HIOKI

8851

MEMORY Hi CORDER

INSTRUCTION MANUAL

Vol. 2

HIOKI E.E. CORPORATION

[The supplement and amendment to
the 8851 MEMORY HiCORDER INSTRUCTION MANUAL VOL.2]

1. Supplement

Sets and queries the FFT frequency axis.		
Syntax	(command):	CALCulate:FFTHZ A$
	(query):	CALCulate:FFTHZ?
Explanation	(command):	Sets the frequency axis for FFT calculation according to the character data.
	(query):	Returns the frequency axis for FFT calculation as character data.
When allowed	:In the memory recorder function.	

2. Amendment

p20-90

Outputs FFT data

⋮

Incorrect

Example :CALCULATE:FFTPOINT CH1,0

↓

Correct

Example :CALCULATE:FFTPOINT 0

Contents

Section 13

Waveform Processing

Contents

13-1 Storage Modes

Using the memory recorder function, there are three storage modes for waveform capture.

(1) Normal mode

This captures the input signal unchanged.

(2) Averaging mode

The input signal is subjected to an averaging process.

(3) Envelope mode

This shows the envelope of the input signal.

13-2 Using the Averaging Function

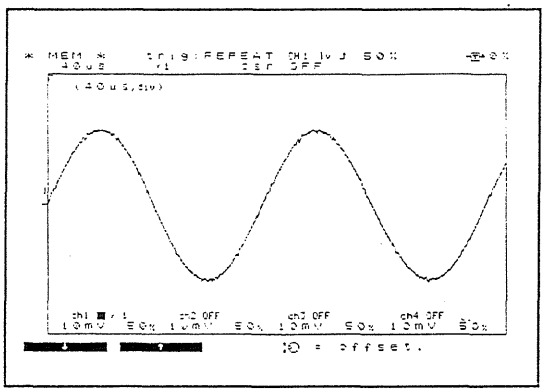
Function

Setting the memory recorder storage mode to averaging provides a sliding average value for the waveform.

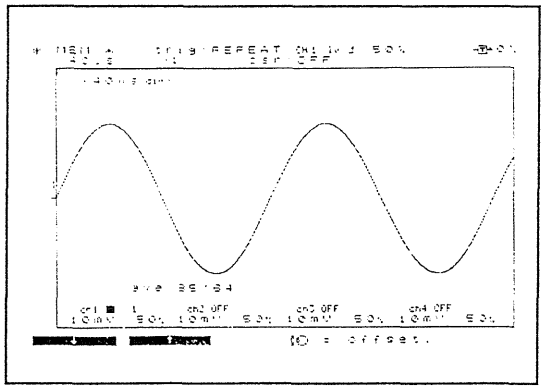
This enables noise components to be removed, and the underlying signal observed.

The averaging length is variable, and can be set to 4, 8, 16, 32, 64, 128 or 256 samples. The larger this value, the more the waveform is smoothed, and the more noise components are removed.

Normal mode



Averaging mode (averaging length 64 samples)



Procedure

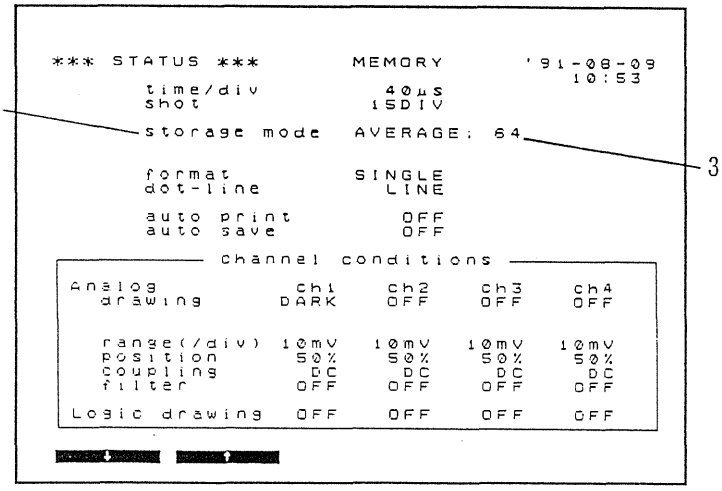
1. Select the status mode.
2. "storage mode"

   Select the storage mode.

   (NORMAL, AVERAGE, ENVELOPE)

   In this case select AVERAGE for the averaging mode.
3. Select the averaging length.

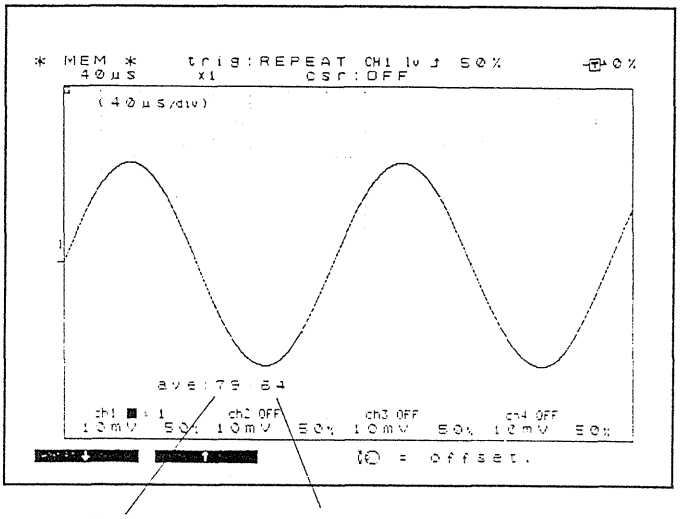
   (4, 8, 16, 32, 64, 128, 256)



4. Press the START key to begin measurement. The display shows the averaging length, and also indicates the number of samples captured so far.

   Once this number of samples has been captured, and the arithmetic mean calculated, the waveform begins to appear on the screen.

   Note that averaging does not apply to logic channels, which simply show the last captured value.



Number of samples Specified averaging length

Notes

(1) Selecting the averaging function automatically disables the memory division function and FFT computation.

(2) When the averaging function is enabled, no waveform processing computations are carried out as data is captured.

For an averaged waveform, after data capture it is possible to carry out waveform computations by a manual operation (pressing the (exec) soft key).

(3) Averaging and the trigger mode

When the trigger mode is SINGLE:

After the START key is pressed, once the trigger conditions hold, data is captured, and after the specified number of samples have been captured measurement automatically stops. Then averaging is applied to the data, and the waveform is displayed on the screen.

If the STOP key is pressed to abandon measurement, the data captured up to the point of abandonment is subjected to averaging, and the waveform is displayed.

When the trigger mode is REPEAT:

After the START key is pressed, once the trigger conditions hold, data is captured, and after the specified number of samples have been captured, averaging is applied to the data, and the waveform is displayed on the screen. Thereafter, each time a data sample is captured, a sliding average is calculated, and the display waveform is rewritten. Pressing the STOP key terminates measurement.

When the trigger mode is AUTO:

After the START key is pressed, even if the trigger conditions do not hold, once a certain time interval has elapsed data is captured. It is therefore possible to apply averaging to signals which are not synchronized, yielding meaningless data.

For this reason, when using averaging, ensure that the trigger mode is either SINGLE or REPEAT.

(4) Sliding averaging

The averaging method comprises two slightly different algorithms, that for the initial samples, which is a simple averaging method, and that for the continuing samples, which is a true sliding average.

The simple averaging method gives the mean value of the values captured:

$$An = \{(n - 1)\, A_{n-1} + Z_n\}/n$$

n: number of samples

A_n: nth average value

Z_n: nth measurement value

The sliding average method is used once the number of captured samples exceeds the averaging length. This gives the greatest weighting to the latest sample, and progressively reduces the weightings for the previous samples. The value is determined by the following expression:

$$A_n = \{(N - 1)\, A_{n-1} + Z_n\}/N$$

N: specified averaging length (4 to 256 samples)

n: number of samples captured ($n > N$)

A_n: nth average value

Z_n: nth measurement value

(5) Upper limit on shot length

In the averaging mode, the upper limit on the shot length is 3000 divisions (when using memory for channels 1 to 4).

Setting the shot length above this limit automatically switches to normal mode.

(6) When using memory for one channel or channels 1 and 2 only, the averaging function is not available.

(7) Time taken for averaging processing

The time from starting measurement until the specified number of samples has been captured and the waveform displayed, or if the trigger mode is REPEAT, the time required after the specified number of samples is initially captured to rewrite the waveform display for each new data sample, depends on the product of the time axis range and the shot length, and the specified averaging length.

13-3 Using the Envelope Function

Function

Setting the memory recorder storage mode to envelope provides the following advantages:

(1) Since even in the low speed ranges a high sampling speed of 800 kS/s is used, transient phenomena can be positively captured.

(2) Since the sampling rate is fixed at 800 kS/s irrespective of the time axis range (TIME/DIV) aliasing distortion is effectively prevented.

(For more details see the background information on aliasing distortion in Section 5-4-2 "Time Axis Range Setting.")

(3) The input signal envelope can be measured.

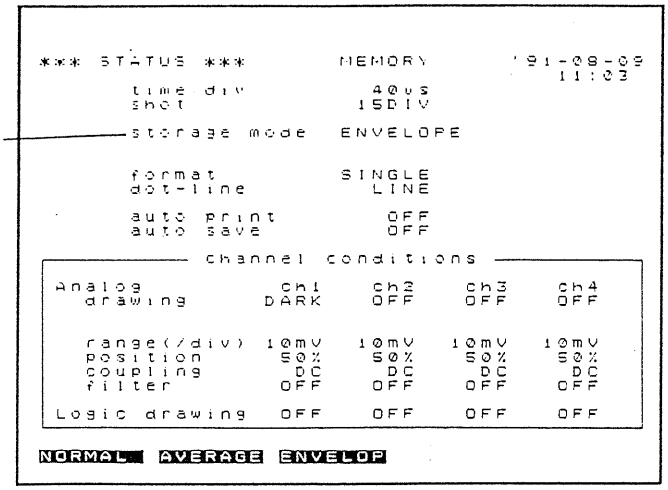
Procedure

1. Select the status mode.
2. "storage mode"

   Select the storage mode.

   (NORMAL, AVERAGE, ENVELOPE)

   In this case select ENVELOPE for the averaging mode.



Notes

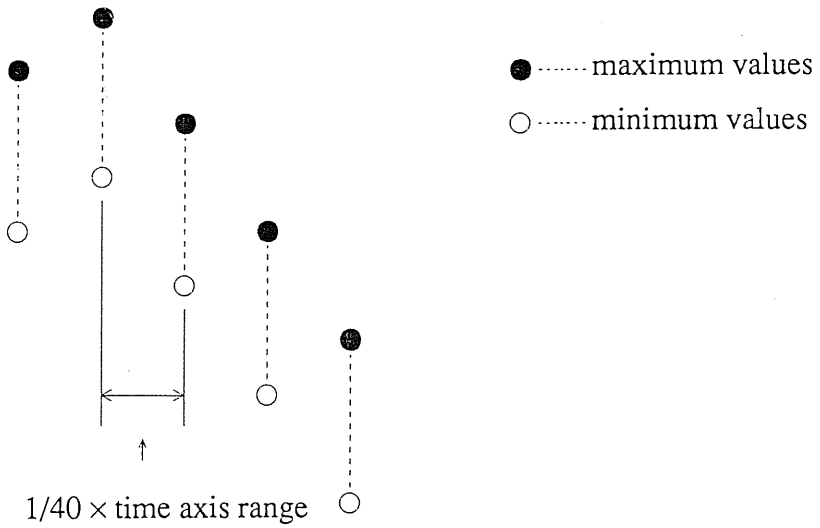
- When using the envelope function, the minimum setting for the time axis range is 100μs/division. (The 40μs/division and 50μs/division settings are not possible.)
- It is not possible to use the envelope function in X-Y format.
- The maximum shot length when using the envelope function is one half of that in normal mode.

Background

- Data processing method for the envelope mode

  Data is captured at a fixed sampling rate of 800 kS/s, and over a period of 1/40 of the time axis range (TIME/DIV), the maximum and minimum values are computed and displayed.

  (When the line interpolation function is enabled, linear interpolation is carried out for minimum and maximum values.)



Section 14

Trigger Functions

Contents

14-1 Overview

(1) The term "trigger" refers to a signal which determines the timing to start or stop recording or internal data capture.

(2) There are three different types of trigger source - the signal from which the trigger is derived.

Channel 1 (A) to channel 4 (D): internal triggers

- The trigger is derived from the input signals to channels 1 to 4 or the logic inputs to channel groups A to D.
- The trigger function monitors the state of the signals, and is activated when a predetermined signal state occurs.

External trigger

- The trigger is activated when the EXT TRIG terminal is shorted or the signal input falls below 0.7 V.
- The external trigger facility enables the unit to be synchronized to other equipment.
- It also enables a number of 8851 units to be synchronized for parallel use.

The internal and external triggers can be combined by an AND or OR logical operator.

Timer trigger (timer source)

- The timer trigger applies between predetermined times for starting and stopping operation.
- Use the timer trigger for fixed time recording.
- The timer trigger is always ORed with the AND/OR combination of the internal and external triggers.

(3) Trigger mode setting (except in the X-Y recorder function)

This determines whether the trigger is accepted repeatedly after once completing measurement operation.

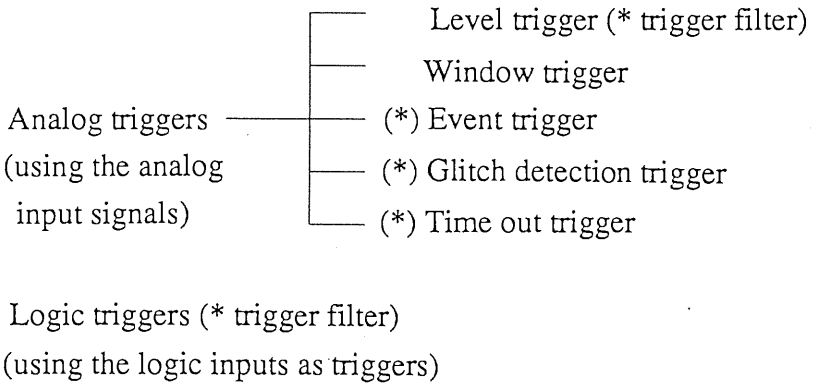
(4) Pre-trigger and trigger timing settings

The pre-trigger setting determines how much of the captured data is actually before the trigger event.

The trigger timing setting refers to which of the start and stop events are controlled by the trigger.

14-2 Internal Triggers

All of the analog input channels and logic inputs can be used as as the basis of trigger signals. The following figure shows the different types of trigger available.



* The selections marked by an asterisk are not available if the logical operator for the internal and external triggers is set to AND.

It is not possible to use all four of the analog and all 16 of the logic inputs simultaneously as triggers. The following four trigger sources can be used:

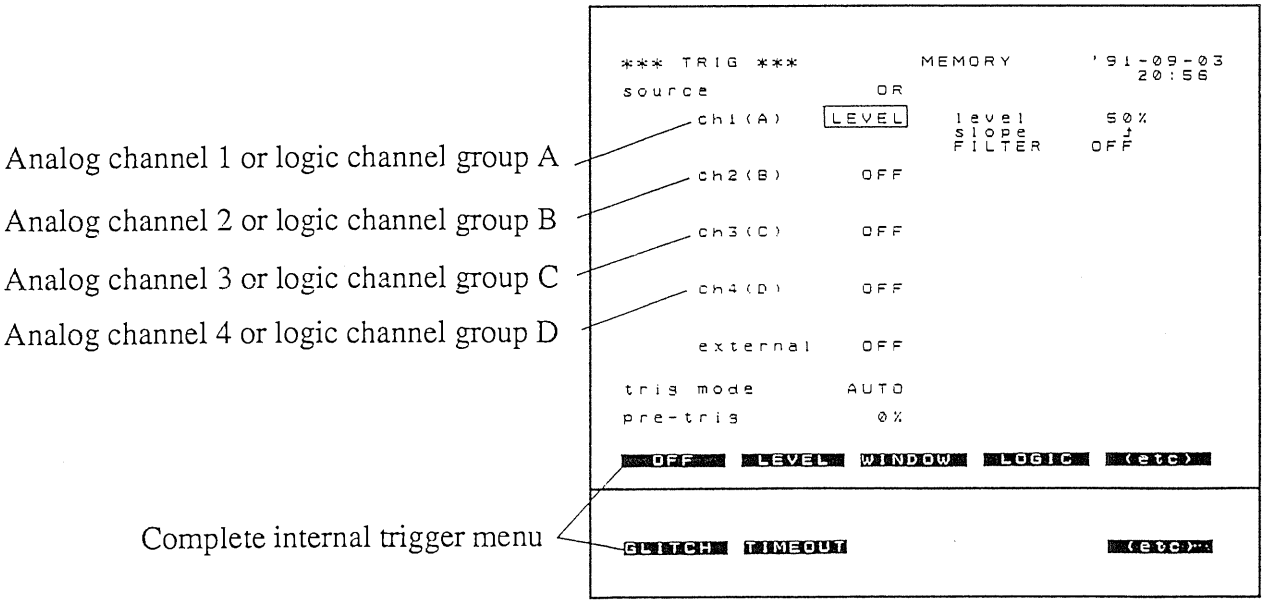
Either analog channel 1 or logic channel group A (1 - 4)

Either analog channel 2 or logic channel group B (1 - 4)

Either analog channel 3 or logic channel group C (1 - 4)

Either analog channel 4 or logic channel group D (1 - 4)

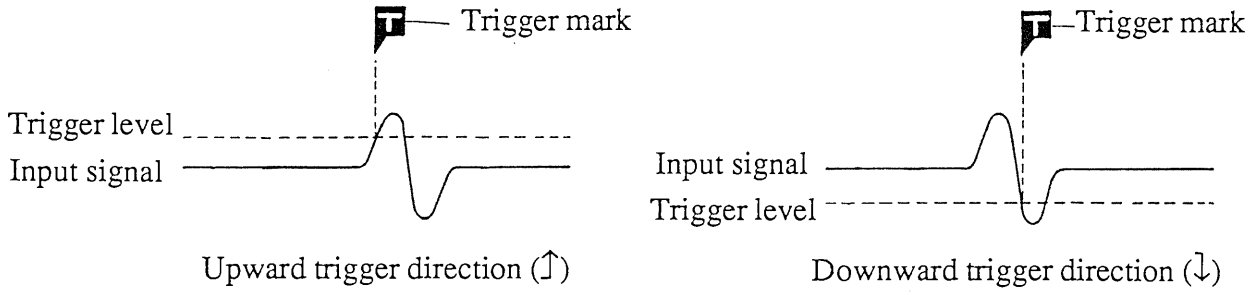
Example: memory recorder function



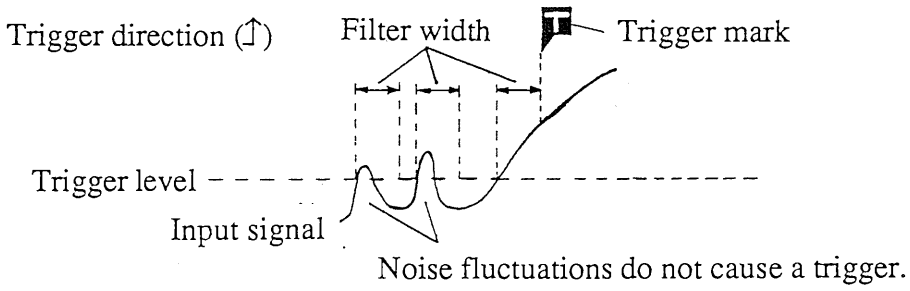
14-2-1 Level Trigger

Function

This trigger is activated when the input signal level crosses a predetermined level (0% to 100% of the range) in a particular direction ("slope": ↥, or ↧).

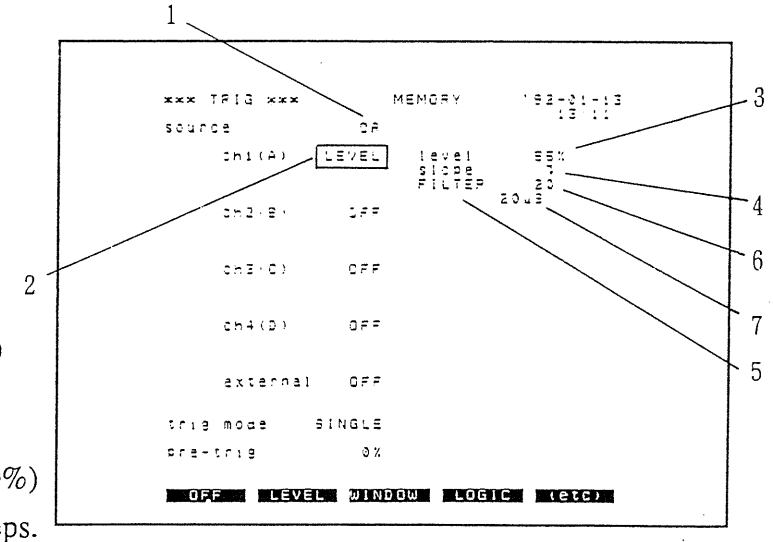


Using the trigger filter requires the condition to hold for the filter width before the trigger is activated. This provides a mechanism for avoiding spurious triggers caused by noise.



Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.



1. AND/OR setting

   If you select AND, the trigger filter cannot be used.

   (See Section 14-4.)

2. Select trigger type

   Press the [LEVEL] soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

   Pressing the [(etc)] soft key changes the trigger menu.

3. Set the trigger level. (0% to 100%)

   The setting is variable in 1% steps.

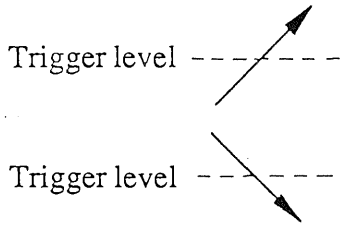
   When there is no voltage axis zoom factor in effect, the lower limit is 0% and the upper limit 100%.

4. Select the trigger direction (slope)

   (↥,↧)

   (↥): the trigger is activated when the signal crosses the trigger level (threshold) in the upward direction.

   (↧): the trigger is activated when the signal crosses the trigger level (threshold) in the downward direction.



   The remaining settings do not appear when AND was selected in step 1.

5. FILTER/EVENT setting

   Select the [FILTER] soft key.

6. When using the trigger filter, set the filter width. Otherwise, set this to OFF.

   (OFF, 2 to 4000) The filter width is the specified number multiplied by the sampling interval.

7. Filter width are displayed.

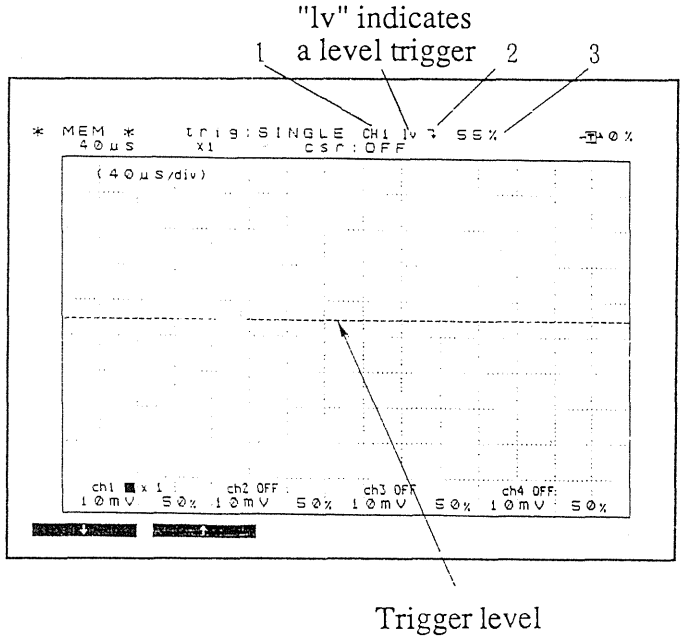
   It is also possible to set the trigger level and direction (slope) in the display mode.

   ① Switch to the appropriate trigger channel. (CH1 to CH4)

   ② Set the trigger direction (↥,↧)

   ③ Set the trigger level. (0% - 100%)

   When the cursor is moved to the trigger setting, the trigger level is shown on the screen by a broken line.



Example

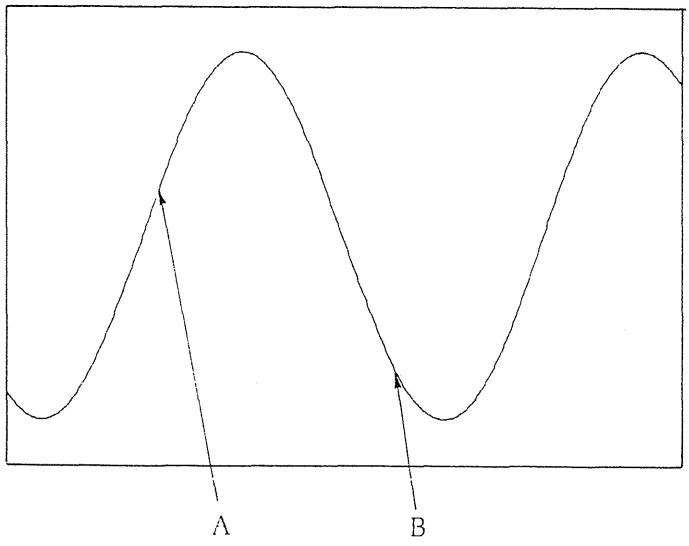
To apply a trigger at point A or point B on the waveform shown on the right, use the following settings.

Point A ..trigger level 60%

trigger direction rising (slope =↥)

Point B ..trigger level 20%

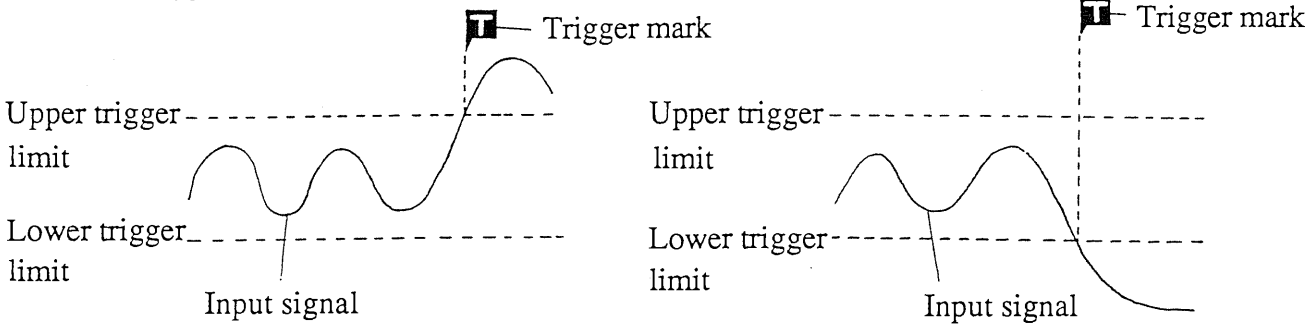
trigger direction falling (slope =↧)



14-2-2 Window Trigger

Function

The window trigger applies lower and upper limits; when the input signal goes outside these limits, the trigger is activated.



Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.

1. AND/OR setting

   (See Section 14-4.)

2. Select trigger type

   Press the [WINDOW] soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

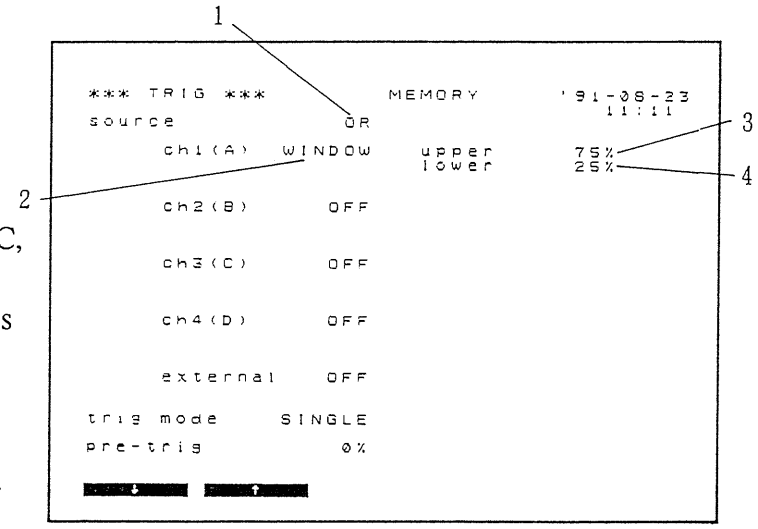
   Pressing the [(etc)] soft key changes the trigger menu.

3. Set the upper trigger limit. (0% to 100%)

   The setting is variable in 1% steps. This value cannot be less than the lower limit.

4. Set the lower trigger limit. (0% to 100%)

   The setting is variable in 1% steps. This value cannot be more than the upper limit.



It is also possible to set the upper and lower trigger limits in the display mode.

① Switch to the appropriate trigger channel. (CH1 to CH4)

② Select the upper or lower trigger limit.

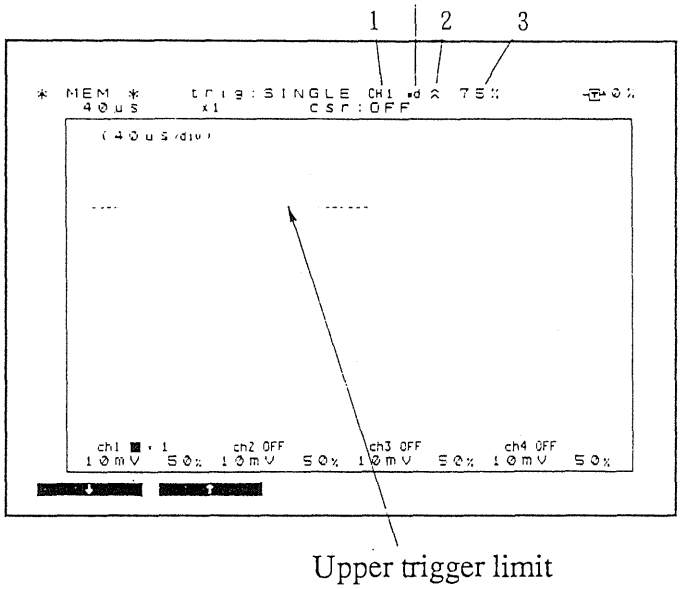
Indication on screen: (⩓ , ⩔)

Soft key indications: (upper, lower)

③ Set the corresponding level (0% - 100%)

When the cursor is moved to the limit setting, the corresponding limit is shown on the screen by a broken line.

"wd" indicates a window trigger



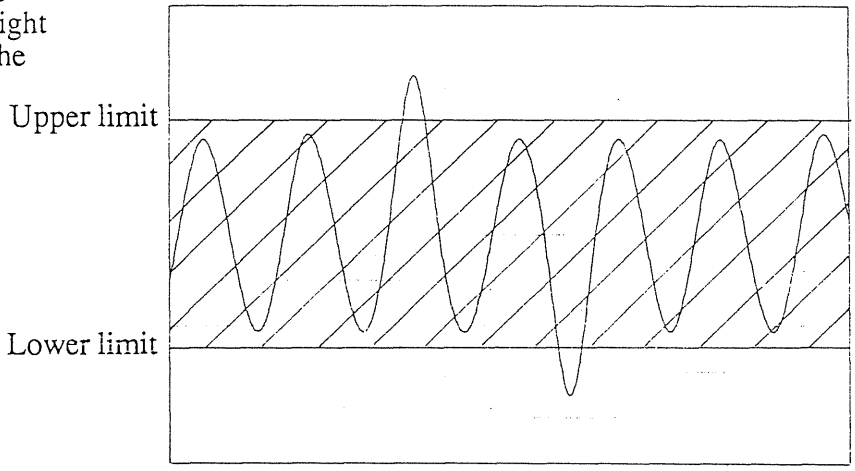
Upper trigger limit

Example

To apply a window trigger to detect when the waveform shown on the right goes outside the hatched area, use the following settings.

Upper trigger limit ... 75%

Lower trigger limit ... 25%



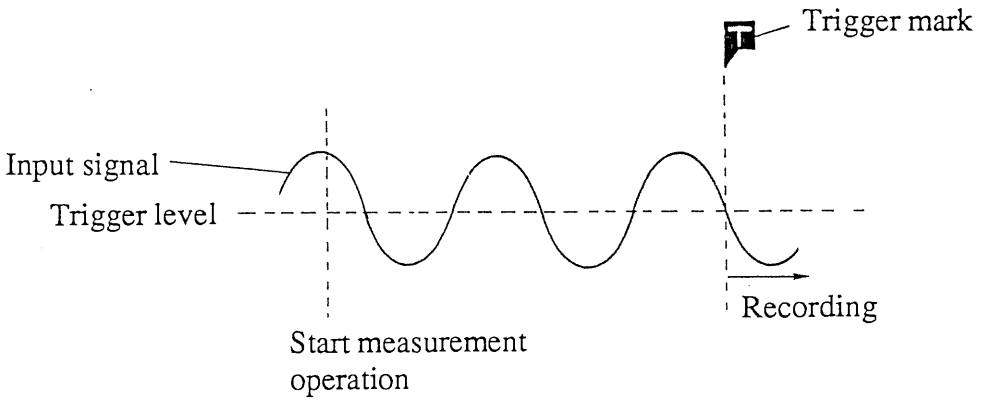
14-2-3 Event Trigger

Function

The event trigger is activated when the input signal has crossed a predetermined trigger level (0% to 100%) in the direction up or down, (set by the "trigger slope") a particular number of times after beginning measurement operation (in the trigger wait state).

Trigger direction (↓)(pre-trigger 0%)

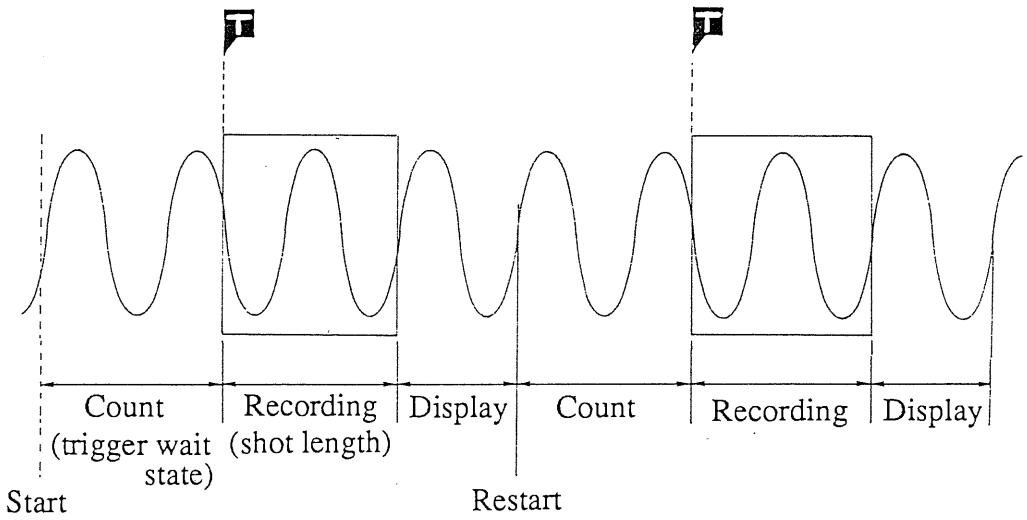
Event setting count: 3



When the trigger mode is set to REPEAT, the measurement is repeated, but events are not counted during display; the event count is restarted from the internal restart point, and the trigger is then activated when the event count is reached.

Trigger direction (↓) (pre-trigger 0%)

Event setting count: 2



Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.

1. AND/OR setting

   Select OR. The event trigger cannot be used if AND is selected.

   (See Section 14-4.)

2. Select trigger type

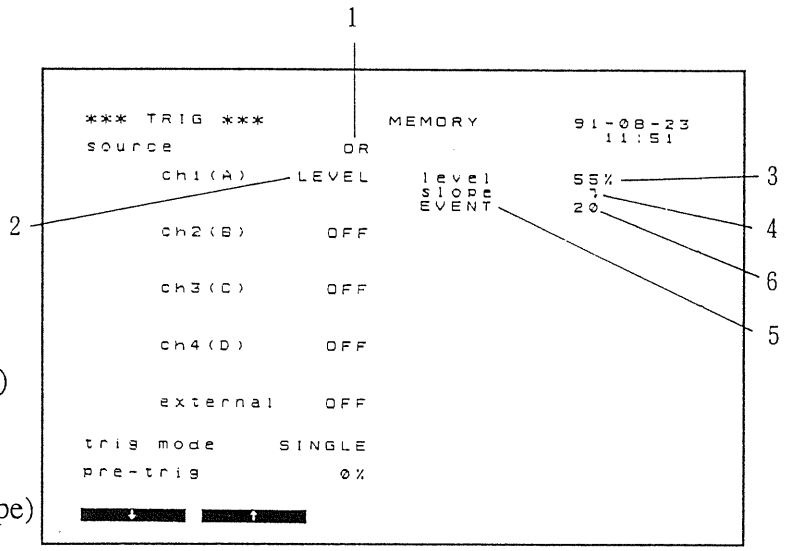
   Press the [LEVEL] soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

3. Set the trigger level.
   (0% to 100%)

4. Select the trigger direction (slope)

   (↥,↧)



5. FILTER/EVENT setting

   Select the [EVENT] soft key.

6. Set the event count - that is the number of times that the input signal must cross the trigger level in the specified direction (slope).

   (OFF, 2 to 4000)

   The OFF setting is equivalent to a simple level trigger (that is, a count of 1).

   It is also possible to set the trigger level and direction (slope) in the display mode. (See Section 14-2-1 "Level Trigger.")

Example

To apply a trigger at point A or point B on the waveform shown on the right, use the following settings. (When the pre-trigger setting is 0%)

Point A ..trigger level 60%

trigger direction rising (slope =↥)

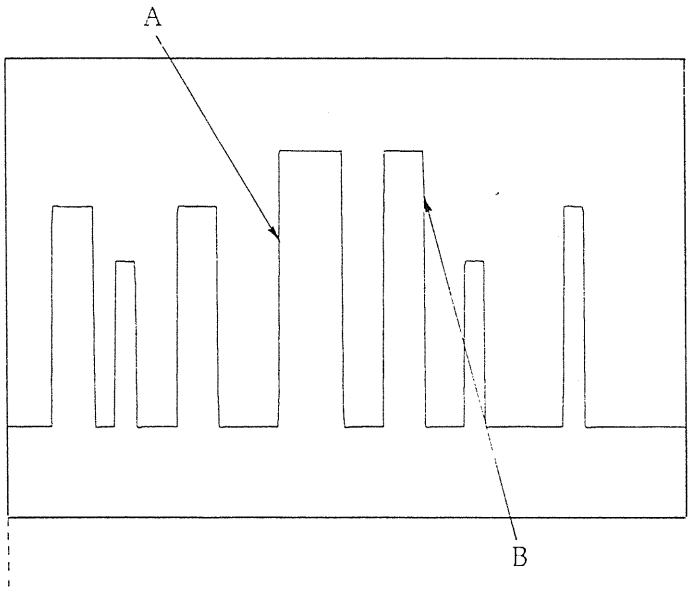
event count 3

Point B ..trigger level 70%

trigger direction falling (slope =↧)

event count 2

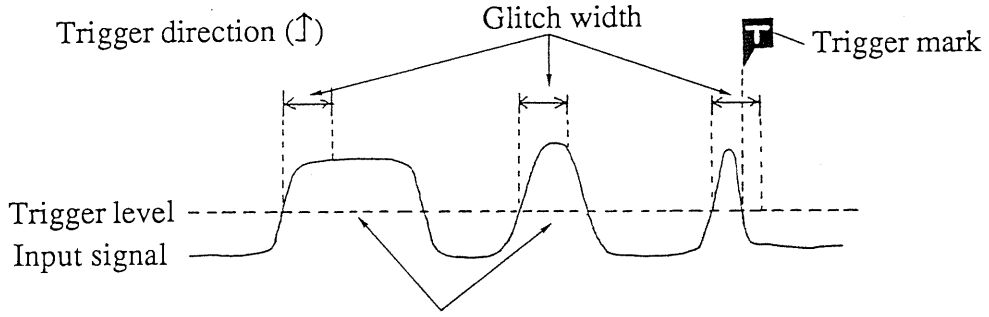
Note: The recorded portion will be that following point A or point B, respectively.



14-2-4 Glitch Detection Trigger

Function

The glitch detection trigger is activated when the input signal crosses a predetermined trigger level (0% to 100%) in the direction up or down, (set by the "trigger slope") and then returns across the same level in the opposite direction within a set time (the glitch width). This thus detects particularly narrow pulses.



Both pulse widths are longer than the glitch width, so there is no trigger.

Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.

1. AND/OR setting

   Select OR. The glitch detection trigger cannot be used if AND is selected.

   (See Section 14-4.)

2. Select trigger type

   Press the [GLITCH] soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

   Pressing the [(etc)] soft key changes the trigger menu.

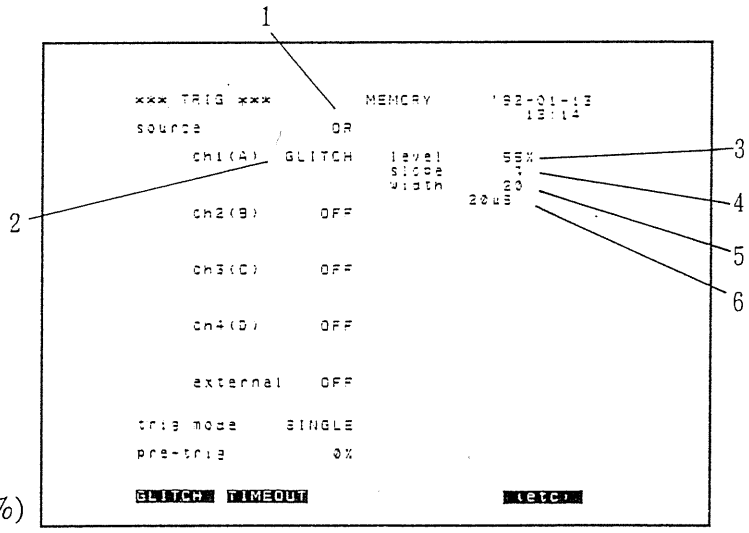
3. Set the trigger level. (0% to 100%)
4. Select the trigger direction (slope)

   (↥,↧)

5. Set the glitch width. (2 to 4000)

   The glitch width is the specified number multiplied by the sampling interval.

6. The glitch width is displayed.



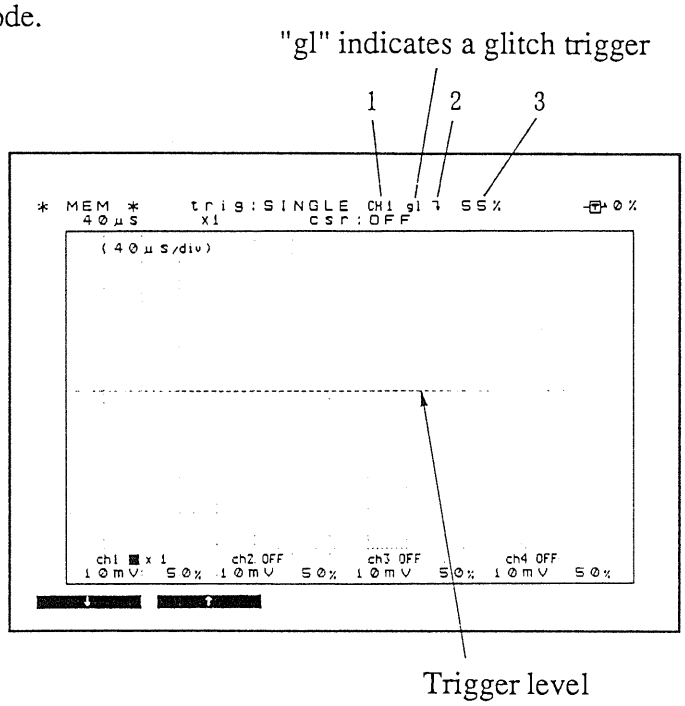
It is also possible to set the trigger level and direction (slope) in the display mode.

① Switch to the appropriate trigger channel. (CH1 to CH4)

② Set the trigger direction (↥,↧)

③ Set the trigger level. (0% - 100%)

When the cursor is moved to the level setting, the trigger level is shown on the screen by a broken line.

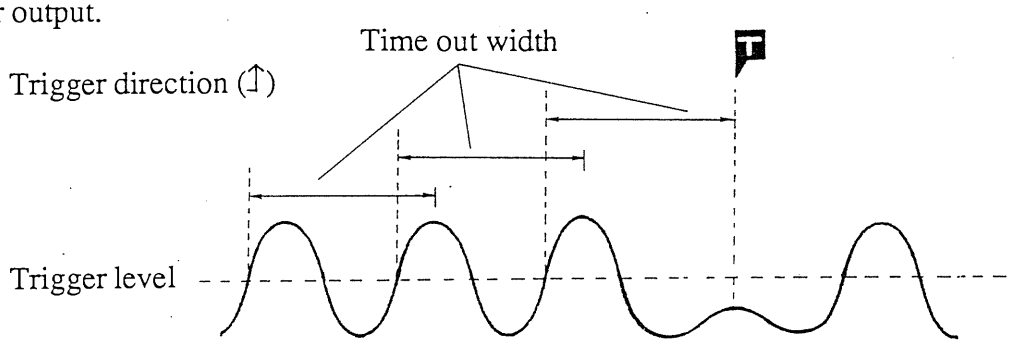


14-2-5 Time Out Trigger

Function

The time out trigger is activated more than a certain time interval (the time out "width") elapses between successive occasions on which the input signal crosses a predetermined trigger level (0% to 100%) in the direction up or down, (set by the "trigger slope").

This can therefore be used to detect irregularities in an AC power supply, or missing pulses in an encoder output.



Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.

1. AND/OR setting

   Select OR. The time out trigger cannot be used if AND is selected.

   (See Section 14-4.)

2. Select trigger type

   Press the [TIMEOUT] soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

   Pressing the [(etc)] soft key changes the trigger menu.

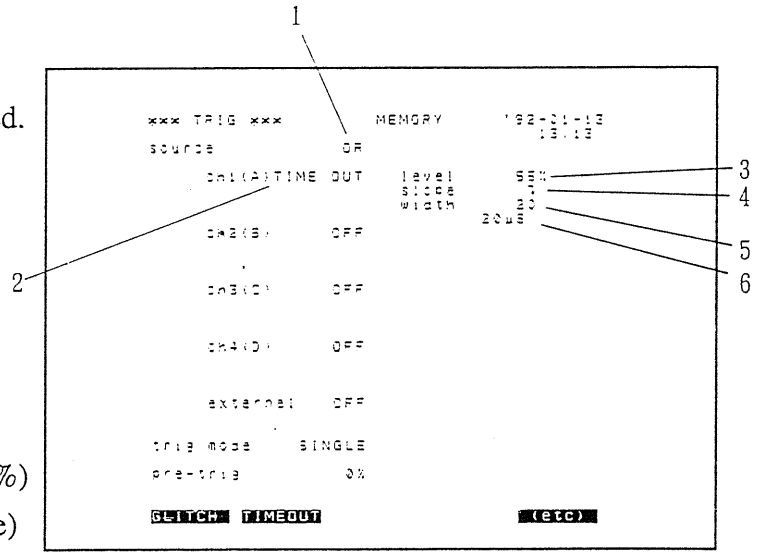
3. Set the trigger level. (0% to 100%)
4. Select the trigger direction (slope)

   (↑,↓)

5. Set the time out width. (2 to 4000)

   The time out width is the specified number multiplied by the sampling interval.

6. The time out width is displayed.



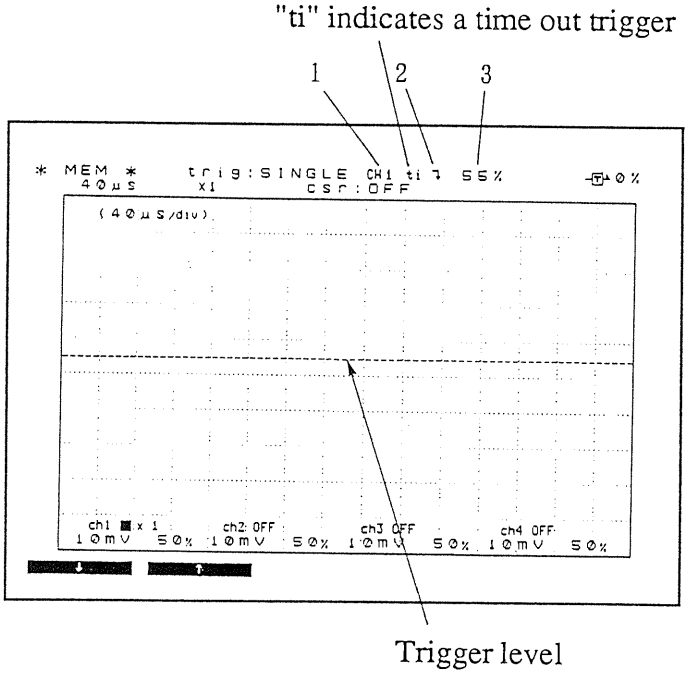
It is also possible to set the trigger level and direction (slope) in the display mode.

① Switch to the appropriate trigger channel. (CH1 to CH4)

② Set the trigger direction (↥,↧)

③ Set the trigger level. (0% - 100%)

When the cursor is moved to the level setting, the trigger level is shown on the screen by a broken line.



Example

Detecting an instantaneous failure of a commercial power supply (100 V, 60 Hz).

Settings

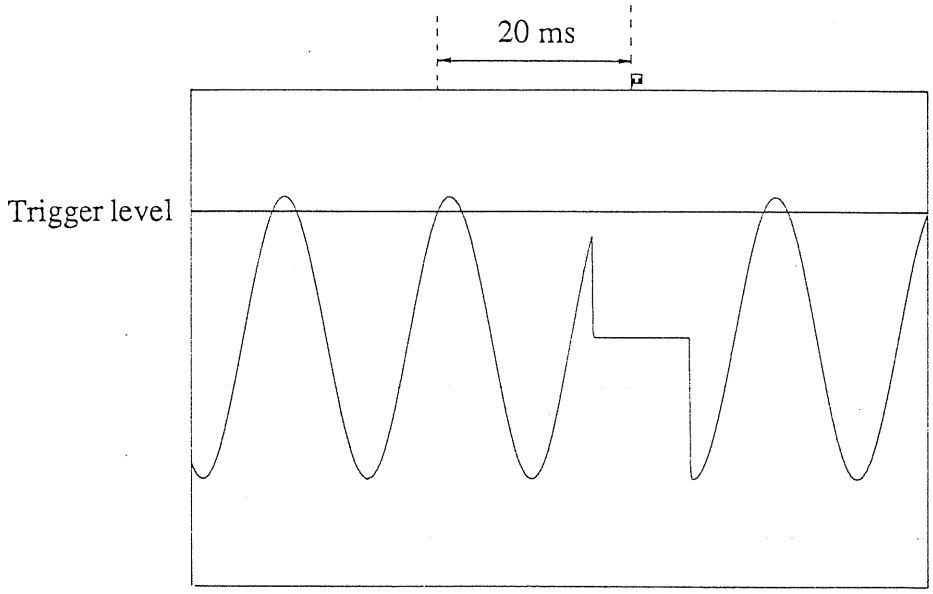
- Voltage range 50 V/division, origin position 50%, input coupling DC, filter off.
- Time axis range 5 ms/division (sampling period 125Ωs)

Trigger conditions

Trigger level 75%, trigger direction up (slope = ↥), time out width setting 160 (20 ms)

It is preferable to set the trigger level close to peak value, so that even a very short failure will be detected.

The time out width is set to be slightly longer than the period of the signal (16.7 ms)



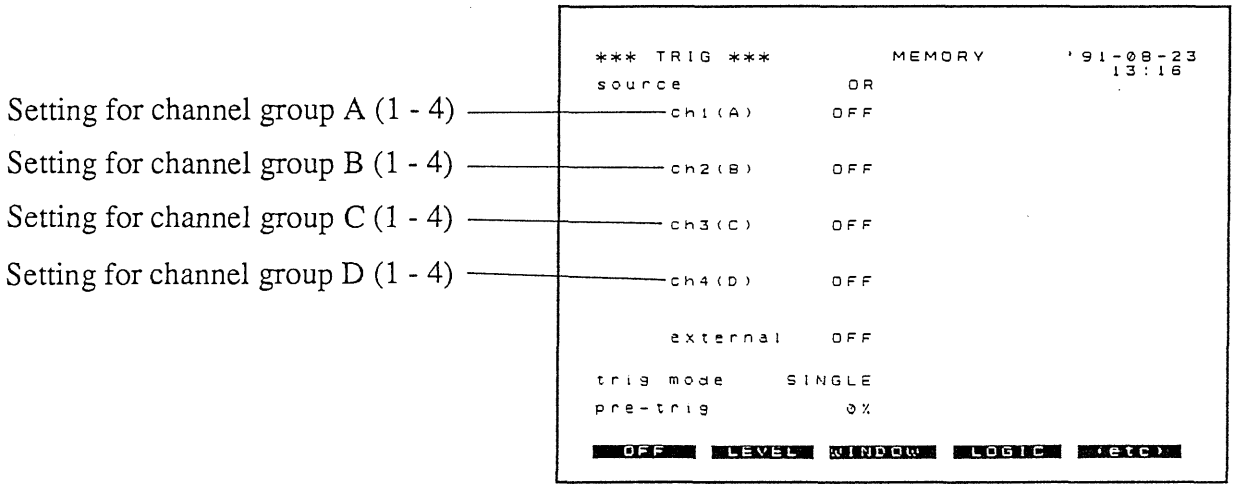
14-2-6 Logic Trigger

Logic triggers are derived from the logic inputs.

A trigger pattern and logical operator (AND or OR) are specified, and when the conditions are met, the trigger is applied.

Using the trigger filter means that the trigger conditions have to hold for the specified interval in order to apply the trigger.

The settings are made in groups of four logic channels.



Procedure

The procedure is described for channel 1 (logic channels A); the procedure for channels 2 to 4 (B to D) is analogous.

1. AND/OR setting

   (See Section 14-4.)

2. Select trigger type

   Press the LOGIC soft key.

   (OFF, LEVEL, WINDOW, LOGIC, GLITCH, TIME OUT)

   Pressing the (etc) soft key changes the trigger menu.

3. Set the trigger pattern.

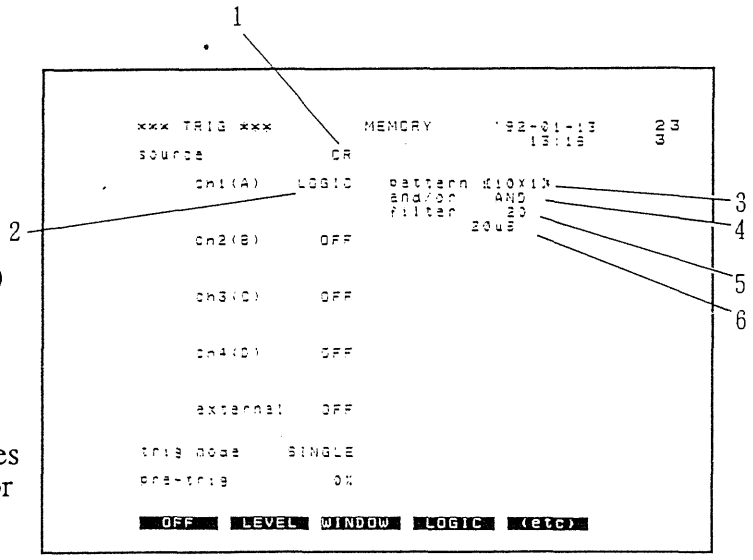
   This determines the signal values for the four channels in order for the trigger to be applied.

   The setting for channel 1 (A) corresponds to logic channels A1 to A4. The specification for each channel is 1, 0 or ×.

   1 ... high level signal

   0 ... low level signal

   × ... ignore signal



4. Select the trigger pattern logical operator.

   (AND, OR)

   AND: all four logic signals must agree with the trigger pattern for the trigger to apply.

   OR: the trigger is applied when changing from the state in which all signals fail to agree to the state where at least one signal agrees with the pattern.

   The remaining setting does not appear when AND was selected in step 1.

5. When using the trigger filter, set the filter width. Otherwise, set this to OFF.

   (OFF, 2 to 4000)

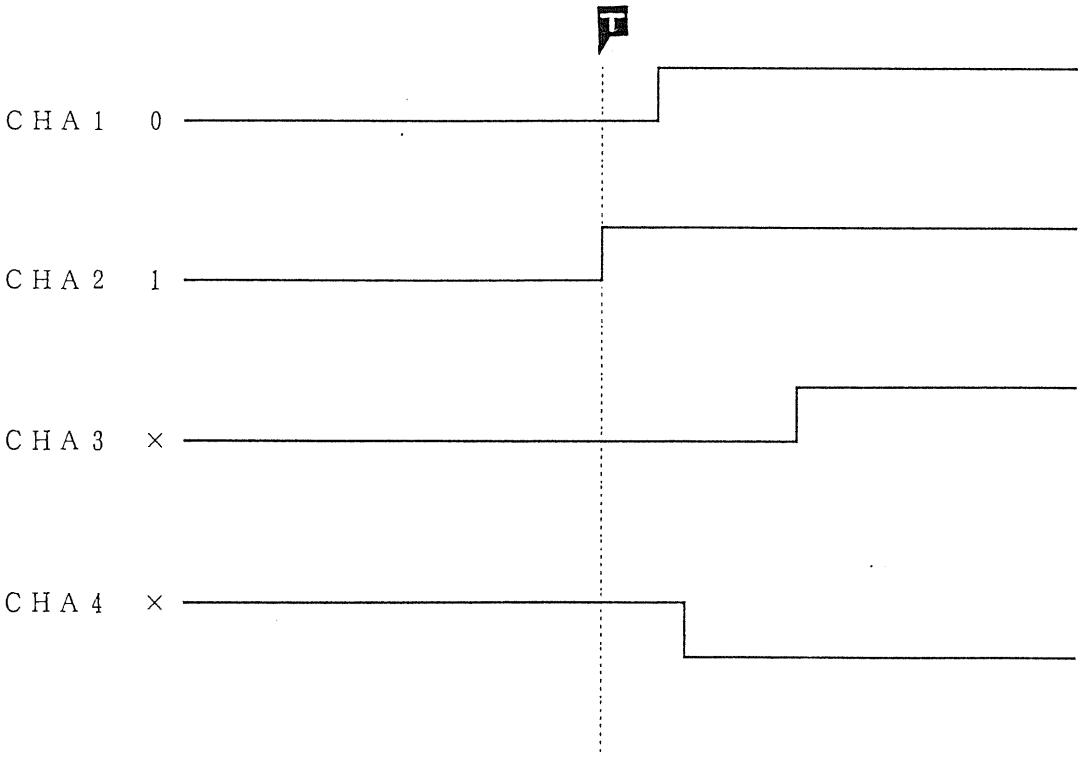
   The filter width is the specified number multiplied by the sampling interval.

6. The filter width is displayed.

Examples

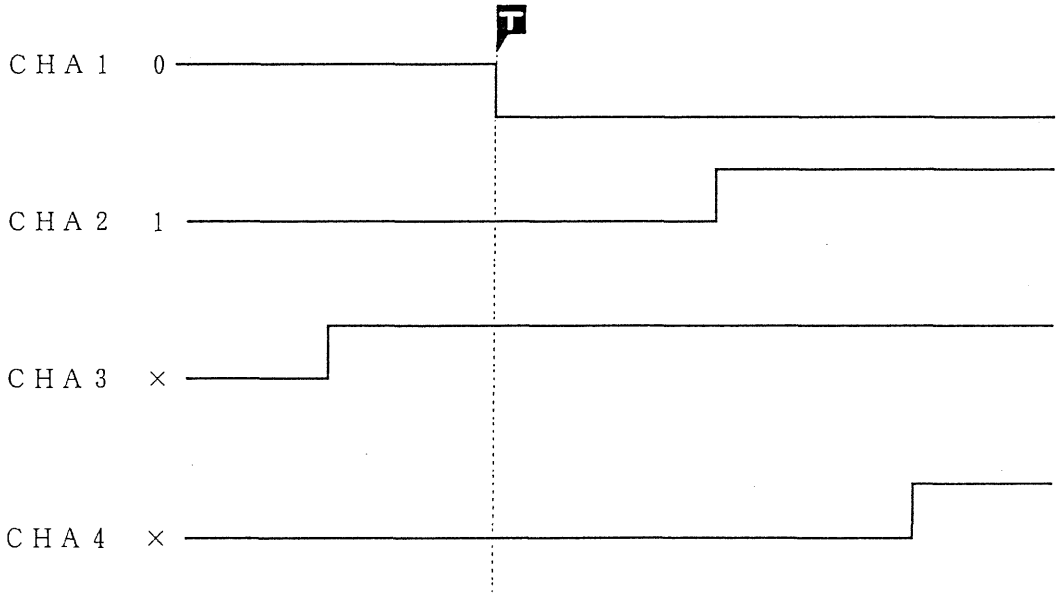
(1)

```
ch1 (A)   LOGIC      pattern    1[0 1 × × ]4
                     and/or       AND
                     filter       OFF
```



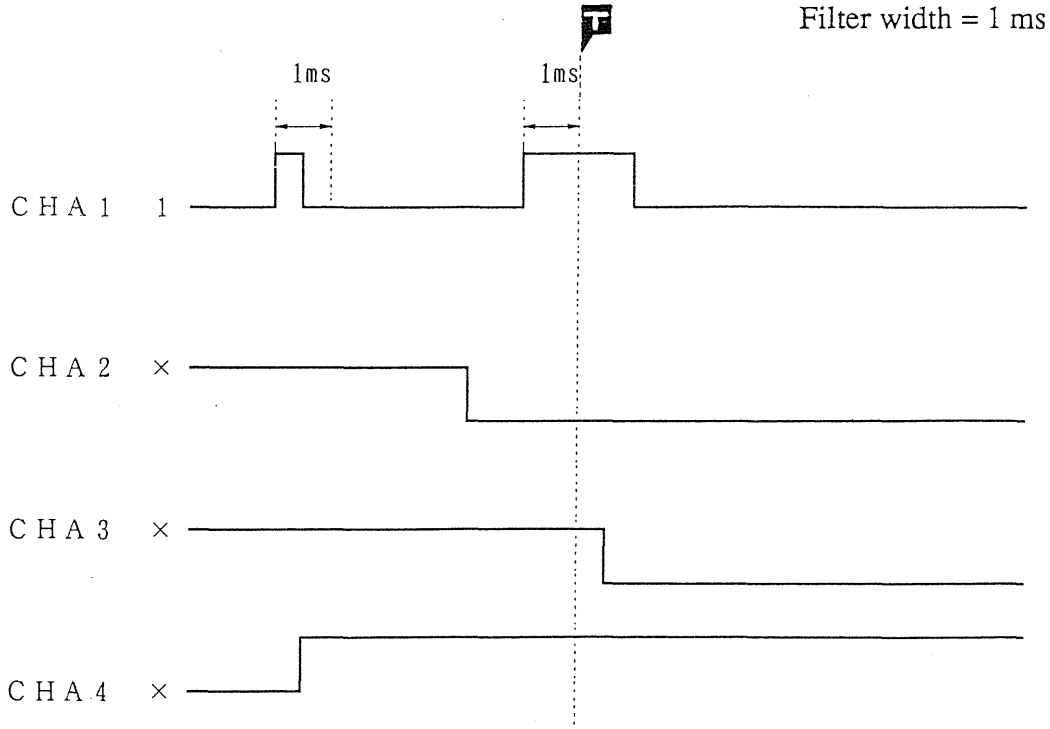
The trigger applies when all signals agree with the pattern.

(2) ch1 (A) LOGIC pattern 1[0 1 × ×]4
and/or OR
filter OFF



The trigger applies when at least one signal agrees with the pattern.

(3) ch1 (A) LOGIC pattern 1[1 × × ×]4
and/or AND
filter 400



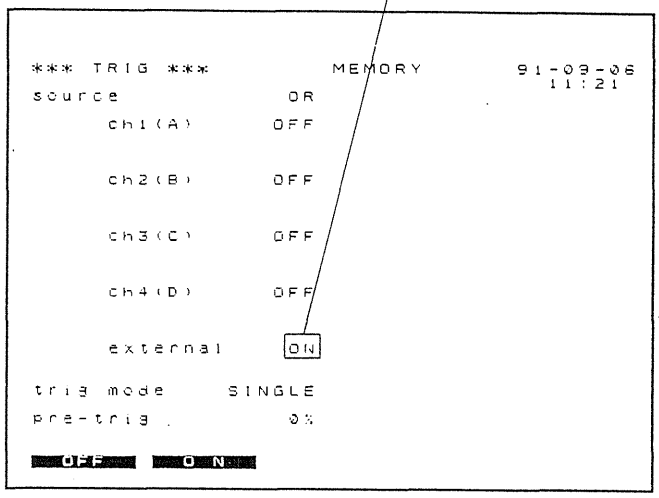
The trigger applies when all signals agree with the pattern for the period of the filter width.

14-3 External Trigger

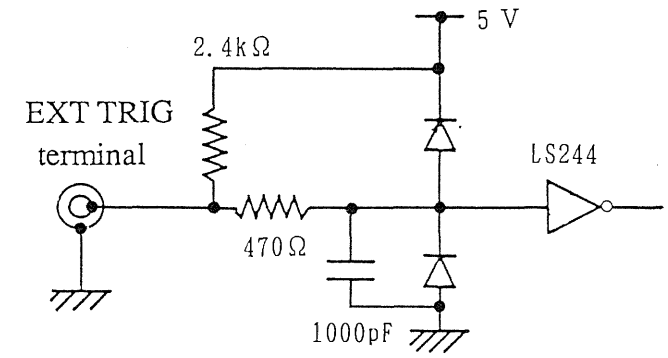
The external input is available as a trigger source.

The external trigger is activated by either shorting the EXT TRIG terminal or applying a falling edge signal going below 0.7 V.

External trigger enabled

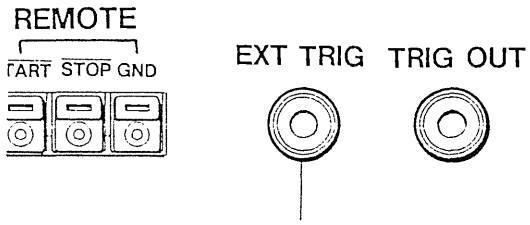


Circuit diagram



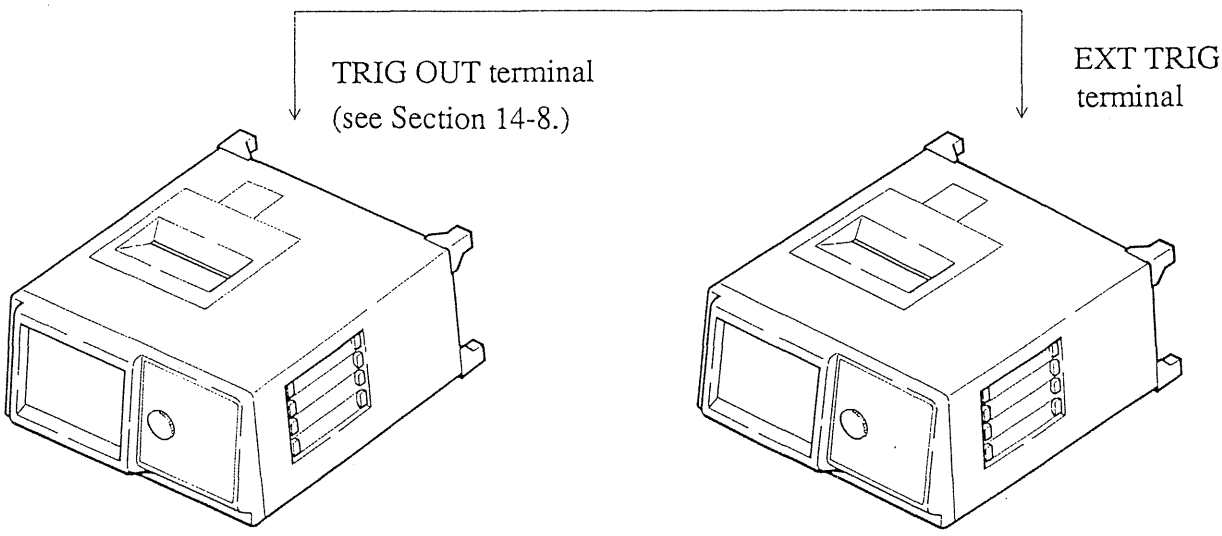
Input voltage range -5 V to +10 V

Rear panel



EXT TRIG terminal
[Mini-jack, 3.5 mm dia]

The external trigger facility can be used to synchronize a number of 8851 units for parallel operation.



External trigger enabled

14-4 Internal and External Trigger Logical Operator

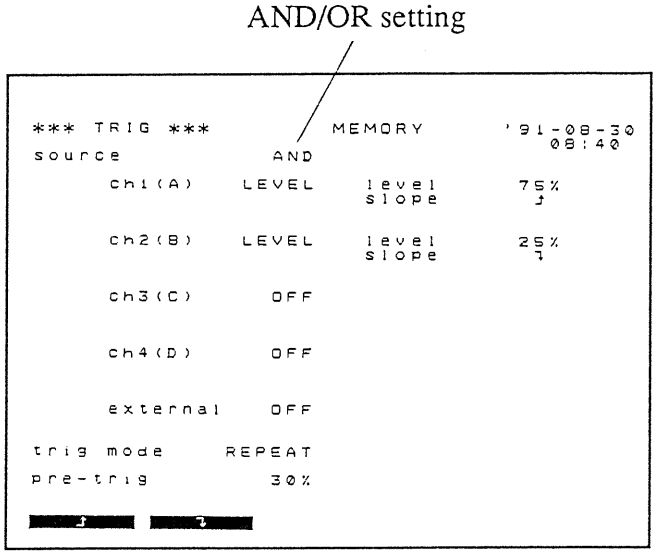
This setting determines the logical operator applied to the five trigger conditions (four internal plus external). That is, it determines whether all five conditions must hold (AND) or any one condition (OR) in order for the trigger to be applied.

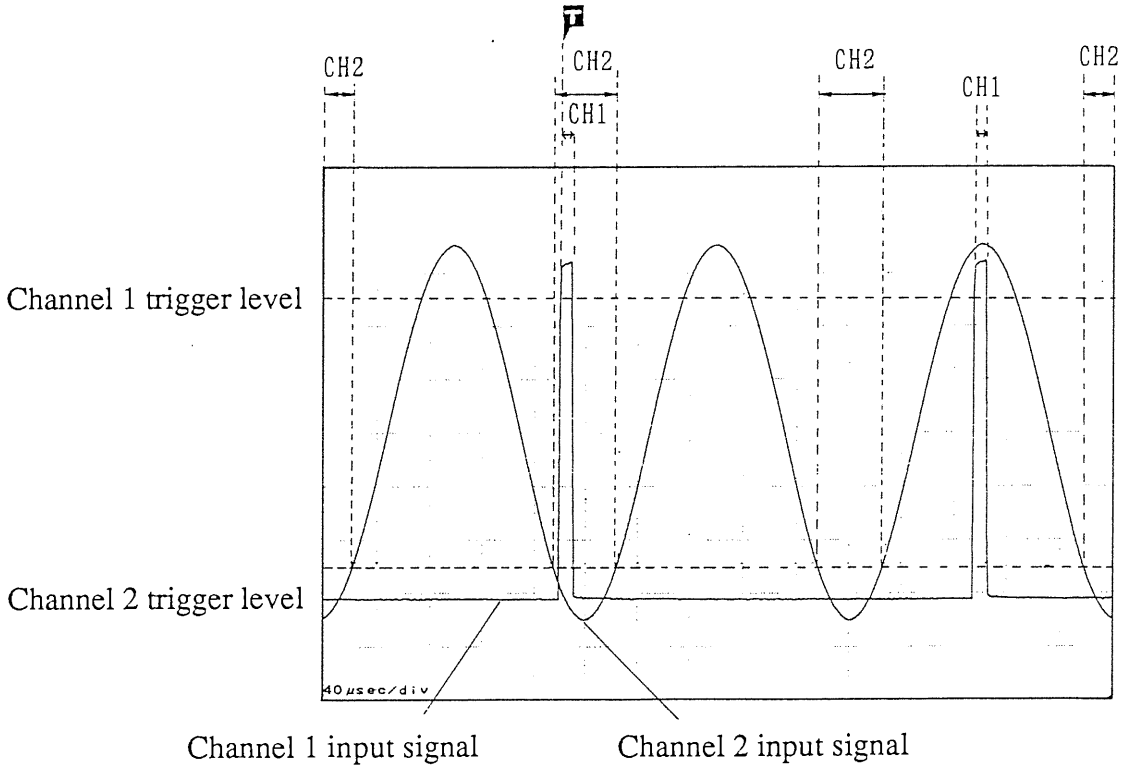
(1) AND setting

This restricts the internal triggers to be level triggers, window triggers, or logic triggers.

In other words, the trigger filter cannot be enabled for level triggers or logic triggers, and event triggers, glitch detection triggers and time out triggers cannot be selected.

The figure on the right shows example settings; the trigger will be applied when the conditions for both channels 1 and 2 hold.



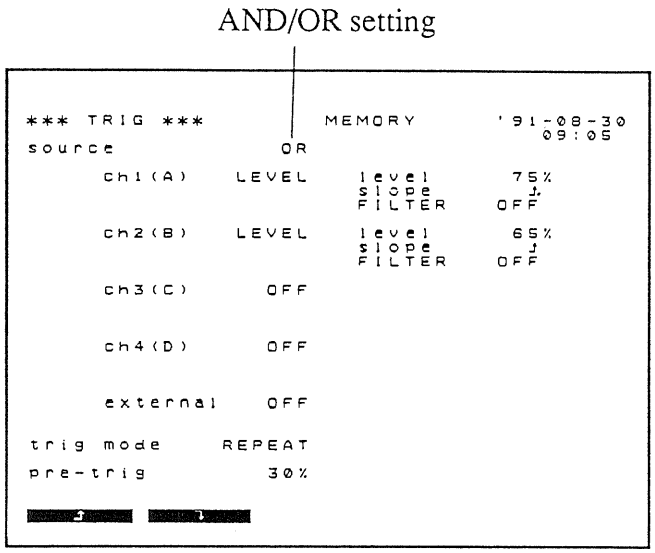


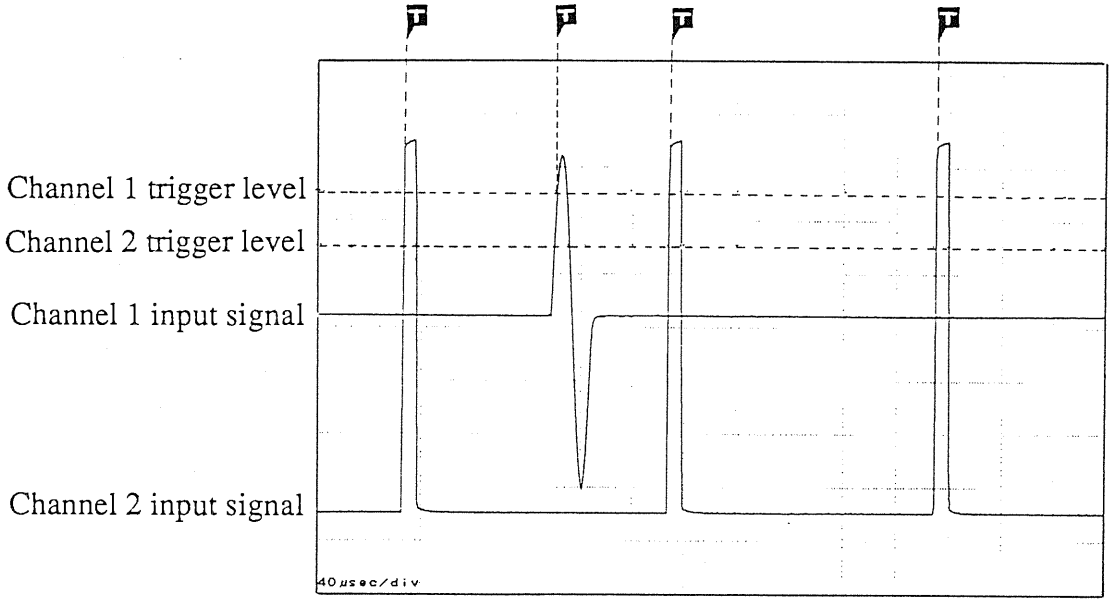
CH 1 ... period in which channel 1 trigger condition holds

CH 2 ... period in which channel 2 trigger condition holds

(2) OR setting

The figure on the right shows example settings; the trigger will be applied when the conditions for either of channels 1 and 2 hold.





14-5 Trigger Modes

Except in the X-Y recorder function, the trigger mode is variable. It determines whether triggers are activated repeatedly after a recording operation is complete.

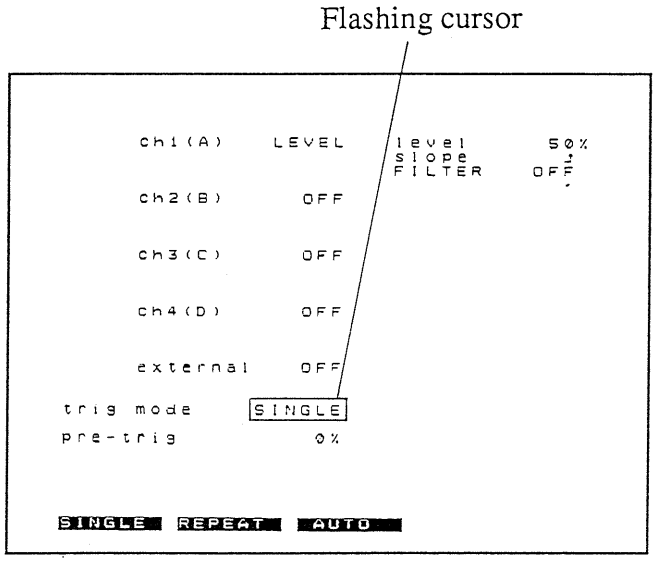
If all trigger sources are disabled, when a recording operation is completed the next measurement operation begins immediately.

You can carry out the setting in trigger mode or display mode.

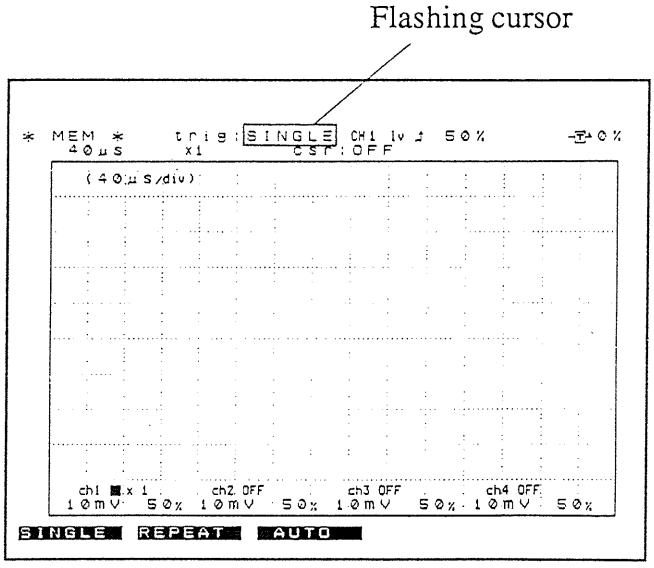
SINGLE: The trigger is activated once after the START key is pressed. It does not repeat.

REPEAT: The trigger is activated repeatedly. Measurement is carried out each time the trigger event occurs.

AUTO: The trigger is activated repeatedly, but if approximately 1 second elapses without the trigger applying, recording starts automatically. This is convenient for checking input waveforms. (Memory recorder function only)



Trigger mode



Display mode

14-6 Pre-Trigger and Trigger Timing

These settings determine the proportion of a recording which is before the trigger point, and whether the trigger controls starting or stopping the measurement, or both.

If the trigger sources are all disabled (OFF) the pre-trigger setting cannot be made.

(1) Pre-trigger setting

(For the memory recorder function and the memory recorder mode of the recorder and memory function)

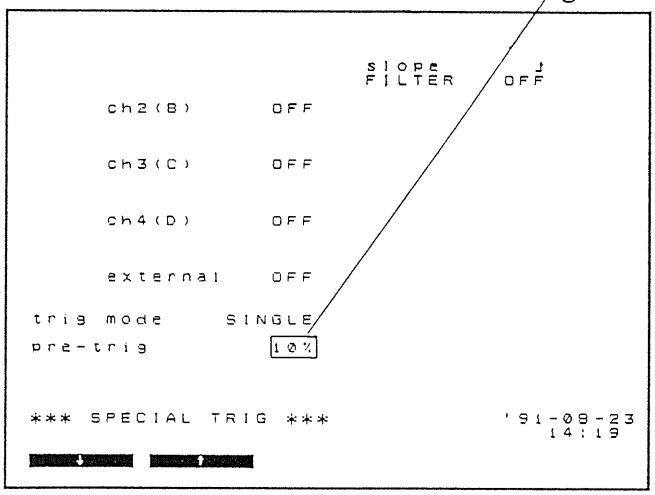
Set the portion of the recording before the trigger point, as a percentage of the shot length.

0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, and values between -50% and -950% (*) in 50% steps.

(* If the memory recorder function shot length is 12500 divisions or more, only -50 and -100 settings are possible.)

Example: memory recorder function

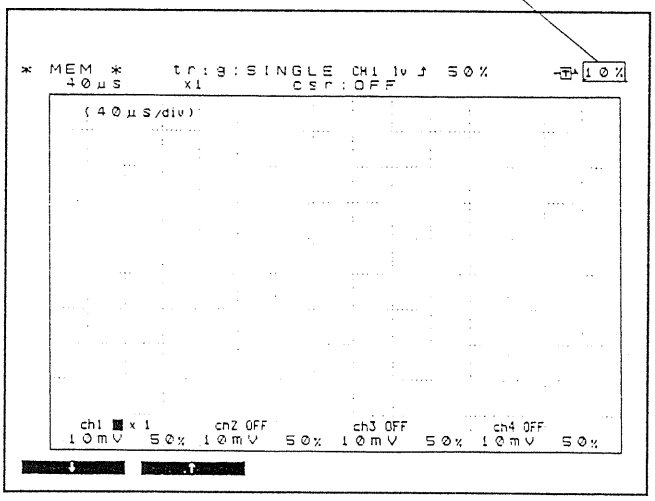
Flashing cursor



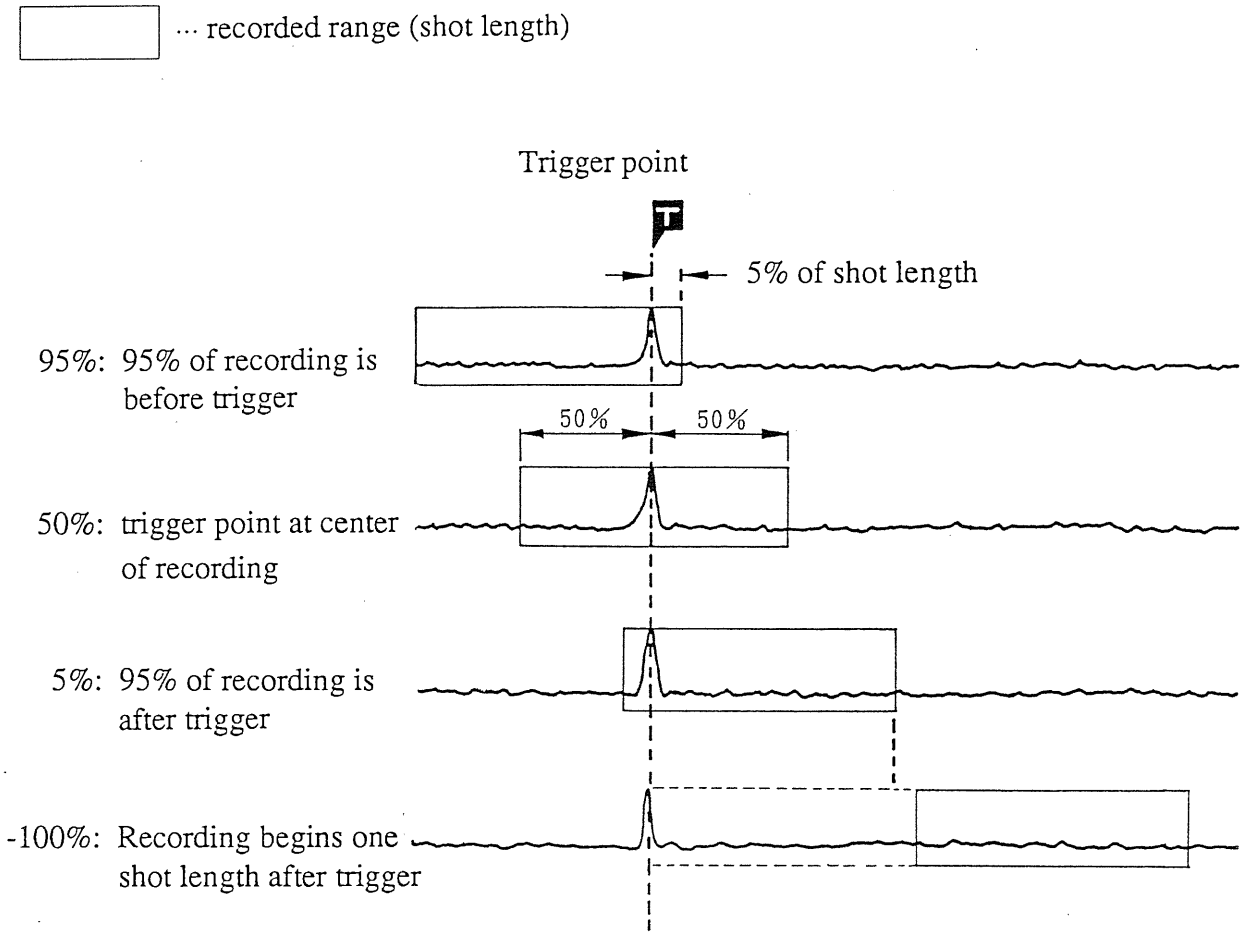
Trigger mode

The setting can also be made in display mode.

Flashing cursor



Display mode

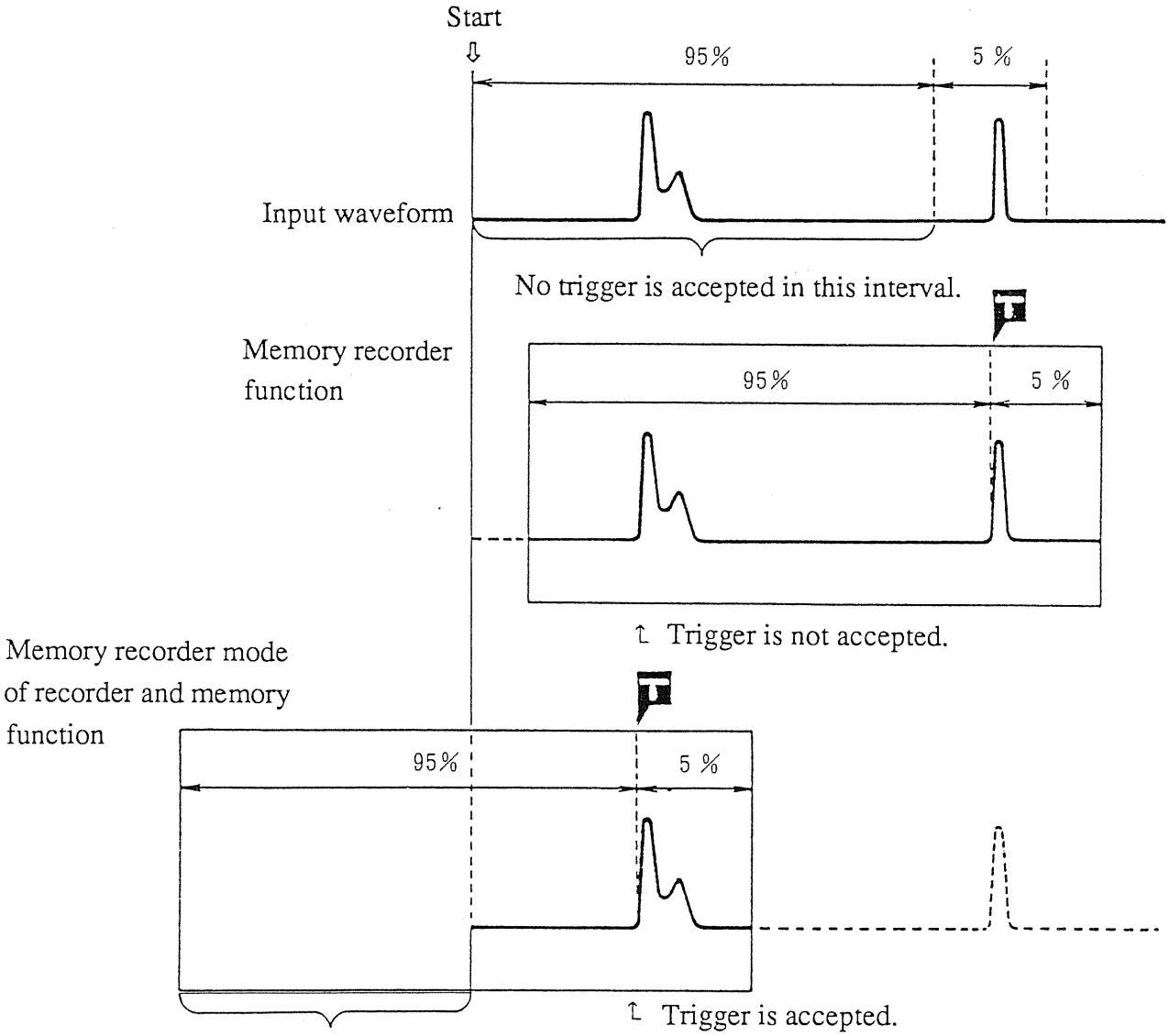

··· recorded range (shot length)
Trigger point
T
5% of shot length
95%: 95% of recording is before trigger
50%
50%
50%: trigger point at center of recording
5%: 95% of recording is after trigger
-100%: Recording begins one shot length after trigger

Notes

In the memory recorder function, when the pre-trigger setting is between 2 and 100% inclusive, the trigger is not accepted during a certain interval after starting measurement operation. (In this interval the message "pre-trig wait" appears on the screen.) In the memory recorder mode of the recorder and memory function, however, the trigger applies immediately. (No-wait operation)

(In the interval until a trigger is applied, the message "wait for trig" appears.)

Example: pre-trigger set to 95%



All data before recording started is set to zero.
(Zero means the lowest data value on the voltage axis when no zoom factor is in effect.)

(2) Trigger timing setting

(For the recorder function, X-Y recorder function, and the recorder mode of the recorder and memory function)

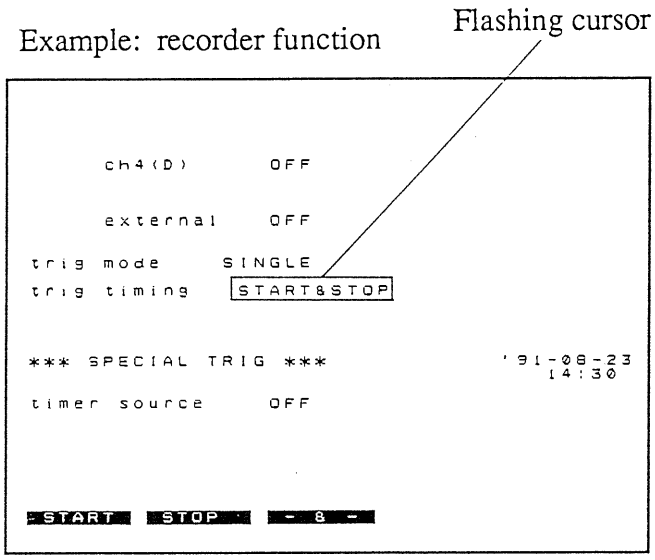
START: Recording starts when the trigger is applied.

STOP: Recording starts only when the START key is pressed, and stops when the trigger is applied.

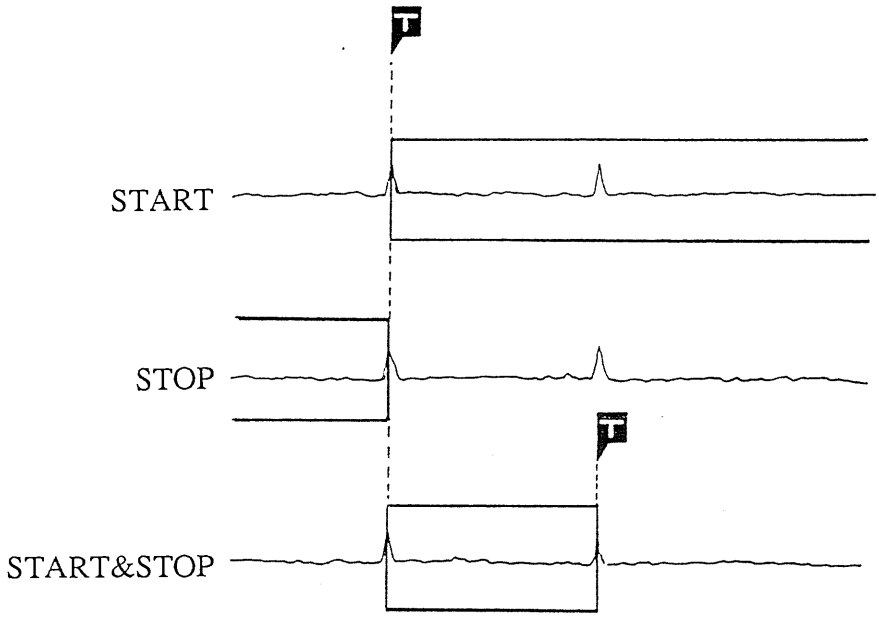
START&STOP: Recording starts when the trigger is applied, and stops when the trigger is next applied.

(Soft key indication: [- & -])

Example: recorder function



[ ] ... recorded range (with shot length set to CONT)

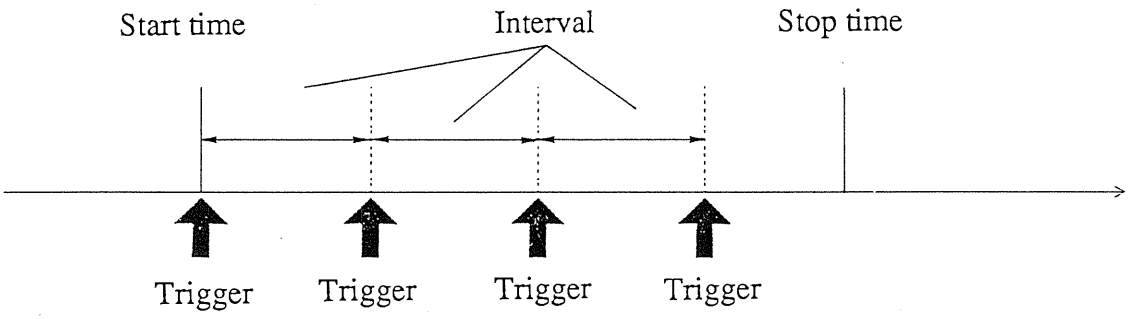


14-7 Timer Trigger

Function

The timer trigger is useful for carrying out recordings at fixed times.

It applies a trigger at a predetermined interval from the start time to the stop time.



Procedure

This example shows the procedure in the memory recorder function.

1. "timer source"

   Press the [ON] soft key.

2. "start"

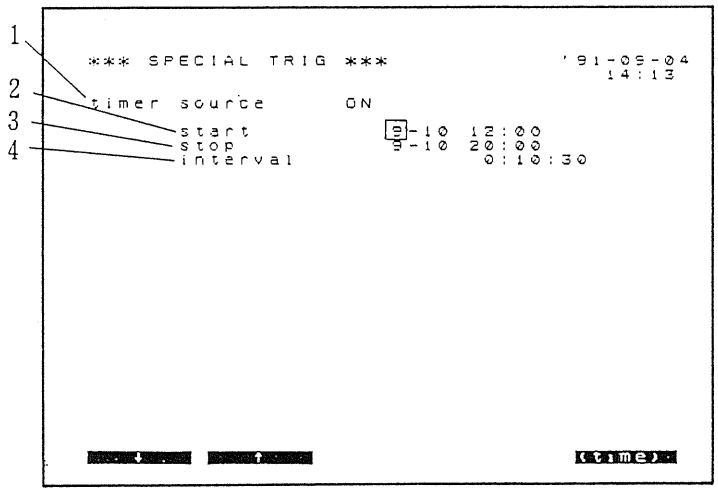
   Set the date and time to start recording (mm-dd hh:mm).

   Press the [(time)] soft key to set to the current time.

3. "stop"

   Set the date and time to stop recording (mm-dd hh:mm).

   Press the [(time)] soft key to set to the current time.



4. "interval"

   Set the timer repeat interval (hh:mm:ss).

   If set to "00:00:00" the trigger applies once only, at the start time.

   Note: Pressing the [(time)] soft key in 2 or 3 above sets both the start and stop times to the current time.

Notes

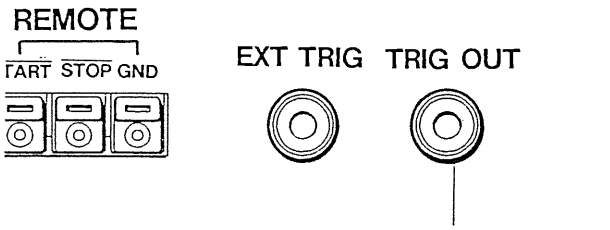
- The start and stop times are times after the START key is pressed.
- When the trigger mode is set to SINGLE, regardless of the interval setting, the trigger is applied only once, at the start time.

  However, in the recorder function, X-Y recorder function, and recorder mode of the recorder and memory function, when the trigger timing setting is START&STOP, recording starts from the start time, and stops after the interval has elapsed.
- The timer trigger is in a logical OR relationship with the combination (AND/OR) of the internal and external triggers.

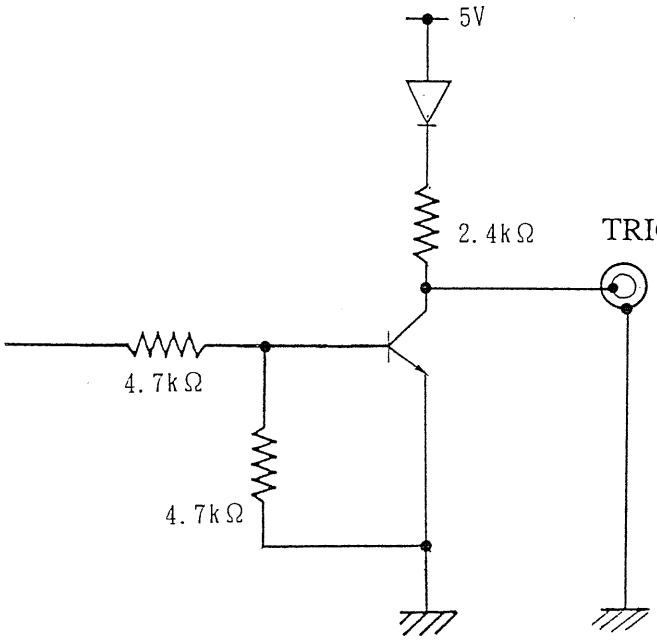
14-8 Trigger Output Terminal

The TRIG OUT terminal on the rear panel outputs the trigger signal.

Rear panel



TRIG OUT terminal



Open collector output,
with 5 V output
Active low
Pulse width approximately 1.5 ms
Mini-jack, 3.5 mm dia.

TRIG OUT terminal

Input voltage range -20 to +30 V
Maximum input current 500 mA
Maximum input power 200 mW

Note: Pressing the AUTO key to use the auto ranging function causes a trigger signal to be output. Care is therefore required when using the auto ranging function when the trigger output terminal is in use.
(Only memory recorder function)

Section 15

Memory Division Function

Contents

15-1 What is the Memory Division Function?

This function allows the memory to be divided into blocks for use in the memory recorder function and the memory recorder mode of the recorder and memory function.

There are two different functions for different applications of the divided memory. The first, the multi-block function (memory recorder function only) allows any block to be used as required, and the second, the sequential save function divides the memory, then allows successive blocks to be used to hold successively triggered recordings, thus reducing the recording and display dead time.

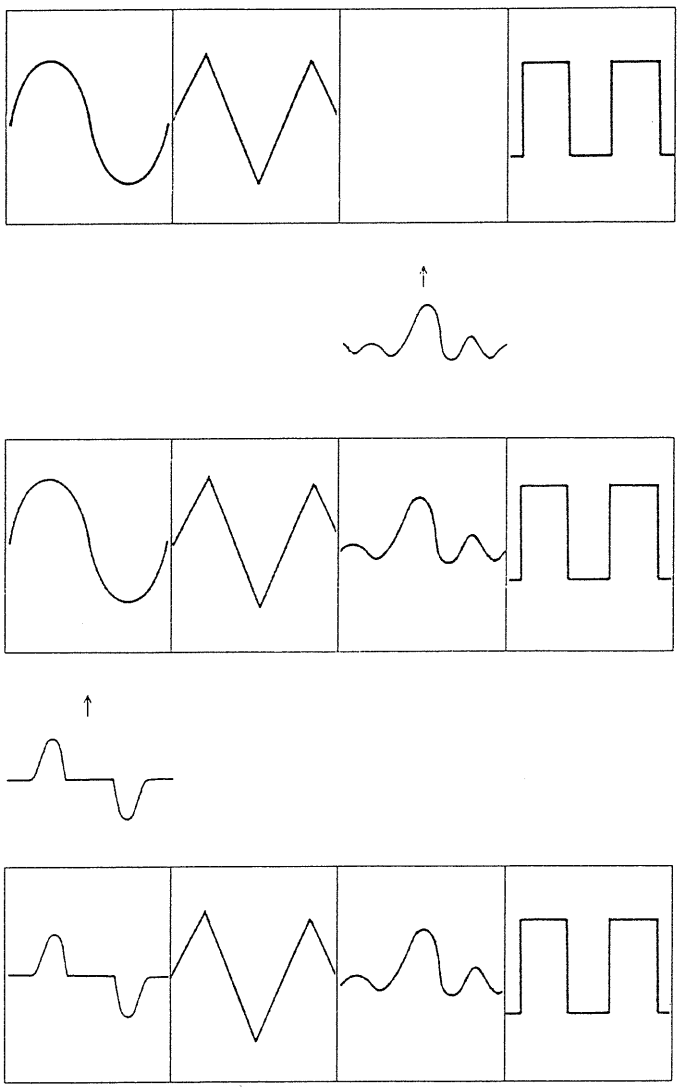
15-2 Multi-Block Function

Function

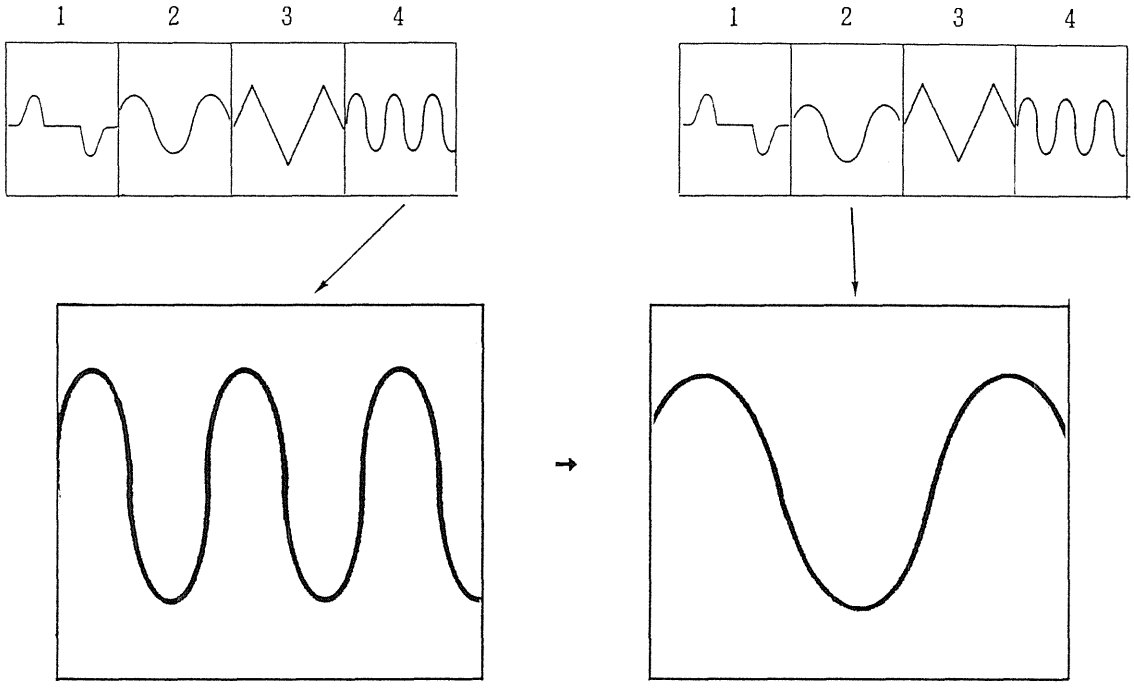
In the memory recorder function, the multi-block function divides the memory into blocks and allows the blocks to be used flexibly, offering the following three facilities.

(1) Waveform data can be stored in any selected block.

Even when a block has already been used, it can be used again, overwriting the previous data.



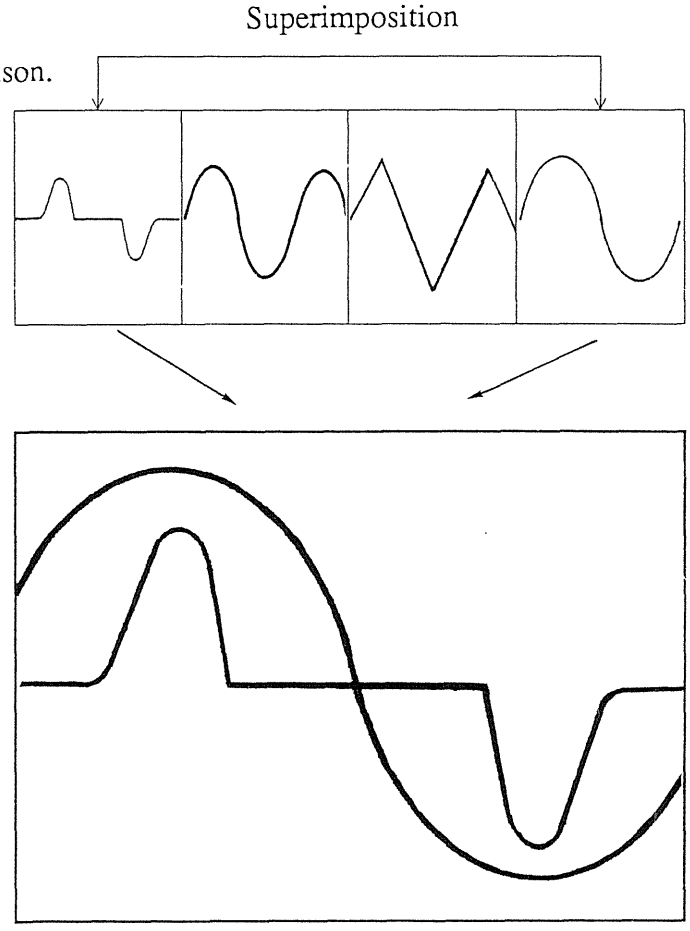
(2) Any block which holds recorded data can be displayed on the screen. (It can then also be printed.)



Display of waveform data from block 4

Display of waveform data from block 2

(3) Data from any two blocks of memory can be superimposed on the screen, for easy comparison.

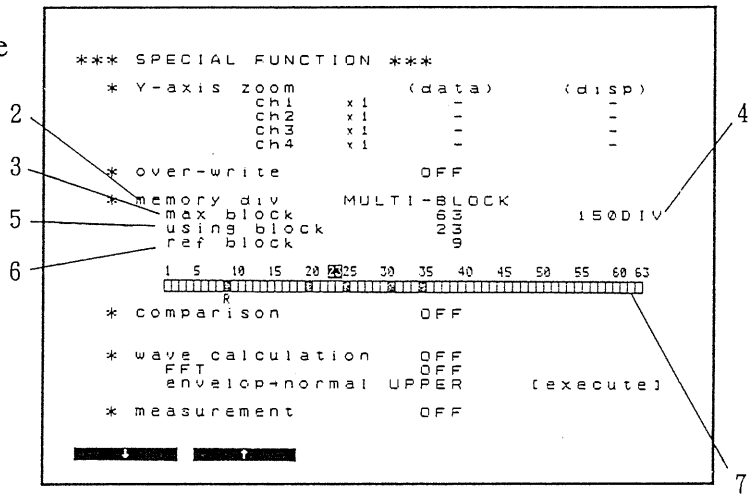


Procedure

Select the special function screen in the memory recorder function.

1. STATUS, cursor keys (or rotary knob)

   Select the status mode, then hold down the cursor ▼ key, or use the rotary knob to scroll the screen to see the special function display.



2. "memory div"

   Select whether or not to use a memory division function, and if so, which.

   (OFF, SEQUENTIAL SAVE, MULTI-BLOCK)

   In this case, select the MULTI soft key, to select the multi-block function.

3. "max block"

   Set the number of usable blocks into which the memory is to be divided.

   (2, 3, 7, 15, 31, 63)

4. The maximum shot length which can be used (depending on the number of blocks) appears here. (See Section 15-4 "Supplementary Information.")

5. "using block"

   Select the current memory block number into which the input waveform is to be stored. (See (1) in **Function** above.)

   Alternatively, select the memory block number from which the waveform is to be displayed. (See (2) in **Function** above.)

   (1 - max block)

6. "ref block"

   Use this item to select the block holding a reference waveform. (OFF, 1 - max block)

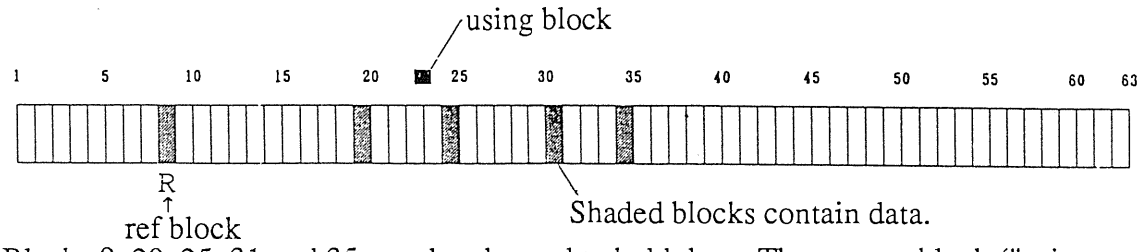
   This block and the block specified by the "using block" item can be displayed superimposed. (See (3) in **Function** above.)

   Notes: The reference block cannot be displayed simultaneously if it has a different shot length.

   The reference block cannot be displayed simultaneously if it has a different storage mode (normal or envelope).

7. A bar graph display shows which blocks already hold data, and which is selected by the "using block" item.

   Example: with memory divided into 63 blocks



   Blocks 9, 20, 25, 31 and 35 are already used to hold data. The current block ("using block") is block 23 and the reference block ("ref block") is block 9.

Notes

- The setting of the number of memory blocks takes precedence over the shot length setting. In other words, if the number of memory blocks is increased, and the shot length is set to a value larger than the maximum which can be held in one block, the shot length is automatically reduced.
- If the storage mode is set to averaging, the memory division function is not available.

Related item

The "using block" setting, and an indication of which memory blocks are in use (that is contain data) is available in the display mode. See Section 5-4-20 "Help Function" for details.

15-3 Sequential Save Function

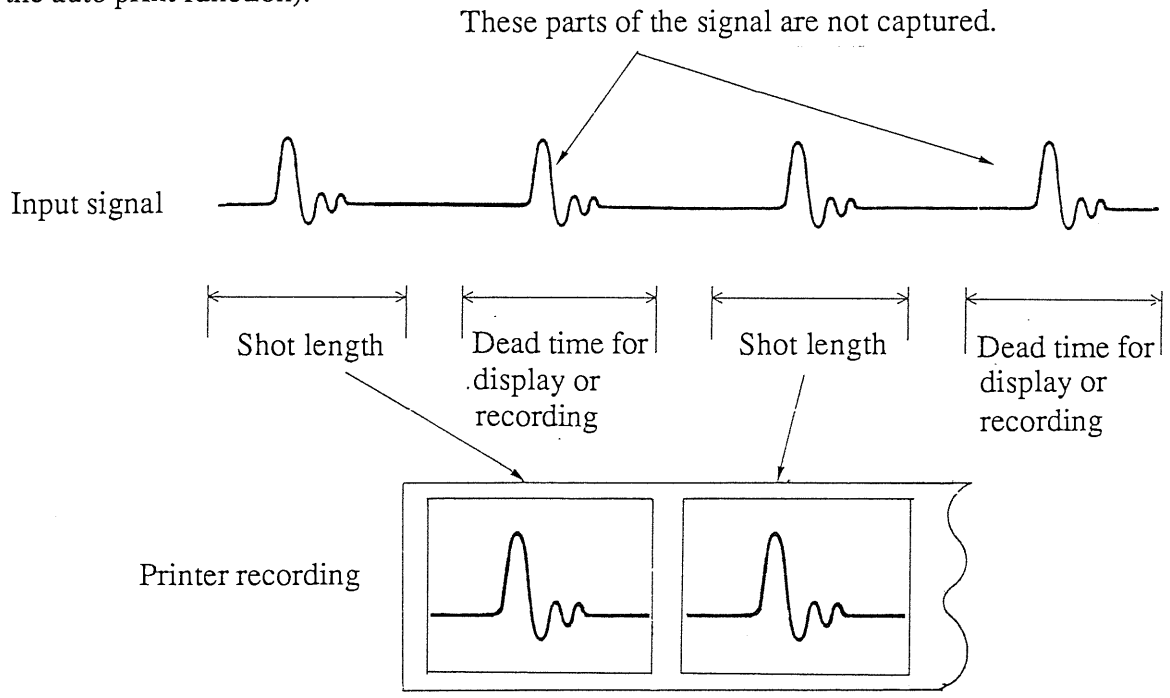
Function

The uses of this function are different for the memory recorder function and the memory recorder mode of the recorder and memory function.

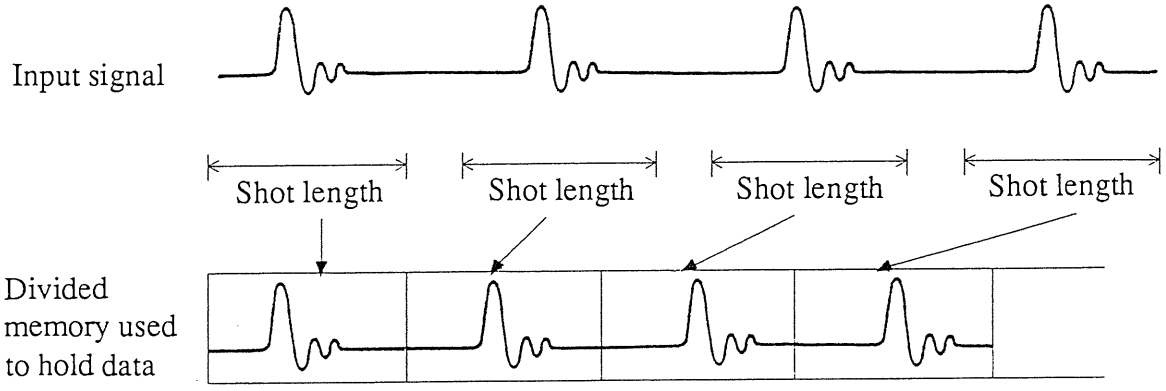
(1) Memory recorder function application

The memory is divided up into a number of blocks, and without displaying or making a printed recording of the data, a trigger is used to capture successive sections of the input waveform. This allows the dead time for display or printed recording to be reduced. (During measurement operation, no display or recording is carried out until all memory blocks have been used for data capture.)

The following example has the trigger mode set to REPEAT, for continuous printing (using the auto print function).



Using the sequential save function reduces the dead time, and prevents the loss of important signal recording, as shown below.

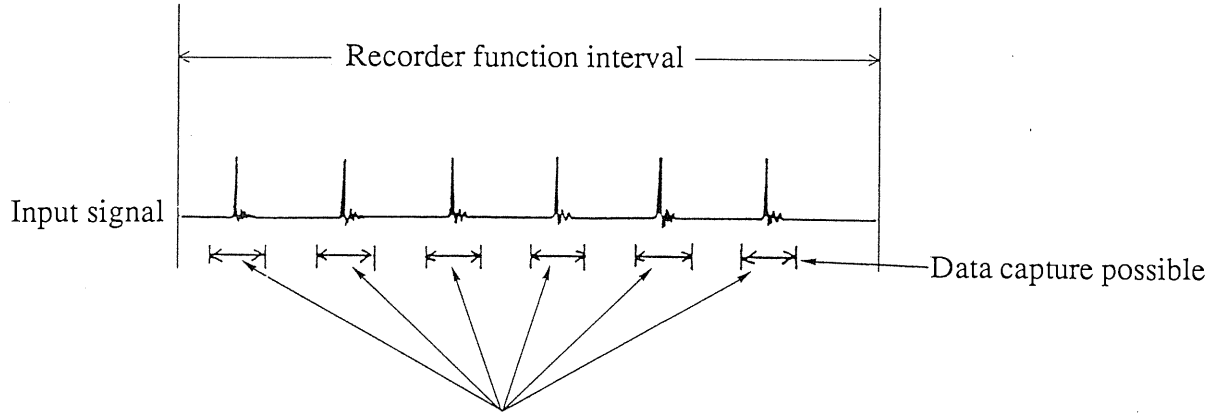


(2) Recorder and memory function application

Normally, during recorder operation, it is not possible to use the memory recorder mode to capture more than one shot length. By using the sequential save function, however, the memory is divided, and during recorder operation the corresponding number of memory recorder waveforms can be captured.

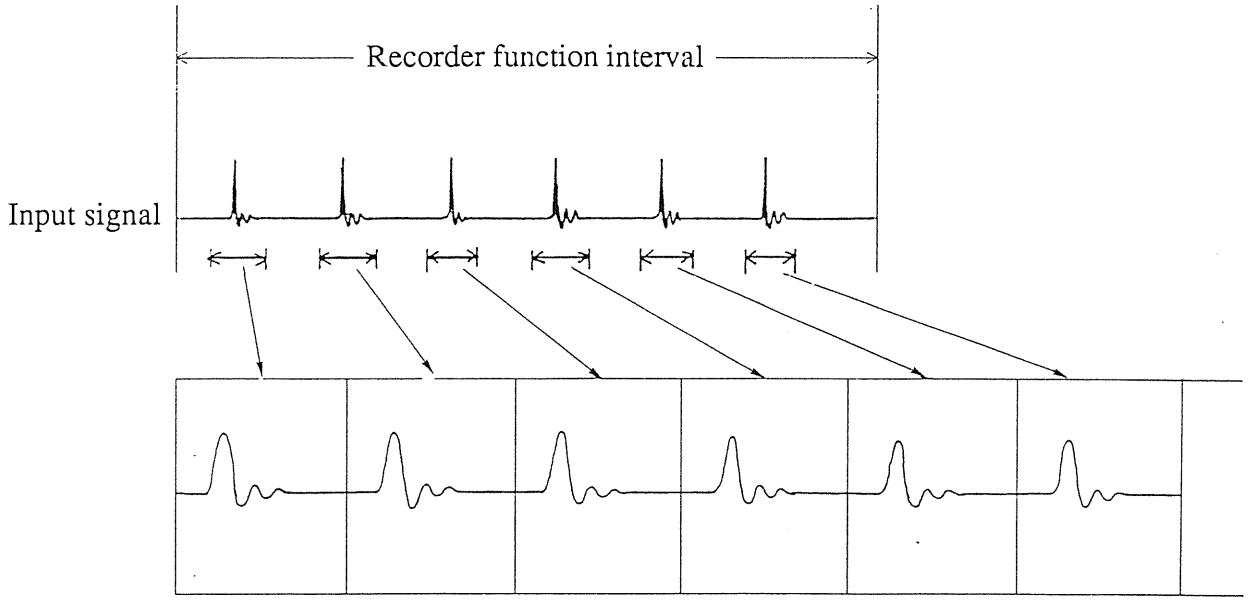
(During measurement operation there is no display.)

For example, even if the trigger mode is set to REPEAT, unless the sequential save function is enabled the following is the result.



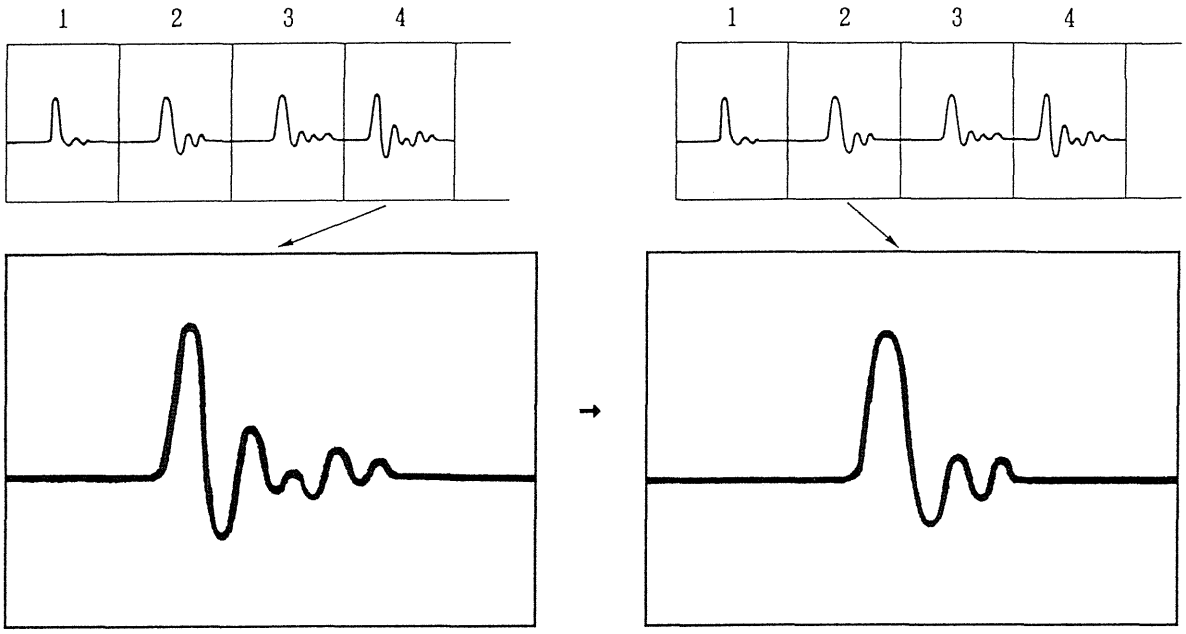
The memory recorder function operates, and all of the waveform sections are captured, but each one overwrites the previous one. Since it is not possible to print each waveform section during measurement operation when in the memory recorder function, only the last triggered section is preserved.

Using the sequential save function, the sections of waveform can be captured sequentially as shown below, enabling the complete data to be preserved.



(3) Common application

The sequential save function provides the same facility as the multi-block function to display the data from any required block on the screen. (It can then also be printed.)



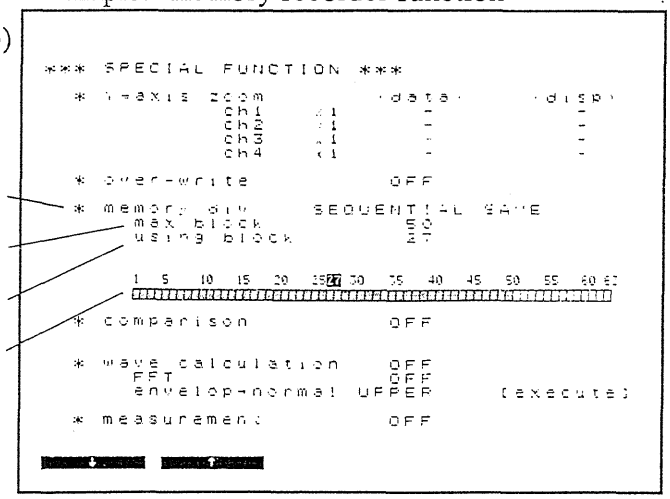
Display of waveform data from block 4

Display of waveform data from block 2

Procedure

Select the special function screen in either the memory recorder function or the recorder and memory function.

Example: memory recorder function



1. STATUS, cursor keys (or rotary knob)

   Select the status mode, then hold down the cursor ▼ key, or use the rotary knob to scroll the screen to see the special function display.

2. "memory div"

   Select whether or not to use a memory division function, and if so, which.

   (OFF, SEQUENTIAL SAVE, MULTI-BLOCK)

   In this case, select the SEQUENCE soft key, to select the sequential save function.

   Note: In the recorder and memory function, the MULTI-BLOCK option is not present.

3. "max block"

   The memory is automatically divided into an appropriate number of blocks, depending on the current shot length.

   (2, 3, 7, 15, 31, 63) (See Section 15-4 "Supplementary Information.")

   Select how many of these blocks are to be used.

   (1 - max block)

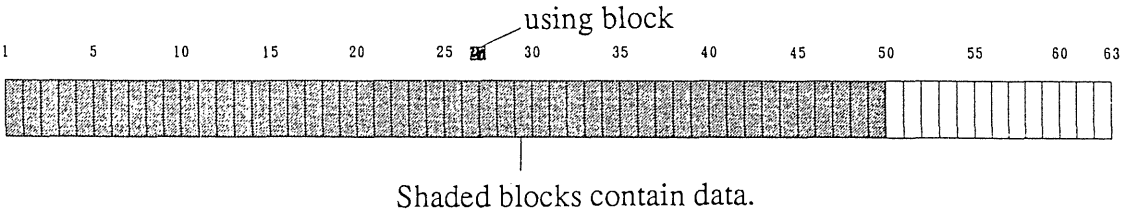
4. "using block"

   Select the memory block number from which the waveform is to be displayed. (See (3) in **Function** above.)

   (1 - max block)

5. A bar graph display shows which blocks already hold data, and which is selected for screen display.

   Example: with memory divided into 63 blocks, and "max block" set to 50



Shaded blocks contain data.

The blocks are used sequentially from block 1 to hold captured data, and all blocks up to 50 already contain data.

The "using block" setting specifies block 27.

Notes

- Relationship between trigger mode and sequential save function

  When the trigger mode is SINGLE

  After the START key is pressed, data is captured, and stored in each block in turn from block 1 to max block; the data capture process then stops, and the data in the block specified by the "using block" setting is displayed on the screen.

  When the trigger mode is REPEAT or AUTO (memory recorder function only)

  After the START key is pressed, data is captured, and stored in each block in turn from block 1 to max block, but after this last block the data capture process continues, storing data in block 1 again, and so on, cyclically. When data has been stored in the last block ("max block"), the data in the block specified by the "using block" setting is displayed on the screen.

  (If the auto print function is enabled, a printed recording is also made.) Data capture stops when the STOP key is pressed.

  If the storage mode is set to averaging, the memory division function is not available.

Related item

The "using block" setting, and an indication of which memory blocks are in use (that is contain data) is available in the display mode. See Section 5-4-20 "Help Function" for details.

15-4 Supplementary Information

Relationship of the number of memory blocks and shot length, depending on the number of channels selected for use (See Section 18-5-11 "Channel Selection.")

Multi-block function ... the number of memory blocks has precedence.

After setting the number of memory blocks, read off the maximum shot length for a block from the table, taking into account the number of channels being used.

Where the table says 15 - 150 divisions, this should be interpreted as 150 divisions.

Sequential save function ... the shot length has precedence.

Taking into account the number of channels being used, find the currently set shot length in the table, then read off the maximum number of memory blocks which can be used.

- Shot lengths for memory recorder function

Number of channels used / Number of memory blocks	4 channels	2 channels	1 channel
63	15~150 (75) DIV	15~ 300 (150) DIV	15~ 750 (300) DIV
31	300 (150)	750 (300)	1500 (750)
15	750 (300)	1500 (750)	3000 (1500)
7	1500 (750)	3000 (1500)	6000 (3000)
3	3000 (1500)	6000 (3000)	12500 (6000)
2	6000 (3000)	12500 (6000)	25000 (12500)
1	12500 (6000)	25000 (12500)	50000 (25000)

Figures in ( ) indicate the values when the storage mode is set to envelope.

- Shot lengths for recorder function

Number of channels used / Number of memory blocks	4 channels	2 channels	1 channel
63	Not possible	15~150 DIV	15~300 DIV
31	15~150 DIV	300	750
15	300	750	1500
7	750	1500	3000
3	1500	3000	6000
2	3000	6000	12500
1	6000	25000	25000

Section 16

Waveform Decision Function (Memory Recorder Function)

Contents

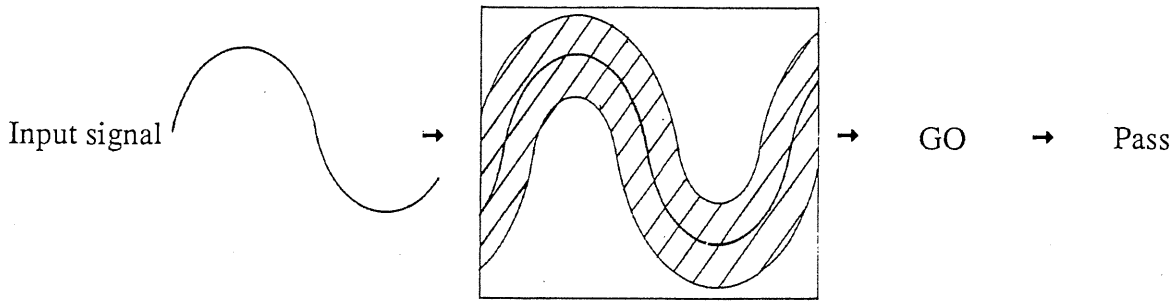
16-1 Overview

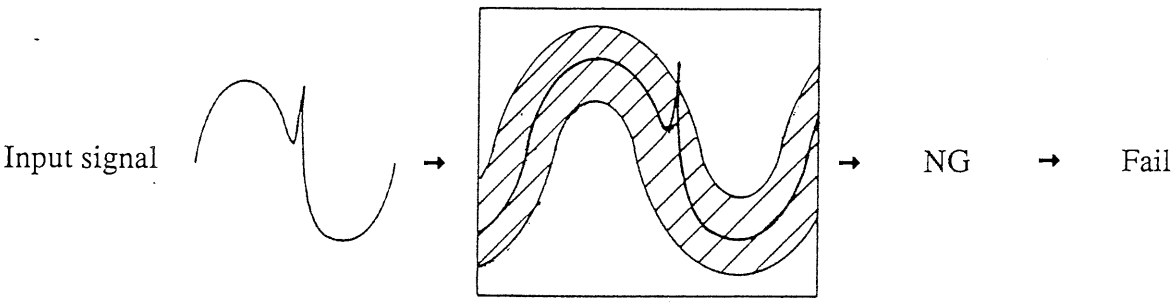
This function provides a pass/fail decision (GO/NG) for the input signal with respect to an arbitrarily defined decision area.

It can be used to detect abnormalities in the input waveform.

The decision result is output from the rear panel, for production line applications.

The waveform decision function can be used in the memory recorder function single format, X-Y format, and in single format for the fast Fourier transform.





Example waveform decision

16-2 Waveform Decision Settings

There are two items to be set: the decision mode and the stop mode.

16-2-1 Decision Mode Setting

The decision mode ("comparison" setting) must be selected from the following two possibilities.

OUT	The result is fail if any part of the waveform falls outside the decision area.
ALL-OUT	The result is fail if the entire waveform falls outside the decision area.

Procedure

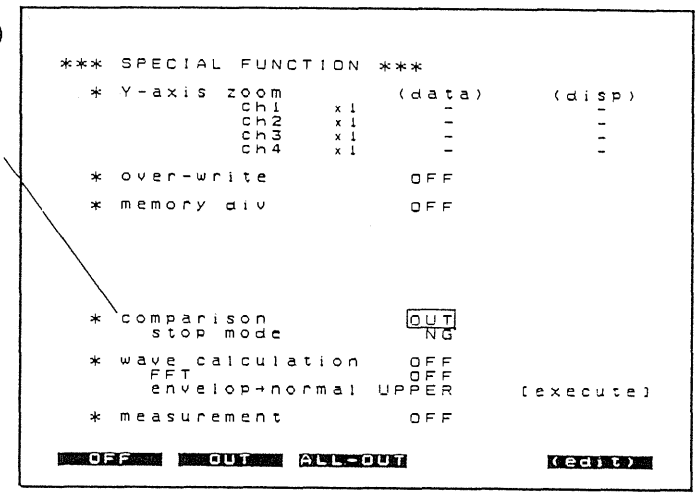
1. [STATUS], cursor keys (or rotary knob)

   Select the status mode, then hold down the cursor [▼] key, or use the rotary knob to scroll the screen to see the special function display.

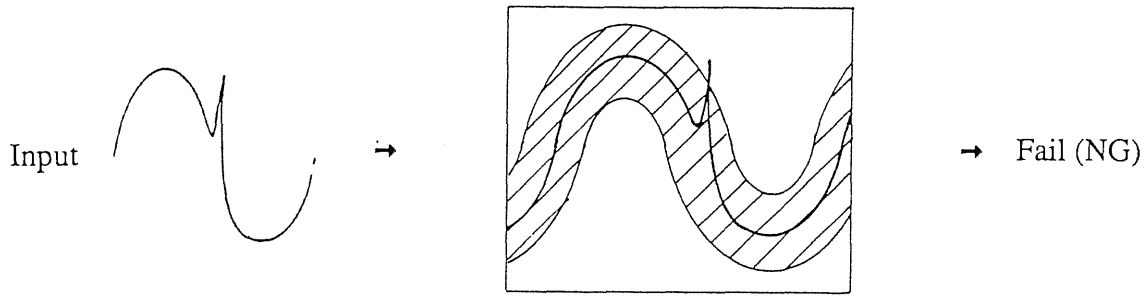
2. "comparison"

   Select the required decision mode.

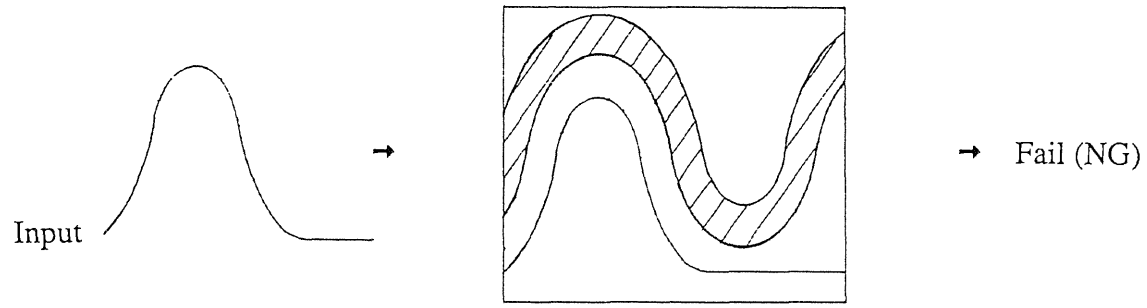
   (OFF, OUT, ALL-OUT)



Example



OUT failure decision



ALL-OUT failure decision

Notes

When the waveform decision function is enabled, the input waveform is automatically shown in high intensity and the decision area in low intensity.

16-2-2 Stop Mode Setting

Procedure

1. "stop mode"

   Select whether operation should stop after a pass result, a fail result, or either.

   GO: stop operation only after a pass.

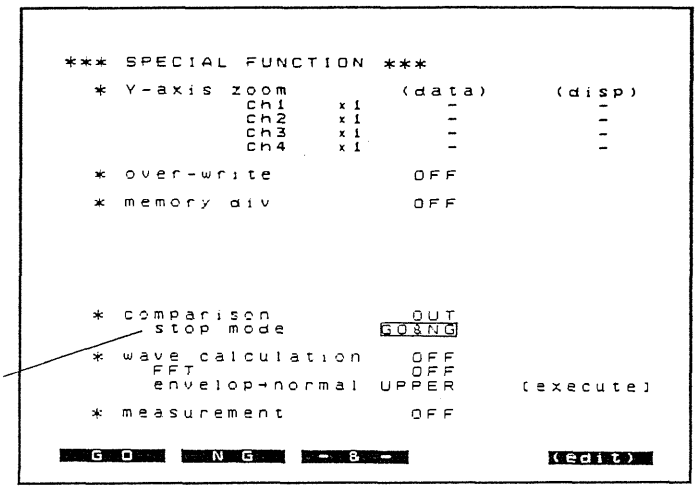
   NG: stop operation only after a fail.

   GO&NG: stop operation regardless of the decision result.

   Trigger mode and stop operation

   When the trigger mode is SINGLE, measurement continues until the operation stop, then stops.

   When the trigger mode is REPEAT or AUTO, after the operation stop, the unit returns to the start state. Pressing the STOP key terminates measurement.

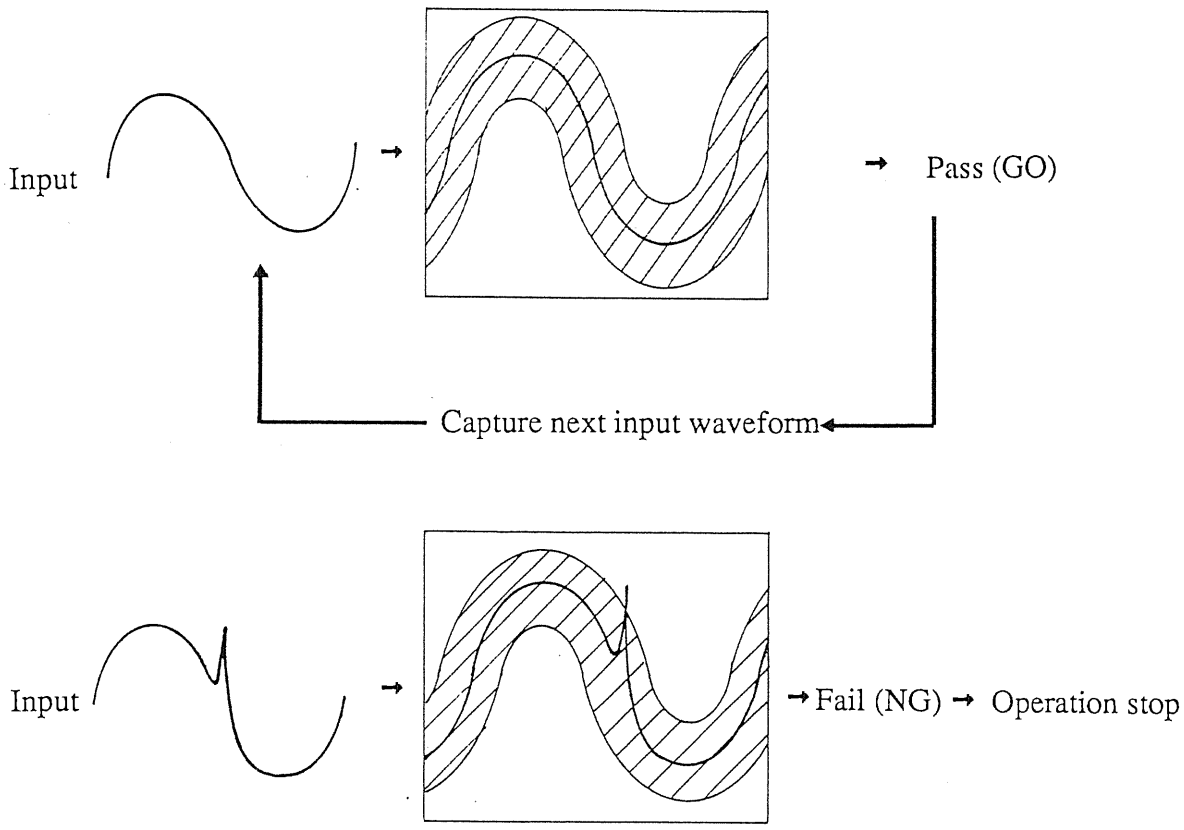


Notes

When an operation stop occurs:

- When the auto print function is enabled, the waveform is printed when the operation stop occurs.
- When the auto save function is enabled, the waveform is saved to floppy disk when the operation stop occurs.
- When the memory division function (sequential save) is in effect, data is only stored in memory when the operation stop occurs.

Example



Note

If the trigger mode is REPEAT or AUTO, in the upper case the operation is repeated continuously.

16-3 Using the Graphics Editor

Function

The graphics editor allows you to draw the waveform decision area directly on the screen.

The graphics editor can be used in the memory recorder function single format, X-Y format, and in single format for the fast Fourier transform.

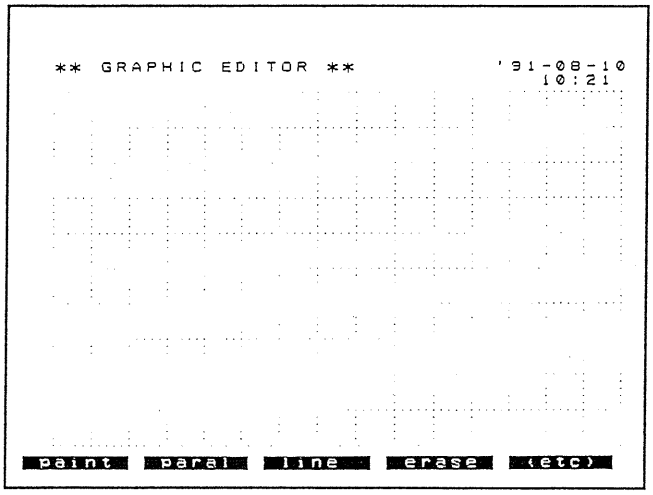
Note: The decision area drawn by the graphics editor is displayed in low intensity.

Procedure

(1) Starting the graphics editor

The flashing cursor can be positioned on either of the "comparison" and "stop mode" items.

1. Press the (edit) soft key, to start the graphics editor.



(2) Graphics editor commands

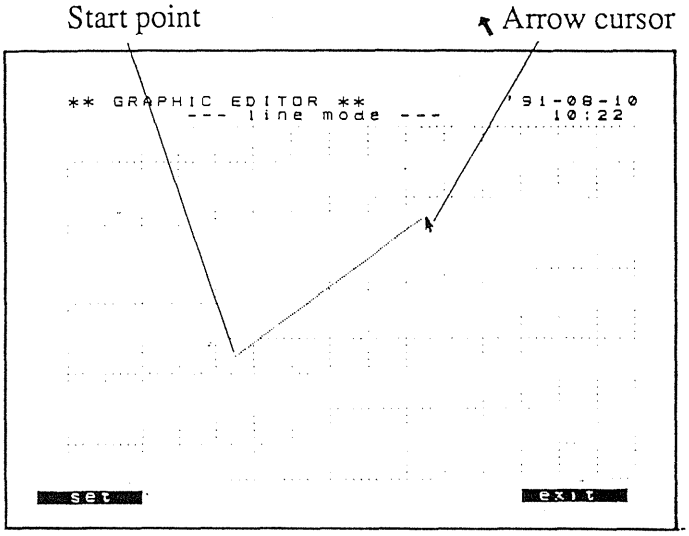
line:	draw a chain of straight-line segments
paint:	fill the closed curve surrounding the arrow cursor
reverse:	reverse the sense of all pixels
storage:	capture the displayed waveform into the graphics editor
parallel:	spread out the display pattern by parallel movement
erase:	use the block cursor to erase selected portions
clear:	use the arrow cursor to clear a rectangle
all clear:	clear the whole screen
undo:	undo the previous operation
save:	save the decision area in memory
end:	exit from the graphics editor with or without saving the decision area

line: draw a chain of straight-line segments

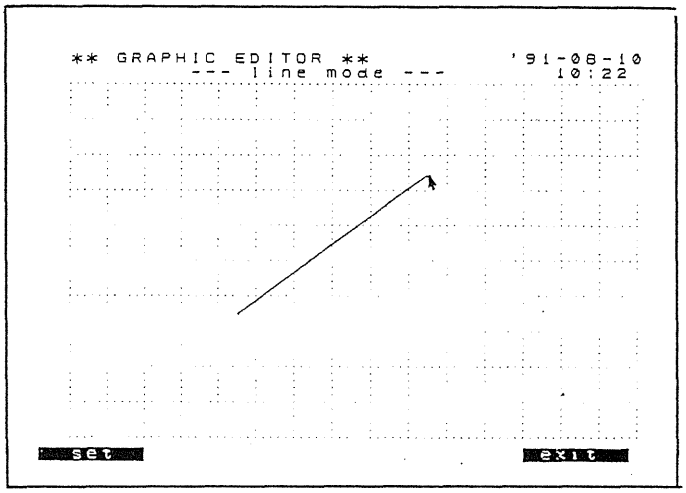
Press the line soft key to enter the line mode.

Example operation

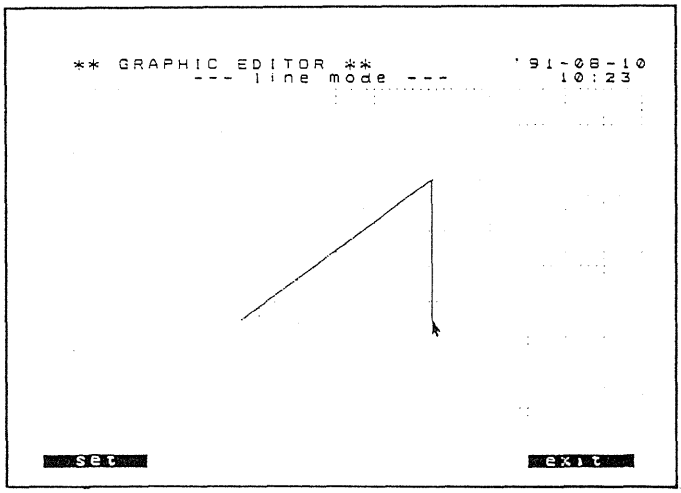
1. Use the cursor keys to move the arrow cursor to the start point.
2. Press the set soft key to mark the start point.
3. Using the cursor keys, move the arrow cursor. A dotted line appears, joining the start point to the current cursor position.



4. Press the set soft key to make the line into a solid line joining the start point to the current cursor position.



5. Use the cursor keys to move the arrow cursor again.
6. Press the set soft key to draw another straight-line segment joining the previous end-point to the current cursor position.
7. Press the exit soft key to exit from line mode.

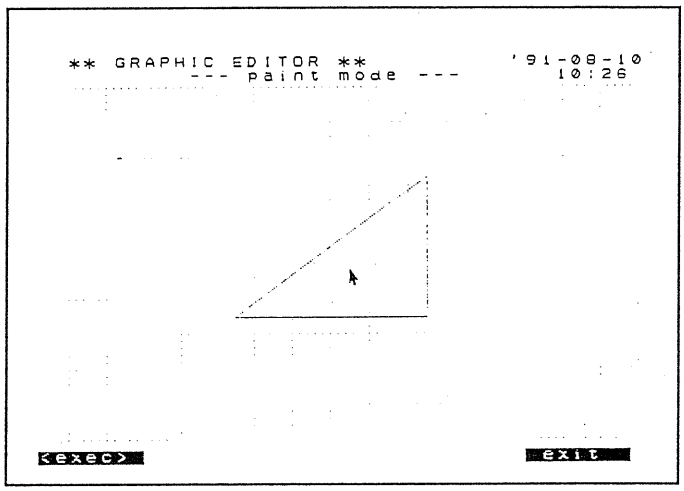


paint: fill the closed curve surrounding the arrow cursor

Press the paint soft key to enter the paint mode.

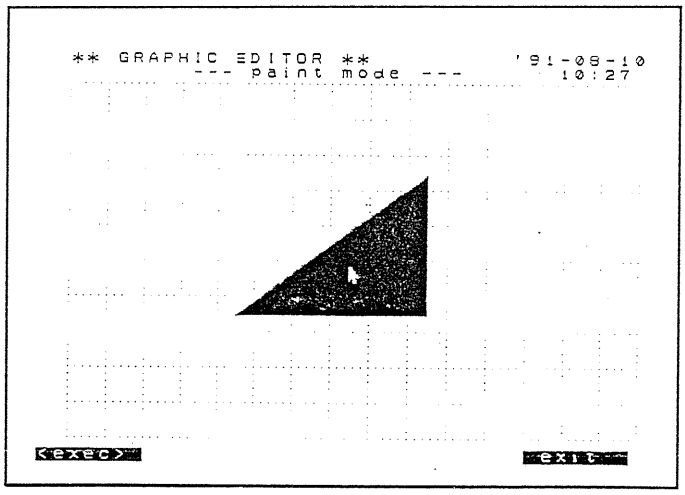
Example operation

1. Use the cursor keys to move the arrow cursor inside the closed curve to be filled.



2. Press the exec soft key to fill the area with solid pixels.
3. Press the exit soft key to exit from paint mode.

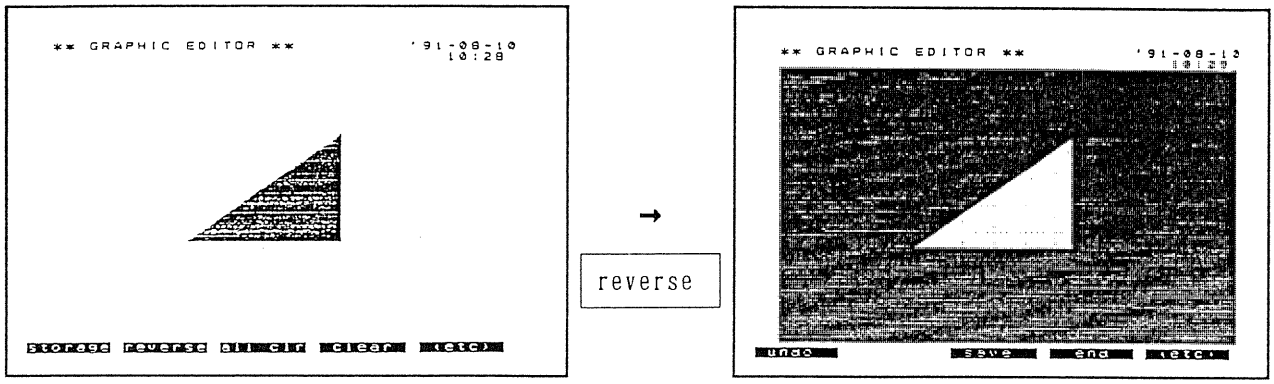
   Note: Take care that the required area is completely surrounded. Otherwise the "paint" may leak out and fill the screen.



reverse: reverse the sense of all pixels

Press the reverse soft key to reverse the video.

Example



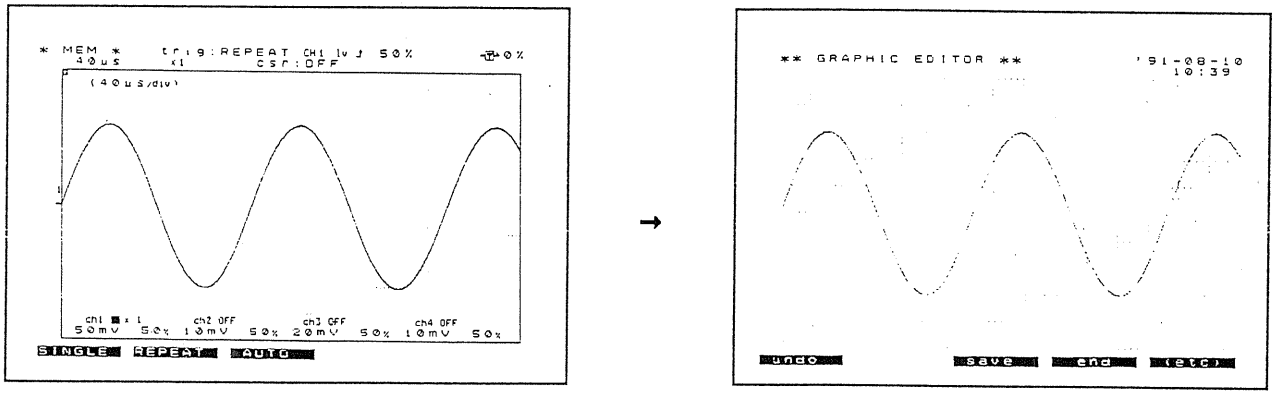
storage: capture the displayed waveform into the graphics editor

Press the storage soft key to capture the displayed waveform into the graphics editor.

Example

Displayed waveform

Graphics editor screen after executing the storage command



Note: Regardless of its original display mode, the waveform appears in the graphics editor screen in low intensity.

parallel: spread out the display pattern by parallel movement

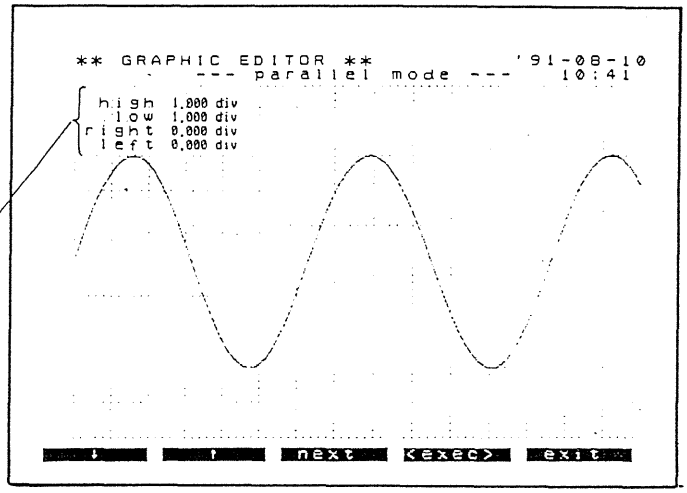
Press the [paral] soft key to enter the parallel mode.

Example operation

1. Set the amounts for the parallel movement.

   Use the [↑] and [↓] soft keys to change the values shown on the screen.

   To move the cursor to the next value to change, press the [next] soft key.



Parallel movement amounts

   high: amount of upward spreading

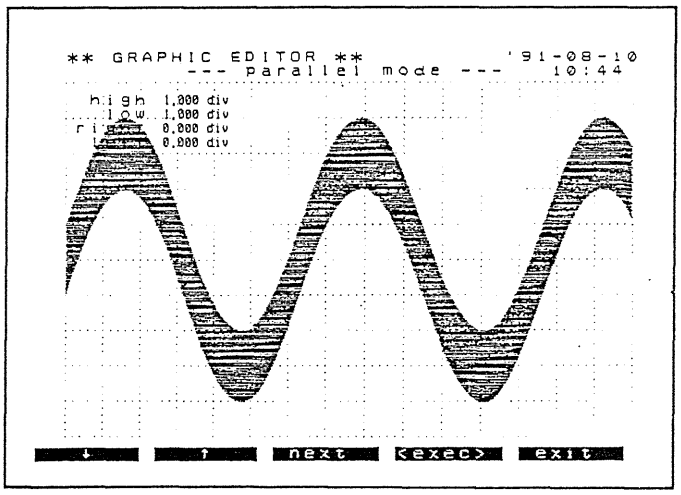
   low: amount of downward spreading

   right: amount of rightward spreading

   left: amount of leftward spreading

   (The amounts are variable in 0.04-division steps vertically and 0.025-division steps horizontally.)

2. Press the [exec] soft key to carry out the parallel spreading, and create the decision area.
3. Press the [exit] soft key to exit from parallel mode.

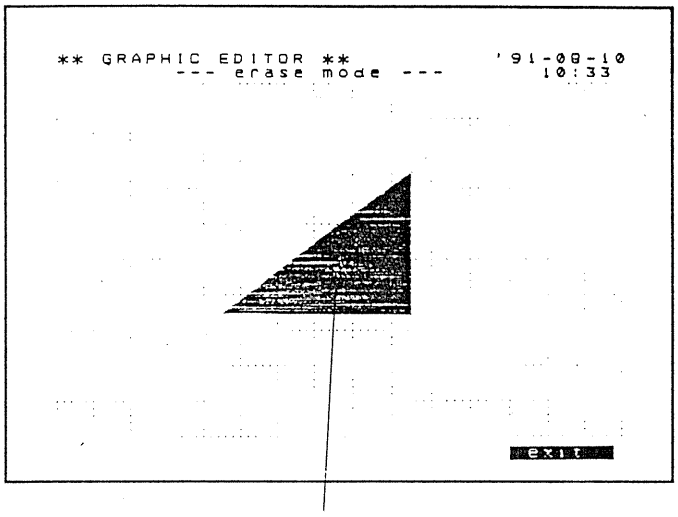


erase: use the block cursor to erase selected portions

Press the erase soft key to enter the erase mode.

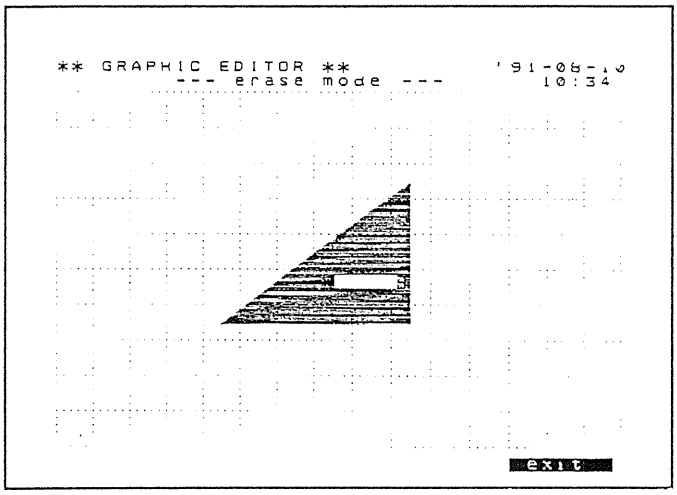
Example operation

1. Use the cursor keys to move the arrow cursor to the start point.
2. Press the set soft key to change from the arrow cursor to the block cursor.
3. Use the cursor keys to move the block cursor, and erase portions not required.



Block cursor

4. Press the exit soft key to exit from erase mode.

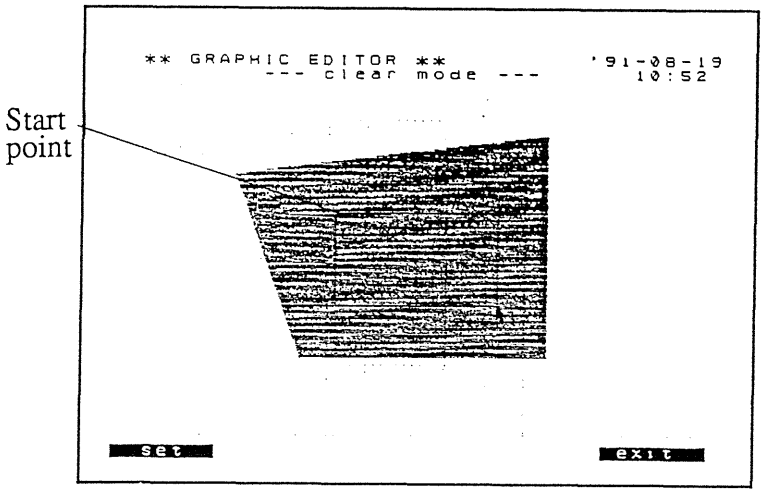


clear: use the arrow cursor to clear a rectangle

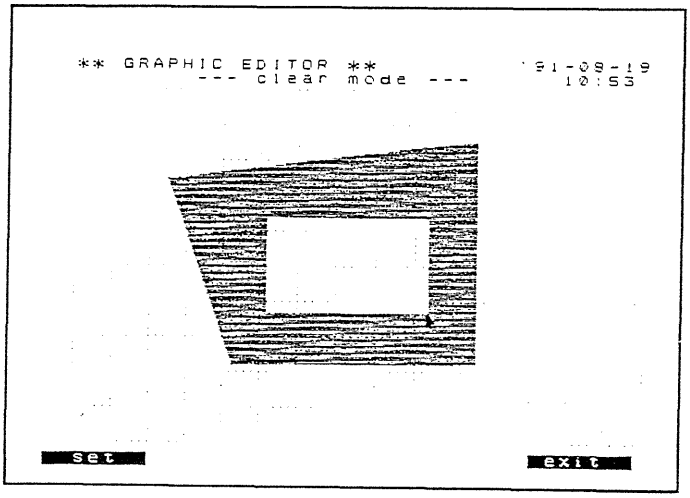
Press the clear soft key to enter the clear mode.

Example operation

1. Use the cursor keys to move the arrow cursor to the start point.
2. Press the set soft key to mark the start point.
3. Using the cursor keys, move the arrow cursor. A dotted line appears, outlining a rectangle with the start point and the current cursor position at diagonally opposite corners.



4. Press the set soft key to clear the rectangular area.
5. Press the exit soft key to exit from clear mode.



all clear: clear the whole screen

Pressing the all clr soft key clears the whole screen.

undo: undo the previous operation

This undoes the effect of any operation other than save or end.

save: save the decision area in memory

end: exit from the graphics editor with or without saving the decision area

After pressing the end soft key, select the save or nosave soft key.

end save ..... save the decision area in memory, then exit from the graphics editor. The decision area can then be used for waveform decisions.

end no save ..... exit from the graphics editor without saving the decision area in memory. The decision area is then lost.

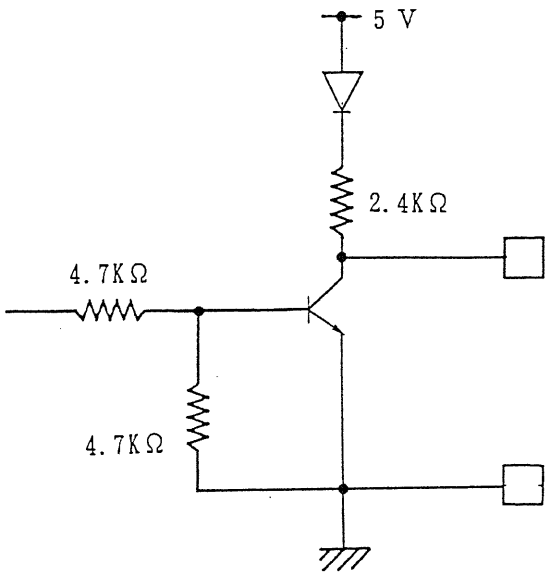
Note: If you exit the graphics editor immediately after starting it, or after a save command without any intervening commands, then pressing the end soft key exits immediately.

16-4 Using the Pass/Fail Decision Output

(1) Terminals on the rear panel provide an output of the waveform decision result.

The signal between the GO and GND terminals is the pass output, and the signal between the NG and GND terminals is the fail output.

The output circuits are as shown below.



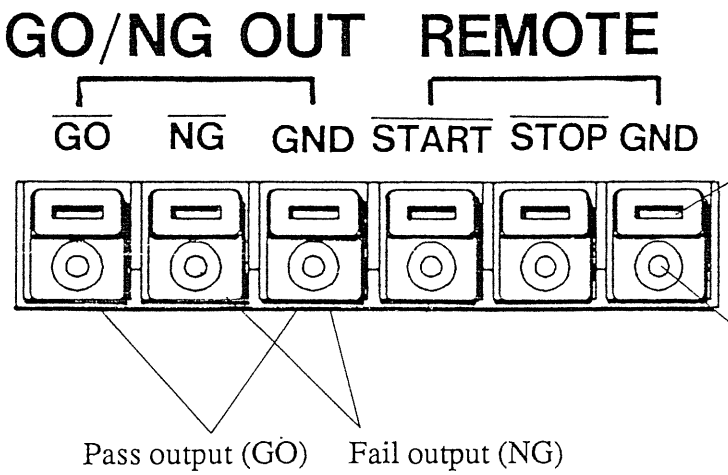
Open collector with 5 V output, active low

$\overline{GO}$ or $\overline{NG}$ terminal

Input voltage range -20 to +30 V
Maximum input current 500 mA
Maximum input power 200 mW

GND terminal

Connections to the output terminals



Button

- When inserting or removing wires, use a screwdriver to press the button.

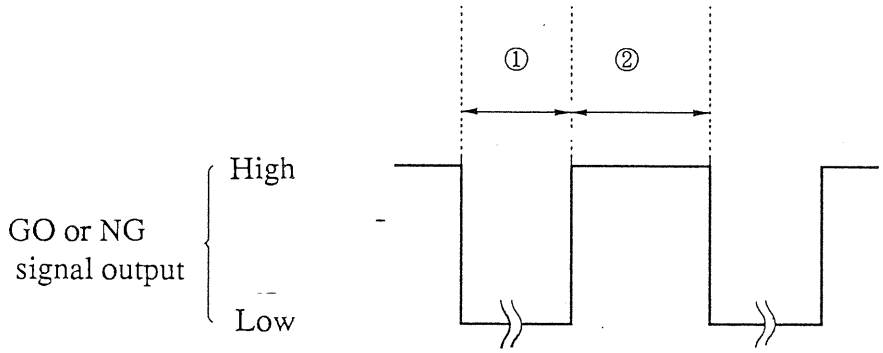
Wire connection aperture

- Insert the end of the wire to be connected.

Connecting wires and tools

Recommended wire size:	Single strand, 1.0 mm dia. (AWG 18), multi-strand 0.75 mm^2.
Usable wire sizes:	Single strand, 0.4 to 1.0 mm dia. (AWG 26 to 18), multi-strand 0.3 to 0.75 mm^2 (AWG 22 to 20).
	Minimum strand diameter 0.18 mm
Standard insulation stripping length:	10 mm
Button pressing tool:	Blade screwdriver (tip width 2.6 mm)

(2) Pass/fail output signals



① Low signal output (minimum approximately 70 ms)

During this interval data is captured, and the waveform data is built. The slower the time axis, and the longer the recording length, the longer this period. One of the GO and NG signals goes low.

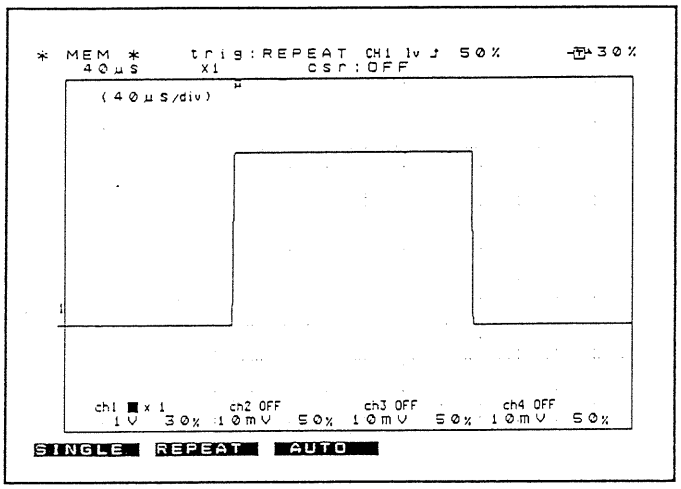
② High signal output (minimum approximately 40 ms)

The decision is made in this interval. Both the $\overline{GO}$ and $\overline{NG}$ outputs are high level.

16-5 Example Waveform Decision Settings

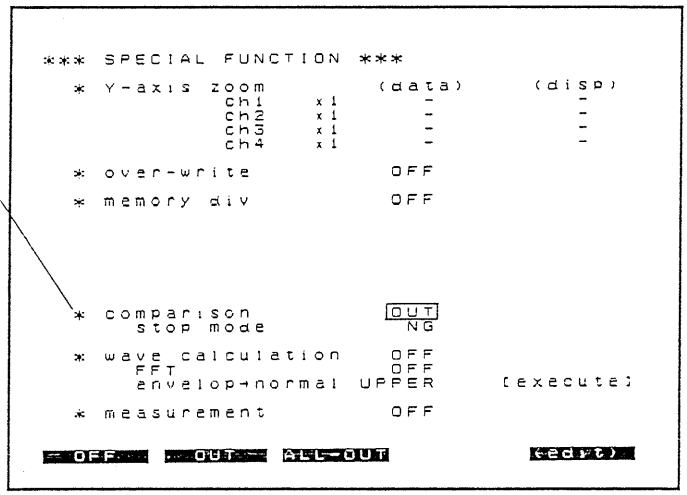
Rising and falling edges from a logic IC are input, and a decision area is derived from this output. This is used to test ICs for undershoot and overshoot waveform problems.

(1) First a reference waveform is captured. A trigger is used so that the same waveform is always drawn on the screen, then this is captured, and displayed in high intensity.

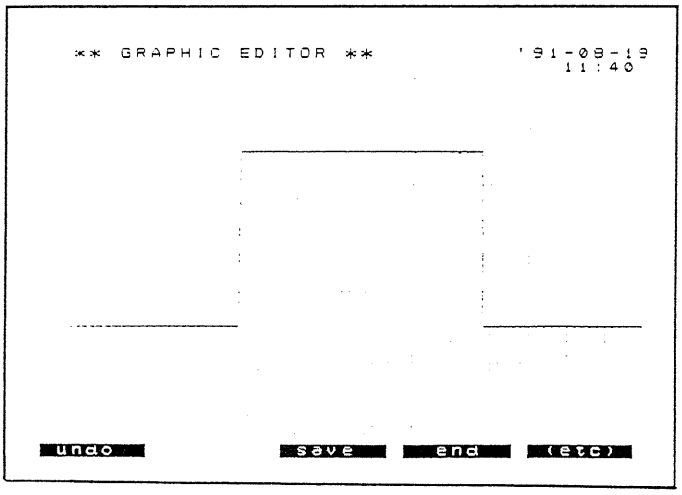


(2) The waveform decision area is built from this reference waveform.

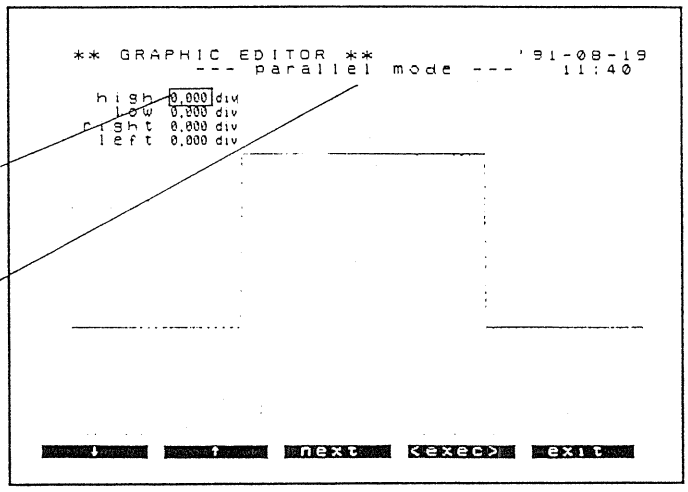
1. On the special function display, set the "comparison" item for an operation stop if the waveform goes outside the decision area.
2. Press the (edit) soft key to start the graphics editor.



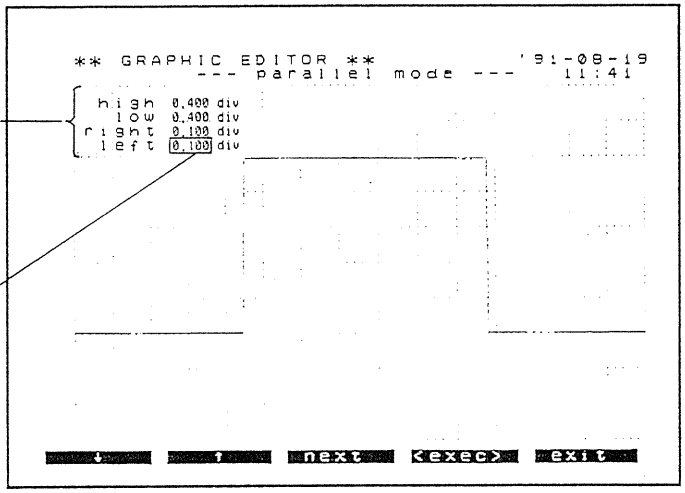
3. Press the storage soft key, to copy the displayed waveform into the graphics editor.



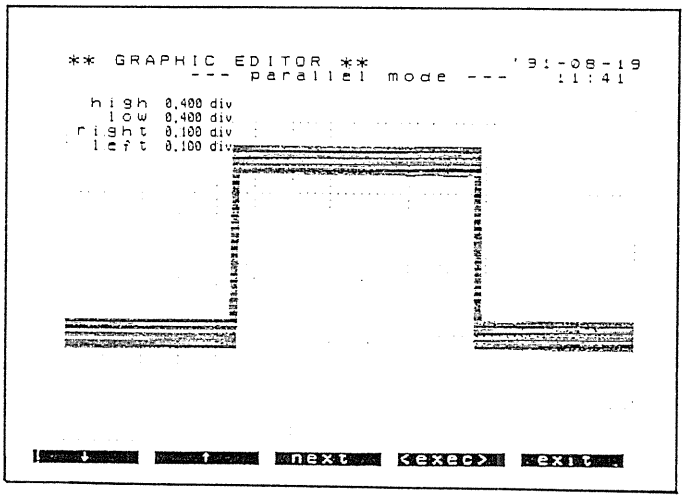
4. Press the [paral] soft key for parallel spreading of the waveform.



5. Use the [↑] [↓] [next] soft keys to adjust the parallel spreading amount.



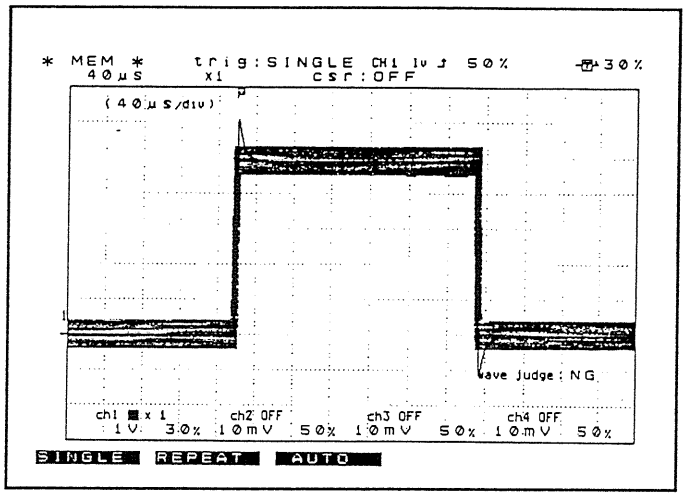
6. Press the [exec] soft key to carry out the spreading.
7. Press the [exit] soft key to exit from parallel mode.



8. Press the end and save soft keys in sequence, to exit from the graphics editor.

(3) To carry out a single waveform decision operation, set the trigger mode to SINGLE.

(4) Press the START key to begin the waveform decision operation.



Example failing waveform

Notes

The waveform decision function comprises two operations: (1) capturing the data and (2) making the decision. These are repeated alternately, and therefore during the decision making, no data is captured. Note therefore that this function cannot be used for continuous monitoring of the input signal. The time required to make the decision is approximately 50 ms. (This does not include the time to capture the data or the display time.)

The following table shows the approximate time for the decision cycle, when making a decision on approximately two cycles of a sine wave on the screen.

Number of channels for decision	Time axis	Shot length	Zoom factor	Dot/line display	Decision cycle
1 ch	50 µs	15 DIV	1/1	Dot	140 ms
2 ch	50 µs	15 DIV	1/1	Line	190 ms
1 ch	50 µs	150 DIV	1/10	Line	170 ms

Section 17

Calculation Functions (Memory Recorder Function)

Contents

17-1 Summary of the Calculation Function

Section 17 describes five kinds of calculation function, which are listed below. Apart from these, the averaging function is also one which performs calculation processing. For details, refer to Section 13-2 "Using the Averaging Function."

(1) Waveform processing calculation

This is a calculation whose result appears as a waveform.

This calculation is available in the following varieties:

the four arithmetic operations, taking absolute value, exponentiation, taking common logarithm, taking square root, taking moving average, differentiation (once and twice), integration (once and twice), and parallel displacement along the time axis.

(2) Waveform parameter calculation

This is a calculation whose result appears as a numerical value.

This calculation is available in the following varieties:

Maximum value, minimum value, peak to peak value, average value, effective value, area value, period, frequency, rise time, fall time, XY area.

(3) Waveform parameter decision

By comparing the result of a waveform parameter calculation with a previously set value, a yes/no decision is reached.

(4) Envelope to normal conversion calculation

The storage mode is set to envelope, and a sampled and displayed waveform is converted into either its upper or lower envelope curve, only.

(5) FFT calculation

By performing FFT calculation, it is possible to analyze a sampled waveform into a frequency spectrum.

17-2 Waveform Processing Calculation

17-2-1 Summary

The following operations can be performed on measurement data: the four arithmetic operations (+, -, *, /), taking absolute value (ABS), exponentiation (EXP), taking common logarithm (LOG), taking square root (SQR), taking moving average (MOV), differentiation (once and twice - DIF and DIF2), integration (once and twice - INT and INT2), and parallel displacement along the time axis (SLI).

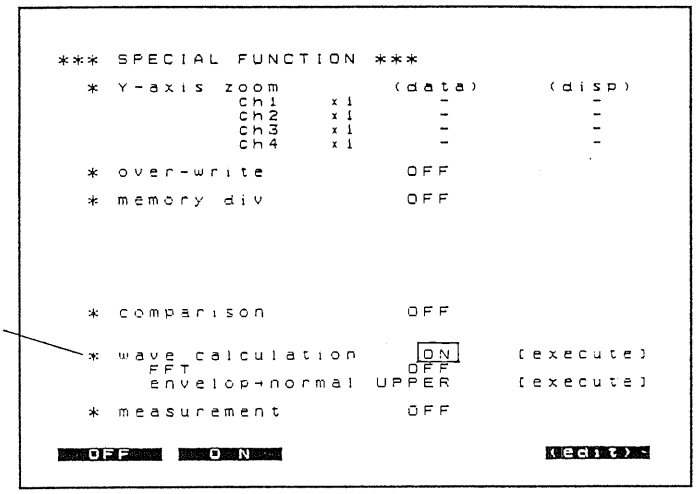
Further, it is possible to set the display scale in the vertical direction.

17-2-2 Method of Calculation

1. Select the status mode, then use either the ▼ cursor key or the rotary knob to show the special function display.
2. "wave calculation"

   (OFF, ON, (edit))

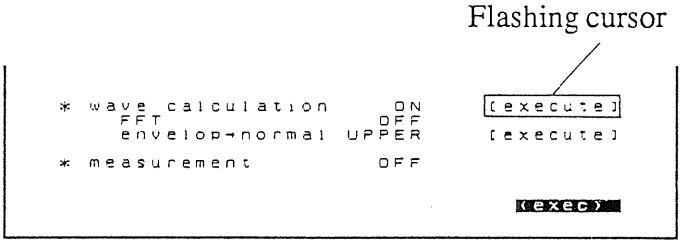
   Press the soft key edit and the calculation screen appears. On this screen, each of the types of calculation is available for selection. For details, refer to page 17-4 and following.



3. The following two alternative methods are available for performing calculation.

   ① From step 2, while holding down the soft key ON , press the START key. After the waveform has been sampled, the result of the calculation performed will be displayed on the screen.

   ② If calculation is to be performed for measurement data loaded from a floppy disk or measurement data that have been previously sampled, from step 2, after pressing the soft key ON , move the flashing cursor to the position shown in the figure to the right, and press the soft key (exec) . The calculation will be performed and its results will be displayed on the screen.



Notes

- If memory is being used for one or two channels, calculation cannot be performed.
- If the shot length is greater than or equal to 3000 divisions, calculation cannot be performed.
- If the storage mode is AVERAGE, calculation cannot be performed.
- When the memory division function is in use, calculation cannot be performed. (After performing a temporary save to the floppy disk, disable the memory division function, then load the data again, to allow the calculation to be performed.)
- If scaling is set, only the units are valid, and anything else will be disregarded.

Settings on the calculation screen

1. Z1 to Z4

   These are for setting equations for calculation.

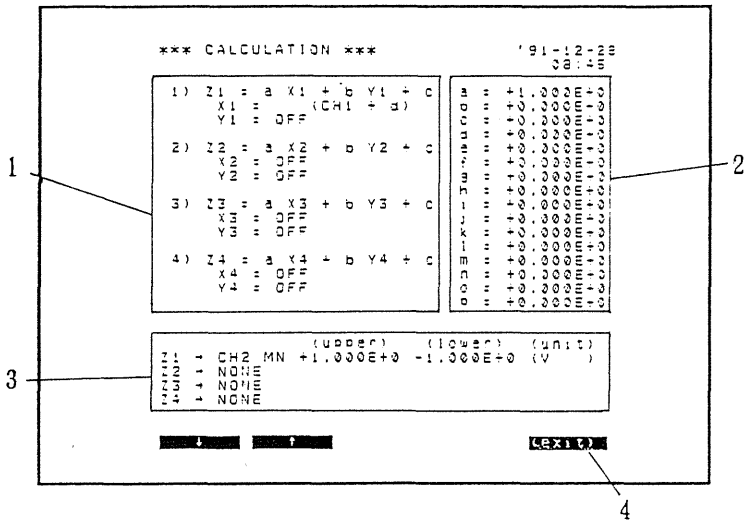
2. a to p

   These are for inputting constants.

3. These are for setting into which channels of the memory, from channel 1 to channel 4, the results of the calculations are to be stored.

   Furthermore, the vertical scale of the display can be set.

4. Pressing the soft key (exit) causes the calculation screen to be deleted and returns to the special function display.



Next follows detailed explanation relating to the above mentioned calculation equations, constants, channels for storage of calculation results, and vertical scaling of the screen.

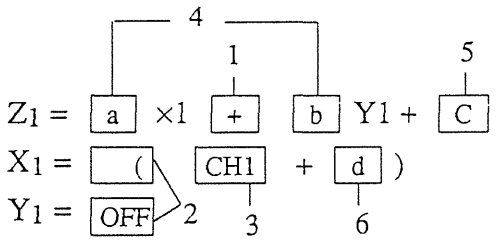
For detailed explanation of each type of calculation, and examples of their setting, refer to Section 17-2-4 "Details of the Various Calculations".

Calculation equations

Four calculation equations can be set, denoted Z1 to Z4.

Example:

1)



1. For setting the four arithmetic operations (+, -, *, /), the following keys are used: + for addition, - for subtraction, * for multiplication, / for division.
2. For setting operations other than the four arithmetic operations, pressing the soft key (etc) changes the display to the calculation menu, with the soft key display as follows: OFF, (, ABS, EXP, LOG, SQR, MOV, DIF, INT, DIF2, INT2, SLI.

   OFF... same meaning as the constant value 0;

   (... if no calculation is set, the measurement data are used in their original unchanged form)

   ABS....king the absolute value — EXP..ponentiation

   LOG...king the common logarithm — SQR..king the square root

   MOV..king the moving average — DIF....fferentiation

   INT.....tegration — DIF2..fferentiation twice

   INT2...tegration twice — SLI.....rallel displacement along the time axis

3. Set the channel of which measurement data will be used, using the soft keys. (CH1 to CH4, (Z1), (Z2), (Z3))

   For Z1: CH1 to CH4 only

   For Z2: CH1 to CH4 and Z1

   For Z3: CH1 to CH4, Z1, and Z2

   For Z4: CH1 to CH4 and Z1 to Z3

4. Set the coefficients. (a to p)

   These must be previously set to numerical values.

5. Set the offset values for the calculation results. (a to p)

   These must be previously set to numerical values.

6. Set the offset values for the measurement data. (a to p)

   These must be previously set to numerical values.

   In steps 4 to 6 above, the same constants a to p can be used as many times as desired.

   Note: The order of calculation proceeds by first calculating X1 and Y1, and then calculating Z1. These calculations are repeatedly performed in order for Z1 to Z4.

   For examples of the setting of each type of calculation, and detailed explanation thereof, refer to Section 17-2-4 "Details of the Various Calculations."

Constants

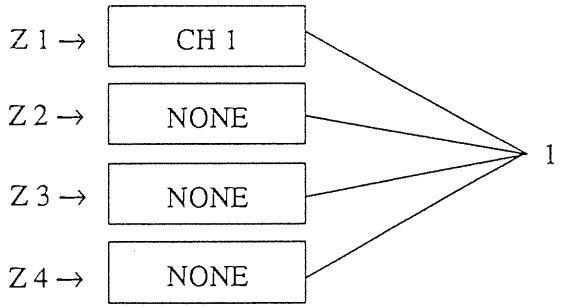
Altogether 16 constants can be set, denoted a to p.

$$a = \underbrace{+0.000E}_{\text{mantissa}}\ \underbrace{+0}_{\text{exponent}}$$

The mantissa can be set to any value from -9.999 to +9.999.

The exponent can be set to any value from -9 to +9.

Setting the channels for storage of calculation results



1. Set the channel in memory into which each of the calculation results obtained from the calculation equations Z1 to Z4 will be stored.

   (CH1 to CH4, NONE)

   When a calculation result is not used, set the corresponding channel to NONE.

   Note: If a channel used as a source during the course of a calculation equation and the channel in which the results of the calculation are stored are the same, after the calculation has been performed the source data is lost.

Vertical scaling of the screen

```
                    (upper)        (lower)        (unit)
Z1 → CH1 MN + 1.000E + 0     - 1.000E + 0    (V      )
             |     |               |              |
             1     2               3              4
```

1. Select whether or not to make an automatic setting for the vertical scaling. (AUTO, MANUAL)
2. Set the upper end value for the vertical axis during display and recording of the result of a calculation.

   +1.000E +0
   mantissa exponent

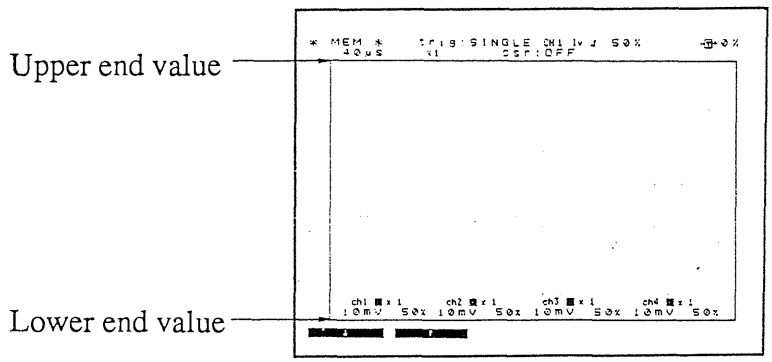
   The mantissa can be set to any value from -9.999 to +9.999.

   The exponent can be set to any value from -9 to +9.

3. Set the lower end value for the vertical axis. (same as 2.)
4. Shows the units to be used for the vertical axis.

   Although these units are usually volts, when scaling is being performed the name of the units which have been set (up to 4 characters) is displayed. However, scaling processing with any setting other than named units is invalid.

   For details refer to Section 18-3 "Scaling Function."



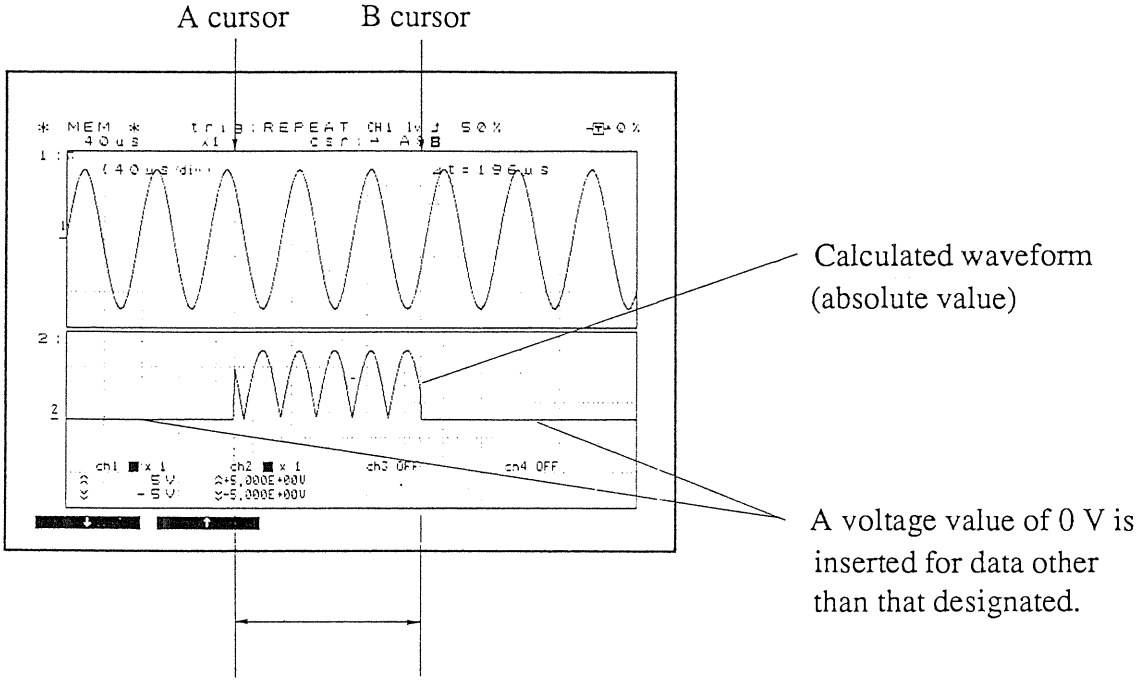
17-2-3 Waveform Calculation Positions

When the A and B cursors are not being used, or if horizontal cursors are being used, the calculation is performed for all the data.

It is possible to designate the waveform position for calculation using the A and B cursors (vertical or cross-hair cursors).

When both A and B cursors are used.e calculation is based on the data between the A cursor and the B cursor.

When only the A cursor is used.e calculation is based on the data after the A cursor.



17-2-4 Details of the Various Calculations

This section describes each of the various types of calculation. Further, a specimen waveform calculation will be described in terms of a concrete example of setting on the calculation screen.

(1) The four arithmetical operations (+, -, *, /)

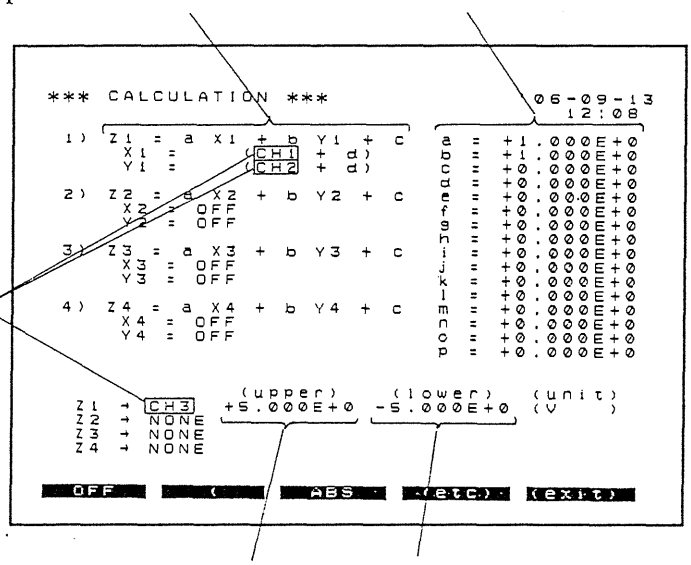
According to the operators set, the four arithmetical operations are performed.

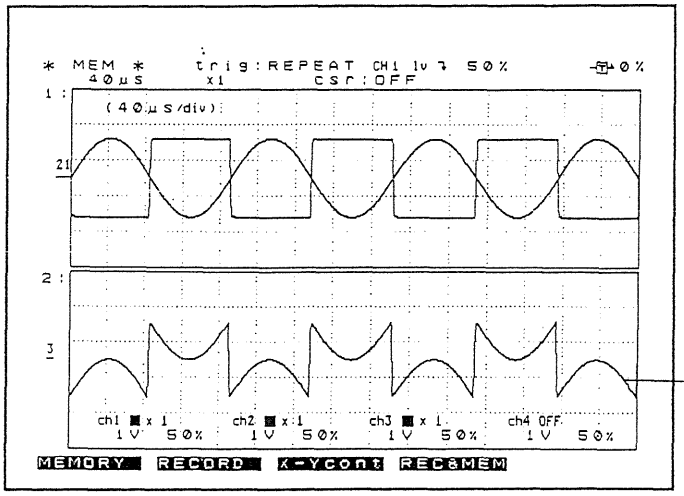
Example: Addition

Add the waveform data in channel 1 to the waveform data in channel 2, storing the result in the channel 3.

CH1 + CH2 → CH3

Channel specifications





(2) Absolute value (ABS)

The calculation equation is set up as follows:

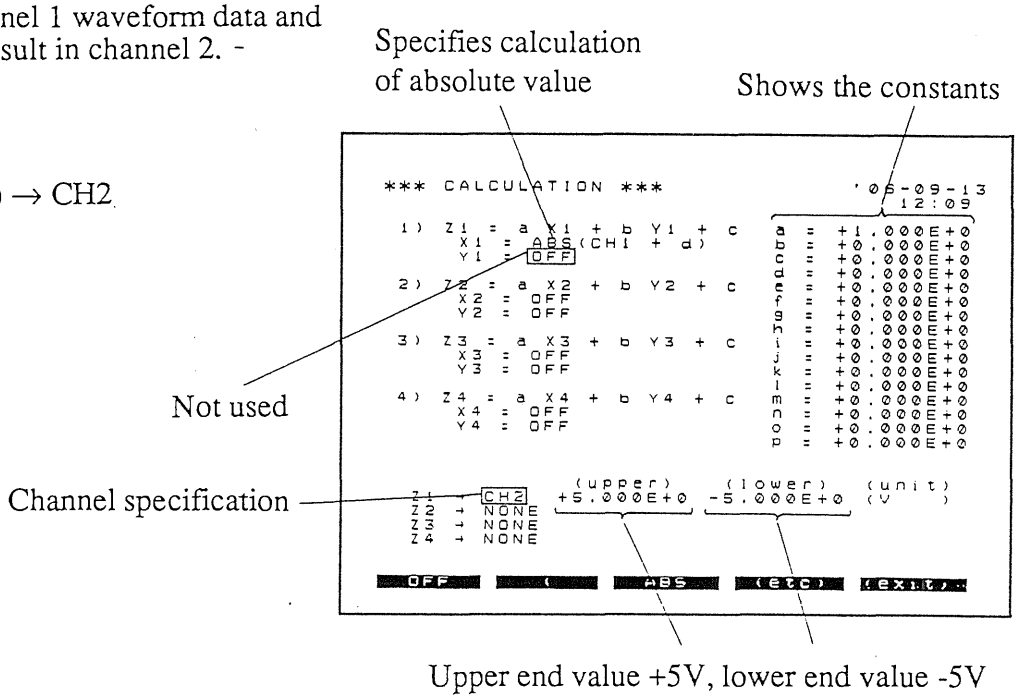
bi = |di| (i=0, 1, ..., n)

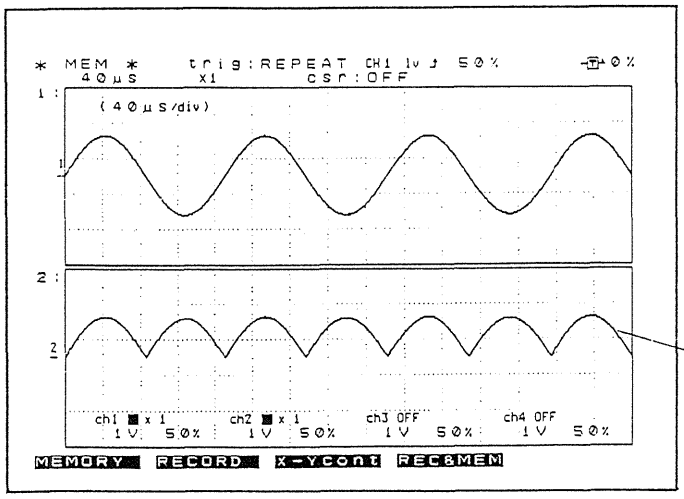
bi = the ith data item of the result of the calculation

di = the ith data item of the source channel

Example: Calculate the absolute value of the channel 1 waveform data and store the result in channel 2. -

ABS(CH1) → CH2





(3) Exponential (EXP)

The calculation equation is set up as follows:

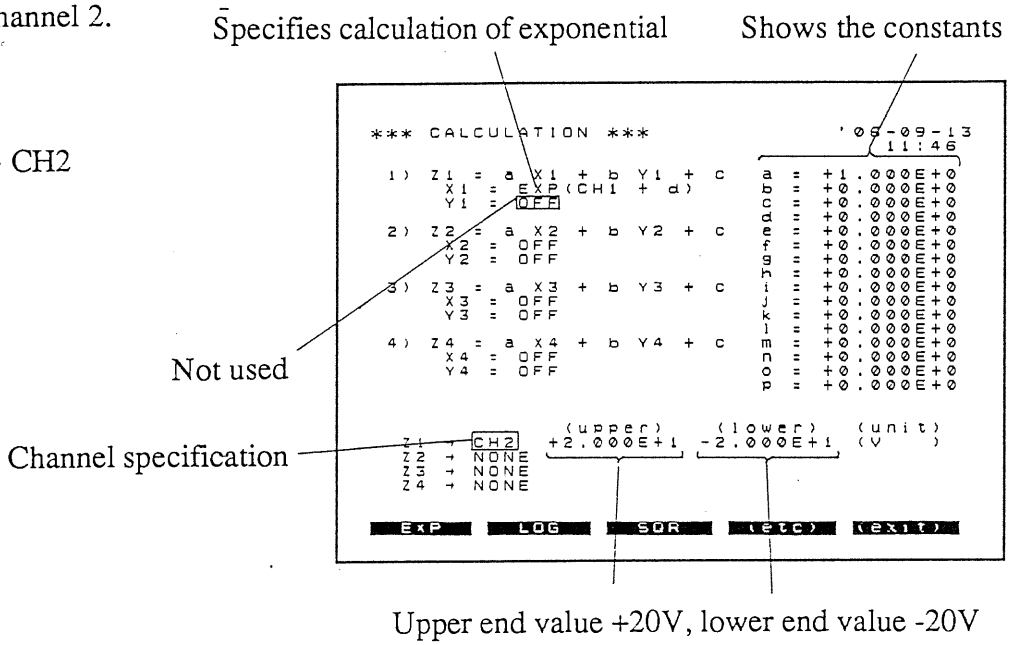
bi = exp (di) (i=0, 1, ..., n)

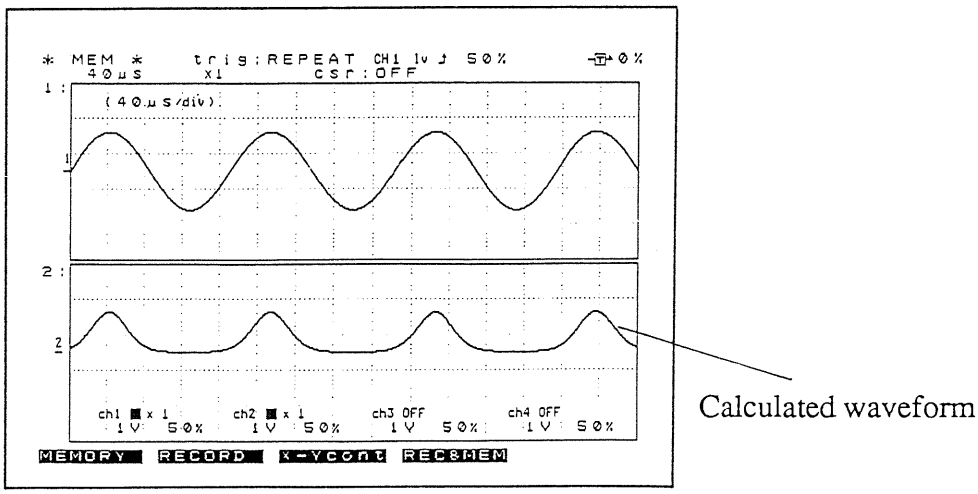
bi = the ith data item of the result of the calculation

di = the ith data item of the source channel

Example: Calculate the exponential of the channel 1 waveform data store the result in channel 2.

EXP(CH1) → CH2





(4) Common logarithm (LOG)

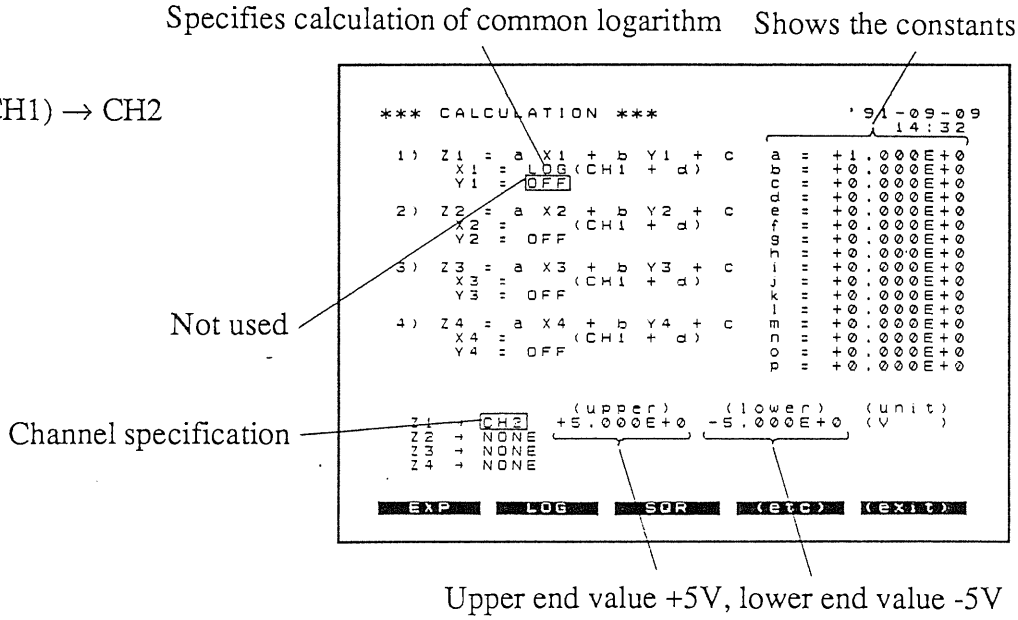
The calculation equation is set up as follows:

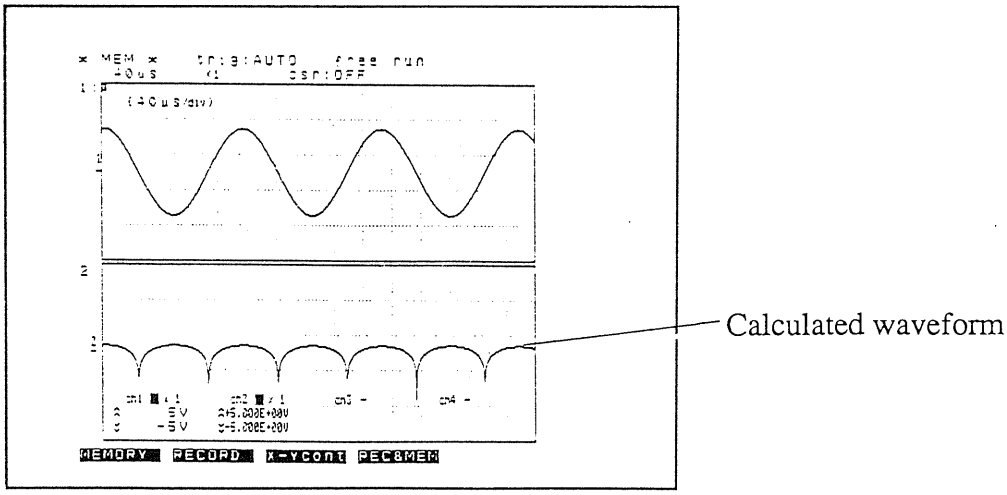
when di > 0, bi = log10 di (i=0, 1, ..., n)

when di = 0, bi = 0 bi = the ith data item of the result of the calculation

when di < 0, bi = -log10 |di| di = the ith data item of the source channel

Example: Calculate the common logarithm of the channel 1 waveform data and store the result in channel 2.





Background

When calculation of the natural logarithm is required, because $loge\ X = \frac{\log_{10} X}{\log_{10} e}$, it can be done in the following manner:

Z1 = a X1 + bY1 + c	a = +2. 303E + 0 (≒ 1/log 10e)
X 1 = LOG (CH1 + d)	b = + 0. 000 E + 0
Y 1 = OFF	c = + 0. 000 E + 0
	d = + 0. 000 E + 0

(5) Square root (SQR)

The calculation equation is set up as follows:

when $di \geqq 0$, $bi = \sqrt{di}$ (i=0, 1, ... ,n)

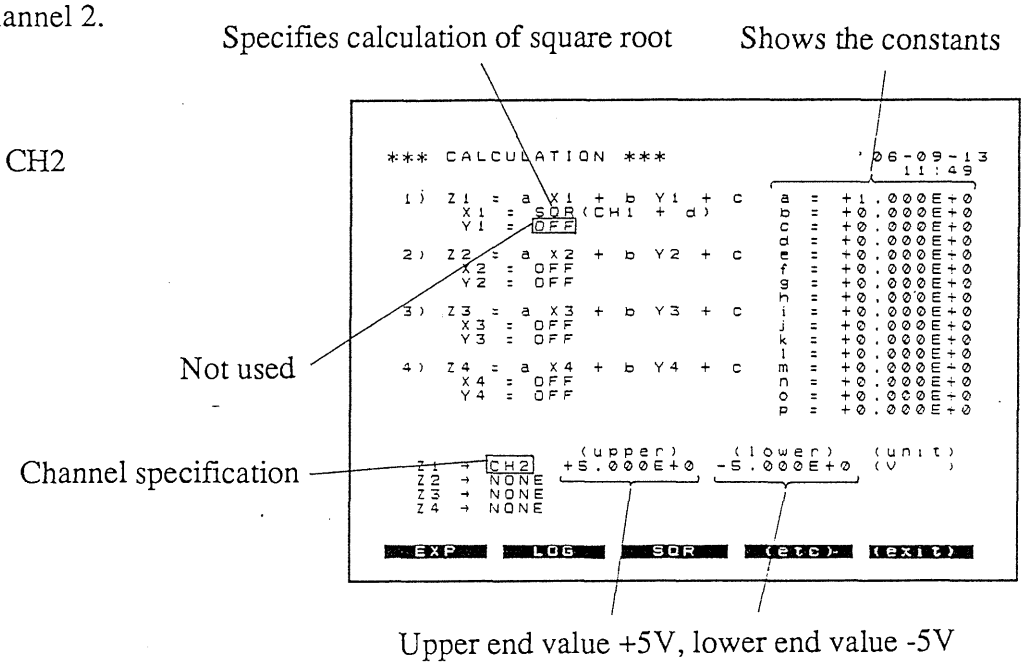
when $di < 0$, $bi = -\sqrt{|di|}$

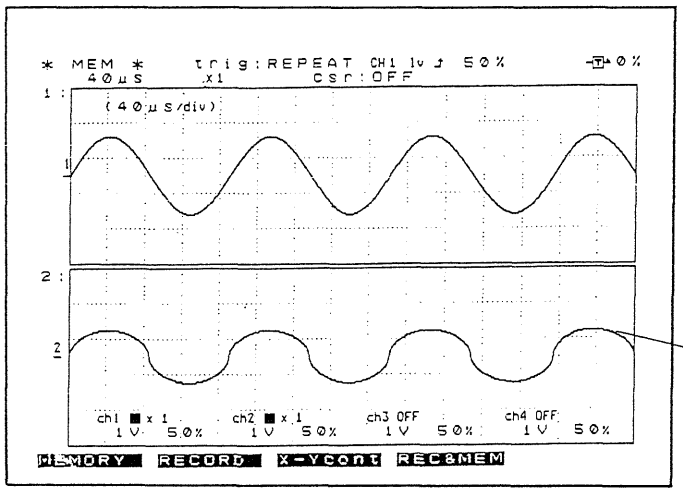
bi = the ith data item of the result of the calculation

di = the ith data item of the source channel

Example: Calculate the square root of the channel 1 waveform data and store the result in channel 2.

SQR(CH1) → CH2





(6) Moving average (MOV)

The calculation equation is set up as follows:

$$b_i = \frac{1}{k} \sum_{t=i-k/1}^{i+k/2} d_t$$

(i=0, 1, ..., n)

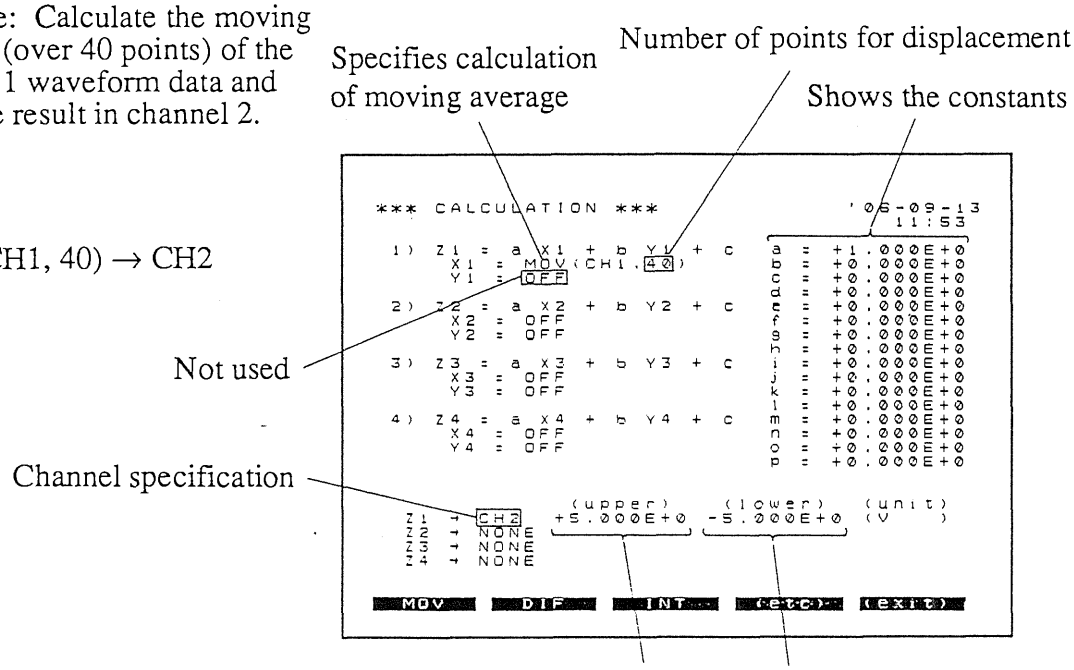
bi = the ith data item of the result of the calculation

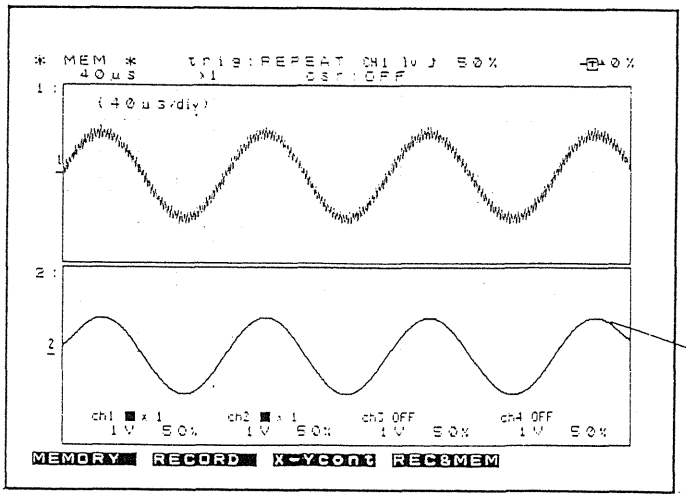
di = the ith data item of the source channel

k = the number of points for averaging (1 to 4000)

Example: Calculate the moving average (over 40 points) of the channel 1 waveform data and store the result in channel 2.

MOV(CH1, 40) → CH2





(7) Differentiation once or twice (DIF, DIF2)

For the equations for calculation, refer to pages 17-16 and 17-17.

Example: Calculate the differential of the channel 1 waveform data and store the result in channel 2.

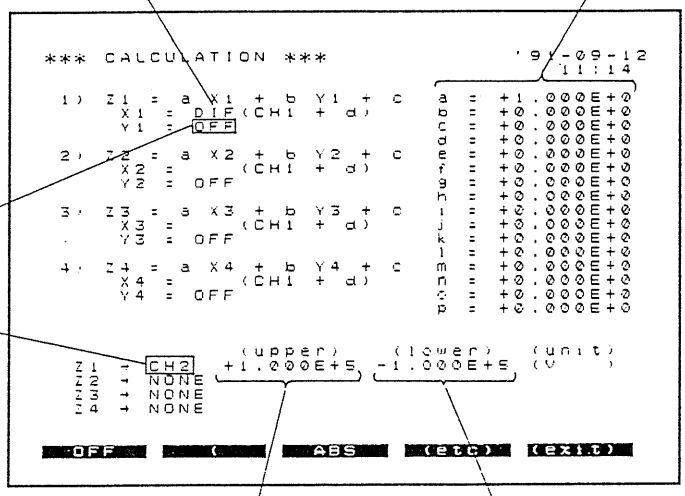
DIF(CH1) → CH2

Specifies calculation of differential

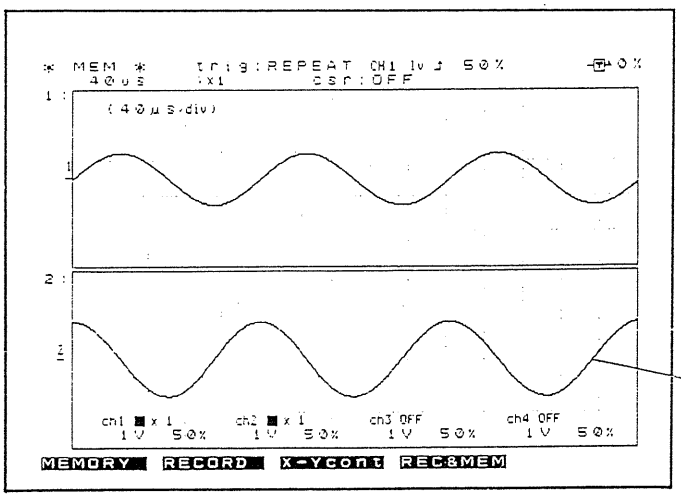
Shows the constants

Not used

Channel specification



Upper end value $+1\times10^5$V, lower end value -1×10^5V



Calculated waveform

(8) Integration once or twice (INT, INT2)

For the equations for calculation, refer to page 17-16 and 17-17.

Example: Calculate the integral of the channel 1 waveform data and store the result in channel 2.

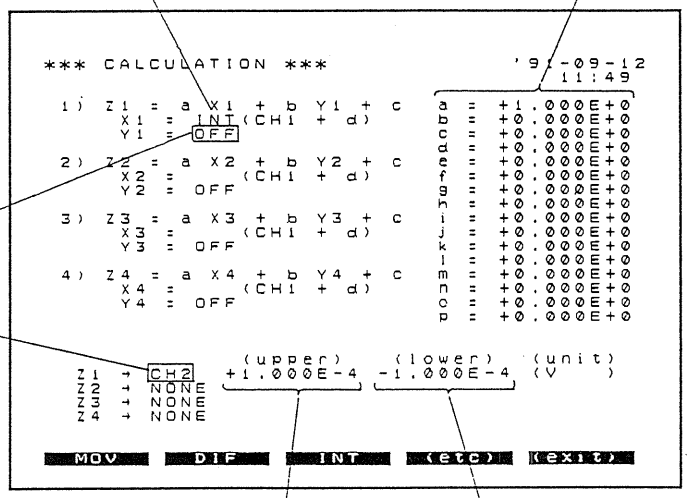
INT(CH1) → CH2

Specifies calculation of integral

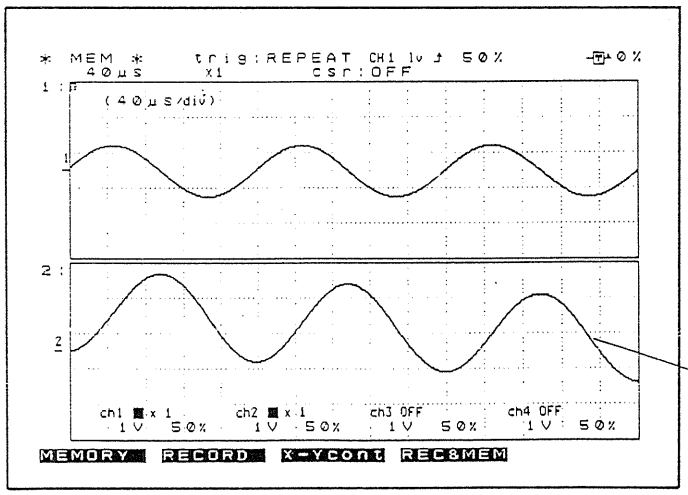
Shows the constants

Not used

Channel specification



Upper end value $+1\times10^{-4}$V, lower end value -1×10^{-4}V



Calculated waveform

Calculation equations for differentiation and integration

① Differentiation:

The calculation of the first and second differential coefficients uses the fifth degree Lagrange interpolation formula, and the result for one data point is obtained from the five data points centered on the given data point.

Using d_0 to d_n for the data at sampling times t_0 to t_n, the values of the differential coefficients for these data points are calculated as follows:

Equations for calculating the first differential coefficient:

$$\text{Point } t_0: \quad b_0 = \frac{1}{12h}\left[-25 \cdot d_0 + 48d_1 - 36d_2 + 16d_3 - 3d_4\right]$$

$$\text{Point } t_1: \quad b_1 = \frac{1}{12h}\left[-3d_0 - 10d_1 + 18d_2 - 6d_3 + d_4\right]$$

$$\text{Point } t_2: \quad b_2 = \frac{1}{12h}\left[d_0 - 8d_1 + 8d_3 - d_4\right]$$

$$\vdots$$

$$\text{Point } t_i: \quad b_i = \frac{1}{12h}\left[d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2}\right]$$

$$\text{Point } t_{n-2}: \quad b_{n-2} = \frac{1}{12h}\left[d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n\right]$$

$$\text{Point } t_{n-1}: \quad b_{n-1} = \frac{1}{12h}\left[-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n\right]$$

$$\text{Point } t_n: \quad b_n = \frac{1}{12h}\left[3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n\right]$$

b_0 to b_n are the data values resulting from the calculation.

h is Δt ... the sampling interval (See Section 2-2 "Tables")

Equations for calculating the second differential coefficient:

$$\text{Point } t_0: \quad b_0 = \frac{1}{12h^2}\left[35d_0 - 104d_1 + 114d_2 - 56d_3 + 11d_4\right]$$

$$\text{Point } t_1: \quad b_1 = \frac{1}{12h^2}\left[11d_0 - 20d_1 + 6d_2 + 4d_3 - d_4\right]$$

$$\text{Point } t_2: \quad b_2 = \frac{1}{12h^2}\left[-d_0 + 16d_1 - 30d_2 + 16d_3 - d_4\right]$$

$$\vdots$$

$$\text{Point } t_i: \quad b_i = \frac{1}{12h^2}\left[-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - d_{i+2}\right]$$

$$\vdots$$

$$\text{Point } t_{n-2}: \quad b_{n-2} = \frac{1}{12h^2}\left[-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n\right]$$

$$\text{Point } t_{n-1}: \quad b_{n-1} = \frac{1}{12h^2}\left[-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n\right]$$

$$\text{Point } t_n: \quad b_n = \frac{1}{12h^2}\left[11d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n\right]$$

② Integration:

The calculation of the first and second integrals is done using the trapezoidal formula.

Using d_0 to dn for the data at sampling times t_0 to tn, the values of the integrals for these data points are calculated as follows:

Equations for calculating the first integral:

Point t_0: $I_0 = 0$

Point t_1: $I_1 = \frac{1}{2}(d_0 + d_1)h$

Point t_2: $I_2 = \frac{1}{2}(d_0 + d_1)h + \frac{1}{2}(d_1 + d_2)h = I_1 + \frac{1}{2}(d_1 + d_2)h$

⋮

Point t_n: $I_n = I_{n-1} + \frac{1}{2}(d_{n-1} + d_n)h$

I_0 to I_n are the data resulting from the calculation.

h is Δt ... the sampling interval ((See Section 2-2 "Tables.")

Equations for calculating the second integral:

Point t_0: $II_0 = 0$

Point t_1: $II_1 = \frac{1}{2}(I_0 + I_1)h$

Point t_2: $II_2 = \frac{1}{2}(I_0 + I_1)h + \frac{1}{2}(I_1 + I_2)h = II_1 + \frac{1}{2}(I_1 + I_2)h$

⋮

Point t_n: $II_n = II_{n-1} + \frac{1}{2}(I_{n-1} + I_n)h$

I_0 to I_n are the data values resulting from the calculation.

(9) Parallel displacement along the time axis (SLI)

The number of points for displacement is specified, and then a displacement is performed along and parallel to the time axis.

The calculation equation is set up as follows:

$b_i = d_i - k$ (i=0, 1, ..., n)

bi ... the ith data item of the result of the calculation

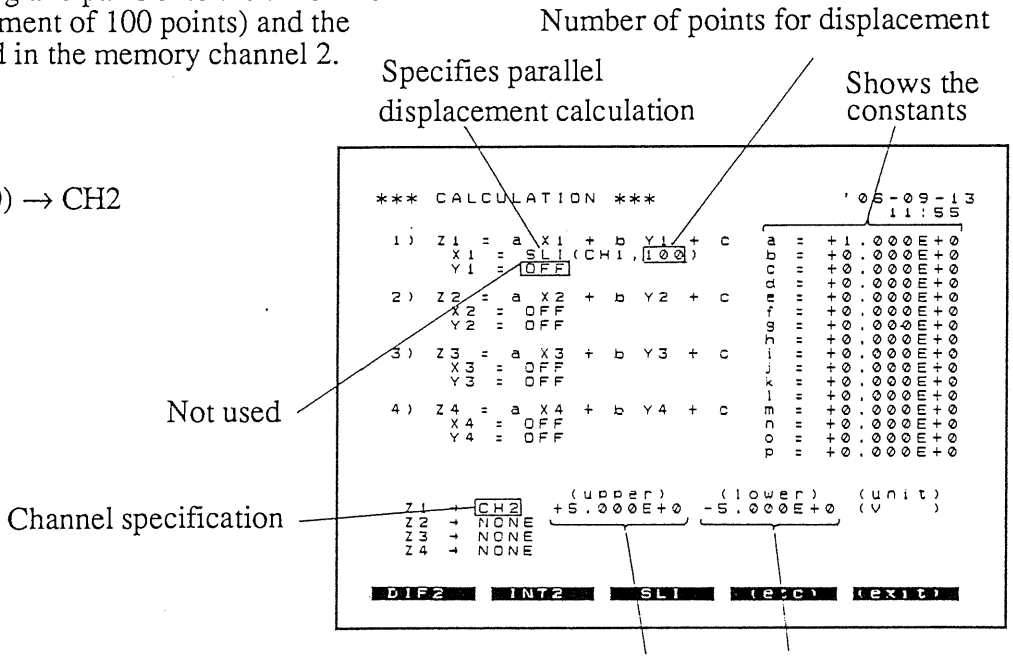
di ... the ith data item of the source channel

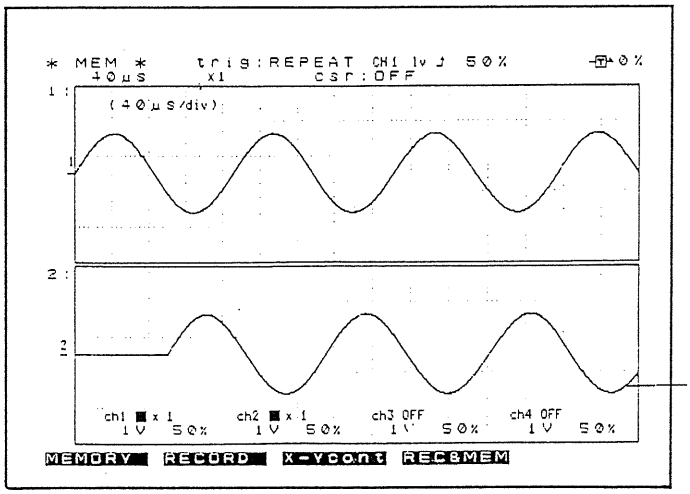
k ... number of points for displacement (-4000 to 4000)

Note: For the part of the calculation result data, either at the start or the end, for which there is no source data in the source channel, a voltage value of 0V is supplied.

Example: The channel 1 waveform data is displaced along and parallel to the time axis (by a displacement of 100 points) and the result is stored in the memory channel 2.

SLI(CH1, 100) → CH2





17-3 Waveform Parameter Calculation and Decision

17-3-1 Summary

It is possible to perform calculation on sampled waveform data or on waveform data which are the results of waveform calculation processing, of the following types: maximum value, minimum value, peak to peak value, average value, effective value, area value, period, frequency, rise time, fall time, XY area. The result of each of these types of calculation appears as a numerical value.

Further, by setting an upper limit value and a lower limit value, it is possible to perform a decision (waveform parameter decision) as to whether the result of one of these calculations falls in the specified range or not.

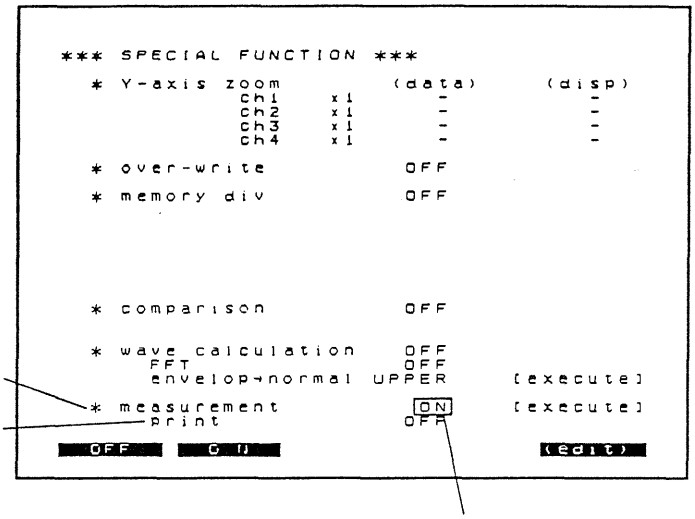
If the A and B cursors are not being used, the calculation is performed for all of the data. When both cursors are used, the calculation is performed for the data between the A cursor and the B cursor. Further, if only the A cursor is used, the calculation is performed for all the waveform data before and up to the A cursor.

17-3-2 Method of Calculation

1. Select the status mode, then use either the ▼ cursor key or the rotary knob to show the special function display.
2. "measurement"

   (OFF, ON, (edit))

   Move the flashing cursor by using the cursor keys, press the soft key (edit) , and the waveform parameter calculation setting screen appears. On this screen, each of the types of calculation is available for selection. For details, refer to the next and following pages.



3. "print"

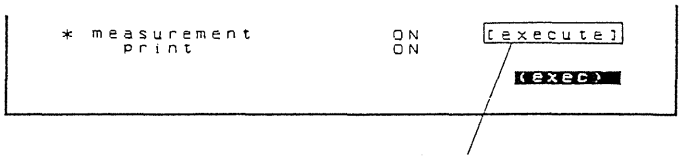
   (OFF, ON, (edit))

   If in step 2 ON is selected, this appears. Press the soft key (edit) , and the waveform parameter calculation setting screen appears. If printing is set to ON, the results of calculations are printed during the process of calculation.

4. The following two alternative methods are available for performing calculation.

   ① From step 2, while holding down the soft key ON , press the START key. After the waveform has been sampled, the calculation will be performed, and along with the display of the waveform, the results of the calculation will be displayed. If printing was set on in step 3, then the results of the calculation will be printed.

   ② If calculation is to be performed for measurement data loaded from a floppy disk or measurement data that have been previously sampled, from step 2, after pressing the soft key ON , move the flashing cursor to the position shown in the figure to the right, and press the soft key (exec) . The calculation will be performed and its result will be displayed on the screen.



Notes

- If "wave calculation" is set to ON, the waveform parameter calculation will be performed on the waveform after the waveform processing calculation.
- Waveform parameter calculation cannot be performed on the results of FFT caloulation.

Settings on the waveform parameter calculation setting ("MEASUREMENT") screen:

1. Set the calculations.

   Up to four calculations, No. 1 to No. 4, can be set simultaneously.

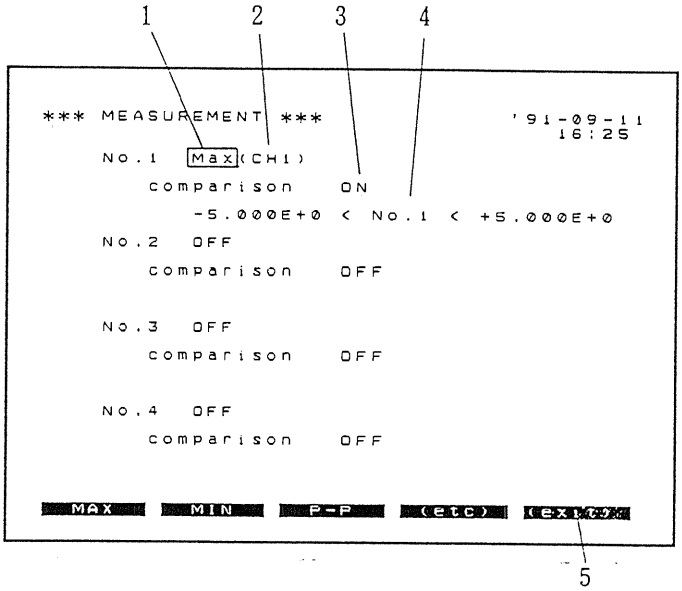
   (Max, Min, Peak to Peak, Average, RMS, Area, Period, Frequency, Rise-time, Fall-time, X-Y Area, OFF)

   Note: No. 1 cannot be set to OFF.

2. Select the channel or channels for which calculation will be performed.

   (ALL, CH1, CH2, CH3, CH4)

   ALL ... all channels from channel 1 through channel 4.



Notes: If this is set to ALL, calculation will not be performed for channels for which display and recording are OFF.

If X-Y Area was selected in step 1, the setting is done differently. Refer to page 17-28, the section relating to XY area calculation.

3. "comparison"

   Select whether or not waveform parameter decision will be performed. (OFF, ON)

4. If waveform parameter decision is to be performed, set the upper and lower limit values here. This only appears if ON is selected in step 3.

   For detailed explanation of waveform parameter decision, refer to Section 17-3-3 "Waveform Parameter Decision".

5. Press the soft key (exit) , to return from this screen to the special function display.

Notes

- The calculations are performed in order from No. 1 to No. 4.
- If the storage mode is set to envelope, it is only possible to perform the calculations for maximum value, minimum value, and peak to peak value.

  (Although it is possible to specify other calculations, they will not be performed.)
- For an input channel for which no input unit is installed, no calculation is performed unless waveform calculation results have been stored in it, or data has been loaded from a floppy disk.
- If scaling has been set, it is effective.

  (With RMS and Area, calculation is done after scaling has been performed.)

17-3-3 Waveform Parameter Decision

An upper limit value and a lower limit value are set, and then a pass/fail (GO/NG) decision is made as to whether the result of a waveform parameter calculation falls in the specified range or not.

For each of the waveform parameter calculations No. 1 to No. 4, a corresponding waveform parameter decision can be set.

1. Select whether or not to make a waveform parameter decision.

   (OFF, ON)

   In this example, select ON.

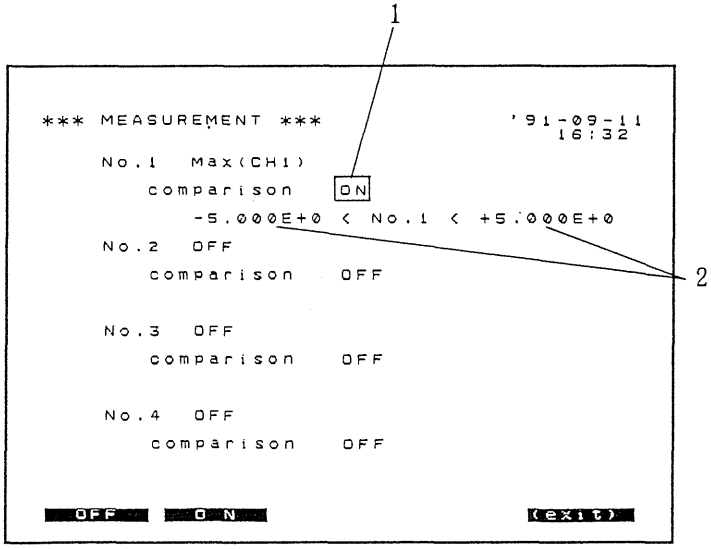
2. Set the maximum and minimum values.

   +0.000E +0

   Mantissa Exponent

   The mantissa can be set to values from -9.999 to +9.999.

   The exponent can be set to values from -9 to +9.



Note: If the lower limit is set to be greater than or equal to the upper limit, then the result of the decision will always be fail (NG).

Stop mode

If, in the condition with waveform parameter calculation and decision set to ON, the START key is pressed so that measurement is started, if the result of the calculation does not lie between the upper limit value and the lower limit value, (so that the result of the waveform parameter decision is NG), then the 8851 stops operating.

The functions when operation stops:

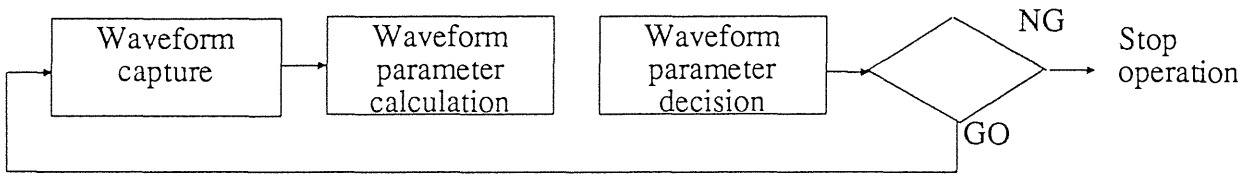
If the auto print function is enabled, when operation stops the waveform is printed.

If the auto save function is enabled, when operation stops the data is saved to the floppy disk.

If the memory division function (sequential save) is enabled, data is recorded in the memory blocks only when operation is stopped.

Example

If the trigger mode is SINGLE, the flow proceeds according to the following pattern:

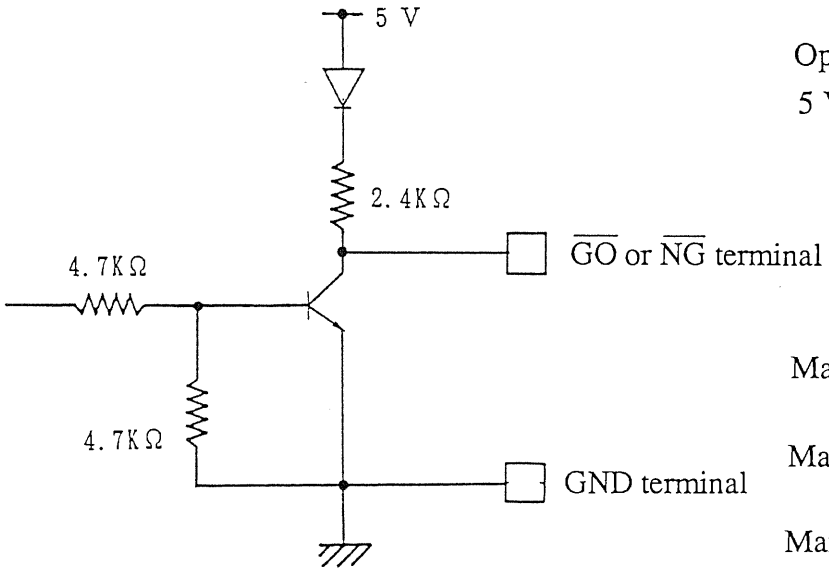


Note: If the trigger mode is REPEAT or AUTO, the above series of operations is repeated.

Pass (GO)/fail (NG) decision output

- The output of the results of waveform parameter decisions can be taken from the back panel of the 8851.

  The pass decision output is provided between the GO and GND terminals, and the fail decision output between the NG and GND terminals. The output circuit is as shown below.



Open collector output

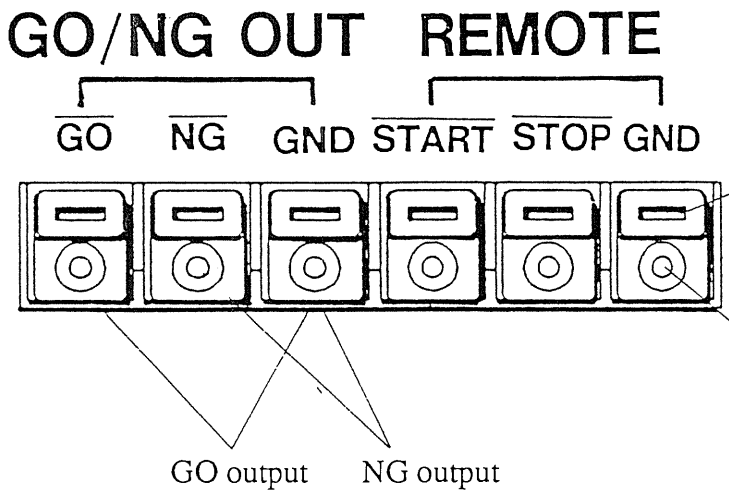
5 V voltage output, active low

Maximum input voltage: -20 to +30 V

Maximum input current: 500 mA

Maximum input power: 200 mW

Connections to the output terminals



Button

- When inserting or removing wires, use a screwdriver to press the button.

Wire connection aperture

- Insert the end of the wire to be connected.

〔Connecting wires and tools〕

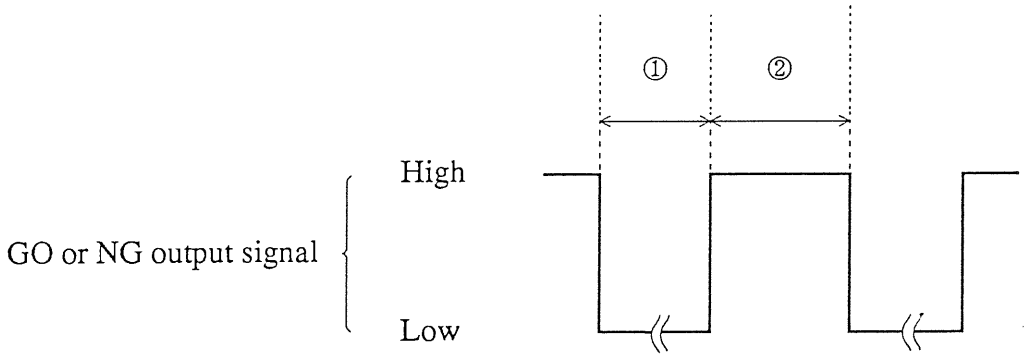
Recommended wire size: Single strand, 1.0 mm dia. (AWG 18), multi-strand 0.75 mm^2.

Usable wire sizes: Single strand, 0.4 to 1.0 mm dia. (AWG 26 to 18), multi-strand 0.3 to 0.75 mm^2 (AWG 22 to 20). Minimum strand diameter 0.18 mm

Standard insulation stripping length: 10 mm

Button pressing tool: Blade screwdriver (tip width 2.6 mm)

- GO and NG output signals



① Time period for low level output (minimum about 70 ms)

During this period data sampling takes place and the waveform data is created. The slower the time axis is set, and the longer the recording time is set, the longer this time period becomes. Either the GO or the NG output, whichever is appropriate, goes low.

② Time period for high level output (minimum about 20 ms)

The decision takes place during this period. Both the $\overline{GO}$ and the $\overline{NG}$ outputs are high at this time.

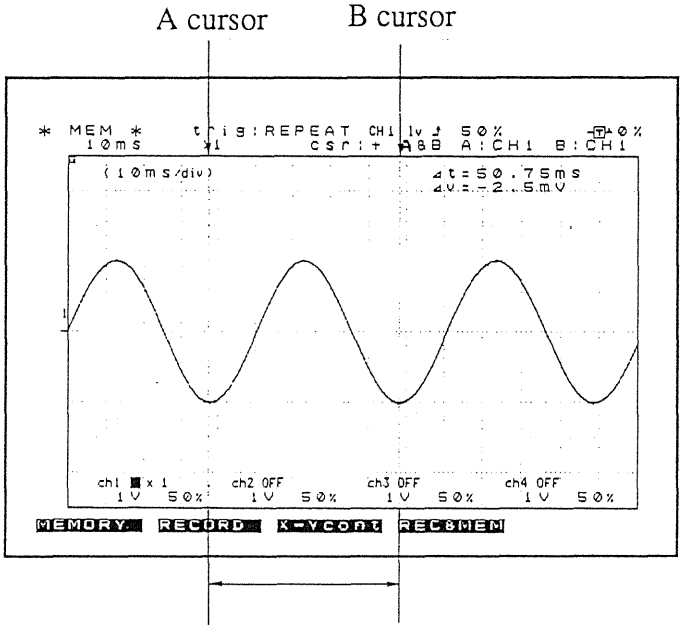
Note

- If several waveform parameter decisions are set, they are ORed together. If any one of them has resulted in a fail (NG) decision, operation stops.
- If the waveform decision function is enabled, for stopping operation and for output the result of the waveform decision is given priority, and therefore the result of the waveform parameter decision is disregarded.

For details of the waveform decision function, see Section 16.

17-3-4 Waveform Calculation Position

If the A and B cursors are not being used, or if the horizontal cursors are being used, the calculation is performed for all of the data. When the A and B cursors are being used as vertical or cross-hair cursors, it is possible to designate the position for waveform calculation. When both the A and the B cursors are being used, the calculation is performed for the data between the A cursor and the B cursor. Further, if only the A cursor is in use, the calculation is performed for all the waveform data before and up to the A cursor.



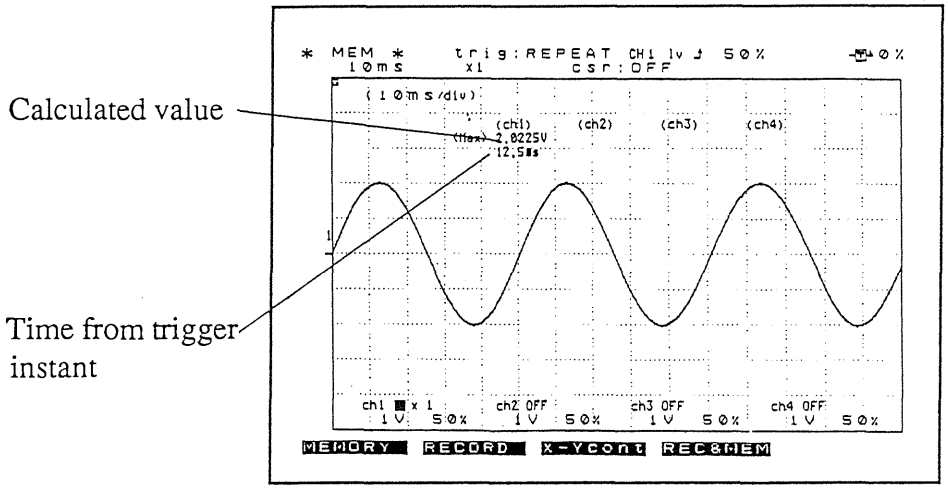
Calculation is performed for the waveform data in this interval.

17-3-5 Details of the various calculations

Each of the various types of calculation will now be explained in concrete terms.

(1) Maximum value (2) Minimum value

Along with displaying (in volts) the maximum value or the minimum value of the waveform data, the time interval (in seconds) is shown from the trigger instant to that maximum value or minimum value.



Note: If scaling has been set, the displayed units appended to the calculated value only show the first character of the set units.

(3) Peak to peak value

The peak-to-peak value (the distance between the maximum value and the minimum value) of the waveform data is shown (in volts).

(4) Average value

The average value (in volts) of the waveform data is shown.

The equation used for the calculation is as follows:

Average value $\bar{d} = \frac{1}{n+1} \sum_{i=0}^{n} d_i$

n ... number of data samples

d_i ... the ith data value of the source channel

(5) Effective value (RMS)

The effective value (in volts) of the waveform data is shown.

The equation used for the calculation is as follows:

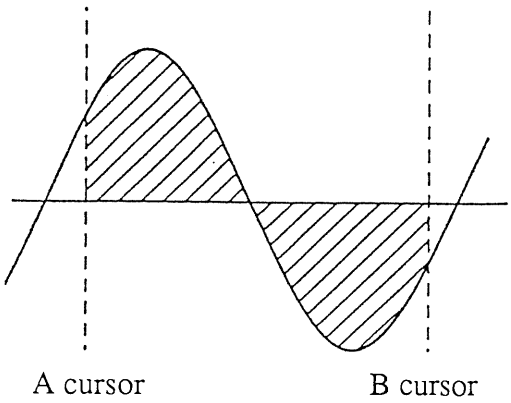
Effective value $RMS = \sqrt{\frac{\sum_{i=0}^{n} d_i^{\,2}}{n+1}}$

n ... number of data samples

d_i ... the ith data value of the source channel

(6) Area value

- The value of the area from the position of the waveform (the point corresponding to 0 V) to the signal waveform is shown in volt-seconds.
- If the A and B cursors are in use, the area of the space bounded by the cursors (the shaded area in the figure) is displayed.
- The equation used for the calculation is as follows:



$$\text{the area } A = \sum_{i=0}^{n} |d_i|$$

n ... number of data samples

d_i ... the ith data value of the source channel

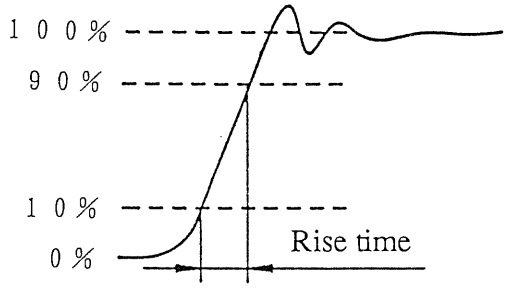
(7) Period (8) Frequency

- These are, respectively, the period of the signal waveform (in seconds) and the frequency of the signal (in Hz).
- The midpoint of the amplitude of the signal waveform is found, and then the period or frequency, as appropriate, is calculated, based upon the time period from the instant that the signal first passes that level when rising or falling to the next instant that it again passes that level.

Note: Unless at least two cycles of the input waveform are supplied, the calculated result will not be displayed.

(9) Rise time (10) Fall time

- The time (in seconds) is displayed which is taken by the signal waveform, either to rise from the 10% level to the 90% level, or to fall from the 90% level to the 10% level, respectively.
- The calculation is performed based upon the computed 0% and 100% values of the sampled waveform data.
- If the A and B cursors are not being used, then the time period taken by the very first occurring rising or falling edge of the entire sampled waveform data is displayed.



- If the A and B cursors are in use, then the time period taken by the first rising or falling edge that occurs in the portion of the sampled waveform data between them is displayed.

Note: Depending on the waveform, it can happen that no calculated result will be displayed.

(11) XY area

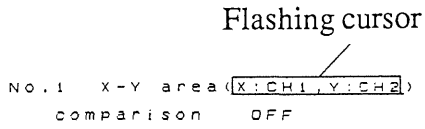
- This shows the area enclosed by an XY plot (in volts-squared). (This does not depend upon the current format)
- The XY waveform is defined by a line, and the area bounded by the line is calculated.
- For formats other than the XY format, if the A and B cursors (vertical cursors or cross-hair cursors) are set, the X-Y plot is generated for the section of data between the two cursors (see Section 17-3-4), and the area is calculated.
- In the XY plot format, it is not possible to delimit an area between the A and B cursors.

How to designate the channels

Move the flashing cursor to the position as shown in the figure on the right, and set the channels with the soft keys [↓] and [↑].

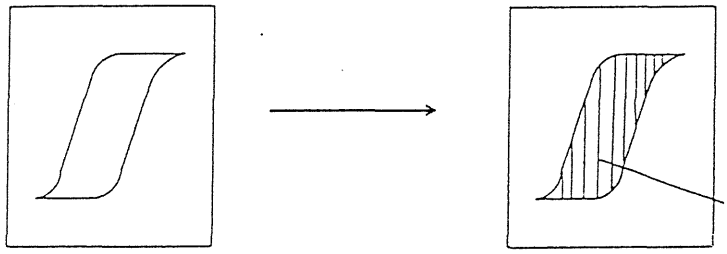
There are six combinations.

(The setting described here has no relation to the setting of the x-axis for display using the XY format)

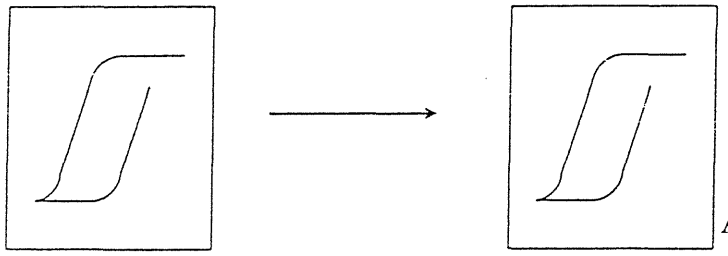


The portion for which calculation is performed:

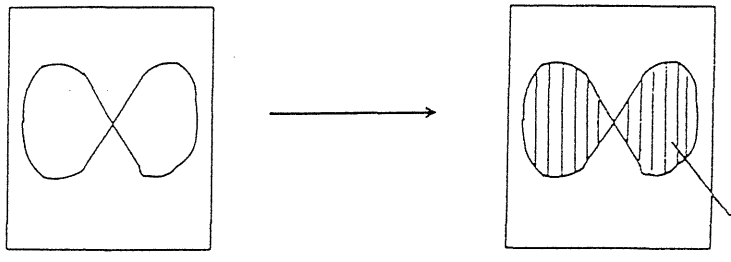
XY waveform



XY waveform (if no portion is surrounded)



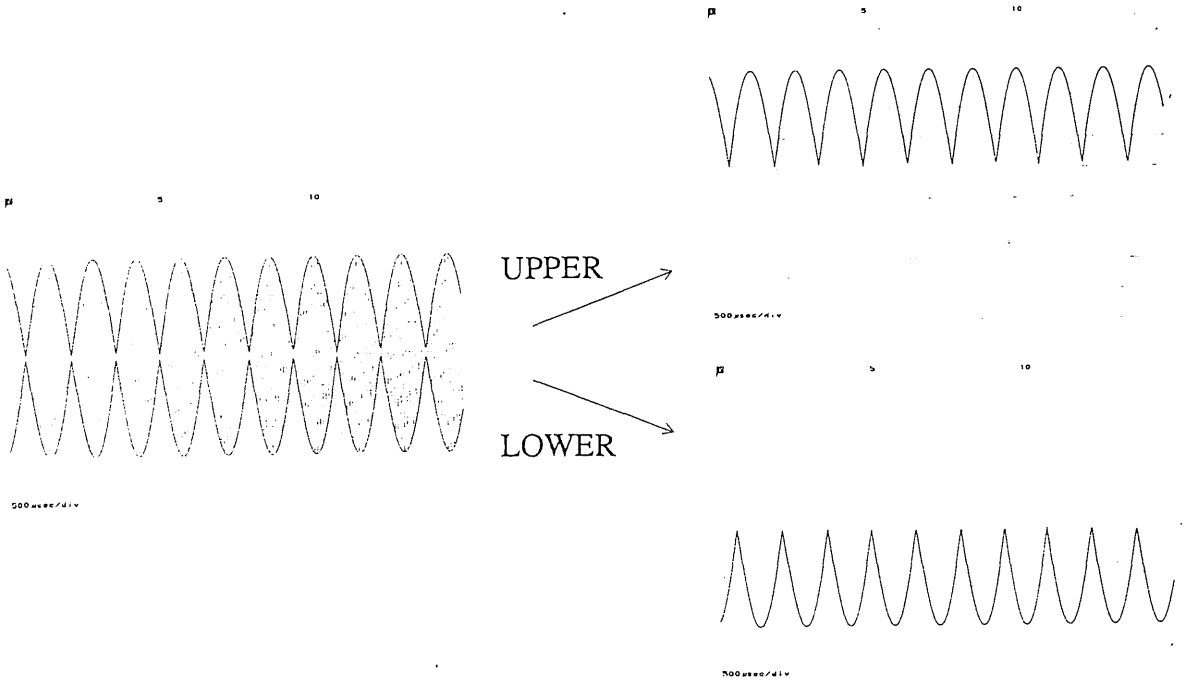
XY waveform



17-4 Envelope To Normal Conversion Calculation

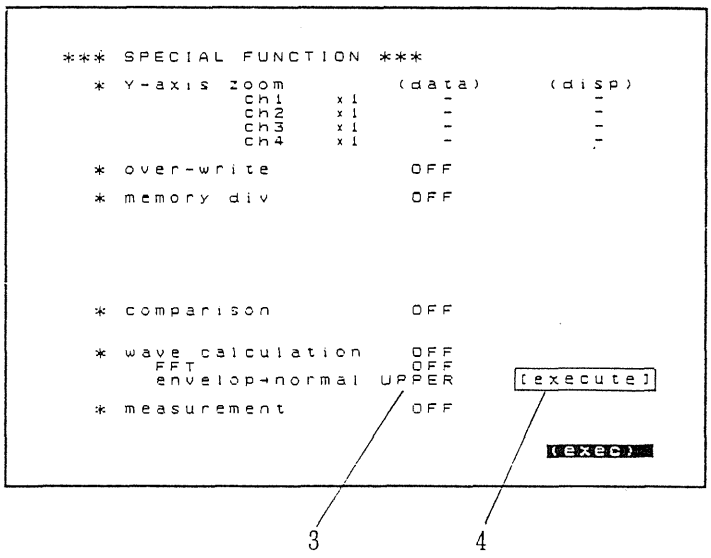
Function

If the storage mode is set to envelope, this function performs the conversion from a sampled and displayed waveform to only its upper or lower envelope curve.



Method

1. The storage mode is set to envelope, and a waveform is sampled.
2. Select the status mode, then use either the ▼ cursor key or the rotary knob to show the special function display.
3. Set whichever one (only) of the upper and the lower envelope waveform curves is the one into which it is desired to convert the waveform.
4. Move the flashing cursor to this position, and press the soft key (exec) . The calculation takes place, and the result is displayed upon the screen.



Note: The basic envelope waveform is deleted from memory. If necessary, save it to a floppy disk first.

17-5 FFT Calculation

17-5-1 Summary

- This allows a Fourier transform of the sampled waveform to be calculated, giving a frequency spectrum.
- Linear spectrum, power spectrum, or storage analysis (time axis waveform) is possible.
- Using the A cursor (vertical cursor or cross-hair cursor), it is possible to perform FFT calculation from any desired position.

17-5-2 Specification

(1) FFT calculation specification

Sampling number:	800 points
Dynamic range:	72 dB (theoretical value)
Frequency range:	4 Hz to 400 kHz, 500 kHz (can be set to ×1, ×1/2, ×1/5) (according to time axis range (TIME/DIV))
Frequency resolution:	1/400
Window:	Rectangular, Hanning

(2) Specification for displaying the calculated results

Display function:	Linear spectrum (real axis, imaginary axis, amplitude) Power spectrum, storage waveform (time)
Display format	
Horizontal axis:	Frequency axis
	Linear display
	Logarithmic display (except for storage waveform)
Vertical axis:	Voltage axis
	Linear [v] (storage waveform, linear spectrum)
	Linear (V^2) (power spectrum)
	Logarithmic [dB] (power spectrum)
CRT resolution:	Vertical 1/250, Horizontal 1/400
Cursor display functions	
Cursor read-out:	time and voltage values from the start point of analysis (storage waveform)
	Frequency and voltage values (linear spectrum) (the voltage values can selectably be set to wave maximum values or RMS values)
	Frequency and power (V^2) values (power spectrum)
	Frequency and logarithm of maximum values [dB] (power spectrum)
Printer output	
Screen waveform copy:	CRT screen waveform copy
Waveform resolution:	vertical 1/250, horizontal 1/400
Data printout function:	Depending on the display function, provides listed output on the printer of the data of all display frequencies (time).

17-5-3 Before Measurement

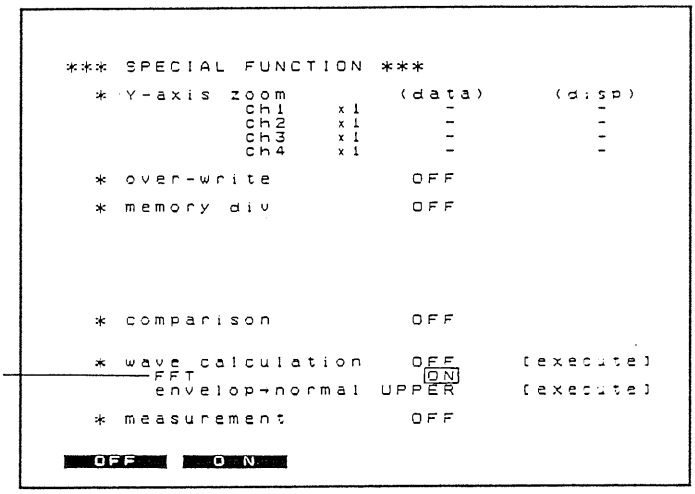
- The frequencies which can be measured and the resolution capability depend on the time axis range (TIME/DIV) of the memory recorder function. By reference to 2-2 "Tables," set an appropriate time axis range (TIME/DIV).
- It is not possible to obtain correct calculation results for a waveform of which the top and bottom have been truncated. Select a more suitable input range.

17-5-4 Calculation Method

1. Select the status mode, then use either the [▼] cursor key or the rotary knob to show the special function display.
2. FFT

   (OFF, ON)

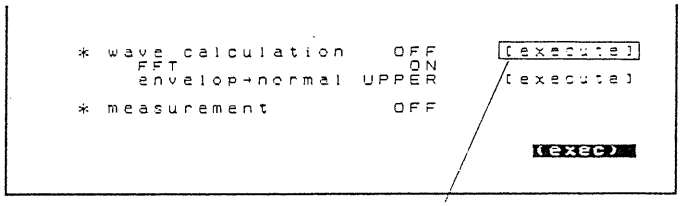
   Press the soft key [ON] and then the [DISP] key, to display the FFT screen. After making the FFT calculation settings, the results of the FFT calculation appear on this screen. For the settings on this FFT screen, refer to the following pages.



3. The following three alternative methods are available for performing calculation.

   ① From step 2, while holding down the soft key [ON] , press the [START] key. After the waveform has been sampled, the result of the calculation performed will be displayed on the FFT screen.

   ② If calculation is to be performed for measurement data loaded from a floppy disk or measurement data that have been previously sampled, from step 2, after pressing the soft key [ON] , move the flashing cursor to the position shown in the figure to the right, and press the soft key [(exec)] . The calculation will be performed and its results will be displayed on the FFT screen.



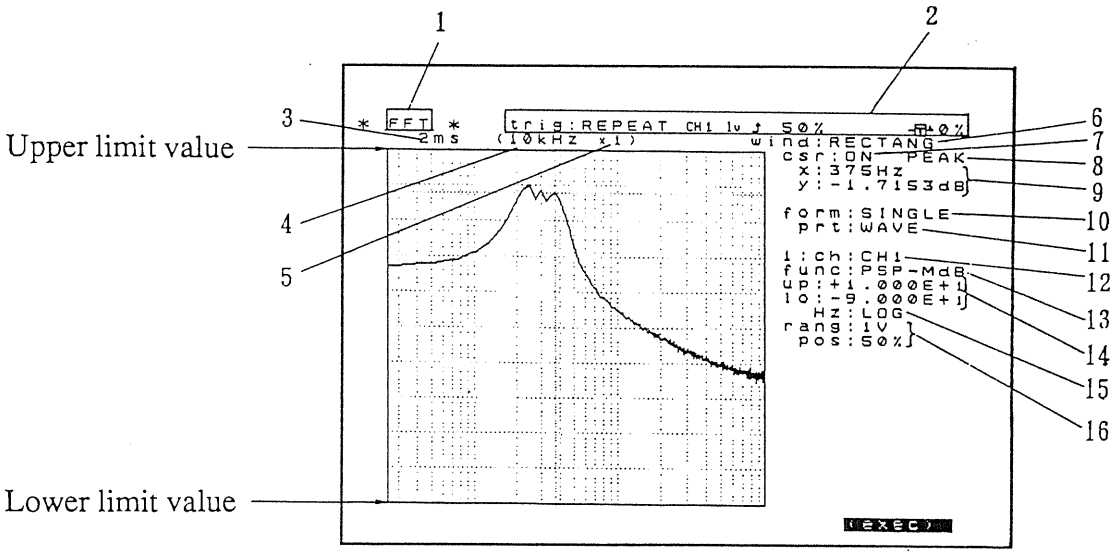
Flashing cursor

   ③ See step 1 on the next page.

Notes

- Even if "over-write" is set to ON, there in no superimposition.
- If the storage mode is not NORMAL, FFT calculation cannot be performed.
- If "wave calculation" is set to ON, FFT calculation is performed on the waveform which results from the waveform processing calculation.
- Even if scaling is set, it will be disregarded.

FFT screen



1. In this position, after moving the flashing cursor by using the cursor keys, pressing the soft key (exec) , and performing calculation on the sampled measurement data, the result is displayed.
2. Make the settings which relate to the trigger here.

   For details refer to Section 14 "Trigger Functions."

   Note: The settings here are linked to those on the display screen and the trigger screen.
3. Set the time axis range for sampling a normal time axis waveform.

   (40 µs, 50 µs, 100 µs, 200 µs, 500 µs, 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s)

   For details, refer to 5-4-2 "Time Axis Range Setting."

   Note: The settings here are linked to those on the display screen and the trigger screen.
4. The frequency range for FFT calculation corresponding to the time axis range set in step 2 is displayed.
5. Next set the compression ratio in the frequency axis direction (the horizontal axis).

   (×1, ×1/2, ×1/5)

   ×1 ... Calculation is performed using 800 of the sampled data points in order.

   ×1/2 ... Calculation is performed using 800 points of the sampled data, taken one every two data points.

   ×1/5 ... Calculation is performed using 800 points of the sampled data, taken one every five data points.
6. Setting the window.

   (RECTANG, HANNING)

   RECTANG ... The waveform data is calculated as it is without alteration.

   HANNING ... A Hanning window is applied to the waveform data.

7. Select whether or not the cross-hair cursor is used.

   (OFF, ON)

   Note: The centers of the cross-hair cursors follow (trace) the waveform. If the format is DUAL, the trace follows the waveform in display window 1. When, after having pressed the knob select key, only the A.B CSR indicator is lit, then the rotary knob moves the cross-hair cursor.

8. This selects whether the cursor value is shown as a peak value or an RMS value.

   (when the function is LIN)

9. Display of cursor value (during DUAL, always in display window 1).

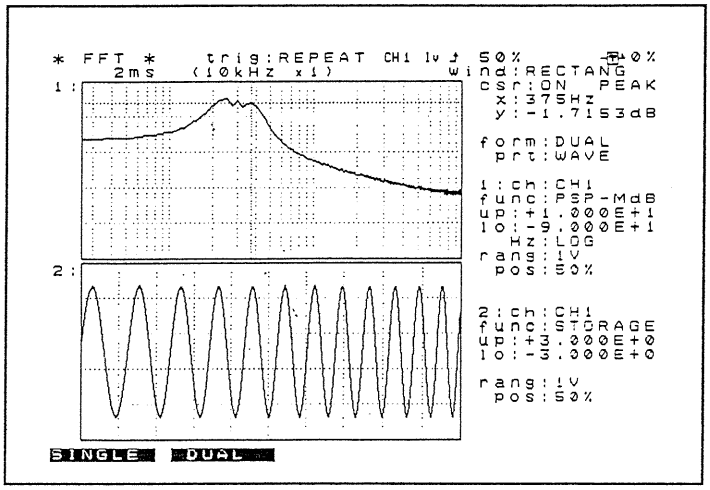
10. Set the format.

    (SINGLE, DUAL)

    SINGLE ... Display and recording are performed on the one frequency axis.

    DUAL ... Display and recording are performed on the upper and lower frequency axes.

    Note: When the function is set to STORAGE, this becomes the time axis.



DUAL Display

11. When the results of the calculations are being recorded on the printer, select whether to print the waveform or numerical data.

    (WAVE, DATA)

    WAVE ... The calculation results are printed as a waveform.

    DATA ... The calculation results are printed as numerical data.

    For details relating to the printing of numerical data, refer to Section 17-5-7 "How to Look at a Waveform Data Listing".

    Note: If WAVE is selected, even if the grid type is set to FINE on the system screen, the waveform will be printed with a NORMAL grid superposed.

12. Set the channel for calculation. (channel 1 to channel 4)

13. Set the function.

    (STORAGE, PSP-MdB, PSP-MAG, LIN-MAG, LIN-IMG, LIN-RAL)

    STORAGE ... A time axis waveform is displayed.

    PSP-MdB ... A power spectrum is displayed logarithmically (dB) on the vertical axis.

    PSP-MAG ... A power spectrum is displayed as a vertical axis $(\text{voltage})^2$.

    LIN-MAG ... A linear spectrum is displayed as a vertical axis voltage.

    LIN-IMG ... The imaginary component of a linear spectrum is displayed as a voltage.

    LIN-RAL ... The real component of a linear spectrum is displayed as a voltage.

14. Set the upper limit value (up) and the lower limit value (lo) for the vertical axis.

up: + 1.000 E + 0

Mantissa Exponent

The mantissa can be set to values from -9.999 to +9.999.

The exponent can be set to values from -9 to +9.

The units vary according to the function.

15. Set the type of scale along the frequency axis.

(LIN, LOG)

LIN ..... The horizontal axis shows frequency on a linear scale.

LOG ..... The horizontal axis shows frequency on a logarithmic scale.

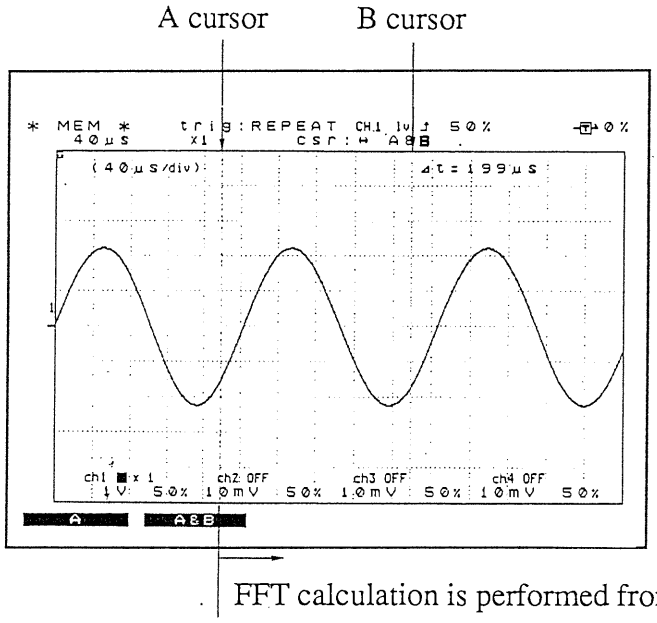
Note: If the function is STORAGE, this is not displayed.

16. Shows the voltage range (rang) and origin position (pos) for the input unit on the channel selected in step 12.

17-5-5 Position For Waveform Analysis

When using the A and B cursors in the memory recorder function, the analysis position of the waveform can be altered.

FFT calculation is performed from the leftward one of the A and B cursors.



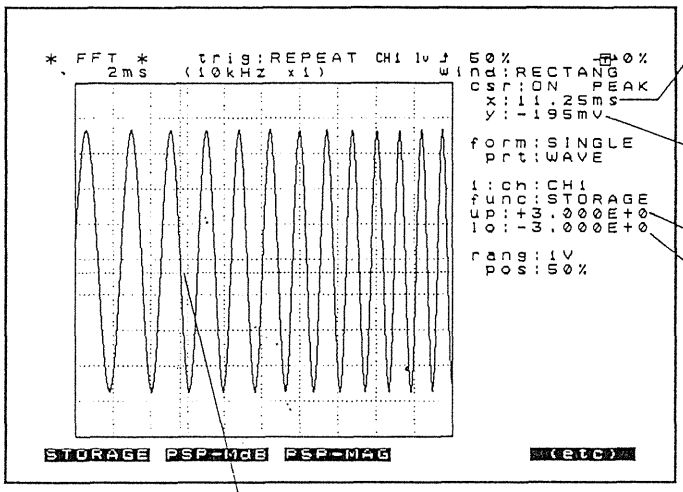
If the A and B cursors are off, FFT calculation is performed from the start of the waveform.

Note: If the number of points of waveform data is not sufficient, the missing waveform data will be calculated as having a 0 V data voltage value.

17-5-6 Display for Each Function

(1) STORAGE

The time axis waveform used for analysis is displayed.



The value of the cross-hair cursor (the trace point)

X axis (time from the start position for analysis)

Y axis (voltage values)

Vertical axis scale

Upper limit value 3 V

Lower limit value − 3 V

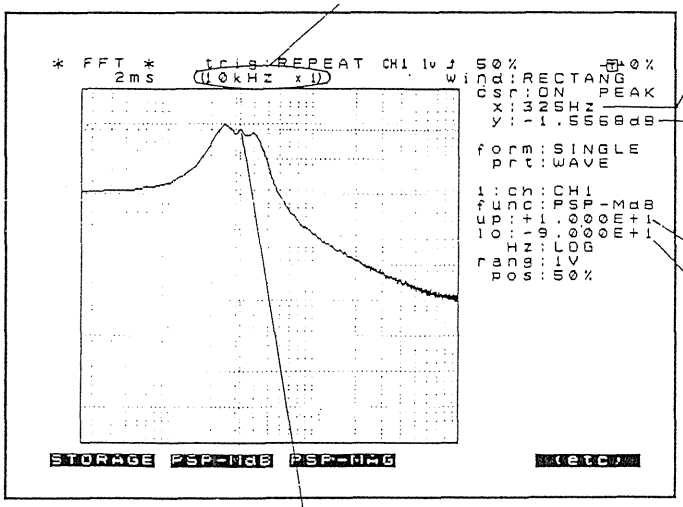
Center of the cross-hair cursor (the trace point)

(2) PSP-MdB

A power spectrum P is shown by the logarithmic value $10\log_{10}(P/P_{max})$, where its maximum value is P_{max}.

The amplitude value V of a linear spectrum is shown by the logarithmic value $20\log_{10}(V/V_{max})$, where its maximum value is P_{max}. This gives the same result as with a power spectrum.

Maximum frequency value



The value of the cross-hair cursor (the trace point)

X axis (frequency)

Y axis (logarithm of maximum value)

Vertical axis scale

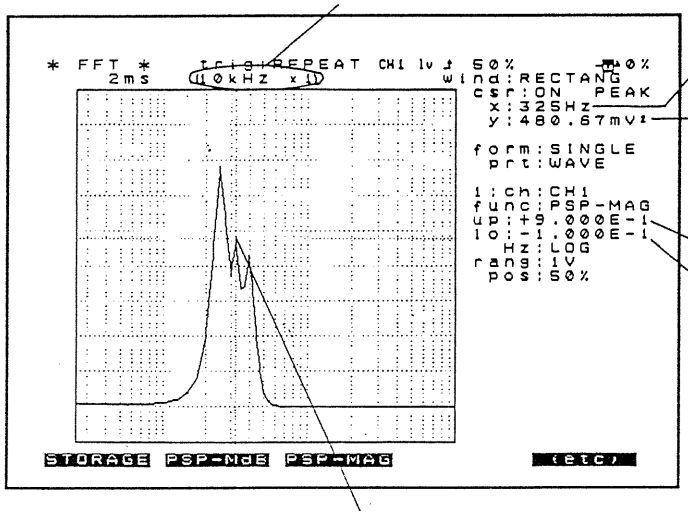
Upper limit value 10 dB

Lower limit value -90 dB

Center point of the cross-hair cursor (the trace point)

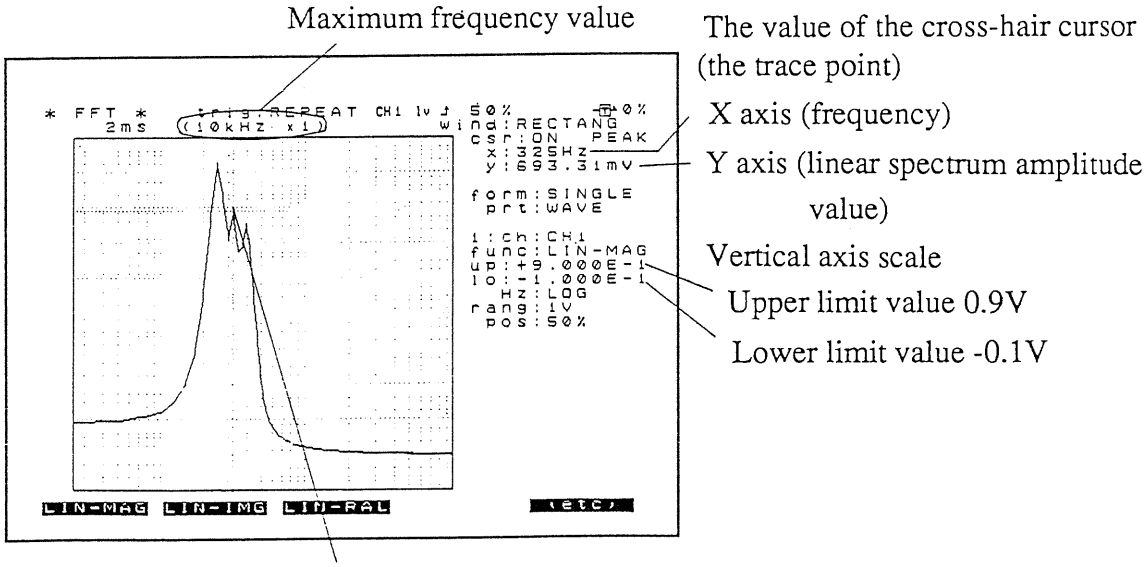
(3) PSP-MAG

A power spectrum is shown. The units are (V^2).



(4) LIN-MAG

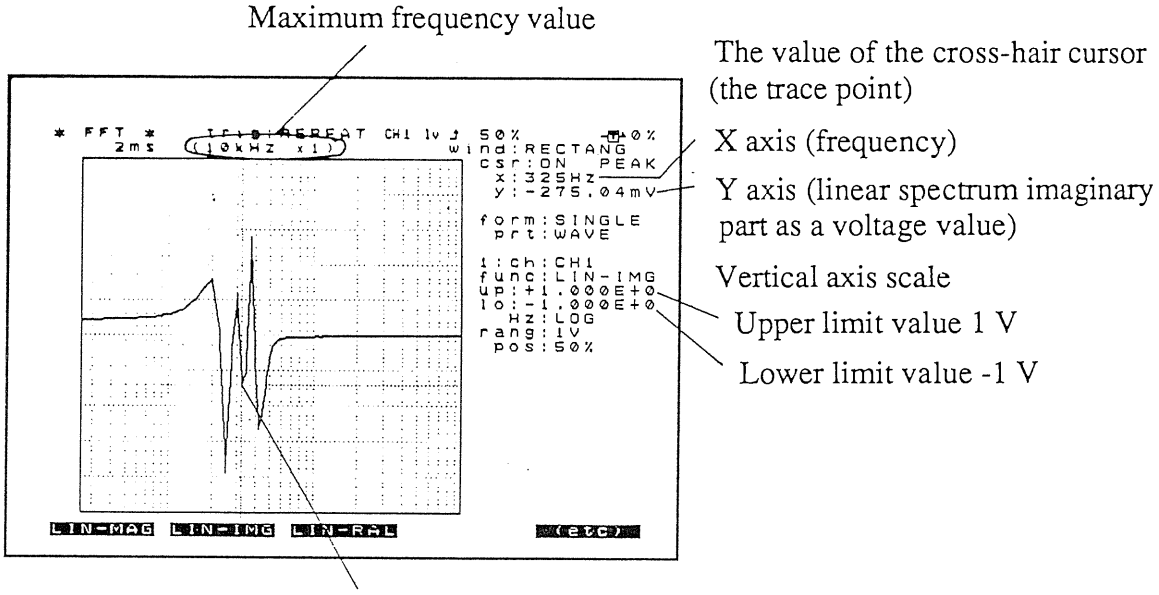
The amplitude of a linear spectrum is shown. The units are (V).



(5) LIN-IMG

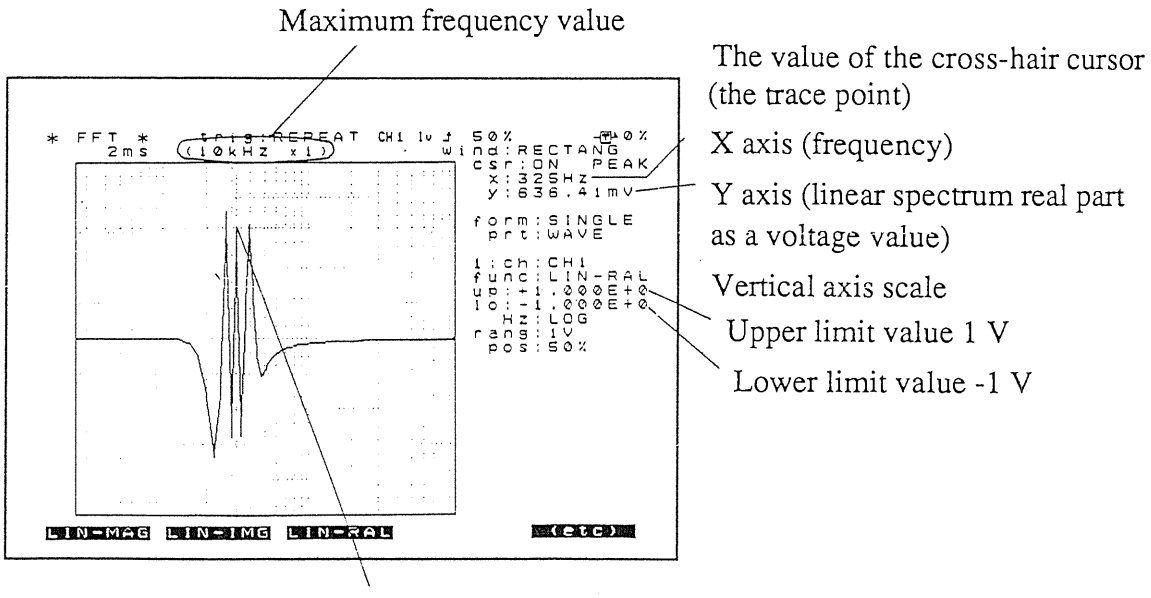
The imaginary part of a linear spectrum is shown as a voltage value (V).

The phase can be derived as $\tan^{-1}$(LIN-IMG/LIN-RAL).



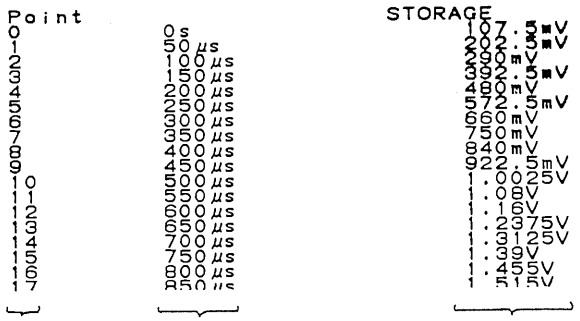
(6) LIN-RAL

The real part of a linear spectrum is shown as a voltage value (V).



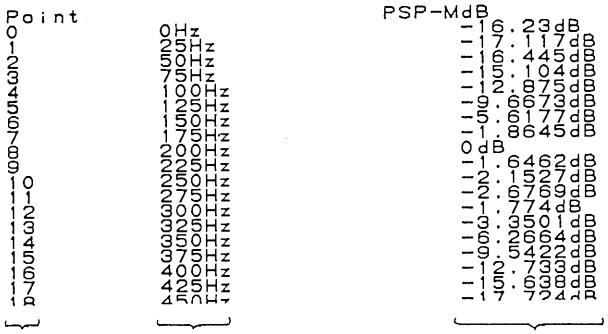
17-5-7 How to Look at a Waveform Data Listing

(1) STORAGE



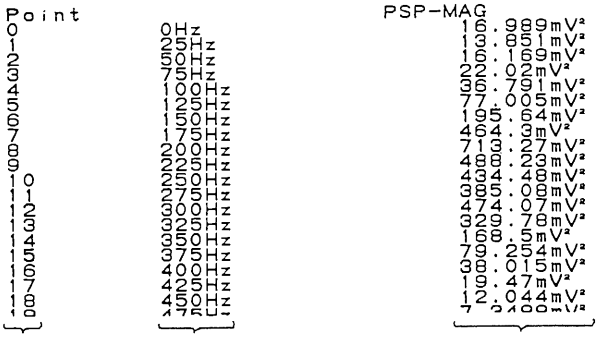
Point no. Analysis start position Voltage value

(2) PSP-MdB



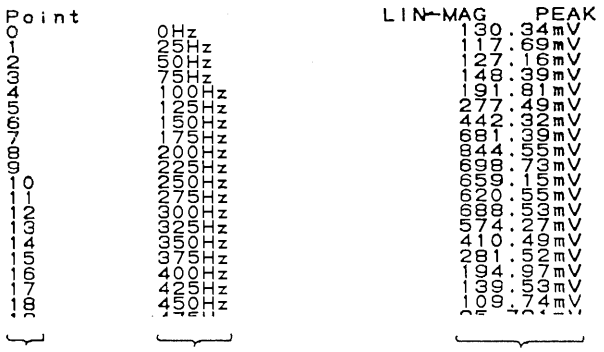
Point no. Frequency Logarithm of maximum value (maximum value 0 dB)

(3) PSP-MAG

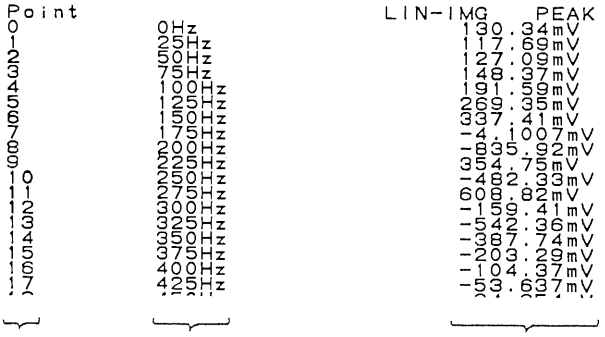


Point no. Frequency Power spectrum voltage^2 value

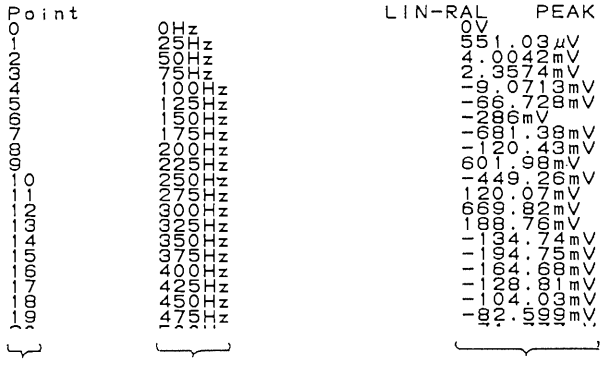
(4) LIN-MAG



(5) LIN-IMG



(6) LIN-RAL



17-5-8 More About the FFT Function

(1) Introduction

The term FFT is an abbreviation of "Fast Fourier Transform", and is a computational technique for decomposing a time waveform into frequency components.

The way the system operates is that FFT calculation is performed on input data sampled in the memory recorder function. The result of the calculation is put into graphic form and printed out.

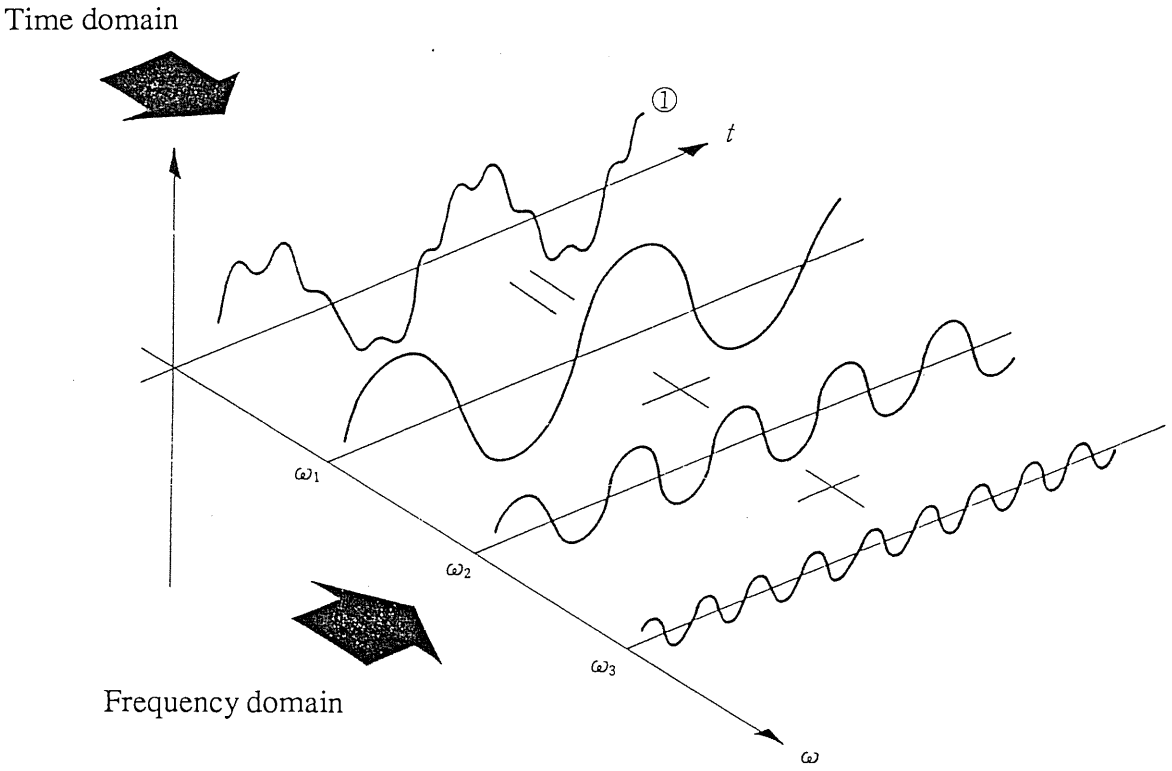
(2) General concept of the analysis function

① Time domain and frequency domain

Suppose that a signal measured in the memory recorder function looks like the waveform ① in the figure as a function of time. This is the time domain way of viewing the situation.

Actually, this signal is a composite waveform made up from sine waves of various frequencies. Showing the waveform ① of the original signal as a function of frequency is the frequency domain way of viewing the situation.

Even if a signal is difficult to analyze as a waveform measured in the time domain, if it is measured in the frequency domain, the characteristics of this signal become very easy to understand.



② FFT analyzers and spectrum analyzers

Currently two types of measurement device are available for performing frequency domain analysis. One of these is generally called a spectrum analyzer; the other is an FFT analyzer. A spectrum analyzer uses a large number of filters, and measures the spectrum by hardware, whereas the FFT technique calculates the spectrum mathematically.

In principle, both of these have strong points and weak points. One point is that a spectrum analyzer cannot see a direct current component, as opposed to an FFT analyzer which can; however, another point is that high frequency spectra can be seen with a spectrum analyzer, but not with an FFT analyzer.

Moreover, a spectrum analyzer only views a spectrum simply; but because an FFT analyzer, during calculation, obtains the imaginary component of the data, it can do many calculations. For example, there is the point that, while looking at the energy component of a spectrum (the power spectrum), and while looking at the result of multiplying together two waves (the cross power spectrum) or of dividing them (their transmission function), an FFT analyzer can see the correlation along the time axis of one wave, or of two waves.

(3) Physical interpretation of Fourier transform analysis

The mathematical definitions of the Fourier transform and the reverse Fourier transform are shown below.

$$F(\omega) = \mathcal{F}[f(t)] = \int_{-\infty}^{+\infty} f(t) \cdot \exp(-j\omega t)dt \qquad (\mathrm{I})$$

$$f(t) = \mathcal{F}^{-1}[F(\omega)] = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(\omega) \cdot \exp(j\omega t)d\omega \qquad (\mathrm{II})$$

($\omega = 2\pi f$, j is the unit on the imaginary axis, $f(t)$ is a non-periodic function, $\mathcal{F}$ is the Fourier transform, exp is natural logarithm.)

Further, in general $F(\omega)$ is a complex function.

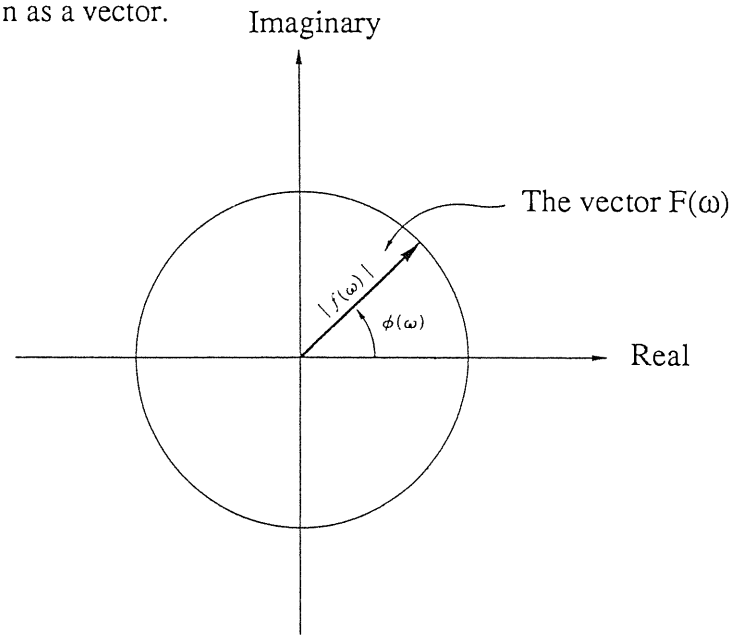
$$F(\omega) = |F(\omega)| \cdot \exp(j\phi(\omega)) = |F(\omega)| \angle \phi(\omega) \qquad (\mathrm{III})$$

$$\mathcal{F}[f(t)] = F(\omega) = F(j\omega) \qquad (\mathrm{IV})$$

$|F(\omega)|$: the absolute value spectrum of $f(t)$.

$\phi(\omega)$: the unit spectrum of the phase of $f(t)$.

By performing the conversion from a time domain to a frequency domain, the amplitude information and phase information as shown by equation (III) are presented clearly. Below, $F(\omega)$ is shown as a vector.



(3) Definitions and meanings for the analysis function

[STR]: Time axis waveform (Storage)

Function (channel a): fa

Meaning: The time domain waveform of the input signal on channel a (channel 1 to channel 4). 800 words of data after A/D conversion.

[LIN]:Linear Spectrum

Function: $Fa = F(fa)$

$= | Fa | \cdot \exp(ja)$

$= | Fa | \cdot (\cos \angle a + j \sin \angle a)$

Meaning: The spectrum of the waveform stored in memory channel a (channel 1 to channel 4).

The main uses of this are:

Investigating the peaks of the frequency component of a waveform.

Investigating the level of a high frequency wave or a low frequency wave.

Investigating the frequency characteristics of a filter or the like by using an impulse signal.

[PSP]:Power Spectrum

Function: $Gaa = Fa \cdot Fa^*$

$= Re^2(Fa) + Im^2(Fa)$

$= | Fa |$

Meaning: Fa* is the complex conjugate of Fa.

The energy spectrum of the waveform stored in memory channel a (channel 1 to channel 4). It only includes the amplitude information.

The main uses of this are:

Investigating the peaks of the frequency component of a waveform. Because the differences of level appears to be larger that with a linear spectrum, this is suitable for finding the peaks.

Investigating the level of a high frequency wave or a low frequency wave.

(4) Aliasing Distortion

① A/D Conversion

The 8851 converts input signals from analog values into digital values, and then internally performs all processing of signals using digital values. This A/D conversion process is called sampling.

The process of sampling can mathematically be viewed as multiplying a continuous signal by a succession of unit impulses.

As the period of sampling a signal, i.e. the sampling interval, is made larger, at some limiting point erroneous information starts to be produced.

As illustrated in the figures, the phenomenon of overlapping of the spectrum of a signal which has been subjected to A/D conversion is called frequency aliasing.

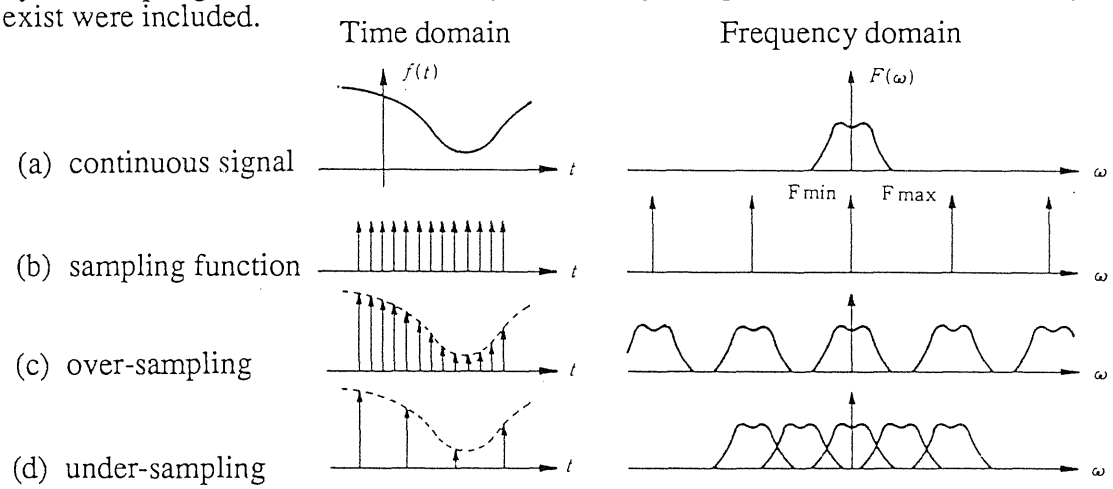
The sampling theorem is this obtaining of the sampling frequency (the Nyquist frequency) when the spectrum overlaps.

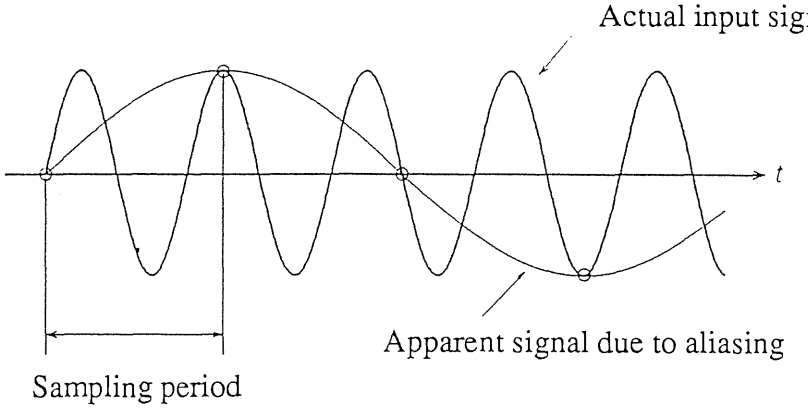
$F_S = 2 \cdot F_{max}$

Fmax =highest analysis frequency

Fs=Nyquist frequency

If sampling is performed at a frequency lower than the Nyquist frequency as determined by the sampling theorem, it will seem just as though frequencies which do not really exist were included.





② Anti-aliasing filter

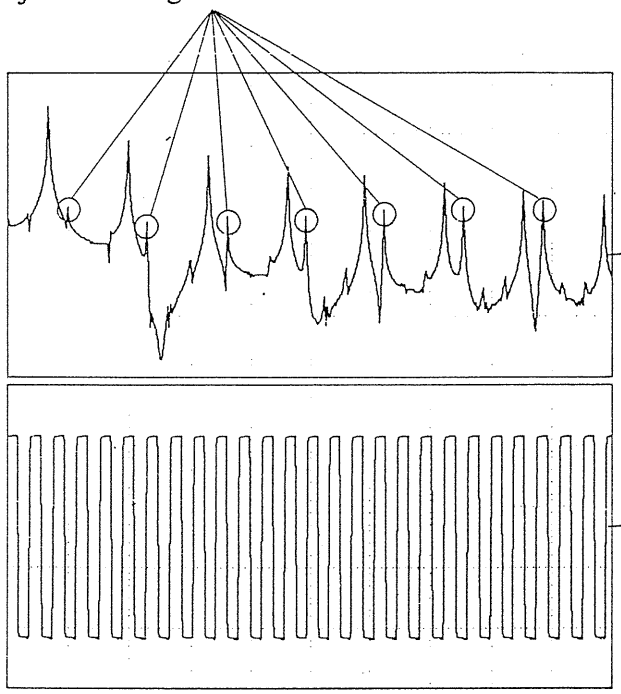
Because with the 8851 the sampling frequency is determined according to the setting of the time axis range, it can be considered certain that the highest frequency component included in the input signal will exceed the Nyquist frequency.

In the case of FFT calculation, many spectrum frequencies that do not really exist can appear because of the influence of errors during calculation.

In order to prevent this phenomenon, it is necessary to provide, before the sampling, a low bypass filter having a cutoff frequency half of the sampling frequency. This low pass filter is called an anti-aliasing filter.

With the 8851, this anti-aliasing filter function is not available. Kindly use it bearing in mind the characteristics of digital signals.

A spectrum originating according to aliasing distortion of a high frequency component by comparison with the sampling rate of the A/D converter, although it does not exist, is observed just as though it did exist.



Section 18

System Screen

Contents

18-1 System Screen Basics

During any function, pressing the SYSTEM key switches to the system screen mode. The system mode provides functions for setting the clock, setting scaling, appending comments, setting special functions, settings related to the GPIB interface, settings related to plotter output, and self-checking. Apart from the special function settings, the settings are common to all functions.

18-2 The Clock Function and How to Set It

Function

(1) The 8851 is internally provided with a calendar capable of automatic leap year discrimination, and with a twenty-four hour clock.

(2) The current year, month, day, hour, and minute are shown on the status screen and on the trigger screen, and additionally the current second is shown on the system screen.

(3) The clock is used for the time trigger function.

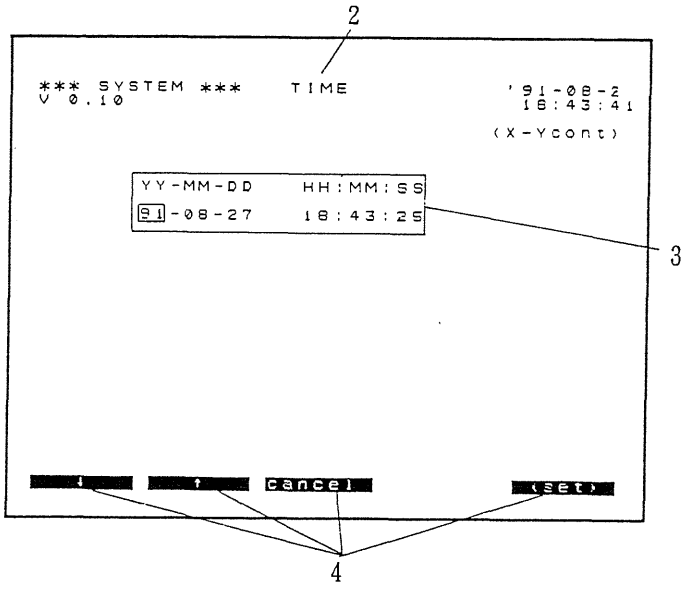
(4) The clock is also used for the storage start time for a listing.

Procedure

1. Press [SYSTEM] .
   The system screen will appear.
2. Press the soft key [TIME] and the clock-calendar setting screen will appear.

   (TIME, SCALING, COMMENT, SETUP, GP-IB, PLOTTER, SELF CHECK)

   Pressing the soft key [(etc)] changes the setting menu.



3. Set the date and time.

   YY — MM — DD HH : MM : SS

   year month day hour : minute : second

4. Cycle the numbers upwards and downwards by pressing the soft keys [↓] and [↑] respectively.

   Press the soft key [cancel] to leave the time and date at the current values, as displayed in the upper right corner of the screen.

   Press the soft key [(set)] to change the time and date to the new setting.

18-3 Scaling Function

Function

(1) By setting the physical amount of input signal per one volt (EU/V), the offset (EU offset), and the name of the units used (EU), a measurement value which has been obtained as a voltage value can be converted into a value in the set units.

(2) The scaled values appear on the gauge scale, the values of the scale (the upper and lower limit values along the perpendicular axis), and the value of ΔV when the A and B cursors are in use. (See the note)

(3) For a calculated waveform, the scaling is performed on the waveform which results after the calculation has been finished. (See Section 17 "Calculation Functions.")

Note: EU ("Engineer Units") refers to the external physical units which a measurement represents.

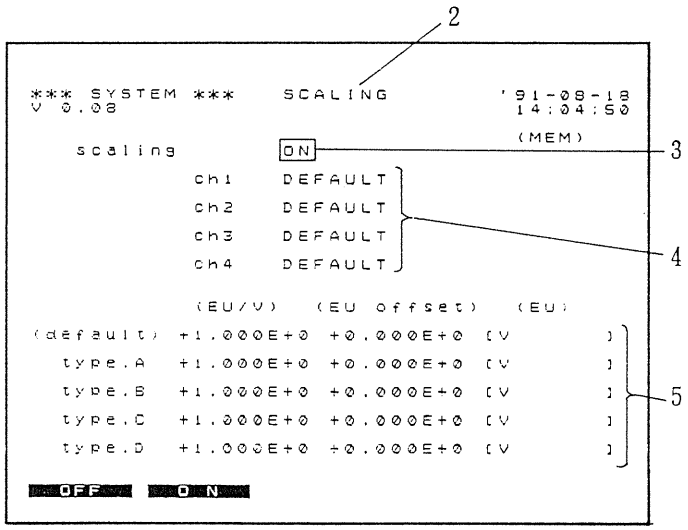
Method

An example from the use of the memory recorder function will be taken.

1. Press SYSTEM.
   The system screen will appear.
2. Press the soft key SCALE and the scaling setting screen will appear.

   (TIME, SCALING, COMMENT, SETUP, GPIB, PLOTTER, SELF CHECK)

   Pressing the soft key (etc) changes the setting menu.
3. Press the soft key ON and scaling will be performed.
4. For the scaling for each channel, use the soft keys to select which of the five schemes displayed below will be used: (default), type.A, ... type.D



   (DEFAULT, TYPE.A, TYPE.B, TYPE.C, TYPE.D)

   When set to DEFAULT, no scaling is performed. (However, the method of display of the gauge scale, the scale values, and the value of ΔV when the A and B cursors are in use will be changed). For those channels for which scaling is not required, DEFAULT should be set.
5. Scaling set to one of type.A to type.D

   ① (EU/V) +1.000E+0 The mantissa portion can be set to any value from -9.999 to +9.999.

   The exponent portion can be set to any value from -9 to +9.

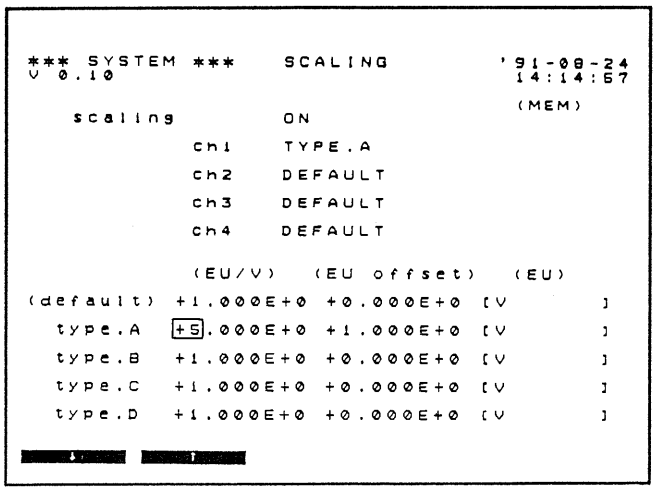
   ② (EU offset)+0.000E+0 The mantissa portion can be set to any value from -9.999 to +9.999.

   The exponent portion can be set to any value from -9 to +9.

   ③ (EU) [V] Input the physical unit name for each channel. The units name can be up to 7 characters long.

Making settings ① and ② :

Set each digit in order using the soft keys [↓] and [↑].



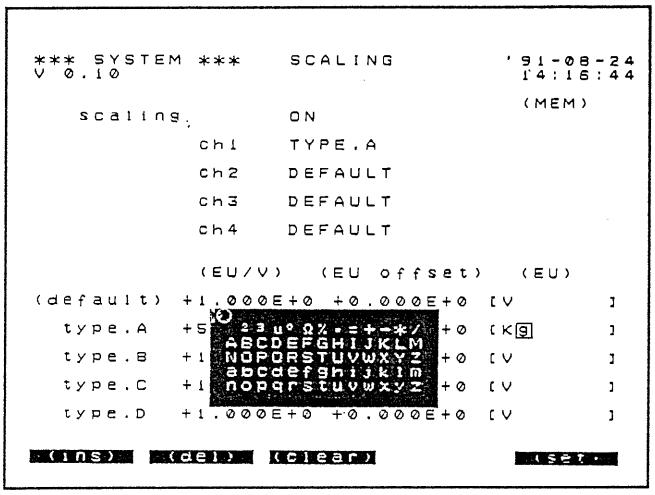
Making setting ③ :

Bring the flashing cursor into the area [V] and a window will appear.

a. Turn the rotary knob and move the cursor in this window, to select each character required.

b. Pressing the soft key (set) moves the flashing cursor one space to the right. (The cursor key [▶] performs the same function).

Repeat actions a. and b.



- Explanation of the soft keys

The soft key (ins) .... is used for inserting a character between two other characters.

Example: ... Press the soft key (ins) ... Select the character "Z" using the rotary knob ...

The soft key (del) .... is used for deleting the character at the position indicated by the flashing cursor.

Example: ... Press the soft key (del) ...

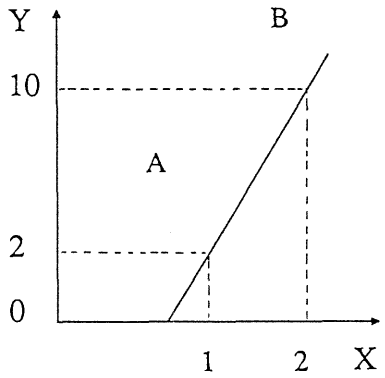
The soft key (clear) ....is used for deleting all characters to the right of the position indicated by the flashing cursor.

Example: ... Press the soft key (clear) ...

The soft key (set) .... is used for accepting the character at the position indicated by the flashing cursor and moving the cursor one space to the right.

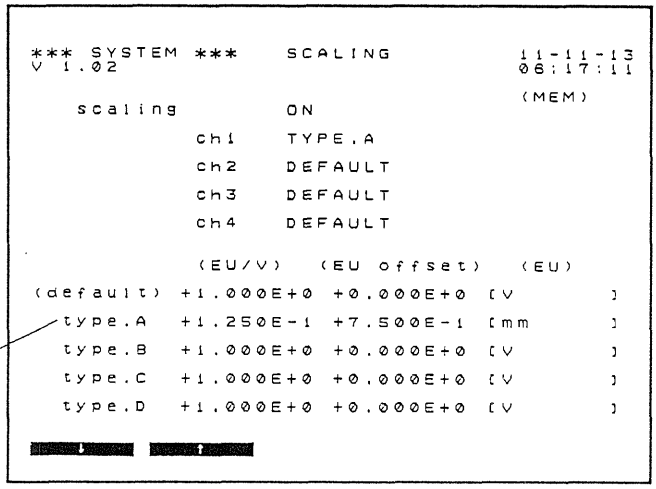
Example of scaling operation

Required: To set the scaling for the measurement values which are produced when a displacement sensor with a characteristic as shown by the following graph is used.



Y=8X-6 .... (1)
(V) (mm)
⇩
X=0.125Y+0.75 ... (2)
(mm) (V)

Inverting equation (1) results in equation (2). If scaling is performed as specified in the figure shown on the right, then the results of measurement, which have been obtained as voltage values, are scaled into displacement values in mm.



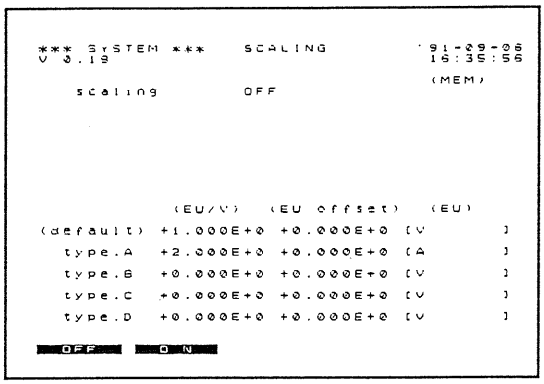
scaling

For example, point A, when Y=2V, is scaled into a position
(+1.250 E - 1) × 2 + (+7.500 E-1)= 1 mm
and point B, when Y=10V, is scaled into a position
(+1.250 E -1) × 10 + (+7.500 E -1) = 2 mm

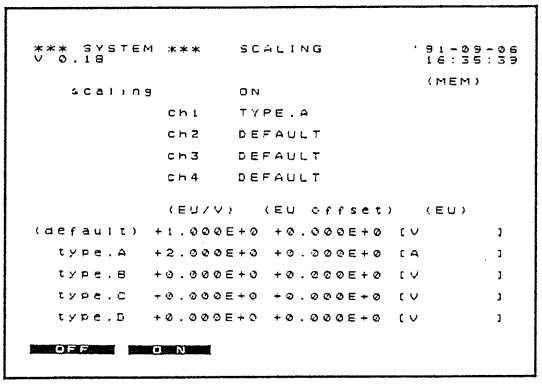
Notes

The scaled values are shown in the following way on the gauge scale, as the range values (the upper and lower limit values along the perpendicular axis), and the value of ΔV when the A and B cursors are in use.

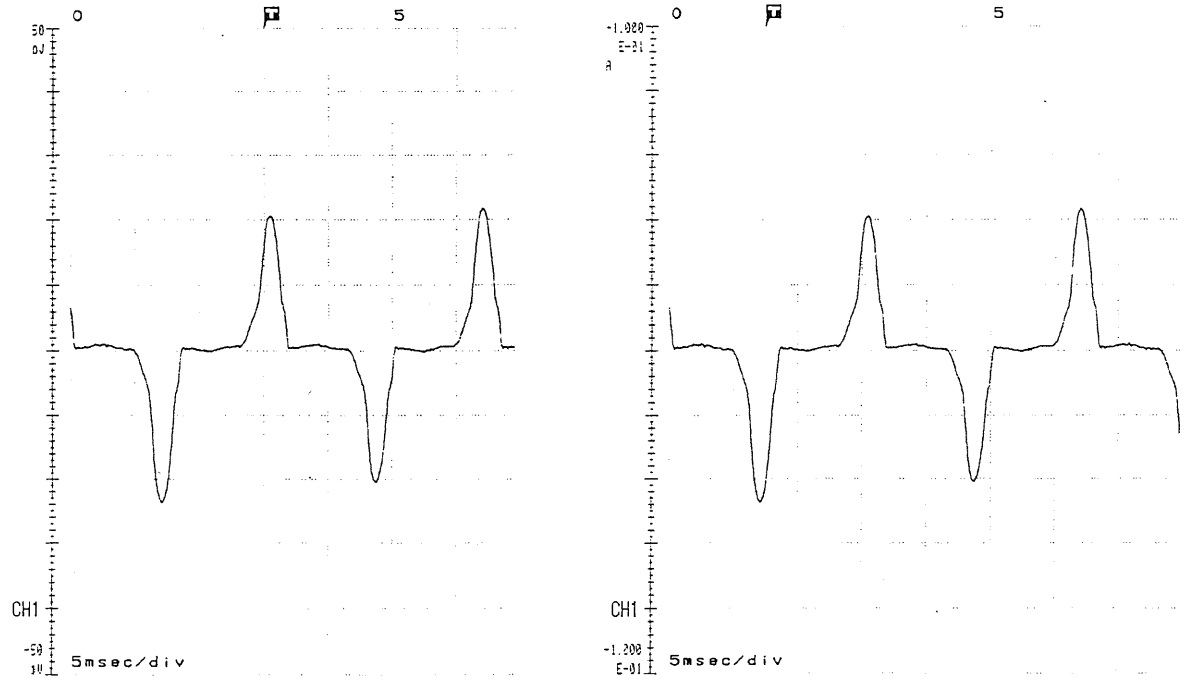
Scaling off



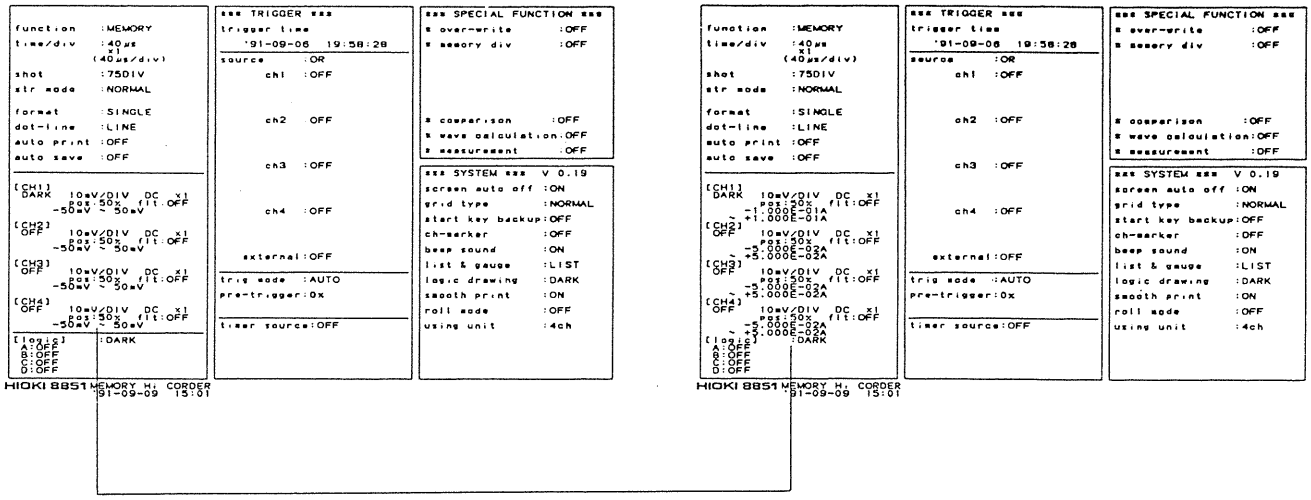
Scaling on



Gauge markings



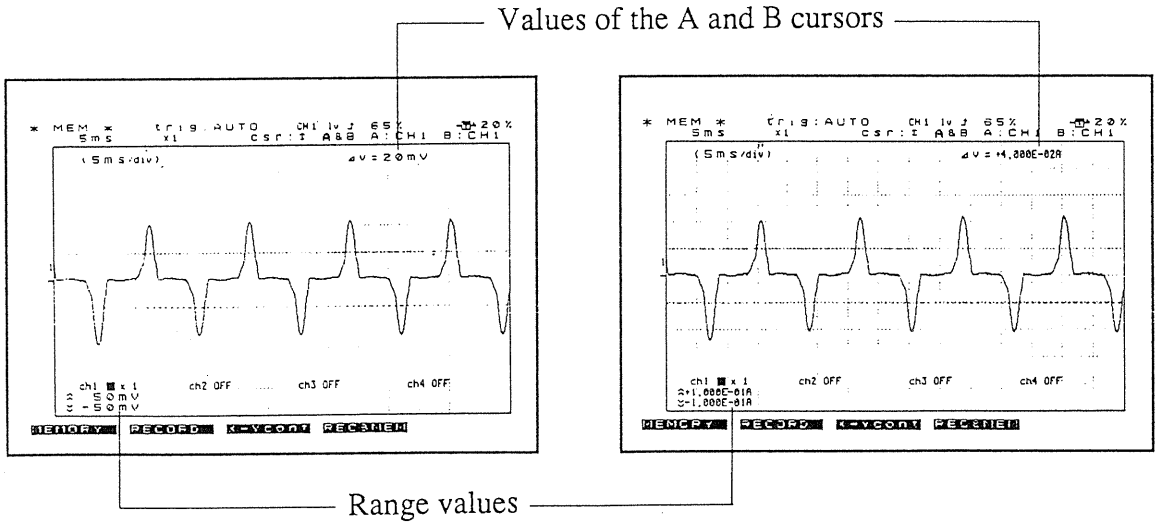
Listing



Range values (the upper and lower limit values along the perpendicular axis)

Scaling off

Scaling on



18-4 Adding Comments

Function

(1) Title comment input

Title comments of up to 20 characters can be included in listings. If input of a title comment is set, this title comment will be entered into listings in all functions.

(2) Input of comments for each channel

Comments of up to 20 characters can be included in listings on each channel. If input of a comment is set, this comment will be entered into listings in all functions.

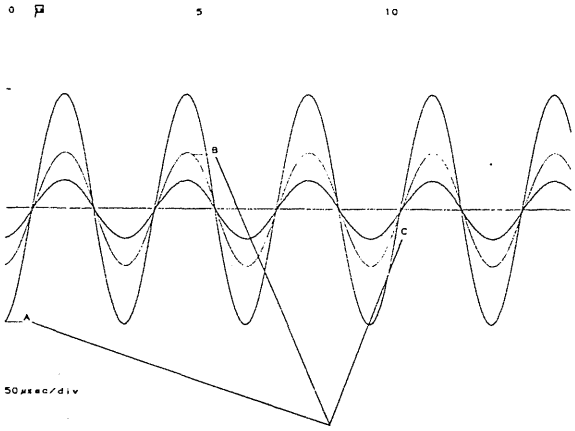
If channel marker setting is enabled, the comments for each channel are shown on the waveform chart drawn on the recording paper.

(3) If either of these settings (1) or (2) is made, the corresponding comment also appears on plotter output.

Memory recorder function (except during XY format)

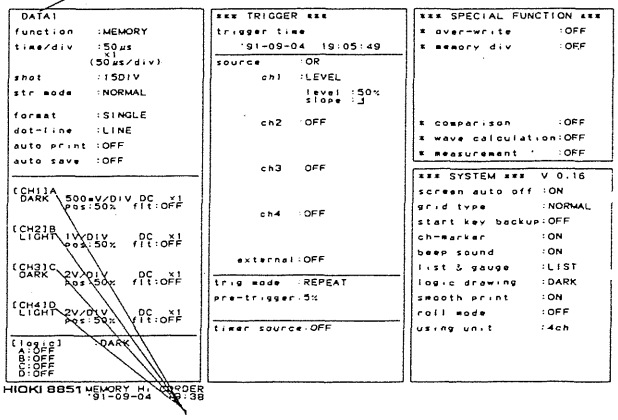
Recorder function

Recorder and memory function



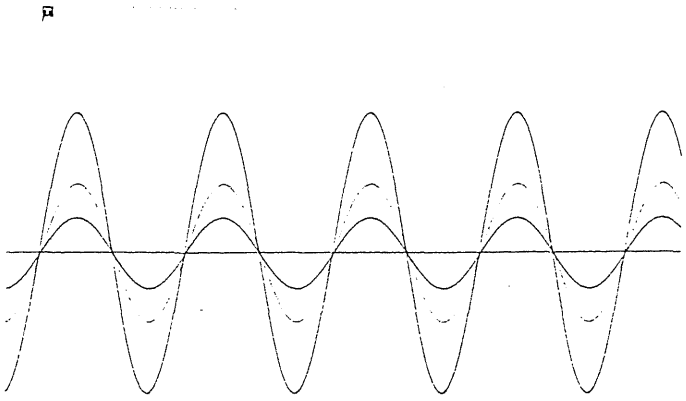
Comments for each channel
(when channel marker is enabled)

Title comment

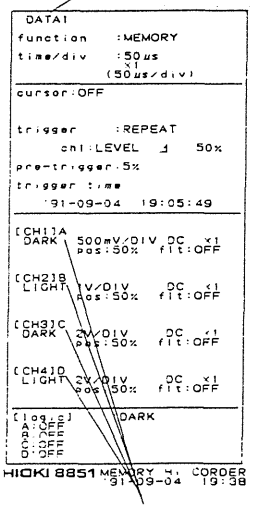


Comments for each channel

When the COPY key and the FEED key have been pressed at the same time



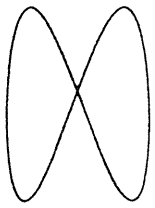
Title comment

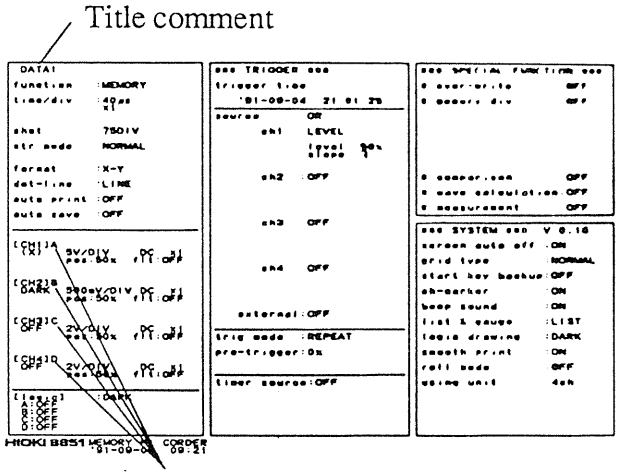


Comments for each channel

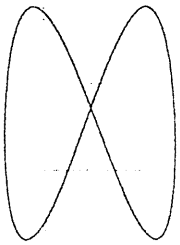
Memory recorder function (during XY format)

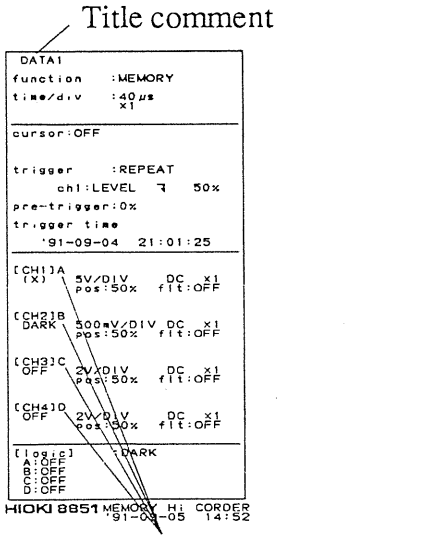
XY recorder function





When the COPY key and the FEED key have been pressed at the same time





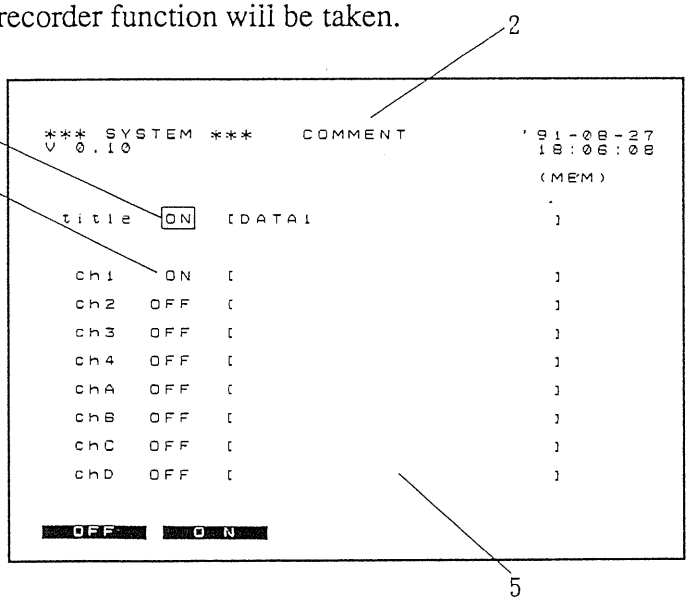
Procedure

An example from the use of the memory recorder function will be taken.

1. Press SYSTEM. The system screen will appear.
2. Press the soft key COMMENT and the scaling setting screen will appear.

   (TIME, SCALING, COMMENT, SETUP, GP-IB, PLOTTER, SELF CHECK)

   Pressing the soft key (etc) changes the setting menu.
3. Press the soft key ON and the title comment which has been set will be output on charts for all functions.



4. Press the soft key [ON] and the comments which have been set for each channel will be output on charts for all functions.

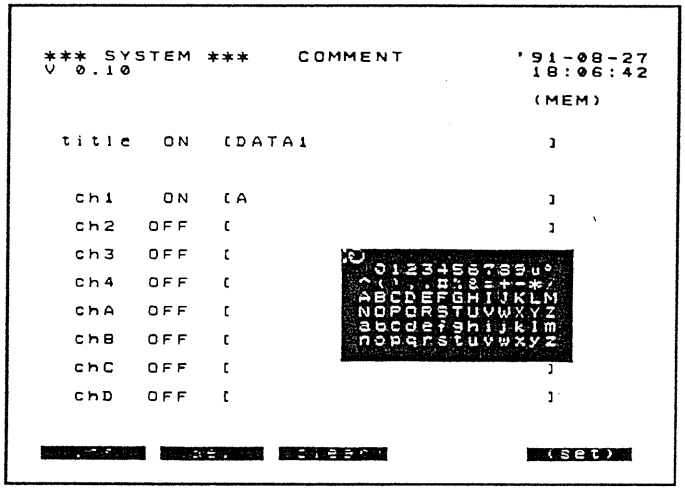
5. How to input a title comment:

   Bring the flashing cursor into the area [ ] and a window will appear.

   a. By turning the rotary knob and moving the cursor in this window, select each character required.

   b. Pressing the soft key [(set)] moves the flashing cursor one space to the right. (The cursor key [◀] performs the same function).

   Repeat actions a. and b.



- Explanation of the soft keys

  The soft key [(ins)] .... is used for inserting a character between two other characters.

  Example: ... Press the soft key [(ins)] ... Select the character "Z" using the rotary knob ...

  The soft key [(del)] .... is used for deleting the character at the position indicated by the flashing cursor.

  Example: ... Press the soft key [(del)] ...

  The soft key [(clear)] .... is used for deleting all characters to the right of the position indicated by the flashing cursor.

  Example: ... Press the soft key [(clear)] ...

  The soft key [(set)] .... is used for accepting the character at the position indicated by the flashing cursor and moving the cursor one space to the right.

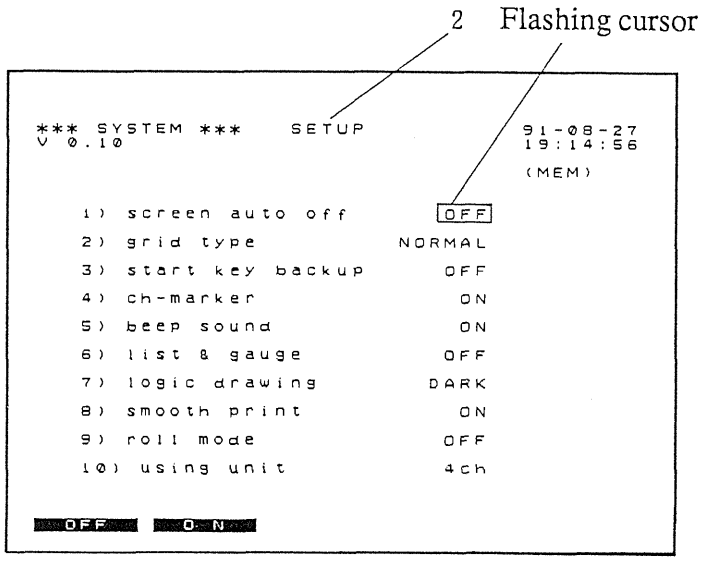
18-5 Special Function Settings

18-5-1 Setting Procedure

1. Press SYSTEM. The system screen will appear.
2. Press the soft key SETUP.

   (TIME, SCALING, COMMENT, SETUP, GP-IB, PLOTTER, SELF CHECK)

   Pressing the soft key (etc) changes the setting menu.
3. Using the cursor keys, bring the flashing cursor to the selected item and perform setting with the soft keys.



	The selected item ( ) indicates initial setting)	Explanation of function
(1) screen auto off	[OFF] , ON	→ 18-5-2.
(2) grid type	OFF, [NORMAL] , FINE	→ 18-5-3.
(3) start key backup	[OFF] , ON	→ 18-5-4.
(4) ch-marker	OFF, [ON] , ON (pos)	→ 18-5-5.
(5) beep sound	OFF, [ON]	→ 18-5-6.
(6) list & gauge	[OFF] , LIST, GAUGE, L&G	→ 18-5-7.
(7) logic drawing	[DARK] , LIGHT	→ 18-5-8.
(8) smooth print	OFF, [ON]	→ 18-5-9.
(9) roll mode	[OFF] , ON	→ 18-5-10.
(10) using unit	1ch, 2ch, [4ch]	→ 18-5-11.

Some of (7) to (10) may not be available, depending upon the function.

18-5-2 Screen Saver Function

Function

If "screen auto off" is set to ON, then if for a continuous period of ten minutes no operation key is pressed, the display is automatically switched off.

Pressing any key turns the display on again.

Eliminating unnecessary display operation prolongs the operational life of the display.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

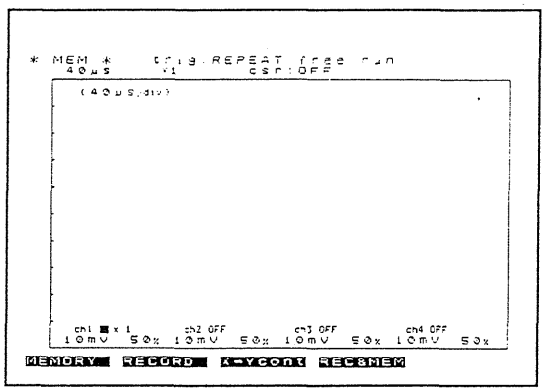
18-5-3 Setting the Grid

Function

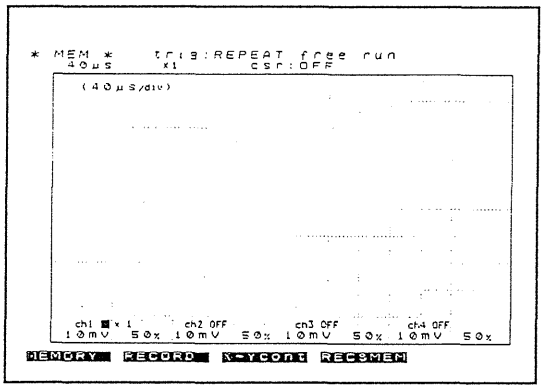
It is possible to select the type of grid shown on the display screen and the type of grid drawn on the recording paper. There are three settings: OFF, NORMAL, and FINE. However, whichever of NORMAL and FINE is selected for the display screen, in fact NORMAL will be implemented.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

Grid setting: display screen

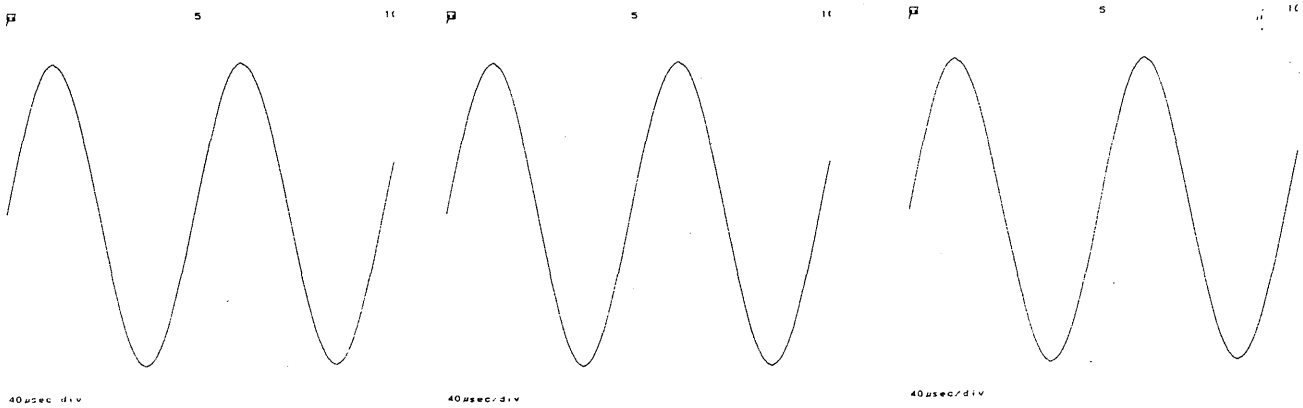


OFF



NORMAL, FINE

Grid setting: printed chart



OFF NORMAL FINE

18-5-4 Start Key Backup Function

Function

If the power supply fails during recording operation (while the LED above the START key is illuminated), and then the power supply is restored, so that the 8851 goes back into the measurement operation mode, then, if "start key backup" is set to ON, recording starts immediately. If a trigger is in use, then startup is in the waiting-for-trigger state.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

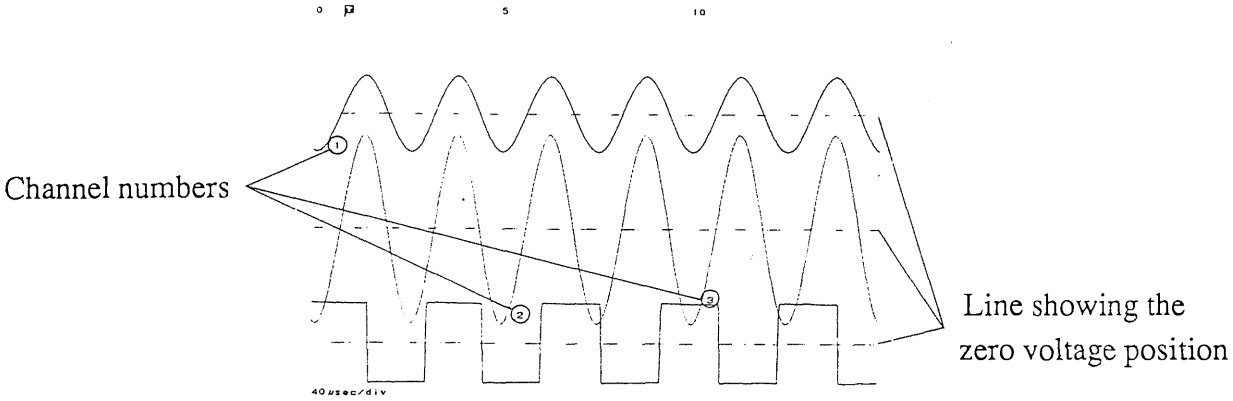
18-5-5 Channel Marker Function

Function

If ch-marker is set to ON, then the channel numbers are printed together with the waveform on the recording paper; if it is set to ON(pos), in addition to the channel numbers a line showing the origin (the position corresponding to 0 V) is printed.

If comment setting is enabled for any of the channels, then, instead of the channel number, the appropriate comment is printed.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."



Note In XY format in the memory recorder function, and in the XY recorder function, the channel numbers and the line showing the Xaxis position are not printed.

The channel numbers of logic channels are not printed.

18-5-6 Setting the Beep Sound

Function

If the "beep sound" is set to ON, then when an error occurs or a warning is made, and when a waveform decision results in an NG verdict, the speaker produces a beep sound.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

18-5-7 Listing and Gauge Functions

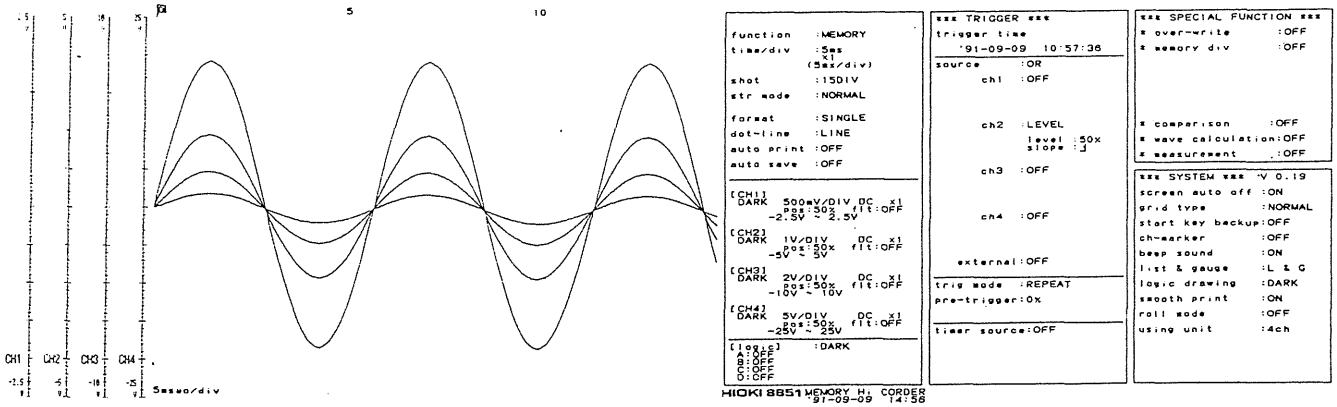
Function

When a waveform is printed out (except for screen dumps, and when the COPY key and the FEED key are pressed together), the gauge can be printed out at the beginning, and a listing can be printed out at the end.

The choice is between four alternatives: OFF means that neither the gauge nor the listing is printed; LIST means that the gauge is not printed but a listing is printed; GAUGE means that the gauge is printed but a listing is not printed; and L&G means that both the gauge and a listing are printed.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

When the setting is "L&G":



Note: The gauge is only printed out for the channels of which the waveform is being drawn.

18-5-8 Setting Logic Waveform Display Brightness

Function

Except for during the XY recorder function, when a logic waveform is being displayed on the screen, it is possible to set the display to high intensity (DARK) or low intensity (LIGHT).

For how to set this function, refer to Section 18-5-1 "Setting Procedure."

18-5-9 Smooth Print Function

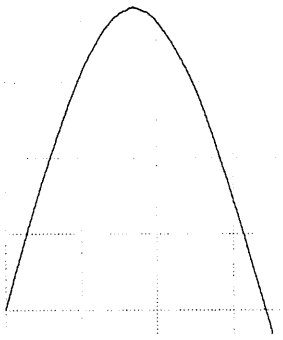
Function

This function can only be set when performing memory recorder recording in the memory recorder function or in the recorder and memory function.

It is possible to select whether smooth printing close to an analog waveform will be performed ("ON") at a time axis density of 80 dots/division, or whether printing will be performed at a time axis density of 40 dots/division ("OFF") at twice the chart speed.

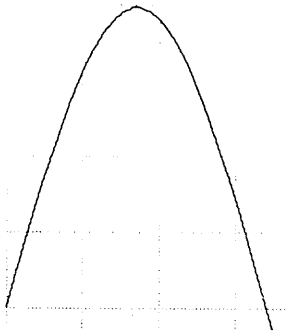
For how to set this function, refer to Section 18-5-1 "Setting Procedure."

smooth print ON



Time axis density 80 dots/division

smooth print OFF



Time axis density 40 dots/division

18-5-10 Roll Mode

Function

This function can only be set when performing memory recorder recording in the memory recorder function or in the recorder and memory function.

Usually after the start of measurement, because display of the waveform occurs from when the shot length of data has finished being sampled, during low speed sampling it takes a long time from the trigger to the initial display of the waveform. (roll mode disabled)

If roll mode is enabled, after the trigger it is possible to start waveform display simultaneously with sampling the waveform. (scrolling is performed just as is done during the operation of the recorder function)

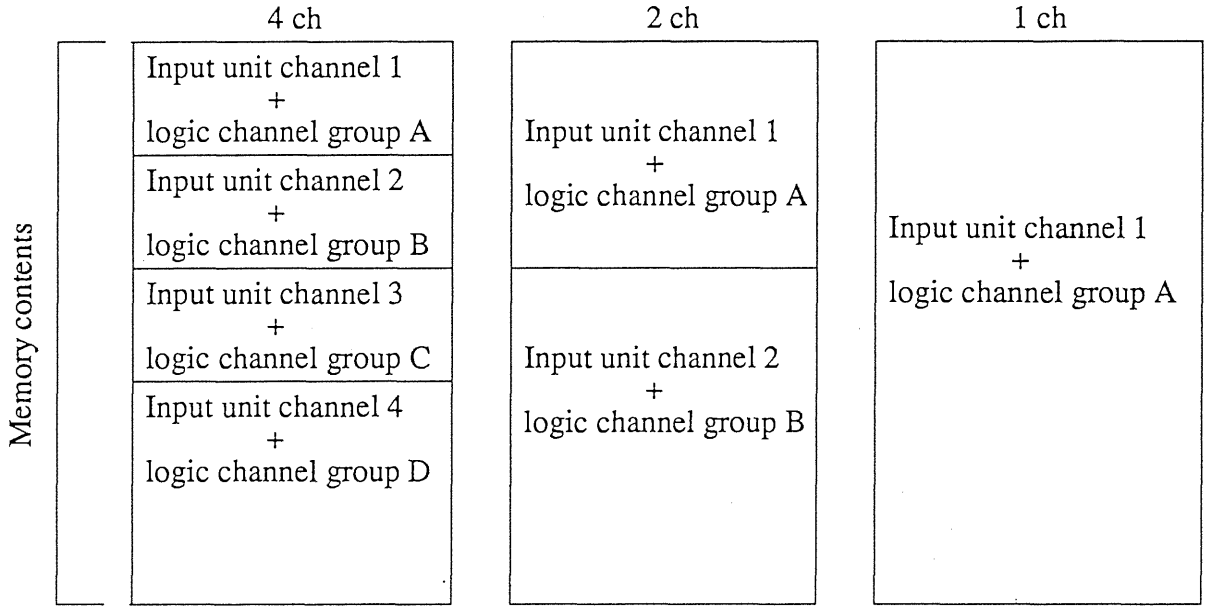
For how to set this function, refer to Section 18-5-1 "Setting Procedure."

18-5-11 Channel Selection

Function

This function can only be set in the recorder function. It is possible to select whether the memory will be used by being divided up into four channels, or by being divided up into two channels, or by all being used for one channel.

For how to set this function, refer to Section 18-5-1 "Setting Procedure."



Maximum shot length settable

Channels used	Maximum shot length settable (divisions)
4 channels	12500
2 channels	25000
1 channel	50000

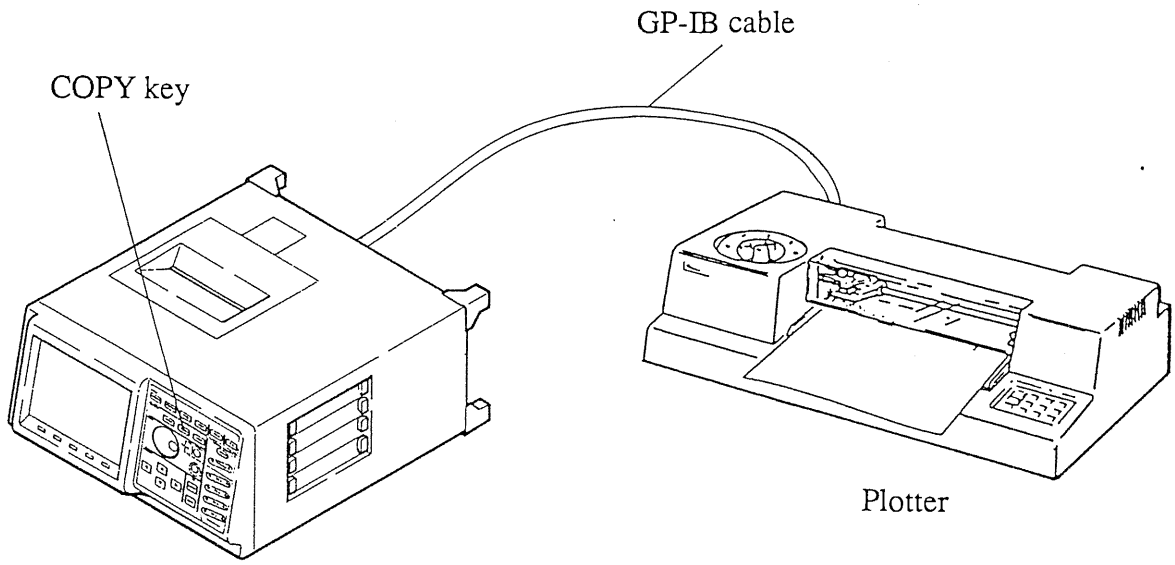
18-6 GPIB Interface Settings

Refer to Section 20 "GP-IB Interface."

18-7 Plotter Output

Function

If a plotter (HPGL compatible) is connected to the 8851 via its GP-IB connector, then by pressing the COPY key a displayed waveform can be drawn on the plotter (only in the memory recorder function).



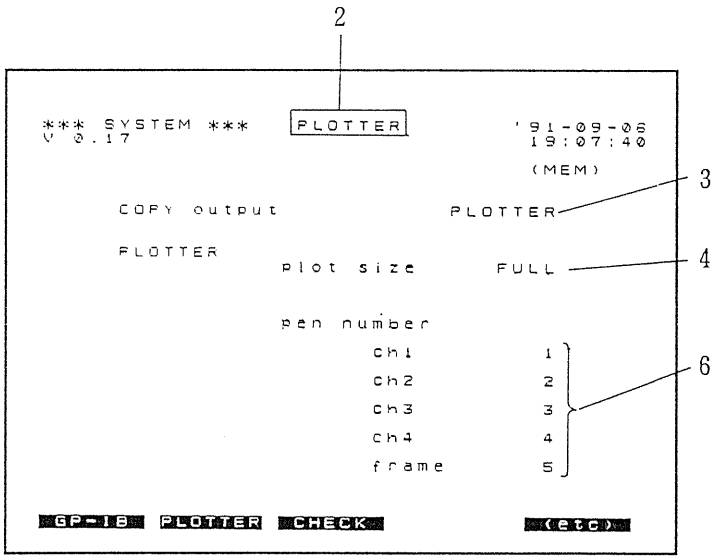
Procedure

1. Press SYSTEM.
   The system screen will appear.
2. Press the soft key PLOTTER and the plotter output setting screen will appear.

   Pressing the soft key (etc) changes the setting menu.
3. Select whether pressing the COPY key causes a copy of the display screen to be printed on the internal printer or on an externally connected plotter
   (display screen only).

   (PRINTER, PLOTTER)

   Here the soft key PLOTTER has been chosen.



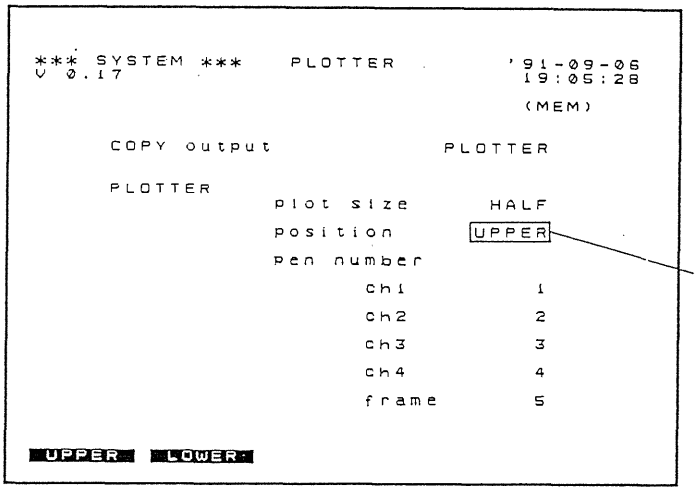
4. If output to the external plotter has been chosen, set the drawing size.

   (FULL, HALF)

   Here the soft key [FULL] has been chosen.

   FULL ..... The drawing is done with the long side of the paper taken as the horizontal direction.

   HALF ..... With the paper viewed as turned 90° from the FULL orientation, the drawing is done on the upper or the lower half of the paper as seen vertically.



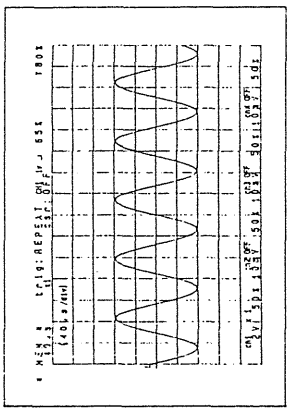
Note: When switching between FULL and HALF, at the same time the setting for the system of coordinates to be used on the plotter should be changed over.

5. When the drawing size has been set to HALF, the position of the drawing on the paper should be set.

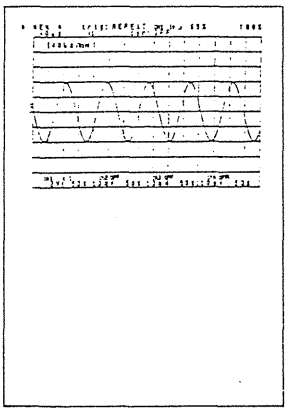
   (UPPER, LOWER)

   UPPER ... The drawing is done on the upper half of the paper.

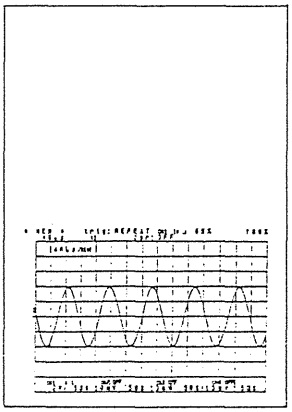
   LOWER ... The drawing is done on the lower half of the paper.



Set to FULL



Set to HALF (UPPER)



Set to HALF (LOWER)

6. Set the number of the pen to be used.

   The pen number may be selected to be any number from 1 to 8.

   "ch1" to "ch4"

   Use different pen settings for each channel to provide a color contrast.

   "frame"

   Select the pen to be used for frames, grids, and listings here.

The GP-IB settings follow.

1. Press the soft key GP-IB and the GP-IB setting screen appears.
2. "mode"

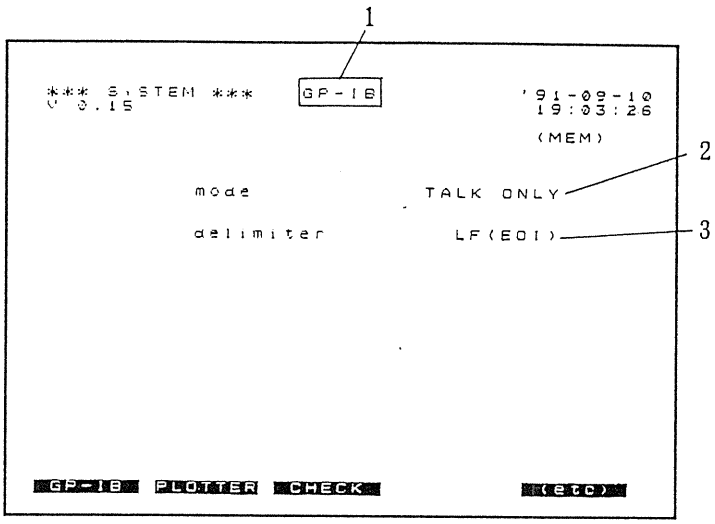
   Press the soft key TALK to set the system to TALK ONLY mode.

   (ADDRESSABLE, TALK ONLY, DISABLE)
3. "delimiter"

   This varies according to the type of plotter that has been connected.

   Consult the user manual for the plotter in question and set the delimiter appropriately.

   (CR-LF(EOI), CR(EOI), LF(EOI), (EOI))

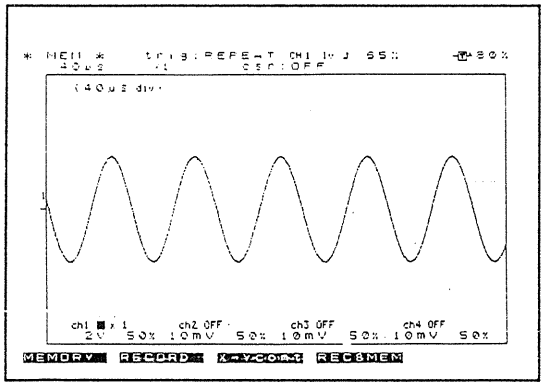


When the above has been done, the setting of the 8851 is completed.

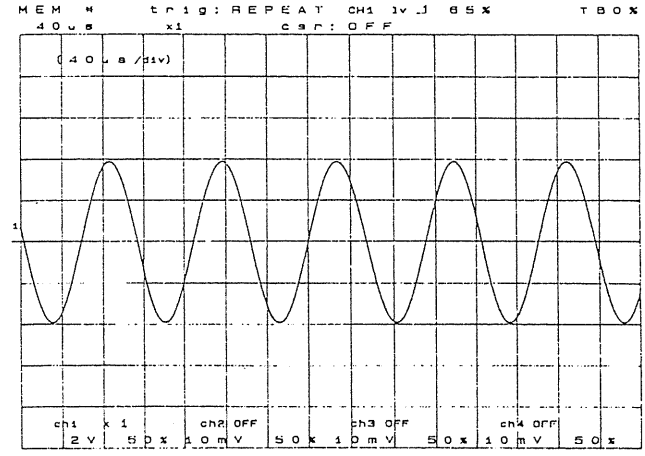
Be sure to use a plotter that is HP-GL compatible.

The plotter should be set to LISTEN ONLY.

If the COPY key is pressed from the display screen, the displayed waveform is output to the plotter as shown in the figures below.



Screen display



Plotter output

Notes

- Plotter output can only be performed for the display screen in the memory recorder function or the X-Y recorder function.
- For plotter output in the case that a computer (a controller) is connected, refer to Section 20.

18-8 Self Check Functions

Function

Five types of self-check can be performed: the ROM and RAM check, the LED check, the printer check, the keyboard check, and the CRT screen check.

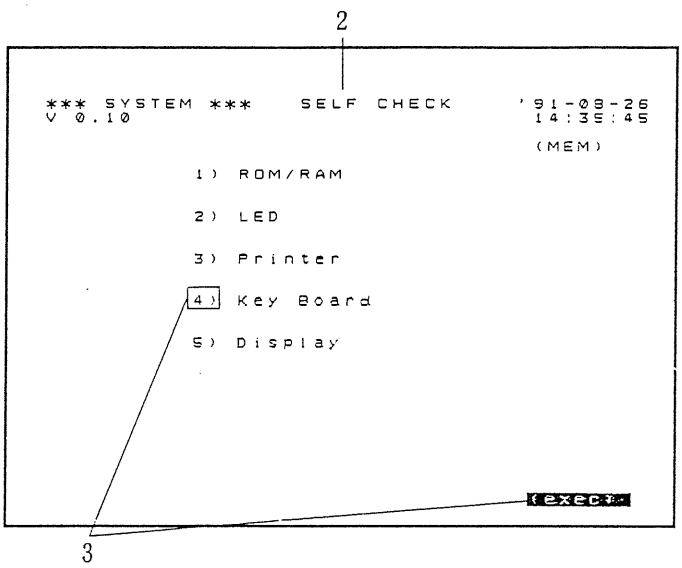
Procedure

An example from the use of the memory recorder function will be taken.

1. Press SYSTEM.
   The system screen will appear.
2. Press the soft key CHECK and the self check screen will appear.

   (TIME, SCALING, COMMENT, SETUP, GPIB, PLOTTER, SELF CHECK)

   Pressing the soft key (etc) changes the setting menu.
3. In order to perform a self check, move the flashing cursor to the appropriate one of 1) through 5), and press the soft key (exec) (except for 5)).



18-8-1 ROM and RAM Checks

- A check of the internal memory (ROM and RAM) of the 8851 is performed.
- The result is displayed on the screen

  OK: passed

  NG: failed
- Even when the ROM/RAM check is performed, the contents of the RAM are not disturbed.

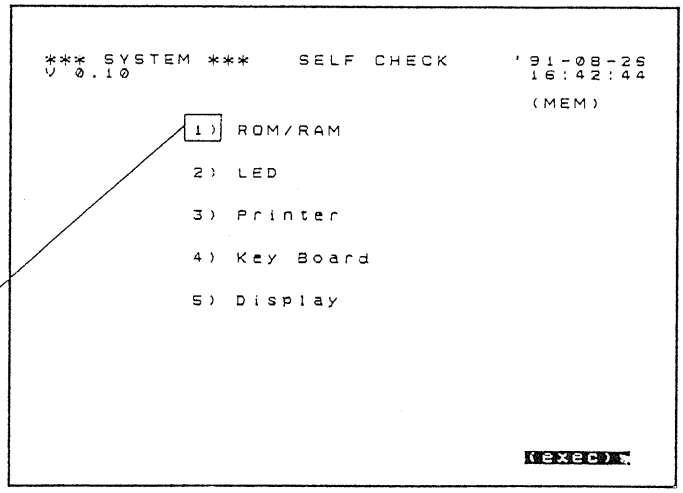
Procedure

Move the flashing cursor to position 1) with the cursor keys, and press the soft key (exec) .

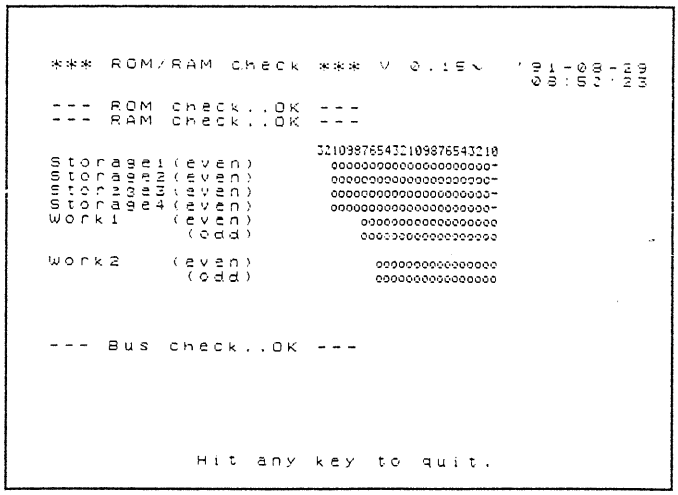
After the check has been completed, press any key. The system returns to the self check screen.

During the self checking process, no key has any effect.

Flashing cursor



If the result "OK" appears the self-check was passed.



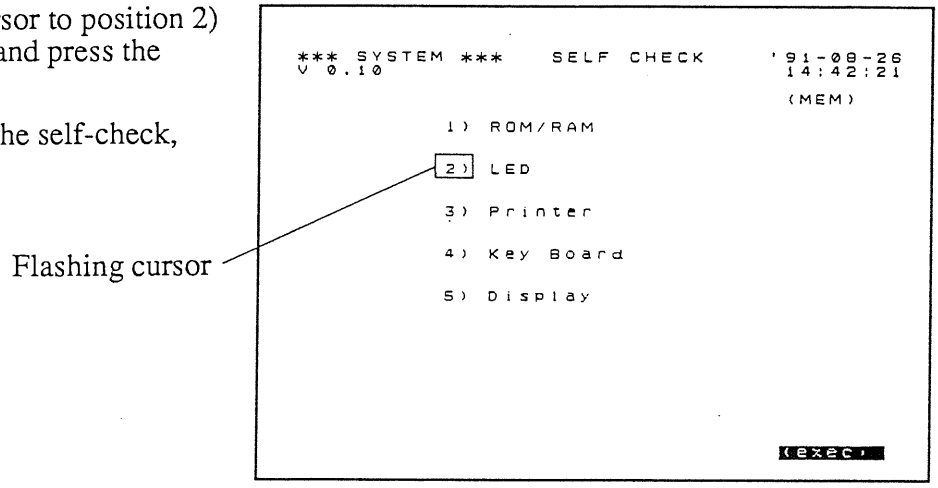
18-8-2 LED Check

- This checks all of the LED indicators.
- Check that all of the LED indicators flash at once.

Procedure

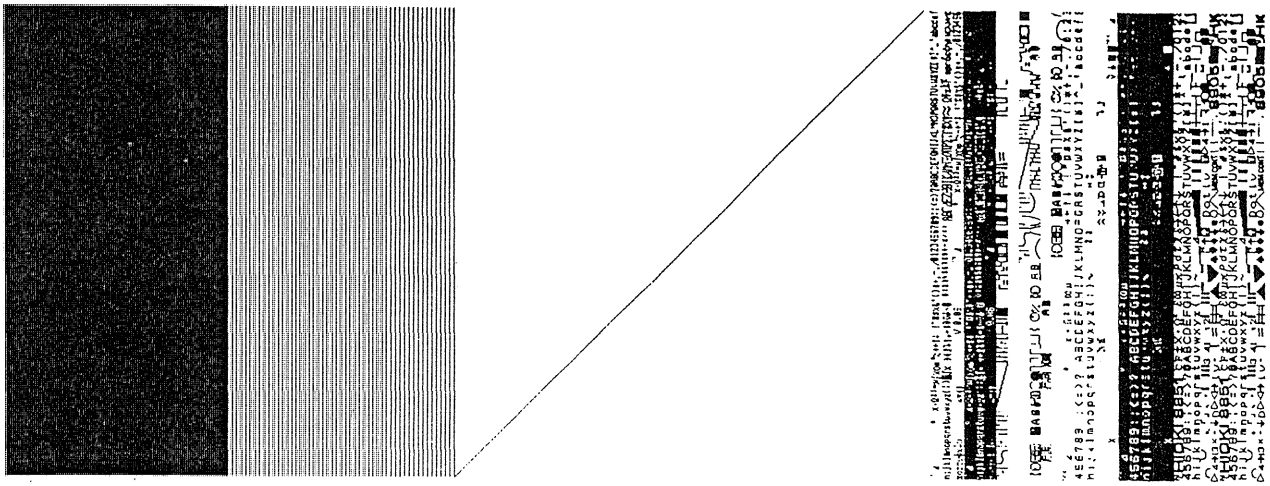
Move the flashing cursor to position 2) with the cursor keys, and press the soft key (exec) .

In order to terminate the self-check, press any key.



18-8-3 Printer Check

- A check is made of printer printing capability.

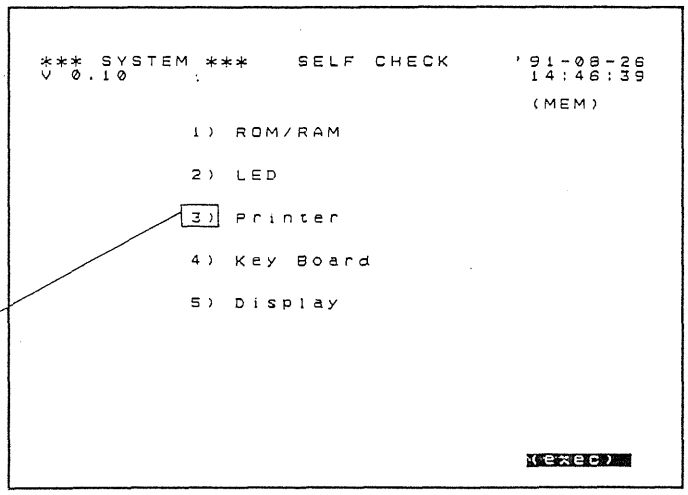


Test pattern of printer check

Procedure

Move the flashing cursor to position 3) with the cursor keys, and press the soft key (exec) .

If it is desired to stop the self-checking process partway through, press the STOP key.



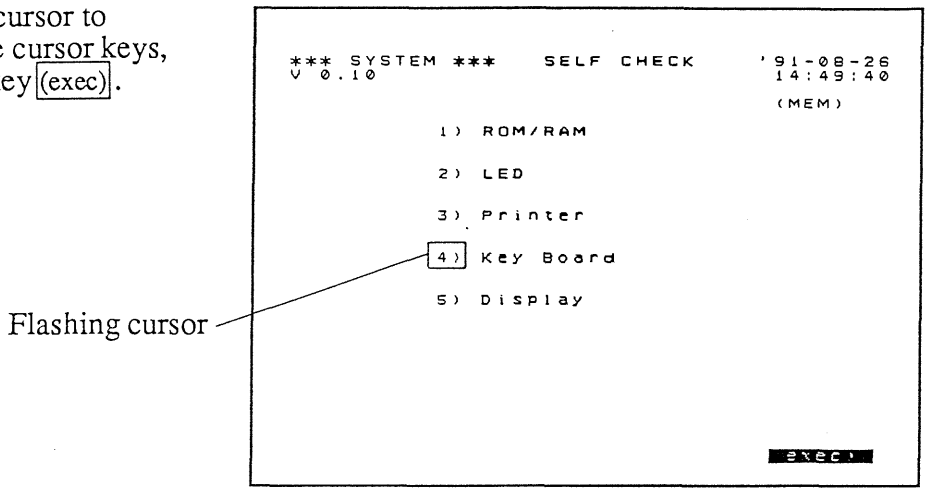
Flashing cursor

18-8-4 Keyboard Check

- A check is made as to whether the keys are operating normally.

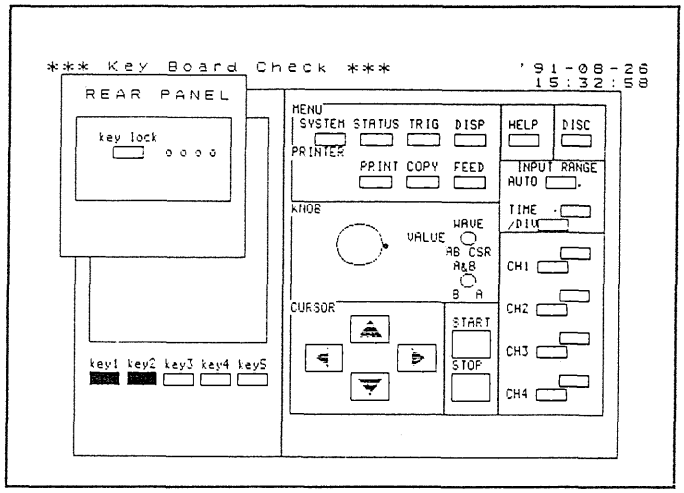
Procedure

1. Move the flashing cursor to position 4) with the cursor keys, and press the soft key (exec).



↓

2. Pressing each key on the keyboard causes the corresponding place on the display to go dark. Further, turning the rotary knob rotates the black dot around the circle (see "KNOB" box in figure).



↑

Soft keys 1 and 2 have been pressed, and the rotary knob is oriented as turned to the right.

3. Turn the rotary knob right and left at least once, and press each of the keys at least once, and the keyboard check will be finished. Pressing any key returns to the self check screen.

   (If something is wrong with the keyboard, and if even one of the keys cannot be recognized, then the keyboard self-check cannot be terminated. In this case, press the START key and the STOP key together, and the system will return to the self check screen.)

18-8-5 Display Check

- This checks the display screen.

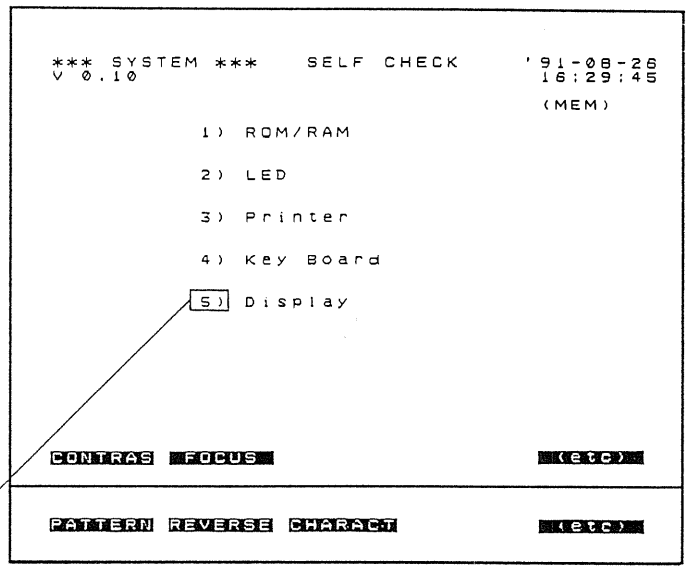
Procedure

Move the flashing cursor to position 5) with the cursor keys, and the following five kinds of test pattern can be selected between by the use of the soft keys.

(CONTRAST, FOCUS, PATTERN, REVERSE, CHARACTER)

Pressing the soft key [(etc)] changes the check menu.

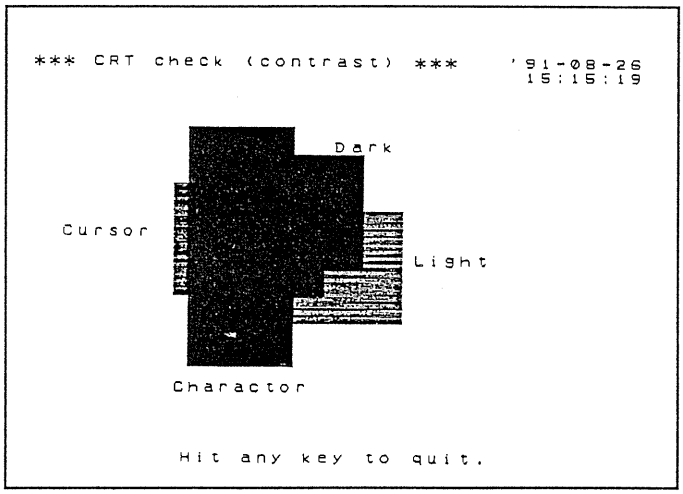
In order to terminate the test, press any key.



Flashing cursor

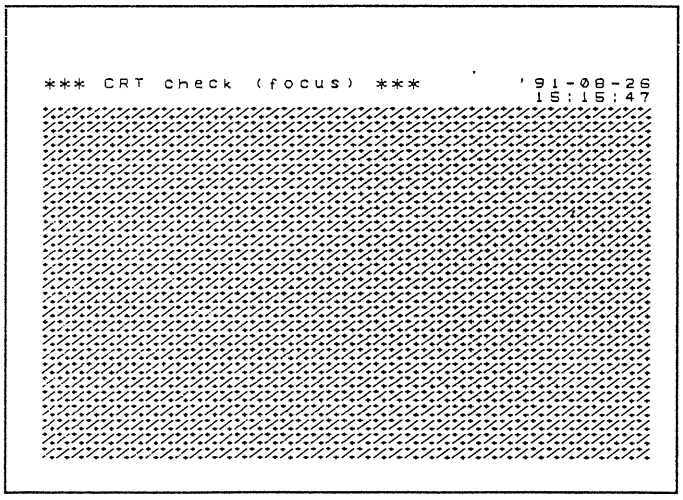
① Contrast check (CONTRAST)

This checks the contrast of the display.



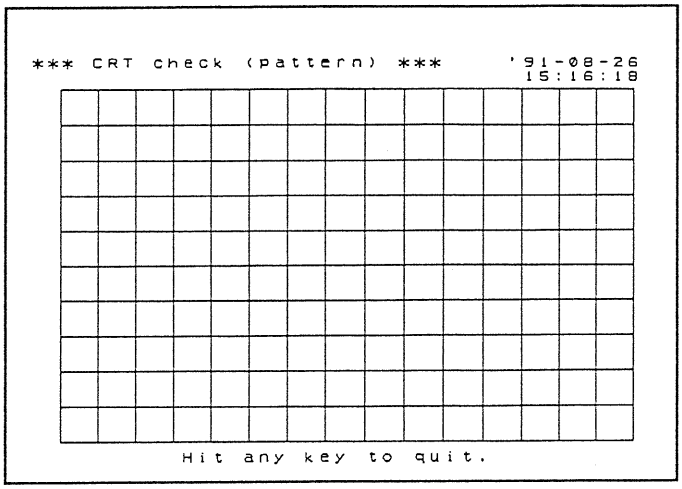
② Focus check (FOCUS)

A focus check is performed.



③ Pattern check (PATTERN)

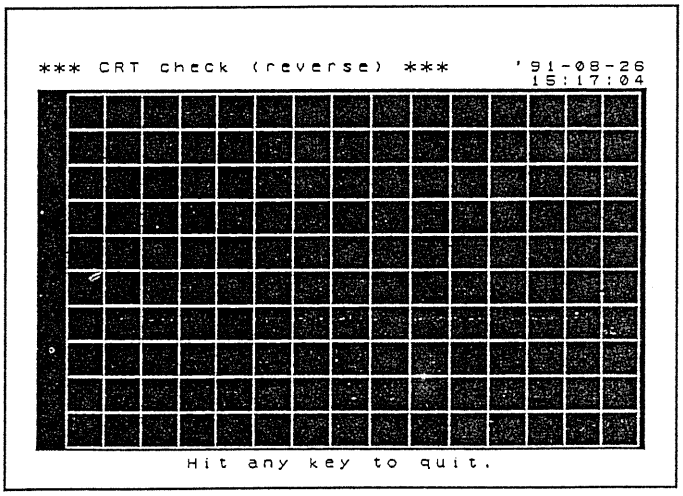
A 10 × 15 grid pattern is displayed. Check for distortion on the screen.



④ Reverse check (REVERSE)

The same grid pattern is displayed, in reverse video.

Check for distortion on the screen.

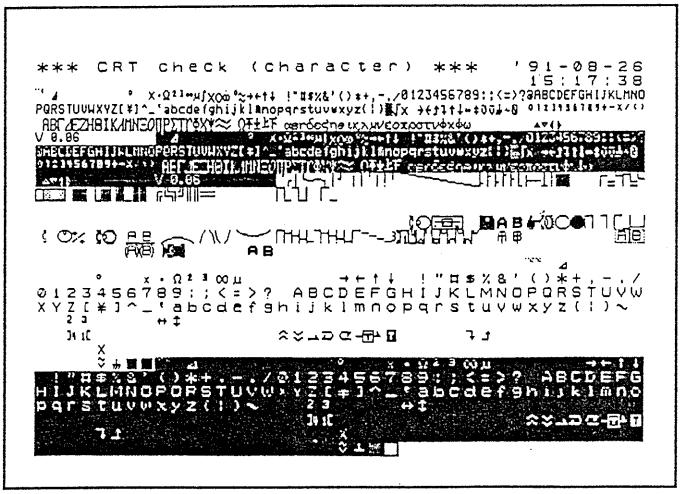


⑤ Character generator check (CHARACTER)

The contents of the character generator for the screen are displayed.

If the COPY key is pressed and a screen dump of the CRT screen is printed, because the contents of the character generator for the printer will thus be printed, this copy and the contents of the screen may be compared.

Note: Sometimes the actual display may vary from that shown in the figure on the right.



Section 19

Floppy Disk Operations

Contents

19-1 Floppy Disk Functions

(1) 3.5 inch 2HD or 2DD floppy disks can be used. 2HD disks are formatted in NEC PC9801 format, and 2DD disks in IBMPC/AT MSDOS format. The recording capacity on PC9801 format 2HD disks is 1.2M bytes, and on IBMPC/AT format 2DD disks is 720Ktes.

Note: 2DD floppy disks formatted in PC9801 640K-byte format cannot be used.

(2) Saving the setting state of the unit on a floppy disk allows you to return to identical conditions for performing measurements.

(3) If measurement data is recorded on a floppy disk, afterwards it can be read out, analyzed, and compared with other data.

By recording the waveform decision area, it is possible to perform waveform decision using the same area as many times as required.

(4) It is possible to record by transferring only one portion of the captured waveform to the floppy disk. (Partial save function).

(5) With the memory recorder function, during startup it is possible automatically to record the captured waveform on the floppy disk. (Auto save function).

(6) It is possible, when the power is turned on, automatically to read a setting state or a waveform decision area which has been recorded on a floppy disk and to set it up. (Auto setup function)

(7) The following commands can be used:

FORMAT:	formats a floppy disk in MS-DOS format.
SAVE:	writes to the floppy disk.
LOAD:	reads out from the floppy disk to the 8851.
DELETE:	erases from the floppy disk.
infor.:	Gives detailed information on a file on the floppy disk.

Notes

- If a floppy disk is inserted upside down, backwards, or in the wrong direction, it is possible to damage the floppy disk or the 8851.
- While the floppy disk unit is operational (the LED on the floppy disk unit is on) do not remove the floppy disk.
- When transporting the 8851, be sure to remove any floppy disk.

19-2 What Can Be Recorded And How Much

(1) Setting state (FUNC)

① It is possible to record the setting state for each of the functions: the memory recorder function, the recorder function, the XY recorder function, and the recorder and memory function.

② When a setting state is read into the 8851, the unit is set to the state written on the floppy disk.

Size of recording for each function:

Memory recorder function.....
Recorder function.....
XY recorder function.....
Recorder and memory function.....
} 2 blocks

Note: 1 block = 1024 bytes

(2) Measurement data (WAVE)

① It is possible to save the measurement data of a waveform which has been captured by the memory recorder function.

② When measurement data is read into the 8851, it is put into the memory channel designated by the waveform data recorded on the floppy disk. (For details, refer to the description of LOAD in Section 19-5, "Detailed Explanation Of the Commands").

③ When the measurement data of a waveform is recorded, its setting state is also simultaneously recorded. Because when this is loaded the unit is set to the condition when the measurement data was recorded, it can be checked by being listed.

Memory capacity required for measurement data.

- When the storage mode is normal:

$$\frac{(\text{Recording length (DIV)} \times 80) \times \text{number of channels}}{1024} + 2 \text{ blocks (rounded downwards)}$$

- When the storage mode is envelope:

$$\frac{(\text{Recording length (DIV)} \times 160) \times \text{number of channels}}{1024} + 2 \text{ blocks (rounded downwards)}$$

(* Logic channels CHA to CHD are considered as one channel)

(3) Waveform decision area (AREA)

① For the memory recorder function, it is possible to save a waveform decision area which has been created.

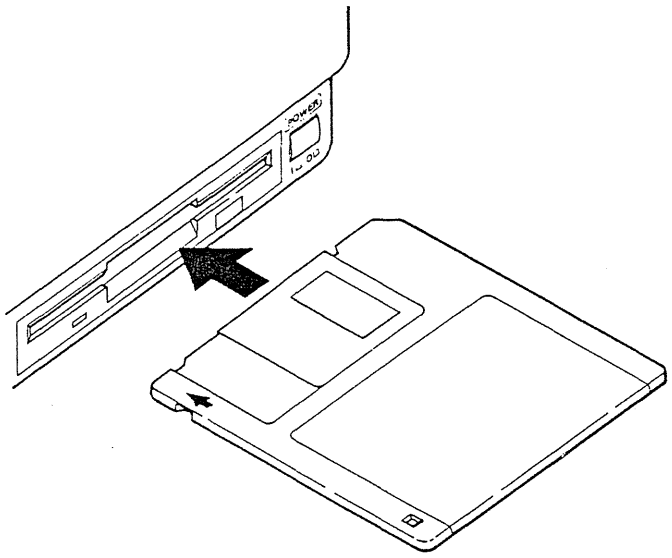
② Only the settings necessary for waveform decision when a waveform decision area has been created are saved simultaneously.

Memory capacity required for a waveform decision area ... 21 blocks.

19-3 Using the Floppy Disk Drive

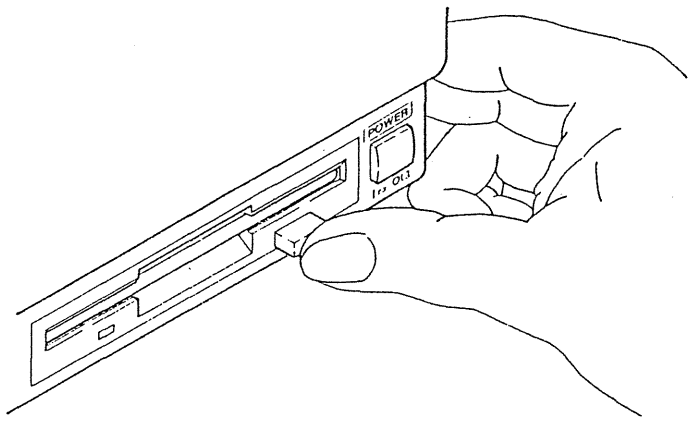
How to insert a floppy disk:

Hold the disk with its written-on face upwards and push it all the way into the slot in the proper orientation.



How to remove a floppy disk:

Press the button as shown in the figure below and the disk is ejected. Because it pops out quite smartly, be careful not to let it drop.



19-4 Settings on the Floppy Disk Control Screen

This section describes settings on the floppy disk control screen. Refer to Section 19-5 "Detailed Explanation of the Commands" for an in-depth explanation of each of the commands.

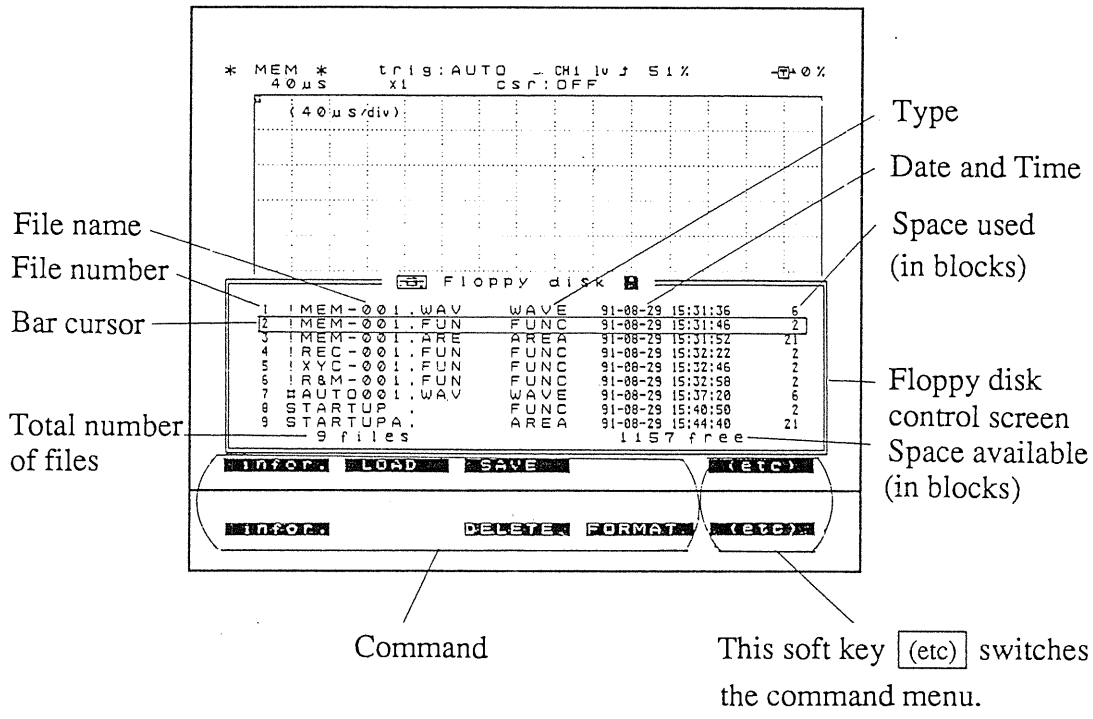
1. Put in a floppy disk.
2. Press the FD key and the floppy disk control screen will appear. While information about the files recorded on the disk is being loaded, the following message appears:

   Now loading, please wait

   Note: If the disk is not formatted in MS-DOS format, the following error message is displayed:

   ERROR 72: Illegal format.

   Press the stop key and, after the error message has disappeared, format the disk. For details, refer to Section 19-5 "Detailed Explanation of the Commands".



Note: 1 block = 1024 bytes.

- File Name .... The file names which were set during SAVE commands are displayed.

  The following files have special meanings:

  !MEM-OOO.WAV
  !MEM-OOO.FUN
  !MEM-OOO.ARE
  !REC-OOO.FUN
  !XYC-OOO.FUN
  !R&M-OOO.FUN (OOO: number)

  These are names of files made during auto setup. Refer to the explanation of the SAVE command.

  AUTO OOO.WAV (OOO: number) This is a file created by the auto save function.

  STARTUP.
  STARTUPA.

  These are files used by the auto setup function. For details, refer to Section 19-8 "Auto Setup Function".

- Type ..... This indicates the type of the contents of the file.

  FUNC Setting state

  WAVE Measurement data

  AREA Waveform decision area

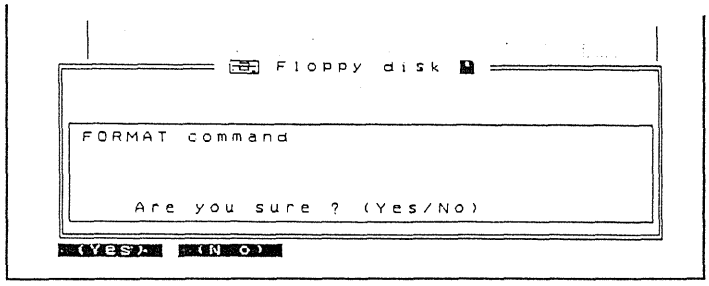
3. If more than nine files are stored on the floppy disk, the file names can be seen by scrolling them up and down with the cursor keys [▲] [▼].
4. The commands can be selected with a soft key. When the soft key [etc] is pressed, the command menu changes. For an in-depth explanation of each of the commands, refer to Section 19-5 "Detailed Explanation of the Commands".
5. When finished with the floppy disk control screen, press the FD key again.

19-5 Detailed Explanation of the Commands

FORMAT:	The floppy disk is formatted in MS-DOS format. Before using a floppy disk on the 8851, ensure that it is correctly formatted.

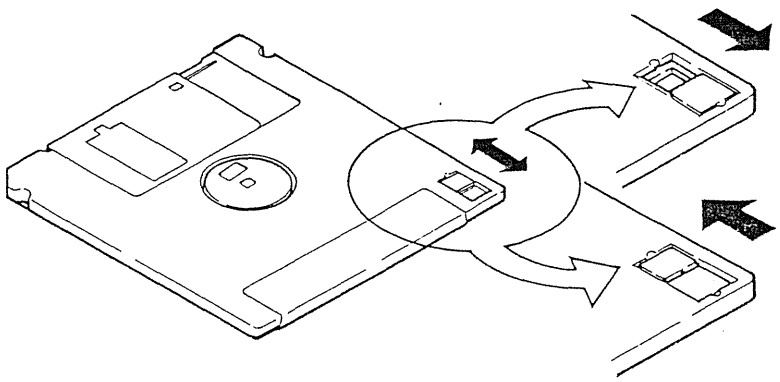
1. Press the [FORMAT] soft key and the screen shown on the right appears.
2. Now pressing the soft key [(YES)] starts the formatting. During the formatting process the following message appears:
   "Now formatting. Please wait".
   Formatting a 2HD disk takes about one minute.

   But pressing the soft key [(NO)] cancels the format command.



Note: Soft keys other than [(YES)] and [(NO)] will have no effect.

If the write-protect tab on the floppy disk is in the set position, the disk cannot be formatted. To allow formatting, move the write-protect tab to the unset position.



Write-protect set position

Write-protect unset position

SAVE: Transfers a setting state, measurement data, or a waveform decision area on the 8851 to the floppy disk.

The information which can be transferred to the floppy disk depends upon the function:

Memory recorder function ..... setting state, measurement data, or waveform decision area.

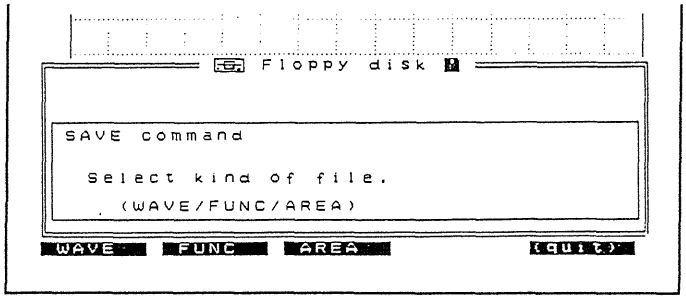
Recorder function..... setting state, only.

XY recorder function..... setting state, only.

Recorder and memory function.... setting state, only.

(1) Memory recorder function

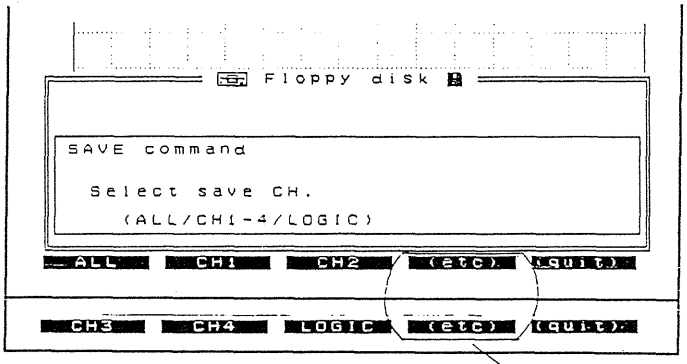
1. Press the SAVE soft key and the screen shown on the right appears. Then press the appropriate soft key corresponding to the information to be transferred: FUNC for setting state, WAVE for measurement data, or AREA for waveform decision area.

   Pressing the soft key (quit) cancels the SAVE command.

   After pressing the FUNC or AREA soft key, next input the file name as described in step 3.

2. After pressing the WAVE soft key in step 1, the screen shown on the right appears. Next the measurement data to be transferred should be indicated.

   ALL ..... transfers the measurement data of all of the channels of which the waveform is shown on the display screen, including logic.

   In the case of OFF the measurement data of the channel is not transferred.

   CH1~ CH4 ..... transfers only the measurement data for the designated channel.

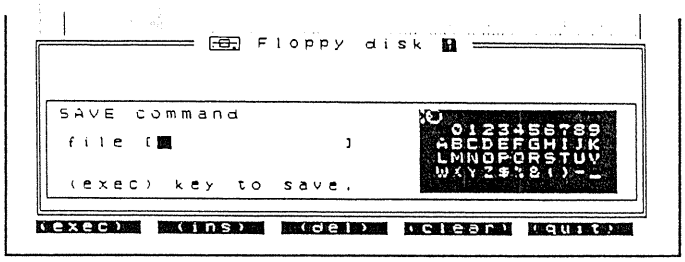
   LOGIC ..... transfers the measurement data for all 16 logic channels.

   This soft key (etc) switches the command menu.

   Pressing the soft key (etc) changes the menu.

   Pressing the soft key (quit) cancels the SAVE command.

3. Next input the file name using the screen shown on the right.



If no file name is input by the user, a file name is automatically set by the 8851. (Since the file name used in the previous operation persists, this can happen only if all the files have been deleted).

See Notes below.

a. By turning the rotary knob and moving the cursor in the window, the desired characters for the filename can be selected.

b. Pressing the cursor key [▶] moves the cursor one space to the right.

```
file  [                    ]
      ──────────  ─────
      8 character 3 character
```

Repeat actions a. and b. as appropriate.

Note: File names are left justified and cannot include spaces.

Explanation of the soft keys

[(exec)] ... starts the transfer.

[(ins)] ..... is used to insert a character between two other characters:

[A[B]]
↓ Press the soft key [(ins)]
[A[B]]
↓ Select "Z" by turning the rotary knob
[A[Z]]

[(del)] ... deletes the character at the cursor position:

[A[B]C]
↓ Press the soft key [(del)]
[A[C]]

[(clear)] ... deletes all characters from the cursor position to the right:

[A[B]CD]
↓ Press the soft key [(clear)]
[A[ ]]

[(quit)] ... cancels the SAVE command.

4. Pressing the soft key [(exec)] starts the data transfer.

During data transfer, the following message appears:

"Now saving. Please wait"

If a file already exists with the same name as that input, the following message appears:

"File already exists."

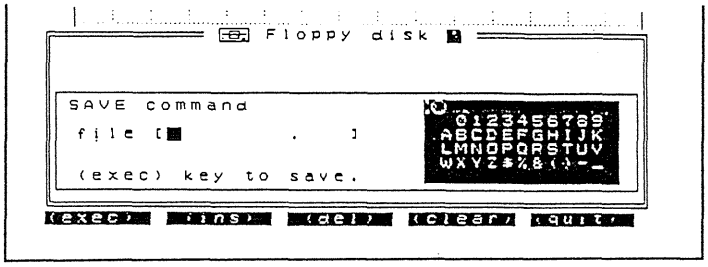
"Overwrite OK ? (Yes/No)"

Press the soft key [(Yes)] if it is desired to overwrite the already existing current file and to create a new file.

Note: Make sure the write-protect tab is in the unset position.

(2) Recorder function, XY recorder function, and recorder and memory function

1. Press the SAVE soft key and the screen shown on the right appears. Input a file name and the setting state will be transferred.



Refer to steps 3 and 4 in (1) above.

Note

- Automatic creation of file names:

  If nothing is entered into "file[.]", when the SAVE command is obeyed, a file name is automatically created. This can only happen if all the files have been deleted, since the file name used in the previous operation persists.

! MEM	-	OOO.	WAV
Function		3-digits 001 to 999	Type of file
MEM (memory recorder)		001 ⋮ 999	WAV (measurement data) FUN (setting state)
REC (recorder)			ARE (waveform decision area)
XYC (XY recorder)			
R&M (recorder and memory)			

- Time taken for saving:

  Type of file:

  FUNC (setting state) ..... approx. 2 seconds.

  AREA (waveform decision area) ... approx. 4 seconds.

  WAVE (measurement data) ..... for a shot length of 300 divisions and 4 channels, approx. 35 seconds.

  In the case of WAVE (measurement data), the time taken for saving is approximately proportional to the shot length and to the number of channels.

  After the save has been completed, a time of approx. 0.2 seconds multiplied by the total number of files is required to redisplay the list of files on the floppy disk control screen.

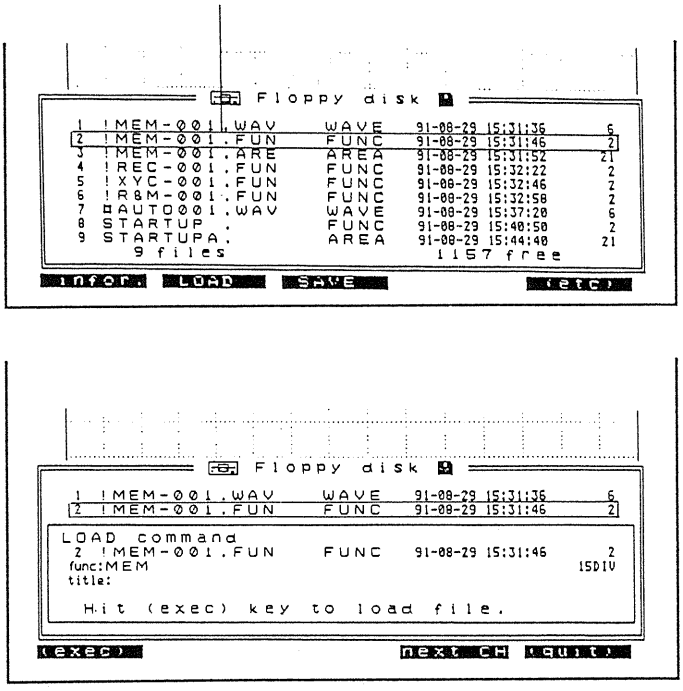
LOAD: Transfers data from the floppy disk to the 8851.

The file at the position of the bar cursor is transferred.

1. Using the ▲ ▼ cursor keys or the rotary knob, select the file to be transferred.
2. Press the soft key LOAD . A screen appears as shown on the right with details about the file.

   Pressing the soft key (quit) cancels the LOAD command.
3. Pressing the soft key (exec) causes the LOAD command to be executed.

   When the loading is finished, the floppy disk control screen is displayed again.

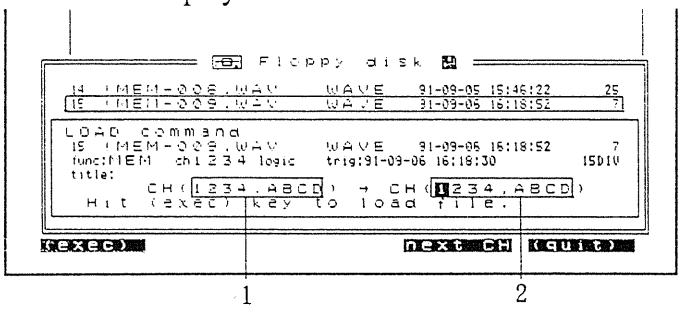


- When the type of file is WAVE (measurement data), then channel designation is possible.

1. The channels which are recorded in the file are displayed.

   1, 2, 3, and 4 correspond to the data for analog channels 1, 2, 3, and 4, and A, B, C, and D correspond to the data of logic input channel groups A, B, C, and D, respectively.

   A dash "-" is shown for channels that are not recorded.



2. This screen is for establishing into which channels of the memory of the 8851 the data will be transferred. At first the contents described above in 1. are shown on the screen, and if in this state the soft key (exec) is pressed transfer takes place to the same channels of memory, based upon when the save was performed.

   If it is desired to transfer to other channels of the memory, the transfer should be performed after moving the cursor using the cursor keys ◀ ▶ and setting the channels with the soft key next CH .

   Note: Data transfer takes place in the order of channels 1, 2, 3, 4, A, B, C, and D.

   If a channel is designated more than once, that channel is written into several times. The data transferred last takes precedence.

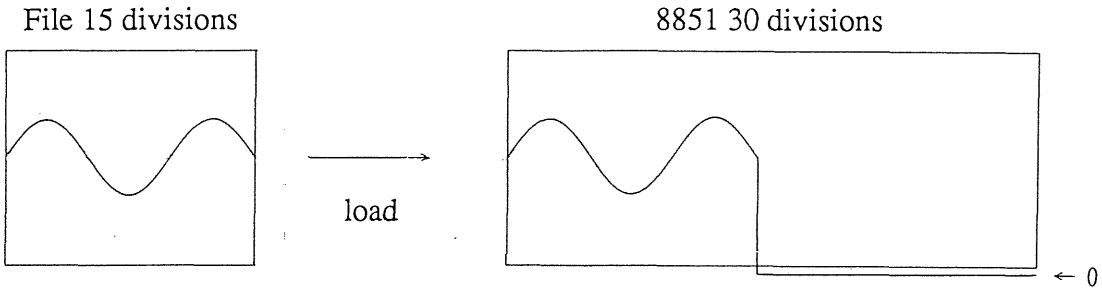
   Example: With CH(1234,ABCD) → CH(2143,BCDA):

   CH1 is loaded into CH2, CH2 is loaded into CH1, CH3 is loaded into CH4, CH4 is loaded into CH3, CHA is loaded into CHB, CHB is loaded into CHC, CHC is loaded into CHD, and CHD is loaded into CHA.

Notes

- If the shot length of the file is longer than the shot length of the 8851, only the initial portion of the waveform data from its start as far as the shot length of the 8851 will be loaded, and the remaining portion of the data will not be loaded. If the shot length of the 8851 is longer than the shot length of the file, then the last portion of the shot length not filled by the waveform data is filled with zeros. (Zero is the lowest possible data value if there is no magnification or compression in the direction of the voltage axis).

  Example:



- When FUNC (setting state) is transferred, the contents of the list of waveforms already recorded on the 8851 is updated.
- Time taken for loading:

  Type of file

  FUNC (setting state) ..... approx. 2 seconds

  AREA (waveform decision area) ..... approx. 4 seconds

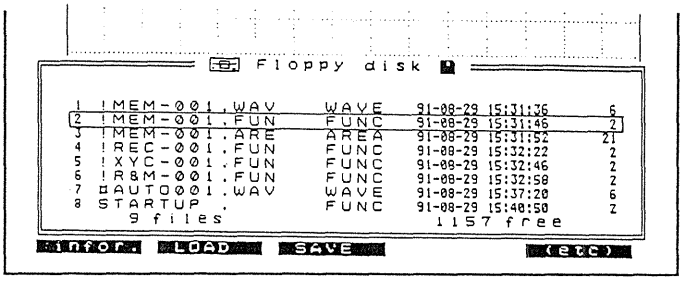
  WAVE (measurement data) ..... for a shot length of 300 divisions and 4 channels, approx. 35 seconds.

  In the case of WAVE (measurement data), the time taken for loading is approximately proportional to the shot length and to the number of channels.

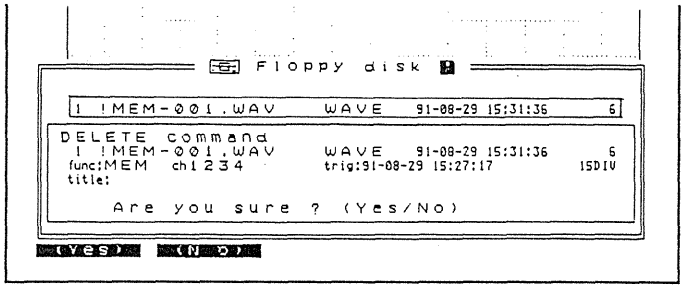
  After the load has been completed, a time of approx. 0.2 seconds multiplied by the total number of files is required for the list of files to be again displayed upon the floppy disk control screen.

DELETE: Deletes a selected file from the floppy disk.

1. Using the ▲ ▼ cursor keys or the rotary knob, select the file to be deleted.



2. Press the soft key DELETE . A screen appears as shown on the right with details about the file.



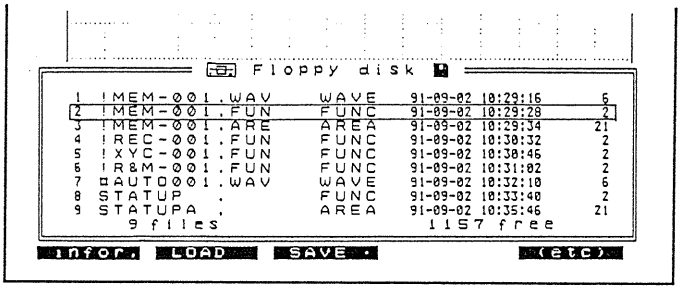
3. Now pressing the soft key (Yes) deletes the file. After the deletion has been completed and while directory display is being performed, the following message appears on the display: "Now deleting. Please wait".

   But pressing the soft key (No) cancels the DELETE command.

   Note: Soft keys other than (Yes) and (No) will have no effect.

infor.: Provides details about a file.

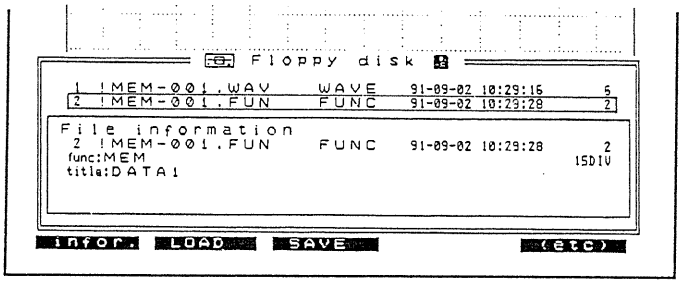
1. Using the rotary knob, select the file about which the details are required.



2. Press the soft key infor., and a screen will appear as shown on the right with detailed information about the file.

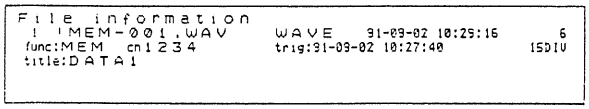
   A title comment input from the system screen is shown here as a title.

   Note: The details of the file are also shown when LOAD and DELETE are executed.

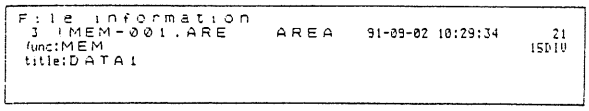


   When the type of file is WAVE or AREA, the screen appears as shown on the right.

When the file type is WAVE



When the file type is AREA



19-6 Partial Save Function

Function

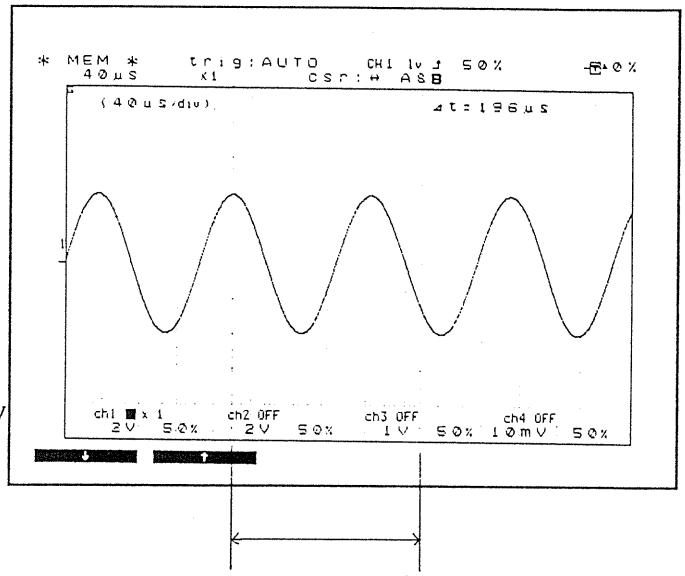
With the memory recorder function, the portion of the captured waveform delimited by the A and B cursors can be saved to the floppy disk as measurement data.

Procedure

1. After measurement is finished, select the portion to save with the A · B cursors, which may be vertical cursors or crosshair cursors.

   If only the A cursor is used, the portion from the position of the A cursor to the end of the waveform is saved.

2. Press the FD key, and, after the floppy disk control screen appears, perform a save to the floppy disk by an identical procedure to that employed for normal measurement data. (See the SAVE command in Section 19-5 "Detailed Explanation of the Commands.")



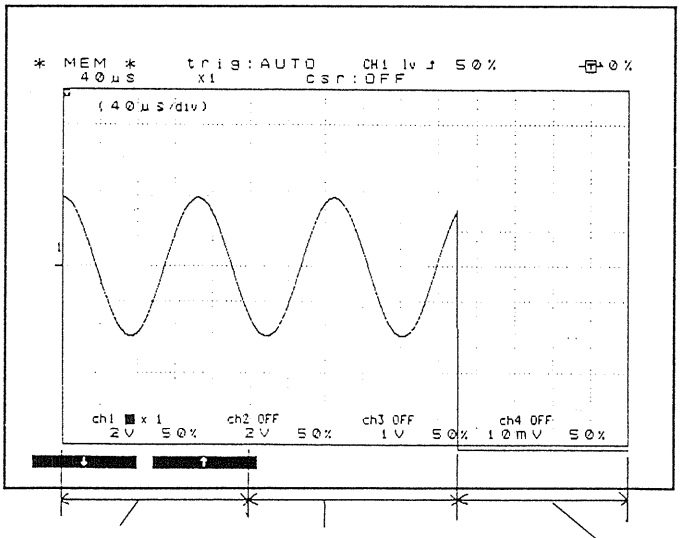
This portion is saved

Note:

The shot length of a waveform which is partially saved is determined as the minimum shot length including the designated range. The remainder of the shot length is filled by measurement data if such measurement data exists, while if such measurement data does not exist it is filled by zeros.

(Zero is the lowest possible data value if there is no magnification or compression in the direction of the voltage axis).

Example:



Designated portion

If there is waveform data after the specified portion, this is used for filling.

The portion where there is no waveform data is made up with zeros.

19-7 Auto Save Function

Function

With the memory recorder function, automatically records a captured waveform on the floppy disk during the measurement process.

Procedure

1. STATUS

   Select the status mode.

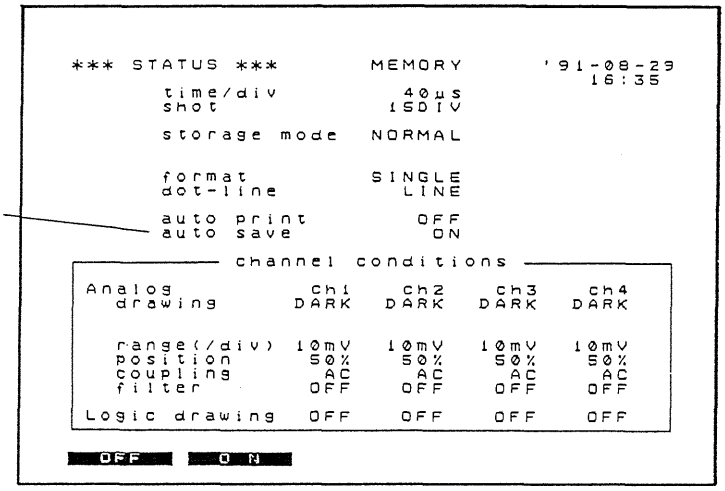
2. "auto save"

   Enable the auto save function.

   (OFF, ON)

   With the above, the auto save function is completed.

   After inserting a floppy disk and performing measurement and capturing data into the memory of the 8851, it is shown on the display, and also a save on the floppy disk is automatically performed.



Note: Check that the waveform can be recorded in the space remaining on the floppy disk. If the remaining space is not sufficient, the waveform will be captured and will be displayed without being saved.

During a save, capturing of the waveform is not performed.

The following message appears:

"Now saving. Please wait"

The channels that are saved are those for which ON appears.

For a logic waveform, whichever channels are displayed, all the channels are saved.

Make sure the write-protect tab is in the unset position.

When data is saved by the auto save function the filename used follows this pattern:

File name	Type
#AUTO 001.WAV	WAVE

Shows that this is a file made by the auto save function

3 digits, 001 to 999

Notes

- When the waveform decision function is on:

  When the waveform decision action has stopped, its measurement data is saved.

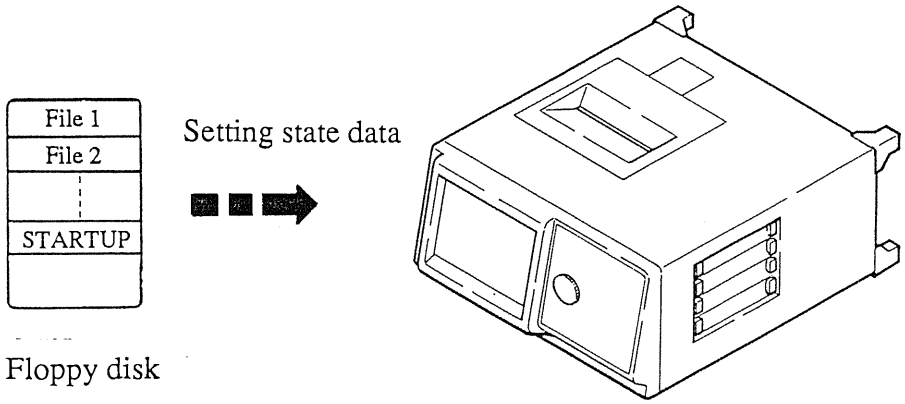
- When the memory division function (sequential save) is on:

  The captured waveform data is saved into all the indicated memory blocks by stages in order from the first memory block.

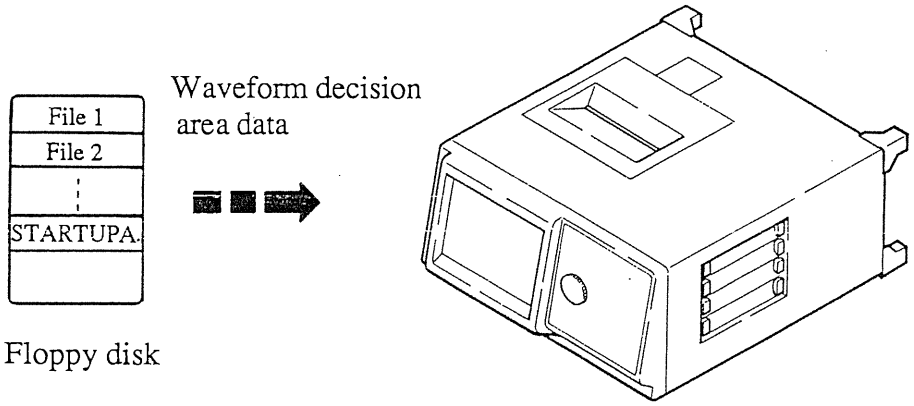
19-8 Auto Setup Function

Function

(1) When the power is switched on with a floppy disk inserted, the setting up of the 8851 is performed automatically by reading the setting state (FUNC) file called STARTUP on the floppy disk. Just by switching on the power with the floppy disk in, the same measurement conditions can be simply established.



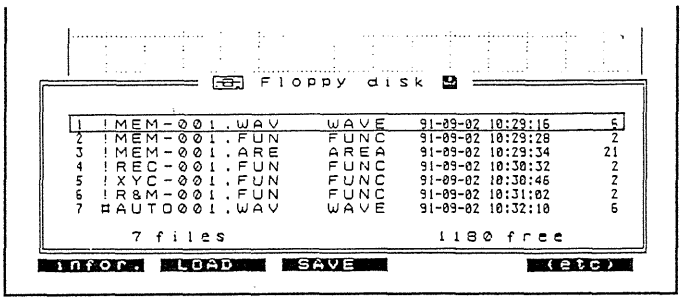
(2) When the power is switched on with a floppy disk inserted, by reading the waveform decision area (AREA) file called STARTUPA on the floppy disk, waveform decision area and waveform decision conditions are set in the 8851. This function can be taken advantage of when waveform decision with always the same area is desired, for purposes of examination or the like.



Procedure

(1) Auto setup function for setting state

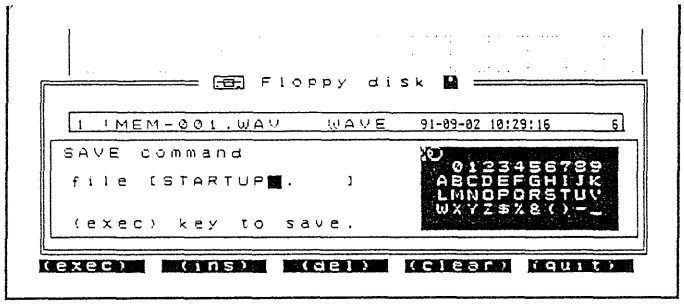
1. Set the conditions desired in the status mode, the trigger mode, the display mode, and the system screen.
2. Press the FD key and the floppy disk control screen will appear.



3. Press the soft key [SAVE] and the soft key [FUNC] in order.
4. Set the file name to [STARTUP.]
5. Press the soft key [(exec)] and the save will be performed.

   This creates a file called STARTUP. on the floppy disk.

   This completes the setting up of the auto setup function.

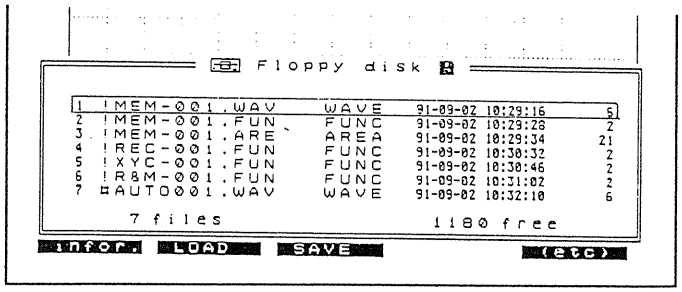


   Next the operation of the auto setup function should be checked in the following manner.

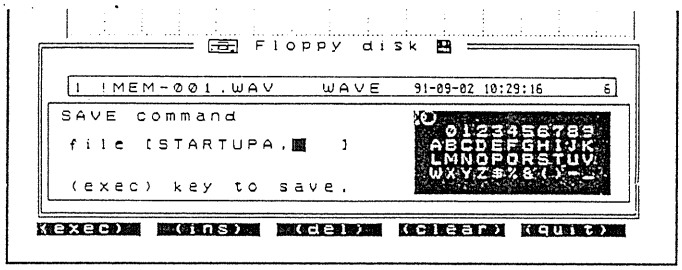
6. Press the FD key again and the floppy disk control screen will disappear.
7. Change the setting state to be different from that of step 1.
8. Check that the floppy disk is inserted, and turn the power temporarily off and then on again. The setting state should now no longer be set as it was in step 7, but should be returned to what it was set to be in step 1.

(2) Auto setup function for waveform decision area.

1. Set the waveform decision area which it is desired to record. At the same time, set the setting state (waveform decision mode, stop mode) for when the waveform decision is performed. For details, see Section 16.
2. Press the FD key and the floppy disk control screen will appear.



3. Press the soft key [SAVE] and the soft key [AREA] in order.
4. Set the file name to [STARTUPA.]
5. Press the soft key [(exec)] and the save will be performed.



This creates a file called STARTUPA. on the floppy disk.

With this the setting up of the auto setup function is completed.

Next the operation of the auto setup function should be checked in the following manner.

6. Press the FD key again and the floppy disk control screen will disappear.
7. Set a waveform decision area different from that set in step 1.
8. Check that the floppy disk is inserted, and turn the power temporarily off and then on again. The waveform decision area previously set in step 1 should now be automatically loaded into the 8851, and it should not be as set in step 7.

19-9 Example Floppy Disk Operation

In this example a waveform which was recorded on channel 1 and which was memorized and recorded on the floppy disk is superposed upon a newly recorded waveform, and is displayed and compared with it.

(1) In the memory recorder function, the input signal on channel 1 is recorded with the following settings:

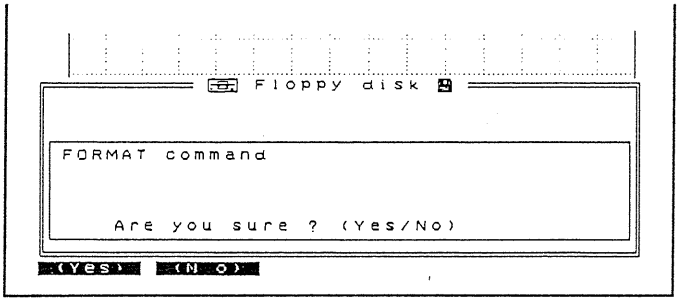
Time axis range ..... 100 µs/divisions

Shot length ..... 150 divisions

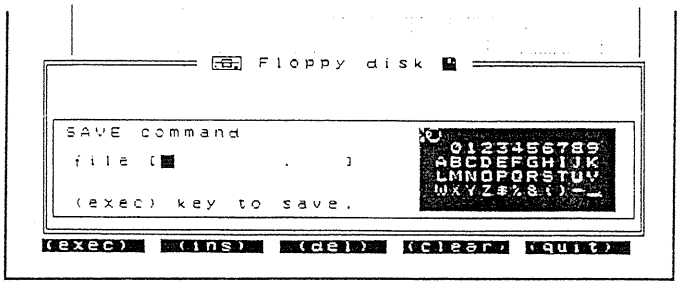
(2) Insert the floppy disk into the 8851 main unit.

(3) By pressing the FD key, the floppy disk control screen is displayed.

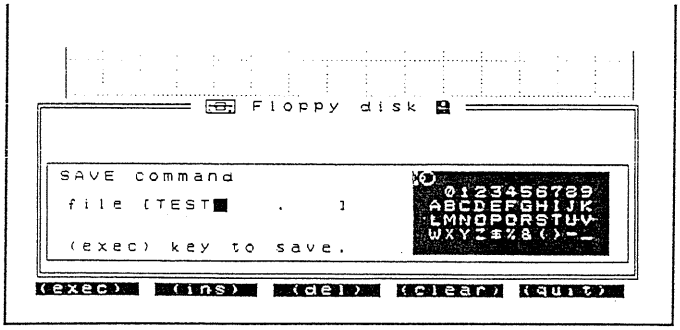
If the floppy disk is a new one, it should be formatted by pressing the soft key FORMAT and then the soft key YES in order.



(4) The measurement data is recorded on the floppy disk by pressing the soft key SAVE , the soft key WAVE , and the soft key CH1 in order.



(5) Set the file name to "TEST". The letters of this file name are input in order by turning the rotary knob so as to select characters from the window, and by pressing the cursor key ▶.

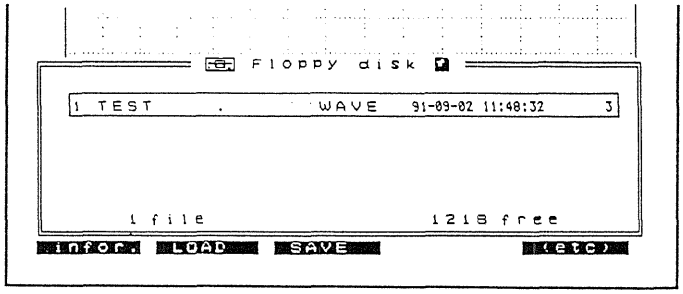


(6) The soft key (exec) is pressed and the save is performed.

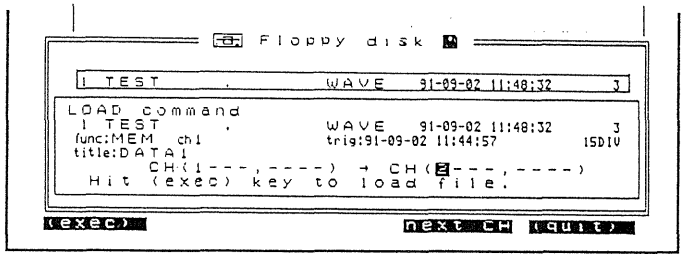
(7) In the same state, a new waveform is recorded on channel 1.

Now both the waveform which has been recorded as "TEST" on the floppy disk and this latest waveform which has been recorded on channel 1 will be simultaneously displayed for comparison.

(8) The FD key on the display screen is pressed, and the floppy disk control screen appears.



(9) The file "TEST" will now be loaded from the floppy disk into channel 2 of the the 8851 main unit. With the bar cursor the file "TEST" is selected, and the soft key [LOAD] is pressed.



(10) With the soft key [next CH], the screen is set to "CH(1---,----) → (2 ---,----)", so as to load into the memory for channel 2.

(11) By pressing the soft key [(exec)], the load is executed.

(12) By pressing the FD key again, and by making the display of channel 2 either DARK or LIGHT, now this waveform which has been recorded on channel 1 and the waveform "TEST" on the floppy disk are simultaneously displayed.

In this manner, it is possible to compare a waveform recorded on the floppy disk and a currently measured waveform.

19-10 Internal File Format

From the start of a file, information is stored in the following manner.

The following is the internal format, which will be required in order to read data stored on the floppy disk into a personal computer.

```
HIOKI8851V 1.00 1MEMWAVE91-08-02 12:16:11  20%HIOKI 8851 Sample 01  40/DIV
15 DIV  601W12 50us/DIV 400/DIV  4  1111108944  1V /DIV  30%  OFF DC8944
2V /DIV  50%  OFF DC8944 10V /DIV  70%  OFF DC8944  1V /DIV  50%  OFF DC
```

Byte number Example data	Meaning	Number of characters
1: HIOKI8851	ID	(9)
10:V 1.00	Version	(6)
16:_1	Length of header	(2)
18:MEM	Function	(3)
21:WAVE	Type of file	(4)
25:91-08-02_12:16:11	Trigger instant	(17)
42:___20%	Pre-trigger	(6)
48:HIOKI_8851_Sample_01	Title comment	(20)
68:__40/DIV	Time axis data/division	(8)
76:__15_DIV	Shot length	(8)
84:____601	Total number of data values	(7)
91:W	Length of data word	(1)
92:12	A/D resolution	(2)
94:_50us/DIV	Time/division	(9)
103:_400/DIV	Voltage axis data/division	(8)
111:__4	Number of analog channels	(3)
114:__1	Number of logic channels	(3)
117:11110	Data save conditions	(4+1)
122:8944__1V_/DIV___30%___OFF_DC	Channel 1 ※1	(28)
150:8944__2V_/DIV___50%___OFF_DC	Channel 2 ※1	(28)
178:8944_10V_/DIV___70%___OFF_DC	Channel 3 ※1	(28)
206:8944__1V_/DIV___50%___OFF_DC	Channel 4 ※1	(28)

※1: model number (4), voltage range (9), origin position (6), filter (6), input coupling (3)

ID	Shows the name of the type of device the data was stored from.
Version	Shows the ROM version.
Length of header	Shows the length of the header portion present at the head of the data (unit is blocks, 1 block = 1024 bytes).
Function	Shows the function of the saved data: MEM ... memory recorder function; REC ... recorder function; XYc ... XY recorder function; R&M ... recorder and memory function.
type of file	Shows the type of the saved data: WAVE .. measurement data; FUNC ... setting state; AREA ... waveform decision area.
Trigger instant	Shows the trigger time.
Pre-trigger	Indicates the proportion of the shot length before the trigger.
Title comment	This is a comment used for a title.
Time axis data/division	Shows the number of data samples per division.
Shot length	Shows the shot length of the saved data.
Total number of data samples	Shows the total number of saved data samples.
Length of data word	Shows the length of one data sample. W..... 16 bit (2 byte).
A/D resolution	Shows the A/D resolution.
Time/division	Shows time axis information for the saved waveform.
Voltage axis data/division	Shows the resolution one/division.
Number of analog channels	Shows the number of analog input units. (maximum value)
Number of logic channels	Shows the number of logic channels, in units of 16 channels.
Data save condition	Shows whether the data for the corresponding channel was saved; 0.... not saved; 1.... saved.
Channel 1 to Channel 4	Show the information in the corresponding channel: model number voltage range origin position filter input coupling

Internal structure of a measurement data file

The following example shows the case when channel 1, channel 3 and logic data have been saved.

File information (1024 bytes)
Waveform data (total number of data samples × 2 bytes) (channel 1)
Waveform data (total number of data samples × 2 bytes) (channel 3)
Waveform data (total number of data samples × 2 bytes) (logic)

① Analog data

Sample 1 (upper byte)	Sample 1 (lower byte)	Sample 2 (upper byte)	Sample 2 (lower byte)	...

Sample 1 (16 bits) Sample 2 (16 bits)

② Logic data

CH A	CH B	CH C	CH D	CH A	CH B	CH C	CH D	...

Sample 1 (16 bits) Sample 2 (16 bits)

③Envelope mode data

Since in the envelope mode samples of the maximum and minimum values are storaged, the envelope function can strage twice as many samples as the normal function.

Sample 1 minimum	Sample 1 maximum	Sample 2 minimum	Sample 2 maximum	...

Sapmple 1 (32 bits) Sample 2 (32 bits)

19-11 Sample Program for IBM-PC(VGA) Series

This program runs on a IBM-PC(VGA) series computer, and reads and lists the data from a file on floppy disk.

```
1000 CLS : SCREEN 12
1010 'Read Header from File ************************************************
1020 INPUT "File name = ", FI$
1030 OPEN FI$ FOR BINARY AS #1
1040 FLAG = 1
1050 FOR I = 0 TO 1023
1060 A$ = INPUT$(1, #1): IF A$ = CHR$(&H1A) THEN FLAG = 0
1070 IF FLAG = 0 THEN 1090
1080 HD$ = HD$ + A$
1090 NEXT
1100 'Display Header ********************************************************
1110 ID$ = MID$(HD$, 1, 9): LOCATE 3, 1: PRINT "ID="; ID$
1120 VR$ = MID$(HD$, 10, 6): LOCATE 3, 21: PRINT "Version="; VR$
1130 HL$ = MID$(HD$, 16, 2): LOCATE 3, 41: PRINT "Header len.="; HL$
1140 FU$ = MID$(HD$, 18, 3): LOCATE 4, 1: PRINT "Function="; FU$
1150 KI$ = MID$(HD$, 21, 4): LOCATE 4, 21: PRINT "Kind="; KI$
1160 TT$ = MID$(HD$, 25, 17): LOCATE 5, 41: PRINT "Trig. Time="; TT$
1170 PT$ = MID$(HD$, 42, 6): LOCATE 7, 61: PRINT "Pre Trig.="; PT$
1180 CO$ = MID$(HD$, 48, 20): LOCATE 4, 41: PRINT "Comment="; CO$
1190 TP$ = MID$(HD$, 68, 8): LOCATE 6, 1: PRINT "X axis="; TP$
1200 SH$ = MID$(HD$, 76, 8): LOCATE 6, 21: PRINT "Shot len.="; SH$
1210 TD$ = MID$(HD$, 84, 7): LOCATE 6, 61: PRINT "No. of data="; TD$
1220 DL$ = MID$(HD$, 91, 1): LOCATE 7, 21: PRINT "Data len.="; DL$
1230 AD$ = MID$(HD$, 92, 2): LOCATE 7, 41: PRINT "A/D="; AD$
1240 TI$ = MID$(HD$, 94, 9): LOCATE 6, 41: PRINT "TIME="; TI$
1250 YP$ = MID$(HD$, 103, 8): LOCATE 7, 1: PRINT "Y axis="; YP$
1260 AN$ = MID$(HD$, 111, 3): LOCATE 5, 1: PRINT "Analog="; AN$
1270 LN$ = MID$(HD$, 114, 3): LOCATE 5, 21: PRINT "Logic="; LN$
1280 AC$ = MID$(HD$, 117, VAL(AN$))'Analog channel ON,OFF
1290 LC$ = MID$(HD$, 121, VAL(LN$))'Logic channel ON,OFF
1300 'Display Graph *********************************************************
1310 IF ID$ <> "HIOKI8851" THEN 1940
1320 IF KI$ <> "WAVE" THEN 1960
1330 X = 30: Y = 255: XW = 600: YW = 250: AD = 2 ^ VAL(AD$) / 2: AD2 = AD /
 128
1340 XB = 15: YB = INT(2 ^ VAL(AD$) / VAL(YP$))
1350 YD = INT(2 ^ VAL(AD$) / YW)
1360 LOCATE 8, 61: PRINT "MAG=x1/"; (VAL(TD$) - 1) / (VAL(TP$) * XB)
1370 LINE (X, Y - YW / 2)-(X + XW, Y - YW / 2): LINE -(X + XW, Y + YW / 2)
1380 LINE -(X, Y + YW / 2): LINE -(X, Y - YW / 2)
1390 FOR L = 1 TO XB - 1
1400 LINE (X + L * XW / XB, Y - YW / 2)-(X + L * XW / XB, Y + YW / 2), , ,
&H1111
1410 NEXT
1420 FOR L = 1 TO YB - 1
1430 LINE (X, Y - YW / 2 + L * YW / YB)-(X + XW, Y - YW / 2 + L * YW / YB),
 , , &H1111
1440 NEXT
1450 'Display Analog wave and Channel information ***************************
1460 FOR CH = 1 TO VAL(AN$)
1470 IF MID$(AC$, CH, 1) = "0" THEN 1640
1480 COLOR CH + 1 MOD 4 + 8: LOCATE 25, 8 + (CH - 1) * 20: PRINT "CH"; HEX$
(CH)
1490 N = 117 + VAL(AN$) + VAL(LN$)
1500 LOCATE 25, 14 + (CH - 1) * 20: PRINT MID$(HD$, N + (CH - 1) * 28, 4)
1510 LOCATE 26, 5 + (CH - 1) * 20: PRINT MID$(HD$, N + (CH - 1) * 28 + 4, 9
)
1520 LOCATE 27, 5 + (CH - 1) * 20: PRINT MID$(HD$, N + (CH - 1) * 28 + 13,
6)
```

```
1530 LOCATE 27, 12 + (CH - 1) * 20: PRINT MID$(HD$, N + (CH - 1) * 28 + 19,
 6)
1540 LOCATE 26, 15 + (CH - 1) * 20: PRINT MID$(HD$, N + (CH - 1) * 28 + 25,
 3)
1550 A$ = INPUT$(1, #1): B$ = INPUT$(1, #1)
1560 DT = (ASC(A$) AND AD2 - 1) * 256 + ASC(B$)
1570 PSET (X, Y + (AD - DT) / YD), CH + 1 MOD 4
1580 FOR J = 1 TO VAL(TD$) - 1
1590 K = X + J * XW / (VAL(TD$) - 1)
1600 A$ = INPUT$(1, #1): B$ = INPUT$(1, #1)
1610 DT = (ASC(A$) AND AD2 - 1) * 256 + ASC(B$)
1620 LINE -(K, Y + (AD - DT) / YD), CH + 1 MOD 4 + 8
1630 NEXT
1640 NEXT
1650 'Display Logic wave ************************************************
1660 IF MID$(LC$, 1, 1) = "0" THEN 1910
1670 FOR LG = 1 TO 16
1680 LINE (10, Y - (8 - LG + 1) / 20 * YW)-(25, Y - (8 - LG + 1) / 20 * YW)
, INT((LG - 1) / 4) + 2
1690 NEXT
1700 FOR J = 0 TO VAL(TD$) - 1
1710 A$ = INPUT$(1, #1): B$ = INPUT$(1, #1)
1720 AA = ASC(A$): BB = ASC(B$)
1730 FOR LG = 1 TO 8
1740 K = X + J * XW / (VAL(TD$) - 1)
1750 BIT = (2 - INT((LG - 1) / 4)) * 4 - 4 + ((LG - 1) MOD 4)
1760 IF J = 0 THEN 1790
1770 IF (INT(AA / (2 ^ (BIT))) AND 1) = (INT(AAA / (2 ^ (BIT))) AND 1) THEN
 1790
1780 LINE (K, Y - (8 - LG + 1) / 20 * YW)-(K, Y - (8 - LG + 1) / 20 * YW -
1 * YW / 30), INT((LG - 1) / 4) + 2
1790 PSET (K, Y - (8 - LG + 1) / 20 * YW - (INT(AA / (2 ^ (BIT))) AND 1) *
YW / 30), INT((LG - 1) / 4) + 2
1800 NEXT
1810 FOR LG = 9 TO 16
1820 K = X + J * XW / (VAL(TD$) - 1)
1830 BIT = (4 - INT((LG - 1) / 4)) * 4 - 4 + ((LG - 1) MOD 4)
1840 IF J = 0 THEN 1870
1850 IF (INT(BB / (2 ^ (BIT))) AND 1) = (INT(BBB / (2 ^ (BIT))) AND 1) THEN
 1870
1860 LINE (K, Y - (8 - LG + 1) / 20 * YW)-(K, Y - (8 - LG + 1) / 20 * YW -
1 * YW / 30), INT((LG - 1) / 4) + 2
1870 PSET (K, Y - (8 - LG + 1) / 20 * YW - (INT(BB / (2 ^ (BIT))) AND 1) *
YW / 30), INT((LG - 1) / 4) + 2
1880 NEXT
1890 AAA = AA: BBB = BB
1900 NEXT
1910 'End of display ************************************************
1920 COLOR 7: LOCATE 29, 1, 0
1925 PRINT "Hit any key !";
1926 IF INKEY$ = "" THEN 1926
1930 CLOSE : END
1940 LOCATE 10, 1: PRINT "This is not a 8851's file."
1950 GOTO 1930
1960 LOCATE 10, 1: PRINT "This is not a wave file."
1970 GOTO 1930
```

Section 20

GP-IB Interface

Contents

20-1 Outline

The GP-IB (General Purpose Interface Bus) was developed as an interface for general use by programmable instrumentation, and as an interface is rich in expandability and has many distinctive features.

There are various interfaces with specific names apart from the GP-IB, such as the IEE488 bus, the IEC bus, and the HP-IB which is an internal standard within the Hewlett-Packard Company. These are basically the same standard, but, because the number of connector pins and the arrangement of the signals and so on differ, much care should be exercised.

In this explanation of management and operation, only the GP-IB related resources of the 8851 will be described.

If more detailed knowledge of the GP-IB interface is required, reference should be made to the following literature:

(1) The Institute of Electrical and Electronics Engineers, Inc.: "IEEE Standard Digital Interface for Programmable Instrumentation", IEEE Std 488.1 11987, IEEE Std 488.21987 (1987)

20-2 GP-IB Specification

20-2-1 Standards

IEEE Standard 488.1-1987

IEEE Standard 488.2-1987

20-2-2 Interface Functions

Function	Implementation
SH1	SH (Source Handshake) - All Functions
AH1	AH (Acceptor Handshake) - All Functions
T6	Basic Talk Function, Serial Poll Function MLA (My Listen Address) Talk Release Function
L3	Basic Listener Function, Listen Only Function MTA (My Talk Address) Listen Release Function
SR1	SR (Service Request) - All Functions
RL1	RL (Remote/Local) - All Functions
PP0	PP (Parallel Poll) - No Function
DC1	DC (Device Clear) - All Functions
DT0	DT (Device Trigger) - No Function
C0	C (Control) - No Function

20-2-3 GP-IB Signal Lines

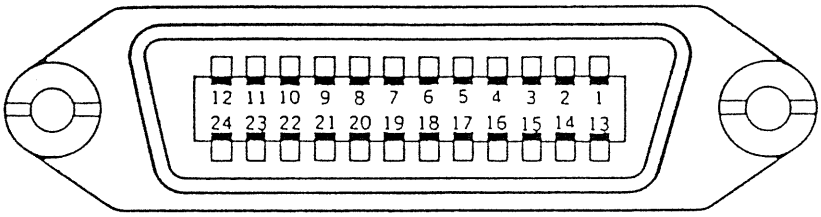
Bus Signal Lines		Remarks	
Data bus	DIO 1 (Data Input Output 1) DIO 2 (Data Input Output 2) DIO 3 (Data Input Output 3) DIO 4 (Data Input Output 4) DIO 5 (Data Input Output 5) DIO 6 (Data Input Output 6) DIO 7 (Data Input Output 7) DIO 8 (Data Input Output 8)	Apart from input and output of data, these are used for input and output of interface messages and device messages.	
Transfer bus	DAV (Data Valid) NRFD (Not Ready For Data) NDAC (Not Data Accepted)	Signal which indicates data bus information validity. Input preparation completed signal. Input completed signal.	These perform acceptor and source handshake.
Control bus	ATN (Attention) IFC (Interface Clear) SRQ (Service Request) REN (Remote Enable) EOI (End or Identify)	Signal which indicates that the information on the data bus is an interface message or a device message. Signal which sets the interface bus system to the initial condition. Signal which requests a non-synchronous service. Signal which performs changeover of remote and local control. Indicates the last byte of data.	

20-2-4 Connector Pin Assignment

On the 8851: 57LE-20240 (made by DDK) or compatible.

On the cable: 57-10240 (made by DDK) or compatible.

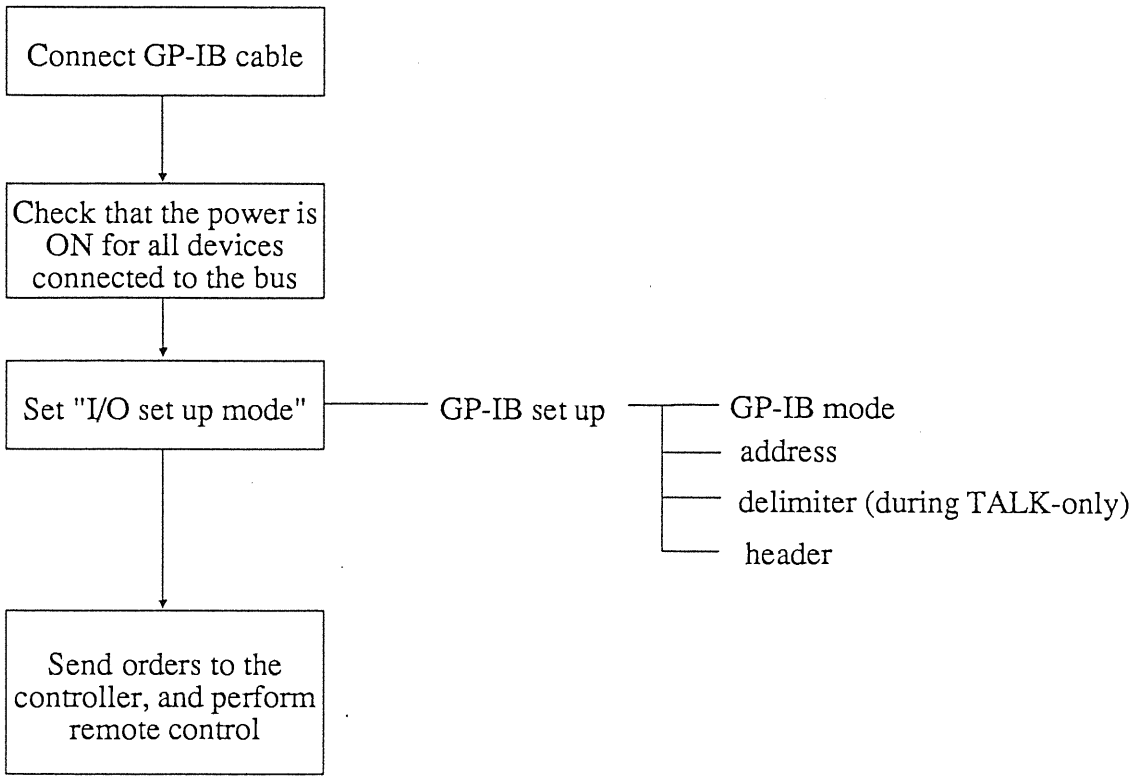
Pin arrangement diagram for the GP-IB interface connector on the 8851:



Pin number	Name of signal line	Pin number	Name of signal line
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	LOGIC GND

20-3 Method of Operation

20-3-1 Basic Operational Procedure



⚠ Warning

The GP-IB interface is not isolated from the 8851 system. Exercise caution, because the ground of the logic inputs and the GP-IB interface ground are connected.

20-3-2 Setup Procedure

1. SYSTEM

   Select system mode.

2. Press the soft key GP-IB, and the GP-IB setup screen appears.

3. "mode" (GP-IB mode)

   Sets up the functions and role of the 8851 for the GP-IB interface.

   (ADDRESSABLE, TALK ONLY, DISABLE)

   ADDRESSABLE... Sets the 8851 bus address: the system can be used both in the TALK mode and in the LISTEN mode.

   TALK ONLY.... The system can only be used in the TALK mode.

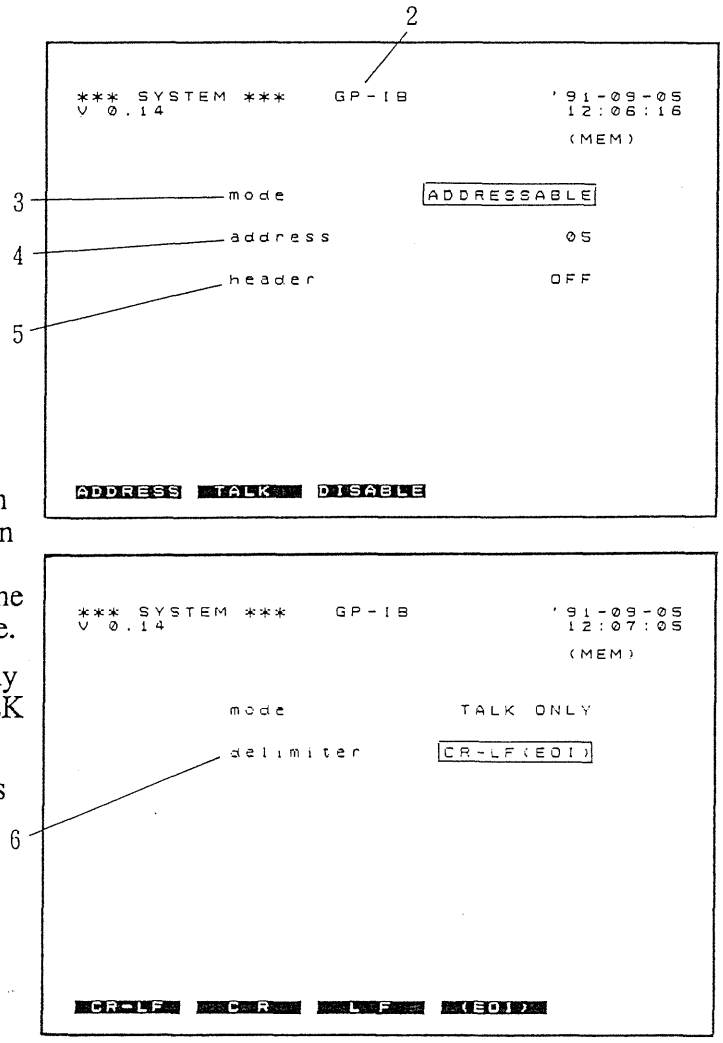
   DISABLE..... Use of the GP-IB is prohibited.

4. "address"

   The address of the 8851 on the bus can be set to any number from 0 to 30. (0 - 30)

5. "header"

   This determines whether headers are sent in response to requests, when the 8851 is in the TALK mode. (OFF, ON)



6. "delimiter"

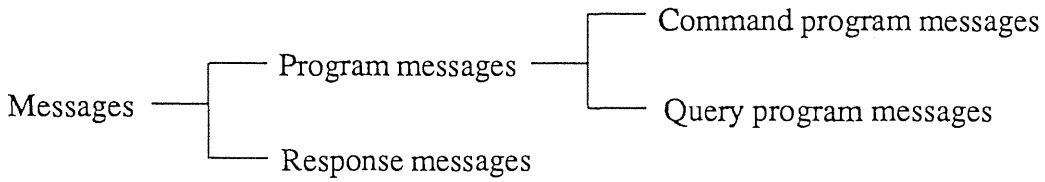
   This is a code which marks off send data, only during talk-only. This is set to the one, among the four types CRLF(EOI), CR(EOI), LF(EOI), and (EOI), which corresponds to the capabilities of the plotter which is being used.

20-3-3 Receive and Send Protocols

(1) Messages

Data received or sent by the GP-IB interface is called a message.

The following are the message types:



Of these, program messages are those received by the unit from the controller, while response messages are those sent from the unit to the controller.

Further, program messages can be either command program messages such as ones which make settings on the unit, or query program messages which interrogate the unit.

(2) Command program headers

The minimum requirement for a command (a message sent to the unit is briefly termed a command) is a header.

There are three kinds of header: the simple command type, the compound command type, and the standard command type.

These headers begin with a colon, except for the standard command type.

Most of the commands have a long form and a short form, and either of these will be accepted. However, intermediate forms will not be accepted.

Further, no distinction is made between upper case letters and lower case letters.

Example: For DISPLAY, either DISPLAY or DISP will be accepted. However, any one of DISPLA, DISPL, or DIS is wrong and will generate an error.

In command references in this manual, the short form is written in upper case letters, and then this is continued in lower case letters so as to constitute the long form.

- Simple command type header:

  From the colon the first word constitutes the header.

  Example: :HEADer ON

- Compound command type header:

  A header made up from a plurality of simple command type headers marked off by colons.

  Example: :CONFigure:TDIV 1. E3

- Standard command type header:

  A command beginning with an asterisk and stipulated by IEEE488.2 (except for "*ESE0", "*ESE0?", and "*ESRO?")

  Example: *RST

(3) Query program headers

These are for commands used for interrogating the unit about the result of an operation or about a setting.

These can be recognized as queries by a question mark appearing after the program header. The structure of the header is identical to that of a command program header, with "?" always being affixed to the last command. There are queries possible in each of the three previously described types of command form.

(4) Response messages

Response messages relating to queries are made up from header portions (which also may be absent due to header disablement) and data portions identical to those of program messages, and as a general rule are sent in an identical format to the format of the program message corresponding to their originating query.

(5) Terminators and separators

① Message Terminator

A terminator is used in order to separate the transmission of one message from another, and this terminator is not itself included in the message. On the 8851, LF+EOI is used as the message terminator.

② Message Unit Separator

A semicolon ";" is used as a message unit separator when it is desired to set out several messages on a single line.

Example: CONFIGURE:TDIV 1. E3;:CONFIGURE:SHOT 25

Message unit separator

③ Header separator

With a message which has both a header and data, a space " " is used as a header separator to separate the header from the data.

Example: :CONFIGURE:SHOT 25

header separator

④ Data separator

Commas are used as data separators for separating several data items from one another.

(6) The command tree

The rule when writing several messages of compound command form on the same line, when no colon is prefixed to the next header after the semicolon (the message unit separator), is that that header is considered as continuing on from the header before the last colon in the message directly preceding.

This corresponds to the general concept of the current directory in the directory structure of UNIX or MS-DOS, and this directly preceding header is called the "current path".

Example 1: :CONF:TDIV 1. E3;:CONF:SHOT 25

Example 2: :CONF:TDIV 1. E3;SHOT 25

Both Example 1 and Example 2 are messages setting TIME/DIV to 1 and recording length to 25 divisions.

With Example 1, because there is a colon directly after the semicolon, the current position is the "root". Accordingly the reference of the next command is performed from the root.

On the other hand, with Example 2, because with ":CONF:TDIV 1. E3;" the current path has become ":CONF", it is now possible to omit the ":CONF" before "SHOT".

(7) Data format

The 8851 uses character data, decimal data and character string data.

- Character data

① The first character must be alphabetic.

② The characters after the first character can only be alphabetic characters, numerals, or underline characters (_).

③ As alphabetic characters, during sending only upper case letters are used, but during receiving both upper case and lower case letters are permitted.

- Decimal data

Decimal data values are represented in what is termed NR format.

There are three types of NR format from NR1 to NR3, and each of these can appear as either a signed number or an unsigned number. Unsigned numbers are taken as positive.

Further, if the accuracy of a numerical value exceeds the range with which the 8851 can deal, it is rounded off. (5 and above is rounded up; 4 and below is rounded down).

NR1 format - integer data.

Examples: +15, -20, 25

NR2 format - fixed point numbers.

Examples: +1.23, -4.56, 7.89

NR3 format - floating point numbers.

Examples: +1.0E-3, -2.3E+3

The term "NRf format" includes all these three formats.

When the 8851 is receiving it accepts NRf format, but when it is sending it utilizes whichever one of the formats NR1 to NR3 is indicated in the particular command.

- Character string data

Character string data is enclosed within quotation marks.

① The data is composed of 7 bit ASCII characters.

② Characters which cannot be handled by the 8851 are replaced by spaces.

③ When the 8851 is sending, only the double quotation mark (") is used as a quotation mark, but when receiving both this double quotation mark and also the single quotation mark (') are accepted.

20-3-4 Remote Control

- Local state

  This is the state in which the 8851 is controlled by its keys. When the power is turned on, the 8851 always comes up in local state.

- Remote state

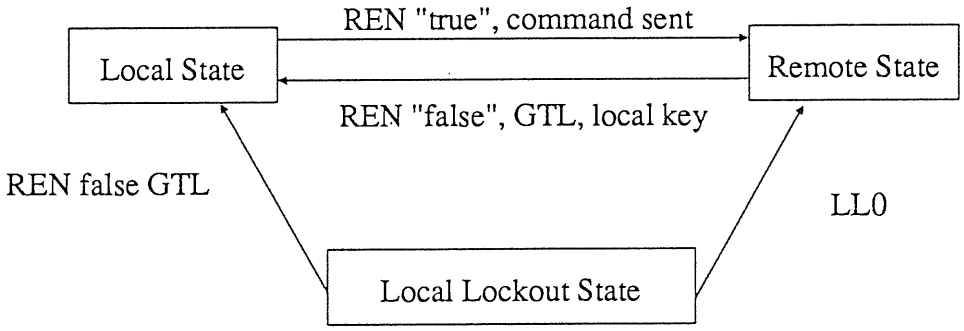
  In this state the 8851 is controlled from the GP-IB interface (the REN line is "true"), and its keys are disabled. When in the remote state, the 8851 returns to local state if the local key (the soft key [LCL]) is pressed.

- Local lockout state

  When an LLO (Local Lockout) command (this is a GP-IB universal command) is received, even if the local key is pressed, the 8851 is prevented from returning to the local state. This state is called the local lockout state.

  In order to return the 8851 from the local lockout state to the local state, it is necessary either (a) to send a GTL (Go To Local) command (this is a GP-IB universal command), or (b) to turn the power to the 8851 temporarily off and then on again, or (c) to bring the line REN to "false".

  If a command is sent with REN in the "false" state, then the only way to return to the local state is with the local key.



Program example 1:.....	HP-9816 (Hewlett-Packard)	
	local lockout	LOCAL LOCKOUT 7
	local	LOCAL 7
Program example 2.....	PC-9801 (NEC)	
	local lockout	ISET REN WBYTE &H11;
	local	IRESET REN

20-3-5 Device Clear

When the 8851 receives the device clear command, it clears the input buffer and the output queue.

The device clear command is exemplified by the following:

1) HP 9816 (made by Hewlett-Packard)

CLEAR 7

2) PC 9801 (made by NEC)

WBYTE &H14;

20-3-6 The Status Byte and the Event Registers

(1) The status byte

Each bit of the status byte is a summary (logical OR) of the event register corresponding to that bit.

Further, the status byte and each event register has an enable register corresponding to it, and according to the setting of this enable register (which starts off at zero when the power is turned on) it is possible to mask the service requests originating from each event.

Status byte bit settings

bit 7:	Unused: 0
bit 6: rsv MSS	Set when a service request is issued.
bit 5: ESB	Event summary bit. Shows a summary of the standard event status register.
bit 4: MAV	Message available. Shows that a message is present in the output queue.
bit 3:	Unused: 0
bit 2:	Unused: 0
bit 1:	Unused: 0
bit 0: ESB0	Event summary bit 0 Shows a summary of event status register 0.

The following commands are used for reading the status byte, and for setting the service request enable register and for reading it.

Reading the status byte: *STB?

Setting the service request enable register: *SRE

Reading the service request enable register: *SRE?

(2) Standard event status register (SESR)

The summary of this register is set in bit 5 of the status byte.

Each bit is masked by setting the standard event status enable register (which starts off at zero when the power is turned on).

The circumstances when the contents of the standard event status register are cleared are as listed below.

1. When the *CLS command is received.
2. When the contents have been read by an *ESR? query.
3. When the power is turned off and turned on again.

Bit allocations in the standard event status register

bit 7: PON	The power has been turned on again. Since this register was last read, the unit has been powered off and on.
bit 6: URQ	User request: not used.
bit 5: CME	Command error. There is an error in a command that has been received; either an error in syntax, or an error in meaning.
bit 4: EXE	Execution error. An error has occurred while executing a command. Range error; Mode error.
bit 3: DDE	Device dependent error. It has been impossible to execute some command, due to an error other than a command error, a query error, or an execution error.
bit 2: QYE	Query error. The queue is empty, or data loss has occurred (queue overflow)
bit 1:	Request for controller right (not used) Unused: 0
bit 0: OPC	Operation finished. Only set for the *OPC command.

The following commands are used to read the standard event status register, and to set or read the standard event status enable register.

Read the standard event status register: *ESR?

Set the standard event status enable register: *ESE

Read the standard event status enable register: *ESE?

(3) Event status register 0 (ESR0)

The summary of this register is set in bit 0 of the status byte.

Each bit is masked when the event status enable register 0 (which starts off at zero when the power is turned on) is set.

The circumstances when the contents of event status register 0 are cleared are as listed below.

1. When the *CLS command is received.
2. When the contents have been read by an :ESR0? query.
3. When the power is turned off and turned on again.

The bits of event status register 0

bit 7:	Waveform decision fail (NG).
bit 6:	Unused.
bit 5:	Unused.
bit 4:	Unused.
bit 3:	Printer operation finished (print, copy, or plotter output).
bit 2:	Trigger wait finished (set when the trigger event occurs).
bit 1:	Measurement operation concluded (set by STOP).
bit 0:	Error not related to the GP-IB interface; printer error etc.

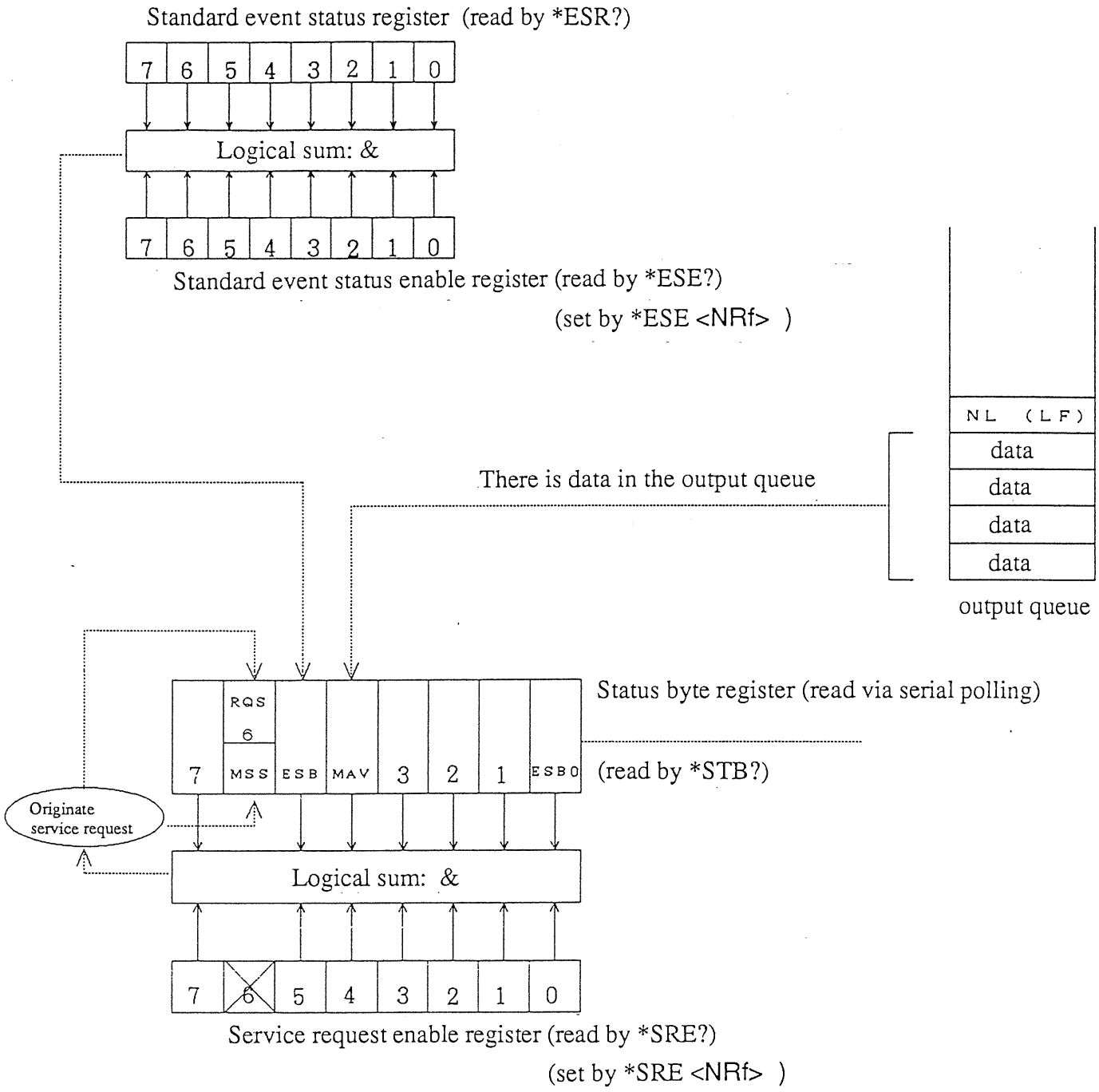
The following commands are used for reading the event status register 0, and for setting the event status enable register 0 and for reading it.

Reading event status register 0: *ESR0?

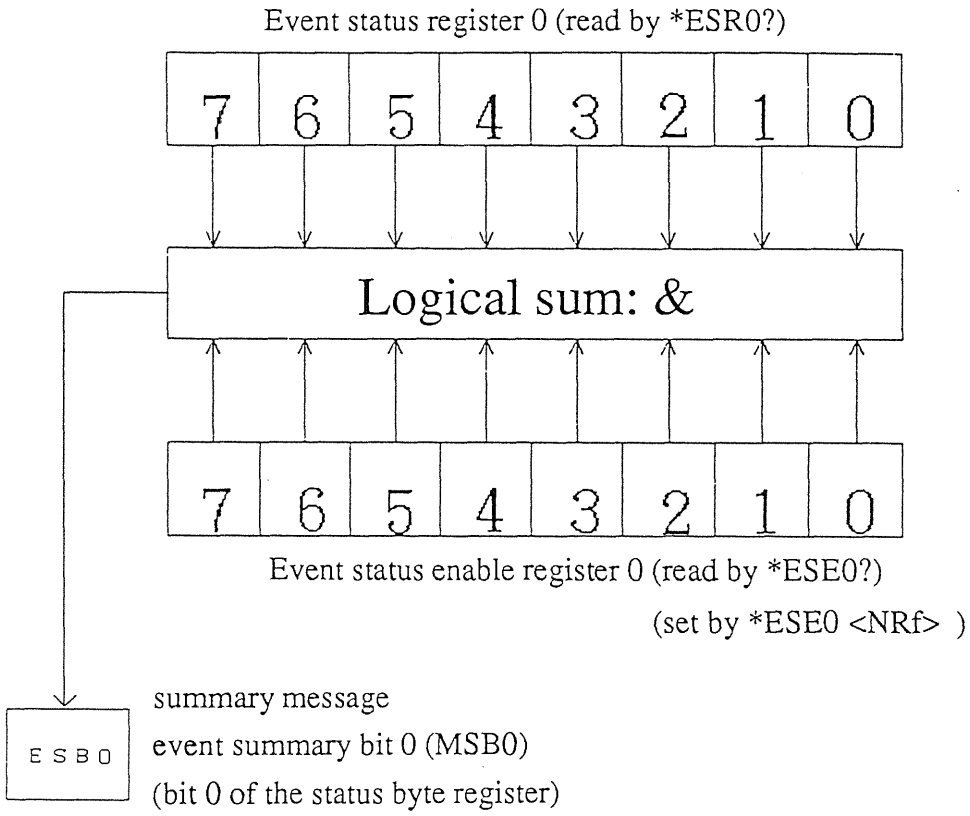
Setting event status enable register 0: *ESE0

Reading event status enable register 0: *ESE0?

Status byte data structure:



Event status register 0 data structure



20-3-7 The Input Buffer and the Output Queue

(1) Input buffer

The 8851 has an input buffer of 256 bytes capacity.

Messages which are received are put into this buffer and executed in order.

However, an ABORT command is executed instantly as soon as it is received.

(2) Output queue

The 8851 has an output queue of 256 bytes capacity.

Response messages are accumulated in this queue and are read out from the controller.

The circumstances when the output queue is cleared are as listed below:

1. When the controller has read out its entire contents.
2. When a device clear is issued.
3. When the power is turned off and turned on again.
4. Upon receipt of the next message.

If the length of a response message has exceeded 256 bytes, a query error occurs.

20-3-8 GP-IB Errors

When a command which has been received contains an error, that one of bits 25 of the standard event status register which corresponds to the event which has occurred is set.

Further, if a command has given rise to an error (apart from an execution error), commands accumulated in the input buffer and waiting for execution after that command are ignored.

Bit allocations in the standard event status register

bit 7: PON	The power has been turned on again. Since this register was last read, the unit has been powered off and on.
bit 6: URQ	User request: not used.
bit 5: CME	Command error. There is an error in a command that has been received; either an error in syntax, or an error in meaning.
bit 4: EXE	Execution error. An error has occurred while executing a command. Range error; Mode error.
bit 3: DDE	Device dependent error. It has been impossible to execute some command, due to an error other than a command error, a query error, or an execution error.
bit 2: QYE	Query error. The queue is empty, or data loss has occurred (queue overflow)
bit 1:	Request for controller right (not used) Unused: 0
bit 0: OPC	Operation finished. Only set for the *OPC command.

20-4 GP-IB Commands

20-4-1 Command Summary

(1) Standard commands specified by IEEE488.2

Command	Data (for a query, response data)	Explanation	Reference page
*IDN?	Maker's name, model number, serial number, software version (not used, zero)	Queries device ID.	20-37
*OPT?	Whether channel 1 input unit exists Whether channel 2 input unit exists Whether channel 3 input unit exists Whether channel 4 input unit exists	Queries device option provision.	20-37
*RST		Device initial setting.	20-37
*TST?	<NR1> (0 = normal)	Queries the result of the self-test.	20-37
*OPC		Sets the LSB of SESR after all action has been completed.	20-38
*OPC?	<NR1>	Queries whether all action has been completed. ASCII [1] is the response.	20-38
*WAI		Wait until action fully completed.	20-38
*CLS		Clears the status byte and associated queues.	20-38
*ESE	<NRf> 0 to 255	Sets SESER.	20-38
*ESE?	<NR1> 0 to 255	Queries SESER.	20-39
*ESR?	<NR1>	Queries the contents of SESR.	20-39
*SRE	<NRf> 0 to 255	Sets SRER.	20-39
*SRE?	<NR1> 0 to 63, 128 to 191	Queries SRER.	
*STB?	<NR1> 0 to 255	Reads the STB and the MSS bit, without performing serial polling.	20-39
:ESE0	<NRf> 0 to 255	Writes ESER0.	20-40
:ESE0?	<NR1> 0 to 255	Reads ESER0.	
:ESR0?	<NR1> 0 to 255	Reads ESR0.	20-40

* commands specific to the 8851.

(2) Commands specific to the 8851.

① Execution control etc. (common to all functions, except for the AUTO command)

Command	Data (for a query, response data)	Explanation	Ref page
:STARt		Same as the START key.	20-41
:STOP		Same as the STOP key.	20-41
:ABORT		Forced halt.	20-41
:PRINt		Same as the PRINT key.	20-41
:HCOPY		Same as the COPY key.	20-41
:FEED	<NR f> 1 ~ to 255 (unit mm)	Feeds the paper the specified distance.	20-42
:AUTO		Sets the time axis and the voltage axis automatically. Only the memory recorder function	20-42
:ERRor?		Queries 8851 error number.	20-42
:ERRor	<NR 1> error number	Response with 8851 error number.	
:HEADer A$	A$ = OFF,ON	Enables and disables headers.	20-42
:HEADer?		Queries header enablement.	
:FUNCtion A$	A$ = MEM,REC,XYC,R_M	Changes the function.	20-43
:FUNCtion?		Queries the function.	

② Setting and querying the time axis range (TIME/DIV), the shot length, etc.

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CONFigure				
:TDIV A	A = time per division (unit seconds)	Sets the time axis range (except for R&M).	MEM, REC, XYC	20-43
:TDIV?	<NR 3> (unit seconds)	Queries the time axis range		
:TDIV A,B	A = time per division for REC, B = time per division for MEM	Sets the time axis ranges.	R&M	20-43
:TDIV?	<NR 3> (unit seconds)	Queries the time axis range		

MEM ... memory recorder function
REC ... recorder function
XYC ... XY recorder function
R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CONFigure				
:SHOT A	A = shot length	Sets the shot length (except for R&M function)	MEM, REC	20-44
:SHOT?	<NR 1> (unit: DIV)	Queries the shot length.		
:SHOT A,B	A = the REC shot length, B = the MEM shot length.	Sets the shot lengths.	R&M	20-44
:SHOT?	<NR 1> (unit: DIV)	Queries the shot lengths.		
:STRMode A$	A$ = NORMal, AVERage, ENVElop	Sets the storage mode.	MEM	20-44
:STRMode?		Queries the storage mode.		
:AVERage A	A = 4,8,16,32,64,128,256	Sets the number of times for averaging.	MEM	20-45
:AVERage?	<NR 1>	Queries the number of times for averaging.		
:FORmat A$	A$ = SINGle, DUAL, QUAD, XY(MEM only)	Sets the format.	MEM, REC, R&M	20-45
:FORmat?		Queries the format.		
:DOTLine A$	A$ = DOT, LINE	Sets the interpolation function.	MEM, XYC, R&M	20-45
:DOTLine?	Queries the interpolation function.			
:ATPRint A$	A$ = OFF, ON	Enables and disables auto print.	MEM	20-45
:ATPRint?		Queries auto print enablement.		
:ATSAve A$	A$ = OFF, ON	Enables and disables auto save.	MEM	20-46
:ATSAve?		Queries auto save enablement.		
:PRINt A$	A$ = OFF, ON (REC only), REC (R&M only)	Sets printer output.	REC, R&M	20-46
:PRINt?		Queries printer output.		
:MEMDiv A$	A$ = OFF, SEQ, MULTI (MEM only)	Sets the memory division function.	MEM, R&M	20-46
:MEMDiv?		Queries the memory division function.		
:MAXBlock A	A = 2,3,7,15,31,63 (in multi-block function); a = 2 to 63 (in sequential save function)	Sets the memory block number (in sequential save and multi-block function)	MEM, R&M	20-47
:MAXBlock?	<NR 1>	Queries the memory block number		

MEM ... memory recorder function
REC ... recorder function
XYC ... XY recorder function
R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CONFigure				
:USEBlock A	A = 1 to number of memory divisions	Sets the number of the memory block used (in sequential save and multi-block function).	R&M, MEM	20-47
:USEBlock?	<NR 1> to number of memory divisions	Queries the number of the memory block used.		
:REFBlock A	A = 1 to number of memory divisions	Sets the reference block (in multi-block function).	MEM, R&M	20-47
:REFBlock?	<NR 1> to number of memory divisions	Queries the reference block.		
:WVCOmp A$	A$ = OFF, OUT, ALLOUT	Sets the waveform decision mode.	MEM	20-47
:WVCOmp?		Queries the waveform decision mode.		
:CMPStop A$	A$ = GO, NG, G_N	Sets the waveform decision stop mode.	MEM	20-48
:CMPStop?		Queries the waveform decision stop mode.		
:OVWRite A$	A$ = OFF, ON	Enables and disables waveform superimposition.	MEM, R&M	20-46
:OVWRite?		Queries waveform superimposition enablement.		

③ Setting and querying changeover of the screen mode (status, trigger, etc.), OFF, DARK, and LIGHT settings for the waveform, and so on.

Command	Data (for a query, response data)	Explanation	Function	Ref page
:DISPlay	ch$ = CH1 to CH4			
:CHANge A$	A$ = SYSTem, STATus, TRIGger, DISPlay	Changes over the display screen.	All	20-55
:CHANge?		Queries the display screen.		
:DRAW ch$, A$	A$ = OFF, DARK, LIGHT	Sets display and recording intensity for waveform.	All	20-55
:DRAW? ch$		Queries display and recording of a waveform.		
:GRAPh ch$, A	A = 1,2	Sets waveform display screen in dual format.	MEM, REC, R&M	20-55
:GRAPh? ch$	<NR 1>	Queries waveform display screen in dual format.		

MEM ... memory recorder function
REC ... recorder function
XYC ... XY recorder function
R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:DISPlay	ch$ = CH1 to CH4			
:XYCLr A$	A$ = OFF, ON	Sets X-Y recorder display clear.	XYC	20-55
:XYCLr?		Queries X-Y recorder display clear setting.		
:LOGDraw ch$, A$	A$ = ON, OFF	Enables and disables display and recording of logic waveform.	All	20-56
:LOGDraw? ch$		Queries display and recording enablement of logic waveform.		
:XMAG A$	A$ = ×10, ×5, ×2, ×1, ×1_2, ×1_5, ×1_10, ×1_20, ×1_50, ×1_100, ×1_200, ×1_500, ×1_1000, ×1_2000, ×1_4000	Sets the zoom factor on the time axis (In R&M function, during display of the memory recorder waveform).	MEM, R&M	20-56
:XMAG?		Queries the zoom factor on the time axis.		
:YMAG ch$, A$	A$ = ×10, ×5, ×2, ×1, ×1_2	Sets the zoom factor on the voltage axis.	MEM, REC, R&M	20-56
:YMAG? ch$		Queries the zoom factor on the voltage axis.		
:YZOOm ch$, A$	A = 5 to 95 (%): during ×10 display 10 to 90: during ×5 display 25 to 75: during ×2 display 25 to 75: during ×1_2 display	Sets the display position when a zoom factor is applied to the voltage axis.	MEM, REC, R&M	20-57
:YZOOm? ch$	<NR 1> (%)	Queries the display position when a zoom factor is applied to the voltage axis.		
:XAXIs ch$		In XY format, sets the X axis.	MEM, XYC	20-57
:XAXIs?		In XY format, queries the X axis.		
:WAVE A$	A$ = ACUR (A-cursor), TRIG (trigger point), POINT (the point set with :MEMOry:POINt)	Executes waveform display.	MEM	20-57
:RMDIsplay A$	A$ = REC, MEM	Sets the CRT display waveform in the R&M function.	R&M	20-58
:RMDIsplay?		Queries the CRT display waveform in the R&M function.		

MEM ... memory recorder function
REC ... recorder function
XYC ... XY recorder function
R&M ... recorder and memory function

④ Setting and querying input units (voltage range, trigger, etc.)

Command	Data (for a query, response data)	Explanation	Function	Ref page
:UNIT	(ch$ = CH1 to CH4)			
:RANGe ch$, A	A = voltage range (unit volts)	Sets input unit voltage range	All	20-53
:RANGe? ch$	<NR 3> voltage range (unit volts)	Queries input unit voltage range.		
:POSItion ch$, A	A = -100 to 100 (unit %)	Sets the origin position for an input unit.	All	20-54
:POSItion? ch$	<NR 1> -100 to 100 (unit %)	Queries the origin position for an input unit.		
:COUPling ch$, A$	A$ = GND, AC, DC	Sets input unit coupling.	All	20-54
:COUPling? ch$		Queries input unit coupling.		
:FILTer ch$, A$	A$ = 0, 500, 5 (0 is OFF)	Sets input unit filter.	All	20-54
:FILTer ch$	<NR 1>	Queries input unit filter.		

⑤ Setting and querying trigger source, level, etc.

Command	Data (for a query, response data)	Explanation	Function	Ref page
:TRIGger	(ch$ = CH1 to CH4)			
:KIND ch$, A$	A$ = OFF, LEVEl, WINDow, LOGIc, GLITch, TIMEout	Sets type of trigger for the indicated channel.	All	20-48
:KIND? ch$		Queries type of trigger for the indicated channel.		
:EXTErnal A$	A$ = OFF, ON	Enables and disables external trigger.	All	20-48
:EXTErnal?		Queries external trigger enablement.		
:SOURce A$	A$ = OR, AND	Sets trigger logical operator to AND or OR.	All	20-49
:SOURce?		Queries trigger logical operator (AND or OR).		
:LEVEl ch$, A	A = 0 to 100 (unit %)	Sets the trigger level of the indicated channel.	All	20-49
:LEVEl? ch$	<NR 1> 0 to 100 (unit %)	Queries the trigger level of the indicated channel.		
:SLOPe ch$, A$	A$ = UP, DOWN	Sets the trigger direction (slope) of the indicated channel.	All	20-49
:SLOPe? ch$		Queries the trigger direction (slope) of the indicated channel.		

MEM ... memory recorder function
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R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:TRIGger	(ch$ = CH1 to CH4)			
:FILTer ch$, A	A = 0.2 to 4000 (0 for OFF)	Sets filter width of level or logic trigger.	All	20-50
:FILTer? ch$	<NR 1> 0 (OFF), 2 to 4000	Queries filter width of level or logic trigger.		
:WIDTh ch$, A	A = 2 to 4000	Sets width of timeout or glitch detection trigger.	All	20-50
:WIDTh? ch$	<NR 1> 2 to 4000	Queries width of timeout trigger or glitch detection.		
:UPPEr ch$, A	A = lower limit level to 100 (unit %)	Sets upper limit level of window trigger.	All	20-50
:UPPEr?, ch$	<NR 1> lower limit level to 100 (unit %)	Queries upper limit level of window trigger.		
:LOWEr ch$, A	A = 100 to upper limit level (unit %)	Sets lower limit level of window trigger.	All	20-50
:LOWEr?, ch$	<NR 1> 100 to upper limit level (unit %)	Queries lower limit level of window trigger.		
:LOGPat ch$, "A$"	A$ = XXXX trigger pattern (X, 0, 1)	Sets the trigger pattern for a logic trigger.	All	20-51
:LOGPat?, ch$		Queries the trigger pattern for a logic trigger.		
:LOGAnd ch$, A$	A$ = OR, AND	Sets AND/OR for the logic trigger pattern.	All	20-51
:LOGAnd?, ch$		Queries AND/OR for the logic trigger pattern.		
:MODE A$	A$ = SINGle, REPEat, AUTO (only in MEM)	Sets trigger mode.	MEM, REC, R&M	20-51
:MODE?		Queries trigger mode.		
:PRETrig A	A = 0,2 , 5, 10, 20,...90, 95, 100, and -950 to 0 in 50% steps	Sets pre-trigger.	MEM, R&M	20-51
:PRETrig?		Queries pre-trigger		
:TIMIng A$	A$ = START, STOP, S_S	Sets trigger timing.	REC, XYC	20-52
:TIMIng?		Queries trigger timing.		
:TIMEr A$	A$ = OFF, ON	Sets timer trigger.	All	20-52
:TIMEr?		Queries timer trigger.		

MEM ... memory recorder function
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Command	Data (for a query, response data)	Explanation	Function	Ref page
:TRIGger	(ch$ = CH1 to CH4)			
:TMSTart <M>, <d> <h>, <m>	<month>, <day>, <hour>, <min> <month> = 1 to 12 <day> = 1 to 31 <hour> = 0 to 23 <min> = 0 to 59	Sets start time of timer trigger.	All	20-52
:TMSTart?	<NR 1>	Queries start time of timer trigger.		
:TMSTop	Same as TMSTart	Sets stop time of timer trigger.	All	20-52
:TMSTop?	Same as TMSTart? !! ERROR IN ORIGINAL !!	Queries stop time of timer trigger.		
:TMINTvl	<hour>, <min>, <sec>, <hour> = 0 to 23 <min> = 0 to 59 <sec> = 0 to 59	Sets time interval for timer trigger.	All	20-53
:TMINTvl?	<NR 1>	Queries time interval for timer trigger.		
:EVENt ch$, A	A = 0:OFF, 2 to 4000	Sets event trigger.	All	20-53
:EVENt? ch$		Queries event trigger.		

⑥ Cursor setting and reading

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CURSor	(ch$ = CH1 to CH4)			
:MODE A$	A$ = OFF, HZ, TIME, VOLT, XCUR, YCUR, TRACe	Sets the A and B cursor type.	All	20-67
:MODE?		Queries the A and B cursor type.		
:ABCUrsor A$	A$ = A, A_B	Chooses between the A and the A&B cursors.	All	20-67
:ABCUrsor?		Queries between the A and the A&B cursors.		
:ACHAnnel ch$		Sets the A cursor channel.	All	20-67
:ACHAnnel?		Queries the A cursor channel.		

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Command	Data (for a query, response data)	Explanation	Function	Ref page
:CURSor	(ch$ = CH1 to CH4)			
:BCHAnnel ch$		Sets the B cursor channel.	All	20-67
:BCHAnnel?		Queries the B cursor channel.		
:APOSition A	(vertical cursor, cross-hair cursor) A = 0 to amount of stored data:MEM 0 to amount of stored data:REC 0 to 400:XY (horizontal cursor) A = 0 to 250:MEM,REC 0 to 250:XY	Sets the position of the A cursor.	All	20-68
:APOSition?	<NR 1>	Queries the position of the A cursor.		
:BPOSition A	(vertical cursor, cross-hair cursor) A = 0 to amount of stored data:MEM 0 to amount of stored data:REC 0 to 400:XY (horizontal cursor) A = 0 to 250:MEM,REC 0 to 250:XY	Sets the position of the B cursor.	All	20-68
:BPOSition?	<NR 1>	Queries the position of the B cursor.		
:DTREad?	A$ = readout value (Δt)	Query the cursor readout value (Δt)	All	20-69
:DVREad?	A$ = readout value (Δv)	Query the cursor readout value (Δt)	All	20-69

⑦ Setting and querying input and output, etc., from the memory

Command	Data (for a query, response data)	Explanation	Function	Ref page
:MEMory	(ch$ = CH1 to CH4)			
:POINt ch$, A	A = 0 to 2000000	Sets point in memory for input and output.	MEM	20-62
:POINt?	<NR 1> = 0 to 2000000	Queries point in memory for input and output.		
:MAXPoint?	<NR 1> = 0: not stored 600 to 48000(÷ 40 = number of divisions)	Queries the amount of data stored.	MEM	20-62

MEM ... memory recorder function REC ... recorder function
XYC ... XY recorder function R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:MEMory	(ch$ = CH1 to CH4)			
:ADATa <NR f> ,<NR f>...	<NRf> = -48 to 4047	Input data to memory (ASCII).	MEM	20-63
:ADATa? A	A = 1 to 40 (number of output units) Response data = -48 to 4047	Output data from memory.		
:VDATa <NR f> ,<NR f>...	<NR f> = voltage values (units V)	Input data to memory (voltage values).	MEM	20-64
:VDATa? A	A = 1 to 10 (amount of data) Response data = voltage value (units v)	Output stored data.		
:AREAl? ch$	<NR 1> = -48 to 4047	Output stored data. Real time data output	ALL	20-64
:VREAl? ch$	<NR 3> = voltage value (units V)	Real time data output (voltage value)		
:LDATa <NR f> ,<NR f>...	<NR f> = 0 to 15	Input logic data to memory.	ALL	20-65
:LDATa? A	A = 1 to 50 (amount of output data) Response data = 0 to 15	Output logic data from memory.		
:RECTomem		Convert recorder waveform to memory recorder data.	REC	20-65

⑧ Commands relating to graphics

Command	Data (for a query, response data)	Explanation	Function	Ref page
:GRAPh				
:EDIT A$	A$ = OFF, ON	Enables and disables the graphics editor.	MEM	20-93
:EDIT?		Queries graphics editor enablement.		
: LINE X1, Y2 X2, Y2	X 1, X2 = x-coordinates Y1, Y2 = y-coordinates	Draws a line from (X1, Y1) to (X2, Y2).	MEM	20-93
: PARAllel high, low right, left	high = 0 to 9.96 (div) low = 0 to 9.96 (div) right = 0 to 14.975 (div) left = 0 to 14.975 (div)	Carries out a parallel movement of the drawing.	MEM	20-94
: PAINt X, Y	X = x-coordinate, Y = y-coordinate	Begins solid fill from the point specified by (X, Y).	MEM	20-94
: ERASe X1, Y1 X2, Y2	X 1, X2 = x-coordinates Y1, Y2 = y-coordinates	Erases from (X1, Y1) to (X2, Y2).	MEM	20-94
: STORage		Loads a waveform into the editor.	MEM	20-94
: UNDO		Reverses the effect of the immediately previous editor command.	MEM	20-95
: SAVE		Saves the decision area created with the editor.	MEM	20-95
:REVErse		Reverses the drawing	MEM	20-94
:ALLClear		Clears the entire drawing	MEM	20-94
:POINt X,Y, A	X = x-coordinates, Y = y-coordinates A = 0,1	Set waveform decision area data.	MEM	20-95
: CLEAr X1, Y1, X2, Y2	X 1, X2 = x-coordinate Y1, Y2 = y-coordinate	Clears the rectangle with the points (X1, Y1) and (X2, Y2) at diagonally opposite corners.	MEM	20-95

MEM ... memory recorder function
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⑨ Calculation setting and querying

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CALCulate				
:WVCALc A$	A$ = ON, OFF, EXEC (execute)	Enables and disables waveform processing calculation.	MEM	20-72
:WVCALc ?		Queries enablement of waveform processing calculation.		
:FFT A$	A$ = ON, OFF, EXEC (execute)	Enables and disables, and performs, FFT calculation.	MEM	20-72
:FFT?		Queries FFT calculation enablement.		
:ENVNormal A$	A$ = UP, LOW	Setting and performance of conversion of envelope waveform to normal waveform.	MEM	20-73
:ENVNormal?		Queries conversion of envelope waveform to normal waveform.		
:MEASure A$	A$ = ON, OFF, EXEC (execute)	Enables and disables waveform parameter calculation.	MEM	20-73
:MEASure?		Queries enablement of waveform parameter calculation.		
:MEASPrint A$	A$ = OFF, ON	Enables and disables printing of waveform parameter calculation values.	MEM	20-73
:MEASPrint?		Queries enablement of printing of waveform parameter calculation values.		
ANSWer? A$,B$	A$ = NO.1 to NO.4 B$ = CH1 to CH4	Queries a waveform parameter calculation result.	MEM	20-73
ANSWer? C$,<NR 3>	C$ = NONE, MIN, MAX, PP, AVE RMS, AREA, PERI, FREQ, RISE, FALL, XYAREA <NR 3> = calculation result (units volts and seconds)	Waveform parameter calculation result response		
:Z1 A$, B$, C$, D$	A$, B$, C$ = A to P D$ = PLUS, MINUS, MULT, DIVI	Sets the coefficients for the waveform processing calculation equation for Z1	MEM	20-74
:Z1?		Queries the coefficients for the waveform processing calculation equation for Z1		
:Z2 A$, B$, C$, D$	A$, B$, C$ = A to P D$ = PLUS, MINUS, MULT, DIVI	Sets the coefficients for the waveform processing calculation equation for Z2	MEM	20-74
:Z2?		Queries the coefficients for the waveform processing calculation equation for Z2		
:Z3 A$, B$, C$, D$	A$, B$, C$ = A to P D$ = PLUS, MINUS, MULT, DIVI	Sets the coefficients for the waveform processing calculation equation for Z3	MEM	20-75
:Z3?		Queries the coefficients for the waveform processing calculation equation for Z3		
:Z4 A$, B$, C$, D$	A$, B$, C$ = A to P D$ = PLUS, MINUS, MULT, DIVI	Sets the coefficients for the waveform processing calculation equation for Z4	MEM	20-75
:Z4?		Queries the coefficients for the waveform processing calculation equation for Z4		

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Command	Data (for a query, response data)	Explanation	Function	Ref page
:CALCulate				
:X1 A$, ch$, B$	A$ = OFF(ch$,B$ are disregarded) PAR,ABS,EXP,LOG,SQR,MOV,DIF, INT,DIF2,INT2,SLI ch$ = CH1 to CH4 B$ = A to P (when A$ = MOV, a value from 1 to 4000;when SLI, a value from -4000 to 4000)	Sets calculation equation for X1.	MEM	20-76
:X1?		Queries calculation equation for X1.		
:X2 A$, ch$, B$	same as X1 (ch$ = CH1 to CH4, Z1)	Sets calculation equation for X2.	MEM	20-77
:X2?		Queries calculation equation for X2.		
:X3 A$, ch$, B$	same as X1 (ch$ = CH1 to CH4, Z1,. Z2)	Sets calculation equation for X3.	MEM	20-78
:X3?		Queries calculation equation for X3.		
:X4 A$, ch$, B$	same as X1 (ch$ = CH1 to CH4, Z1 to Z3)	Sets calculation equation for X4.	MEM	20-79
:X4?		Queries calculation equation for X4.		
:Y1 A$, ch$, B$	A$ = OFF(ch$,B$ are disregarded) PAR,ABS,EXP,LOG,SQR,MOV,DIF, INT,DIF2,INT2,SLI ch$ = CH1 to CH4 B$ = A to P(when A$ = MOV, a value from 1 to 4000;when SLI, a value from -4000 to 4000)	Sets calculation equation for Y1.	MEM	20-80
:Y1?		Queries calculation equation for Y1.		
:Y2 A$, ch$, B$	same as Y1 (ch$ = CH1 to CH4, Z1)	Sets calculation equation for Y2.	MEM	20-81
:Y2?		Queries calculation equation for Y2		
:Y3 A$, ch$, B$	same as Y1 (ch$ = CH1 to CH4, Z1, Z2)	Sets calculation equation for Y3.	MEM	20-82
:Y3?		Queries calculation equation for Y3.		
:Y4 A$, ch$, B$	same as Y1 (ch$ = CH1 to CH4, Z1 to Z3)	Sets calculation equation for Y4.	MEM	20-83
:Y4?		Queries calculation equation for Y4.		

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Command	Data (for a query, response data)	Explanation	Function	Ref page
:CALCulate				
:FACTor A$ <NRf>	A$ = A to P	Sets the value of calculation equation coefficient a to p.	MEM	20-84
:FACTor? A$	<NR3> = -9.999E-9 to +9.999E+9	Queries the value of calculation equation coefficient a to p.		
:Z1DIsplay ch$, A$, up, low	ch$ = CH1 to CH4 A$ = AUTO, MANUal up, low = 9.999E-9 to +9.999E+9 (units v)	Sets the channel for receipt of the calculated result of the waveform treatment calculation equation for Z1.	MEM	20-84
:Z1DIsplay?		Queries the channel for receipt of the calculated result of the waveform treatment calculation equation for Z1.		
:Z2DIsplay ch$, A$, up, low	Same as Z1DIsplay	Sets the channel for receipt of the calculated result of the waveform treatment calculation equation for Z2.	MEM	20-85
:Z2DIsplay?		Queries the channel for receipt of the calculated result of the waveform treatment calculation equation for Z2.		
:Z3DIsplay ch$, A$, up, low	Same as Z1DIsplay	Sets the channel for receipt of the calculated result of the waveform treatment calculation equation for Z3.	MEM	20-85
:Z3DIsplay?		Queries the channel for receipt of the calculated result of the waveform treatment calculation equation for Z3.		
:Z4DIsplay ch$, A$, up, low	Same as Z1DIsplay	Sets the channel for receipt of the calculated result of the waveform treatment calculation equation for Z4.	MEM	20-86
:Z4DIsplay?		Queries the channel for receipt of the calculated result of the waveform treatment calculation equation for Z4.		
:MEASSet NO$, A$, ch$	NO$ = NO1 to NO4 A$ = OFF(not when NO$ = NO1), MAX,MIN,PP,AVE,RMS,AREA, PERI,FREQ,RISE,FALL,XYAREA ch$ = CH1 to CH4,ALL	Sets waveform parameter calculation.	MEM	20-86
:MEASSet? NO$		Queries waveform parameter calculation.		
:COMP NO$, A$	NO$ = NO1 to NO4; A$ = ON, OFF	Enables or disables waveform parameter decision calculations.	MEM	20-87
:COMP? NO$		Queries enablement of waveform parameter decision calculations.		
:COMPArea A$, up, low	:COMPArea A$, up, low A$ = NO1 to NO4; up,low = -9.999E-9 to +9.999E+9	Sets upper limit and lower limit values for waveform parameter calculation decision.	MEM	20-87
:COMPArea? A$		Queries upper limit and lower limit values for waveform parameter calculation decision.		

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Command	Data (for a query, response data)	Explanation	Function	Ref page
:CALCulate				
:FFTWind A$	A$ = RECTan, HANNing	Sets FFT window.	MEM	20-87
:FFTWind?		Queries FFT window.		
:FFTCsr A$	A$ = ON, OFF	Sets FFT cursor.	MEM	20-87
:FFTCsr?		Queries FFT cursor.		
:FFTCSRDisp A$	A$ = PEAK, RMS	Sets display value for FFT cursor.	MEM	20-88
:FFTCSRDisp ?		Queries display value for FFT cursor.		
:FFTFOrm A$	A$ = SINGLE, DUAL	Sets the FFT format.	MEM	20-88
:FFTFOrm?		Queries the FFT format.		
:FFTPrint A$	A$ = WAVE, DATA	Sets FFT printer output.	MEM	20-88
:FFTPrint?		Queries FFT printer output.		
:FFTCH A, B$	A = 1,2; B$ = CH1 to CH4	Sets FFT channel.	MEM	20-88
:FFTCH? A		Queries FFT channel.		
:FFT Function A, B$	A = 1,2; B$ = STORage, PSPMDB, PSPMAG, LINMAG, LINIMAG, LINREAL	Sets the FFT function.	MEM	20-89
:FFT Function? A		Queries the FFT function.		
:FFTUp A, B	A = 1,2; B = -9.999E-9 to +9.999E+9	Sets vertical axis upper end value for FFT display.	MEM	20-89
:FFTUp? A		Queries vertical axis upper end value for FFT display.		
:FFTLow A, B	A = 1,2; B = -9.999E-9 to +9.999E+9	Sets vertical axis lower end value of FFT display.	MEM	20-89
:FFTLow? A		Queries vertical axis lower end value of FFT display.		
:FFTPOint A	A = 0 to 799 (when function is STORAGE), 0 to 399	Sets the output point for FFT data.	MEM	20-90
:FFTPOint?	<NR 1>	Queries the output point for FFT data.		

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R&M ... recorder and memory function

Command	Data (for a query, response data)	Explanation	Function	Ref page
:CALCulate				
:FFTData?		Queries the FFT data at the output point.	MEM	20-90
:FFTData "A$","B$"	A$ = X-axis data; B$ = Y-axis data	Responds with the FFT data at the output point.		
:FFTFRq A$	A$ = ×1, ×1_2, ×1_5	Sets the thinning for FFT calculation sampling.	MEM	20-90
:FFTFRq?		Queries the thinning for FFT calculation sampling.		20-90

⑩Setting and querying the system screen

Command	Data (for a query, response data)	Explanation	Function	Ref page
:SYSTem				
:CRTOff A$	A$ = ON, OFF	Enables and disables the screen saver function.	All	20-58
:CRTOff?		Queries enablement of the screen saver function.		
:GRID A$	A$ = OFF, NORMal, FINE	Sets the grid type.	All	20-58
:GRID?		Queries the grid type.		
:STARt A$	A$ = ON, OFF	Enables and disables start key backup.	All	20-58
:STARt?		Queries start key backup enablement.		
:CHMArk A$	A$ = OFF, ON, POSItion	Enables and disables channel markers.	All	20-58
:CHMArk?		Queries enablement of channel markers.		
:BEEPer A$	A$ = ON, OFF	Enables and disables the beep sound.	All	20-59
:BEEPer?		Queries beep sound enablement.		
:LIST A$	A$ = OFF, LIST, GAUGE, L_G	Sets list and gauge functions.	All	20-59
:LIST?		Queries list and gauge functions.		
:SMOOth A$	A$ = ON, OFF	Enables and disables smooth printing.	All	20-59
:SMOOth?		Queries smooth printing enablement.		

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Command	Data (for a query, response data)	Explanation	Function	Ref page
:SYSTem				
:ROLL A$	A$ = ON, OFF	Enables and disables roll mode.	All	20-60
:ROLL?		Queries roll mode enablement.		
:TIME	<hour>, <min>, <sesc> <hour> = 0 to 23 <min> = 0 to 59 <sec> = 0 to 59	Sets the time.	All	20-60
:TIME?	<NR 1>	Queries the current time.		
:DATE	<year>, <month>, <day> <year> = 0 to 99 <month> = 1 to 12 <day> = 1 to 31	Sets the calendar.	All	20-60
:DATE?	<NR 1>	Queries the calendar.		
:COPY A$	A$ = PRINter, PLOTter	Sets the destination for screen dump output.	All	20-60
:COPY?		Queries the destination for screen dump output.		
:PLOT A$	A$ = FULL, HALF	Sets plot size.	All	20-61
:PLOT?		Queries plot size.		
:PEN ch$, A	ch$ = CH1 to CH4, FRAME; A = 1 to 8	Sets pen number for plotter output.	All	20-61
:PEN? ch$	<NR 1> 1 to 8	Queries pen number for plotter output.		
:USECH A	A = 1,2,4	Sets number of channels used.	All	20-61
:USECH?	<NR 1>	Queries number of channels used.		
:LOGDraw A$	A$ = DARK, LIGHT	Sets logic waveform display.	All	20-61
:LOGDraw?	<NR 1> 1 to 8	Queries logic waveform display.		
:PLPOsition A$	A$ = LEFT, RIGHT	Sets plot position during A5 plotter output.	All	20-61
:PLPOsition?		Queries plot position during A5 plotter output.		

MEM ... memory recorder function
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⑪Setting and querying comments

Command	Data (for a query, response data)	Explanation	Function	Ref page
:COMMent				
:TITLe A$, "B$"	A$ = ON, OFF; B$ = comment string (20 characters)	Sets a title comment.	All	20-70
:TITLe?		Queries a title comment.		
:CH ch$, A$, "B$"	ch$ = CH1 to CH4; CHA to CHD A$ = ON, OFF; B$ = comment string (20 characters)	Sets a comment for a particular channel	All	20-70
:CH? ch$		Queries comment for a particular channel.		

⑫ Setting and querying scaling

Command	Data (for a query, response data)	Explanation	Function	Ref page
:SCALing				
:MODE A$	A$ = ON, OFF	Enables and disables scaling.	All	20-71
:MODE?		Queries scaling enablement.		
:SET ch$, A$	ch$ = CH1 to CH4; A$ = DEFAult, TYPEA to TYPED	Sets scaling type.	All	20-71
:SET?		Queries scaling type.		
:OFFSet A$, <NR f>	A$ = TYPEA to TYPED	Sets scaling offset.	All	20-71
:OFFSet? A$	<NR 3> = scaling offset (-9.999E-9 to +9.999E+9)	Queries scaling offset.		
:UNIT A$, "B$"	A$ = TYPEA to TYPED; B$ = scaling unit (7 characters)	Sets scaling unit.	All	20-72
:UNIT? A$		Queries scaling unit.		
:VOLT A$, B	A$ = TYPEA to TYPED; B = -9.999E-9 to 9.999E+9	Sets the scaling conversion value.	All	20-71
:VOLT? A$		Queries the scaling conversion value.		

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⑬Commands relating to the floppy disk drive

Command	Data (for a query, response data)	Explanation	Function	Ref page
:FDISC				
:MODE A$	A$ = ON, OFF	Enables or disables the floppy disk mode.	All	20-91
:MODE?		Queries enablement of the floppy disk mode		
:LOAD NO	NO = file number	Executes a load from the floppy disk (in floppy disk mode)	All	20-91
:SAVE "NAME1$, NAME2$", A$, B$,	NAME1$ = file name (8 characters); NAME2$ = file extension (3 characters); A$ = type of data to save (W:measurement data, F:unit settings, A: waveform decision area); B$ = channels to save (when A$ = W), ALL, CH1 to CH4, LOG (logic channel)	Performs a save to the floppy disk	All	20-91
:DELEte	NO = file number	Deletes a file from the floppy disk (in floppy disk mode).	All	20-91
:FORMat		Formats a floppy disk (in floppy disk mode).	All	20-92
:FILE?	<NR 1> = number of files	Queries how many files are saved on the floppy disk	All	20-92
:NINFor? A	A = file number	Queries filename on floppy disk	All	20-92
:NINFor A, "NAME$"	A = file number NAME$ = file name	Response is filename on floppy disk	All	20-92
:INFOr? "NAME$"	NAME$ = file name	Queries information about a file on the floppy disk	All	20-92
:INFOR	"NAME$", A, B$, "DATE$", "TIME$", B A = file number (if no file exists, then -1) B$ = type of data saved W: measurement data F: conditions of creation A: waveform decision area N: no such file DATE$ = year/month/day of save TIME$ = hour:min:sec of save B = file size	The response from the floppy disk		

MEM ... memory recorder function
REC ... recorder function
XYC ... XY recorder function
R&M ... recorder and memory function

20-4-2 Command Reference

Execution of commands

Commands are input into the input buffer and are executed in order.

However the ABORT command is executed immediately, even if commands are waiting in the input buffer - more precisely, at the instant its terminator is received.

Responses to queries

If headers are disabled the response which is made to a query consists only of a data portion, but if headers are enabled it is accompanied by a header.

Numerical data is returned in the one of the formats <NR 1 to NR 3> specified in the command reference.

Commands other than those which can be handled by the 8851 in its current state are not executed but generate execution errors. (This happens, for example, when in recorder function it is attempted to execute a command which can be handled only in memory recorder function.)

Further, there are hardly any commands which can be executed during measurement operation.

20-4-3 Standard Commands Stipulated by IEEE488.2

A. System data commands and queries

(1) *IDN? command

Queries device ID.

Syntax (query) *IDN?

Response HIOKI, 8851, 0, V1, 00
First field: Manufacturer's name
Second field: Model name
Third field: Serial number (not used: 0)
Fourth field: Software version

(2) *OPT? command

Queries device option provision.

Syntax (query) *OPT?

Response Whether or not channel 1 input unit present; whether or not channel 2 input unit present; whether or not channel 3 input unit present; and whether or not channel 4 input unit present.
0: not present.
1: input unit present.

B. Internal operation commands and queries

(1) *RST command

Device initial setting.

Syntax (command) *RST

Explantion Initializes the 8851 (same as system reset).
However, it does not clear GP-IB related items.
(the event registers and the enable registers)
(the input buffer and the output queue)

(2) *TST? command

Queries the result of the self-test.

Syntax (query) *TST?

Response <RN1>
0 = normal 1= failure

Explantion The result of the self-test of the 8851 is returned as an NR1 numerical value.

C. Synchronous commands and queries

(1) *OPC command

After all action has been completed during execution, sets the LSB (bit 0) of SESR (the standard event status register).

Syntax (command) *OPC

Explanation When the command preceding the *OPC command completes execution, the LSB of SESR is set.

Explanation "A$;B$;*OPC;C$
After the execution of the commands A$ and B$ is completed, the LSB of SESR is set.

(2) *OPC? query

After execution is completed, replies with ASCII [1].

Syntax (query) *OPC?

Explanation When the command preceding the *OPC command completes execution, the response of ASCII [1] is made.

(3) *WAI command

After all execution is completed, subsequently performs the following command

Syntax (command) *WAI

Explanation "A$;B$;*WAI;C$"
The command following *WAI is not executed until the execution of the commands A$ and B$ is completed.

D. Status and event control commands and queries

(1) *CLS command

Clears the status byte and associated queues (except for the output queue).

Syntax (command) *CLS

Explanation This instruction clears the event register associated with each bit of the status byte register. Accordingly, it also clears the status byte register. However, because it does not clear the output queue, it has no effect upon bit 4 (MAV) of the status byte.

(2) *ESE command

Writes the standard event status enable register (SESER).

Syntax (command) *ESE <RN>1
<NR 1> = 0 to 255

Sets the mask pattern of SESER to a value in the range 0 to 255. Outside this range, an execution error occurs. The initial value (when the power is turned on) is 0.

Example *ESE 36
Bit 5 and bit 2 of SESER are set.

(3) *ESE? command

Reads the standard event status enable register (SESER).

Syntax (query) *ESE?

Response *ESE <NR 1>

Explanation The contents of SESER as set by the *ESE command are returned as an integral value in the range 0 to 255.

(4) *ESR? command

Reads out and queries the contents of the standard event status register (SESR).

Syntax (query) *ESR?

Response *ESR <NR 1>

Explanation The contents of SESR are returned as an NR1 numerical value.

(5) *SRE command

Writes the service request enable register (SRER).

Syntax (command) *SRE <NR 1>
<NR 1> = 0 to 255

Explanation Sets the mask pattern of SRER to a value in the range 0 to 255. Outside this range, an execution error occurs. However, the value of bit 6 is disregarded. The initial value (when the power is turned on) is 0.

Example *SRE 33
Bits 5 and 0 of SRER are set.

(6) *SRE? command

Reads the service request enable register (SRER).

Syntax (query) *SRE?

Response *SRE <NR 1> 0 to 63, 128 to 191

Explanation The contents of SRER as set by the *SRE command are returned as an NR1 numerical value in the range 0 to 63, 128 to 191. Bit 6 is always 0.

(7) *STB? command

Reads the status byte and the MSS bit, without performing serial polling.

Syntax (query) *STB?

Response <NR 1> 0 to 255

Explanation This is the same as reading out the status byte with serial polling. However, bit 6 is not RQS, but is MSS. (Refer to the description of the status byte and the event register).
(Commands specific to the 8851)

(8) :ESE0 command

Writes event status enable register 0 (ESER0)

Syntax (command) :ESE0 <NR 1>
<NR 1> 1 = 0 to 255

Explanation Sets the mask pattern of ESER0 to a value in the range 0 to 255. Outside this range, an execution error occurs. The initial value (when the power is turned on) is 0.

Example :ESE0 36
This sets bit 5 and bit 2 of ESER0.

(9) :ESE0? command

Reads event status enable register 0 (ESER0).

Syntax (query) :ESE0?

Response :ESE0 <NR 1> 0 to 255

Explanation The contents of ESER0 are returned as an NR1 numerical value.

(10) :ESR0? command

Reads event status register 0 (ESR0).

Syntax (query) :ESR0?

Response :ESR0 <NR 1> 0 to 255

Explanation The contents of ESR0 are returned as an NR1 numerical value, and ESR0 is cleared.

20-4-4 Commands Specific to the 8851

(1) :START command

Performs starting.

Syntax (command) : START

Unit Same as the START key.
Starts waveform sampling operation.

When allowed : In all functions.

(2) :STOP command

Performs stopping.

Syntax (command) : STOP

Unit Same as the STOP key.
Terminates at the instant that waveform sampling operation is completed.

When allowed : In all functions.

(3) :ABORT command

Aborts processing.

Syntax (command) : ABORT

Unit Same as the STOP key. Forced halt. Terminates even if waveform sampling operation is not yet completed. Also stops printer operation.

When allowed : In all functions.

(4) :PRINT command

Performs printing.

Syntax (command) : PRINT

Unit Same as the PRINT key.

When allowed : In all functions.

(5) :HCOPY command

Screendump function.

Syntax (command) : HCOPY

Unit Same as the COPY key. Produces a hard copy of the screen.

When allowed : In all functions.

(6) :FEED command

Feeds printer paper.

Syntax (command) : FEED <NR 1>
<NR 1> = 1 to 255

Explanation Feeds the paper by a distance from 1 to 255 in millimeters determined by the numerical value in the data portion.

When allowed : In all functions.

(7) :AUTO command

Performs automatic range setting.

Syntax (command) : AUTO

Unit Same as the AUTO key. Sets the time axis and the voltage axis automatically.

When allowed : In the memory recorder function.

(8) :ERROR? command

Queries the 8851 error number.

Syntax (query) : ERROR?

Response :ERROR <NR 1>
<NR 1> = error no.

Explanation The type of error that has occurred on the 8851 is returned in <NR 1> as a numerical value. If an error occurs during execution of :ERROR? then the error number is cleared.

When allowed : In all functions.

(9) :HEADER command

Enables and disables headers, and queries header enablement.

Syntax (command) : HEADer A$
(query) : HEADer?
A$ = OFF,ON

Explanation (command) Sets header enablement. When headers are enabled, responses to queries are prefixed by headers; when headers are disabled, responses are not so prefixed.

(query) Returns whether or not headers are prefixed to responses to queries. The initial toggle state for headers (when the power is turned on) is OFF.

Example When headers are disabled:
response to :HEADER? is OFF
When headers are enabled:
response to :HEADER? is :HEADER ON

When allowed : In all functions.

(10) :FUNCTION command

Changes and queries the function selection.

Syntax
(command) : FUNCtion A$
(query) : FUNCtion?
A$ = MEM : memory recorder function
REC : recorder function
XYC : XY recorder function
R_M : recorder and memory function

Explanation
(command) Switches to the function designated by A$.
(query) Returns the name of the current function as character data.

Example
:FUNCTION MEM
The function is set to the memory recorder function.

When allowed : In all functions.

(11) :CONFIGURE command

Sets and queries the time/div (except for the recorder and memory function).

Syntax
(command) : CONFigure:TDIV <NR 3>
(query) : CONFigure:TDIV?

Explanation
(command) Sets the time per division to a numerical value (unit seconds).
(query) Returns the currently set value of the time per division as an NR3 numerical value.
(If an attempt is made to set the time per division to a non-permitted value, it will be set to the next range above that value.)

Example
: CONFIGURE:TDIV +40.0E-6
Sets the time per division to 40 Ωs.

When allowed : In the memory recorder function, the recorder function, and the XY recorder function.

Sets and queries the time/div (recorder and memory function).

Syntax
(command) : CONFigure:TDIV A, B
(query) : CONFigure:TDIV?

A = the time per division for REC

B = the time per division for MEM

Explanation
(command) Sets the time per division, for both recorder and memory recorder modes, to numerical values (unit seconds).
(query) Returns the currently set values of the time per division, for both REC and MEM, as NR3 numerical values.
(If an attempt is made to set either of these times per division to a non-permitted value, it will be set to the next range above that value.)

Example
: CONFIGURE:TDIV +400.E-3,+40.E-6
Sets the time per division for recorder mode to 400 ms, and the time per division for memory recorder mode to 50 Ωs.

When allowed : In the recorder and memory function.

Sets and queries the shot length (except for the recorder and memory function).

Syntax
(command) : CONFigure:SHOT <NR 1>
(query) : CONFigure:SHOT?

Explanation
(command) Sets the numerical value of the shot length (unit divisions).
(query) Returns the currently set value of the shot length as an NR1 numerical value.
(For the recorder function, 0 = CONT).

Example
: CONFIGURE: SHOT 30
Sets the shot length to 30 divisions.

When allowed : In the memory recorder function, and the recorder function.

Sets and queries the shot length (for the recorder and memory function).

Syntax
(command) : CONFigure:SHOT A, B
(query) : CONFigure:SHOT?

A = shot length for the REC function

B = shot length for the MEM function

Explanation
(command) Sets the numerical values of the shot lengths (unit divisions).
(query) Returns the currently set values of the shot lengths as NR1 numerical values.

Example
: CONFIGURE: SHOT 15, 15
Sets the shot length for MEM to 15 divisions and sets the shot length for REC to 15 divisions.

When allowed : In the recorder and memory function.

Sets and queries the storage mode.

Syntax
(command): CONFigure:STRMode A$
(query) : CONFigure:STRMode?
A$ = NORMal
AVERage
ENVElop

Explanation
(command) Sets the storage mode with character data.
(query) Returns the current storage mode as character data.

Example
:CONF:STRM ENVE
Sets the storage mode to envelope.

When allowed : In the memory recorder function.

Sets and queries the number of times over which averaging is performed.

Syntax
(command) : CONFigure:AVERage<NR 1>
(query) : CONFigure:AVERage?
<NR 1> = 4 to 256

Explanation
(command) Sets the averaging length (for sliding averaging).
(query) Returns the current value of the averaging length as an <NR 1> numerical value.

When allowed : In the memory recorder function.

Sets and queries the format.

Syntax
(command) : CONFigure:FORMat A$
(query) : CONFigure:FORMat?
A$ = SINGle
DUAL
QUAD
XY (memory recorder function only)

Explanation
(command) Sets the format.
(query) Returns the current format as character data.

Example
:CONF:FORM: SINGLE
Sets the format to SINGLE.

When allowed : In the memory recorder function, the recorder function, and the recorder and memory function.

Sets and queries the interpolation function.

Syntax
(command) : CONFigure:DOTLine A$
(query) : CONFigure:DOTLine?
A$ = DOT, LINE

Explanation
(command) Sets the interpolation function (DOT or LINE).
(query) Returns the currently set interpolation as character data.

When allowed : In the memory recorder function, the XY recorder function, and the recorder and memory function.

Sets and queries the auto print function.

Syntax
(command) : CONFigure:ATPRint A$
(query) : CONFigure:ATPRint?
A$ = OFF,ON

Explanation
(command) Toggles the auto print function on and off.
(query) Returns the current setting of the auto print function as character data.

When allowed : In the memory recorder function.

Sets and queries the auto save function.

Syntax
(command) : CONFigure:ATSAve A$
(query) : CONFigure:ATSAve?
A$ = OFF,ON

Explanation
(command) Toggles the auto save function on and off.
(query) Returns the current setting of the auto save function as character data.

When allowed : In the memory recorder function.

Sets and queries printer output.

Syntax
(command) : CONFigure:PRINt A$
(query) : CONFigure:PRINt?
A$ = OFF
ON (the recorder function only)
REC (the recorder and memory function only)

Explanation
(command) Sets the printer output.
(query) Returns the currently set state of the printer output as character data.

When allowed : In the recorder function, and the recorder and memory function.

Sets and queries the waveform superimposition function.

Syntax
(command) : CONFigure:OVWRite A$
(query) : CONFigure:OVWRite?
A$ = OFF,ON

Explanation
(command) Enables and disables screen waveform superimposition.
(query) Returns the current setting of the waveform superimposition enablement as character data.

When allowed : In the memory recorder function, and the recorder and memory function.

Sets and queries memory division.

Syntax
(command) : CONFigure:MEMDiv A$
(query) : CONFigure:MEMDiv?
A$ = OFF
SEQ : sequential save
MULTI : multi-block (in the memory recorder function only)

Explanation
(command) Sets the method of memory division recording.
(query) Returns the current setting for method of memory division recording as character data.

When allowed : In the memory recorder function, and the recorder and memory function.

Sets and queries the number of memory blocks.

Syntax
(command) : CONFigure:MAXBlock <NR 1>
(query) : CONFigure:MAXBlock?
<NR 1> = 2 to 63 (during multi-block operation, 2,3,7,15,31, or 63)

Explanation
(command) Sets the number of memory blocks.
(query) Returns the current number of memory blocks as an NR1 numerical value.

When allowed : In the memory recorder function and the recorder and memory function, when the memory division function is in use.

Sets and queries the division block used.

Syntax
(command) : CONFigure:USEBlock <NR 1>
(query) : CONFigure:USEBlock?
<NR 1> = 1 to number of memory divisions

Explanation
(command) During memory division, sets the block used.
(query) Returns the currently used block as an NR1 numerical value.

When allowed : In the memory recorder function and the recorder and memory function, when the memory division function is in use.

Sets and queries the reference block.

Syntax
(command) : CONFigure:REFBlock <NR 1>
(query) : CONFigure:REFBlock?
<NR 1> = 1 to number of memory divisions
0 = OFF

Explanation
(command) In multi-block mode, sets the reference block.
(query) Returns the current reference block as an NR1 numerical value.

When allowed : In the memory recorder function and the recorder and memory function, when the memory division multi-block function is in use.

Sets and queries the waveform decision mode.

Syntax
(command) : CONFigure:WVCOmp A$
(query) : CONFigure:WVCOmp?
A$ = OFF
OUT
ALLOUT

Explanation
(command) Sets the waveform decision mode.
(query) Returns the current waveform decision mode as character data.

When allowed : In the memory recorder function.

Sets and queries the waveform decision stop mode.

Syntax
(command) : CONFigure:CMPStop A$
(query) : CONFigure:CMPStop?
A$ = GO
NG
G_N

Explanation
(command) Sets the stop mode during waveform decision.
(query) Returns the current stop mode as character data.

When allowed : In the memory recorder function.

(12) :TRIGger command

Sets and queries the kind of trigger.

Syntax
(command) : TRIGger:KIND ch$, A$
(query) : TRIGger:KIND? ch$
ch$ = CH1 to CH4
A$ = OFF
LEVEl
WINDow
LOGIc
GLITch
TIMEout

Explanation
(command) Sets the type of trigger for the channel designated by ch$.
(query) Returns as character data the type of the current trigger for the channel designated by ch$.

Example
:TRIGGER:KIND CH1, WINDOW
Sets channel 1 to window trigger.

When allowed : In all functions.

Sets and queries external trigger.

Syntax
(command) : TRIGger:EXTErnal A$
(query) : TRIGger:EXTErnal?
A$ = OFF,ON

Explanation
(command) Enables and disables external trigger.
(query) Returns the current external trigger enablement state as character data.

When allowed : In all functions.

Sets and queries trigger logical operator (AND/OR).

Syntax
(command) : TRIGger:SOURce A$
(query) : TRIGger:SOURce?
A$ = OR,AND

Explanation
(command) Sets the logical operator determining whether the internal and external triggers are ORed or ANDed.
(query) Returns the currently setting of the trigger logical operator (AND/OR) as character data.

When allowed : In all functions.

Sets and queries trigger level.

Syntax
(command) : TRIGger:LEVEl ch$ <NR 1>
(query) : TRIGger:LEVEl? ch$
ch1$ = CH1 to CH4
<NR 1> = 0 to 100 (%)

Explanation
(command) Sets the trigger level of the level, glitch detection, or time out trigger, of the channel designated by ch$.
(query) Returns the current trigger level as an NR1 numerical value.

Example
:TRIGGER:LEVEL CH1, 50
Sets the trigger level of channel 1 to 50%.

When allowed : In all functions.

Sets and queries trigger direction (slope).

Syntax
(command) : TRIGger:SLOPe ch$, A$
(query) : TRIGger:SLOPe? ch$
ch$ = CH1 to CH4
A$ = UP (rising)
DOWN (falling)

Explanation
(command) Sets the trigger direction of the level, glitch detection, or time out trigger, of the channel designated by ch$.
(query) Returns the current trigger direction as a character value.

Example
:TRIGGER:SLOPE CH1, UP
Sets the trigger direction of channel 1 to rising.

When allowed : In all functions.

Sets and queries filter width for level or logic trigger.

Syntax
(command) : TRIGger:FILTer ch$, <NR 1>
(query) : TRIGger:FILTer? ch$
ch$ = CH1 to CH4
<NR 1> = 0 : OFF
2 to 4000

Explanation
(command) Sets the filter width for a level trigger of the channel designated by ch$ to a numerical value from 2 to 4000. If the value is zero, then the filter is disabled.
(query) Returns the current filter width as an NR1 numerical value.

When allowed : In all functions.

Sets and queries width for glitch detection or timeout trigger.

Syntax
(command) : TRIGger:WIDTh ch$, <NR 1>
(query) : TRIGger:WIDTh? ch$
ch$ = CH1 to CH4
<NR 1> = 2 to 4000

Explanation
(command) Sets the width for a glitch detection trigger or time out trigger, for the channel designated by ch$ to a numerical value from 2 to 4000.
(query) Returns the current glitch width or set width as an NR1 numerical value.

When allowed : In all functions.

Sets and queries upper limit level for a window trigger.

Syntax
(command) : TRIGger:UPPEr ch$, <NR 1>
(query) : TRIGger:UPPEr? ch$
ch$ = CH1 to CH4
<NR 1> = from the lower limit level to 100 (%)

Explanation
(command) Sets the upper limit level of the window trigger of the channel designated by ch$ to a numerical value in the range from the lower limit level to 100 (in percent).
(query) Returns the current upper limit level as an NR1 numerical value.

When allowed : In all functions.

Sets and queries lower limit level for a window trigger.

Syntax
(command) : TRIGger:LOWEr ch$, <NR 1>
(query) : TRIGger:LOWEr? ch$
ch$ = CH1 to CH4
<NR 1> = from 0 to the upper limit level (%)

Explanation
(command) Sets the lower limit level of the window trigger of the channel designated by ch$ to a numerical value in the range from zero to the upper limit level (in percent).
(query) Returns the current lower limit level as an NR1 numerical value.

When allowed : In all functions.

Sets and queries the trigger pattern for a logic trigger.

Syntax
(command) : TRIGger:LOGPat ch$, "A$"
(query) : TRIGger:LOGPat? ch$
ch$ = CH 1 to CH 4
A$ = XXXX :trigger pattern (X,0,1)

Explanation
(command) Sets the trigger pattern for the logic trigger of the channel designated by ch$ to that specified by the given character data.

Example
:TRIGGER:LOGPAT CH1, "X001"
Sets the trigger pattern for channel 1 to "X001".

When allowed : In all functions.

Sets and queries the logical operator (AND/OR) for the trigger pattern of a logic trigger.

Syntax
(command) : TRIGger:LOGAnd ch$, A$
(query) : TRIGger:LOGAnd? ch$
ch$ = CH 1 to CH 4
A$ = OR,AND

Explanation
(command) Sets the AND/OR logical operator for the trigger pattern of a logic trigger.
(query) Returns the present AND/OR setting as a character string.

When allowed : In all functions.

Sets and queries trigger mode.

Syntax
(command) : TRIGger:MODE A$
(query) : TRIGger:MODE?
A$ = SINGle
REPEat
AUTO (only in the memory recorder function)

Explanation
(command) Sets the trigger mode.
(query) Returns the current trigger mode as character data.

Example
:TRIGGER:MODE REPEAT
Sets the trigger mode to repeat.

When allowed : In the memory recorder function, the recorder function, and the recorder and memory function.

Sets and queries pre-trigger.

Syntax
(command) : TRIGger:PRETrig <NR 1>
(query) : TRIGger:PRETrig?

Explanation
(command) Sets pre-trigger value to a numerical value (in percent). If an attempt is made to set a value which cannot be set on the 8851, setting is performed to the next higher permitted value.
(query) The currently set pre-trigger value is returned as an NR1 numerical value.

Example
:TRIGGER:PRETRIG 10
Pre-trigger value is set to 10%.

When allowed : In the memory recorder function and the recorder and memory function.

Sets and queries trigger timing.

Syntax
(command) : TRIGger:TIMIng A$
(query) : TRIGger:TIMIng?
A$ = START
STOP
S_S (START&STOP)

Explanation
(command) Sets the trigger timing.
(query) The currently set trigger timing is returned as character data.

When allowed : In the recorder function, and the XY recorder function.

Sets and queries whether the timer trigger is on or off.

Syntax
(command) : TRIGger:TIMEr A$
(query) : TRIGger:TIMEr?
A$ = OFF,ON

Explanation
(command) Enables or disables the timer trigger.
(query) Returns the current enablement state of the timer trigger as character data.

When allowed : In all functions.

Sets and queries the start instant for the timer trigger.

Syntax
(command) : TRIGger:TMSTArt <month>,<day>,<hour>, <min>
(query) : TRIGger:TMSTArt?
<month> = 1 to 12
<day>= 1 to 31
<hour>= 0 to 23
<min> = 0 to 59

Explanation
(command) Sets the start instant for the timer trigger.
(query) Returns the current setting for the timer trigger start instant as NR1 numerical values.

Example
:TRIGGER:TMSTART 7, 5, 9, 30
Sets the start instant for the timer trigger to 09:30 on July 5th.

When allowed : In all functions.

Sets and queries the stop instant for the timer trigger.

Syntax
(command) : TRIGger:TMSTOp <month>,<day>,<hour>, <min>
(query) : TRIGger:TMSTOp?
<month> = 1 to 12
<day> = 1 to 31
<hour>= 0 to 23
<min> = 0 to 59

Explanation
(command) Sets the stop instant for the timer trigger.
(query) Returns the current setting for the timer trigger stop instant as NR1 numerical values.

Example
:TRIGGER:TMSTOP 7, 5, 10, 30
Sets the stop instant for the timer trigger to 10:30 on July 5th.

When allowed : In all functions.

Sets and queries the time interval for the timer trigger.

Syntax
(command) : TRIGger:TMINTvl <hour>, <min>, <sec>
(query) : TRIGger:TMINTvl?
<hour> = 0 to 23
<min> = 0 to 59
<sec> = 0 to 59

Explanation
(command) Sets the time interval for the timer trigger.
(query) Returns the current setting for the timer trigger time interval as NR1 numerical values.

Example
:TRIGGER:TMINTVL 1, 20, 30
Sets the time interval for the timer trigger to one hour, twenty minutes, and thirty seconds.

When allowed : In all functions.

Sets and queries an event trigger.

Syntax
(command) : TRIGger:EVENt ch$, <NR 1>
(query) : TRIGger:EVENt? ch$
ch$ = CH1 to CH4
<NR 1> = 0 : OFF
2 to 4000

Explanation
(command) Sets the number of events for the event trigger for the channel designated by ch$ to a numerical value from 2 to 4000.
If the set value is zero, the event trigger is disabled.
(query) Returns the number of events for the event trigger for the channel designated by ch$ as an NR1 numerical value.

When allowed : In all functions.

(13) :UNIT command

Sets and queries the voltage range of an input unit.

Syntax
(command) : UNIT:RANGe ch$, <NR 3>
(query) : UNIT:RANGe? ch$
ch$ = CH1 to CH4
<NR 3> = voltage range (unit V)

Explanation
(command) Sets the voltage range for the channel designated by ch$ to a numerical value (unit V).
(query) Returns the current voltage range for the channel designated by ch$ as an NR3 numerical value.

Example
:UNIT:RANGE CH1, +10.E-3
Sets the voltage range for channel 1 to 10 mV.

When allowed : In all functions.

Sets and queries input unit origin position.

Syntax
(command) : UNIT:POSItion ch$, <NR 1>
(query) : UNIT:POSItion? ch$
ch$ = CH1 to CH4
<NR 1> = -100 to 100 (%)

Explanation
(command) Sets the origin position for the channel designated by ch$ in the range from -100% to 100% (in steps of 1%).
(query) Returns the current origin position for the channel designated by ch$ as an NR1 numerical value (unit percent).

Example
:UNIT:POSITION ch1, 50
Sets the origin position for channel 1 to 50%.

When allowed : In all functions.

Sets and queries input coupling for an input unit.

Syntax
(command) : UNIT:COUPling ch$, A$
(query) : UNIT:COUPling? ch$
ch$ = CH1 to CH4
A$ = GND, AC, DC

Explanation
(command) Sets the input coupling for the channel designated by ch$.
(query) Returns the current input coupling for the channel designated by ch$ as character data.

Explanation
:UNIT:COUPLING CH1, DC
Sets the input coupling for channel 1 to DC.

When allowed : In all functions.

Sets and queries the filter for an input unit.

Syntax
(command) : UNIT:FILTer ch$, A
(query) : UNIT:FILTer? ch$
A = 0, 500, 5 (0 means OFF)

Explanation
(command) Sets the filter for the channel designated by ch$.
(query) Returns the current filter setting for the channel designated by ch$ as character data.

Example
:UNIT:FILTER CH1, 500
Sets the filter for channel 1 to 500 Hz.

When allowed : In all functions.

(14) :DISPlay command

Sets and queries the screen mode.

Syntax
(command) : DISPlay:CHANge A$
(query) : DISPlay:CHANge?
A$ = SYSTem
STATus
TRIGger
DISPlay

Explanation
(command) Changes the screen mode.
(query) Returns the current screen mode as character data.

Example
:DISPLAY:CHANGE DISPLAY
Switches to the display mode.

When allowed : In all functions.

Sets and queries waveform display style.

Syntax
(command) : DISPlay:DRAW ch$, A$
(query) : DISPlay:DRAW? ch$
ch$ = CH1 to CH4
A$ = OFF, DARK, LIGHT

Explanation
(command) Sets the waveform display style for the channel designated by ch$ to OFF, DARK (high intensity), or LIGHT (low intensity).
(query) Returns the current waveform display style setting for the channel designated by ch$ as character data.

When allowed : In all functions.

Sets and queries display clearing in the X-Y recorder function.

Syntax
(command) : DISPlay:XYCLr A$
(query) : DISPlay:XYCLr?
A$ = OFF, ON

Explanation
(command) Enables or disables display clearing in the X-Y recorder function.
(query) In the X-Y recorder function, returns the enablement of display clearing.

When allowed : In the X-Y recorder function.

Sets and queries waveform display screen in dual format.

Syntax
(command) : DISPlay:GRAPh ch$, <NR 1>
(query) : DISPlay:GRAPh? ch$
ch$ = CH1 to CH4
<NR 1> = 1,2

Explanation
(command) Sets the waveform display windows in dual format.
(query) In dual format, returns the current waveform display window for a channel as an NR1 numerical value.

Example
:DISPLAY:GRAPH CH1, 1
Displays the channel 1 waveform in display window 1.

When allowed : In the memory recorder function, the recorder function, and the recorder and memory function.

Enables and disables, and queries, display of logic waveforms.

Syntax
(command) : DISPlay:LOGDraw ch$, A$
(query) : DISPlay:LOGDraw? ch$
ch$ = CH1 to CH4
A$ = OFF, ON

Explanation
(command) Enables and disables display of logic waveforms.
(query) Returns current enablement state of logic waveform display as character data.

Example
:DISPLAY:LOGDRAW CH1, ON
Enables display of the channel 1 logic waveform.

When allowed : In all functions.

Sets and queries zoom factor on the time axis.

Syntax
(command) : DISPlay:XMAG A$
(query) : DISPlay:XMAG?
A$ = ×10, ×5, ×2, ×1, ×1_2, ×1_5, ×1_10, ×1_20
A$ = ×1_50, ×1_100, ×1_200, ×1_500, ×1_1000, ×1_2000, ×1_4000

Explanation
(command) Sets the zoom factor on the time axis according to character data.
(query) Returns the current zoom factor on the time axis as character data.

Example
:DISPLAY:XMAG X1_10
Sets the compression ratio along the time axis to be 1/10.

When allowed : In the memory recorder function and the recorder and memory function.

Sets and queries zoom factor on the voltage axis.

Syntax
(command) : DISPlay:YMAG ch$, A$
(query) : DISPlay:YMAG? ch$
ch$ = CH1 to CH4
A$ = ×10, ×5, ×2, ×1, ×1_2

Explanation
(command) Sets the zoom factor on the voltage axis for the channel designated by ch$ according to the character data.
(query) Returns the current zoom factor on the voltage axis for the channel designated by ch$ as character data.

When allowed : In the memory recorder function, the recorder function, and the recorder and memory function.

Sets and queries display position when a zoom factor is applied to the voltage axis.

Syntax
(command) : DISPlay:YZOOm ch$, A
(query) : DISPlay:YZOOm? ch$
ch$ = CH1 to CH4
A = 5 to 95 (%) : during ×10 display
10 to 90 : during ×5 display
25 to 75 : during ×2 display
25 to 75 : during ×1/2 display

Explanation
(command) Sets in percent the central position for a waveform display which is magnified or compressed along the voltage axis. In the case of compression, sets where the central position of the waveform will appear on the display; in the case of magnification, sets the center of the portion of the magnified waveform data which is to be displayed.
(query) Returns the current display position as character data.

Explanation
:DISPLAY:YZOOM CH1, 60 (during ×5 magnification)
Shows in magnified form the portion of the data from 50% to 70%.

When allowed
: In the memory recorder function, the recorder function, and the recorder and memory function.

Sets and queries the X-axis, in the XY format.

Syntax
(command) : DISPlay:XAXIs ch$
(query) : DISPlay:XAXIs?
ch$ = CH1 to CH4

Explanation
(command) Sets the Xaxis channel in the XY format.
(query) Returns the current Xaxis channel as character data.

Example
:DISPLAY:XAXIs CH1
Sets channel 1 to the Xaxis.

When allowed
: In the memory recorder function (in XY format), and in the XY recorder function.

Performs waveform display.

Syntax
(command) : DISPlay:WAVE A$
A$ = ACUR (the A-cursor)
TRIG (the trigger point)
POINT (the point set by :MEMOry:POINt)

Explanation
Displays the waveform on the CRT from the position indicated by A$.

When allowed
:Memory recorder function (when A$ = ACUR, the A-cursor must be displayed)

Sets and queries the CRT display waveform for the recorder and memory function.

Syntax
(command) : DISPlay:RMDIsplay A$
(query) : DISPlay:RMDIsplay?
A$ = REC
MEM

Explanation
(command) Sets the waveform shown on the screen, in the recorder and memory function, according to the character data.
(query) Returns the waveform shown on the screen, in the recorder and memory function, as character data.

When allowed : In the recorder and memory function.

(15) :SYSTem command

Enables and disables, and queries, the screen auto off (screen saver) function.

Syntax
(command) : SYSTem:CRTOff A$
(query) : SYSTem:CRTOff?
A$ = OFF, ON

Explanation
(command) Enables or disables the screen saver function.
(query) Returns the current enablement state of the screen saver function as character data.

When allowed : In all functions.

Sets and queries the grid type.

Syntax
(command) : SYSTem:GRID A$
(query) : SYSTem:GRID?
A$ = OFF, NORMal, FINE

Explanation
(command) Sets the type of grid displayed.
(query) Returns the current grid setting as character data.

When allowed : In all functions.

Enables and disables, and queries, the start key backup function.

Syntax
(command) : SYSTem:STARt A$
(query) : SYSTem:STARt?
A$ = OFF, ON

Explanation
(command) Enables and disables the start key backup function.
(query) Returns the current enablement state of the start key backup function as character data.

When allowed : In all functions.

Enables and disables, and queries, the channel marker.

Syntax
(command) : SYSTem:CHMArk A$
(query) : SYSTem:CHMArk?
A$ = OFF, ON, POSItion

Explanation
(command) Makes the corresponding channel marker setting.
(query) Returns the current channel marker setting as character data.

When allowed : In all functions.

Enables and disables, and queries, the sound of the beeper.

Syntax
(command) : SYSTem:BEEPer A$
(query) : SYSTem:BEEPer?
A$ = OFF,ON

Explanation
(command) Enables and disables the beeper sound.
(query) Returns the current enablement state of the beeper sound as character data.

When allowed : In all functions.

Sets and queries the list function and the gauge function.

Syntax
(command) : SYSTem:LIST A$
(query) : SYSTem:LIST?
A$ = OFF
LIST
GAUGE
L_G (LIST&GAUGE)

Explanation
(command) Sets the list function and the gauge function according to a character string.
(query) Returns the current settings for the list function and the gauge function as a character string.

When allowed : In all functions.

Enables and disables, and queries, the smooth printing function.

Syntax
(command) : SYSTem:SMOOth A$
(query) : SYSTem:SMOOth?
A$ = OFF,ON

Explanation
(command) Enables and disables the smooth printing function.
(query) Returns the current enablement state of the smooth printing function as character data.

When allowed : In all functions.

Enables and disables, and queries, the roll mode function.

Syntax
(command): SYSTem:ROLL A$
(query): SYSTem:ROLL?
A$ = OFF,ON

Explanation
(command): Enables and disables the roll mode function.
(query): Returns the current enablement state of the roll mode function as character data.

When allowed : In all functions.

Sets the time, and queries the current time.

Syntax
(command): SYSTem:TIME <hour>, <min>, <sec>
(query): SYSTem:TIME?
<hour>= 0 to 23
<min> = 0 to 59
<sec> = 0 to 59

Explanation
(command): Sets the time.
(query): Returns the current time.

Example
:SYSTEM:TIME 10, 0, 0
Sets the internal clock to 10:00.

When allowed : In all functions.

Sets the calendar date, and queries the current calendar date.

Syntax
(command): SYSTem:DATE <year>, <month>, <day>
(query): SYSTem:DATE?
<year> = 0 to 99
<month> = 1 to 12
<day> = 1 to 31

Explanation
(command): Sets the date on the internal calendar.
(query): Returns the current date.

Example
:SYSTEM:DATE 91, 7, 7
Sets the internal calendar to July 7th, 1991.

When allowed : In all functions.

Sets and queries the output destination for screen dumps.

Syntax
(command): SYSTem:COPY A$
(query): SYSTem:COPY?
A$ = PRINter
PLOTter

Explanation
(command): Sets the output destination for screen dumps.
(query): Returns the current output destination for screen dumps as character data.

When allowed : In all functions.

Sets and queries plot size.

Syntax
(command): SYSTem:PLOT A$
(query): SYSTem:PLOT?
A$ = A4,A5

Explanation
(command): Sets the plot size during plotter output.
(query): Returns the current plot size during plotter output as character data.

When allowed : In all functions.

Sets and queries the pen number during plotter output.

Syntax
(command): SYSTem:PEN ch$, <NR 1>
(query): SYSTem:PEN? ch$
ch$ = CH1 to CH4, FRAME
<NR 1> = 1 to 8

Explanation
(command): Sets the pen number during plotter output.
(query): Returns the current pen number during plotter output as an NR1 numerical value.

When allowed : In all functions.

Sets and queries the number of channels used.

Syntax
(command): SYSTem:USECH <NR 1>
(query): SYSTem:USECH?
<NR 1> = 1, 2, 4

Explanation
(command): Sets the number of input units used to a numerical value.
(query): Returns the current number of input units used as an NR1 numerical value.

When allowed : In the memory recorder function.

Sets and queries the display intensity for logic waveform display.

Syntax
(command): SYSTem:LOGDraw A$
(query): SYSTem:LOGDraw?
A$ = DARK, LIGHT

Explanation
(command): Sets the display intensity for logic waveforms as character data.
(query): Returns the current logic waveform display mode as character data.

When allowed : In the memory recorder function, the recorder function, and the recorder and memory function.

Sets and queries the plot position.

Syntax
(command): SYSTem:PLPOsition A$
(query): SYSTem:PLPOsition?
A$ = LEFT, RIGHT

Explanation
(command): Sets the plot position during A5 size plotter output according to character data.
(query): Returns the plot position during A5 size plotter output as character data.

When allowed : In all functions.

(16) MEMory command

Sets and queries the point in memory for input/output.

Syntax

(command): MEMory:POINt ch$, <NR 1>
(query): MEMory:POINt?
ch$ = CH1 to CH4
<NR 1> = 0 to 2000000

Explanation

(command): Sets the input/output point in memory.
(query): Returns the current input/output point in memory as an NR1 numerical value.

Example

:MEMORY:POINT CH1, 100
Sets the input/output point for channel 1 to the 100th location from the start of memory.

When allowed : In the memory recorder function.

Queries the number of data samples stored.

Syntax

(query): MEMory:MAXPoint?
(response) : MEMory:MAXPoint <NR 1>
<NR 1> = 0 :no data stored
600 to 48000 (divided by 40 gives the number of divisions)

Explanation

Returns the number of data samples stored in the memory.

Example

:MEMORY:MAXPOINT?
Response: 600 (when headers are off)
The number of data samples stored in the memory is 600 (15 divisions).

When allowed : In the memory recorder function.

Inputs data to memory, and outputs stored data.

Syntax

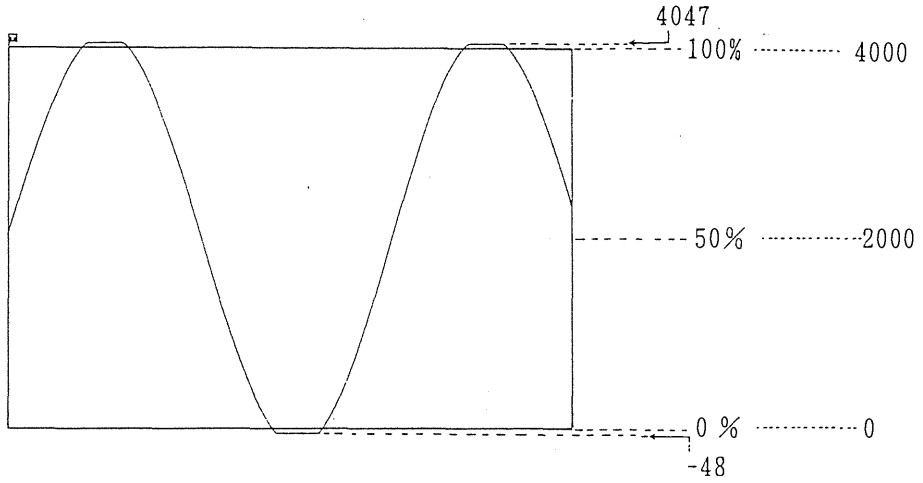
(command): MEMory:ADATa <NR 1>, <NR 1> .....
(query): MEMory:ADATa? A
<NR 1> = -48 to 4047 (data for storage)
A = 1 to 40 (number of data values to be output)

Explanation

(command): Puts the data of the data portion into the memory at the channel and point set by the MEMory:POINT command. If there are several data values, they are input in order from the point set by the MEMory:POINT command.
The input/output point is incremented by the number of data values.

(query): The number of data values specified by A are output from the memory channel and point set by the MEMory:POINT command. The input/output point is incremented by the number of data values.
This cannot be executed during measurement operation.

The following figure illustrates the relationship between the data values input and output using the :MEMory:ADATa command and the position on the recording.



Example

:MEMORY:POINT CH1, 0
:MEMORY:ADATA? 10
Sets the input/output point to channel 1 and data value zero in memory, then outputs 10 stored data values.

When allowed : Provided that stored data is present, and provided that the input/output point is lower than the amount of data stored.

Input voltage data to memory, and output voltage data from memory.

Syntax

(command): MEMory:VDATa <NR 3>, <NR 3> .....
(query): MEMory:VDATa? A
<NR 3> = voltage values (unit volts)
A = 1 to 10 (amount of data)

Explanation

(command): Puts the data values (voltage values) in the data portion into the memory at the channel and point set by the MEMory:POINT command. If there are several data values, they are input in order from the point set by the MEMory:POINT command. The input/output point is incremented by the number of data values.

(query): The number of stored data values specified by A are output as voltage values from the memory channel and point set by the MEMory:POINT command. The input/output point is incremented by the number of data values.
This cannot be executed during measurement operation.

Example

:MEMORY:POINT CH1, 0
:MEMORY:VDATa? 10
Sets the input/output point to channel 1 and data value zero in memory, then outputs 10 stored data values as voltage values.

When allowed : Provided that stored data is present, and provided that the input/output point is lower than the amount of data stored.

Outputs real time data (in ASCII).

Syntax

(query): MEMory:AREAl? ch$
(response) : MEMory:AREAl <NR 1>
ch$ = CH1 to CH4
<NR 1> = -48 to 4047

Explanation (query): Returns the value input on the channel designated by ch$.

When allowed : Providing that measurement operation is not taking place.

Outputs real time data (voltage values).

Syntax

(query): MEMory:VREAl? ch$
(response) : MEMory:VREAl <NR 3>
ch$ = CH1 to CH4
<NR 3> = a voltage value (unit volts)

Explanation (query): Returns as a voltage value the value input on the channel designated by ch$.

When allowed : Providing that measurement operation is not taking place.

Input logic data to memory, and output logic data from memory.

Syntax

(command): MEMory:LDATa <NR 1>, <NR 1> .....
(query): MEMory:LDATa? A
<NR 1> = 0 to 15 (logic data)
A = 1 to 50 (number of data values to be output)

Explanation

(command): Puts the data values (logic values) in the data portion into the memory at the channel and point set by the MEMory:POINt command. If there are several data values, they are input in order from the point set by the MEMory:POINt command. The input/output point is incremented by the number of data values.

(query): The number of stored data values specified by A are output as logic values from the memory channel and point set by the MEMory:POINt command. The input/output point is incremented by the number of data values.
This cannot be executed during measurement operation.

Note: The following is the correspondence between the channels set by the MEMOry:POINt command and the logic channel groups:
CH1 ... CHA
CH2 ... CHB
CH3 ... CHC
CH4 ... CHD

The four logic channels in each group are encoded as binary bits in the NR1 data value, as shown in the following example.

7	6	5	4	3	2	1	0
0	0	0	0	A4	A3	A2	A1

LOW: 0

HIGH: 1

Example

:MEMORY:POINT CH1, 0
:MEMORY:LDATa? 1
If the response is :MEMORY:LDATA 10
then channels A1 to A4 are as follows;

7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0

When allowed : Provided that stored data is present, and provided that the input/output point is lower than the amount of data stored.

Converts a recorder waveform into a memory waveform.

Syntax

(command): MEMory:RECTomem

Explanation

(command): Changes a waveform captured in the recorder function into a waveform for the memory recorder function.

When allowed : In the recorder function.

Input and output of envelope waveforms

A waveform stored in envelope mode has, at each point set by MEMORY:POINT, two data values: a lowest value and a highest value. Accordingly, the amount of data input and output is twice the number of data values specified by A. Further, A is limited to lie within the ranges:

MEMORY:ADATA? ... ... 1 to 20
MEMORY:VDATA? ... ... 1 to 5
MEMORY:LDATA? ... ... 1 to 25

If A is 1, the data input or output is just the lowest value and the highest value. The data is input or output in the order:

west value highest value west value highest value ... ...

Example:

:MEMORY:ADATA? 1

The response, if headers are enabled, is of the form:

:MEMORY:ADATA 10, 3500
(lowest value) (highest value)

(17) CURSor command

Turns on and off, and queries, the A and B cursors.

Syntax
(command): CURSor:MODE A$
(query): CURSor:MODE?
A$ = OFF
TIME
HZ
VOLT
TRACe
In X-Y recorder operation:
XCUR : (↔)
YCUR : (↕)

Explanation
(command): Sets the A and B cursor type (vertical cursor, horizontal cursor, cross-hair cursor).
(query): Returns the current A and B cursor type as character data.

Example
: CURSor:MODE TIME
Sets horizontal cursors.

When allowed
: In all functions.

Selects between, and queries, A only or A and B cursors.

Syntax
(command): CURSor:ABCUrsor ch$
(query): CURSor:ABCUrsor?
A$ = A, A_B

Explanation
(command): Selects between A only or A and B cursors.
(query): Returns whether currently the A cursor only or both A and B cursors are in use, as character data.

When allowed
: In all functions.

Sets and queries the channel for the A cursor.

Syntax
(command): CURSor:ACHAnnel ch$
(query): CURSor:ACHAnnel?
ch$ = CH1 to CH4

Explanation
(command): Sets the channel for the A cursor.
(query): Returns the current A cursor channel as character data.

When allowed
: During use of the cross-hair cursor or the horizontal cursor.

Sets and queries the channel for the B cursor.

Syntax
(command): CURSor:BCHAnnel ch$
(query): CURSor:BCHAnnel?
ch$ = CH1 to CH4

Explanation
(command): Sets the channel for the B cursor.
(query): Returns the current B cursor channel as character data.

When allowed
: During use of the cross-hair cursor or the horizontal cursor.

Sets and queries the position of the A cursor.

Syntax

(command): CURSor:APOSition <NR 1>
(query): CURSor:APOSition?
(vertical cursor, cross-hair cursor)
A = 0 to (number of stored data values) :MEMORY
when TIME/DIV = 400, 500 ms :RECORDER
0 to 80 × shot length
Otherwise,
0 to 160 × shot length (CONT = 750)
0 to 400 :X-Y
(horizontal cursor)
A = 0 to 250 :MEMORY, RECORDER
0 to 250 :X-Y

Explanation

(command): Sets the A cursor position (refer to next page).
(query): Returns the current A cursor position as an NR1 numerical value.

When allowed : When stored data is present.

Sets and queries the position of the B cursor.

Syntax

(command): CURSor:BPOSition <NR 1>
(query): CURSor:BPOSition?
(vertical cursor, trace cursor)
A = 0 to (amount of stored data) :MEMORY
when TIME/DIV = 400, 500 ms :RECORDER
0 to 80 × shot length
Otherwise,
0 to 160 × shot length (CONT = 750)
0 to 400 :X-Y
(horizontal cursor)
A = 0 to 250 :MEMORY, RECORDER
0 to 250 :X-Y

Explanation

(command): Sets the B cursor position (refer to next page).
(query): Returns the current B cursor position as an NR1 numerical value.

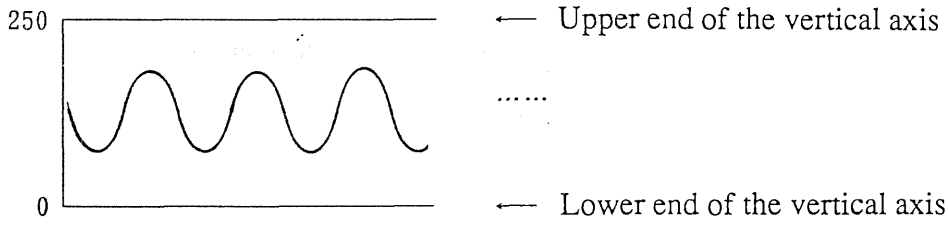
When allowed : When stored data is present.

The cursor position has the following meaning:

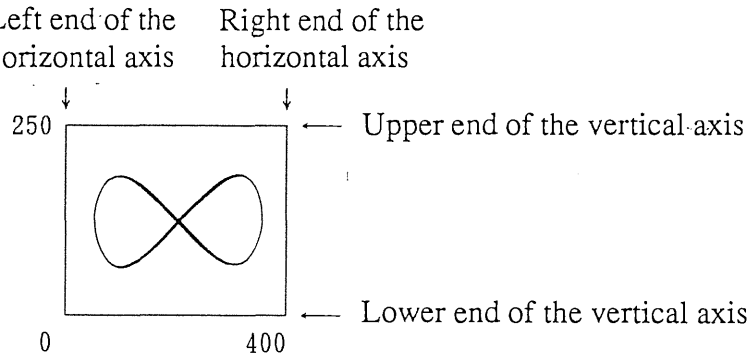
In the memory recorder function, the recorder function, and the recorder and memory function, when the vertical cursor or the cross-hair cursor is in use, the cursor position is an indication of the current point in memory.

(When storage is performed on a basis of 15 divisions, the number of stored data values is 600, and the cursor position indication lies in the range from 0 to 600)

The horizontal cursor, and in the memory recorder function in XY format and in the XY recorder function both the vertical cursor and the horizontal cursor, are shown to the lower right of the waveform area on the display in a standard position. (refer to next page).



In the memory recorder function in XY format and in the XY recorder function



Sets and queries the cursor readout value (Δt).

Syntax
(command): CURSor:DTREad?
(query): CURSor:DTREad A$
A$ = the readout value (Δt, 1/Δt)

Explanation
(query): Returns the cursor readout value (Δt, 1/Δt) as a line of character data.

Example
:Response :CURSOR:DTREad"168us"

When allowed
: Provided that the cursor is not off, and that (Δt, 1/Δt) are being shown on the display.

Sets and queries the cursor readout value (ΔV).

Syntax
(command): CURSor:DVREad?
(query): CURSor:DVREad A$
A$ = the readout value (ΔV)

Explanation
(query): Returns the cursor readout value (ΔV) as a line of character data.

Example
:Response :CURSOR:DVREad"12.3mV"

When allowed
: Provided that the cursor is not off, and that (ΔV) is being shown on the display.

(18) COMMent command

Enables and disables, and queries, title comments, and inputs comment characters.

Syntax

(command): COMMent:TITLe A$, "B$"
(query): COMMent:TITLe?
A$ = OFF,ON
B$ = comment characters (up to 20 characters)

Explanation

(command): Enables and disables comments, and inputs a string of comment characters. Characters that can be used are:
0 to 9, ~u (= μ), ~c (= °), ␣ ,^, (,), , , , . #, %, &, = , +, -, *, /, A to Z, a to z
Characters other than the above are replaced by spaces.
Comments may be omitted.

(query): Returns the current enablement state of title comments, and the characters of the comment if any, as character data.

Example

:COMMENT:TITLE ON, "HIOKI 8851"
Inputs "HIOKI 8851" as a title comment.

When allowed

: In all functions.

For each channel, enables and disables and queries comments, and inputs comment characters.

Syntax

(command): COMMent:CH ch$, A$, "B$"
(query): COMMent:CH? ch$
ch$ = CH1 to CH4, CHA to CHD
A$ = OFF,ON
B$ = comment characters (up to 20 characters)

Explanation

(command): Enables and disables comment display for the channel specified by ch$, and inputs a string of comment characters. Characters that can be used are: 0 to 9, ~u (= μ), ~c (= °), ␣ , ^, (,), , , . #, %, &, = , +, -, *, /, A to Z, a to z
Characters other than the above are replaced by spaces.
Comments may be omitted.

(query): Returns the current enablement state of comment display for the channel specified by ch$, and the characters of the comment if any, as character data.

Example

:COMMENT:CH1 ON, "ch1 = TEST"
Sets the comment display for channel 1 to "ch1 = TEST".

When allowed

: In all functions.

(19) SCALing command

Enables and disables, and queries, the scaling function.

Syntax
(command): SCALing:MODE A$
(query): SCALing:MODE?
A$ = OFF, ON

Explanation
(command): Enables or disables the scaling function.
(query): Returns the current state of enablement of the scaling function as character data.

When allowed : In all functions.

Sets and queries scaling type.

Syntax
(command): SCALing:SET ch$, A$
(query): SCALing:SET? ch$
ch$ = CH1 to CH4
A$ = DEFAult
TYPEA to TYPED

Explanation
(command): Sets the scaling type for the channel designated by ch$.
(query): Returns the current scaling type for the channel designated by ch$ as character data.

When allowed : In all functions.

Sets and queries the scaling conversion value.

Syntax
(command): SCALing:VOLT A$, <NR 3>
(query): SCALing:VOLT? A$
A$ = TYPEA to TYPED
<NR 3> = scaling conversion value (EU/volts)
(-9.999E-9 to +9.999E+9)

Explanation
(command): Sets the scaling conversion value for TYPEA to TYPED.
(query): Returns the current scaling conversion value for TYPEA to TYPED as character data.

When allowed : In all functions.

Sets and queries the scaling offset.

Syntax
(command): SCALing:OFFSet A$, <NR 3>
(query): SCALing:OFFSet? A$
A$ = TYPEA to TYPED
<NR 3> = scaling offset (EU offset)
(-9.999E-9 to +9.999E+9)

Explanation
(command): Sets the scaling offset for TYPEA to TYPED.
(query): Returns the current scaling offset for TYPEA to TYPED as an NR3 numerical value.

When allowed : In all functions.

Sets and queries the scaling unit.

Syntax
(command): SCALing:UNIT A$, "B$"
(query): SCALing:UNIT? A$
A$ = TYPEA to TYPED
B$ = scaling unit (7 characters)

Explanation
(command): Sets the scaling unit for TYPEA to TYPED (up to 7 characters allowed).
Characters that can be used are: ^2 (= ^{2}), ^3 (= ^{3}), ~u (= μ), ␣ , ~o (= Ω), ~c (= °), %, . , = , +, -, *, /, A to Z, a to z
Characters other than the above are replaced by spaces.
(query): Returns the current scaling unit for TYPEA to TYPED as character data.

Example
:SCALING:UNIT TYPEA, "mA"
Sets the scaling unit for type A to milliamps.

When allowed : In all functions.

(20) CALCulate command

Enables and disables, and queries, waveform processing calculation.

Syntax
(command): CALCulate:WVCAlc A$
(query): CALCulate:WVCAlc?
A$ = OFF, ON, EXEC (execute)

Explanation
(command): Enables or disables, according to character data, the execution of waveform processing calculation.
(query): Returns, as character data, whether execution of waveform processing calculation is enabled or disabled.
Only valid when execution (EXEC) is enabled.

When allowed : In the memory recorder function.

Enables and disables, and queries, FFT calculation.

Syntax
(command): CALCulate:FFT A$
(query): CALCulate:FFT?
A$ = OFF, ON, EXEC (execute)

Explanation
(command): Enables or disables, according to character data, the execution of FFT calculation.
(query): Returns, as character data, whether execution of FFT calculation is enabled or disabled.
Only valid when execution (EXEC) is enabled.

When allowed : In the memory recorder function.

Sets, executes, and queries conversion of envelope waveform data to normal waveform data.

Syntax

(command): CALCulate:ENVNormal A$
(query): CALCulate:ENVNormal?
A$ = UP, LOW

Explanation

(command): Sets whether the upper limit data (UP) or the lower limit data (LOW) of an envelope waveform is to be used, then executes the conversion into normal waveform data.
(query): Returns, as character data, whether the upper limit data (with the response "UP") or the lower limit data (with the response "LOW") of an envelope waveform is used for conversion into a normal waveform.

When allowed : In the memory recorder function.

Enables and disables, and queries, waveform parameter calculation.

Syntax

(command): CALCulate:MEASure A$
(query): CALCulate:MEASure?
A$ = OFF, ON, EXEC (execute)

Explanation

(command): Enables or disables, according to character data, the execution of waveform parameter calculation.
(query): Returns, as character data, whether execution of waveform parameter calculation is enabled or disabled.
Only valid when execution (EXEC) is enabled.

When allowed : In the memory recorder function.

Enables and disables, and queries, waveform parameter calculation value printing.

Syntax

(command): CALCulate:MEASPrint A$
(query): CALCulate:MEASPrint?
A$ = OFF, ON

Explanation

(command): Enables or disables, according to character data, print output of waveform parameter calculation values.
(query): Returns, as character data, whether execution of print output of waveform parameter calculation values is enabled or disabled.

When allowed : In the memory recorder function.

Queries result of waveform parameter calculation.

Syntax

(query): CALCulate: ANSWer? A$, B$
(command): CALCulate: ANSWer C$, <NR 3>
A$ = NO1 to NO4
B$ = CH1 to CH4
C$ = NONE, MIN, MAX, MINT, MAXT, PP, AVE, RMS, AREA, PERI, FREQ, RISE, FALL, XYAREA
<NR 3> = calculation result (units volts and seconds, or appropriate units if scaling is in effect)

Explanation

(command) For the waveform parameter calculation specified by A$ and B$, returns the identification of the item calculated and the value.
If C$ is "NONE", there is no calculation result.

When allowed : In the memory recorder function.

Sets and queries the coefficients for the waveform processing calculation equation for Z1.

Syntax

(command): CALCulate:Z1 A$, B$, C$, D$
(query): CALCulate:Z1?
A$, B$, C$ = A to P
D$ = PLUS : +
MINUS : -
MULT : *
DIVI : /

Explanation

(command): Sets the coefficients for the waveform processing calculation equation for Z1 according to the character data.
(query): Returns the current coefficients for the waveform processing calculation equation for Z1 as character data.
A$, B$, C$, D$ are used to set up the calculation equation for Z1 in the following way:
Z1 = A$ X1 D$ B$ Y1 + C$

Example

:CALCULATE:Z1 A, B, C, PLUS
Sets up the calculation equation for Z1 to be Z1 = aX1+bY1+c

When allowed : In the memory recorder function.

Sets and queries the coefficients for the waveform processing calculation equation for Z2.

Syntax

(command): CALCulate:Z2 A$, B$, C$, D$
(query): CALCulate:Z2?
A$, B$, C$ = A to P
D$ = PLUS : +
MINUS : -
MULT : *
DIVI : /

Explanation

(command): Sets the coefficients for the waveform processing calculation equation for Z2 according to the character data.
(query): Returns the current coefficients for the waveform processing calculation equation for Z2 as character data.
A$, B$, C$, D$ are used to set up the calculation equation for Z2 in the following way:
Z2 = A$ X2 D$ B$ Y2 + C$

Example

:CALCULATE:Z2 A, B, C, PLUS
Sets up the calculation equation for Z2 to be Z2 = aX2+bY2+c

When allowed : In the memory recorder function.

Sets and queries the coefficients for the waveform processing calculation equation for Z3.

Syntax

(command): CALCulate:Z3 A$, B$, C$, D$
(query): CALCulate:Z3?

A$, B$, C$ = A to P
D$ = PLUS : +
MINUS : -
MULT : *
DIVI : /

Explanation

(command): Sets the coefficients for the waveform processing calculation equation for Z3 according to the character data.
(query): Returns the current coefficients for the waveform processing calculation equation for Z3 as character data.
A$, B$, C$, D$ are used to set up the calculation equation for Z3 in the following way:

Z3 = A$ X3 D$ B$ Y3 + C$

Example

:CALCULATE:Z3 A, B, C, PLUS
Sets up the calculation equation for Z3 to be Z3 = aX3+bY3+c

When allowed : In the memory recorder function.

Sets and queries the coefficients for the waveform processing calculation equation for Z4.

Syntax

(command): CALCulate:Z4 A$, B$, C$, D$
(query): CALCulate:Z4?

A$, B$, C$ = A to P
D$ = PLUS : +
MINUS : -
MULT : *
DIVI : /

Explanation

(command): Sets the coefficients for the waveform processing calculation equation for Z4 according to the character data.
(query): Returns the current coefficients for the waveform processing calculation equation for Z4 as character data.
A$, B$, C$, D$ are used to set up the calculation equation for Z4 in the following way:

Z4 = A$ X4 D$ B$ Y4 + C$

Example

:CALCULATE:Z4 A, B, C, PLUS
Sets up the calculation equation for Z4 to be Z4 = aX4+bY4+c

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for X1.

Syntax

(command): CALCulate:X1 A$, ch$, B$
(query): CALCulate:X1?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the X1 calculation equation for the waveform processing calculation equation for Z1 according to the character or numerical data.

(query): Returns the current X1 calculation equation for the waveform processing calculation equation for Z1 as character or numerical data.

A$, B$, and ch$ are used to set up the calculation equation in the following way:

X1 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
X1 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1 : CALCULATE:X1 ABS, CH1, A
Sets up the calculation equation for X1 to be X1 = ABS(ch1+A)

Example 2 : CALCULATE:X1 MOV, CH1, 50
Sets up the calculation equation for X1 to be X1 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for X2.

Syntax

(command): CALCulate:X2 A$, ch$, B$
(query): CALCulate:X2?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the X2 calculation equation for the waveform processing calculation equation for Z2 according to the character or numerical data.

(query): Returns the current X2 calculation equation for the waveform processing calculation equation for Z2 as character or numerical data.

A$, B$, and ch$ are used to set up the calculation equation in the following way:

X2 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
X2 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:X2 ABS, CH1, A
Sets up the calculation equation for X2 to be X2 = ABS(ch1+A)

Example 2: CALCULATE:X2 MOV, CH1, 50
Sets up the calculation equation for X2 to be X2 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for X3.

Syntax

(command): CALCulate:X3 A$, ch$, B$
(query): CALCulate:X3?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1, Z2
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the X3 calculation equation for the waveform processing calculation equation for Z3 according to the character or numerical dat
(query): Returns the current X3 calculation equation for the waveform processing calculation equation for Z3 as character or numerical data.
A$, B$, and ch$ are used to set up the calculation equation in the following way:

X3 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
X3 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:X3 ABS, CH1, A
Sets up the calculation equation for X3 to be X3 = ABS(ch1+A)

Example 2: CALCULATE:X3 MOV, CH1, 50
Sets up the calculation equation for X3 to be X3 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for X4.

Syntax

(command): CALCulate:X4 A$, ch$, B$
(query): CALCulate:X4?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1 to Z3
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the X4 calculation equation for the waveform processing calculation equation for Z4 according to the character or numerical data.

(query): Returns the current X4 calculation equation for the waveform processing calculation equation for Z4 as character or numerical data. A$, B$, and ch$ are used to set up the calculation equation in the following way:

X4 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
X4 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:X4 ABS, CH1, A
Sets up the calculation equation for X4 to be X4 = ABS(ch1+A)

Example 2: CALCULATE:X4 MOV, CH1, 50
Sets up the calculation equation for X4 to be X4 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for Y1.

Syntax

(command): CALCulate:Y1 A$, ch$, B$
(query): CALCulate:Y1?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the Y1 calculation equation for the waveform processing calculation equation for Z1 according to the character or numerical data.

(query): Returns the current Y1 calculation equation for the waveform processing calculation equation for Z1 as character or numerical data.

A$, B$, and ch$ are used to set up the calculation equation in the following way:

Y1 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
Y1 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:Y1 ABS, CH1, A
Sets up the calculation equation for Y1 to be Y1 = ABS(ch1+A)

Example 2: CALCULATE:Y1 MOV, CH1, 50
Sets up the calculation equation for Y1 to be Y1 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for Y2.

Syntax

(command): CALCulate:Y2 A$, ch$, B$
(query): CALCulate:Y2?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the Y2 calculation equation for the waveform processing calculation equation for Z2 according to the character or numerical data.

(query): Returns the current Y2 calculation equation for the waveform processing calculation equation for Z2 as character or numerical data.
A$, B$, and ch$ are used to set up the calculation equation in the following way:
Y2 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
Y2 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:Y2 ABS, CH1, A
Sets up the calculation equation for Y2 to be Y2 = ABS(ch1+A)

Example 2: CALCULATE:Y2 MOV, CH1, 50
Sets up the calculation equation for Y2 to be Y2 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for Y3.

Syntax

(command): CALCulate:Y3 A$, ch$, B$
(query): CALCulate:Y3?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1, Z2
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the Y3 calculation equation for the waveform processing calculation equation for Z3 according to the character or numerical data.

(query): Returns the current Y3 calculation equation for the waveform processing calculation equation for Z3 as character or numerical data.

A$, B$, and ch$ are used to set up the calculation equation in the following way:

Y3 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
Y3 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:Y3 ABS, CH1, A
Sets up the calculation equation for Y3 to be Y3 = ABS(ch1+A)

Example 2: CALCULATE:Y3 MOV, CH1, 50
Sets up the calculation equation for Y3 to be Y3 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets up and queries the calculation equation for Y4.

Syntax

(command): CALCulate:Y4 A$, ch$, B$
(query): CALCulate:Y4?

A$ = OFF (in this case, ch$ and B$ are disregarded)
PAR : (
ABS : Absolute value
EXP : Exponential
LOG : Common logarithm
SQR : Square root
MOV : Moving average
DIF : Differentiation once
INT : Intergration once
DIF2 : Differentiation twice
INT2 : Intergration twice
SLI : Parallel displacement

ch$ = CH1 to CH4, Z1 to Z3
B$ = A to P;
or, when A$ is set to MOV, a numerical value from 1 to 4000;
or, when A$ is set to SLI, a numerical value from -4000 to 4000.

Explanation

(command): Sets the Y4 calculation equation for the waveform processing calculation equation for Z4 according to the character or numerical data.

(query): Returns the current Y4 calculation equation for the waveform processing calculation equation for Z4 as character or numerical data.

A$, B$, and ch$ are used to set up the calculation equation in the following way:

Y4 = A$(ch$+B$)
or, when A$ is set to MOV or SLI:
Y4 = [MOV or SLI] (ch$,B$)
(Refer to Section 17 "Calculation Functions.")

Example 1: CALCULATE:Y4 ABS, CH1, A
Sets up the calculation equation for Y4 to be Y4 = ABS(ch1+A)

Example 2: CALCULATE:Y4 MOV, CH1, 50
Sets up the calculation equation for Y4 to be Y4 = MOV(ch1,50)

When allowed : In the memory recorder function.

Sets and queries numerical values for coefficients a to p of the waveform processing calculation equation.

Syntax

(command): CALCulate:FACTor A$, <NR 3>
(query): CALCulate:FACTor? A$
A$ = A to P
<NR 3> = +9.999E+9 to -9.999E-9

Explanation

(command): Sets to the given numerical value the one of the coefficients a to p which is designated in A$.
(query): Returns as an <NR 3> numerical value the current value of that one of the coefficients a to p which is designated in A$. (Refer to Section 17 "Calculation Functions.")

Example

:CALCULATE:FACTOR A, +1.234E+1
Sets the coefficient a to be equal to +1.234E+1

When allowed : In the memory recorder function.

Sets and queries the display channel for the calculated result of the waveform processing calculation equation for Z1.

Syntax

(command): CALCulate:Z1DIsplay ch$, A$, upper, lower
(query): CALCulate:Z1DIsplay?
ch$ = CH1 to CH4, NONE
A$ = AUTO, MANUal
(if ch$ = NONE, may be omitted)
upper, lower = +9.999E+9 to -9.999E-9
(if ch$ = NONE or A$ = AUTO, may be omitted)

Explanation

(command): Displays the calculated result of the waveform processing calculation equation for Z1 on the channel designated by ch$ within the range from lower to upper (unit volts - however, if scaling is being performed, in those units).
(query): Returns the currently set display channel, scale setting lower limit, and upper limit for display of the calculated result of the waveform processing calculation equation for Z1.

Example

:CALCULATE:Z1DISPLAY CH1, MANUAL, +0.000E+0, +5.000E+0
Displays the calculated result of the waveform processing calculation equation for Z1 on channel 1 within the range from 0 volts to 5 volts.

When allowed : In the memory recorder function.

Sets and queries the display channel for the calculated result of the waveform processing calculation equation for Z2.

Syntax

(command): CALCulate:Z2DIsplay ch$, A$, upper, lower
(query): CALCulate:Z2DIsplay?
ch$ = CH1 to CH4, NONE
A$ = AUTO, MANUal
(if ch$ = NONE, may be omitted)
upper, lower = +9.999E+9 to -9.999E-9
(if ch$ = NONE or A$ = AUTO, may be omitted)

Explanation

(command): Displays the calculated result of the waveform processing calculation equation for Z2 on the channel designated by ch$ within the range from lower to upper (unit volts - however, if scaling is being performed, in those units).
(query): Returns the currently set display channel, scale setting lower limit, and upper limit for display of the calculated result of the waveform processing calculation equation for Z2.

Example

:CALCULATE:Z2DISPLAY CH1, MANUAL, +0.000E+0, +5.000E+0
Displays the calculated result of the waveform processing calculation equation for Z2 on channel 1 within the range from 0 volts to 5 volts.

When allowed : In the memory recorder function.

Sets and queries the display channel for the calculated result of the waveform processing calculation equation for Z3.

Syntax

(command): CALCulate:Z3DIsplay ch$, A$, upper, lower
(query): CALCulate:Z3DIsplay?
ch$ = CH1 to CH4, NONE
A$ = AUTO, MANUal
(if ch$ = NONE, may be omitted)
upper, lower = +9.999E+9 to -9.999E-9
(if ch$ = NONE or A$ = AUTO, may be omitted)

Explanation

(command): Displays the calculated result of the waveform processing calculation equation for Z3 on the channel designated by ch$ within the range from lower to upper (unit volts - however, if scaling is being performed, in those units).
(query): Returns the currently set display channel, scale setting lower limit, and upper limit for display of the calculated result of the waveform processing calculation equation for Z3.

Example

:CALCULATE:Z3DISPLAY CH1, MANUAL, +0.000E+0, +5.000E+0
Displays the calculated result of the waveform processing calculation equation for Z3 on channel 1 within the range from 0 volts to 5 volts.

When allowed : In the memory recorder function.

Sets and queries the display channel for the calculated result of the waveform processing calculation equation for Z4.

Syntax

(command): CALCulate:Z4DIsplay ch$, A$, upper, lower
(query): CALCulate:Z4DIsplay?
ch$ = CH1 to CH4, NONE
A$ = AUTO, MANUal
(if ch$ = NONE, may be omitted)
upper, lower = +9.999E+9 to -9.999E-9
(if ch$ = NONEor A$ = AUTO, may be omitted)

Explanation

(command): Displays the calculated result of the waveform processing calculation equation for Z4 on the channel designated by ch$ within the range from lower to upper (unit volts - however, if scaling is being performed, in those units).
(query): Returns the currently set display channel, scale setting lower limit, and upper limit for display of the calculated result of the waveform processing calculation equation for Z4.

Example

:CALCULATE:Z4DISPLAY CH1, MANUAL, +0.000E+0, +5.000E+0
Displays the calculated result of the waveform processing calculation equation for Z4 on channel 1 within the range from 0 volts to 5 volts.

When allowed : In the memory recorder function.

Sets and queries waveform parameter calculations.

Syntax

(command): CALCulate:MEASSet NO$, A$, ch$
(query): CALCulate:MEASSet? NO$
NO$ = NO1 to NO4
A$ = OFF (when NO$ = NO1, OFF is not allowed)
MIN
MAX
PP
AVE
RMS
AREA
PERI
FREQ
RISE
FALL
XYAREA
ch$ = CH1 to CH4, ALL During XYAREA,
ch$ = xaxis channel, yaxis channel.

Explanation

(command): Sets the channel and the calculation item of the waveform parameter calculation designated by NO$.
(query): Returns the the channel and the calculation item of the waveform parameter calculation designated by NO$.
Example 1: CALCULATE:MEASSET NO1,MAX,CH1
Sets the calculation to be of the maximum value on channel 1.
Example 2 : CALCULATE:MEASS NO2,XYAREA,CH1,CH2
If the x-axis is channel 1 and the Y-axis is channel 2, sets X-Y area value calculation.

When allowed : In the memory recorder function.

Enables and disables, and queries, decision for waveform parameter calculation.

Syntax
(command): CALCulate:COMP No$, A$
(query): CALCulate:COMP?
No$ = No1 to No4
A$ = OFF, ON

Explanation
(command): Enables and disables, according to the character data, the decision of the calculation result of waveform parameter calculation.
(query): Returns, as character data, the enablement state of the decision of the calculation result of waveform parameter calculation.

When allowed : In the memory recorder function.

Sets and queries upper and lower limits for the decision value for waveform parameter calculation.

Syntax
(command): CALCulate:COMPArea A$, upper, lower
(query): CALCulate:COMPArea? A$
A$ = No1 to No4
upper, lower = -9.999E-9 to +9.999E+9

Explanation
(command): Sets, according to the numerical values supplied, the upper limit and the lower limit used when performing a decision on the waveform parameter calculated value designated by A$.
(query): Returns, as <NR 3> numerical values, the upper limit and the lower limit used when performing a decision on the waveform parameter calculated value designated by A$.

Example
:CALCULATE:COMPAREA NO1, +1.000E+0,-1.000E+0
Sets the decision value for the waveform parameter calculation NO1 to be in the range -1.000E+0 < NO1 < +1.000E+0

When allowed : In the memory recorder function.

Sets and queries FFT window.

Syntax
(command): CALCulate:FFTWind A$
(query): CALCulate:FFTWind?
A$ = RECTan
HANNing

Explanation
(command): Sets the window for FFT calculation according to the character data.
(query): Returns the window for FFT calculation as character data.

When allowed : In the memory recorder function.

Enables or disables, and queries, the FFT cursor.

Syntax
(command): CALCulate:FFTCsr A$
(query): CALCulate:FFTCsr?
A$ = OFF,ON

Explanation
(command): Enables or disables the FFT cursor according to the character data.
(query): Returns the enablement state of the FFT cursor as character data.

When allowed : In the memory recorder function.

Sets and queries FFT cursor display value.

Syntax
(command): CALCulate:FFTCSRDisp A$
(query): CALCulate:FFTCSRDisp?
A$ = PEAK
RMS

Explanation
(command): Sets the FFT cursor display value according to the character data.
(query): Returns the setting of the FFT cursor display value as character data.

When allowed : In the memory recorder function.

Sets and queries FFT format.

Syntax
(command): CALCulate:FFTFOrm A$
(query): CALCulate:FFTFOrm?
A$ = SINGLE
DUAL

Explanation
(command): Sets the FFT format according to the character data.
(query): Returns the setting of the FFT format as character data.

When allowed : In the memory recorder function.

Sets and queries FFT printer output.

Syntax
(command): CALCulate:FFTPrint A$
(query): CALCulate:FFTPrint?
A$ = WAVE
DATA

Explanation
(command): Sets FFT printer output according to the character data.
(query): Returns the setting of FFT printer output as character data.

When allowed : In the memory recorder function.

Sets and queries the FFT channel.

Syntax
(command): CALCulate:FFTCH A, B$
(query): CALCulate:FFTCH? A
A = 1,2
B$ = CH1 to CH4

Explanation
(command): Sets the FFT calculation channel according to the character data.
(query): Returns the setting of the FFT calculation channel as character data. When the format is SINGLE, A should be 1, but when the format is DUAL, A = 1 for the single screen mode, and A = 2 for the two-screen mode.

When allowed : In the memory recorder function.

Sets and queries the FFT function.

Syntax

(command): CALCulate:FFTFunction A, B$
(query): CALCulate:FFTFunction? A
A = 1,2
B$ = STORage
PSPMDB
PSPMAG
LINMAG
LINIMG
LINREAL

Explanation

(command): Sets the FFT function according to the character data.
(query): Returns the setting of the FFT function as character data.
When the format is SINGLE, A should be 1, but when the format is DUAL, A = 1 for the single screen mode, and A = 2 for the two-screen mode.
(For details, refer to Section 17 "Calculation Functions.")

When allowed : In the memory recorder function.

Sets and queries the upper end value for the vertical axis for the FFT display.

Syntax

(command): CALCulate:FFTUp A, B
(query): CALCulate:FFTUp? A
A = 1,2
B = -9.999E-9 to +9.999E+9

Explanation

(command): Sets the vertical axis upper end value for the FFT display according to the numerical value.
(query): Returns the vertical axis upper end value for the FFT display as a numerical value.
When the format is SINGLE, A should be 1, but when the format is DUAL, A = 1 for the single screen mode, and A = 2 for the two-screen mode.
(For details, refer to Section 17 "Calculation Functions.")

When allowed : In the memory recorder function.

Sets and queries the lower end value for the vertical axis for the FFT display.

Syntax

(command): CALCulate:FFTLow A, B
(query): CALCulate:FFTLow? A
A = 1,2
B = -9.999E-9 to +9.999E+9

Explanation

(command): Sets the vertical axis lower end value for the FFT display according to the numerical value.
(query): Returns the vertical axis lower end value for the FFT display as a numerical value.
When the format is SINGLE, A should be 1, but when the format is DUAL, A = 1 for the single screen mode, and A = 2 for the two-screen mode.
(For details, refer to Section 17 "Calculation Functions.")

When allowed : In the memory recorder function.

Sets and queries the output point for FFT data.

Syntax
(command): CALCulate:FFTPOint
(query): CALCulate:FFTPOint?
A = 0 to 799 (when the function is STORAGE)
0 to 399 (otherwise)

Explanation
(command): Sets the output point for FFT data.
(query): Returns the output point for FFT data.
(refer to :CALCulate:FFTData?)

When allowed : In the memory recorder function.

Sets and queries the FFT compression ratio.

Syntax
(command): CALCulate:FFTFRq A$
(query): CALCulate:FFTFRq?
A$ = X1, X1_2, X1_5

Explanation
(command): Sets the compression ratio for FFT data according to the character data.
(query): Returns the compression ratio for FFT data as character data.
(refer to :CALCulate:FFTData?)

When allowed : In the memory recorder function.

Outputs FFT data.

Syntax
(query): CALCulate:FFTData?
(response): CALCulate:FFTData "A$", "B$"
A$ = x-axis data
B$ = y-axis data
0 to 399

Explanation
(command): Outputs FFT data as character string data from the FFT data output point as set by :CALCulate:FFTPoint.

Example
:CALCULATE:FFTPOINT CH1, 0
:CALCULATE:FFTDATA?

When allowed : In the memory recorder function.

(21) :FDISK command

Sets and queries the floppy disk mode.

Syntax
(command): FDISK:MODE A$
(query): FDISK:MODE?
A$ = OFF,ON

Explanation
(command): Enables and disables the floppy disk mode.
(query): Returns whether the floppy disk mode is currently enabled or disabled.

When allowed : In all functions.

Performs a load from the floppy disk.

Syntax
(command): FDISK:LOAD NO
NO = file number

Explanation
(command): Loads the data in the file numbered NO.

Example
:FDISK:LOAD 1
Loads the data of the file numbered 1 on the floppy disk as follows:

When allowed :When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Performs a save to the floppy disk.

Syntax
(command) :FDISK:SAVE "NAME1$.NAME2$", A$, B$ (when A$ = W)
:FDISK:SAVE "NAME1$.NAME2$", A$ (when A$ = F or A)
NAME1$ = file name (8 characters)
NAME2$ = extension (3 characters)
A$ = type of saved information
W: measurement data
F: setting data
A: waveform decision area
B$ = saved channels (only when A$ = W)
ALL
CH1 to CH4
LOG (logic channels)

Explanation
(command): Saves on the floppy disk the information specified by A$. If an attempt is made to save to a filename that already exists, an execution error is generated.

Example
:FDISK:SAVE:"TEST.DAT",W,ALL
Saves all channels of measurement data on the floppy disk under the file name "TEST.DAT"

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Deletes a file from the floppy disk.

Syntax
(command): FDISK:DELEte NO
NO = file number

Explanation
(command): Deletes from the floppy disk the file whose number is specified by NO.

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Formats a floppy disk.

Syntax (command): FDISK:FORMat

Explanation (command): Formats a floppy disk.

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Queries how many files are saved on the floppy disk.

Syntax (query): FDISK:FILE?
(response) : FDISK:FILE<NR 1>
<NR 1> = number of files

Explanation (query): Returns the number of files which are currently saved on the floppy disk.

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Queries the name of a file saved on the floppy disk.

Syntax (query): FDISK:NINFor? No
(response) : FDISK:NINFor No, NAME$
No = file number
NAME$ = name of the file

Explanation (query): Returns the filename of the file whose number is specified in No.

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

Queries information about a file saved on the floppy disk.

Syntax (query): FDISK:INFOr? "NAME$"
(response) : FDISK:INFOR "NAME$", A,B$,"DATE$","TIME$", B
NAME$ = file name
A = file number (if no such file exists, 1)
B$ = type of information saved:
W: measurement data
F: conditions of creation
A: waveform decision area
N: no such file
DATE$ = date of save - year-month-day
TIME$ = time of save - hour:minute:second
B = size of file

Explanation (query): Returns information about the file whose name is specified in NAME$. If no such file exists, returns:
-1, N, "----", "-:-:-", 0

When allowed : When the floppy disk control screen is displayed (after :FDISK:MODE ON).

(22) GRAPh command

Enables and disables, and queries the enablement of, the graphics editor.

Syntax

(command): GRAPh:EDIT A$
(query): GRAPh:EDIT?
A$ = OFF,ON

Explanation

(command): Enables, and disables, the graphic editor mode.
(query): Returns whether or not the graphic editor mode is enabled as character data.

When allowed : In the memory recorder function.

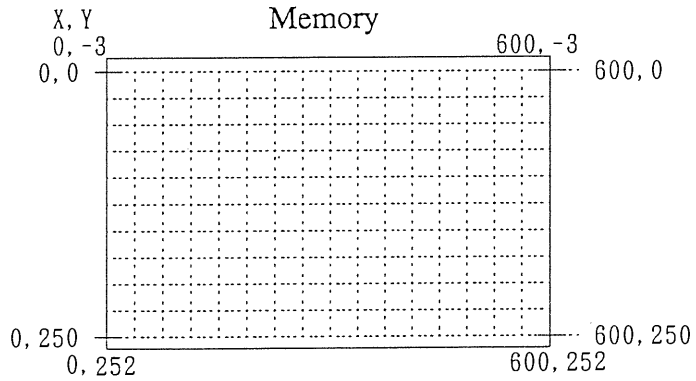
Line command

Syntax

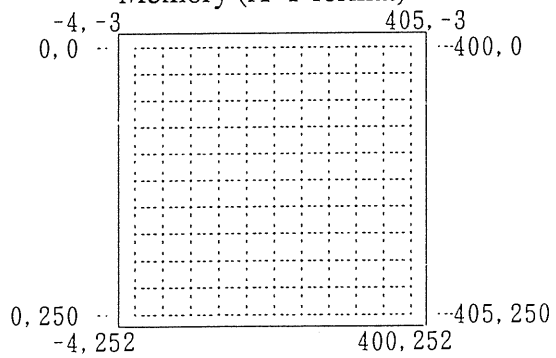
(command): GRAPh: LINE X1, Y1, X2, Y2
X1, X2 = x-coordinates
Y1, Y2 = y-coordinates

Explanation

Draws a line from (X1, Y1) to (X2, Y2).
The relationship between the x- and y-coordinates is as follows.



Memory (X-Y format)



When allowed : In the memory recorder function, when in the graphic editor mode.

Parallel Command

Syntax (command): GRAPh: PARAllel high, low, right, left
high = 0 to 9.96 (div)
low = 0 to 9.96 (div)
right = 0 to 14.975 (div)
left = 0 to 14.975 (div)

Explanation Carries out a parallel movement of the drawing.
The "high" and "low" parameters are set in units of 0.04 steps, and the "right" and "left" parameters in units of 0.025 steps.

When allowed : In the memory recorder function, when in the graphics editor mode.

Paint command

Syntax (command): GRAPh: PAINt X, Y
X = x-coordinate
Y = y-coordinate

Explanation Begins solid fill from the point specified by (X, Y).
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed : In the memory recorder function, when in the graphics editor mode.

Erase command

Syntax (command): GRAPh:ERASe X1, Y1, X2, Y2
X1, X2 = x-coordinates
Y1, Y2 = y-coordinates

Explanation Erases from (X1, Y1) to (X2, Y2).
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed : In the memory recorder function, when in the graphics editor mode.

Loads a waveform from storage.

Syntax (command): GRAPh: STORage

Explanation Loads a waveform into the editor.

When allowed In the memory recorder function, when in the graphics editor mode.

The reverse command.

Syntax (command): GRAPh:REVErse

Explanation (command): Reverses the video of the drawing.

When allowed : In the memory recorder function, when in the graphic editor mode.

The all clear command.

Syntax (command): GRAPh:ALLClear

Explanation (command): Clears the entire drawing.

When allowed : In the memory recorder function, when in the graphic editor mode.

Clear command

Syntax (command): GRAPh: CLEAr X1, Y1, X2, Y2
X1, X2 = x-coordinates
Y1, Y2 = y-coordinates

Explanation Clears the rectangle with the points (X1, Y1) and (X2, Y2) at diagonally opposite corners.
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed In the memory recorder function, when in the graphics editor mode.

Undo command

Syntax (command): GRAPh: UNDO

Explanation Reverses the effect of the immediately previous editor command.

When allowed In the memory recorder function, when in the graphics editor mode.

Saves the drawing (decision area)

Syntax (command): GRAPh: SAVE

Explanation Saves the decision area created with the editor.

When allowed In the memory recorder function, when in the graphics editor mode.

Sets and queries decision area data points.

Syntax (command): GRAPh:POINt X, Y, A
(query): GRAPh:POINt? X, Y
X = x-coordinate
Y = y-coordinate
A = 0, 1

Explanation Writes the value A at the coordinates indicated by X and Y.
Returns the value A at the coordinates indicated by X and Y.
A is 1 for a point within the decision area, 0 for a point outside it.

When allowed : In the memory recorder function, when in the graphic editor mode.

20-5 Example Programs

Example 1 Using a setting command

Send the command in the format specified, when the conditions for the command to be acceptable are met.

Line 140:	Set delimiter code.
Line 150:	Set ADR to address of 8851.
Lines 160-170:	Send interface clear, and switch to remote mode.
Line 180:	Select memory recorder function.
Line 200:	Time/division is 500 μs.
Line 210:	Enter measurement operation mode.
Line 220:	End remote mode.

```
100 ' ---------------------------------- '
110 '    8851      Set Command  PC9801    '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Adress=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180  PRINT@ ADR;":FUNCTION MEM"                    'Function MEM
190  PRINT@ ADR;":CONFIGURE:TDIV +500.E-6"         'Time/Div 500us
200  PRINT@ ADR;":CONFIGURE:SHOT 15"               '15DIV
210  PRINT@ ADR;":START"                           '< START >
220 IRESET REN
230 END
```

Example 2 Using a query

(1) Send the query in the format specified, when the conditions for the query to be acceptable are met.

Next switch the 8851 to be the talker, and receive the output data.

(2) The response data from the query is returned in the format specified for the corresponding command.

Line 140:	Set delimiter code.
Line 150:	Set ADR to address of 8851.
Lines 160-170:	Send interface clear, and switch to remote mode.
Line 180:	Disable headers.
Lines 190-200:	Ask function, and load into ANS.
Lines 210-220:	Ask current time, and load into TH$ and TM$.
Line 240:	Release talker.
Line 250:	End remote mode.

```
100 ' ---------------------------------- '
110 '   8851     Read Command  PC9801    '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                        'GP-IB Adress=5
160 ISET IFC                                     'Interface Clear
170 ISET REN                                     'Rmote Enable
180  PRINT@ ADR;":HEADER OFF"                    'Header OFF
190  PRINT@ ADR;":FUNCTION?"                     'Read Function
200   LINE INPUT@ ADR;ANS$
210  PRINT@ ADR;":SYSTEM:TIME?"                  'Read Time
220   INPUT@ ADR;TH$,TM$,TS$
230  PRINT ANS$,TH$":"TM$":"TS$
240 WBYTE &H5F;                                  'UN TALK
250 IRESET REN
260 END
```

Example 3 Using service requests

(1) Using the *SRE and *ESE commands, this program sets the service request response mask, and sets the jump address in the controller for a service request interrupt. It then enables the service request interrupt.

(2) The service request interrupt handling routine uses serial polling to read the 8851 status byte, then carries out appropriate processing depending on the value of the status byte. It then re-enables the service request interrupt, and returns.

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 160-170: Send interface clear, and switch to remote mode.

Line 180: Set jump address for service request.

Line 190: Mask bit 6 (rsv) of the status byte by the service request enable register.

Line 200: Mask bits 2, 3, 4, and 5 of the standard event status register by the standard event status enable register.

Line 210: Clear the status byte associated queue.

Line 220: Enable the service request interrupt.

Line 240: Set the function.

Line 260: Set the averaging length.

Lines 300-330: Serial polling to read the status byte. If bit 6 is set, jump to line 360. Otherwise force the PC-9801 service request bit cleared.

Line 400: Enable service request interrupt.

Lines 410-420: Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '   8851   Service Request PC9801    '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Adress=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 ON SRQ GOSUB *SUB
190 PRINT@ ADR;"*SRE 32"                           'SRQ Mask
200 PRINT@ ADR;"*ESE 60"                           'SESER Mask
210 PRINT@ ADR;"*CLS"                              'Statusbyte Clear
220 SRQ ON
230 '
240  PRINT@ ADR;":FUNCTION MEM"                    'Function Set
250 I=0
260  PRINT@ ADR;":"CONFIGURE:AVERAGE "+STR$(I)     'Average Set
270 I=I+50 : GOTO 240
280 '
290 *SUB                                           'SRQ Intr
300    POLL ADR,S
310    IF (S AND &H40)<>0 THEN 350                 'SRQ Check
320      DEF SEG=&H60 : A%=PEEK(&H9F3)
330      A%=A% AND &HBF : POKE &H9F3,A%            'SRQ Bit Clear
340      GOTO 380
350 '
360    WBYTE &H14;                                 'Buffer Clear
370      PRINT "SRQ=";S
380    PRINT@ ADR;"*SRE 32"                        'SRQ Mask
390    PRINT@ ADR;"*ESE 60"                        'SESER Mask
400    SRQ ON
410 WBYTE &H5F                                     'UN TALK
420 IRESET REN
430 END
```

Note on use of the PC-9801 series

On the PC-9801 series, even if no service request is issued, it is possible for the service request interrupt to be triggered for some reasons. In such cases it is necessary to clear the PC-9801 service request bit forcibly, as shown in lines 320 and 330 above.

(From "PC Note", published by NEC's personal computer marketing division.)

Example 4 Outputting stored data

(1) Using the :MEMORY:MAXPOINT? query, this program checks whether data can be output from memory. If this query returns zero, no data is stored, and it cannot therefore be output.

(2) Next, the program specifies the channel and point for output, using the :MEMORY:POINT command. As data is input or output, the point is incremented automatically. If capturing data consecutively, it is sufficient to specify the point once only.

(3) To capture data in ASCII format use the :MEMORY:ADATA? query, and to capture data as voltage values use the :MEMORY:VDATA? query.

The number of data samples which may be output in one set is 1 to 40 using :ADATA? and 1 to 10 using the :VDATA? query.

Note: Outputting data in bigger sets reduces the overall processing time.

Program example ... read data (1200 samples) for channel 1 when stored with a 30-division shot length.

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 160-170: Send interface clear, and switch to remote mode.

Line 190: Set memory recorder function and 30-division shot length.

Line 210: Enter measurement operation mode.

Lines 220-230: Wait for end of measurement operation.

Lines 250-260: Disable headers, and read number of stored data samples into MX.

Line 290: Set output data to be from channel 1, point 0.

Lines 300-330: Set size of output data set to be 10 samples, and read as voltage values.

Lines 380-390: Release talker and remote mode.

```
100 '-------------------------------------'
110 '  8851   Data Out (ASCII) PC9801    '
120 '-------------------------------------'
130             DIM D(1200)
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Adress=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 '
190 PRINT@ ADR;":FUNCTION MEM;:CONFIGURE:SHOT 30"     'MEM,30DIV,<START>
200 PRINT@ ADR;":TRIGGER:MODE SINGLE"              'Trigger Mode SINGLE
210 PRINT@ ADR;":START;*OPC?"                       '<START>
220 'PRINT@ ADR;"*OPC?"
230  INPUT@ ADR;O$
240 'IF VAL(O$) <> 0 THEN 270
250 'GOTO 220
255 FOR I=0 TO 1000:NEXT I
260 '
270 PRINT@ ADR;":HEADER OFF;:MEMORY:MAXPOINT?"        'Header OFF
280 INPUT@ ADR;MX
290 IF MX<>1200 THEN 390
300 '
310 PRINT@ ADR;":MEMORY:POINT CH1,0"               'Output Point CH1,No.0
320   FOR I=0 TO 1190 STEP 10
330     PRINT@ ADR;":MEMORY:VDATA? 10"
340     INPUT@ ADR;D(I),D(I+1),D(I+2),D(I+3),D(I+4)
                  ,D(I+5),D(I+6),D(I+7),D(I+8),D(I+9)
350     NEXT I
360     PRINT@ ADR;":MEMORY:VDATA? 1"              'Last Data
370     INPUT@ ADR;D(1200)
380 FOR I=0 TO 1200:PRINT D(I):NEXT I
390 WBYTE &H5F;                                    'UN TALK
400 IRESET REN
410 END
```

Example 5 Inputting storage data

(1) Using the :MEMORY:MAXPOINT? query, this program checks whether data can be input to memory. If this query returns zero, the state is such as not to store data, and it cannot therefore be input.

(2) Next, the program specifies the channel and point for input, using the :MEMORY:POINT command, and then uses the :MEMORY:ADATA command to input data.

Note: As with output, is is more efficient to input data in bigger sets.

Program example ... with the unit storing with a 30-division shot length, write sine wave data into memory for channel 1.

Line 140:	Set delimiter code.
Line 150:	Set ADR to address of 8851.
Lines 160-170:	Send interface clear, and switch to remote mode.
Lines 190-200:	Read maximum number of data samples in memory into MX.
Line 230:	Set input data to be to channel 1, point 0.
Lines 240-260:	Write the sine wave.
Lines 280-290:	Release talker and remote mode.

```
100 '-----------------------------------'
110 '  8851   Data Input       PC9801    '
120 '-----------------------------------'
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Adress=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 '
190 PRINT@ ADR;":HEADER OFF;:MEMORY:MAXPOINT?"     'Header OFF
200 INPUT@ ADR;MX                                  'Maxpoint
210 IF MX<>1200 THEN 280
220 '
230 PRINT@ ADR;":MEMORY:POINT CH1,0"               'Input Point CH1,No.0
240   FOR I=0 TO 1200
250    PRINT@ ADR;":MEMORY:ADATA "+STR$(INT(1500*SIN(3.14*I/500)+2000))
260   NEXT I
270 '
280 WBYTE &H5F;                                    'UN TALK
290 IRESET REN
300 END
```

Example 6 Making storage condition settings

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 170-180: Send interface clear, and switch to remote mode.

Lines 200-310: Set the 8851 function, trigger conditions, etc.

Line 330: Enter measurement operation mode with the conditions set.

Line 350: Release talker.

Line 360: End remote mode.

```
100 ' ---------------------------------- '
110 '   8851     SAMPLE PROGRAM NO.1     '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 '
170 ISET IFC                                       'Interface Clear
180 ISET REN                                       'Remote Enable
190 '
200 PRINT@ ADR;":FUNCTION MEM"                     'Function MEM
210 PRINT@ ADR;":CONFIGURE:TDIV 1.E-3"             'TIME/DIV 1ms
220 PRINT@ ADR;":MEMORY:SHOT 15"                   'SHOT     15DIV
230 '
240 PRINT@ ADR;":TRIGGER:SOURCE OR"                'TRIG Source OR
250 PRINT@ ADR;":TRIGGER:KIND CH1,LEVEL"           'LEVEL TRIG  CH1
260 PRINT@ ADR;":TRIGGER:PRETRIG 5"                'Pre-TRIG    5%
270 PRINT@ ADR;":TRIGGER:LEVEL CH1,60"             'TRIG Level  60%
280 PRINT@ ADR;":TRIGGER:SLOPE CH1,UP"             'TRIG Slope  UP
290 PRINT@ ADR;":TRIGGER:KIND CH2,OFF"             'CH2 OFF
300 PRINT@ ADR;":TRIGGER:KIND CH3,OFF"             'CH3 OFF
310 PRINT@ ADR;":TRIGGER:KIND CH4,OFF"             'CH4 OFF
320 '
330 PRINT@ ADR;":START"                            '< START >
340 '
350 WBYTE &H5F;                                    'UN TALK
360 IRESET REN
370 END
```

Example 7 Start measurement operation mode, and if no trigger is detected execute a STOP.

Line 140:	Set delimiter code.
Line 150:	Set ADR to address of 8851.
Lines 160-170:	Send interface clear, and switch to remote mode.
Lines 190-260:	Set the function and trigger conditions. Clear event status register 0. Clear the standard event status register.
Line 300:	Enter measurement operation mode.
Lines 320-340:	Read the standard event status register and check that the OPC bit is set, confirming that measurement operation has started.
Lines 360-400:	At fixed intervals, check whether the trigger has been applied. Read event status register 0, and check if bit 2 is set. When it is, go to line 470.
Lines 410-420:	If no trigger has been detected, abort measurement.
Lines 460-490:	If a trigger has been detected, read event status register 0, and check that bit 1 is set, confirming that measurement operation has started.
Lines 510-520:	Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '   8851     SAMPLE PROGRAM NO.2     '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 '
190 PRINT@ ADR;"*CLS;*ESE 1;:FUNCTION MEM"         'SESER OPCbit Enable
200 PRINT@ ADR;":CONFIGURE:TDIV 1.E-3;SHOT 15"     'MEM,1ms/DIV,15DIV
210 PRINT@ ADR;":TRIGGER:SOURCE OR"
220 PRINT@ ADR;":TRIGGER:KIND CH1,LEVEL;KIND CH2,LEVEL"
230 PRINT@ ADR;":TRIGGER:KIND CH3,OFF;KIND CH4,OFF"
240 PRINT@ ADR;":TRIGGER:LEVEL CH1,60;SLOPE CH1,UP"     'TRIG CH1,60%,UP
250 PRINT@ ADR;":TRIGGER:LEVEL CH2,60;SLOPE CH2,UP"     'TRIG CH2,60%,UP
260 PRINT@ ADR;":TRIGGER:MODE SINGLE"              'TRIG Mode
290 '
300 PRINT@ ADR;":START;*OPC"                       '< START >
310 '
320     POLL ADR,S                                 'START ?
330 '   INPUT@ ADR;B1
340     IF (S AND &H20)=0 THEN 320
350 '
360   FOR W=1 TO 100
370     PRINT@ ADR;"*ESR0?"                        'TRIG Wait ?
380     INPUT@ ADR;B2
390     IF (B2 AND &H4)<>0 THEN 480
400   NEXT W
410     PRINT "Not Trigger"
420     PRINT@ ADR;":ABORT"                        '< STOP >
430
440     GOTO 520
450 '
460     PRINT@ ADR;"*ESR0?"                        'END ?
470     INPUT@ ADR;B3
480     IF (B3 AND &H2)<>0 THEN 460
490     PRINT "Storage End"
500 '
510 WBYTE &H5F;                                    'UN TALK
520 IRESET REN
530 END
```

Example 8 Checking which input units are present, and displaying their input ranges on the screen.

Line 1040: Set delimiter code.

Line 1050: Set ADR to address of 8851.

Lines 1070-1080: Send interface clear, and switch to remote mode.

Line 1110: Disable headers.

Lines 1130-1180: Screen display.

Lines 1200-1210: Determine which input units are present, setting variables CH1 to CH4.

Lines 1220-1250: Display an indication of input units which are not present.

Lines 1270-1310: Screen display.

Lines 1330-1520: Read real time data for the channels with input units installed into variables.

Lines 1540-1840: Read real time data for the channels and display.

Lines 1870-1880: Release talker and remote mode.

```
1000 ' ---------------------------------- '
1010 '   8851      SAMPLE PROGRAM NO.3     '
1020 ' ---------------------------------- '
1030 '
1040 CMD DELIM=2
1050 ADR=5                                          'GP-IB Address=5
1060 SP=2                                           'Set CONST
1070 ISET IFC                                       'Interface Clear
1080 ISET REN                                       'Remote Enable
1090 ON STOP GOSUB *ENDP : STOP ON                  'STOP Key ON
1100 SCREEN 3,0:CONSOLE 0,25,0,1:CLS 3              'Clear Display
1110 PRINT@ ADR;":HEADER OFF"                       'Header OFF
1120 '
1130 LOCATE 5,0:PRINT "< Level Monitor >"
1140 LOCATE 50,0:PRINT "CH1 :          CH2 :          ";
1150 LOCATE 50,1:PRINT "CH3 :          CH4 :          ";
1160 LOCATE 0,3:PRINT "100"
1170 LOCATE 1,11:PRINT "50"
1180 LOCATE 2,19:PRINT "0"
1190 '
1200 PRINT@ ADR;"*OPT?"                             'Unit ?
1210 INPUT@ ADR;CH1,CH2,CH3,CH4
1220 IF CH1=0 THEN LOCATE 55,0:PRINT "Nothing"
1230 IF CH2=0 THEN LOCATE 70,0:PRINT "Nothing"
1240 IF CH3=0 THEN LOCATE 55,1:PRINT "Nothing"
1250 IF CH4=0 THEN LOCATE 70,1:PRINT "Nothing"
1260 '
1270 CLS 2
1280 LINE (30,57)-(620,307),7,B,&HCCCC              'Frame
1290 FOR Y=82 TO 282 STEP 25
1300   LINE(30,Y)-(620,Y),7,,&H1010
1310 NEXT Y
1320 '
```

```
1330 IF CH1=0 THEN 1380                                    'CH1 ?
1340 LINE(440,8)-(490,10),6,B
1350 PRINT@ ADR;":MEMORY:AREAL? CH1"
1360 INPUT@ ADR;Y10
1370 YY10=INT(Y10/16)
1380 IF CH2=0 THEN 1430                                    'CH2 ?
1390 LINE(560,8)-(610,10),5,B
1400 PRINT@ ADR;":MEMORY:AREAL? CH2"
1410 INPUT@ ADR;Y20
1420 YY20=INT(Y20/16)
1430 IF CH3=0 THEN 1480                                    'CH3 ?
1440 LINE(440,24)-(490,26),4,B
1450 PRINT@ ADR;":MEMORY:AREAL? CH3"
1460 INPUT@ ADR;Y30
1470 YY30=INT(Y30/16)
1480 IF CH4=0 THEN 1530                                    'CH4 ?
1490 LINE(560,24)-(610,26),3,B
1500 PRINT@ ADR;":MEMORY:AREAL? CH4"
1510 INPUT@ ADR;Y40
1520 YY40=INT(Y40/16)
1530 '
1540 FOR X=30 TO 620-SP STEP SP
1550 *CH1
1560  IF CH1=0 THEN *CH2
1570 PRINT@ ADR;":MEMORY:AREAL? CH1"
1580 INPUT@ ADR;Y11
1590 YY11=INT(Y11/16)
1600 LINE(X,307-YY10)-(X+SP,307-YY11),6                    'CH1 Line
1610 YY10=YY11
1620 *CH2
1630 IF CH2=0 THEN *CH3
1640 PRINT@ ADR;":MEMORY:AREAL? CH2"
1650 INPUT@ ADR;Y21
1660 YY21=INT(Y21/16)
1670 LINE(X,307-YY20)-(X+SP,307-YY21),5                    'CH2 Line
1680 YY20=YY21
1690 *CH3
1700 IF CH3=0 THEN *CH4
1710 PRINT@ ADR;":MEMORY:AREAL? CH3"
1720 INPUT@ ADR;Y31
1730 YY31=INT(Y31/16)
1740 LINE(X,307-YY30)-(X+SP,307-YY31),4                    'CH3 Line
1750 YY30=YY31
1760 *CH4
1770  IF CH4=0 THEN 1830
1780 PRINT@ ADR;":MEMORY:AREAL? CH4"
1790 INPUT@ ADR;Y41
1800 YY41=INT(Y41/16)
1810 LINE(X,307-YY40)-(X+SP,307-YY41),3                    'CH4 Line
1820 YY40=YY41
1830 NEXT X
1840 GOTO 1270
1850 '
1860 *ENDP
1870 WBYTE &H5F;                                           'UN TALK
1880 IRESET REN
1890 STOP OFF
1900 CLS 3
1910 END
```

Example 9 Saving stored data onto drive 2 (sequential file)

Line 140:	Set delimiter code.
Line 150:	Set ADR to address of 8851.
Lines 170-180:	Send interface clear, and switch to remote mode.
Lines 190-200:	Set the jump addresses for if the STOP key is pressed, or if an error occurs, to ensure that the program does not exit with the file left open.
Lines 250-260:	Disable headers, and read the number of stored data values into MX.
Lines 310-330:	Input the channels to be saved and the filename.
Line 390:	Set the stored data output point.
Line 410:	Write the number of data values saved, at the beginning of the file.
Lines 420-460:	Read the stored data from the 8851 into variable DT, and save sequentially.
Lines 560-570:	Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '   8851      SAMPLE PROGRAM NO.4     '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 DR$="2:"                                       'FDD No.2
170 ISET IFC                                       'Interface Clear
180 ISET REN                                       'Remote Enable
190 ON ERROR GOTO *EXIT0                           'If ERROR Then *EXIT0
200 ON STOP GOSUB *EXIT1 : STOP ON                 'If STOP  Then *EXIT1
210 '
220 CLS 3:LOCATE 3,3
230 PRINT "< Storage Data SAVE >"
240 PRINT :PRINT
250 PRINT@ ADR;":HEADER OFF;:MEMORY:MAXPOINT?"     'Header OFF
260 INPUT@ ADR;MX                                  'Read Maxpoint
270 IF MX<>0 THEN 300                              'Output OK ?
280   PRINT "No Strage Data !!"
290   GOTO *EXIT2
300 '
310 PRINT "      Max Point=";MX : PRINT
320 INPUT "    Channel(CH1-CH4)";CH$               'Input Channel
330 INPUT "       File Name";NA$                   'Input File Name
340 PRINT :PRINT
350 '
360 DD$=DR$+NA$
370 OPEN DD$ FOR OUTPUT AS #1                      'File Open
380 '
390 PRINT@ ADR;":MEMORY:POINT "+CH$+",0"           'Set Output Point
400 '
410 PRINT #1,MX                                    'Save Max Point
420 FOR I=0 TO MX
430   PRINT@ ADR;":MEMORY:ADATA? 1"
440   INPUT@ ADR;DT
450   PRINT #1,DT                                  'Save Data
460 NEXT I
470 PRINT "      Complete."
480 GOTO *EXIT2
490 '
500 *EXIT0
510 PRINT "         ERROR !!" : GOTO *EXIT2
520 *EXIT1
530 PRINT "         STOP !!"
540 *EXIT2
550 CLOSE #1                                       'File Close
560 WBYTE &H5F;                                    'UN TALK
570 IRESET REN
580 END
```

Example 10 Reading the data saved in Example 4, and loading it into the 8851

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 170-180: Send interface clear, and switch to remote mode.

Lines 190-200: Set the jump addresses for if the STOP key is pressed, or if an error occurs, to ensure that the program does not exit with the file left open.

Lines 250-260: Specify the filename to be opened and channel.

Line 310: Set the stored data input point.

Lines 340-350: Read the number of stored data values into MM.

Lines 380-410: Read the data from the file into DT, and write to memory on the 8851.

Lines 510-520: Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '   8851      SAMPLE PROGRAM NO.5     '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 DR$="2:"                                       'FDD No.2
170 ISET IFC                                       'Interface Clear
180 ISET REN                                       'Remote Enable
190 ON ERROR GOTO *EXIT0                           'If ERROR Then *EXIT0
200 ON STOP GOSUB *EXIT1 : STOP ON                 'If STOP  Then *EXIT1
210 '
220 CLS 3:LOCATE 3,3
230 PRINT "< Storage Data LOAD >"
240 PRINT :PRINT
250 INPUT "       File Name";NA$                   'Input File Name
260 INPUT "   Channel(CH1-CH4)";CH$                'Input Channel
270 '
280 DD$=DR$+NA$
290 OPEN DD$ FOR INPUT AS #1                       'File Open
300 '
310 PRINT@ ADR;":MEMORY:POINT "+CH$+",0"           'Set Input Point
320 '
330 INPUT #1,MX                                    'Load Max Point
340 PRINT@ ADR;":HEADER OFF;:MEMORY:MAXPOINT?"
350 INPUT@ ADR;MM                                  'Read Maxpoint
360 IF MX<>MM THEN *EXIT0
370 '
380 FOR I=0 TO MX
390   INPUT #1,DT                                  'Load Data
400   PRINT@ ADR;":MEMORY:ADATA "+STR$(DT)
410 NEXT I
420 PRINT "     Complete."
430 GOTO *EXIT2
440 '
450 *EXIT0
460 PRINT "         ERROR !!" : GOTO *EXIT2
470 *EXIT1
480 PRINT "         STOP !!"
490 *EXIT2
500 CLOSE #1                                       'File Close
510 WBYTE &H5F;                                    'UN TALK
520 IRESET REN
530 END .
```

Example 11 Setting measurement conditions, and starting measurement operation after synchronizing with the *OPC command

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 160-170: Send interface clear, and switch to remote mode.

Line 180: Set jump address for if a service request is received.

Line 190: Mask bit 6 (rsv) of the status byte by the service request enable register.

Line 200: Mask bit 0 of the standard event status register by the standard event status enable register.

Line 210: Clear the status byte associated queue.

Line 220: Enable the service request interrupt.

Lines 240-300: Set the measurement conditions.

Line 310: Wait for a service request.

Lines 340-370: Serial polling to read the status byte. If bit 6 is set, jump to line 390. Otherwise force the PC-9801 service request bit cleared.

Line 400: After confirming the completion of condition setting, start measurement operation.

Line 420: Disable service request interrupt.

Lines 430-440: Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '   8851      SAMPLE PROGRAM NO.6     '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 ON SRQ GOSUB *SUB
190 PRINT@ ADR;"*SRE 32"                           'SRQ Mask
200 PRINT@ ADR;"*ESE 1"                            'SESER Mask
210 PRINT@ ADR;"*CLS"                              'Statusbyte Clear
220 SRQ ON
230 '
240 PRINT@ ADR;":FUNCTION MEM"                     'Function MEM
250 PRINT@ ADR;":CONFIGURE:TDIV 1.E-3"             'TIME/DIV 1ms
260 PRINT@ ADR;":MEMORY:SHOT 15"                   'SHOT     15DIV
270 '
280 PRINT@ ADR;":TRIGGER:KIND CH1,LEVEL"           'LEVEL TRIG  CH1
290 PRINT@ ADR;":TRIGGER:PRETRIG 5"                'Pre-TRIG    5%
300 PRINT@ ADR;":TRIG:LEVEL CH1,60;SLOPE CH1,UP;*OPC"    'Level 60%
310 GOTO 310                                                'Slope Up
320 '
330 *SUB
340    POLL ADR,S
350    IF (S AND &H40)<>0 THEN 390                 'SRQ Check
360      DEF SEG=&H60 : A%=PEEK(&H9F3)
370      A%=A% AND &HBF : POKE &H9F3,A%            'SRQ Bit Clear
380      GOTO 430
390 PRINT " START OK "
400 PRINT@ ADR;":START"                            '< START >
410 '
420 SRQ OFF
430 WBYTE &H5F;                                    'UN TALK
440 IRESET REN
450 END
```

Example 12 Using service requests to display errors

Line 140: Set delimiter code.

Line 150: Set ADR to address of 8851.

Lines 160-170: Send interface clear, and switch to remote mode.

Line 180: Set jump address for if a service request is received.

Line 190: Mask bit 6 (rsv) of the status byte by the service request enable register.

Line 200: Mask bits 2, 3, 4, and 5 of the standard event status register by the standard event status enable register.

Line 210: Clear the status byte associated queue.

Line 220: Enable the service request interrupt.

Line 240: Set the function.

Lines 250-270: Set averaging length. (Error source)

Lines 300-330: Serial polling to read the status byte. If bit 6 is set, jump to line 360. Otherwise force the PC-9801 service request bit cleared.

Line 350: Read the standard event status register.

Lines 360-400: From the value read, determine the error, and display it.

Line 420: Disable service request interrupt.

Lines 430-440: Release talker and remote mode.

```
100 ' ---------------------------------- '
110 '    8851    SAMPLE PROGRAM NO.7      '
120 ' ---------------------------------- '
130 '
140 CMD DELIM=2
150 ADR=5                                          'GP-IB Address=5
160 ISET IFC                                       'Interface Clear
170 ISET REN                                       'Remote Enable
180 ON SRQ GOSUB *SUB
190 PRINT@ ADR;"*SRE 32"                           'SRQ Mask
200 PRINT@ ADR;"*ESE 60"                           'SESER Mask
210 PRINT@ ADR;"*CLS"                              'Statusbyte Clear
220 SRQ ON
230 '
240  PRINT@ ADR;":FUNCTION MEM"                    'Function Set
250 I=0
260  PRINT@ ADR;":CONFIGURE:AVERAGE "+STR$(I)      'Average Set
270 I=I+50 : GOTO 250
280 '
290 *SUB                                           'SRQ Intr
300    POLL ADR,S
310    IF (S AND &H40)<>0 THEN 350                 'SRQ Check
320      DEF SEG=&H60 : A%=PEEK(&H9F3)
330      A%=A% AND &HBF : POKE &H9F3,A%            'SRQ Bit Clear
340      GOTO 410
350 PRINT@ ADR;"*ESR?"                             'Error Kind ?
360 INPUT@ ADR;B
370    IF (B AND &H4)<>0 THEN PRINT" ｸｴﾘ ERROR "
380    IF (B AND &H8)<>0 THEN PRINT" MACHINE ERROR "
390    IF (B AND &H10)<>0 THEN PRINT" EXE ERROR "
400    IF (B AND &H20)<>0 THEN PRINT" COMMAND ERROR "
410 '
420 SRQ OFF
430 WBYTE &H5F                                     'UN TALK
440 IRESET REN
450 END
```

Appendix

Appendix 1 Error and Warning Messages

The unit produces two levels of message to indicate problems. These are distinguished as follows.

Error messages

(1) The "ERROR" indication appears on the bottom line of the screen, followed by the message. This remains until the cause of the error is removed, or a key is pressed. (In some cases all keys other than the STOP key are disabled.)

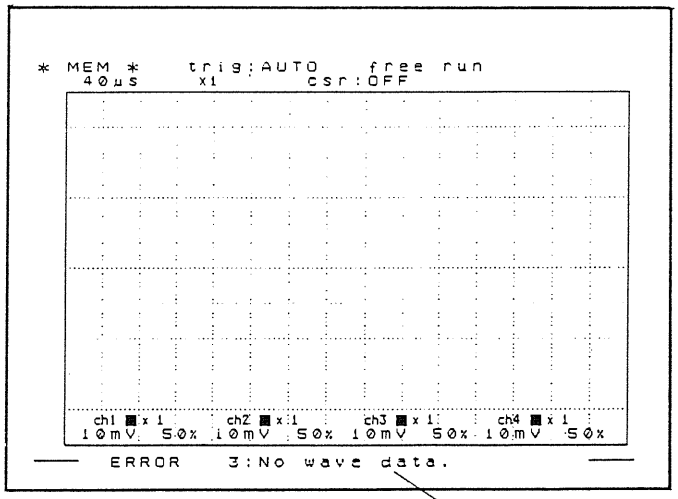
(2) If the "beep sound" item on the system screen is set to ON, then the beeper sounds intermittently while the message is displayed.

Warning messages

(1) The "WARNING" indication is displayed on the bottom line of the screen, followed by the message, but disappears after a few seconds.

(2) Warning messages also disappear if any key is pressed.

(3) If the "beep sound" item on the system screen is set to ON, then the beeper sounds once only when the message is displayed.



1-1 Error Messages

ERROR 1: Set printer paper.	....	Printer paper has run out. Reload.
ERROR 2: Set printer lever.	....	The head up/down lever has been left in the up position. Lower it.
ERROR 3: No wave data.	....	Printing is not possible, because there is no waveform data present. Start measurement operation to capture data.
ERROR 5: Wrong time/div. (REC&MEM)	....	Measurement is not possible because the memory recorder time axis range is set to an invalid value. Correct the setting.
ERROR 6: Wrong time/div. (ENVELOP)	....	Because the unit is set to envelope storage mode, the memory recorder time axis range value is invalid, and measurement is not possible. Correct the setting.
ERROR 40: No wave data.	....	Conversion to memory recorder waveform data is not possible, because there is no waveform data present. Start measurement operation to capture data.
ERROR 41: Bad A&B cursor position.	....	Move the A and B cursors to appropriate positions for the current operation.
ERROR 70: Set floppy disk.	....	No disk is present in the floppy disk drive. Insert one.
ERROR 71: Can't load. (no 8851)	....	File cannot be loaded, because it is not a set of data created by the 8851.
ERROR 72: Illegal format.	....	The floppy disk is not a correctly formatted MS-DOS disk.
ERROR 73: Write protect.	....	The floppy disk is write-protected. Change the write-protect setting or use a different disk.
ERROR 74: Disk full.	....	There is insufficient space remaining on the disk.
ERROR 75: Access read only file.	....	File cannot be written or deleted, because it is read-only
ERROR 76: General failure.	....	Access to disk is not possible because of some low-level error, such as in formatting or file saving.

1-2 Warning Messages

WARNING 205: Invalid. (START) .... The key pressed is not valid, because measurement operation is in progress.

WARNING 206: No calc. (AVERAGE) .... Because the storage mode is set to averaging, waveform calculations cannot be carried out.

WARNING 207: Fault AUTO range. .... The auto ranging function has failed. Check the input signal.

WARNING 208: Can't SAVE. (Write protect) .... The auto save function has failed, because the floppy disk in the drive is write-protected. Change the write-protect setting or use a different disk.

WARNING 209: Can't SAVE. (Disk full) .... The auto save function has failed, because there is insufficient space remaining on the disk.

WARNING 211: Can't SAVE. (General failure) .... The auto save function has failed.

WARNING 300: Can't START. (SYSTEM) .... It is not possible to start operation from the system screen.

WARNING 301: Invalid key. (SYSTEM) .... The key pressed is not valid in the system mode.

WARNING 320: Invalid. (no ENVELOPE) .... The stored data is not envelope waveform data, so the conversion to normal waveform data is not possible.

WARNING 321: Wrong time/div. (REC&MEM) .... The time axis range set is not permissible in the recorder and memory function.

WARNING 322: Wrong time/div. (ENVELOP) .... The time axis range set is not permissible when the storage mode is set to envelope.

WARNING 323: Invalid. (ENVELOPE) .... A setting is not permissible when the storage mode is set to envelope.

WARNING 324: Ignor in running. (AVERAGE) .... Since the storage mode is set to envelope, waveform calculation processing is not possible during measurement operation.

WARNING 326: Ignor this meas. (ENVELOP) .... Since the storage mode is set to envelope, this calculation is not carried out.

WARNING 327: Invalid key. (FFT) .... In the FFT screen, the key pressed is invalid.

WARNING 328: Invalid. (Over write) .... Operation is not possible, since the superimposition function ("over-write") is enabled.

WARNING 329: Wrong format. (Dual) .... Since the format is DUAL or DUAL (print quad), a waveform decision is not possible.

WARNING 330: Invalid. (SHOT too long) .... The shot length is too long for the memory division function or a waveform processing calculation to be carried out.

WARNING 331: Invalid. (AVERAGE) .... Since the storage mode is set to averaging, the FFT calculation cannot be carried out.

WARNING 332: Wrong FFT format. (Dual) .... In the FFT screen, since the format is set to DUAL, a waveform decision cannot be carried out.

WARNING 333: Invalid. (Using unit 1ch) .... Since the use of memory is restricted to one channel, averaging and waveform processing calculations cannot be carried out.

WARNING 334: Invalid. (Using unit 2ch) .... Since the use of memory is restricted to two channels, averaging and waveform processing calculations cannot be carried out.

WARNING 335: Invalid. (SEQUENTIAL)	....	Since memory division (sequential save) is in use, waveform processing calculations cannot be carried out.
WARNING 336: Invalid. (MULTI BLOCK)	....	Since memory division (multi-block) is in use, waveform processing calculations cannot be carried out.
WARNING 337: Invalid. (ROLL MODE)	....	Since the roll mode function is enabled, superimposition is not possible.
WARNING 338: Invalid. (COMPARISON)	....	Since the waveform decision function is enabled, superimposition is not possible.
WARNING 339: Invalid key. (STATUS)	....	In the status mode, the key pressed is invalid.
WARNING 350: Can't select. (AND trig)	....	This selection is not possible, since the logical operator for the internal and external triggers is set to AND.
WARNING 351: Invalid. (Free run)	....	The pre-trigger setting cannot be made, since all trigger sources are switched off (free run).
WARNING 352: Invalid key. (TRIG)	....	In the trigger mode, the key pressed is invalid.
WARNING 380: No reference data.	....	When using the memory division function (multi-block), there is no data in the reference block.
WARNING 381: Ref. block = using block	....	When using the memory division function (multi-block), the reference block and the block specified by the "using block" item are the same.
WARNING 382: No wave data.	....	Because there is no waveform data present, it cannot be displayed. Start measurement operation to capture data.
WARNING 383: No FFT data.	....	There is no FFT calculation data, and therefore it cannot be displayed. Carry out the required FFT calculation.
WARNING 384: Different REF shot.	....	The shot lengths are different for the reference block and the block specified by the "using block" item. Capture data with the block lengths set the same.
WARNING 385: Differe storage mode REF.	....	The storage modes are different for the reference block and the block specified by the "using block" item. Capture data with the storage modes set the same.
WARNING 386: Invalid key. (RECORDER)	....	In the recorder function, the key pressed is invalid.
WARNING 387: Invalid key. (X-Ycont)	....	In the X-Y recorder function, the key pressed is invalid.
WARNING 388: Invalid key. (REC&MEM)	....	In the recorder and memory function, the key pressed is invalid.

Appendix 2 Glossary

Averaging length:	The number of samples used for calculation of the sliding average function. See Section 13.
Cutoff frequency:	The frequency for which the output of a filter falls below $\sqrt{2}$ (-3 dB) of the input.
Dark:	High intensity display or recording. This is "blackboard" terminology when the display is white on black.
Gauge:	Voltage axis scale.
GO:	Pass result for a waveform decision.
Light:	Low intensity display or recording. This is "blackboard" terminology when the display is white on black.
List:	Printed listing of settings etc.
NG:	Fail result for a waveform decision.
PC-9801:	Series of personal computers manufactured by NEC and using a Japanese-language version of MS-DOS.
Shot length:	The recording length, which is always expressed in terms of divisions.
Timer trigger:	Trigger function using the clock for fixed real time triggering.
Trigger timing:	Determines whether the trigger controls starting, stopping, or both.
Unbalanced input:	When one of two input terminals is used as the reference for the signal.
Word	The amount of memory representing a single sampled value digitally.

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