

1. Brief Introduction

Thank you for buying YB33000 Series Function/Arbitrary waveform generator. We would promise as following:

- Repair for one and a half years free of fee
- Software upgrading free of fee
- Technical consulting service free of fee
- Responsible warranty for customers

1.1 What is YB33000 Series Function/Arbitrary Waveform Generator

YB33000 series function /arbitrary waveform generator is a kind of intellect PC signal source with the DDS technology integrated with computer software, which can generate any kind of optional waveforms. It has been up to the advanced level of the ones from aboard with it lower prices. And it becomes the new replacement of the signal sources of high grade at home.

YB33000 series function/ arbitrary waveform generators can be connected to PC by the serial terminal or GPIB to be the most popular suppositional instrument, also it can be

operated separately to be suitable for the necessary measurement outdoors. It integrates the new concept and the old technology into one whole to meet all kinds of demands of each age to the most degree.

YB33000 series function/arbitrary waveform generator is of the popular international style, Chinese displayed on the liquid crystal with back light, which is not only very beautiful, but also add very large amount of information. The panel is very convenient for operation with its PC intellect digital controlling and the rolling menu indicating and the joint operation of the keyboard and the handwheel.

The technology of DOS digital integration has been used in YB33000 series function/arbitrary waveform generator, large scale of digital integrated circuit has been replaced with many analogue parts and the stability has been increased greatly. The inner accuracy and stability of the digital circuit have very important effectiveness to instrument adjustment. The knowability and controlling of used instrument have been increased to a new stage.

The function of any waveform generating (AWG) of YB33000 series function/arbitrary waveform generator is a very advanced technology of signal generating in the world. It integrates computers、communication、test and measurement

scientifically, and it represents the trend that the instrument and equipment are following along with the computers developing and it is the direction to develop the signal source technology for a long time.

1.2 What is DDS technology

The technology of Direct Digital Synthesis is a kind of new signal waveform generating technology which is developed and used for about ten years, which makes that the large scale and high speed digital circuit is used in the signal generators. At present, the signal generators from the main companies aboard all adapt the technology, which says the technology has super features.

The traditional signal generator is of analogue. At the beginning, the squarewave is generated by oscillators and later adjusted by triangle wave, then the function generator appeared. The technology of phase lock was used to raise the frequency stability. Because the intrinsic defects of the analogue, the frequency stability became the most difficult problem especially when the frequency is very low. And it is very difficult to determine the frequency scanning range. It is very hard to observe the measuring results while the waveform phase is shaking.

Then DDS technology appears, all digital concepts and large scale integrated

circuit are adapted in stead of the traditional analogue. The working principle is almost the same as the oscillator, so the frequency stability can be easily got even if the frequency is very low. The frequency changes in very fast speed and the phase still continues. The frequency resolution is very high and only controlled by the scale of used integrated circuit. Because of few analogue parts, the stability and reliability are increased greatly.

Not only are much more function-waveforms in YB33000 series function/arbitrary waveform generator, but also it has many features that the analogue generator didn't have because DDS technology is adapted. The frequency set can be calculated mathematically for its digital presentation. The starting and final frequencies can be set accurately and the frequency response can be observed stably and measured correctly, which is very important to adjust wave filters. It can lock the starting phase of the signals, then the frequency scanning signal is definitely stable and there is no floating of any analogue signals. It looks very obviously like drawing curves. The specially BURST function can generate the pulse waveform of integer periods, especially when one period of the waveform has been output, input the formal function waveform, then the series waveforms such as BURST can be got. And if it is

connected with the function of any waveform, it can generate more kinds of waveforms.

1.3 What is AWG technology

In 90's, the function generators from main companies in the world all have the function of ARBITRARY WAVEFORM GENERATOR. What's more, its complexity and the operating convenience and matching software have been developing very rapidly. The AWG function would be the main trend for a long time in the development of signal generators technology.

With the arbitrary waveform generator, the traditional manufacturing method determined by suppliers has been changed. According to customers' requirements, the suppliers can work out the generators for them to produce the arbitrary waveforms for scientific research、teaching、manufacturing。

The traditional signal generator and the modern computer produce the arbitrary waveform generator. The generator can produce the satisfactory waveform curves with its obviously、flexible and convenient computer software. Generally, the arbitrary waveform curves can be got by three methods: One is to draw a curve by mouse or keyboard directly; The second is to get the curve data by mathematical

formula; The third is to collect the signal waveform by a digital sampling oscilloscope. The three methods can be used separately and coordinately. Then ideal waveform would appear. Download the arbitrary waveform data to the instrument by RS-232 or GPIB interface using the editing software, the instrument would output the electric signal according to the changing principle of the arbitrary waveform.

The advantage of the arbitrary waveform generator is its casualty and reality. The limited waveform of the traditional generator cannot analogue the complex world. But with the arbitrary waveform generator, it is very convenient. Collect all kinds of the actual waveforms as much as possible with a portable data collector to the library. Do some necessary editing the download them to the arbitrary waveform generator. Then you can get the actual waveform of the world in the library, which simples the working steps. With the developing of the internet, you can even get the waveforms from every place in the world through the internet and measure them in the library easily.

1.4 Instrument list

The standard instrument list is as following:

Function / Arbitrary Waveform Generator	1 set
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Editing Software Disk	1 piece
Connecting cable	1 piece
Instruction manual	1 copy

Note: IEEE-488 card should be bought additionally.

1.5 Points for Attention while using

The instrument cannot be put directly under the sun or near the heat

Resources.

The instrument cannot be used outdoors when it is very cold.

The instrument cannot be taken from very hot places to very cold places and vice versa.

If the instrument is put in the places of high relative humidity or the dusty places, there would be something wrong with it. The best relative humidity is 35% — 90%.

The instrument should not be put the places where vibrate very strongly since the instrument is a kind of measuring instrument of high accuracy. Or the instrument would break down.

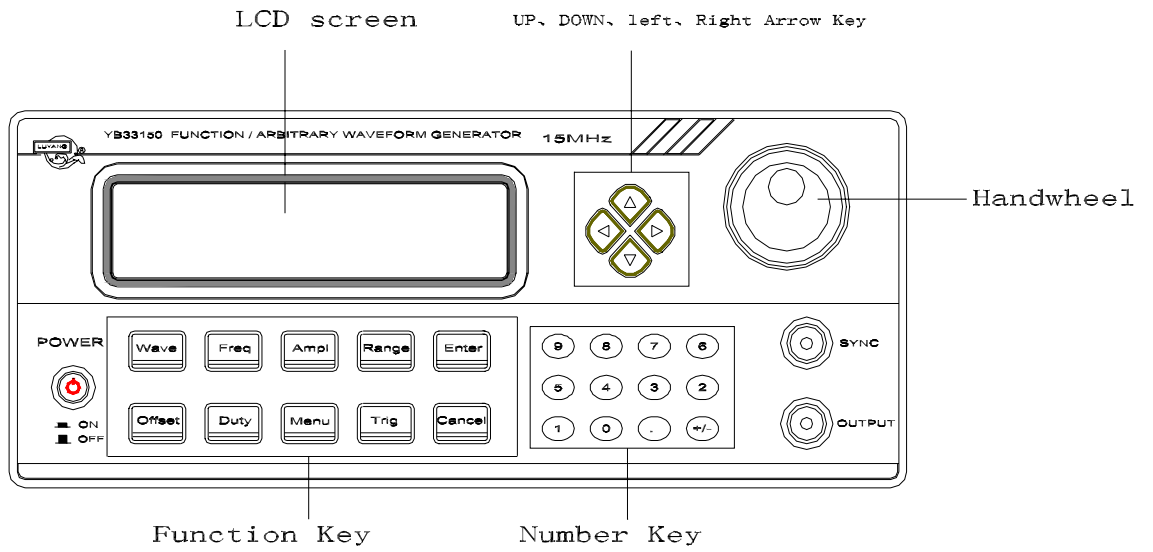
Don't use the connecting cable to pull the instrument.

In order to avoid the circuit damage for high current, please use the correct fuse.

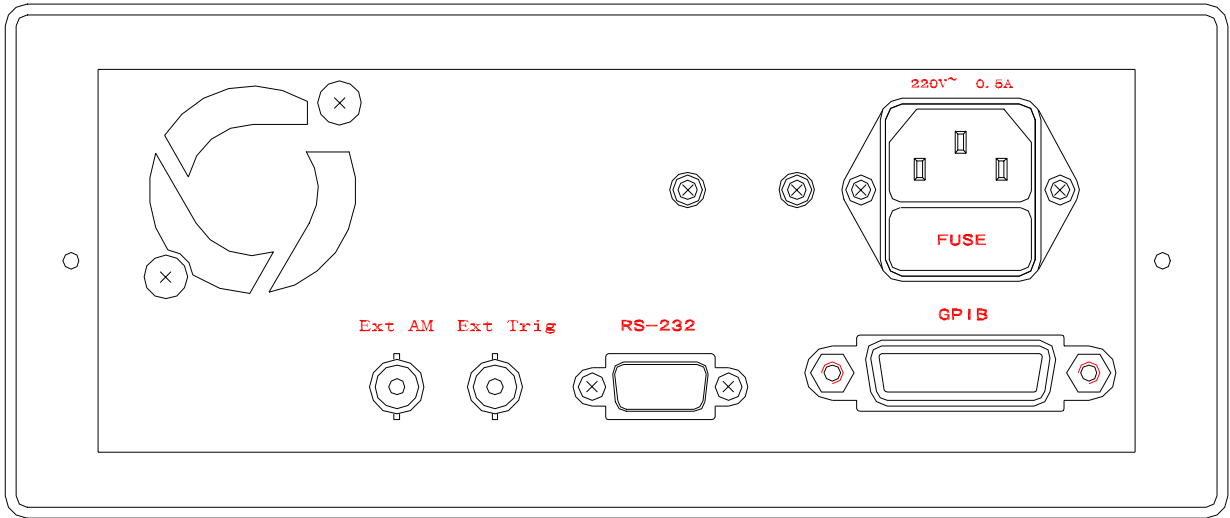
Rated voltage	Rated current
AC 220V	1A

Please contact with the nearest sales stations for repair if there is anything wrong with the instrument.

II 、 Panel Function & Menu Operation



Front Panel Diagram of YB33150 Function/Arbitrary Waveform Generator



Rear Panel Diagram of YB33150 Function/Arbitrary Waveform Generator

There are altogether ten function controllers、 twelve digital keys、 four direction keys and one handwheel in YB33000 panel.

The common function can be completed using one controller such as “Waveform”、 ”Frequency”、 ”Amplitude”、 Deflection Ratio”、 “Duty Ratio” . Some other functions, such as “On-line” 、 “Mode” and the modulated parameters and so on, press “Menu” key to enter the rolling mode, then change the menu by up or down key.

There are two basic operating methods: Parameter setting and Mode setting.

Parameter setting indicates the operation of “Frequency” 、 “Amplitude” and etc, Mode setting indicates the operation of “Waveform” 、 “Mode” and etc.

Parameter setting can be adjusted by rotating handwheel directly (The handwheel can be used while it shines on the screen) . Then one parameter is shining on the screen, it changes in the current state to the following step. Use the left or right key to change the shining number to the next, that is to change the adjusting sequences. With the handwheel adjustment, the parameter setting is changed at the same time.

The handwheel setting method is almost the same with the traditional potential knob.

Another setting method is to write into the digits: Press “Enter” key, the original digits all disappear, input the number by number keys, and all the inputting digits are

shining continuously, that is to say that it is in the inputting state. If there is a wrong number input, use the left key to delete the right digits. In the inputting state of the keyboard, press “ESC” key to escape from the inputting state to recover the original setting. After all digits are input, press “Enter” key to set the instrument to be the new setting state and at the same time, the digits stop shining.

The instrument can automatically stop at the limitation values of every parameter. When it is in the mode of “Line Frequency Scanning” 、 “Log Frequency Scanning” 、 “Inner Frequency Modulation” 、 “Inner Amplitude Modulation” and etc, some parameters can be input only through keyboard because it is slightly slow for the inner software to calculate and it cannot follow the rapid changing of the handwheel. And then, there is on shining digits on the screen.

Mode setting can only be completed by the handwheel or by the left or right key. And then, the mode variable is shining such as “ Sine wave” of the “Waveform” menu. Use the handwheel or the left or right key to adjust them in cycle turn.

The following paragraph introduces the function and operation of each menu.

Waveform: Press “Waveform” to enter into the waveform selecting menu.

Waveform:	Sine
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Rotate the handwheel or use the left or right, the outputting waveforms are : sine wave、square wave、triangle wave、up-slant wave、down-slant wave、noise、SIN(X)/X、up index、down index、DC and six kinds of arbitrary waveforms in turn.

Frequency: Press “Frequency” key to enter into the frequency setting menu.

Frequency =	1.0000000kHz
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There is a digit shining on the screen, it is to say that the sequence of the parameter can be adjusted using the handwheel. Using the left or the right key to change the shining digit to realize the rough adjustment or the variable adjustment. With the handwheel adjustment the instrument setting changes at the same time.

Press “Distance” key, the frequency unit, for example “KHz” , begins to shine on the screen. Then the current unit can be adjusted. Press the up key or the down key or rotate the handwheel each time for ten times of the original and the unit changes to “MHz”、“KHz”、“Hz”、“mHz” in turn. Press “Distance” key to make it stop shining and it is in the stepping state adjusted by the handwheel.

Using the digits inputting mode to set the parameters once. Press “ Enter” key, the original values displayed on the screen disappear and the instrument is in the state of keyboard inputting mode. Use the number keys to input the necessary frequency value directly. During the input, all the new digits are shining continuously. If there are any wrong digits, use the left key to delete the right number. And if you want to escape from the current keyboard operation, please press “ESC” key and the original values would appear on the screen again. Press “Distance” key, the frequency unit, for example “KHz”, begins to shine. It is in the state of adjusting the current unit. Then press the up or down key for 1000 times changing each and the frequency unit changes to “MHz”、“KHz”、“Hz”、“mHz” in turn. Press “Distance” key to make it stop shining. During the inputting, the instrument always keeps the original frequency values. The digits stop shining and change to the new ones till the “Enter” key is pressed.

The up limitation of the frequency is 15MHz and the down one is 10mHz, the starting frequency is 1KHz.

Please note that the instrument can be set during the above range as to every waveform. But it is suggested that the using range should be below 100kHz except for sine waves and square waves. Otherwise there would be too much distortion appeared on the screen.

Amplitude: Press “Amplitude” key to enter into the amplitude setting menu.

Amplitude=	100mV
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Since YB33000 is not a constant voltage supplier, there is a $50\ \Omega$ resistance output internally, with the same amplitude setting, the actual output voltage would change with the outside loading. So the loading condition should be indicated clearly. The loading for YB33000 is $50\ \Omega$.

The menu operation is the same with “Frequency” menu. The up limitation is 10Vpp and the down one is 50mVpp. The starting amplitude is 100mVpp.

Deflection Ratio: Press “Deflection Ratio” key to enter into DC deflection ratio setting menu

Deflection Ratio=	0%。
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DC deflection is to add a DC voltage to the output signals from the two symmetrical slopes. Then the signal can move up and down relative to the symmetrical zero point. The deflection ratio is the rate between the adding DC voltage and the signal peak value. When it is 100%, the signal is justly at the zero level. When it is -100%, the signal is all below the zero level.

The menu operation is the same as “Frequency” menu.

The up limitation of Deflection Ratio is 100% and the down one is -100%. The starting ratio is 0%.

Duty Ratio: Press “Duty ratio” key to enter into duty ratio setting menu.

Duty ratio =	50%
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The menu is only used to set the duty ratio of the square waves. The duty ratio is to indicate the occupied percentage of the high level time as to the whole period.

The menu operation is the same as “Frequency” menu.

The up limitation of the duty ratio is 80% and the down one is 20%. The starting duty ratio is 50%.

The above-mentioned menus are used very frequently on YB33000. So we list the detailed operating methods. For too many functions, it is impossible to list the direct operating keys and they can only operated in the rolling menu. The rolling menu is entered by pressing “Menu” key.

Menu: Press “Menu” key to enter to the rolling menu operation

The rolling menu is divided into 12 degrees. They are “On-line”、“Mode”、“Starting Frequency”、“Final Frequency”、“Pulse Width”、“Interval”、“Pulse Number”、“Starting Phase”、“Wave Modulation”、“Frequency Modulation”、“Frequency Deflection”、“Depth of Amplitude Modulation” . Use the up and down keys to select the rolling functions. The details are as following:

1、On-line

On-line:	OFF
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The menu sets the online state and mode between YB33000 and the computer. There are three selections: “OFF”、“RS-232” and “GPIB” .

It is “OFF” at the beginning and it says that YB33000 is off line and not controlled by computers. Press “Enter” key and “OFF” begins to shining. Use the left or right key or the handwheel to select one of the two online modes: “RS-232” or “GPIB” . Press “Enter” key again to stop shining and it is in the online state. In online state, download the datum about the arbitrary waveform to YB33000 inner memory through computers and the detailed operating methods are referred to the following paragraphs. If you want to escape from the online state, please press “ESC” to return to “OFF” state.

2、 Mode

Mode:	No
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The menu is used to set the instrument modulating modes. “No” indicates that the single frequency and stable amplitude work continuously and there is no modulation. If the modulating mode should be set, use the left or the right key or the handwheel to select the modes. There are altogether eight kinds of modulating modes: “Line Frequency Scanning”、 “Log Frequency Scanning”、 “Frequency Moving Controller”、 “Filling Pulse”、 “Burst”、 “Inner Frequency Modulation”、 “Inner Amplitude Modulation”、 “Ext Amplitude Modulation” .

In each modulating modes, rolling menus can do the setting selections. The rolling menu includes the following: “Starting Frequency”、 “Final Frequency”、 “Pulse Width”、 “Interval”、 “Pulse Number”、 “Starting Phase”、 “Wave Modulation”、 “Frequency Modulation”、 “Frequency Deflection”、 “Depth of Amplitude Modulation” .

In “Line Frequency Scanning” mode, the frequency changes from “Starting Frequency” to “Final Frequency” . “Starting Frequency” and “Final Frequency” haven’t been distinguished as big or small and the frequency scanning can be done positively or negatively. The time and interval can be set by “Pulse Width” and

“Interval” .

In “Log Frequency Scanning” mode, the frequency changes from “Starting Frequency” to “Final Frequency” on indexes. And the displayed result is the same as the frequency response curve drawn according to the relative logs.

“Frequency Moving Controller” is FSK. It is a kind of changing between “Starting Frequency” and “Final Frequency” of a signal. The continuous time of “Starting Frequency” and “Final Frequency” can be set by “Pulse Width” and “Interval” .

“Filling Pulse” is a state of interval output of signals controlled by gates. The filling signal frequency is set by “Frequency” menu and the opening and closing time of the gate are set by “Pulse Width” and “Interval” . The waveform phase at the opening is set by “Starting Phase” .

“Burst” is the state of BURST abrupt state. The signal outputs the definite number of BURST interval. The signal frequency is set by “Frequency” menu and the number is set by “Pulse Number”, the interval time is set by “Interval”, the waveform phase at the beginning is set by “Starting Phase” .

“Inner Frequency Modulation” is FM frequency modulation. The waveform of the modulating signal can be any one kind of YB33000 inner stored ones except square waves

and it is set by “Wave Modulation” . The frequency of the signal is set by “Frequency” menu and the frequency of the frequency modulation is set by “Frequency Modulation” . The biggest frequency deflection of the signal is set by “Frequency Deflection” .

“Inner Amplitude Modulation” is AM amplitude modulation. The waveform of the amplitude modulation can be any one kind of YB33000 inner stored ones except square waves and it is set by “Wave Modulation” . The frequency is set by “Frequency” menu. The frequency of the amplitude modulation signal and its strength are set separately by “Frequency Modulation” and “Depth of Amplitude Modulation” . Then the setting of “Amplitude” Menu has no definite meaning.

“Ext Amplitude Modulation” is a kind of signal used to amplitude the instrument from BNC plug. And the instrument would automatically decrease the signal amplitude to the half to leave out the amplitude modulation space.

3、Starting Frequency

Starting Frequency= 1.0000000kHz

Set the starting frequency or the frequency scanning and the frequency No 1 of FSK. In FSK, the adjusting method of the starting frequency is the same as “Frequency” menu; but in frequency scanning, it is input only through the keyboard for it needs a long time to

do calculations while the parameters are changed. It is impossible to change with the handwheel.

The up limitation of the starting frequency is 15MHz and the down one is 10mHz. The starting is 1KHz.

4、 Final Frequency

Final Frequency= 100.00000kHz

Set the final frequency of the frequency scanning and the frequency No.2 of FSK. The operating method is the same as the above.

The up limitation of the final frequency is 15MHz and the down one is 10mHz. The starting is 100KHz.

5、 Pulse Width

Pulse Width= 10.0ms

Set the frequency scanning, the frequency No.1 of FSK and the continuous time of the filling pulse. The operating method is as the same as the above.

The up limitation of the pulse width is 500s and the down one is 10us. The starting is 10ms.

6、 Interval

Interval=	10.0ms
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Set the frequency scanning, the frequency No.2 of FSK and the time interval of the filling pulse. The operating method is the same as the above.

The up limitation of the interval is 500s and the down is 10us. The starting is 10ms.

7、 Pulse Number

Pulse Number=	1
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Set the pulse number in the mode of BURST.

The up limitation of the pulse number is 65535 and the down is 1. The starting is 1.

8、 Starting Phase

Starting Phase=	0
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Set the phase of the frequency scanning, the filling pulse and the waveform in the mode of BURST.

The up limitation of the starting phase is 360 degree and the down is -360 degree. The starting is 0.

9、 Wave Modulation

Wave Modulation= Sine

Set the waveform of the amplitude modulation and the frequency modulation. It can be any one kind of YB33000 inner stored ones except square waves, such as sine wave, triangle wave, rising-slant wave, dropping-slant wave, noise, SIN(X)/X, rising-index, dropping-index or six arbitrary waveforms.

10、 Frequency Modulation

Frequency Modulation= 1.000kHz

Set the frequency of the modulating signals for amplitude and frequency modulations. The up limitation is 20KHz and the down is 10mHz. The starting is 1KHz.

11、 Frequency Deflection

Frequency Deflection= 1.0000kHz

Set the biggest frequency deflection in frequency modulation (Including the negative frequency deflection).

The up limitation is 15MHz and the down is 10mHz. The starting is 1KHz.

Please note: Since the frequency of the frequency modulation is set by “Frequency” menu, it can not be over 15mHz or below 10mHz plus the max frequency

deflection.

12、 Depth of Amplitude Modulation

Depth of Amplitude Modulation=	100%
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Set the changing degree of the amplitude in amplitude modulation.

The up limitation is 120% and the down is 0%. The starting is 100%.

“Trigger” key

“Trigger” key is used in the mode of single pulse output.

It can be also used in the modes of Frequency Scanning、 Filling Pulse and BURST. Press the key for once to enter the single triggering mode, there will be a stable definite pulse waveform appeared in Frequency Scanning、 Filling Pulse and BURST modes. Its time is set by “Pulse Width” rolling menu. If you want to escape from the state, please press “ESC” key, the modes of Frequency Scanning、 Filling Pulse and BURST would change to the mode of continuous output pulse.

III Editing Software for Arbitrary Waveform

3.1 Brief Introduction

As you know from Paragraph 1, Arbitrary Waveform Generator is the product of

the computer technology integrating with the signal generator technology. So there is a set of operating system software supplied with each instrument. It is used to establish the arbitrary waveform for it is impossible for the instrument itself to establish the arbitrary waveform and do some editing. It can be only done with a computer with complex calculating methods and the features of high speed and convenient software.

3.2 Software Interface

The software is operated under the WINDOWS environment and its interface is of WINDOWS style.

Same as most WINDOWS software, the name of the operating system is shown in the top, then follows the operating menus. The menu is of Pull-down type and press ALT and the letter key in the square brackets at the same time to select the Pull-down menu. Of course mouse can do this very conveniently. The software has the picture-mark operating mode that is very popular currently. All the marks are listed just below the menu and there is a relative picture on each mark to indicate the operating mask. It is very obvious and the customer hit the left key the mouse to enter into the relative operating mode. It is not necessary to pull down the menu grade by

grade. The “information” column lies to the right of the picture marks. When the mouse arrow directs the picture marks, the operating content would be shown on the column in text. Also there are some other indications appearing on the “Information” column.

In the software interface, the most important area is the middle window for displaying waveforms. The establishing and editing of the arbitrary waveforms are done in the window. A horizontal rolling bar is just below the bottom of the window that is used to move the waveform for observation and editing when the waveform is enlarged. Both ends of the rolling bar are the coordinate indications. If there is no editing area, the indication shows the horizontal coordinates of the left and right ends of the curves in the current window. If there is an editing area, it shows the horizontal coordinates of the left and right ends of the editing area. Other parameters relating with waveform editing are set in the area of “Drawing Parameters”, among which there are two indicating methods of storing coordinate and physical coordinate for selection in “Cursor Position”. The storing coordinate indicates the position of the data in the memory and the Bit value. The physical coordinate indicates the actual time and voltage of the data. The selection can be set in “Selection” menu.

Hit the up and down arrows in the right of “Waveform Setting” window. The diagram will change with it and can set the output waveform vividly. Amount of information columns that can spring out are supplied for guiding the customers.

3.3 Mouse and Keyboard

The software of WINDOWS style is operated almost by mouse and at the same time it can also be operated with keyboard. It is also for the software used here. In most cases, mouse can be instead of keyboard and especially during drawing work, the more accurate operating can be done by keyboard. Here we explain the functions mainly by mouse. So we list the relative functions set on keyboard as below for referring:

Left key of mouse	Enter
Right key of mouse	Esc
Mouse sliding	up key、 down key、 left and right key

3.4 Data Text Format

There is a requirement on storing style for the waveform data. It should be saved as alphabetic string and the expanding name should be .awg. File with the expanding name of awg should be: The 10 alphabetic strings in the front should be the file head,

each string for a row and list row by row and the first string represents the length of the file data. The others are ready for definition. Customers can set it as zero while saving the files. From the eleventh string, the followings are all the ones indicating waveform data values and the first string of the file sets the length. There are 32 strings in the string series and they are separated by “,”. And they are listed row by row. The detailed file format would be as the one you save one curve on the screen.

Since the waveform datum are from different sources and the amplitude resolution of the instrument is 12bit, so the customers should normalize and invert their datum according to the detailed condition. The biggest one is 4095 and the smallest is 0. The range 0~4095 indicates the peak to peak of the signal. As to each actual voltage, adjust the amplitude and DC deflection while outputting. Obviously, the range 0~4095 had better be filled with the datum so the 12Bit amplitude resolution can be fully used. Customers invert the datum from a Digit Sampling Oscilloscope or the datum calculated by formulas into the specified styles, the software used here can read、display、edit them。As to another method for establishing the waveform, that is to draw lines, can be completed by the software itself.

The inner memory in YB33000 for storing the arbitrary waveform is 32K bit, that

is 32768 effective data points. So the data amount of the downloading arbitrary waveform should be 32768 points, or error information would appear on the screen. But there is no limitation for the software to open、edit、save or print. The customers can cut、copy、paste or shorten the waveform datum collected by a Digit Sampling Oscilloscope. The definition of the arbitrary waveform is to supply the biggest creating space for customers to operate the instrument practically.

3.5 Waveform Display Mode

There are two mode for the waveform curves to display: Data curve 数 and vector curve. The data curve is formed by a large amount of data points, such as the curve from opening a file. Line segments, such as hand-drawing curve, form the vector curve. During editing there are often two kinds of curves at the same time, but while the file is saved, the vector curve would be changed into the data curve with actual meaning by the operating system.

The existence of the vector curve makes it possible to modify the waveform in hand. In order to make the waveform look be more like the actual, the instrument has the function of adding noises of different strength to the data curve. Then the vector curve would be not so distorted after it is inverted into data curves.

In order to distinguish data and vector curves during operation, the red line is used to indicate the data curve and the blue one indicates the vector curve.

3.6 Menu Functions and Operation

Since it is changeable for the menu and the picture marks, we now would list the function of each menu as below.

3.6.1 Open Save and Print:

The editing software can open、 save and print the general files same as common operating systems. For it is of WINDOWS style, you can use them easily. The printing function is another method to save the waveform for customers. Before entering into the printing dialogue, set the position and size of the printing content on the paper in the printing parameters setting dialogue and the setting would be saved automatically.

3.6.2 Recover

During editing the data curves, the formal waveform data is still in the memory if it is not saved. You can recover it to the formal by the function of “Recover” in the “Edit” menu. Also the function can cancel the marking the editing area、cutting and Enlarging operation.

3.6.3 Mark Editing Area

The customers can cut, shorten, adding noise, smooth, enlarge the data waveform curves and trace with cursors and etc. The editing area should be marked before any operation.

Hit “ Mark editing area” in the “Edit” menu when there is a data waveform curve displayed on the window. The cursor would stop on the left and up corner and at the same time, there is a vertical measurement line appearing. Slide mouse (Direction keys also OK) to move the measurement line to the left or to the right. “Cursor Position” in the “Drawing Parameters” column would show the position of the relative data point, which is very important to determine the accurate position. Then the cursor is limited with the displaying window. If you hit the right key of the mouse, the measurement line would disappear and it cancels the marking operation. The cursor would be active on the full screen. Hit the left key of the mouse at the selected point at the left to mark the editing area and slide the mouse to the right. There would be a blue area. Select the right board to click the left key of the mouse and the area is marked. And if you want to cancel marking, you can click the right key of the mouse and the blue area disappears, the mouse is active on the full screen. If you want to

change the marking area, you can click the “Mark Editing Area” again, the formal blue area would disappear and you can begin to operate once more.

Click “Recover” to cancel marking editing area.

3.6.4 Cut

After the editing area is determined, the item “Cut” can delete the data points in the area, and the waveform can be modified by hand drawing on the blank areas. The details are referred to the paragraph of “Establishment of the vector curve” .

It is the basic function to cut the data curve for the arbitrary waveform editing software. You can get a complete waveform by collecting a digit sampling oscilloscope or by working out with mathematical formulas, but you cannot pick up its detailed parts, such as to get rid of the disturbance of the sharp peak or adding by human. It is very uncomfortable for you to describe them with mathematical formulas. You can draw the lines by hand, that is, draw the line by sliding the mouse. Save it once more, it has been inverted into the waveform data for downloading.

If it is not saved, click “Recover” to cancel cutting operation and the formal diagram is still on display.

3.6.5 Shorten

Cutting is to cut the curve data in the editing area and keep the 剪 others outside the area. But shorten is to delete the part outside the editing area and to keep the ones in the editing area. Other than cutting, it would cancel editing the formal data curve while shortening and “Recover” cannot be used to recover displaying the formal curve while the data haven’t been deleted.

The purpose is to keep the useful part of the data curve ready for usage especially when the data bigger than 32768 points is collected by a digit sampling oscilloscope, you can get a downloading waveform data for one time with the function.

3.6.6 Noise

The shortcoming of hand drawing is that the line is too smooth. The actual signal waveform is rough with all kinds of noise, which should be considered while establishing the arbitrary waveforms. So only the arbitrary waveform generator can imitate the actual nature. Even if the waveform from a digit sampling oscilloscope or worked out by formulas cannot meet the requirement of the experiment in the library.

If there is a data curve, click “Noise” in “Edit” menu to add noise. Adjust its strength with “Strength”, click “Noise” again to recover the formal waveform. If you want to keep the current waveform with noise, please save it.

3.6.7 Sliding

Too neat waveform is easily distorted and too rough waveform would be hard to observe. The environment for a digit sampling oscilloscope to collect waveforms is very difficult and the waveforms are often with unexpected disturbance. Filter it with a smooth filter to get rid of disorderly disturbance, and the main features would appear.

If there is a data curve, click “Smooth” to modify the waveform displayed to be smooth. Select the proper smooth factor in the “Strength”. Click “smooth” again to recover. Please save it if you want to keep the smoothed waveform.

Please note that “Smooth” and “Noise” cannot work at the same time.

3.6.8 Magnify

Since there are 32768 points on the waveform, there are only 512 points on the displaying window, the whole curve should be sampled to display and the hand drawing can only connect the points. Then the details would be lost. So there is a function of magnification. “Magnify” can magnifies the whole or the part. If there is no editing area, the whole is magnified and every piece would have 512 effective points. Or it magnifies the data in the editing area to the whole piece. When the

effective points in the editing area are less than 512 and some points in the middle would be the points for inserting values. Move the waveform to the left or to the right to observe the other part of the waveform. Slide the displaying window of two ends to show the starting number and the final number. The difference between the two values is 511 when it is magnified to the whole.

The advantage of the whole magnification is to observe point by point the arbitrary waveform with “Cursor tracing” and the physical position is consistent with the stored position, which is easy to understand and operate.

The details can be edited in the magnified mode.

Click “Recover” to recover the whole display.

3.6.9 Cursor Trace

In many cases, the customers hope to know the size and position of each data on the curve and the cursor is necessary. Click “Cursor trace” to display the big cross cursor. The coordinates of the cursor center would be indicated by “Cursor Position” in the “Drawing Parameter” column. Slide the mouse to move the cursor and trace the curve point by point. The relative factors would be determined clearly. The cursor trace can also be used in the magnified mode.

3.6.10 Hand Drawing

Hand drawing has a superiority compared with other methods especially when it is used to modify the waveforms.

If there is no data curve, click “hand drawing” to enter into hand drawing state and the mouse is restricted in the displaying window. Slide the mouse and press the left key of the mouse continuously, there would be a curve made of a series of line segments. If you want to cancel the operation, please press the right key to release the window restriction. And the cursor can move in the whole screen. Click “Hand drawing” again to draw the line continuously to the right, then it auto cancels the operation. If you want to delete the drawn line segments, click “Delete line” and the indicating area would appear with each line segment to one area. The segments should be deleted from the right to the left. Press the left key of the mouse to delete and the right key to escape. It is a cause to establish a waveform thoroughly by hand.

If there is a data curve displayed on the window, please set the editing area at fist. Enter into the cutting state, and draw the lines by hand. The operation can also be used to modify part of the data curve and it is very useful in practices. The details are referred to the paragraph before.

3.6.11 New, Clear

All the settings are recovered to the starting state after clearing the screen.

3.6.12 Download Arbitrary Waveform

The purpose of all operation is to save the data of the waveform curve to YB33000 inner memory that can keep the data even if the power is shut off. The memory is a special data memory that can revise the data when the power is on and it can save the data when the power is off. Only such memory can ensure that YB33000 can operate while it is off line: It can save the common waveforms to the memory by computers. Then the saved waveforms can be used without computers and it is very quick and convenient.

Before downloading, select one wave in the range of wave1~wave6 or the wrong information would appear. Only it is correct, can the datum be written into the definite memory.

It is different to write datum into the memory compared with the common static RAM in the order. For RAM, the datum should be written into in file for intervals. But for the memory that can save datum even if the power is off, it is very different. The datum should be written in lots. And there should be 10ms interval between two lots for the memory to

deal with. For the different running speed of the computers, there is no standard of the time interval. Customers can set a proper interval according to the running speed of their computers, at which the data is the smallest and the waveform can be completely download. The setting is automatically saved. The one set by the supplier is much bigger for customers and you can make it smaller properly.

3.6.13 Options

The options are used to set the working conditions for customers.

It is necessary to define a data coordinate in practice. The physical coordinates with actual meaning are more useful than those given by the memory and the Bit number. Here the menu of “X-Y Sample Coordinate” is used to select the coordinate in the memory and the menu of “Time-Voltage Coordinate” to select the physical coordinate. And the later would be changed with the setting of “Frequency” or “Cycle” column.

The operating software would save the settings automatically.

3.7 Establish the arbitrary waveform with maths formulas

We have explained that there are three methods to establish the arbitrary waveforms. The method of hand drawing has been described carefully in the former paragraphs and the operating software is mainly used to establish and modify the hand-drawing curves. The

second method is that customers establish the arbitrary waveforms by a digit-sampling oscilloscope and edit a little program, then normalize it and save to the files with the expansion name of awg. For there are too many kinds of digit-sampling oscilloscopes, customers can select a proper one according to the requirement.

The third method is to establish an arbitrary waveform with maths formulas. In fact, it can be done by any kind of maths software. Here we only list the programs edited by QBASIC and C language. It is a small language and can be understood by anyone who knows about the programming knowledge. Customers should pay attention to the saving sentences and do some proper changing with the maths software.

3.7.1 Establishing program edited by BASIC language

Customers can find the software of QUICK BASIC language and the establishing program of the arbitrary waveform with the name of awgfile.bas in the directory of QBASIC in the disk with the instrument. The establishing program has been past the testing. Customers can establish all kinds of arbitrary waveforms by changing the maths formulas.

The detailed steps are as following: Execute QBASIC.EXE in DOS system, and enter into BASIC language, open awgfile.bas program to change the maths formula necessarily.

The file 1.awg also can be changed according to the demand. Press ALT+R to run the program and customers can establish a series of arbitrary waveforms. Open the saved file in WINDOWS to display.

The program awgfile.bas is as following:

```
'Set up the datum string of the sine wave amplitude modulation in the file 1.awg
'a data of an arbitrary waveform
AWGMEMORYLENGTH = 32768
'Data string variable
DIM AWGWAVEFORM AS INTEGER
'Open the saving file
OPEN "1.awg" FOR OUTPUT AS #1 ' Define the file name
'Set up the file header
PRINT #1, AWGMEMORYLENGTH 'Code string mode
FOR N = 0 TO 8
PRINT #1, 0
NEXT
'Establish the curve data string
```

```

P = 0
TEMP$ = ""
'Data string is calculated with maths formulas, the range is 12bit ,that is 0~
4095
FOR N = 0 TO AWGMEMORYLENGTH - 1
    AWGWAVEFORM = 2048 + 2047 * .5 * (1 + .9 *
    COS(2*3.1415926# * N / (AWGMEMORYLENGTH/2))* SIN(2 *
    3.1415926# *N / (AWGMEMORYLENGTH/32)
'Save the data string in the .awg format
    TEMP$ = TEMP$ + STR$(AWGWAVEFORM) + ","
P = P + 1
IF P = 32 THEN      ' 32 code string each row, separated by ","
    PRINT #1, TEMP$
    P = 0
    TEMP$ = ""
END IF
NEXT

```

```
PRINT #1, TEMP$ '32 remainder saving
'End saving
CLOSE #1 'Close the file
```

3.7.2 Edit the program with C Language

There are TURBO C language software and the program file awgfile.c for establishing arbitrary waveforms in the TC directory in the disk supplied with the instrument, and the program file has been past the testing. Customers can get different arbitrary waveforms by modifying the maths formulas in the program.

The detailed operating method is as following: Firstly make a directory named TC to copy the extracted files from the file TC30.EXE in the TC directory that is not an executing file. Run the file TC.EXE in the extracted files in DOS system to enter into TURBO C language environment and open the program awgfile.c to change the maths formulas. The file 2.awg also can be changed according to the demand. Press CTRL+F9 to run the program to establish an arbitrary waveform in the definite file. Display the saved file in WINDOWS system.

C program is as following:

```
/* Establish a data string of a attenuated waveform in the file 2.awg */
```

```

# include <stdio.h>
# include <stdlib.h>
# include <conio.h>
# include <math.h>
/* a data of an arbitrary waveform */
# define AWGMEMORYLENGTH  32768
  /* data string variable */
unsigned char awgwaveform;
int p = 0;
  /* save the sub-program */
void savedatatofile(FILE *fp,unsigned char data);
void main(void)

{
    long i;
    FILE *fp;
/*  save the file */

```

```

    fp = fopen("2.awg","w+"); /* open the file 2.awg */
/* set up the file head */
    fprintf(fp,"%d\n",AWGMEMORYLENGTH); /* code string mode*/
    for(i=0;i<9;i++)
        fprintf(fp,"%d\n",0);
/* The data string is calculated with maths formulas, the range is 12bit, that is 0~
255 and saved in .awg format */
    for(i=0;i<AWGMEMORYLENGTH;i++)
    {
        awgwaveform =
2048+2047*(sin(2*M_PI*i/(AWGMEMORYLENGTH/16.))*exp(-(float)i/(A
WGMEMORYLENGTH/8.)));
        savedatofile(fp,awgwaveform);
    }
/* End saving */
    fclose(fp); /* Close the file */

```

```
}
/* save the sub-program with the format of .awg*/
void savedatatofile(FILE *fp, unsigned char data)
{
    fprintf(fp, "%d,", data);
    p++;
    if(p>=32) /* 32 code string each row, separated by “,” */
    {
        p=0;
        fprintf(fp, "\n"); /* Enter */
    }
}
```

Appendix Technical Specifications

Function Waveform	Sine wave, Square wave, Triangle wave, Up-slant wave, Down-slant wave, Noise, SIN(X)/X, Up-index, Down-index												
Arbitrary waveform	Waveform storing-length 32 (32768) points Amplitude resolution 12 bit (Including brackets) Sampling rate 80Msa/s Memory with power protection Six waveforms with 32k												
Frequency	<table> <tr> <td>Sine wave and square wave (YB33150)</td> <td>10mHz—15MHz</td> </tr> <tr> <td>Sine wave and square wave (YB33100)</td> <td>10mHz—10MHz</td> </tr> <tr> <td>Sine wave and square wave (YB33050)</td> <td>10mHz—5MHz</td> </tr> <tr> <td>Other waveforms</td> <td>10mHz—100kHz</td> </tr> <tr> <td>Resolution</td> <td>100mHz or 8 digits</td> </tr> <tr> <td>Stability Value)</td> <td>≤50ppm (Typical Value)</td> </tr> </table>	Sine wave and square wave (YB33150)	10mHz—15MHz	Sine wave and square wave (YB33100)	10mHz—10MHz	Sine wave and square wave (YB33050)	10mHz—5MHz	Other waveforms	10mHz—100kHz	Resolution	100mHz or 8 digits	Stability Value)	≤50ppm (Typical Value)
Sine wave and square wave (YB33150)	10mHz—15MHz												
Sine wave and square wave (YB33100)	10mHz—10MHz												
Sine wave and square wave (YB33050)	10mHz—5MHz												
Other waveforms	10mHz—100kHz												
Resolution	100mHz or 8 digits												
Stability Value)	≤50ppm (Typical Value)												

Signal Features	Square wave Rising time $\leq 25\text{ns}$ Overshot (1Vpp) $\leq 2\%$ Non-symmetry (1KHz) 优于 2% Range for duty setting 20%-80% Linearity of Triangle and Slant wave $\leq 1\%$								
OUTPUT FEATURES	Range for amplitude (50 Ω) 50mVpp—10Vpp Attenuating error (1kHz) $\leq 5\%$ Frequency response(1Vpp,Basic frequency 1MHz) $\leq 5\%$ Range for Deflection Ratio setting(within 5V) -100%—100% Output impedance About 50 Ω Resolution setting 3 bit								
Distortion of Sine wave	<table border="0"> <tr> <td><1kHz</td> <td>-60dBc</td> </tr> <tr> <td>1kHz-100kHz</td> <td>-50dBc</td> </tr> <tr> <td>100kHz-1MHz</td> <td>-40dBc</td> </tr> <tr> <td>1MHz-15MHz</td> <td>-30dBc</td> </tr> </table>	<1kHz	-60dBc	1kHz-100kHz	-50dBc	100kHz-1MHz	-40dBc	1MHz-15MHz	-30dBc
<1kHz	-60dBc								
1kHz-100kHz	-50dBc								
100kHz-1MHz	-40dBc								
1MHz-15MHz	-30dBc								
Phase Noise (fc=10MHz,RBW=3k Hz, VBW=300Hz)	<table border="0"> <tr> <td>30kHz deflected</td> <td>-55dBc</td> </tr> </table>	30kHz deflected	-55dBc						
30kHz deflected	-55dBc								

Frequency Scanning	Type Direction Starting Frequency/Final Frequency Range for Time Phase	Linearity or log Positive or Negative 10mHz—15MHz 10ms—100s Adjustable for starting phase
FREQUENCY MOVING CONTROLLERS & WAVE FILLING	Inner speed setting Source (frequency controllers) Phase for filling wave	10mHz-50kHz INT/EXT Adjustable for starting phase
BURST	Wave-loading frequency setting Counting Range for starting phase Time interval setting	$\leq 1\text{MHz}$ 1-65535 $-360^\circ -360^\circ$, setting step 1° $10 \mu\text{s}-100\text{s}$
AMPLITUDE MODULATION	Waveform modulation: Range for frequency modulation: Range for depth of amplitude modulation: Source:	Any inner function waveforms and arbitrary waveforms 10mHz-20kHz 0%-120% INT/EXT
FREQUENCY MODULATION	Waveform modulation: Range for frequency modulation Range for frequency deflection Source	Any inner function waveforms and arbitrary waveforms 10mHz-20kHz 10mHz-15MHz INT

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