Digital Storage Oscilloscope

A. TDO3000 Series of Digital Storage Oscilloscope

TDO3102A

Features

- Signal bandwidth: 25MHz/60MHz/100MHz
  Real-time sampling rate: Max. 400Msps
  Equivalent sampling rate: Max. 10Gsps
- 5.6-inch TFT LCD Color display with better clearance, multi-color schemes available
- With up to 2.4Mpts memory depth, more signal details can be seen.
- Independent vertical scale and position control knobs for each channel
- Edge, Pulse width and Video trigger mode available. Alternating triggering function is also available to stably display asynchronous signals
- Unique variable trigger sensitivity to suit special measurement requirements on different occasions
- Math functions including add, subtract, multiply and 1024-point FFT
- Up to 24 kinds of parameters automatic measurements
- Advanced cursor modes: Manual, Auto and Track
- Practical low-pass, high-pass, band-pass, band-reject digital filters with adjustable cut-off frequency
- Unique waveform recording and playback function.
- PASS / FAIL detection, optical isolated PASS/FAIL output
- Built-in 5 digital hardware frequency counter
- Auto-calibration feature
- Multiple language user interface
- Pop-up menu, the user operation more convenient and intuitive
- Embedded help information system in Chinese and English
- Up to 10 internal setup and waveform files memories, external storage of setup, track, waveform, BMP bitmap and CSV files
- USB Host Port, Support USB disk storage, and firmware upgrade can be carried out through an USB disk.
- PRINT button pressed to directly store the screen image (BMP) or the waveform data (CSV) in an USB disk
- USB device and RS232C interface for the instrument remote control

Application Fields

- Laboratory and training center in colleges and universities
- Production line test and quality Control
- Test and measurement in R&D department
- Maintenance and aftersales service

Brief Introduction

- TDO3000A series digital storage oscilloscopes provide you with excellent performance and strong functions in a compact design. Even as a new generation of portable low-priced general product, the series still offers many measurement functions of middle or high end product and meets your measurement requirement with affordable cost.

With bandwidth 25MHz, 60MHz and 100MHz, the series offers a maximum real-time sample rate of 400Msps and equivalent sample rate of 10Gsps to ensure you accurate observation of signal details.

Many standard advanced features such as multi triggering modes, cursor measurement functions, auto measurement, digital filtering, waveform storage, math function, FFT, PASS/FAIL judgement, multi communication interfaces, etc. make the measurement faster and easier

Prominent Signal Measuring Capability

Observation of the signal more clearly

TDO3000A Series features a 5.6-inch 320x234 TFT LCD color display for watching signals from any viewing angle. Different from traditional oscilloscope's fixed menu display, TDO3000A can display the waveform to full screen according to your need.

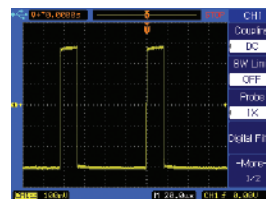**Single MENU ON/OFF key** enables you to view more information in 25% more display area.

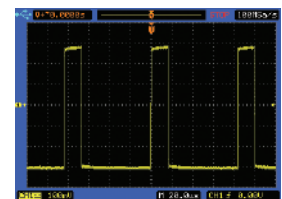Figure 1 Normal display with menu on   Figure 2 Full-screen display with menu off

Deep memory depth for capturing more

Maximum 2.4Mpts memory depth for each channel on all models, TDO3000A Series is easy to record and analyze the waveform. Even under the slow time base settings, you can maintain a high sampling rate. This allows you observe the signal in more details. In a given sampling speed, the more sampling points mean the longer the time observed.
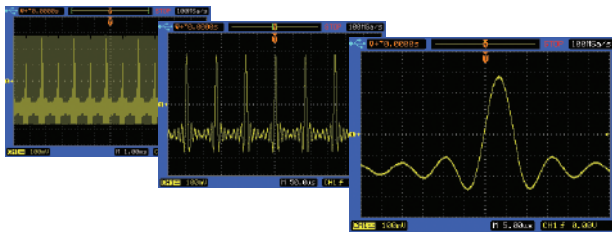
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Figure 3 Deep memory depth waveform display

Delayed sweep mode for both details and the whole waveform

In Delayed sweep mode, you can view simultaneously the details on a particular part and the whole waveform. Through split display you can zoom in on a particular area on your signal while still viewing the entire captured waveform.
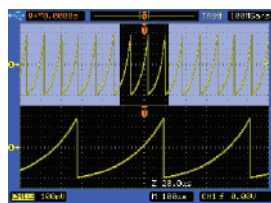

Figure 4 Delay mode to observe signal details

Powerful Functions

TDO3000A series oscilloscope is your indispensable assistant to get your job done easier and faster.

Auto scale

Auto scale can evaluates all input signals and sets the correct condition to best display the signals. Single period or multi periods can be selected to display in the current display window.

Running control

RUN/STOP mode: The oscilloscope starts or stops repetitive acquisition, so you can observe the waveform continuously or freeze the current waveform on the screen.

SINGLE mode: The oscilloscope acquire a single trigger of data when trigger condition is met. It is useful to capture single shoot signals.

Math Function and FFT

TDO3000A series provides some important math operations, including addition, subtraction, multiplication, or 1024-point FFT (Fast Fourier Transforms). For time-domain signal analysis, you can use additions (signal superimpose), subtraction (elimination of noisy component or differential operation, etc.), multiplication (frequency mixing, etc.) processes. For frequency-domain analysis, you have FFT (Fast Fourier Transforms) with five windowing operation (Rectangular, Hanning, Hamming, Blackman, Flat-Top). And spectrum amplitudes of FFT can be displayed in linear or dBV (RMS) scale type.
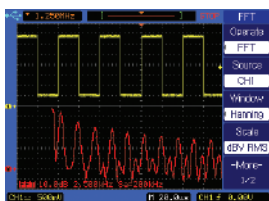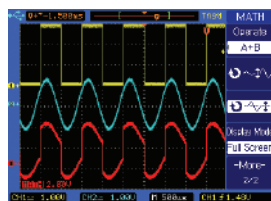

Figure 5 FFT analysis (dBV)

Figure 6 Addition operation

24 Automatic Parametric Measurements

TDO3000A series provides up to 24 automatic parametric measurements. You can either install three commonly used screen measurements or display all the 24 measurements of the current selected source on the screen. Auto measurement can not only save your time for eye observation, but also provide you more accurate results. Without complicated operation, you can get your measurement results easily and quickly.

Figure 7 Auto measurement display

Convenient observation of all signals

Roll mode: It is one of the useful features of TDO3000A series to test low-speed signal accurately. Using the Roll mode, the change of ultra slow speed signal can be observed.
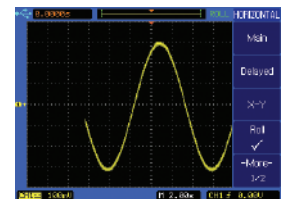

Figure 8 Slow speed signal in Roll mode

X-Y mode: In X-Y mode, channel 1 becomes the X input and channel 2 becomes the Y input. Lissajou's figure can be displayed to calculate phase difference of same-frequency signals.
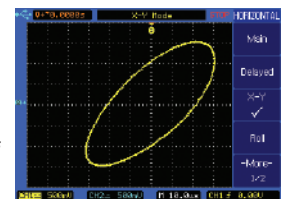
Figure 9 Lissajou's figure in X-Y mode

Video Trigger: TDO3000A series can synchronously trigger on specified line or field of the standard NTSC or PAL/SECAM video signal.
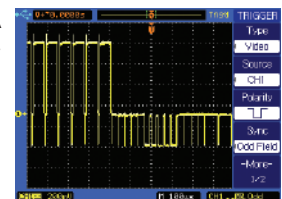
Figure 10 Video trigger mode for TV signal

More Functions

Digital Filter

TDO3000A series provides several digital filters, including low pass, high pass, band pass, and band reject filters. It can be applied to displayed signals to acquire expected results, such as to simulate the effect of a hardware filter, to reject aliasing noise or error signal to clearly observe a signal of interest, etc. The high and low cut-off frequency can be set randomly.

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Figure 11 Signal with noises   Figure 12 Signal processed with a low pass filter
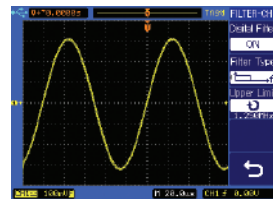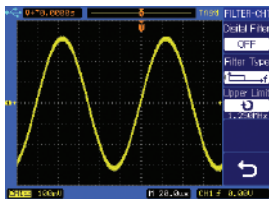
Waveform Record and Replay

TDO3000A series can record the input signal over a period of time continuously in the internal or external memory for future analysis. Up to 1000 frames can be recorded with the variable time interval ranging from 1 ms to 1000s. The recorded frames can be played back continuously or played frame by frame, so that you can observe any frame and capture any tiny abnormality.

PASS/FAIL Judgment

IOn the production line, it is valuable to judge some kind of signal and decide if it is good or not. TDO3000A series can measure the selected input signal and compare it with the predefined PASS/FAIL regulations and then output the PASS/FAIL result. This function is quick and easy and can greatly reduce the man-made mistakes.
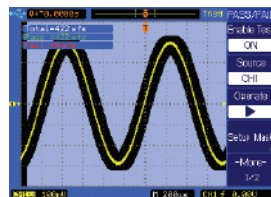

Figure 13 PASS/FAIL measurement

Auto Calibration

TDO3000A can automatically calibrate its vertical, horizontal and trigger system, so that it can operate with the best measurement accuracy.

Unique Built-in Function/Arbitrary Waveform Generator Module

- The first digital oscilloscope with built-in function/ arbitrary waveform generator module in the world
- More accurate, stable and low distortion output with the help of advanced DDS technology
- 200MSa/S sampling rate, 14bits vertical A/D resolution
- 10MHz / 20MHz / 40MHz sine/ square waveform frequency output
- Maximum 10MHz impulse signal frequency output

- Up to 30 kinds of built-in waveforms with up to 1MHz output frequency, such as sine, square, triangle etc.
- Built-in multiple modulation function, including AM, FM, PWM, FSK, PSK and Bias modulation.
- 1uHz to 40MHz frequency sweep in Up, Down and Round sweep mode.
- Up to 30 kinds of commonly used waveforms burst output, including sine, square, triangle waveforms
- 8kpts arbitrary waveform memory depth

Flexible Human-Machine Interface

Logical and easy operation

Different function areas, including input channels, time base, trigger channel and function areas, are positioned and marked respectively, so that it is easy to access and operate. The main front-panel keys light when the corresponding functions are available or active. This human-oriented feature makes your job much easier.

Figure 14 The front panel key board

Multi interface selections

The instrument provides multi interfaces, including USB host interface used to store waveform files (BMP, CSV file format) to an USB disk by simply pressing "PRINT" key, and USB device interface or RS232 interface used to communicate with a computer to control the instrument or to transmit the waveform data.

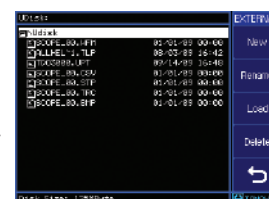
Figure 15 USB disk file system

Software update

The latest updated software of TDO3000A series can be downloaded free from our website (www.tonghui.com.cn), and can be loaded to the corresponding oscilloscope through the USB host interface.

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Specifications

Model	TDO3022A/TDO3022AS	TDO3062A/TDO3062AS	TDO3102A/ TDO3102AS
Sampling System			
Max real time sampling rate	400Msps		
Max equivalent sampling rate	10Gsps		
Memory depth	Single channel ON:2.4Mpts Double channel ON:1.2Mpts		
Vertical A/D resolution	8 Bits		
Sampling mode	Sample, Peck detect, Averaging		
Auto scale	Automatically set vertical scale(V/div), time base(s/div), and trigger mode.		
Vertical System			
Channels	2 analog input channels and 1 trigger input channel		
Bandwidth	25MHz	60MHz	100MHz
Coupling	DC, AC and GND		
Bandwidth limit (-3dB)	Not available	20MHz	
Calculated rise time	<14.0ns	<5.83ns	<3.50ns
Vertical scale (V/div)	2mV/div to5V/div 1-2-5 step		
Vertical gain accuracy	2mV/div, 5mV/div ±4%×reading±0.1div×V/div+0.5mV; 10mV/div to 5V/div ±3%×reading±0.1div×V/div+1mV;		
Vertical offset range	±8 div away from the screen center		
Probe attenuation factor	×1, ×10, ×100, ×1000		
Input impedance	1MΩ‖18pF		
Delay differential	±150ps when vertical scale and coupling settings are identical		
Max. input voltage	400V (DC+AC peak,@1MΩ)		
Probe compensation output	3Vp-p, 1kHz		
Horizontal System			
Time base range (1-2-5step)	10ns—50s/div	5ns—50s/div	
Horizontal mode	Main, Delayed, X-Y and Roll		
Time base accuracy	±0.01%		
XY mode — Input	X-axis input (horizontal): CH1 Y-axis input (vertical): CH2		
XY mode — Bandwidth	25MHz	60MHz	100MHz
XY mode — Phase error	±3°		
Trigger System			
Trigger source	CH1, CH2, EXT, EXT/5, LINE, Alternating		
Trigger mode	Auto, Normal, Single		
Trigger coupling	DC, AC, LF-reject, HF- reject		
Trigger type	Edge, Pulse width, Video		
Trigger level range	Internal: ±8 div from screen center; EXT:±1.6V; EXT/5: ± 8V		
Trigger sensitivity	0.1div to 1.0div user adjustable		
EXT input impedance	1MΩ‖18pF		
EXT max. Input voltage	400V (DC+AC peak,@1MΩ)		
Signal Measurement			
Voltage parameters	Max, Min, VPP, High, Low, Amplitude, Average, RMS, Overshoot, Preshoot, Cycle average, Cycle RMS		
Time parameters	Frequency, Period, Rise time, Fall time, +Width, -Width, +Duty, -Duty, Delay, Phase, X@MAX, X@MIN		
Math functions	CH1-CH2, CH1+CH2, CH1×CH2, FFT(1024points)		
Cursor measurement	Manual, Auto, Track		
Hardware frequency counter	5-digit frequency counter up to full bandwidth		
Storage & Interface			
Internal storage	10 setup files and 10 trace files		
File format	Setup, Waveform, Trace, BMP and CSV file		
Interface	USB HOST, USB DEVICE, RS232C and PASS/FAIL OUT		
Display System			
Display screen	TFT LCD display, 5.6-inch		
Resolution	320(horizontal)×234(vertical) dot matrix		
Color	24 bit true color		
Menu language	Simplified Chinese, Traditional Chinese, English etc.		
Waveform Display — Scale	Menu ON:8div(vertical)×10div(horizontal) i.e. 200(vertical)×250(horizontal) dot matrix Menu OFF:8div(vertical)×12div(horizontal) i.e. 200(vertical)×300(horizontal) dot matrix		
Waveform Display — Type	Dot , Vector		
Waveform Display — Interpolation	(Sinx)/x, Linear		
Waveform Display — Persistence	Off, Infinite		
Waveform Display — Format	YT / XT		
Other Specifications			
Operation ambient temperature & humidity	0°C to 40°C, ≤90%RH		
Line voltage	99V to 242V AC,47Hz to 440Hz		
Power consumption	≤ 50VA		
Instrument dimension	320mm(W)×156.5mm(H)×123mm(D)		
Net weight	Approx. 2.5kg		

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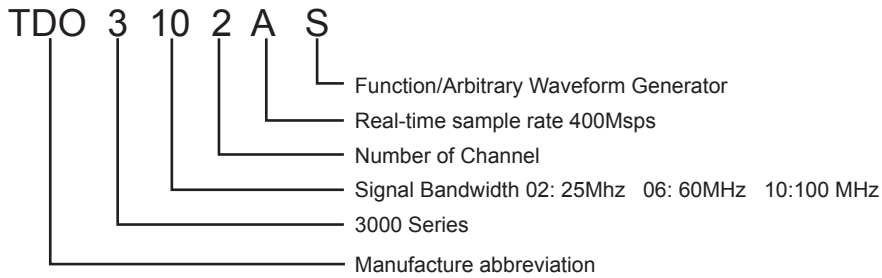
Function/Arbitrary Waveform Generator Specifications

Model	TDO3022AS	TDO3062AS	TDO3102AS
Frequency Characteristics			
Max output frequency	10MHz	20MHz	40MHz
Sine, Square waveform	1μHz--10MHz	1μHz--20MHz	1μHz--40MHz
Pulse waveform	1μHz--10MHz		
Other waveforms	1mHz--1MHz		
Frequency resolution	1μHz(Sine, Square, Pulse), 1mHz(other)		
Frequency accuracy	$\leq\pm5\times10^{-4}$		
Frequency stability	$\pm5\times10^{-5}$		
Sine Characteristics			
Harmonic Distortion	<5MHz: -50dBc ≤10MHz: -45dBc >10MHz: -40dBc		
Total harmonic distortion	20Hz--100kHz: ≤0.2%		
Amplitude Characteristics			
Amplitude range into 50Ω	When freq.≤20MHz, 1mVpp to 10 Vpp When freq. > 20MHz, 1mVpp to 3.16 Vpp		
Amplitude range into open circuit	When freq.≤ 20MHz, 2mVpp to 20 Vpp When freq. > 20MHz, 2mVpp to 6.32 Vpp		
Max resolution into 50Ω	1μVp-p		
Max resolution into open circuit	2μVp-p		
Amplitude accuracy	≤±2%+1mV (1kHz sine waveform)		
Amplitude stability	±1 % in 4 hours		
Amplitude flatness (Sine, Square, Pulse)	When freq. ≤ 5 MHz: ±5% When freq. > 5MHz: ±10%		
Amplitude flatness (other waveforms)	When freq. ≤ 50 kHz: ±5% When freq. > 50kHz: ±20%		
Output impedance	50Ω		
AM Modulation Characteristics			
Carrier waveforms	Sine, Square		
Source waveforms	30 commonly used waveforms, including Sine, Square, Triangle etc.		
Source frequency	1mHz to1MHz		
Source depth	1% to 120%		
FM Modulation Characteristics			
Carrier waveforms	Sine, Square		
Source waveforms	30 commonly used waveforms, including Sine, Square, Triangle etc.		
Source frequency	1mHz to 1MHz		
Frequency deviation	0.1% to 99.9%		
PWM Modulation Characteristics			
Carrier waveform	Pulse		
Source waveforms	30 commonly used waveforms, including Sine, Square, Triangle etc.		
Source frequency	1mHz to 1MHz		
Width deviation	1% ~ 99%		
FSK Modulation Characteristics			
Carrier waveform	Sine		
Hop frequency	1μHz to10MHz		
Interval time	1ms to 40s		
PSK Modulation Characteristics			
Carrier waveform	Sine		
Hop phase	1° to 360°		
Interval time	1ms to 40s		
DCOM Modulation Characteristics			
Carrier waveforms	Sine, Square		
Source waveforms	30 commonly used waveforms, including Sine, Square, Triangle etc.		
Source frequency	1mHz to1MHz		
Function description	Realize addition of carrier waveform and modulated waveform		
Frequency Sweep Characteristics			
Waveforms	Sine, Square		
Frequency range	1μHz to 10MHz	1μHz to 20MHz	1μHz to 40MHz
Sweep mode	Up, Down, Round		
Sweep time	1ms to 500s		
Burst Characteristics			
Waveforms	30 commonly used waveforms, including Sine, Square, Triangle etc.		
Counts	1 to 60000 cycles		
Burst frequency	1mHz to 1MHz		

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Ordering Information

Naming principle:

TDO 3 10 2 A S

- Function/Arbitrary Waveform Generator
- Real-time sample rate 400Msps
- Number of Channel
- Signal Bandwidth 02: 25Mhz   06: 60MHz   10:100 MHz
- 3000 Series
- Manufacture abbreviation

TDO3000A Series

Model	Real-time sample rate	Equivalent sample rate	Memory depth	Bandwidth
TDO3022A	400Msps	10Gsps	2.4Mpts	25MHz
TDO3062A	400Msps	10Gsps	2.4Mpts	60MHz
TDO3102A	400Msps	10Gsps	2.4Mpts	100MHz
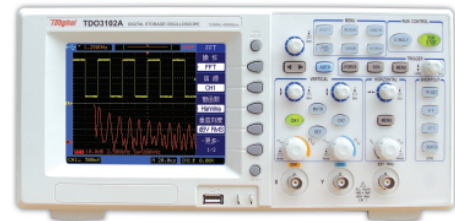
TDO3000AS Series

Model	Real-time sample rate	Equivalent sample rate	Memory depth	Function/Arbitrary Waveform Generator
TDO3022AS	10Gsps	10Gsps	2.4Mpts	10MHz
TDO3062AS	10Gsps	10Gsps	2.4Mpts	20MHz
TDO3102AS	10Gsps	10Gsps	2.4Mpts	40MHz
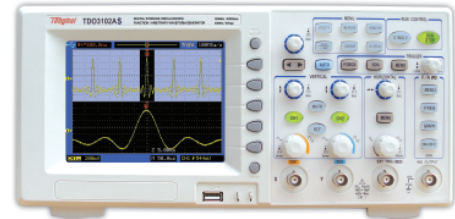
Instrument Accessories

TDO-XXX   oscilloscope probe (XXX indicating bandwidth) 2
3-wire power cord   1
Operation Manual   1

Options

TDO-comsoft03   connection software
BNC cable