Digital Storage Oscilloscope

GDS-3000 Series

POWER ANALYSIS MANUAL

GW INSTEK PART NO. 82DS-PWR00U01



ISO-9001 CERTIFIED MANUFACTURER



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GETTING STARTED

This chapter describes how to install the power analysis software as well as how to deskew the probes.



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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 XX.LIS activation keys		
Steps	1. Insert a USB stick into the front panel USB port with the activation keys located in the root directory.		
	2. Press the <i>Utility</i> key. Utility		
	3. Press <i>File Utilities</i> from the bottom File Utilities		
	4. The file system appears.		

	G₩INSTEK			~4~~		rig'd Jm	26 Oct 2010 13:25:45
	USB:/licens	e/EK190907_P21	0.lis		FreeSiz	xe :1.96	File Utilities
	FileName		FileSiz	0		Date	Create Folder
	EK198987	P210.lis _S220.lis	18B 18B	Tue Tue	e Sep 28 15:19 e Sep 28 15:19	:58 2010 :50 2010	Rename
1							Delete
						E	5.00016MHz
0	- 100nV (2)	100mV (6)	180nV ()	- 108AU) (5	0ns 🗐 0.000:	e) 🚺 🕹	9.00V
	Language English	System	Date & Time	Printout	File Utilities	1/0	

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	Tł be eq	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 <i>Channel</i> keys that was set as the voltage or current probe.	CH1	
	3.	Press <i>Probe</i> from the bottom menu.	Probe Voltage 1 X	
	4.	Press <i>Deskew</i> on the side menu and use the variable knob to set the deskew time.	Deskew	
		Alternatively, press <i>Set to 0s</i> to reset the deskew time.	Set to 0s	
		Typically, both channels should line up with a common edge.		
		Range -50ns~50ns, 10ps increm	nents	
	5.	If necessary, repeat the procedure for channel.	or the other	



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

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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



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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 p quality measureme	arameters ents.	are used f	or power
Measurement	Measure	ment Gro	up
	Normal	Inrush	Ballast
V RMS	\checkmark	\checkmark	\checkmark
I RMS	\checkmark		\checkmark
True Power	\checkmark		\checkmark
Apparent Power	✓		\checkmark
Reactive Power	\checkmark		\checkmark
Frequency	\checkmark	\checkmark	\checkmark
Power Factor	\checkmark		\checkmark
Phase Angle	\checkmark		
V Crest Factor	\checkmark		\checkmark
l Crest Factor	\checkmark		\checkmark
(+)V Peak		\checkmark	\checkmark
(-)V Peak		\checkmark	\checkmark
(+)I Peak		\checkmark	\checkmark
(-)I Peak		\checkmark	\checkmark
DC Voltage			\checkmark
DC Current			\checkmark
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 Page 7 probes.

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 $1M\Omega$)
	5.	Configure the the following	e channel with the current probe to settings:
	Probe Attenu	Probe	Current
		Attenuation	As suitable (typically x10)
		Coupling Impedance	DC
			Matching the probe (typically $1M\Omega$)
	6.	Connect and when all the configured.	turn on the AC power source connections have been made and
Panel operation	1.	Press the <i>Test</i> panel.	t key on the front
	2.	Press <i>Power</i> A bottom menu	Analysis from the Power 1. Analysis
	3.	Press <i>Power</i> (menu.	<i>Quality</i> from the side Power Quality
	4.	The automati appear (for d	ic measurements for power quality efault 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.







Current



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 <i>Freq</i> bottom m	10. Press <i>Frequency Reference</i> from the bottom menu.		
	11. Choose Vo frequency	oltage or Current as the reference.		
	Range	Voltage, Current		
Gating	To set the me <i>Gating</i> from t select the <i>Gat</i> menu. See the details.	easurement area press he bottom menu and <i>ing</i> mode from the side e user manual for more	Gating OFF	
	Gating	Off (Full Record), Scree Cursors	n, Between	

Harmonics

Harmonics parameter overview

All the following harmonic measur	paramete: rements.	rs are us	ed for
Measurement	None	IEC 61	000-3-2 *
Frequency (H	z) 🗸	\checkmark	All classes
Magnitude (%	ճ) ✓	\checkmark	All classes
Mag. RMS (A)	√	\checkmark	All classes
Phase (°)	\checkmark		
Limit (A)		\checkmark	A, B C.1, C.3,D
Limit (%)		\checkmark	C.2
Pass Fail		\checkmark	All classes
Max all Windows (A)		\checkmark	All classes
200% Limit		\checkmark	All classes
POHC Limit		\checkmark	All classes
THD-F	\checkmark	\checkmark	All classes
THD-R	\checkmark		
RMS	\checkmark	\checkmark	All classes
Overall		\checkmark	All classes
РОНС		\checkmark	All classes
POHL		\checkmark	All classes
Input Power		\checkmark	C.3, D
Power Factor		\checkmark	C.1, C.2, C.3
Fundamental Current		✓	C.1, C.2, C.3

A 11 - 1 - C - 11 . 1 0

Harmonic 3	\checkmark	C.3
Harmonic 5	\checkmark	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.
	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	Power Supply C C C C C C S S S S S S S S S S S S S S
	Differential probe: Line and Neutral. Current probe: Line.
Setup	 Deskew the current and voltage Page 7 probes.

Analysis

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 $1M\Omega$) 5. Configure the channel with the current probe to the following settings: Probe Current As suitable (typically x10) Attenuation Coupling DC Matching the probe (typically Impedance 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. Test 2. Press Power Analysis from the Power

bottom menu.

Harmonics

- 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.

Define Inputs

Voltage

CH1

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 <i>Test</i> key.	Test
	2.	Press <i>Power Analysis</i> from the bottom menu.	Power Analysis
	3.	Press <i>Harmonics</i> from the side menu.	Harmonics
	4.	Press <i>Test to Standard</i> from the lower menu.	Test to Standard none
	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 <i>Test</i> key.	Test	
	2. Press <i>Power Analysis</i> from the bottom menu.	Power Analysis	
	3. Press <i>Harmonics</i> from the side menu.	Harmonics	

4.	Press Setup	from the lower menu.	Setup
5.	Set the Nur the side me	<i>nber of Harmonics</i> from enu.	Number of Harmonics 10 20
	Range	20-~400	
6.	Choose the	Harmonics Source.	Harminics Source V I
	Source	V, I	
7.	Set the Freq	quency Reference.	Frequency Reference Harm. Source
	Reference	V, I, Harmonics source,	Fixed
8.	If Fixed wa reference, s frequency.	set as the frequency set the <i>Fixed Reference</i>	Fixed Reference € <u>60.0Hz</u>
	Reference	10F1Z~400F1Z	

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 <i>Test</i> key.	Test
	2. Press <i>Power Analysis</i> from the bottom menu.	Power Analysis

	3. Press Harma menu.	<i>onics</i> from the side	Harmonics
	4. Press Setup	from the lower menu.	Setup
	5. Set the <i>Line</i> menu.	<i>Frequency</i> from the side	Line Frequency 50 60
	Range	50, 60 Hz	
	6. Choose the	Observation Period.	Observation Period 2.8s
	Time	200ms~ 150 seconds	
Default Settings	Press <i>Set to IEC</i> default setting	<i>C Defaults</i> to set to IEC s.	Set to IEC Defaults
	Default	Observation Period. 10s	
		Grouping. On	
		Filter. On	
Device Class	Four device clas standard.	sses can be chosen for the	IEC
	1. Press <i>More</i> menu.	from the Setup side	more
	2. Choose a <i>D</i> menu.	evice Class from the side	Device Class A
	Class	A, B, C(Table 1), C(Table C(Table3), D	e 2),
	3. For class C Power Facto	devices, choose the <i>r</i> and <i>Current</i> .	Class C Power Factor

	Pow. Fact. 0.00~1.00 Current 100mA~16.0A
	4. For class C(Table 3) and Class D devices, choose the <i>Input Power</i> . ♥ 100M
	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 <i>more</i> twice from the side menu.
Filter	2. Press <i>Filter</i> to toggle the filter time on or off for 1.5 seconds.
	Filter On, Off
Grouping	3. Press <i>Grouping</i> to toggle grouping on or off. Grouping
	Grouping On, Off

Harmonics Display options

Background	Harmonic measurements can be display screen in graph or table format. When it format, a harmonic must be chosen for i measurements.	ved on- n graph individual
Panel operation	1. Press the <i>Test</i> key.	Test
	2. Press <i>Power Analysis</i> from the bottom menu.	Power Analysis
	3. Press <i>Harmonics</i> from the side menu.	Harmonics
	4. Press <i>Display</i> from the lower menu.	Display
	5. Choose to display harmonic measurements as a graph or as a table.	Graph
	Range Table, Graph	Table
	6. Toggle between viewing <i>All</i> , <i>Odd</i> or <i>Even</i> harmonics.	All Odd Even
	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



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 <i>Test</i> key.	Test	
	2. Press <i>Power Analysis</i> from the bottom menu.	Power Analysis	

	3. Press menu.	Harn	nonics from	m the side	e	Harmonics	
	4. Press a lower	S <i>ave</i> men	<i>Meas. To</i> u.	File from	the	Save Meas. to File	
File Type	Each mea HarmXX Each file 9999. For Harm000 so on.	ach measurement that is saved is saved as farmXXXX.CSV into the designated USB file path. ach file is numbered sequentially from 0000 to 999. For example the first file will be saved as farm0000.CSV, the second as Harm0001.CSV, and o on.					
Data	The data that is saved depends on whether <i>Test to Standard</i> is set to <i>None</i> or to <i>IEC 61000-2-3</i> . Please page 20 for details.						
Example	Below shows an example of the harmonic data that is saved.						
	GW G	GW GDS-3354, serial number P930116		930116, ve	rsion V1.05		
	Harm	Harmonics					
	THD-I	F	113%				
	THD-I	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 2	300.3	47.2	102m	29	
		0 7	200.4	JJ4III ЛЛ 0	1.10111 07.5m	10.2	
		8	480.5	1.27	2.77m	2.35	

Ripple

Using Ripple Measurements

Background	ripple function allows power supply ripple to neasured with ease. The function allows omatic vertical scaling to maximize the vertical plution of the measurement by isolating the AC oponent from the DC waveform.			
	nsure safe working practices are adhered to when rorking with live voltages. Failure to do so could rad to electric shock or loss of life.			
Connection	Coad			
	Differential probe: Positive terminals.	e and negative		
Setup	With the power disconnected from the power source, connect the differential voltage probe to the positive and negative output terminals.			
	Connect the differential probe to an input channel.			
	Configure the channel with the differential probe to the following settings:			
	Probe Voltage			
	Attenuation Matching t	he probe settings		
	Coupling DC			

G≝INSTEK

Impedance Matching the probe output $(typically 1M\Omega)$

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



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



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



- 6. Choose the *Voltage* input (source) from the side menu.
 - Range CH1~4

Example

G^wINSTEK

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

Current

CH2

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 rush current ger first turned on. the first and seco	s able to quickly measure the in- nerated when a power supply is The Inrush function can measure ond peak.		
	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 prob	e: Line		
Setup	1. With the pov source, conne	ver disconnected from the power ect 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 $1M\Omega$)		

- 4. Connect and turn on the power source when all the connections have been made and configured.
- Panel operation 1. Press the Test key. Test 2. Press Power Analysis from the Power bottom menu. Analysis 3. Press Inrush Current from the side Inrush menu. Current
 - 4. The automatic measurements for inrush current appear measuring the first and second inrush current peaks. (default settings)



5. Press Define Inputs from the lower menu.

Define Inputs

CH2

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

CH1~4, Ref1~4 Range

Example



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.

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