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Digital Storage Oscilloscope

GDS-2000A Series

OPTIONS USER MANUAL

ISO-9001 CERTIFIED MANUFACTURER

GW INSTEK

July 2013

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GETTING STARTED

This chapter gives a brief overview of optional modules and software available for the GDS-2000A, how to install or uninstall any options already installed on the scope.

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GDS-2000A Options Overview

The GDS-2000A has a number of options that can be installed to increase the functionality of the base models. Some of the options are hardware only, and some of the options require both hardware modules and software to be installed. Below is a list of options available for the GDS-2000A.

GW Instek will continue to develop modules and optional software. Please see the GW Instek website or see your local distributor for further updates.

Hardware Options

Option Number	Description
DS2-LAN	Ethernet & SVGA output
DS2-GPIB	GPIB Interface
DS2-FGN	DDS Function Generator
DS2-8LA	8-Channel Logic Analyzer Card (GLA-08)with 8-Channel Logic Analyzer Probe (GTL-08LA)
DS2-16LA	16-Channel Logic Analyzer Card (GLA-16)with 16-Channel Logic Analyzer Probe (GTL-16LA)

Module Installation

Background

The GDS-2000A has a number of optional modules that can be installed into the module slots on the rear panel. These modules must be installed before power up.

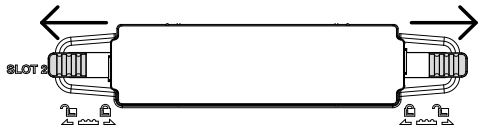
Note

The modules are not hot-swappable. Please ensure the power is off before connecting or disconnecting any of the modules from the rear panel.

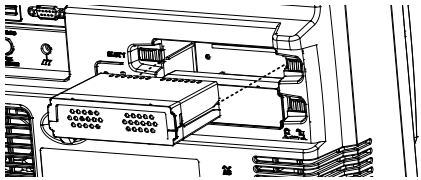
Steps

1. Make sure the power is turned off before installing any of the optional modules.

2. Slide the tabs holding the module cover to the unlock position and then remove



3. Install the optional module. Be sure to make sure that the groves on the module line-up to the slots in the module bay.



4. Slide the tabs back into the lock position.

5. Install the corresponding optional software, if any. See the next section for installation instructions.

Software Installation

Background

The GDS-2000A has optional software packages to expand the functionality of the standard GDS-2000A. Optional software may also require optional hardware modules to also be installed. An activation key is required to activate any optional software. A different activation key is required for each optional software package.

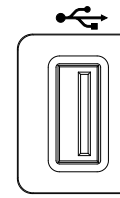
For the latest files and information regarding the optional software packages, see the GW Instek website: www.gwinstek.com or contact your nearest distributor.

Steps

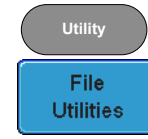
1. Install any hardware modules if needed. See page 6 for installation details.

Panel Operation

2. Insert the USB serial key for the desired option into the front panel USB A port.

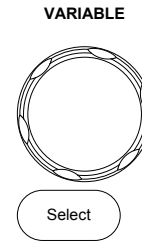


3. Press the *Utility* key then the *File Utilities* soft-key.



4. Navigate to the desired file in the USB file path.

   When the desired installation file has been found, press the *Select* key to start the installation.



5. The installation will complete in a few seconds. When finished a pop-up message will appear asking you to restart the GDS-2000A.

6. Restart the GDS-2000A.

Uninstalling Optional Software

Background

Optional software packages such as the Search function can be uninstalled from the system menu.

Panel Operation

1. Press the *Utility* key.

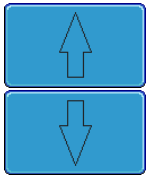
2. Press *System* from the bottom menu.

3. Press more *1 of 2* from the side menu.

4. Press *Option Uninstall* on the side menu.

5. Select the optional software packages that you wish to uninstall from the side menu.

6. Use the *Up* and *Down* arrows on the side menu to select an option to uninstall.



7. Press *Uninstall* to uninstall the option.

QUICK REFERENCE

This chapter describes the menu tree for the option software.

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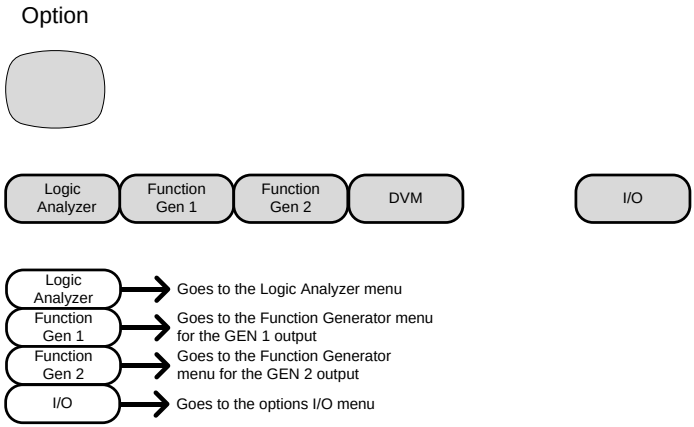
Trigger - Bus 13
Trigger - Logic 14
Bus 14
Bus - UART 15
Bus – I²C 16
Bus – SPI 17
Bus – Parallel 18

Options Menu Tree

Option Key

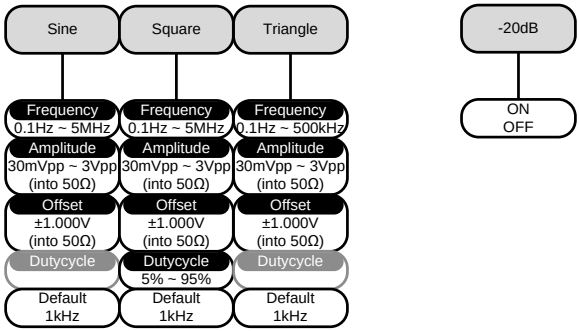
Accesses the functions in the Option menu.



*Note: Any option that is not installed will be grayed-out.

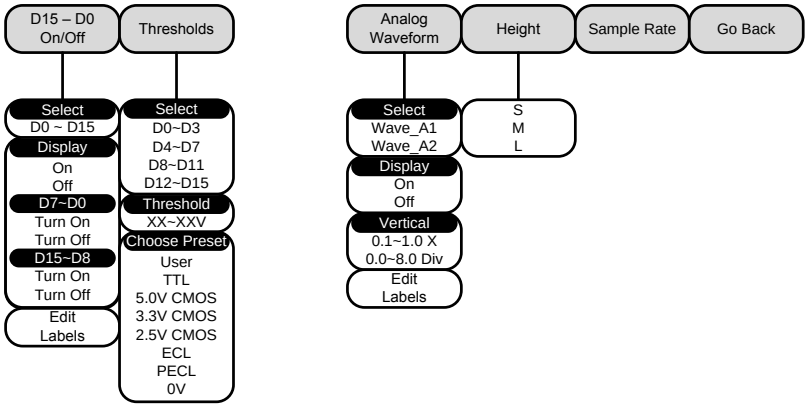
Function Generator

Setup the Function Generator output.



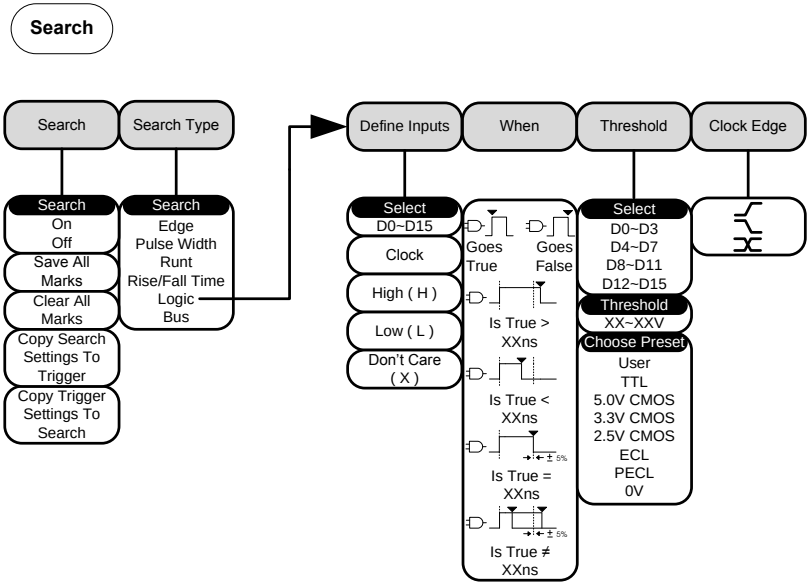
Logic Analyzer

Setup the Logic Analyzer inputs.



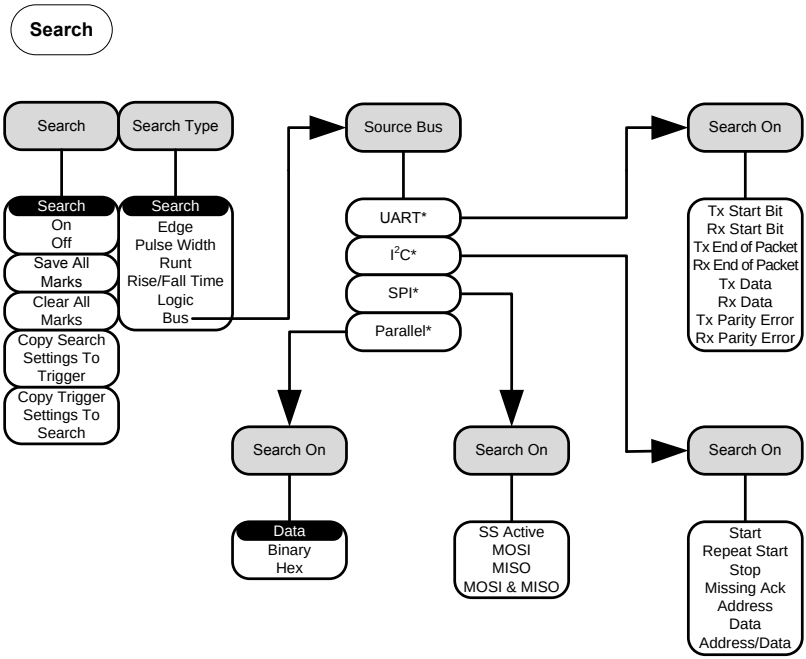
Search - Logic

Set the Search function for logic events.



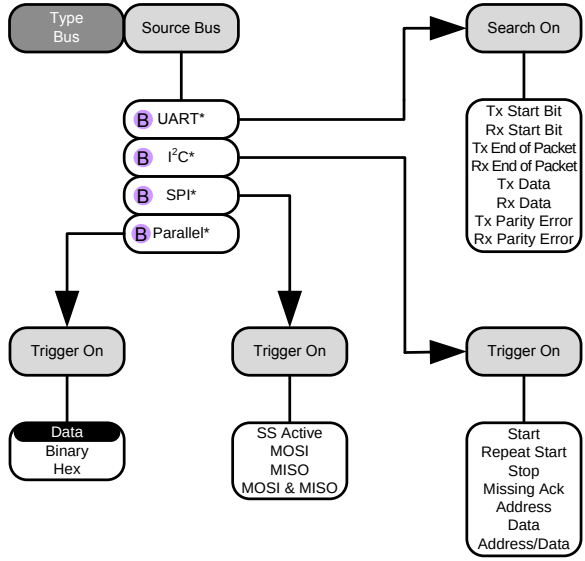
Search - Bus

Set the Search function for bus events.
Note: The source bus is determined from the bus trigger settings.



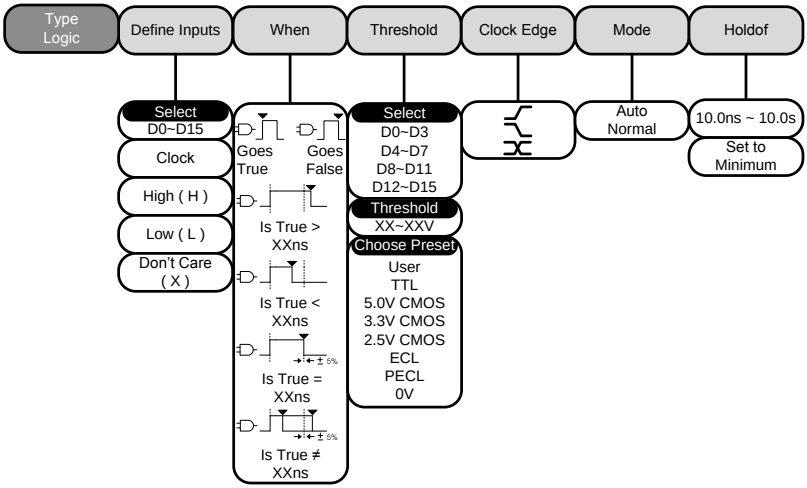
*The source bus is determined from the bus trigger settings.

Trigger - Bus



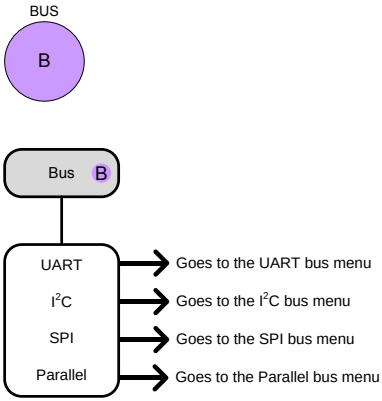
*The source bus is set in the bus menu.

Trigger - Logic

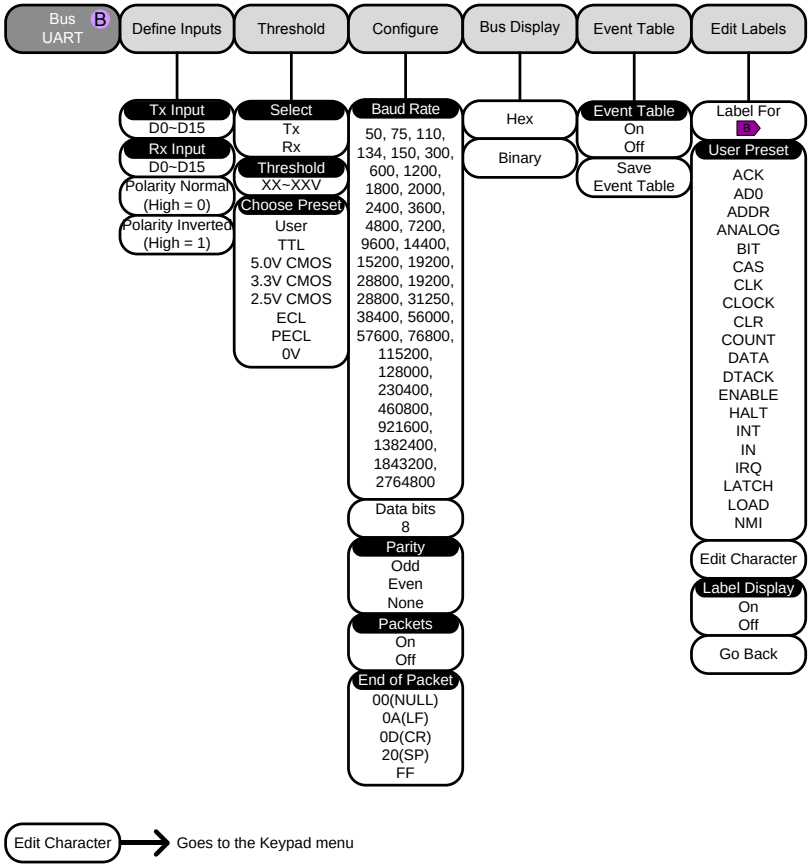


*The source bus is determined from the bus menu.

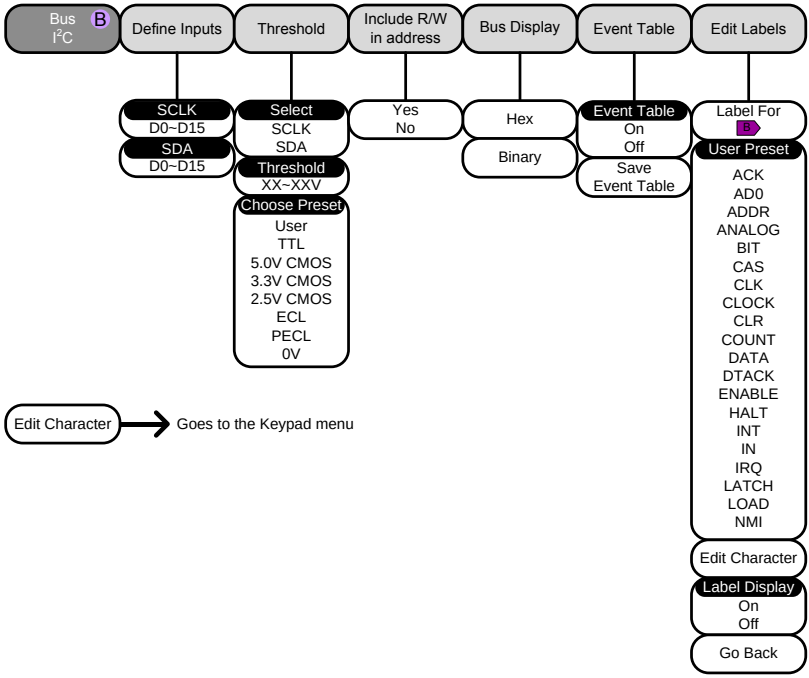
Bus



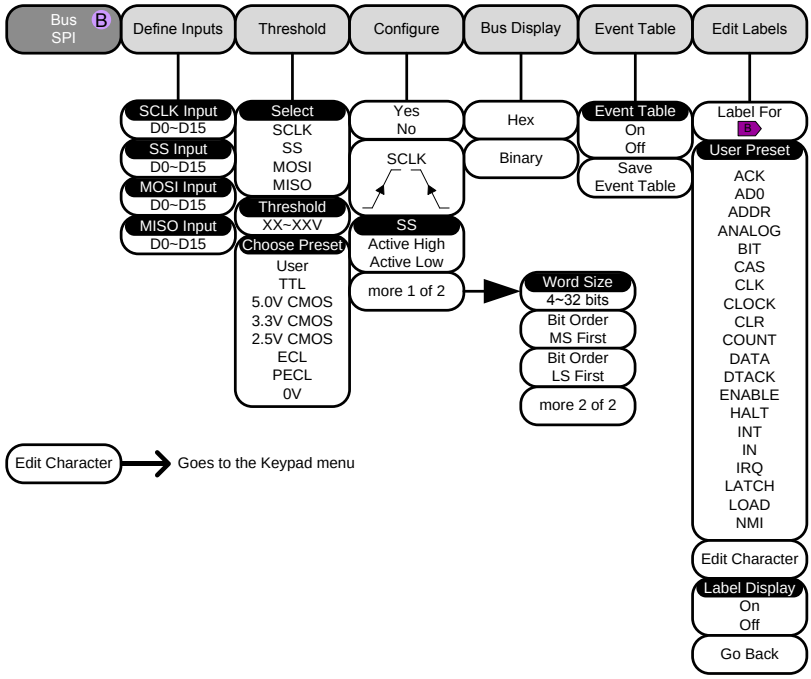
Bus - UART


Bus B UART
Define Inputs
Threshold
Configure
Bus Display
Event Table
Edit Labels
Tx Input
D0~D15
Rx Input
D0~D15
Polarity Normal (High = 0)
Polarity Inverted (High = 1)
Select
Tx
Rx
Threshold
XX~XXV
Choose Preset
User
TTL
5.0V CMOS
3.3V CMOS
2.5V CMOS
ECL
PECL
0V
Baud Rate
50, 75, 110, 134, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 15200, 19200, 28800, 19200, 28800, 31250, 38400, 56000, 57600, 76800, 115200, 128000, 230400, 460800, 921600, 1382400, 1843200, 2764800
Data bits
8
Parity
Odd
Even
None
Packets
On
Off
End of Packet
00(NULL)
0A(LF)
0D(CR)
20(SP)
FF
Hex
Binary
Event Table
On
Off
Save Event Table
Label For B
User Preset
ACK
AD0
ADDR
ANALOG
BIT
CAS
CLK
CLOCK
CLR
COUNT
DATA
DTACK
ENABLE
HALT
INT
IN
IRQ
LATCH
LOAD
NMI
Edit Character
Label Display
On
Off
Go Back
Edit Character
Goes to the Keypad menu

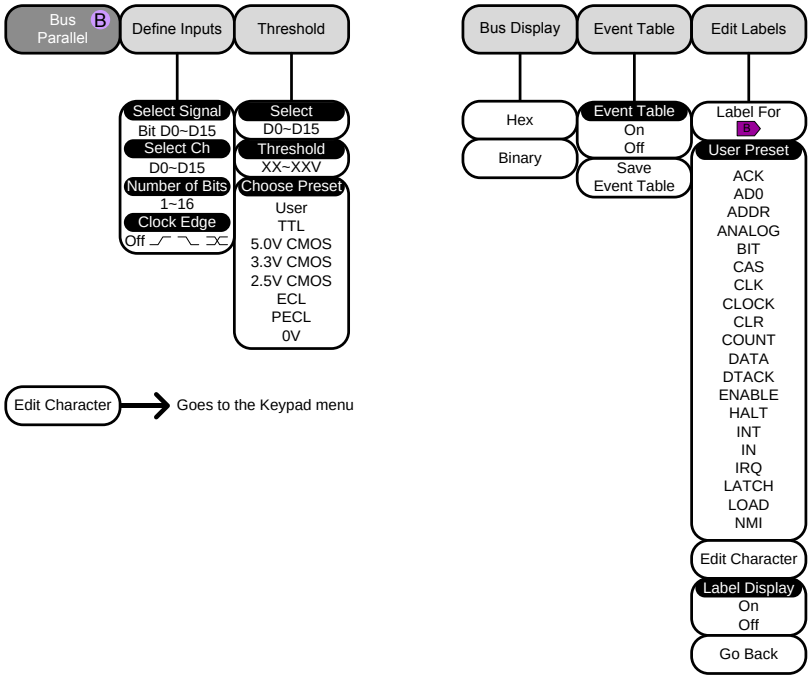
Bus – I^2C


Bus I²C B
Define Inputs
Threshold
Include R/W in address
Bus Display
Event Table
Edit Labels
SCLK
D0~D15
SDA
D0~D15
Select
SCLK
SDA
Threshold
XX~XXV
Choose Preset
User
TTL
5.0V CMOS
3.3V CMOS
2.5V CMOS
ECL
PECL
0V
Yes
No
Hex
Binary
Event Table
On
Off
Save Event Table
Label For
B
User Preset
ACK
AD0
ADDR
ANALOG
BIT
CAS
CLK
CLOCK
CLR
COUNT
DATA
DTACK
ENABLE
HALT
INT
IN
IRQ
LATCH
LOAD
NMI
Edit Character
Label Display
On
Off
Go Back
Edit Character
Goes to the Keypad menu

Bus – SPI


Bus B
SPI
Define Inputs
Threshold
Configure
Bus Display
Event Table
Edit Labels
SCLK Input
D0~D15
SS Input
D0~D15
MOSI Input
D0~D15
MISO Input
D0~D15
Select
SCLK
SS
MOSI
MISO
Threshold
XX~XXV
Choose Preset
User
TTL
5.0V CMOS
3.3V CMOS
2.5V CMOS
ECL
PECL
0V
Yes
No
SCLK
SS
Active High
Active Low
more 1 of 2
Word Size
4~32 bits
Bit Order
MS First
Bit Order
LS First
more 2 of 2
Hex
Binary
Event Table
On
Off
Save
Event Table
Label For
B
User Preset
ACK
AD0
ADDR
ANALOG
BIT
CAS
CLK
CLOCK
CLR
COUNT
DATA
DTACK
ENABLE
HALT
INT
IN
IRQ
LATCH
LOAD
NMI
Edit Character
Label Display
On
Off
Go Back
Edit Character
Goes to the Keypad menu

Bus – Parallel



FUNCTION GENERATOR

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Function Generator Operation

Overview

Background	The DDS Function Generator module allows the GDS-2000A to create basic sine, square and triangle waveforms.
⚠ Note	The function generator option can only be used with firmware version 1.13 or later. However it is highly recommended that firmware version V1.16 or later be installed to access the full functionality of the module. The instructions on the following pages are based on V1.16 or later. Please see the GW Instek website for the latest firmware and the firmware installation procedure.

Function Generator Specifications

Waveforms	Sine, Square, Triangle
Frequency range	0.1Hz ~ 5MHz for sine 0.1Hz ~ 5MHz for square 0.1Hz ~ 500KHz for triangle
Frequency Stability	±50ppm
Frequency Accuracy	±50ppm (± 0.25Hz)
Aging	±5ppm/Year
Amplitude Range	60mVpp ~ 6Vpp (into 1MΩ) 30mVpp ~ 3Vpp (into 50Ω)
Amplitude Accuracy	±10%
Attenuator	-20dB
Impedance	50Ω
DC Offset	±2V (into 1MΩ) ±1V (into 50Ω)
Duty Control Range	5%(min) ~ 95%(max) (Square wave only)
Rise or Fall Time	≤15ns (Square wave only)

Using the Function Generator Option

Background

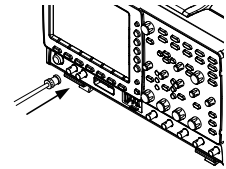
This section will describe how to use the function generator modules. To use the function generator option, the DS2-FGN function generator module must be installed. Please see page 6 for installation details.

Note

The GDS-2000A can have two function generator modules installed at the same time. Operating the CDS-2000A using one or two function generator modules is the same.

Connection

1. The function generator signal is output from the GEN 1 or GEN 2 outputs on the front panel. If the function generator module is installed in slot one, then the signal is output from GEN 1, and if the function generator is installed in slot two, then the signal is output from GEN 2.
2. Connect a BNC cable to the appropriate output (GEN 1 or GEN 2).

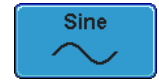


Panel Operation

1. Press the *Option* key.

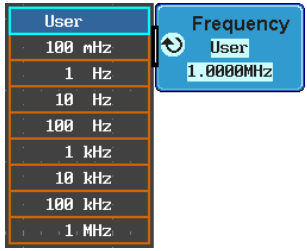
2. Press *Function Gen 1* or *Function Gen 2* from the bottom menu.

3. Select *Sine*, *Square* or *Triangle* from the bottom menu.



4. Press *Frequency* from the side menu.

   Use the Variable knob to highlight either *User* or a preset frequency base unit.



   The frequency can now be adjusted using fine adjustment or coarse adjustment:

Range	100mHz ~ 5MHz (500kHz for triangle)

COARSE ADJUSTMENT:

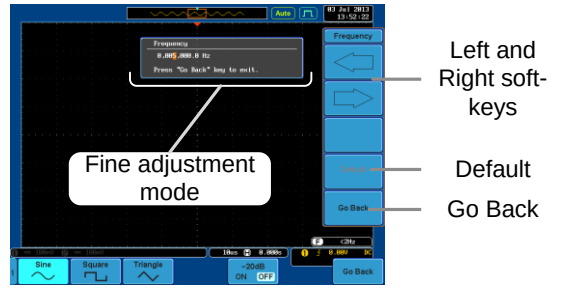
Press the *Frequency* soft-key again to reduce the frequency menu.

- Use the *Variable* knob to adjust the frequency at the selected base unit.
- The adjusted frequency will automatically be saved to the *User* variable.

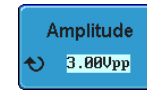
FINE ADJUSTMENT:

Press the *Select* key. The frequency can now be adjusted one digit at a time.

- Use the *Left* and *Right* soft-keys to select a digit.
- Use the *Variable* knob to adjust the digit.
- Pressing the *Default* soft-key will return the frequency back to the default base unit. (not available for the *User* variable)
- Press *Go Back* when you have finished editing the frequency.
- The adjusted frequency will automatically be saved to the *User* variable.



5. Press the *Amplitude* key to set the amplitude.



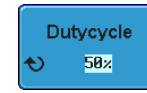
Range 300mVpp ~ 3Vpp (into 50Ω load)*.

*range depends on attenuation settings.

6. Press the *Offset* key to set the DC offset.

Range ±1.000V (into 50Ω load).

7. Press *DutyCycle* (Square wave only) to set the duty cycle.



Range 5% to 95%.

8. Press *-20dB* to attenuate the output by 20dB.

Range ON, OFF

9. The signal will be output immediately from the GEN 1 or GEN 2 outputs.

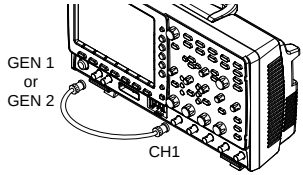
Function Generator Calibration

Background

The function generator module can also be calibrated from the System menu. The calibration function is only available for firmware version V1.16 or later.

Connection

Connect the GEN 1 or GEN 2 output (depending on which module slot the function generator is installed in) to CH1 using a BNC cable.



Note

If two function generator modules are installed, the system will automatically choose to calibrate the function generator in module slot 1. If you wish to calibrate the second function generator, first select it from the Option menu (*Option* key > *Function Gen 2*).

Panel Operation

1. Press the *Utility* key.

2. Press *System* from the bottom menu.

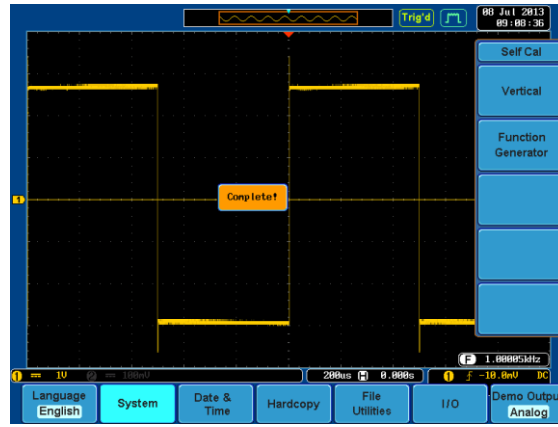
3. Press *More 1 of 2* from the side menu.

4. Press *Self CAL* from the side menu.

5. Press *Function Generator* from the side menu.

Wait a few moments for the calibration to finish. "Complete" will be displayed on the screen when the calibration has completed.

- If the calibration fails, please check the connection and perform the calibration procedure again.



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Logic Analyzer Operation

Overview

Background	The Logic Analyzer inputs can only be used when a Logic Analyzer option is installed (GW Instek part no. DS2-8LA or DS2-16LA). Both the 8-chanel and 16-channel models have a sample rate of 500MSa/s with bandwidth of 200MHz. The logic analyzer inputs can be used to measure discrete inputs or can be used to measure values on a parallel or serial bus.

Supported Logic Thresholds	TTL, CMOS, ECL, PELC, User- defined	The GDS-2000A supports common logic thresholds and supports user-defined thresholds of ± 10V if the in-built threshold levels are unsuitable.
Digital Trigger Types	Edge, Pulse Width, Rise and Fall, Bus, Logic	As standard, the digital channels support basic edge, pulse width, rise and fall as well as bus and logic triggers.

Using the Logic Analyzer Probes

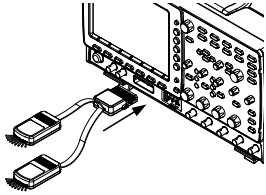
Background

This section will describe how to connect the digital channels to the device under test. To use the digital channels the optional logic analyzer module must be installed. Please see page 6 to install the logic analyzer module.

Connection

1. Turn the DUT off to protect it from being short circuited when the probes are attached.

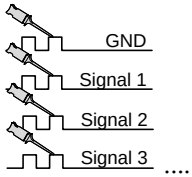
2. Insert the Logic Analyzer probe into the Logic Analyzer input.



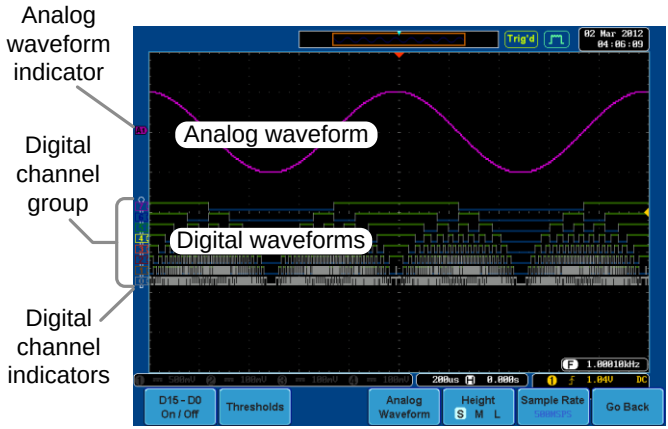
3. Connect the ground lead from the logic analyzer probe to the circuit ground on the DUT.

4. Connect another probe lead to a point of interest on the circuit. Make note of which probe lead is connected to which point.

5. Repeat step 3 with any remaining probes.



Digital Display Overview



Analog Waveform Indicator — Used to show the position of the analog waveform outputs.

A1 Active analog waveform

A1 Activated analog waveform

Digital Channel Indicators — Used to show the position and grouping of the digital channels.

7 Active digital channel

7 Activated digital channel

Digital Channel Group

When digital channels are grouped together, they are shown as being pinned together. When grouped, digital channels can moved as a single group.

Activating Digital Channels

The digital channels can be initially turned on in groups of 8 or individually.

Activate Digital Channels as a Group

Background

The digital channels can be turned on or off in groups of eight, D0~D7 and D8~D15.

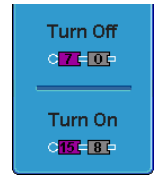
Panel Operation

6. Press the *Option* key.

7. Press *Logic Analyzer* from the bottom menu.

8. Press D15 – D0 On/Off key.

9. Select which group of digital inputs you want turned on or off from the side menu.



Group1	D0~D7
Group2	D8~D15

10. The digital channels will appear on the graticule.

Note

When all the digital channels are turned on, they will appear as a single group.

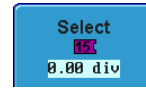
Activate Individual Channels

Background

Each digital channel or group can be turned on or off individually.

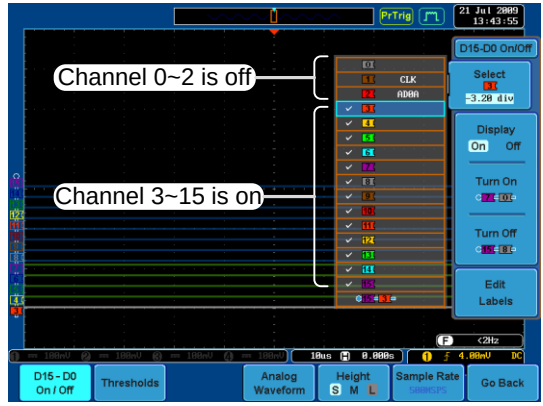
Panel Operation

1. Press the *Select* soft-key.



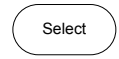
2. Use the variable knob to highlight a channel or a group.

3. A 'tick' next to a particular channel or group indicates that that channel or group is currently on.



4. Press the *Display* soft-key or the *Select* key to toggle the selected channel or group on or off.

or



5. Press the *Select* soft-key again to reduce the menu.

Note

Channels can also be selected just by turning the variable knob when the mode is set to LA move mode. In this mode the selected channel or group will be shown on the Select soft-key. However this method will only show those channels/groups that have already been turned on. See page 33 for details.

Moving the Digital Channels or Creating Digital Channel Groups

Note

The digital channels must first be activated. See page 31.

Background

The logic analyzer has two basic modes of operation for selecting or moving digital channels.

LA Select mode: This mode is used to select digital channels that have already been activated.

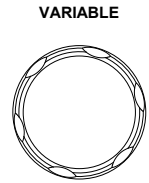
LA Move mode: This mode is used to move the vertical position of the digital channels and to group digital channels into groups.

The Select key is used to toggle between both modes when in the *D15~D0 On/Off* menu.

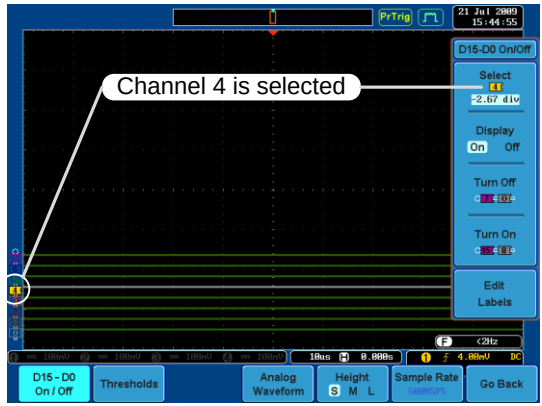
Panel Operation

1. Press the D15~D0 On/Off key. The scope will initially be in 'LA Select mode'.

2. Use the variable knob to choose a channel or group. The selected channel/group will be shown on the Select key. Only channels that have been activated can be selected this way.

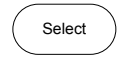


Below, channel 4 is selected.



Note: If the Variable knob cannot select a channel, press the Select key to toggle the scope into 'LA Select mode'.

3. Press the *Select* key. The mode toggles from 'LA Select mode' to 'LA Move mode'.



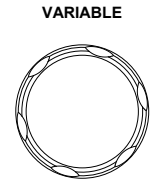
A message will indicate which mode is currently active.

The Move mode is used to move the digital channel position on the graticule as well as to group the channels. If you turned on all the digital channels, you will notice that they are already grouped as a single group.

You can tell when it is in move mode as the selected channel/group flashes and the labels for the other channels/groups become grayed out.

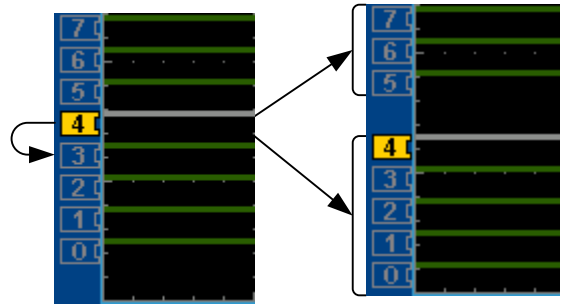
Channel 4 is in the 'Move' mode and the labels for the other channels are grayed out

4. Use the variable knob to position the selected channel/group:

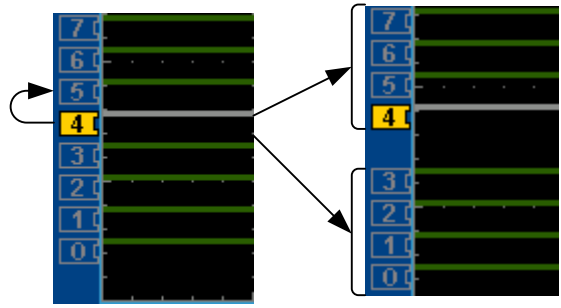


If you position the channel indicator over the next/previous channel, it will split the group into 2.

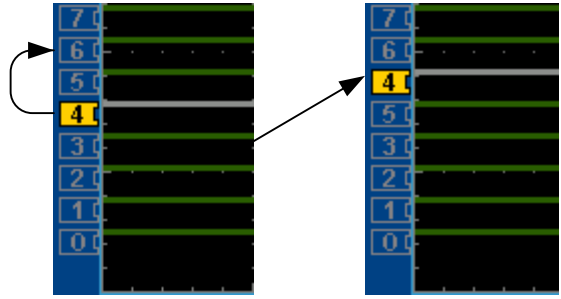
Split the group above the selected channel:



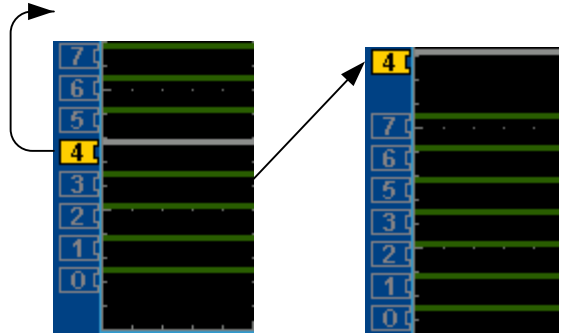
Split the group below the selected channel:



If you continue to move the channel indicator past the next/previous channel, it will move the indicator anywhere within that group.



5. If you move the indicator *outside* of the group, it will remove the selected channel from the group.



6. Press the *Select* key again. This will return you to the LA Select mode.

You can tell when it is in the Select mode as no channel will be grayed out.

Digital Channel Vertical Scale

Background	The digital channels have 3 preset scales, S, M, L.
Panel Operation	1. From the *D15~D0 On/Off* menu, press *Height* to toggle the vertical scale of the digital channels. Height S, M, L

Note If more than 8 digital channels are active, the large (L) option will be disabled.

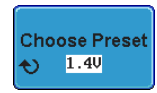
Digital Channel Threshold Levels

Note Threshold levels can be set to four groups of digital channels: D0~D3, D4~7, D8~D11 and D12~D15. Each group can have a different threshold level.

The GDS-2000A has 4 preset threshold levels and a user-defined threshold. A user-defined threshold level can be set for each group. Any signal over the threshold level corresponds to a high (1), any signal under the threshold level is a low (0).

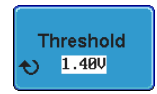
Panel Operation	1. From the D15~D0 On/Off menu, press the *Thresholds* soft-key.
	2. Press *Select* from the side menu and choose a group of channels.

3. Press *Choose Preset* to select a preset logic threshold.



Logic Type	Threshold
TTL	1.4V
5.0V CMOS	2.5V
3.3V CMOS	1.65V
2.5V CMOS	1.25V
ECL	-1.3V
PECL	3.7V
0V	0V

4. Press *Threshold* to set a user defined threshold for the currently selected group.



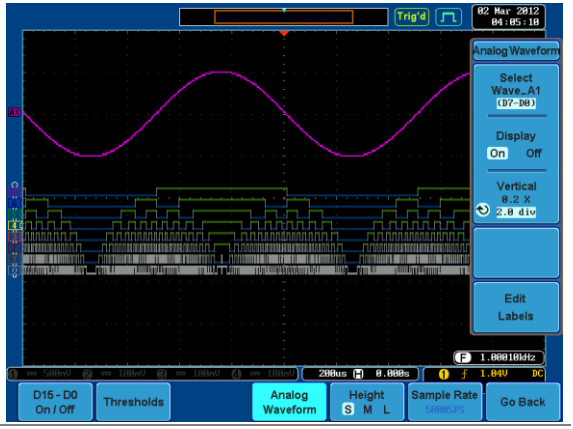
Range	±10V

Analog Waveform

Background

The analog waveform function combines the digital channel inputs into two 8-bit analog waveforms. The analog waveforms are created from the digital channel groups D0~7 and D8~15.

Example



Panel Operation

1. Press the *Option* key.

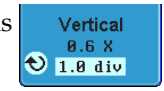
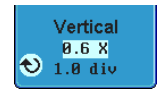
Option

2. Press the Analog Waveform key.

3. Press *Select* and select which analog waveform you which to display, Wave_A1 (D7~D0) or Wave_A2 (D15~D8).

Display on Screen

4. Press *Display* to display the selected waveforms on the screen.

Set Vertical Position	5. Press *Vertical* until div parameter is highlighted. Use the *Variable* knob to set the position.	
Set Vertical Scale	6. Press Vertical until *X* scale parameter is highlighted. Use the *Variable* knob to set the scale.	
Edit Labels	7. Press Edit Labels to edit the label for the currently selected analog waveform. See page 41 for details.	

⚠ Note — Only one analog waveform can be displayed at a time.

Adding Labels to Digital Channels

Background	Digital labels can be added to each digital channel or to one of the analog waveforms.

Panel Operation

1. To edit labels for the digital channels, press the *Edit Labels* soft-key from the D15~D0 On/Off menu.

   To edit labels for the analog waveforms, press the *Edit Labels* soft-key from the *Analog Waveform* menu.

2. Press *Label For* and select a channel or waveform.

Label For	D0~D15
	A1, A2

3. To choose a preset label, Press *User Preset* from the side menu and choose a label.

Labels ACK, AD0, ADDR, ANALOG, BIT, CAS, CLK, CLOCK, CLR, COUNT, DATA, DTACK, ENABLE, HALT, INT, IN, IRQ, LATCH, LOAD, NMI

Edit Label

4. Press *Edit Character* to edit the current label.

5. The Edit Label window appears.

6. Use the Variable knob to highlight a character.

Press *Enter Character* to select a number or letter.

Enter Character

Press *Back Space* to delete a character.

Back Space

Press *Editing Completed* to create the new label and return to the previous menu.
Note: this key must be pressed to create a label, even for a preset label.

Editing Completed

Press *Cancel* to cancel the editing and return to the Edit Label menu.

Cancel

7. The label will appear next to corresponding channel indicator.

   Below, the label "LABEL_1" was created for the D0 channel.

D0 is labeled as LABEL_1

Remove Label

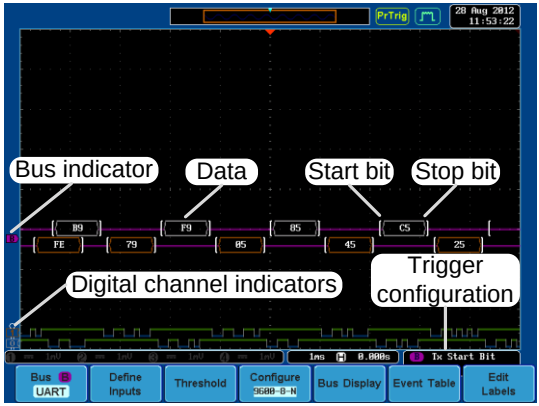
Press *Label Display* to toggle the selected label on or off.

Label Display On Off

Bus Key Configuration

The Bus key is used to configure the Parallel and Serial bus inputs. The Bus menu also features an event tables to track and save your bus data.

Bus Display



Start Bit [The Start bit is shown as a open bracket (Serial bus data only).

Stop Bit] The Stop bit is shown as an closed bracket (Serial bus data only).

Data F9 Data packets can be shown in Hex or Binary. The color of the packet is the same as the channel color.

Error Indicator If there is an error in decoding the serial data, an error indicator will be shown.

Bus Indicator The Bus indicator shows the bus position. The active bus is shown with a solid color. The Variable knob can be used to horizontally position the Bus indicator when it is active.

B Active bus (solid indicator)

B Activated bus (transparent indicator)

Trigger Configuration

Shows the bus trigger (B) and the *Trigger On* settings.

Parallel Bus

Input Configuration

Background

The digital channels can be configured as a parallel bus. The number of bits that define the bus as well as which bit is used as the bus clock can also be configured.

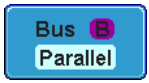
Note

The trigger should also be set to parallel bus. Please see page 74 for details.

Panel Operation

1. Press the *Bus* key.

2. Press the *Bus* soft-key and select Parallel from the side menu.



3. Press *Define Inputs* from the bottom menu.

4. Press *Number of Bits* from the side menu and select the number of bits for the data bus.

   By default the bus is assigned bits D0, D1, D2 and so on up to the last bit.

5. You may also assign a bit as a clock. This bit will be one of the bits in the bus. To add a clock bit, press *Clock Edge* and select type of clock edge. Selecting *Off* will disable the clock bit.

6. If you wish to define which channels are assigned to the bus, press *Select Signal* from the side menu and select the bit that wish to assign.

7. Next, press *Select Ch* and select which channel is assigned to the bit selected above.

8. Repeat steps 6 and 7 for any remaining bits and for the clock, if enabled.

Threshold Configuration

Background

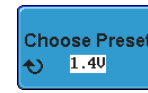
The threshold levels for the parallel bus can be set to either a user-defined threshold level or to pre-set threshold.

Operation

1. Press *Thresholds* from the bottom menu.

2. Press *Select* from the side menu and select a digital channel.

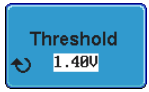
3. Press *Choose Preset* to select a pre-set logic threshold for the selected channel.



Logic Type	Threshold
TTL	1.4V
5.0V CMOS	2.5V

3.3V CMOS	1.65V
2.5V CMOS	1.25V
ECL	-1.3V
PECL	3.7V
0V	0V

4. Press *Threshold* to set a user defined threshold for the selected input.



Range	±10V

Note

Setting the threshold levels from the Bus menu will also change the threshold levels set in the Logic Analyzer menu (page 38).

Bus Encoding

Background

The bus that is displayed on the screen or in the event tables can be set to either hex or binary formats.

Operation

Press *Bus Display* from the Bus menu and choose either Hex or Binary from the side menu.

Parallel Bus Event Table

Event Table

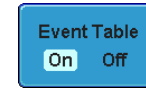
The parallel bus event table lists when each data event on the bus occurred. The data is displayed as either hex or binary, depending on the bus display settings.

Event tables can be saved to disk in a CSV format. The files will be named "Event_TableXXXX.CSV", where XXXX is a number from 0000 to 9999. See page 64 for details.

Operation

1. Press Event Table from the bottom menu.

2. Press Event Table from the side menu to turn the event table on or off.



Event	On, Off

3. To save the event table, press *Save Event Table*.

Use the variable knob to scroll through the event table.

Example

Adding a Label to the Parallel Bus

Background — A label can be added to the parallel bus.

Panel Operation

1. To add a label to the bus, press Edit Labels from the Parallel Bus menu.

2. To choose a preset label, Press *User Preset* from the side menu and choose a label.

Labels — ACK, AD0, ADDR, ANALOG, BIT, CAS, CLK, CLOCK, CLR, COUNT, DATA, DTACK, ENABLE, HALT, INT, IN, IRQ, LATCH, LOAD, NMI

Edit Label

3. Press *Edit Character* to edit the current label.

4. The Edit Label window appears.

5. Use the Variable knob to highlight a character.

Press *Enter Character* to select a number or letter.

Enter Character

Press *Back Space* to delete a character.

Back Space

Press *Editing Completed* to create the new label and return to the previous menu.
Note: this key must be pressed to save the label, even for the preset labels.

Editing Completed

Press *Cancel* to cancel the editing and return to the Edit Label menu.

6. The label will appear next to the bus indicator.

   Below, the label "BUS_1" was created for the parallel bus.

Remove Label

Press *Label Display* to toggle the label on or off.

Serial Bus

The Serial Bus for Logic Analyzer software includes support for 3 common serial interfaces, SPI, UART and I²C. Each interface is fully configurable to accommodate variations in the basic protocols.

Each input can be displayed as binary or hexadecimal. An event table can also be created to aid in debugging.

Serial Bus Overview

UART	Universal Asynchronous Receiver Transmitter. The UART bus is able to accommodate a wide range of various common UART serial communications. The UART serial bus software is suitable for a number of RS-232 protocol variants.	
	Inputs	Tx, Rx
	Threshold	Tx, Rx
	Configuration	Baud rate, Parity, Packets, End of packets, Input polarity
	Trigger On	Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, Rx Parity Error
I²C	Inter Integrated Circuit is a two line serial data interface with a serial data line (SDA) and serial clock line (SCLK). The R/W bit can be configured.	
	Inputs	SCLK, SDA
	Threshold	SCLK, SDA
	Configuration	Addressing mode, Read/Write in address
	Trigger On	Start, Repeat Start, Stop, Missing Ack, Address, Data, Address/Data

SPI	The SPI (Serial Interface Peripheral) bus is fully configurable to accommodate the wide variety of SPI interfaces. This bus is only available on 4 channel models.	
	Inputs	SCLK, SS, MOSI, MISO
	Threshold	SCLK, SS, MOSI, MISO
	Configuration	SCLK edge, SS logic level, Word size, Bit order
	Trigger On	SS Active, MOSI, MISO, MOSI&MISO

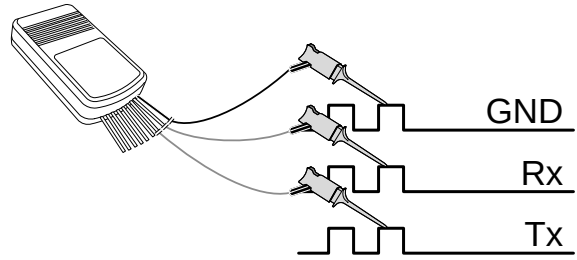
UART Serial Bus Configuration

The UART bus menu is designed to decode RS-232 and other common RS-232 variants such as RS-422, RS-485. The software configuration is also flexible enough to decode the many proprietary protocols based on RS-232.

Background	Basic RS-232 protocol uses single-ended data transmissions. The signal voltage levels can be high (±15V)* and employ active low signaling. High speed variants of RS-232, such as RS-422 and RS-485 use differential signaling and commonly employ low voltage differential signals with active high signaling. Universal Asynchronous Receiver / Transmitter (UART) or RS-232 driver/receiver ICs commonly used for embedded applications typically use active high signaling with standard IC signal levels. *Note: the GDS-2000A does not support ±15V signaling for the Logic Analyzer inputs)

Operation

1. Connect each of the bus signals (*Tx*, *Rx*) to one of the logic analyzer inputs. Connect the ground potential of the bus to the logic analyzer's ground probe line.



2. Press the *Bus* key.

3. Press *Bus* from the bottom menu and choose the *UART* serial bus on the side menu.

Define Inputs

4. Press *Define Inputs* from the bottom menu.

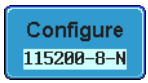
5. From the side menu choose the *Tx Input* and the *Rx Input* source and the signal polarity.

Tx	OFF, D15~D0
Rx	OFF, D15~D0
Polarity	Normal (High = 0), Inverted (High = 1)

Configuration

The Configure key sets the baud rate, number of data bits and parity.

1. Press *Configure* from the bottom menu.



2. From the side menu select the *Baud rate*, *Data bits*, *Parity*, *Packets* and *End of Packet bits*.

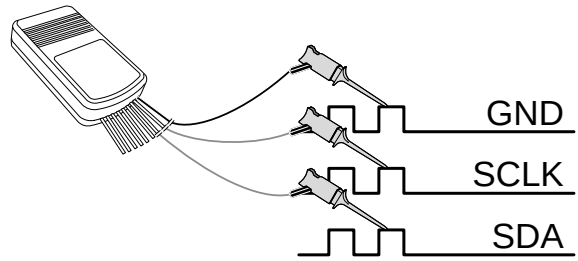
Baud Rate	50, 75, 110, 134, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 15200, 19200, 28800, 31250, 38400, 56000, 57600, 76800, 115200, 128000, 230400, 460800, 921600, 1382400, 1843200, 2764800
Data Bits	8 (fixed)
Parity	Odd, Even, None
Packets	On, Off
End of Packet (Hex)	00(NUL), OA(LF), OD(CR), 20(SP), FF

I²C Serial Bus Interface

The I²C bus is a 2 wire interface with a serial data line (SDA) and serial clock line (SCLK). The I²C protocol supports 7 or 10 bit addressing and multiple masters. The decode software will trigger on any of the following conditions: a start/stop condition, a restart, a missing acknowledge message, Address, Data or Address&Data frames. The I²C trigger can be configured for 7 or 10 bit addressing with the option to ignore the R/W bit as well as triggering on a data value or a specific address and direction (read or write or both).

Panel operation

1. Connect each of the bus signals (*SCLK*, *SDA*) to one of the logic analyzer inputs. Connect the ground potential of the bus to the logic analyzer's ground probe line.



2. Press the *Bus* key.

3. Press *Bus* from the bottom menu and choose *I²C* from the side menu.

Define Inputs

4. Press *Define Inputs* from the bottom menu.

5. From the side menu choose the *SCLK* input and the *SDA* Input.

SCLK	D15~D0
SDA	D15~D0

Include R/W in address

To configure whether you want the R/W bit to be included in the address, press *Include R/W in address* and set to Yes or No in the side menu.

R/W Bit	Yes, No

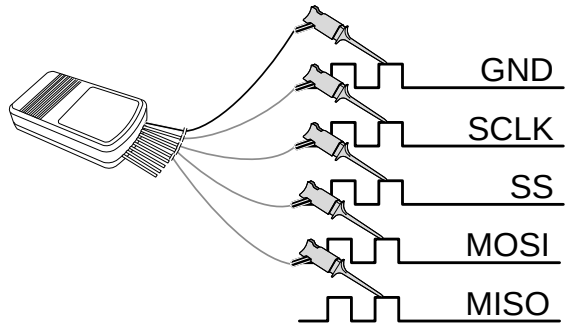
SPI Serial Bus Interface

The serial peripheral interface (SPI) is a full duplex 4 wire synchronous serial interface. The 4 signals lines: Serial clock line (SCLK), slave select (SS), Master output/slave input (MOSI, or

SIMO) and the Master input/slave output (MISO, or SOMI). The word size is configurable from 4 to 32 bits. The SPI triggers on the data pattern at the start of each framing period.

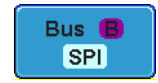
Panel operation

1. Connect each of the bus signals (*SCLK*, *SS*, *MOSI*, *MISO*) to one of the logic analyzer inputs. Connect the ground potential of the bus to the logic analyzer's ground probe line.



2. Press the *Bus* key.

3. Press *Bus* from the bottom menu and choose the *SPI* serial bus.



Define Inputs

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

5. From the side menu choose the *SCLK*, *SS*, *MOSI* and *MISO* inputs.

SCLK	D15~D0
SS	D15~D0
MOSI	OFF, D15~D0
MISO	OFF, D15~D0

Configuration

The *Configure* menu sets the data line logic level, SCLK edge polarity, word size and bit order.

1. Press *Configure* from the bottom menu.

2. From the side menu select SCLK edge, SS logic level, word Size and Bit order.

SCLK	rising edge, falling edge
SS	Active High, Active Low
Word Size	4 ~ 32 bits
Bit Order	MS First, LS First

Bus Encoding

Background

The bus that is displayed on the screen or in the event tables can be set to either hex or binary formats.

Operation

Press *Bus Display* from the Bus menu and choose either Hex or Binary from the side menu.

Threshold Configuration

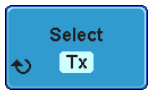
Background

The threshold levels for the Serial buses can be set to either a user-defined threshold level or to pre-set threshold.

Set the Threshold

1. Press *Threshold* from the bottom menu.

2. Press *Select* from the side menu and choose a one of the serial bus lines.



UART	Tx, Rx
I^2C	SCLK, SDA
SPI	SCLK, SS, MOSI, MOSI

3. Press *Choose Preset* to select a preset logic threshold.

Logic Type	Threshold
TTL	1.4V
5.0V CMOS	2.5V
3.3V CMOS	1.65V
2.5V CMOS	1.25V
ECL	-1.3V
PECL	3.7V
0V	0V

4. Press *Threshold* to set a user defined threshold for the currently selected group.

Range	± 10V

Note

Setting the threshold levels from the Bus menu will also change the threshold levels set in the Logic Analyzer menu (page 38).

Serial Bus Event Tables

Background

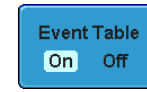
The serial bus event tables list when each data event on the bus occurred. The data is displayed as either hex or binary, depending on the bus display settings.

Event tables can be saved to disk in a CSV format. The files will be named "Event_TableXXXX.CSV", where XXXX is a number from 0000 to 9999. See page 64 for details.

Operation

1. Press *Event Table* from the bottom menu.

2. Press *Event Table* from the side menu to turn the event table on or off.



Event	On, Off

Use the Variable knob to scroll through the event table.

Data Detail (I²C only)

3. To view the data at a particular address in more detail, turn *Data Detail* On. This is only available for the I²C bus.

Detail	On, Off

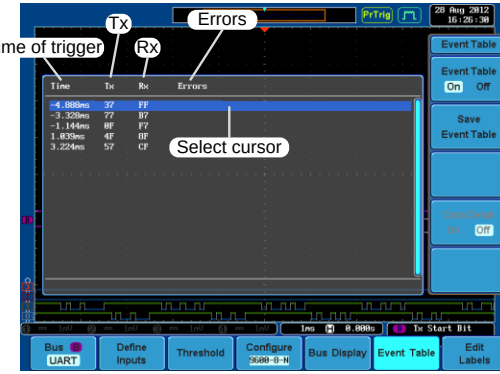
Use the Variable knob to scroll through the Data Detail event table.

Save Event Table

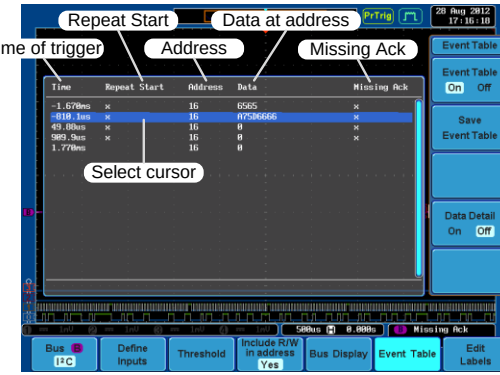
4. To save the event table, press *Save Event Table*. The Event table will be saved to the current file path in a CSV format. See page 64 for details.

Use the variable knob to scroll through the event table.

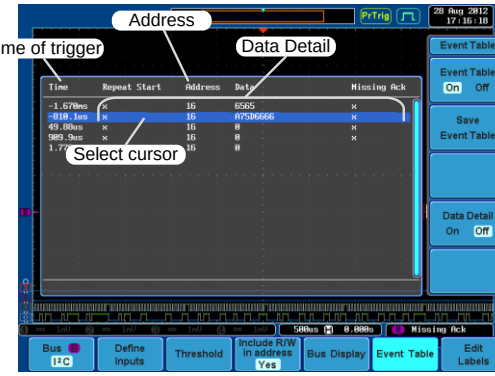
Example:
UART Event table



Example:
I²C Event table

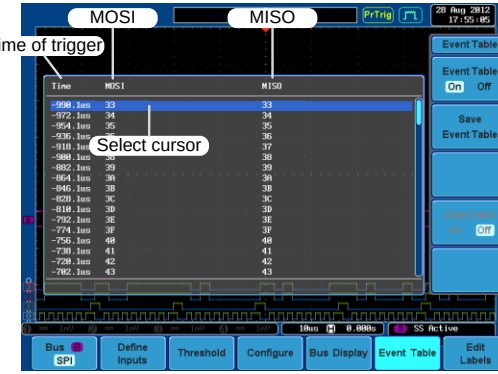


Example:
I²C Data Detail



Note Data Detail is only available with the I²C bus.

Example:
SPI Event table



Event Tables Format

Each bus type (Parallel, UART, I²C, SPI) can have an event table saved containing each bus event as a .CSV file. For serial buses, an event is defined as the data on the bus when a Stop or End of Packet (UART) is encountered. For parallel buses, an event depends on the number of bits on the bus. The data associated with each event and the time of each event is recorded.

File Type

Each event table is saved as Event_TableXXXX.CSV into the designated file path. Each event table is numbered sequentially from 0000 to 9999. For example the first event table will be saved as Event_Table0000.CSV, the second as Event_Table0001.CSV, and so on.

Event Table Data

Each event table saves a timestamp of each event relative to the trigger as well as the data in each frame/packet at the time of an event. The frame/packet data is saved in HEX format.

The table below lists in order the data saved for each event table.

UART	Time, Tx frame data, Rx frame data, Errors.
I²C	Time, Repeat Start, Address, Data, Missing Ack.
SPI	Time, MISO frame data, MOSI frame data.

Example

Below shows the data associated with an SPI event table in a spreadsheet.

Time	MOSI	MISO
-11.60us	0D87	0D87
-10.16us	06C0	06C0
-8.720us	8343	343
-7.282us	243	243
-5.840us	0C88	0C88

Adding a Label to the Serial Bus

Background

A Label can be added to the serial buses. This label will appear next to the bus indicator on the left hand-side of the display.

Panel Operation

1. To add a label to the bus, press *Edit Labels* from the Parallel Bus menu.

2. To choose a preset label, Press *User Preset* from the side menu and choose a label.

Labels

ACK, AD0, ADDR, ANALOG, BIT, CAS, CLK, CLOCK, CLR, COUNT, DATA, DTACK, ENABLE, HALT, INT, IN, IRQ, LATCH, LOAD, NMI

Edit Label

3. Press *Edit Character* to edit the current label.

4. The Edit Label window appears.

5. Use the Variable knob to highlight a character.

Press *Enter Character* to select a number or letter.

Press *Back Space* to delete a character.

Press *Editing Completed* to create the new label and return to the previous menu.
Note: this key must be pressed to save the label, even for the preset labels.

Press *Cancel* to cancel the editing and return to the Edit Label menu.

6. The label will appear next to the bus indicator.

   Below, the label "BUS_1" was created for the bus.

The bus is labeled as BUS_1

Remove Label	Press *Label Display* to toggle the label on or off.

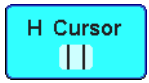
Using Cursors with the Serial Bus

Background	The cursors can be used to read bus values at any position.
Note	Ensure that one of the serial buses has been selected and is activated.

Panel Operation

1. Press the *Cursor* key. Horizontal cursors appear on the display.

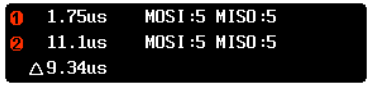
2. Press the *H Cursor* soft-key and select which cursor(s) you wish to position.



Range	Description
	Left cursor (1) movable, right cursor position fixed
	Right cursor (2) movable, left cursor position fixed

| | Left and right cursor (❶+❷) movable together

3. The cursor position information appears on the top left hand side of the screen.

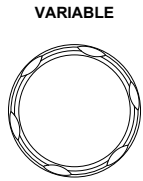


Example: SPI cursors.

Cursor ❶ Hor. position, Bus value(s)

Cursor ❷ Hor. position, Bus value(s)

4. Use the *Variable knob* to move the movable cursor(s) left or right.



Trigger Settings

Serial Bus Trigger Settings

UART BUS Trigger Settings

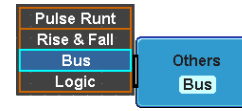
The UART bus trigger conditions can be set at any time after the bus settings have been set to *UART*.

Panel Operation

1. Set the Bus to UART in the bus menu. Page 54
2. Press the *Trigger Menu* key.

3. Press *Type* from the bottom menu.

4. Press *Others* from the side menu and select *Bus*.



5. Press *Trigger On* and select the triggering condition for the UART bus.

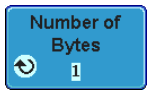
Trigger On: Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, Rx Parity Error

Trigger On – Tx Data, Rx Data

If Tx Data or Rx Data was configured for the Trigger On setting, then the number of bytes and data can also be configured.

1. Press *Data* from the bottom menu.

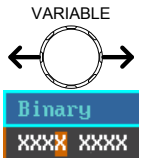
2. Press *Number of Bytes* from the side menu and choose the number of bytes for the data.



UART	1~10 Bytes

3. Press *Data* from the side menu to edit the triggering data.

To edit the data, use the *Variable* knob to highlight a binary or hex digit and press *Select*. Use the *Variable* knob to choose a value for the digit and press *Select* to confirm.



Binary	0,1,X (don't care)
Hex	0~F, X (don't care)
ASCII	ASCII characters for the equivalent Hex characters 00 to FF

The Trigger on settings will be reflected on the Trigger Configuration icon.

I²C Bus Trigger Settings

The I²C bus trigger conditions can be set at any time after the bus settings has been set to 1²C.

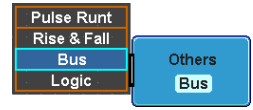
Panel Operation

1. Set the Bus to I²C in the bus menu. Page 56

2. Press the *Trigger Menu* key.

3. Press *Type* from the bottom menu.

4. Press *Others* from the side menu and select *Bus*.



5. Press *Trigger On* and select the triggering condition for the selected bus.

Trigger On Start, Repeat Start, Stop, Missing Ack, Address, Data, Address/Data

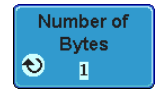
---

Trigger On – Data

If Data or Address/Data was configured for the Trigger On setting, then the number of bytes, data and addressing mode (I^2C) can be configured.

6. Press *Data* from the bottom menu.

7. Press *Number of Bytes* from the side menu and choose the number of bytes for the data.

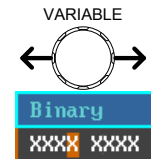


I^2C 1~5 Bytes

8. Press *Addressing Mode* to toggle between 7 and 10 bit addressing modes.

9. Press *Data* from the side menu to edit the triggering data.

To edit the data, use the *Variable* knob to highlight a binary or hex digit and press *Select*. Use the *Variable* knob to choose a value for the digit and press *Select* to confirm.



Binary	0,1,X (don't care)
Hex	0~F, X (don't care)

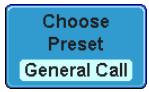
Trigger On - Address

If Address or Address/Data was configured for the Trigger On setting, then the triggering address must be configured.

10. Press *Address* on the bottom menu.

11. Press *Addressing Mode* to toggle between 7 and 10 bit addressing modes.

12. To choose a preset address as the default address, press *Choose Preset* and select a preset address.



Address	Description
0000 000 0	General Call
0000 000 1	START Byte
0000 1XX X	Hs-mode
1010 XXX X	EEPROM
0000 001 X	CBUS

Press *Apply Preset* to set the default address to the preset.

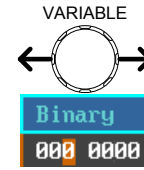
Note

- Presets are not available for *Trigger On Address/Data*.

13. Press *Address* from the side menu to manually edit the triggering address.

To edit the address, use the

Variable knob to highlight a binary or hex digit and press *Select*. Use the *Variable* knob to choose a value for the digit and press *Select* to confirm.



Binary	0,1, X (don't care)
Hex	0~F, X (don't care)

Direction

14. Press *Direction* on the bottom menu and choose the direction from the side menu.

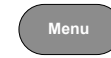
Direction	Write, Read, Read or Write

SPI Bus Trigger Settings

The SPI bus trigger conditions can be set at any time after the bus setting has been set to SPI.

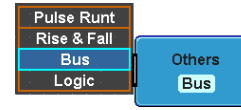
Panel Operation

1. Set the Bus to SPI in the bus menu. Page 57
2. Press the *Trigger Menu* key.



3. Press *Type* from the bottom menu.

4. Press *Others* from the side menu and select *Bus*.



5. Press *Trigger On* and select the triggering condition for the SPI bus.

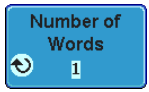
SPI	SS Active, MOSI, MISO, MOSI&MISO

Trigger On – Data

If MOSI, MISO or MISO/MOSI was configured for the Trigger On setting, then the number of words and the data can be configured.

6. Press *Data* from the bottom menu.

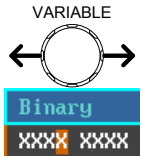
7. Press *Number of Words* from the side menu and choose the number of words for the data.



SPI	1~32 Words

8. Press *MOSI or MISO* from the side menu to edit the triggering data.

To edit the data, use the *Variable* knob to highlight a binary or hex digit and press *Select*. Use the *Variable* knob to choose a value for the digit and press *Select* to confirm.



Binary	0,1,X (don't care)
Hex	0~F, X (don't care)

Parallel Bus Trigger

Background

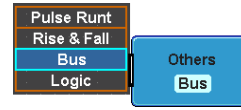
The parallel bus can be set up to trigger on a specified data pattern.

Panel Operation

1. Press the *Trigger Menu* key.

2. Press *Type* from the bottom menu.

3. Select *Others* → *Bus* from the side menu. The Bus indicator appears at the bottom of the display.

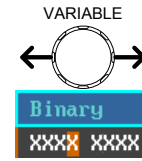


From left: Bus trigger, Data source

4. Press *Data* from the bottom menu.

5. Press *Data* from the side menu to edit the triggering data.

To edit the data, use the *Variable* knob to highlight a binary or hex digit and press *Select*. Use the *Variable* knob to choose a value for the digit and press *Select* to confirm.



Binary	0,1,X (don't care)
Hex	0~F, X (don't care)

6. The bus will now trigger when the specified data appears on the bus.

Common Bus Trigger Settings

Bus Trigger Mode

Trigger Mode

1. Like the other trigger configurations, the Bus Trigger mode can be set to Auto (Untriggered Roll) and Normal.

   This applies to the serial and parallel buses.

2. Press *Mode* from the bottom menu to change the triggering mode.

3. Use the side panel to select *Auto* or *Normal* triggering modes.

Range	Auto, Normal

Logic Trigger

Background

The digital channels can be set up to trigger on specified logic levels and for a specified clock edge.

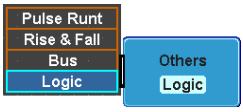
For example the digital channels can be set to trigger on the rising edge of the clock signal when bit 1 (D1) is high and all other channels are ignored.

Panel Operation

1. Press the *Trigger Menu* key.

2. Press *Type* from the bottom menu.

3. Select *Others* → *Logic* from the side menu. The Logic indicator appears at the bottom of the display.

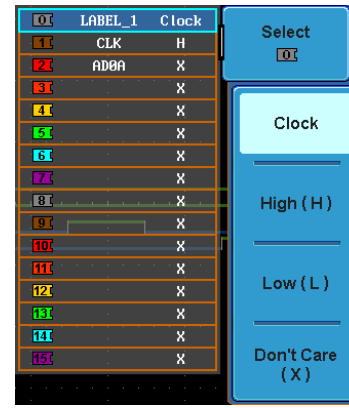


From left: Bits D15~D0

4. Press *Define* inputs from the bottom menu.

5. Press *Select* on the side menu and select a channel.

6. Next, select a logic level for the selected channel, or set the selected channel as the clock signal.



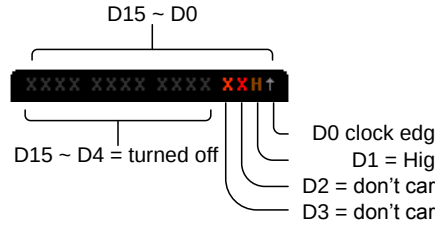
Logic Clock, High (H), Low (L), Don't Care (X)

7. If *Clock* was selected, press *Clock Edge* from the bottom menu and select a clock transition.

8. Repeat steps 5 to 7 for the remaining channels.

9. The chosen logic levels will be reflected in the trigger indicator at the bottom of the screen. The color of each channel, if active will also be displayed. If a channel is not turned on, it will be grayed-out.

Example



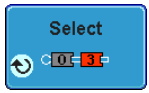
10. The bus will now trigger when the specified logic appears on the bus.

Trigger Threshold Levels	The trigger threshold levels for the can assigned from a selected number of preset logic levels or a user-defined threshold level can be set.

Note	The threshold levels set with the logic bus menu will replace the logic levels that are set in the Logic Analyzer menu (page 38).

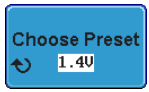
1. Press *Thresholds* from the bottom menu.

2. Press *Select* from the side menu and choose a group of channels.



Group	D0~D3, D4~D7, D8~D11, D12~D15

3. Press *Choose Preset* to select a pre-set logic threshold.



Logic Type	Threshold
TTL	1.4V
5.0V CMOS	2.5V
3.3V CMOS	1.65V
2.5V CMOS	1.25V
ECL	-1.3V
PECL	3.7V
0V	0V

4. Press *Threshold* to set a user defined threshold.

Range	± 10V

Logic Trigger Mode

Background

Like the other trigger configurations, the Logic Trigger can be set to Auto (Untriggered Roll) and Normal.

1. Press *Mode* from the bottom menu to change the triggering mode.

2. Use the side panel to select *Auto* or *Normal* triggering modes.

   Range Auto, Normal

Logic Trigger Holdoff

Background

The holdoff function defines the waiting period before the GDS-2000A starts triggering again after a trigger point. Please see the user manual for further details.

1. To set the Holdoff time, press the *Holdoff* menu button on the bottom menu.

2. Use the side menu to set the Holdoff time.

   Range 10ns~10s

   Pressing *Set to Minimum* sets the Holdoff time to the minimum, 10ns.

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