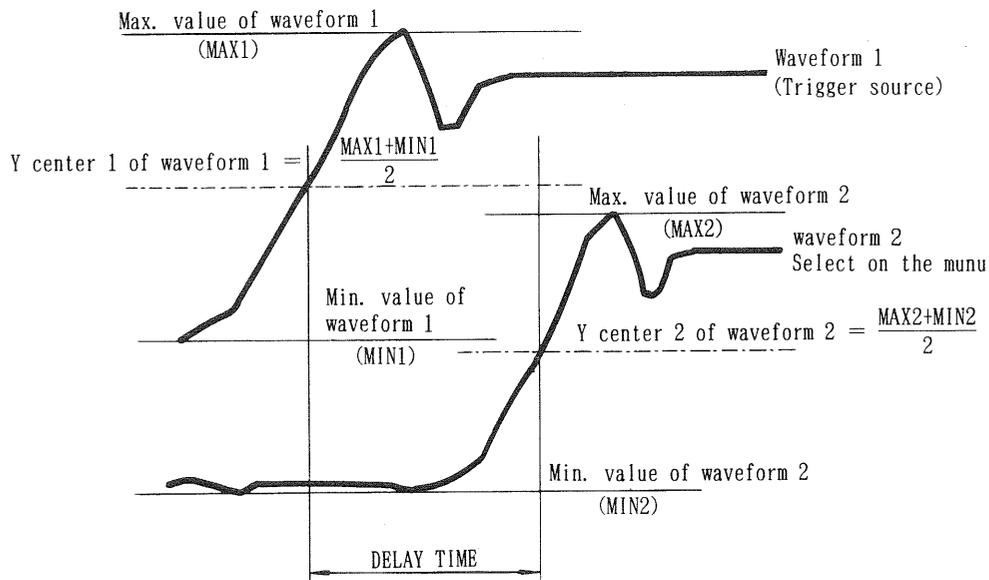
Fig. 9

[30] SUB-PARAMETER MENU

```
┌─────────────────────────────────┐
│          * PARAMETER *          │
│                                 │
│  1.  Delay to        CH1        │
│  2.  Delay Mode      ↑ to ↑     │
│  3.  Current Source  CH1        │
│  4.  Current Range   50mA/div   │
│                                 │
│                                 │
└─────────────────────────────────┘
```
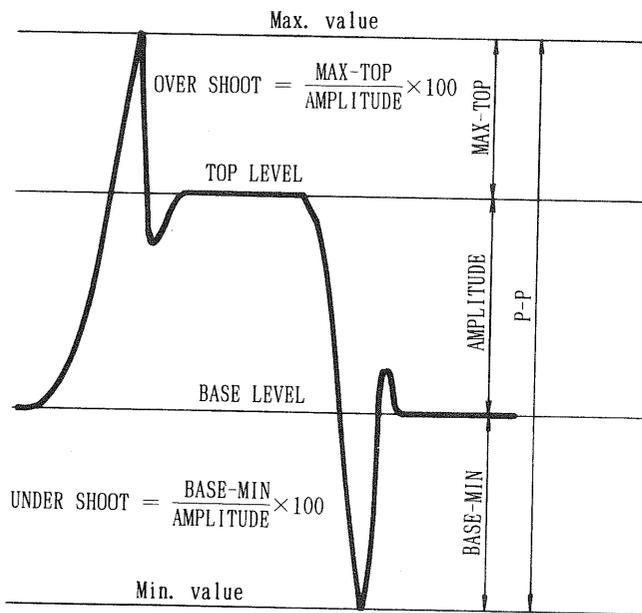

Over-Shoot and Under-Shoot

Fig. 10

If DELAY TIME is selected on the menu, the sub-parameter setting munu [30] appears. Specify a channel to be measured and measurement mode on this menu.

The waveform in the channel specified as the trigger source serves as the reference waveform. Time difference between it and the waveform in the channel specified on the subparameter setting menu is measured.

The centers of the peaks of both waveforms are used as the datum points. Measurement is performed in the positive direction only. Four measurement modes are available as shown below:

    a. Between leading edges (↑-↑)
    b. Between leading edge and trailing edge
$$(↑-↓)$$
    c. Between trailing edge and leading edge
$$(↓-↑)$$
    d. Between trailing edges (↓-↓)

Any of the above modes may be selected optionally. Accurate measurement is allowed if a leading or trailing edge is within each cursor range. A measured value is displayed in the form of "DLY #####s" on the screen.

7) OVER SHOOT

Over-shoot of a waveform in a channel selected as the trigger source is measured and displayed in percentage based on the amplitude.

$$\text{OVER SHOOT} = \frac{\text{MAX-TOP}}{\text{AMPLITUDE}} \times 100 \ [\%]$$

Accurate measurement is allowed if a waveform having a single leading edge and about a period is in the cursor range.

A measured value is displayed in the form of "OVRS #####%" on the screen.

8) UNDER SHOOT

Under-shoot of a waveform in a channel selected as the trigger source is measured and displayed in percentage based on the amplitude.

$$\text{UNDER SHOOT} = \frac{\text{BASE-MIN}}{\text{AMPLITUDE}} \times 100$$

Accurate measurement is allowed if a waveform having a single trailing edge and about a period is in the cursor range.

A measured value is displayed in the form of "UNDS #####%" on the screen.

9) PEAK to PEAK

The difference between the maximum and minimum values of a waveform in a channel selected as the trigger source is measured within the cursor range. A measured value is displayed in the form of "P-P #####V" on the screen.

10) VRMS

The effective voltage of a waveform in a channel selected as the trigger source is measured. It may not be measured by periods. Before measurement, the GND level (GND-REF) of the channel to be measured should be specified.

Return to the waveform display screen from the parameter setting munu [29] ; a "REF →" mark is displayed on the screen at the position where "5" is displayed on the R/O display screen. Press the F5 key ⑯ ; the GND level at that time is regarded as GND-REF for internal computation. A measured value is averaged based on the difference between it and GND-REF.
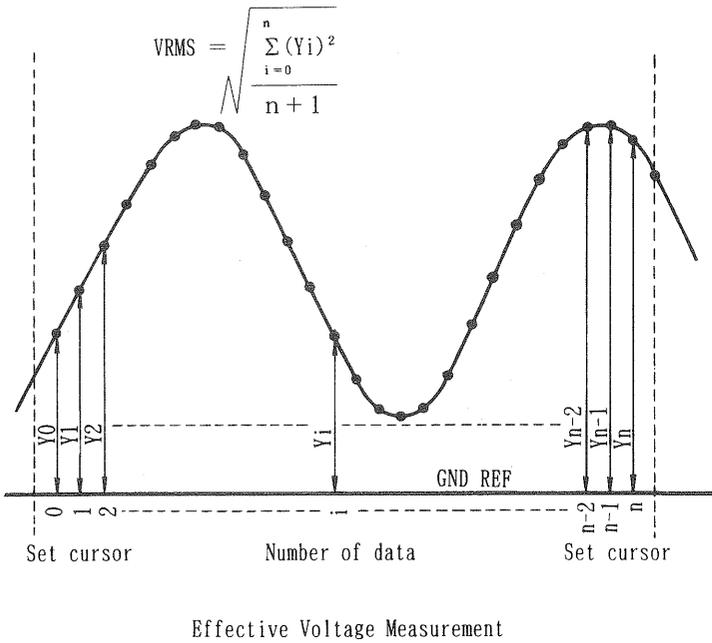
$$VRMS = \sqrt{\frac{\sum_{i=0}^{n}(Yi)^2}{n+1}}$$

$$VRMS = \sqrt{\frac{\sum_{i=0}^{n}(Yi)^2}{n+1}}$$

A measured value is displayed in the form of "Vrms #####V" on the screen.

Effective Voltage Measurement

Fig. 11

Display on R/O Screen

```
*******1*******        *******2*******
*******3*******        *******4*******
                       *17*####18####
                       *19*####20####
                       *21*####22####
Display setting on     *23*####24####
R/O screen


*******16******               **5**
***6***###7#####       *8  ##9### *10*
**11***###12####       *13 ##14## *15*
```
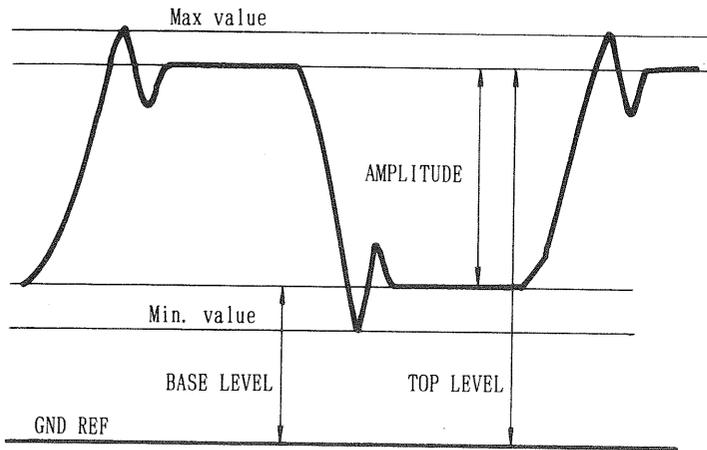
Fig. 12

11) TOP LEVEL

The data frequency of a waveform in a channel selected as the trigger source is measured in the cursor range.

The top point of data having the maximum frequency is detected, and the difference between it and GND-REF is regarded as the top level.

Before measurement, the GND level (GND-REF) of the channel to be measured should be specified.

Return to the waveform display screen from the parameter setting menu [29]; a "REF→" mark is displayed on the screen. Press the F5 key ⑯: the GND level at that time is regarded as GND-REF for internal computation. A measured value is displayed in the form of "TOP #####V" on the screen.

12) BASE LEVEL

The data frequency is measured in the cursor range. The bottom point of data having the maximum frequency is detected, and the difference between it and GND-REF is regarded as the base level.

Before measurement, the GND level (GND-REF) of the channel to be measured should be specified.

Return to the waveform display screen from the parameter setting menu; a "REF→" mark is displayed on the screen. Press the F5 key ⑯ ; the GND level at that time is regarded as GND-REF for internal computation.

A measured value is displayed in the form of "BASE #####V" on the screen.

13) AMPLITUDE

The difference between the top level in 11) and base level in 12) is found. It is displayed in the form of "AMP #####V" on the screen.

AMPLITUDE = TOP − BASE

14) POWER

The average power in the cursor range is measured. Measurement is not performed for each period.

Specify "POWER" on the menu [29], and the sub-parameter setting menu [30] appears. Specify a current waveform channel and current range. A waveform in a channel selected as the trigger source serves as voltage waveform.

Before starting measurement, GND-REF should be specified. Return to the waveform display screen from the parameter setting menu; a "REF→" mark is displayed on the screen. Press the F5 key ⑯; the GND level at that time is regarded as GND-REF for internal computation.

An average power is found from the product of differences from the GND-REF.

$$\text{POWER} = \frac{\sum_{i=0}^{n}(Vi \times Ii)}{n+1}$$

Average Power Measurement
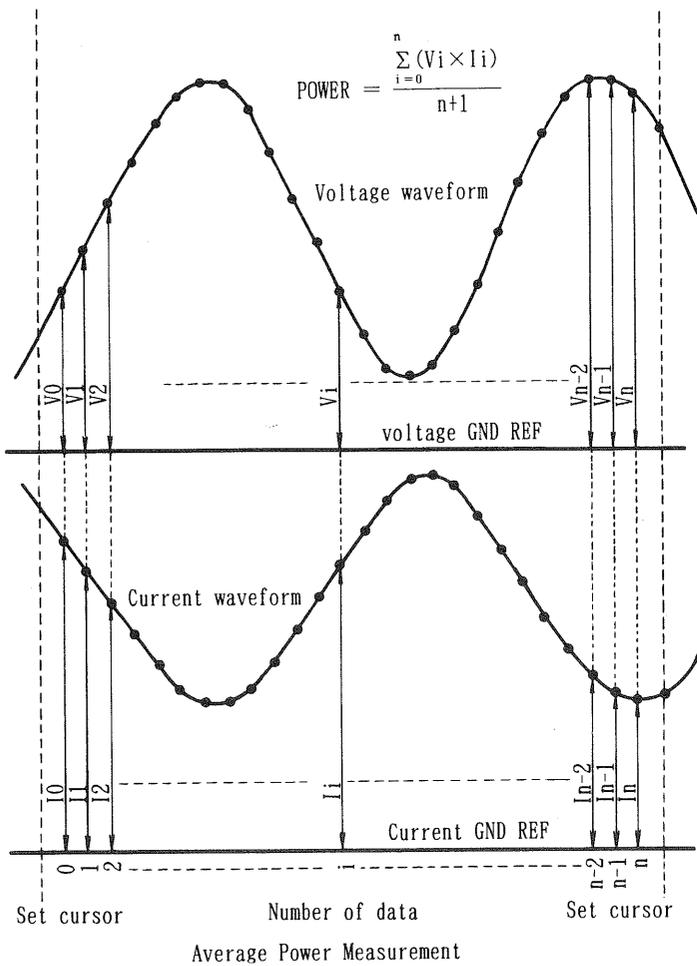
Fig. 13

$$\text{POWER} = \frac{\sum_{i=0}^{n}(Vi \times Ii)}{n+1}$$

An average power is displayed in the form of "PWR #####W" on the screen.

```
          * PARAMETER *

    1.  Delay to        CH1
    2.  Delay Mode      ↑ to ↑
    3.  Current Source  CH1
    4.  Current Range   50mA/div
```

[30] SUB-PARAMETER Setting Menu

┌─ NOTE ───┐
│ Accurate measurement is disabled unless GND-REF is specified. Be sure to specify it before │
│ measurement.   │
└───┘

┌─ NOTE ───┐
│ Once GND-REF is specified, it is stored internally unless the power is turned off. If the power │
│ is turned off, specify GND-REF again.   │
└───┘

┌─ NOTE ───┐
│ Specify GND-REF of four channels simultaneously. GND-REF need not be re-specified when a │
│ measurement channel is changed.   │
└───┘

50

```
┌─ NOTE ─────────────────────────────────────────────────────────────────────┐
│ Accurate measurement is disabled if setting of the POSITION control of the measurement channel │
│ is changed after GND-REF has been set.  If setting of the POSITION control is changed, set │
│ GND-REF again. │
└────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ─────────────────────────────────────────────────────────────────────┐
│ GND-REF may not be changed in ROLL or EQU mode.  Set GND-REF in the NORM mode, then select the │
│ ROLL or EQU mode. │
└────────────────────────────────────────────────────────────────────────────┘
```

4 Menu Readout

The main menu opens by pressing the MENU switch ⑨ in the normal operation.
The main menu is closed and the normal operation restarts by pressing the MENU switch ⑨ on the main menu. On any menu other than the main menu, pressing the MENU switch ⑨ opens the main menu.
F1 ⑫ to F5 ⑯ keys, SET switches ⑩ and ⑪, and △REF and △controls are used.
The menus have a tree-structure for finding an intended menu easily.
The main menu has the following sub-menus:

   0) Main menu ·············· [1]
   1) Processing menu ········ [2]
   2) Memory menu ············ [9]
   3) Set menu ··············· [13]
   4) Output menu ············ [20]
   5) Option menu ············ [25]

                          (Numbers enclosed in braces indicate the menu Nos. shown in the section
                          "Controls and Indicators".)

The following show the functions displayed on the sub-menus:

To execute a job set in the menu, exit from the menu screen to the ordinary screen of waveform display.
(Some functions are executable from the menu.) Back in the waveform display menu, execute the job by pressing the execution key assigned with the menu item (function). (Some functions are executed immediately after return to the waveform display screen.)

1) Processing menu ·············· [2]

   a) PEAK DETECT
   b) CALUCULATION
   c) AVERAGE
   d) INTERPOLATION
   e) GO/NO-GO

   a) PEAK DETECT ·············· [3]
       Set the peak detection mode as follows:
          MINIMUM: F1 ⑫
          MAXIMUM: F2 ⑬
          MAX/MIN: F3 ⑭
       On completion of setting, press the MENU switch ⑨ to return to the processing menu. To execute this function, press STORAGE MODE (PEAK) ㉕ on the panel.

b) CALCULATION •••••••••••••• [4]

Select calculation in CH1 and CH2 or CH3 and CH4 as follows:

In real-time mode: (+ only)

CH1 and CH2: F1 ⑫

CH3 and CH4: F2 ⑬

In storage mode: (+, −, ×, ÷)

CH1 and CH2: F3 ⑭

CH3 and CH4: F4 ⑮ <For the DCS-9320/9120, storage channels are only CH1 and CH2.>

Only calculated waveform is output in the storage mode.

On completion of setting, press the MENU switch ⑨ to return to the processing menu.

To execute this function, press ADD ㊳ on the panel.

c) AVERAGE •••••••••••••••••• [5]

Activate or deactivate storage algebraic sum function and set the number of additions.

Channel ON/OFF setting

CH1: F1 ⑫

CH2: F2 ⑬

CH3: F3 ⑭

CH4: F4 ⑮ <For the DCS-9320/9120, storage channels are only CH1 and CH2.>

Number of times: F5 ⑯ (Set value: 2, 4, 8, 16, 32, 64, 128 or 256)

On completion of setting, press the MENU switch ⑨ to return to the processing menu. To execute

this function, press AVG ㉕ on the panel.

d) INTERPOLATION •••••••••••• [6]

Set storage interpolation operation as follows:

OFF   : F1 ⑫

LINEAR: F2 ⑬

SINE : F3 ⑭

SPLINE: F4 ⑮

On completion of setting, press the MENU switch ⑨ to return to the processing menu.

This function is executed immediately when return to the waveform displayed screen.

e) GO/NO-GO •••••••••••••••••• [7] & [8]

Sets conditions for GO/NO-GO judgment.

In addition to "GO" or "NO-GO" displayed on the CRT, buzzer alarm and TTL-level output via the BNC

connector on the rear panel are provided.

JUDGE MODE: F1 ⑫ (OFF/V/VH)

BUZZER   : F2 ⑬ (OFF/GO/NO-GO)

OUTPUT   : F3 ⑭ (OFF/ON)

HOLD   : F4 ⑮ (OFF/GO/NO-GO)

Then, quit the menu by pressing the MENU switch ⑨; the range can be set and screen chainged for GO/

NO-GO mode may be executed.

The GO/NO-GO range setting screen appears and four cursors are displayed on it.

Use the △REF ⑲ and △ ㉑ to specify the range.

Change the vertical and horizontal cursors with the cursor mode switch ⑱.

On completion of setting, press the MENU switch ⑨ to execute GO/NO-GO judgment.

```
┌── NOTE ──────────────────────────────────────────────────────────────────────┐
│ In the operation of four rules of arithmetic (+, −, ×, ÷), use the correct channel for GO/NO│
│ -GO judgment as follows:                                                        │
│ For CH1 and CH2, set TRIG SOURCE ㉗ to CH1 or CH2.  For CH3 and CH4, set TRIG SOURCE to CH3│
│ or CH4. <For the DCS-9320/9120, judgment channels are only CH1 and CH2.>        │
└────────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ PENOUT output is not available in the GO/NO-GO mode.                         │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Once HOLD is activated in the GO/NO-GO mode, DISPLAY ADDRESS cannot be changed.  To change it, │
│ exit from the GO/NO-GO mode.                                                 │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ The local mode is unusable in the GO/NO-GO mode.                            │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ A INT B, ALT, and X-Y cannot be used for H-MODE in the GO/NO-GO mode.       │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ In the GO/NO-GO mode, TRIG SOURCE ㉗ takes on another function of selecting a GO/NO-GO │
│ judgment channel.  Thus, VERT and LINE are not usable.                      │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Cursor measurement is disabled in the GO/NO-GO mode.                        │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ If automatic waveform parameter measurement is selected in the GO/NO-GO mode, the GO/NO-GO │
│ mode is deactivated automatically.                                          │
└──────────────────────────────────────────────────────────────────────────────┘
```

2) Memory menu ·················· [9]

    a) DISPLAY ADDRESS
    b) MEMORY SIZE
    c) REFERENCE MEMORY

    a) DISPLAY ADDRESS ·········· [10]
        Select the memory capacity, 16k words or 2k words×8, and set display scroll in hold magnification.
          OFF: F1 ⑫
          ON : F2 ⑬
        On completion of setting, press the MENU switch ⑨ to return to the memory menu.
        This function is executed immediately after the menu reappears.

    b) MEMORY SIZE ·············· [11]
        Select the memory size.
          2K : F1 ⑫
          16K : F2 ⑬
          2K*8: F3 ⑭
        On completion of setting, press the MENU switch ⑨ to return to the memory menu.
        This function is executed immediately when return to the waveform displayed on the screen.

    c) REFERENCE MEMORY ·········· [12]
        Select the memory for saving the reference waveform for each channel.
          CH1 : F1 ⑫
          CH2 : F2 ⑬
          CH3 : F3 ⑭

CH4 : F4 ⑮
　<For the DCS-9320/9120, storage channels are only CH1 and CH2.>
On completion of setting, press the MENU switch ⑨ to return to the memory menu.
This function is executed immediately when return to the waveform displayed on the screen.

3)　SET MENU ·················· [13]

　　a)　TV MODE
　　b)　BUZZER
　　c)　DISPLAY OFFSET
　　d)　TIME SET

　　a)　TV MODE ················· [14]
　　　　Select a video signal type for the video line counter function.
　　　　The automatic NTSC/PAL discrimination function may be selected.
　　　　　AUTO (NTSC/PAL): F1 ⑫
　　　　　NTSC　　　　　　: F2 ⑬
　　　　　PAL　　　　　　 : F3 ⑭
　　　　On completion of setting, press the MENU switch ⑨ to return to the set menu.
　　　　This function is executed immediately when return to the waveform displayed on the screen.

　　b)　BUZZER ··················· [15]
　　　　Set the mode of the built-in buzzer.
　　　　　OFF　　 : F1 ⑫
　　　　　ON KEYIN: F2 ⑬ (When the panel switch is pressed (Rotary encoder not included))
　　　　　ON ERROR: F3 ⑭ (When an invalid switch is pressed (such as the ×10MAG switch in the storage
　　　　　　　　　　　　　mode)
　　　　　ALL　　 : F4 ⑮ (Functions in both the KEYIN and ERROR modes.)
　　　　On completion of setting, press the MENU switch ⑨ to return to the set menu.
　　　　This function is executed immediately when return to the waveform displayed on the screen.

　　c)　DISPLAY OFFSET ············ [16]
　　　　This function corrects deviation of the full-scale cursor positions due to the earth magnetism.
　　　　Four cursor lines appear on the screen.　Bring the X-axis cursor to the ±4 div position on the
　　　　screen scale using ∆REF control ⑲, and the Y-axis to the ±3 div position on the screen scale
　　　　using ∆ control ㉑.　After setting the cursor lines, return to the SET MENU using MENU switch ⑨.

　　d)　TIME DISPLAY ·············· [17]
　　　　The time display menu appears and allows the following setting:
　　　　　OFF　　　 : F1 ⑫ (Time is not displayed on the waveform display screen.)
　　　　　ON TIME　 : F2 ⑬ (Current time display mode)
　　　　　TRIG TIME: F3 ⑭ (Trigger time stamp display mode)
　　　　　TIME SET : F4 ⑮ (Sets the current time.)
　　　　If TIME SET is selected, the time set menu [18] is displayed, allowing the following setting:
　　　　　YEAR　 : F1 ⑫
　　　　　MONTH　: F2 ⑬
　　　　　DAY　　: F3 ⑭
　　　　　HOUR　 : F4 ⑮
　　　　　MIN　　: F5 ⑯
　　　　Select the item to be changed, then change the setting with the SET switches ⑩ and ⑪ and
　　　　∆REF control.

54

On completion of setting, press the MENU switch ⑨; The value is determin after the time set menu reappears.

e) DELAY TIME UNIT .... [19]
   Select "div." or "sec." as the unit of setting the pretrigger and post-trigger.
      sec. MODE: F1 ⑫
      div. MODE F2 ⑬
   On completion of "div." or "sec." selection, press the MUNU switch ⑨ to return to the option menu.

4) OUTPUT MENU .... [20]

   a) PEN OUT
   b) PLOT OUT
   c) RS-232C

   a) PEN OUT .... [21]
      Set the following in order to output screen data to an analog pen recorder:
         OUTPUT: F1 ⑫ (Output mode setting; OFF, WAVE or +SCALE)
                 WAVE   : Outputs waveform only.
                 +SCALE : Outputs waveform and scale.
         CAL   : F2 ⑬ (Turns on/off the output of 10 div × 10 div square waveform.)
         SPEED : F3 ⑭ (Output speed setting per word; 10, 50, 100 or 500ms/word)
      On completion of setting, press the MENU switch ⑨ to return to the output menu.

   b) PLOT OUT .... [22]
      Set the following in order to output screen data to a digital pen plotter:
      This setting is common to the GP-IB and RS-232C.
         OUTPUT : F1 ⑫ (Output mode setting; OFF, WAVE, +READOUT, +SCALE or ALL)
                   WAVE   : Outputs waveform only.
                   +READOUT: Outputs waveform and readout settings.
                   +SCALE : Outputs waveform and scale.
                   ALL   : Outputs waveform, readouts and scale.
         SETTING : F4 ⑮ .... [23] (Specifies PEN number for waveform, readout, and scale.)
                   WAVE PEN   : F1 ⑫ (SAME=PEN1, /CH=1, 2, 3, 4)
                   SCALE PIN : F2 ⑬ (1 to 8)
                   READOUT PEN: F3 ⑭ (1 to 8)
                   PAPER   : F4 ⑮ (A3, A4)
                   MODE   : F5 ⑯ (Output position selection 1/4, 2/4, 3/4 or 4/4)
                       1/1: 1 screen on 1 sheet of paper
                       1/4: 1st field of 4-division output.
                       2/4: 2nd field of 4-division output.
                       3/4: 3rd field of 4-division output.
                       4/4: 4th field of 4-division output.

1/4	2/4
3/4	4/4
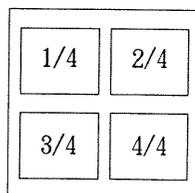
NOTE: Automatic increment function is built in. If started at 4/4, the next number is automatically 1/4.

   On completion of setting, press the MENU switch ⑨ to return to the output menu.

c) RS-232C ·················· [24]
   Select the following for the RS-232C interface:
      SPEED : F1 ⑫ (Baud rate: 1200, 2400, 4800 or 9600)
      PARITY: F2 ⑬ (Parity: None, odd or even)
      BIT   : F3 ⑭ (7 or 8 bits)
   On completion of setting, press the MENU switch ⑨ to return to the output menu.

5) OPTION MENU ·················· [25]

   a) AUTO SET (AUTO RANGE)
   b) PROGRAM
   c) PARAMETER
   d) COMMENT
   e) STATUS

   a) AUTO SET (AUTO RANGE) ···· [26]
      Set the following:
        MODE: F1 ⑫ (Mode setting: Vertical, horizontal or both; OFF/V/H/VH)
        V   : F2 ⑬ (Set the vertical direction amplitude: 2/4)
        H   : F3 ⑭ (Set the horizontal direction amplitude: 2/4)
      On completion of setting, press the MENU switch ⑨ to return to the option menu.
      To execute this function, press the AUTO SET key ⑰ on the panel.

   b) PROGRAM ·················· [27]
      Set the following in order to store on-panel settings:
        MODE : F1 ⑫ (Program OFF/RUN/EDIT)
        GROUP : F2 ⑬ (Program group No.: 1 to 5)
        REPEAT: F3 ⑭ (Final step No. in group: 2 to 20)
      Select the EDIT mode first, then select a group No. press the MENU switch ⑨; the program edit
      screen [28] appears.
      (The menu is quit temporarily, and group No. and step No. are displayed on the waveform displayed
      screen.)
      The previous panel setting for the number is displayed. The set No. may be changed with the SET
      switches ⑩ and ⑪. As the set No. is changed, the panel setting also changes.
      Set the condition to be stored on the panel with these switches.
        SAVE : F1 ⑫ (Displayed panel setting is stored for the current set No. It is overwritten over
                     the previous step.)
        INS : F2 ⑬ (Displayed panel setting is inserted in the current set No. The previous steps are
                     incremented by one.)
        DEL : F3 ⑭ (The previous steps are deleted.)
        CALL : F4 ⑮ (The panel setting before opening this menu is restored.)
        EXIT : F5 ⑯ (Program editing is terminated, and program menu reappears.)
      Select the RUN mode, set any repeat No., then press the MENU switch ⑨; the menu mode is quit, and
      the program runs in the above setting.

   c) PARAMETER ··············· [29]
      Select a maximum of four items of fourteen automatic parameter measurement items.
        Selection keys: ↑→ SET ⑩, ←↓ ⑪
        Setting   : Select the first item with the F1 key ⑫.
                        : Select the second item with the F2 key ⑬.
                        : Select the third item with the F3 key ⑭.
                        : Select the fourth item with the F4 key ⑮.

Normal Screen   [30] Sub-Parameter Menu

```
┌─────────────────────────────────────┐   ┌─────────────────────────────────────┐
│ *******1*******    *******2*******   │   │          * PARAMETER *              │
│ *******3*******    ********4*******  │   │                                     │
│                    *17*####18####    │   │                                     │
│                    *19*####20####    │   │  1.  Delay to        CH1            │
│                    *21*####22####    │   │  2.  Delay Mode      ↑ to ↑         │
│                    *23*####24####    │   │  3.  Current Source  CH1           │
│                                      │   │  4.  Current Range   50mA/div       │
│                                      │   │                                     │
│ *******16******         **5**        │   │                                     │
│ ***6***###7#####    *8  ##9### *10*  │   │                                     │
│ **11***###12####    *13 ##14## *15*  │   │                                     │
└─────────────────────────────────────┘   └─────────────────────────────────────┘
```

Move the ">" mark to an intended item with the SET keys ⑩ and ⑪. A press of the F1 key ⑫
selects the item. Likewise, select other items with the F2, F3 and F4 keys. If an item in the
OFF area is selected, automatic parameter measurement is not executed. The F1 to F4 keys correspond
to the display positions (17-18), (19-20), (21-22) and (23-24) on the normal screen.
The option menu [25] reappears by pressing the MENU switch ⑨. If "DELAY" or "POWER" is selected as
a measurement item, the sub-parameter munu [30] appears, which allows the following setting:

    Delay to   : F1 ⑫ (Select a channel whose delay time shall be measured. The waveform in a
                     channel selected as the trigger source is used as the reference waveform.)
    Delay Mode   : F2 ⑬ (In case the delay time is to be measured, select any of the following
                     four modes:
                     Between leading edges (↑ to ↑)
                     Between leading edge and trailing edge (↑ to ↓)
                     Between trailing edge and leading edge (↓ to ↑)
                     Between trailing edges (↓ to ↓)
Current Source: F3 ⑭ (Specify a current channel if power measurement is selected.)
Current Range : F4 ⑮ (Specify a current range if power measurement is selected. In fifteen
                     ranges between 1 mA and 50 A.)

┌─ NOTE ──┐
│ If the GO/NO-GO mode has been selected, it is deactivated automatically.   │
└──┘

┌─ NOTE ──┐
│ Do not use comment No.10 in automatic parameter measurement.   │
└──┘

┌─ NOTE ──┐
│ Automatic parameter measurement may not be executed if waveform computation is selected. │
└──┘

d) COMMENT ·················· [31]
    Enter a comment to be displayed on the normal screen.
      DISPLAY   : F1 ⑫ (Comment display ON/OFF)
      COMMENT EDIT: F3 ⑭ (Opens the comment edit mode.)
    The comment edit screen [32] allows the following entry and editing:
      Cursor Up   : F1 ⑫
      Cursor Down   : F2 ⑬
      Cursor Left   : F3 ⑭
      Cursor Right   : F4 ⑮
      Character selection: SET switches ⑩ and ⑪ or △REF control ⑲.
      Character setting : F5 ⑯

Press the MENU switch ⑨ to terminate editing and return to the comment menu.

If DISPLAY is set to ON, the comment is displayed when the normal screen is re-displayed by pressing the MENU switch ⑨.

e) STATUS ･･･････････････････ [33]

Setting is displayed as follows:

```
              ⁑ STATUS ⁑
PEAK DETECT ･･･････････････ MAX
CALC REAL      CH1+CH2  CH3  CH4
CALC STORAGE   CH1−CH2  CH3×CH4
AVERAGE CH1 CH2 CH3 CH4 TIMES 256
INTERPOLATION ･･･････････ SPLINE
DISPLAY ADDRESS ･･･････････ ON
MEMORY SIZE ･････････････ 2K
REFERENCE ･･････ CH1 CH2 CH3 CH4
TV MODE ･･･････････････ AUTO
BUZZER ･･･････････････ ALL
TIME DISPLAY ･････････ ON
PEN OUT ･･･････････････ OFF
PLOT OUT ･･････ A4 1/1 + SCALE
RS232C      1200bps NONE 7bit
AUTO SET ･･･････････ VH V:2 H:4
```

<For the DCS-9320/9120, the "REFERENCE" and "CALC STORAGE" option in the menu does not include "CH3" and "CH4".>

Press the MENU switch ⑨ to return to the option menu.

[C] Digital Storage Oscilloscope Operations

The DCS-9300 [9100] may be used as a digital storage oscilloscope in the same manner as using the real-time oscilloscope functions.

1 Normal Sampling

1) Press the SCOPE MODE ㊱ to select the storage mode.

If no storage function is selected, the normal sampling mode is established.

2) Select the channels for observation, set the trigger source, perform triggering, etc. in the same manner as the real-time functions. Through these operations, digitally-converted signals are displayed on the CRT.

① HOLD

If the HOLD switch is pressed, the previous input waveform may be held and displayed.

During holding, no other signal data are read. Held data is displayed continuously.

The vertical and horizontal positions (FINE) may be adjusted during holding.

┌─ NOTE ──┐
│ ･In the HOLD state, VOLTS/DIV ㊽, �54, �59, and ㊎ do not work. │
│ ･When SWEEP TIME/DIV ⑦ is used for expansion, in the HOLD state, in the HOLD state, the │
│ fifth division serves as the center of expansion. │
│ ･If AUTO SET is performed in the realtime mode, the memory contents are not stored. │
└──┘

58

② DISPLAY ADDRESS

If DISPLAY ADDRESS on the menu is set to ON, an address of screen display in the hold mode is displayed.

Change it with the △REF and SET switch ⑩, ⑪. The address changes by 2k words if the memory capacity is set to 2k words×8. Or, it changes continuously if the memory capacity is set to 16k words or in the hold magnification mode (except that the cursors are displayed). "ADDR xxxx-xxxx" is displayed on the CRT. When the current selection is 2k words×8, addresses change from 0 to 16,383 in units of 2k words. When the current selection is 16k-word, addresses consecutively change from 0 to 16,371. (In the ROLL mode, addresses 0 to 16383 are displayed.)

③ SINGLE SWEEP

Single sweep may be set like the real-time operation.
The instrument is ready for single sweep by pressing the RESET switch.

2 Pre- and Post-Triggering

Pre-triggering and post-triggering offer a wide range of setting of the trigger point of the signal used for storage operation.

1) Select a channel to be observed, specify the trigger source, and set the trigger level.

2) Select the pre- or post-triggering.

3) Select single sweep to observe once-only events or sudden events.

① PRE TRIG

Set necessary time or number of divisions with the △REF control and SET switch ⑩, ⑪. In the pre-trigger mode, data are stored and displayed from the point before the trigger point by the time or number of divisions set with the △REF control and SET switch ⑩, ⑪.
The pre-triggering range is between 0 and -80 divisions. (If it is set in time, the time shall correspond to the above.) (For 2K or 2K×8 of memory, the range is between 0 and -10 divisions.)

② POST TRIG

Like the pre-triggering, set necessary time or number of divisions with the △REF control and SET switch ⑩, ⑪.
In the post-trigger mode, data are stored and displayed from the point after the trigger point by the time or number of divisions set with the △REF control and SET switch ⑩, ⑪. The post-triggering range is between 0 and 10000 divisions. (If it is set in time, the time shall correspond to the above.)

┌─ NOTE ──┐
│ The setting value for pre- or post-triggering takes on the value that is set when the sweep │
│ start point is set to the leftmost scale of the CRT screen. │
└──┘

3 Equivalent Sampling

Data storage operation is enabled in the equivalent sampling method faster than 2μs/division [5μs/division]. By using the equivalent sampling function, signals repeating at high speed can always be observed in the storage mode at the highest resolution of this instrument.

1) Select a channel to be observed, specify the trigger source, and set the trigger level.

2) Set the SWEEP TIME/DIV to a value faster than 2μs/division [5μs/division]. (This cannot be set in B sweep.) Then, press the EQU switch.

3) The hold function may be used in the same manner as in the normal sampling mode.

4 Roll Sweep

Data storage is enabled in the roll sweep mode in a range slower than 0.1s/division.
In the roll sweep mode, input signals are digitally converted and displayed uninterruptedly. Thus, all events can be observed without omission.

1) Select a channel to be observed.

2) Set the SWEEP TIME/DIV to a value slower than 0.1s/division. Then, press the ROLL switch.

3) The hold function may be used in the same manner as in the normal sampling mode.

5 Peak Hold

If signals are observed at a sweep speed much slower than the repetition frequency of the signal, aliasing (Note 1) may occur, disabling accurate measurement, in some conditions.
Or, if the signals observed at a low speed contain high-frequency spikes more than 1000 times as high as the main frequency, accurate data reading is disabled, since the horizontal resolution of this instrument in the storage mode is 2000 points. Such spikes may exceed the horizontal resolution.
In such a case, possibility of reading spikes, etc. depends on cases.
When observing such signals, the peak hold function avoids aliasing and reads securely spikes having time width over the rating of this instrument.

1) Select a channel to be observed, specify the trigger source, and set the trigger level and SWEEP TIME/ DIV. (Effective sweep range: 10μs/div to 500s/div)

2) Press the PEAK switch. (From the menu, select one of the three modes:)

① MAX/MIN
The maximum and minimum values (Note 2) of the input signal are displayed.
If a high-frequency signal is observed at low sweep speed, the periphery of the signal is the envelop.

② MAX
The only maximum value of the input signal is displayed.
Select this mode in order to observe the true maximum value (positive) of waveform containing ripples or spikes whose appearing positions are known.

③ MIN
The only minimum value of the input signal is displayed.
Select this mode in order to observe the true minimum value (negative) of waveform containing ripples or spikes whose appearing positions are known.

Note 1: Aliasing

If a frequency having a certain bandwidth is sampled at a frequency less than half of the former frequency, the difference frequency components between the signal to be observed and sampling frequency are composed. The digital storage oscilloscope displays the difference components, disabling accurate observation in some cases. The digital conversion timing clock used in this instrument has quite high accuracy and stability. Thus, if the frequency of the signal to be observed is stable, the composed waveform including the difference components is also stable, and observation is liable to errors.

Note 2: Maximum value (and minimum value)

The maximum and minimum values denote the maximum and minimum values of the input signal within 1 sampling interval of preset sweep time.

6 Averaging

If signals to be observed are repeated though they contain random noises, an algebraic sum of the repetitions is calculated for improved S/N ratio.
This instrument can average 2 to 256 times of repetitions.
(In the menu, set the channel to be averaged and the number of averaging times.)

1) Select a channel to be observed, specify the trigger source, and set the trigger level and SWEEP TIME/DIV.

2) Press the AVG switch. Set a number of averaging with the MENU switch ⑨.

3) The hold function may be used as in the normal sampling mode. If the HOLD is pressed in process of averaging, averaging operation continues until the number of averaging operations reaches the set value, then data is held.

> --- NOTE ---
> If the vertical position is controlled during holding, averaging applies to both the waveform data while and after controlling the vertical position (including the changed position). If the changed position shall be executed from averaging, use the following averaging sequence after completion of position control.
> On completion of holding, the vertical position may be changed by using the display offset, regardless of storage data. Thus, the position may be changed without corrupting averaging data.

7 Interpolation

If an event repeating at high speed need be observed in a range over the maximum resolution (2μs/division [5μs/division]), it can be observed at high resolution by using the equivalent sampling. However, the equivalent sampling is not effective for once-only events or sudden events. For such events, the interpolation function can improve the resolution of low-resolution data.
After conducting HOLD, an enlarged waveform can be interpolated.

1) Select a channel to be observed, specify the trigger source, and set the trigger level and SWEEP TIME/DIV.

2) Select an interpolation function on the menu.

① Linear interpolation
Intervals between sampled data are interpolated linearly.

② Sine interpolation

Intervals between sampled data are interpolated using a function SIN(x)/x. Physically, data are filtrated by an ideal low-pass filter having the cross-over frequency which is half of the maximum sampling frequency.

③ Spline interpolation

Intervals between sampled data are interpolated using a function which minimizes the secondary derivatives of the interpolation functions. (Data are interpolated using the most smooth curve.)

8 Reference Waveform Memory

The DCS-9300 [9100] has 16k-word reference waveform memory for each channel, in addition to 16k-word acquisition memory for each channel.
This reference waveform memory is capable of storing the data in the acquisition memory.

1) On the menu, select a channel to be observed, activate the reference waveform memory of the channel, specify the trigger source, set the trigger level and SWEEP TIME/DIV, then read data.

2) Press the HOLD switch to hold data.

3) Then, press the SAVE switch; data in the acquisition memory are copied and stored in the reference waveform memory.

4) The reference waveform memory of each channel can be activated or deactivated on the menu, enabling data to be observed together with acquisition memory display of each channel.

5) The vertical position of the output data from the reference waveform memory may be adjusted with the TRACE - SEPARATION control. The intensity may be adjusted with the B INTENSITY control ⑧.

```
┌─ NOTE ────────────────────────────────────────────────────────────────────────┐
│ Attention should be paid when attempting averaging with memory size set to 16k word. That is,│
│ averaging CH3 rewrites the reference waveform data stored for CH1 and CH2. Similarly, averaging CH4│
│ rewrites the reference waveform data stored for CH3 and CH4. However, the results of averaging│
│ can be stored for all four channels. <For the DCS-9320/9120, storage channels are only CH1 and CH2.>│
│ A waveform in the magnified range (1μs/div [2μs/div] to 20μs/div [50μs/div]) cannot be stored│
│ as a reference waveform.                                                        │
└────────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ────────────────────────────────────────────────────────────────────────┐
│ With the memory size set to the 16K words mode, the effective display address of the reference│
│ waveform is 0-16383 in the ROLL mode, and 0-16371 in the NORM mode. When the waveform data saved in│
│ the NORM mode is viewed in the ROLL mode, the waveform data at and after address 16371 becomes│
│ invalid.                                                                        │
└────────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ────────────────────────────────────────────────────────────────────────┐
│ If the expansion mode is established when the reference waveform is displayed, the reference│
│ waveform becomes a trace line at and after display address 16371 (or 16383).     │
└────────────────────────────────────────────────────────────────────────────────┘
```

9 Operation Functions <For the DCS-9320/9120, the calculation function is available in CH3 or CH4.>

The DCS-9300 [9100] is capable of calculating stored CH1-CH2 data or CH3-CH4 data.

1) Select a channel to be observed, specify the trigger source, set the trigger level and SWEEP TIME/DIV, then read data.

2) Select any of the following four operations on the menu. To execute this function, press ADD ⊗ on the panel. (The following description also applies to CH3 and CH4 by replacing "CH1" and "CH2" with CH3 and CH4.)

① +
    Stored CH1 and CH2 waveform data are added and displayed. (CH1+CH2)
    If CH2 INV is specified, CH1 data is added to phase-inverted CH2 data, or a result of subtraction CH1-CH2 is displayed.

② −
    Stored CH2 data is subtracted from CH1 data and displayed. (CH1−CH2)

③ ×
    Stored CH1 and CH2 data are multiplied. (CH1×CH4)
    Multiplication is performed from the CRT center in units of divisions.
    (1 division×1 division=1 division)

④ ÷
    Stored CH1 data is divided by CH2 data. (CH1/CH2)
    Division is performed from the CRT center in units of divisions. (1 division÷1 division=1 division)
    Results of division by 0 are distributed to the maximum or minimum value in accordance with the signs.

    ┌─── NOTE ──┐
    │ The CRT center is regarded as zero for addition, subtraction, division and multiplication. │
    │ If CH2 or CH4 data close to the CRT center is used for division, calculation result may exceed │
    │ the CRT display range. │
    └──┘

    ┌─── NOTE ──┐
    │ In the X-Y mode for four rules of arithmetic, selecting CH1 or CH2 as the trigger source │
    │ causes the X-axis to represent the results of arithmetic operation on CH1 and CH2. Similarly, │
    │ selecting CH3 or CH4 as the trigger source causes the X-axis to represent the results of │
    │ arithmetic operation on CH3 and CH4. │
    └──┘

10 Smoothing function

If random noise is included in the signal under observation, the smoothing function reduces the RF component which provides noise to single-shot signals.

1) Select the channel subject to observation, and set the trigger source, trigger level and SWEEP TIME/DIV.

2) Press the 20MBW switch.

3) Depending on the input signal, the displayed waveform may be different from the true waveform.

11 Others

1) TRIG TIME STAMP

If TRIG TIME display is selected on the menu, the time when trigger signal is input is displayed in the calendar display position in the single sweep storage mode.
In this case, "T" is displayed between the time and month/day.

[D] Programmable Oscilloscope Operations

1 Writing and Reading Program

The DCS-9300 [9100] stores 100 panel settings and reproduces them easily. (Program step is divided into 5 blocks.) The SET switches ⑩ and ⑪ or the program step input BNC terminal on the rear panel are used for program creation (and correction), and step-up and step-down when executing the program. (The program step terminal is used for step-up only.)

1) Writing Program

① Open the PROGRAM sub-menu on the main menu.
   MODE: OFF, RUN or EDIT
     RUN : Program execution mode
     EDIT: Program creation and edition mode
   GROUP: 1 to 5
     1   2   3   4   5
     1～20 1～20 1～20 1～20 1～20
   REPEAT: 2 to 20
     Set a step No. for repeating execution of the program. If a repetition No. is set to 4, steps are executed as follows:
       $1 \to 2 \to 3 \to 4 \to 1 \to 2 \to 3 \to 4 \to 1$ •••• (Or $4 \to 3 \to 2 \to 1 \to 4 \to 3 \to$ •••)

   Writing (or correcting) program

```
            * PROGRAM *

    1.   MODE  : EDIT
    2.   GROUP : 5
    3.   REPEAT: 12
```

② To store the setting displayed on the CRT, select the EDIT mode.
   Then, select a group No. with F2 ⑬.
   Press the MENU switch ⑨ to display the program screen.

③ Change the set No. with the SET switches ⑩ and ⑪.

④ To change the setting of the current set No., change the setting on the panel, then press the SAVE switch (F1 ⑫). (Overwrite)

⑤ If the INS switch (F2 ⑬) is pressed, panel setting is written in the current set No. The panel setting before pressing the INS switch is written in the following set No. Further settings are written in 1 larger set Nos.

⑥ If the DEL switch (F3 ⑭) is pressed, panel setting of the currently-displayed set No. is deleted. The settings following this No. are written in 1 smaller Nos.

⑦ If the CALL switch (F4 ⑮) is pressed, the panel setting immediately before opening the program menu can be called. Saving, insertion, etc. are effective for the called setting.

Program setting menu

```
############### ################
GROUP 5 No. 20  ################
                    1.  SAVE
                    2.  INS
                    3.  DEL
                    4.  CALL


############### ################
############### ################
```

⑧ On completion of setting, pres the MENU switch ⑨ to return to the program sub-menu.

⑨ Select the final step No. with the REPEAT switch (F3 ⑭).
The selected step is the final step when program steps are executed repeatedly.

┌─ NOTE ───
When INS operation is made, the previously stored setting for the 20th step is lost because the setting for the 19th step is written. When DEL operation is made, however, the setting for the 20th setting remains even after the setting for the 19th step is written.
└──

2) Reading Program

In this mode, the program set in the program write mode is executed.

① Open the program sub-menu on the main menu.

② Choose RUN from MODE (F1⑫), then select a group number. Pressing the MENU switch ⑨ calls up the PROGRAM screen. The screen shows the number of PROGRAM, indicating that the PROGRAM state is now in effect.

③ The set No. may be increased and decreased with the SET switches ⑩ and ⑪. As the set No. is changed, corresponding panel setting is displayed.
The program No. may be increased by grounding the PROGRAM STEP input BNC terminal ㊇ on the rear panel.

④ To terminate the program, open the program sub-program from the main menu, then deactivate the program mode.

> **NOTE**
> If automatic parameter measurement requiring GND-REF is selected in the program, GND-REF is read automatically when changing a step.

2 GO/NO-GO Operation (Data judgment)

Result of judging whether or not data is within a set range is output.

mode V   mark : ⊽ / ⊥   mode V   mark : ⊥ / ⊽

NG	GO
GO	NG
NG	GO

mode VH mark : ⊢⊽⊣   mode VH mark : ⊢⊥⊣   mode VH mark : ⊣⊽⊢   mode VH mark : ⊣⊥⊢

NG	GO	NG	NG	GO	GO
GO	NG	GO	GO	NG	NG
NG	GO	NG	NG	GO	GO
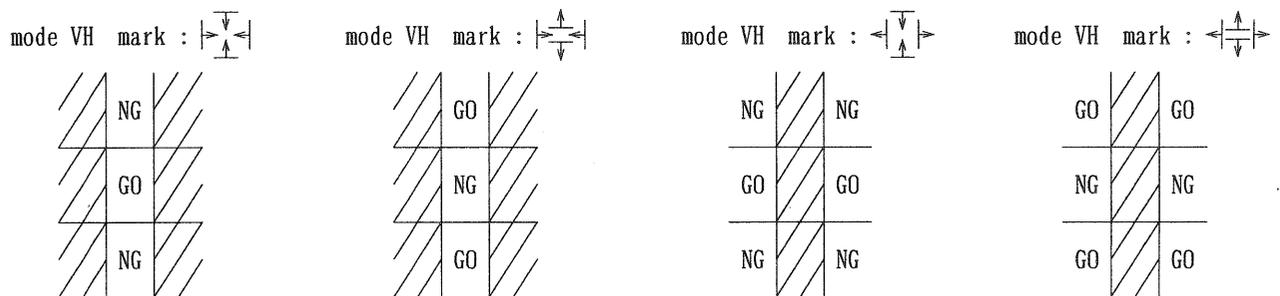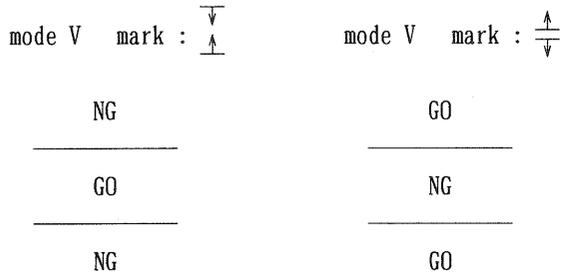
No judgment is made in the part ⧄ .

1) Open the GO/NO-GO sub-menu from the main menu.

2) Select a judge mode (OFF, V or VH) with the F1 switch ⑫. (If OFF is selected, the GO/NO-GO mode is canceled.)
   Likewise, set BUZZER, TTL OUT, and HOLD as output indicators.

3) Then, press the MENU switch ⑨ to open the GO/NO-GO menu. Determine the range with the cursor mode switch, ΔREF and Δ.
   Use TRIGGER FOURCE ㉗ to select the channel to be judged.

4) If the range is specified, the GO/NO-GO judgment starts immediately.

> **NOTE**
> The GO/NO-GO mode works in the storage mode only. If TTL OUT is selected as an output indicator, pen out is disabled. Once HOLD ON is selected and the data is held, the HOLD condition persists unless judgment is disabled set by changing the judgment cursor. Cursor measurement is disabled in the GO/NO-GO judgment mode.

[E] Output to Pen Recorder and Plotter

1 Output to Analog Pen Recorder

> **NOTE**
>
> When turning on or off the power to the oscilloscope, be sure to turn off the power to the pen recorder or unplug the connecting cable.

Before outputting data to a pen recorder, set the output conditions (OUTPUT and SPEED) on the menu. If a pen recorder to which an output is mode is used with this equipment for the first time, select (turn ON) the menu item "2. CAL" from the PEN OUT MEMU. CAL is the function to output the 10 div× 10 div square (for calibration use) from the PEN OUT terminal. After selecting the menu item "CAL," return to the waveform display screen. Conduct HOLD and press the F5 key for output. Calibrate the pen recorder level and the scale on the output paper.

After making the calibration, select WAVE or +SCALE for the menu item "1. OUTPUT" on the PEN OUT MENU, and specify a pen speed corresponding to the pen recorder in use for the menu item "3. SPEED".

In the standby state, the output terminal voltage is -0.4V for the Y-axis, and -5V for the X-axis. The full scale voltage is -5.5V for the Y-axis, and -5V for the X-axis. If the pen recorder has the pen lift function, the PEN LIFT terminals ㉛ and (BNC) on the rear panel of this equipment can be used. To output a waveform, correct the influence of the earth magnetism using DISPLAY OFFSET on the MENU.

1) Select a channel to be observed, specify the trigger source, set the trigger level and SWEEP TIME/DIV, then read data.

2) Press the HOLD switch to hold data.
   If OUTPUT is set to WAVE or +SCALE, OUT → will appear at the lower right of the screen.

3) If the data may be output, check that the cable is connected properly between the pen out BNC connector on the rear panel of the DCS-9300 and the connector of the analog pen recorder, then press F5 ⑯; Data are output to the pen recorder in the conditions set on the menu.
   While data are being output, the OUT -> indicator flashes.

2 Output to Digital Plotter
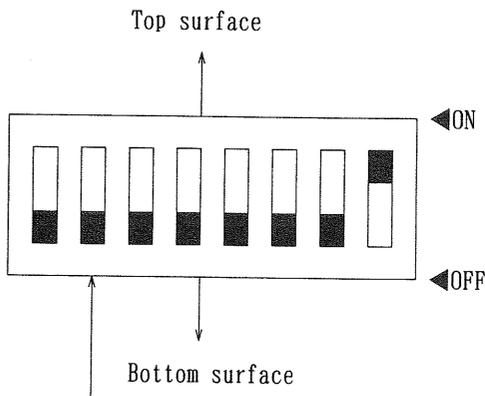
GP-IB/RS-232C selector switch
   ON : GP-IB
   OFF: RS-232C (The above figure shows RS-232C setting.)

Fig. 14

Data may be output to a digital plotter through the GP-IB or RS-232C interface, which may be selected with the second switch from the left of the DIP switch cluster on the rear panel. Set it ON to select the GP-IB. Set it OFF to select the RS-232C. If the GP-IB is selected, the talk-only mode is established automatically. Control by the controller is disabled in the talk-only mode.

Set the DIP switch befor turning on the power. Before outputting data to a digital plotter, set the output conditions (OUTPUT and SETTING) and RS-232C interface conditions (SPEED, PARITY, BIT) on the menu. To output a waveform, correct the influence of the earth magnetism using DISPLAY OFFSET on the MENU.

1) Select a channel to be observed, specify the trigger source, set the trigger level and SWEEP TIME/DIV, then read data.

2) Press the HOLD switch to hold data. If OUTPUT is set to WAVE or +SCALE or +R/O, OUT → will appear at the lower right of the screen.

3) Make sure that the cable is connected properly between the connector on the plotter and the GP-IB connector or RS-232C connector on the rear panel of the oscilloscope. If data may be output, press the F5 key ⑯. Data is output in the conditions specified on the menu. During data output, the "OUT→" indicator keeps flashing.

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Before connecting or disconnecting the GP-IB or RS-232C cable, be sure to check that both the │
│ DCS-9300 and plotter are turned off. If the cable is connected or disconnected with power turned │
│ on, electric stress is applied to the plotter. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Data may be output to a plotter through either the GP-IB or RS-232C. Before outputting data, │
│ chech the connected plotter, connection cable, and connectors carefully. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Before outputting data to a plotter through the GP-IB, check the connection cable, plotter power, │
│ etc. carefully. If data is output in improper condition, the oscilloscape will not recover from the │
│ output condition. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ If a GP-IB plotter is selected with the DIP switch cluster on the rear panel, the oscilloscope │
│ enters the talk-only mode automatically, where the normal GP-IB operation is disabled. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ If AVERAGE operation is in process and you activate HOLD followed by PLOTOUT, counting lasts to │
│ the set value before PLOTOUT takes place. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ If the digital plotter is set, the analog pen recorder setting will automatically go OFF, and vice │
│ versa. │
└──────────────────────────────────────────────────────────────────────────────┘
```

```
┌─ NOTE ──────────────────────────────────────────────────────────────────────┐
│ Selection of the GP-IB or RS-232C plotter with the DIP switch cluster on the rear panel is read in │
│ when the oscilloscope power is turned on. If DIP switch setting is changed, turn the power off │
│ once, then turn it on again. │
└──────────────────────────────────────────────────────────────────────────────┘
```

[F] Automatic Range Setting Operation (AUTO SET)

1 Automatic Range Setting Operation (AUTO SET)

If the AUTO SET switch ⑰ is pressed, the range is automatically adjusted to fit the input level.

1) Select a channel to be observed, and specify the trigger source.

2) Press the AUTO SET switch ⑰; the vertical range is adjusted automatically. The horizontal range is automatically adjusted to fit the channel selected as the trigger source.

3) The automatic settings may be changed on the menu.
   Choose the V, H, or VH mode, and select the 2 div or 4 div setting for each of V (peak value) and H (cycle).

> **NOTE**
> The horizontal range is automatically adjusted to fit the channel selected as the trigger source. (The trigger mode and coupling are fixed to FIX and AC, respectively.)

> **NOTE**
> The ranges of the amplitude and frequency applicable to the AUTO SET function are between 2mV and 40Vp-p and between 50Hz and 5MHz, respectively. If waveform signals have extreme duty ratio, they may not be detected.

> **NOTE**
> AUTO SET is unusable in the GO/NO-GO mode.

> **NOTE**
> AUTO SET is unusable if ADD alone is ON for VERT MODE (while CH1 to CH4 are all OFF).

[G] External Control via GP-IB

1 Control via GP-IB

Through the GP-IB interface, the DCS-9300 allows the user to control and check settings and output data stored in the internal memory via the input terminals to external devices, except for activation and deactivation of the POWER switch and partial CRT operations.
Sequential automatic measurements and data sampling are enabled by programming data measurement settings. Sampled data can be processed by advanced operation by a computer for efficient measurement. (For details, refer to the section GP-IB INTERFACE.)

1) Refer to the GP-IB command reference in the section GP-IB INTERFACE, program a desired measurement sequence.

2) Input the program into a computer having a GP-IB driver.
   Make sure that the RS-232C is selected for data output to a plotter with the DIP switch cluster on the rear panel, proper device address and delimiter are set, and the GP-IB cable is connected properly.

3) Make sure that signals to be measured are input to the input terminal, then execute the program.

NOTE

Before connecting or disconnecting the GP-IB cable, be sure to check that both the DCS-9300 and computer are turned off. If the cable is connected or disconnected with power turned on, electric stress is applied to both equipments.

NOTE

GP-IB or RS-232C plotter selection, delimiter and device address setting, and other settings with the DIP switches on the rear panel are read in when the power is turned on. If DIP switch setting is changed, turn the power off once, then turn it on again.

NOTE

If the GP-IB is selected for data output to a plotter, the oscilloscope enters the talk-only mode automatically. Thus, if the normal GP-IB operation (in the talk/listen mode) is required, select the RS-232C.

NOTE

If REN is displayed in process of GP-IB control, the DCS-9300 is in the remote state. In this state, the only INTENSITY control and switches on the panel not under GP-IB control are functional. Other controls and switches are not functional.

---

6. APPLICATION EXAMPLES

Items

[A] Application Examples Common to Real-Time and Storage Oscilloscope Operations
    1 Voltage Measurement
    2 Time Measurement
    3 Frequency Measurement
    4 Relative Measurement
    5 X-Y Operation Applications
    6 Others

[B] Storage Oscilloscope Applications
    1 Storage Waveform Observation in Hold Mode
    2 Once-Only Events Observations
    3 Low-Frequency Signal Observations
    4 Repetitive Event Observations
    5 Relative Measurement of Waveform Data
    6 Data Output

[C] Programmable Oscilloscope Applications
    1 Application to Routine Measurement

Before starting measurement, make sure that the following have been calibrated.

【Probe compensation】

The probe should be calibrated properly in order to conduct accurate measurement using the probe.

【Trace rotation compensation】

If the trace is tilted with respect to the horizontal scale, an measurement error occurs.
For compensation of the above, refer to the compensation instructions in the section "Maintenance and Adjustment".

[A] Application Examples Common to Real-Time and Storage Oscilloscope Operations

1 Voltage Measurement

1) DC voltage measurement

DC voltage may be measured in two methods: normal measurement and cursor measurement.

a) Normal measurement

To measure the DC level of waveform, operate as shown below:

① Input the signal to be measured to the INPUT terminal.
Set the TRIG MODE switch to AUTO and input coupling switch to GND. The displayed trace shows the GND position (i.e., reference line). Adjust the trace to the reference scale line with the vertical position control. Once the reference line is adjusted, do not change the vertical position.

② Set the input coupling switch to DC.
Waveform containing DC components is displayed on the CRT. Re-adjust the VOLTS/DIV control if necessary. (Set the VARIABLE to the CAL position.)

③ Measure the vertical interval (i.e., divisions) between the reference line and measurement point. (The reference line is displayed by setting the input coupling switch to GND.)
The voltage is obtained by multiplying the vertical interval by a VOLTS/DIV reading.
If waveform is over the reference line, the voltage is positive. If it is below the reference line, the voltage is negative.

    i) Measurement using the PC-31 or direct measurement
        DC level = vertical interval (in divisions) × VOLTS/DIV reading

    ii) Measurement using the 10:1 probe
        DC level = vertical interval (in divisions) × VOLTS/DIV reading × 10

b) Cursor measurement

① Set the reference line (GND) in the same way as in item ① above.

72

② Select the △V mode in accordance with the channel used for cursor measurement.

③ Adjust the △REF cursor (reference line) to GND.

④ Set the AC-GND-DC to DC.

⑤ Adjust the △cursor to the point to be measured.

⑥ A result of measurement is displayed following "△Vx" in the upper right of the CRT.

┌─ NOTE ───┐
│ If the attached probe PC-31 is used, measurement result including an attenuation ratio is │
│ displayed. If a probe not compatible with the readout function, measurement result shall be │
│ multiplied by the attenuation ratio. If the △cursor is below the △REF cursor, the voltage │
│ is negative and the "−" sign is displayed. │
└───┘

2) AC voltage measurement

a) Potential difference measurement at 2 points on waveform

Voltage between two points on waveform or peak-to-peak voltage may be measured in the same procedures described in 1) DC voltage measurement above, in principle. Measure the interval between two measurement points, then multiply it by a reading of the VOLTS/DIV. If the 10:1 probe is used, multiply the above value by 10. Select any mode of △V1 to △V4 in accordance with the channel usedin the cursor mode, adjust the △REF cursor to the lower measurement point, and adjust the △cursor to the other measurement point. Measurement result is displayed following the selected mode (△V1 to △V4) in the upper right of the CRT.

b) Elimination of undesired signal component

In the Add mode, undesired signal components contained in signals are eliminated and only necessary component is displayed. (When the Add mode is selected for CH1 and CH2)

① Input the signal containing undesired component to the CH1 INPUT terminal. Input undesired component to be eliminated to the CH2 INPUT terminal.

② Set CH2 mode to INV. Make sure that CH2 input signal has reverse polarity to the envelop of the undesired component.

③ Set the V-MODE to ADD, then adjust the VOLTS/DIV and VARIABLE of CH2 so that the undesired component is minimized.

Elimination of undesired signal component
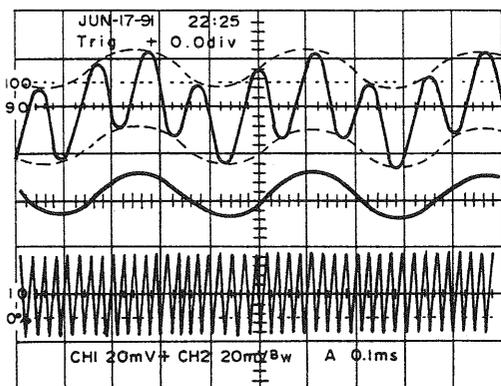
Fig. 8

※ This is also effective for CH3 and CH4.

3) Voltage ratio measurement

a) Overshoot

To measure overshoot of square wave, operate as shown below:

① Input the signal to the INPUT terminal.
Set the input coupling signal to DC to activate the normal sweep.

② Use the vertical axis VARIABLE control to adjust the amplitude to the width of 5 divisions on the CRT (0% and 100% divisions). Use the vertical position control if necessary.

> ── NOTE ──
> If the vertical VARIABLE control is set to UNCAL, ratio measurement is performed.

③ Select the ΔV1 cursor mode, then adjust the ΔREF cursor to the 100% position.

④ Adjust the Δcursor to the overshoot position to be measured.
The voltage ratio of the overshoot with respect to 5 divisions (=100%) is displayed in percentage following "RATIO" in the upper right of the CRT.

2 Time Measurement

1) Time measurement

The time between two points on waveform can be obtained from the horizontal distance between the two points and SWEEP TIME/DIV.

a) Normal measurement

① Input the signal to the INPUT terminal.
Set the V-MODE to a channel to be used and the input coupling switch to DC for normal sweep operation. Set the vertical VARIABLE and SWEEP TIME/DIV to the CAL positions.

② Adjust the start point of measurement to any vertical scale with the horizontal position control.

74

Measure the horizontal distance between the measurement points.
Multiply this horizontal distance by the reading of the SWEEP TIME/DIV.

Time = horizontal distance (in divisions) × SWEEP TIME/DIV reading

b) Cursor measurement

① Move the waveform to be measured to an easy-to-see position in the normal procedure.

② Set the cursor measurement mode to ΔT.

③ Adjust the ΔREF cursor to the left measurement point. Adjust the Δcursor to the right point. Result of measurement is displayed following "ΔT" in the upper right of the CRT.

c) Precise time measurement making use of delayed sweep

① Input the signal to the INPUT terminal.
Set the V-MODE to a channel to be used and the input coupling switch to DC for normal sweep operation. Set the SWEEP TIME/VARIABLE control to the CAL positions.

② Control the A SWEEP TIME/DIV to display the part to be measured. Set the H-MODE to A INT B. Set the B SOURCE to AFTER DLY.
Control the B SWEEP TIME/DIV to minimize the intensity-modulated portion.

③ Adjust the intensity-modulated part to the measurement start point with the ΔREF/DELAY TIME control. Record a measured value displayed in the DELAY area.

④ Adjust the intensity-modulated part to the second measurement point with the ΔREF/DELAY TIME control. Subtract the first measured value from the second measured value to obtain the time between two points.

Time = second measured value − first measured value

2) Time difference measurement

a) Normal measurement

Time difference between two synchronous signals can be measured.

① Input two synchronous signals to the CH1 and CH2 INPUT terminals. Set the V-MODE switch to ALT or CHOP. In general, use the ALT position for high repetition frequency. Use the CHOP position for low repetition frequency.

② Select the earlier one of the two signals as A SOURCE (reference signal). Control the VOLTS/DIV and SWEEP TIME/DIV to obtain easy-to-observe condition.
Set the SWEEP TIME/VARIABLE control to the CAL positions.

③ Move the waveform to the center with vertical position controls.

④ Measure the horizontal distance between the two signals. Multiply the horizontal distance by the

reading of the SWEEP TIME/DIV.

Time difference = horizontal distance (in divisions) × SWEEP TIME/DIV reading

b) Cursor measurement

① Adjust the waveform to an easy-to-measure position in the normal procedure shown above.

② Set the cursor measurement mode to ΔT.

③ Adjust the ΔREF cursor to the left one of two measurement points. Adjust the Δcursor to the right point. Measurement result is displayed following "ΔT" in the upper right of the CRT.

3) Rise time measurement

a) Normal measurement

The rise (or fall) time is found by measuring the time elapsed between 10% and 90% of the peak value.

① Input the signal to the INPUT terminal. Set the V-MODE to a channel to be used. Adjust the VOLTS /DIV and vertical VARIABLE so that the displayed waveform has amplitude of 5 divisions.

② Adjust the horizontal position in the normal sweep to center the waveform.
Adjust the SWEEP TIME/DIV as fast as possible in the measurable range.
Set the SWEEP VARIABLE to CAL.

③ Move the 10% point of the waveform to the scale line corresponding to the 10% division on the vertical scale with the vertical position control, then measure the interval between the 10% and 90% positions. Multiply this horizontal distance by the reading of the SWEEP TIME/DIV.

┌─ NOTE ───┐
The 0%, 10%, 90% and 100% scale lines are displayed on the CRT, provided 5 divisions represent
100%. Use these scale lines.
└───┘

Rise time = horizontal distance (in divisions) × reading of SWEEP TIME/DIV

b) Cursor measurement

① Adjust the amplitude of the waveform displayed on the CRT to 5 divisions in the normal procedure, then control the vertical positions to adjust the peak and bottom of the waveform to the 0% and 100% lines.

② Set the cursor measurement mode to ΔT.

③ Adjust the ΔREF cursor to the intersection of the waveform and 10% scale line. Adjust the Δcursor to the intersection of the waveform and 90% scale line.
Measurement result is displayed following "ΔT" in the upper right of the CRT.

c) Rise time measurement making use of delayed sweep

① Carry out the normal setting.

② Set the H-MODE to A INT B. Set the B SOURCE to AFT' D.
Control the B SWEEP TIME/DIV to minimize the intensity-modulated portion.

③ Control the △REF/DELAY to intensity-modulate the 10% point of the waveform, then record a measured value displayed in the DELAY area.

④ Then, control the △REF/DELAY to intensity-modulate the 90% point of the waveform.
The rise (or fall) time of the waveform is found as follows:

Rise (or fall) time = 2nd measured value − 1st measured value

4) Time ratio measurement

a) Duty ratio

The duty ratio of a square wave may be measured as shown below:

① Input the signal to the CH1 INPUT terminal.
Set the input coupling switch to DC, and carry out setting for the normal sweep.

② Control the SWEEP VARIABLE to adjust the amplitude of 1 cycle to 5 divisions on the CRT. Adjust the horizontal position if necessary.

③ Set the cursor measurement mode to △T.
```
┌─ NOTE ──────────────────────────────────────────────────────────────┐
│ The ratio is measured if the SWEEP TIME is set to UNCAL.             │
└─────────────────────────────────────────────────────────────────────┘
```

④ Adjust the △REF cursor to the left one of two points to be measured. Adjust the △cursor to the right point. The duty ratio with respect to 5 divisions (=100%) is displayed in percentage following RATIO in the upper right of the CRT.

3 Frequency Measurement

1) Frequency measurement

a) Normal measurement

Since frequency is an inverse number of period, it is found from the time of 1 cycle (i.e., period) as follows:

Frequency=1/period

In addition to the above method, frequency may be found by counting the number of cycles on the CRT.

① Input the signal to the INPUT terminal.
   Set the V-MODE to a channel to be used, and carry out setting for the normal sweep.
   Set the vertical variable control and SWEEP TIME/DIV to the CAL positions.

② Count the number of cycles between any two vertical lines.
   Find the time of these cycles from the horizontal distance and the reading of the SWEEP TIME/DIV.
   Multiply the inverse number of the found time by the number of cycles. However, this method may
   cause measurement errors if the number of cycles is not so many.

$$\text{Frequency} = \frac{\text{Number of cycles}}{\text{Horizontal distance} \times \text{SWEEP TIME/DIV reading}}$$

b) Cursor measurement

① Input the signal to the INPUT terminal.
   Set the V-MODE to a channel to be used, and carry out setting for the normal sweep.
   Set the vertical variable control and SWEEP TIME/DIV to the CAL positions.

② Set the cursor measurement mode to $1/\Delta T$.

③ Adjust the ΔREF cursor to the left one of two points to be measured. Adjust the Δ cursor to
   the right point. Measurement result is displayed following $1/\Delta T$ in the upper right of the CRT.

2) Phase difference measurement

a) Normal measurement

   The phase difference between two sine wave signals having the same frequency can be measured as
   shown below:

① Input two signals to the CH1 and CH2 INPUT terminals. Set the V-MODE to ALT or CHOP.

② Select the signal of advanced phase with the A-SOURCE switch (as the reference switch). Control the
   VOLTS/DIV and vertical variable controls so that the two signals have the same amplitude.

③ Control the SWEEP TIME/DIV and variable controls to adjust the width of 1 cycle of the wave to
   8 divisions. Move two waves to the center of the scale line with the vertical position controls.
   Through the above operations, 1 division represents 45 degrees ($360 \div 8 = 45°$). Thus, the sweep
   ratio is expressed as 45° /division.

④ Measure the horizontal distance between the corresponding positions of two waves. Multiply the
   distance by the sweep ratio (i.e., 45° /division).

   Phase difference (degree) = horizontal distance (in divisions) $\times$ 45° /division

   To obtain the accuracy higher than the above-shown 45° /division, control the SWEEP TIME/DIV to
   expand the waveform without using the variable control. Adjust the trigger level if necessary. The
   phase difference is found as shown below from the SWEEP TIME/DIV set value in the above 8-division
   cycle setting and new SWEEP TIME/DIV setting for improved accuracy:

Phase difference = horizontal distance in new sweep range (div.) × 45 °

$$\times \frac{\text{new SWEEP TIME/DIV set value}}{\text{reference SWEEP TIME/DIV set value}}$$

For easier measurement, use the ×10MAG switch without changing the sweep range.
In this case, the sweep ratio is 4.5° /division.

b) Cursor measurement

① Move the waveform to an easy-to-measure position in the normal procedures shown in ① and ② above.

② Control the SWEEP TIME/DIV and SWEEP VARIABLE to adjust the width of 1 cycle wave to 5 divisions.
Move two signals to the center of the scale with the vertical position controls.

```
┌─ NOTE ─────────────────────────────────────────────────────────────┐
│ In the cursor measurement, 5 divisions represent 360 degrees.       │
│ Phase measurement is enabled if the SWEEP TIME is set to the UNCAL  │
│ position.                                                           │
└─────────────────────────────────────────────────────────────────────┘
```

③ Set the cursor mode to 1/△T.

④ Adjust the △REF cursor to the intersection of the waveform of advanced phase and the horizontal center scale line. Adjust the △cursor to the intersection of the waveform of delayed phase and the horizontal center scale line.
Measurement result is displayed following PHASE in the upper right of the CRT.

4 Relative Measurement

If the amplitude and repetition time of the reference signal are known, voltage, frequency, etc. of an unknown signal can be measured, regardless of the VOLTS/DIV and SWEEP TIME/DIV readings.

1) Voltage

Setting relative vertical sensitivity making use of the reference signal.

① Input the reference signal to the INPUT terminal. Carry out setting so that sweep waveform is free from flickering. Control the VOLTS/DIV and vertical variable control to adjust the amplitude to several divisions accurately. After this, do not change the setting of the variable control.

② Divide the amplitude voltage of the reference signal by the product of the vertical amplitude (in divisions) and VOLTS/DIV set value determined in ① above.

$$\text{Vertical coefficient} = \frac{\text{Reference signal voltage (V)}}{\text{Vertical amplitude (div.)} \times \text{VOLTS/DIV set value}}$$

③ Stop inputting the reference signal, input unknown signal to the INPUT terminal, and carry out setting with the VOLTS/DIV so that the waveform can be observed clearly.
Measure the amplitude of the wave, then find the voltage of the unknown signal as follows:

Voltage of unknown signal = vertical distance (in divisions) × vertical coefficient
 × VOLTS/DIV set value

2) Time period

Setting relative sweep ratio making use of the reference frequency

① Input the reference signal to the INPUT terminal.
Then, control the VOLTS/DIV and vertical variable controls so that the waveform may be observed clearly. Control the SWEEP TIME/DIV and sweep variable controls to adjust the 1 cycle width to several divisions accurately. After this, do not change the setting of the sweep variable control.

② Divide the time period of the reference signal by the product of the horizontal distance (in divisions) and SWEEP TIME/DIV set value determined in 1 above.

$$\text{Horizontal coefficient} = \frac{\text{Reference signal time period (sec.)}}{\text{Horizontal distance (div.)} \times \text{SWEEP TIME/DIV set value}}$$

③ Stop inputting the reference signal, input unknown signal to the INPUT terminal, and carry out setting with the SWEEP TIME/DIV so that the waveform can be observed clearly. Measure the horizontal distance of 1 cycle wave, then find the time period of the unknown signal as follows:

Period of unknown signal = horizontal distance (in divisions) × horizontal coefficient
× SWEEP TIME/DIV set value

5 X-Y Operation Applications

1) Phase

The X-Y operation may be used for phase measurement.
Measurement of phase distortions in circuit designed to have constant phase shifts or audio amplifiers is a typical application.
Amplitude distortion may also be measured. Phase measurement is performed as follows:

① Input low-distortion sine wave to an audio circuit to be tested.

② Connect the CH1 probe to the input terminal of the test circuit. Connect CH2 to the output terminal.

③ Adjust the oscillator output level to the normal level of the test circuit. Observe the output signal on the CRT. If excessive signal is input, displayed waveform clips. Decrease the input level in such a case.

④ Set the H-MODE to X-Y. Set the A-SOURCE to CH1.

⑤ Control the gains of both channels to adjust the Lissajous' figure to a proper size.

⑥ If both signals have the same phase, the Lissajous' figure is a straight line. If the vertical and horizontal gains are equalized, it is displayed as a 45° slanted line.

If the phase difference is 90 degrees, it is displayed in a circle.
If the phase difference is more than or less than 90 degrees, the Lissajous' figure is an oval.
The actual phase difference is found as follows:

$Sin\phi = B/A \quad \phi = $Phase angle
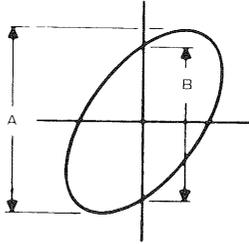
No amplitude distortion No phase difference	Phase difference, but no amplitude distortion
Amplitude distortion, but no phase difference	Both phase difference and amplitude distortion
No amplitude distortion, 180° phase difference	No amplitude distortion, 90° phase difference

Fig. 9   Fig. 10

2) Frequency

In addition to the phase, the frequency can be measured from the Lissajous' figure.

① Input sine wave of known frequency to the CH1 input terminal of the oscilloscope.
Input the signal to be measured to the CH probe.
Set the H-MODE to X-Y. Set the A-SOURCE to CH1.

② Adjust the CH1 and CH2 amplitudes.

③ Displayed Lissajous' figure indicates the frequency ratio of two signals.

Connect unknown frequency signal to the vertical input and reference frequency signal to the horizontal input.	Comparison of a signal of unknown frequency with the reference signal
	$\frac{1}{2}$: 1
	1 : 1
	$1\frac{1}{2}$: 1
	6 : 1

Lissajous' figures in frequency measurement

Fig. 11

6 Others

1) TV-LINE counter applications

TV signal observation

① Input the signal to the INPUT terminal.
Set the V-MODE to a channel to be used, then carry out setting for the normal sweep operation.
Set the vertical variable and SWEEP TIME/DIV controls to CAL.

Example of control settings
    Input signal   : CH1
    V-MODE   : CH1
    H-MODE   : A
    A SOURCE   : VERT (CH1) or CH1
    COUPLING   : F1
    A SWEEP TIME/DIV: 5 ms

② Specify a line No. to be observed with the △REF/DELAY or SET key.
figure (A) below. Figure (B) shows the image signal at the 23th line.

(A) TV-FRAME waveform   (B) Waveform ovservation with TV-counter
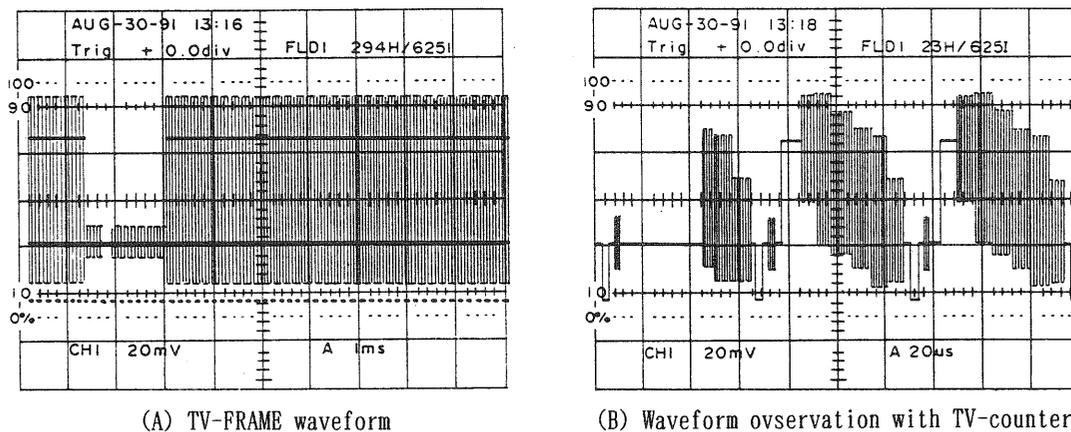
Fig. 12

2) Pulse jitter measurement

Pulse jitters may be measured as shown below:

a) Normal measurement

① Input the signal to the INPUT terminal.
Set the V-MODE to a channel to be used, then carry out setting for the normal sweep operation.
Set the vertical variable and SWEEP TIME/DIV controls to CAL.
The controls related to triggering should be adjusted to obtain stable display.

② Set the H-MODE to A INT B. Set the B SOURCE to AFT' D.
Control the △REF/DELAY so that the pulse to be measured is intensity-modulated.

③ Control the B SWEEP TIME/DIV so that the whole part where jitters are produced is intensity-modulated.

④ Set the H-MODE to B.
Measure the horizontal shift of the pulses with jitters.
The time of jitters is found by multiplying the horizontal distance by the set value of the B SWEEP TIME/DIV.

Pulse jitter = horizontal distance of jitter (in divisions) × B SWEEP TIME/DIV set value

b) Cursor measurement

① Display the waveform to be observed through the normal procedures shown in ① to ③.

② Set the H-MODE switch to B. Set the cursor mode to ΔT.

③ Adjust the ΔREF cursor to the left measurement point. Adjust the Δcursor to the right point. Measurement result is displayed following ΔT on the CRT.

3) Trigger counter applications

Observation of logic signals
The relationship between two logic signals may be known by making use of the trigger counter.

① Input the signals to the CH1 and CH2 INPUT terminals. Select the CH1, CH2 and CHOP of the V-MODE.

② Set the A-SOURCE to the channel of the longer period. (The signal input to CH2 is assumed to have the longer period.)

    Example of control settings
      Input signal : CH1 and CH2
      V-MODE   : CH1 and CH2
      H-MODE   : A INT B
      SOURCE   : CH2   —
      COUPLING   : DC   —
      SWEEP TIME/DIV: 0.5ms

③ Set the H-MODE to A INT B.

④ Select the TRIG COUNT switch. Set a count value with the ΔREF/DELAY TIME or SET key. Adjust the intensity-modulated point to the edge of the CH2 signal.

⑤ The number of CH1 pulses with respect to the period of CH2 signals can be found from a count value.

Trigger counter waveform

Fig. 13

4) 4-trace operation applications

   With CH1 to CH4 sensitivity calibration, wide bandwidth up to 100 MHz and full-range attenuators, the
   DCS-9300 [9100] is ideal for 4-trace observation and operations shown below:

   i) Checking timing of 4-trace wave signals

   ii) Monitoring video signal

   iii) Measuring audio signal gain and phase

       The following shows an example of audio signal gain and phase characteristics measurement.

4-trace waveform
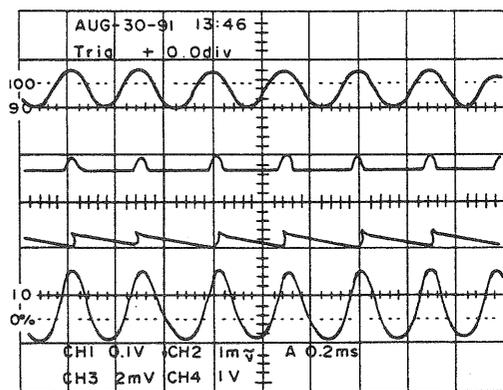
Fig. 14

[B] Storage Oscilloscope Applications

1 Storage Waveform Observation in Hold Mode

As mentioned above, a storage oscilloscope mode enables waveform observation in the same manner as the
normal real-time oscilloscope mode. The storage mode offers additional waveform observation which is
impossible in the real-time mode. The data storage function is required for measuring the below-shown
once-only or sudden events. As for repetitive phenomena, if a part of repetitive waves changes, for
example, if noises or other non-cyclic components overlay repetitive signals, it is difficult to observe
such signals in the real-time mode due to overlaid waveform.

1) In such a case, select the NORM storage mode and hold the input signal to hold and display the
   previous input signal.

   ① Input the signal to the CH1 INPUT terminal. Carry out setting for the normal sweep. (These
      operations may be performed in either the real-time mode or storage mode.)

   ② Select the NORM storage mode to read data, then press the HOLD switch.

   ③ If data cannot be observed in the display area at a time, use the DISPLAY ADDRESS to scroll up to
      8 screens worth of data. (Set the DISPLAY ADDRESS to ON and MEMORY SIZE to 16KW on the memory

menu, read data as mentioned above, then hold the data. Eight times as much data as the display size (2K words) may be stored (i.e., 2K words ×8=16K words). The display area may be changed with the ΔREF control or SET keys.}

Eight screens worth of data may be read at each trigger by selecting MEMORY SIZE = 2K × 8 on the memory menu (provided the trigger interval is longer than the reading time of 1 screen worth of data.) Waveform change at each trigger may be observed in details by changing the display screen with the ΔREF control or SET key.

④ If necessary, cancel holding to read data again, then repeat operations in ② and ③.
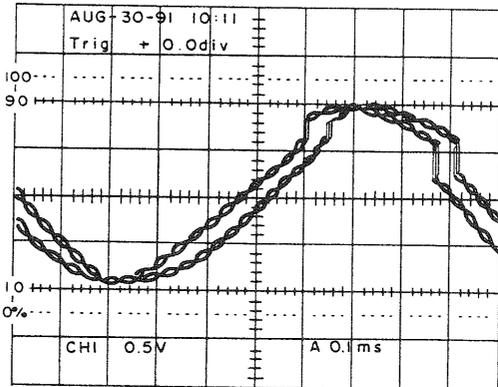
Waves changing simultaneously at trigger point
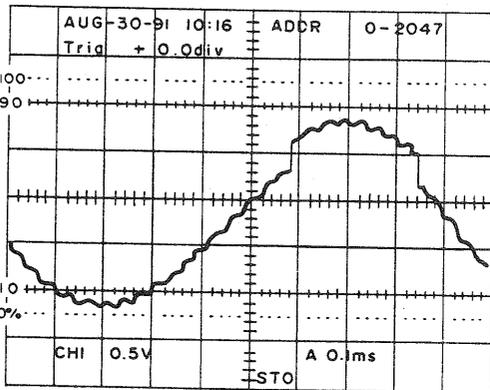
Trigger 1 waveform
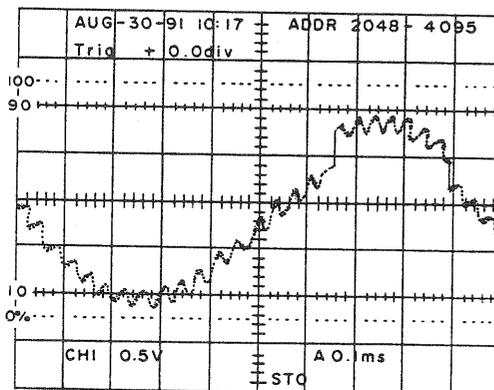
Trigger 2 waveform

Fig. 15

2 Once-Only Events Observations

The storage oscilloscope is capable of observing once-only events or phenomena occurring suddenly, which are hard to be observed on a normal oscilloscope.

As for a once-only event, previous signal status before triggering should be observed in many cases. In addition, signal status after a trigger point should be observed in other cases.

1) Event observation before trigger point

① In the NORM storage mode, carry out single sweep mode setting in the same way as the real-time operation.

② Select the channel carrying the signal containing the trigger point as the trigger source, then

85

set the trigger point and trigger slope.

③ Then, select pre-trigger in the storage mode in order to set the start point of observing phenomenon before the trigger point. Use the △REF control or SET key for setting in units of divisions on the CRT or time. (Using OPTION MENU)

④ Press the RESET key. Make sure that the READY LED goes on.

⑤ Read the signal to start observation. If necessary, repeat operations ②, ③ and ④ for optimum setting.

⑥ The time (Tpr) from the trigger point of the observed waveform is found as follows:

Tpr= {PRE TRIG reading (in div.)−number of divisions from left end of CRT} ×sweep range (s/div.)

If pre-trigger is set in units of time, Tpr is found as follows:

Tpr=PRE TRIG reading (in time)− {number of divisions from left end of CRT×sweep range (s/div.)}
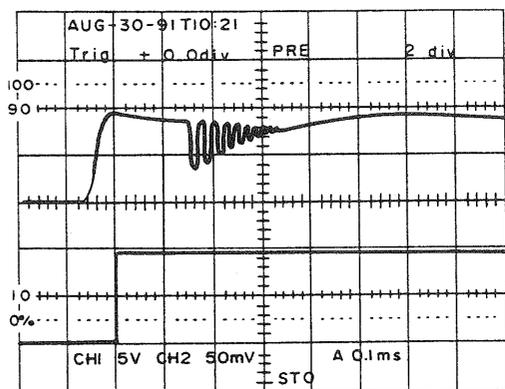
Pre-trigger waveform

Fig. 16

2) Event observation after trigger point

① In the NORM storage mode, carry out single sweep mode setting in the same way as the real-time operation.

② Select the channel carrying the signal containing the trigger point as the trigger source, then set the trigger point and trigger slope.

③ Then, select post-trigger in the storage mode in order to set the start point of observing phenomenon after the trigger point. Use the △REF control or SET key for setting in units of divisions on the CRT or time. (Using OPTION MENU)

④ Press the RESET key. Make sure that the READY LED goes on.

⑤ Read the signal to start observation. If necessary, repeat operations ②, ③ and ④ for optimum setting.

⑥ The time (Tpt) from the trigger point of the observed waveform is found as follows:

Tpt= {POST TRIG reading (in div.)+number of divisions from left end of CRT} ×sweep range (s/div.)

If post-trigger is set in units of time, Tpt is found as follows:

Tpt=POST TRIG reading (in time)+ {number of divisions from left end of CRT×sweep range (s/div.)}
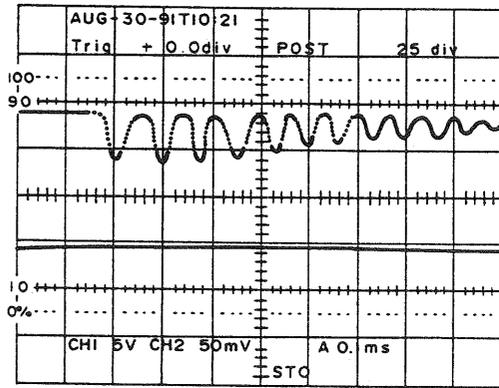
Post-trigger waveform

Fig. 17

3) Measurement making use of data interpolation

The maximum sampling time of this instrument is 10 ns [25ns]. Thus, the resolution along the time axis of the CRT is found from 2000 samples as follows:

10ns [25ns]×2000SAMPLE=20μs [50μs]=2μs/div [5μs/div]

In the range over this value (1μ [2μ] to 20ns/div. [50ns/div.]), observation is performed in the magnification mode, where the resolution along the time axis is deteriorated. Data interpolation is a means of observing once-only events in the range 1μs/div. [2μs/div.] to 20ns/div [50ns/div] with satisfactory time axis resolution. In without using interpolation, the latest sampled data is held and displayed up to the following sampling point.

① To check the sampled data only, observe it without using interpolation.

② To check the profile or feature of the waveform data, use the linear interpolation for linking between sampled data. For smooth interpolation between sampled data while maintaining the data, use either of the following two interpolations.

③ Sine interpolation based on the sampling principle equivalent to the digital filtration processing at the roll-off frequency approx. 2.5 times as high as the sampling frequency

④ Spline interpolation to obtain the smoothest compensation curve between sampled data (The secondary derivatives are minimized.)
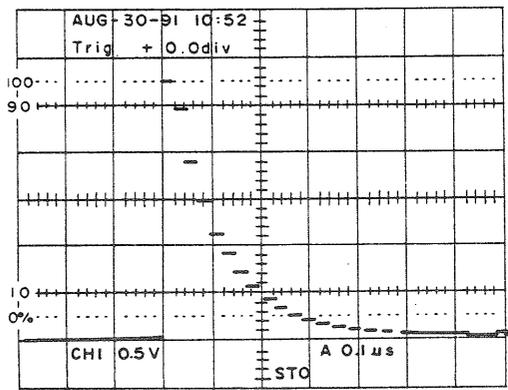
Non-interpolated waveform
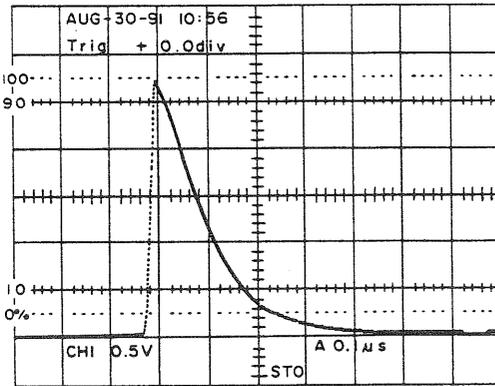
Linear interpolation waveform
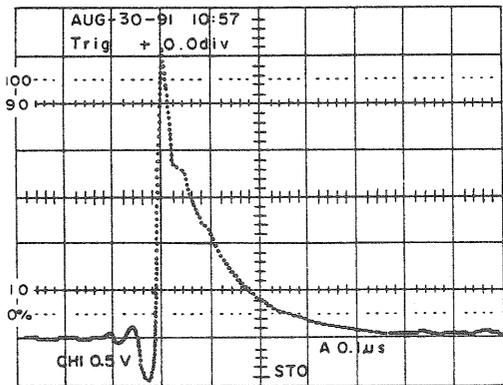
Sine interpolation waveform
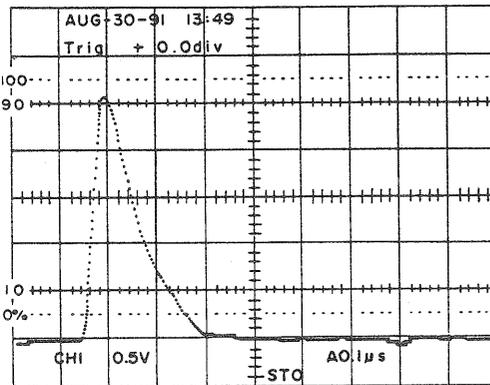
Spline interpolation waveform

Fig. 18

3 Low-Frequency Signal Observations

1) Long-term observation (No-manned measurement)

It is difficult to observe quite-low-frequency signals or non-cyclic low-speed phenomena on a real-time oscilloscope. This instrument is capable of long-term observation in the storage mode at a low sweep speed of 500 seconds/div. (Up to approx. 11 hours continuously with 16KW setting) If the TIME DISPLAY is set to TRIG TIME STAMP with the SET MENU in observation of low-frequency once-only events, trigger point time may be recorded on the CRT, enabling no-manned measurement.

2) Roll mode (0.2s/div. to 500s/div.)

Use the roll mode in order to observe low-frequency signals uninterruptedly.
In the roll mode, input signals are stored and displayed, regardless of triggering. It is suitable for observing non-trigger signals or minute changes to which triggering is not applicable.

3) Peak detector applications

The storage oscilloscope has fixed data resolutions in the amplitude and time directions. Thus, spikes and other high-frequency components contained in low-frequency signals may be lost in the normal sampling. For example, since the time axis resolution per screen (10 divisions) is 2KW (i.e., 2000 samples), sampling interval Sw is found as follows, provided the sweep time is 0.2s/division:

$Sw = 0.2s \times 10div/2000sample = 1ms/sample$

If the observed signal contains spikes of 0.5 ms wide, the result of sampling is either of the following two.

Input signal
(containing spike)

Sampling timing

```
    *         *         *            *         *         *
 ──────────────────────────    ──────────────────────────
    1         2         3 (ms)      1         2         3 (ms)
```

Stored data

```
              *
    *         |         *            *         *         *
 ──────────────────────────    ──────────────────────────
    1         2         3 (ms)      1         2         3 (ms)
```
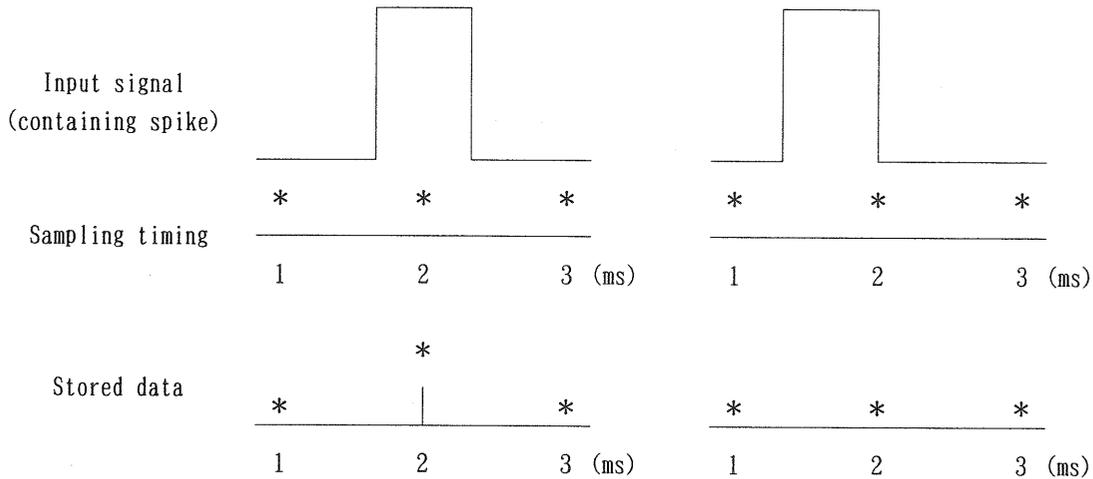
Fig. 19

The sampling probability Ps is found as follows:

Ps=0.5ms (i.e., spike pulse width)/1ms (i.e., sampling interval)=0.5 (i.e., 50%)

In this case, spikes, etc. can be captured without omission by using the peak detector function.

If PEAK is selected in the storage mode, sampling is always performed at the maximum sampling interval 25ns/sampling and size comparison is performed in each sampling, regardless of the sweep time.

Thus, spikes as shown above can be captured without omission.

Peak detector OFF   Peak detector ON
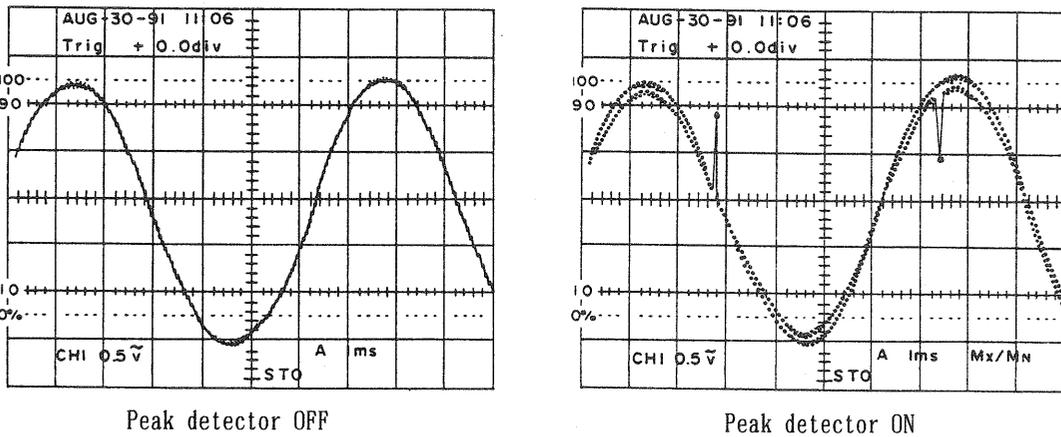
Fig. 20

NOTE

If the direction of spikes (positive or negative with respect to the signal) is known, select MINIMUM or MAXIMUM in the peak detector mode. The minimum glitch resolution is 25ns. If spike direction is unknown, select MIN/MAX in the peak detector mode. The minimum glitch resolution is 50ns.

4 Repetitive Event Observations

1) Extraction of signals masked by noises

Repetitive signals masked by external noises or system noises are quite common in the actual waveform measurement. Such signals are also hard to be observed on a real-time oscilloscope.

Such cyclic signals masked by noises may be extracted with improved S/N ratio by means of add averaging. If AVG is selected in the storage mode, add averaging is performed in accordance with the number of averaging operations set with the SET MENU. The degree of improving the S/N ratio is as follows, provided the set value (number of times) is n:

$$1\sqrt{n}$$

Averaging OFF   Averaging n = 4

Averaging n = 16   Averaging n = 64
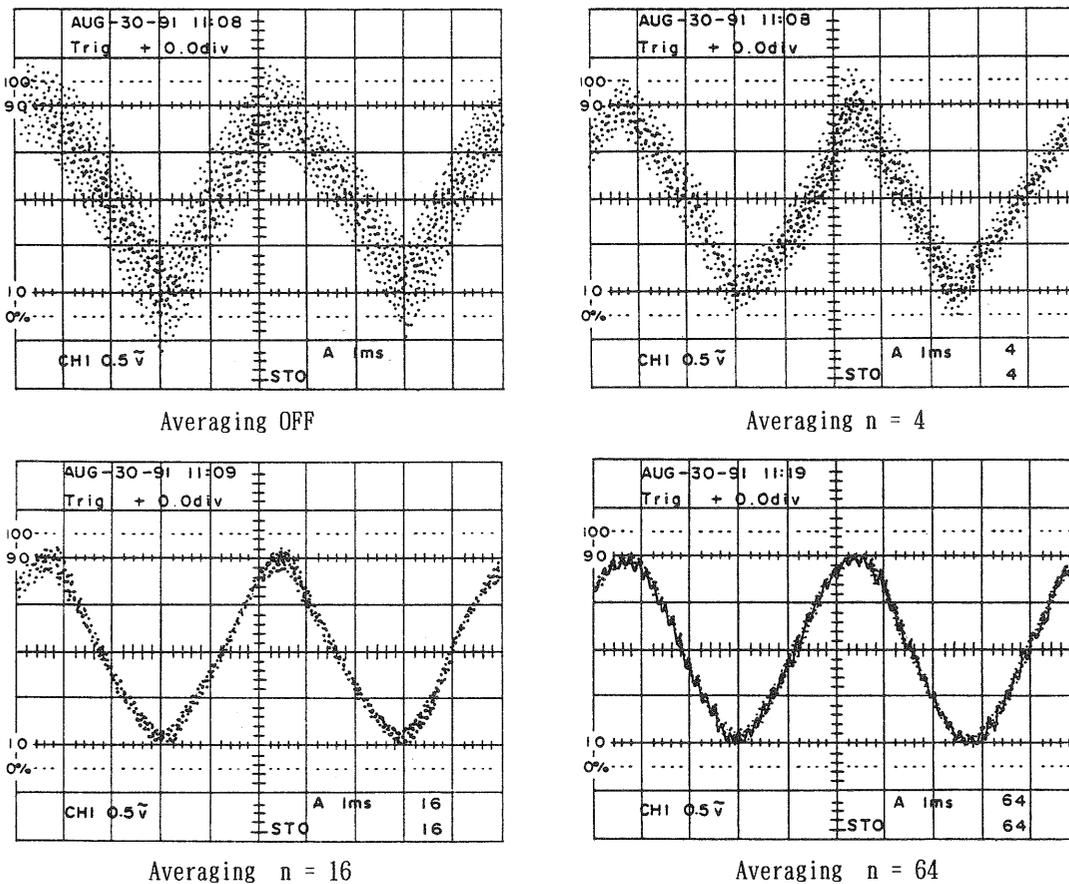
Fig. 21

2) High-speed event observation

Observation in the range over $2\mu s$ [$5\mu s$]/div. is available in two methods: Measurement using data interpolation mentioned in 2) and 3) above, and equivalent sampling applicable for repetitive phenomena. Different from the data interpolation, in the equivalent sampling, the actual input data are displayed on the CRT. Thus, use this mode if data of high-speed and stable phenomena are required.

For example, if the equivalent sampling is used at the maximum sampling sweep speed of 20ns/division, the resolution along the time axis is 2000 samples. Thus, the equivalent sampling time is found as follows:

(20ns × 10div)/2000sample = 0.1ns (100ps)/sample·

Like this, measurement at high time axis resolution is possible.
As shown above, the equivalent sampling shall be selected with the MODE switch in the range over $2\mu s$ [$5\mu s$]/div. where time axis resolution is deteriorated.

Equivalent sampling OFF   Equivalent sampling ON
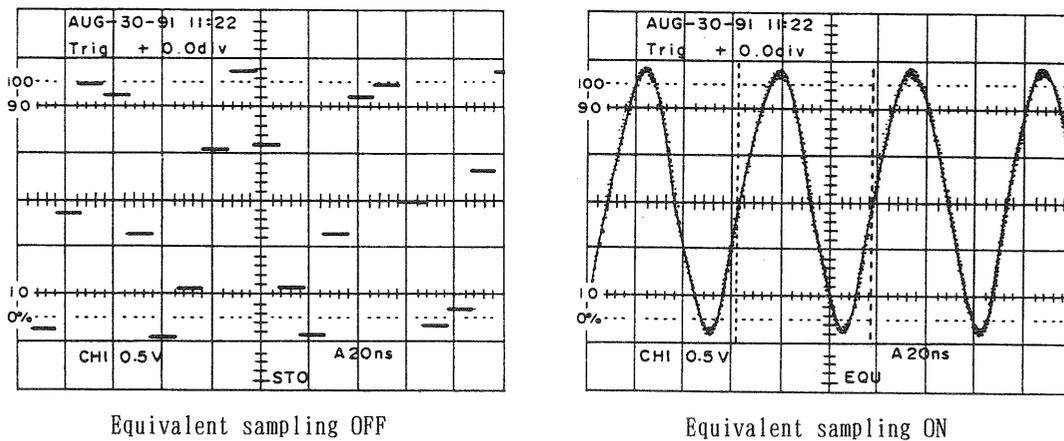
Fig. 22

5 Relative Measurement of Waveform Data

1) Using reference data

For waveform comparison of the same signal sources or same type of signals, waveforms may be compared accurately by using the reference data in the below-mentioned procedures.
Assume that the rise characteristics of a switching power supply circuit using AC input voltage to generate DC output voltage is to be measured, for example. As the reference data, the output characteristic using another DC power supply, instead of the AC power supply, is used.

① Activate the CH1 and CH2 reference memory on the menu, then select the single sweep storage mode.

② Input the input DC voltage into CH1 and output voltage into CH2. Set the TRIG SOURCE to CH1 to read data using the point when the DC supply voltage is turned on as the trigger point. Adjust the pre-trigger value if necessary.

③ If data are read, press the HOLD switch, then press the SAVE switch. By this, the data in the acquisition memory is copied and saved in the reference memory.

④ Then, use the actual AC supply voltage as the input signal, and read the input and output in the same manner.

⑤ The reference data are not changed. Read data repeatedly as mentioned in ④ above until necessary waveform is obtained.

⑥ Compare the read data with the reference data.
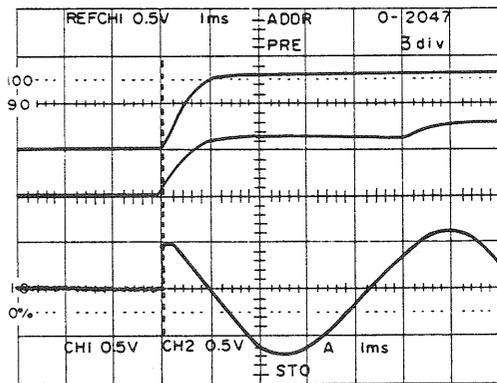
Waveform comparison with reference data

Figure 23

```
┌─ NOTE ─────────────────────────────────────────────────────────────────┐
│ The vertical position of the reference data can be adjusted with the TRACE SEP control. │
│ Its intensity can be adjusted with the B-INTENSITY control.             │
└─────────────────────────────────────────────────────────────────────────┘
```

6 Data Output

1) Output to plotter

Measured data may be stored in several ways. If a great amount of waveform data need be output, plotter output or recorder output minimizes the running costs. The following example assumes that chattering data of a number of relays are measured and saved.

① Connect the relay driving input to CH1. Connect the waveform of the relay contact to CH2. In the NORM storage mode, set the single sweep mode in the same way as in the real-time operation.

② Then, select CH1 as the trigger source, adjust the sweep time, select pre-triggering in the storage trigger mode, and set time so that both the CH1 and CH2 wave signals are observed.

③ Press the SINGLE switch, make sure that the READY LED goes on, and activate the relay driving input.

④ Make sure that data is read in, press the HOLD switch and plotter output setting of this instrument is proper, and the plotter is ready for operation. Then, press the PLOT switch (F5) to output data to the plotter.

By repeating the above operations, waveform data may be stored easily.

2) Output to pen recorder

Like the plotter output shown above, measured data may be stored as waveform data to reduce running costs. Difference from the plotter output, analog pen recorder output allows the output scale to be set freely and output data to be overwritten over other data (including hand writing) for easy data comparison.
The following assumes that the same data as mentioned above is measured.

① Carry out operations ① to ③ mentioned above.

② Make sure that data are read in. Set the analog pen recorder output condition of this instrument. The pen recorder output voltage of this instrument is 0.5V per division of the CRT. Set the recorder range. If necessary, carry out test output to adjust the scale with the output form used (such as a copy of specification and so forth).

③ On completion of above setting, press the PLOT switch (F5) to output data to the recorder.

Through these operations, data may be compared with data in the specification easily.

[C] Programmable Oscilloscope Applications

1 Application to Routine Measurement

1) Programming applications using single oscilloscope

Measurement of the interval and rise time of non-cyclic pulses
For example, pulse signals under computer's control are not cyclic in many cases. A storage oscilloscope is more suitable than a real-time oscilloscope to measure their intervals and delay time. On the contrary, such pulses rise and fall at high speed since they are generated by high-speed digital ICs. To measure their rise time and fall time accurately, a high-speed real-time oscilloscope is advantageous. This instrument has both functions. If the above two types of measurements are used for several pulse strings, measurement sequences may be programmed for efficient measurement.

The following description assumes that the delay time and rise time of non-cyclic pulse strings synchronous with each other.

① Open the PROGRAM sub-menu on the main menu.

② Specify a group No. with the F2 key (GROUP). (In this example, group No. =1.)
Select EDIT with the MODE key (F1), then press the MENU switch ⑨. The program menu opens. (On the normal program menu, a program and No. are displayed. The previous panel setting for the No. is displayed.)
In the upper left part of the CRT, a step No. is displayed. Set the step No. to "1" with the SET switch. "GROUP 1 No.1" is displayed.

③ Select the storage mode to measure the pulse interval.

④ Input the pulse strings to be measured into the CH1 and CH2 INPUT terminals. Select a channel for observation, specify the trigger source (CH1), and set the trigger level and SWEEP TIME/DIV.

⑤ Adjust the cursor mode to ΔT to measure the delay time between the pulses. (See Fig. 24.)
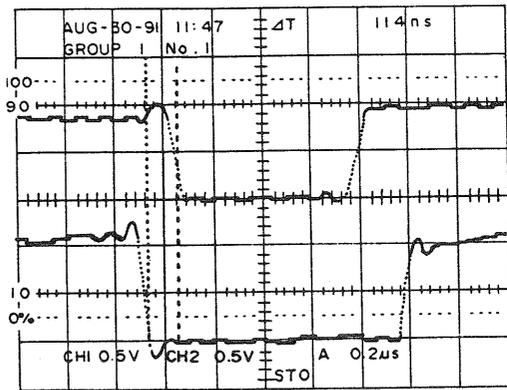
Delay time between pulses

Fig. 24

⑥ Press F1 (SAVE) to store the above setting. Press the SET switch to select "GROUP 1 No. 2".

⑦ Then, set the SCOPE MODE to the real-time mode, and set the SWEEP TIME/DIV to a range where the rise time of the pulses may be measured.
Then, select a channel for measuring the rise time, and set the voltage range to 1V/division.

⑧ Adjust the cursor mode to ΔT, then measure the rise time between the pulses. (See Fig. 25.)
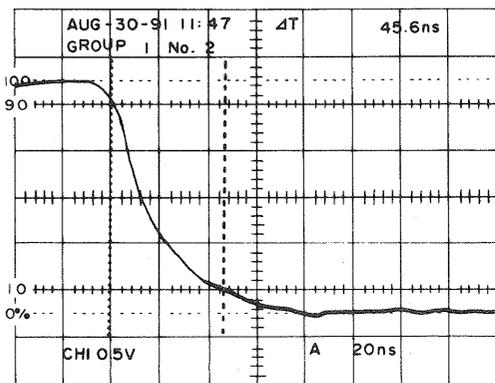
Delay time between pulses

Fig. 25

⑨ Press F1 (SAVE) to store the setting.

⑩ On completion of setting, press the MENU switch to return to the PROGRAM sub-menu. Press the REPEAT switch (F3) to set the repeat No. to 2.
By this, a program containing repetitive steps 1, 2, 1, 2, 1, ... is created.
To start the program, select RUN with the MODE switch (F1 ⑫) and return to the normal screen by pressing the MENU switch ⑨; the program is activated in accordance with the stored setting.

⑪ While the program is running, PROGRAM is displayed in the upper left of the CRT as in process of editing. The step No. may be changed with the SET switch. As the step No. is changed, panel

setting also changes like 1-1, 1-2, 1-1, ... (The step No. may be incremented or decremented.)
If a foot switch, etc. is connected to the program step input terminal on the rear panel, the step
No. may be incremented from outside. (In this case, the step No. can only be incremented.)

⑫ Change the input signal. Same setting may be performed using the SET switch only in the same manner
as described in ⑪ above.

7. GP-IB INTERFACE

7-1 General

The DCS-9000 Series (DCS-9100, 9120, 9320 and 9300) have the GP-IB interfaces as standard. By connecting them with host computers as controllers, the remote functions and waveform data transfer can be controlled via the GP-IB interfaces.

7-2 GP-IB Specifications

The GP-IB interface of this series complies with the IEEE Standard 488-1978.

1) Bus line configuration

The bus lines of the GP-IB interface consist of eight control signal lines (3 hand shake lines and 5 control lines), eight data signal lines and eight GND lines.
Table 1 shows the GP-IB bus line configuration. Figure 26 shows the device connection diagram.

Table 1 GP-IB bus line configuration

Type	Signal Name	Function Explanation
Handshake Control Line	DAV : Data Valid	Indicates that the information on the data bus is valid
	NRFD : Not Ready For Data	Indicates that the listener that is connected is ready to receive the information on the data bus
	NDAC : Not Data Accepted	Indicated that the listener that is connected has received the information on the data bus
Supervisor Control Line	IFC : Inter face Clear	Initializes the GP-IB interface unit

	ATN : Attention	Indicated the type of data on the data bus
		  LOW : Address command
		  HIGH : Data

	SRQ : Service Request	Requests service to the controller
	REN : Remote Enable	Specifies remote control or local control
	EOI : End or Identify	Indicates the end of the transmitted data block
Data Bus	DIO 1~8: Data Input Output	The data bus consists of 8 bidirectional signal lines, and transfers information in the byte serial form.
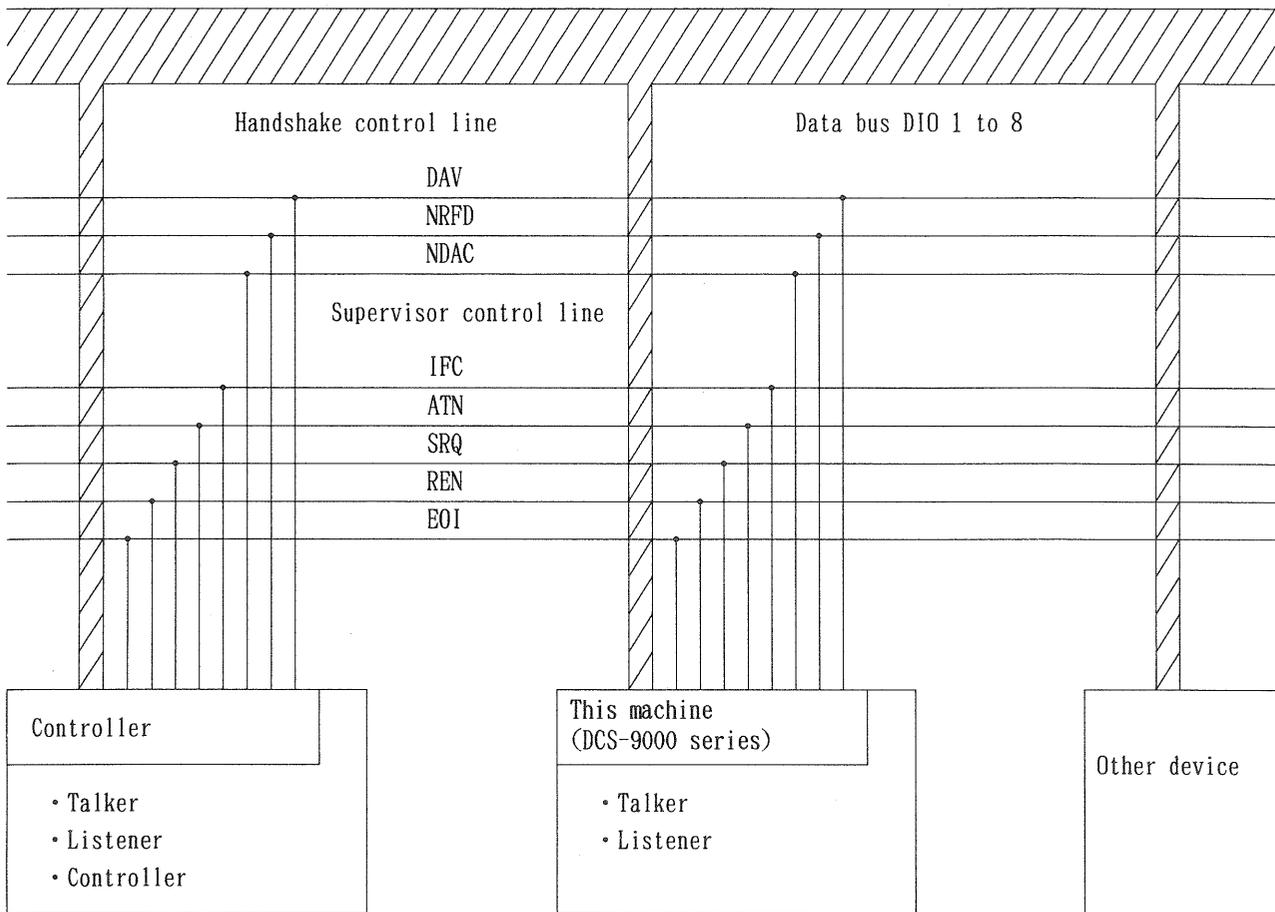
Fig. 26 Device Connection Diagram

2) Interface function

Table 1 describes the functions of data bus, handshake control line, and interface control line.

① SH (Source handshake)
This is the function that transmits the data on the data bus, and this machine has all functions at the SH1 level.

② AH (Accepter handshake)
This is the function that receives the data on the data bus, and this machine has all functions at the AH1 level.

③ T (Talker)
This is the function that transmits data through the data bus to other devices such as a controller. The support level of this device is T5, and it releases the talker function by the receipt of basic talker, serial polling and MLA (My Listen Address) signals.

④ L (Listener)
This is the function that receives data through the data bus from other devices. The support level of this device is L4, and it releases the listener function by the receipt of basic listener and MTA (My Talk Address) signals.

⑤ SR (Service request)

This is used to send asynchronous service requests to the controller. The support level of this device is SR1.

⑥ RL (Remote/local)

This device selects whether the control will be remote control (program control through the GP-IB) or local control (by the panel switch operations). The support level of this device is RL2, and it has the remote/local function, but it cannot support the local lockout (LLO) function.

⑦ PP (Parallel polling)

This device is PP0, and does not have a parallel polling function.

⑧ DC (Device clear)

This device is DC1, and has all device clear functions.

⑨ DT (Device trigger)

This device is DT0, and does not support device trigger functions.

⑩ C (Controller)

This device is C0, and does not support controller functions.

* The implementation of the interface functions described above is given in the "multiline interface message command" section.

3) Multiline interface message commands

The response of this device to the IEEE standardized message commands is given in the following.

The interface message commands are classified as shown below.

```
┌─ Primary command group (PCG)
│
│    ┌─ Address command group (ACG)
│    ├─ Universal command group (UCG)
│    ├─ Listener address group (LAG)
│    └─ Talker address group (TAG)
│
└─ Secondary command group (SCG)
```
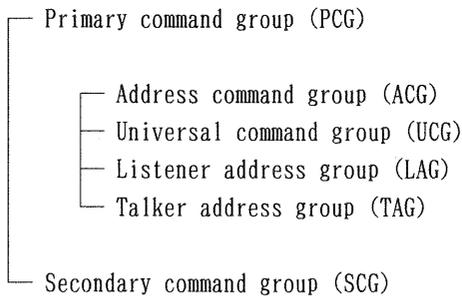
A list of interface message command codes is given in Table-2.

This device does not support any of the secondary command group (SCG).

Table-2 Interface Message Command Code List

b7 b6 b5 →					0 0 0	MSG	0 0 1	MSG	0 1 0	MSG	0 1 1	MSG	1 0 0	MSG	1 0 1	MSG	1 1 0	MSG	1 1 1	MSG
b4	b3	b2	b1	Line \ Column	0		1		2		3		4		5		6		7	
0	0	0	0	0	NUL		DLE		SP		0		@		P				p	
0	0	0	1	1	SOH	GTL	DC1	LLO	!		1		A		Q		a		q	
0	0	1	0	2	STX		DC2		"		2		B		R		b		r	
0	0	1	1	3	ETX		DC3		#		3		C		S		c		s	
0	1	0	0	4	EOT	SDC	DC4	DCL	$		4		D		T		d		t	
0	1	0	1	5	ENQ	PPC③	NAK	PPU	%		5		E		U		e		u	
0	1	1	0	6	ACK		SYN		&		6		F		V		f		v	
0	1	1	1	7	BEL		ETB		'		7		G		W		g		w	
1	0	0	0	8	BS	GET	CAN	SPE	(	MLA assigned to the device	8	MLA assigned to the device	H	MTA assigned to the device	X	MTA assigned to the device	h	Meaning is defined by PCG	x	Meaning is defined by PCG
1	0	0	1	9	HT	TCT	EM	SPD	)		9		I		Y		i		y	
1	0	1	0	10	LF		SUB		*		:		J		Z		j		z	
1	0	1	1	11	VT		ESC		+		;		K		[		k		{	
1	1	0	0	12	FF		FS		,		<		L		\		l		|	
1	1	0	1	13	CR		GS		−		=		M		]		m		}	
1	1	1	0	14	SO		RS		.		>		N		^		n		~	
1	1	1	1	15	SI		US		/		?	UNL	O		_	UNT	o		DEL	

Address command group (ACG) — columns 000, 001
Universal command group (UCG) — column 001
Listen address group (LAG) — columns 010, 011
Talk address group (TAG) — columns 100, 101

Primary command group (PCG)   Secondary command group (SCG)

NOTE : ① MSG = Interface signal
② b1 = DIO1 ···· b7 = DIO7, DIO8 is not used
③ Used with secondary command
④ Most often used subset (column 010 to 101)

MLA : My Listner Address
MTA : My Talk Address

① Address command group (ACG)

MSG	Message Command Name	This Machine's Answer
GTL	Go to Local	Make the Local state.
SDC	Select Device Clear	Clears the receive/send buffer and the status byte.
PPC	Parallel Poll Configure	No response
GET	Group Execute Trigger	No response
TCT	Take Control	No response

② Universal command group (UCG)

MSG	Message Command Name	This Machine's Answer
LLO	Local Lockout	No response
DCL	Device Clear	Clears the receive/send buffer and the status byte.
PPU	Parallel poll uncondigure	No response
SPE DPD	Serial Poll Enable Serial Poll Disable	Serial poll operative, status byte transmitted

4) Uniline commands

The controller, by accessing the interface control line, controls the GP-IB device.

This machine's response to the uniline command

① IFC (Interface Clear)
Initialize the GP-IB interface unit. In other words, this command is used to initialize the interface unit when there is an inconsistency between the specified initial address and the number of transmitted data, and the transmission is suspended by the 3-line handshake, when waveform data is transmitted.

Because generally when an inconsistency occurs, matching of the controller and this device cannot be obtained with the interface command clear only, it is necessary to initialize this device with the device clear command in the multiline interface message command.

② REN (Remote Enable)
When this device is remotely controlled by the controller, it is necessary to place this device in the remote status using this command.

When this device assumes the remote status, the panel becomes unable to receive this operation, and only the remote control from the controller is effective.

When the remote control from the controller ends, perform Remote Disable with this command or GTL command send to this device. The panel operation is now effective.

100

7-3 GP-IB HARDWARE SETTINGS

1) Connections

The connections between the controller and this machine are made with standard GP-IB cable.

2) DIP switches

Use the DIP switches on the rear panel (as shown below) for selection of the GP-IB or RS-232C for output to a plotter, for GP-IB address setting, and delimiter control setting.
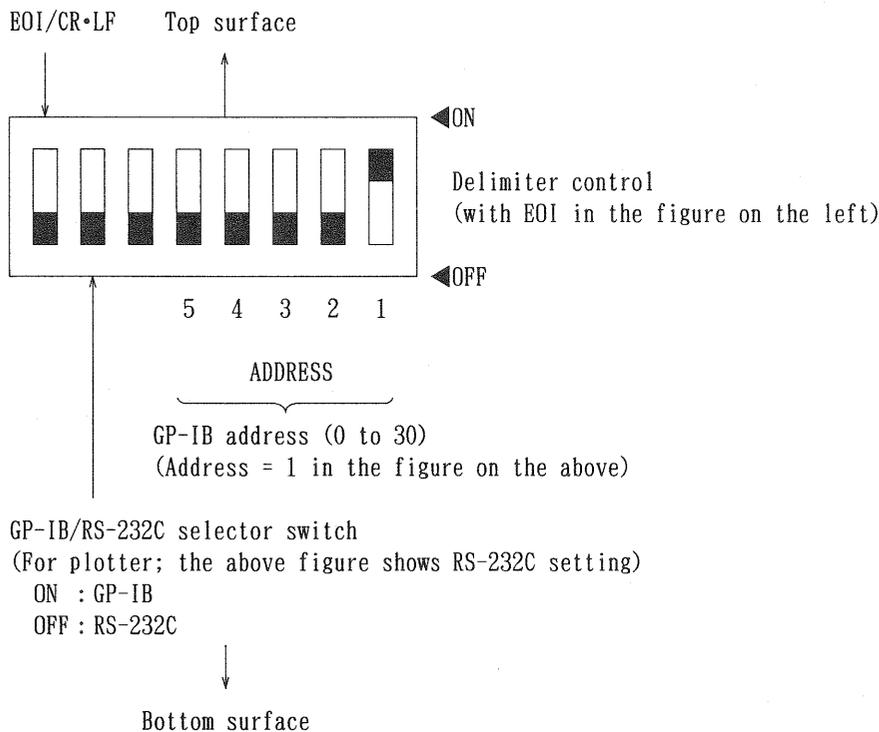
Fig. 27

Because the reading of the DIP switches is only done once with the power on, set the DIP switches before turning on the power.

① GP-IB address
The addresses that can be set are from 0 to 30.
The listener address is added for this setting value as 20H in hexadecimal, and the talker address as 40H.

② Delimiter control
Either the method using CR/LF as the delimiter that indicates the end of the transmitted data block or the method in which the EOI signal is applied to the last data byte (with EOI) can be selected.
However, the delimiter using CR/LF is used only with ASCII code, and for binary data transmission, regardless of the setting of these DIP switches, the delimiter with EOI is always used.
For details, see the command format.

③ Plotter setting

Set the second DIP switch from the left ON to select the GP-IB. Set it OFF to select the RS-232C.
If the GP-IB is selected for data output to a plotter, the oscilloscope enters the talk-only mode
sutomatically and GP-IB control by the controller is disabled. Thus, if the normal GP-IB
operation is required, set the DIP switch OFF to select the RS-232C.

7-4 Inherent Commands (GP-IB commands)

1) Remote mode

Before starting GP-IB control, bring the DCS-9300 [9100] into the remote mode. Set the GP-IB REN
(remote enable) signal to Low. If the REN signal is set High, the DCS-9300 [9100] enters the local mode.
In the remote mode, the POWER switch and the non-GP-IB switches and controls for CRT adjustments are
only functional. Other switches and controls do not function. The DCS-9300 [9100] can only be
controlled using remote commands.

2) Functions of GP-IB commands

The GP-IB commands are issued by the controller to the DCS-9300 [9100] to execute remote operations.
These commands may be divided into two types: The commands only issued by the controller, and the
commands to which the DCS-9300 [9100] sends responses.
   Commands issued only
   Panel remote control commands
   Waveform data write commands
   Commands to which DCS-9300 [9100] sends responses
   Panel status response commands
   Waveform data response (output) commands

3) Format of GP-IB commands

a) Parameter format

A GP-IB command consists of the following seven fields (T, U, V, W, X, Y and Z), in principle:

Table 3 Field list

T	Command operand	3 to 7 alphabetic characters; Inevitable
U	Code	+ or − (Used with V field)
V	Numeric	0 to 9 and "."; Up to 7 figures including the decimal point
W	Index	Index part beginning with E (Used with V field)
X	Data	ASCII : 0 to 255 separated by "," Binary: 0 to FF (hex.) binary data
Y	Sub-delimiter	If plural parameters (U, V and W) are used continuously, they are separated by ",".
Z	Separator and delimiter	Separators are used ":" or ";". Delimiter, CR/LF or CR/LF +EOI, is added to the end.

A GP-IB command consists of a T field (command operand), control parameter area consisting of three fields (U, V and W), X field (data field), and Z field (delimiter). The control parameters and data are separated by Y fields (sub-delimiters). For the control parameters, necessary fields, data length and effective data range are determined for each command operand. For the X field (data field), decimal ASCII or hexadecimal binary may be used.

The length of each field may include spaces. (The DCS-9300 [9100] ignores spaces included in a received command.) A command issued by the DCS-9300 [9100] always has the data length specified in the command specification. Data are aligned to the end.

   Example: Output from controller (Variable length, spaces are ignored.)
       VOLTS_1, __ 10E-3: (_indicate spaces.)

       Output from DCS-9300 [9100] (Fixed length, aligned to the end)
       __VOLTD1, __10E-3:
       T field =6, V field=3

The following shows an example of the command format (arrangement of fields):
  TZ   : Operand only
  TVZ   : Operand and parameter (Numeric)
  TUVWZ : Operand and parameter (Code+numeric+index)
  TUVZ   : Operand and parameter (Code+numeric)
  TVYVYZ : Plural parameters
  TVYVYXZ: Data is included.

b) Command format

The GP-IB format consists of one or more commands and separators ":" for marking off each command.
A delimiter is attached to the end of the format. The delimiter may be CR/LF or With EOI, which is chosen via the selector switch (DIP switch) on the rear panel. However, With EOI is automatically selected for commands which handle binary data. Commands, separators, and delimiter are arranged as follows:

  C: <delimiter>   "c" command
  C:C:C:C: <delimiter>   ":" separator

If the total number of characters included in multi-statement format exceeds 1843, the commands preceding the command that includes more than 1843 characters are executed as a single block. The remaining commands are executed as the next block.
The WOUT command is not usable in multi-statement format. (Collected data could not be guaranteed.)

┌─ NOTE ──┐
│ If two or more STATUS commands are sent in multi-statement and the response to them are │
│ retrieved with an INPUT and LINE INPUT statements of BASIC, the beginning characters of the │
│ responses may be missing depending on the controller. If this is the case, send the │
│ 'NLSET n' command to the DCS-9300/9100 before sending the first command in the BASIC command. │
│ (Letter "n" denotes the number of beginning characters that are missing. Usually, n = 2 to 4.) │
└──┘

c) Error processing

① Command error
   If a command output from the controller does not exist or is unexecutable, a service request for command error is output to the controller.
   If an abnormal character string follows a command, the characters in that string are considered a parameter. Thus, it does not result in a command error (but it results in a parameter error).
   The maximum total number of characters, including spaces, is 1843 per command. If this number is exceeded, a command error occurs.

② Parameter error
   If the parameter of a command output from the controller is outside the available range, a service request for parameter error is output to the controller.
   When displaying a numeral value including a decimal point, the figures following the decimal point can be omitted. A parameter error occurs if any figure preceding the decimal point is omitted or if the figures following the decimal point are too many.
   Generally, space characters are ignored. However, a parameter error occurs if a space character is included in the display of exponent value.

③ Error with multi-statement
   In the event of an error with a multi-statement, the system continues execution up to the command immediately before the error. The commands following the error are aborted and the command string is ignored.

d) Processing with parameter omission
   Parameter omission applies the parameter which was used for the same last-executed command.
   To omit all following an arbitrary parameter, the commas ",” that follow may be omitted. If a parameter error occurred with the previous command, an error occurs if a parameter is omitted.

4) Service request

   If an error occurs, the DCS-9300 [9100] outputs a service request using a serial pole when operation is completed. Upon receipt of the service request, the controller shall read the status byte and execute appropriate processing.

a) Status byte list

Bit	STATUS BYTE	ERR	END
DB8	Extension status	0	0
DB7	SRQ Bit	1	1
DB6	ERR Bit	1	0
DB5	DATA Bit4	Not defined	Not defined
DB4	DATA Bit3	RUN error	Not defined
DB3	DATA Bit2	Data error	AUTO SET completed
DB2	DATA Bit1	Parameter error	Output completed
DB1	DATA Bit0	Command error	Reading completed

Command error   : occurs with a command which is not supported or is wrongly spelled.
Parameter error   : Occurs if a command parameter is incorrect. (quantity, attribute, specified range, notation)
Run error   : Occurs if a command is specified although it is set under unexecutable conditions.
Data error   : This error occurs if a talker is specified when data is not prepared on the DCS-9300/9100.
Reading completed : Reading of waveform is completed. (Single, average, hold)
Output completed   : Pen out or plot out is completed.
AUTO SET completed: AUTO SET operation completed.

b) Extension status byte

The DCS-9300 [9100] does not use the extension status byte. Thus, DB8 is fixed to 0.

c) Service request masking

In process of remote control operation, a service request should be issued under limited conditions for the reason of the remote sequence of the controller. (For example, a specific SRQ should be obtained in a sequence which may cause plural SRQs.) In such a case, a mask command may be used to set the condition in units of status byte bits. (Refer to No. 62 SRQ mask command [MASK] in the command reference.)

7-5 Command Specifications (GP-IB command reference)

1) GP-IB command list

Operation	Function type	Function name	No.	Command	Stabilizing time
Vertical axis	Input	VOLTS/div	1	VOLTD	0.1s Note 1
		VARIABLE (CHx)	2	VVARI	
		CHx POSITION	3	VPOSI	
		COUPLING	4	COUPLE	0.5s
	Display	V-MODE (CHx)	5	VMODE	0.1s
		INVERT	6	INV	0.1s
		CHOP	7	CHOP	
		ADD	8	ADD	0.1s
		20MHz BWL	9	BWL	
Horizontal axis	Setting	A-SWEEP TIME/div	10	TIMEDA	
		B-SWEEP TIME/div	11	TIMEDB	
		SWEEP TIME VARIABLE	12	HVARI	
		×10MAG	13	MAG	
	Display	H-POSITION	14	HPOSI	
		H-POSITION FINE		HPOSI	
		H-MODE A	15	HMODE	
		H-MODE AINTB		HMODE	

Operation	Function type	Function name	No.	Command	Stabilizing time
Horizontal axis	Display	H-MODE ALT		HMODE	
		H-MODE B		HMODE	
		H-MODE XY		HMODE	
		TRACE SEPARATION	16	TRACES	
Trigger	A trigger	TRIGGER LEVEL	17	LEVEL	
		TRIGGER SOURCE VERT	18	SOURCE	0.1s
		TRIGGER SOURCE CH1 to CH4		SOURCE	0.1s
		TRIGGER SOURCE LINE		SOURCE	0.1s
		TRIGGER COUPLING	19	TRCPL	0.5s
		TV LINE SELECTER	20	TRCPV	
		SLOPE	21	SLOPE	
		TRIG MODE AUTO	22	TRIGMD	0.1s
		TRIG MODE NORMAL		TRIGMD	
		TRIG MODE FIX		TRIGMD	0.5s
Trigger		TRIG MODE SINGLE		TRIGMD	
	A trigger	TRIG MODE SINGLE RESET	23	RST	
		HOLD OFF TIME	24	HLDOF	
	B trigger	B SOURCE AFTER DELAY	25	BSOURC	
		B SOURCE TRIG'D		BSOURC	
		B SOURCE COUNT		BSOURC	
Readout	Cursor	CURSOR V	26	CURSOR	
		CURSOR T		CURSOR	
		CURSOR 1/T		CURSOR	
		△REF CURSOR	27	REFCS	
		△CURSOR	28	DELTA	
		CURSOR TRACKING	29	CTRACK	
	Automatic measurement	PARAMETER	66	PMES	0.5s
		PARAMETER	67	PASET	0.5s
		GND-REF	68	GREF	0.5s
		PARAMETER	69	WDPIN	
	Judgment	GO/NO-GO	30	GONO	
		GO/NO-GO	31	GNL	
Readout (Menu)	Setting	AUTO-SET	32	AUTOR	
		PROGRAM	33	PSTEP	
		PROGRAM REPEAT	65	PSTREP	
		STORAGE/REAL	34	STOR	
		TV-TYPE	35	TVMODE	
		BUZZER	36	BUZZER	
		TIME DISP	50	TIMSET	
		COMMENT	37	CMW	
		COMMENT	38	CMD	

106

Operation	Function type	Function name	No.	Command	Stabilizing time
Storage	Storage function	DETECT PEAK	39	DPEAK	~5s Note 2
		EQU SAMPLING	40	EQU	2s~ Note 3
		ROLL MODE	41	ROLL	
		PRE-TRIGGER	42	PRETRG	
		POST-TRIGGER	43	PSTTRG	
		HOLD	44	HOLD	
		AVERAGE	45	AVERAG	
		CALCULATION	46	CALEDT	
		INTERPOLATION	47	INTERP	
		SAVE	48	SAVE	
	Display	DISPLAY-ADDRESS	49	DISPAD	
		TIME DISP	50	TIMSET	
		STO HORIZONTAL POSITION	51	SXPOS	
		REFERENCE	52	REF	
		STO HOLD CHx POSITION	53	SHVPOS	
Storage	Setting	DETECT PEAK	39	DPEAK	
		AVERAGE	45	AVERAG	
		DISPLAY-ADDRESS	49	DISPAD	
		MEMORY SIZE	54	MEMSIZ	
	Data hard copy output	PEN OUT	55	PEN	
		PLOTTER OUT	56	PLOT	
		PEN SETUP	57	PENSET	
		PLOTTER SETUP	58	PLOTSET	
		RS232C	59	RSSET	
GP-IB	Data I/O	Data Input	60	WOUT	
		Waveform data output request	61	WREAD	
		Waveform data output request (DMA)	63	WDREAD	
	Status	SRQ Masking	62	MASK	

Stabilizing time: Period from command setting to the time when function is stabilized (in seconds)
For example, if the vertical input coupling is changed from DC into AC, wait for approx. 0.5 seconds before starting measurement in order to charge (or discharge) DC voltage.

Note 1: 10 times as large if the 10:1 probe is used.
Note 2: At the maximum sweep range (20ns [50ns]/div.)
Decreases in proportion to the ratio with respect to the maximum range in the range below it.
Note 3: 1 screen in the roll sweep range corresponds to the stabilizing time.
At 0.5 s/div., for example, the stabilizing time is approx. 5 seconds (0.5×10.24＝5.12 seconds).

2) GP-IB command specifications (GP-IB command reference)

Note 1: The # mark indicates the number of characters.
Note 2: The format of the "3. Status response" is not specified, the format specified in "2. Format"
is used. If the first parameter (a requested command name) should be followed by the second
parameter (a requested item) in the status request, these parameters should be specified
continuously with no character between them.
Example: STATUS VOLTD1 ("1" serves as the second parameter.)
Note 3: The accuracy of setting analog values and reading is as follows:
Division display: ±0.5 division
% display   : Not specified.

```
┌─────────────────────────────────┐
│ 1  VOLTS/div command: VOLTD     │
└─────────────────────────────────┘
```

1. Function and operation specification: Real/storage
Sets the vertical axis sensitivity in CH1 to CH4.
Alternatively, the probe (10:1) may be used for correct setting.

2. Format: 'VOLTD X1, X2'

X1	channel No.	X2 (Vertical axis sensitivity)	
#		#####	
1	CH1	50 (50V/div)	Note 1
2	CH2	20 (20V/div)	Note 1
3	CH3	10 (10V/div)	Note 1
4	CH4	5 (5V/div)	
		2 (2V/div)	
		1 (1V/div)	
		0.5 (0.5V/div)	
		0.2 (0.2V/div)	
		0.1 (0.1V/div)	
		50E-3 (50mV/div)	
		20E-3 (20mV/div)	
		10E-3 (10mV/div)	
		5E-3 (5mV/div)	Note 2
		2E-3 (2mV/div)	Note 2
		1E-3 (1mV/div)	Note 2

Note 1: When the probe (10:1) is used.
Note 2: When the probe (1:1) is used.

3. Status response 1: 'STATUS VOLTD X1' → 'VOLTD X1 X2'
X1, and X2 are indicated previously in "2. Format".
Status response 2: 'STATUS VOLTD' ⟶ 'VOLTD Y1, Y2, Y3, Y4'

Y1	CH1	DATA	DATA=#####
Y2	CH2	DATA	50 (50V/div)
Y3	CH3	DATA	20 (20V/div)
Y4	CH4	DATA	10 (10V/div)
			5 (5V/div)
			2 (2V/div)

```
1  (1V/div)
0.5  (0.5V/div)
0.2  (0.2V/div)
0.1  (0.1V/div)
50E-3  (50mV/div)
20E-3  (20mV/div)
10E-3  (10mV/div)
5E-3  (5mV/div)
2E-3  (2mV/div)
1E-3  (1mV/div)
```

2 VARIABLE (CHx) command: VVARI

1. Function and operation specification: Real/storage
   Sets the vertical axis variable amount in CH1 to CH4.

2. Format: 'VVARI X1, X2'

X1	channel No.	X2	Variable amount (%)	
#		###		
1	CH1		0 to 100	Variable amount and actual data attenuation level are not
2	CH2			calibrated.
3	CH3			
4	CH4			

3. Status response 1: 'STATUS VVARI X1' → 'VVARI X1 X2'
   X1, and X2 are indicated previously in "2. Format".
   Status response 2: 'STATUS VVARI' ⟶ 'VVARI Y1, Y2, Y3, Y4'

Y1	CH1	DATA	DATA=###
Y2	CH2	DATA	0
Y3	CH3	DATA	10
Y4	CH4	DATA	100

3 CHx POSITION command: VPOSI

1. Function and operation specification: Real/storage
   Sets the vertical axis positions in CH1 to CH4.

2. Format: 'VPOSI X1, X2'

X1	channel No.	X2	Position
#		##.#	
1	CH1	±7.9	
2	CH2		
3	CH3		
4	CH4		

3. Status response 1: 'STATUS VPOSI X1' → 'VPOSI X1 X2'
      X1, and X2 are indicated previously in "2. Format".
   Status response 2: 'STATUS VPOSI' ——→ 'VPOSI Y1, Y2, Y3, Y4'
      Y1 CH1 DATA   DATA=##.#
      Y2 CH2 DATA   ±7.0 [div]
      Y3 CH3 DATA
      Y4 CH4 DATA

```
4  COUPLING command: COUPLE
```

1. Function and operation specification: Real/storage
      Selects the vertical axis coupling methods in CH1 to CH4. (AC, GND or DC)

2. Format: 'COUPLE X1, X2'
      X1 channel No.   X2 Coupling method
      #   #
      1   CH1   1   AC
      2   CH2   2   GND
      3   CH3   3   DC
      4   CH4

3. Status response 1: 'STATUS COUPLE X1' → 'COUPLE X1 X2'
      X1, and X2 are indicated previously in "2. Format".
   Status response 2: 'STATUS COUPLE' ——→ 'COUPLE Y1, Y2, Y3, Y4'
      Y1 CH1 DATA   DATA=1 AC
      Y2 CH2 DATA   2 GND
      Y3 CH3 DATA   3 DC
      Y4 CH4 DATA

```
5  V-MODE (CHx) command: VMODE
```

1. Function and operation specification: Real/storage
      Selects the display channel in CH1 to CH4.

2. Format: 'VMODE X1, X2, X3, X4'
      X1 CH1 ON/OFF   X2 CH2 ON/OFF   X3 CH3 ON/OFF   X4 CH4 ON/OFF
      #   #   #   #
      1   OFF   0   OFF   0   OFF   0   OFF
      2   ON   1   ON   1   ON   1   ON
      <For the DCS-9320 and -9120, X3 and X4 may not be set ON in the storage mode only.>

3. Status response 1: 'STATUS VMODE X1' → 'VMODE X1 X2'
      X1, and X2 are indicated previously in "2. Format".
   Status response 2: 'STATUS VMODE' ——→ 'VMODE Y1, Y2, Y3, Y4'
      Y1 CH1 ON/OFF   Y2 CH2 ON/OFF   Y3 CH3 ON/OFF   Y4 CH4 ON/OFF
      #   #   #   #
      0   OFF   0   OFF   0   OFF   0   OFF
      1   ON   1   ON   1   ON   1   ON

6 INVERT command: INV

1. Function and operation specification: Real/storage
   Inverts the phases of the input signals in CH2 and CH4.

2. Format: 'INV X1, X2'

X1	CH2INV	X2	CH4INV
#		#	
0	OFF	0	OFF
1	ON	1	ON

3. Status response: 'STATUS INV' → 'INV X1, X2'
   X1, and X2 are indicated previously in "2. Format".

7 CHOP command: CHOP

1. Function and operation specification: Real
   Selects the switching mode (ALT/CHOP) of the vertical axis display.

2. Format: 'CHOP X1'

X1	Chop mode ON/OFF
#	
0	OFF (ALT MODE)
1	ON (CHOP MODE)

3. Status response: 'STATUS CHOP' → 'CHOP X1'
   X1 is indicated previously in "2. Format".

8 ADD command: ADD

1. Function and operation specification: Real
   Selects addition of CH1 - CH2 or CH3 - CH4 signals.

2. Format: 'ADD X1'

X1	Operation
#	
0	OFF
1	CH1+CH2
2	CH3+CH4
3	CH1+2, CH3+4

3. Status response: 'STATUS ADD' → 'ADD X1'
   X1 is indicated previously in "2. Format".

```
9  20 MHz BWL command: BWL
```

1. Function and operation specification: Real/storage
   Real mode   : Sets 20 MHz band-pass filtering.
   Storage mode: Sets smoothing operation.

2. Format: 'BWL X1'/Smoothing
   X1   BWL
   #
   0   OFF
   1   ON

3. Status response: 'STATUS BWL' → 'BWL X1'
   X1 is indicated previously in "2. Format".

```
10  A SWEEP TIME/div. command: TIMEDA
```

1. Function and operation specification: Real/storage
   Selects the A sweep time range.

2. Format: 'TIMEDA X1'

X1	Range
######	
5000	5000s (Hold contraction)
500	500s
50	50s
5	5s
0.5	0.5s
50E-3	50ms
5E-3	5ms
0.5E-3	0.5ms
50E-6	50μs
5E-6	5μs
0.5E-6	0.5μs
50E-9	50ns

   ┌─ NOTE ───┐
   │ Range setting is described for a 5-range configuration. The same description applies to a 2- │
   │ and 1- range configurations.   │
   │ In REAL mode, the range is 20ns to 0.5s/div. [In the STORAGE mode, the maximum setting is │
   │ 20 ns/div. for the DCS-9300 and 9320 or 50 ns/div. for the DCS-9100 and 9120.] │
   └──┘

3. Status response: 'STATUS TIMEDA' → 'TIMEDA X1'
   X1 is indicated previously in "2. Format".

---

11 B SWEEP TIME/div. command: TIMEDB

1. Function and operation specification: Real/storage
   Selects the B sweep time range.
   (If a range greater than the A range is specified, it is equalized to the A range.)

2. Format: 'TIMEDB X1'

X1	Range
#######	
0.5	0.5s (HOLD contraction)
50E-3	50ms
5E-3	5ms
0.5E-3	0.5ms
50E-6	50μs
5E-6	5μs
0.5E-6	0.5μs
50E-9	50ns

   ```
   ┌─ NOTE ──────────────────────────────────────────────────────────────────┐
   │ Range setting is described for a 5-range configuration.  The same description applies to a 2-
   │ and 1- range configurations.
   │ In REAL mode, the range is 20ns to 0.5s/div. [In the STORAGE mode, the maximum setting is
   │ 20 ns/div. for the DCS-9300 and 9320 or 50 ns/div. for the DCS-9100 and 9120.]
   └──────────────────────────────────────────────────────────────────────────┘
   ```

3. Status response: 'STATUS TIMEDB' → 'TIMEDB X1'
   X1 is indicated previously in "2. Format".

---

12 SWEEP TIME VARIABLE command: HVARI

1. Function and operation specification: Real
   Sets the variable amount of the horizontal sweep time.

2. Format: 'HVARI X1'

X1	Variable amount
###	
0 to 100	Variable amount and actual data attenuation level are not calibrated.

3. Status response: 'STATUS HVARI' → 'HVARI X1'
   X1 is indicated previously in "2. Format".

---

13 ×10MAG command: MAG

1. Function and operation specification: Real
   Increases the horizontal sweep time 10 times as high.

2. Format: 'MAG X1'
   X1 Horizontal sweep time
   #
   0   ×1
   1   ×10

3. Status response: 'STATUS MAG' → 'MAG X1'
   X1 is indicated previously in "2. Format".

---

14 HORIZONTAL POSITION command: HPOSI

1. Function and operation specification: Real
   Sets the horizontal display position.

2. Format: 'HPOSI X1'
   X1   Horizontal position
   ##.#
   ±7.9 [div]

3. Status response: 'STATUS HPOSI' → 'HPOSI X1'
   X1 is indicated previously in "2. Format".

---

15 H-MODE command: HMODE

1. Function and operation specification: Real/storage
   Sets the H-MODE (A, A INT B, ALT, B or X-Y).

2. Format: 'HMODE X1'
   X1 H-MODE
   #
   0   A
   1   AINTB
   2   ALT
   3   B
   4   X-Y

3. Status response: 'STATUS HMODE' → 'HMODE X1'

---

16 TRACE SEPARATION command: TRACES

1. Function and operation specification: Real/storage
   Real mode   : A/B sweep trace separation
   Storage mode: Reference data position

2. Format: 'TRACES X1'
   X1   Setting
   ####
   ±5.0 [div]

114

3. Status response: 'STATUS TRACES' → 'TRACES X1'
   X1 is indicated previously in "2. Format".

---

17 TRIG LEVEL command: LEVEL

1. Function and operation specification: Real/storage
   Sets the trigger level.

2. Format: 'LEVEL X1'
   X1   Trigger level
   ####
   ±7.9 [div]

3. Status response: 'STATUS LEVEL' → 'LEVEL X1'
   X1 is indicated previously in "2. Format".

---

18 TRIGGER SOURCE command: SOURCE

1. Function and operation specification: Real/storage
   Selects the trigger source (VERT, CH1, CH2, CH3, CH4 or LINE).

2. Format: 'SOURCE X1'
   X1 Mode selection
   #
   0   VERT
   1   CH1
   2   CH2
   3   CH3
   4   CH4
   5   LINE

3. Status response: 'STATUS SOURCE' → 'SOURCE X1'
   X1 is indicated previously in "2. Format".

---

19 COUPLING TV command: TRCPV

1. Function and operation specification: Real/storage
   Sets a trigger line No. for the TV line selector (TV-F1 or TV-F2).

2. Format: 'TRCPV X1'
   X1   LINE No.
   ###
   1 to 625 (NTSC: 263)

3. Status response: 'STATUS TRCPV' → 'TRCPV X1'
   X1 is indicated previously in "2. Format".

20	COUPLING command: TRCPL

1. Function and operation specification: Real/storage
   Sets the input coupling of the trigger signal.

2. Format: 'TRCPL X1'
   X1 Mode selection
   #
   0   AC
   1   HF
   2   DC
   3   TV-F1
   4   TV-F2
   5   TV-L

3. Status response: 'STATUS TRCPL' → 'TRCPL X1'
   X1 is indicated previously in "2. Format".

21	SLOPE command: SLOPE

1. Function and operation specification: Real/storage
   Sets the trigger slope (+/−).

2. Format: 'SLOPE X1'
   X1 Slope selection
   #
   0   −
   1   +

3. Status response: 'STATUS SLOPE' → 'SLOPE X1'
   X1 is indicated previously in "2. Format".

22	TRIG MODE command: TRGMD

1. Function and operation specification: Real/storage
   Sets the trigger mode (AUTO, NORMAL, FIX or SINGLE).

2. Format: 'TRIGMD X1'
   X1 Mode selection
   #
   0   AUTO
   1   NORMAL
   2   FIX
   3   SINGLE

3. Status response: 'STATUS TRIGMD' → 'TRIGMD X1'
   X1 is indicated previously in "2. Format".

1. Function and operation specification: Real/storage
   Sets the ready state of the single sweep (RESET).

2. Format: 'RST X1'
   X1 Setting
   #
   1 RESET

3. Status response: 'STATUS RST' → 'RST X1'
   X1
   #
   0 NON READY
   1 READY

1. Function and operation specification: Real/storage
   Sets the hold off time.
   However, position data and actual data are not calibrated.

2. Format: 'HLDOF X1'
   X1 Max. time ratio (%)
   ###
   0 to 100

3. Status response: 'STATUS HLDOF' → 'HLDOF X1'
   X1 is indicated previously in "2. Format".

1. Function and operation specification: Real/storage
   Sets the B-SOURCE condition (COUNT, TRIG'D or AFT'D).

2. Format: 'BSOURC X1, X2'

X1	B source	X2 Count value/Position	
#		####	####
1	COUNT	1 to 2000	—
2	TRIG'	—	0.2 to 10.0 [div]
3	AFT.D	—	0.2 to 10.0 [div]

3. Status response: 'STATUS BSOURC' → 'BSOURC X1, X2'
   X1 and X2 are indicated previously in "2. Format".

1. Function and operation specification: Real/storage
    Sets the cursor mode and outputs measured data.

    ┌─── NOTE ──┐
    │ This command cannot be set in the GO/NO-GO mode.   │
    └───┘

2. Format: 'CURSOR X1'
    X1 Cursor setting
    #
    0   OFF
    1   ΔV1
    2   ΔV2
    3   ΔV3
    4   ΔV4
    5   ΔT
    6   1/ΔT
    7   ΔV12
    8   ΔV34
    <In the storage mode, ΔV3, ΔV4 and ΔV34 may not be set for the DCS-9320 or 9120.>

3. Status response: 'STATUS CURSOR' → 'CURSOR X1, X2'
    X1 Reading cursor   X2 Measured data (with unit)
    #   ########
    0   OFF
    1   ΔV1
    2   ΔV2
    3   ΔV3
    4   ΔV4
    5   ΔT
    6   1/ΔT (The unit of angle " ° " is not displayed during PHASE measurement.)
    7   ΔV12
    8   ΔV34
    <In the storage mode, ΔV3, ΔV4 and ΔV34 may not be set for the DCS-9320 or 9120.>

1. Function and operation specification: Real/storage
    Sets the ΔREF cursor position.

2. Format: 'REFCS X1, X2'
    X1 Cursor position   X2 Cursor position
    ####   ####
    ±4.0 (vertical)   0.0 to 10.0 (horizontal)

3. Status response: 'STATUS REFCS' → 'REFCS X1, X2'
    X1 and X2 are indicated previously in "2. Format".

---

28   △CURSOR command: DELTA

---

1. Function and operation specification: Real/storage
    Sets the △cursor position.

2. Format: 'DELTA X1, X2'

X1 Cursor position	X2 Cursor position
####	####
±4.0 (vertical)	0.0 to 10.0 (horizontal)

3. Status response: 'STATUS DELTA' → 'DELTA X1, X2'
    X1 and X2 are indicated previously in "2. Format".

---

29   CURSOR TRACKING command: CTRACK

---

1. Function and operation specification: Real/storage
    Sets the tracking operations of the △REF and △cursors.

2. Format: 'CTRACK X1'
    X1   Tracking
    #
    0   OFF
    1   ON

3. Status response: 'STATUS CTRACK' → 'CTRACK X1'
    X1 is indicated previously in "2. Format".

---

30   GO/NO-GO command: GONO

---

1. Function and operation specification: storage
    Outputs the result of GO/NO-GO judgment.

2. Format: Status response only

3. Status response: 'STATUS GONO' → 'GONO X1'
    X1   Judgment
    #
    0   NO-GO
    1   GO

---

31   GO/NO-GO command: GNL

---

1. Function and operation specification: storage
    Sets the range of GO/NO-GO judgment.

2. Format: 'GNL X1, X2, X3, X4, X5, X6, X7, X8'

X1	Operation	X2	Buzzer	X3	TTL OUT	X4	Hold
#		#		#		#	
0	OFF	0	OFF	0	OFF	0	OFF
1	V	1	GO	1	ON	1	GO
2	VH	2	NO-GO			2	NO-GO

X5	VMIN LIMIT	X6	VMAX LIMIT	X7	HSTART LIMIT	X8	HEND LIMIT
####		####		####		####	
±4.0 [div]		±4.0 [div]		0.0~10.0 [div]		0.0~10.0 [div]	

3. Status response: 'STATUS GNL' → 'GNL X1, X2, X3, X4, X5, X6, X7, X8'
   X1 to X8 are indicated previously in "2. Format".

---

32 AUTO-SET command: AUTOR

1. Function and operation specification: Real/storage
   Sets the AUTO-SET mode (auto range and operation).

2. Format: 'AUTOR X1, X2, X3'

X1	Setting method	X2	V setting target	X3	H setting target
#		#		#	
1	V	2		2	
2	H	4		4	
3	V, H				

3. Status response: 'STATUS AUTOR' → 'AUTOR X1, X2, X3'
   X1 to X3 are indicated previously in "2. Format".

   ┌─ NOTE ──
   │ When using this command, wait for the SRQ (44$_H$) issued after completion of AUTO SET, and
   │ then send the next command.
   └──

---

33 PROGRAM command: PSTEP

1. Function and operation specification: Real/storage
   Sets the step No. in program operation.

2. Format: 'PSTEP X1, X2, X3'

X1	Step condition	X2	Group No.	X3	Step No.	
#		#		##		
0	OFF	—		—		(The symbol "—" denotes omission.)
1	Direct setting call	1 to 5		1 to 20		
2	Direct setting save	1 to 5		1 to 20		
3	Step No. up	—		—		
4	Step No. down	—		—		

3. Status response: 'STATUS PSTEP' → 'PSTEP X1, X2, X3'

X1	Step condition	X2	Group No.	X3	Direct step No.
#		#		##	
0	OFF	—		—	
1	ON	1 to 5		1 to 20	

(The symbol "—" denotes omission.)

---

34 STORAGE/REAL command: STOR

1. Function and operation specification: Real/storage
    Selects the storage/real operation mode.

2. Format: 'STOR X1'

X1	Mode
#	
0	REAL
1	STORAGE

3. Status response: 'STATUS STOR' → 'STOR X1'
    X1 is indicated previously in "2. Format".

---

35 TV-TYPE command: TVMODE

1. Function and operation specification: Real/storage
    Selects the TV line selector input signal (NTSC or PAL).

2. Format: 'TVMODE X1'

X1	Setting
#	
0	AUTO (NTSC/PAL)
1	NTSC
2	PAL

3. Status response: 'STATUS TVMODE' → 'TVMODE X1'
    X1 is indicated previously in "2. Format".

---

36 BUZZER command: BUZZER

1. Function and operation specification: Real/storage
    Sets the condition of causing an alarm during operation.

2. Format: 'BUZZER X1'

X1	Alarm condition
#	
0	OFF
1	ERROR
2	KEYIN
3	ERROR+KEYIN

3. Status response: 'STATUS BUZZER' → 'BUZZER X1'
   X1 is indicated previously in "2. Format".

---

37 COMMENT (WRITE) command: CMW

1. Function and operation specification: Real/storage
   Edits comments.

2. Format: 'CMW X1, X2, X3'

X1	COMMENT No.	X2	LINE No.	X3	Comment
##		##		## to ##	
1 to 10	Set No.	1 to 11	Line No.	Within 32 characters	

3. Status response: 'STATUS CMW X1, X2' → ' CMW X1, X2, X3'
   X1 to X3 are indicated previously in "2. Format".

   > ── NOTE ──
   > A comment cannot include a colon, semicolon, comma, or any character code between 80_H and FF_H.

---

38 COMMENT command: CMD

1. Function and operation specification: Real/storage
   Displays comment data on the CRT.

2. Format: 'CMD X1'

X1	Comment setting
##	
0	OFF
1 to 10	ON: Display No.

3. Status response: 'STATUS CMD' → 'CMD X1'
   X1 is indicated previously in "2. Format".

---

39 DETECT PEAK command: DPEAK

1. Function and operation specification: Real/storage
   Sets the peak hold mode.

2. Format: 'DPEAK X1'

X1	Mode
#	
0	OFF
1	MIN
2	MAX
3	MIN/MAX

3. Status response: 'STATUS DPEAK' → 'DPEAK X1'
   X1 is indicated previously in "2. Format".

40 EQU SAMPLING command: EQU

1. Function and operation specification: Storage
   Sets the equivalent sampling mode.

2. Format: 'EQU X1'
   X1 Mode
   #
   0   OFF
   1   ON

3. Status response: 'STATUS EQU' → 'EQU X1'
   X1 is indicated previously in "2. Format".

41 ROLL MODE command: ROLL

1. Function and operation specification: Storage
   Sets the roll sweep mode.

2. Format: 'ROLL X1'
   X1 Mode
   #
   0   OFF
   1   ON

3. Status response: 'STATUS ROLL' → 'ROLL X1'
   X1 is indicated previously in "2. Format".

42 PRE-TRIGGER command: PRETRG

1. Function and operation specification: Storage
   Sets the pre-trigger mode and pre-trigger amount.

2. Format: 'PRETRG X1, X2'
   X1 Pre-trigger   X2 Position
   #   ##

   0   OFF   0 to 80 [div]
   1   ON

3. Status response: 'STATUS PRETRG' → 'PRETRG X1, X2'
   X1 and X2 are indicated previously in "2. Format".

43 POST-TRIGGER command: PSTTRG

1. Function and operation specification: Storage
   Sets the post-trigger mode and post-trigger amount.

2. Format: 'PSTTRG X1, X2'

    X1 Post-trigger   X2 Position
    #   #####
    0 OFF   0 to 10000 [div]
    1 ON

3. Status response: 'STATUS PSTTRG' → 'PSTTRG X1, X2'

    X1 and X2 are indicated previously in "2. Format".

---

44   HOLD command: HOLD

1. Function and operation specification: Storage

    Holds data reading in the storage mode.

2. Format: 'HOLD X1'

    X1 HOLD
    #
    0 OFF
    1 ON

3. Status response: 'STATUS HOLD' → 'HOLD X1'

    X1 is indicated previously in "2. Format".

---

45   AVERAGE command: AVERAG

1. Function and operation specification: Storage

    This command sets conditions for averaging and executes averaging.

2. Format: 'AVERAG X1, X2, X3, X4, X5'

    <For the DCS-9320/9120, the X4 and X5 commands are not available.>

X1 Count value	X2 CH1		X3 CH2		X4 CH3		X5 CH4	
###	#		#		#		#	
2 to 256	0	OFF	0	OFF	0	OFF	0	OFF
	1	ON	1	ON	1	ON	1	ON

3. Status response: 'STATUS AVERAG' → 'AVERAG X1, X2, X3, X4, X5'

    X1 to X5 are indicated previously in "2. Format".

---

46   CALCULATION command: CALEDT

1. Function and operation specification: Storage

    Sets operation of CH1-CH2 or CH3-CH4 data.

    <For the DCS-9320/9120, the calculation function is available in CH3 or CH4.>

2. Format: 'CALEDT X1, X2'
   <For the DCS-9320/9120, the X2 commands are not available.>
X1	CH1-CH2	X2	CH3-CH4
#		#	
0	OFF	0	OFF
1	+	1	+
2	—	2	—
3	×	3	×
4	÷	4	÷

3. Status response: 'STATUS CALEDT' → 'CALEDT X1, X2'
   X1 and X2 are indicated previously in "2. Format".

---

47 INTERPOLATION command: INTERP

---

1. Function and operation specification: Storage
   Sets interpolation.

2. Format: 'INTERP X1'
X1	Setting
#	
0	OFF
1	LINEAR
2	SINE
3	SPLINE

3. Status response: 'STATUS INTERP' → 'INTERP X1'
   X1 is indicated previously in "2. Format".

---

48 SAVE command: SAVE

---

1. Function and operation specification: Storage
   Saves CH1 to CH4 data memory in the reference memory.

2. Format: 'SAVE X1'
X1	Saving
#	
1	Executes.

3. Status response: Disabled.

---

49 DISPLAY-ADDRESS command: DISPAD

---

1. Function and operation specification: Storage
   Displays data addresses of the acquisition memory and reference memory on the CRT.

2. Format: DISPAD X1, X2
   X1 Address setting   X2 Start address
   #   #####
   0   OFF   0 to 16383 [words] (2K×8 and 16K with ROLL mode)
   1   ON   16371 [words] (16K)

3. Status response: 'STATUS DISPAD' → 'DISPAD X1, X2'
   X1 and X2 are indicated previously in "2. Format".

| 50 TIME SETUP command: TIMESET |

1. Function and operation specification: Real/storage
   This command displays date and time. For SINGLE operation, the command also toggles TRIG TIME
   between ON and OFF and sets date and time.

2. Format: 'TIMSET X1, X2, X3'
   X1 Adjust or set   X2 Date   X3 Time
   #   ##-##-##   ##-##
   0   OFF   —   —   (The symbol "—" denotes
   1   ON   —   —   omission)
   2   TRIG TIME   —   —
   3   SET   1 to 12, 1 to 31, 1 to 99   0 to 23, 0 to 59
                         Month - Day - Yaer   O'clock:minute

3. Status response: 'STATUS TIMSET' → 'TIMSET X1, X2, X3'
   X1 to X3 are indicated previously in "2. Format".

| 51 STO HORIZONTAL POSITION command: SXPOS |

1. Function and operation specification: Storage
   Sets the horizontal position of displaying storage waveform.

2. Format: 'SXPOS X1'
   X1   Horizontal position
   ####   [div]
   ±1.0

3. Status response: 'STATUS SXPOS' → 'SXPOS X1'
   X1 is indicated previously in "2. Format".

| 52 REFERENCE command: REF |

1. Function and operation specification: Storage
   Sets the condition of displaying reference memory data.

2. Format: 'REF X1, X2, X3, X4'

X1	CH1 ON/OFF	X2	CH2 ON/OFF	X3	CH3 ON/OFF	X4	CH4 ON/OFF
#		#		#		#	
1	OFF	0	OFF	0	OFF	0	OFF
2	ON	1	ON	1	ON	1	ON

<For the DCS-9320/9120, the X3 and X4 commands are not available.>

3. Status response 1: 'STATUS REF X1' → 'REF X1 X2'

X1, and X2 are indicated previously in "2. Format".

Status response 2: 'STATUS REF' ⟶ 'REF Y1, Y2, Y3, Y4'

Y1	CH1	Y2	CH2	Y3	CH3	Y4	CH4
#		#		#		#	
0	OFF	0	OFF	0	OFF	0	OFF
1	ON	1	ON	1	ON	1	ON

<For the DCS-9320/9120, the Y3 and Y4 commands are not available.>

---

53 STO HOLD CHx POSITION command: SHVPOS

1. Function and operation specification: Storage

    Sets the CH1 to CH4 vertical positions in the storage hold mode.

2. Format: 'SHVPOS X1, X2'

X1	Channel	X2	Position
#		####	
1	CH1	±5.0 [div]	
2	CH2		
3	CH3		
4	CH4		

<3 CH3 and 4 CH4 may not be set for the DCS-9320 or 9120.>

3. Status response 1: 'STATUS SHVPOS X1' → 'SHVPOS X1 X2'

    X1, and X2 are indicated previously in "2. Format".

    Status response 2: 'STATUS SHVPOS' ⟶ 'SHVPOS Y1, Y2, Y3, Y4'

Y1	CH1	DATA	DATA=####
Y2	CH2	DATA	±5.0 [div]
Y3	CH3	DATA	
Y4	CH4	DATA	

<For the DCS-9320/9120, the Y3 and Y4 commands are not available.>

---

54 MEMORY SIZE command: MEMSIZ

1. Function and operation specification: Storage

    Sets the memory size used.

2. Format: 'MEMSIZ X1'

X1	Size
#	
0	2K
1	16K
2	2K×8

127

3. Status response: 'STATUS MEMSIZ' → 'MEMSIZ X1'
   X1 is indicated previously in "2. Format".

---

55 PEN OUT command: PEN

1. Function and operation specification: Storage
   Outputs data to the pen recorder. (Enabled in hold mode only.)

2. Format: 'PEN X1'
   X1 Setting
   #
   0 Cancellation
   1 Executes.

3. Status response: Not used.

---

56 PLOTTER OUT command: PLOT

1. Function and operation specification: Storage
   Outputs data to the X-Y plotter. (Enabled in hold mode only.)

2. Format: 'PLOT X1'
   X1 Setting
   #
   0 Cancellation
   1 Executes.

3. Status response: Not used.

---

57 PEN SETUP command: PENSET

1. Function and operation specification: Storage
   Sets the pen recorder conditions.

2. Format: 'PENSET X1, X2, X3'

X1	Setting	X2	SPEED	X3	DATA OUT
#		#		#	
0	OFF	0	10	0	WAVE
1	ON	1	50	1	WAVE+SCALE
		2	100	4	CAL
		3	500 [ms/word]		

3. Status response: 'STATUS PENSET' → 'PENSET X1, X2, X3'
   X1 to X3 are indicated previously in "2. Format".

128

58 PLOTTER SETUP command: PLOTSET

1. Function and operation specification: Storage
    Sets the X-Y plotter conditions.

2. Format: 'PLOTSET X1, X2, X3, X4, X5, X6, X7'

X1	Setting	X2	Output mode	X3	Position	X4	Waveform pen	X5	R/O
#		#		#		#		#	
0	OFF	0	WAVE	0	1/1	0	1 to 4/CH [No.]	1 to 8 [No.]	
1	ON	1	WAVE+SCALE	1	1/4	1	SAME		
		2	WAVE+R/O	2	2/4				
		3	WAVE+SCALE+R/O	3	3/4				
				4	4/4				

<For the DCS-9320/9120, storage channels are only CH1 and CH2.>

X6	SCALE	X7	SIZE
#		#	
1 to 8 [No.]		0	A4
		1	A3

3. Status response: 'STATUS PLOTSET' → 'PLOTSET X1, X2, X3, X4, X5, X6, X7'
    X1 to X7 are indicated previously in "2. Format".

59 RS232C command: RSSET

1. Function and operation specification: Storage
    Sets the RS-232C conditions.

2. Format: 'RSSET X1, X2, X3, X4'

X1	Baud rate	X2	Parity	X3	Bit length
#		#		#	
0	1200 bps	0	NONE	0	7BIT
1	2400 bps	1	ODD	1	8BIT
2	4800 bps	2	EVEN		
3	9600 bps				

3. Status response: 'STATUS RSSET' → 'RSSET X1, X2, X3'
    X1 to X3 are indicated previously in "2. Format".

60 Data input command: WOUT

1. Function and operation specification: Storage
    The oscilloscope receives data from the controller andwrites them in the specified memory. (ASCII or binary data)

2. Format: WOUT X1, X2, X3, X4, X5, X6

X1	Channel	X2	Read memory	X3	Data format	X4 Start address	X5 Number of data
#		#		#		#####	#####
1	CH1	1	ACQUISITION	1	ASCII	0 to 16383	1 to 16384
2	CH2	2	REFERENCE	2	BINARY	(10 Decimal)	(10 Decimal)
3	CH3						
4	CH4						

X6 Waveform data (1st data to final data)

\#\# Binary   A single character corresponding to a hexadecimal number between 00 and FF indicates a single data.

\#\#\# ASCII   A number between 0 and 255 indicates a single data. Each data should be separated by using a comma ",".

<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

┌───┐
│ 61 Waveform data output request command: WREAD   │
└───┘

1. Function and operation specification: Storage
   Sends oscilloscope's waveform data to the controller. (ASCII or binary data)

2. Format: WREAD X1, X2, X3, X4, X5

X1	CH	X2	Output memory	X3	Data format	X4 Start address	X5 Number of data
#		#		#		#####	#####
1	CH1	1	ACQUISITION	1	ASCII	0 to 16383	1 to 16384
2	CH2	2	REFERENCE	2	BINARY	10 Decimal	10 Decimal
3	CH3	3	DISPLAY DATA				
4	CH4	4	DISPLAY REFERENCE				

<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

3. Status response: STATUS response is not usable. When the WREAD command is used for transmission, the response is in the following format:

4. Response format: WDAOUT X1, X2, X3, X4, X5, X6

X1	CH	X2	Output memory	X3	Data format	X4 Start address	X5 Number of data
#		#		#		#####	#####
1	CH1	1	ACQUISITION	1	ASCII	0 to 16383	1 to 16384
2	CH2	2	REFERENCE	2	BINARY	10 Decimal	10 Decimal
3	CH3	3	DISPLAY DATA				
4	CH4	4	DISPLAY REFERENCE				

X6 Waveform data (1st data to final data)

\#\# Binary   A single character corresponding to a hexadecimal number between 00 and FF indicates a single data.

\#\#\# ASCII   A number between 0 and 255 indicates a single data. Each data should be separated by using a comma ",".

<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

130

---

62 SRQ MASK command: MASK

---

1. Function and operation specification: Real/storage
    Effectuates the SRQ (service request) output selectively.

2. Format: 'MASK X1'
    X1   Masking
    ######## SRQ is issued if bit is 1.
                Default value is 11111111. (An SRQ concerning an error occurs.)

X1	Masking
bit7	RUN error
bit6	Data error
bit5	Parameter error
bit4	Command error
bit3	Not defined
bit2	AUTO SET completed
bit1	Output completed
bit0	Reading completed

3. Status response: 'STATUS MASK' → 'MASK X1'
    X1 is indicated previously in "2. Format".

---

63 Waveform data read request command: WDREAD

---

1. Function and operation specification: Storage
    Waveform data is retrieved from the oscilloscope and sent to the controller via DMA. (Data format is binary.)

2. Format: 'WDREAD X1, X2, X3, X4'

X1	CH	X2	Output memory	X3 Start address	X4 No. of data
#		#		#####	#####
1	CH1	1	ACQUISITION	0 to 16383	1 to 16384
2	CH2	2	REFERENCE		
3	CH3	3	DISPLAY DATA	10 Decimal	10 Decimal
4	CH4	4	DISPLAY REFERENCE		

    <For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

3. Status response: Not used.

4. Response format: 'WDOUT X1, X2, X3, X4, X5'

X1	CH	X2	Output memory	X3 Start address	X4 No. of data
#		#		#####	#####
1	CH1	1	ACQUISITION	0 to 16383	1 to 16383
2	CH2	2	REFERENCE		
3	CH3	3	DISPLAY DATA	10 Decimal	10 Decimal
4	CH4	4	DISPLAY REFERENCE		

X5 Waveform data (1st data to final data)

A single character corresponding to a hexadecimal number between 00 and FF indicates a single data.

\<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

| 64 Reference waveform range read request command: WDRIN |

1. Function and operation specification: Storage

Sends various range conditions associated with the reference waveform from the oscilloscope to the controller. (Data format: ASCII)

2. Format: 'WDRIN X1'

X1 CH
#
1   CH1
2   CH2
3   CH3
4   CH4

\<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

3. Status response: The STATUS response cannot be used. In response to the WDRIN command received, the controller returns data in the format below.

4. Response format: 'WDROUT X1, X2, X3'

X1	CH	X2 Voltage range	X3 sweep range
#		#####	######
1	CH1	5 to 1E-3	500 to 20E-9 [50E-9]
2	CH2	50 to 10E-3 when PC-31 is used	
3	CH3		
4	CH4		

\<For the DCS-9320/9120, the X1 command does not support "3 CH3" or "4 CH4".>

| 65 Program repeat command: PSTREP |

1. Function and operation specification: Real/storage

Sets the repeat No. for program step.

2. Format: 'PSTREP X1, X2'

X1 Group No.	X2 Repeat No.
#	##
1 1 to 5	2 to 20

3. Status response 1: 'STATUS PSTREP X1' → 'PSTREP X1, X2'

X1 and X2 are indicated previously in "2. Format".

Status response 2: 'STATUS PSTREP' ——→ 'PSTREP Y1, Y2, Y3, Y4, Y5'

Y1 Repeat No. of Group No.1	Y2 Repeat No. of Group No.2	Y3 Repeat No. of Group No.3
##	##	##
2 to 20	2 to 20	2 to 20

Y4 Repeat No. of Group No. 4   Y5 Repeat No. of Group No. 5
##
2 to 20   2 to 20

┌───┐
│ 66 Parameter measurement setting command: PMES   │
└───┘

1. Function and operation specification: Storage
    Sets automatic parameter measurement items.

2. Format: 'PMES X1, X2'
    X1 Parameter position   X2 Parameter No.
    #   ##
    1   1st parameter   0   OFF
    2   2nd parameter   1   PERIOD
    3   3rd parameter   2   FREQUENCY
    4   4th parameter   3   PULSE WIDTH
                              4   RISE TIME
                              5   FALL TIME
                              6   DELAY TIME
                              7   OVER SHOOT
                              8   UNDER SHOOT
                              9   PEAK TO PEAK
                              10 VRMS
                              11 TOP LEVEL
                              12 BASE LEVEL
                              13 AMPLITUDE
                              14 POWER

3. Status response 1: 'STATUS PMES X1' → 'PMES X1 X2'
    X1 and X2 are as shown in "2. Format" above.
    Status response 2: 'STATUS PMES ——→ 'PMES Y1, Y2, Y3, Y4'
    Y1 1st parameter setting   Setting = ##   Setting is shown in "2. Format" above.
    Y2 2nd parameter setting
    Y3 3rd parameter setting
    Y4 4th parameter setting

67 Parameter measurement condition setting command: PASET

1. Function and operation specification: Storage
   Sets parameter measurement conditions.

2. Format: 'PASET X1, X2, X3, X4'

   X1 Delay time comparison channel setting
   #
   1   CH1
   2   CH2
   3   CH3
   4   CH4

   X2 Delay time measurement type
   #
   0   ↑~↑
   1   ↑~↓
   2   ↓~↑
   3   ↓~↓

   X3 Average power current channel setting
   #
   1   CH1
   2   CH2
   3   CH3
   4   CH4

   X4 Current range setting
   #####
   50   (50A/div)
   20   (20A/div)
   10   (10A/div)
   5   (5A/div)
   2   (2A/div)
   1   (1A/div)
   0.5   (0.5A/div)
   0.2   (0.2A/div)
   0.1   (0.1A/div)
   50E-3 (50mA/div)
   20E-3 (20mA/div)
   10E-3 (10mA/div)
   5E-3   (5mA/div)
   2E-3   (2mA/div)
   1E-3   (1mA/div)

   <3 CH3 of X1 and X3 and 4 CH4 may not be set for the DCS-9320 or 9120.>

3. Status response 1: 'STATUS PASET' → 'PASET X1, X2, X3, X4'
   X1, X2, X3 and X4 are shown in "2. Format" above.
   <The PCS-9320 and 9120 do not have 3 CH3 of X1 and X3 or 4 CH4.>

68 GND-REF setting command: GREF

1. Function and operation specification: Storage
   Sets the GND level necessary for computation in automatic parameter measurement.

2. Format: 'GREF X1'
   X1
   #
   1   GND REFERENCE input

3. Status response: Unusable

1. Function and operation specification: STORAGE
    Sends various values measured in automatic parameter measurement to the controller
    (in the ASCII format)

2. Format: (1) 'WDPIN X1'
    X1 Parameter position
    #
    1   1st parameter
    2   2nd parameter
    3   3rd parameter
    4   4th parameter
        (2) 'WDPIN 0'

3. Status response:
    No status response may be used. If the WDPIN command is sent, a response is made in the following
    format:

4. Response format : (1) 'WDPIN X1' → 'WDPOUT X1, X2'
        X1 is shown in "2. Format" above.

X2	Title	Data	Unit
	####	######	###
	PER	0.0001~5000	ns
	FREQ		us
	WID+		ms
	WID−		s
	RISE		ks
	FALL		uHz
	DLY		mHz
	OVRS		Hz
	UNDS		kHz
	P-P		MHz
	Vrms		GHz
	TOP		mV
	BASE		V
	AMP		uW
	PWR		mW
			W
			kW

        (2) 'WDPIN 0' → 'WDPOUT Y1, Y2, Y3, Y4'
            Y1, Y2, Y3 and Y4 show the first, second, third and fourth parameters,
            respectively. The display format is the same as shown in "X2" above.

7-6 Program Examples

1) With PC-98

Presented below are program examples for the controller (assuming the PC-9800 Series) to control the DCS-9300.

The language used in the examples is N-88 BASIC (86).

Note: On the rear panel, set the delimiter to EOI.   The GP-IB address is 0 for the controller and 1 for the DCS-9000 series.

Program example 1 ···· This program sets VOLTS/DIV for CH1 to 50mV.

```
10   '
20   '********************************
30   '*   DCS_REM  :  Remote Control   *
40   '*                                *
50   '*                                *
60   '*    Example Program             *
70   '********************************
80   '
90   '
100  '
110  ''**** GP-IB Initialize
120  '
130      ISET IFC        ' GP-IB Interface Clear
140      ISET REN        ' Remote Enable
150  '
160  ''**** Enable Service Request
170      ON ERROR GOTO *END.P     ' If control does not finish within 5 sec, go to statement No.560
180      ON SRQ GOSUB *RCVSRQ     ' If SRQ is ON, go to statement No.470.
190      SRQ ON
200  '
210  ''**** Set Time Out Timer
220  '
230      CMD TIMEOUT=5      ' Set timer to 5 sec.
240  '
250  '
260  ''**** Delimitter Control
270  '
280      CMD DELIM=3      ' 0: CrLf
290                       ' 1: Cr
300                       ' 2: Lf
310                       ' 3: with EOI
320                       ' Select delimiter EOI.
330  ''********************************
340  '
350  ''**** Message Send Process
360  '
370      PRINT@1; "VOLTD1,50E-3:" @
380                       ' Set VOLTS/DIV for CH1 to 50mV.
390                       ' Last Data with EOI  ( @ )
400  '
410      PRINT
420      PRINT "VOLTD1, 50E-3"    ' Display the send command on CRT.
430      PRINT
440  '
450      GOTO   *END.P
460  '           ·
470  ''**** SRQ Receive Process
```

```
480   '
490   *RCVSRQ
500      POLL 1,DCS.STAT   ' Status byte display for SRQ ON.
510   '
520      PRINT "DCS-Unit Status = ";HEX$ ( DCS.STAT )
530      SRQ ON
540      RETURN
550   '
560   ''**** END Process
570   '
580   *END.P
590      FOR I=0 TO 5000 : NEXT I ' Wait
600      IRESET REN        ' Disable Remote Control
610      END
```

Program example 2 ···· This program displays the range to which VOLTS/DIV for
CH1 is set

```
10    '
20    '********************************
30    '*   DCS-REM  :  STATUS GET       *
40    '*                                *
50    '*                                *
60    '*      Example Program           *
70    '********************************
80    '
90    '
100   '
110   ''**** GP-IB Initialize
120   '
130      ISET IFC          ' GP-IB Interface Clear
140      ISET REN          ' Remote Enable
150   '
160   ''**** Enable Service Request
170      ON ERROR GOTO *END.P     ' If reception does not end within 6 sec, go to *END.P.
180      ON SRQ GOSUB *RCVSRQ     ' If SRQ is ON, go to *RCVSRQ.
190      SRQ  ON
200   '
210   ''**** Set Time Out Timer
220   '
230      CMD TIMEOUT=5     ' Set timer to 5 sec.
240   '
250   '
260   ''**** Delimitter Control
270   '
280      CMD DELIM=3       ' 0: CrLf
290                        ' 1: Cr
300                        ' 2: Lf
310                        ' 3: with EOI
320                        ' Select delimiter EOI.
330   ''********************************
340   '
350   ''**** Message Send Process
360   '
370      PRINT@1; "STATUS VOLTD1:" @
380                        ' Which range is VOLTS/DIV for CH1 is set to ?
390                        ' Last Data with EOI ( @ )
400   '
410   '
420   ''**** Answer Read Process
430   '
440      INPUT@1; A$
450   '
460   ''**** Print Out Message
```

```
470  '
480     PRINT
490     PRINT    "STATUS" ; A$ ' Display the send command and the range of CH1 on CRT.
500     PRINT
510  '
520     GOTO *END.P
530  '                    .
540  ' '**** SRQ Receive Process
550  '
560  *RCVSRQ
570     POLL 1,DCS.STAT   ' Get STB from DCS_Unit
580  '
590     PRINT "DCS_Unit Status = ";HEX$  ( DCS.STAT )
600     SRQ ON
610     RETURN
620  '
630  ' '**** END Process
640  '
650  *END.P
660     FOR I=0 TO 5000 : NEXT I ' Wait.
670     IRESET REN        ' Disable Remote Control
680     END
```

Program example 3 ···· In this example, the contents of the waveform memory in the DCS-9000 series are overwritten with the waveform data sent from the controller.

Applicable channel: CH1
Memory   : Acquisition memory

Data format   : ASCII

Memory addresses : Starting at address 0
Data size   : 10 words

Data to be sent   : 125, 126, 127, 128, 129, 130, 131, 132, 133, 134

```
10   '
20   '*********************************
30   '*   DCS_REM  :  WAVE DATA PUT   *
40   '*                               *
50   '*                               *
60   '*     Example Program           *
70   '*********************************
80   '
90   '
100  '
110  ' '**** GP-IB Initialize
120  '
130     ISET IFC          ' GP-IB Interface Clear
140     ISET REN          ' Remote Enable
150  '
160  ' '**** Enable Service Request
170     ON ERROR GOTO *END.P    ' If control does not finish within 5 sec, go to *END.P.
180     ON SRQ GOSUB *RCVSRQ    ' If SRQ is ON, go to *RCVSRQ.
190     SRQ  ON
200  '
210  ' '**** Set Time Out Timer
220  '
230     CMD TIMEOUT=5     ' Set timer to 5 sec.
```

```
240 '
250 '
260 ''**** Delimitter Control
270 '
280     CMD DELIM=3        ' 0: CrLf
290                        ' 1: Cr
300                        ' 2: Lf
310                        ' 3: with EOI
320 '                      ' Select delimiter EOI.
330 ''**********************************
340 '
350 ''DCS-9300 Initialize
360 '
370     PRINT@1;"STOR 1:"@              ' storage mode
380     PRINT@1;"HOLD 1:"@             ' HOLD ON
390 *W.TIME                            ' waiting time for waveform read
400     IF HEX$(DCS.STAT)="41" THEN GOTO 420
410     GOTO 400
420 '
430 ''**** Message Send Process
440 '
450     PRINT@1; "WOUT1, 1, 1, 0, 10, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134 :"@
460                     ' Send 10 data sets, starting at address 0, in ASCII format to CH1 acquisition
                        memory.
470                     ' Last Data with EOI  ( @ )
480 '
490     PRINT
500     PRINT "WOUT1, 1, 1, 0, 10"    'Display the send command on CRT.
510     PRINT
520 '
530     GOTO *END.P
540 '
550 ''**** SRQ Receive Process
560 '
570 *RCVSRQ
580     POLL 1,DCS.STAT    ' Get STB from DCS_Unit
590 '
600     PRINT "DCS_Unit Status = ";HEX$ ( DCS.STAT )
610     SRQ ON
620     RETURN
630 '
640 ''**** END Process
650 '
660 *END.P
670     FOR I=0 TO 5000  : NEXT I ' Wait.
680     IRESET REN        ' Disable Remote Control
690     END
```

Program example 4 **** In this example, the waveform data owned by the
DCS-9000 series are read to the controller.

```
Applicable channel: CH1
Memory            : Acquisition memory

Data format       : ASCII

Memory addresses  : Starting at address 0
Data size         : 20 words
```

In this program example, the data having been read is displayed on the CRT screen.

```
10    '
20    '*********************************
30    '*   DCS_REM  :  WAVE DATA GET    *
40    '*                                *
50    '*                                *
60    '*      Example Program           *
70    '*********************************
80    '
90    '
100   '
110   '
120   ''**** GP-IB Initialize
130   '
140       ISET IFC             ' GP-IB Interface Clear
150       ISET REN             ' Remote Enable
160   '
170   ''**** Enable Service Request
180       ON ERROR GOTO *END.P      ' If reception does not finish within 5 sec, go to *END.P.
190       ON SRQ GOSUB *RCVSRQ      ' If SRQ is ON, go to *RCVSRQ.
200       SRQ  ON
210   '
220   ''**** Set Time Out Timer
230   '
240       CMD TIMEOUT=5       ' Set timer to 5 sec.
250   '
260   '
270   ''**** Delimitter Control
280   '
290       CMD DELIM=3         ' 0: CrLf
300                           ' 1: Cr
310                           ' 2: Lf
320                           ' 3: with EOI
330                           ' Select delimiter EOI.
340   ''*********************************
350   '
360   ''DCS-9300 Initialize
370   '
380       PRINT@1;"STOR 1:"@                    ' storage mode
390       PRINT@1;"HOLD 1:"@                    ' HOLD ON
400   *W.TIME                                   ' waiting time for waveform read
410       IF HEX$(DCS.STAT)="41" THEN GOTO 430
420       GOTO 410
430   '
440   ''**** Message Send Process
450   '
460       PRINT@1; "WREAD 1, 1, 1, 0, 20 :"@
470                       ' Receive 20 data sets from CH1 memory, starting at address 0.
480                       ' Last Data with EOI  ( @ )
490   '
500       PRINT
510       PRINT "WREAD"
520       PRINT
530   '
540   ''**** Answer Read Process
550   '
560       LINE INPUT @1 ; D1$
570   '
580   '
590   ''**** Print Out Wave Data
600   '
610       PRINT D1$
620       PRINT
630   '
640   ''**** Wait Key_Board Input
650   '
```

140

```
660      PRINT "PUSH Any Key"
670   '
680   *KB.WAIT
690      KB$ = INKEY$
700      IF KB$ = "" THEN *KB.WAIT
710      GOTO *END.P
720   '
730   ''**** SRQ Receive Process
740   '
750   *RCVSRQ
760      POLL 1, DCS.STAT   ' Get STB from DCS_Unit
770   '
780      PRINT "DCS_Unit Status = ";HEX$ ( DCS.STAT )
790      SRQ ON
800      RETURN
810   '
820   ''**** END Process
830   '
840   *END.P
850      FOR I = 0 TO 5000 : NEXT I ' Wait.
860      IRESET REN        ' Disable Remote Control
870      END
```

2) With IBM-PC

Examples of programs that for the controller (with the IBM PC) that performs remote control of this device
are shown below.

Language BASICA

Note: Set the delimiter on the rear panel to "EOI".
      Set the controller GP-IB address to "0", and the DCS-9000 series GP-IB address to "1".

Program example 1 •••• The program used to the VOLTS/DIV of CH1 to 50mV.


```
100   '
110   '****************************************************************
120   '*                      DCS Remote Control                     *
130   '*   Computer  :  IBM PC / AT (R)                              *
140   '*      I / F  :  National Instruments (R) GP-IB ( IEEE-488 )  *
150   '*                     Example Program No.1                    *
160   '****************************************************************
170   '
180   ' Set up
190   '
200   CLEAR ,60000! : IBINIT1=60000! : IBINIT2=IBINIT1+3
210   BLOAD "\bib.m",IBINIT1
220   CALL IBINIT1 ( IBFIND, IBTRG, IBCLR, IBPCT, IBSIC, IBLOC, IBPPC, IBBNA, IBONL, IBRSC, IBSRE, IBRSV, IBPAD, IBSAD,
                     IBIST, IBDMA, IBEOS, IBTMO, IBEOT, IBRDF, IBWRTF, IBTRAP, IBDEV, IBLN )
230   CALL IBINIT2 ( IBGTS, IBCAC, IBWAIT, IBPOKE, IBWRT, IBWRTA, IBCMD, IBCMDA, IBRD, IBRDA, IBSTOP, IBRPP, IBRSP,
                     IBDIAG, IBXTRC, IBRDI, IBWRTI, IBRDIA, IBWRTIA, IBSTA%, IBERR%, IBCNT% )
240   '
250   ' Initialize
260   '
270   UDNAME$ = "dcs"
280   CALL  IBFIND ( UDNAME$, DCS% )
290   IF DCS% < 0 THEN GOTO 570
300   CALL  IBCLR ( DCS% )                    ' Send device clear
310   ON ERROR GOTO 540
320   '
330   V% = 9 : CALL  IBTMO  ( DCS%, V% )       ' Time out
```

141

```
340    V% = 1 : CALL   IBEOT  ( DCS%, V% )           ' End of string with EOI
350    '
360    ' Send message
370    '
380    WRT$ = "VOLTD1,50E-3:"                        ' DCS command
390    CALL   IBWRT ( DCS%, WRT$ )
400    MASK% = &H4800                                ' Time out or SRQ
410    CALL   IBWAIT ( DCS%, MASK% )
420    FOR I=0 TO 500 : NEXT I
430    IF ( IBSTA% AND &H800 ) <> 0 GOTO 490         ' On SRQ go to "Device Status"
440    PRINT WRT$                                    ' Print DCS command
450    GOTO 540
460    '
470    ' Receive device status
480    '
490    CALL IBRSP ( DCS%, SPR% )
500    PRINT "DCS-UNIT STATUS = ";HEX$ ( SPR% )      ' Print DCS-UNIT STATUS
510    '
520    ' End process
530    '
540    CALL IBLOC ( DCS% )                           ' Send device local
550    END
560    '
570    PRINT "IBFIND ERROR"
580    END
```

Program example 2 ···· The program used to display the range to which the VOLTS/DIV of CH1 is set.

```
100    '
110    '*************************************************************
120    '*                      DCS Remote Control                 *
130    '*    Computer  :  IBM PC / AT (R)                          *
140    '*      I / F  :  National Instruments (R) GP-IB ( IEEE-488 ) *
150    '*                      Example Program No.2                *
160    '*************************************************************
170    '
180    ' Set up
190    '
200    CLEAR ,60000! : IBINIT1=60000! : IBINIT2=IBINIT1+3
210    BLOAD "\bib.m", IBINIT1
220    CALL IBINIT1 ( IBFIND, IBTRG, IBCLR, IBPCT, IBSIC, IBLOC, IBPPC, IBBNA, IBONL, IBRSC, IBSRE, IBRSV, IBPAD, IBSAD,
                       IBIST, IBDMA, IBEOS, IBTMO, IBEOT, IBRDF, IBWRTF, IBTRAP, IBDEV, IBLN )
230    CALL IBINIT2 ( IBGTS, IBCAC, IBWAIT, IBPOKE, IBWRT, IBWRTA, IBCMD, IBCMDA, IBRD, IBRDA, IBSTOP, IBRPP, IBRSP,
                       IBDIAG, IBXTRC, IBRDI, IBWRTI, IBRDIA, IBWRTIA, IBSTA%, IBERR%, IBCNT% )
240    '
250    ' Initialize
260    '
270    UDNAME$ = "dcs"
280    CALL   IBFIND ( UDNAME$, DCS% )
290    IF DCS% < 0 THEN GOTO 590
300    CALL   IBCLR ( DCS% )                         ' Send device clear
310    ON ERROR GOTO 560
320    '
330    V% = 7 : CALL   IBTMO  ( DCS%, V% )           ' Time out
340    V% = 1 : CALL   IBEOT  ( DCS%, V% )           ' End of string with EOI
350    '
360    ' Send message
370    '
380    WRT$ = "STATUS,VOLTD1:"                        ' DCS command
390    CALL   IBWRT ( DCS%, WRT$ )
400    RD$ = SPACE$ ( 20 )
410    CALL   IBRD ( DCS%, RD$ )                      ' Receive DCS data
420    MASK% = &H4800                                ' Timeout or SRQ
```

```
430    CALL   IBWAIT ( DCS%, MASK% )
440    FOR I=0 TO 500 : NEXT I
450    IF ( IBSTA% AND &H800 ) <> 0 GOTO 510        ' On SRQ go to "Device Status"
460    PRINT "STATUS", RD$                          ' Print DCS data
470    GOTO 560
480    '
490    ' Receive device status
500    '
510    CALL IBRSP ( DCS%, SPR% )
520    PRINT "CS-UNIT STATUS = ";HEX$ ( SPR% )      ' Print DCS-UNIT STATUS
530    '
540    ' End process
550    '
560    CALL   IBLOC ( DCS% )                        ' Send device local
570    END
580    '
590    PRINT "IBFIND ERROR"
600    END
```

Program example 3 •••• An example of replacing the contents of the waveform memory of the DCS-9000 series with the waveform data sent from the controller.

```
Object channel  : CH1
Memory          : Acquisition memory

Data format     : ASCII

Memory address  : From address number 0
Number of data  : 10 werds

Transfer data   : 121, 122, 123, 124, 125, 126, 127, 128, 129, 130
```

```
100    '
110    '****************************************************************
120    '*                      DCS Remote Control                     *
130    '*   Computer  :  IBM PC / AT (R)                              *
140    '*       I / F :  National Instruments (R) GP-IB ( IEEE-488 )  *
150    '*                      Example Program No. 3                  *
160    '****************************************************************
170    '
180    ' Set up
190    '
200    CLEAR ,60000! : IBINIT1=60000! : IBINIT2=IBINIT1+3
210    BLOAD "\bib.m", IBINIT1
220    CALL IBINIT1 ( IBFIND, IBTRG, IBCLR, IBPCT, IBSIC, IBLOC, IBPPC, IBBNA, IBONL, IBRSC, IBSRE, IBRSV, IBPAD, IBSAD,
                      IBIST, IBDMA, IBEOS, IBTMO, IBEOT, IBRDF, IBWRTF, IBTRAP, IBDEV, IBLN )
230    CALL IBINIT2 ( IBGTS, IBCAC, IBWAIT, IBPOKE, IBWRT, IBWRTA, IBCMD, IBCMDA, IBRD, IBRDA, IBSTOP, IBRPP, IBRSP,
                      IBDIAG, IBXTRC, IBRDI, IBWRTI, IBRDIA, IBWRTIA, IBSTA%, IBERR%, IBCNT% )
240    '
250    ' Initialize
260    '
270    UDNAME$ = "dcs"
280    CALL   IBFIND ( UDNAME$, DCS% )
290    IF DCS% < 0 THEN GOTO 570
300    CALL   IBCLR ( DCS% )                        ' Send device clear
310    ON ERROR GOTO 540
320    '
330    V% = 7 : CALL   IBTMO ( DCS%, V% )           ' Time out
340    V% = 1 : CALL   IBEOT ( DCS%, V% )           ' End of string with EOI
```

143

```
350  '
360  ' Send message
370  '
380    WRT$ = "STOR1:"                              'DCS command
390    CALL IBWRT ( DCS%, WRT$ )
400    WRT$ = "HOLD1:"                              'DCS command
410    CALL IBWRT ( DCS%, WRT$ )
420    MASK% = &H800
430    CALL IBWAIT ( DCS%, MASK% )                  ' Wait for SRQ
440    CALL IBRSP ( DCS%, SPR% )
450    IF HEX$ ( SPR% ) <> "41" GOTO 610            ' Waveform read completed
460    WRT$ = "WOUT1,1,1,0,10,121,122,123,124,125,126,127,128,129,130:"
                                                    ' DCS command
470    CALL  IBWRT ( DCS%, WRT$ )
480    MASK% = &H4800                               ' Timeout or SRQ
490    CALL  IBWAIT ( DCS%, MASK% )
500    FOR I=0 TO 1000 : NEXT I
510    IF ( IBSTA% AND &H800 ) <> 0 GOTO 570        ' On SRQ go to "Device Status"
520    PRINT "WOUT1,1,1,0,10"                       ' Print DCS command
530    GOTO 650
540  '
550  'Receive device status
560  '
570    CALL  IBRSP ( DCS%, SPR% )
580    PRINT "CS-UNIT STATUS = ";HEX$ ( SPR% )      ' Print DCS-UNIT STATUS
590    GOTO 650
600  '
610    PRINT "HOLD ERROR"
620  '
630  ' End process
640  '
650    CALL IBLOC ( DCS% )                          ' Send device local
660    END
670  '
680    PRINT "IBFIND ERROR"
690    END
```

Program example 4 ···· Example of reading out the waveform data of the
DCS-9000 series with the controller.

```
Object channel : CH1
Memory         : Acquisition memory

Data format    : ASCII

Memory address : From address number 0
Number of data : 20 words
```

The data read out in this program example is displayed on the CRT screen.

```
100  '
110  '************************************************************
120  '*                     DCS Remote Control                  *
130  '*    Computer  :  IBM PC / AT (R)                         *
140  '*      I / F  :  National Instruments (R) GP-IB ( IEEE-488 )  *
150  '*                    Example Program No.4                 *
160  '************************************************************
170  '
180  ' Set up
190  '
200    CLEAR ,60000! : IBINIT1=60000! : IBINIT2=IBINIT1+3
```

```
210    BLOAD "\bib.m", IBINIT1
220    CALL IBINIT1 ( IBFIND, IBTRG, IBCLR, IBPCT, IBSIC, IBLOC, IBPPC, IBBNA, IBONL, IBRSC, IBSRE, IBRSV, IBPAD, IBSAD,
                      IBIST, IBDMA, IBEOS, IBTMO, IBEOT, IBRDF, IBWRTF, IBTRAP, IBDEV, IBLN )
230    CALL IBINIT2 ( IBGTS, IBCAC, IBWAIT, IBPOKE, IBWRT, IBWRTA, IBCMD, IBCMDA, IBRD, IBRDA, IBSTOP, IBRPP, IBRSP,
                      IBDIAG, IBXTRC, IBRDI, IBWRTI, IBRDIA, IBWRTIA, IBSTA%, IBERR%, IBCNT% )
240    '
250    '  Initialize
260    '
270    UDNAME$ = "dcs"
280    CALL  IBFIND ( UDNAME$, DCS% )
290    IF DCS% < 0 THEN GOTO 600
300    CALL  IBCLR ( DCS% )                            ' Send device clear
310    ON ERROR GOTO 570
320    '
330    V% = 7 : CALL  IBTMO  ( DCS%, V% )              ' Time out
340    V% = 1 : CALL  IBEOT  ( DCS%, V% )              ' End of string with EOI
350    '
360    '  Send message
370    '
380    WRT$ = "STOR1:"                                 ' DCS command
390    CALL  IBWRT ( DCS%, WRT$ )
400    WRT$ = "HOLD1:"                                 ' DCS command
410    CALL IBWRT ( DCS%, WRT$ )
420    MASK% = &H800
430    CALL IBWAIT ( DCS%, MASK% )                     ' Wait for SRQ
440    CALL IBRSP ( DCS%, SPR% )
450    IF HEX$ ( SPR% ) <> "41" GOTO 640               ' Waveform read completed
460    WRT$ = "WREAD1,1,1,0,10:"                       ' DCS command
470    CALL  IBWRT ( DCS%, WRTS )
480    FOR I=0 TO 1000 : NEXT I
490    RD$ = SPACE$ ( 80 )
500    CALL  IBRD ( DCS%, RD$ )                        ' Receive DCS data
510    MASK% = &H4800                                  ' Timeout or SRQ
520    CALL  IBWAIT ( DCS%, MASK% )
530    FOR I=0 TO 1000 : NEXT I
540    IF ( IBSTA% AND &H800 ) <> 0 GOTO 600           ' On SRQ go to "Device Status"
550    PRINT "DATA", RD$                               ' Print DCS data
560    GOTO 680
570    '
580    'Receive device status
590    '
600    CALL  IBRSP ( DCS%, SPR% )
610    PRINT "CS-UNIT STATUS = ";HEX$ ( SPR% )         ' Print DCS-UNITUS
620    GOTO 680
630    '
640    PRINT "HOLD ERROR"
650    '
660    'End process
670    '
680    CALL  IBLOC ( DCS% )                            ' Send device local
690    END
700    '
710    PRINT "IBFIND ERROR"
720    END
```

Note : "IBM" is a trademark of International Business Machines Corp.
       "National Instruments" is a trademark of National Instruments Corp.

8.   MAINTENANCE AND ADJUSTMENT

Items

[A] Maintenance

1 Fuse Replacement

If the fuse blows, the DCS-9000 series does not function. If the fuse blows, locate the cause, then remove the cap from the fuse holder on the rear panel with a screwdriver, draw out the fuse holder, and replace the fuse with a new one.
   90 to 132V : 5A fuse
   180 to 250V: 5A fuse

2 Changing Supply Voltage

Set the voltage selector switch on the rear panel to the voltage range which includes the supply voltage used.

[B] Adjustment and Compensation

1 Case Removal

How to remove case and base plate

To detach the case, remove 11 screws from the top and side panels with a Phillips type screwdriver, then lift the case. The base plate may be detached by removing 7 screwdrivers.

2 Probe Compensation

For accurate measurement, calibrate the probe properly before measurement.

1) Connect the probe to the INPUT terminal, then adjust the controls so that the normal sweep waveform is displayed.

2) Connect the probe to the CAL terminal on the front panel, then adjust the SWEEP TIME/DIV control so that several cycles of waves are displayed.

3) Control the trimmer of the probe so that the waveform displayed on the CRT is calibrated properly.

3　Trace Rotation Compensation

If the trace is tilted with respect to the horizontal scale, measurement errors occur.

1) Adjust the controls so that the normal sweep waveform is displayed.

2) Set the AC-GND-DC switch to GND and the TRIG MODE switch to AUTO.

3) Adjust the POSITION control so that the trace overlaps with the horizontal scale line in the CRT center.

4) If the trace is tilted, adjust it to the horizontal scale line with the TRACE ROTATION control on the front panel.

4　Calendar and Clock Setting

Follow the instructions described below in order to change the settings of the calendar and clock at the top of the Readout area or set them after replacing the battery or activate or deactivate display:

1) Select SET on the main menu, then select TIME DISPLAY on the set menu.

2) If the display mode is set to OFF, press the F1 key to set it ON. (If on-screen display should be deactivated, set the display mode to OFF.)

3) Then, press the F2 key to select ON TIME.

4) Press the F4 key to select TIME SELECT. The TIME SET menu is displayed.

5) Select year, month, day, o'clock, or minute with the corresponding key (F1-F5), then set a value with the SET switch. (All items from year to minute need not be set. Select necessary item (s) and set value (s).)

6) On completion of setting, press the MENU/NEXT switch to enter the value (s). (The TIME DISPLAY screen reappears. If further setting is not necessary, press the MENU/NEXT switch again to quit the menu.)

> **NOTE**
> The second is set to 0 when the mode changes from the set mode into the normal mode.

OPTIONS

OPTIONAL ACCESSORIES
Probe Pouch (MC-78)

This soft vinyl pouch attaches to the top side oscilloscope housing and provides storage space for two probes and the operators manual.   Install the probe pouch as follow:

1   Unsnap the probe pouch from the retainer plate.

2   Align the retainer plate with 4 holes on the top side of the case, with 4 snaps at the top.

3   Attach the 4 corners of the retainer plate to the oscilloscope case with the 4 nylon rivets supplied.

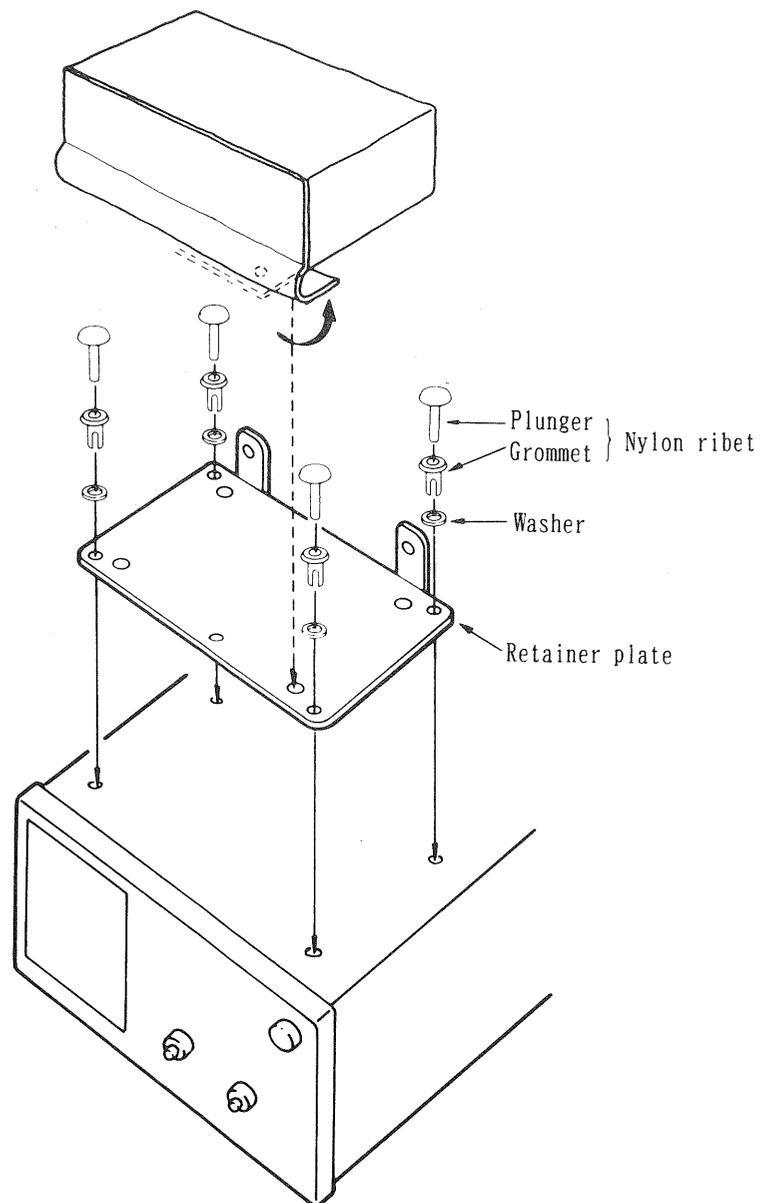4   Attach the pouch to the retainer plate using the snap fastener.

Fig. 28