User's Manual

DL7440/DL7480 Digital Oscilloscope Power Supply Analysis Function (/G4 Option) User's Manual

YOKOGAWA
Yokogawa Electric Corporation

IM 701450-61E
1st Edition

Thank you for purchasing the DL7440 or DL7480 Digital Oscilloscope (herein after referred to as the DL7400) with the Power Supply Analysis Function (/G4 option, the /G4 option includes user-defined computation).
This User's Manual describes only the power analysis function. For information about other functions, operating procedures, and handling precautions of the DL7400, see the following manuals.

Manual Title	Manual No.	Description
DL7440/DL7480 User's Manual	IM 701450-01E	Explains all functions and procedures of the DL7440/DL7480 excluding the communication functions.
DL7440/DL7480 Operation Guide	IM 701450-02E	Explains briefly the functions and basic operations.
DL7440/DL7480 Communication Interface User's Manual (CD-ROM)	IM 701450-17E	Explains the function used to control the DL7400 using communication commands (communication function).

Notes

- The firmware version of the DL7400 Digital Oscilloscope that supports the Power Supply Analysis Function (/G4 Option) is 1.20 or later. For instructions on checking the firmware version, see section 16.4 in the *DL7440/DL7480 User's Manual*.
- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
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How to Use This Manual

Notes

The following marking is used in this manual.

Note Calls attention to information that is important for proper operation of the instrument.

Notations Used on Pages Describing Operating Procedures

The following notations are used to distinguish the contents of the explanations.

Procedure Follow the numbered steps. All procedures are written with inexperienced users in mind; experienced users may not need to carry out all the steps.

Explanation This subsection describes the setup parameters and the limitations on the procedures.

Notations Used in the Procedures

Panel Keys and Soft keys
Bold characters used in the procedural explanations indicate characters that are marked on the panel keys or the characters of the soft keys or menus displayed on the screen.

Jog Shuttle & SELECT
Jog shuttle & SELECT indicates selecting or setting parameters and entering values using the jog shuttle, the SELECT key, and other keys. For details on the procedure, see section 4.1 or 4.2 in the *DL7440/DL7480 User's Manual IM701450-01E*.

Unit

k	Denotes 1000. Example: 100 kS/s
K	Denotes 1024. Example: 459 KB (file data size)

Contents

1 Overview of the Power Analysis Function

Correcting (Deskewing) the Difference in the Transfer Time of Analyzed Signals

To correctly measure the analysis parameters (power analysis parameters) such as power, impedance, power factor, watt hour, and ampere hour from the voltage and current under analysis, the voltage and current signals must be applied to the signal input terminals of the DL7400 with no difference in the transfer time. However, difference in the transfer time may occur between signals depending on the probe that is being used. When the probe* and deskew correction signal source are connected, the DL7400 can correct (deskew) the difference in the transfer time of the signals automatically or manually and measure the power analysis parameters.

* It is recommended that YOKOGAWA products listed below be used to execute deskew and measure the power analysis parameters.

Deskew correction signal source	Model 701935
Passive probe	Model 700988
Differential probe	Model 700924 or 701921
Current probe	Model 700937

Automated Measurement and Statistical Processing of Power Analysis Parameters

As with the standard measurement parameters (waveform parameters), the following power analysis parameters (waveform parameters) can be measured automatically on the displayed waveform (within the display record length).

Voltage	Amplitude UP-P, maximum value U+pk, minimum value U-pk, DC component Udc, rms value Urms, AC component Uac, rectified mean value calibrated to the rms value Umn, and rectified mean value Urmn
Current	Amplitude IP-P, maximum value I+pk, minimum value I-pk, DC component Idc, rms value Irms, AC component Iac, rectified mean value calibrated to the rms value Imn, and rectified mean value Irmn
Power	Apparent power S, active power P, and reactive power Q
Power factor	Power factor λ of the circuit under measurement
Impedance	Impedance Z of the circuit under measurement
Watt hour	Sum of positive and negative watt hours Wp, sum of positive watt hours Wp+, and sum of negative watt hours Wp-
Ampere hour	Sum of positive and negative ampere hours q, sum of positive ampere hours q+, and sum of negative ampere hours q-
Heat energy	Joule integral I^2t

Automated Measurement of Power Analysis Parameters on Dual Areas

As with the standard measurement parameters, you can specify two areas and perform automated measurement of power analysis parameters on each area. For details on the function and procedural explanations, see section 10.8 in the *DL7440/DL7480 User's Manual IM701450-01E*.

Statistical Processing

As with the standard measurement parameters, you can perform statistical processing on the measured values of power analysis parameters. Normal statistical processing, statistical processing per cycle, and statistical processing of history data are available. For details on the function and procedural explanations, see section 10.7 in the *DL7440/DL7480 User's Manual*.

Waveform Computation on Power Analysis Parameters

As with the standard waveform computation, waveform computation such as active power, impedance, Joule integral, power spectrum, and harmonics can be performed on the displayed waveform (within the display record length), and the computed results can be displayed using waveforms (computed waveforms).

In harmonics computation, the harmonics generated by the equipment under test[2] as defined by the IEC Standard[1] can be computed for each applicable class (A through D). Bar graphs and lists can be displayed for making comparisons between the limits of the harmonic current and the measured values. The computed results (computed values) obtained through this function do not accurately comply with the standard. To make accurate measurements complying with the standard, the WT2000 Series Digital Power Meter and Harmonic Analysis Software (Model 761922) are required.

1 IEC 61000-3-2 (Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)) Edition 2:2000 consolidated with amendment 1:2001, abbreviated as IEC 61000-3-2 Edition 2.1, and EN61000-3-2 Amendment 14.

2 Electrical and electronic equipment having an input current of up to 16 A per phase and connected to public low-voltage distribution systems. The figure below shows the description of the applicable equipment. However, the DL7400 can only compute the harmonics of single-phase equipment. It cannot compute the harmonics of three-phase equipment.

Electrical and electronic equipment having an input current up to 16 A per phase

Class A

- **Balanced three-phase equipment**
- **Household appliances, excluding equipment identified as Class D**
- **Tools excluding portable tools (portable tools are Class B)**
- **Dimmers for incandescent lamps**
- **Audio equipment**
- **Equipment not specified in one of the other three classes (B, C, and D)**

Class B

Portable tools

Class C

Lighting equipment

Class D

Television receivers, personal computers (PCs), and PC monitors with a rated power of 600 W or less

Trend Display of Measured Values of Waveform Parameters per Cycle

Using a procedure similar to the measurement and statistical processing per cycle (see section 10.7 in the *DL7440/DL7480 User's Manual*), the measured values of waveform parameters per cycle can be determined on the displayed waveform (within the display record length), and the change over time in the measured values can be shown on the trend display.

History Search Using Measured Values of Power Analysis Parameters (Waveform Parameter Search)

As with the standard measurement parameters, you can perform history search using power analysis parameters. For details on the function and procedural explanations, see section 10.3 in the *DL7440/DL7480 User's Manual*.

GO/NO-GO Determination Using Measured Values of Power Analysis Parameters

As with the standard measurement parameters, you can perform GO/NO-GO determination using power analysis parameters. For details on the function and procedural explanations, see section 10.10 in the *DL7440/DL7480 User's Manual*.

Display of the Area of Voltage-Current Operation (X-Y Display)

By assigning the voltage input channel and current input channel to the X-axis and Y-axis, respectively, and displaying the X-Y waveform on the DL7400, the area of voltage-current operation of the equipment under test can be displayed. You can check whether this area is within the area of safe operation (ASO). For instructions on displaying the X-Y waveform, see section 8.5 in the *DL7440/DL7480 User's Manual*. This manual does not explain the procedure.

2 Connecting Probes/Performing Phase Correction, Degauss, and Zero Adjustment/Deskewing

Connecting the Probes

To measure power analysis parameters, voltage and current signals must be applied to predefined signal input terminals (channels). The following figure shows the channels for applying the signals and the channel pairs (combinations) when measuring power analysis parameters.

Signal Input Terminal (Channel)	Input Signal	Channel Pair When Measuring Power Analysis Parameters
CH1 CH2	Voltage Current	Measures power analysis parameters on the voltage and current applied to CH1 and CH2.
CH3 CH4	Voltage Current	Measures power analysis parameters on the voltage and current applied to CH3 and CH4.
CH5 CH6	Voltage Current	Measures power analysis parameters on the voltage and current applied to CH5 and CH6.

* CH5 and CH6 can be used only on the DL7480.

Connect the voltage probes (passive probes or differential probes) and current probes to the signal input terminals of the DL7400 and the probe power terminals on the rear panel of the DL7400 as necessary. For the precautions to be taken when connecting probes and descriptions on the current capacity of the DL7400 probe power supply and other items, see section 3.4 in the *DL7440/DL7480 User's Manual IM701450-01E*.

Compensating Voltage Probes (Phase Correction)

After connecting the voltage probes to the signal input terminals, perform phase correction on probes that can be phase corrected.

For a description of the handling of voltage probes, see the manual that came with the product.

For instructions on the phase correction of probes, see section 3.5 in the *DL7440/ DL7480 User's Manual*.

Degaussing Current Probes and Performing Zero Adjustment

After connecting the current probes to the signal input terminals, perform degaussing[1] and zero adjustment[2] of the current probes before making measurements if such functions are available.

For a description of the degaussing and zero adjustment as well as the handling of current probes, see the manual that came with the product.

1 Degauss is a function used to cancel the magnetization of the magnetic core of current probes caused by the ON/OFF of the power supplied to the current probes, excessive input signal, and other factors. Be sure to degauss the current probes before making measurements.

2 Zero adjustment is a function used to correct the characteristic drift of the current probes caused by temperature changes. Before making measurements, perform zero adjustment after degaussing.

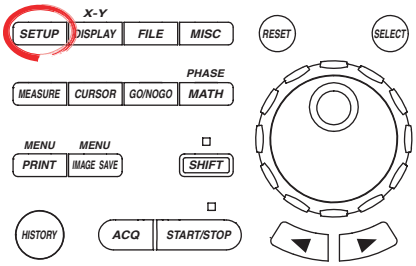
Deskewing

Depending on the probe that is being used, a difference in the transfer time may occur between voltage and input signals. You can deskew the difference in the transfer time between the signals automatically or manually on the DL7400. To correctly measure power analysis parameters, execute deskew between the signals after connecting the probes and the deskew correction signal source. It is recommended that YOKOGAWA products listed below be used to execute deskew and measure the power analysis parameters on the DL7400.

Deskew correction signal source	Model 701935
Passive probe	Model 700988
Differential probe	Model 700924 or 701921
Current probe	Model 700937

3 Turning ON the Power Analysis Function/ Selecting the Attenuation or Current-to-Voltage Conversion Ratio of Probes/Enabling Waveform Computation Setup

Procedure

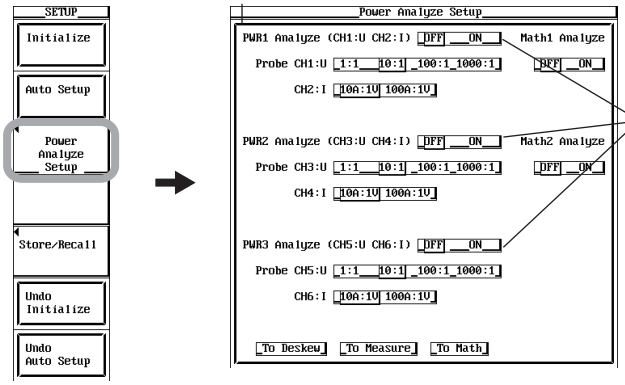


- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

1. Press **SETUP**. The SETUP menu appears.
2. Press the **Power Analyze Setup** soft key. The Power Analyze Setup dialog box opens.

Turning ON the Power Analysis Function

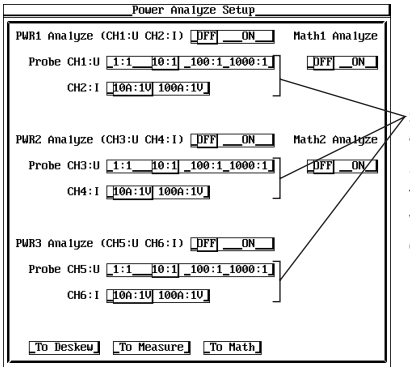
3. Use **jog shuttle & SELECT** to select ON or OFF for each power analysis channel pair (PWR1 Analyze, PWR2 Analyze, and PWR3 Analyze (PWR3 Analyze is available only on the DL7480)).
   - When OFF is selected, power analysis will not be performed on the channel pair.
   - When ON is selected, power analysis will be performed on the channel pair.



Turn ON/OFF the power analysis function
Power analysis is performed on a pair of channels that are turned ON.

Selecting the Probe Attenuation or Current-to-Voltage Conversion Ratio

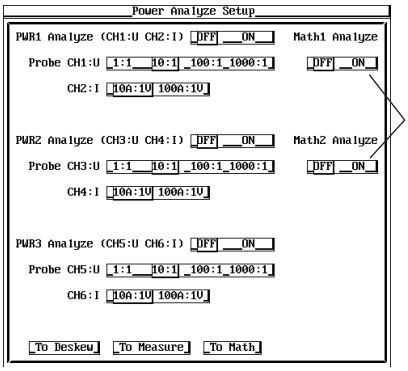
4. Use **jog shuttle & SELECT** to select the attenuation of the voltage probes of the voltage input channels (CH1, CH3, and CH5 (CH5 is available only on the DL7480)).
5. Use **jog shuttle & SELECT** to select the current-to-voltage conversion ratio of the current probes of the current input channels (CH2, CH4, and CH6 (CH6 is available only on the DL7480)).



Select the probe attenuation/current-to-voltage conversion ratio
Select the attenuation of the voltage probe of the voltage input channel and the current-to-voltage conversion ratio of the current probe of the current input channel.

Performing Waveform Computation (Enabling Power Analysis Parameters to Be Assigned to Computed Waveforms)

6. Use **jog shuttle & SELECT** to turn ON/OFF Math1 or Math2.
   - When OFF is selected, standard waveform computation parameters can be assigned to the computed waveform.
   - When ON is selected, power analysis parameters can be assigned to the computed waveform.

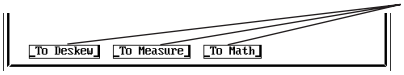


Turn ON/OFF the assignment of the power analysis parameters to the computation waveform
Power analysis parameters can be assigned to computation waveforms that are turned ON.

Jumping to Related Menus

(Perform the following operations as necessary. You can also display the same menu using panel keys and soft keys.)

7. Use **jog shuttle & SELECT** to select To Deskew, To Measure, or To Math to jump to the respective menu.
   - To Deskew: Displays a menu used to correct the difference in the transfer time of signals.
   - To Measure: Displays a menu used to set the automated measurement of waveform parameters.
   - To Math: Displays a menu used to set waveform computation.



Jump to related menus

Explanation

To compute power analysis parameters using the power analysis function (/G4 option), you must turn ON the power analysis function, select the voltage probe attenuation, and select the current-to-voltage conversion ratio of current probes. In addition, the waveform computation setting must be turned ON (enabled) when performing waveform computation.

Turning ON/OFF the Power Analysis Function

Channels for applying voltage and current signals are predefined. The pairing of channels is also predefined as shown below.

Signal Input Terminal (Channel)	Input Signal	Channel Pair When Measuring Power Analysis Parameters
CH1	Voltage	Measures power analysis parameters on the voltage and current applied to CH1 and CH2.
CH2	Current	
CH3	Voltage	Measures power analysis parameters on the voltage and current applied to CH3 and CH4.
CH4	Current	
CH5	Voltage	Measures power analysis parameters on the voltage and current applied to CH5 and CH6.
CH6	Current	

* CH5 and CH6 can be used only on the DL7480.

You can select whether to perform power analysis (ON/OFF) for each channel pair.

OFF
Power analysis is not performed on the channel pair.

ON
Power analysis is performed on the channel pair.

Selecting the Probe Attenuation or Current-to-Voltage Conversion Ratio

You can select the probe attenuation or current-to-voltage conversion ratio for each voltage/current input channel.

- You can select the attenuation of the voltage probes of the voltage input channels (CH1, CH3, and CH5 (CH5 is available only on the DL7480)).

1:1, 10:1, 100:1, or 1000:1

- You can select the current-to-voltage conversion ratio of the current probes of the current input channels (CH2, CH4, and CH6 (CH6 is available only on the DL7480)).

10A:1V or 100A:1V

* The conversion notation of the YOKOGAWA 700937 Current Probe is 0.1 V/A. This indicates that the output voltage of the current probe is 1 V when the current probe measures 10 A. If you connect the 700937 Current Probe to the signal input terminal of the DL7400 and select a current-to-voltage conversion ratio of 10A:1V, the DL7400 displays the current value measured on the current probe as 10 A when the output voltage from the current probe is 1 V.

Waveform Computation (Enabling Power Analysis Parameters to Be Assigned to Computed Waveforms)

You can select whether to assign power analysis parameters to computed waveform Math1 or Math2.

OFF
Standard waveform computation parameters can be assigned to the computed waveform.

ON
Power analysis parameters can be assigned to the computed waveform.

Jumping to Related Menus

Perform the following operations as necessary. You can also display the same menu using panel keys and soft keys.

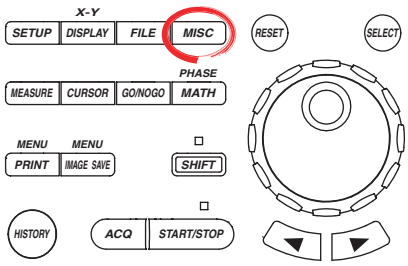
To Deskew
Displays the deskew menu.

To Measure
Displays a menu used to set automated measurement.

To Math
Displays a menu used to set waveform computation.

4 Correcting (Deskewing) the Difference in the Transfer Time of Analyzed Signals

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

Connecting the Deskew Correction Signal Source

Depending on the probe that is being used, a difference in the transfer time may occur between voltage and input signals. Connect the deskew correction signal source, voltage probe (passive probe or differential probe) and current probe to the DL7400.

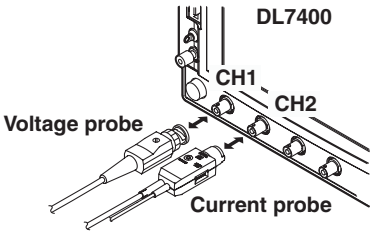
1. Connect the voltage probe (passive probe or differential probe) and current probe to the deskew correction signal source.

   For the connection procedure, see the manual for the deskew correction signal source. For information on the handling when the YOKOGAWA 701935 Deskew Correction Signal Source is used, see the *Deskew Correction Signal Source User's Manual IM701935-01E*.

2. Connect the voltage probe and current probe to the DL7400 as shown below.

   For a description on the pair of channels for applying the voltage and current signals when measuring power analysis parameters, see page 6 in this manual.

3. Set the attenuation for the voltage probe and current-to-voltage conversion ratio for the current probe.
   - Turn ON the power analysis function and set the attenuation and current-to-voltage conversion ratio according to the procedures given in chapter 3 in this manual or set the attenuation and current-to-voltage conversion ratio according to the procedures given section 5.5 of the *DL7440/DL7480 User's Manual IM701450-01E*.
   - For a current probe, perform degauss and zero adjustment. In the case of the current signal that the YOKOGAWA 701935 Deskew Correction Signal Source outputs, perform zero adjustment with the vertical sensitivity (V/div, see section 5.2 in the *DL7440/DL7480 User's Manual*) set to 20.0 mA/div. If zero adjustment is not performed correctly, auto deskew may not be possible.

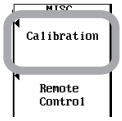


Executing the Deskew

Execute deskew after the warm-up time of the DL7400 and other equipment (as necessary) has elapsed.

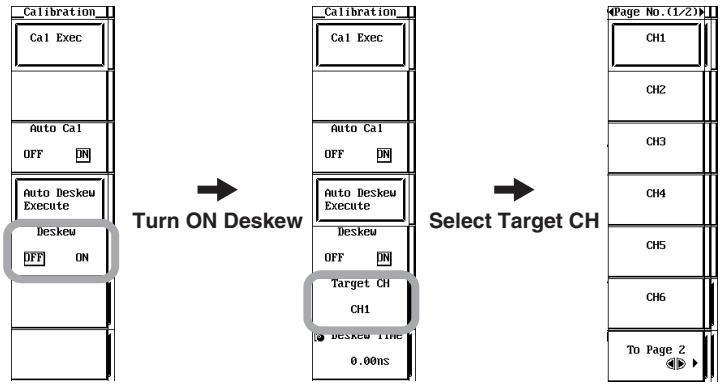
4. Press **MISC**. The MISC menu appears.
5. Press the **Calibration** soft key. The Calibration menu appears.

   You can also display the Calibration menu by selecting To Deskew in the Power Analyze Setup dialog box described in section 3 of this manual and pressing SELECT. If you jumped from the Power Analyze Setup dialog box to the Calibration menu, check that the attenuation of the voltage probe and current-to-voltage conversion ratio of the current probe have been set properly and degauss and zero adjustment have been performed correctly.



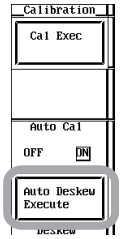
6. Press the **Deskew** soft key to select ON.
7. Press the **Target CH** soft key. The Target CH menu appears.
8. Press one of the **CH1** to **CH6/4** soft keys to select the displayed channel to be corrected.
   - CH1 to CH4 and CH1 to CH6 are channels on which power analysis is performed on the DL7440 and DL7480, respectively.
   - Select a channel that is not set to be the trigger source* of edge trigger for the correction target channel. When deskewing the voltage and current signals applied to CH1 and CH2 and CH1 is set to be the trigger source, select CH2 to be corrected. When deskew is executed, the CH2 signal approaches the CH1 signal on the time axis, and the difference in the transfer time is corrected. Likewise, execute deskew on the CH3 and CH4 pair and CH5 and CH6 pair.

   * For a description of the edge trigger and trigger source, see section 6.5 in the *DL7440/DL7480 User's Manual*.



Executing Auto Deskew

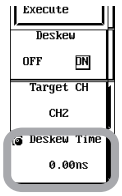
9. Press the **Auto Deskew Execute** soft key. Deskew is automatically executed.



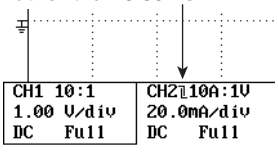
Executing Manual Deskew

- You can also manually execute deskew. You can use manual skew to correct the difference further after executing auto deskew.
- For a description of the settings related to the vertical axis or horizontal axis (time axis) used when displaying the signals applied to each channel, see the procedural explanations in the respective sections in the *DL7440/DL7480 User's Manual* and set the display for easy viewing of the correction condition.

9. Turn the **jog shuttle** and set Deskew Time so that the offset in the displayed voltage and current waveforms is small as possible.



This mark appears when the Deskew setting is ON and the deskew time of the selected target CH is set to a value other than 0.00 ns

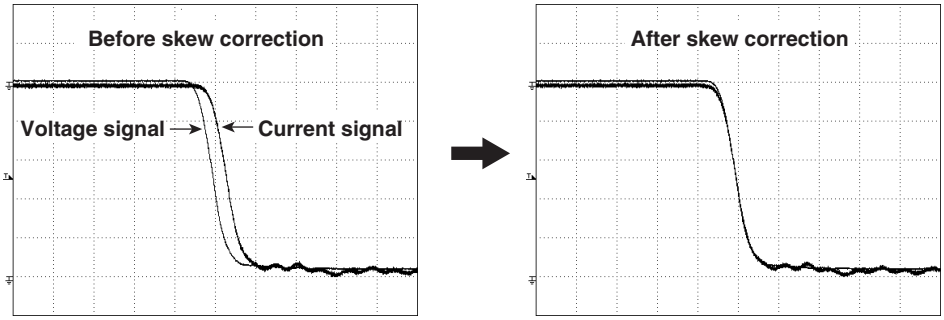


Note

- To improve the deskew accuracy, it is recommended that the bandwidth limit of the two channels be set the same (as close to Full as possible) when executing deskew.
- Execute deskew each time you change the bandwidth setting.
- Auto deskew may not work properly due to noise effects.

Deskew Execution Example

In the example shown below, the waveform is displayed smoothly because the acquisition mode (waveform acquisition condition) is set to averaging. When automatic deskew is executed, the waveform is not smooth because the acquisition mode is set to normal.



Explanation

To correctly measure the power analysis parameters such as power, impedance, power factor, watt hour, and ampere hour from the voltage and current under analysis, the difference in the transfer time of the voltage and current signals must be corrected (deskewed).

Connecting the Deskew Correction Signal Source

Apply the voltage and current signals from the deskew correction signal source to the pair of channels on the DL7400 that you wish to deskew using a voltage probe (passive probe or differential probe) and a current probe. For a description on the pair of channels for applying the voltage and current signals when measuring power analysis parameters, see page 6 in this manual.

Note

For information on the handling of the deskew correction signal source, passive probe, differential probe, and current probe, see the respective manuals.

Executing the Deskew

- Deskew is a function used to adjust the signal of the correction target channel (Target CH) to match the signal of the channel set to be the trigger source* of edge trigger along the time axis. It is a function used to correct the difference in the transfer time.
- Execute auto deskew after the warm-up time of the DL7400 and other equipment (as necessary) has elapsed.
- As necessary, execute deskew on the channel pairs of CH1 and CH2, CH3 and CH4, and CH5 and CH6.

* For a description of the edge trigger and trigger source, see section 6.5 in the *DL7440/DL7480 User's Manual IM701450-01E*.

Auto Deskew

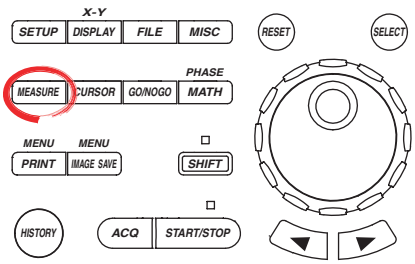
- If you execute auto deskew, only the trigger source channel and the correction target channel (Target CH) are displayed.
- If you execute auto deskew, settings of T/div, ACQ menu, SIMPLE menu (TRIGGER menu), CH menu, and MEASURE menu are changed to match the signal received from the 701935 Deskew Correction Signal Source. For details, see appendix 1.

Manual Deskew

- You can deskew further after performing auto deskew described above.
- For a description of the settings related to the vertical axis or horizontal axis (time axis) used when displaying the signals applied to each channel, see the procedural explanations in the respective sections in the *DL7440/DL7480 User's Manual* shown below and set the display for easy viewing of the correction condition.
  - Auto setup: section 4.5
  - V/div setting: section 5.2
  - Bandwidth limit selection: section 5.8
  - Channel ON/OFF: section 5.1
  - Vertical position setting: section 5.3
  - T/div setting: section 5.12

5 Performing Automated Measurement of Power Analysis Parameters

Procedure



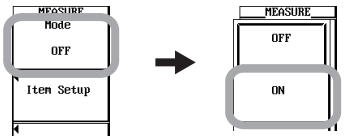
- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

To perform automated measurement of power analysis parameters, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

1. Press **MEASURE**. The MEASURE menu appears.
   You can also display the MEASURE menu by selecting To Measure in the Power Analyze Setup dialog box described in section 3 of this manual and pressing SELECT.
2. Press the **Mode** soft key. The Mode menu appears.
3. Press the **ON** soft key.



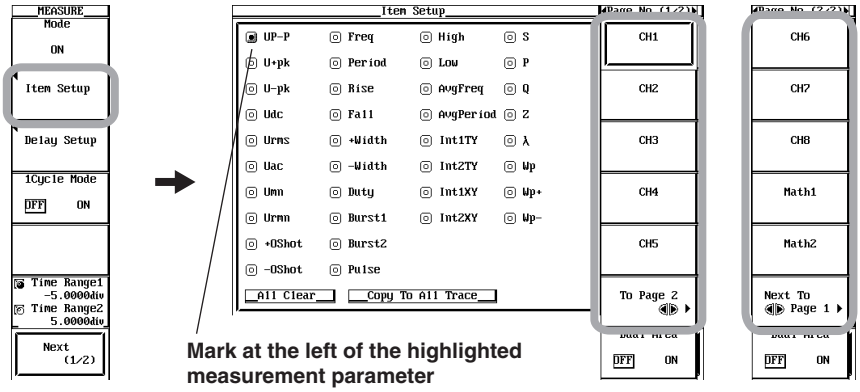
Selecting the Measurement Parameters

4. Press the **Item Setup** soft key. The Item Setup menu and Item Setup dialog box appear.
5. Press one of the soft keys from **CH1** to **CH8/4**, **Math1**, or **Math2** to select the waveform to be measured.
   - **If you select a measurement target waveform (one of the channels from CH1 to CH6) that has the power analysis function turned ON, the Item Setup dialog box showing power analysis parameters appears.**
   - On the DL7440, you can select from CH1 to CH4, Math1, and Math2.
   - On the DL7480, you can select from CH1 to CH8, Math1, and Math2. CH6, CH7, CH8, Math1, and Math2 appear when you press the To Page 2 soft key.
6. Turn the **jog shuttle** to select the parameter to be measured.
7. Press **SELECT**. The mark to the left of the measurement parameter is highlighted.
   - The measurement parameter whose mark to the left of the parameter is highlighted is the parameter to be measured.
   - If you execute All Clear using **jog shuttle & SELECT**, all the highlighted displays are cleared, and all parameters are not measured.
   - If you execute Copy To All Trace using **jog shuttle & SELECT**, the settings in the current Item Setup dialog box are copied to the Item Setup dialog boxes of all waveforms.
8. Press **ESC**. The Item Setup dialog box closes.

Display example of the Item Setup dialog box

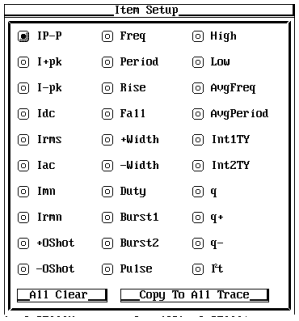
CH1, CH3, and CH5 when power analysis is specified on the measured waveform

Menu on the DL7480

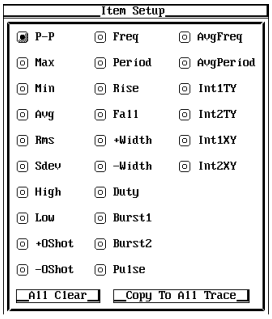


Mark at the left of the highlighted measurement parameter

CH2, CH4, and CH6 when power analysis is specified on the measured waveform



CH7, CH8, Math1, Math2 and CH1 to CH6 when power analysis is not specified on the measured waveform



- CH5 to CH8 can be used only on the DL7480.
- For CH5 to CH8, measurement parameters Int1XY and Int2XY are not available.

The rest of the procedure is the same as steps 9 to 32 in section 10.6 (pages 10-47 to 10-49) in the *DL7440/DL7480 User's Manual IM701450-01E*.

Performing Automated Measurement of Power Analysis Parameters on Dual Areas

The procedure is the same as steps 1 to 15 in section 10.8 (pages 10-61 to 10-63) in the *DL7440/DL7480 User's Manual IM701450-01E*. If the power analysis function is turned ON, power analysis parameters are available when selecting the measurement parameters in the Item box under Area1 or Area2 in the Item dialog box. The selectable types are the same as those of normal automated measurement described above (automated measurement on single area).

Explanation

To perform automated measurement of power analysis parameters, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

The addition of the power analysis function (/G4 option) allows automated measurement on power analysis parameters (waveform parameters) as with standard measurement parameters (waveform parameters). For details on the standard function and procedural explanations, see section 10.6 or 10.8 in the *DL7440/DL7480 User's Manual IM701450-01E*. The sections that differ from the standard function are described below.

Measured Waveforms and Measurement Parameters

The selectable parameters vary depending on whether power analysis is specified on the selected measured waveform as indicated below.

- **CH1, CH3, and CH5 (CH5 Only Applies to the DL7480) When Power Analysis Is Specified on the Measured Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, see "Determining Power Analysis Parameters" on the next page.
  UP-P, U+pk, U-pk, Udc, Urms, Uac, Umn, Urmn, S, P, Q, Z, λ, Wp, Wp+, and Wp-

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, High, Low, AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, Int2XY, and delay between waveforms

  * For CH5, Int1XY and Int2XY are not available.

- **CH2, CH4, and CH6 (CH6 Only Applies to the DL7480) When Power Analysis Is Specified on the Measured Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, see "Determining Power Analysis Parameters" on the next page.
  IP-P, I+pk, I-pk, Idc, Irms, Iac, Imn, Irmn, q, q+, q-, and I^2t

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, High, Low, AvgFreq, AvgPeriod, Int1TY, Int2TY, and delay between waveforms

- **CH7, CH8, Math1, Math2 and CH1 to CH6 (CH5 to CH8 only apply to the DL7480) When Power Analysis Is Not Specified on the Measured Waveform**

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  P-P, Max, Min, Avg, Rms, Sdev, High, Low, +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, Int2XY, and delay between waveforms

  * For CH5 to CH8, Int1XY and Int2XY are not available.

Automated Measurement of Power Analysis Parameters on Dual Areas

Power analysis parameters can be selected for measurement parameters in the same fashion as normal automated measurement described above (automated measurement on single area).

Determining the Power Analysis Parameter Values

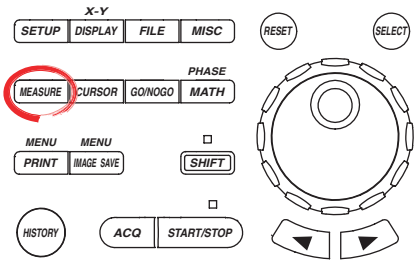
<table>
<tr><th>Power Analysis Parameter</th><th colspan="5">Method of Determination, Equation</th></tr>
<tr><td rowspan="4">Voltage U [V]
DC component Udc
True rms value Urms
AC component Uac
Rectified mean value calibrated to the rms value Umn
Rectified mean value Urmn
Amplitude UP-P
Maximum value U+pk
Minimum value U-pk</td><td>Udc</td><td>Urms</td><td>Uac</td><td>Umn</td><td>Urmn</td></tr>
<tr><td>$\frac{1}{T}\int_0^T u(t)\,dt$</td><td>$\sqrt{\frac{1}{T}\int_0^T u(t)^2\,dt}$</td><td>$\sqrt{Urms^2 - Udc^2}$</td><td>$\frac{\pi}{2\sqrt{2}}\frac{1}{T}\int_0^T \lvert u(t)\rvert\,dt$</td><td>$\frac{1}{T}\int_0^T \lvert u(t)\rvert\,dt$</td></tr>
<tr><td colspan="2">UP-P</td><td colspan="2">U+pk</td><td>U-pk</td></tr>
<tr><td colspan="2">Amplitude (equivalent to the standard measurement parameter P-P)</td><td colspan="2">Maximum value (equivalent to the standard measurement parameter Max)</td><td>Minimum value (equivalent to the standard measurement parameter Min)</td></tr>
<tr><td rowspan="4">Current I [A]
DC component Idc
True rms value Irms
AC component Iac
Rectified mean value calibrated to the rms value Imn
Rectified mean value Irmn
Amplitude IP-P
Maximum value I+pk
Minimum value I-pk</td><td>Idc</td><td>Irms</td><td>Iac</td><td>Imn</td><td>Irmn</td></tr>
<tr><td>$\frac{1}{T}\int_0^T i(t)\,dt$</td><td>$\sqrt{\frac{1}{T}\int_0^T i(t)^2\,dt}$</td><td>$\sqrt{Irms^2 - Idc^2}$</td><td>$\frac{\pi}{2\sqrt{2}}\frac{1}{T}\int_0^T \lvert i(t)\rvert\,dt$</td><td>$\frac{1}{T}\int_0^T \lvert i(t)\rvert\,dt$</td></tr>
<tr><td colspan="2">IP-P</td><td colspan="2">I+pk</td><td>I-pk</td></tr>
<tr><td colspan="2">Amplitude (equivalent to the standard measurement parameter P-P)</td><td colspan="2">Maximum value (equivalent to the standard measurement parameter Max)</td><td>Minimum value (equivalent to the standard measurement parameter Min)</td></tr>
<tr><td>Active power P [W]</td><td colspan="5">$\frac{1}{T}\int_0^T u(t)\cdot i(t)\,dt$</td></tr>
<tr><td>Apparent power S [VA]</td><td colspan="5">$Urms \cdot Irms$</td></tr>
<tr><td>Reactive power Q [var]</td><td colspan="5">$\sqrt{S^2 - P^2}$</td></tr>
<tr><td>Power factor λ</td><td colspan="5">$\frac{P}{S}$</td></tr>
<tr><td>Impedance of the load circuit Z [Ω]</td><td colspan="5">$\frac{Urms}{Irms}$</td></tr>
<tr><td>Watt hour [Wh]
Wp
Wp+
Wp–</td><td colspan="5">$\int_0^T u(t)\cdot i(t)\,dt$
Wp is the sum of positive and negative watt hours.
Wp+ is the sum of positive P (consumed watt hours).
Wp– is the sum of negative P (watt hours returned to the power supply).</td></tr>
<tr><td>Ampere hour [Ah]
q
q+
q–</td><td colspan="5">$\int_0^T i(t)\,dt$
q is the sum of positive and negative Idc (ampere hours).
q+ is the sum of positive Idc (ampere hours).
q– is the sum of negative Idc (ampere hours).</td></tr>
<tr><td>Joule integral I^2t [A^2s]</td><td colspan="5">$\int_0^T i^2(t)\,dt$</td></tr>
</table>

Note

- *T* in the table above is the time range of measurement specified when performing automated measurement. For the measurement range, see section 10.6 in the *DL7440/DL7480 User's Manual*.
- *u(t)* and *i(t)* denote the sampled data of the voltage signal and the current signal, respectively.

6 Performing Statistical Processing on the Measured Values of Power Analysis Parameters

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

To perform automated measurement of power analysis parameters and statistical processing, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

1. Press **MEASURE**. The MEASURE menu appears.
   You can also display the MEASURE menu by selecting To Measure in the Power Analyze Setup dialog box described in section 3 of this manual and pressing SELECT.

The rest of the procedure is the same as steps 2 to 15 in section 10.7 (pages 10-54 to 10-58) in the *DL7440/DL7480 User's Manual IM701450-01E*.
However, the steps for selecting measurement parameters are the same as steps 4 to 8 in section 5 (page 13) in this manual.

Explanation

As with the standard measurement parameters (waveform parameters), you can perform statistical processing on the measured values of power analysis parameters. The following five statistics can be displayed on the measured values of two measurement parameters.

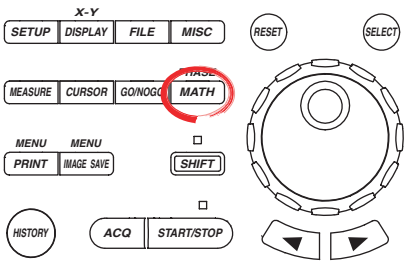
Max	Maximum value
Min	Minimum value
Avg	Average value
Sdv	Standard deviation
Cnt	Number of measured values used in the statistical processing

For example, if you selected power analysis parameter UP-P of CH1 as a measurement parameter, the maximum, minimum, average, standard deviation, and the number of measured values used in the statistical processing of the UP-P of CH1 are displayed.

For a detailed explanation on statistical processing, see the explanation given in section 10.7 (pages 10-59 and 10-60) in the *DL7440/DL7480 User's Manual*.

7 Performing Waveform Computation on Power Analysis Parameters

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

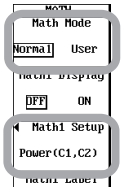
The following setup is required to perform waveform computation on power analysis parameters.

- **Turn ON the power analysis function on the applicable channels, and turn ON the assignment of waveform analysis parameters to computed waveforms. For the setup procedure, see section 3 in this manual.**
- **Turn ON the computed waveform display. For the setup procedure, see section 9.1 in the *DL7440/DL7480 User's Manual IM701450-01E*.**

Note

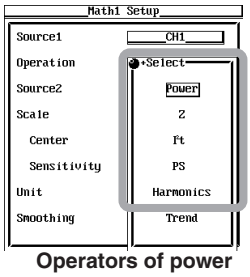
- The setup procedures for computed waveform Math1 are described below. Perform similar steps for Math2.
- For the procedure for turning ON/OFF the computed waveform display (Math1 Display or Math2 Display) and the procedure for setting computed waveform labels (Math1 Label or Math2 Label), see section 9.1 in the *DL7440/DL7480 User's Manual*.
- To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be deskewed. For instructions, see section 4 in this manual.

1. Press **MATH**. The MATH menu appears.
   You can also display the MATH menu by selecting To Math in the Power Analyze Setup dialog box described in section 3 of this manual and pressing SELECT.
2. Press the **Math Mode** soft key to select Normal. The normal computation menu opens.
3. Press the **Math1 Setup** soft key. The Math1 Setup dialog box opens.
   * For the setup procedure of Math1 Display, see section 9.1 in the *DL7440/DL7480 User's Manual*.



Setting the Equation, Scaling, Unit, and Smoothing

4. Use **jog shuttle & SELECT** to set the operator of the power analysis parameter in the Operation box. Then, set the computation source waveform, scaling, unit, smoothing, and other items according to the operator.
   When the Math1 Setup dialog box is closed by pressing ESC or another key, the specified equation appears in the Math1 Setup menu column.



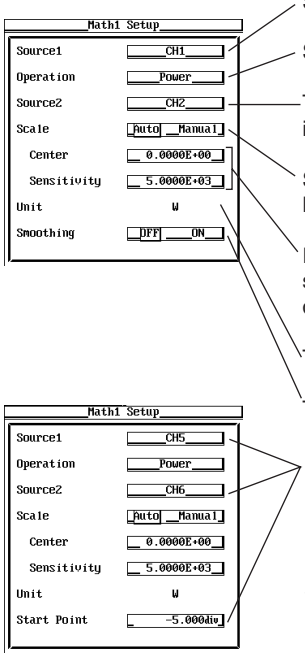
Operators of power analysis parameters

For the setup procedure of the five operators of power analysis parameters, see the pages indicated below. For a description of the Trend operator, see section 8 in this manual.

- Power (active power) -> Page 19
- I^2t (Joule integral) -> Page 20
- Harmonics -> Page 21
- Z (impedance) -> Page 19
- PS (power spectrum) -> Page 20

Setting the Computed Waveform of Active Power (When Power Was Selected in Step 4 on Page 18)

5. Use **jog shuttle & SELECT** to set the computation source waveform, scaling, unit, smoothing, and computation start point of computed waveform Math1.



Select the waveform on which to perform computation.

Select Power.

The waveform (channel) that is paired with the waveform selected in the Source1 box is automatically selected.

Set the scaling used to display computed waveform Math1 or Math2 to Auto (auto scaling) or Manual (manual scaling).

If scaling is set to Manual, set the vertical center line level on the screen (power value) and the sensitivity (power value per division).

The unit is fixed to W.

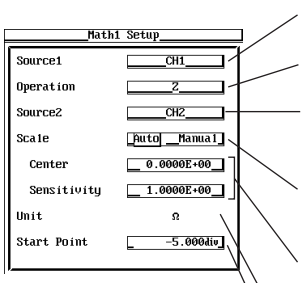
Turn ON/OFF zooming.

If CH5 is selected in Source1, CH6 is automatically selected in Source2. The Smoothing box changes to the Start Point box. Set the computation start point.
When the operator is Power and the computed waveform is CH5 or CH6, the maximum record length that can be computed is from the computation start point to 2 MW.

6. Press **ESC**. The Math1 Setup dialog box closes.

Setting the Computed Waveform of Impedance (When Z Was Selected in Step 4 on Page 18)

5. Use **jog shuttle & SELECT** to set the computation source waveform, scaling, unit, and computation start point of computed waveform Math1.



Select the waveform on which to perform computation.

Select Z.

The waveform (channel) that is paired with the waveform selected in the Source1 box is automatically selected.

Set the scaling used to display computed waveform Math1 or Math2 to Auto (auto scaling) or Manual (manual scaling).

If scaling is set to Manual, set the vertical center line level on the screen (impedance value) and the sensitivity (impedance value per division).

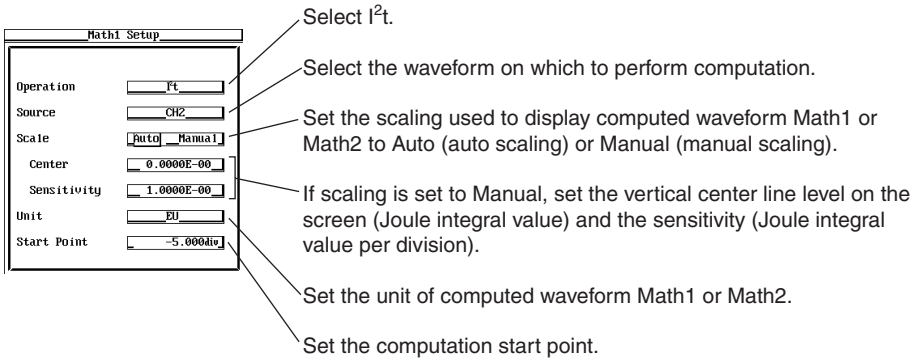
The unit is fixed to Ω.

Set the computation start point.

6. Press **ESC**. The Math1 Setup dialog box closes.

Setting the Computed Waveform of Joule Integral (When I^2t Was Selected in Step 4 on Page 18)

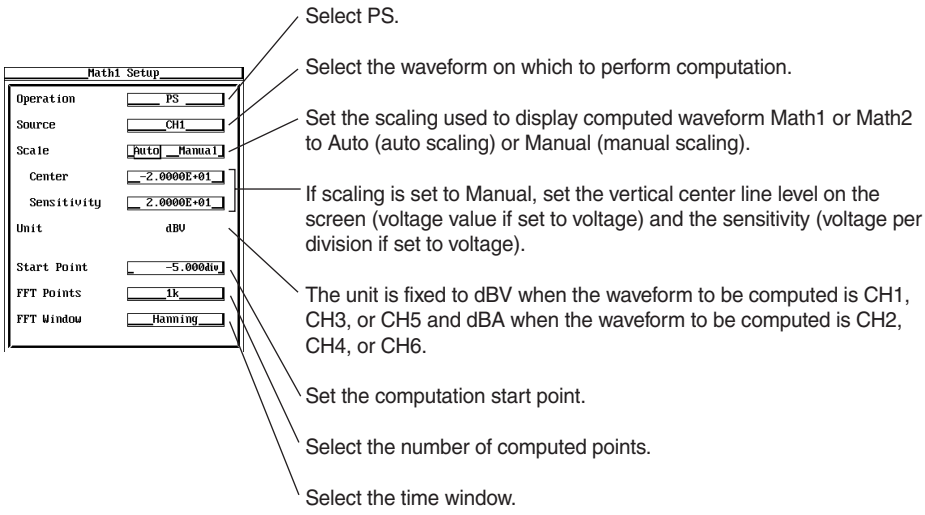
5. Use **jog shuttle & SELECT** to set the computation source waveform, scaling, unit, and computation start point of computed waveform Math1.



6. Press **ESC**. The Math1 Setup dialog box closes.

Setting the Computed Waveform of Power Spectrum (When PS Was Selected in Step 4 on Page 18)

5. Use **jog shuttle & SELECT** to set the computation source waveform, scaling, unit, computation start point, and time window of computed waveform Math1.

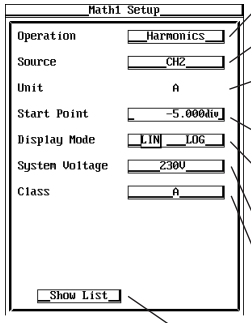


6. Press **ESC**. The Math1 Setup dialog box closes.

Setting the Computed Waveform of Harmonics (When Harmonics Was Selected in Step 4 on Page 18)

5. Use **jog shuttle & SELECT** to set the applicable class of the equipment under test, computation source waveform, computation start point, bar graph scale, supply voltage of the equipment under test, and other items of computed waveform Math1.
   - The setup items vary depending on the applicable class as defined in the harmonic current emissions standard (see page 5).
   - To perform waveform computation of harmonics continuously when waveform acquisition is started, set the trigger mode to Normal. For a description of the trigger mode, see section 6.1 in the *DL7440/DL7480 User's Manual*.

- **When the Applicable Class of the Equipment under Test Is A or B**



Select Harmonics.

Select the waveform on which to perform computation.

When Display Mode (vertical scale of the bar graph) is set to LIN, the unit is fixed to A. When set to LOG, the unit is EU and you can specify the unit.

Set the computation start point.

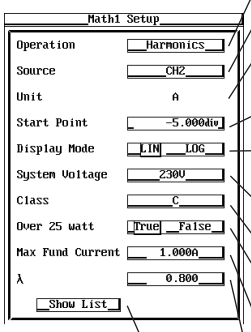
Select LIN (linear) or LOG (logarithmic) for the vertical scale used on the bar graphs showing the harmonic measurement data and the standard limits for each order.

Set the source voltage of the equipment under test.

Select the applicable class A or B.

The harmonic measurement data and the standard limits for each order are listed.

- **When the Applicable Class of the Equipment under Test Is C**



Select Harmonics.

Select the waveform on which to perform computation.

When Display Mode (vertical scale of the bar graph) is set to LIN, the unit is fixed to A. When set to LOG, the unit is EU and you can specify the unit.

Set the computation start point.

Select LIN (linear) or LOG (logarithmic) for the vertical scale used on the bar graphs showing the harmonic measurement data and the standard limits for each order.

Set the source voltage of the equipment under test.

Select applicable class C.

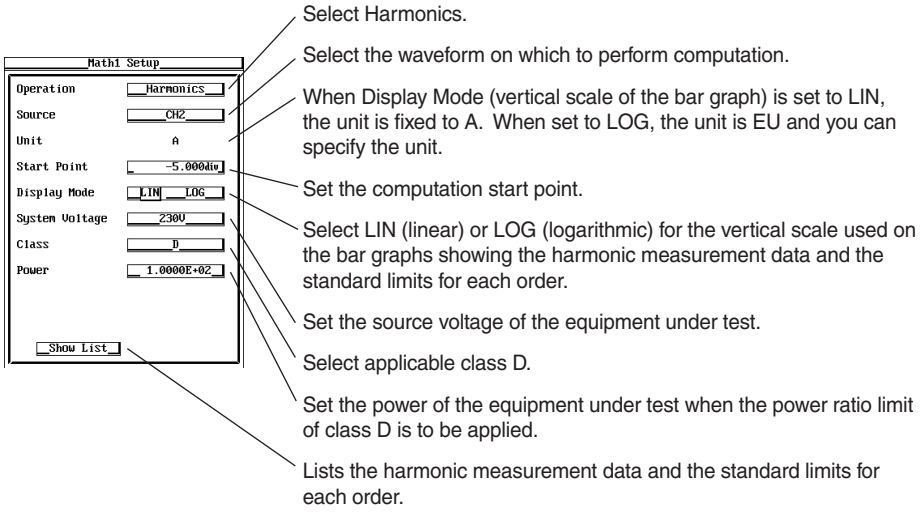
Select whether the active (input) power of the equipment under test exceeds 25 W (True/False).

Set the fundamental current when the load on the equipment under test is set to maximum. To set the maximum current measured on the DL7400, perform harmonic computation with the maximum load, and then set the value that is displayed in the Max box in the list that appears when you select Show List.

If the active (input) power of the equipment under test exceeds 25 W (True), set the power factor when the load on the equipment under test is set to maximum. On the DL7400, set the power factor that is measured according to the procedure given in section 5.

Lists the harmonic measurement data and the standard limits for each order.

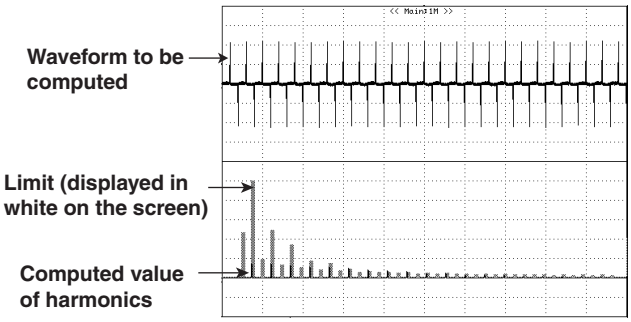
- **When the Applicable Class of the Equipment under Test Is D**



6. Press **ESC**. The Math1 Setup dialog box closes.

Bar Graph Display Example

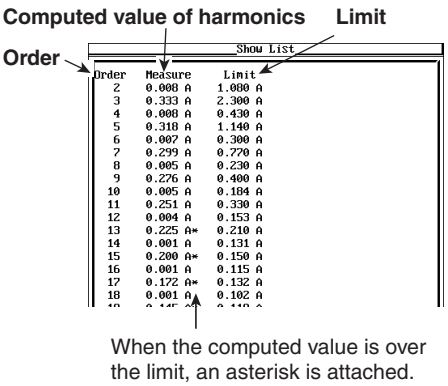
The harmonic measurement data and the standard limits for each order up to the 40th order can be displayed on a bar graph.



List Display Example

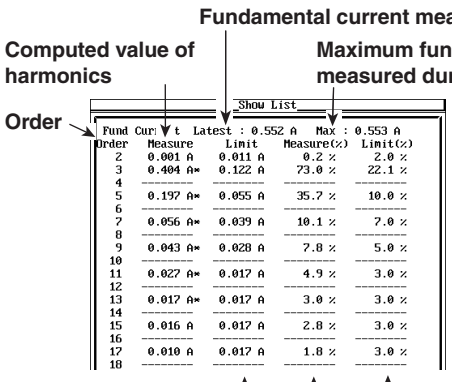
The harmonic measurement data and the standard limits for each order up to the 40th order can be listed.

Display example for applicable class A, B, and D



When the computed value is over the limit, an asterisk is attached.

Display example for applicable class C



In the standard, the limit of Class C is defined as a percentage Limit (%) with respect to the fundamental current.

To make the comparison easy against the percentage limit (%) of the standard, the value obtained by the equation *computed value of harmonics ÷ Max Fund Current (the value specified in the dialog box for Class C on the previous page)* is displayed.

Displays the value obtained by the equation *percentage limit (%) of the standard × Max Fund Current (the value specified in the dialog box for Class C on the previous page)*.

Explanation

The following setup is required to perform waveform computation on power analysis parameters. Turn ON the power analysis function on the applicable channels, and turn ON the assignment of waveform analysis parameters to computed waveforms. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

Turning ON/OFF the Computed Waveform Display and Computed Waveform Label

See section 9.1 in the *DL7440/DL7480 User's Manual*. Computed waveforms are displayed only when the computed waveform display is turned ON.

Operators

You can select the operator for Math1 and Math2. For a description of the Trend operator, see section 8 in this manual.

Power (active power)	**Z (impedance)**	**I^2t (Joule integral)**
PS (power spectrum)	**Harmonics**	

Waveform to Be Computed

The waveforms on which computation can be performed (source) are as follows:

Computation Name	Operator	Source (Source1:Source2)
Math1	Power	(CH1:CH2)
		(CH5:CH6)
	Z	(CH1:CH2)
		(CH5:CH6)
	I^2t	CH2, CH6
	PS	CH1 to CH6
	Harmonics	CH2, CH4, CH6
Math2	Power	(CH3:CH4)
		(CH5:CH6)
	Z	(CH3:CH4)
		(CH5:CH6)
	I^2t	CH4, CH6
	PS	CH1 to CH6
	Harmonics	CH2, CH4, CH6

- On the menu, CH1 to CH8 may be indicated as C1 to C8, Math1 as M1, and Math2 as M2.
- CH5 to CH8 can only be used on the DL7480.

Scaling

See section 9.2 in the *DL7440/DL7480 User's Manual*.

Unit of Computed Waveforms

Units can be assigned to computed waveforms Math1 and Math2 using up to 4 characters. However, units are fixed on some operators.

- The type of characters that can be used are those displayed on the keyboard.
- The specified unit is displayed when scaled values are displayed (section 8.8 in the *DL7440/DL7480 User's Manual*).

Smoothing

See section 9.2 in the *DL7440/DL7480 User's Manual*.

Effects of Linear Scaling

If linear scaling is performed on the channel to be computed on waveform computation other than operator PS, computation is performed using linearly scaled values.

Maximum Record Length That Can Be Computed

The maximum record lengths that can be computed on Math1 and Math2 are as follows:

When the operator is Power and the computation source waveform is CH5 or CH6
2 MW.

When the operator is Z or I^2t
2 MW.

When the operator is PS
1 kW or 10 kW.

When the operator is Harmonics
When 16 cycles of the 50-Hz or 60-Hz waveform (fundamental waveform) contains waveform data of 8192 words or more, 16 cycles of waveform data is used. The T/div and record length settings that meet this condition are listed in the table in appendix 2. For the setup procedure of T/div and record length, see sections 5.12 and 7.2, respectively, in the *DL7440/DL7480 User's Manual*.

For all other cases
- On 4 MW memory models (701450 and 701470), the maximum record length is 4 MW.
- On 16 MW memory models (701460 and 701480), the record length is 8 MW and 4 MW when interleave mode is ON and when interleave mode is OFF, respectively.

Computation Start Point

For waveform computation on which the computation start points is specified, the following range and resolution can be used.

Selectable range	±5 div
Resolution	10 div ÷ display record length

For a description of the display record length, see appendix 1 in the DL7440/DL7480 User's Manual.

Time Window

You can select the time window for operator PS. For details, see section 9.6 in the *DL7440/DL7480 User's Manual*.

Computed Waveform of Harmonics[1]

Special measurement/computation conditions and parameter settings shown in the table below are required for waveform computation of harmonics.

Trigger mode
To perform waveform computation of harmonics continuously when waveform acquisition is started, set the trigger mode to Normal. For a description of the trigger mode, see section 6.1 in the *DL7440/DL7480 User's Manual*.

Time window
Rect (Rectangular).

Number of waveforms and number of waveform data points
To perform computation according to the harmonic current emissions standard, 16 cycles of the fundamental waveform[2] are required In addition, harmonic computation is performed only when the number of data points contained in the 16 cycles of waveform data is at least 8192 points. The T/div and record length settings that meet this condition are listed in the table in appendix 2.

Harmonic order[3]
Harmonic components[4] of up to 40th order are computed.

1 Harmonics
Harmonics refer to sine waves whose frequency is integer multiple of the fundamental wave (normally sine waves of commercial frequency 50-Hz or 60-Hz). The lowest harmonic frequency is twice the fundamental frequency. The input current that flows through the power rectification circuit, phase control circuit, and other circuits used in various electric and electronic equipment generate harmonic current or voltage on the power line. When the fundamental and harmonic waves are combined, distortion occurs in the waveform, and interference sometimes occur in equipment connected to the power line.

2 Fundamental wave and fundamental component
The sine wave with the longest period among the different sine waves derived from the periodic complex wave. Or the sine wave that has the fundamental frequency within the components of the complex wave. *Fundamental frequency* refers to the frequency corresponding to the longest period in the period complex wave.

3 Harmonic order
Integer ratio of the harmonic frequency with respect to the fundamental frequency.

4 Harmonic component
Waveform component with frequency that is an integer multiple (twice or greater) of the fundamental frequency.

Supply voltage of the equipment under test (system voltage)
Set the supply voltage of the equipment on which to perform harmonic computation. The harmonic limit defined by the harmonic current emissions standard (see page 5) is converted[5] using the supply voltage and used as the criteria. The default value is 230 V.
- Selectable range 90 to 440 V
- Resolution 1 V

Applicable class[6] (Class)
Select the applicable class for the equipment under test. The harmonic current emissions standard classifies the equipment under test into Class A through D, and criteria are specified for each class.
- **Additional items set for Class C[6]**
  Active power of the equipment under test (Over 25 watt)
  Select whether the active power of the equipment under test exceeds 25 W. For Class C, the criteria vary depending on the active power of the equipment.
  Fundamental current of the equipment under test (Max Fund Current)
  Set the fundamental current when the load on the equipment under test is set to maximum. To set the maximum current measured on the DL7400, perform harmonic computation with the maximum load, and then set the value that is displayed in the Max box in the list that appears when you select Show List. For Class C, evaluation is made on the percentage of the harmonic component with respect to the maximum fundamental current of the equipment under test.
  Power factor (λ)
  If the active (input) power of the equipment under test exceeds 25 W (True), set the power factor when the load on the equipment under test is set to maximum. On the DL7400, set the power factor that is measured according to the procedure given in section 5. For Class C, if the active (input) power of the equipment under test exceeds 25 W, the circuit power factor when the equipment load is set to maximum is used when evaluating the percentage of the 3rd order harmonic component with respect to the fundamental current.
  - Default value 0.800
  - Selectable range 0 to 1.000
  - Resolution 0.001
- **Additional items set for Class D[6]**
  Active power of the equipment under test
  Set the active power of the equipment under test. For Class D, the harmonic current per watt (power ratio limit) is also evaluated.

Displaying the computed results
- **Bar graph display**
  The harmonic measurement data and the standard limits for each order up to the 40th order can be displayed on a bar graph. You can set the scale to LIN (linear) or LOG (logarithmic).
- **List display (Show List)**
  The harmonic measurement data and the standard limits for each order up to the 40th order can be listed.

5 Conversion of limits using the supply voltage
The harmonic current emissions standard defines limits of harmonics for each order by assuming 220 V, 230 V, and 240 V for the supply voltages of the equipment under test (single phase). For other supply voltages, the limits need to be converted. The power analysis function of the DL7400 uses the following equation to convert the limits of all classes excluding the range of 220 V to 240 V.

$$\text{Converted limit} = \text{Limit of each class} \times \frac{230}{\text{Supply voltage of equipment (rated voltage)}}$$

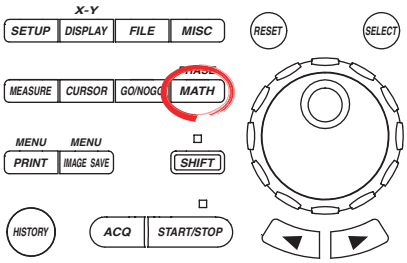
6 For details on each item, see the standard given on page 5 in this manual.

Note

- The DL7400 can only compute the harmonics of single-phase equipment. It cannot compute the harmonics of three-phase equipment.
- The computed results of harmonics obtained through this function do not accurately comply with the standard. To make accurate measurements complying with the standard, the WT2000 Series Digital Power Meter and Harmonic Analysis Software (Model 761922) are required.
- You cannot perform history search on the computed results of harmonics.
- You cannot perform GO/NO-GO determination on the computed values of harmonics (measured values of waveform parameters).
- Of the computed results of harmonics, the computed values of each harmonic component and the limits defined by the standard can be saved to a file in CSV format (see section 11 in this manual). The waveform data of harmonics cannot be saved.
- The original waveform data used to compute the harmonics can be saved. If the original waveform data is saved in binary format, harmonic computation described in this section can be performed by loading the data into the DL7400 with the Power Analysis Function (/G4 option). For instructions on saving the data in binary format, see section 12.7 in the *DL7440/DL7480 User's Manual*.

8 Displaying the Trend of the Measured Values of Waveform Parameters per Cycle

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

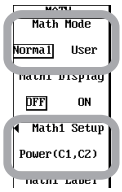
The following setup or procedure is required to display the trend.

- **Turn ON the assignment of the power analysis parameters to the computation waveform. For the setup procedure, see section 3 in this manual.**
- **Display the target waveform on which to compute/display the trend.**
- **Set and execute the measurement of waveform parameters per cycle. For the procedure, see section 10.7 in the *DL7440/DL7480 User's Manual IM701450-01E*. To execute the measurement of waveform parameters per cycle, stop waveform acquisition.**
- **Turn ON the computed waveform display. For the setup procedure, see section 9.1 in the *DL7440/DL7480 User's Manual*.**

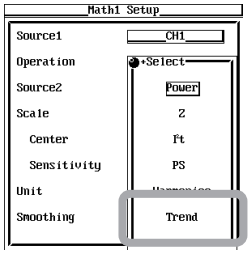
Note

- The setup procedures for computed waveform Math1 are described below. Perform similar steps for Math2.
- For the procedure for turning ON/OFF the computed waveform display (Math1 Display or Math2 Display) and the procedure for setting computed waveform labels (Math1 Label or Math2 Label), see section 9.1 in the *DL7440/DL7480 User's Manual*.
- To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

1. Press **MATH**. The MATH menu appears.
   You can also display the MATH menu by selecting To Math in the Power Analyze Setup dialog box described in section 3 of this manual and pressing SELECT.
2. Press the **Math Mode** soft key to select Normal. The normal computation menu opens.
3. Press the **Math1 Setup** soft key. The Math1 Setup dialog box opens.
   * For the setup procedure of Math1 Display, see section 9.1 in the *DL7440/DL7480 User's Manual*.

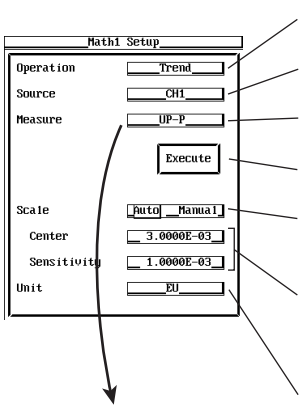


4. Use **jog shuttle & SELECT** to set Trend in the Operation box.
   When the Math1 Setup dialog box is closed by pressing ESC or another key, the specified equation appears in the Math1 Setup menu column.



Trend operator

5. Use **jog shuttle & SELECT** to set the trend source waveform, trend target parameter (measurement parameter), scaling, and unit of computed waveform Math1. Then, execute the trend display.



Select Trend.

Select the target trend waveform.

Select the trend parameter (measurement parameter).

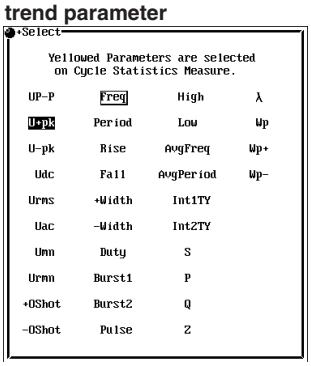
Execute trend display.

Set the scaling used to display computed waveform Math1 or Math2 to Auto (auto scaling) or Manual (manual scaling).

If scaling is set to Manual, set the vertical center line level on the screen (voltage value if set to voltage) and the sensitivity (voltage per division if set to voltage).

Set the unit of computed waveform Math1 or Math2.

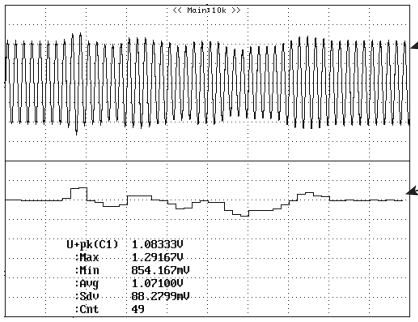
Dialog box used to select the trend parameter



Select the parameter shown in **yellow characters* on a black background**.
* The parameter that is selected in the setup operation (MEASURE menu) of the waveform parameter per cycle and whose measured value is held after the execution of the measurement is displayed in **yellow on a black background**. If the characters are in yellow but the background is not black, it is only selected as a measurement parameter. The parameter does not have measured values per cycle.
If you reselect a parameter on the MEASURE menu after executing the measurement, the measured value is not held. To display a trend, measured values that are held must be present.

6. Press **ESC**. The Math1 Setup dialog box closes.

Trend Display Example



Target waveform for trend

Trend (computed waveform)

Explanation

Turning ON/OFF the Computed Waveform Display and Computed Waveform Label

See section 9.1 in the *DL7440/DL7480 User's Manual IM701450-01E*. Computed waveforms are displayed only when the computed waveform display is turned ON.

Operator

Trend

Effects of Scaling, Unit of Computed Waveform, and Linear Scaling

See section 7 in this manual.

Measurement Range

The measurement range is the same as the measurement range specified in the automated measurement of waveform parameters. See section 10.6 in the *DL7440/DL7480 User's Manual*.

Trend Source Waveform

The waveforms on which trend is displayed are as follows:

Computation Name	Source
Math1	CH1 to CH8
Math2	CH1 to CH8 and Math1

- On the menu, CH1 to CH8 may be indicated as C1 to C8, Math1 as M1, and Math2 as M2.
- CH5 to CH8 can only be used on the DL7480.
- The trend is displayed when you press the Execute button.

Trend Target Parameter (Measurement Parameter)

If Trend is selected, select the measurement parameter of the trend source waveform (see the table below) to be displayed as a trend. The selectable parameters vary depending on whether power analysis is enabled on the selected trend source waveform as indicated below.

- **CH1, CH3, and CH5 (CH5 Only Applies to the DL7480) When Power Analysis Is Specified on the Trend Source Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, see "Determining Power Analysis Parameters" on the next page.
  UP-P, U+pk, U-pk, Udc, Urms, Uac, Umn, Urmn, S, P, Q, Z, λ, Wp, Wp+, and Wp-

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, High, Low, AvgFreq, AvgPeriod, Int1TY, and Int2TY

- **CH2, CH4, and CH6 (CH6 Only Applies to the DL7480) When Power Analysis Is Specified on the Trend Source Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, see "Determining Power Analysis Parameters" on the next page.
  IP-P, I+pk, I-pk, Idc, Irms, Iac, Imn, Irmn, q, q+, q-, and I^2t

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, High, Low, AvgFreq, AvgPeriod, Int1TY, and Int2TY

- **CH7, CH8, Math1, and CH1 to CH6 (CH5 to CH8 only apply to the DL7480) When Power Analysis Is Not Specified on the Trend Source Waveform**

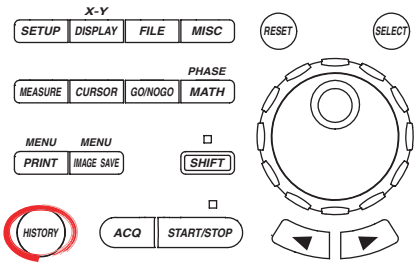
  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual*.
  P-P, Max, Min, Rms, Avg, Sdev, High, Low, +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, AvgFreq, AvgPeriod, Int1TY, and Int2TY

Note

- The displayed trend is cleared when waveform acquisition is started.
- If you execute trend display by changing the record number of the history waveform (see section 10.1 in the *DL7440/DL7480 User's Manual*), the previous trend before execution is cleared.
- You cannot perform history search on the trend display.
- You cannot perform GO/NO-GO determination on the zone or measured values of the trend.
- The waveform of the displayed trend cannot be saved. The original measured values of waveform parameters per cycle used for the trend display can be saved. For instruction on saving the measured values, see section 12.9 in the *DL7440/DL7480 User's Manual*.
- The original waveform data used to determine the measured values of waveform parameters per cycle can be saved. If the original waveform data is saved in binary format, waveform parameter measurement per cycle can be executed, and the trend can be displayed by loading the data into the DL7400 with the Power Analysis Function (/G4 option). For instructions on saving the data in binary format, see section 12.7 in the *DL7440/DL7480 User's Manual*.

9 Performing History Search Using Measured Values of Power Analysis Parameters

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

To perform history search using power analysis parameters, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

1. Press **HISTORY**. The HISTORY menu appears.

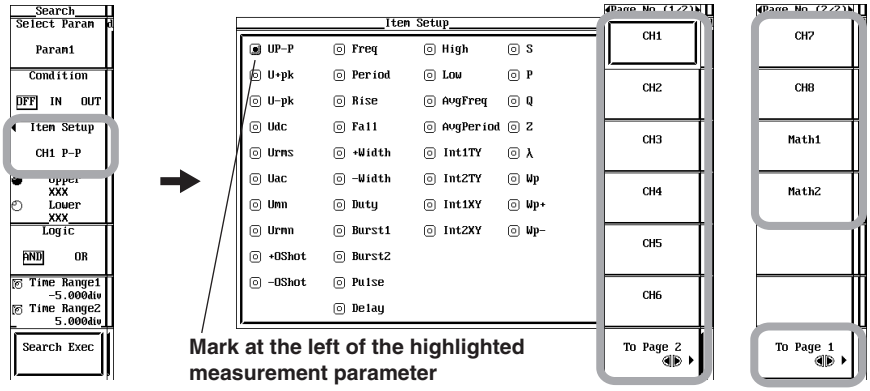
Steps 2 to 7 are the same as steps 2 to 7 in section 10.3 (pages 10-10 and 10-11) in the *DL7440/DL7480 User's Manual IM701450-01E*.

Selecting the Search Target Waveform and Search Measurement Parameter

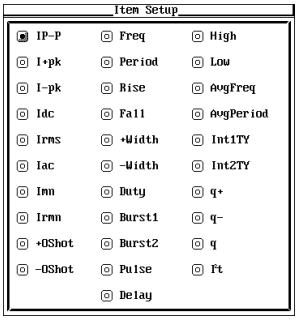
8. Press the **Item Setup** soft key. The Item Setup menu and Item Setup dialog box appear.
9. Press one of the soft keys from **CH1** to **CH8/4**, **Math1**, or **Math2** to select the search target waveform.
   - If you select a search target waveform (one of the channels from CH1 to CH6) that has the power analysis function turned ON, the Item Setup dialog box showing power analysis parameters appears in which you can select the measurement parameter to be used as a search condition.
   - On the DL7440, you can select from CH1 to CH4, Math1, and Math2.
   - On the DL7480, you can select from CH1 to CH8, Math1, and Math2. CH7, CH8, Math1, and Math2 appear when you press the To Page 2 soft key.
10. Turn the **jog shuttle** to select the measurement parameter to be used as a search condition.
11. Press **SELECT**. The mark to the left of the measurement parameter is highlighted.

    The measurement item whose mark to the left of the item is highlighted is the measurement item used as a search condition. You can set a single measurement parameter for a single search parameter.
12. Press **ESC**. The Item Setup dialog box closes.

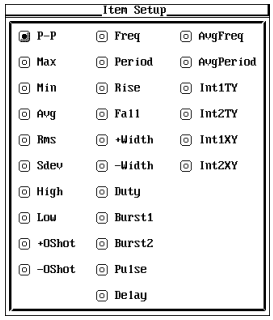
Display example of the Item Setup dialog box



CH2, CH4, and CH6 when power analysis is specified on the searched waveform



CH7, CH8, Math1, Math2 and CH1 to CH6 when power analysis is not specified on the searched waveform



- CH5 to CH8 can be used only on the DL7480.
- For CH5 to CH8, measurement parameters Int1XY and Int2XY are not available.

The rest of the procedure is the same as steps 13 to 22 in section 10.3 (pages 10-12 and 10-13) in the *DL7440/DL7480 User's Manual*.

Explanation

To perform history search using power analysis parameters, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

The addition of the power supply analysis function (/G4 option) allows history search using power analysis parameters (for details on their derivation, see section 5 in this manual) as with standard measurement parameters (waveform parameters). For details on the standard function and procedural explanations, see section 10.3 in the *DL7440/ DL7480 User's Manual IM701450-01E*. The sections that differ from the standard function are described below.

Search Target Waveform and Search Measurement Parameter

The selectable parameters vary depending on whether power analysis is enabled on the selected search target waveform as indicated below.

- **CH1, CH3, and CH5 (CH5 Only Applies to the DL7480) When Power Analysis Is Specified on the Search Target Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, section 5 in this manual.
  UP-P, U+pk, U-pk, Udc, Urms, Uac, Umn, Urmn, S, P, Q, Z, λ, Wp, Wp+, and Wp-

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual.*
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, Delay (delay between waveforms), High, Low, AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, and Int2XY

  * For CH5, Int1XY and Int2XY are not available.

- **CH2, CH4, and CH6 (CH6 only applies to the DL7480) When Power Analysis Is Specified on the Search Target Waveform**

  Power analysis parameters:
  For details on how to determine each parameter, section 5 in this manual.
  IP-P, I+pk, I-pk, Idc, Irms, Iac, Imn, Irmn, q, q+, q-, and I^2t

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual.*
  +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, Delay (delay between waveforms), High, Low, AvgFreq, AvgPeriod, Int1TY, and Int2TY

- **CH7, CH8, Math1, Math2 and CH1 to CH6 (CH5 to CH8 only apply to the DL7480) When Power Analysis Is Not Specified on the Search Target Waveform**

  Standard measurement parameters:
  For details on how to determine each parameter, section 10.6 in the *DL7440/DL7480 User's Manual.*
  P-P, Max, Min, Avg, Rms, Sdev, High, Low, +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, Delay (delay between waveforms), AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, and Int2XY

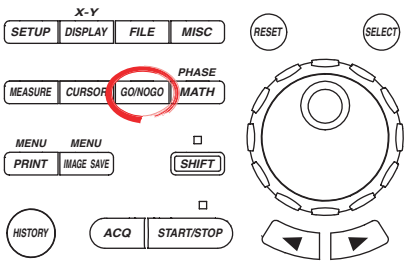
  * For CH5 to CH8, Int1XY and Int2XY are not available.

Note

You cannot perform history search on computed waveforms Math1 or Math2 that are set to waveform computation of harmonics or whose trend is displayed.

10 Performing GO/NO-GO Determination Using Measured Values of Power Analysis Parameters

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

To perform GO/NO-GO determination using power analysis parameters, you must turn ON the power analysis function on the applicable channels. For the setup procedure, see section 3 in this manual.

Note

To make correct measurements and computation, it is recommended that the difference in the transfer time of the analyzed signals be corrected (deskewed). For the setup procedure, see section 4 in this manual.

1. Press **GO/NOGO**. The GO/NO-GO menu appears.

The rest of the procedure is the same as steps 2 to 13 in section 10.10 (pages 10-72 to 10-74) in the *DL7440/DL7480 User's Manual IM701450-01E*.
If power analysis is enabled on the target waveform, power analysis parameters can be selected as measurement parameters.

Explanation

As with the standard measurement parameters (waveform parameters), you can perform GO/NO-GO determination using power analysis parameters. GO/NO-GO determination can be performed on whether the measured value of the measurement parameter leaves or enters the range specified by upper and lower limits.
The measurement parameters vary depending on the target waveform used in the determination. The measurement parameters are the same as the "Search Measurement Parameters" in section 9 (page 31) in this manual.

For a detailed explanation on GO/NO-GO determination using measured values, see the explanation given in section 10.10 (pages 10-74 and 10-75) in the *DL7440/DL7480 User's Manual*.

Note

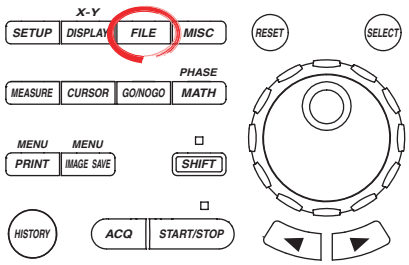
- You cannot perform history search on computed waveforms Math1 or Math2 that are set to waveform computation of harmonics or whose trend is displayed.
- You cannot perform GO/NO-GO determination on the measured values of waveform parameters or zones for computed waveforms Math1 or Math2 whose trend is displayed.

11 Saving the Computed Results of Harmonics

CAUTION

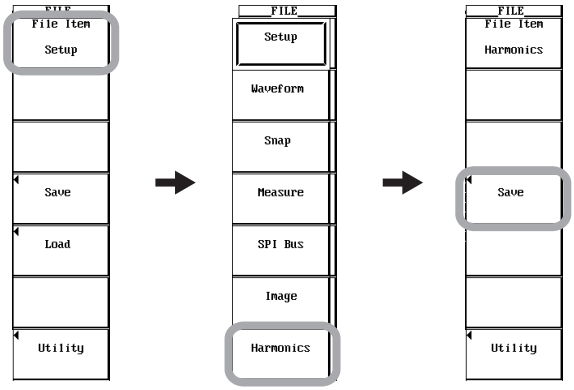
Do not remove the storage medium (disk) or turn OFF the power when the access indicator or icon of the storage medium is blinking. Doing so can damage the storage medium or destroy the data on the medium.

Procedure



- To exit the menu during operation, press **ESC** located above the soft keys.
- In the procedural explanation below, the term *jog shuttle & SELECT* refers to the operation of selecting/setting items and entering values using the **jog shuttle**, **SELECT** and **RESET** keys. For details on the operation using the jog shuttle, SELECT, and RESET, see sections 4.1 or 4.2 in the *DL7440/DL7480 User's Manual*.
- For a description of the operation using a USB keyboard or a USB mouse, see section 4.3 in the *DL7440/DL7480 User's Manual*.

1. Press **FILE**. The FILE menu appears.
2. Press the **File Item** soft key. The File Item menu appears.
3. Press the **Harmonics** soft key.
4. Press the **Save** soft key. The Save menu appears.



The rest of the procedure is the same as steps 13 to 25 in section 12.7 (pages 12-21 and 12-22) in the *DL7440/DL7480 User's Manual IM701450-01E*.

Explanation

The computed values of harmonics can be saved to a file in CSV format (.csv extension) to a floppy disk, Zip disk, PC card, or external SCSI device. The computed results of Harmonic waveform computation are saved.

* Data in CSV format is data in comma-separated format. The CSV file is one of the common data formats used to exchange data between spreadsheet and database applications.

The selection of the storage medium and directory, file name, comments, auto naming function, specification of the files to be displayed in the File List window, and properties are the same as those for saving/loading normal waveform data. For the procedure, see section 12.7 in the *DL7440/DL7480 User's Manual IM701450-01E*.

Precautions to Be Taken When Saving Computed Results of Harmonics

Saving is not possible when the operator of computed waveform Math1 or Math2 is not set to Harmonic or when computed waveform display is OFF.

Example in Which the Data Saved to CSV Format Is Opened Using a Spreadsheet Application

Model Name	DL7400		
Comment			
Date	2003.7.9		
Time	16:15:27.45		
TraceName	Math1		
Source	CH2		
Class	A		
System Voltage	230		
Math1:			
Order	Measure(A)	Limit(A)	Over Flg
2	8.41E-03	1.08E+00	
3	3.33E-01	2.30E+00	
4	8.19E-03	4.30E-01	
5	3.18E-01	1.14E+00	
6	7.14E-03	3.00E-01	
7	7.99E-01	7.70E-01	*
8	5.29E-03	2.30E-01	
9	2.76E-01	4.00E-01	

For a description of the Harmonic waveform computation, see section 7 in this manual.

Data Size

When Math1 and Math2 are Class C	9157 bytes (maximum)
When Math1 is Class A and Math2 is not harmonic computation	3129 bytes (minimum)

The data size vary between 3192 and 9157 bytes depending on the settings.

Extension

The extension is .CSV.

Note

- This function cannot be used when using the FTP server function, the LPR client function, or the Web server function.
- Of the computed results of harmonics, the computed values of each harmonic component and the limits defined by the standard can be saved to a file in CSV format as described above. The waveform data of harmonics cannot be saved.
- The waveform of the displayed trend cannot be saved. The original measured values of waveform parameters per cycle used for the trend display can be saved. For instruction on saving the measured values, see section 12.9 in the *DL7440/DL7480 User's Manual*.
- The original waveform data used to perform harmonic computation or determine the measured values of waveform parameters per cycle can be saved. If the original waveform data is saved in binary format, harmonic computation and waveform parameter measurement per cycle can be executed as described in section 7 and 8 in this manual, and the trend can be displayed by loading the data into the DL7400 with the Power Analysis Function (/G4 option). For instructions on saving the data in binary format, see section 12.7 in the *DL7440/DL7480 User's Manual*.

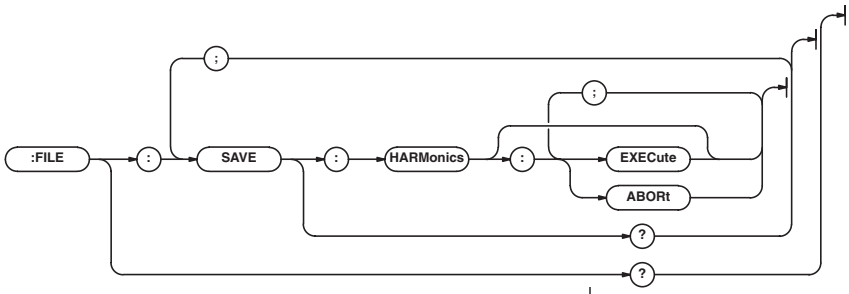
12 Communication Commands

This section contains only the communication commands that have been added for the Power Analysis Function (/G4 Option). For a description of the standard communication commands and other communication interfaces, see the *DL7440/DL7480 Communication Interface User's Manual IM701450-17E* (CD-ROM).

Command	Function	Page
MEASure Group		
:MEASure:CHANnel<x>:{<Parameter>}:{COUNt|SDEViation|MAXimum|MEAN|MINimum}?	Queries the statistical value of the power analysis parameter.	45
:MEASure:CHANnel<x>:{<Parameter>}:STATe	Turns ON/OFF the power analysis parameter or queries the current setting.	45
:MEASure:CHANnel<x>:{<Parameter>}:VALue?	Queries the value resulting from the automated measurement of the power analysis parameter.	45
PANalyze Group		
:PANalyze?	Queries all settings related to the input/output of power analysis.	47
:PANalyze:JUMP	Jumps from the power analysis setup screen to the selected setup screen.	47
:PANalyze:MATH<x>?	Queries all settings related to the computed waveform MATH<x> of power analysis.	47
:PANalyze:MATH<x>:MODE	Enables/Disables the computed waveform MATH<x> of power analysis or queries the current setting.	47
:PANalyze:PWR<x>?	Queries all settings related to the power analysis target PWR<x>.	47
:PANalyze:PWR<x>:MODE	Enables/Disables the power analysis target PWR<x> or queries the current setting.	47
:PANalyze:PWR<x>:U?	Queries all settings related to the voltage input channel of the power analysis target PWR<x>.	47
:PANalyze:PWR<x>:U:PROBe	Sets the probe attenuation of the voltage input channel of the power analysis target PWR<x> or queries the current setting.	47
:PANalyze:PWR<x>:I?	Queries all settings related to the current input channel of the power analysis target PWR<x>.	47
:PANalyze:PWR<x>:I:PROBe	Sets the current-to-voltage conversion ratio of the current input channel of the power analysis target PWR<x> or queries the current setting.	47

FILE Group

The commands in this group deal with the saving of the computed results of harmonics to the storage medium.



:FILE:SAVE:HARMonics:ABORt

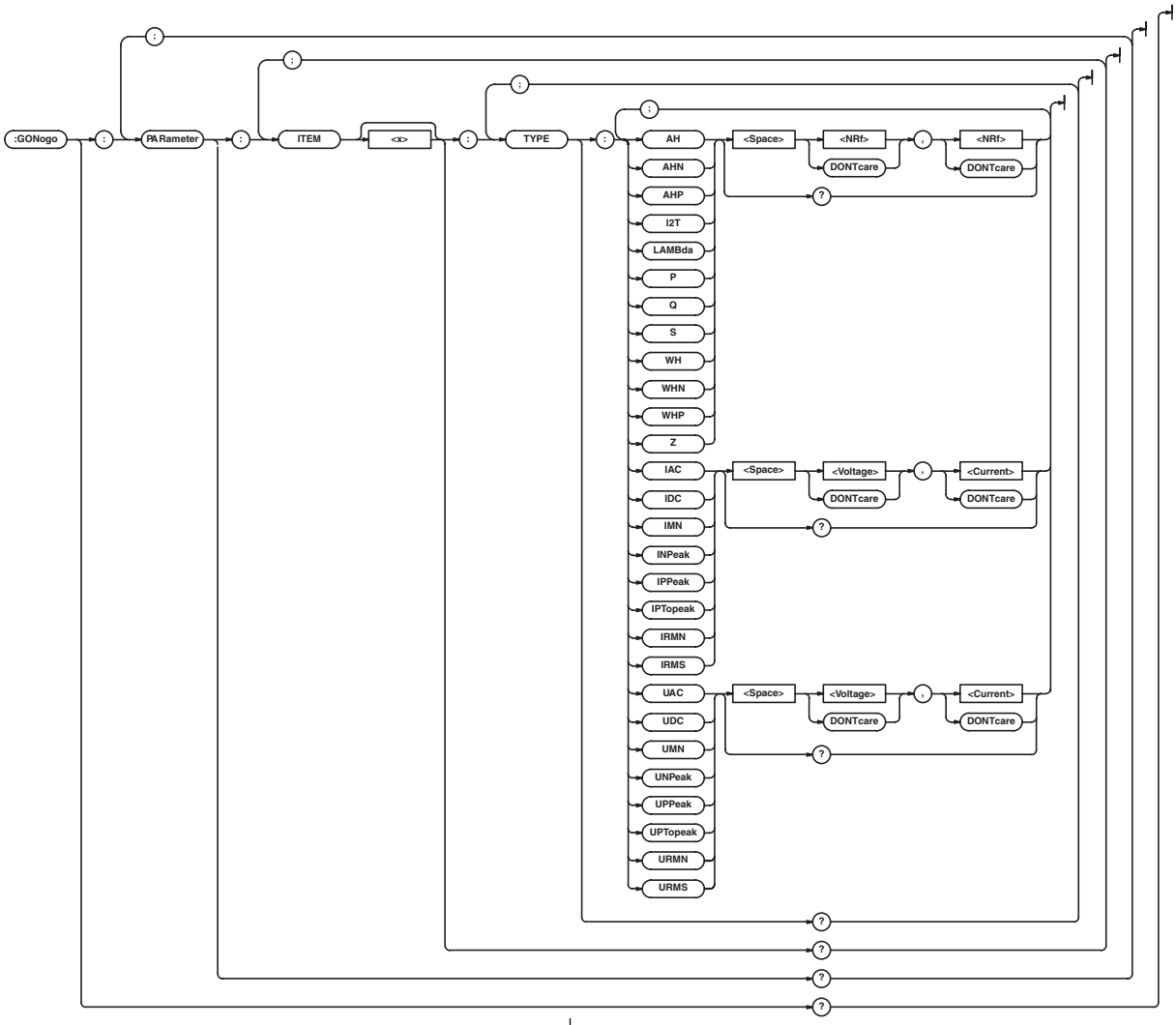
Function	Aborts the saving of the computed results of harmonics.
Syntax	`:FILE:SAVE:HARMonics:ABORt`
Example	`:FILE:SAVE:HARMONICS:ABORT`

:FILE:SAVE:HARMonics:[EXECute]

Function	Executes the saving of the computed results of harmonics.
Syntax	`:FILE:SAVE:HARMonics:[EXECute]`
Example	`:FILE:SAVE:HARMONICS:EXECUTE`

GONogo Group

The commands in this group deal with setting power analysis parameters to be evaluated by the GO/NO-GO determination.



:GONogo:PARameter:ITEM<x>:TYPE:<Parameter>

Function Sets the power analysis parameter of the waveform on which GO/NO-GO determination is to be performed and the upper and lower limits or queries the current setting.

Syntax
```
:GONogo:PARameter:ITEM<x>:TYPE:
<Parameter> {<{Voltage|DONTcare}>,
<{Current|DONTcare}>|<{Current|DONTcare}>,
<{Current|DONTcare>|<{{<NRf>}|DONTcare}>,
<{{<NRf>}|DONTcare}>}

:GONogo:PARameter:ITEM<x>:TYPE:<Parameter>?
<x> = 1 to 4
<Parameter> = {AH|AHN|AHP|I2T|IAC|
IDC|IMN|INPeak|IPPeak|IPTopeak|IRMN|
IRMS|LAMBda|P|Q|S|UAC|UDC|UMN|UNPeak|
UPPeak|UPTopeak|URMN|URMS|WH|WHN|WHP|Z}
```

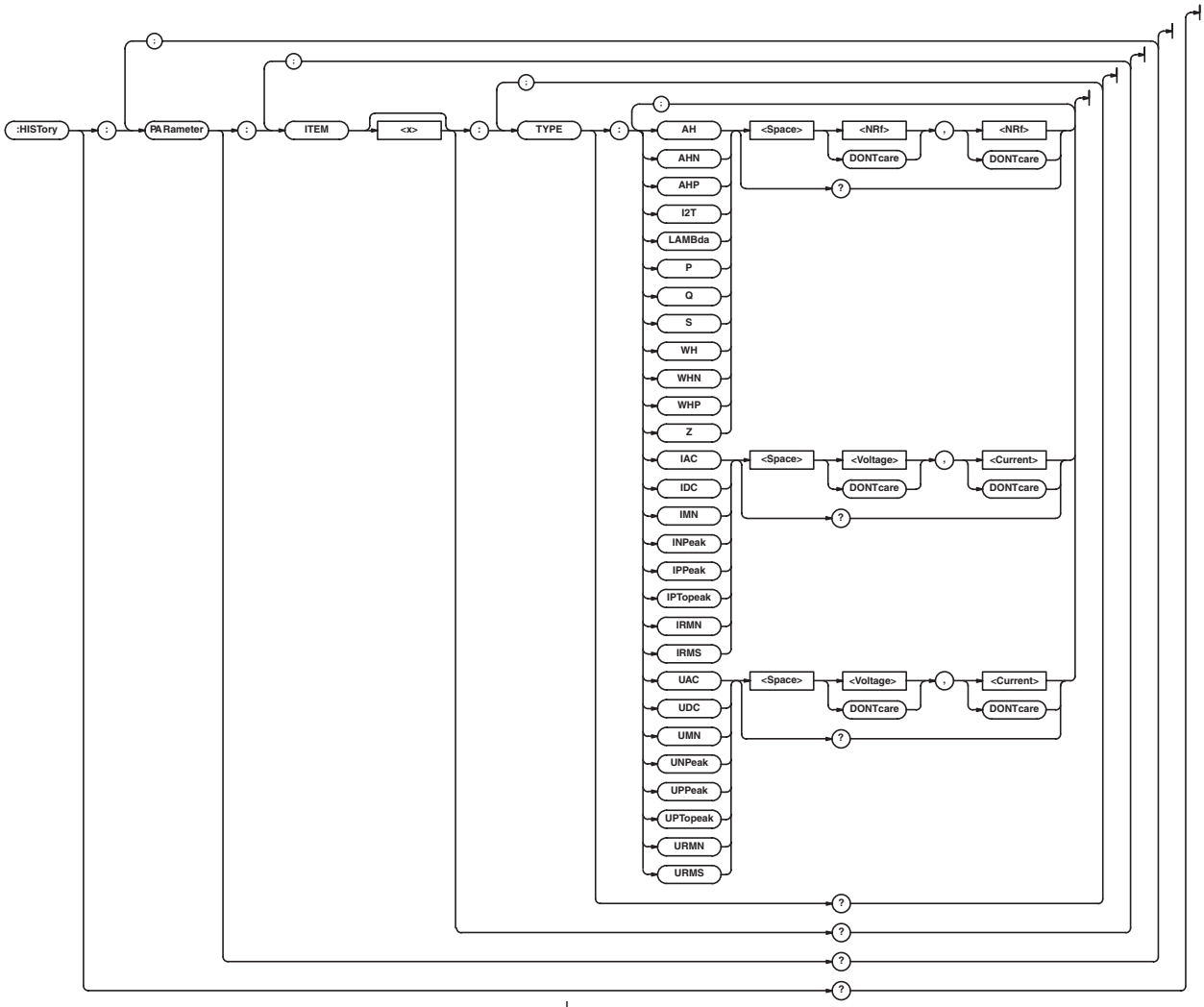
Example
```
:GONOGO:PARAMETER:ITEM1:TYPE:
UDC -2v,2v
:GONOGO:PARAMETER:ITEM1:TYPE:UDC?
-> :GONOGO:PARAMETER:ITEM1:TYPE:
UDC -2.00000E+00,2.00000E+00
```

Description The power analysis parameters below can be substituted using standard waveform parameters.

```
UPTopeak, IPTopeak  = PTOPeak
UPPeak, IPPeak      = MAXimum
UNPeak, INPeak      = MINimum
UDC, IDC            = AVERage
URMS, IRMS          = RMS
UAC, IAC            = SDEViation
```

HISTory Group

The commands in this group deal with executing history search using power analysis parameters.



:HISTory:PARameter:ITEM<x>:TYPE:<Parameter>

Function Sets the power analysis parameter of the waveform on which history search is to be performed and the upper and lower limits or queries the current setting.

Syntax
```
:HISTory:PARameter:ITEM<x>:TYPE:
<Parameter> {<{Voltage|DONTcare}>,
<{Voltage|DONTcare}>|<{Current|DONTcare}>,
<{Current|DONTcare}>|<{{<NRf>}|DONTcare}>,
<{{<NRf>}|DONTcare}>}

:HISTory:PARameter:ITEM<x>:TYPE:<Parameter>?
<x> = 1 to 4
<Parameter> = {AH|AHN|AHP|I2T|IAC|
IDC|IMN|INPeak|IPPeak|IPTopeak|IRMN|
IRMS|LAMBda|P|Q|S|UAC|UDC|UMN|UNPeak|
UPPeak|UPTopeak|URMN|URMS|WH|WHN|WHP|Z}
```

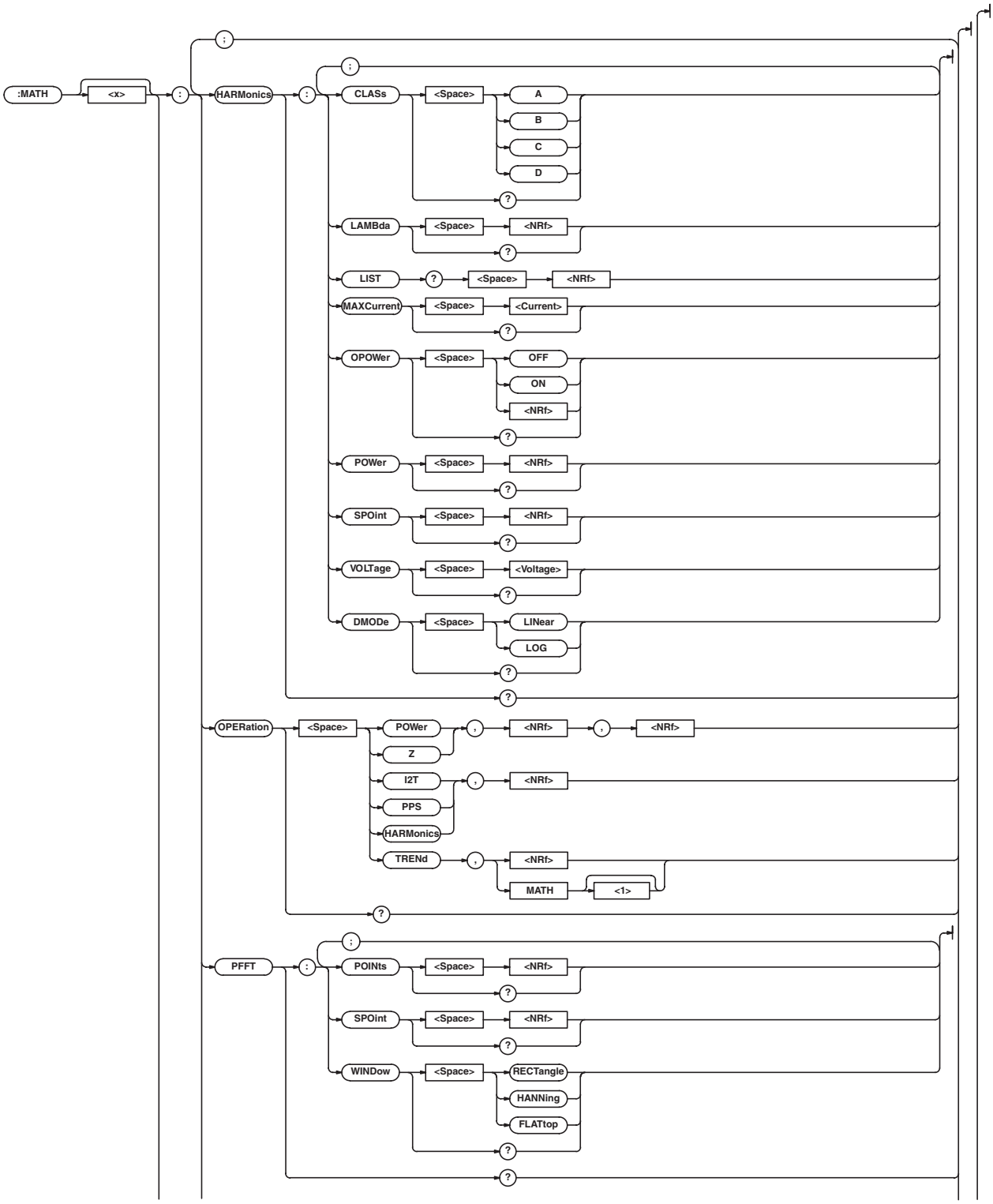
Example
```
:HISTORY:PARAMETER:ITEM1:TYPE:
IDC -3MA,3MA
:HISTORY:PARAMETER:ITEM1:TYPE:IDC?
-> :HISTORY:PARAMETER:ITEM1:TYPE:
IDC -3.00000E-03,3.00000E-03
```

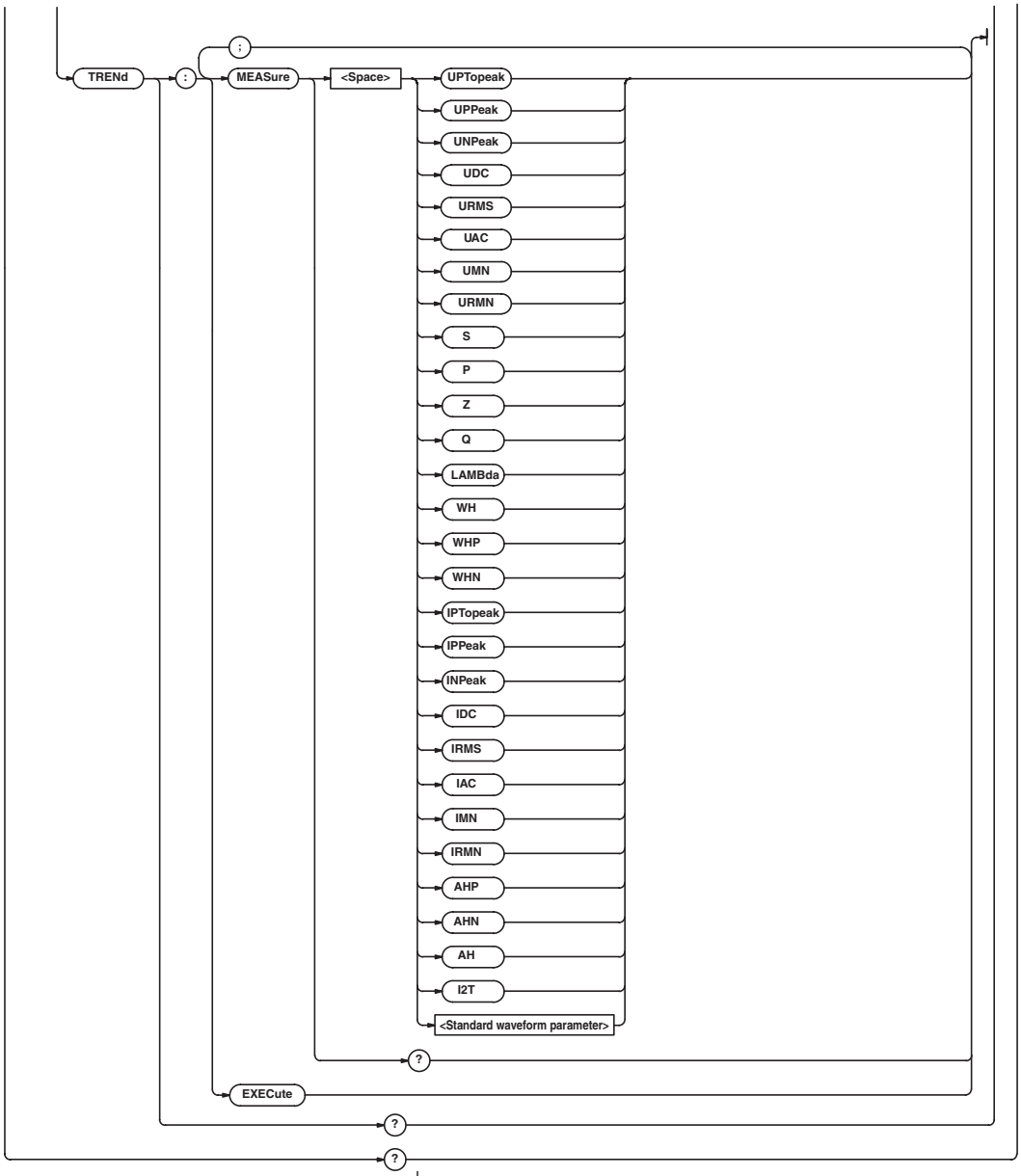
Description The power analysis parameters below can be substituted using standard waveform parameters.

```
UPTopeak, IPTopeak  = PTOPeak
UPPeak, IPPeak      = MAXimum
UNPeak, INPeak      = MINimum
UDC, IDC            = AVERage
URMS, IRMS          = RMS
UAC, IAC            = SDEViation
```

MATH Group

The commands in this group deal with executing waveform computation using power analysis parameters.





:MATH<x>:HARMonics?

Function Queries all settings related to the waveform computation of harmonics.

Syntax
```
:MATH<x>:HARMonics?
<x> = 1 to 2
```

Example
```
:MATH1:HARMONICS? ->
:MATH1:HARMONICS:SPOINT -5.0000000;
VOLTAGE 230;MAXCURRENT 1.000 ;
CLASS C;OPOWER 1;POWER 1.00000E+00;
LAMBDA 80.0;DMODE LINEAR
```

:MATH<x>:HARMonics:CLASs

Function Sets the applicable class of the equipment under test or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:CLASs {A|B|C|D}
:MATH<x>:HARMonics:CLASs?
<x> = 1 to 2
```

Example
```
:MATH1:HARMONICS:CLASS C
:MATH1:HARMONICS:CLASS? ->
:MATH1:HARMONICS:CLASS C
```

:MATH<x>:HARMonics:DMODe

Function Sets the vertical axis scale mode of the bar graph or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:DMODe {LINear|
LOG}
:MATH<x>:HARMonics:DMODe?
<x> = 1 to 2
```

Example
```
:MATH1:HARMONICS:DMODE LINEAR
:MATH1:HARMONICS:DMODE? ->
:MATH1:HARMONICS:DMODE LINEAR
```

:MATH<x>:HARMonics:LAMBda

Function Sets the power factor for Class C or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:LAMBda {<NRf>}
:MATH<x>:HARMonics:LAMBda?
<x> = 1 to 2
<NRf> = 1.0 to 100.0(%)
```

Example
```
:MATH1:HARMONICS:LAMBDA 50
:MATH1:HARMONICS:LAMBDA? ->
:MATH1:HARMONICS:LAMBDA 50.0
```

:MATH<x>:HARMonics:LIST?

Function Queries the computed values of harmonics and limits defined by the standard for each order.

Syntax
```
:MATH<x>:HARMonics:LIST? {<NRf>}
<x> = 1 to 2
<NRf> = 2 to 40(Harmonic order)
```

Example
```
:MATH1:HARMONICS:LIST 50.0000E+03,
50.0000E+03
```

Description
- The first and second parameters after the order are the computed value and limit, respectively. If a value is not present, “NAN (Not A Number)” is returned.
- The percentage value is not returned for Class C.

:MATH<x>:HARMonics:MAXCurrent

Function Sets the fundamental current for Class C or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:
MAXCurrent {<Current>|<NRf>}
:MATH<x>:HARMonics:MAXCurrent?
<x> = 1 to 2
<Current>,<NRf> = 0.001 to
100.000(A)
```

Example
```
:MATH1:HARMONICS:MAXCURRENT 50A
:MATH1:HARMONICS:MAXCURRENT? ->
:MATH1:HARMONICS:MAXCURRENT 50.000
```

:MATH<x>:HARMonics:OPOWer

Function Sets whether active power of 25 W is exceeded or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:
OPOWer {<Boolean>}
:MATH<x>:HARMonics:OPOWer?
<x> = 1 to 2
```

Example
```
:MATH1:HARMONICS:OPOWER ON
:MATH1:HARMONICS:OPOWER? ->
:MATH1:HARMONICS:OPOWER 1
```

:MATH<x>:HARMonics:POWer

Function Sets the power value for Class D or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:POWer {<NRf>}
:MATH<x>:HARMonics:POWer?
<x> = 1 to 2
<NRf> = -9.9999E+30 to 9.9999E+30
```

Example
```
:MATH1:HARMONICS:POWER 100
:MATH1:HARMONICS:POWER? ->
:MATH1:HARMONICS:POWER 100.000E+00
```

:MATH<x>:HARMonics:SPOint

Function Sets the computation start point of the waveform computation of harmonics or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:SPOint {<NRf>}
:MATH<x>:HARMonics:SPOint?
<x> = 1 to 2
<NRf> = -5 to 5 (The resolution is
10div/display record length.)
```

Example
```
:MATH1:HARMONICS:SPOINT 1
:MATH1:HARMONICS:SPOINT? ->
:MATH1:HARMONICS:SPOINT 1.0000000
```

:MATH<x>:HARMonics:VOLTage

Function Sets the supply voltage of the equipment under test or queries the current setting.

Syntax
```
:MATH<x>:HARMonics:
VOLTage {<Voltage>|<NRf>}
:MATH<x>:HARMonics:VOLTage?
<x> = 1 to 2
<Voltage>,<NRf> = 90 to 440(V)
```

Example
```
:MATH1:HARMONICS:VOLTAGE 220
:MATH1:HARMONICS:VOLTAGE? ->
:MATH1:HARMONICS:
VOLTAGE 220.000000E+00
```

:MATH<x>:OPERation

Function Sets the power analysis operator or queries the current setting.

Syntax
```
:MATH<x>:OPERation {PPS|POWer|Z|
I2T|HARMonics|TRENd},{<NRf>|MATH<1>},
<NRf>
:MATH<x>:OPERation?
<x> of MATH<x> = 1 or 2
<NRf> = 1 to 6 (1 to 4 on the
DL7440)
```

Example
```
:MATH1:OPERATION HARMONICS,2
:MATH1:OPERATION? ->
:MATH1:OPERATION HARMONICS,2
```

Description
- For unary operators (I2T|PPS|HARMonics|TRENd), select the target waveform using the first <NRf>.
- For binary operators (POWer|Z), select the target waveform of the first term using the first <NRf> and the target waveform of the second term using the second <NRf>.

:MATH<x>:PFFT?

Function Queries all settings related to the power spectrum computation (FFT) of the voltage/current waveform on which to perform power analysis.

Syntax
```
:MATH<x>:PFFT?
<x> = 1 to 2
```

Example
```
:PANALYZE:PWR1:I:PROBE? ->
:PANALYZE:PWR1:I:PROBE C10
```

:MATH<x>:PFFT:POINts

Function Sets the number of points to be computed in the FFT computation or queries the current setting.

Syntax
```
:MATH<x>:PFFT:POINts {<NRf>}
:MATH<x>:PFFT:POINts?
<x> = 1 to 2
<NRf> = 1000,10000
```

Example
```
:MATH1:HARMONICS:VOLTAGE 220
:MATH1:HARMONICS:VOLTAGE? ->
:MATH1:HARMONICS:
VOLTAGE 220.000000E+00
```

:MATH<x>:PFFT:SPOint

Function Sets the computation start point used in the FFT computation or queries the current setting.

Syntax
```
:MATH<x>:PFFT:SPOint {<NRf>}
:MATH<x>:PFFT:SPOint?
<x> = 1 to 2
<NRf> = -5 to 5 (The resolution is
10 div/display record length.)
```

Example
```
:MATH1:HARMONICS:VOLTAGE 220
:MATH1:HARMONICS:VOLTAGE? ->
:MATH1:HARMONICS:
VOLTAGE 220.000000E+00
```

:MATH<x>:PFFT:WINDow

Function Sets the time window used in the FFT computation or queries the current setting.

Syntax
```
:MATH<x>:PFFT:WINDow {RECTangle|
HANNing|FLATtop}
:MATH<x>:PFFT:WINDow?
<x> = 1 to 2
```

Example
```
:MATH1:HARMONICS:VOLTAGE 220
:MATH1:HARMONICS:VOLTAGE? ->
:MATH1:HARMONICS:
VOLTAGE 220.000000E+00
```

:MATH<x>:TRENd?

Function Queries all settings related to the trend display.

Syntax
```
:MATH<x>:HARMonics?
<x> = 1 to 2
```

Example
```
:MATH1:TREND? ->
:MATH1:TREND:MEASURE UPTOPEAK
```

:MATH<x>:TRENd:EXECute

Function Executes trend display.

Syntax
```
:MATH<x>:TRENd:EXECute
<x> = 1 to 2
```

Example
```
:MATH1:TREND:EXECUTE
```

:MATH<x>:TRENd:MEASure

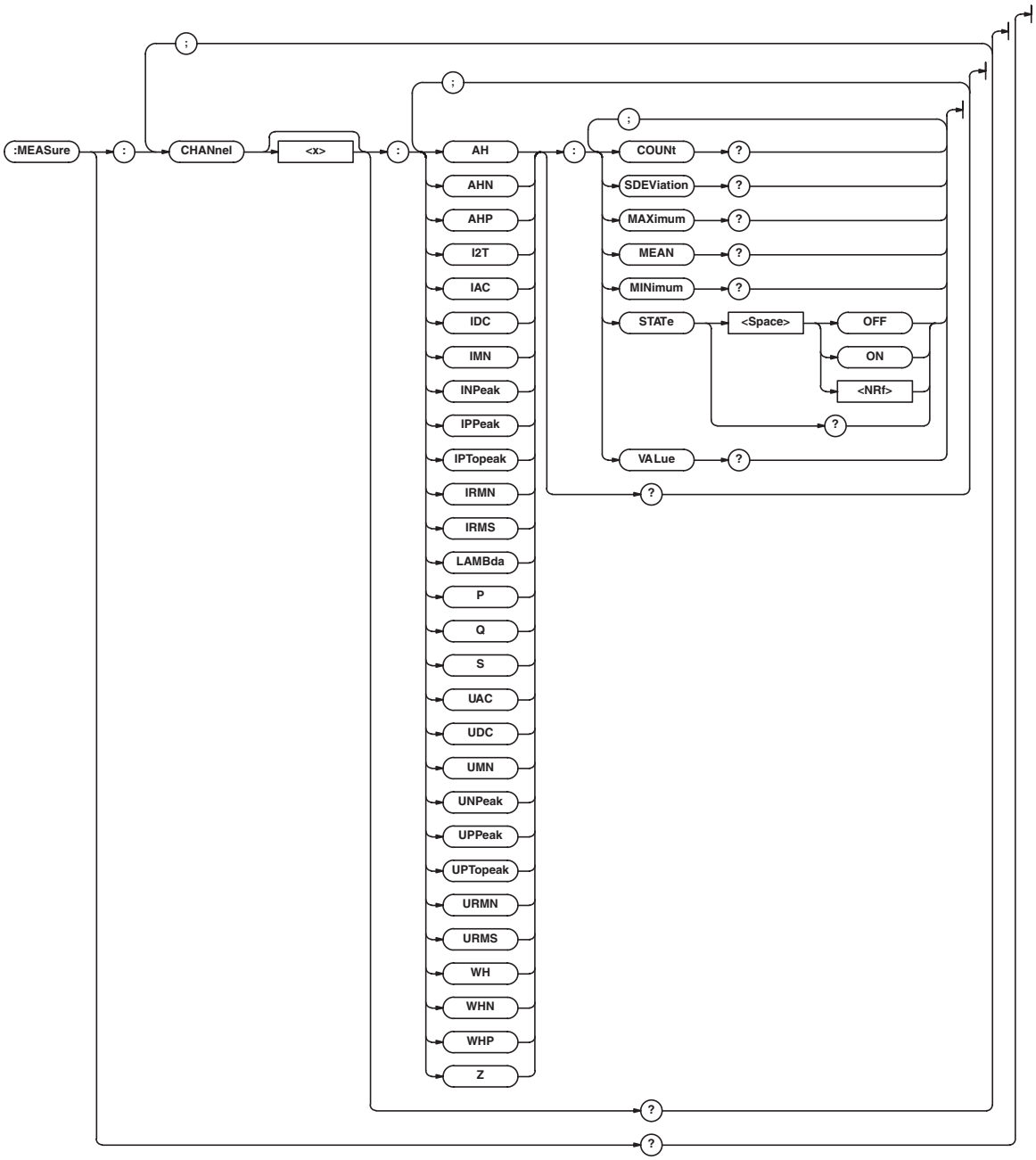
Function Sets the waveform parameter to be displayed in the trend or queries the current setting.

Syntax
```
:MATH<x>:TRENd:MEASure {<Power
analysis parameter>|
<Standard waveform parameter>}
:MATH<x>:TRENd:MEASure?
<x> of MATH<x> = 1 or 2
<Power analysis parameter> =
{AH|AHN|AHP|I2T|IAC|IDC|IMN|INPeak|IPPeak|
IPTopeak|IRMN|IRMS|LAMBda|P|Q|S|UAC|
UDC|UMN|UNPeak|UPPeak|UPTopeak|URMN|
URMS|WH|WHN|WHP|Z}
<Standard waveform parameter> =
{AVERage|AVGFreq|AVGPeriod|BWIDth1|
BWIDth2|DUTYcycle|FALL|FREQuency|
HIGH|LOW|MAXimum|MINimum|NOVershoot|
NWIDth|PERiod|PNUMber|POVershoot|
PTOPeak|PWIDth|RISE|RMS|SDEViation|
TY1Integ|TY2Integ}
```

Example
```
:MATH1:TREND:MEASURE LAMBDA
:MATH1:TREND:MEASURE? ->
:MATH1:TREND:MEASURE LAMBDA
```

MEASure Group

The commands in this group deal with executing automated measurement and statistical processing on power analysis parameters.



:MEASure:CHANnel<x>:{<Parameter>}:{COUNt|SDEViation|MAXimum|MEAN|MINimum}?

Function Queries the statistical value of the power analysis parameter.

Syntax
```
:MEASure:CHANnel<x>:{<Parameter>}:
{COUNt|SDEViation|MAXimum|MEAN|MINimum}?
<x> = 1 to 6 (1 to 4 on the DL7440)
<Parameter> = {AH|AHN|AHP|I2T|IAC|
IDC|IMN|INPeak|IPPeak|IPTopeak|IRMN|
IRMS|LAMBda|P|Q|S|UAC|UDC|UMN|
UNPeak|UPPeak|UPTopeak|URMN|URMS|WH|
WHN|WHP|Z}
```

Example
```
:MEASURE:CHANNEL1:UPTOPEAK:MAXIMUM?
-> :MEASURE:CHANNEL1:UPTOPEAK:
MAXIMUM 10.833333E+00
```

Description The power analysis parameters below can be substituted using standard waveform parameters.

```
UPTopeak, IPTopeak  = PTOPeak
UPPeak, IPPeak      = MAXimum
UNPeak, INPeak      = MINimum
UDC, IDC            = AVERage
URMS, IRMS          = RMS
UAC, IAC            = SDEViation
```

:MEASure:CHANnel<x>:{<Parameter>}:STATe

Function Turns ON/OFF the power analysis parameter one by one or queries the current setting.

Syntax
```
:MEASure:CHANnel<x>:{<Parameter>}:
STATe {<Boolean>}
:MEASure:CHANnel<x>:{<Parameter>}:
STATe?
<x> = 1 to 6 (1 to 4 on the DL7440)
<Parameter> = {AH|AHN|AHP|I2T|IAC|
IDC|IMN|INPeak|IPPeak|IPTopeak|IRMN|
IRMS|LAMBda|P|Q|S|UAC|UDC|UMN|
UNPeak|UPPeak|UPTopeak|URMN|URMS|WH|
WHN|WHP|Z}
```

Example
```
:MEASURE:CHANNEL1:UDC:STATE ON
:MEASURE:CHANNEL1:UDC:STATE? ->
:MEASURE:CHANNEL1:UDC:STATE 1
```

Description The power analysis parameters below can be substituted using standard waveform parameters.

```
UPTopeak, IPTopeak  = PTOPeak
UPPeak, IPPeak      = MAXimum
UNPeak, INPeak      = MINimum
UDC, IDC            = AVERage
URMS, IRMS          = RMS
UAC, IAC            = SDEViation
```

:MEASure:CHANnel<x>:{<Parameter>}:VALue?

Function Queries the value resulting from the automated measurement of the power analysis parameter.

Syntax
```
:MEASure:CHANnel<x>:{<Parameter>}:
VALue? {<NRf>}
<x> = 1 to 6 (1 to 4 on the DL7440)
<Parameter> = {AH|AHN|AHP|I2T|IAC|
IDC|IMN|INPeak|IPPeak|IPTopeak|IRMN|
IRMS|LAMBda|P|Q|S|UAC|UDC|UMN|
UNPeak|UPPeak|UPTopeak|URMN|URMS|WH|
WHN|WHP|Z}
<NRf> = 1 to 24000
```

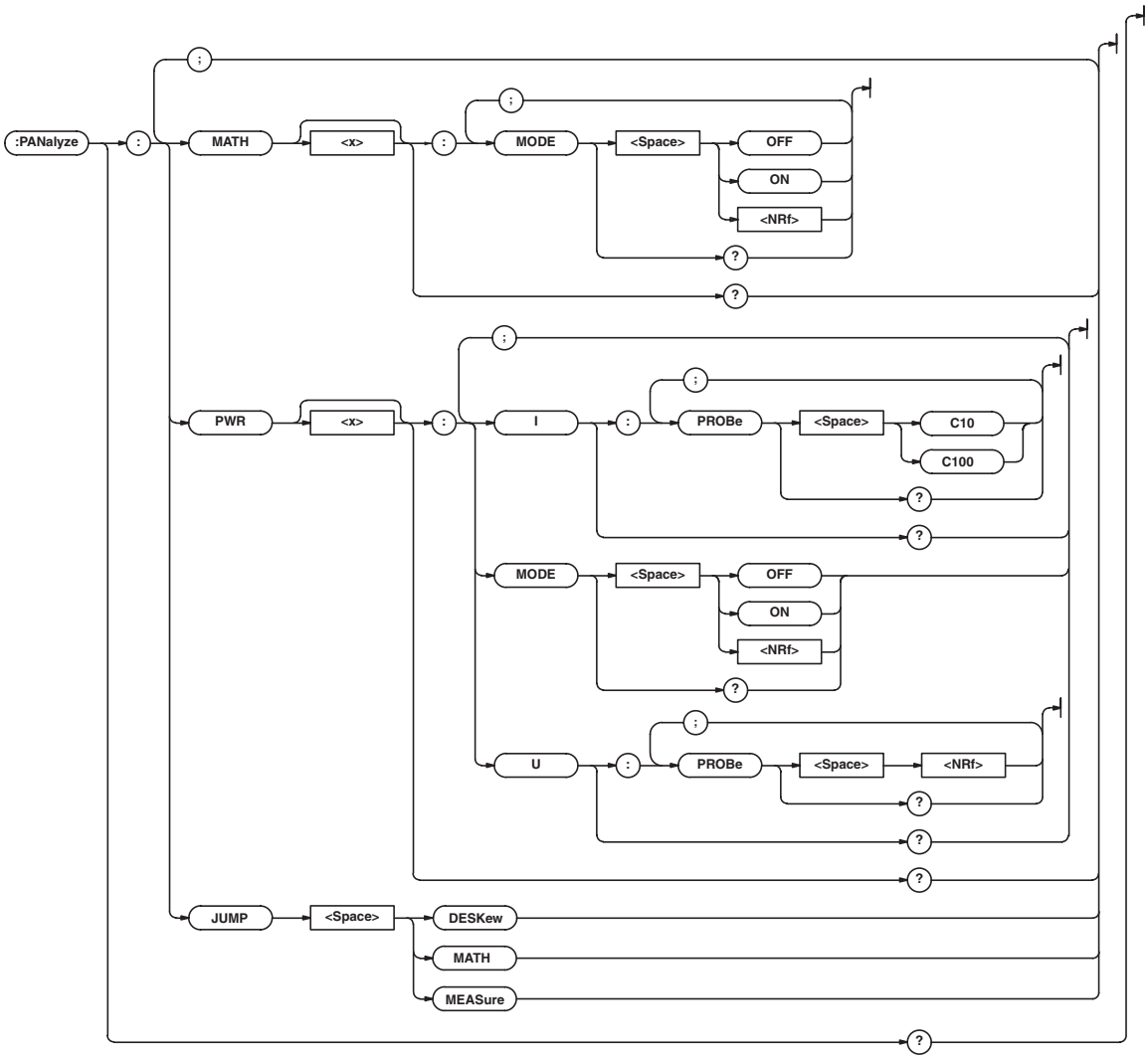
Example
```
:MEASURE:CHANNEL1:UMN:VALUE? ->
:MEASURE:CHANNEL1:UMN:
VALUE 5.0165817E+00
```

Description
- <NRf> can be omitted. If omitted, inquiry is made on the parameter value of the newest history waveform. <NRf> is used to query the parameter value of the <NRf> times after executing the statistical processing. If the value corresponding to the relevant count is not present, “NAN” (Not A Number)” is returned.
- The power analysis parameters below can be substituted using standard waveform parameters.

```
UPTopeak, IPTopeak  = PTOPeak
UPPeak, IPPeak      = MAXimum
UNPeak, INPeak      = MINimum
UDC, IDC            = AVERage
URMS, IRMS          = RMS
UAC, IAC            = SDEViation
```

PANalyze Group

The commands in this group deal with settings of the power analysis function.



:PANalyze?

Function Queries all settings related to the input/output of power analysis.

Syntax `:PANalyze?`

Example
```
:PANALYZE? -> :PANALYZE:PWR1:
MODE 1;U:PROBE 10;:PANALYZE:PWR1:I:
PROBE C10;:PANALYZE:PWR2:MODE 1;U:
PROBE 10;:PANALYZE:PWR2:I:
PROBE C10;:PANALYZE:PWR3:MODE 1;U:
PROBE 10;:PANALYZE:PWR3:I:
PROBE C10;:PANALYZE:MATH1:MODE 1;:
PANALYZE:MATH2:MODE 1
```

:PANalyze:JUMP

Function Jumps from the power analysis setup screen to the selected setup screen.

Syntax `:PANalyze:JUMP {DESKew|MATH|MEASure}`

Example `:PANALYZE:JUMP DESKEW`

:PANalyze:MATH<x>?

Function Queries all settings related to the computed waveform MATH<x> of power analysis.

Syntax
```
:PANalyze:MATH<x>?
<x> = 1 to 2
```

Example
```
:PANALYZE:PWR1:I:PROBE? ->
:PANALYZE:PWR1:I:PROBE C10
```

:PANalyze:MATH<x>:MODE

Function Enables/Disables the computed waveform MATH<x> of power analysis or queries the current setting.

Syntax
```
:PANalyze:MATH<x>:MODE {<Boolean>}
:PANalyze:MATH<x>:MODE?
<x> = 1 to 2
```

Example
```
:PANALYZE:PWR1:MODE ON
:PANALYZE:PWR1:MODE? ->
:PANALYZE:PWR1:MODE 1
```

:PANalyze:PWR<x>?

Function Queries all settings related to the power analysis target PWR<x>.

Syntax
```
:PANalyze:PWR<x>?
<x> = 1 to 3 (1 or 2 on the DL7440)
```

Example
```
:PANALYZE:PWR1? ->
:PANALYZE:PWR1:MODE 1;U:PROBE 10;:
PANALYZE:PWR1:I:PROBE C10
```

:PANalyze:PWR<x>:MODE

Function Enables/Disables the power analysis target PWR<x> or queries the current setting.

Syntax
```
:PANalyze:PWR<x>:MODE {<Boolean>}
:PANalyze:PWR<x>:MODE?
<x> = 1 to 3 (1 or 2 on the DL7440)
```

Example
```
:PANALYZE:PWR1:MODE ON
:PANALYZE:PWR1:MODE? ->
:PANALYZE:PWR1:MODE 1
```

:PANalyze:PWR<x>:U?

Function Queries all settings related to the voltage input channel of the power analysis target PWR<x>.

Syntax
```
:PANalyze:PWR<x>:U?
<x> = 1 to 3 (1 or 2 on the DL7440)
```

Example
```
:PANALYZE:PWR1:U? ->
:PANALYZE:PWR1:U:PROBE 10
```

:PANalyze:PWR<x>:U:PROBe

Function Sets the probe attenuation of the voltage input channel of the power analysis target PWR<x> or queries the current setting.

Syntax
```
:PANalyze:PWR<x>:U:PROBe {<NRf>}
:PANalyze:PWR<x>:U:PROBe?
<x> = 1 to 3 (1 or 2 on the DL7440)
<NRf> = 1,10,100,1000
```

Example
```
:PANALYZE:PWR1:U:PROBE 100
:PANALYZE:PWR1:U:PROBE? ->
:PANALYZE:PWR1:U:PROBE 100
```

:PANalyze:PWR<x>:I?

Function Queries all settings related to the current input channel of the power analysis target PWR<x>.

Syntax
```
:PANalyze:PWR<x>:I?
<x> = 1 to 3 (1 or 2 on the DL7440)
```

Example
```
:PANALYZE:PWR1:I:PROBE? ->
:PANALYZE:PWR1:I:PROBE C10
```

:PANalyze:PWR<x>:I:PROBe

Function Sets the current-to-voltage conversion ratio of the current input channel of the power analysis target PWR<x> or queries the current setting.

Syntax
```
:PANalyze:PWR<x>:I:PROBe {C10|C100}
:PANalyze:PWR<x>:I:PROBe?
<x> = 1 to 3 (1 or 2 on the DL7440)
```

Example
```
:PANALYZE:PWR1:I:PROBE C100
:PANALYZE:PWR1:I:PROBE? ->
:PANALYZE:PWR1:I:PROBE C100
```

13 Messages and Corrective Actions

This section contains only the status and error messages that have been added for the Power Analysis Function (/G4 Option). For a description of the standard messages see section 16.2 in the *DL7440/DL7480 User's Manual IM701450-01E* or appendix 2 in the *DL7440/DL7480 Communication Interface User's Manual IM701450-17E* (CD-ROM).

Code	Message	Corrective Action	Reference Section
43	Aborted the auto deskew processing.	–	Chapter 4
44	Auto deskew cannot be executed in the following cases. • When the trigger type is not Simple • When the trigger type is Simple and the source is Ext or Line • When Trigger Source = Deskew Target CH • When Deskew Target CH is Pod A or Pod B	–	Chapter 4, *
45	Auto deskew is in progress.	Wait until auto deskew completes.	Chapter 4
46	Cycle measure is not executed.	Execute Cycle measure of the trend target item before displaying the trend waveform.	Chapter 8
873	Invalid math operation.	Check the math operation that you are trying to specify.	Chapter 7
874	Invalid math source.	Check the math source that you are trying to specify.	Chapter 7
875	Invalid measure item.	Check the measurement item that you are trying to specify.	Chapter 5, Chapter 7 to 10

* See the *DL7440/DL7480 User's Manual IM701450-01E*.

14 Specifications

Item	Specification
Correction of the difference in the transfer time (Deskew)	Corrects (deskew) the difference in the transfer time of voltage and current signals automatically or manually The correction range is ±100 ns (0.01 ns resolution).
Automated measurement of power analysis parameters	As with the standard measurement parameters (waveform parameters), performs automated measurement of power analysis parameters (see page 4). Automated measurement on dual areas is also possible.
Statistical processing on the measured values	As with the standard measurement parameters, performs statistical processing on the measured values of power analysis parameters.
Waveform computation on power analysis parameters	As with the standard waveform computation, performs waveform computation such as active power, impedance, Joule integral, power spectrum, and harmonics For waveform computation of harmonics, simple comparison against the limits of IEC 61000-3-2 Edition 2.1, and EN61000-3-2 Amendment 14 is possible.
Trend display	Displays the trend of the change in the measured values of waveform parameters per cycle over time
History search	As with the standard measurement parameters, performs history search using power analysis parameters.
GO/NO-GO determination	As with the standard measurement parameters, performs GO/NO-GO determination using power analysis parameters.
Saving of the computed results of harmonics.	Saves the computed result of harmonics to a file in CSV format

Appendix 1 Setup Parameters That Are Changed during the Execution of Auto Deskew

The settings of the following parameters are changed when auto deskew is executed.

Panel Key and Knob	Soft Key	Setting
CH1 to 6 (CH5 and CH6 can be used only on the DL7480): Channel		
	Channel with voltage probe connected (CH1, CH3, or CH5)	
	Display	ON
	Position	–3.00 div
	Coupling	DC1MΩ
	Offset	0 V
	Linear Scale	OFF
	Channel with current probe connected (CH2, CH4, or CH6)	
	Display	ON
	Position	2.00 div
	Coupling	DC1MΩ
	Offset	0 V
	Linear Scale	OFF
V/DIV: Vertical axis		
	Channel with voltage probe connected	
		1 V/div
		(2 V/div when probe attenuation is 1000:1)
	Channel with current probe connected	
		20.0 mA/div
TIME/DIV: Time axis		
		20 ns/div
MODE: Trigger mode		
	When correction is executed and is successful	
		Normal (DL7400 in start condition)
	When correction is executed but is unsuccessful	
		Single (DL7400 in stop condition)
SIMPLE: Simple trigger		
	When the trigger source is the channel that has the voltage probe connected	
	Level	3.00 V
	When the trigger source is the channel that has the current probe connected	
	Level	–40.0 mA
	Slope	Falling edge
POSITION: Trigger position		
	Position	50%
DELAY: Trigger delay		
	Delay	0.00 ns
ACQ: Waveform acquisition conditions		
	Record Length	10k
	Mode	Normal
	Repetitive	ON
	Time Base	Int
MEASURE: Automated measurement of waveform parameters		
	Dual Area	OFF
	1Cycle Mode	OFF
	Time Range	–5.000 to 5.000 div
	Delay Setup	
	Reference	Trig
	Dist/Prox Mode	%

Appendix 2 Record Length and T/div Settings That Allow Waveform Computation of Harmonics

Number of Waveform Data Points According to the Record Length and Time Axis (T/div)

To perform waveform computation on harmonics, 16 cycles of the fundamental waveform is required. In addition, the number of waveform data points must be at least 8192 points within the 16 cycles. The area shown in white in the table below is the area where waveform computation on harmonics is possible. Waveform computation on harmonics is not possible in the gray area.

Record Length	Fundamental Frequency	T/div									
		50ms	100ms	200ms	500ms	1s	2s	5s	10s	20s	50s
1k	50Hz	640	320	160	64	32	16	6	—	—	—
	60Hz	533	267	133	53	27	13	5	—	—	—
10k	50Hz	6400	3200	1600	640	320	160	64	32	16	6
	60Hz	5333	2667	1333	533	267	133	53	27	13	5
50k	50Hz	32000	16000	8000	3200	1600	800	320	160	80	32
	60Hz	26667	13333	6667	2667	1333	667	267	133	67	27
100k	50Hz	64000	32000	16000	6400	3200	1600	640	320	160	64
	60Hz	53333	26667	13333	5333	2667	1333	533	267	133	53
250k	50Hz	160000	64000	32000	16000	6400	3200	1600	640	230	160
	60Hz	133333	53333	26667	13333	5333	2667	1333	533	267	133
500k	50Hz	320000	160000	64000	32000	16000	6400	3200	1600	640	320
	60Hz	266667	133333	53333	26667	13333	5333	2667	1333	533	267
1M	50Hz	640000	320000	160000	64000	32000	16000	6400	3200	1600	640
	60Hz	533333	266667	133333	53333	26667	13333	5333	2667	1333	533
2M	50Hz	1600000	640000	320000	160000	64000	32000	16000	6400	3200	1600
	60Hz	1333333	533333	266667	133333	53333	26667	13333	5333	2667	1333
4M	50Hz	3200000	1600000	640000	320000	160000	64000	32000	16000	6400	3200
	60Hz	2666667	1333333	533333	266667	133333	53333	26667	13333	5333	2667

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