

INSTRUCTION MANUAL

DIGITAL STORAGE OSCILLOSCOPE

MODEL DSS6522

KIKUSUI ELECTRONICS CORPORATION

# Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.

(Revision should be applied to items indicated by a check mark )

Input voltage

The input voltage of this product is \_\_\_\_\_ VAC,  
and the voltage range is \_\_\_\_\_ to \_\_\_\_\_ VAC. Use the product within this range only.

Input fuse

The rating of this product's input fuse is \_\_\_\_\_ A, \_\_\_\_\_ VAC, and \_\_\_\_\_.

### WARNING

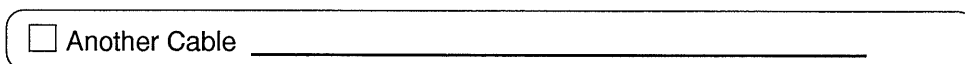
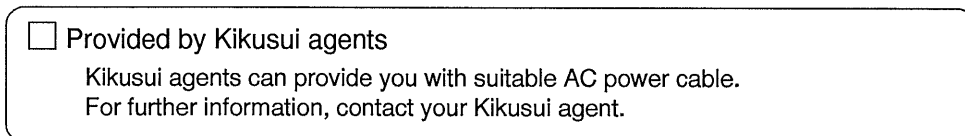
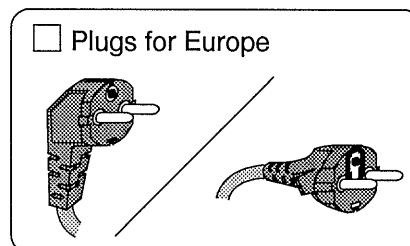
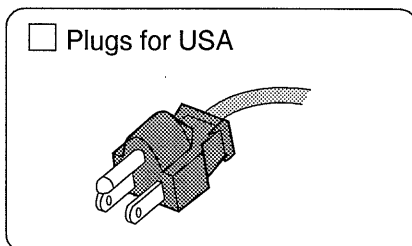
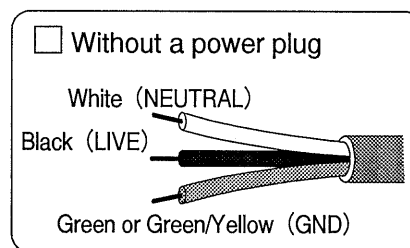
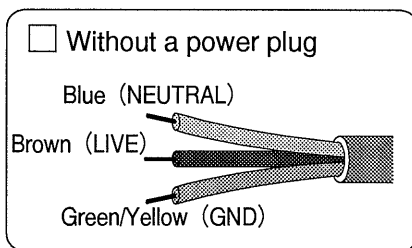
- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

AC power cable

The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

### WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.



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## 1. GENERAL

Model DSS6522 Digital Storage Oscilloscope has some extended functions over those of the conventional type of oscilloscope. Unlike the conventional analog type of storage oscilloscope which employs an storage CRT, the DSS6522 employs a digital storage system. Its operation method, however, is identical with those of the conventional types of oscilloscopes.

The signal to be displayed is converted by an A/D converter into a digital signal, stored in digital memory, and converted back into the analog signal and displayed on the CRT. Therefore, the signal can be stored in digital memory indefinitely, that is, until the next signal is written in memory. The A/D conversion speed is 500 nsec. The memory capacity is 4096 words maximum.

The signal can be stored either in an auto erase mode or a roll mode. The signal stored in memory can be displayed being magnified by 1 to 100 times or over in the horizontal direction. Memory can be used being divided, for the 1k, 2k, and 4k modes. When in the 1k mode, memory can be divided into 0 - 1k, 1k - 2k, 2k - 3k, and 3k - 4k channels for simultaneous 4-trace display.

A pretrigger function is incorporated to display signal waveforms before triggering. With the conventional type of oscilloscope, only the signal waveforms after triggering can be displayed. With the DSS6522 which employs a digital processing system, signal waveforms before triggering also can be displayed for up to 9.9 DIV.

An analog output signal is delivered to protect or hardcopy the stored signal. A digital output signal also is delivered for data processing.

The DSS6522 can be hooked up to a computer system for data transfer through GP-IB, using IF01-DSS Interface (optional).

The digital storage oscilloscope is capable of capturing, reproducing and analyzing an instantaneous one-shot transiential signal. The stored signal can be reproduced on the CRT for any required period of time. When used being connected to a computer, the oscilloscope can be used for various purposes.

## 2. SPECIFICATIONS

### CRT

Type: 6-inch rectangular CRT, with internal graticule

Phosphor: P31

Acceleration voltage: Approx. 2 kV

Effective screen size: 10 DIV × 8 DIV (10 mm/DIV)

Blanking: DC coupling

Graticule illumination: Continuously variable

### Vertical axis

Operation modes: CH1, DUAL, X-Y, ADD, ADD (CH2 INV), and CH2

Sensitivity: 5 mV - 5 V/DIV, 1-2-5 sequence

MAG ×5: 1 mV - 1 V/DIV

Sensitivity accuracy: ±5% or better (at CAL'D position)

Continuously-variable sensitivity adjustment: Continuously variable covering between two adjoining ranges

Frequency bandwidth: DC: DC - 300 kHz (with reference to 1 kHz)  
AC: 10 Hz - 300 kHz (within -3 dB)

A/D converter: 8-bit (256) sequential comparison system

Conversion speed: 500 nsec

POSITION/DC: Offset adjustment for each item

POSITION: Position adjustment for display mode

DC OFFSET: PULL ON for adjustment of DC component superimposed on input signal  
Approximately twice of graticule scale

### DUAL mode

Writing, CHOP mode: CH1 - CH2, time difference approx.  
500 - 800 nsec

Display, CHOP mode:	1k words	5 sec/DIV - 1 msec/DIV	} 500 kHz
	2k/4k words	5 sec/DIV - 0.2 msec/DIV	
ALT mode:	1k words	0.5 msec/DIV - 50 $\mu$ sec/DIV	
	2k/4k words	0.1 msec/DIV - 50 $\mu$ sec/DIV	
Input impedance:	1 M $\Omega$ $\pm$ 2%, 30 pF or less		
Input terminals:	BNC receptacles		
Maximum allowable input voltage:	400 V <sub>p-p</sub> (DC + AC peak, at 1 kHz or less)		
Input coupling:	AC, GND, DC		
Base-line shift caused by range switching:	$\pm$ 0.5 DIV (including DC balance shift) $\pm$ 2 DIV when MAG $\times$ 5		
Linearity:	Vertical amplitude $\pm$ 0.1 DIV or better when a signal with 4-DIV amplitude at the CRT screen center is moved vertically within the effective screen range.		

#### Triggering

Sweep modes:	AUTO/NORMAL/SINGLE		
Trigger source:	INT/LINE/EXT		
Internal trigger:	CH1/CH2		
Sensitivity	DC:	DC - 300 kHz, 1.0 DIV	
	AC:	10 Hz - 300 kHz, 1.0 DIV	


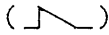
#### External trigger sensitivity

	DC:	DC - 300 kHz, 0.5 V <sub>p-p</sub>
	AC:	10 Hz - 300 kHz, 0.5 V <sub>p-p</sub>
Polarity:	"+", "-", ABS (absolute)	
Coupling:	AC or DC	

#### EXT trigger

Input impedance:	Approx. 1 M $\Omega$
Maximum allowable	$\pm$ 50 V <sub>p-p</sub> (DC + AC peak; AC component not higher than 1 kHz)

Input terminal:	BNC-type receptacle
Horizontal axis (time base)	
Sweep time, 1k words:	5 sec/DIV - 50 $\mu$ sec/DIV
2k words:	10 sec/DIV - 100 $\mu$ sec/DIV
4k words:	20 sec/DIV - 200 $\mu$ sec/DIV
Maximum sampling speed:	Single trace 500 nsec Dual traces 1 $\mu$ sec
Memory capacity:	4096 words (8 bits/words)
Memory selector:	0 - 1023, 1024 - 2047, 2048 - 3071, 3072 - 4095, 0 - 2047, 0 - 4095
When in single trace mode:	As selected by memory selector
When in dual trace mode:	For each channel, a half of the amount selected by memory selector
4-trace mode:	CH1 only  When the 4-TRACE switch is on and memory is operated in the 1k-word mode, four traces representing 0 - 1k, 1k - 2k, 2k - 3k, and 3k - 4k sectors of memory are displayed on CRT.  When in the write mode, the new data is written only in the sector selected by the memory select switch. The other sectors are for display only.
Vertical axis gain is 1/4	
Sweep magnification:	(1) Magnification by 5 times by POSITION SW PULL  (2) Expanded by 100 times or over by STORED mode of operation  Expanded in 1-2.5-5 sequence from cursor point

X-Y operation:	CH1 input for X-axis and CH2 input for Y-axis
Frequency bandwidth of X-axis:	Identical with that of vertical axis
Frequency bandwidth of Y-axis:	Identical with that of vertical axis
Sweep modes:	AUTO ERASE
	ROLL A (  )
	B (  )
	PREDELAY (ROLL)
	Triggering point adjustment with digital switches for 0.1 DIV - 9.9 DIV
VIEW time:	Approx. 0.5 - 5 sec, when switch is on
Memory protect:	HALF, HALF
When in single-trace mode:	Continuous points can be protected as alternate points, individually or totally.
When in dual-trace mode:	Both channels can be protected, individually.
PEN outputs	
Vertical axis:	CH1 and CH2, Approx. 1 V/DIV, 4 V to -4 V
Horizontal axis:	Approx. 1 V/DIV, 0 to 10 V
Sync signal:	TTL level
Read speed:	Depends on TIME/DIV switch setting
Z-axis	
Coupling:	DC coupling
Sensitivity:	Discernible intensity modulation by 3 Vp-p input
Frequency bandwidth:	DC to 50 kHz or over



Polarity: Darkening by positive input  
Input resistance: Approx. 5 k $\Omega$   
Input terminal: BNC-type receptacle  
Maximum allowable input voltage: 50 V<sub>p-p</sub> (DC + AC peak, AC component not higher than 1 kHz)

#### Calibration voltage

Waveform: Positive square wave  
Output voltage: 1 V<sub>p-p</sub>  $\pm$ 5%  
Frequency: 1 kHz,  $\pm$ 0.1%  
Duty ratio: Within 49:51

#### Power requirements

Line voltage: Selectable  
A: 90 - 110 V  
B: 104 - 126 V  
C: 194 - 236 V  
D: 207 - 253 V  
Frequency: 50/60 Hz  
Power consumption: Approx. 77 VA (with line voltage 100 V)

#### Dimensions and weight

External dimensions: 310 W  $\times$  150 H  $\times$  400 D mm  
(12.2 W  $\times$  5.9 H  $\times$  15.7 D in.)  
Maximum dimensions: 370 W  $\times$  190 H  $\times$  465 D mm  
(14.6 W  $\times$  7.5 H  $\times$  18.3 D in.)  
Weight: Approx. 8.7 kg (19 lbs)

#### Accessories

960 BNC probes or P060-S, 10:1, 1:1 ..... 2  
942A terminal adaptors ..... 2  
Instruction manual ..... 1

Ambient conditions

Normal operating conditions: 5 to 35°C (41 to 95°F), 80% RH

Operable limit conditions: 0 to 40°C (32 to 104°F), 85% RH

### 3. OPERATION METHOD

#### 3.1 Description of Front Panel Items (See Figure 3-1.)

- ① POWER: Main power switch of the instrument. When this switch is pressed and locked, the instrument power is turned on and the power pilot lamp turns on.
- ② ILLUM: Graticule illumination control. Graticule becomes brighter as this control is turned clockwise. The graticule is of an internal type.
- ③ INTEN: Spot or trace intensity control. The spot or trace becomes brighter as this control is turned clockwise.
- ④ FOCUS: For focussing the spot or trace to the sharpest image.
- ⑤ TRACE ROTATION: Semi-fixed potentiometer for aligning the horizontal trace with graticule lines. Used to correct slanting of trace caused by terrestrial magnetism, etc.
- ⑥ CLAIB: This terminal provides the calibration  
1 Vp-p voltage of 1 Vp-p, 1-kHz square wave.
- ⑦ GND terminal: Ground terminal of the instrument.
- ⑧ Graticule: Internal graticule of CRT. Filter can be easily replaced.
- ⑨ POSITION: Vertical position controls of the spot or trace for CH1. The outer knob is for the display position control and the outer knob is for DC offset control.  
  
The display POSITION control operates regardless of whether the instrument is in the read mode or in the write mode.

The DC OFFSET control is used to offset the DC component superimposed on the signal so that the required signal alone is displayed in an appropriate position on the CRT. This function is effective only when the signal is written. (The signal after being offset is stored.) When in the read mode (display mode), the function remains idle.

- ⑩ CH1 (X): Vertical input terminal of CH1. When in the X-Y mode, X-axis input terminal.
- ⑪ VOLTS/DIV: To select the vertical sensitivity of CH1 (or X-axis), from 5 mV/DIV to 5 V/DIV with 10 ranges. The inner knob is for continuously variable adjustment of sensitivity. The ranges are calibrated with this knob turned to and locked at the CAL'D position. When this knob is pulled out, the input sensitivity is magnified by a factor of 5 and the input sensitivity ranges become 1 mV/DIV to 1 V/DIV.
- ⑫ AC-GND-DC: Selector switch of input coupling for CH1.
- AC: AC coupling for measurement of AC component.
- GND: Vertical amplifier input is grounded, enabling to check the 0 level on the CRT. The signal input terminal is open.
- DC: DC coupling for measurement of signal including DC component.
- ⑬ POSITION Vertical position controls of the spot or trace for CH2. The functions are the same as those of CH1.
- ⑭ CH2 (Y): Vertical input terminal of CH2. When in X-Y mode, Y-axis input terminal.

- ⑮ VOLTS/DIV: To select the vertical sensitivity of CH2 (or Y-axis). The functions are the same as those of ⑪ .
- ⑯ AC-GND-DC: Selector switch of input coupling of CH2. The functions are the same as those of ⑫ .
- ⑰ INT TRIG: Selects the internal trigger source.
- CH1: Input signal of CH1 is used as triggering signal.
- CH2: Input signal of CH2 is used as triggering signal.
- ⑱ VERT MODE: Selects the operation mode of the vertical axis.
- CH1: Single-channel operation with CH1 alone.
- DUAL: Dual-channel operation with both CH1 and CH2 switched in the CHOP mode or ALT mode. When in this mode, memory size for each channel becomes a half of that when in the single-channel operation (with the even number addresses assigned to CH1 and odd number addresses assigned to CH2).
- X-Y: For X-Y operation with CH1 for X-axis and CH2 for Y-axis. Different from the case of a conventional oscilloscope, the DSS6522 requires setting of sampling time by pressing ⑳ SINGLE button for storing. The most recommendable, efficient manner of use is to display data stored in CH1 and CH2 memory in the X-Y mode.
- ADD: The sum of addition of CH1 and CH2 is displayed.
- When the INT TRIG switch is set to the CH1 state, triggering may become unstable as it is done with the sum signal after addition

and the level of the sum signal may become lower. In such a case, select the CH2 signal for triggering.

ADD CH2 INV: The CH2 input signal with its polarity inverted is added to the CH1 input signal, to subtract the CH2 input signal from the CH1 input signal. For this mode of operation, push both ADD and CH2 switches.

CH2: Single-channel operation with CH2 alone.

①9  SCOPE: The undepressed state is for conventional oscilloscope operation.

PEN: The depressed state is for the PEN mode for hardcopying the data stored in memory, using an X-Y recorder.

The CH1 and CH2 vertical signals, time base (X-axis) signal, and sync signal are delivered via terminals on the rear panel. The output voltages of both X and Y axes are 1 V/DIV. Speed in the X-axis direction is selectable with the time base switch.

The operation is of a single-sweep set/reset type. The operation starts when the PEN START switch is pressed and it ends when data read is complete. As the START switch is pressed again, the operation point returns to the start point. (This state can be monitored on the CRT screen.)

②0 POSITION: Horizontal position control of the spot or trace.  $\leftrightarrow$  When this knob is pulled out, the sweep is magnified by a factor of 5. The frequency bandwidth becomes slightly narrower when in the MAG  $\times 5$  mode.

PULL MAG  $\times 5$ :

②1 TIME/DIV:

Selects the horizontal sweep time base, the sampling time, or horizontal expansion ratio for display of the stored signal. The sweep time per division is as indicated by the switch when memory is used in the 1k mode; when it is used in the 2k or 4k mode, the sweep time per division is as the indicated value is multiplied by 2 or 4, respectively.

Example: When the switch indication is 1 ms/DIV, the sweep time base is as follows.

1k:	1 msec/DIV
2k:	2 msec/DIV
4k:	4 msec/DIV

When in the SCOPE mode, the TIME/DIV switch indicates the sampling time for writing.

The read time is as follows.

When ②2 VIEW TIME knob is not pulled out,

CHOP ranges: 2  $\mu$ sec clock

ALT ranges: When triggered and writing, at the sampling speed selected by the TIME/DIV switch. After completion, 2- $\mu$ sec clock.

When ②2 VAR knob is pulled out, the read time is as set by the TIME/DIV switch.

When in the PEN mode, the read time is as set by the TIME/DIV switch.

When in the DUAL-TRACE mode, the display modes are as follows.

	CHOP	ALT
1k words:	(5 s - 1 ms)/DIV	(0.5 ms - 50 $\mu$ s)/DIV
2k/4k words:	(5 s - 0.2 ms)/DIV	(0.1 ms - 50 $\mu$ s)/DIV

When the knob is turned to the counterclockwise extreme position, the sampling time is switched over to that of an EXT clock. The input terminal for the EXT clock is an BNC-type receptacle on the rear panel.

Expansion mode:

The expansion function remains idle when the instrument is in the regular sweep mode. It is brought into effect when the signal is stored, and both (22) VIEW TIME switch and the EXP switch of (31) DISPLAY MODE selector are pushed in. The sweep is expanded with the point indicated by the cursor as the reference point of expansion. The relationships between the TIME/DIV switch setting and the expansion factor are as follows:

0.2 ms/DIV: 1 time  
0.5 ms/DIV: 2.5 times  
1 ms/DIV: 5 times  
2 ms/DIV: 10 times  
and so forth.

Thus, the sweep can be expanded by a factor of up to 100 times or over.

(22) VIEW TIME:

This control sets the view time (display time). The clockwise extreme position (locked position) is for OFF. When this control is ON, the view time is adjustable for a range of approximately 0.5 sec to 5 sec. It should be set as required when the input signal is of a continuous waveform and this range of period is required for displaying it on the CRT. The signal waveform will remain displayed on the CRT until the period set by the VIEW TIME control elapses and the next trigger is applied. (The triggers which may be applied



within the view time is ignored and no writing operation takes place.)

When this knob is pulled out, the instrument operates in the READ TIME NORMAL mode with the read time (the trace sweep time on the CRT) as set by (21) TIME/DIV switch. See Item (21).

(23) -1

MEMORY (WORDS):

Selects the memory size. The indicated values denote memory sizes when in the SINGLE-TRACE mode. When in the DUAL-TRACE mode, the memory sizes are a half of those when in the SINGLE-TRACE mode. The selectable memory sizes are 1k, 2k, and 3k. When in the 1k-word mode, 0 - 1k, 1k - 2k, 2k - 3k, and 3k - 4k memory channels can be specified and one of them can be selected for writing data.

(23) -2

CH1 4-TRACE:

Four traces corresponding to individual 1k-channels of memory can be displayed on the CRT when (18) VERT MODE switch is set for CH1, the instrument is not in the READ TIME NORMAL mode ((22) VIEW TIME knob is not pulled out) and (23) -1 MEMORY selector is set for the 1k mode. When in the 4-TRACE mode of operation, the vertical axis gain is reduced to 1/4. (For example, an amplitude of 2 scale divisions in this mode is corresponding to that of 8 scale divisions in the regular mode.)

Of the four memory channels, the one which has been selected by the switch is capable of both read and write while the remaining three memory channels are capable of read only.






When in the 4-TRACE mode with the predelay function, the horizontal axes (addresses) are fixed to that of the memory channel in which the signal waveform has been stored lastly and, therefore, the signal waveforms of the preceding memory channels do not maintain the true time relationships with respect to the triggered point.

The four traces are displayed when in the STORED mode. When in the READY state, the signal waveform of the selected memory channel alone is displayed.

The four traces are displayed in the order of those for the 0 - 1k, 1k - 2k, 2k - 3k, and 3k - 4k, from upward to downward on the CRT.

Note: When in the PEN mode, the 4-trace operation cannot be done. The output signal is delivered only of the memory channel selected by (23) -1 MEMORY switch.

When in the SCOPE mode, the waveforms of the four memory channels are displayed in the CHOP mode if (21) TIME/DIV switch is set in the 5 sec - 0.2 msec range or those of the four memory channels are displayed in the ALT mode starting by the 0 - 1k channel if the switch is set in the 0.1 msec or 50  $\mu$ sec range. Note that the instrument operation may become unstable if other switches than those specified are operated, for example, if the X-Y or DUAL button is pressed.

- ②④ TRIGGERING: Triggering mode selector buttons
- o AC/DC: Input coupling selector button
    -  : AC coupling of triggering signal
    -  : DC coupling of triggering signal
  - o +/-: Triggering slope selector button
    -  : Triggering is effected as the triggering signal crosses the triggering level in the positive-going direction (↗).
    -  : Triggering is effected as the triggering signal crosses the triggering level in the negative-going direction (↘).
  - o INT/LINE/EXT: Triggering source selector buttons
    - INT: An internal signal (CH1 or CH2 signal as selected by ①⑦ INT TRIG switch) is used as the triggering signal.
    - LINE: The AC line frequency signal is used as the triggering signal.
    - EXT: An external signal (applied through the EXT TRIG terminal) is used as the triggering signal.
- ②⑤ EXT TRIG: An external triggering signal is applied through this terminal. When ②④ TRIGGERING selector is set in the EXT state, triggering is effected by the signal applied through this terminal.
- ②⑥ LEVEL: To adjust the triggering point (level) of the input signal. The triggering level becomes higher as the outer knob is turned clockwise, and vice versa.
-  FULL VIEW TIME
- When the knob is pulled out, the trigger circuit operates in the ABS (absolute) mode and triggering is effected when the trigger

crosses the triggering level irrespective of polarity. This function is convenient when the input signal waveform is unpredictable.

②⑦ SWEEP MODE:

Sweep mode selector buttons

AUTO:

Sweep runs automatically even when no adequate triggering signal is applied.

NORMAL:

Sweep runs when adequate triggering signal is applied. If no adequate triggering signal is applied, sweep is in the ready state and no waveform data is written.

SINGLE:

Sweep runs only one when it is triggered. To start the next sweep, the sweep circuit must be reset once to the ready state.

After the write operation is over and the instrument has become the stored state, the stored waveform is maintained and ③① STORED lamp lights until the instrument is reset for the next sweep.

②⑧ READY:

This lamp turns on when the sweep is ready.

②⑨ TRIG'D:

This lamp turns on when the sweep is triggered.

③① STORED:

This lamp turns on when the circuit is triggered and the write operation is complete, when ②⑦ SWEEP MODE selector is set in the NORMAL or STORED state.

③① DISPLAY MODE:

Display mode selector buttons.

AUTO ERASE

ROLL



Selects between the AUTO ERASE mode and the ROLL mode. The pulled out state is for the AUTO ERASE mode and the pushed in state is for the ROLL mode.

AUTO ERASE:


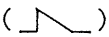
Each time a trigger pulse is applied, the trace on the CRT is refreshed by a newly stored waveform. The display time on the CRT is adjustable with the VIEW TIME knob.

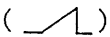
ROLL:

The waveform displayed by the preceding trigger is rewritten with that displayed by the current trigger in a roll-out manner. There are two ROLL modes (mode A and mode B) and either one can be selected as required.


 A (  )

Selects either Mode A or Mode B of ROLL operation.

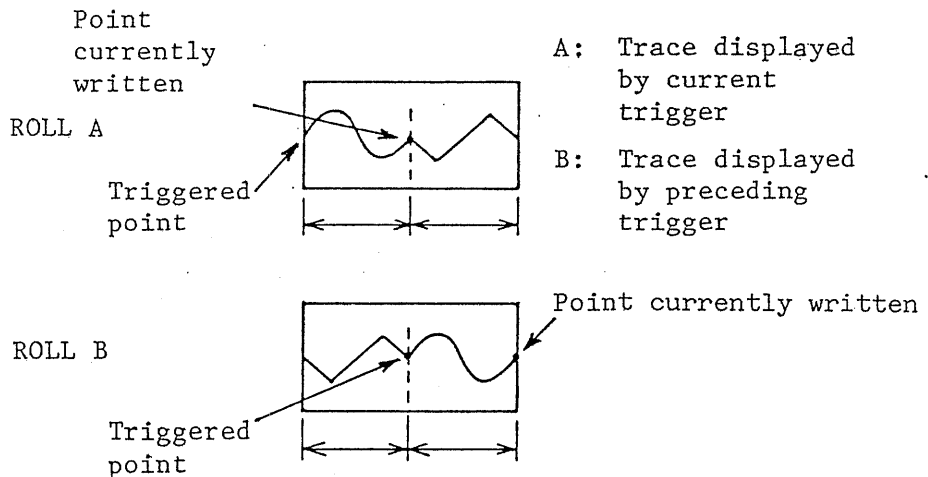
 B (  )

A (  )

The trace is swept from left to right as is the case of the conventional type of oscilloscope. The triggered point is fixed constantly at the left hand end of the displayed waveform. Mode A can be used for all ranges of the TIME/DIV switch.

B (  )

The trace is swept from right to left. The currently input point (currently written point) is at the right hand end of the trace and the waveform which was previously input moves leftward. Mode B can be used for lower sweep speed ranges only (5 sec/DIV - 20 msec/DIV), because the triggered point moves leftward unlike the case of Mode A. At higher sweep ranges, Mode B may be used in conjunction with the VIEW TIME function for ease of observation of the waveform on the CRT.



PREDELAY:

The predelay function is used to store and display the waveform which existed before triggering, in the ROLL A or B mode. The amount of delay can be set up to 9.9 DIV in 0.1-DIV seps. The set amount means the amount of stored signal after triggering. The screen is calibrated from the right-hand end of the trace line.

The trace line exceeds the graticule by 2.4%. To align the trace line with the graticule line, move the trace line with the HOR POSITION control.

The triggered point is indicated on the displayed waveform with the cursor when (22) VIEW TIME knob is not pulled out. When the knob is pulled out, the cursor disappears. The waveforms before and after the triggering point can be displayed conveniently by using this function and adjusting the triggering point adequately.

EXP:

The EXP mode is used to expand the horizontal display axis of the stored signal waveform. For this mode, (21) TIME/DIV switch and (33) EXPANSION MODE switch are used in conjunction.

If the **EXP** mode button is pressed when the TIME/DIV switch is set at 0.2 ms and the EXPANSION mode switch is set at the CURSOR position, the cursor is displayed at the left hand end of the waveform which is with an expansion ratio of 1 time. As the CURSOR switch is operated until the cursor moves to the point for expansion and the EXPANSION mode switch is set to the **EXP** position, the cursor moves to the left hand end of the trace. As the TIME/DIV switch is turned to

the 0.5 sec, 1 msec, 2 msec, and so forth, the trace is expanded rightward by factors of 2.5 times, 5 times, and so forth.

When in the PREDELAY mode, the EXPANSION function cannot be used. If it is used, the time relationships of the waveform which is input in the PREDELAY mode is lost.

As the CURSOR switch is operated, the cursor point on the trace and the displayed waveform are moved.

When in the EXPANSION mode, the cursor point remains ineffective and the reference point is at the left hand end of the screen (trace). Therefore, move the waveform as required for expansion.

Note that, when the  EXP switch is pushed in, the time relationships of the displayed waveform with respect to the actual input are lost and the sequence of data is not restored even when the switches are returned to their original positions. To restore the original state of the waveform, keeping the  EXP switch in the pushed-in state, move the cursor in the CURSOR mode to the initial point (triggering point) of the actual signal input timing and then return the  EXP switch to the original state.

TIMING RESET: This button is for resetting the timing of the internal circuits of the instrument. The button may be pressed to reset the instrument to the initial state when the instrument has run into an erroneous operation state, etc.



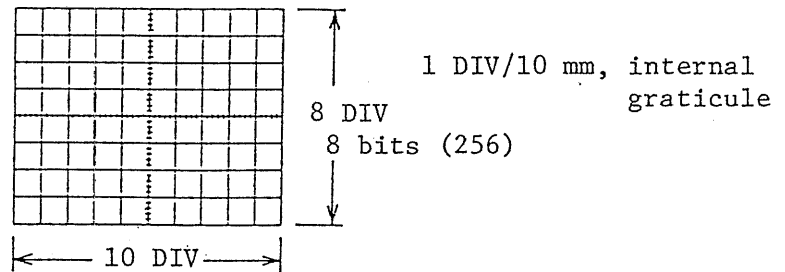


When in the dual-channel mode, both channels are protected mutually independently.

Note: Memory is volatile. It is not protected when the instrument power is turned off.

③ Graticule:

The graticule is as follows.



The bits for the vertical scale are assigned with approximately 5% overscale for each of top and bottom, and those for the horizontal scale with approximately 2.4% overscale.

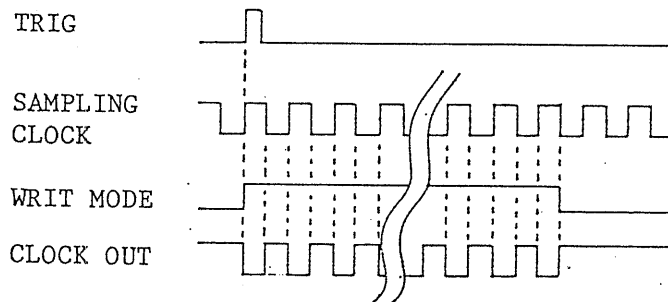
Single trace: 1024, 2048, or 4096 words

Dural traces: 512, 1024, or 2048 words

Words per DIV: 1k: 100 words  
2k: 200 words  
4k: 400 words ) single trace

3.2 Description of Rear Panel Items (See Figure 3-2.)

- ③⑥ SAMPLING CLOCK OUT: This terminal delivers a clock output signal which is synchronized with the sampling clock signal of the instrument when in the write mode. The output signal is of a TTL level.



- ③⑦ Z AZIS INPUT: Input terminal for external intensity modulation signal. May be used to externally control the trace intensity and to apply a marker signal.

- ③⑧ PEN OUT: Output terminals of the stored signals, in the analog form. The signals are constantly delivered.

CH1: Output terminal of CH1 analog signal.

CH2: Output terminal of CH2 analog signal.

TIME BASE: Output terminal of X-axis analog signal as selected by the TIME BASE switch.

SYNC/TTL LEVEL: Output terminal of a signal synchronized with the sweep signal. Used for such purpose as set/lift control of recorder pen.

- ③⑨ EXT CLOCK INPUT TTL: Input terminal for an external sampling clock signal for writing of data. Accepts a signal of TTL level. (See Item (7) of Section 3.3.)

- ④⑩ FUSE: AC power line fuse holder
- ④⑪ Line power: Input connector of the AC line power
- ④⑫ LINE VOLTAGE SET: AC line voltage selector. Set the arrowhead mark at the corresponding AC line voltage position.
- A: 90 - 110 V
- B: 104 - 126 V
- C: 194 - 236 V
- D: 207 - 253 V
- ④⑬ DI/O: Digital input/output terminal for DMA operation. GP-IB Interface IF01-DSS can be connected to this terminal.)

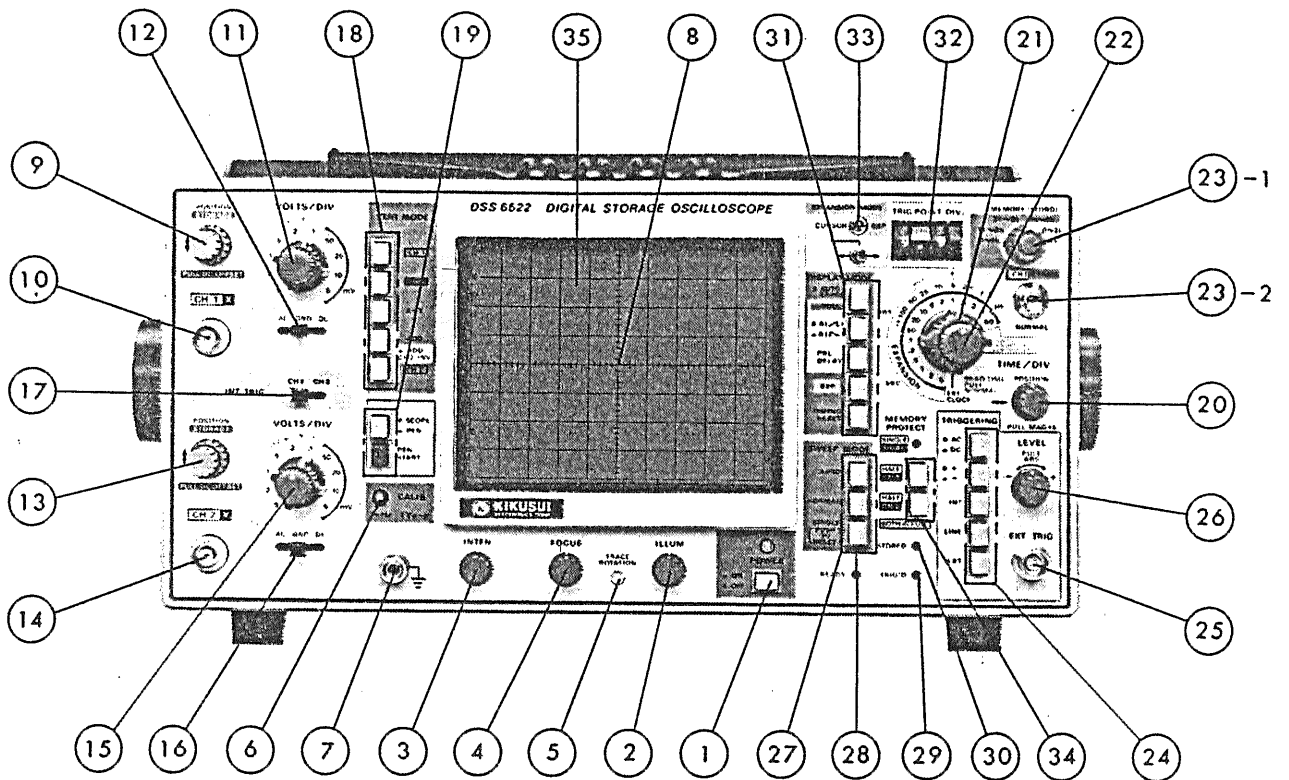


Figure 3-1. Front panel

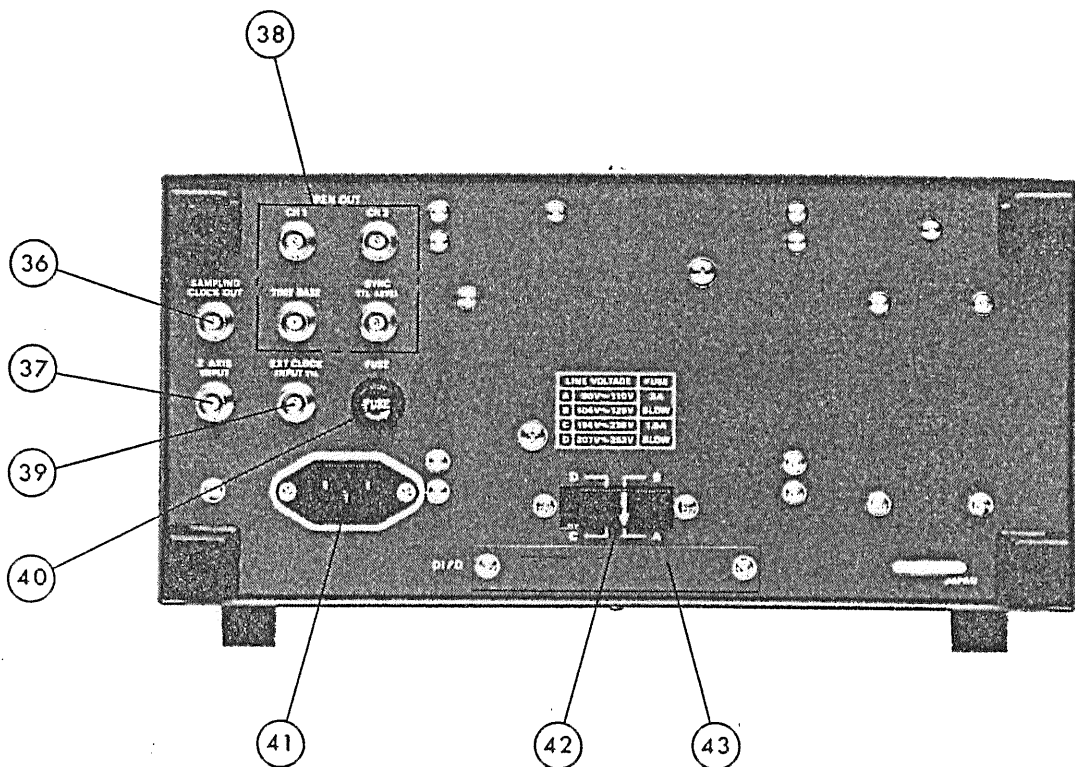
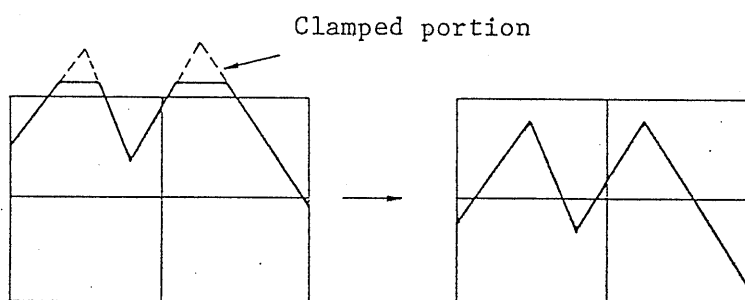


Figure 3-2. Rear panel

### 3.3 Examples of Uses

#### (1) DC Offset

When an AC signal which is superimposed on a DC component is applied to the input terminal, the AC component which is to be displayed and measured may be saturated and clamped. In such a case, the DC offset function may be used to cancel out the DC component.



The DC offset function is effected when the inner VERT POSITION knob is pulled out.

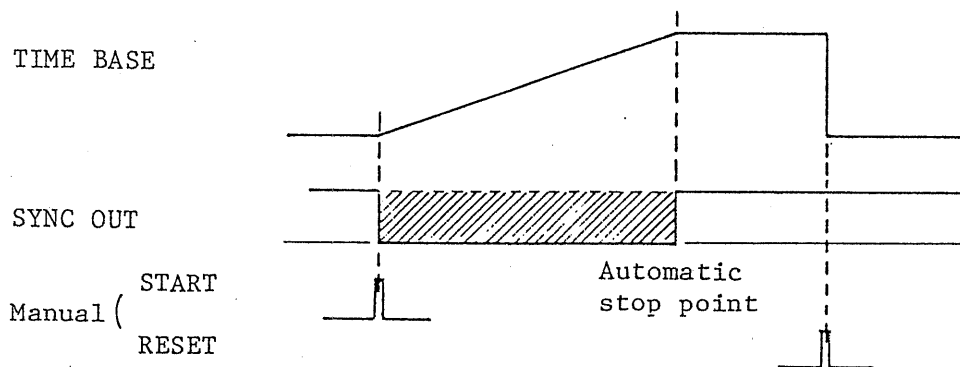
#### (2) PEN

The PEN function is used to obtain a hardcopy of the stored waveform. For this function, the X-Y signals and sync signal are available at the output terminals on the rear panel.

The PEN operation starts as you change the operation mode from the SCOPE mode to the PEN mode and press the PEN START switch. The operation proceeds at the sampling speed selected by the TIME BASE switch and stops when the final data has been read. (When the operation mode is changed from the SCOPE mode to the PEN mode, the read time is set as selected by the TIME BASE switch.)

As you press the START button again, the operation returns to the starting point.

The waveform is monitored on the CRT screen at the same time.



(3) Recording of one-shot signal

The signal of a one-shot event can be recorded using the SINGLE mode. When the circuit is triggered and the write operation is over, the instrument becomes the STORED state and displays the stored waveform until it is reset.

A phenomenon which occurs only once at an unpredictable time can hardly be measured with the regular oscilloscope mode. Such phenomenon can be effectively measured with the single-sweep operation of a storage mode, which automatically captures the phenomenon as it occurs and automatically stores the waveform. When used in conjunction with the PREDELAY function, this SINGLE mode provides a very efficient means of measurement for the waveform both before and after the triggering.

(4) Setting of view time when the input signal is continuously triggered

When the input signal is continuously triggered in the AUTO or NORMAL sweep mode, the displayed waveform is automatically refreshed for each trigger pulse unless the memory protect function is in effect. When this automatic refreshing is undesirable and a certain view time is needed, it can be obtained and adjustable for a period of 0.5 to 5 seconds with the VIEW TIME knob.

(5) Comparison with a reference signal

Operating the instrument in the DUAL mode, write the reference signal in CH1 or CH2, protect the corresponding channel, and apply a measured signal to the other channel.

Or, operating the instrument in the single-channel mode, write the reference signal and protect it with the HALF MEMORY PROTECT, and compare the measured signal with the reference signal.

- ① Reference signal      ② HALF PROTECT signal      ③ Two signals identical      ④ Difference between two signals



Waveforms ④ indicate that the frequency of the measured signal is lower. When the frequency of the measured signal is raised to that of the reference signal, the displayed waveforms will conform as those of ③.

Phase and amplitude also can be measured in a similar manner.

It also is possible to compare waves employing the 4-TRACE mode.

(a) To compare four signals:

Store the four signals in the four 1k-channels, respectively, by selecting them in the CH1 SINGLE-TRACE mode. Turn on the 4-TRACE switch so that the four waveforms are displayed on the CRT at the same time.

(b) To compare a signal which is continuously input:

In the CH1 SINGLE-TRACE mode, write the reference signal as is the case of (a). Select one of the remaining memory channels and write continuously in this channel the signal to be compared. The waveform of the selected channel will be constantly refreshed.

- (6) To measure a waveform which existed before triggering

Different from the conventional oscilloscope, the Digital Storage Oscilloscope is capable of measuring the waveform which existed before triggering, although triggering of the Digital Storage Oscilloscope depends on the slope and level of the triggering signal as in the case of the regular oscilloscope. It often happens that the state which existed before triggering is needed to be known, especially in the cases of one-shot phenomena. The waveform which existed before triggering can be measured by employing the PREDELAY function in the SINGLE mode.

- (7) Use of external clock signal

The oscilloscope can be operated with its sampling speed dictated by an external clock signal (TTL level). This feature is very convenient for maintaining synchronization with an external circuit, as one conversion is made per one clock pulse. The maximum input frequency is 2 MHz when in the SINGLE mode, and 1 MHz when in the DUAL mode. This mode is used in the ROLL mode, with the TIME BASE READ TIME NORMAL knob pulled out. The write timing is such that the internal circuit is driven by the fall down edge (  $\downarrow$  ) of the clock pulse.



### 3.4 Precautions

(1) AC line voltage:

Be sure to check before operating the instrument that the LINE VOLTAGE selector on the rear panel is set at the correct position for the AC line voltage on which the instrument is to be operated. If the LINE VOLTAGE selector is not correctly set, the instrument may be damaged or may not operate properly.

(2) Environments:

Do not operate or store the instrument in high temperature, high humidity environments for a long time as such will cause damage of the instrument or shortening of the instruments life. Do not operate the instrument in a strong magnetic or electric field.

(3) CRT intensity:

Do not make the trace intensity excessively high. Do not leave the spot stationary for a long time. Such will shorten the CRT life.

(4) Memory protect:

Memory is volatile. It is not backed up by any battery. Stored data is lost when the AC line power is turned off.

(5) Display error when in STORAGE mode:

The Digital Storage Oscilloscope displays waveforms in sampling periods. Note that perceptual aliasing may result if an input signal of which frequency is higher than the set time base is applied.

(6) Allowable maximum voltages of input terminals:

The allowable maximum voltages of the input terminals and probes are as shown in the following. Do not apply input voltages

higher than these limits as such will cause damage to the instrument.

CH1, CH2 terminals	400 V (DC + AC peak) AC: 1 kHz or less
Probe (960 BNC)	600 V (DC + AC peak)
EXT TRIG terminal	±50 V (DC + AC peak) AC: 1 kHz or less
EXT CLOCK terminal	TTL level
Z-AXIS INPUT terminal	50 V (DC + AC peak) AC: 1 kHz or less

(7) Uniformity of intensity:

- (a) When in the AUTO ERASE mode and especially in higher CHOP ranges, the right-hand part of the CRT screen may become darker depending on the input signal frequency. This is not an abnormal indication. If such darkening is inconvenient for viewing, turn on the VIEW TIME function, use the ROLL mode, or pull out the VIEW TIME switch.
- (b) When in the ROLL mode, the trace starting point at the right-hand part on the CRT screen may become brighter. This is not an abnormal indication.
- (c) In the case of (a) or (b), or in the cases of certain combinations of modes, ununiformity of trace intensity may result. It results from the operating principles of the instrument and it is not an abnormal indication.

(8) Pretrigger operation in storage mode:

- o When the triggering point is set at 0 DIV, the pretriggering function is not effected and the READY lamp does not turn on.

- o Note that the stored and displayed signals may not be reliable (errors may be introduced) when the 50  $\mu$ S/DIV range is used in the pretriggering mode in the DUAL-TRACE operation.
- (9) To write out the data stored in the memory using a pen-writing recorder or other similar instrument, switch the oscilloscope from the SCOPE mode to the PEN mode after making it sure that the STORED lamp is on. If the oscilloscope is switched to the PEN mode and back into the SCOPE mode when the oscilloscope is in a sweep operation, the sweep operation may stop. This is caused as the oscilloscope is switched to other mode while it is in operation. When this has happened, press the RESET (SINGLE) button once so that the oscilloscope is reset and the normal sweep resumes.




#### 4. OPERATION METHOD

##### 4.1 Setting of Switches and Controls

Before connecting the AC power cord to an AC line outlet, set the switches and controls as follows:

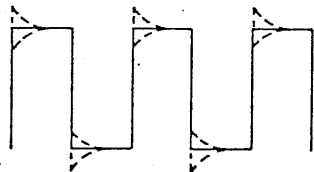
(Item numbers are as shown in Figure 2-1.)

Item No.	Switch or control	Setting
1	POWER	<input type="checkbox"/> OFF
9, 13	POSITION $\updownarrow$	Inner knob: Midposition Outer knob (DC OFFSET knob): Midposition; not pulled out
11, 15	VOLTS/DIV	5 V/DIV range
12, 16	Input coupling selector	GND (center position)
18	VERT MODE	CH1 (Depress the button.)
17	INT TRIG	CH1
19	SCOPE/PEN	SCOPE <input type="checkbox"/>
3	INTEN	Leftward horizontal position
4	FOCUS	10-minute position from mid-position
2	ILLUM	Counterclockwise extreme position
31	DISPLAY MODE	AUTO ERASE, with EXT not pushed in
21	TIME/DIV	0.5 mS
22	READ TIME PULL NORM	VIEW TIME OFF position, with knob not pulled out
20	POSITION	Midposition
27	SWEEP MODE	AUTO button pushed in <input type="checkbox"/>
33	MEMORY PROTECT	Not pushed in <input type="checkbox"/>

Item No.	Switch or control	Setting
24	TRIGGERING	AC  +  INT  (pushed in)
26	LEVEL	Mid-position, not pulled out
27	MEMORY (WORD)	Arbitrary, CH1 4-TRACE switch in NORMAL state

After setting the switches and controls as above, connect the power cord to an AC line outlet of the correct voltage.

- (1) Press the POWER switch. The lamp will turn on to indicate that the instrument power is on.
- (2) A trace will appear on the CRT in approximately 10 seconds. Adjust the trace brightness to an appropriate intensity with the INTEN knob.
- (3) Adjust the trace to the sharpest image with the FOCUS knob.
- (4) Connect the probe cable to the CH1 input terminal and the probe tip to the CALIB terminal. (Use the 1:10 probe.)
- (5) Set the input coupling selector switch to the DC position and the VOLTS/DIV switch to the 50 mV range. Adjust the LEVEL (trigger) knob so that the displayed waveform becomes stationary. Check the phase compensation of the probe and adjust it as required.



If the displayed waveform is as indicated with the dotted lines, adjust it to the waveform as indicated with the solid lines by adjusting the phase compensation control of the probe.

- (6) Set the VOLTS/DIV, TIME/DIV, TRIGGER MODE, and other selector switches in conformity with the amplitude, frequency, and other characteristics of the signal to be measured.

The above explanation is for the case of single-trace operation with CH1. CH2 may be used in a similar manner; dual-trace operation also may be used as required.

#### 4.2 Dual-trace Operation

Depress and lock the DUAL button of the VERT MODE selector so that both CH1 and CH2 traces are displayed. Either CH1 or CH2 signal can be used as the internal triggering source signal. The trace positions are adjustable with respective POSITION knobs.

#### 4.3 X-Y Operation

Depress the X-Y button of the VERT MODE selector so that the instrument operates as an X-Y scope with CH1 for the X-axis and CH2 for the Y-axis. Of the Y-axis, the electrical performances and operation method remain the same with that of CH2. For the X axis, the CH1 POSITION control remains idle and the horizontal POSITION control directly operates as the X-axis POSITION control.

Different from the case of the X-Y operation of the conventional type of oscilloscope, the X-Y operation of the DSS6522 requires setting of sampling time for writing data in memory. A sampling speed appropriate for the X-Y operation should be selected with the TIME/DIV switch.

Since the capacity of memory is limited, after it has been fully written, the preceding data is rewritten by the current data.

To store data, press the SINGLE switch of SWEEP MODE selector. To rewrite data, return the selector to the AUTO mode.

#### 4.4 Sweep Magnification or Expansion

##### (1) Sweep Magnification ( $\times 5$ MAG Mode)

Part of the signal, either the signal currently input or the signal which has been stored in memory, can be displayed being magnified. That is, as you pull out the horizontal POSITION knob, the sweep is expanded by 5 times to right and left with an approximate center of screen as the center of magnification. For this mode of operation, therefore, move the part to be expanded to the center of screen and pull out the position knob.

##### (2) Sweep Expansion (EXP Mode)

See Item (31) EXP of Section 3.1.

#### 4.5 Sweep Modes

##### (1) AUTO Mode

Stable triggering operation can be made with a triggering signal of 50 Hz or over. Even when no triggering signal is applied, the sweep runs in a free mode and the zero level is indicated. Bright traces are displayed even at high sweep ranges. This sweep mode is most commonly used for general waveform measurement.

##### (2) NORMAL Mode

Triggering is effected and the sweep runs only when a triggering signal of an effective amplitude and level is applied to drive the trigger circuit. Until the next trigger is applied, the stored waveform is displayed.

##### (3) SINGLE Mode

The SINGLE mode is used to measure a non-repetitive signal or a one-shot signal. The trace remains on the CRT until the next trigger is applied.

#### 4.6 PREDELAY

Depress and lock the ROLL and PREDELAY buttons of the DISPLAY MODE selector and set the triggering point. Setting of the triggering point is to set the amount of write after triggering. The amount is in terms of graticule divisions and it can be set up to 9.9 DIV in 0.1-DIV steps. The triggering point is indicated with a cursor on the waveform. Setting of the triggering point is made with reference to the right-hand end of the trace line. Since the trace line is overscaled by 2.4%, the trace position should be adjusted to the scale line by means of the horizontal POSITION knob.

Assume that waveforms before and after the triggering point are to be displayed fifty-fifty (50% and 50%). For this display, set the triggering point at 5.0 DIV. Set the triggering level and then press the SINGLE buttons of the SWEEP MODE selector. The waveform is written and displayed until the triggering point. After the triggering point, the waveform for 5 DIV is written and displayed.

For rewriting, press the SINGLE button each time.

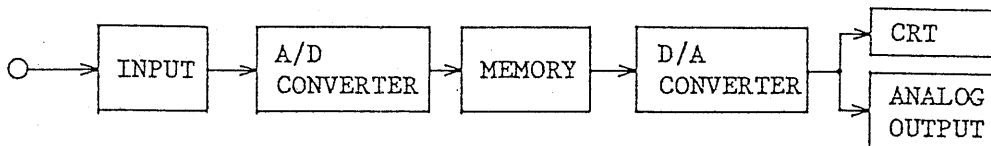


## 5. D I/O

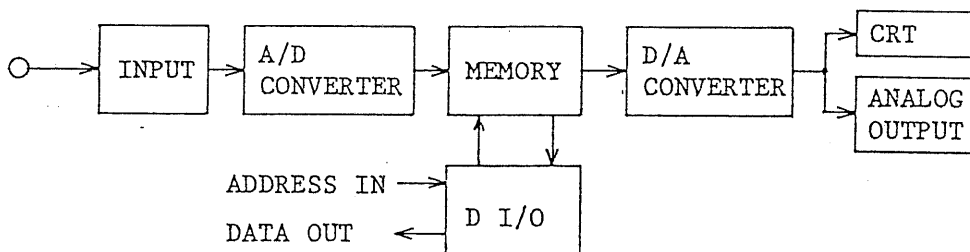
### 5.1 Memory Access (The D I/O is only for Kikusui GP-IB Interface.)

The D I/O is used to deliver the stored data as a digital signal and to accept an external digital signal into the oscilloscope.

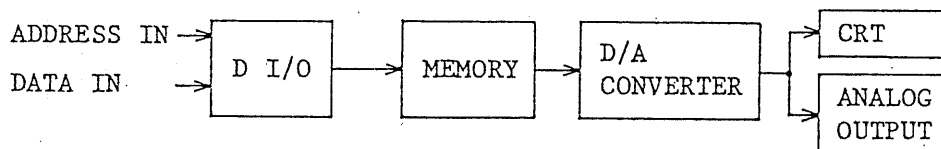
#### (1) Normal storage-scope operation



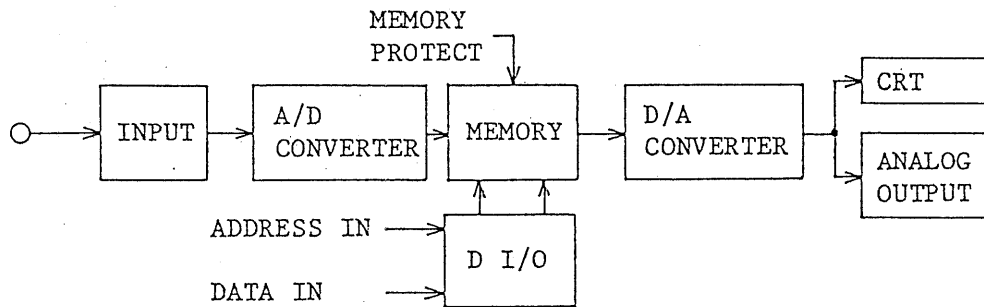
(2) To deliver data stored in the storage oscilloscope: By applying an external address signal, an output for the corresponding data stored in the oscilloscope is delivered and at the same time the data is displayed on CRT.



(3) To specify the memory addresses with an external signal, to write data at such addresses, and to monitor the written data with CRT.



(4) To apply an external reference signal for comparison. When in the DUAL-TRACE mode, one of the memory channels is protected.



## 5.2 D I/O Terminal Pins

GND	1	2	D0
"	3	4	D1
"	5	6	D2
"	7	8	D3
"	9	10	D4
"	11	12	D5
"	13	14	D6
"	15	16	D7
"	17	18	
"	19	20	
"	21	22	
"	23	24	
A0	25	26	A1
A2	27	28	A3
A4	29	30	A5
A6	31	32	A7
A8	33	34	A9
A10	35	36	A11
GND	37	38	STORED
"	39	40	WE
"	41	42	DI
"	43	44	SINGLE
"	45	46	BUSY
"	47	48	REMOTE
"	49	50	WRITE END

### 5.3 Description of Signals

REMOTE: L level, No. 48 (IN)

When the REMOTE mode is specified by the signal applied through the D I/O terminal, read/write operation of memory is controlled by external signals and the panel switches for storage oscilloscope mode remain idle.

SINGLE: L level, No. 44 (IN)

For the single-sweep mode. When the circuit is triggered and data is stored, the operation is reset as the SINGLE state is released once.


L → H → L

This function is used in such case that a waveform is to be stored once and sent out as a digital output signal.


Input → Store → Output

DI: L level, No. 42 (IN)

This input/output switching signal for data is used when directly reading/writing the memory in the REMOTE mode.

WE:  Pulse signal, No. 40 (IN)

This write-enable signal is used to write data in memory in the REMOTE mode.

WRITE END:  Pulse signal, No. 50 (IN)

As this signal is applied when the write operation in the REMOTE mode is over, the circuit becomes the STORED state and the indicator lamp turns on.

STORED: L level, No. 33 (OUT)

When the write operation is over in the LOCAL mode, the STORED lamp turns on and this signal is delivered. (SINGLE sweep)

BUSY: L level, No. 46 (OUT)

This signal is delivered during the period the circuit is triggered and is in the write operation.

#### 5.4 Timing of WE Signal

