Digital Storage Oscilloscope

GDS-3000 Series

POWER ANALYSIS MANUAL

GW INSTEK PART NO. 82DS-PWR00U01

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

April 2011

The information in this manual was correct at the time of printing. However, Good Will continues to improve products and reserves the rights to change specification, equipment, and maintenance procedures at any time without notice.

Good Will Instrument Co., Ltd.
No. 7-1, Jhongsing Rd., Tucheng City, Taipei County 236, Taiwan.

Table of Contents

GETTING STARTED

This chapter describes how to install the Power Analysis Software as well as how to deskew the probes.

Activating Optional Software

This procedure describes how to install and uninstall the optional Power Analysis and other software modules that use a GW Instek USB license key.

License keys can be uninstalled and transferred* to another oscilloscope at anytime. A license key can only be used with one machine at a time.

For more information, contact your local distributor or GW Instek at www.gwinstek.com/marketing@goodwill.com.tw.

Note

This installation guide only applies to firmware versions 1.07 or above. Do not attempt this installation procedure with older firmware.

*For USB flash disks using a license key file with the XXXX.lis format

The "XXXX.lis" license files use an older format which can still be used; however these files are tied to the serial number of an oscilloscope and cannot be transferred. All the optional software functions are identical for both formats, except that the optional software cannot be transferred to other oscilloscopes if they use the XXXX.lis format.

The XXXX.lis format license keys are no longer available, only the XXXX.lic license keys can be purchased.

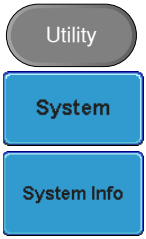
Firmware Check

Background

Before the optional software is installed, ensure the target oscilloscope is running firmware V1.07 or above.

1. Press the *Utility* key and select *System* from the bottom menu. Press *System Info* from the side menu.

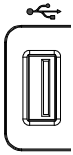
   The firmware version will be shown in a pop-up window.



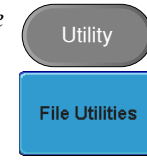
Installation Procedure

Steps

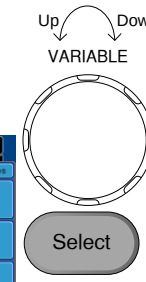
1. Turn on the oscilloscope and insert the GW Instek USB license key into the front panel USB port.



2. Press the *Utility* key and select *File Utilities* from the bottom menu.



3. Use the *Variable* knob to select the USB directory and then press the *Select* key.



4. Select *PowerAnalysis.lic* to install the Power Measurement software.

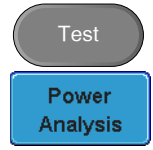
5. Restart the oscilloscope after the software has finished installing.

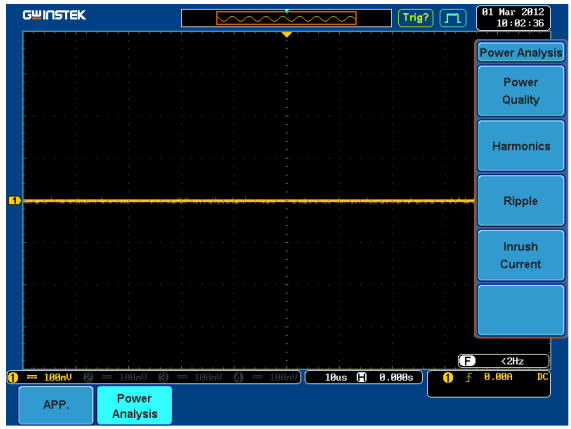
Note

The license keys will be erased from the USB flash drive after they have been installed onto the oscilloscope. Only a single license key can be installed to any one oscilloscope at a time.

Power Analysis Confirmation

Press the *Test* key on the front panel and *Power Analysis* from the bottom menu to see if the Power Analysis activation worked.





Uninstallation / Transfer of License Key

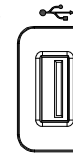
Background

License keys can be uninstalled and transferred to another oscilloscope at anytime. Only one license key can be used on one oscilloscope at a time.

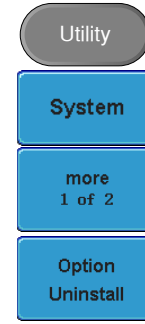
When one of the optional software license keys has been uninstalled, the license key is automatically transferred back to the GW Instek USB license key flash drive- ready to be installed on another oscilloscope.

Steps

1. Turn on the oscilloscope and insert the GW Instek USB license key flash drive into the front panel USB port.

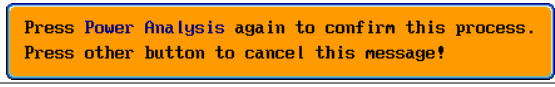


2. Press the *Utility* key and select *System* from the bottom menu. Select *more 1 of 2* and *Option Uninstall"* from the side menu.



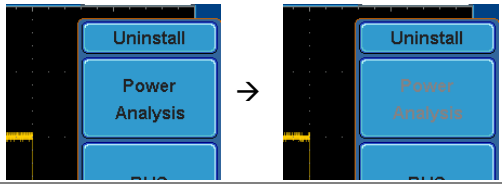
3. Select *Power Analysis* to uninstall the Power Measurement software.

4. A warning message will appear to confirm the uninstallation. Press the same keys again to continue the uninstallation.



Note

The uninstall options will be grayed out when the uninstallation is successful. Below, *Power Analysis* has been uninstalled.

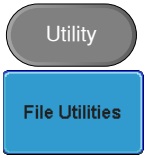


License Key Transfer Confirmation

When one of the optional software modules has been uninstalled, the license key should be transferred back to the GW Instek USB license key flash drive. The license key can then be used on another oscilloscope.

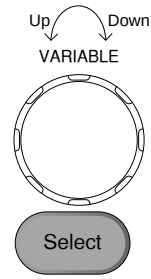
Follow the procedure below to check that the license key was transferred back.

5. Press the *Utility* key and select *File Utilities* from the bottom menu.



6. Use the *Variable* knob to select the

USB directory and then press the *Select* key.



PowerAnalysis.lic should now be in the USB root directory*.

*See the note below.

Note

FOR LICENSE KEYS THAT ARE SAVED TO A USB FLASH DISK WITH XXXX.LIS FORMAT

The "XXXX.lis" license files use an older format which can still be used; however these files are tied to the serial number of the oscilloscope. All the optional software functions are identical for both formats, except that the optional software cannot be transferred to another oscilloscope if the license key uses the XXXX.lis format.

Set the Deskew

The deskew function is used to compensate for the propagation delay between the oscilloscope and the probe. For power measurements this is especially important as voltage and current probes are often used in measurements and have differing propagation delays.

Background

The deskew function allows the time delay between voltage and current probes to be equalized.

Panel operation

1. If necessary configure a channel as a voltage probe and another channel as a current probe.

   See the user manual.

2. Press one of the *Channel* keys that was set as the voltage or current probe.

3. Press *Probe* from the bottom menu.

4. Press *Deskew* on the side menu and use the variable knob to set the deskew time.

   Alternatively, press *Set to 0s* to reset the deskew time.

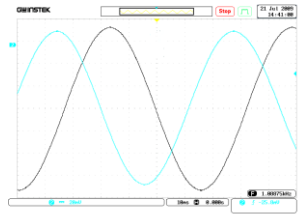
   Typically, both channels should line up with a common edge.

   Range -50ns~50ns, 10ps increments

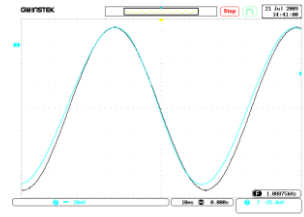
5. If necessary, repeat the procedure for the other channel.

Example

Before deskew



After deskew

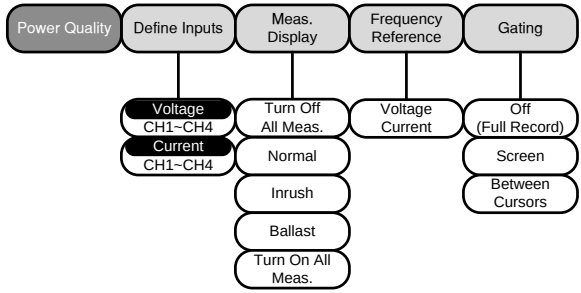


QUICK REFERENCE

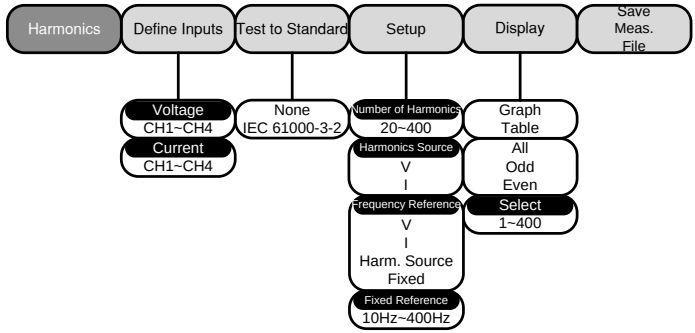
This chapter depicts the power analysis menu tree. Use them as a handy reference to get quick access to the functionality.

Menu Tree / Operation Shortcuts

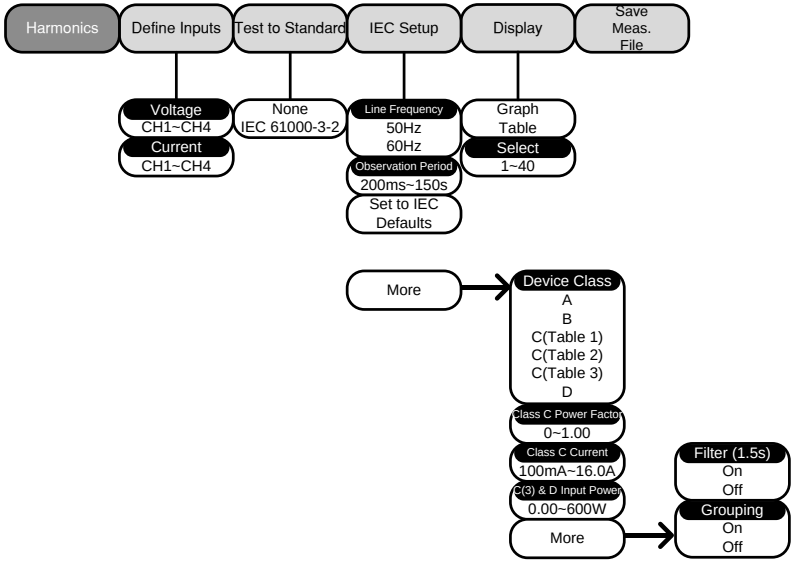
Test key – Power Analysis - Power Quality



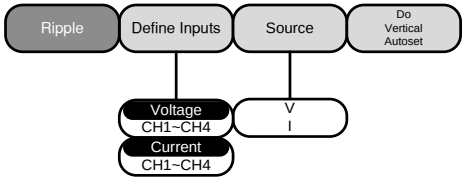
Test key – Power Analysis - Harmonics (None)



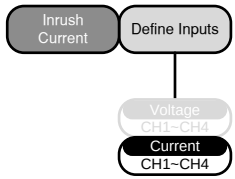
Test key – Power Analysis - Harmonics (IEC)



Test key – Power Analysis - Ripple



Test key – Power Analysis - Inrush



MEASUREMENT

Power Analysis

The Power Analysis software provides automatic measurement for a number of advanced measurement types such as power quality, harmonics, ripple and inrush current. The Power analysis software is an optional software module. To install the optional software module, please see page 5.

Power Analysis overview

Power Quality	Power quality measures the power of a signal from the voltage and current measurement.
Harmonics	The harmonics function shows signal harmonics up to the 400th harmonic. Harmonic tests can be user defined and common harmonic standards such as IEC 61000-3-2 can also be tested for.
Ripple	The ripple function automatically calculates the ripple and noise of the waveform.
Inrush Current	The inrush function automatically calculates the first peak and second peak inrush current.

Power Quality

Power Quality parameter overview

All the following parameters are used for power quality measurements.

Measurement	Measurement Group		
	Normal	Inrush	Ballast
V RMS	✓	✓	✓
I RMS	✓		✓
True Power	✓		✓
Apparent Power	✓		✓
Reactive Power	✓		✓
Frequency	✓	✓	✓
Power Factor	✓		✓
Phase Angle	✓		
V Crest Factor	✓		✓
I Crest Factor	✓		✓
(+)V Peak		✓	✓
(-)V Peak		✓	✓
(+)I Peak		✓	✓
(-)I Peak		✓	✓
DC Voltage			✓
DC Current			✓
Impedance			
Resistance			
Reactance			

Using Power Quality Measurements

Background

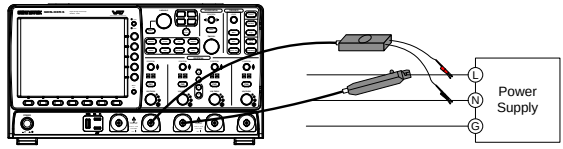
For typical power measurements, one channel is used to measure voltage using a differential probe and the other channel is used to measure current using a current probe.

In the example below, the power quality of an AC power source is tested.

⚠ WARNING

Ensure safe working practices are adhered to when working with live voltages. Failure to do so could lead to electric shock or loss of life.

Connection



Differential probe: Line and Neutral.
Current probe: Line.

Setup

1. Deskew the current and voltage probes. Page 12
2. With the power disconnected from the AC power source, connect the differential voltage probe to the Line and Neutral wires and the current probe to the Line wire.
3. Connect the differential probe and current probe to an input channel.
4. Configure the channel with the differential probe to the following settings:

Probe	Voltage

Attenuation	Matching the probe settings
Coupling	DC
Impedance	Matching the probe output (typically 1MΩ)

5. Configure the channel with the current probe to the following settings:

Probe	Current
Attenuation	As suitable (typically x10)
Coupling	DC
Impedance	Matching the probe (typically 1MΩ)

6. Connect and turn on the AC power source when all the connections have been made and configured.

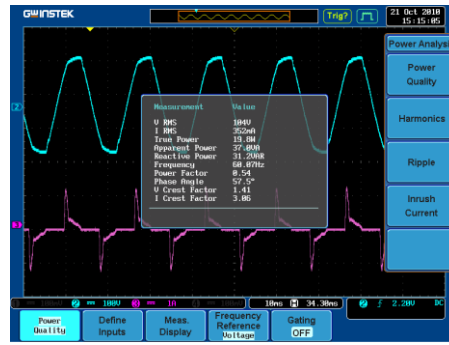
Panel operation

1. Press the *Test* key on the front panel.

2. Press *Power Analysis* from the bottom menu.

3. Press *Power Quality* from the side menu.

4. The automatic measurements for power quality appear (for default settings).



5. Press *Define Inputs* from the lower menu.

6. Choose the *Voltage* input (differential voltage source) from the side menu.

Range	CH1~4

7. Choose the *Current* input (current probe source) from the side menu.

Range	CH1~4

8. Press *Meas. Display*.

9. Choose what type of automatic measurements should be displayed from the side menu.

Range	Turn Off All Meas.
	Normal
	Inrush
	Ballast
	Turn On All Meas.

10. Press *Frequency Reference* from the bottom menu.

11. Choose *Voltage* or *Current* as the frequency reference.

Range	Voltage, Current

Gating

To set the measurement area press *Gating* from the bottom menu and select the *Gating* mode from the side menu. See the user manual for more details.

Gating	Off (Full Record), Screen, Between Cursors

Harmonics

Harmonics parameter overview

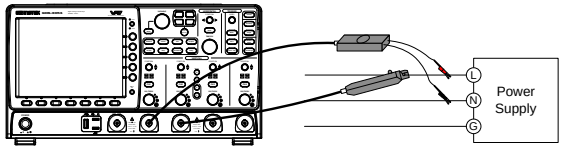
All the following parameters are used for harmonic measurements.

Measurement	None	IEC 61000-3-2 *	
Frequency (Hz)	✓	✓	All classes
Magnitude (%)	✓	✓	All classes
Mag. RMS (A)	✓	✓	All classes
Phase (˚)	✓		
Limit (A)		✓	A, B C.1, C.3,D
Limit (%)		✓	C.2
Pass | Fail		✓	All classes
Max all Windows (A)		✓	All classes
200% Limit		✓	All classes
POHC Limit		✓	All classes
THD-F	✓	✓	All classes
THD-R	✓		
RMS	✓	✓	All classes
Overall		✓	All classes
POHC		✓	All classes
POHL		✓	All classes
Input Power		✓	C.3, D
Power Factor		✓	C.1, C.2, C.3
Fundamental Current		✓	C.1, C.2, C.3

Harmonic 3	✓	C.3
Harmonic 5	✓	C.3

*A, B, C.1, C.2, C.3, D are Class A, Class B, Class C (Table 1), Class C (Table2), Class C (Table 3), Class D

Define Harmonic Inputs

Background	Current and voltage inputs must be defined for harmonic measurements.
Background	For harmonic measurements, one channel is used to measure voltage using a differential probe and the other channel is used to measure current using a current probe. In the example below, the harmonic content of an AC power source is tested.
⚠ WARNING	Ensure safe working practices are adhered to when working with live voltages. Failure to do so could lead to electric shock or loss of life.
Connection	 Differential probe: Line and Neutral. Current probe: Line.
Setup	1. Deskew the current and voltage probes. Page 12

2. With the power disconnected from the AC power source, connect the differential voltage probe to the Line and Neutral wires and the current probe to the Line wire.

3. Connect the differential probe and current probe to an input channel.

4. Configure the channel with the differential probe to the following settings:

Probe	Voltage
Attenuation	Matching the probe settings
Coupling	DC
Impedance	Matching the probe output (typically 1MΩ)

5. Configure the channel with the current probe to the following settings:

Probe	Current
Attenuation	As suitable (typically x10)
Coupling	DC
Impedance	Matching the probe (typically 1MΩ)

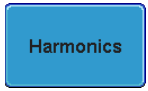
6. Connect and turn on the AC power source when all the connections have been made and configured.

Panel operation

1. Press the *Test* key.

2. Press *Power Analysis* from the bottom menu.

3. Press *Harmonics* from the side menu.



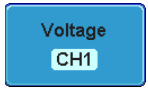
4. The automatic measurements for Harmonics appear (when using default settings).

Example

IEC 61000-3-2

5. Press *Define Inputs* from the lower menu.

6. Choose the *Voltage* input (source) from the side menu.



Range CH1~4

7. Choose the *Current* input (source) from the side menu.

Range CH1~4

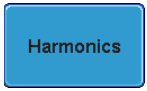
Choosing a Harmonic Standard Test

Panel operation

1. Press the *Test* key.

2. Press *Power Analysis* from the bottom menu.

3. Press *Harmonics* from the side menu.



4. Press *Test to Standard* from the lower menu.

5. Choose the desired Test Standard from the side menu.

   Standard None, IEC 61000-3-2

Harmonics Setup – Default (None)

Background

The setup menu depends entirely on the test standard chosen. If no test standard is chosen the default harmonics setup is used.

Panel operation

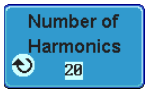
1. Press the *Test* key.

2. Press *Power Analysis* from the bottom menu.

3. Press *Harmonics* from the side menu.

4. Press *Setup* from the lower menu.

5. Set the N*umber of Harmonics* from the side menu.

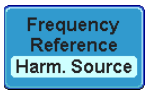


Range 20-~400

6. Choose the *Harmonics Source*.

Source V, I

7. Set the *Frequency Reference*.



Reference V, I, Harmonics source, Fixed

8. If Fixed was set as the frequency reference, set the *Fixed Reference* frequency.

Reference 10Hz~400Hz

Harmonics Setup – IEC

Background

The following Setup menu is only applicable when IEC is chosen as the testing standard. See page 29 for details.

Panel operation

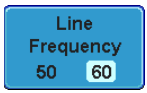
1. Press the *Test* key.

2. Press *Power Analysis* from the bottom menu.

3. Press *Harmonics* from the side menu.

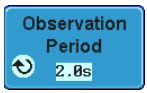
4. Press *Setup* from the lower menu.

5. Set the *Line Frequency* from the side menu.



Range	50, 60 Hz

6. Choose the *Observation Period*.



Time	200ms~ 150 seconds

Default Settings

Press *Set to IEC Defaults* to set to IEC default settings.

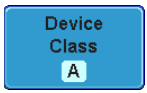
Default	Observation Period. 10s Grouping. On Filter. On

Device Class

Four device classes can be chosen for the IEC standard.

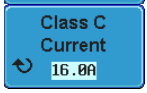
1. Press *More* from the Setup side menu.

2. Choose a *Device Class* from the side menu.



Class	A, B, C(Table 1), C(Table 2), C(Table3), D

3. For class C devices, choose the *Power Factor* and *Current*.



Pow. Fact. 0.00~1.00

Current 100mA~16.0A

4. For class C(Table 3) and Class D devices, choose the *Input Power*.

Power 0~600 W, 10Watt increments

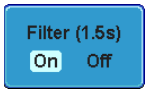
Filter, Grouping and Hysteresis

The filter function applies a 1.5 second smoothing filter function. The Grouping function groups inter-harmonic measurements.

1. Press *more* twice from the side menu.

Filter

2. Press *Filter* to toggle the filter time on or off for 1.5 seconds.



Filter On, Off

Grouping

3. Press *Grouping* to toggle grouping on or off.

Grouping On, Off

Harmonics Display options

Background

Harmonic measurements can be displayed on-screen in graph or table format. When in graph format, a harmonic must be chosen for individual measurements.

Panel operation

1. Press the *Test* key.

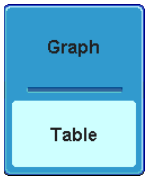
2. Press *Power Analysis* from the bottom menu.

3. Press *Harmonics* from the side menu.

4. Press *Display* from the lower menu.

5. Choose to display harmonic measurements as a graph or as a table.

   Range Table, Graph



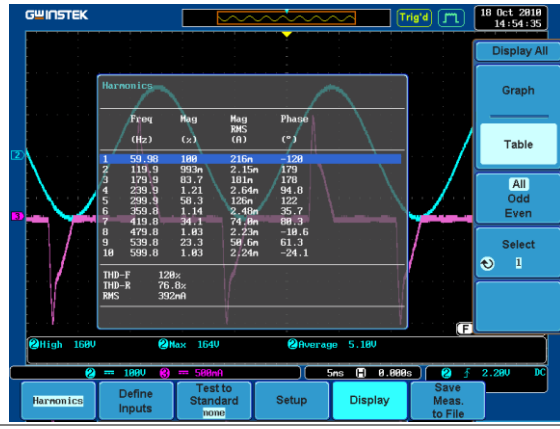
6. Toggle between viewing *All*, *Odd* or *Even* harmonics.

   Harmonic All, Odd, Even

7. Press *Select* and use the Variable knob to choose a harmonic measurement to view or to navigate the harmonic list.

Select	1~number of measurement results

Table Example



Graph Example

Save Harmonic Measurements

Background	All harmonic measurements can be saved internally or to USB. The files are stored as .CSV.
Panel operation	1. Press the *Test* key. 
	2. Press *Power Analysis* from the bottom menu. 
	3. Press *Harmonics* from the side menu. 
	4. Press *Save Meas. To File* from the lower menu. 
File Type	Each measurement that is saved is saved as HarmXXXX.CSV into the designated USB file path. Each file is numbered sequentially from 0000 to 9999. For example the first file will be saved as Harm0000.CSV, the second as Harm0001.CSV, and so on.
Data	The data that is saved depends on whether *Test to Standard* is set to *None* or to *IEC 61000-2-3*. Please page 25 for details.

Example

Below shows an example of the harmonic data that is saved.

GW GDS-3354, serial number P930116, version V1.05				
Harmonics				
THD-F	113%			
THD-R	75.10%			
RMS	353mA			
	Freq	Mag	Mag RMS	Phase
	Hz	%	A	Degrees
1	60.07	100	217m	0
2	120.1	294m	640u	-135
3	180.2	62.1	135m	31.4
4	240.2	241m	524u	-135
5	300.3	47.2	102m	29
6	360.4	534m	1.16m	79.1
7	420.5	44.8	97.5m	10.3
8	480.5	1.27	2.77m	2.35

Ripple

Using Ripple Measurements

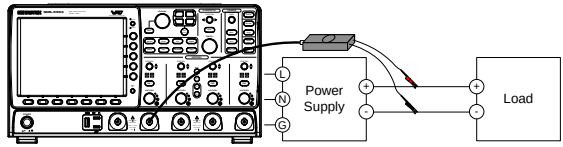
Background

The ripple function allows power supply ripple to be measured with ease. The function allows automatic vertical scaling to maximize the vertical resolution of the measurement by isolating the AC component from the DC waveform.

WARNING

Ensure safe working practices are adhered to when working with live voltages. Failure to do so could lead to electric shock or loss of life.

Connection



Differential probe: Positive and negative terminals.

Setup

1. With the power disconnected from the power source, connect the differential voltage probe to the positive and negative output terminals.
2. Connect the differential probe to an input channel.
3. Configure the channel with the differential probe to the following settings:

Probe	Voltage
Attenuation	Matching the probe settings
Coupling	DC

Impedance	Matching the probe output (typically 1MΩ)

4. Connect and turn on the power source when all the connections have been made and configured.

Panel operation

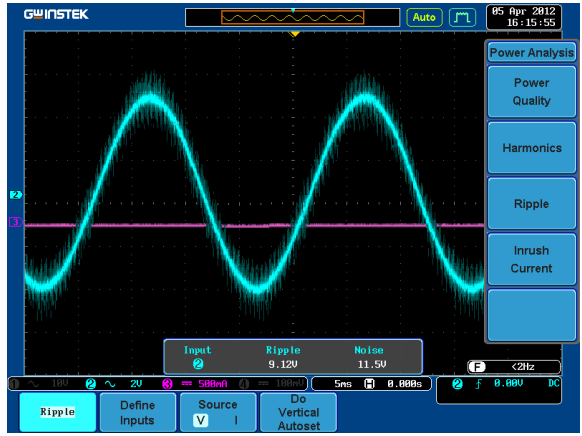
1. Press the *Test* key.

2. Press *Power Analysis* from the bottom menu.

3. Press *Ripple* from the side menu.

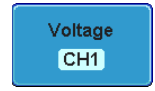
4. The automatic measurements for Ripple appear (when using default settings).

Example



5. Press *Define Inputs* from the lower menu.

6. Choose the *Voltage* input (source) from the side menu.



Range CH1~4

7. Choose the *Current* input (source) from the side menu.

Range CH1~4

8. Press *Source* from the bottom menu to toggle the ripple source type.

Source V, I

9. To automatically set the vertical scale, press *Do Vertical Autoset*. This will offset the DC component to maximize the accuracy of the ripple measurement.

Inrush

Using Inrush Current Measurements

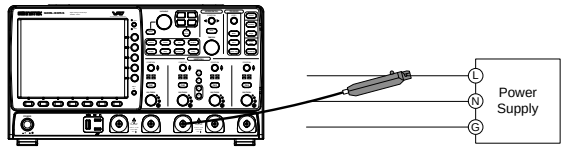
Background

The GDS-3000 is able to quickly measure the in-rush current generated when a power supply is first turned on. The Inrush function can measure the first and second peak.

WARNING

Ensure safe working practices are adhered to when working with live voltages. Failure to do so could lead to electric shock or loss of life.

Connection



Current probe: Line

Setup

1. With the power disconnected from the power source, connect the current probe to Line wire.
2. Connect the current probe to an input channel.
3. Configure the channel with the current probe to the following settings:

Probe	Current
Attenuation	As suitable (typically x10)
Coupling	DC
Impedance	Matching the probe (typically 1MΩ)

4. Connect and turn on the power source when all the connections have been made and configured.

Panel operation

1. Press the Test key.

2. Press Power Analysis from the bottom menu.

3. Press *Inrush Current* from the side menu.

4. The automatic measurements for inrush current appear measuring the first and second inrush current peaks. (default settings)

Example

5. Press *Define Inputs* from the lower menu.

6. Choose the *Current* input (source) from the side menu.

Range CH1~4, Ref1~4

⚠ Note

To effectively measure inrush current, use the oscilloscope in *Single* mode to capture the inrush current when it occurs.

A voltage source cannot be selected for inrush current.

PROGRAMMING COMMANDS

The following programming commands only apply to the power analysis software module. For more details on remote control, please see the programming manual.

Note: When remote commands are used, any changes to the on-screen menu system and any messages are also updated on the display.

When remote queries are used, if the on-screen menu is not at the same node as the query command, then the returned value will be the last known value. A new value will not be calculated if the menu system node and query node are not the same.

(For example if the menu system is at the POWer:RIPPle node, then using the :POWer:QUALity:DCVOLTage? query will return the last DC voltage that was calculated)

If the menu node and query node are at the same level, then the returned values will be recalculated each time the query is used.

Power Commands

:POWer:TYPe

Set → / → Query

Description	Selects or returns the selected power analysis function.	
Syntax	:POWer:TYPe {QUALity | HARMonics | RIPPle | INRUshcurrent | ? }	
Parameter/Return parameter	QUALity	Power quality function
	HARMonics	Harmonics function
	RIPPle	Ripple function
	INRUshcurrent	Inrush current function
Example	:POWer:TYPe QUALity Sets the power analysis function to power quality.	

:POWer:CURRent:SOURce

Set → / → Query

Description	Sets or queries the current source.

Syntax	:POWer:CURRent:SOURce {CH1 | CH2 | CH3 | CH4 | ?}	
Parameter/Return parameter	CH1~CH4	Channel of the current source.
Example	:POWer:CURRent:SOURce CH1 Sets the current source to CH1.	

:POWer:VOLTage:SOURce

Set → / → Query

Description	Sets or queries the voltage source.	
Syntax	:POWer:VOLTage:SOURce {CH1 | CH2 | CH3 | CH4 | ?}	
Parameter/Return parameter	CH1~CH4	Channel of the voltage source.
Example	:POWer:VOLTage:SOURce CH2 Sets the voltage source to CH2.	

:POWer:HARMonics:STANDard

Set → / → Query

Description	Sets the harmonics standard to none or to IEC standards.	
Syntax	:POWer:HARMonics:STANDard {NONe | IEC | ?}	
Parameter/Return parameter	NONe	No harmonics standard.
	IEC	IEC standards
Example	:POWer:HARMonics:STANDard NONe Sets the harmonics standard to none.	

:POWer:HARMonics:NR_HARMonics

Set → / → Query

Description	Sets the number of harmonics when the harmonic standard is set to none.
Note	Only applicable if Standard is set to None.

Syntax	:POWer:HARMonics:NR_HARMonics {<NR3> | ?}	
Parameter/ Return parameter	<NRf> <NR3>	20~400
Example	:POWer:HARMonics:NR_HARMonics 20 Sets the number of harmonics to 20.	

:POWer:HARMonics:SOURce

Set / Query

Description	Sets or queries the harmonics source when the harmonic standard is set to none.	
Note	Only CURRent is supported when the standard is set to IEC.	
Syntax	:POWer:HARMonics:SOURce {VOLTage | CURRent | ?}	
Parameter/Return parameter	VOLTage	Voltage source.
	CURRent	Current source.
Example	:POWer:HARMonics:SOURce VOLTage Sets the harmonics source as the voltage source.	

:POWer:HARMonics:FREQRef

Set / Query

Description	Sets or queries the harmonics reference when the harmonic standard is set to none.	
Syntax	:POWer:HARMonics:FREQRef {VOLTage | CURRent | HARMSOURce | FIXEDFREQuency | ?}	
Parameter/Return parameter	VOLTage	Voltage source.
	CURRent	Current source.
	HARMSOURce	Harmonic source.
	FIXEDFREQuency	A fixed frequency value. The frequency is set by the FREQRef:FIXEDFREQValue command.

Example	:POWer:HARMonics:FREQRef VOLTage Sets the harmonics reference as the voltage source.

:POWer:HARMonics:FREQRef :FIXEDFREQValue

Set → / → Query

Description	Sets or queries the fixed frequency value for the :POWer:HARMonics:FREQRef command.
Note	This command is only applicable when the Standard is set to None and the frequency reference is set to Fixed.
Syntax	:POWer:HARMonics:FREQRef:FIXEDFREQValue {<NR3> | ?}
Parameter/Return parameter	<NRf> <NR3> (10Hz to 400Hz)
Example	:POWer:HARMonics:FREQRef:FIXEDFREQValue 1.0E+1 Sets the fixed frequency to 10Hz.

:POWer:HARMonics:DISPlay:SELect

Set → / → Query

Description	Sets or queries the whether the odd, even or all the harmonics are displayed in the results. This command is only applicable when the harmonic standard is set to none.	
Syntax	:POWer:HARMonics:DISPlay:SELect {ODD | EVEN | ALL | ?}	
Parameter/Return parameter	ODD	Display only odd harmonics
	EVEN	Display only even harmonics
	ALL	Display all the harmonics
Example	:POWer:HARMonics:DISPlay:SELect ODD Display only the odd harmonics.	

:POWer:HARMonics:DISPlay:TYPe

Set → / → Query

Description	Sets or queries the whether the results are displayed as a graph or as a table.	
Syntax	:POWer:HARMonics:DISPlay:TYPe {GRAph | TABle | ?}	
Parameter/Return parameter	GRAph	Display as graph
	TABle	Display as table
Example	:POWer:HARMonics:DISPlay:TYPe GRAph Display results in a graph.	

:POWer:HARMonics:IEC:LINEFREQuency

Set → / → Query

Description	Sets or queries the line frequency when the harmonics standard is set to IEC.	
Syntax	:POWer:HARMonics:IEC:LINEFREQuency {<NR3>(50,60) | ?}	
Parameter/Return parameter	<NR3>	50 or 60.
Example	:POWer:HARMonics:IEC:LINEFREQuency 5.0e+1 Sets the line frequency to 50Hz.	

:POWer:HARMonics:IEC:OBSPERiod

Set → / → Query

Description	Sets or queries the "observation period" in seconds when the harmonics standard is set to IEC.	
Syntax	:POWer:HARMonics:IEC:OBSPERiod {<NR3>(0.2~150) | ?}	
Parameter/Return parameter	<NRf> <NR3>	0.2~150 seconds.
Example	:POWer:HARMonics:IEC:OBSPERiod 1.5E+2 Sets the observation period to 150 seconds.	

:POWer:HARMonics:IEC:CLAss

Set → Query

Description	Sets or queries the IEC device class.			
Syntax	:POWer:HARMonics:IEC:CLAss {A | B | C1 | C2 | C3 | D | ?}			
Parameter/Return parameter	A	Class A	B	Class B
	C1	Class C (table1)	C2	Class C (table2)
	C3	Class C (table3)	D	Class D
Example	:POWer:HARMonics:IEC:CLAss B Sets the device class to B.			

:POWer:HARMonics:IEC:POWERFACtor

Set → Query

Description	Sets or queries the power factor when the class is set to C. This is only applicable when the harmonics standard is set to IEC.	
Syntax	:POWer:HARMonics:IEC:POWERFACtor {<NR3> | ?}	
Parameter/Return parameter	<NRf> <NR3>	0.00~1.00
Example	:POWer:HARMonics:IEC:POWERFACtor 5.1E-1 Sets the power factor to 0.51.	

:POWer:HARMonics:IEC:FUNDamental

Set → Query

Description	Sets or queries the class C current. This is only applicable when the harmonics standard is set to IEC	
Syntax	:POWer:HARMonics:IEC:FUNDamental {<NR3> | ?}	
Parameter/Return parameter	<NR3>	0.1A ~ 16A

Example	:POWer:HARMonics:IEC:FUNDamental 1.5E+0 Sets the class C current to 1.5A.

:POWer:HARMonics:IEC:INPUTPOWer

Set → / → Query

Description	Sets or queries the class C3/D input power. This is only applicable when the harmonics standard is set to IEC
Syntax	:POWer:HARMonics:IEC:INPUTPOWer {<NR3> | ?}
Parameter/Return parameter	<NRf> <NR3> 0~600Watts. (10W steps)
Example	:POWer:HARMonics:IEC:INPUTPOWer 1.0E+2 Sets the class C3/D input power to 100W.

:POWer:HARMonics:IEC:FILter

Set → / → Query

Description	Turns the IEC harmonics filter on/off.
Syntax	:POWer:HARMonics:IEC:FILter {OFF | ON | ?}
Parameter/Return parameter	OFF Filter off ON Filter on
Example	:POWer:HARMonics:IEC:FILter ON Turn the IEC harmonic filter on.

:POWer:HARMonics:IEC:GROUPing

Set → / → Query

Description	Turns the IEC grouping on/off.
Syntax	:POWer:HARMonics:IEC:GROUPing {OFF | ON | ?}
Parameter/Return parameter	OFF Grouping off ON Grouping on
Example	:POWer:HARMonics:IEC:GROUPing ON Turn grouping on.

:POWer:HARMonics:RESults:HAR<1-400>:FREQuency? → Query

Description	Returns the frequency at the specified harmonic.	
Syntax	:POWer:HARMonics:RESults:HAR<1-400>:FREQuency?	
Parameter	<1-400>	<NR1> Harmonic number.
Return parameter	<NR3>	Unit = Hz.
Example	:POWer:HARMonics:RESults:HAR20:FREQuency?	

:POWer:HARMonics:RESults:HAR<1-40>:IECMAX? → Query

Description	Returns the "Max all Windows" result when the harmonics standard is set to IEC.	
Syntax	:POWer:HARMonics:RESults:HAR<1-40>:IECMAX?	
Parameter	<1-40>	<NR1> Harmonic number.
Return parameter	<NR3>	Unit = A.
Example	:POWer:HARMonics:RESults:HAR2:IECMAX?	

:POWer:HARMonics:RESults:HAR<1-40>:LIMit? → Query

Description	Returns the "Limit" result when the harmonics standard is set to IEC.	
Syntax	:POWer:HARMonics:RESults:HAR<1-40>:LIMit?	
Parameter	<1-40>	<NR1> Harmonic number.
Return parameter	<NR3>	For device class C2, Unit = %. All other device classes, Unit = A.
Example	:POWer:HARMonics:RESults:HAR1:LIMit?	

:POWer:HARMonics:RESults :HAR<1-400>:PHASe? → Query

Description	Returns the "Phase" (˚) result when the harmonics standard is set to none.	
Syntax	:POWer:HARMonics:RESults:HAR<1-400>:PHASe?	
Parameter	<1-400>	<NR1> Harmonic number.
Return parameter	<NR3>	Unit = ˚.
Example	:POWer:HARMonics:RESults:HAR20:PHASe?	

:POWer:HARMonics:RESults :HAR<1-400>:RMS:ABSolute? → Query

Description	Returns the absolute "RMS" result.	
Syntax	:POWer:HARMonics:RESults:HAR1:RMS: ABSolute?	
Parameter	<1-400>	<NR1> Harmonic number.
Return parameter	<NR3>	Unit = V.
Example	:POWer:HARMonics:RESults:HAR20:RMS:ABSolute?	

:POWer:HARMonics:RESults :HAR<1-400>:RMS:PERCent? → Query

Description	Returns the "Mag%" result.	
Syntax	:POWer:HARMonics:RESults:HAR<1-400> :RMS:PERCent?	
Parameter	<1-400>	<NR1> Harmonic number.
Return parameter	<NR3>	Unit = %.
Example	:POWer:HARMonics:RESults:HAR20:RMS:PERCent?	

:POWer:HARMonics:RESults :HAR<1-40>:TEST:IEC:CLASSALIMit? → Query

Description	Returns the class A "limit" result when the testing standard is set to IEC.	
Syntax	:POWer:HARMonics:RESults:HAR<1-40> :TEST:IEC:CLASSALIMit?	
Parameter	<1-40>	<NR1> Harmonic number.
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
	N/A	N/A - device class is not A.
Example	:POWer:HARMonics:RESults:HAR1:TEST:IEC :CLASSALIMit?	

:POWer:HARMonics:RESults :HAR<1-40>:TEST:IEC:NORMAL? → Query

Description	Returns the "limit" result for all device classes excluding class A. Only applicable for IEC.	
Syntax	:POWer:HARMonics:RESults:HAR<1-40>:TEST:IEC:NORMAL?	
Parameter	<1-40>	<NR1> Harmonic number.
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
Example	:POWer:HARMonics:RESults:HAR1:TEST:IEC :NORMAL?	

:POWer:HARMonics:RESults :HAR<1-40>:TEST:IEC:POHCLIMit? → Query

Description	Returns the "POHC Limit" result for all device classes when the standard is set to IEC.

Syntax	:POWer:HARMonics:RESults:HAR<1-40>:TEST:IEC :POHCLIMit?	
Parameter	<1-40>	<NR1> Harmonic number.
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
	NA	Not applicable
Example	:POWer:HARMonics:RESults:HAR1:TEST:IEC :POHCLIMit?	

:POWer:HARMonics:RESults:IEC :FUNDamental? → Query

Description	Returns the current level of the fundamental frequency. Only applicable with IEC.
Syntax	:POWer:HARMonics:RESults:IEC:FUNDamental?
Return parameter	<NR3> Unit = A
Example	:POWer:HARMonics:RESults:IEC:FUNDamental?

:POWer:HARMonics:RESults:IEC :HARM3ALTernate? → Query

Description	Returns the limit test result of the IEC harmonic test for the 3rd harmonic.	
Syntax	:POWer:HARMonics:RESults:IEC:HARM3ALTernate?	
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
	NA	Not applicable
Example	:POWer:HARMonics:RESults:IEC:HARM3ALTernate?	

:POWer:HARMonics:RESults:IEC :HARM5ALTernate? → Query

Description	Returns the limit test result of the IEC harmonic test for the 3rd harmonic.	
Syntax	:POWer:HARMonics:RESults:IEC:HARM5ALTernate?	
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
	NA	Not applicable
Example	:POWer:HARMonics:RESults:IEC:HARM5ALTernate?	

:POWer:HARMonics:RESults:IEC:POHC? → Query

Description	Returns the POHC measurement when the standard is set to IEC.	
Syntax	:POWer:HARMonics:RESults:IEC:POHC?	
Return parameter	<NR3>	Unit = A
Example	:POWer:HARMonics:RESults:IEC:POHC?	

:POWer:HARMonics:RESults:IEC:POWer? → Query

Description	Returns the input power for IEC device class C3.	
Syntax	:POWer:HARMonics:RESults:IEC:POWer?	
Return parameter	<NR3>	Unit = W
Example	:POWer:HARMonics:RESults:IEC:POWer?	

:POWer:HARMonics:RESults:IEC :POWERFactor? → Query

Description	Returns the power factor for IEC device classes C1, C2 and C3.

Syntax	:POWer:HARMonics:RESults:IEC:POWERFactor?	
Return parameter	<NR3>	0~1
Example	:POWer:HARMonics:RESults:IEC:POWERFactor?	

:POWer:HARMonics:RESults:PASSFail? → Query

Description	Returns the overall pass/fail result. Only applicable to when the standard is set to IEC.	
Syntax	:POWer:HARMonics:RESults:PASSFail?	
Return parameter	PASS	Passed limit testing
	FAIL	Failed limit testing
	NA	Not applicable
Example	:POWer:HARMonics:RESults:PASSFail?	

:POWer:HARMonics:RESults:RMS? → Query

Description	Returns the RMS value of the source.	
Syntax	:POWer:HARMonics:RESults:RMS?	
Return parameter	<NR3>	Unit = A
Example	:POWer:HARMonics:RESults:RMS?	

:POWer:HARMonics:RESults:THDF? → Query

Description	Returns the THDF as a percentage. THDF is the ratio of total harmonic distortion to the RMS value of the fundamental component of the source.	
Syntax	:POWer:HARMonics:RESults:THDF?	
Return parameter	<NR3>	%
Example	:POWer:HARMonics:RESults:THDF?	

:POWer:HARMonics:RESults:THDR? → Query

Description	Returns the THDF as a percentage. THDF is the ratio of total harmonic distortion to the RMS value of the source.	
Syntax	:POWer:HARMonics:RESults:THDR?	
Return parameter	<NR3>	%
Example	:POWer:HARMonics:RESults:THDR?	

:POWer:HARMonics:RESults:SAVe Set →

Description	Saves the harmonic results to USB. See the operation chapter for save details.
Syntax	:POWer:HARMonics:RESults:SAVe

:POWer:GATing Set → / → Query

Description	Sets the measurement gating area.	
Syntax	:POWer:GATing {OFF | SCREen | CURSor | ?}	
Parameter/ Return parameter	OFF	Turn gating off.
	SCREen	Set the measurement gating to the screen width.
	CURSor	Set the measurement gating to between the cursors.
Example	:POWer:GATing SCREen Sets the measurement gating to the screen area.	

:POWer:QUALity:DISPlay Set → / → Query

Description	Sets the measurement display for the power quality measurements.

Syntax	:POWer:QUALity:DISPlay {OFF | NORMal | INRUsh | BALLast | ALL | ?}	
Parameter/ Return parameter	OFF	Off
	NORMal	Normal power quality measurements
	INRUsh	Inrush current related measurements
	BALLast	Ballast related measurements
	ALL	All power quality measurements
Example	:POWer:QUALity:DISPlay NORMal Sets the measurement display to "normal".	

:POWer:QUALity:FREQREFerence

Set → / → Query

Description	Sets the frequency reference as the voltage or current source.	
Syntax	:POWer:QUALity:FREQREFerence {VOLTage | CURRent | ?}	
Parameter/ Return parameter	VOLTage	Voltage source.
	CURRent	Current source.
Example	:POWer:QUALity:FREQREFerence? >VOLTAGE	

:POWer:QUALity:VMAX?

→ Query

Description	Returns the "VMAX".	
Syntax	:POWer:QUALity:VMAX?	
Return parameter	<NR3>	V
Example	:POWer:QUALity:VMAX? >1.5E+0	

:POWer:QUALity:VMIN?

→ Query

Description	Returns the "VMIN".
Syntax	:POWer:QUALity:VMIN?
Return parameter	<NR3> V
Example	:POWer:QUALity:VMIN? >0.5E-1

:POWer:QUALity:IMAX? → Query

Description	Returns the "IMAX".
Syntax	:POWer:QUALity:IMAX?
Return parameter	<NR3> A
Example	:POWer:QUALity:IMAX? >2.0E-2

:POWer:QUALity:IMIN? → Query

Description	Returns the "IMIN".
Syntax	:POWer:QUALity:IMIN?
Return parameter	<NR3> A
Example	:POWer:QUALity:IMIN? >0.5E-2

:POWer:QUALity:DCVOLTage? → Query

Description	Returns the "DC Voltage".
Syntax	:POWer:QUALity:DCVOLTage?
Return parameter	<NR3> A
Example	:POWer:QUALity:DCVOLTage? >1.11E-2

:POWer:QUALity:DCCURRent? → Query

Description	Returns the "DC Current".
Syntax	:POWer:QUALity:DCCURRent?
Return parameter	<NR3> A
Example	:POWer:QUALity:DCCURRent? >1.5E-3

:POWer:QUALity:VCRESTfactor? → Query

Description	Returns the "V Crest Factor".
Syntax	:POWer:QUALity:VCRESTfactor?
Return parameter	<NR3>
Example	:POWer:QUALity:VCRESTfactor? >1.41E+0

:POWer:QUALity:ICRESTfactor? → Query

Description	Returns the "I Crest Factor".
Syntax	:POWer:QUALity:ICRESTfactor?
Return parameter	<NR3>
Example	:POWer:QUALity:ICRESTfactor? >3.06E+0

:POWer:QUALity:IMPedance? → Query

Description	Returns the "Impedance".
Syntax	:POWer:QUALity:IMPedance?
Return parameter	<NR3> Ω

Example	:POWer:QUALity:IMPedance?

:POWer:QUALity:RESIstance? → Query

Description	Returns the "Resistance".	
Syntax	:POWer:QUALity:RESIstance?	
Return parameter	<NR3>	Ω
Example	:POWer:QUALity:RESIstance?	

:POWer:QUALity:REACtance? → Query

Description	Returns the "Reactance".	
Syntax	:POWer:QUALity:REACtance?	
Return parameter	<NR3>	VAR
Example	:POWer:QUALity:REACtance?	

:POWer:QUALity:APPpwr? → Query

Description	Returns the "Apparent Power".	
Syntax	:POWer:QUALity:APPpwr?	
Return parameter	<NR3>	Units = VA
Example	:POWer:QUALity:APPpwr?	
	>3.7E+1	

:POWer:QUALity:FREQuency? → Query

Description	Returns the "Frequency" of the input.	
Syntax	:POWer:QUALity:FREQuency?	
Return parameter	<NR3>	Hz

Example	:POWer:QUALity:FREQuency? >6.007E+1

:POWer:QUALity:ICRESTfactor? → Query

Description	Returns the current "Crest factor".
Syntax	:POWer:QUALity:ICRESTfactor?
Return parameter	<NR3>
Example	:POWer:QUALity:ICRESTfactor? >1.41E+0

:POWer:QUALity:IRMS? → Query

Description	Returns the "I RMS".
Syntax	:POWer:QUALity:IRMS?
Return parameter	<NR3> Unit=A
Example	:POWer:QUALity:IRMS? >3.52E-2

:POWer:QUALity:PHASEangle? → Query

Description	Returns the "Phase Angle".
Syntax	:POWer:QUALity:PHASEangle?
Return parameter	<NR3> Unit=°
Example	:POWer:QUALity:PHASEangle? >5.75E+1

:POWer:QUALity:POWERFACtor? → Query

Description	Returns the "Power Factor".

Syntax	:POWer:QUALity:POWERFACtor?
Return parameter	<NR3> 0~1
Example	:POWer:QUALity:POWERFACtor? >0.54E0

:POWer:QUALity:REACTpwr? → Query

Description	Returns the "Reactive Power".
Syntax	:POWer:QUALity:REACTpwr?
Return parameter	<NR3> Unit =VAR
Example	:POWer:QUALity:REACTpwr? >3.12E1

:POWer:QUALity:TRUEpwr? → Query

Description	Returns the "True Power".
Syntax	:POWer:QUALity:TRUEpwr?
Return parameter	<NR3> Unit =W
Example	:POWer:QUALity:TRUEpwr? >1.98E+1

:POWer:QUALity:VRMS? → Query

Description	Returns the "V RMS".
Syntax	:POWer:QUALity:VRMS?
Return parameter	<NR3> Unit =V
Example	:POWer:QUALity:VRMS? >1.04E+2

:POWer:RIPPle

Set →

Description	Performs a vertical autoset.
Note	Only supported when the Ripple menu is turned on.
Syntax	:POWer:RIPPle {VERTAUTOset}
Parameter	VERTAUTOset
Example	:POWer:RIPPle VERTAUTOset

:POWer:RIPPle:RESults:AMPlitude?

→ Query

Description	Returns the "Noise" amplitude.
Syntax	:POWer:RIPPle:RESults:AMPlitude?
Return parameter	<NR3> Unit =A or V
Example	:POWer:RIPPle:RESults:AMPlitude? >1.15E+1

:POWer:RIPPle:RESults:REALamplitude?

→ Query

Description	Returns the "Ripple" amplitude.
Syntax	:POWer:RIPPle:RESults:REALamplitude?
Return parameter	<NR3> Unit =A or V
Example	:POWer:RIPPle:RESults:REALamplitude? >9.25E+1

:POWer:RIPPle:SOURce

Set →
→ Query

Description	Sets or queries the ripple source.
Syntax	:POWer:RIPPle:SOURce {VOLTage | CURRent | ?}

Note	Only supported when the Ripple menu is turned on.	
Parameter/ Return Parameter	VOLTage	Voltage source
	CURRent	Current source
Example	:POWer:RIPPle:SOURce VOLTage	

:POWer:INRUshcurrent:RESults:FIRStpeak? → Query

Description	Returns the "First Peak" inrush current.	
Syntax	:POWer:INRUsh:RESults:FIRStpeak?	
Return parameter	<NR3>	Unit =A
Example	:POWer:INRUshcurrent:RESults:FIRStpeak? >2.44E+1	

:POWer:INRUshcurrent:RESults :SECondpeak? → Query

Description	Returns the "Second Peak" inrush current.	
Syntax	:POWer:INRUsh:RESults:SECondpeak?	
Return parameter	<NR3>	Unit =A
Example	:POWer:INRUsh:RESults:SECondpeak? >-2.36E+1	

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