Digital Storage Oscilloscope

GDS-3000 Series

POWER ANALYSIS MANUAL

GW INSTEK PART NO. 82DS-PWR00U01

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

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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

Background

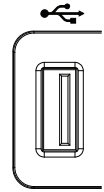
The GDS-3000 has Power Analysis software (page 13), Serial bus decoding software as well as other GW Instek software packages as optional extras. An activation key is required to activate the software. An activation key is required for each optional software package.

For the latest files and information regarding the optional software packages, see the GW Instek website: www.gwinstek.com

Activation key filenames		
	Power analysis activation keys	XX.LIS

Steps

1. Insert a USB stick into the front panel USB port with the activation keys located in the root directory.



2. Press the *Utility* key.

3. Press *File Utilities* from the bottom menu.

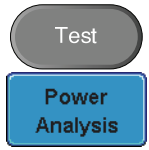
4. The file system appears.

5. Use the Variable knob and Select key to select the activation key from the USB root directory. When prompted to continue, press the *Select* key again.

   Files: XX.LIS

Confirm Activation key

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



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.

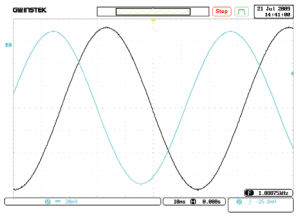
   Typically, both channels should line up with a common edge.

   Range -50ns~50ns, 10ps increments

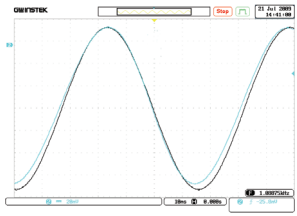
5. If necessary, repeat the procedure for the other channel.

Example

Before deskew



After deskew

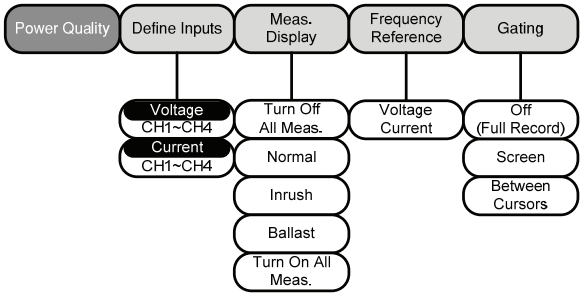


QUICK REFERENCE

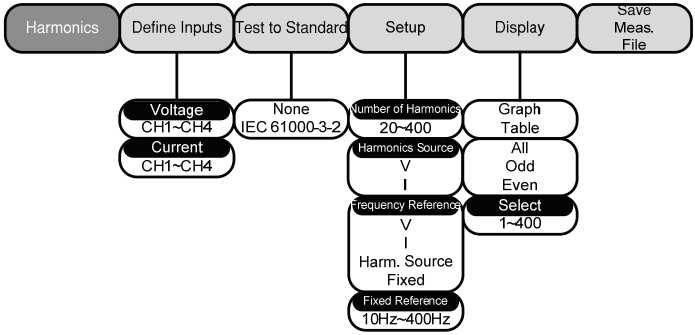
This chapter depicts the power analysis menu tree. Use them as a handy reference to get quick access to the functionality.

Menu Tree / Operation Shortcuts

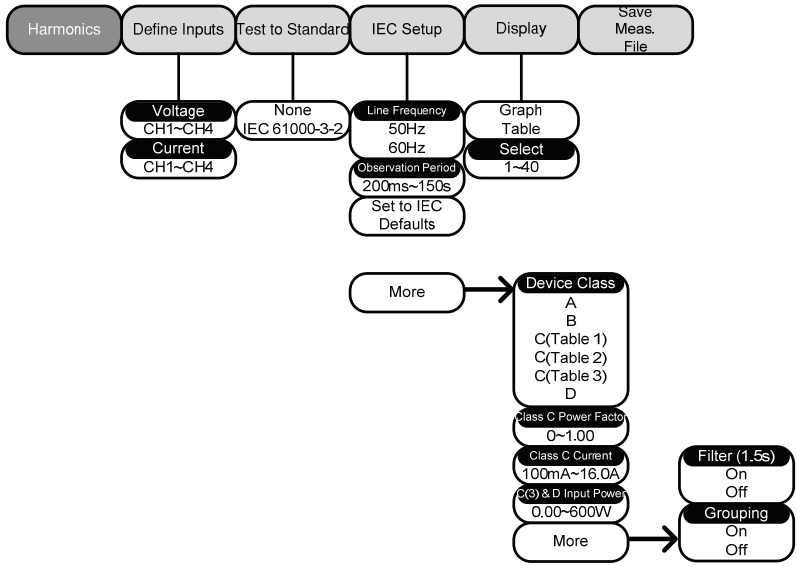
Test key – Power Analysis - Power Quality



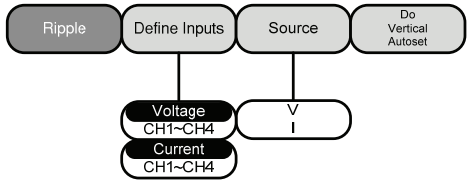
Test key – Power Analysis - Harmonics (None)



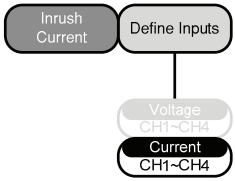
Test key – Power Analysis - Harmonics (IEC)



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

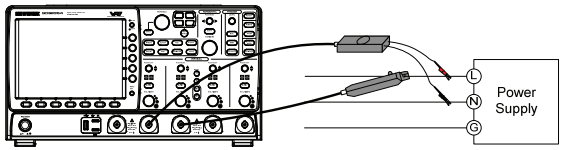
For typical power measurements, one channel is used to measure voltage using a differential probe and the other channel is used to measure current using a current probe.

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 7

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.

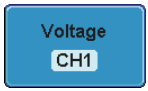
2. Press *Power Analysis* from the bottom menu.

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

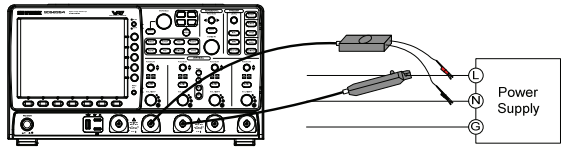
All the following parameters are used for harmonic measurements.

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 7

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.

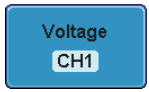
4. The automatic measurements for Harmonics appear (when using default settings).

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

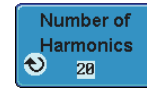
1. Press the *Test* key.

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 24 for details.

Panel operation

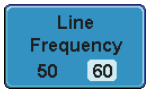
1. Press the *Test* key.

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

3. Press *Harmonics* from the side menu.

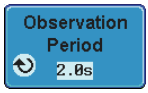
4. Press *Setup* from the lower menu.

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.

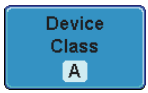
Default	Observation Period. 10s Grouping. On Filter. On

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.

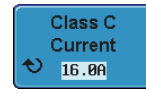


Class	A, B, C(Table 1), C(Table 2), C(Table3), D

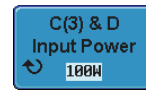
3. For class C devices, choose the *Power Factor* and *Current*.

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

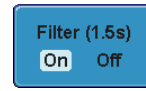
Filter, Grouping and Hysteresis

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.

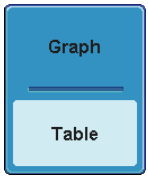
2. Press *Power Analysis* from the bottom menu.

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



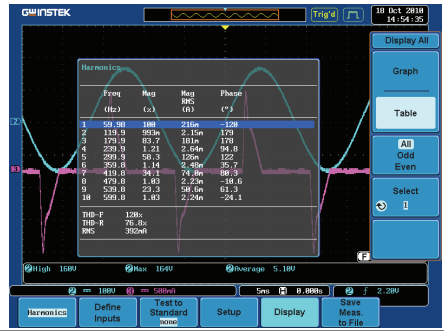
6. Toggle between viewing *All*, *Odd* or *Even* harmonics.

   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 20 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

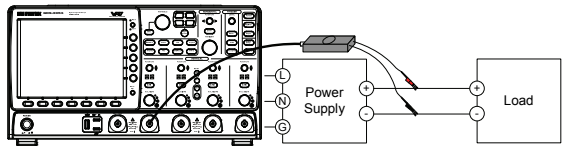
Background

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

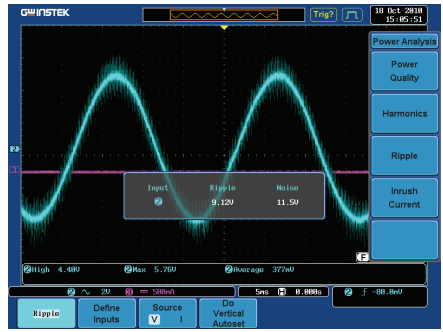
1. Press the *Test* key.

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

3. Press *Ripple* from the side menu.

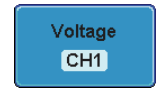
4. The automatic measurements for Ripple appear (when using default settings).

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

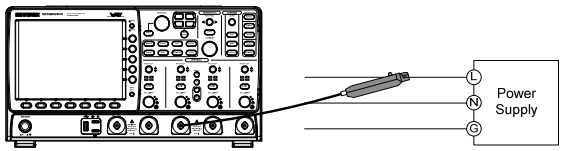
Background

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

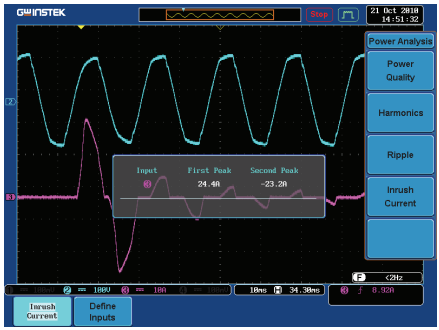
1. Press the Test key.

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.

INDEX