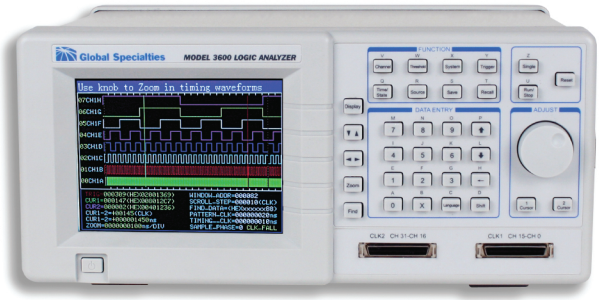
3600

32-Channel Logic Analyzer

User Manual



Introduction

Congratulations on the choice of Global Specialties Model 3600. This 32 channel Logic Analyzer observes and measures digital signals in digital information processing. It captures and displays many signals at once, and analyzes their timing relationships. Use its internal clock, or connect up to 2 external clocks for sampling rate variability. This logic analyzer will prove to be a versatile tool to help in digital hardware debugging and verifying circuit designs. Model 3600 operates as a stand-alone unit or connected to a computer via USB interface.

Product Contents

Model 3600 Mainframe

Users Manual

1 ea 3-core power line

2 Sets of 50 wires cables and connector

2 ea Input transferring boxes

40 ea Test hooks

40 ea Test hook connecting lines

1 ea Interface demo CD

1 ea USB interface cable

1 ea RS232 interface cable

Operating Conditions

Input Power Voltage: AC 100V~240V

Frequency: 45 Hz ~ 65 Hz

Power: <30 VA

Environmental Conditions: Temperature: 0~40°C

Relative Humidity: ≤80%

No powerful electromagnetic interference

Safety Summary

1) Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

2) Only qualified personnel should perform service procedures.

3) Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

4) Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

5) Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and marking on the product. Consult the product manual for further ratings information before making connections to the product.

6) The common terminal is at ground potential. Do not connect the common terminal to elevated voltages.

7) Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

8) Use Proper Fuse. Use only the fuse type and rating specified for this product.

9) Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

10) Do Not Operate in Wet/Damp Conditions.

11) Keep Product Surfaces Clean and Dry.

12) Provide Proper Ventilation.

Theory of Operation

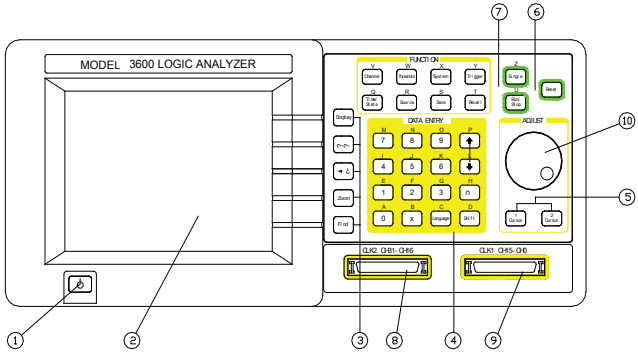
To sample an external signal source, the external signal is sent into the positive input port of the high-speed comparator via the input circuitry. The threshold circuit generates a threshold voltage according to the set values, and sends the voltage to the negative input port of the high-speed comparator. A TTL level digital signal is generated by the comparison of the 2 signals and then the digital signal is stored synchronously in the data flip-latch by sampling clock. When sampling the internal code, the code generator will produce 30 channels of internal digital signals which are stored synchronously in the data flip-latch by sampling clock. The sampling data in the data flip-latch are

stored in high-speed memory according to appointed addresses.

Selecting the internal clock timing sampling will set the cycle of the sampling clock. State sampling with the external clock will select the phase of the sampling clock.

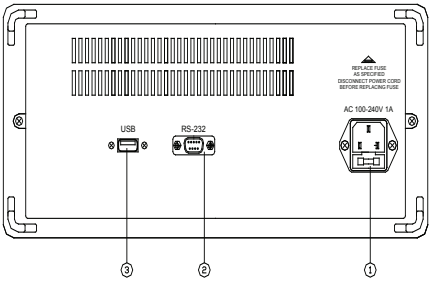
During the sampling storage period, a “sequence add 1 counter ” supplies the storage address for the high-speed memory in the memory control circuit, each sampling clock makes the memory change to a new writing address. At the same time the flip-latch sends new sampling data, creating a new data point stored in memory. The start-up and end of the address counter is determined by the memory control circuit according to the parameters set by the triggering process. After sampling storage, the microcontroller unit reads a series of data and sends them to the LCD to display the timing waveform and data list.

Model 3600 Front Panel



1) ON / Off power switch
2) Display screen
3) Display control pushbuttons
4) Data entry input pushbuttons
5) Cursor control pushbuttons
6) Sample rate pushbuttons
7) Function Selection pushbuttons
8) Signal input connector, Channels 0 through 15
9) Signal input connector, Channels 16 through 31
10) Cursor Adjust knob

Model 3600 Back Panel



1) AC power source outlet

2) RS232 interface

3) USB device interface

Keyboard Description

There are 34 pushbuttons on the front panel divided into these groups: Display Control, Function Selection, Data Entry, Cursor Control, and Sample Rates.

Display Control

Display: display timing waveforms or data lists in cycle.

↑ ↓: use the knob to roll timing waveforms and data lists up and down

← →: use the knob to roll timing waveforms and left and right

Zoom: use the knob to zoom timing waveforms

Find: find and display the data points suited the search conditions

Data Entry

(11 pushbuttons for Number input, 4 pushbuttons for Input control, 1 pushbutton for Language)

Number Input:

【0】【1】【2】【3】【4】【5】【6】【7】【8】【9】: number input;
【x】: special characters x, only used for data search input

Input Control

【↑】【↓】: select the setting parameters up to down in cycle

【←】: backspace, to delete the input data when the input hasn't finished

【Shift】: used for inputting the English letters above the button

【Language】: English only

Cursor Control and Adjust knob

【Cursor 1】: use the knob to move the cursor1 left and right

【Cursor 2】: use the knob to move the cursor2 left and right

Sample Rates

Run/Stop: circular run/stop recycling sample

Single: single sample

Reset: initialize the instrument and resume the default parameters settings

Function Selection

Channel: select and set the sequence order, name, color and switch of each channel in cycle.

Threshold: select and set the threshold voltage.

System: select and set the system parameters.

Trigger: select and set the parameters and the switch in the trigger process.

Time/State: select the mode of timing sample or state sample in cycle

Source: select internal code generator or external signal source in cycle.

Save: save the current setting parameters.

Recall: recall the last saved setting parameters

Display Description

The top row of the display screen indicates chosen function. There are 3 types of display interface described below.

Waveform Interface Display

The Waveform Interface displays 8 channels of timing waveforms, the serial number and the name of the waveform and includes four different vertical cursor lines in varied colors. There is one scale on the top of the waveform frame, and another one is on the bottom of the waveform frame. These are the zoom scales. The time value of every scale varies with the zoom coefficient. Below the waveform frame is the parameters display frame, the six parameters on the left is the state parameters which varies automatically with different operations, showing the current state of the equipment. The six parameters on the right is the parameters settings of the system and can be set with the numeric pushbuttons.

Data Interface Display

The data interface displays 19 rows of data. Each row is one sampled data point in memory, corresponding to 32 sample channels. The three columns of data from left to right is the address of data, the data value in Decimal (Dec), the data value in Hex, the data value in Binary (Bin). The parameters display frame is below the data lists frame, the three parameters on the left are the state parameters which changes automatically with different operations, showing the current state of the instrument. The 2 parameters on the right are the parameters settings of the system and can be set with numeric pushbuttons.

Trigger Interface Settings

The trigger interface displays the whole trigger process. It utilizes a graphical display mode to easily illustrate the entire triggering process. The panes in the display interface are the nodes of the trigger process. The connecting lines among the panes show the direction of the trigger process, six parameters can be set on the right, the left side has six switches for setting. The specifications of these settings are explained later in this manual.

Operating Instructions

Initialization

Turn on the Model 3600 using the front panel ON/OFF pushbutton. The model number and the manufacturer of the instrument will first be seen on the display. Operate the initialization program by loading the

default parameter settings. Next the timing waveforms of internal code will be displayed.

Most of functions performed by the logic analyzer are single or non-cyclical signals included in high speed data streams. The analyzer can't display the signals in real-time on the screen as an oscilloscope would, but it can sample the signals according to certain time rate (sample clock). The analyzer will catch and save any signal anomalies by setting up the appropriate trigger process. The saved data can be recalled onto the screen and analyzed repeatedly.

Keyboard Description

When any pushbutton is pressed, there is a corresponding display on the screen which explains the function and its operation. If there is a circular symbol, consisting of two arrows laid end to end, on the left of the explanation then it is a cycle key. It runs different functions by pressing it repeatedly. If there is no circular symbol, the pushbutton has only one function.

Parameters Input

If there are reverse numbers or characters displayed on the screen, this means the parameter is a selected one which can be set by pressing the pushbutton. If the user needs to select other data, 【↑】and【↓】can be used. The user also can turn the knob left and right to select other cyclical data. If a wrong character or number is input, the user can delete the one by pressing【←】. As soon as the reverse character areas are filled with numbers, the parameter settings take effect. At this point the【←】will no longer work, unless the input process is restarted.

Letter Input

The 26 letters, from A to Z, are marked above 26 keys on the front panel. During the process of parameter input, press the【shift】key, release the shift key, then input the letter desired. If there is no letter on the key, the user can input a space. The【shift】key is a single step. In order to input the next letter, the process above is to be repeated.

Channel Setting

Channel Order Setting

The double digit numbers 00-31 on the left side of the waveform display frame are the serial numbers for each channel. Press【Channel】key to select the channel serial number setting. Then set the channel sequence using the numeric keys. The settings only change the position of channel waveforms on the screen so that different channels of waveforms can be closely displayed and easily compared. However the real positions of sampling channels and the sampled data are not changed. If the real positions of sampling channels need to be changed, the user needs to change the connection of the test hooks for sampling on the circuit board.

Channel Label Setting

The four characters on the right of the channel serial numbers are the label of the channel. Press【Channel】key to select the channel label setting. Set the channel label by using the numeric keys or letter keys. Every channel label can be set by the user.

Channel Color Setting

Press【Channel】key to select the desired channel color setting. Set the color using the numeric keys. Every channel can be set according to user's choice of color.

Channel Switch Setting

Press the【Channel】 key to select channel switch setting. Set the channel "on" by using the numeric key【1】. Set the channel "off" by using the key【0】. The settings will take effect in the process of next sampling display.

Generally, the settings of the channels are not required to be changed often. Press【Save】to save the defined channel settings to re- use then without having to reset the settings.

Threshold Setting

Press the【Threshold】key to set the threshold voltage setting. The【↑】and【↓】pushbuttons are used to circularly select one of the six threshold voltages. Only the knob can be used to set the value of threshold voltages in a continuous manner (numeric keys can't

be used). The voltage will increase by turning the knob to right and decrease by turning the knob to left. When the voltage value passes the zero, the polarity sign will automatically change. The internal code-generator doesn't pass the voltage comparator, so the settings on threshold voltage aren't valid when sampling the internal code.

The analyzer has 32 external signal input channels and 2 external clock channels. The best performance is when the peak-to-peak value of input voltage is between 500 mVpp and 20 Vpp. The maximum input voltage the instrument can handle is ±40 V. After accessing the analyzer, the input signal first passes through the voltage comparison circuit and is compared with the threshold voltage set by the user. If the input signals are higher than the threshold voltage, the analyzer shows the number "1", otherwise it displays the number "0". Then the signals are sampled and saved and displayed on the screen.

Waveforms displayed by this means only reflect the timing logic when the input signals are higher or lower than the threshold voltage. It doesn't reflect the real amplitude of the input signals, and may be far different from the real waveforms of the input signals. This kind of waveform displayed by the logic analyzer is usually called a "pseudo waveform".

Sampled Signals

In practical operation, the sampled signals appear by groups. For example, grouped by the data bus or the address bus .The characteristics of amplitude of a group of signals are the same, so use the same compare threshold voltage. The amplitude characteristics of a group of signals are the same, so use the same comparative threshold voltage. In practical operation there are many kinds of signals with different amplitudes to be tested, such as TTL, CMOS and ECL. In every experimental circuit, the amplitude characteristics of signals may be various. To satisfy these conditions, the instrument is deployed with six individual adjustable threshold voltages. Four of them are used in four channel groups which contain 8 signal input channels in each one. And the other 2 threshold voltages are used in 2 external clock input channels.

Measured Signals

In practice, the instruments measures signals in groups, for instance

in the total line and address line. The amplitude characteristic of one group is identical and should also use the same comparison threshold voltage. However the instrument has 32 signal input channels and again, it is not necessary to setup 32 independently adjustable threshold voltages. But in practice, there are measured signals with different amplitudes for instance TTL, CMOS, and ECL. In many experimental circuits, the amplitudes required may vary. For this application, six independently adjustable threshold voltages can be configured, four of which are used for four channel groups, each group has 8 signal input channels. The other 2 are used for 2 external clock input channels separately.

In practice, the voltage amplitudes of +5 V or +3.3 V are commonly used in a digital circuit. Model 3600's default settings of the threshold voltage are at +1.6 V. Generally, the setting range of the threshold voltages for TTL is between +5V and +3.3V. The setting range of threshold voltages for CMOS is between +5V and +4.3V. If the tested signals contain large ringing effects or other voltage noises, there will be extraneous data in the sampled results. If this happens, repeat the sampling function to adjust the threshold voltage and observe the sampling waveforms, until clear and correct sampling waveforms are obtained.

Display Setting

The 3600 logic analyzer can display a vast amount of data. There are two display modes of sampling data: timing waveform display and data listing display.

Timing Waveform Display

Press【Display】to view timing waveforms for up to 8 channels. Each channel can be displayed with different colors to easily identify and separate them visually. The order of 32 channels waveforms is that the highest channel is on the top and the lowest channel is at the bottom. This is to enable the highest-order digit of the byte to be on the top and the lowest-order digit on the bottom.

Waveform Rolling Up/Down

The waveform rolling can be used to observe all the waveforms in 32 channels. Press【↑ ↓】and turn the knob to browse the waveforms.

If there is a need to compare the waveforms, the method of channel order setting (see Channel Order Setting) can be used to display the desired waveforms.

Waveform Rolling Left/Right

The Model 3600 allows for 260,000 memory addresses for each channel, however only 280 data points can be viewed due to the horizontal width of the screen. In order to display the needed blocks from the mass of stored data, the screen display window needs to be repositioned to the desired data in memory. This requires setting a changeable "window address" for the display window. The screen of the analyzer will show the stored data block using this new window address as starting point.

The parameter in the first row on the right bottom of the wave frame is the window-address. The waveform displays the data on the most left, that is the data corresponding to the window address in sampling memory. Press【System】to select window-address and set the window address in Dec numbers with the range of 0~260000. After setting, the waveform of sampled stored data block associated with this new window address will be displayed. To continuously observe a waveform on the display, press【← →】 and turn the knob. The window-address will change continuously showing the waveform rolling from left to right in the display window.

The parameter in the second row on the right bottom of the wave frame is a scroll-step function. Turn the knob one step and the window-address will increase one scroll-step value. The higher the value of scroll-step, the faster the speed of the rolling waveform. This could possibly surpass the desired data block. The lower the value of scroll-step, the slower the speed of rolling and the finer observation of the waveforms. Press【System】to select scroll-step. The value of the scroll-step can be set by using the number keys with the range of 1~ 260 000. After setting, press【← →】 and turn the knob to roll the waveform left and right, so that the speed of rolling waveform will change.

Setting the window-address using the number keys directly enables display window to locate the desired sampled block of data. Rolling waveforms utilizing the knob allows observation of section changes in a continuous manner.

Waveform Zoom

In digital systems, changing rates of different logic levels can vary within different data channels. When trying to view these on the display, it is possible to have 8 channels with big differences in the changing rates of logic levels. This can cause viewing problems due to the large number of pulse waveforms crowded together on the screen and the fast changing logic level rates will not be seen clearly. Conversely, if a channel has slow changing rates, it becomes a flat line on the screen. To solve these two visual problems, either stretch the waveforms in level direction to de-compress and unfold the crowded fast-changing pulse waveforms. Or compress the slow-changing waveforms to easier view their characteristics.

De-Compressed Waveform

Press the【Zoom】key and turn the knob to make the display waveforms stretch or compress in the horizontal direction. “Zoom= ns/div” in the sixth row on the left bottom of the wave frame will change. This ratio coefficient stands for the time increment that each lattice of scale line represents both in the above and underside two rows of waveform frame. The essence of waveform amplification is that a number of sampled data points in memory are displayed continuously. The amplified waveform allows dense waveforms to be viewed more clearly. This does not generate any distortion to the waveform. However waveform amplification is unable to increase the resolution. Unsampled data points will still not be seen after amplification. If it is desired to see in more detail, then it is required to increase the sampling velocity.

The waveform zoom function uses the sampling clock as its time unit. If the user needs to measure the interval of the waveform accurately, it is recommended to use the cursor measurement method.

Compressed Waveform

The theory of waveform compression is displaying one number comprised from several data points in the sampled memory. After compression, the waveform’s observation is broadened. This could possibly lead to distortion and allow the user to miss viewing fast changing steps. The higher the compression rate, the greater the possibility for distortion. It is suggested to make compression changes

gradually to minimize distortion. If distortion is found, the user should no longer continue compressing the waveform.

Data Lookup - Search Function

Model 3600 has a convenient search function. After a sampling of data, the user can find the data conforming to the setting conditions within a large group of sampled data. Parameters in the third row on the right bottom of the wave frame is the find-data which is a 32 bit data word in Hex format. Press【System】to select find-data function. Select search data word and input the numbers from 0~9 or the letters of A~F. User can also input x (Note: the【x】on the right of the key 【0】is not the letter "x" in English). x means "ignore". After setting the find data word, press 【Find】again to locate the data according to the search conditions. This will be denoted with a yellow dash, generally seen on the left of the screen. At the same time, the window address will change to show the position of this data in the sampled memory. Press【Find】repeatedly until reaching the end point of sampled data memory. This allows user to find all the data words conforming to setting conditions from sampled data.

The find-data function runs after finishing the data sampling. It is used to look up a data word set randomly in stored sampling data. This point is different from the trigger conditions data word that will be described in another section. Trigger conditions is preset in advance before sampling and used to capture data word conforming to trigger conditions.

Data Listing Display

Press the【Display】key and 19 rows of data listings will be displayed. In the data listing interface, the most left line is the Dec address value of sampled data in memory. The middle is the address value of the sampled data in Hex, the right is the Bin address value. A differentiating line is displayed between each 8 bits Bin code for convenient reading. There are two different colors to distinguish the two adjacent lines to allow for clear viewing and eliminate confusion.

The storage depth of the instrument is 260,000 storing addresses, but the screen shows only 19 rows in a vertical manner. Therefore, data lists also must roll up and down in the display window. The parameter definitions and operation methods shown in the data listing display

are the same as timing waveform display mentioned in the Timing Waveform Display section. The functions of window addresses, rolling steps, find-data words are also identical. The difference is that rolling up and down in the data listing display equals rolling left and right in the timing waveform display. The found data is a row of orange data displayed in the upper part of data listing. The data listing cannot roll left and right, or zoom.

Cursor Setting

There are two cursors for Model 3600: Cursor1 and Cursor2.

Timing Waveform Cursor

In the timing waveform display interface, press the【cursor 1】key, the green cursor1 shows an active state. Turn the knob to enable the cursor1 to move left and right. Press the【cursor 2】key, the purple cursor is then chosen. Turn the knob to enable the cursor2 to move left and right. The step width of the cursor movement can be set with number keys 0~9. For example, press 【1】and turn the knob a step. The cursor moves one point distance on the screen. Press 【9】, then turn the knob a lattice, the cursor moves nine points distance on the screen. Recommendation is to first move the cursor with a longer step to the desired aim point. Then move the cursor with a shorter step to the aim point.

Cursor Measurement

Model 3600 is able to measure the sampling data value of any point in the display waveforms and the time interval between any two points in a waveform.

The second row on the left bottom of the waveform frame is the parameter value of cursor1. The third row is the parameter value of cursor2. The six numbers on the left of the parameter are the decimalization data address that the cursor is indicating. The 8 numbers on the right of the parameter are the Hex data value of the position the cursor is indicating. This is the sampling data of 32 input channels. Each number represents 4 channels. The data from left to right represents the 32 input channels of waveforms from the top to the bottom in turn. Because the screen only shows the waveforms of 8 channels, the user can know the logic levels of the 32 channels.

This is done by reading the data value of the cursor without moving waveforms up and down to view. When turning the knob to make the measurement cursor move, the cursor parameter's address value and data value will change dynamically with it. When the two cursors move into the same point, their parameter values are identical.

The difference in value between cursor1 and cursor2 displays in the 4th row on the left bottom of the waveform frame. This is indicated as sampling clock cycle which can also be called the address difference.

The data in the 5th row on the left bottom is the difference in value between cursor1 and cursor2, denoted by absolute time (ns). When the cursor1 is on the right of the cursor2, the two parameters are positive values; they are negative values on the left of cursor2. When the two cursors coincide with each other, their parameters are 0.

This allows the user to measure the time difference between any two points in a waveform by positioning cursor1 and cursor2 to the two points of interest. It will then display time difference or the address difference between the two points.

However, if the address difference between the two points measured exceeds 280, the two points can't be displayed in the same interface at the same time. A different measuring procedure is used. Set the cursor1 and the cursor2 into different characteristic modes. Cursor1 is a drift cursor appearing in the display window continuously. It can be seen as an aim line and is able to move anywhere within the window using the knob. Cursor1 appears to suspend on waveform, and does not move together with the waveforms. Its address value and data value will change with the waveform movement, denoting waveform's address value and data value cursor placed at any step.

Cursor 2 is an adhering cursor. Even though it can be moved anywhere within the window using the knob, it will adhere to the waveform once movement stops. When the waveform moves, cursor2 moves with it. When moving the cursor2 out, visualize that it still adheres to and moves with the waveform. Its address value and data value won't change regardless how far the waveform moves.

When using cursor1 as a drift cursor and cursor2 as an adhering cursor, first move cursor2 to the first aim point. The move the waveform left or right until the second aim point displays. Turn the knob to move cursor1 to this second aim point to read the time or address

value difference between the two points. After finishing this type of measurement , press【cursor 2】key to recall it into display window and begin the next measurement.

Data Listing Cursor

In the Data Listing interface, cursor1, cursor2 and cursor measurement are the same as the cursors in the Timing Waveform interface. The difference is that the cursors in the timing waveform display are vertical cursor lines, but in the data listing display interface, the cursors are horizontal white rows in the display. There is only an address display of two cursor rows regarding the parameter display under the data listing (data values are contained the listing).

Sampling Setting

Model 3600 uses the sampling mode for obtaining data. This procedure involves sampling to a digital input, not collecting a sample to the input signal directly. Instead it digitally generates data points through comparison and distinguishes between input signals and thresholds. It then stores sampled data in memory which requires properly setting the sampling parameters.

Sampling Mode

There are two sampling modes for this logic analyzer. One is timing sample which collects samples of the external signals using the internal equal time interval clock. The sampled data is equal time interval data, in other words it takes “time” as the independent variable. The timing waveforms after sampling will basically reflect the changes of the tested signal as time. This approach is known as the timing analysis, but the sampling clock and the tested system are independent of each other and not synchronous and called “asynchronous sampling.”

The other sampling mode is the state sample which collects samples using the clock of the system under test. The clock utilizes equal or random time intervals. The sampling clock pulse can be seen as a discrete event. Take the “event” sequences as independent variables. The data listing after sampling reflects the logic state relation between the system clock and the other signals in the system. This mode is known as state analysis. Here, the sampling clock is synchronous with the system under test and is also called “synchronous sampling.” If the

user takes samples using the inner clock to inner code generator, this also belongs to "synchronous sampling."

If state sampling is used as the sampling clock signal in a measured system, it is required to connect to special input channel clk1 or clk2. Otherwise the sampling will not start. If the noise in the external clock signal is too large, adjust the threshold voltage settings of the external clock to obtain a pure clock signal. If the sampling clock signal is poor, the sampled data cannot be used and the external clock signals will not be stored to allow access to the displayed waveforms. It will then be impossible to know the quality of the clock signals after passing through threshold voltage comparator. A substitute method: press 【source】to select the aim source and use the inner clock as the timing sampling. Then connect external clock signal to the special clock channels clk1 and clk2. Now the external clock can take samples to external clock signals. Clk1 and clk2's timing waveforms display in 30~31 channels after sampling. When adjusting the threshold voltage settings of the external clock, one can use the two channels to monitor the adjustment effect.

Sampling mode can be set with the 【Time/State】key, inner clock for timing sampling and the external clock for state sampling. The external clock contains external clk1 and external clk2. The default setting is the timing sample using the internal clock.

Clock Limitations

To view variations of tested signal, a higher sampling velocity should be used, however this may greatly increase the amount of data stored in memory. Also the tested signal may be single/occasional and included in a long data stream. To effectively capture these signals, it is necessary to lengthen the time of the sampling. Again, this causes a greater amount of data to be stored in memory. Considering memory space has its limitations, there is a solution. Model 3600 sets two external clocks into a logic "and" and logic "or" mode. This limits an external clock by using another external clock. For example, select the logic "and" of two external clocks as the sampling clock. Use the high level of the external clk1 as the limit condition. Only when external clk1 is at a high level can the sampling clk2 be opened. Then the sampling of data will run. All other times the clk2 is shut down and no sampling will occur. If the set limit conditions are suitable, it ensures that the unit only captures the

desired signals and saves memory space.

Sampling Cycle

The logic analyzer captures data on the hop edge of the sampling clock and the data between two hop edges is ignored. (hop edge means the moment of potential shifting). If a longer sampling cycle is chosen, the fast-changing sections of the input signals will be missed. This causes the displayed waveforms to have distortion compared to the true waveforms of the input signals both in amplitude and time. One should use a shorter sampling cycle in order to observe the particular changes of the tested signals, that is, to increase the sampling rate. It is recommended the sampling cycle should be 3-5 times less than the narrowest pulse width of the tested signals. In other words, even the narrowest pulse of the tested signals should include three sampling points at least, which can truly reflect input signals' change as time.

The instrument uses an internal clock in the time sampling and the clock cycle can be set. Press 【system】 to select parameter pattern-clk and input the clock cycle value with decimalization numbers 0~9. Its unit is ns, resolution is 10ns, the last number on the right is to be ignored as it has no use. The minimum cycle value is 10 ns; the maximum value is 999999990ns, approximate to 1s. When the code generator's clock is changed, the waveform's display change is visible. The default setting of the clock cycle is 10 ns, meaning the highest sampling velocity is 100 MHz.

The instrument uses the external clock cycle in state sampling; the sampling cycle can't be changed optionally. One needs to select the suitable signals as the sampling clock according to the state of the tested signals.

Sampling Phase

The logic analyzer uses the sampling clock's rising edge for obtaining data. However the user should choose the clock's function edge according to the logical relation between the signal and system clock of tested system. For instance, if various logic levels change within the system clock's rising edge and samples use the rising edge the timing is not consistent, then various logic levels are changing and the sampled data may be wrong. By choosing the falling edge in this situation, all logic levels are in a stable state and sampled data will be correct.

Model 3600 sets sampling phase choices of rising edge sampling and falling edge samplingWhen connecting the timing sampling to an external signal with the internal clock, the sampling phase setting may be out of phase due to "asynchronous sampling".

Press【system】to select sample-phase and set sampling phase in numbers, press【0】to select clock falling edge, press【1】to select rising edge. The rising edge is applicable for internal sampling sources and the falling edge for external sampling sources. The default setting is the falling edge. The user needs to select what is appropriate for their measurement needs.

Sampling Control

There are two keys used for controlling the sampling process: press the【single】key and the sample process runs only once. After sampling, display the result in timing waveform or the data listing. The user can then utilize for various operations and analysis.

Press【Run/Stop】, the sampling process runs automatically and repeatedly with results displaying continuously. When user presses【Run/Stop】again the, sampling process stops. This is generally used to view a dynamic change of a tested signal or dynamic response of the adjusting parameter setting. Once the characteristics of tested signal are analyzed or parameter setting adjust suitably, press the【single】key to sample and analyze the results in detail.

Trigger Setting

In today's modern digital system, the date code stream rate is very high, typically in μs or ηs rates, which require a comparable sampling velocity for a logic analyzer. Because the memory has its limitations, the effective sampling time is very short. Using a manual sampling process【Single】requires extremely accurate timing which is difficult to do, making it difficult for the analyzer to know when to start capturing data. Also due to memory space allocation, large amounts of data will enter the memory and following data will overwrite preceding data points.

The logic analyzer must run the sampling process automatically according to user set-up and stop automatically after capturing useful signal data. This is the fundamental difference between a logic analyzer and a data collector.

Press【trigger】to display the graphical trigger setting interface. This will allow the user to view the entire sampling process directly, as well as the master trigger setting.

Signal Input

The signal input process is on the left of the trigger setting display. The externally tested signal from the probe passes through test hooks, "commuting case", transmitting cable, connector, to "comparator", then compared with the "threshold voltage" to generate digital signals. The Internal code generator pattern generates an emulating digital signal. Choose one of these two signals through switch "source select" by pressing【source】to select the switch state in cycle. The selected input signal passes through the channel switch to the sampling circuit. The setting of the channel switch has been described in section called Channel Switch Setting.

Start Conditions

The sampling trigger process is on the right of the trigger setting display. Press the【Single】key , the sampling process does not initially start but first checks the start conditions. When it is determined the data in the input signals is a match, the sampling process starts immediately.

The start "bit-select" can be set with numbers in Hex, representing 32 input channels. If the bit-select is set to 0, this indicates this channel is to be ignored. It is not involved in the start match checking and has no influence on start time regardless of signal level of this channel. If bit-select is set to 1, this indicates the channel is effective and is to be included in the start match checking. The default setting of start bit-select is 0000FFFF which means it only detected 00~15 channels, ignoring the 16~32 channels. The default setting is only an example. The user can modify for their measurement needs.

The start "compare word" can be set with numbers in Hex and its default setting 00001234. This means when "1234" appears in 00~15 channels in the input data streams (logic level of 00~15 channels is "0001001000110100") the sampling process starts.

Start Select

The "start select" can be set with numbers. The key【0】opens the

switch, the key【1】connects the switch. If the start select switch is connected, "the start conditions" will be short-circuited eliminating their use. For example, after pressing【Single】, the sampling process starts directly without detecting the start conditions, equal to random sample manually.

The default setting of the "start select switch" is "connect" in order to make random sampling without specific sampling purpose and not needing to set the start conditions. If the setting of the start select switch is "open", then only the tested signal with specific sampling purpose can set the suited start conditions.

Trigger Conditions

When sampling starts up, the instrument writes the sampling data into the high-speed memory continuously according to the sampling clock time. Once the memory is filled, it will be return to the top of the memory stack and overwrite the former data.

The sampling purpose is to make limited storage data blocks that contain the signals of concern. The user needs to set the appropriate trigger conditions to capture the desired signals. After the signals are captured and stored, the instrument takes a short time of "store delay" and the sampling process stops automatically. The suitable setting of trigger conditions can decrease storage of useless data which improves the effective utilization of the memory.

The start "bit-select" can be set with numbers in Hex, representing 32 input channels. If the bit-select is set to 0, this indicates the channel will be ignored. It is not involved in the start match checking and has no influence on start time regardless of signal level of this channel. If set bit-select is set to 1, this indicates the channel is effective and is included in the start matching checking. The default setting of start bit-select is 0000FFFF, means that only check 00~07 channels, ignore 08~31 channels. The default setting is only an example, the user can configure it for their needs.

The start "compare word" can be set with numbers in Hex, the default setting of start compare word is 00000069. This means once Hex number 69 appears in 00~07 channels in the input data streams the trigger condition is satisfied. Meaning when the logic level of 00~07 channels is "01101001"the trigger condition is satisfied.

Different from the start conditions, the trigger conditions sets three trigger limit switches, <, =,>. These are useful for testing the data with respect to the tested signals. The trigger limit switch can be set with number keys. Press the 【1】key to connect the switch, which connects only one in the three trigger limit switch. Once one switch is connected, the other two switches are disconnected. The default setting of the trigger limit switch is "=" connection.

Event Count

When the sampling process starts, the instrument stores the sampled data in the memory. At the same time, it compares the sampled data with the trigger conditions and the trigger limit switch. If the sampled data satisfies the trigger conditions and the trigger limit switch it will capture a trigger event. In some applications, the user may want to have the trigger event appear many times in one sampling making analysis more convenient to capture desired events. So the instrument sets a trigger event counter after the sampling process starts. The count value first resets and the count value increments one when it meets the trigger event once. This happens until the count value reaches the setting value of the trigger event and the trigger process finishes. The trigger events count can be set with numbers in Dec, the setting range is 1~999, the default setting of the trigger event count value is 001.

Trigger Select

The trigger select switch can be set with numbers, the key【0】opens the switch, the key【1】connects the switch. If the trigger select switch is connected, the trigger conditions, the trigger limit switch and the event counter are all short-circuited with no use. For example, after the sampling process starts, the instrument does not detect the trigger conditions and also does not count the event. The trigger process finishes unconditionally.

The default setting of the "start select switch" is "connect" in order to make random sampling. This has no specific sampling purpose on capturing what kind of signal. It is not necessary to set the trigger conditions or event counter. If the setting of the start select switch is "open", then only the tested signal clearly and specific sampling requirements can set the suitable trigger conditions, trigger limit switch and event count.

Store Delay

The sampling process can stop automatically after the trigger process finishes. But in some applications, we want to delay a period of storage time of the sampling data in order to analyze some signals characteristics after trigger events. So a delay counter is set in this instrument, after the trigger process finishes, the sampling process still runs, meanwhile clears the delay counter and counts for sampling clock, the count value adds one each clock cycle, the sample process stops when the count value reaches the setting value of the delay counter.

The "store delay" can be set with numbers in Decimalization, the setting range is 1~260000, the unit is the number of sample cycles; the default setting of storage delay is 600 sample cycles.

Because both the default setting of the start select switch and the trigger select switch are "connected", we don't need to set the trigger process, just press【Single】key, the instrument doesn't check, but directly starts sampling and makes storage delay, in other words, the sampling process stops automatically after sampling 600 clock cycles randomly.

Manually Stop Sampling Process

If the start select switch is disconnected, but the start conditions are set unsuitably, the sampling process will not start. Or if set trigger select switch is disconnected, but trigger conditions are set unsuitably, the trigger process can not stop. Under these two conditions, the instrument is in the detecting mode continuously until the suitable signals appear and displays "sample is processing, press any key to stop". To release from this state, press any key to stop the sampling process manually. Then one must study the tested signals carefully, reset the trigger process to make sure the sampling process will run normally.

Trigger Cursor

It is possible there may be one or more vertical red lines in the timing waveforms interface. These are trigger cursors. The positions of the cursors are the sampling data points that satisfy the setting of the trigger conditions.

The parameter value of the trigger cursor is on the left bottom of the waveform frame in the first row. The six numbers on the left of the parameter are the addresses in Dec of the data the cursor indicates.

The 8 numbers on the right of the parameter are the values in Hex of the data the cursor indicates. For example: the sampled data of the 32 input channels, every number represents four channels. The data from left to right represents the 32 channels of waveforms from the top to the bottom in turn. Press【single】repeatedly for sampling and cursor indication. Because it is random sampling, the position of the trigger cursor line changes every time. The address value in the parameters of the trigger cursor changes as well. The left six numbers of the data value change every time, but the right 2 bits of the parameter value is always 69. This is due to the default setting of the trigger condition being 69 Hex, which appears in the 00~07 channels thus the other channels are ignored. The position that the trigger cursor line displays in the timing waveform display are the data points which are in line with the trigger conditions. The trigger cursor is the same as the above description in data listing interface, displaying in a row of red data. The left line is address value of cursor in Dec, the middle line is data value of cursor in Hex, and the Bin data value of cursor is on the right line.

Save/Recall

Parameter Storage

Parameter settings will be different for various measurement applications and just using the default settings may not be adequate. To set the parameters each individual time can be time consuming. It is recommended the user utilize the parameter "save" function and store the present parameters for future use. Retain the settings of the instrument for future use by pressing the【save】key. Model 3600 will query first with "Store? 0: parameter, 1: waveform, 2: cancel". Press【0】key to save the all the currently set parameters. These will be stored even when the unit is powered down.

Waveform Storage

The user can set the Model 3600 for waveform storage. This function saves stored sample data for further analysis. The length of the waveform is 16348 sampled data points. The Start address is current displayed window address on screen. User can change the displayed window address by setting parameters or moving the figure. Press the【save】key. The instrument will query first "Store? 0: parameter, 1: waveform, 2: cancel". Press【1】to save data with length of 16k, and

the current displayed window as the start address.

Cancel Storage

If the user presses the【save】key in error and does not want to save the currently set parameter or waveforms, press【2】key to cancel. The original parameters or waveform will be maintained.

Recall

Press【Recall】to recall the saved parameters and waveform data. After recalling, they can be displayed with window and data list. The user can also measure and analyze them in different ways. After pressing【Single】or【Run/Stop】, new data will be shown. If needed, saved waveform data will be recalled by pressing【Recall】again.

Reset

Every time the power is turned on to Model 3600, the instrument first loads the default parameters settings and stores them. If the user modifies the parameter settings during a measurement and the data isn't being captured correctly, press【Reset】to recall the default parameters settings for initialization to return the instrument to normal operation.

Programmable Interface

Model 3600 is configures for USB device and RS232 interface. The user can send programmable commands to Model 3600 using a computer. It can also upload the sample data into a computer and display the sample waveform or data list on the computer display. Refer to CDROM for detailed instructions.

Remote Update

Using the function of remote update, the user can update the system software through computer interface. Please refer to CDROM for detailed instructions.

Specifications

Input

Input Channel	32 data sample channels, two external clock channels
Threshold voltage	6 independently adjustable threshold voltages
Adjusting range	- 6 V to + 6 V, Resolution: 0.1 V
Input impedance	Resistance > 100 kΩ, Capacitance < 8 pf
Input range	500 mVpp to 20 Vpp
Input protection	Maximum input voltage ± 40 V

Sampling / Storage

Timing Sample	Internal clock, Sampling Rate 1Hz to 100MHz (10ns to 1s cycle), resolution: 10ns
State Sample	External clock clk1, external clock clk2, Sampling rate: 1Hz to 35MHz
Clock limit	External clock: clk1 AND clk2; clk1 OR clk2
Sample phase	Rising edge, Falling edge
Sampling objective	Internal code-generator, external signal source
Sample control	Single sampling, continuous repetitive sampling
Storage depth	256K sampling points for each channel

Trigger

Start conditions	32bits start-select, 32bits start-compare word
Start select	Select-switch: On/Off
Trigger conditions	32 bits trigger select, 32 bits trigger comparing word
Trigger Limit	select switch : >, =, <
Event counter	1 to 999 times
Trigger select	Select switch: On/Off
Store delay	1 to 256K sample cycles

Display

Screen display	5.7-inch color LCD screen, resolution: 320 × 240 points
Display format	8-channel timing waveforms, 18 rows data lists
Waves rolling	32 Channels vertical rolling display, 256K data points horizontal rolling display
Lists rolling	256K data rows vertical rolling display
Waveform Zoom	Horizontal zoom times: 1 to 100, scale: 1ns/div to 4s/div

Cursor

Measure Cursor 1	Floating cursor, floats arbitrarily in display screen. Does not move with waveforms or lists.
Measure Cursor 2	Sticking cursor as a reference point affixed on the waveform or lists, moves along with them.
Cursor measure	Movement of the position of the cursor dynamically displays the data values, address distance and the interval of the two cursors.
Trigger cursor	The sample point accords with the trigger conditions.

Search cursor	The sample point accords with the search conditions.

Internal Code Generator

Code Type	00 to 15 channels are counters with adding one, 16 to 29 channels are shift pulses, 30 to 31 channels are used for monitoring external clock clk1 and clk2
Code Rate	Frequency: 1Hz to 50MHz (cycle 20ns to 1s) resolution: 10ns

Operation

Options	Keyboard operations, continuous adjustment knob

Power Conditions

Voltage	AC 100V~240V
Frequency	45Hz~65Hz
Power	< 30 VA

Environmental

Temperature	0 to 40 °C (32 °F to 104 °F)
Humidity	< 80 %

Dimensions	329 × 283 × 155 mm (13.2 x 11.3 x 6.2 in)
Weight	3 kg (6.6 lb)

Service

Warranty

Global Specialties warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from date of purchase.

Global Specialties will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing a warranty registration form on www.globalspecialties.com within fifteen (15) days of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

Global Specialties shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

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Non-Warranty Service

Return the product in the original packaging to the address below. Clearly state in writing the performance problem and return any leads, probes, connectors and accessories that you are used with the device.

Customers not on open account must include payment in the form of a money order or credit card. For the most current repair charges please visit www.globalspecialties.com and click on Calibration & Repair.

Return all merchandise to Global Specialties with pre-paid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North American is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact Global Specialties. Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

Procedure
All repairs and/or calibrations must have a Return Authorization (RMA) number prior to sending the unit to Global Specialties.

1. Call the factory 800-572-1028 for RMA # or

2. Fill out the RMA request on-line using the RMA form and receive an RMA# via email.

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