DSO QUAD (DS203)

4-Channel Digital Storage Oscilloscope
With Built-In Multiple-Pattern Signal Generator

Chip Software Edition v2.55

Technical Specifications

- Processor:
  - CPU - ARM Cortex M3
  - ADC - AD9288-40[1,2]
- 4 Channels:
  - Channel 1 – Analog input CH (A)
  - Channel 2 – Analog Input CH (B)
  - Channel 3 – Digital Input CH (C)
  - Channel 4 – Digital Input CH (C)
- Additional CH4 Display Modes:
  [CH(A)] + [CH(B)], [CH(A)] – [CH(B)], [CH(C)] & [CH(D)], [CH(C)] ! [CH(D)], REC_A, REC_B, REC_C, REC_D
- Vertical sensitivity (in a range, or a single division):
  - 50мV, 100мV, 200мV, 500мV, 1V, 2V, 5V, 10V (80V maximum input voltage)
- Horizontal Scan (in a range or on a single division):
  - 1s, 500мs, 200мs, 100мs, 50мs, 20мs, 10мs, 5мs, 2мs, 1мs, 500µs, 200µs, 100 µs, 50 µs, 20 µs, 10 µs, 5 µs, 2 µs, 1 µs, 500ns, 200ns, 100ns ,50ns
  - In SCROL 1s- 10s.
- Scan Modes
  - AUTO, NORM, SINGL, SCAN, TAUTO, TNORM, TSINGL, TSCAN, X_Y, FFT, WATRFL, VIDEO, SCROL
- Supports the following Triggers on CH A,B,C and D:
  - Rising Edge
  - Falling Edge
  - Voltage Level
  - Pulse Duration
- Signal Bandwidth: >5 MHz
- Input impedance:> 800 ohms
- Sampling Frequency (sampling) to 72 MS / s
- Vertical Resolution (bit ADC): 8-bit
- Buffer memory: up to 4096 samples per channel (about 14 screens)
- Memory: Internal 2 MB USB Flash Disk
- Automatic Measurements: Vpp (scale), Vdc (dc component, the average level), RMS (RMS voltage), Max (maximum voltage), Min (minimum voltage), Vbt (battery voltage), FPS (frame rate of your screen)
- Cursor measurements: the axis Y - level (voltage), the X-axis – time
- Screenshot: save waveform (in the format DAT, BUF, CSV, BMP)
- Signal Generator:
  - "Square" from 1 Hz to 8 MHz spanning 2.8 V
  - Adjustable “PWM” from with Duty configurable from 1% to 100%, voltage 0 to 2.56V and 1 Hz to 25 kHz
  - "Sine", "Triangle", "Saw", "Noise" from 1 Hz to 25 kHz voltage 0 to 2.56V
- Screen: TFT 3" 240 × 400 pixels
- Power: Lipo battery charging from the USB (5V), recharge time 4:00
- Size: 98mm x 60mm x 14.5mm
- Weight: 100g
- Open Source Design (H / W and S / W)

Notes

[1] Can be replaced with the AD9288-80, AD9288-100 as well as the low noise version of the AD9218-40, AD9218-60, AD9218-80 or AD9218-105)

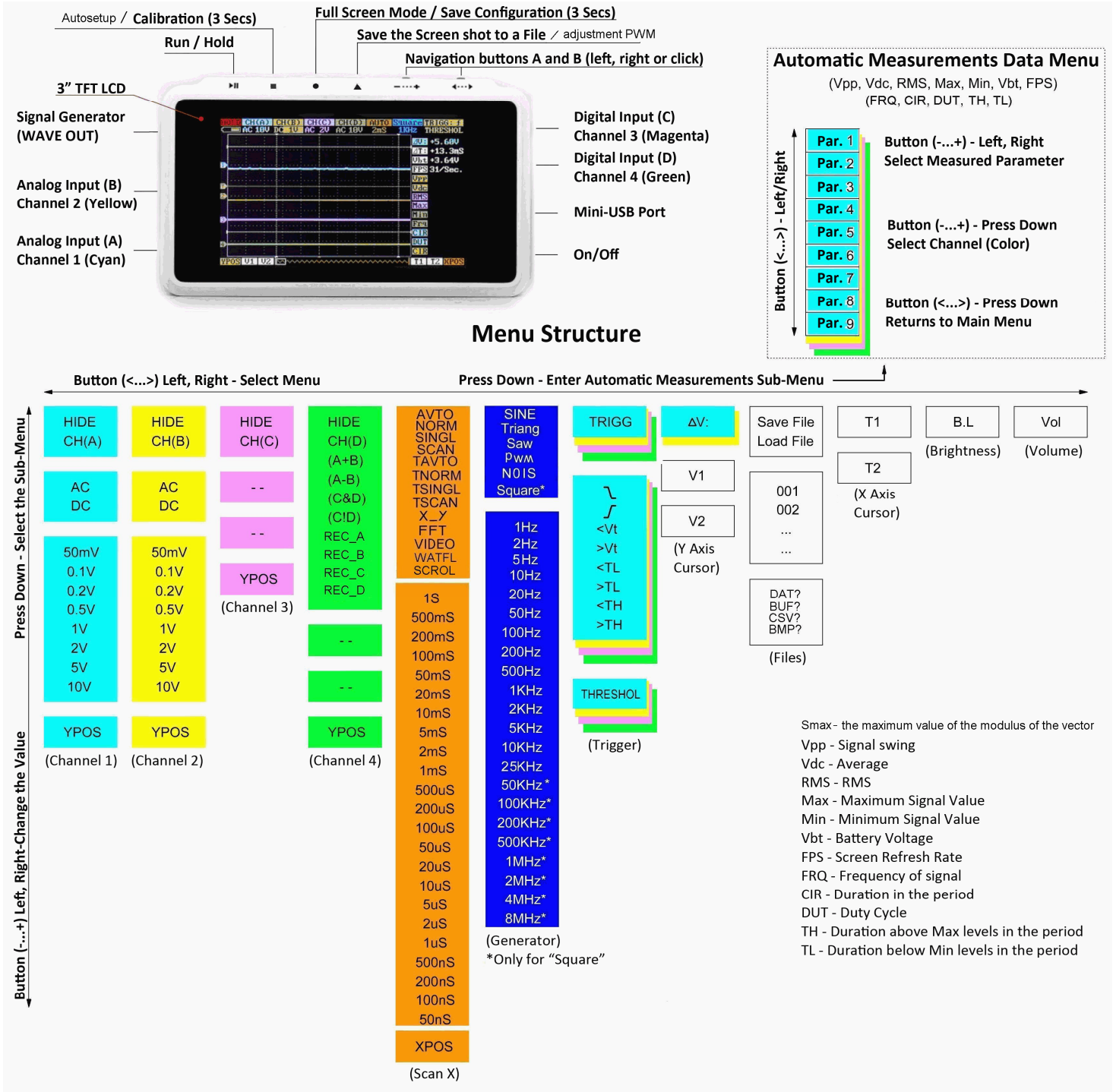
[2] The AD9288-40 ADC in the unit runs in two modes: two channels of 40 MHz or80 MHz one on, but in this oscilloscope the ADC (over clocked) runs, depending on the scan mode, up to 72MHz as one or two channels simultaneously .

Software Information & Quick Reference

The information in this document relates to the following Software Versions:

- SYS-chipV1.52 or Greater
- APP-chipV2.54 or Greater
- FPGA-V2.61

(The version number can be located when first powering on the device. You should see a Label “Chip”. This software fixes a few bugs that appear in the official version and adds new features.



AUTO, NORM, SINGL, SCAN- modes with a buffer size of 4096 samples, which is useful for analyzing signals with high frequency, or with a big period. But these modes are awkward when dealing with a slow-scan as the size of a screen is about 300 samples and with a sweep like 0.1s/div the screen is equal to 1 s, and the entire buffer is filled in 15 seconds.

AUTO - sweep trigger (if no trigger event starts automatically).

NORM - sweep trigger is started only if the trigger event occurs (the screen continues to display the old signal until the new one occurs).

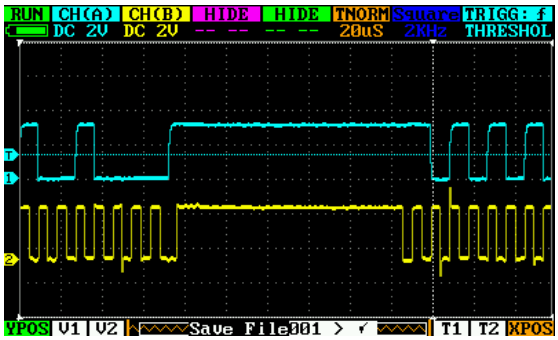
SINGL - Single sweep event start. Click the ▶ **II** button to clear the previous signal. When you press the button (4) (generator square) you can set number of buffers to skip to capture the signal.

SCAN - Scan without trigger.

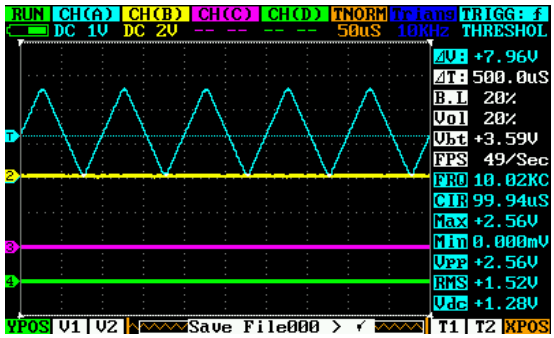
TAUTO, TNORM, TSINGL, TSCAN - Scan modes as above with a buffer size equal to the size of the screen that allows real-time tracking of the signal changes, even on slow scans. This mode is most similar to a standard oscilloscope.

When you press the button (4) (generator square) accumulation (freezing) A waveform channel.

Full-Screen Mode

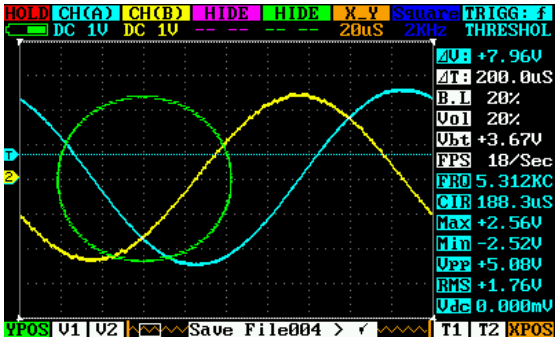


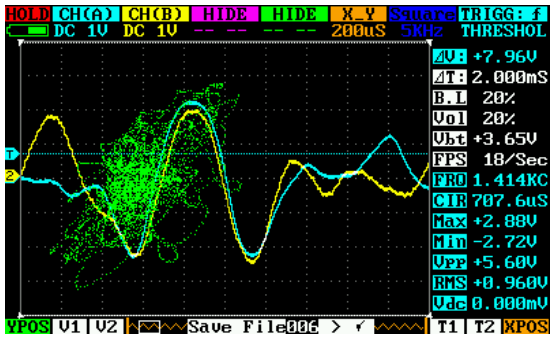
Automatic Measurements Mode



X_Y - In this mode, Channel A is scanned along the X axis and Channel B is along the Y axis. Displays both Channels A and B, but you can disable it.

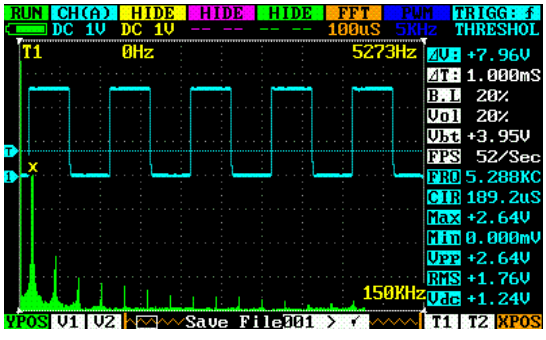
X_Y Scan Mode Examples

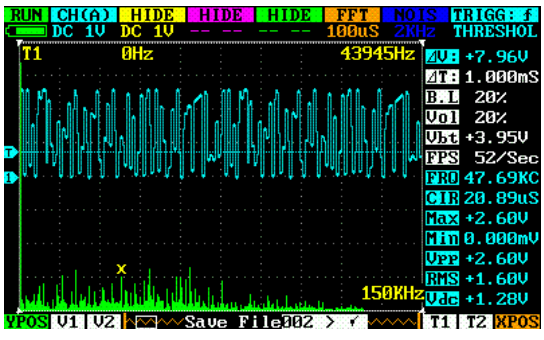




FFT - Fast Fourier Transform Mode (Spectrum Analyzer). Based on the selected sweep time measurement value can be from 15 Hz to 36 MHz. This appears at the bottom right side of the spectrum and the frequency of the maximum signal level at the top right. The spectrum can be observed from Channel A or Channel B, if you include both channels it will range only from channel A.

FFT Mode Examples



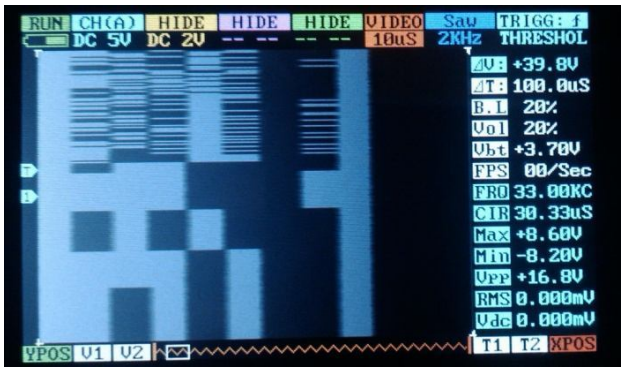


VIDEO – mode in which its convenient to analyze the different signal sequences and compare them. The trigger in this mode operates as per TNORM. This mode works only with the channel A

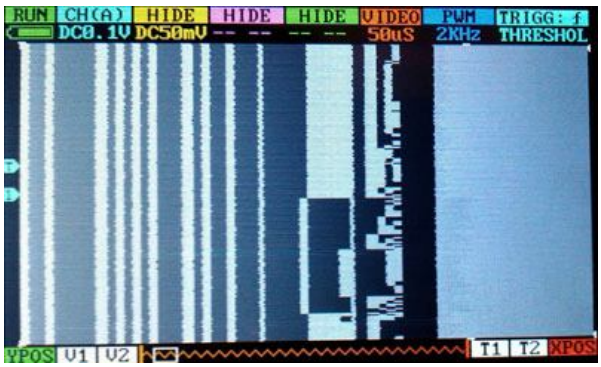
Square Wave in Video Mode

Sine Wave in Video Mode

Letters from RS232 in Video Mode



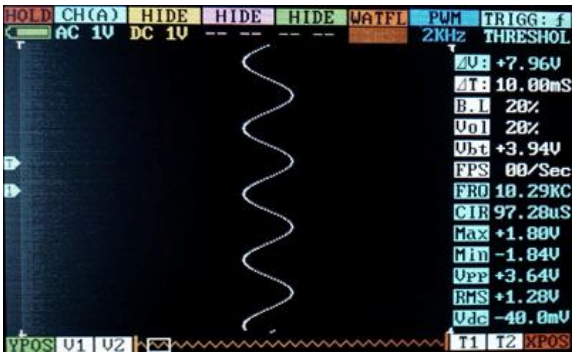
i2c



WATFL – FFT mode (Waterfall) in which the frequency change can be observed in the time interval (eg for frequency modulation).

sine wave with increasing frequency

FM



Signal Generator

The Signal Generator is capable of producing the following Wave Shapes:

Signal	Icon	Valid Ranges
Square Wave	**SQUARE**	1 Hz to 8 MHz, 0-2.56Volts[2]
Sine Wave	**SINE**	1 Hz to 25 KHz, 0-2.56Volts[2]
Saw Wave	**SAW**	1 Hz to 25 KHz, 0-2.56Volts[2]
Triangle Wave	**TRIANGLE**	1 Hz to 25 KHz, 0-2.56Volts[2]
Noise Wave	**NOIS**	1 Hz to 25 KHz, 0-2.56Volts[2]
PWM[1]	**PWM**	1 Hz to 25 KHz , 1%-100% Duty[1], 0-2.56Volts[2]

Notes:

[1.] Hold down the ▲ Button and use ▼ to adjust PWM Duty Cycle

[2.] Hold down the ▲ Button and use ◀ ▼ ▶ to adjust Voltage Level

Triggers

Triggers can be set to start scanning based on the following modes:

NAME	DESCRIPTION	ICON
Rising Edge	Start to scan when the signal rises above the level of THRESHOL, triggering to start waveform	^
Trailing Edge	Start to scan when the signal falls below the level of THRESHOL, triggering to start waveform	v
Below Vt	Start the scan if the signal level is less than the level THRESHOL	<Vt
Above Vt	Start the scan if the signal level is greater than the level THRESHOL	>Vt
Min $\Delta T^{1,2}$	Start scan when a low level pulse duration is less than ΔT^2	<TL
Max $\Delta T^{1,2}$	Start scan when a low level pulse duration is greater than ΔT^2	>TL
Low $\Delta T^{1,2}$	Start scanning the moment high-level duration is less than ΔT^2	<TH
High $\Delta T^{1,2}$	Start scanning the moment high-level duration is greater than ΔT^2	>TH

Notes:

[1.] The last four modes are useful for SINGL Scan Mode

[3.] ΔT is defined as the delta of markers T1 and T2.

Saving the Configuration

To save the currently configured settings as the Power-On Defaults, press and hold the (?) button for 3s. “Configuration Saved” will appear at the bottom of the screen.

You can also use the automatic setting by pressing the second button. Timing configure the channel on which the trigger is active.

Working with the USB drive

Most PCs and other USB Host Devices should recognize the DSO via its USB connection as a standard USB Mass-Storage Device – however only when the DSO is powered up. You can work with MINIDSO disk like a normal memory stick.

Working with Files (Images/Waveforms)

The software allows the oscilloscope to capture waveforms (snapshots) and store them in files for later comparison with real signals. In order to take a snapshot, complete the following:

Access Menu "Save File" (save)

Select the file name (a number)

Select the file extension. There is currently four formats supported:

a. DAT - for viewing on the DSO screen. Each channel individually can be seen on Channel D
b. BUF - for viewing on the DSO screen. Data is loaded into the buffer and operates as if the HOLD button had been pressed
c. BMP – Bitmap image for viewing on other platforms
d. CSV - data for further processing on a computer

To execute, press the (▲) button.

To view previously saved waveforms on the DSO and compare them with real-time signals, they must be selected and loaded using Channel D and one of the four File Slots (REC_A, REC_B, REC_C or REC_D). To load files for comparison:

Access Menu "Load File" (download)

Select the file name (number)

Choose the extension

Press the (▲) button.

If the process of saving or loading a file is successful OK will appear in place of the Extension.

Software Updates

To enter update mode,

1. Connect the DSO to a USB port on your computer and turn the power on while holding down the ⏵⏸ button.
2. The computer system should recognize a virtual disk labeled DFU V3_10_B.
3. The DSO's screen should display a message "Device Firmware Upgrade V3.10" and quick steps on the tasks - "Please copy. Hex /. Bin file to DFU virtual USB disk".
4. Copy the updated files to the drive. Once copied, the drive will reload itself and the filename will appear with the .rdy extension.
5. To complete the update you need to power cycle the device.

To upgrade the FPGA, you must do it in two stages - first copy the file with the address «CFG_FPGA.ADR» and then the file «V261FPGA.BIN» with the firmware.

You can load up to four(4) applications onto the DSO and access them by holding down the various buttons during Power On. Slots 1 and 2 are utilized by the current Application, which leaves slots 3 and 4 for use by small applications. You must be careful that they are not too large, as they will spill over into the next slot if they are. Some example applications you could load for example are a Logic Analyzer and a Frequency Analyzer available at http://essentialscrap.com/dsoquad/logic.html http://essentialscrap.com/dsoquad/freq.html) respectively, or perhaps one larger Button 3 one.

Charging the Battery

When you connect the DSO to a PC or other USB Host via the USB port, it will charge the battery. Charging process is indicated by a bright red glow of the LED. Upon completion of the charging LED brightness will decrease to a minimum. Charging occurs regardless of whether the DSO is powered or not. It takes an average of about 4 hours to charge a depleted battery.

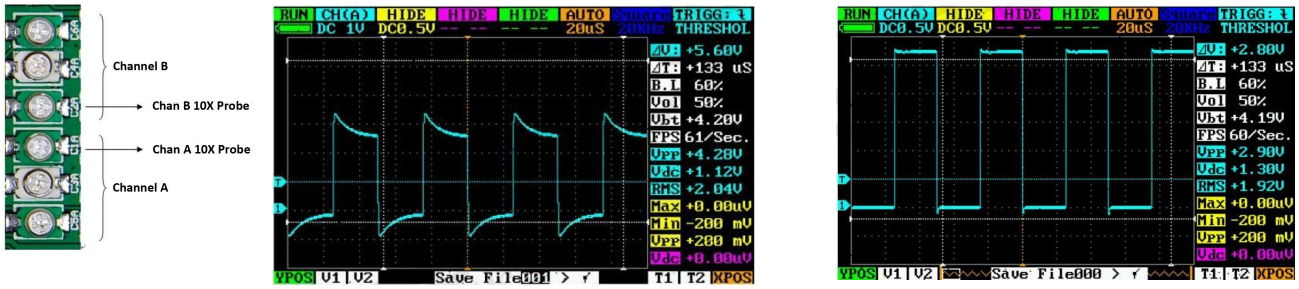
Hardware Calibration (Probes & Input)

When you first get your DSO, whenever you change the probes connected to a particular input or just periodically to ensure accuracy, it is important to perform Hardware Calibration of the Inputs and the Probes. Hardware level calibration (in this case, the frequency compensation) is carried out using the trimmer capacitors, which are located under the battery

Connect the respective probes to the Signal Generator (WAVE OUT), Set the Signal Generator to Square and 10 KHz. Set the Scan Mode to Auto with a period of 20µS. Now check that the wave form is displayed correctly when connected to either Analog Channels. You should see even rectangular pulses with no visible overshoot or undershoot.

If you see something similar to the image below, you need to perform Hardware Calibration. Open the back cover of the DSO (by sliding it left or untwisting the screws on an aluminum casing) and underneath the battery you will see six trimmer capacitors like the image below on the left.

Trim Capacitors **Poor Calibration** **Good Calibration**



Connect the output of the generator (10 kHz Square Wave) to the either Channel and set it to DC 0.5V as the input level, trigger set to AUTO, Scan Period 20µS. Take a screwdriver made from a dielectric material and adjust the signal using the C3, C5 capacitors for Channel A and C4, C6 for Channel B. Switch alternately between modes of 0,5 V and 1,0 V (4-6 times usually) to adjust the maximum rectangular waveform with no overshoot at either limits.

If you have a probe with a divider, put it in position X10 (then compensate for the reduction in the amplitude and the more sensitive limit) and adjust the maximum rectangular signal without overshoot using the two central capacitors C1 and C2 for Channel A and Channel B respectively.

Hardware Input Calibration adjustment is now complete and you can move onto Software Calibration to adjust the Zero and Offset levels.

Software Calibration (Zeroing/Offset)

To enter Calibration Mode you must be in the main menu and on either [CH (A) or CH (B)], then press the (■) button 4s.

Calibration is carried out for each analog channel individually and automatically by the software. You will need a constant voltage supply as indicated once the initial Zeroing/Offset adjustment has occurred. The top row of the display will indicate what to do - For example, "Please connect CH_A input to GND" – This means Connect Input Channel A to "ground".

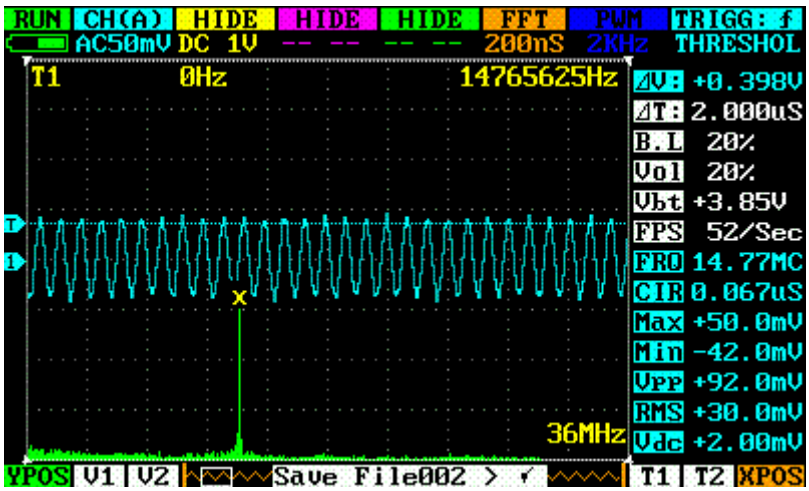
To save the calibration, use ◄ ¨▼¨ ► to move into the bottom line, and then using -¨▼¨+ select –

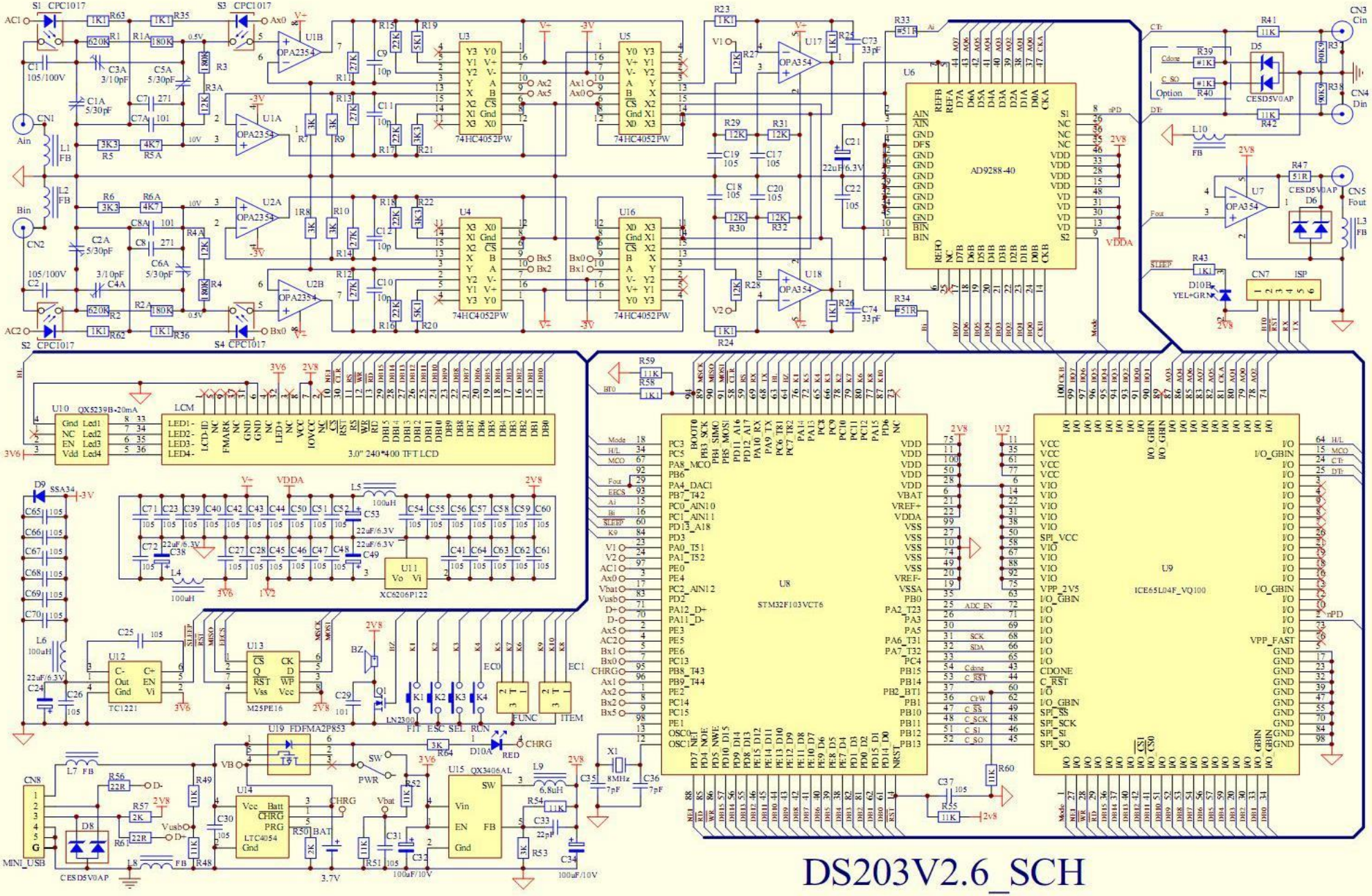
1. "Exit with save calibration" and press the (■) button.
2. "Exit without calibration" - quit without saving.
3. "Exit with Restore defaults" - restore factory calibration values.

In order for values to take effect, you need to power cycle the DSO once you exit Calibration Mode.

A Note about Analog Frequencies

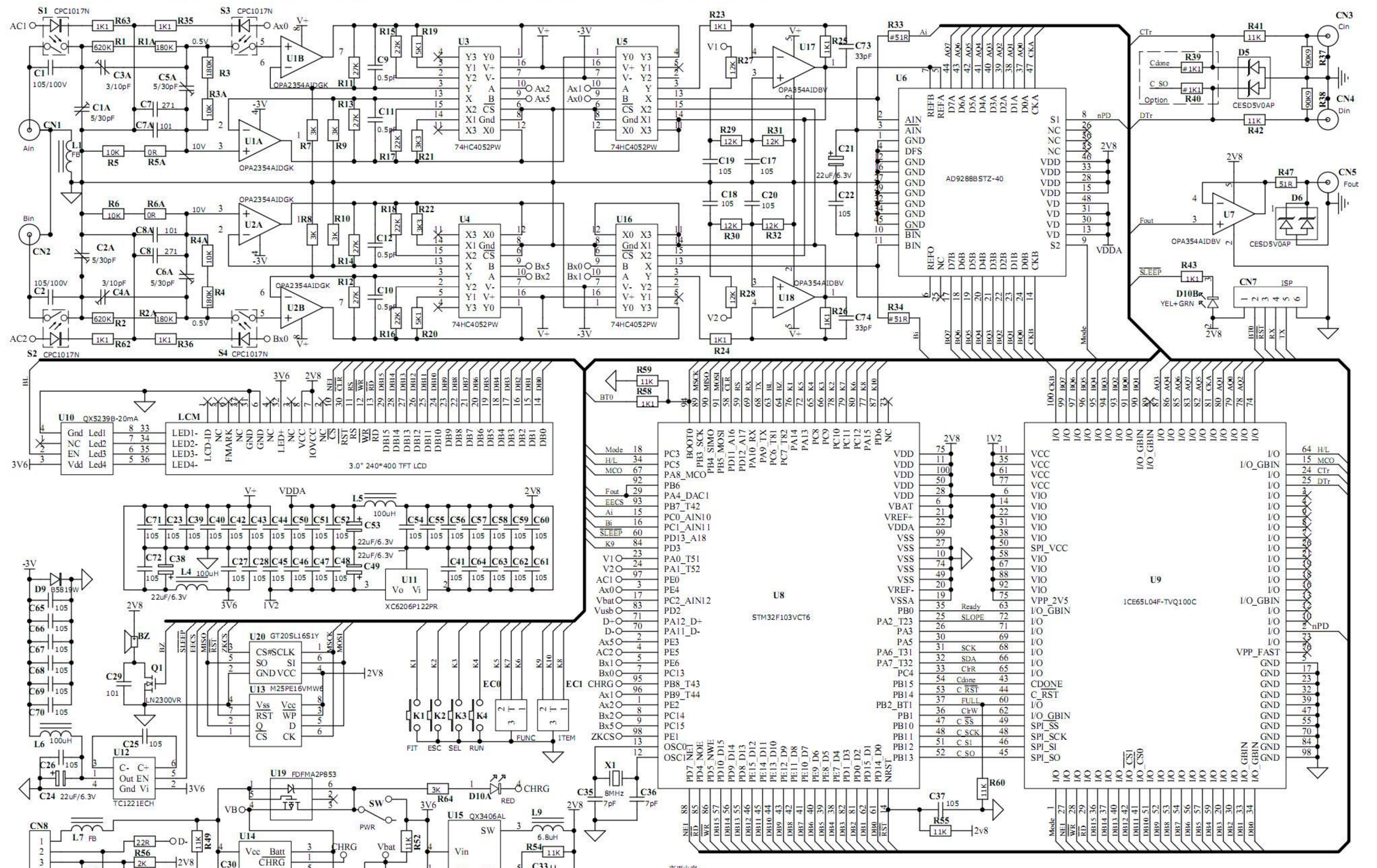
The analog circuit of the oscilloscope is not designed for frequencies above 10 MHz. At these higher frequencies the potential losses are so large, frequencies of tens of megahertz can be observed only with signals that have large amplitude. This applies to both the oscilloscope and its probe.




DS203V2.6_SCH

5V

0.2V: Ax0=1, Ax1=1	10 V: Ax0=0, Ax1=1	x1: Ax2=0, Ax5=0	x2: Ax2=1, Ax5=0	0.2V: Bx0=1, Bx1=1	10 V: Bx0=0, Bx1=1	x1: Bx2=0, Bx5=0	x2: Bx2=1, Bx5=0
5.0V: Ax0=0, Ax1=0	ChB: Ax0=1, Ax1=0	x5: Ax2=0, Ax5=1	x10: Ax2=1, Ax5=1	5.0V: Bx0=0, Bx1=0	ChA: Bx0=1, Bx1=0	x5: Bx2=0, Bx5=1	x10: Bx2=1, Bx5=1



变更内容：
1、C9~C12从原101变更为10pF，2011-3-17，LQ
2、C9~C12从原10pF变更为0.5pF，2011-4-21，改善频响，LQ
3、K1~K4从原EVQPUL02K变更为EVQPUC02K，2011-7-14，LQ
4、LCM从原希恩凯FGD300C0704J变更为希恩凯CNK300C3704，2011-7-14，LQ
5、D1从SSA34变更为B5819，2011-8-10，LQ

Title: DS203			
Size: C	Number: 2011-8-10		Revision: 2.7
Date: 9-Jan-2012		Sheet 1 of 1	
File: E:\Projet\EDA\DS203.ddb		Drawn By: CXG	