HIOKI

INSTRUCTION MANUAL

For 3193,3193-10

9605

HARMONIC/FLICKER MEASUREMENTS UNIT

HIOKI E. E. CORPORATION

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600030634

Contents

Introduction

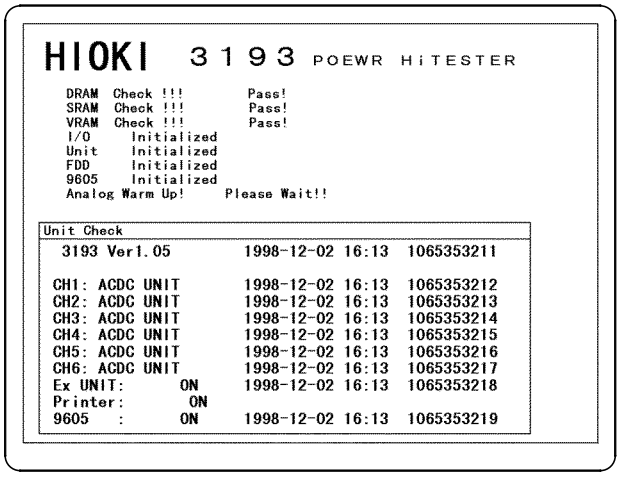
Thank you for purchasing this HIOKI 9605 HARMONIC/FLICKER MEASUREMENTS UNIT. To get the maximum performance from the unit, please read this manual first, and keep this at hand.

NOTE

- The HIOKI 3193, 3193-10 POWER HiTESTER will be referred to as the "HIOKI 3193" in this manual.
- This unit is designed for installation in the HIOKI 3193, 3193-10 POWER HiTESTER to enable harmonic analysis and flicker measurement. For details on operation of the HIOKI 3193, please refer to its instruction manual.
- Harmonic analysis and flicker measurement cannot both be performed at the same time.
- The 9605 measures flicker in terms of voltage fluctuations. The specific measurement parameters are as follows:
  Voltage measurements d measurements (dc, dmax, d(t)500ms)
  Flicker measurements (Pst, Plt)
- This unit is a factory-fitted option. When the HIOKI 3193 unit is powered on, you can check the installation on the screen.
- For operating environment, maintenance, and disposal at end of life, the same conditions apply as to the main 3193 unit.
- Because of differences in measurement principle, frequency response, and accuracy, the values measured by the 9605 (effective voltage value, effective current value, active power, and phase difference) may not agree with values measured by 9600/9601/9602 units installed in the same 3193 unit.
- The 9605 does not save analysis data if there is a power failure. All data values from before the power failure are treated as zero. However, time averaging values, peak hold values, and similar data values are preserved when there is a power failure.
- The D/A output is not possible for the analyzed data by the 9605.
- For Flicker measurement, cumulative integration is not possible.
- The HIOKI 3193-10 does not come with a floppy disk drive (FDD). Even if there is no special mention in the instruction manual, the FDD will not be supported when using the 9605 unit in the 3193-10.

Safety Read the Instruction Manual supplied with the HIOKI 3193 unit very carefully, and follow the indications given under "DANGER," "WARNING," "CAUTION," and "NOTE."

Before use Before using the unit, inspect it and check the operation to make sure that the unit was not damaged due to poor storage or transport conditions. If damage is found, contact your dealer or HIOKI representative.



Chapter 1
Overview and Features

1.1 Product Overview

Installing the 9605 HARMONIC/FLICKER MEASUREMENTS UNIT in a 3193 POWER HiTESTER enables voltage, current, and power harmonic analysis and flicker measurement to be carried out on the voltage and current waveforms captured by an input unit, for single phase to three-phase four-wire lines. It also provides list, a range of display options, including graph and vector displays.

1.2 Features

Installing the 9605 HARMONIC/FLICKER MEASUREMENTS UNIT in a 3193 POWER HiTESTER adds the following functions to the basic functions of the 3193.

(1) Support for range of power lines

Harmonic analysis or flicker measurement of voltage, current, and power can be carried out on lines from single phase to three-phase four-wire. If the frequencies are the same, up to three single phase lines can be analyzed simultaneously.

(2) Harmonic analysis and flicker measurement is possible

harmonic analysis function
(Reference standard IEC61000-3-2:2000/ IEC61000-4-7:1991)
Flicker Measurement Function
(Reference standard IEC61000-3-3:1995+A1:2001/ IEC61000-4-15:1997)

(3) Range of display options (harmonic analysis function)

The amplitude value, proportions, phase angle, and distortion of each harmonic for voltage, current, and power can be found. The analysis results can be displayed in a list, as a bar graph, or as a vector display.

(4) Waveform display (harmonic analysis function)

It is possible to display the waveform of the measured voltage or current.

(5) Floppy disk support

The analysis data can be saved to the floppy disk drive in the 3193, and a periodic automatic save function is also available.
(The HIOKI 3193-10 does not support this function as there is no FDD.)

(6) Built-in printer (option)

This can be used to print required data, and for periodic automatic printing. There is also a screen copy function.

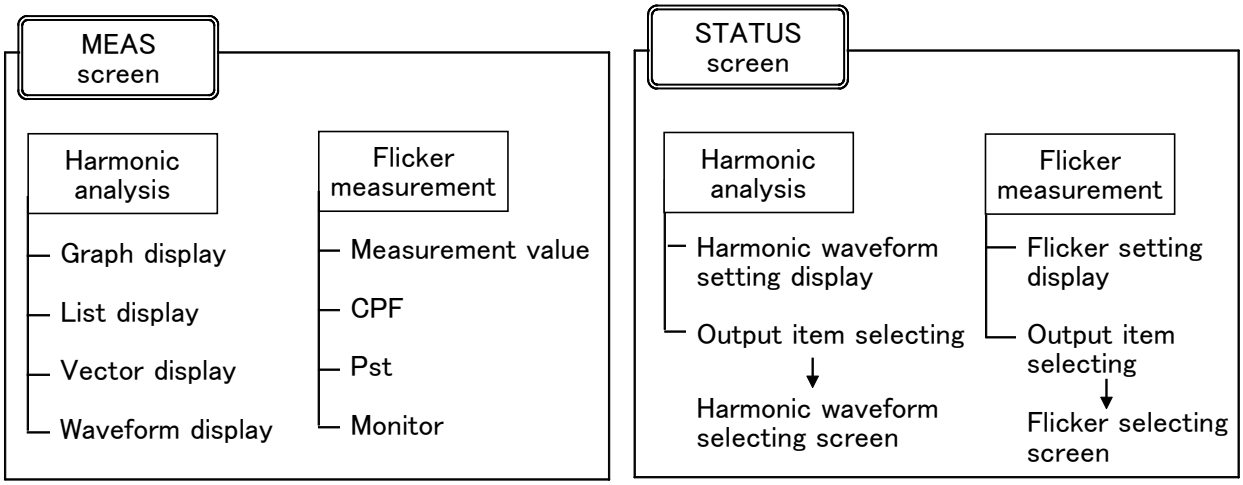
Chapter 2
Key Operations and the Screen Configuration

2.1 Key Operations

For details on how to operate keys of the 3193, refer to Chapter 2 "Name and Functions of Parts" in the instruction manual of the 3193.

2.2 Screen Configuration

When the 9605 HARMONIC/FLICKER MEASUREMENTS UNIT is installed in the 3193, the following screen is added to the 3193 functionality.
Refer to Section 2.3.1, "Screen Configuration" in the instruction manual of the 3193.



NOTE

- In the Selection screen, the distortion (THD-R, THD-F) produced by 9605 analysis can be displayed, but not other data.
- No waveform and graph colors change is possible.

Chapter 3
Setting the Basic Functions

This chapter describes the function settings when using the 9605.
For other functions, refer to the Instruction Manual supplied with the 3193 unit.

NOTE

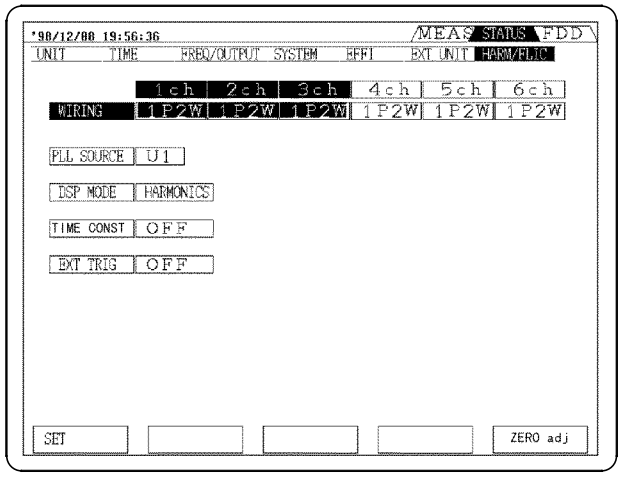
The following settings have no effect on harmonic analysis and flicker measurement.
Selecting RMS/MEAN value, setting the phase polarity discrimination filter, switching the waveform peak value, setting the response, setting the equation for reactive power/apparent power, and setting the indications for out-of range inputs

3.1 Setting the Wiring Mode (1P2W to 3P4W)

Set the wiring mode of the 3193.
For details, refer to Section 4.1, "Setting the Wiring Mode" in the instruction manual of the 3193.

3.2 Analysis Channel Selection

You can select three input unit channels for harmonic analysis from the input units (maximum three channels) in the 3193. If the frequencies are the same, analysis on three single-phase channels is possible.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic measurement setting screen. This displays the selected wiring mode.
2. Use the **CURSOR** keys to select the "WIRING" item.
3. Move the cursor to the channel to be analyzed with the **CURSOR** keys, then press the **F1** "SET" key to complete the setting.

NOTE

- The channel selection is always of adjacent input units, corresponding to the wiring modes set on the 3193 unit. If the 3193 unit wiring mode is set to 3P3W for each of channels 1 and 2 and channels 3 and 4, then the selection becomes channels 1, 2, and 3. In this case, the third channel is treated as single phase for analysis.
- Up to three channels can be selected; a single-channel analysis specification is not possible.

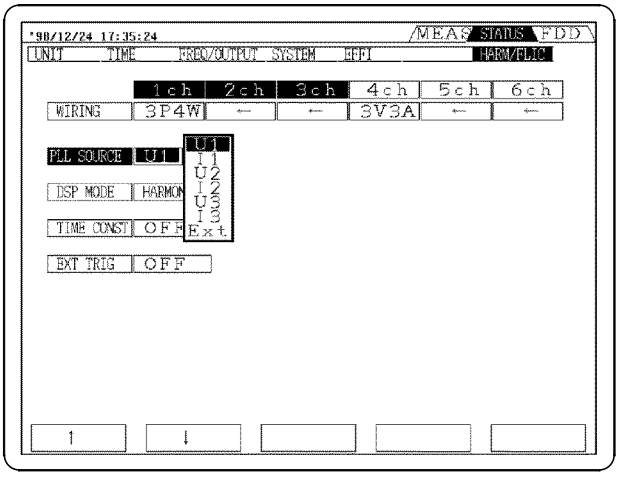
Wiring mode and selected channels

	1ch	2ch	3ch	4ch	5ch	6ch	Using channels
①	1P2W	1P2W	1P2W	1P2W	1P2W	1P2W	1+2+3, 2+3+4, 3+4+5, 4+5+6
②	1P3W/3P3W		1P2W	1P2W	1P2W	1P2W	12+3, 3+4+5, 4+5+6
③	1P3W/3P3W		1P3W/3P3W		1P2W	1P2W	12+3, 34+5, 4+5+6
④	1P3W/3P3W		1P3W/3P3W		1P3W/3P3W		12+3, 34+5, 56
⑤	3V3A/3P4W			1P2W	1P2W	1P2W	123, 4+5+6
⑥	3V3A/3P4W			1P3W/3P3W		1P2W	123, 45+6
⑦	3V3A/3P4W			3V3A/3P4W			123, 456

3.3 PLL Source Setting

To carry out analysis accurately, it is necessary to sample the waveform at a frequency synchronized to the measurement waveform. To create this synchronized frequency, specify voltage or current as the PLL source from the channels specified in Section 4.2. The PLL circuit enables analysis synchronized to the signal waveform. When an external clock signal (EXT) is selected, it is also possible to analyze low frequency ranges (1 Hz to 5 Hz) to which the PLL circuit cannot synchronize.

When the PLL is locked, the "PLL" indication on the screen goes off; when the PLL is unlocked the "PLL" indication stays on continuously.



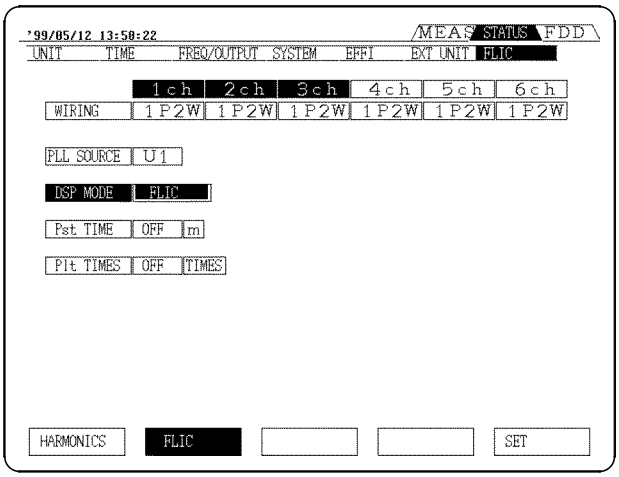
1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic measurement setting screen.
2. Moving the cursor to "PLL SOURCE" with the **CURSOR** keys displays the settings available for the PLL source in a window.
3. Use the **F1** ″↓″ and **F2** ″↑″ key to specify the required item.

NOTE

- If the signal selected for the source setting is very distorted, if the level is low for the range setting, or the signal frequency is not stable, the PLL circuit may not function. In such cases accurate analysis is not possible.
- If the three channels selected in Section 4.2 are separate systems with different signal frequencies, the analysis results are only valid for the channel for which the PLL source is set.
- When an external clock signal (EXT) is selected, it is necessary to input a clock signal with the following relationship to the fundamental frequency of the waveform to be measured. For details, refer to Section 8.1, "EXT.CLOCK."
  Input frequency = Basic wave frequency×8192×256
- In the following cases, the waveform display does not agree with the point of crossing the axis:
  (1) When an external clock signal (EXT) is selected
  (2) When the PLL source is set to current
- Flicker measurement has the following limitations:
  ① The measurement frequency must be between 45 and 66 Hz. Measurement is not possible outside of this range.
  ② A voltage must be selected as the PLL source.
  ③ An external clock cannot be used.

3.4 Setting the Analysis Mode (Harmonic/Flicker)

To measure the short-term (Pst) or long-term (Plt) flicker values, the Pst interval and Plt repetitions must be set.
The 9605 analysis mode is selectable between harmonic analysis and flicker measurement. Harmonic analysis and flicker measurement cannot both be performed at the same time.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic/flicker measurement setting screen.
2. Use the **CURSOR** keys to select the "DSP MODE" item.
3. Select the item by pressing the **F1** "HARMONICS" or **F2** "FLIC" key.
4. Press the **F5** "SET"

NOTE It takes about 10 seconds to switch the screen by pressing the F5.

3.5 Setting the Coupling Mode (Harmonic/Flicker)

For the channel of which the analysis results are shown on the screen only, press the **SHIFT** key then use the **CURSOR** ◀ key to switch.
It is also possible to change the setting in the STATUS/Units screen.
Refer to Section 4.2, "Setting the Coupling Mode" in the instruction manual of the 3193.

NOTE

- When AC mode (coupling mode) is selected on the 3193 unit, a DC blocking filter is required on the input unit. Therefore, if the measurement frequency is 10 Hz or below, or the waveform has a superimposed DC component (e.g. a half-wave rectified signal), errors may become large.
- Analysis results in the DC mode and analysis results in the AC+DC mode are the same.
- When the AC+DC or DC mode is selected, a value is shown with a harmonic index of "0." This shows the DC component included in the analysis data. However, the polarity is not displayed for the voltage and current since the effective value is converted.

3.6 Switching the Voltage Range and Current Range (Harmonic/Flicker)

For the channel of which the analysis results are shown on the screen only, press the **RANGE** key to switch. It is also possible to change the setting in the STATUS/Units screen.

Refer to Section 4.3, "Switching the Voltage Range and Current Range" in the instruction manual of the 3193.

3.7 Setting the Low-pass Filter (Harmonic/Flicker)

For the channel of which the analysis results are shown on the screen only, press the **SHIFT** key then use the **CURSOR ▶** key to switch.
It is also possible to change the setting in the STATUS / Units screen.

Refer to Section 4.6, "Setting the Low-pass Filter" in the instruction manual of the 3193.

NOTE

When the 3193 unit has a low-pass filter setting, a signal with the cut-off frequency passes through the low-pass filter, and the voltage and current waveforms are analyzed, but in this case the accuracy of the data cannot be guaranteed. Normally set this off unless required for some special reason.

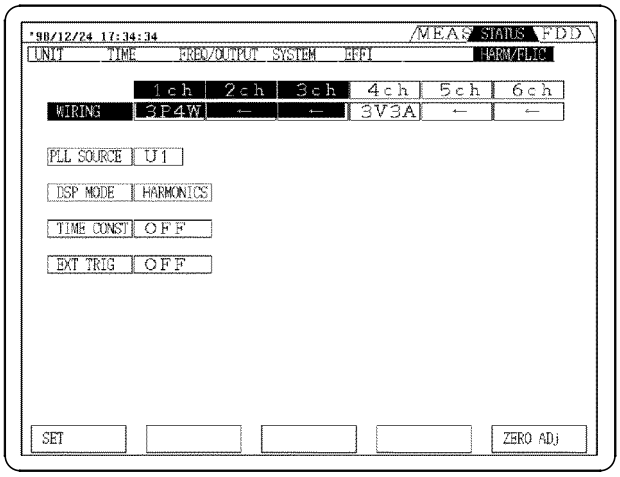
3.8 Degaussing (Harmonic)

For the channel of which the analysis results are shown on the screen only, press the **SHIFT** key then use the **RANGE** key to degauss.

Refer to Section 4.13, "Degaussing" in the instruction manual of the 3193.

3.9 Zero Adjustment Operation (Harmonic/Flicker)

The 9605 subjects a monitor output waveform from the input unit to digital sampling and analysis, but the zero adjustment of the A/D converter used must be carried out after warming up.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic measurement setting screen.
2. Move the cursor to "WIRING."
3. Press the **F5** "ZERO ADj" key to start zero adjustment.

NOTE

- The operation is carried out for 3 channels simultaneously.
- The operation takes about 3 seconds.
- Carry out the operation with no inputs on either voltage or current.
- Carry out the operation after degaussing (DMAG).

3.10 Averaging Setting (Harmonic)

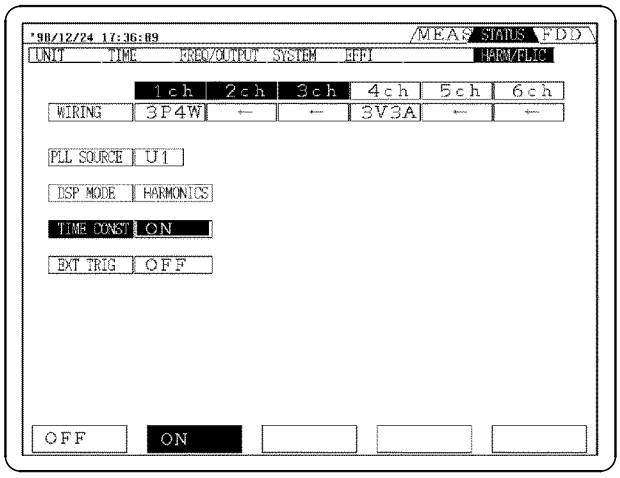
When combined with time averaging on the 3193, the harmonic values found by analysis with the 9605 can be shown as average values over a time period.
For settings, refer to the instruction manual of the 3193, Section 4.10, "Setting the Averaging" and Section 7.2, "Setting the Control Time."

NOTE

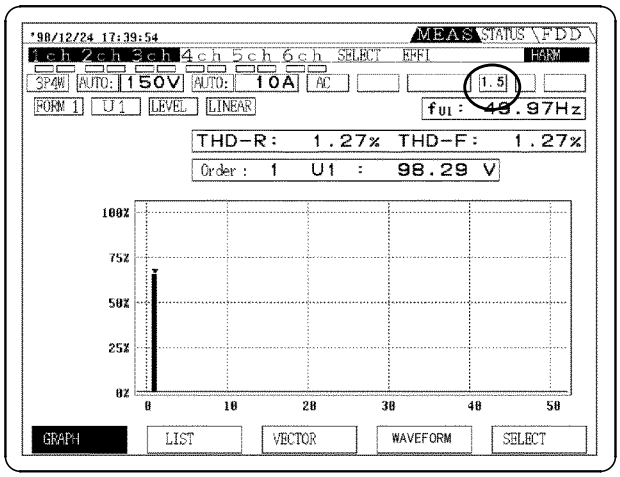
- If sliding averaging or exponential averaging is specified, this has no effect on the 9605 analysis data.
- The time averaging value for the harmonic phase angle is found by time averaging of the real and imaginary components of the FFT calculation results.
- No power failure processing is carried out for 9605 calculation values.
- When combined with an interval time, the TOTAL value after ending time averaging shows the value for the last interval time.
- This setting is not applicable to flicker measurement.

3.11 Time Constant Setting (Harmonic)

A time constant (τ) = 1.5 seconds is applied to 9605 analysis data.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic measurement setting screen.
2. Use the **CURSOR** keys to select the "TIME CONST" (time constant setting) item.
3. Press the **F2** "ON" key and the operation starts.

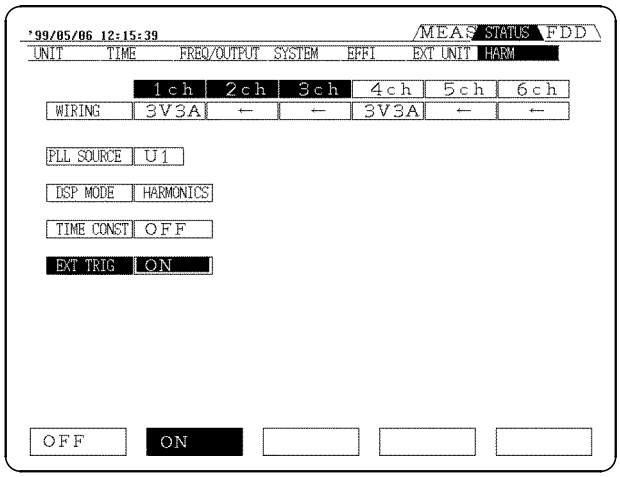


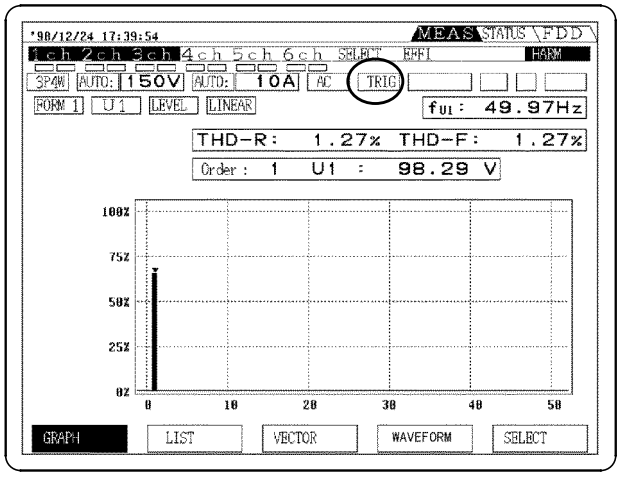
NOTE

- This does not affect data on the 3193 unit and units other than the 9605 unit. It also does not affect harmonic phase angle and harmonic phase difference.
- This setting is not applicable to flicker measurement.

3.12 Measurement by External Trigger (Harmonic)

By setting an external trigger, analysis can be started when the trigger signal is input. One window of analysis data is displayed, then the process stops. By synchronizing the timing with an external device, a number of 3193 units can perform analysis simultaneously.





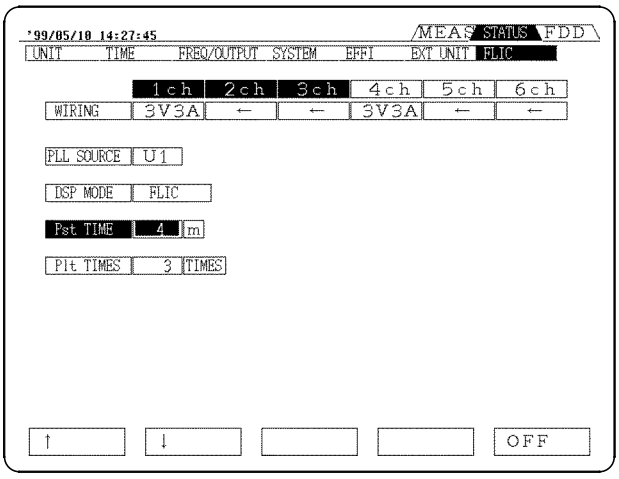
1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM/FLIC," to display the harmonic measurement setting screen.
2. Use the **CURSOR** keys to select the "EXT TRIG" item.
3. Press the **F2** "ON" key, putting the unit on hold for a trigger.
   When a trigger signal is input from the outside, analysis starts.

NOTE

- The analysis always starts from a point at which the PLL source waveform crosses the zero value, and there is therefore a delay of a maximum of one cycle of the waveform with respect to the trigger signal.
- This does not affect data on the 3193 unit (other than the 9605 unit).
- The PLL should be locked.
- This setting is not applicable to flicker measurement.

3.13 Setting the Pst Time and Plt Times (Flicker)

To measure the short-term (Pst) or long-term (Plt) flicker values, the Pst interval and Plt repetitions must be set.



Set the analysis mode to flicker measurement.

1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "FLIC," to display the flicker measurement setting screen.
2. Use the **CURSOR** keys to move the cursor to "Pst/Plt" .
3. Press the **F1** " ↑ " or **F2** " ↓ " key to select the time or number of times.

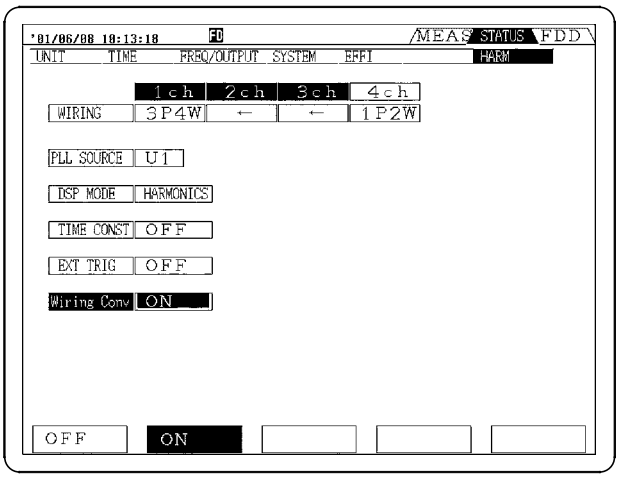
NOTE

- The Pst interval and Plt repetition settings correspond to the 3193 interval time and timer settings. For example, setting Pst to 1 minute and Plt to 120 times results in the 3193 interval timer being set to 60 seconds and the timer time to 2 hours. The Pst and Plt settings have priority, so the control times cannot be changes directly on the 3193 side. When you need to change the timing at the 3193 side, set the Pst and Plt settings to OFF.
- Output to the floppy diskette or printer is coordinated with the set Pst interval and Plt repetition settings.
- Available Pst interval settings are OFF and 1 to 30 minutes, and available Plt repetition settings are OFF and 1 to 2000 times. When both are OFF, the d measurements (dc, dmax and d(t)500ms) are performed according to the interval and timer settings on the 3193, and Pst and Plt are not measured.

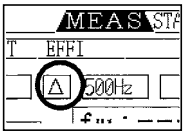
3.14 Connection Conversion Function

The new function converts the 3V3A or 3P4W connection and executes operations.

- The new function executes △-Y conversion and uses the 3V3A connection as a 3φ4W line in the operation.
- The new function executes Y-△ conversion and uses the 3P4W connection as a 3φ3W line in the operation.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "HARM," to display the harmonic measurement setup screen.
2. Use the **CURSOR** keys to move the cursor to "Wiring Conv" .
3. Press the **F2** "ON" key to start/boot the connection conversion function.
4. For △-Y conversion, "Y" appears on the screen. For Y-△ conversion, "△" appears on the screen.

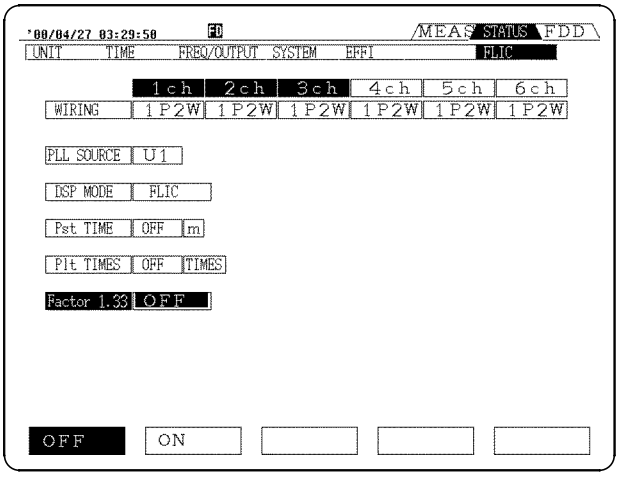


NOTE

- △-Y conversion is an operation based on the virtual neutral point.
- High-frequency analysis is executed using the converted waveforms.
- This conversion is disabled in 1P2W, 1P3W, and 3P3W modes.
- This conversion is disabled when flicker is being measured.

3.15 Limit Multiplication Setting Function (Flicker)

It allows you to choose whether to multiply the limit for the d (t) measurement by 1.33. When the function is OFF, the limit of d (t) is set to 3.3%. When the function is ON, the limit of d (t) is set to 4.389%.



1. Press the **STATUS** key, then use the **PAGE** keys to move the cursor to "FLIC", to display the flicker measurement setup screen.
2. Use the **CURSOR** keys to move the cursor to "Factor 1.33."
3. Press the **F2** "ON" key to set the Limit Multiplication Factor to 1.33.

Chapter 4
Harmonic Measurement

This describes analysis using the 9605 HARMONIC/FLICKER MEASUREMENTS UNIT.
First refer to Chapter 3 "Preparations for Measurement" in the instruction manual of the 3193. Pay special attention to the precautions listed in this chapter.

4.1 Harmonic Analysis Procedure

1. Check that the line to be measured is shut off, and check that the 3193 unit is powered off and the power cord disconnected from the outlet.

2. Connect the ground terminal to earth and connect the power cord to the 3P-outlet.

(Warming-up 1 hour or more
When using the 9600 or 9602,
carry out degaussing after warming-up.)

3. Turn the power on.

See Section 4.1 in the 3193 manual.

4. Make a connections and check there is no short circuit

See Section 3.2 in this manual.

5. Select the wiring mode on the STATUS "UNIT" screen.

See Section 3.2 in this manual.

6. Specify the channel for analysis on the harmonic/flicker screen.

See Section 3.3 in the 3193 manual.

7. Specify the analysis mode on the harmonic/flicker screen.

See Section 4.7 in this manual.

8. Specify the voltage or current from the selected channel as the PLL source.

9. Specify the output item on STATUS "freq/output" screen when the data is output on FD or printer.

10. Select voltage range and current range.

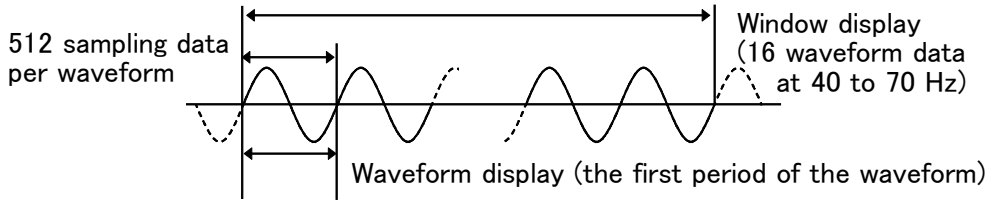
11. Carry out zero adjustment.

12. Check the connection of line being measured again, and turn on the power line.

13. Start the measurement.

4.2 Harmonic Measurement

The harmonic analysis function of the 9605 HARMONIC/FLICKER MEASUREMENTS UNIT operates by carrying out a fast Fourier transform (FFT) calculation window by window on the data which has been subjected to A/D conversion.
The harmonic analysis results can be displayed in list, graph, or vector form, depending on the particular application. The waveform producing the analysis can also be displayed.



NOTE

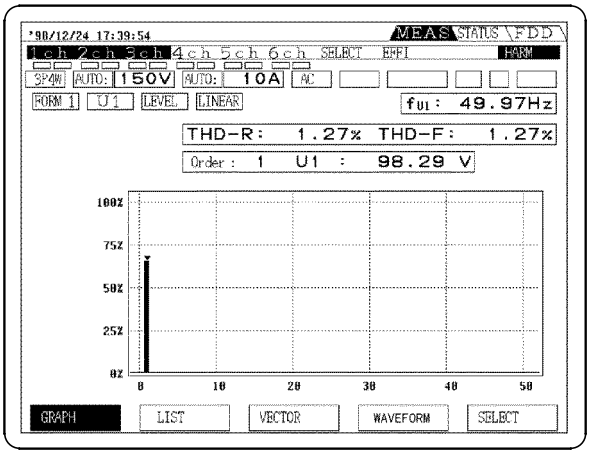
- Because of differences in measurement principle, frequency response, and accuracy, the values measured by the 9605 and 9600/9601/9602 units installed in the same 3193 unit may not agree. Similarly, values may not agree with measurements made by other devices.
- Because items not displayed are calculated internally at the same time, by switching to the hold state and switching the screen, it is possible to read simultaneous values for other analysis data.
- Be sure to carry this out with the PLL in the locked state.
- The harmonics which can be analyzed depend on the frequency of the PLL source. For details see the Specifications.
- Color specifications are not possible.
- The zeroth index is displayed when using a 9600/9602 with AC+DC or DC mode selected. This zeroth index is the DC component of the analyzed waveform. In the voltage/current mode, effective values are computed, and there is therefore no polarity. The accuracy of the zeroth index is not specified.
- When using 3P3W/3V3A mode, analysis results for power signify the total values (ΣP). The power analysis results are shown for each channel, but these have no significance. The total value (ΣP) is the same result for 3P3W and 3V3A.
- The phase angle indicates the phase angle of all data, taking the phase angle of the fundamental from the PLL source as 0°. For the total value (ΣP), the phase angle is not displayed.
- The phase difference indicates the phase difference of the current with respect to the voltage on the same channel for each harmonic.
- When the rms value of voltage or current exceeds 130% of range, or when the peak value of voltage or current exceeds crest factor, the value of analysis data and power analysis data is shown in red.

Term/meaning

Effective voltage value, effective current value, active power	Found from waveform sampling at a sampling frequency determined from the frequency of the fundamental. Includes harmonics above the analyzed number.
Fundamental (component, level)	Fourier coefficient of fundamental component
Harmonic (component, level)	Fourier coefficient second and subsequent harmonics
Harmonic content	Taking the fundamental component level as 100%, indicates the other harmonic components as proportions.
Harmonic phase angle	Generic term for harmonic voltage phase angle, harmonic current phase angle, and harmonic voltage current phase difference
Harmonic voltage phase angle, harmonic current phase angle	Taking the phase angle of the fundamental from the PLL source as 0°, indicates the phase difference of other voltage and current harmonics.
Harmonic voltage–current phase difference	The phase difference between the voltage and current for a particular harmonic
Total harmonic	The total value of the harmonics being analyzed (from 2nd to limit of analysis)
Total harmonic distortion	THD-F: total harmonic content as proportion of the fundamental. THD-R: total harmonic content as proportion of the effective voltage (current) value
PLL (Phase Locked Loop)	This generates a clock signal synchronized to the fundamental component of the measured waveform. The waveform is sampled using this clock signal. If the PLL does not function correctly, accurate harmonic analysis is not possible.

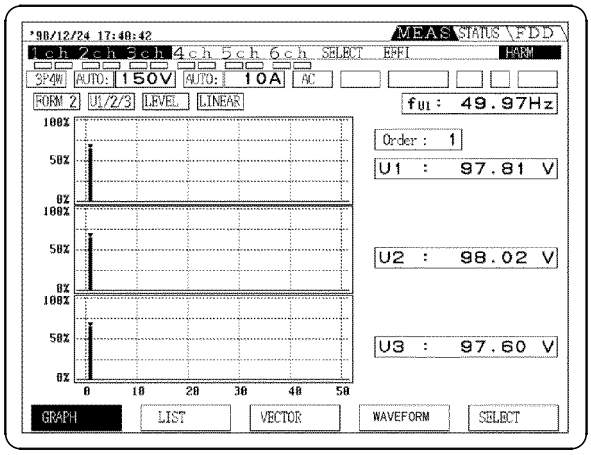
4.3 Graph Display of Harmonics

A harmonic graph can display the amplitude, proportion, or phase of each of the voltage, current, and power as a graph. There are three formats.



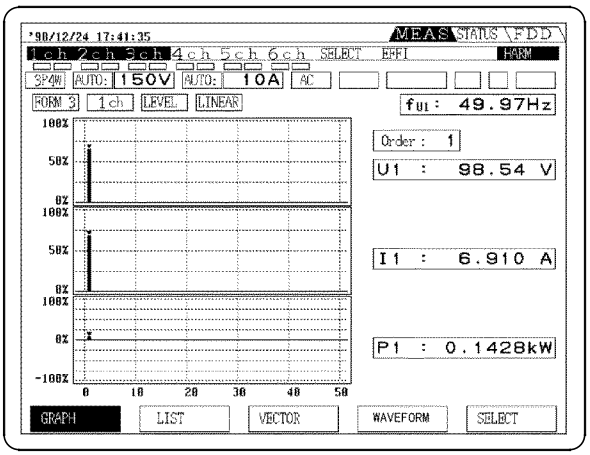
Format 1

One only of the analyzed voltage and current is displayed as a graph.



Format 2

The display is divided into three graphs. Voltage, current, and power are displayed for each channel.



Format 3

The display is divided into three graphs. In this case, the same item is displayed for each of the three systems.

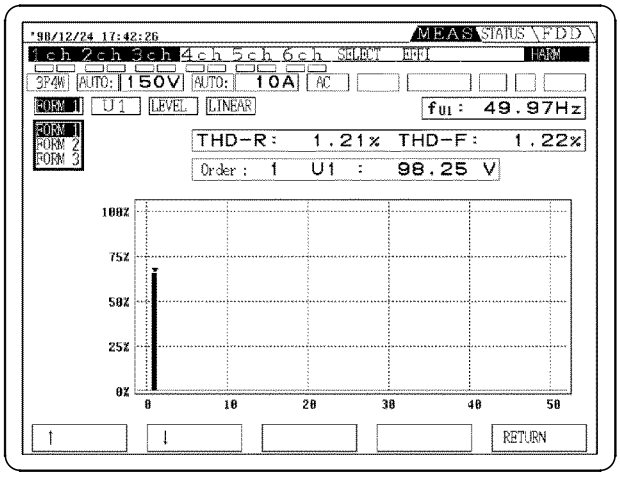
NOTE

- Distortion is not displayed.
- The display items cannot be individually selected.

(1) Displaying procedure

In harmonic mode, press the **F1** ″GRAPH″, to switch to the graph screen.

(2) Selecting the display format (two methods)



Method 1

Press the **SHIFT** key, then press the **F1** ″GRAPH" key to to cycle through the format.

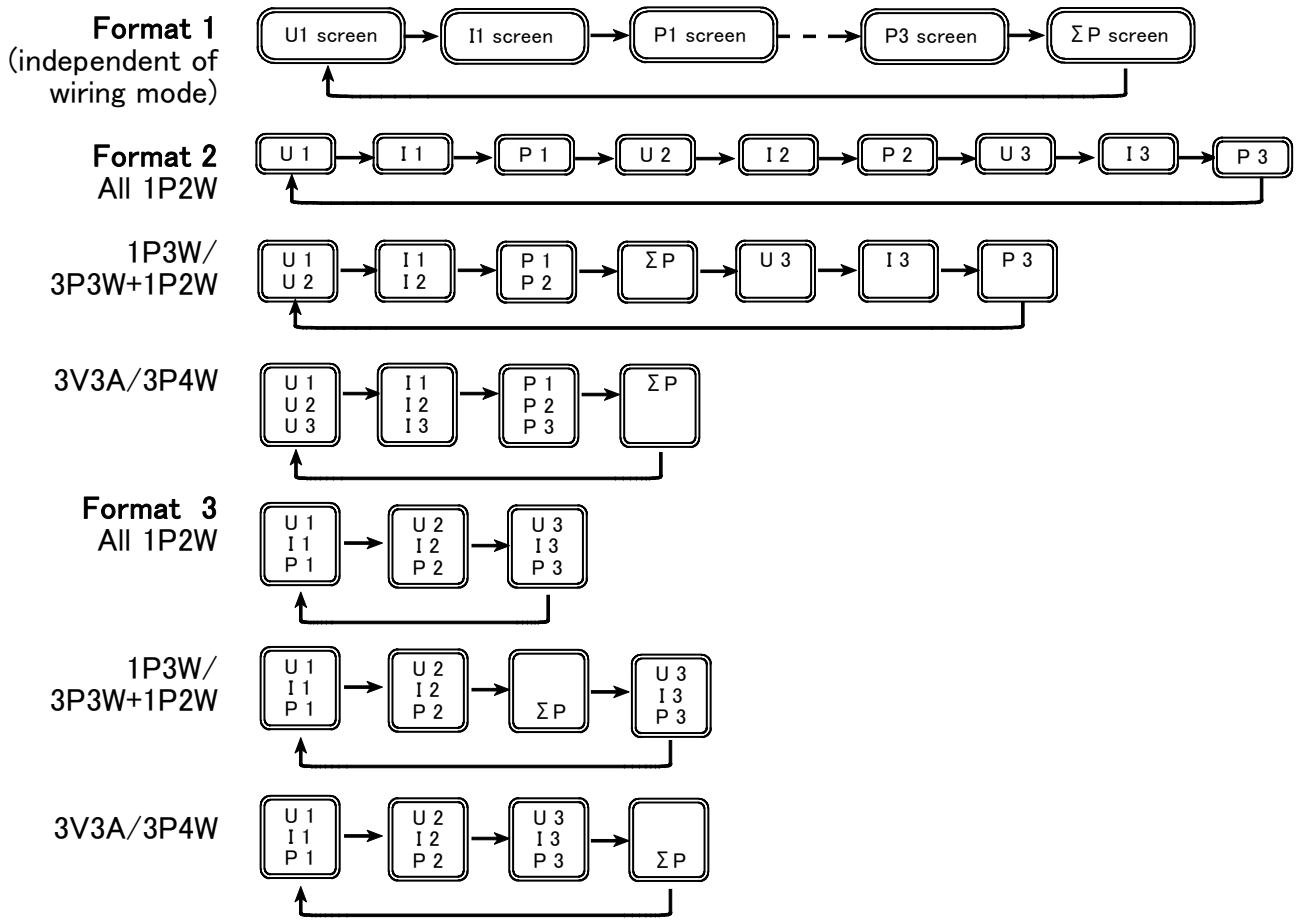
Method 2

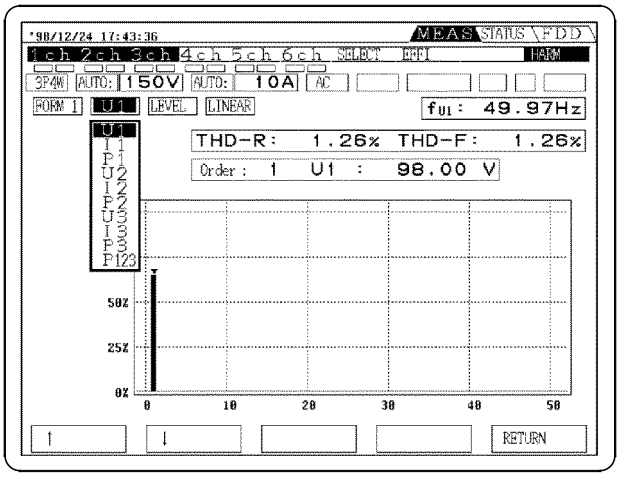
Press the **F5** ″SELECT″ key.
Move the cursor to the display format box, and use the **F1** ″↑″ and **F2** ″↓" keys to make a selection.
After specifying, press the **F5** ″RETURN" key.

(3) Specifying the item to display (two methods)

Method 1

Press the **F1** ″GRAPH″ key to cycle through the display items (when channels 1, 2, and 3 are selected).



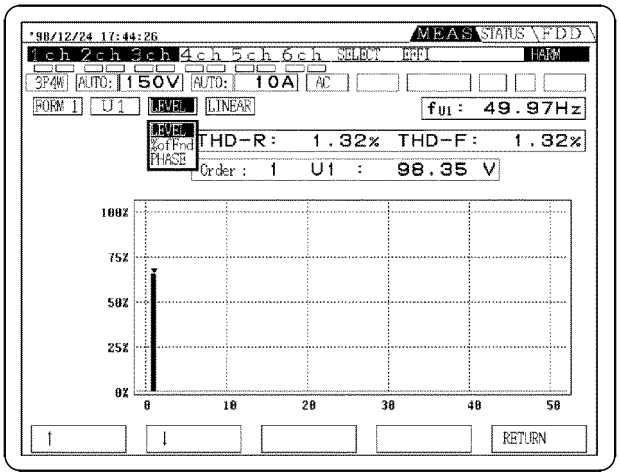


Method 2

Press the **F5** ″SELECT″ key.
Move the cursor to the display item box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection.
After specifying, press the **F5** ″RETURN″ key.

(4) Selecting the display analysis information

Select the information from the analysis from Amplitude, Proportion, and Phase.



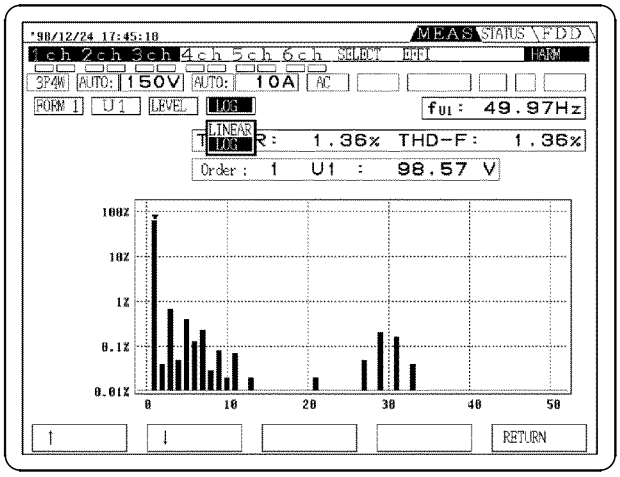
Press the **F5** ″SELECT″ key.
Move the cursor to the analysis item box, and use the **F1** ″↑″ and **F2** ″↓″keys to make a selection.
After specifying, press the **F5** ″RETURN″ key.

NOTE

- This specification affects the list display in all screens.
- Selecting "PHASE" has the following significance:
  For voltage (*U*) or current (*I*), display the phase angle of the fundamental waveform with respect to the PLL source.
  For power (*P*), display the voltage-current phase difference

(5) Selecting the vertical axis

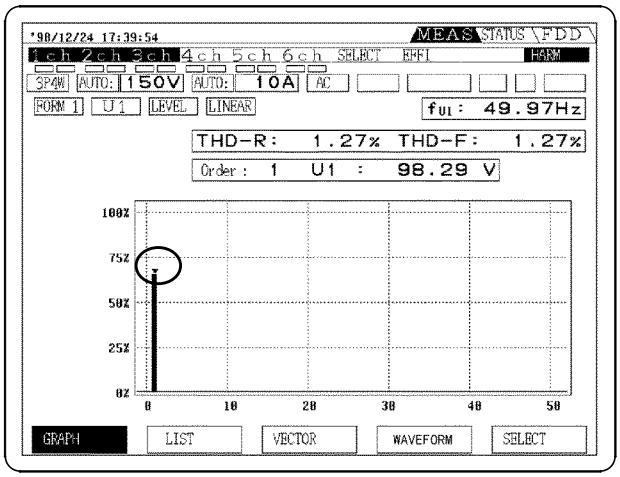
Select a linear (LINEAR) or logarithmic display (LOG) for the vertical axis.



Press the **F5** ″SELECT″ key.
Move the cursor to the LINEAR/LOG box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection. After specifying, press the **F5** ″RETURN″ key.

NOTE It is not possible to make individual LINEAR/LOG selections. The vector display also changes accordingly.

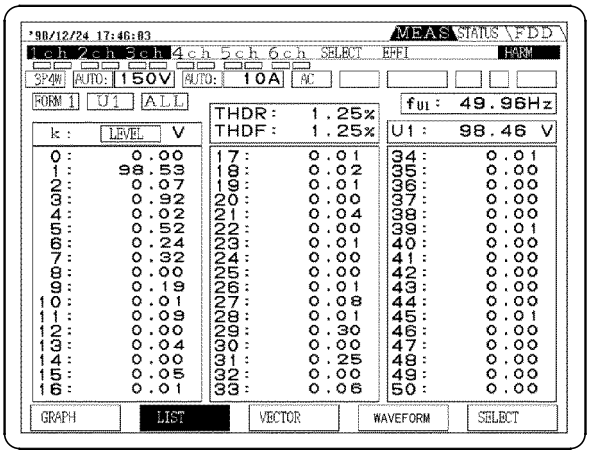
(6) Data read-out with the cursor



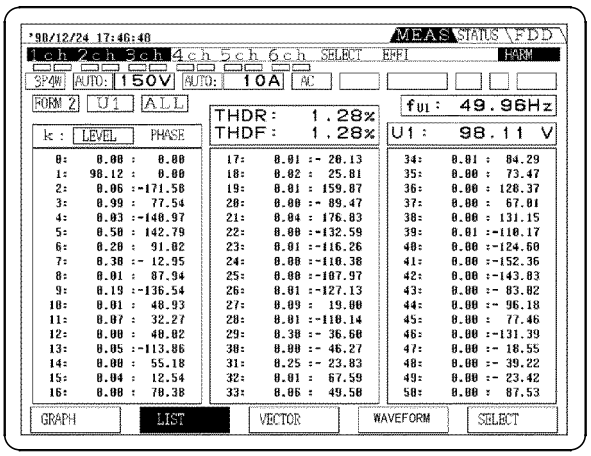
On a displayed graph, you can use the cursor to select the harmonics to be read. Use the **CURSOR** keys ◀ and ▶ to move the cursor ▼ on the screen, and display the selected data.

4.4 List Display of Harmonics

The harmonic list display shows the amplitude value, proportion, phase angle, and distortion for each harmonic of voltage, current, and power. There are two display formats: format 1 and format 2.



Format 1



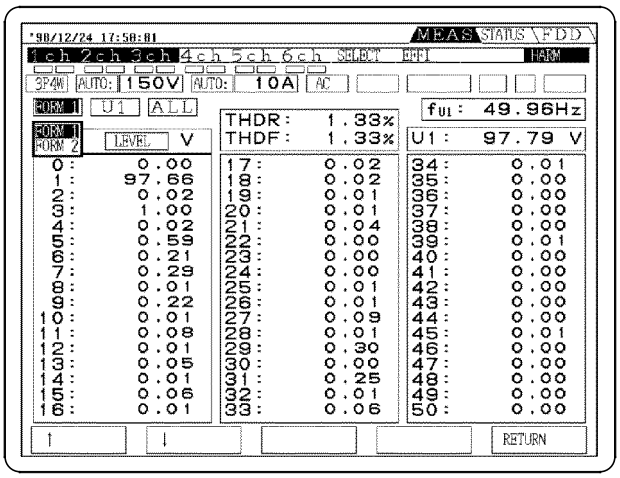
Format 2

Only the analysis data for the channel synchronized to the PLL source is valid.

(1) Display procedure

In harmonic mode, press the **F2** "LIST" key, to switch to the List screen.

(2) Selecting the display format (two methods)



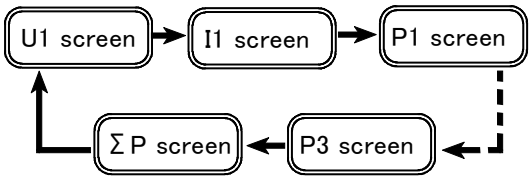
Method 1

Press the **SHIFT** key, then press the **F2** "LIST" key to cycles through the format.

Method 2

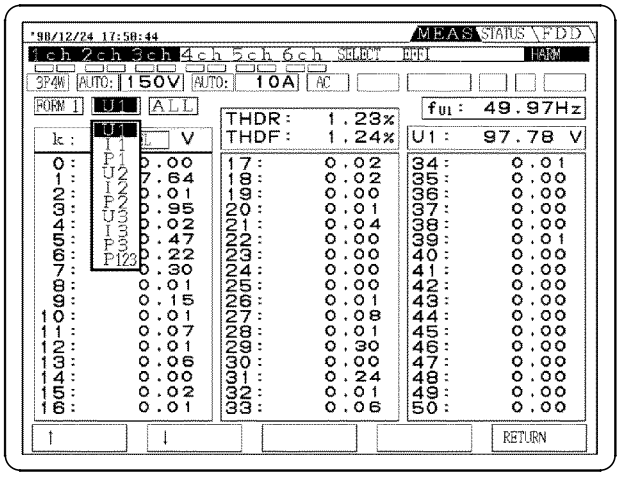
Press the **F5** ″SELECT″ key.
Move the cursor to the display item box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection. After specifying, press the **F5** ″RETURN″ key.

(3) Specifying the item to display (two methods)



Method 1

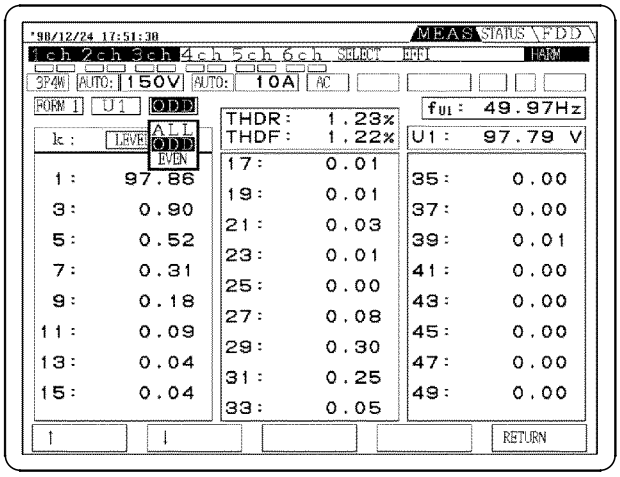
Press the **F2** "LIST" key to cycle through the measurement items (voltage, current, and power).



Method 2

Press the **F5** ″SELECT" key.
Move the cursor to the display item box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection.
After specifying, press the **F5** ″RETURN″ key.

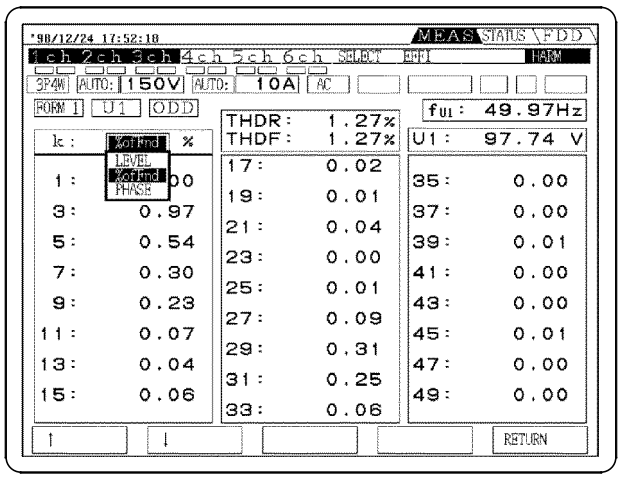
(4) Specifying the display order



Select whether to display all harmonics, or only the even or odd harmonics.

(5) Specifying the analysis information

Specify information from the analysis to be displayed.



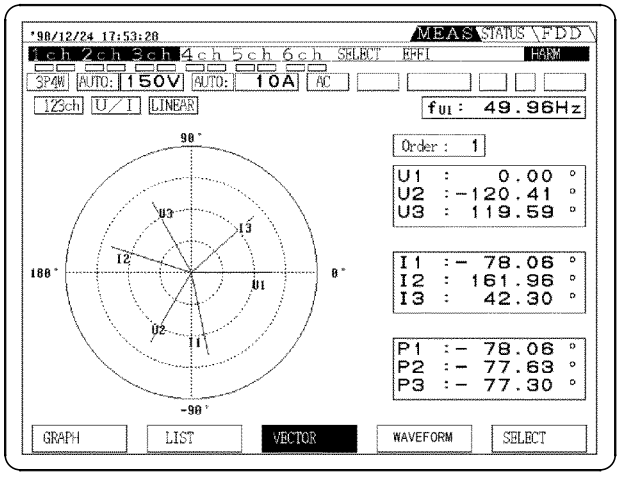
Press the **F5** ″SELECT" key.
Move the cursor to the display item box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection.
After specifying, press the **F5** ″RETURN″ key.

NOTE

- This specification affects the list display in all screens.
- Select the analysis information from the amplitude, proportion, and phase angle.
- Selecting "PHASE" has the following significance:
  For voltage (U) or current (I), display the phase angle of the fundamental waveform with respect to the PLL source.
  For power (P), display the voltage-current phase difference
- For the total value (ΣP) , the phase angle and total harmonic distortion are not displayed.

4.5 Vector Display of Harmonics

The harmonic vector display shows the voltage, current, and phase angle for each harmonic, making clear the phase relationship between voltage and current. The numeric values of the displayed harmonics also appear.
For details on wiring mode and vector display, see Appendix.



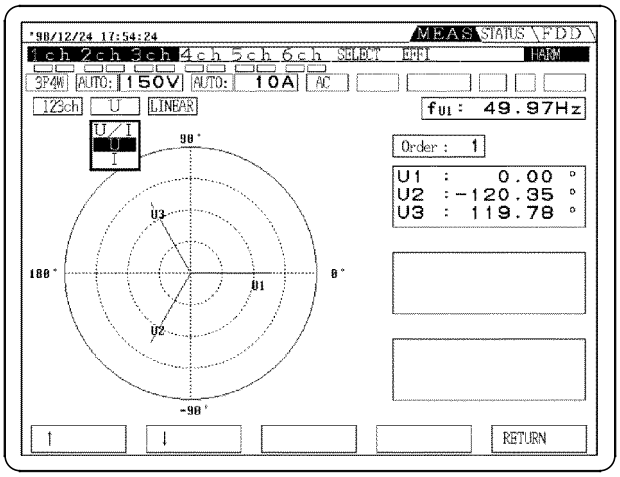
NOTE

- It is only possible to display the voltage and current for a single system on the screen. Again, only one harmonic can be selected for display. Therefore, for a single phase system two lines (voltage and current) appear, and for a three-phase four-wire system, six lines (voltage ×3, current ×3) are displayed.
- By setting the hold state, and switching the screen, it is possible to read other analysis data for the same time instant.
- The distortion is not displayed.
- The voltage/current phase angle indicates the phase angle taking the phase angle of the fundamental from the PLL source as 0°.
- The power phase difference indicates the phase difference of the current with respect to the voltage on the same channel for each harmonic.
- This reflects the harmonic selected on the harmonic graph display.

(1) Display procedure

In harmonic mode, press the **F3** "VECTOR" key, to switch to the Vector display screen.
Pressing the **F3** "VECTOR" key cycles through U/I, U, and I.

(2) Selecting the display item (U/I, U, I) (two methods)



Method 1

Press the **F3** "VECTOR" key to cycles through the items (U/I, U, and I).

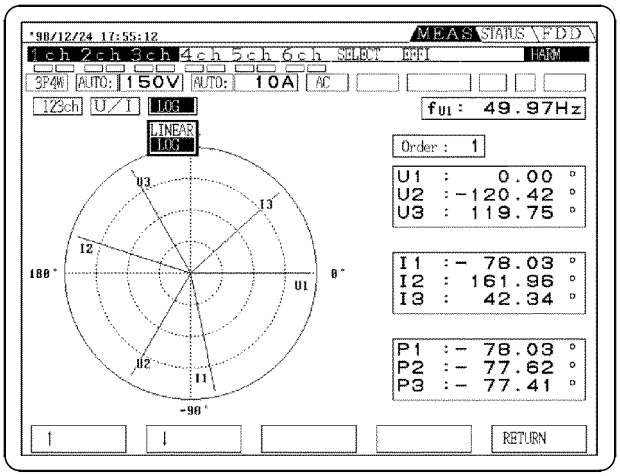
Method 2

Press the **F5** ″SELECT″ key.
Move the cursor to the display format box, and use the **F1** "↑" and **F2** "↓" keys to make a selection. After specifying, press the **F5** "RETURN" key.

(3) Specifying the display order

Pressing the **CURSOR** keys (◀ and ▶) cycles through the display order.

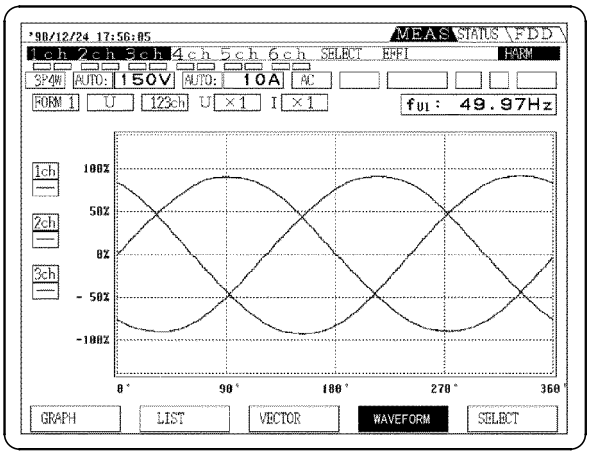
(4) Selecting the vertical axis:



Select a linear (LINER) or logarithmic display (LOG) for the vertical axis. Switch the display in the same way of the graph display.

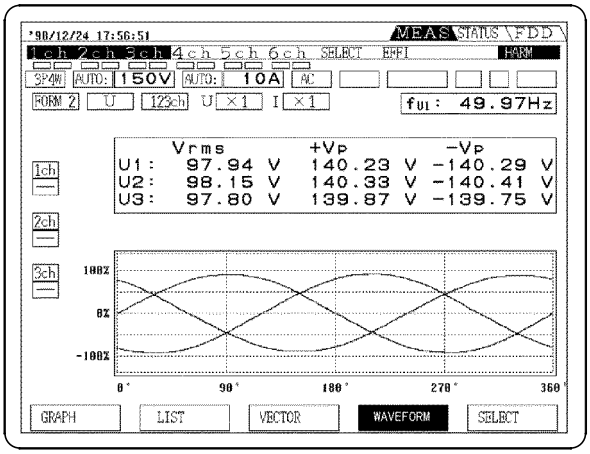
4.6 Waveform Display

The waveform display shows one cycle of the voltage and current waveforms being measured. There are three formats.



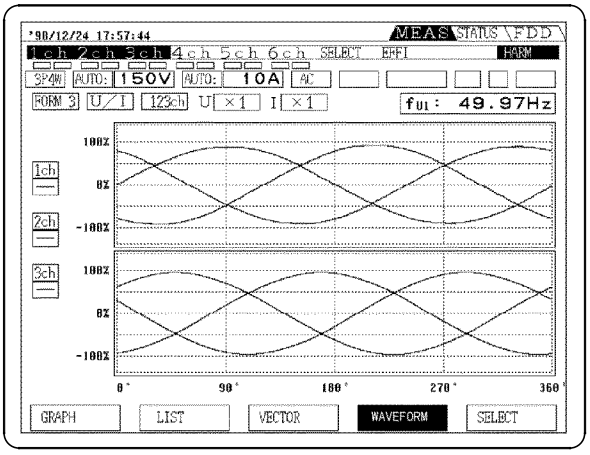
Format 1

Shown the waveforms (voltage or current) for each system being measured together.



Format 2

Shown the waveforms (voltage or current) for each system being measured together. The display is smaller than the graph of format 1, but the effective and peak values are shown.



Format 3

The display is divided into two, and the voltage waveform (above) and current waveform (below) for the system being measured are shown together.

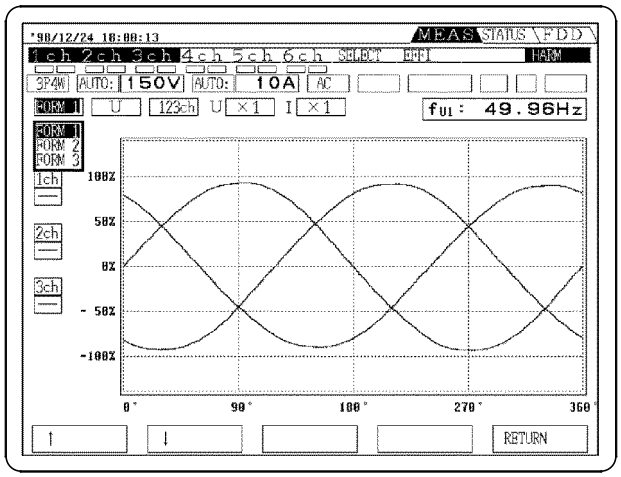
NOTE

- The waveform starts from a point at which the voltage waveform (or current waveform) specified as the PLL source waveform crosses the zero value, and displays the first cycle from the window being analyzed. The other waveforms are displayed for the same time interval as this waveform.
- It is not possible to select individual items for display.
- Because items not displayed are calculated internally at the same time, by switching to the hold state and switching the screen, it is possible to display simultaneous parts of other waveforms.
- The power waveform is not displayed.
- Only waveforms for channels synchronized to (at the same frequency as) the PLL source channel are valid.

(1) Selecting the display format

Move the cursor to harmonic mode, and press the **F4** ″WAVEFORM″, to switch to the waveform display screen. Each time you press the **F4** ″WAVEFORM″ the waveform display switches to the next format. (when channels 1, 2, and 3 are selected).

(2) Selecting the display format (Expanded, compressed, or two-screen) (two methods)



Method 1

Press the **SHIFT** key, then press the **F4** ″WAVEFORM" key to cycle through the format.

Method 2

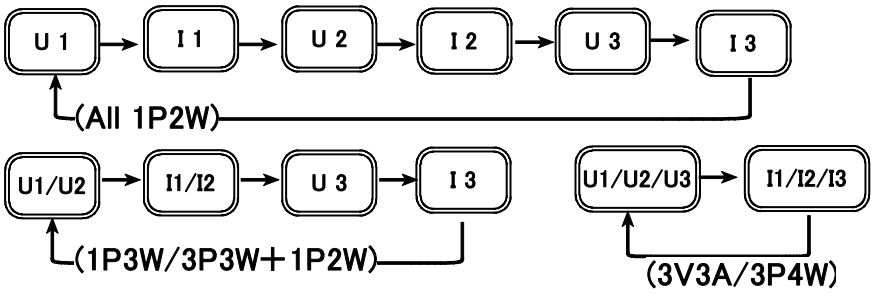
Press the **F5** ″SELECT″ key.
Move the cursor to the display format box, and use the **F1** ″↑″ and **F2** ″↓″ key to make a selection. After specifying, press the **F5** ″RETURN" key.

(3) Specifying the item to display (Voltage, Current) (two methods)

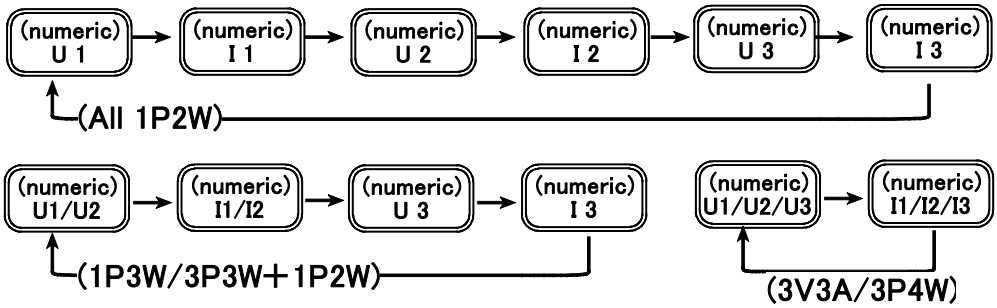
Method 1

Press the **F4** ″WAVEFORM″ key to cycle through the display items.

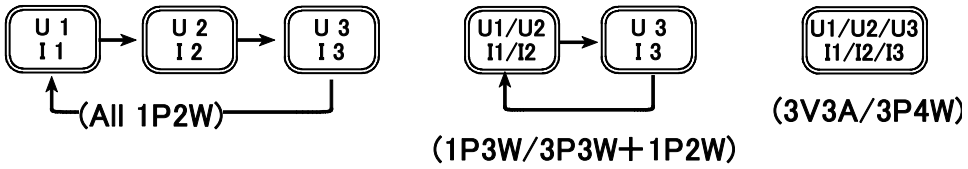
Magnification displays

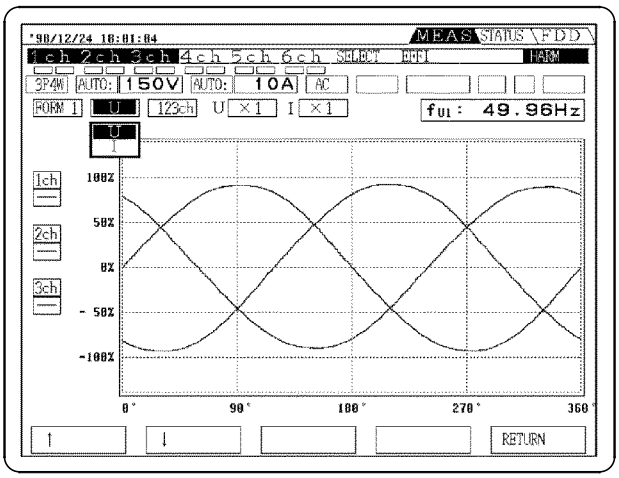


Compression displays



Dual displays

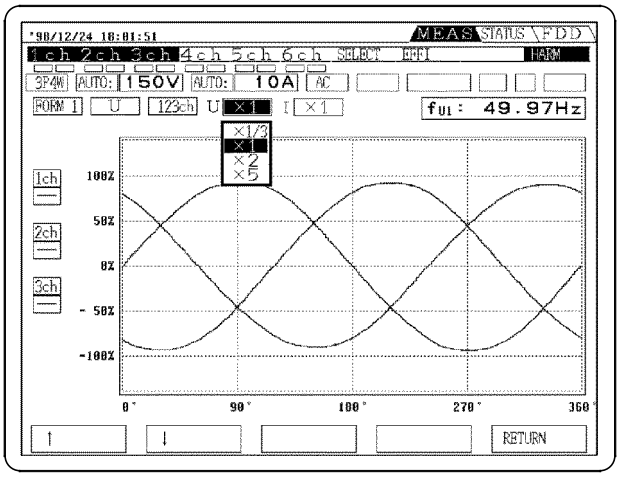




Method 2

Press the **F5** ″SELECT″ key.
Move the cursor to the display item box, and use the **F1** ″↑″ and **F2** ″↓" keys to make a selection. After specifying, press the **F5** ″RETURN" key.

(4) Vertical axis scaling setting:

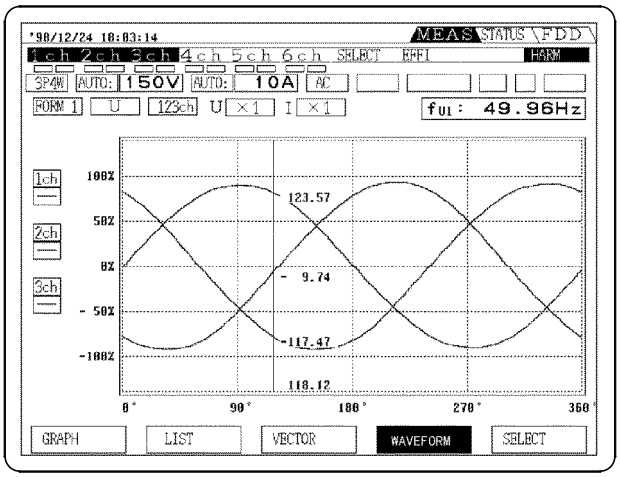


You can change the scaling ratio for the waveform vertical axis.
Press the **F5** ″SELECT" key.
Move the cursor to the scaling factor box, and use the **1** ″↑″ and **F2** ″↓″ keys to make a selection.
After specifying, press the **F5** ″RETURN" key.

NOTE

- Select the scaling factor from ×1/3, ×1, ×2, and ×5. In this case, for example, using a scaling factor of ×5, the waveform is magnified by 5 times.
- There is no offset function for moving the position of the axis.

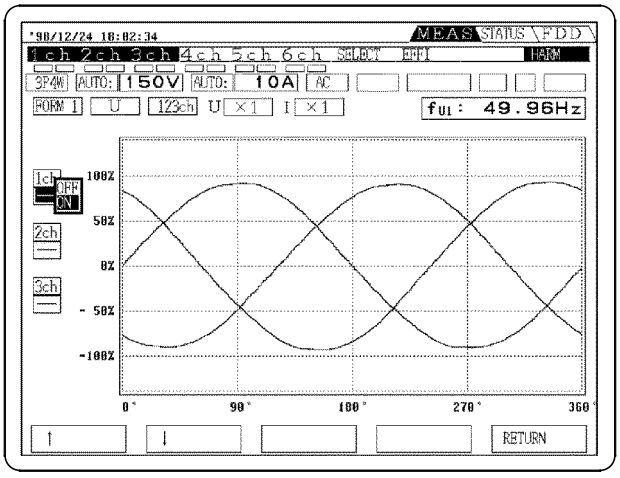
(5) Cursor read-out function



This displays the measurement values for the displayed waveforms at the position of the cursor.

1. Press the **CURSOR** keys (◀ and ▶) to display the line cursor.
2. Use the **CURSOR** keys (◀ and ▶) to move the line cursor. The measurement values move with the cursor.
   If the displayed values overlap a waveform, you can use the **CURSOR** keys (▼and ▲) to reposition the value indication.

(6) Deleting the displayed channels



In 1P3W mode or above, more than one waveform is shown within the same graph. In this case you can switch off a waveform which is not required.

Press the **F5** ″SELECT" key.
Move the cursor to the waveform setting box, and use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection. After specifying, press the **F5** ″RETURN" key.

Chapter 5
Flicker Measurement

Flicker is a sense of visual instability typically caused by the repeated change in brightness or spectral characteristics of a light source over time: that is, frequently repeating voltage fluctuations that cause discomfort to people due to the resulting flicker of ambient lighting. The 9605 is designed to be able to measure the state of this flicker.

The 9605 measures flicker in terms of voltage fluctuations. The specific measurement parameters are as follows:
Voltage measurements d measurements (dc, dmax, d(t)500ms)
Flicker measurements (Pst, Plt)

(1) Voltage rms value "Urms"

"Urms" shows the effective value of a half cycle (10 ms in the case of 50 Hz) of voltage waveforms that are being measured. All calculation values are computed based on this data. The display of "Urms" when AGC (Auto gain control circuit) is set and display of "Urms" when AGC is not set may not match.

(2) Relative Voltage Change "ΔU/U"

ΔU/U = (Urms - Un)/Un
"ΔV" is the difference between "Urms" and the reference voltage "Un".

(3) Relative Voltage Change Characteristic "d(t)"

The change in the effective value every half cycle (10 ms in the case of 50 Hz) of the fundamental voltage wave is called the effective-value voltage change "U(t)", and the time function of change of the effective-value voltage for a period in which the voltage is stable for at least one second is called the voltage change characteristic "ΔU(t)". The ratio of the size of this voltage change characteristic to the reference voltage "Un" is called the relative voltage change characteristic "d(t)".

(4) Relative Steady-State Voltage Change "dc"

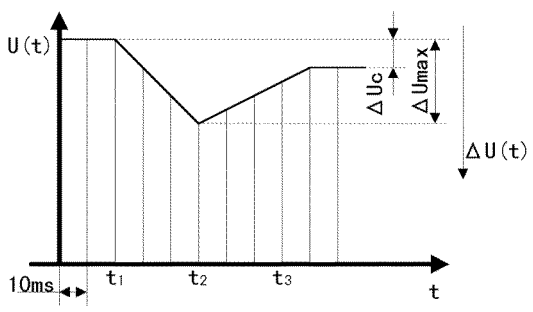
The voltage difference between two steady-state waves separated by the voltage change characteristic is called "ΔUc", and the ratio of the amplitude of the phase voltage to the reference voltage "Un" of this steady-state voltage change is called the relative steady-state voltage change, "dc".

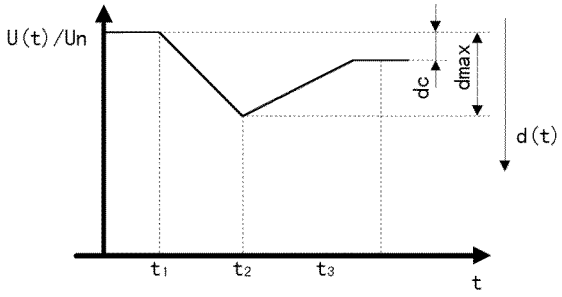
(5) Relative Maximum Voltage Change "dmax"

The difference between the maximum and minimum effective values of the voltage change characteristic is called "ΔUmax", and the ratio of the amplitude of this maximum voltage change to the reference voltage "Un" is called the relative maximum voltage change, "dmax".

(6) 500-ms Period Analysis "d(t)[ms]"

Within one period of relative steady-state voltage change, this parameter indicates whether the cumulative duration of fluctuations of over 3.3% of the previous steady-state exceeds 500 ms.





(7) Short-Term Flicker Value "Pst"

The value representing the stimulus reaction to flicker (flicker severity) measured over a short term (10 minutes per IEC standard) is called the short-term flicker value, "Pst". Pst=1 is the standard value of the stimulus reaction.

(8) Long-Term Flicker Value "Plt"

The value representing the stimulus reaction to flicker (flicker severity) measured over a long period (2 hours per IEC standard) using a continuous Pst value is called the long-term flicker value, "Plt". Generally, the Plt value is required to evaluate a device for which the normal usage period exceeds 30 minutes at a time.

(9) Instantaneous Flicker Value "S(t)"

Human perception of instantaneous flicker is numerically quantified in units of "P.U." (Perceptibility Units). This instantaneous flicker value "S(t)" is obtained by statistical calculation over a specific time period using "Pst" and "Plt".

(10) Cumulative Probability "P0.1/P1s/P3s/P10s/P50s"

The instantaneous flicker value "S(t)" is determined from the cumulative probability function curve line classified as 1024 and is used for obtaining the short-term flicker value "Pst".

(11) Cumulative Probability Function Curve Line "CPF Curve Line"

The instantaneous flicker value "S(t)" is determined and the cumulative probability function curve line "CPF Curve Line" is calculated by statistical processing. The shape of this graph indicates the perceptibility of flicker.

(12) Steady-state Times

Steady-state time is the time of an interval of variation in relative voltage within 0.1% for more than 1 second.
With the 9605, time is shown in "Pst" time when "Pst/Plt" measurement starts. When "Pst/Plt" is not measured, time is counted from the point the "PLL" circuit is locked, but the time display can be cleared by the following operations.

- When the **MEAS** key is pressed on the MEAS screen.
- When you return to the MEAS screen from the STATUS/FDD screen.
- When RANGE/COUPLING/LPF is switched.

(13) Auto Gain Control Circuit "AGC"

AGC is the circuit that sets the effective-value "Urms" of the input voltage to the reference voltage "Un" without affecting "ΔU/U". It has a 60-second response time (time to change the variation width from 10% to 90%) for "Urms" stepped-variation.
All data other than "Urms" is data that has passed through the AGC. Also, a waiting time of about 10 seconds is required for AGC response time.

NOTE

- With the 9605, the reference voltage "Un" is the effective value of voltage gotten by the following timing.
  - When the PLL circuit is locked.
  - When the **MEAS** key is pressed on the MEAS screen.
  - When you return to the MEAS screen from the STATUS/FDD screen.
  - When RANGE/COUPLING/LPF is switched.
- When the reference voltage is set, all data is cleared.
- The value for data when the PLL circuit is not locked is displayed in red. In this case the data is invalid.
- It is not possible to measure voltage at other than 45 to 66 Hz.

5.1 Flicker Measurement Procedure

Before beginning, please read the notes to "Chapter 3. Preparations Before Measurement" in the operating manual supplied with the 3193.

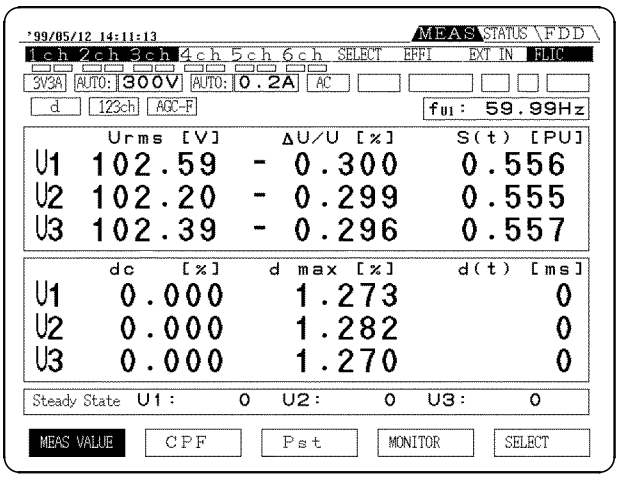
1. Check that the line to be measured is shut off, and check that the 3193 unit is powered off and the power cord disconnected from the outlet.
2. Connect the ground terminal to earth and connect the power cord to the 3P-outlet.
3. Turn the power on.(at least 1 hour warming-up)
   When using the 9600 or 9602, carry out degaussing after warming-up.)
4. Make a connections and check there is no short circuit
5. Select the wiring mode on the STATUS "UNIT" screen.
6. Specify the channel for analysis on the harmonic/flicker screen.
7. Set the analysis mode to "FLIC" on the harmonic/ flicker screen.
8. Specify the voltage from the selected channel as the PLL source.
9. Specify the Pst time and Plt times
10. Specify the output item on STATUS "freq/output" screen when the data is output on FD or printer.
11. Select the voltage range to be measured.
12. Carry out zero adjustment.
13. Check the connection of line being measured again, and turn on the power line.
14. Obtain the reference voltage. Press the MEAS key on the MEAS screen and wait for about 10 seconds.
15. Press the START button to start the measurement. "INTEG" mark is displayed in yellow.
    Measurement finishes automatically after the specified measurement time and the times specified for Pst and Plt."INTEG" mark is displayed in blue.
16. To interrupt measurement before completion, press the START/STOP key again. Then press the SHIFT key and START/STOP key once more to reset the data.

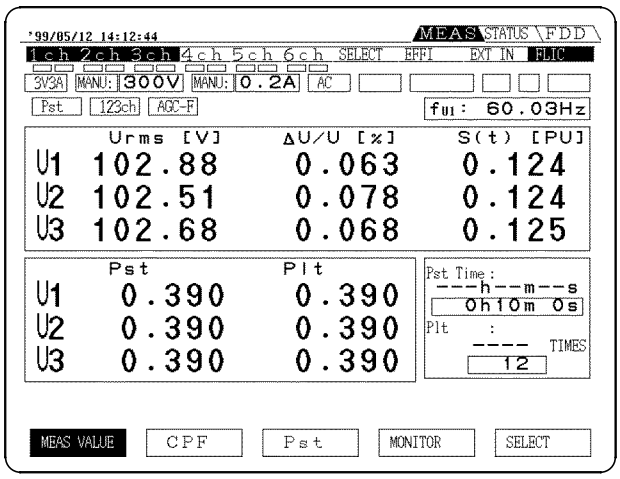
NOTE

- During measurement, the integration function is always in operation. When finished measurement, always reset the integrated values. If not, restart operation is disabled. Press the **SHIFT** key and then the **START/STOP** key to reset. Confirm that the "INTEG" indicator is not turned on.
- For Flicker measurement, cumulative integration is not possible.
- Measurement start, stop and reset can be externally controlled just as can product calculation.
  See Section 9.3.1, "INTEG.EXT.CONT and INTEG.RESET" of the 3193 Instruction Manual.

5.2 Measurement Value Display

Pressing the **F1** ″MEAS VALUE″ key from the MEAS "Flicker" screen displays the measured Urms, ΔU/U, S(t), dc, dmax, d(t)500ms, Pst and Plt values (Steady-state Times). Progress and interval/repetition times are also displayed.





NOTE

- Values of Urms, ΔU/U, S(t), dc, dmax and d(t)500ms are displayed even before measurement has started. In this case, they are refreshed with the maximum data value. When measurement has started, the maximum value at each setting time is displayed.
- When measurement has not yet started, or if the Pst and Plt times are set to OFF, Pst and Plt values are displayed as "--- --". When measurement starts, progress data is displayed.

(1) Switching ″d″ and ″Pst″ displays

dc/dmax/d(t)500ms and Pst/Plt are shown on different screens.
The following two methods can be used to switch the display.
"d(t)500ms" is abbreviated as "d(t)[ms]" on the screen.

Method 1 Press the **F1** ″MEAS VALUE″ key repeatedly to select the channel to display.

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of d/Pst and use the **F1** "↑"/**F2** "↓" key to make a selection.
Press the **F5** "RETURN" key to end the settings.

(2) Selecting Display Channel

Except in the case of 3P4W mode, displayed channels must be set by one of the following two methods.

Method 1 Press the **F1** ″MEAS VALUE″ key repeatedly to select the channel to display.
1P2W＋1P2W+1P2W: U1→U2→U3→U1
1P3W (3P3W)+1P2W: U1/U2→U3→U1/U2
3V3A(3P4W): U1/U2/U3

Method 2 Press the **F5** "SELECT" key to move the cursor to the column of the channel to set.

(3) Switching Before/After AGC

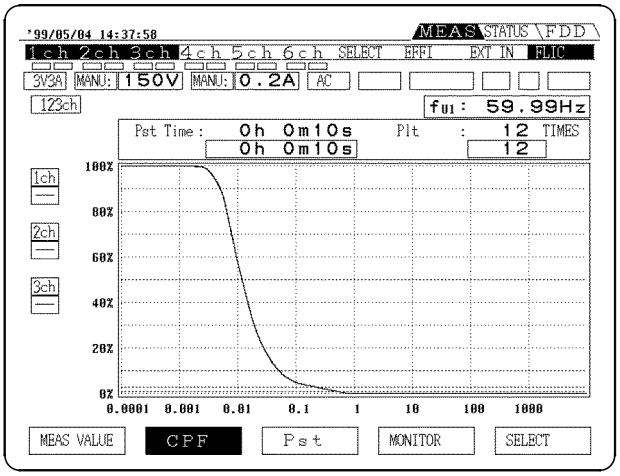
1. Press the **F5** "SELECT" key to move the cursor to the column of AGC-F/AGC-R and use the **F1** "↑"/**F2** "↓" key to make a selection.
2. Press the **F5** "RETURN" to end the settings.
   AGC-F: Data before passing through the Auto Gain Control circuit
   AGC-R: Data that has passed through the Auto Gain Control circuit

NOTE

AGC sets the effective-value "Urms" to the reference voltage "Un" without affecting "ΔU/U". Therefore, the "Urms" display value when AGC is set may appear different from the actual effective value being measured. All data other than effective-value "Urms" are calculated from post-AGC data, regardless of the setting.

5.3 CPF Display

On the MEAS "FLIC" screen, pressing the **F2** ″CPF″ key displays the CPF curve.

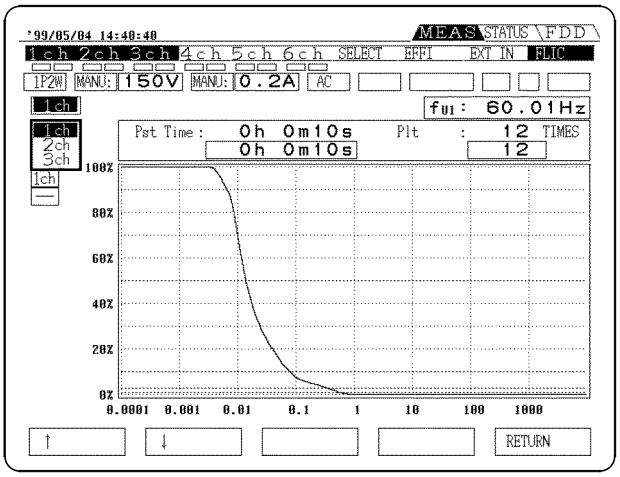


(1) Selecting Display Channel

The values for only one channel are displayed. The following two methods can be used to switch the display.

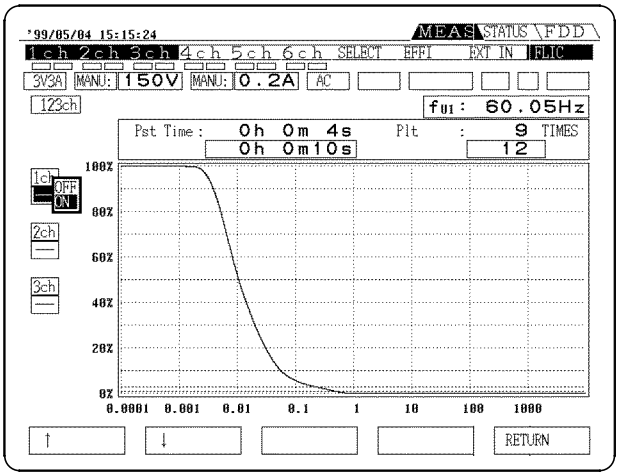
Method 1 Press the **F2** ″CPF″ key repeatedly to select the channel to display.
U1→U2→U3

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of the channel to set.



(2) Deleting Display Channel

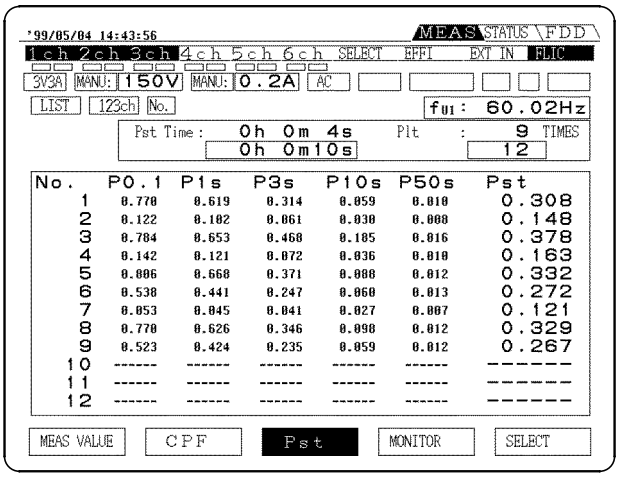
For modes with more channels than 1P3W mode, the maximum of CPF curve lines for 3 channels are displayed on the same graph. Therefore, it is possible to delete unnecessary display of channels.

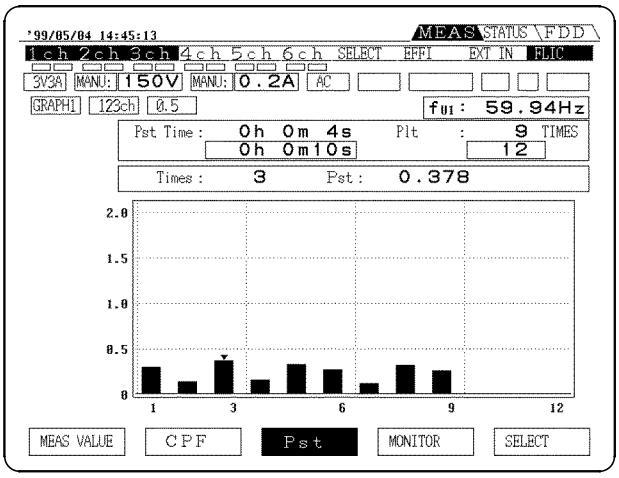


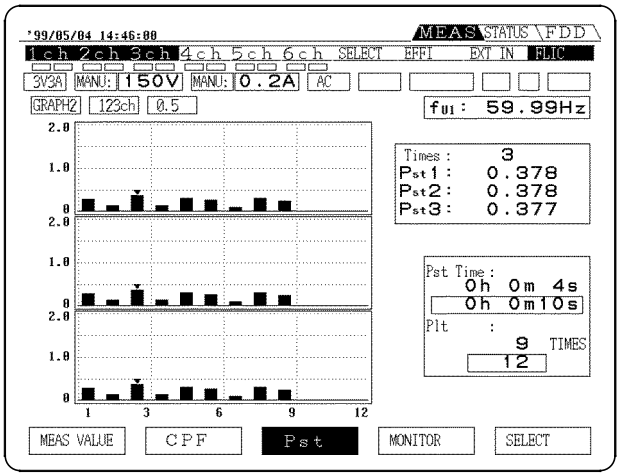
1. Press the **F5** ″SELECT″ key to move the cursor to the column of OFF/ON and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key to end the settings.

5.4 Pst Display

On the MEAS ″Flicker″ screen, pressing the **F3** ″Pst″ key displays the Pst value or graph.







(1) Switching List/Graph

Switching between a list or graph of measured "Pst" values up to a maximum of 12 points can be done.

There are two graph formats: magnified screen and compressed screen. Magnified screen displays one unit per screen. Compressed screen displays up to 3 graphs. Also, on the compressed screen, you can display "Pst" values by moving the cursor with the CURSOR key.
How to switch graph formats when in the graph state of List/Graph is explained in step 2 of the procedure below.

Method 1 Press the **SHIFT** key and then press the **F3** ″Pst″ key.

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of LIST/GRAPH1/GRAPH2 and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
Press the **F5** ″RETURN″ key.

(2) Selecting Display Channel

The values for only one channel are displayed. The following two methods can be used to switch the display.

Method 1 Press the **F3** ″Pst″ key repeatedly to select the channel to display.
U1→U2→U3

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of the channel to set.

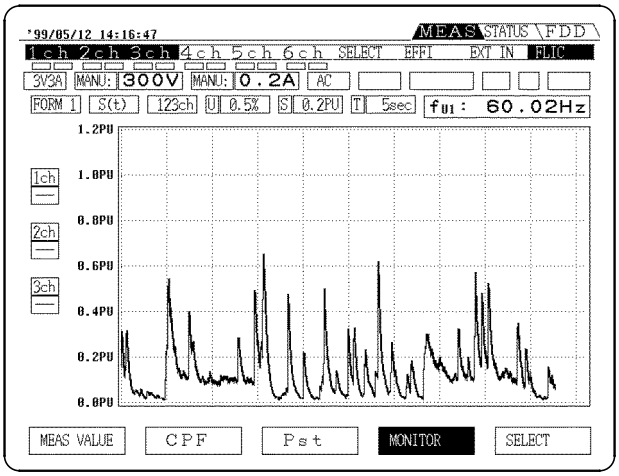
(3) Vertical Axis Setting

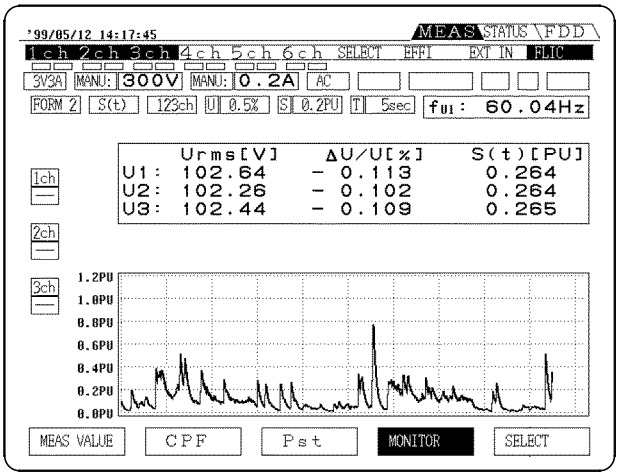
The resolution of vertical axis can be changed for graph display.
Press the **F5** ″SELECT″ key to move the cursor to the column of vertical axis "0.25/0.5/1.0/2.0/5.0" and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
Press the **F5** ″RETURN″ key.

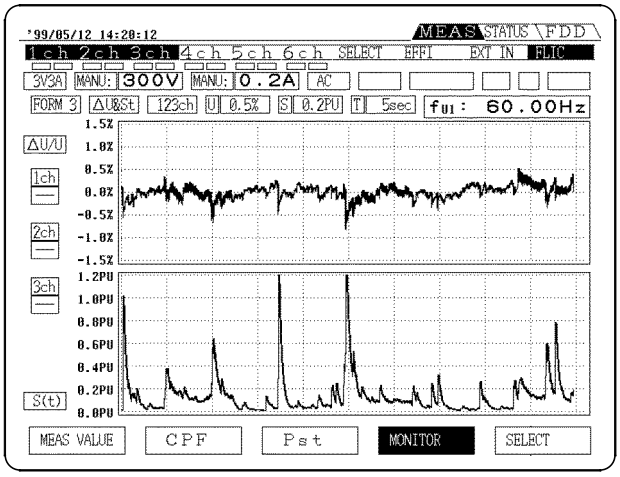
NOTE When the Plt time exceeds 12, the oldest data is erased as new data is input and shown on the screen. In this case, erased data cannot be displayed after measurement is finished, so if needed, it should be saved on a floppy diskette or printer.

5.5 Monitor Display

Press the **F4** "MONITOR" key to display a graph of the chronological changes of the relative voltage change "ΔU/U" and the instantaneous flicker value "S(t)". There are three screen formats.







NOTE

- When in the HOLD state, graph plotting stops. When HOLD is removed, plotting continues from the data that existed directly before HOLD was put on.
- When setting reference voltage (pressing the MEAS key), changing the setting of ranges, or switching screens with the **STATUS/FDD** key, about 10 seconds is required for the data to stabilize.

(1) Switching Graph Formats

The following two methods can be used to switch the display.

Method 1 Press the **F4** ″MONITOR″ key repeatedly to select the channel to display.

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of "FORM1/FORM2/FORM3" and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
Press the **F5** ″RETURN″ key.

(2) Switching the effective value of voltage/instantaneous flicker value (when screen format is FORM1/FORM2)

1. Press the **F5** ″SELECT″ key to move the cursor to the column of ΔU/U, S(t) and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key.

NOTE

For 2 screens, ΔU/U is shown in the upper display and S(t) is shown in the lower display.

(3) Switching the display channel

Channels that are combined by the wiring mode are displayed on the same graph, so when there is more than one mode, such as 1P2W, it is necessary to switch the screen. Switch channels with the method explained in step 2 below.

Method 1 The channel changes each time the **F4** "MONITOR" key is pressed.

Method 2 Press the **F5** ″SELECT″ key to move the cursor to the column of 1ch/2ch/3ch (when 1P2W mode) and use the **F1** ″↑″/**F2** ″↓″ key to make a selection. Press the **F5** ″RETURN″ key.

(4) Switching the vertical axis factorization ability on ΔU/U display

Switching the vertical axis factorization ability of a ΔU/U graph is possible.

1. Press the **F5** ″SELECT″ key to move the cursor to the column of V[10%/5%/1%/0.5%/0.1%] and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key.

(5) Switching the vertical axis factorization ability on S(t) display

Switching the vertical axis factorization ability of a S(t) graph is possible.

1. Press the **F5** ″SELECT″ key to move the cursor to the column of S[10PU/5PU/1PU/0.5PU/0.2PU] and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key.

(6) Setting the time axis

Switching the plotting speed to observe short-term measurement in detail or observe long-term changes is possible. For example, when "1 sec" is set, data is plotted at 1 second per 1DIV.

1. Press the **F5** ″SELECT″ key to move the cursor to the column of T[0.5sec/1sec/2sec/5sec/10sec/30sec/1min] and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key.

(7) Deleting the Display Channel

When measuring multiple channels, such as 3P4W, you can delete unnecessary data from the same graph.
(When you don't want ch3 to appear)

1. Press the **F5** ″SELECT″ key to move the cursor to the column of ch3[OFF/ON] and use the **F1** ″↑″/**F2** ″↓″ key to make a selection.
2. Press the **F5** ″RETURN″ key.

Chapter 6
Hold/Peak Hold Function

6.1 Hold Function

6.1.1 Harmonic Analysis

Press the panel **HOLD** key to freeze the display of all items on the screen. In this case, by switching the screen selection, you can view harmonic data for the same time interval which was not displayed.

Since internally the measurement continues, each time you press the **HOLD** key the values at that time are displayed. To end the hold function, hold down the **SHIFT** key and press the **HOLD** key.

The following measurements are also possible.

- When combined with the interval timer, the results of analysis at the end of each interval can be displayed.
- When combined with time averaging and the interval timer, the results of analysis can be shown as average values over the time period.

NOTE

The hold function applies to the whole 3193 unit.
Refer to the following sections in the instruction manual of the 3193.
Section 4.10, "Setting the Averaging", 6.1, "Hold Function", and 7.2, "Setting the Control Time."

The basic operations are the same, and all items are held. In this case, when combining interval time and "Pst" measurement time, display is updated for each interval time or "Pst" time.
When on the monitor screen, data is continuously displayed after HOLD is removed, so data is ignored during the HOLD period.

6.1.2 Flicker Measurement

The basic operations are the same, and all items are held. In this case, when combining interval time and "Pst" measurement time, display is updated for each interval time or "Pst" time.
When on the monitor screen, data is continuously displayed after HOLD is removed, so data is ignored during the HOLD period.

6.2 Peak Hold Function

6.2.1 Harmonic Analysis

When the peak hold is activated, only the largest value to date of the analysis data is updated. Internally the 9605 carries out analysis without gaps, so the maximum value can be found, including data not shown on the screen.

To activate or deactivate this function, press the **SHIFT** key and then press the **HOLD** key. When the peak hold function is activated, pressing the **HOLD** key resets the peak value, and starts a new peak hold operation from that point.

When combined with the interval timer, the maximum values of each harmonic with each interval can be found.

NOTE

- The maximum value of the phase difference is taken as the maximum absolute value. For example, of "+20° " and "-35° " the value of "-35° " is taken as the maximum.
- The peak hold function applies to the whole 3193 unit. Refer to the following sections in the instruction manual of the 3193. Section 6.2, "Peak Hold Function", 7.2, "Setting the Control Time."
- The waveform display is updated when the peak value exceeds the highest previous value. The channels are updated individually, so the displayed waveforms need not be from the same times.
- During peak hold and when the PLL is unlocked, the frequency display is shown in red. In this case, the measurement data is invalid. Resets the peak value by pressing the **HOLD** key or release the peak hold.

6.2.2 Flicker Measurement

The basic operations are the same. When PEAK HOLD is operated, only the measurement values of "Urms", "ΔU/U", and "S(t)" are operated.
Also, when "Pst" measurement time is combined with interval time, the maximum value in "Pst" time or interval time is displayed.

Chapter 7
Output to Floppy Disk/Printer

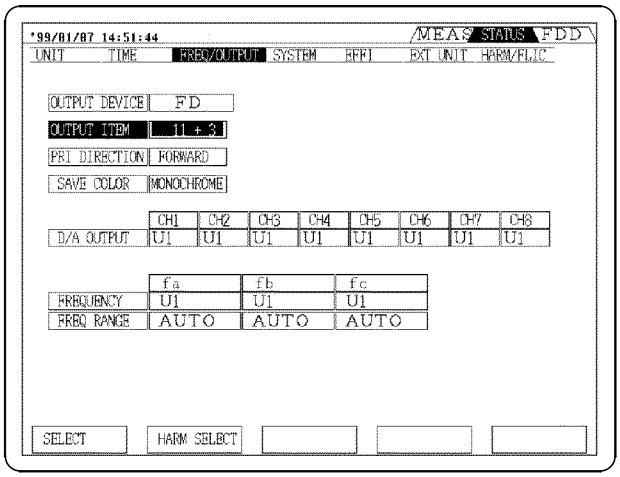
Measurement data of the 9605 unit can be output to the 3193 FDD (not applicable for 3193-10), and the printer (optional). The measured data and setting data can be easily printed out.

NOTE

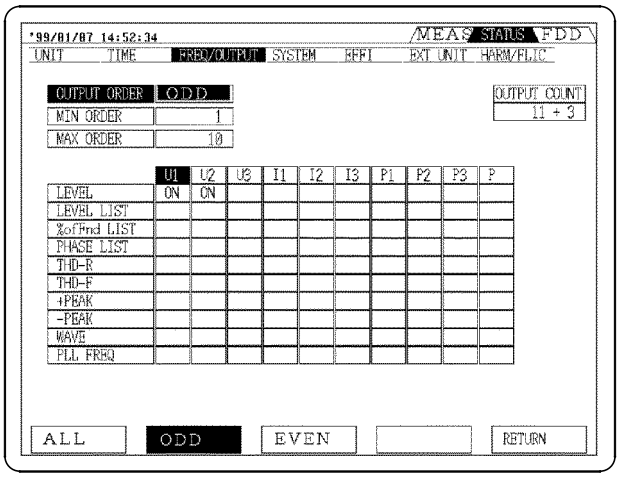
- If output items other than the data measured by the 9605 input unit are also specified, they are output at the same time.
- For the basic method of using the floppy disk/printer, and various notes on this, refer to the Instruction Manual for the 3193 unit, Chapter 11 "Using the Floppy Disk and Chapter 13 "Using the Printer."
- The total number of output items of the data analyzed by the 9605 and other output setting data is displayed. "+3" shows three items (date, time, and interval time) and it is always affixed.
- The waveform data cannot be printed out.

7.1 Selecting the Output Item to FDD/Printer

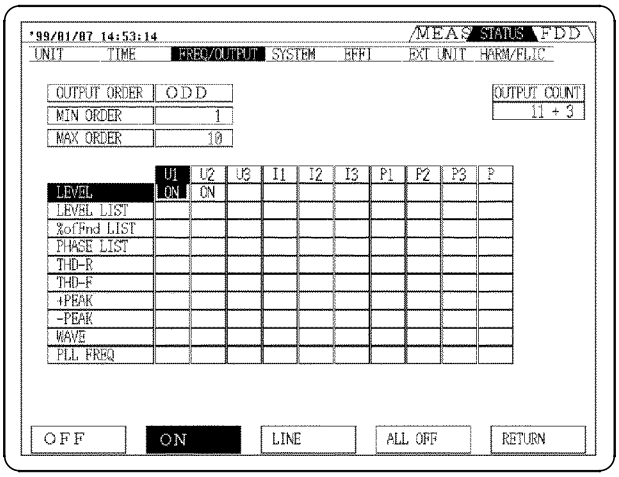
7.1.1 Output Setting in Harmonic Analysis Mode



1. Press the **F2** ″HARM SELECT″ key, to display the screen for output item selection.



2. Move the cursor to ″OUTPUT ORDER″ key.
3. Select the **F1** ″ALL″, **F2** ″ODD″, or **F3** ″EVEN″ key.
4. Move the cursor to ″MIN ORDER″ or ″MAX ORDER″ key.
5. Use the **F1** ″↑″ and **F2** ″↓″ keys to make a selection.



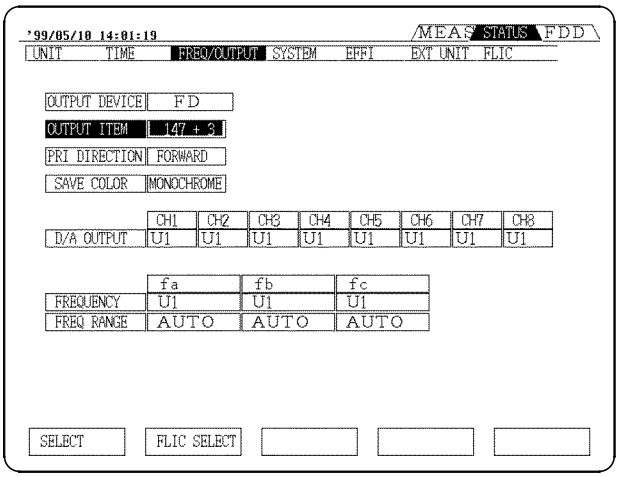
6. Using the **CURSOR** keys, move the cursor to the item to be output.
7. Press the **F2** ″ON″ key to make a setting. To delete the item which has been set, press the **F1** ″OFF″ key.
8. Pressing the **F3** ″LINE″ key sets the items on the specified line to on or off.
9. When the settings are completed, press the **F5** ″RETURN″ key.

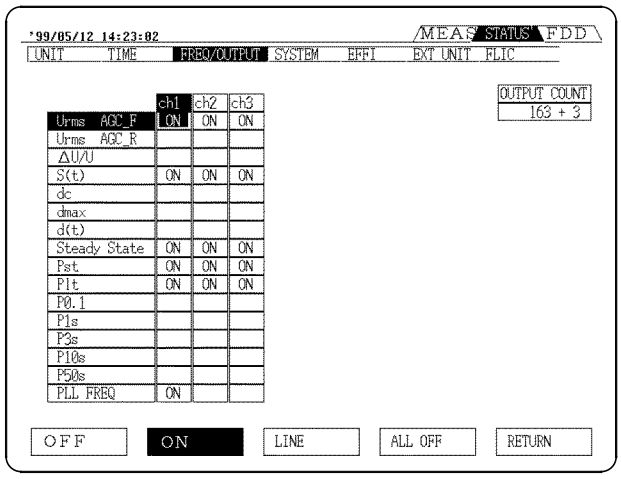
NOTE

For example, when the output item is set to ODD, and "MIN ORDER" is set to 1, and "MAX ORDER" is set to 10, this selects the data items for odd harmonics in the range 1 to 10.
Even if the waveform output is set to ON, the data is not output on a printer.

7.1.2 Output Setting in Flicker Measurement Mode

1. Press the **STATUS** key. Move the cursor to "FREQ/OUTPUT" using the PAGE key to display the Frequency/output setting screen.
2. Using the CURSOR keys, move the cursor to "Output Item", and press the **F2** "FLICK SELECT" key.
3. Using the **CURSOR** keys, move the cursor to the item to be output.
4. Pressing the **F3** ″LINE″ key sets the items on the specified line to on or off.
5. When the settings are completed, press the **F5** ″RETURN″ key.





7.2 Timer Control of Output

7.2.1 Harmonic Analysis

You can set control times to output automatically at those times.
1. Set the control time.
2. Select the output items.
3. Press the **START/STOP** key to start operation.

NOTE

- For the basic method of using the timer control, refer to the Instruction Manual for the 3193 unit. Section 7.2, "Setting the Control Time"
- The minimum interval which can be specified is varied automatically, depending on the number of output items.

7.2.2 Flicker Measurement

If the Pst interval and Plt repetitions are set for flicker measurement, an output occurs for each Pst interval, and then the operation is completed after the Plt repetition.

NOTE

- The Pst interval and Plt repetition settings correspond to the 3193 interval time and timer settings. For example, setting Pst to 1 minute and Plt to 120 times results in the 3193 interval timer being set to 60 seconds and the timer time to 2 hours. The Pst and Plt settings have priority, so the control times cannot be changes directly on the 3193 side. When you need to change the timing at the 3193 side, set the Pst and Plt settings to OFF.
- Output to the floppy diskette or printer is coordinated with the set Pst interval and Plt repetition settings.
- Available Pst interval settings are OFF and 1 to 30 minutes, and available Plt repetition settings are OFF and 1 to 2000 times. When both are OFF, the d measurements (dc, dmax and d(t)500ms) are performed according to the interval and timer settings on the 3193, and Pst and Plt are not measured.

7.2.3 Relationship Between the Number of Output Items and Interval Time

The maximum number of items to be output and corresponding minimum interval times for output to floppy diskette or printer are determined automatically as follows.

	Number of setting items	Minimum interval time
FDD only	1 to 70, 71 to 400 400 or more	10 s 20 s (20 s + 10 s)/370 items
Printer only	1 to 60 lines every 60 lines	10 s +10 s
FDD+Printer	1 to 60 every 60	Total value of FDD only and printer only

- For integration data, one data value is regarded as two values.
- A waveform saved to floppy disk counts as 512 data values.
- Waveform data cannot be output to the printer.

Specifications of the floppy disk data for the 9605 (Harmonic Analysis)

Harmonic data is output appended to the end of a line of ordinary measurement data. The output sequence is as shown in the table on the following page. The data for each of the harmonics in the list is output consecutively. If the time averaging or peak hold functions are active, the corresponding values (the same as on the screen) are output.
The suffixes (n) are output as two digit values (xx), with a leading space in the case of a single-digit value.
Example "U1(3),I2(23)"

The channel numbers, such as 1, 2, and 3 in "U1," "U2," and "U3" change, for example to "U4," "U5," and "U6," depending on the analysis channel settings.

	Headers	Meaning	Units
Fundamental frequency	HFREQ	Fundamental frequency of PLL source	Hz
Amplitude value	HU1 HU2 HU3	Voltage (U1) rms value Voltage (U2) rms value Voltage (U3) rms value	V
	HI1 HI2 HI3	Current (I1) rms value Current (I2) rms value Current (I3) rms value	A
	HP1 HP2 HP3 HP123	Active power (P1) Active power (P2) Active power (P3) Active power (Σ P)	W

	Headers	Meaning	Units
Peak value	U1+PEAK U2+PEAK U3+PEAK	Voltage (U1) positive peak value Voltage (U2) positive peak value Voltage (U3) positive peak value	V
	I1+PEAK I2+PEAK I3+PEAK	Current (I1) positive peak value Current (I2) positive peak value Current (I3) positive peak value	A
	U1-PEAK U2-PEAK U3-PEAK	Voltage (U1) negative peak value Voltage (U2) negative peak value Voltage (U3) negative peak value	V
	I1-PEAK I2-PEAK I3-PEAK	Current (U1) negative peak value Current (U2) negative peak value Current (U3) negative peak value	A
THD-R	THDR U1 THDR U2 THDR U3	Voltage (U1) total harmonic distortion ratio (THD-R) Voltage (U2) total harmonic distortion ratio (THD-R) Voltage (U3) total harmonic distortion ratio (THD-R)	%
	THDR I1 THDR I2 THDR I3	Current (I1) total harmonic distortion ratio (THD-R) Current (I2) total harmonic distortion ratio (THD-R) Current (I3) total harmonic distortion ratio (THD-R)	%
THD-F	THDF U1 THDF U2 THDF U3	Voltage (U1) total harmonic distortion ratio (THD-F) Voltage (U2) total harmonic distortion ratio (THD-F) Voltage (U3) total harmonic distortion ratio (THD-F)	%
	THDF I1 THDF I2 THDF I3	Current (I1) total harmonic distortion ratio (THD-F) Current (I2) total harmonic distortion ratio (THD-F) Current (I3) total harmonic distortion ratio (THD-F)	%
Harmonic level	U1 (n) U2 (n) U3 (n)	The n-th harmonic voltage (U1) rms value The n-th harmonic voltage (U2) rms value The n-th harmonic voltage (U3) rms value	V
	I1 (n) I2 (n) I3 (n)	The n-th harmonic current (I1) rms value The n-th harmonic current (I2) rms value The n-th harmonic current (I3) rms value	A
	P1 (n) P2 (n) P3 (n) P123 (n)	The n-th harmonic power value (P1) The n-th harmonic power value (P2) The n-th harmonic power value (P3) The n-th harmonic power value (Σ P)	W
Harmonic contents	U1%Fnd(n) U2%Fnd(n) U3%Fnd(n)	The n-th harmonic voltage (U1) contents The n-th harmonic voltage (U2) contents The n-th harmonic voltage (U3) contents	%
	I1%Fnd(n) I2%Fnd(n) I3%Fnd(n)	The n-th harmonic current (I1) contents The n-th harmonic current (I2) contents The n-th harmonic current (I3) contents	%
	P1%Fnd(n) P2%Fnd(n) P3%Fnd(n) P123%Fnd(n)	The n-th harmonic power value (P1) contents The n-th harmonic power value (P2) contents The n-th harmonic power value (P3) contents The n-th harmonic power value (Σ P) contents	%
Harmonic phase angle	U1deg(n) U2deg(n) U3deg(n)	The n-th harmonic voltage (U1) contents The n-th harmonic voltage (U2) contents The n-th harmonic voltage (U3) contents	°
	I1deg(n) I2deg(n) I3deg(n)	The n-th harmonic current (I1) contents The n-th harmonic current (I2) contents The n-th harmonic current (I3) contents	°
	P1deg(n) P2deg(n) P3deg(n) P123deg(n)	The n-th harmonic power value (P1) contents The n-th harmonic power value (P2) contents The n-th harmonic power value (P3) contents The n-th harmonic power value (Σ P) contents	°

Waveform output specification

The following items are output even one or more waveform items is selected.

- File name

  The same file name as for normal measurement items is used, and the file extension is ".TXT".

- Contents

  The first line is a header, and the second and subsequent lines comprise the data.
  Data is output in comma-separated (CSV) format, and one waveform consists of 512 data values.
  Thereafter, each save operation appends a set of data to the end of the file. These subsequent sets of data do not have separate headers.
  Even if no normal measurement items are selected apart from the waveforms, for the output of time series data a file is created for normal measurement items.
  As with a file for normal measurement items, if the floppy disk is removed at an intermediate stage, a header is attached.

- Example output

  Data for one cycle (with U1 and U2 output selected)

U1,	I1	Headers
-0.0192E+00,	**87.07E-03**	First data
0.0671E+00,	**87.05E-03**	Second data
0.1539E+00,	**87.02E-03**	Third data
.....		
-0.2772E+00,	**87.15E-03**	510-th data
-0.1910E+00,	**87.07E-03**	511-th data
-0.1036E+00,	**87.10E-03**	512-th data

Specifications of the floppy disk data for the 9605 (Flicker Measurement)

The channel numbers, such as 1, 2, and 3 in "U1," "U2," and "U3" change, for example to "U4," "U5," and "U6," depending on the analysis channel settings.

	Headers	Meaning	Units
Fundamental frequency	HFREQ	Fundamental frequency of PLL source	Hz
Basic measurement item	AGC_F1 AGC_F2 AGC_F3	Voltage (U1) rms value before AGC Voltage (U2) rms value before AGC Voltage (U3) rms value before AGC	V
	AGC_R1 AGC_R2 AGC_R3	Voltage (U1) rms value after AGC Voltage (U2) rms value after AGC Voltage (U3) rms value after AGC	V
	dU/U1 dU/U2 dU/U3	Voltage (U1) Relative voltage change Voltage (U2) Relative voltage change Voltage (U3) Relative voltage change	%
	S(t)1 S(t)2 S(t)3	Voltage (U1) Instantaneous flicker value Voltage (U2) Instantaneous flicker value Voltage (U3) Instantaneous flicker value	P.U.
d measurement item	dc1 dc2 dc3	Voltage (U1) Relative steady-state voltage change Voltage (U2) Relative steady-state voltage change Voltage (U3) Relative steady-state voltage change	%
	dmax1 dmax2 dmax3	Voltage (U1) Relative maximum voltage change Voltage (U2) Relative maximum voltage change Voltage (U3) Relative maximum voltage change	%
	d(t)1 d(t)2 d(t)3	Voltage (U1) 500-ms period analysis Voltage (U2) 500-ms period analysis Voltage (U3) 500-ms period analysis	ms
	steady1 steady2 steady3	Voltage (U1) steady-state times Voltage (U2) steady-state times Voltage (U3) steady-state times	times
Flicker measurement item	Pst1 Pst2 Pst3	Voltage (U1) Short-term flicker value Voltage (U2) Short-term flicker value Voltage (U3) Short-term flicker value	
	Plt1 Plt2 Plt3	Voltage (U1) Long-term flicker value Voltage (U2) Long-term flicker value Voltage (U3) Long-term flicker value	
Cumulative probability measurement item	P01_U1 P1s_U1 P3s_U1 P10s_U1 P50s_U1 P01_U1 P1s_U1 P3s_U1 P10s_U1 P50s_U1 P01_U1 P1s_U1 P3s_U1 P10s_U1 P50s_U1	Voltage (U1) Cumulative probability P0.1 Voltage (U1) Cumulative probability P1s Voltage (U1) Cumulative probability P3s Voltage (U1) Cumulative probability P10s Voltage (U1) Cumulative probability P50s Voltage (U2) Cumulative probability P0.1 Voltage (U2) Cumulative probability P1s Voltage (U2) Cumulative probability P3s Voltage (U2) Cumulative probability P10s Voltage (U2) Cumulative probability P50s Voltage (U3) Cumulative probability P0.1 Voltage (U3) Cumulative probability P1s Voltage (U3) Cumulative probability P3s Voltage (U3) Cumulative probability P10s Voltage (U3) Cumulative probability P50s	

Chapter 8
External Control

With a connection to the external output connector on the rear panel of the 3193 unit, various external control functions are available. The following controls apply to the 9605.

Pin number	Terminal
24	FDD/PRINTER. START
25	EXT.HOLD
48	EXT.CLOCK
49	TRIGGER.IN
50	TRIGGER.OUT

NOTE

- Be sure to observe the items under the WARNING, CAUTION, and NOTE headings in Chapter 9, "External Output/External Control Terminals" in the Instruction Manual supplied with the 3193 unit.
- The FDD/PRINTER.START and EXT.HOLD controls are common to overall 3193 operation.

8.1 EXT.CLOCK

Used for measurement in the frequency range in which the PLL circuit does not function (1 Hz to 5 Hz).

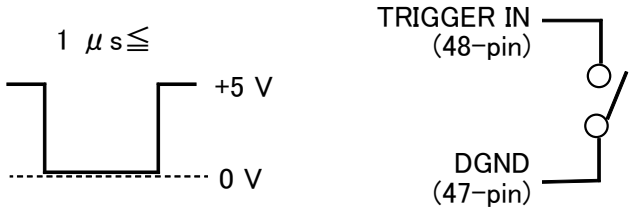
Clock frequency=Measurement waveform frequency (1 to 5 Hz)×4096×256
For example, to analyze a fundamental frequency of 1 Hz, input a clock signal with a frequency: 1× 8192× 256 = 2.097152 MHz

NOTE

Set the PLL source to "EXT."

8.2 TRIGGER.IN

When an external control signal is input, a single measurement is made and displayed. This operation is repeated each time the control signal is input. This is controlled by triggering at the edge of the input waveform, or shorting between 48-pin and 47-pin.



NOTE To use this control, the external trigger setting must be set to "ON."

8.3 TRIGGER.OUT

This outputs a clock signal with the same frequency as the signal waveform selected as the PLL source. For example, when a 50 Hz sine wave is input, this outputs a 50 Hz clock signal.

NOTE
- If the PLL circuit is not functioning correctly, normally no wave-shaped clock signal is output.
- The duty factor of the clock signal is not specified.
- The point at which the signal waveform crosses the zero value is not synchronized to the rising edge of the clock signal.

Chapter 9
GP-IB/RS-232C Interface

9.1 Overview

⚠ WARNING

In order to avoid the possibility of an electric shock, unplug the power meter's power cord and disconnect the other wiring before connecting the GP-IB or RS-232 cable to the interface connector.

⚠ CAUTION

- Turn the power off when connecting the personal computer to the power meter. Connecting or disconnecting cables while the power is on could damage the equipment.
- After connecting the GP-IB or RS-232C cable, always be sure to secure the connection with the screws on the connector.

The 3193 POWER HiTESTER is fitted as standard with a GP-IB/RS-232C interface. Using this interface, all of the functions of the unit can be controlled from a personal computer by remote control, for the acquisition of harmonic measurement data.
This section lists the extra commands added for harmonic measurement.

This section explains only commands added for the 9605.
For details on operation of the GP-IB or RS-232C interface, first refer to Chapter 12, "GP-IB/RS-232C Interface" in the instruction manual of the 3193.

NOTE

- It is not possible to use simultaneously both GP-IB and RS-232C interfaces.
- The 3193 cannot communicate with a PC when the STATUS screen or the FDD screen is shown on the display of the 3193. Make sure that the MEAS screen is on.

9.2 Event Registers

This section explains only event registers added for the 9605.
For the event status registers ESR2, ESR21 to ESR26, refer to Section 12.3.13, "Event Registers" (7) and (8) in the instruction manual of the 3193.

Event status register 0 (ESR0)

This register is used principally to monitor start and stop processing events.
The bit0 is added for the 9605.
For details, refer to ":HARMonic:RTC" command.

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?

Event status register 0 (ESR0)

Bit 7 SE	Sampling End Sampling ended after the end of the sampling count set by the ":RTC:COUNT" command.
Bit 6 ST	Start Time Start time is reached.
Bit 5 PE	Printer Error A printer paper end, head up, or temperature out-of-range status was issued.
Bit 4 FE	Floppy Error A floppy disk write error, read error, or disk full status occurred.
Bit 3 ST	Stop Time Timer and real time processing finished.
Bit 2 IE	Interval End Interval finished.
Bit 1 CE	Clamp Error The clamp was disconnected or connected, or an operation failure occurred.
Bit 0 UE	Harmonic/Flicker sampling processing end Sampling ended after the end of the sampling count set by the ″:HARMonic:RTC″ command.

9.3 Command Reference

9.3.1 Command Reference Explanation

This section explains each command in the harmonic analysis mode.

The 9605 is only capable of simultaneous analysis on three channels. Therefore, when channel are specified in a command, regardless of the channels on which the 9605 is operating, these are specified as channels 1, 2, and 3.
For example, if channels 3, 4, and 5 of the 3193 unit are used for analysis by the 9605, then the specifications to get measurement values are "HU1", "HTFI3", and so forth.

:Command

■ Indicates functions of message reference

Syntax : Indicates the command syntax.

< > : (Data portion)
Indicates the data format for a command that includes data.
<NR1>= integer data

Response syntax : Indicated only for commands for which a response message is returned.

Example : Shows a simple example illustrating the usage of the command. All transmissions are indicated in "short form."

Function : Describes the function of the command.

Note : Describes points that require special attention when using the command.

Error : Indicates the what kinds of errors might occur.

NOTE
"( )", "< >" marks should not be input.

9.3.2 Commands for Switching Harmonic Analysis/ Flicker Measurement

:SELect

■ Selects harmonic analysis or flicker measurement.

Syntax **:SELect** <character>
<character>= HARMonic/ FLICker

Example **:SELect HARMonic;*OPC?**
Select the harmonic analysis mode.

Function Selects the 9605 analysis mode to harmonic analysis or flicker measurement.

Note If the character data is other than <character>, a command error occurs.

If the optional 9605 is not installed, an execution error occurs.

While switching between harmonic and flicker with the :SELect command, other commands cannot be received, so using the :SELect command together with the *OPC? command is recommended. For example, set :SELect HARMonic;*OPC?. After the response message "1" is returned, send the next command.

:SELect?

■ Queries the setting of harmonic analysis or flicker measurement.

Syntax **:SELect?**

Response syntax **:SELECT** <**HARM/FLIC**>

Example
Transmission **:SELect?**
Response **:SELECT HARMONIC**
The harmonic analysis mode is selected.

Function Queries the setting of the 9605 analysis mode.

9.3.3 Specific Commands for Harmonic Analysis Function

:DATAout:ITEM:HARMonic:ALLClear

■ Clears all output items for harmonic default.

Syntax **:DATAout:ITEM:HARMonic:ALLClear**

Example **:DATAout:ITEM:HARMonic:ALLClear**

Function Clears all output items set by the ":DATAout:ITEM:HARMonic" command.

:DATAout:ITEM:HARMonic:ORDer

■ Sets the output item for the harmonic order.

Syntax **:DATAout:ITEM:HARMonic:ORDer** <NR1>,<NR1>,<ODD/EVEN/ALL>

first <NR1> = 0 to 50 (lower limit order)

second <NR1> = 0 to 50 (upper limit order)

Example **:DATAout:ITEM:HARMonic:ORDer 1,15,ODD**

Sets the output harmonic order to 1st to 15th odd-order.

Function Sets the output item for the harmonic order (level, percentage, and phase angle) to FDD or printer.

:DATAout:ITEM:HARMonic:ORDer?

■ Queries the output order of the harmonic data.

Syntax **:DATAout:ITEM:HARMonic:ORDer?**

Response syntax **:DATAOUT:ITEM:HARMONIC:ORDER** <0-50>,<0-50>,<ODD/EVEN/ALL>

Example

Transmission **:DATAout:ITEM:HARMonic:ORDer?**

Response **:DATAOUT:ITEM:HARMONIC:ORDER 1,15,ODD**

Function Queries the output item for the harmonic order (level, percentage, and phase angle) to FDD or printer.

:DATAout:ITEM:HARMonic:LIST

■ Setting the output item for the harmonic list.

Syntax **:DATAout:ITEM:HARMonic:LIST**
<NR1>,...(up to 6 items)
<NR1>= 0 to 63

Example **:DATAout:ITEM:HARMonic:LIST**
1,1,1,1,1,1
As the default output items to the floppy disk drive or printer for the normal measurement, the level, percentage, and phase angle for U1 and P1 are specified.

Function Sets the output item for the harmonic list (level, percentage, phase angle) to FDD or printer.
The item is set as shown below by setting bits, to specify a single numerical value.
For the harmonics to be output, it is necessary beforehand to issue a ":DATAout:ITEM:HARMonic:ORDer" command.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Level	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data2	–	–	–	–	HPSUM	HP3	HP2	HP1
Percentage	data3	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data4	–	–	–	–	HPSUM	HP3	HP2	HP1
Phase angle	data5	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data6	–	–	–	–	–	HP3	HP2	HP1

:DATAout:ITEM:HARMonic:LIST?

■ Queries the output item for the harmonic list.

Syntax **:DATAout:ITEM:HARMonic:LIST?**

Response syntax **:DATAOUT:ITEM:HARMONIC:LIST**
<0 - 63>,...(up to 6 items)

Example
Transmission **:DATAout:ITEM:HARMonic:LIST?**
Response **:DATAOUT:ITEM:HARMONIC:LIST**
1,1,1,1,1,1

Function Queries the item set by the ":DATAout:ITEM:HARMonic:LIST" command.

:DATAout:ITEM:HARMonic:NORMal

Sets the output item for the harmonic measurement value.

Syntax **:DATAout:ITEM:HARMonic:NORMal** <NR1>,..(up to 5 items)
<NR1>= 0 to 63

Example **:DATAout:ITEM:HARMonic:NORMal 9,1,9,9,0**
As the default output items to the floppy disk drive or printer for the normal measurement, U1,I1,P1,THDRU1,THDRI1,THDFU1, THDFI1 are specified.

Function Sets the output item for the harmonic measurement value (rms value, active power, and total harmonic distortion ratio) to FDD or printer.

Note If the setting value is out of range, an execution error occurs.

The item is set as shown below by setting bits, to specify a single numerical value.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
rms value	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1
Power	data2	–	–	–	–	HPSUM	HP3	HP2	HP1
THD-R	data3	–	–	HTRI3	HTRI2	HTRI1	HTRU3	HTRU2	HTRU1
THD-F	data4	–	–	HTFI3	HTFI2	HTFI1	HTFU3	HTFU2	HTFU1
Frequency	data5	–	–	–	–	–	–	–	HF

:DATAout:ITEM:HARMonic:NORMal?

Queries the output item for the harmonic measurement value.

Syntax **:DATAout:ITEM:HARMonic:NORMal?**

Response syntax **:DATAOUT:ITEM:HARMONIC:NORMAL** <0 - 63>,..(up to 5 items)

Example
Transmission **:DATAout:ITEM:HARMonic:NORMal?**
Response **:DATAOUT:ITEM:HARMONIC:NORMAL 9,1,9,9,0**

Function Queries the item set by the ":DATAout:ITEM:HARMonic:NORMal" command.

:DATAout:ITEM:HARMonic:WAVE

■ Sets the output item for the harmonic waveform data.

Syntax **:DATAout:ITEM:HARMonic:WAVE <NR1>,..**(up to 3 items)
<NR1> = 0 to 63

Example **:DATAout:ITEM:HARMonic:WAVE 1,1,1**
As the default output items to the floppy disk drive or printer for the normal measurement, the waveforms of +Upeak, -Upeak, and HU1 are specified.

Function Sets the output item for the harmonic waveform data to FDD or printer.
Sets the waveform data.

Note If the setting value is out of range, an execution error occurs.
The item is set as shown below by setting bits, to specify a single numerical value.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
+Peak	data1	–	–	HPIP3	HPIP2	HPIP1	HPUP3	HPUP2	HPUP1
−Peak	data2	–	–	HMIP3	HMIP2	HMIP1	HMUP3	HMUP2	HMUP1
Waveform	data3	–	–	HWI3	HWI2	HWI2	HWU3	HWU2	HWU1

:DATAout:ITEM:HARMonic:WAVE?

■ Queries the output item for the harmonic waveform data.

Syntax **:DATAout:ITEM:HARMonic:WAVE?**

Response syntax **:DATAOUT:ITEM:HARMONIC:WAVE** <0-63>,<0-63>,<0-63>

Example
Transmission **:DATAout:ITEM:HARMonic:WAVE?**
Response **:DATAOUT:ITEM:HARMONIC:WAVE 1,1,1**

Function Queries the item set by the ":DATAout:ITEM:HARMonic:WAVE" command.

:DISPlay:HARMonic:GRAPh

■ Sets the items to be displayed on the harmonic graph screen.

Syntax **:DISPlay:HARMonic:GRAPh** <NR1>
<NR1> = 1, 2, 3
1: 1 item display
2: each items (3 graphs)
3: each mode (3 graphs)
(non): changing the screen

Example **:DISPlay:HARMonic:GRAPh 2**
Displays 3 graphs for each items.

Function Sets the items to be displayed on the harmonic graph screen.

Note Depending on wiring mode and unit, the number of the graph to be displayed varies.

:DISPlay:HARMonic:GRAPh?

■ Queries the display item on the harmonic graph screen.

Syntax **:DISPlay:HARMonic:GRAPh?**

Function Queries the display item on the harmonic graph screen.

Response syntax **:DISPLAY:HARMONIC:GRAPH** <1/2/3>

Example
Transmission **:DISPlay:HARMonic:GRAPh?**
Response **:DISPLAY:HARMONIC:GRAPH 2**

:DISPlay:HARMonic:LIST

■ Sets the display item on the harmonic list screen.

Syntax **:DISPlay:HARMonic:LIST** <NR1>

Function Sets the display item on the harmonic list screen.

<NR1> =1, 2
1: 1 item display
2: 2 items display
(non): changing the screen

Example **:DISPlay:HARMonic:LIST 1**
Displays the list for one item.

:DISPlay:HARMonic:LIST?

■ Queries the display item on the harmonic list screen.

Syntax **:DISPlay:HARMonic:LIST?**

Function Queries the display item on the harmonic list screen.

Response syntax **:DISPLAY:HARMONIC:LIST** <1/2>

Example
Transmission **:DISPlay:HARMonic:LIST?**
Response **:DISPLAY:HARMONIC:LIST 2**

:DISPlay:HARMonic:VECTor

■ Displays the harmonic vector screen.

Syntax **:DISPlay:HARMonic:VECTor**

Function Displays the harmonic vector screen.

Example **:DISPlay:HARMonic:VECTor**

:DISPlay:HARMonic:WAVE

■ Sets the display item on the harmonic waveform screen.

Syntax **:DISPlay:HARMonic:WAVE** <NR1>
<NR1> = 1, 2, 3
1: 1 cycle waveform
2: 1 cycle waveform and peak value
3: 2 waveforms
If no data is specified, the previous screen is displayed.

Example **:DISPlay:HARMonic:WAVE 1**
Displays 1 cycle waveform.

Function Sets the display item on the harmonic waveform screen.

Note The number of graphs displayed may vary, depending on the number of input units and the wiring mode.

:DISPlay:HARMonic:WAVE?

■ Queries the display item on the harmonic waveform screen.

Syntax **:DISPlay:HARMonic:WAVE?**

Response syntax **:DISPLAY:HARMONIC:WAVE** <1/2/3>

Example
Transmission **:DISPlay:HARMonic:WAVE?**
Response **:DISPLAY:HARMONIC:WAVE 1**

Function Queries the display item on the harmonic waveform screen.

:DISPlay?

■ Queries the screen displays.

Syntax **:DISPlay?**

Response syntax **:DISPLAY** <character>
<character>
H_GRAPH
H_LIST
H_VECTOR
H_WAVE

Example
Transmission **:DISPlay?**
Response **:DISPLAY H_GRAPH**

Function Queries the current screen displayed.

Note The harmonic screen is added to the existing ":DISPLAY" command. There is no change in the response messages for the screen.

:HARMonic:CHANnel

■ Sets the harmonic analysis channel.

Syntax **:HARMonic:CHANnel** <NR1>
<NR1>= 1 to 5

Example **:HARMonic:CHANnel 1**
Harmonic analysis for channel 1, 2, and 3 is carried out.

Function Specifies the first channel for which harmonic analysis is to be carried out.

Note Some channel numbers cannot be specified as the first channel, depending on the input unit configuration and wiring mode of the 3193. In this case, an execution error occurs.

:HARMonic:CHANnel?

■ Queries the harmonic analysis channel.

Syntax **:HARMonic:CHANnel?**

Response syntax **:HARMonic:CHANNEL** <1-5>

Example
Transmission **:HARMonic:CHANnel?**
Response **:HARMONIC:CHANNEL 4**
Harmonic analysis for channel 4, 5, and 6 is carried out.

Function Queries the current setting of the first channel number for harmonic analysis.

:HARMonic:DELTa

■ Enables or disables the connection conversion.

Syntax **:HARMonic:DELTa** <ON/OFF>
<NR1>= 1 to 5

Example **:HARMonic:DELTa ON**
Harmonic analysis for channel 1, 2, and 3 is carried out.

Function This command executes △-Y conversion in 3V3A connection mode or Y-△ conversion in 3P4W connection mode.

Note Some channel numbers cannot be specified as the first channel, depending on the input unit configuration and wiring mode of the 3193. In this case, an execution error occurs.

:HARMonic:DELTa?

■ Queries the connection conversion.

Syntax **:HARMonic:DELTa?**

Response syntax **:HARMonic:DELTa** <ON/OFF>

Example
Transmission **:HARMonic:DELTa?**
Response **:HARMONIC:DELTA ON**

Function This command queries whether △-Y conversion is enabled or △-Y conversion is disabled.

:HARMonic:LPF

■ Enables or disables the time constant.

Syntax **:HARMonic:LPF** <ON/OFF>

Example **HARMonic:LPF ON**
Carries out exponential averaging of the harmonic analysis results.

Function Enables or disables the setting for the time constant of 1.5 seconds (±10%).
For details, see Section 4.10, "Time constant setting."

:HARMonic:LPF?

■ Queries the setting of the time constant.

Syntax **:HARMonic:LPF?**

Response syntax **:HARMONIC:LPF** <ON/OFF>

Example
Transmission **:HARMonic:LPF?**
Response **:HARMONIC:LPF ON**

Function Queries the harmonic analysis filter enablement.

:HARMonic:PLL

■ Sets the PLL source of the harmonic analysis.

Syntax **:HARMonic:PLL** <character>
<character> = HU1, HU2, HU3, HI1, HI2, HI3, EXT
EXT: external clock (see Section 4.3)

Example **:HARMonic:PLL HU1**
Sets the PLL source to HU1.

Function Selects the PLL source of the harmonic analysis. This selects the PLL source for harmonic analysis. Analysis is based on the PLL source selected by this command.

Note Some channel numbers cannot be specified as the first channel, depending on the input unit configuration and wiring mode of the 3193. In this case, an execution error occurs.

:HARMonic:PLL?

■ Queries the PLL source of the harmonic analysis.

Syntax **:HARMonic:PLL?**

Response syntax **:HARMONIC:PLL?** <HU1, HU2, HU3, HI1, HI2, HI3>

Example
Transmission **:HARMonic:PLL?**
Response **:HARMONIC:PLL HU1**

Function Queries the current selecting channel as PLL source.

:HARMonic:RTC

■ Sets the harmonic RTC counter.

Syntax **:HARMonic:RTC** <NR1>
<NR1> = 0 to 10000

Example **:HARMonic:RTC 50**
Sets the harmonic RTC counter to 50.

Function The harmonic display update timing is counted the specified number of times, and is indicated in UE bit (bit 0) of ESR0. When set to 0, this is off.

Note If the setting value is other than 0 to 10000, an execution error occurs.

:HARMonic:RTC?

■ Queries the harmonic RTC counter.

Syntax **:HARMonic:RTC?**

Response syntax **:HARMONIC:RTC** <0-10000>

Example
Transmission **:HARMonic:RTC?**
Response **:HARMONIC:RTC 50**

Function Queries the counter value set by the harmonic RTC counter.

:HARMonic:TRIGger

■ Enables or disables the trigger mode.

Syntax **:HARMonic:TRIGger** <ON/OFF>

Example **:HARMonic:TRIGger ON**

Function Selects whether or not to switch to the trigger pending state. When this is ON, the trigger pending state is entered. When OFF, the trigger pending state is left, and the system switches to normal harmonic analysis.

For details, refer to Section 8.2, "TRIGGER IN."

:HARMonic:TRIGger?

■ Queries the trigger mode.

Syntax **:HARMonic:TRIGger?**

Response syntax **:HARMONIC:TRIGGER** <ON/OFF>

Example
Transmission **:HARMonic:TRIGger?**
Response **:HARMONIC:TRIGGER ON**

Function Queries whether the current state is the trigger pending state. When this is ON, it indicates the trigger pending state. When it is OFF, it indicates not the trigger pending state.

:MEASure:HARMonic?

■ Queries the harmonic analysis data.

Syntax

Default mode:
:MEASure:HARMonic?
Data specification mode:
:MEASure:HARMonic?
<character>,..

Response syntax

Headers: ON
<character> <NR3>;<character> <NR3>;<character> <NR3>,...
Headers: OFF
<NR3>;<NR3>;<NR3>,...

Example

Transmission
:MEASure:HARMonic?
Response
HU1,HPUP1,HTFU1
HU1 +110.44E+00;HPUP1 +151.72E+00;HTFU1 +050.33E+00

Data portion: Numerical data in NR3 format
±□□□□□□E±□□
Mantissa : 6 digits with a decimal point
Exponent : 2 digits

Error: Display blank +6666.6E+99
Calculation impossible +7777.7E+99
Input over +9999.9E+99

Character

HU1, HU2, HU3	Voltage rms value
HI1, HI2, HI3	Current rms value
HP1, HP2, HP3, HPSUM	Active power
HPUP1, HPUP2, HPUP3	Voltage (+) peak value
HMUP1, HMUP2, HMUP3	Voltage (-) peak value
HPIP1, HPIP2, HPIP3	Current (+) peak value
HMIP1, HMIP2, HMIP3	Current (-) peak value
HTRU1, HTRU2, HTRU3	Voltage total harmonic distortion ratio (rms reference)
HTFU1, HTFU2, HTFU3	Voltage total harmonic distortion ratio (fundamental waveform reference)
HTRI1, HTRI2, HTRI3	Current total harmonic distortion ratio (rms reference)
HTFI1, HTFI2, HTFI3	Current total harmonic distortion ratio (fundamental waveform reference)
HF	Frequency

Function

① Default mode
If no parameters are specified in the data section, then this mode is used. Default item data specified by the ":MEASure:ITEM:HARMonic" command is created. In this case the data order is fixed.

② Data (parameter) specification mode
If one or more parameters are specified in the data section, then this mode is used. Measurement item data specified by <data> is created.
If data is specified which cannot be selected, because of the number of input units or the channels being used for harmonic analysis, an execution error results.
The order of arranging the data (parameters) is freely selectable, and data is created in the specified order.

Note

- Up to 70 items can be responded, however, in the data section specification mode, the harmonic level, harmonic proportion, and harmonic phase angle cannot be obtained. Select the output items with the ":MEASure:ITEM:HARMonic:..." command, and get the measurement values in the default mode.
- To change the NR3 numerical data format, see the ":TRANsmit:COLumn" command.

Headers for harmonic level, harmonic percentage, harmonic phase angle are shown below. When headers are ON, headers are affixed to all harmonic measurement value. The value of the last two digits of characters are shown harmonic order.

Level	Voltage Current Power	HU1L00 to HU1L50, HU2L00 to HU2L50, HU3L00 to HU3L50 HI1L00 to HI1L50, HI2L00 to HI2L50, HI3L00 to HI3L50 HP1L00 to HP1L50, HP2L00 to HP2L50, HP3L00 to HP3L50, HPSUML00 to HPSUML50
Percentage	Voltage Current Power	HU1D00 to HU1D50, HU2D00 to HU2D50, HU3D00 to HU3D50 HI1D00 to HI1D50, HI2D00 to HI2D50, HI3D00 to HI3D50 HP1D00 to HP1D50, HP2D00 to HP2D50, HP3D00 to HP3D50, HPSUMD00 to HPSUMD50
Phase angle/ difference	Voltage Current Power	HU1P00 to HU1P50, HU2P00 to HU2P50, HU3P00 to HU3P50 HI1P00 to HI1P50, HI2P00 to HI2P50, HI3P00 to HI3P50 HP1P00 to HP1P50, HP2P00 to HP2P50, HP3P00 to HP3P50

:MEASure:ITEM:HARMonic:ALLClear

■ Clears all harmonic default output item.

Syntax **:MEASure:ITEM:HARMonic:ALLClear**

Example **:MEASure:ITEM:HARMonic:ALLClear**

Function Clears all output items set by the ":MEASure:ITEM" command.

:MEASure:ITEM:HARMonic:ORDer

■ Sets the output order of the harmonic data.

Syntax **:MEASure:ITEM:HARMonic:ORDer** <NR1>,<NR1>,<ODD/EVEN/ALL>

first <NR1> = 0 to 50 (lower limit order)
second <NR1> = 0 to 50 (upper limit order)

Example **:MEASure:ITEM:HARMonic:ORDer 1,15,ODD**

Sets the default output item to odd data up to the 15th.

Function Sets the default items (harmonic output order for the level, percentage, and phase angle) to be transferred in the response message to the ":MEASure:HARMonic?" query in the default mode.

Note Some harmonics cannot be specified, depending on the measurement frequency.

In this case an execution error occurs.

:MEASure:ITEM:HARMonic:ORDer?

■ Queries the output order of the harmonic data.

Syntax **:MEASure:ITEM:HARMonic:ORDer?**

Response syntax **:MEASURE:ITEM:HARMONIC:ORDER** <0-50>,<0-50>,<ODD/EVEN/ALL>

Example

Transmission **:MEASure:ITEM:HARMonic:ORDer?**

Response **:MEASURE:ITEM:HARMONIC:ORDER 1,15,ODD**

Function Queries the default items (harmonic output order for the level, percentage, and phase angle) to be transferred in the response message to the ":MEASure?" query in the default mode.

:MEASure:ITEM:HARMonic:LIST

■ Sets the output item for the harmonic list.

Syntax **:MEASure:ITEM:HARMonic:LIST** <NR1>,..(up to 6 items)
<NR1> = 0 to 63

Example **:MEASure:ITEM:HARMonic:LIST 1,1,1,1,1,1**
As the default output items for the normal measurement, the level, percentage, and phase angle for U1 and P1 are specified.

Function Sets the default items (harmonic list for the level, percentage, and phase angle) to be transferred in the response message to the ":MEASure:HARMonic?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.
For the harmonics to be output, it is necessary beforehand to issue a ":MEASure:ITEM:HARMonic:ORDer" command.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Level	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data2	–	–	–	–	HPSUM	HP3	HP2	HP1
Percentage	data3	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data4	–	–	–	–	HPSUM	HP3	HP2	HP1
Phase angle	data5	–	–	HI3	HI2	HI1	HU3	HU2	HU1
	data6	–	–	–	–	–	HP3	HP2	HP1

:MEASure:ITEM:HARMonic:LIST?

■ Queries the output item for the harmonic list.

Syntax **:MEASure:ITEM:HARMonic:LIST?**

Response syntax **:MEASURE:ITEM:HARMONIC:LIST**<0-63>,..(up to 6 items)

Example
Transmission **:MEASure:ITEM:HARMonic:LIST?**
Response **:MEASURE:ITEM:HARMONIC:LIST 1,1,1,1,1,1**

Function Queries the setting items specified by the ":MEASure:ITEM:HARMonic:LIST" command.

:MEASure:ITEM:HARMonic:NORMal

Sets the output item for the harmonic measurement value.

Syntax **:MEASure:ITEM:HARMonic:NORMal** <NR1>,..(up to 5 items)
<NR1> = 0 to 63

Example **:MEASure:ITEM:HARMonic:NORMal 9,1,9,9,0**
As the default output items for the normal measurement, HU1, HI1, HP1, HTRU1, HTRI1, HTFU1, HTFI1 are specified.

Function Sets the default items (rms value, active power, total harmonic distortion ratio) to be transferred in the response message to the ":MEASure:HARMonic?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
rms value	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1
Power	data2	–	–	–	–	HPSUM	HP3	HP2	HP1
THD-R	data3	–	–	HTRI3	HTRI2	HTRI1	HTRU3	HTRU2	HTRU1
THD-F	data4	–	–	HTFI3	HTFI2	HTFI1	HTFU3	HTFU2	HTFU1
Frequency	data5	–	–	–	–	–	–	–	HF

:MEASure:ITEM:HARMonic:NORMal?

Queries the output item for the harmonic measurement value.

Syntax **MEASure:ITEM:HARMonic:NORMal?**

Response syntax **:MEASURE:ITEM:HARMONIC:NORMAL** <0-63>,..(up to 5 items)

Example
Transmission **:MEASure:ITEM:HARMonic:NORMal?**
Response **:MEASURE:ITEM:HARMONIC:NORMAL 9,1,9,9,0**

Function Queries the setting items specified by the ":MEASure:ITEM:HARMonic:NORMal" command.

MEASure:ITEM:HARMonic:WAVE

Sets the output item for the harmonic waveform data.

Syntax **:MEASure:ITEM:HARMonic:WAVE** <NR1>,<NR1>
<NR1> = 0 to 63

Example **:MEASure:ITEM:HARMonic:WAVE 1,1**
As the default output items for the normal measurement, +Upeak and -Upeak are specified.

Function Sets the default items (waveform data) to be transferred in the response message to the ":MEASure:HARMonic?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
+Peak	data1	–	–	HPIP3	HPIP2	HPIP1	HPUP3	HPUP2	HPUP1
-Peak	data2	–	–	HMIP3	HMIP2	HMIP1	HMUP3	HMUP2	HMUP1

:MEASure:ITEM:HARMonic:WAVE?

■ Queries the output item for the harmonic waveform data.

Syntax **:MEASure:ITEM:HARMonic:WAVE?**

Function Queries the setting items specified by the ":MEASure:ITEM:HARMonic :WAVE" command.

Response syntax **:MEASURE:ITEM:HARMONIC:WAVE** <0-63>,<0-63>

Example
Transmission **:MEASure:ITEM:HARMonic:WAVE?**
Response **:MEASURE:ITEM:HARMONIC:WAVE 1,1**

:ZEROadjust:HARMonic

■ Carries out the zero adjustment of the 9605.

Syntax **:ZEROadjust:HARMonic**

Function This carries out zero adjustment of the analog section of the 9605.
If there is no specification, zero adjustment is carried out for all channels.

Example **:ZEROadjust:HARMonic**

9.3.4 Specific Commands for Flicker Measurement

:DATAout:ITEM:FLICker:ALLClear

■ Clears all output items for flicker measurement default.

Syntax **:DATAout:ITEM:FLICker:ALLClear**

Example **:DATAout:ITEM:FLICker:ALLClear**

Function Clears all output items set by the ":DATAout:ITEM:FLICker" command.

:DATAout:ITEM:FLICker:DMEasure

■ Output selection of d measurement.

Syntax **:DATAout:ITEM:FLICker:DMEasure** <NR1>,<NR1>,<NR1>,<NR1>

<NR1> = 0 to 7

Example **:DATAout:ITEM:FLICker:DMEasure 1,1,1,0**

As the default output of the d measurement, dc, dmax, d(t)500ms are specified.v

As the default output items to the floppy disk drive or printer for the flicker measurement, dc, dmax, d(t)500ms are specified.

Function Sets the output item for d measurement (dc, dmax, d(t)500ms) to FDD or printer.

The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
dc	data1	–	–	–	–	–	FDC3	FDC2	FDC1
dmax	data2	–	–	–	–	–	FDMAX3	FDMAX2	FDMAX1
d(t)500ms	data3	–	–	–	–	–	FDT3	FDT2	FDT1
Constant time	data4	–	–	–	–	–	FSTDY3	FSTDY2	FSTDY1

:DATAout:ITEM:FLICker:DMEasure?

■ Queries the output item of d measurement.

Syntax **:DATAout:ITEM:FLICker:DMEasure?**

Example

Transmission **:DATAout:ITEM:FLICker:DMEasure?**

Response **:DATAOUT:ITEM:FLICKER:DMEASURE 1,1,1,0**

Function Queries the item set by the ":DATAout:ITEM:FLICker:DMEasure <NR1>,..." command.

:DATAout:ITEM:FLICker:FLICker

■ Sets the output item for the flicker value.

Syntax **:DATAout:ITEM:FLICker:FLICker**
<NR1>,...(up to 5 items)
<NR1>= 0 to 31

Example **:DATAout:ITEM:FLICker:FLICker 1,1,1,0,0**
As the default output items to the floppy disk drive or printer for the flicker measurement, Pst, Plt, P0.1 for channel 1 are specified.

Function Sets the output item for the flicker value (Pst, Plt, Ps) to FDD or printer.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Pst	data1	–	–	–	–	–	FPST3	FPST2	FPST1
Plt	data2	–	–	–	–	–	FPLT3	FPLT2	FPLT1
CPF	data3	–	–	–	FP50S1	FP10S1	FP3S1	FP1S1	FP011
	data4	–	–	–	FP50S2	FP10S2	FP3S2	FP1S2	FP012
	data5	–	–	–	FP50S3	FP10S3	FP3S3	FP1S3	FP013

:DATAout:ITEM:FLICker:FLICker?

■ Queries the output item for the flicker value.

Syntax **:DATAout:ITEM:FLICker:FLICker?**

Response syntax **:DATAOUT:ITEM:FLICKER:FLICKER**
<NR1>,.. up to 5 items

Example
Transmission **:DATAout:ITEM:FLICker:FLICker?**
Response **:DATAOUT:ITEM:FLICKER:FLICKER 1,1,1,0,0**

Function Queries the item set by the ":DATAout:ITEM:FLICker:FLICker " command.

:DATAout:ITEM:FLICker:NORMal

■ Sets the output item for the flicker measurement value.

Syntax **:DATAout:ITEM:FLICker:NORMal**
<NR1>,..(up to 5 items)
<NR1>= 0 to 7

Example **:DATAout:ITEM:FLICker:NORMal 1,1,1,0,1**
As the default output items to the floppy disk drive or printer for the flicker measurement, FU1, FAGC1, FDU1, FF are specified.

Function Sets the output item for the flicker measurement value (rms value, frequency) to FDD or printer.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Voltage rms value	data1	–	–	–	–	–	FU3	FU2	FU1
AGC output voltage	data2	–	–	–	–	–	FAGC3	FAGC2	FAGC1
ΔU/U	data3	–	–	–	–	–	FDU3	FDU2	FDU1
S(t)	data4	–	–	–	–	–	FST3	FST2	FST1
Frequency	data5	–	–	–	–	–	–	–	FF

:DATAout:ITEM:FLICker:NORMal?

■ Queries the output item for the flicker measurement value.

Syntax **:DATAout:ITEM:FLICker:NORMal?**

Response syntax **:DATAOUT:ITEM:FLICker:NORMAL**
<0 - 7>,..(up to 5 items)

Example
Transmission **:DATAout:ITEM:FLICker:NORMal?**
Response **:DATAOUT:ITEM:FLICker:NORMAL 1,1,1,0,1**

Function Queries the item set by the ":DATAout:ITEM:FLICker:NORMal" command.

:DISPlay:FLICker:CPF

■ Displays the CPF curve.

Syntax **:DISPlay:FLICker:CPF**

Example **:DISPlay:FLICker:CPF**

Function The CPF curve screen is displayed.

Note Depending on wiring mode and unit, the number of the graph to be displayed varies.

:DISPlay:FLICker:MONitor

■ Sets the display form on the Monitor screen.

Syntax **:DISPlay:FLICker:MONitor** <NR1>

<NR1>=1 to 3
1: Magnification display
2: Compression display
3: Dual display

Function Sets the display form on the Monitor screen.
When no parameter is set, the previous set screen is displayed.

Example **:DISPlay:FLICker:MONitor 3**
The dual display is specified.

:DISPlay:FLICker:MONitor?

■ Queries the display form on the Monitor screen.

Syntax **:DISPlay:FLICker:MONitor?**

Function Queries the current display form on the Monitor screen.

Example
Transmission **:DISPlay:FLICker:MONitor?**
Response **:DISPLAY:FLICKER:MONITOR 3?**

:DISPlay:FLICker:PST

■ Sets the display form on the Pst screen.

Syntax **:DISPlay:FLICker:PST**<NR1>

<NR1>=1 to 3
1: List display
2: Graph magnification display
3: Graph compression display

Function Sets the display form on the Pst screen.
When no parameter is set, the previous set screen is displayed.

Example **:DISPlay:FLICker:PST 1**
The list display is specified.

:DISPlay:FLICker:PST?

■ Queries the display form on the Pst screen.

Syntax **:DISPlay:FLICker:PST?**

Function Queries the current display form on the Pst screen.

Example
Transmission **:DISPlay:FLICker:PST?**
Response **:DISPLAY:FLICKER:PST 1?**

:DISPlay:FLICker:VALue

■ Sets the display item on the Flicker measurement screen.

Syntax **:DISPlay:FLICker:VALue** <NR1>

<NR1>=1 or 2
1: d measurement screen
2: Pst measurement screen

Example **:DISPlay:FLICker:VALue 1**

The d measurement screen is displayed.

Function Sets the display item on the Flicker measurement screen.

When no parameter is set, the previous set screen is displayed.

:DISPlay:FLICker:VALue?

■ Queries the display item on the Flicker measurement screen.

Syntax **:DISPlay:FLICker:VALue?**

Function Queries the current display item on the Flicker measurement screen.

Example

Transmission **:DISPlay:FLICker:VALue?**
Response **:DISPLAY:FLICKER:VALUE 1?**

:DISPlay?

■ Queries the display on the Flicker measurement screen.

Syntax **:DISPlay:FLICker?**

Function Queries the current display on the Flicker screen.

Response syntax **:DISPLAY** <character>

<character>

F_CPF	CPF curb line screen
F_MON	Monitor screen
F_PST	Pst graph screen
F_VALUE	Measurement value screen

Note The flicker screen is added to the existing ":DISPLAY" command. There is no change in the response messages for the screen.

Example

Transmission **:DISPlay?**
Response **:DISPLAY F_CPF**

The CPF curb line screen is displayed.

:FLICker:CHANnel

■ Sets the flicker analysis channel.

Syntax **:FLICker:CHANnel** <NR1>

<NR1>= 1 to 5

Example **:FLICker:CHANnel 1**

Flicker measurement for channel 1, 2, and 3 is carried out.

Function Specifies the first channel for which flicker measurement is to be carried out.

Note Some channel numbers cannot be specified as the first channel, depending on the input unit configuration and wiring mode of the 3193. In this case, an execution error occurs.

:FLICker:CHANnel?

■ Queries the flicker analysis channel.

Syntax **:FLICker:CHANnel?**

Response syntax **:FLICKER:CHANNEL** <1-5>

Example
Transmission **:FLICker:CHANnel?**
Response **:FLICker:CHANNEL 4**
Harmonic analysis for channel 4, 5, and 6 is carried out.

Function Queries the current setting of the first channel number for flicker analysis.

:FLICker:LONGterm

■ Sets the number of flicker evaluation repetitions for a long term.

Syntax **:FLICker:LONGterm** <NR1>
<NR1> = 0 to 2000
0: OFF

Example **:FLICker:LONGterm 12**
Sets the long-term flicker repetitions value to 12 (times).

Function Sets the number of flicker evaluation repetitions for a long term. The long-term flicker evaluation time is the product of the short-term flicker evaluation interval and the number of repetitions.

Note If the setting value is out of range, an execution error occurs.
If the evaluation time is specified when Pst is disabled, an execution error occurs.

:FLICker:LONGterm?

■ Queries the long-term flicker evaluation interval setting

Syntax **:FLICker:LONGterm?**

Response syntax **:FLICKER:LONGTERM** <0 - 2000>

Example
Transmission **:FLICker:LONGterm?**
Response **:FLICKER:LONGTERM 12**

Function Queries the long-term flicker evaluation interval setting

Note If the setting value is out of range, an execution error occurs.

: FLICker:DMULtiple

■ Sets Limit Multiplication Factor of 1.33

Syntax **:FLICker:DMULtiple** <ON/OFF>

Example **:FLICker:DMULtiple ON**

Function Sets whether to multiply the limit for the d (t) measurement by 1.33. When OFF is selected, the limit of d (t) is set to 3.3%. When ON is selected, the limit of d (t) is set to 4.389%.

:FLICker:DMULtiple?

■ Queries Limit Multiplication Factor of 1.33

Syntax **:FLICker:DMULtiple?**

Response syntax **:FLICker:DMULtiple** <ON/OFF>

Example
Transmission **:FLICker:DMULtiple?**
Response **:FLICKER:DMULTIPLE ON**

Function Queries the setting of the limit multiplication factor of 1.33 to on or off.

:FLICker:PLL

■ Sets the PLL source of the flicker measurement.

Syntax **:FLICker:PLL** <character>
<character> = FU1,FU2,FU3

Example **:HARMonic:PLL FU1**
Sets the PLL source to FU1.

Function Selects the PLL source of the flicker measurement. Analysis is based on the PLL source selected by this command.

Note Some channel numbers cannot be specified as the first channel, depending on the input unit configuration and wiring mode of the 3193. In this case, an execution error occurs.

:FLICker:PLL?

■ Queries the PLL source of the flicker measurement.

Syntax **:FLICker:PLL?**

Response syntax **:FLICKER:PLL?** <FU1, FU2, FU3>

Example
Transmission **:FLICker:PLL?**
Response **:FLICKER:PLL FU1**

Function Queries the current selecting channel as PLL source.

:FLICker:REFerence

■ Sets the flicker reference voltage.

Syntax **:FLICker:REFerence**

Example **:FLICker:REFerence**
Sets the flicker reference voltage.

Function Sets the flicker reference voltage.
The voltage effective value at the point this command is sent is set to flicker voltage.
The voltage effective value at that point is set to flicker reference voltage for all channels.

Note Before measurement, always set the flicker reference voltage by this command or panel control.

:FLICker:REFerence?

■ Queries the flicker reference voltage.

Syntax **:FLICker:REFerence?**

Response syntax **:FLICKER:REFERENCE** <NR3>,<NR3>,<NR3>

Example
Transmission **:FLICker:REFerence?**
Response **:FLICKER:REFERENCE 103.06E+00, 99.88E,100.04E+00**

Function Queries the flicker reference voltage.
The reference voltage for specified channels are returned.

Note Depending on the input unit configuration and wiring mode of the 3193, there may not be reference voltage for the specified channel. In that case, the value becomes "+7777.7E+99" which shows calculation not possible.
For changing the NR3 numerical data format, see the ":TRANsmit:COLumn" command.

:FLICker:SHORtterm

■ Sets the short-term flicker evaluation interval.

Syntax **:FLICker:SHORtterm** <NR1>
<NR1> = 0 to 30 (0: OFF
unit: minutes)

Example **:FLICker:SHORtterm 10**
Sets the short-term flicker evaluation interval to 10 minutes.

Function Sets the short-term flicker evaluation interval time (in minutes).as minutes.

Note If the setting value is out of range, an execution error occurs.

:FLICker:SHORtterm?

■ Queries the short-term flicker evaluation interval setting.

Syntax **:FLICker:SHORtterm?**

Response syntax **:FLICKER:SHORTTERM** <0 - 30>

Example
Transmission **:FLICker:SHORtterm?**
Response **:FLICKER:SHORTTERM 10**

Function Queries the short-term flicker evaluation interval setting.

:MEASure:FLICker?

■ Queries the flicker measurement data.

Syntax
Default mode:
:MEASure:FLICker?
Data specification mode:
:MEASure:FLICker? <character>,..

Response syntax
Headers: ON
<character> <NR3>;<character> <NR3>;<character> <NR3>,...
Headers: OFF
<NR3>;<NR3>;<NR3>,...

Example
Transmission **:MEASure:FLICker? FU1,FDU2**
Response **FU1 +110.44E+00;FDU2 +050.43E+00**

Data portion
Numerical data in NR1 format
□□□□□□
Integer 6 digits
Numerical data in NR3 format
±□□□□□□E±□□
Mantissa : 6 digits with a decimal point
Exponent : 2 digits

Error
Display blank:+6666.6E+99
Calculation impossible:+7777.7E+99
Input over +9999.9E+99

FU1,FU2,FU3 ····· Voltage rms value
FAGC1,FAGC2,FAGC3 ·· Voltage rms value after AGC
FDV1,FDV2,FDV3 ····· ΔU/U
FF ····· Frequency
FDC1,FDC2,FDC3 ····· dc
FDMAX1,FDMAX2,FDMAX3 ····· dmax
FDT1,FDT2,FDT3 ····· d(t)500ms
FSTDY1,FSTDY2,FSTDY3 ····· Steady-state times
FST1,FST2,FST3 ····· S(t)
FPST1,FPST2,FPST3 ····· Pst
FPLT1,FPLT2,FPLT3 ····· Plt
FP011,FP012,FP013 ····· P0.1
FP1S1,FP1S2,FP1S3 ····· P1s
FP3S1,FP3S2,FP3S3 ····· P3s
FP10S1,FP10S2,FP10S3 ····· P10s
FP50S1,FP50S2,FP50S3 ····· P50s

Function Queries the flicker measurement data
① Default mode
If no parameters are specified in the data section, then this mode is used. Default item data specified by the ":MEASure:ITEM:FLICker" command is created. In this case the data order is fixed.
② Data (parameter) specification mode
If one or more parameters are specified in the data section, then this mode is used. Measurement item data specified by <data> is created.
If data is specified which cannot be selected, because of the number of input units or the channels being used for flicker measurement, an execution error results.
The order of arranging the data (parameters) is freely selectable, and data is created in the specified order.

Note
- Up to 70 items can be responded.
- The items for d(t)500ms (unit:ms) and steady-state times (unit: times) are returned as integer values.
- To change the NR3 numerical data format, see the ":TRANsmit:COLumn" command.

:MEASure:ITEM:FLICker:ALLClear

■ Clears all flicker measurement default output item.

Syntax **:MEASure:ITEM:FLICker:ALLClear**

Example **:MEASure:ITEM:HARMonic:ALLClear**

Function Clears all output items set by the ":MEASure:ITEM:FLICker" command.

:MEASure:ITEM:FLICker:DMEasure

■ Sets the output item for the d measurement.

Syntax **:MEASure:ITEM:FLICker:DMEasure**
<NR1>,..(up to 7 items)
<NR1> = 0 to 7

Example **:MEASure:ITEM:FLICker:DMEasure 1,1,1,0**
As the default output items for the d measurement, dc, dmax, d(t)500ms for channel 1 are specified.

Function Sets the default items (d measurement items for dc, dmax, d(t)500ms) to be transferred in the response message to the ":MEASure:FLICker?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
dc	data1	–	–	–	–	–	FDC3	FDC2	FDC1
dmax	data2	–	–	–	–	–	FDMAX3	FDMAX2	FDMAX1
d(t)500ms	data3	–	–	–	–	–	FDT3	FDT2	FDT1
Constant time	data4	–	–	–	–	–	FSTDY3	FSTDY2	FSTDY1

:MEASure:ITEM:FLICker:DMEasure?

■ Queries the output item for the d measurement.

Syntax **:MEASure:ITEM:FLICker:DMEasure?**

Function Queries the item set by the ":MEASure:ITEM:FLICker:DMEasure" command.

Response syntax **:MEASURE:ITEM:FLICKER:DMEASURE**
<NR1>,.. up to 4 items

Example
Transmission **:MEASure:ITEM:FLICker:DMEasure**
Response **:MEASURE:ITEM:FLICKER:DMEASURE 1,1,1,0**

:MEASure:ITEM:FLICker:FLICker

■ Sets the output item for the flicker value.

Syntax **:MEASure:ITEM:FLICker:FLICker** <NR1>,..(up to 5 items)
<NR1> = 0 to 31

Example **:MEASure:ITEM:FLICker:FLICker 1,1,1,0,0**
As the default output items for the flicker measurement, Pst, Plt, P0.1 for channel 1 are specified.

Function Sets the default items (flicker value for Pst, Plt, Ps) to be transferred in the response message to the ":MEASure:FLICker?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Pst	data1	–	–	–	–	–	FPST3	FPST2	FPST1
Plt	data2	–	–	–	–	–	FPLT3	FPLT2	FPLT1
CPF	data3	–	–	–	FP50S1	FP10S1	FP3S1	FP1S1	FP011
	data4	–	–	–	FP50S2	FP10S2	FP3S2	FP1S2	FP012
	data5	–	–	–	FP50S3	FP10S3	FP3S3	FP1S3	FP013

:MEASure:ITEM:FLICker:FLICker?

■ Queries the output item for the flicker value.

Syntax **:MEASure:ITEM:FLICker:FLICker?**

Response syntax **:MEASURE:ITEM:FLICKER:FLICKER** <0-31>,..(up to 5 items)

Example
Transmission **:MEASure:ITEM:FLICker:FLICker?**
Response **:MEASURE:ITEM:FLICKER:FLICKER 1,1,1,0,0**

Function Queries the setting items specified by the ":MEASure:ITEM:FLICker:FLICker" command.

:MEASure:ITEM:FLICker:NORMal

■ Sets the output item for the flicker measurement value.

Syntax **:MEASure:ITEM:FLICker:NORMal**
<NR1>,..(up to 5 items)
<NR1> = 0 to 7

Example **:MEASure:ITEM:FLICker:NORMal 1,1,1,0,1**
As the default output items for the normal measurement, FU1, FAGC1, FDU1, FF are specified.

Function Sets the default items (rms value, frequency) to be transferred in the response message to the ":MEASure:FLICker?" query in the default mode.
The item is set as shown below by setting bits, to specify a single numerical value.

Note If the setting value is out of range, an execution error occurs.

		128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Voltage rms value	data1	–	–	–	–	–	FU3	FU2	FU1
AGC output voltage	data2	–	–	–	–	–	FAGC3	FAGC2	FAGC1
ΔU/U	data3	–	–	–	–	–	FDU3	FDU2	FDU1
S(t)	data4	–	–	–	–	–	FST3	FST2	FST1
Frequency	data5	–	–	–	–	–	–	–	FF

:MEASure:ITEM:FLICker:NORMal?

■ Queries the output item for the harmonic measurement value.

Syntax **:MEASure:ITEM:FLICker:NORMal?**

Response syntax **:MEASURE:ITEM:FLICKER:NORMAL**
<0-7>,..(up to 5 items)

Example
Transmission **:MEASure:ITEM:FLICker:NORMal?**
Response **:MEASURE:ITEM:FLICKER:NORMAL 1,1,1,0,1**

Function Queries the setting items specified by the ":MEASure:ITEM:FLICker:NORMal" command.

:ZEROadjust:FLICker

■ Carries out the zero adjustment of the 9605.

Syntax **:ZEROadjust:FLICker**

Example **:ZEROadjust:FLICker**

Function This carries out zero adjustment of the analog section of the 9605.
If there is no specification, zero adjustment is carried out for all channels.

9.4 Specific Commands Reference

(1) Specific commands reference for harmonic analysis

Command	Data format	Explanation	Page
:DATAout:ITEM:HARMonic:ALLClear		Clears all default output item.	63
:DATAout:ITEM:HARMonic:ORDer	NR1 numerical data (2)/ Character data (1)	Sets the harmonic output order.	63
:DATAout:ITEM:HARMonic:ORDer?		Queries the harmonic output order.	63
:DATAout:ITEM:HARMonic:LIST	NR1 numerical data (6)	Sets the output item for the harmonic list.	64
:DATAout:ITEM:HARMonic:LIST?		Queries the output item for the harmonic list.	64
:DATAout:ITEM:HARMonic:NORMal	NR1 numerical data (4)	Sets the output item for the harmonic measurement.	65
:DATAout:ITEM:HARMonic:NORMal?		Queries the output item for the harmonic measurement.	65
:DATAout:ITEM:HARMonic:WAVE	NR1 numerical data (2)	Sets the output item for the harmonic waveform data.	66
:DATAout:ITEM:HARMonic:WAVE?		Queries the output item for the harmonic waveform data.	66
:DISPlay:HARMonic:GRAPh	NR1 numerical data (1)	Sets the displays for the harmonic graph screen.	66
:DISPlay:HARMonic:GRAPh?		Queries the displays for the harmonic graph screen.	67
:DISPlay:HARMonic:LIST	NR1 numerical data (1)	Sets the displays for the harmonic list screen.	67
:DISPlay:HARMonic:LIST?		Queries the displays for the harmonic list screen.	67
:DISPlay:HARMonic:VECTor		Sets the displays for the harmonic vector screen.	67
:DISPlay:HARMonic:WAVE	NR1 numerical data (1)	Sets the displays for the harmonic waveform screen.	68
:DISPlay:HARMonic:WAVE?		Queries the displays for the harmonic waveform screen.	68
:DISPlay?		Queries the current display setting.	68
:HARMonic:CHANnel	NR1 numerical data (1)	Sets the harmonic analysis screen.	69
:HARMonic:CHANnel?		Queries the harmonic analysis screen.	69
:HARMonic:DELTa	ON/OFF (1)	Enables or disables the connection conversion.	69
:HARMonic:DELTa?		Queries the connection conversion.	69
:HARMonic:LPF	ON/OFF (1)	Enables or disables the time constant.	70
:HARMonic:LPF?		Queries the setting of the time constant.	70
:HARMonic:PLL	Character data (1)	Sets the harmonic analysis PLL source.	70
:HARMonic:PLL?		Queries the harmonic analysis PLL source.	70

Command	Data format	Explanation	Page
:HARMonic:RTC	NR1 numerical data (1)	Sets the harmonic RTC counter.	71
:HARMonic:RTC?		Queries the setting of the harmonic RTC counter.	71
:HARMonic:TRIGger	ON/OFF (1)	Enables or disables the trigger mode.	71
:HARMonic:TRIGger?		Queries the trigger mode setting.	71
:MEASure:HARMonic?	Character data (70)	Queries the harmonic analysis data	72
:MEASure:ITEM:HARMonic:ALLClear		Clears the output item for the harmonic default.	73
:MEASure:ITEM:HARMonic:ORDer	NR1 numerical data (2)/ character data (1)	Sets the output order of the harmonic data.	73
:MEASure:ITEM:HARMonic:ORDer?		Queries the setting of the output order of the harmonic data.	73
:MEASure:ITEM:HARMonic:LIST	NR1 numerical data (6)	Sets the output item of the harmonic list.	74
:MEASure:ITEM:HARMonic:LIST?		Queries the output item of the harmonic list.	74
:MEASure:ITEM:HARMonic:NORMal	NR1 numerical data (4)	Sets the output item of the harmonic measurement.	75
:MEASure:ITEM:HARMonic:NORMal?		Queries the output item of the harmonic measurement.	75
:MEASure:ITEM:HARMonic:WAVE	NR1 numerical data (1)	Sets the displays for the harmonic waveform screen.	75
:MEASure:ITEM:HARMonic:WAVE?		Queries the setting of the displays for the harmonic waveform screen.	76
:ZEROadjust:HARMonic		Carries out the zero adjustment.	76

(2) Specific commands reference for flicker measurement

Command	Data format	Explanation	Page
:DATAout:ITEM:FLICker:ALLClear		Clears all default output item.	77
:DATAout:ITEM:FLICker:DMEasure	NR1 numerical data (4)	Sets the output items for d measurement.	77
:DATAout:ITEM:FLICker:DMEasure?		Queries the output items for d measurement.	77
:DATAout:ITEM:FLICker:FLICker	NR1 numerical data (5)	Sets the output item for the flicker value.	78
:DATAout:ITEM:FLICker:FLICker?		Queries the output item for the flicker value.	78
:DATAout:ITEM:FLICker:NORMal	NR1 numerical data (5)	Sets the output item for the flicker measurement.	79
:DATAout:ITEM:FLICker:NORMal?		Queries the output item for the flicker measurement.	79
:DISPlay:FLICker:CPF		Sets the displays for the CPF screen of flicker measurement.	79
:DISPlay:FLICker:MONitor	NR1 numerical data (1)	Sets the displays for the Monitor screen of flicker measurement.	80
:DISPlay:FLICker:MONitor?		Queries the displays for the Monitor screen.	80
:DISPlay:FLICker:PST	NR1 numerical data (1)	Sets the displays for the Pst screen of flicker measurement.	80
:DISPlay:FLICker:PST?		Queries the displays for the Pst screen.	80
:DISPlay:FLICker:VALue	NR1 numerical data (1)	Sets the display value of flicker measurement.	81
:DISPlay:FLICker:VALue?		Queries the display value of flicker measurement.	81
:DISPlay?		Queries the current display setting.	81
:FLICker:CHANnel	NR1 numerical data (1)	Sets the flicker analysis screen.	81
:FLICker:CHANnel?		Queries the flicker analysis screen.	82
:FLICker:LONGterm	NR1 numerical data (1)	Sets the number of flicker evaluation repetitions for a long term.	82
:FLICker:LONGterm?		Queries the long-term flicker evaluation interval setting.	82
:FLICker:DMULtiple	ON/OFF (1)	ON/OFF of the limit multiplication factor of 1.33	82
:FLICker:DMULtiple?		Queries of the limit multiplication factor	83
:FLICker:PLL	Character data (1)	Sets the flicker measurement PLL source.	83
:FLICker:PLL?		the flicker measurement PLL source.	83
:FLICker:REFerence		Sets the flicker reference voltage.	83
:FLICker:REFerence?		Queries the flicker reference voltage.	84

Command	Data format	Explanation	Page
:FLICker:SHORtterm	NR1 numerical data (1)	Sets the number of flicker evaluation repetitions for a short term.	84
:FLICker:SHORtterm?		Queries the short-term flicker evaluation interval setting.	84
:MEASure:FLICker?	Character data (70)	Queries the flicker measurement data	85
:MEASure:ITEM:FLICker:ALLClear		Clears the output item for the flicker measurement default.	85
:MEASure:ITEM:FLICker:DMEasure	NR1 numerical data (4)	Sets the output order of the d measurement data.	86
:MEASure:ITEM:FLICker:DMEasure?		Queries the setting of the output order of the d measurement data.	86
:MEASure:ITEM:FLICker:FLICker	NR1 numerical data (5)	Sets the output item of the flicker value.	87
:MEASure:ITEM:FLICker:FLICker?		Queries the output item of the flicker value.	87
:MEASure:ITEM:FLICker:NORMal	NR1 numerical data (5)	Sets the output item of the flicker measurement.	88
:MEASure:ITEM:FLICker:NORMal?		Queries the output item of the flicker measurement.	88
:ZEROadjust:FLICker		Carries out the zero adjustment.	88

(3) Selecting commands between harmonic analysis and flicker measurement

Command	Data format	Explanation	Page
:SELect	Character data	Selects the harmonic analysis or flicker measurement mode.	62
:SELect?		Queries the selected mode.	62

9.5 Valid Commands for Each Status

(1) Harmonic analysis

Command \ Integration condition	Reset			Start			Stop		
	HOLD		PEAK	HOLD		PEAK	HOLD		PEAK
	OFF	ON	ON	OFF	ON	ON	OFF	ON	ON
:DATAout:ITEM:HARMonic:ALLClear	●	—	—	—	—	—	—	—	—
:DATAout:ITEM:HARMonic:ORDer	●	—	—	—	—	—	—	—	—
:DATAout:ITEM:HARMonic:ORDer?	●	●	●	●	●	●	●	●	●
:DATAout:ITEM:HARMonic:LIST	●	—	—	—	—	—	—	—	—
:DATAout:ITEM:HARMonic:LIST?	●	●	●	●	●	●	●	●	●
:DATAout:ITEM:HARMonic:NORMal	●	—	—	—	—	—	—	—	—
:DATAout:ITEM:HARMonic:NORMal?	●	●	●	●	●	●	●	●	●
:DATAout:ITEM:HARMonic:WAVE	●	—	—	—	—	—	—	—	—
:DATAout:ITEM:HARMonic:WAVE?	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:GRAPh	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:GRAPh?	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:LIST	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:LIST?	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:VECTor	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:WAVE	●	●	●	●	●	●	●	●	●
:DISPlay:HARMonic:WAVE?	●	●	●	●	●	●	●	●	●
:DISPlay?	●	●	●	●	●	●	●	●	●
:HARMonic:CHANnel	●	—	—	—	—	—	—	—	—
:HARMonic:CHANnel?	●	●	●	●	●	●	●	●	●
:HARMonic:DELTa	●	—	—	—	—	—	—	—	—
:HARMonic:DELTa?	●	●	●	●	●	●	●	●	●
:HARMonic:LPF	●	—	—	—	—	—	—	—	—
:HARMonic:LPF?	●	●	●	●	●	●	●	●	●
:HARMonic:PLL	●	—	—	—	—	—	—	—	—
:HARMonic:PLL?	●	●	●	●	●	●	●	●	●
:HARMonic:RTC	●	—	—	—	—	—	—	—	—
:HARMonic:RTC?	●	●	●	●	●	●	●	●	●
:HARMonic:TRIGger	●	—	—	—	—	—	—	—	—
:HARMonic:TRIGger?	●	●	●	●	●	●	●	●	●
:MEASure:HARMonic?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:HARMonic:ALLClear	●	—	—	—	—	—	—	—	—
:MEASure:ITEM:HARMonic:ORDer	●	—	—	—	—	—	—	—	—
:MEASure:ITEM:HARMonic:ORDer?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:HARMonic:LIST	●	—	—	—	—	—	—	—	—
:MEASure:ITEM:HARMonic:LIST?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:HARMonic:NORMal	●	—	—	—	—	—	—	—	—
:MEASure:ITEM:HARMonic:NORMal?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:HARMonic:WAVE	●	—	—	—	—	—	—	—	—
:MEASure:ITEM:HARMonic:WAVE?	●	●	●	●	●	●	●	●	●
:ZEROAdjust:HARMonic	●	—	—	—	—	—	—	—	—

(2) Flicker measurement

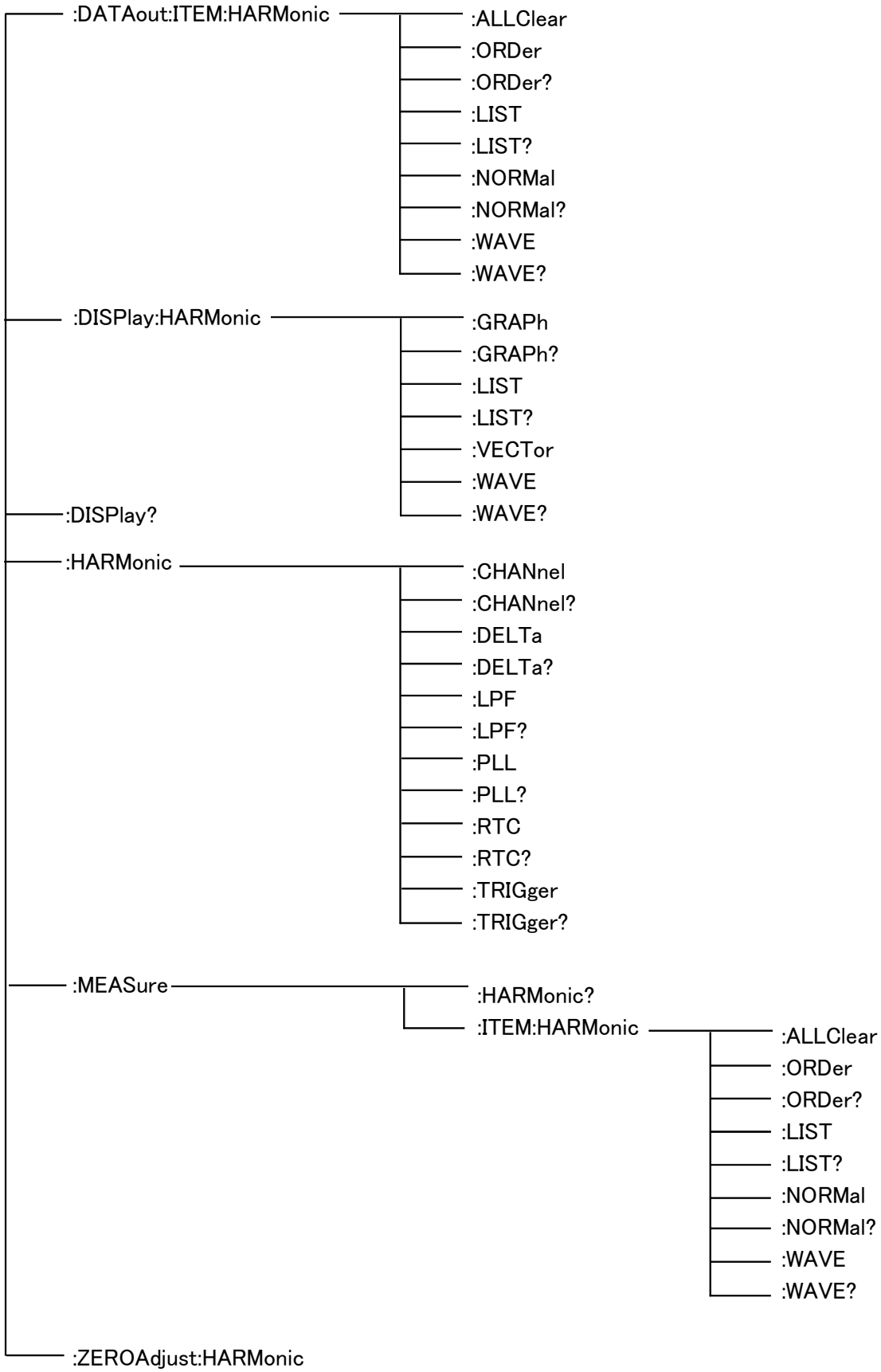
Command \ Integration condition	Reset			Start			Stop		
	HOLD		PEAK	HOLD		PEAK	HOLD		PEAK
	OFF	ON	ON	OFF	ON	ON	OFF	ON	ON
:DATAout:ITEM:FLICker:ALLClear	●	–	–	–	–	–	–	–	–
:DATAout:ITEM:FLICker:DMEasure	●	–	–	–	–	–	–	–	–
:DATAout:ITEM:FLICker:DMEasure?	●	●	●	●	●	●	●	●	●
:DATAout:ITEM:FLICker:FLICker	●	–	–	–	–	–	–	–	–
:DATAout:ITEM:FLICker:FLICker?	●	●	●	●	●	●	●	●	●
:DATAout:ITEM:FLICker:NORMal	●	–	–	–	–	–	–	–	–
:DATAout:ITEM:FLICker:NORMal?	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:CPF	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:CPF?	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:MONitor	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:MONitor?	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:PST	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:PST?	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:VALue	●	●	●	●	●	●	●	●	●
:DISPlay:FLICker:VALue?	●	●	●	●	●	●	●	●	●
:DISPlay?	●	●	●	●	●	●	●	●	●
:FLICker:CHANnel	●	–	–	–	–	–	–	–	–
:FLICker:CHANnel?	●	●	●	●	●	●	●	●	●
:FLICker:LONGterm	●	–	–	–	–	–	–	–	–
:FLICker:LONGterm?	●	●	●	●	●	●	●	●	●
:FLICker:DMULtiple	●	–	–	–	–	–	–	–	–
:FLICker:DMULtiple?	●	●	●	●	●	●	●	●	●
:FLICker:PLL	●	–	–	–	–	–	–	–	–
:FLICker:PLL?	●	●	●	●	●	●	●	●	●
:FLICker:REFerence	●	–	–	–	–	–	–	–	–
:FLICker:REFerence?	●	●	●	●	●	●	●	●	●
:FLICker:SHORtterm	●	–	–	–	–	–	–	–	–
:FLICker:SHORtterm?	●	●	●	●	●	●	●	●	●
:MEASure:FLICker?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:FLICker:ALLClear	●	–	–	–	–	–	–	–	–
:MEASure:ITEM:FLICker:DMEasure	●	–	–	–	–	–	–	–	–
:MEASure:ITEM:FLICker:DMEasure?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:FLICker:FLICker	●	–	–	–	–	–	–	–	–
:MEASure:ITEM:FLICker:FLICker?	●	●	●	●	●	●	●	●	●
:MEASure:ITEM:FLICker:NORMal	●	–	–	–	–	–	–	–	–
:MEASure:ITEM:FLICker:NORMal?	●	●	●	●	●	●	●	●	●
:ZEROAdjust:FLICker	●	–	–	–	–	–	–	–	–

(3) Selecting commands between harmonic analysis and flicker measurement

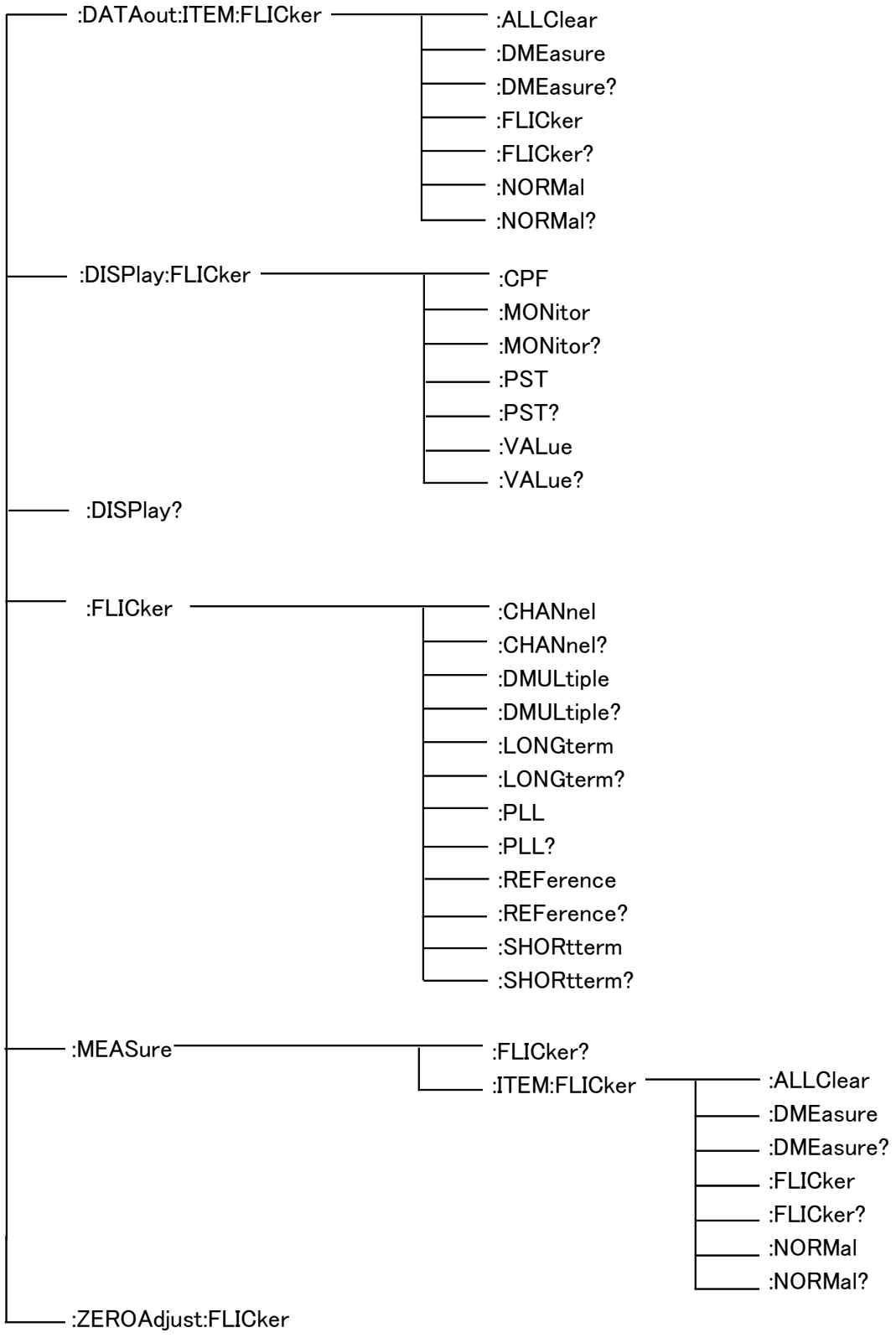
Command \ Integration condition	Reset			Start			Stop		
	HOLD		PEAK	HOLD		PEAK	HOLD		PEAK
	OFF	ON	ON	OFF	ON	ON	OFF	ON	ON
:SELect	●	—	—	—	—	—	—	—	—
:SELect?	●	●	●	●	●	●	●	●	●

9.6 Specific Command Tree

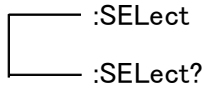
(1) Harmonic analysis



(2) Flicker analysis



(3) Selecting harmonic analysis or flicker measurement



9.7 The Output Item Bits

(1) Harmonic analysis

The data specified by :MEAS:ITEM:HARMonic is output in the following order.

:NORMAL		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
rms value	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1	1
Active power	data2	–	–	–	–	HPSUM	HP3	HP2	HP1	2
THD-R	data3	–	–	HTRI3	HTRI2	HTRI1	HTRU3	HTRU2	HTRU1	3
THD-F	data4	–	–	HTFI3	HTFI2	HTFI1	HTFU3	HTFU2	HTFU1	4
Frequency	data5	–	–	–	–	–	–	–	HF	5

:LIST		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
Level	data1	–	–	HI3	HI2	HI1	HU3	HU2	HU1	6
	data2	–	–	–	–	HPSUM	HP3	HP2	HP1	7
Percentage	data3	–	–	HI3	HI2	HI1	HU3	HU2	HU1	8
	data4	–	–	–	–	HPSUM	HP3	HP2	HP1	9
Phase angle	data5	–	–	HI3	HI2	HI1	HU3	HU2	HU1	10
	data6	–	–	–	–	–	HP3	HP2	HP1	11

:WAVE		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
+Peak	data1	–	–	HPIP3	HPIP2	HPIP1	HPUP3	HPUP2	HPUP1	12
−Peak	data2	–	–	HMIP3	HMIP2	HMIP1	HMUP3	HMUP2	HMUP1	13
Waveform	data3	–	–	HWI3	HWI2	HWI2	HWU3	HWU2	HWU1	14*

*:DATAout only

The bits set by :MEAS:ITEM:HARMonic are scanned according to the following rules, and returned in this order in a response message.

The output data sequence is as follows.

① For item number 1, bits 0 to 5 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

② For item number 2, bits 0 to 3 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

③ For item number 3, bits 0 to 5 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

And so on, repeating up to item number 14.

NOTE A bit is ignored if it is set for a calculation value which cannot be obtained in the power measurement configuration being used.

(2) Harmonic analysis

The data specified by :MEAS:ITEM:HARMonic is output in the following order.

:DMEasure		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
dc	data1	–	–	–	–	–	FDC3	FDC2	FDC1	1
dmax	data2	–	–	–	–	–	FDMAX3	FDMAX2	FDMAX1	2
d(t)500ms	data3	–	–	–	–	–	FDT3	FDT2	FDT1	3
Constant time	data4	–	–	–	–	–	FSTDY3	FSTDY2	FSTDY1	4

:FLICker		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
Pst	data1	–	–	–	–	–	FPST3	FPST2	FPST1	5
P1t	data2	–	–	–	–	–	FPLT3	FPLT2	FPLT1	6
CPF	data3	–	–	–	FP50S1	FP10S1	FP3S1	FP1S1	FP011	7
	data4	–	–	–	FP50S2	FP10S2	FP3S2	FP1S2	FP012	8
	data5	–	–	–	FP50S3	FP10S3	FP3S3	FP1S3	FP013	9

:NORMal		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Item No.
Voltage rms value	data1	–	–	–	–	–	FU3	FU2	FU1	10
AGC output voltage	data2	–	–	–	–	–	FAGC3	FAGC2	FAGC1	11
ΔU/U	data3	–	–	–	–	–	FDU3	FDU2	FDU1	12
S(t)	data4	–	–	–	–	–	FST3	FST2	FST1	13
Frequency	data4	–	–	–	–	–	–	–	FF	14

The bits set by :MEAS:ITEM:FLICker are scanned according to the following rules, and returned in this order in a response message.

The output data sequence is as follows.

① For item number 1, bits 0 to 2 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

② For item number 2, bits 0 to 2 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

③ For item number 3, bits 0 to 2 are scanned in order, and when a bit is set to 1 the calculation value for the corresponding item is returned.

And so on, repeating up to item number 14.

Chapter 10
Specifications

10.1 Harmonic Analysis Function

(1) General Specifications

Application	Fitted in a 3193 unit (factory-fitted option)
Measurement lines	Single-phase,two-wire (1P2W)/ Single-phase,three-wire (1P3W)/ Three-phase,three-wire (3V3A, 3P3W)/ Three-phase,four-wire (3P4W)
Number of channels	Maximum of 3 channels selectable from channels 1 to 6, depending on 3193 unit wiring mode

	1ch	2ch	3ch	4ch	5ch	6ch	Using channels
①	1P2W	1P2W	1P2W	1P2W	1P2W	1P2W	1+2+3, 2+3+4, 3+4+5, 4+5+6
②	1P3W/3P3W		1P2W	1P2W	1P2W	1P2W	12+3, 3+4+5, 4+5+6
③	1P3W/3P3W		1P3W/3P3W		1P2W	1P2W	12+3, 34+5, 4+5+6
④	1P3W/3P3W		1P3W/3P3W		1P3W/3P3W		12+3, 34+5, 56
⑤	3V3A/3P4W			1P2W	1P2W	1P2W	123, 4+5+6
⑥	3V3A/3P4W			1P3W/3P3W		1P2W	123, 45+6
⑦	3V3A/3P4W			3V3A/3P4W			123, 456

Measurement range	Basic frequency 1 to 440 Hz, external clock type: 1 to 5 Hz, PLL type: 5 to 440 Hz
Measurement system	PLL synchronization For fundamental from 45 Hz to 66 Hz, fundamental frequency and PLL synchronizing frequency phase deviation no more than ±0.01%
Analysis method	FFT
Type of window	Rectangular (no gaps or overlaps in window)
Display update rate	Every 1 window (excluding when FFD/printer output and communication)
A/D	16 bits
Computational accuracy	32 bits (floating-point calculations)
PLL source	Select voltage (U) or current (I) from the channel combination selected for measurement
Reference standard	IEC61000-3-2:2000 IEC61000-4-7:1991

External clock signal	Input clock signal of frequency ((measured signal frequency)×8192×256) (TTL levels) enables measurement in the low-frequency range (1 Hz to 5 Hz)
Crest factor	4 max. (current), 3 max. (voltage)
Output function	FD, printer,GP-IB, RS-232C
Sampling rate	External clock input frequency: (1 to 5 Hz)×8192×256 Analysis harmonic order: 50th Window width: 1 cycle

Basic input frequency f	Sampling rate	Analysis harmonic order	Window width
5 to 10 Hz	f×4096	50th	2 cycles
10 to 20 Hz	f×2048	50th	4 cycles
20 to 40 Hz	f×1024	50th	8 cycles
40 to 70 Hz	f×512	50th	16 cycles
70 to 140 Hz	f×256	50th	32 cycles
140 to 250 Hz	f×128	50th	64 cycles
250 to 440 Hz	f×64	27th	128 cycles

(2) Measurement items

Basic items: Voltage rms value, current rms value, active power value, frequency, ±Upeak, ±Ipeak

Harmonic measurement items

Measurement items	Voltage	Current	Active power
Harmonic level	Harmonic voltage	Harmonic current	Harmonic power
Harmonic percentage	Harmonic voltage percentage	Harmonic current percentage	Harmonic power percentage
Harmonic phase angle	Harmonic voltage phase angle	Harmonic current phase angle	Harmonic power phase angle
Total harmonic distortion ratio *1 (THD-F and THD-R)	Total harmonic voltage distortion ratio	Total harmonic current distortion ratio	

*1 THD-F: total harmonic distortion as proportion of the fundamental
THD-R: total harmonic distortion as proportion of the effective value

(3) Screen Displays

Display screen	Display items
List display	Voltage rms value, current rms value, active power value, harmonic level, harmonic percentage, harmonic phase angle, total harmonic distortion ratio
Graph display	Harmonic level, harmonic percentage, harmonic phase angle
Vector display	Harmonic level
Waveform display	Voltage waveform, current waveform, voltage rms value, current rms value, voltage peak value, current peak value

(4) Analysis accuracy

(23℃±5℃,80%RHmax.warming-up 1 hour or more
Guaranteed accuracy period: six months)

Basic measurement item/ Harmonic measurement item	Voltage,current/ Harmonic voltage/ current	Active power (power factor = 1)/ Harmonic active power	——/ Harmonic phase difference between voltage and current
1 to 5 Hz	±1.0%rdg.±0.5 %f.s.	±2.0%rdg.±0.5%f.s.	±15 deg
5 to 10 Hz	±1.0%rdg.±0.5 %f.s.	±2.0%rdg.±0.5%f.s.	±15 deg
10 to 45 Hz	±1.0%rdg.±0.2 %f.s.	±1.5%rdg.±0.2%f.s.	± 5 deg
45 to 66 Hz	±0.5%rdg.±0.05%f.s.	±1.0%rdg.±0.1%f.s.	± 2 deg
66 Hz to 1 kHz	±1.0%rdg.±0.05%f.s.	±1.5%rdg.±0.1%f.s.	± 5 deg
1k to 3 kHz	±2.0%rdg.±0.05%f.s.	±2.0%rdg.±0.1%f.s.	±10 deg
3k to 12 kHz	±3.0%rdg.±0.2 %f.s.	±3.0%rdg.±0.3%f.s.	±30 deg
Harmonic current	Note 1: With fundamental frequency from 45 Hz to 66 Hz, PLL locked. Note 2: The effective input range is 0.1% to 110%. Note 3: Not specified when combined with 9602. Note 4: The effective input range other than harmonic current (45 Hz to 66 Hz) is 10% to 110%. Note 5: For the harmonic voltage phase angle and current phase angle, only basic frequency (45 Hz to 64 Hz) is specified.		
Frequency	±0.1%rdg.±1dgt (0℃ to 40℃,sine wave of 10% to 130% of the U/I range)		

Note 1: In actual use, the rdg. accuracy of the input unit in the combination must be added to the analysis accuracy figures given above. When used with a clamp sensor, the accuracy values and frequency characteristics of the clamp must be added to the analysis accuracy figures given above. The harmonic voltage-current phase difference, however, is not added.
Note 2: When the low-pass filter (500 Hz or 5 kHz) on an input unit is activated, the accuracy above 66 Hz is not specified.
Note 3: When using a 9600/9602 in AC mode or a 9601, at 10 Hz and below the accuracy is not specified.

(5) Basic Calculation Formulas

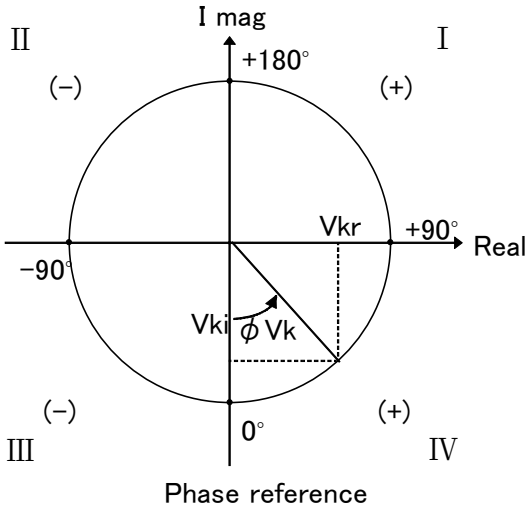
Item \ Mode	1P2W	1P3W	3P3W	3V3A	3P4W
Voltage rms value $U_{(i)}=\sqrt{\frac{1}{M}\sum_{s=0}^{M-1}\{U_{(i)s}\}^2}$	*U* (i) *U* (i+1) *U* (i+2)	*U* (i) *U* (i+1)	*U* (i) *U* (i+1)	*U* (i) *U* (i+1) *U* (i+2)	*U* (i) *U* (i+1) *U* (i+2)
Current rms value $I_{(i)}=\sqrt{\frac{1}{M}\sum_{s=0}^{M-1}\{I_{(i)s}\}^2}$	*I* (i) *I* (i+1) *I* (i+2)	*I* (i) *I* (i+1)	*I* (i) *I* (i+1)	*I* (i) *I* (i+1) *I* (i+2)	*I* (i) *I* (i+1) *I* (i+2)
Active rms value $P_{(i)}=\sqrt{\frac{1}{M}\sum_{s=0}^{M-1}\{U_{(i)s}I_{(i)s}\}^2}$	*P* (i) *P* (i+1) *P* (i+2) *P* (i)+P(i+1)+P(i+2)	*P* (i) *P* (i+1) *P* (i)+P(i+1)	*P* (i) *P* (i+1) *P* (i)+*P* (i+1)	*P* (i) *P* (i+1) *P* (i+2) *P* (i)+*P* (i+1)	*P* (i) *P* (i+1) *P* (i+2) *P* (i)+*P* (i+1)+*P* (i+2)

・(i), (i+1), and (i+2) are the measurement channel numbers.
・M is the number of samples; s is the sample point number.
・The active power of 3P3W and 3V3A channel are displayed but there is no meaning. However, only a sum value (Additional value) has a meaning.

(6) Harmonic Basic Calculation Formulas

Items \ Process		The kth-order harmonic		Total value up to Kth-order harmonic	
Voltage	U [Vrms]	U_k	$\sqrt{\{(U_{kr})^2 + (U_{ki})^2\}}$	U_K	$\sqrt{\sum_{K=2}^{K}(U_k)^2}$
Voltage phase angle	θ U [°]	θU_k	$\tan^{-1}\left(\frac{U_{kr}}{-U_{ki}}\right)$	——	——
Current	I [Arms]	I_k	$\sqrt{\{(I_{kr})^2 + (I_{ki})^2\}}$	I_K	$\sqrt{\sum_{K=2}^{K}(I_k)^2}$
Current phase angle	θ I [°]	$\theta U I_k$	$\tan^{-1}\left(\frac{I_{kr}}{-I_{ki}}\right)$	——	——
Active power	P [W]	P_k	$U_{kr} \times I_{kr+} U_{ki} \times I_{ki}$	P_K	$\sum_{K=2}^{K} P_k$
Phase difference between voltage and current	θU_I [°]	θI_k	$\theta_{(i)k} = \theta_{(i)} U_k - \theta_{(i)} U_k$	——	——
Harmonic voltage percentage	HD_U [%]	HDU_k	$\frac{U_k}{U_1} \times 100$	——	——
Harmonic current percentage	HD_I [%]	HDI_k	$\frac{I_k}{I_1} \times 100$		
Harmonic power percentage	HD_P [%]	HD_{Pk}	$\frac{P_k}{P_1} \times 100$		
Total harmonic voltage distortion ratio	THD_{UF} [%]	——	——	THD_{UF}	$\frac{\sqrt{\sum_{k=2}^{k}(U_k)^2}}{U_I} \times 100$
Total harmonic current distortion ratio	THD_{IF} [%]			THD_{IF}	$\frac{\sqrt{\sum_{k=2}^{k}(I_k)^2}}{I_I} \times 100$
Total harmonic voltage distortion ratio	THD_{UR} [%]	——	——	THD_{UR}	$\frac{\sqrt{\sum_{k=2}^{k}(U_k)^2}}{U} \times 100$
Total harmonic current distortion ratio	THD_{IR} [%]			THD_{IR}	$\frac{\sqrt{\sum_{k=2}^{k}(I_k)^2}}{I} \times 100$

Note 1: (i), (i+1), and (i+2) are the measurement channel numbers.
Note 2: The subscript "k" on U, I, and P indicates the harmonic number, so for example "U_1" is the fundamental component of voltage. A "K" indicates the total harmonic analyzed.
Note 3: The subscripts "r" and "i" on Uk and Ik indicate the real and imaginary components of the results of FFT analysis.
Note 4: The harmonic voltage phase angle and harmonic current phase angle are corrected and displayed taking the PLL source forming the phase reference as 0°. A positive sign indicates the phase leading, and a negative sign the phase lagging. (Figure 1 on the next page)
Note 5: The harmonic voltage-current phase difference indicates the difference between the harmonic voltage phase angle and the harmonic current phase angle for the same harmonic. (Figure 2 on the next page)



When the harmonic voltage

$$\text{I}: \quad \tan^{-1}\left(\frac{U_{kr}}{-U_{ki}}\right)+180^\circ$$

$$\text{II, III}: \quad \tan^{-1}\left(\frac{U_{kr}}{-U_{ki}}\right)$$

$$\text{IV}: \quad \tan^{-1}\left(\frac{U_{kr}}{-U_{ki}}\right)-180^\circ$$

$U_{ki}=0,\ U_{kr}<0$: +90°
$U_{ki}=0,\ U_{kr}>0$: –90°
$U_{ki}<0,\ U_{kr}=0$: +180°
$U_{ki}=0,\ U_{kr}=0$: 0°

Figure 1

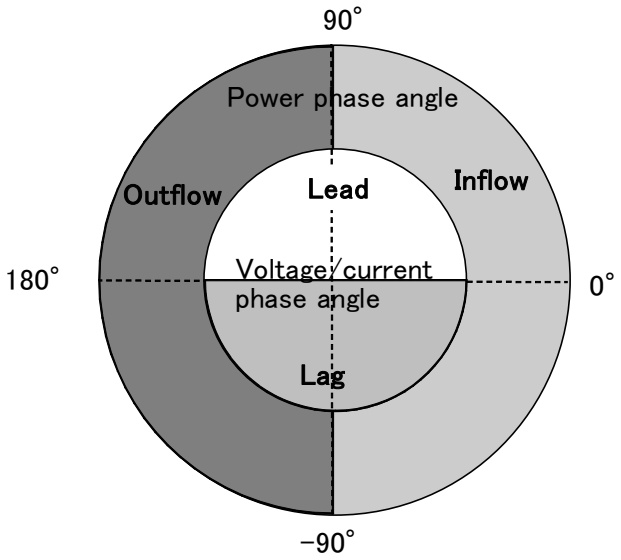


Figure 2

(7) Harmonic calculations for each wiring mode

Item \ Mode	1P2W	1P3W	3P3W	3V3A	3P4W
Harmonic voltage	$U_{(i)k}$ $U_{(i+1)k}$ $U_{(i+2)k}$	$U_{(i)k}$ $U_{(i+1)k}$	$U_{(i)k}$ $U_{(i+1)k}$	$U_{(i)k}$ $U_{(i+1)k}$ $U_{(i+2)k}$	$U_{(i)k}$ $U_{(i+1)k}$ $U_{(i+2)k}$
Harmonic current	$I_{(i)k}$ $I_{(i+1)k}$ $I_{(i+2)k}$	$I_{(i)k}$ $I_{(i+1)k}$	$I_{(i)k}$ $I_{(i+1)k}$	$I_{(i)k}$ $I_{(i+1)k}$ $I_{(i+2)k}$	$I_{(i)k}$ $I_{(i+1)k}$ $I_{(i+2)k}$
Harmonic power	$P_{(i)k}$ $P_{(i+1)k}$ $P_{(i+2)k}$	$P_{(i)k}$ $P_{(i+1)k}$ $P_{(i)k+P\ (i+1)k}$	$P_{(i)k}$ $P_{(i+1)k}$ $P_{(i)k+P\ (i+1)k}$	$P_{(i)k}$ $P_{(i+1)k}$ $P_{(i+2)k}$ $P_{(i)k+P\ (i+1)k}$	$P_{(i)k}$ $P_{(i+1)k}$ $P_{(i+2)k}$ $P_{(i)k}+P_{(i+1)k}+P_{(i+2)k}$
Harmonic voltage percentage	HD $_{(i)}U_k$ HD $_{(i+1)}U_k$ HD $_{(i+2)}U_k$	HD $_{(i)Uk}$ HD $_{(i+1)Uk}$	HD $_{(i)Uk}$ HD $_{(i+1)Uk}$	HD $_{(i)Uk}$ HD $_{(i+1)Uk}$ HD $_{(i+2)Uk}$	HD $_{(i)Uk}$ HD $_{(i+1)Uk}$ HD $_{(i+2)Uk}$
Harmonic current percentage	HD $_{(i)Ik}$ HD $_{(i+1)Ik}$ HD $_{(i+2)Ik}$	HD $_{(i)Ik}$ HD $_{(i+1)Ik}$	HD $_{(i)Ik}$ HD $_{(i+1)Ik}$	HD $_{(i)Ik}$ HD $_{(i+1)Ik}$ HD $_{(i+2)Ik}$	HD $_{(i)Ik}$ HD $_{(i+1)Ik}$ HD $_{(i+2)Ik}$
Harmonic power percentage	HD $_{(i)Pk}$ HD $_{(i+1)Pk}$ HD $_{(i+2)Pk}$	HD $_{(i)pk}$ HD $_{(i+1)pk}$ HD $_{(i)pk}$+HD $_{(i+1)pk}$	HD $_{(i)pk}$ HD $_{(i+1)pk}$ HD $_{(i)pk}$+HD $_{(i+1)pk}$	HD $_{(i)pk}$ HD $_{(i+1)pk}$ HD $_{(i+2)pk}$ HD $_{(i)pk}$+HD $_{(i+1)pk}$	HD $_{(i)pk}$ HD $_{(i+1)pk}$ HD $_{(i+2)pk}$ HD $_{(i)pk}$+HD $_{(i+1)pk+}$ HD $_{(i+2)pk}$
Harmonic voltage phase angle	$\theta_{(i)}U_k$ $\theta_{(i+1)}U_k$ $\theta_{(i+2)}U_k$	$\theta_{(i)}U_k$ $\theta_{(i+1)}U_k$	$\theta_{(i)}U_k$ $\theta_{(i+1)}U_k$	$\theta_{(i)}U_k$ $\theta_{(i+1)}U_k$ $\theta_{(i+2)}U_k$	$\theta_{(i)}U_k$ $\theta_{(i+1)}U_k$ $\theta_{(i+2)}U_k$
Harmonic current phase angle	$\theta_{(i)}I_k$ $\theta_{(i+1)}I_k$ $\theta_{(i+2)}I_k$	$\theta_{(i)Ik}$ $\theta_{(i+1)Ik}$	$\theta_{(i)Ik}$ $\theta_{(i+1)Ik}$	$\theta_{(i)Ik}$ $\theta_{(i+1)Ik}$ $\theta_{(i+2)Ik}$	$\theta_{(i)Ik}$ $\theta_{(i+1)Ik}$ $\theta_{(i+2)Ik}$
Harmonic phase difference between voltage and current	$\theta_{(i)k}$ $\theta_{(i+1)k}$ $\theta_{(i+2)k}$	$\theta_{(i)k}$ $\theta_{(i+1)k}$	$\theta_{(i)k}$ $\theta_{(i+1)k}$	$\theta_{(i)k}$ $\theta_{(i+1)k}$	$\theta_{(i)k}$ $\theta_{(i+1)k}$ $\theta_{(i+2)k}$
Total harmonic voltage distortion ratio (THD-F)	THD $_{(i)}U_F$ THD $_{(i+1)}U_F$ THD $_{(i+2)}U_F$	THD $_{(i)}U_F$ THD $_{(i+1)}U_F$	THD $_{(i)}U_F$ THD $_{(i+1)}U_F$	THD $_{(i)}U_F$ THD $_{(i+1)}U_F$ THD $_{(i+2)}U_F$	THD $_{(i)}U_F$ THD $_{(i+1)}U_F$ THD $_{(i+2)}U_F$
Total harmonic current distortion ratio (THD-F)	THD $_{(i)}I_F$ THD $_{(i+1)}I_F$ THD $_{(i+2)}I_F$	THD $_{(i)}I_F$ THD $_{(i+1)}I_F$	THD $_{(i)}I_F$ THD $_{(i+1)}I_F$	THD $_{(i)}I_F$ THD $_{(i+1)}I_F$ THD $_{(i+2)}I_F$	THD $_{(i)}I_F$ THD $_{(i+1)}I_F$ THD $_{(i+2)}I_F$
Total harmonic voltage distortion ratio (THD-R)	THD $_{(i)}U_R$ THD $_{(i+1)}U_R$ THD $_{(i+2)}U_R$	THD $_{(i)}U_R$ THD $_{(i+1)}U_R$	THD $_{(i)}U_R$ THD $_{(i+1)}U_R$	THD $_{(i)}U_R$ THD $_{(i+1)}U_R$ THD $_{(i+2)}U_R$	THD $_{(i)}U_R$ THD $_{(i+1)}U_R$ THD $_{(i+2)}U_R$
Total harmonic current distortion ratio (THD-R)	THD $_{(i)}I_R$ THD $_{(i+1)}I_R$ THD $_{(i+2)}I_R$	THD $_{(i)}I_R$ THD $_{(i+1)}I_R$	THD $_{(i)}I_R$ THD $_{(i+1)}I_R$	THD $_{(i)}I_R$ THD $_{(i+1)}I_R$ THD $_{(i+2)}I_R$	THD $_{(i)}I_R$ THD $_{(i+1)I\ R}$ THD $_{(i+2)}I_R$

10.2 Flicker Measurement Function

(1) General Specifications

Application	Fitted in a 3193 unit (factory-fitted optional 9605 installation is completed by a software upgrade from floppy disk.)
Measurement lines	Single-phase,two-wire (1P2W)/ Single-phase,three-wire (1P3W)/ Three-phase,three-wire (3V3A, 3P3W)/ Three-phase,four-wire (3P4W)
Number of channels	Maximum of 3 channels selectable from channels 1 to 6, depending on 3193 unit wiring mode

	1ch	2ch	3ch	4ch	5ch	6ch	Using channels
①	1P2W	1P2W	1P2W	1P2W	1P2W	1P2W	1+2+3, 2+3+4, 3+4+5, 4+5+6
②	1P3W/3P3W		1P2W	1P2W	1P2W	1P2W	12+3, 3+4+5, 4+5+6
③	1P3W/3P3W		1P3W/3P3W		1P2W	1P2W	12+3, 34+5, 4+5+6
④	1P3W/3P3W		1P3W/3P3W		1P3W/3P3W		12+3, 34+5, 56
⑤	3V3A/3P4W			1P2W	1P2W	1P2W	123, 4+5+6
⑥	3V3A/3P4W			1P3W/3P3W		1P2W	123, 45+6
⑦	3V3A/3P4W			3V3A/3P4W			123, 456

Measurement range	Basic frequency 45 to 66 Hz
Measurement system	PLL synchronization Fundamental frequency and PLL synchronizing frequency phase deviation no more than ±0.01%
CPF class	1024
Measurement time	1 to 30 minutes
Number of measurement times	1 to 2000 times
Display update rate	Every 5 time/second
A/D	16 bits
Computational accuracy	32 bits (floating-point calculations)
Crest factor	3 max. (voltage)
Output function	FD, printer,GP-IB, RS-232C
Reference standard	IEC61000-3-3:1995+A1:2001 IEC61000-4-15:1997

(2) Measurement items

Urms	Voltage rms value
ΔU/U	Relative Voltage Change
S(t)	Instantaneous Flicker Value
dc	Relative Constant Voltage Change
dmax	Maximum Relative Voltage Change
d(t)500ms	Relative Voltage Change Time
P0.1, P1s, P3s, P10s, P50s	Cumulative Probability
Pst	Short-Term Flicker Value
Plt	Long-Term Flicker Value

(3) Screen Displays

Measurement value display, CPF curve display, Pst display, Monitor display

(4) Accuracy

(23℃±5℃, 80%R.H.max.warming-up 1 hour or more, 45 to 66 Hz, 50% to 110% of range input, guaranteed accuracy period: six months)

Voltage Fluctuation	Within ±5% rdg. (d measurement is the same) of the limit value with the limit value curve line (Pst=1) specified by IEC61000-4-15.
Voltage rms value	±0.5% rdg. ±0.05% f.s.

Note Effective value of every half cycle
To be combined with the accuracy of the input unit.

(5) Calculation Formulas

dc

The relative voltage difference of two sequential periods that are in steady state for at least one second is referred to as ΔUc, and the rated voltage of the phase being measured is referred to as Un. The ratio ΔUc/Un between these two values is referred to as dc.
The 3193 displays the maximum value measured during the measurement period.

dmax

The difference between the maximum and minimum value of relative voltage within a period of relative voltage change.

d(t)500ms

The period in which the relative voltage change exceeds the threshold level within a period of one cycle of relative voltage change.

Pst

$$Pst = \sqrt{(K_1P_{0.1}+K_2P_{1s}+K_3P_{3s}+K_4P_{10s}+K_5P_{50s})}$$

K_1=0.0314, K_2=0.0525, K_3=0.0657, K_4=0.28, K_5=0.08

Class 1024 of cumulative probability function (CPF). Each cumulative probability (Pi) is obtained by linear interpolation to calculate the cumulative probability (Pis) by smoothing with the following method.

$P_{1s}=(P_{0.7}+P_1+P_{1.5})/3$
$P_{3s}=(P_{2.2}+P_3+P_4)/3$
$P_{10s}=(P_6+P_8+P_{10}+P_{13}+P_{17})/5$
$P_{50s}=(P_{30}+P_{50}+P_{80})/3$

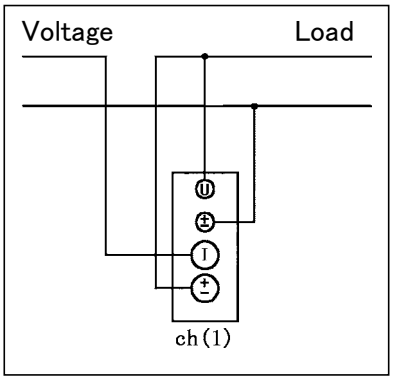
Plt

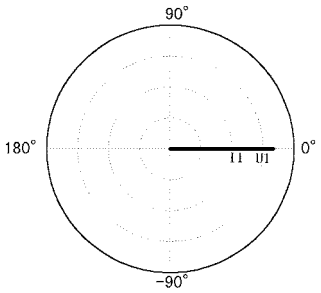
$$Plt = \sqrt[3]{(\Sigma (Pst_i)^3/N}$$

N is the number of measurements

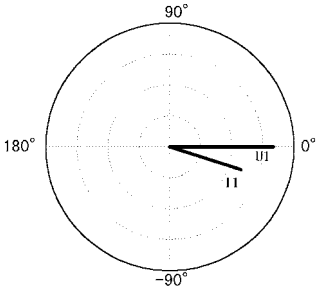
Appendix

1P2W wiring





①

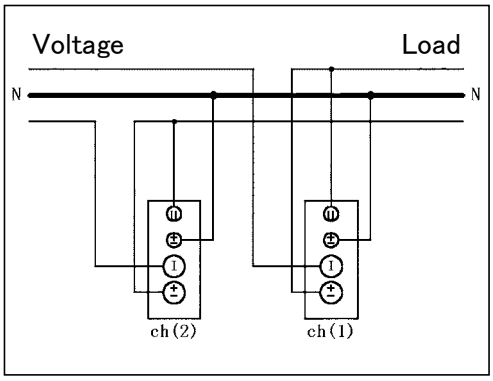


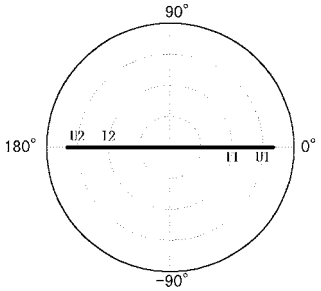
②

① When the U1 is selected as the PLL source
When the load is purely resistive, the phase difference between voltage and current is 0.

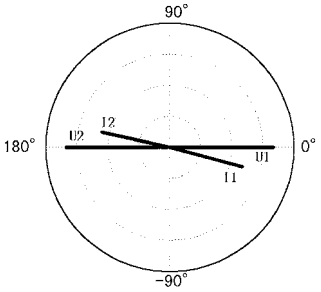
② When the load is capacitive
The current has lagging phase, and when the load is inductive, the current has leading phase.

1P3W wiring





①

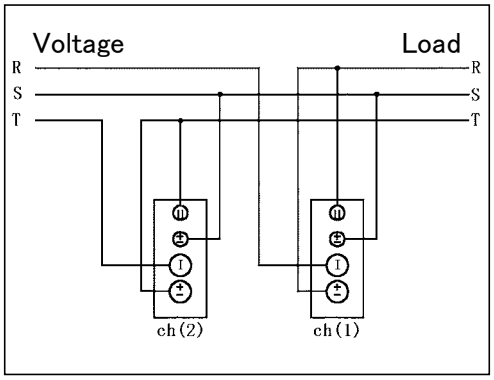


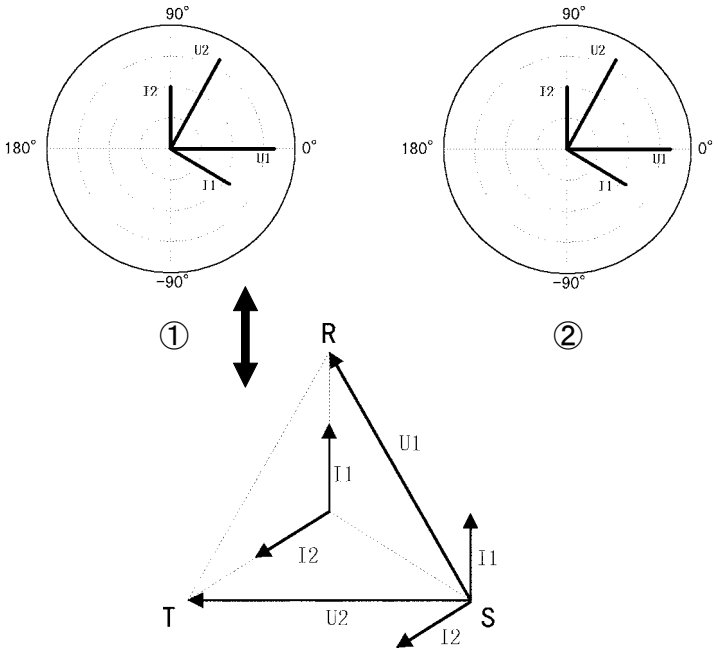
②

① When the U1 is selected as the PLL source
U2 is reverse phased 180 ° from U1.

② When the load is purely resistive
The phase difference between U1 and I1 and U2 and I2 is 0, as shown above. When the load is inductive, the current phase lags the voltage.

3P3W wiring

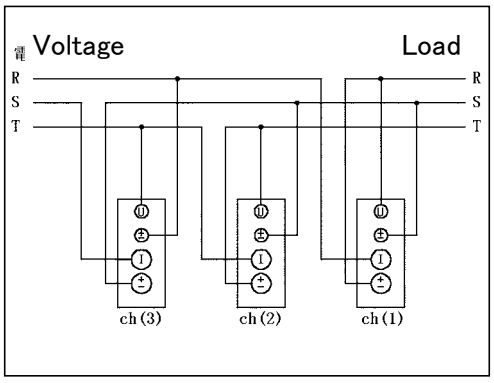


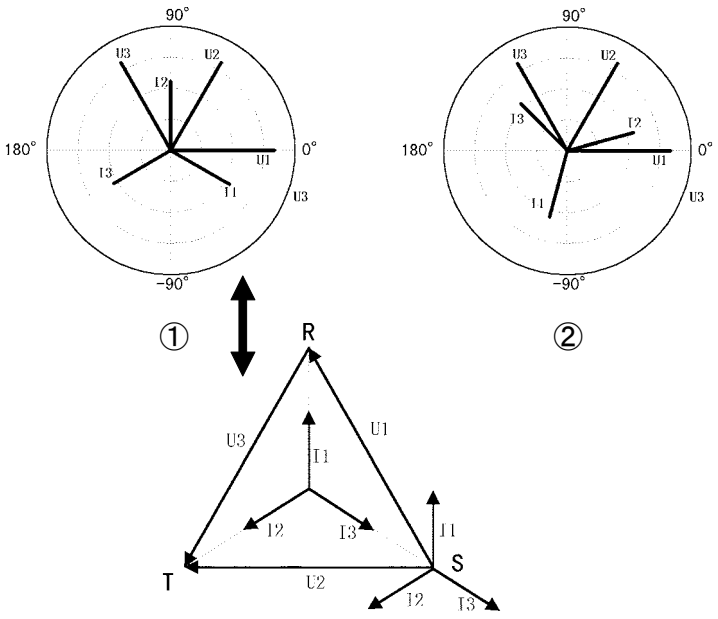


① When the U1 is selected as the PLL source
Voltage is measured between lines and current is measured with phase, so U2 is phased 60 ° from U1. When the load is purely resistive, I1 lags U1 by 30 ° , and I2 leads U2 by 30 ° .

② With an inductive load such as a motor, when the effective power of ch1 is negative, the phase of I1 lags U1 by more than 90 ° .

3V3A wiring

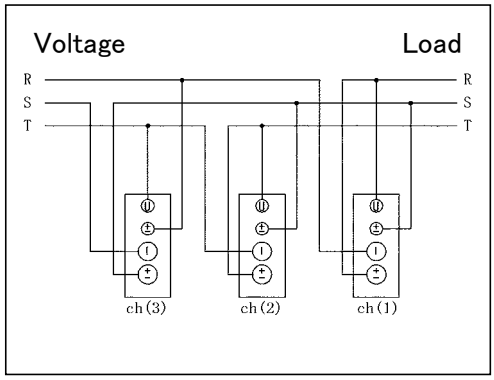


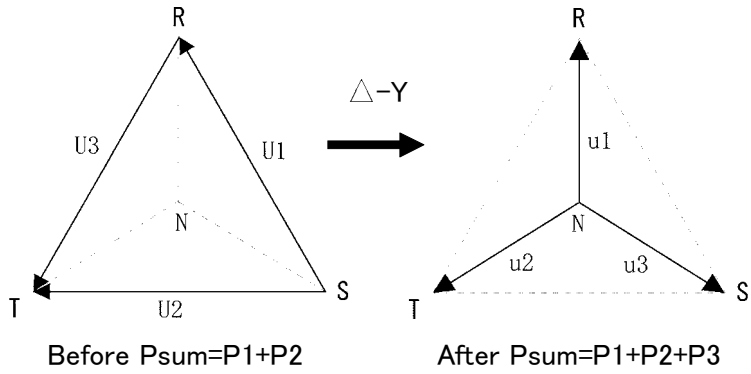


① When the U1 is selected as the PLL source
Based on 3P3W wiring, the three channels of voltage and current are summed. The figures above show the state when the load is purely resistive.

② With an inductive load such as a motor
The effective power of ch1 appears negative because I1 lags U1 by more than 90 ° . However, the summed data for ch(3) is not related to power measurement, so wiring can be reversed.

3V3A wiring (△-Y conversion)





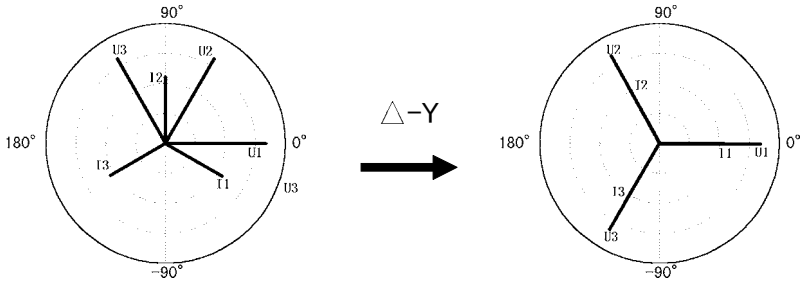
Before Psum=P1+P2 After Psum=P1+P2+P3

Principle of conversion

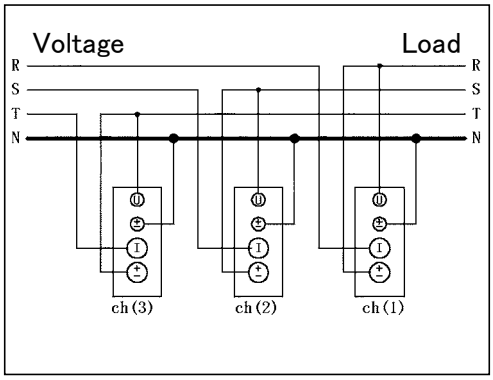
The momentary waveforms of the line voltages (U1, U2, and U3) are converted into momentary waveforms for phase voltages (u1, u2, and u3) using the following operation expressions ("s" refers to value).
u1s=(U1s-U3s)/3, u2s=(U3s+U2s)/3, u3s=(-U2s-U1s)/3

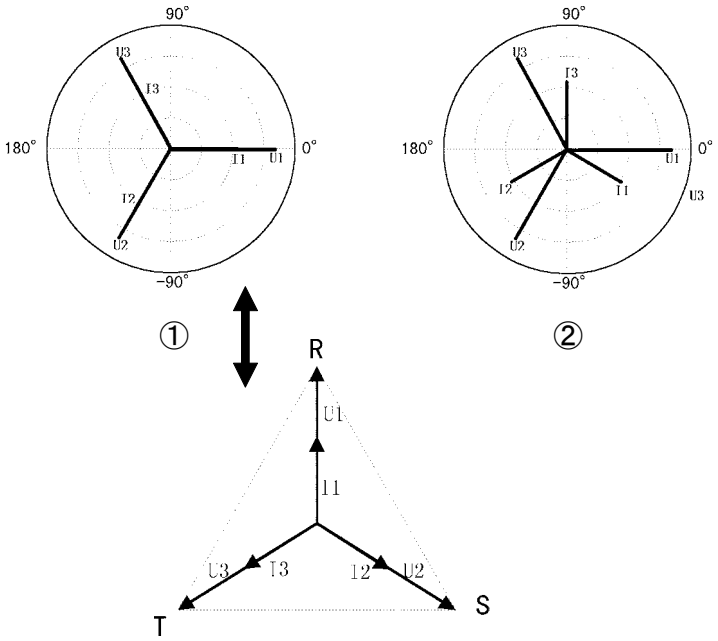
NOTE

- Since N is a virtual neutral point, phase voltages may differ from actual values.
- Following conversion, the three power meter method is applied.
- Following conversion, the 9605 vector screen changes as follows. (Load: resistance)



3P4W wiring

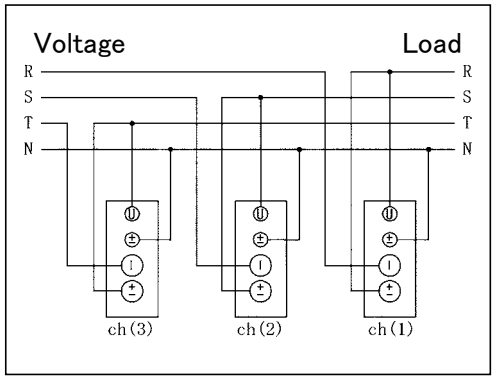


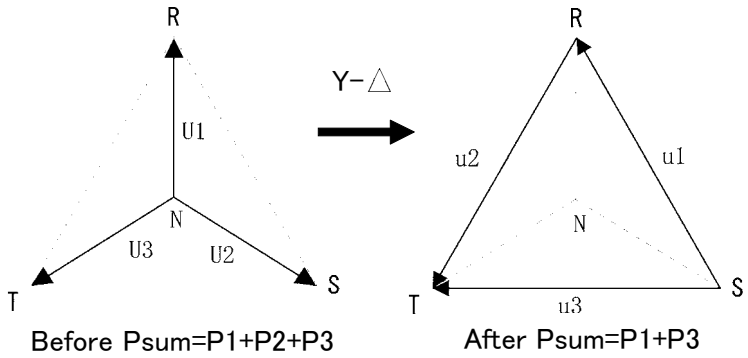


① When the U1 is selected as the PLL source
To measure voltage and current phase, the phase of the voltage of each channel is shifted 120 ° . When the load is purely resistive, as shown above, the phase difference of the voltage and current of each channel is 0.
Compared to 3P3W (3V3A) wiring, ch(2) and ch(3) are switched.

② With an inductive load such as a motor, the phase of the current lags the voltage.

3P4W wiring (Y−△ conversion)





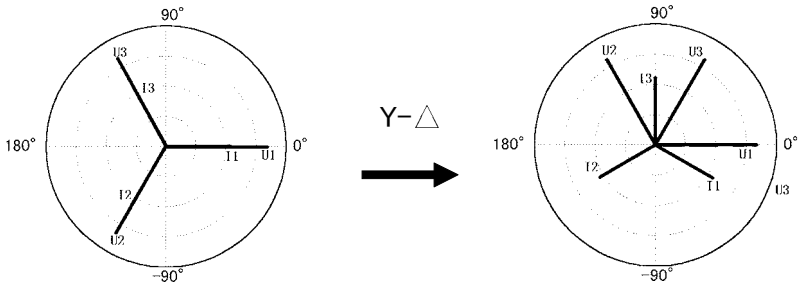
Before Psum=P1+P2+P3 After Psum=P1+P3

Principle of conversion

The momentary waveforms for phase voltages (U1, U2, and U3) are converted into momentary waveforms for line voltages (u1, u2, and u3) using the following operation expressions ("s" refers to sampling value).
u1s=(U1s-U2s), u2s=(U3s-U1s), u3s=(U3s-U2s)

NOTE

- Following conversion, the two power meter method is applied.
- Following conversion, the 9605 vector screen changes as follows. (Load: resistance)



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