

DL1640/DL1640L DIGITAL OSCILLOSCOPES

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We have developed the DL1640/DL1640L digital oscilloscopes that feature 4-channel inputs, 200-MS/s maximum sampling rates, a 200-MHz analog bandwidth and a 32-MWord maximum record length. Compared with former model DL1500, this general purpose oscilloscope has realized an extremely compact size and light weight as a result of our development of an ADC IC incorporating preamplifier, a VLSI for an acquisition system and our employment of a high-efficiency power supply. This paper provides an over-view of these new digital oscilloscopes.

INTRODUCTION

We have developed the DL1640 and DL1640L digital oscilloscopes, successors to the popular DL1500 series of general-purpose oscilloscopes which were released in 1995. The new oscilloscopes have increased performance capabilities, and are more compact and lightweight, thanks to the analog block employing specially developed ICs, a digital block of larger packaging density, and a power supply block with increased efficiency. The specially developed ICs are namely an ADC IC united with a preamplifier and a highly integrated data acquisition IC. Equipped with a Web server function, DL1640 and DL1640L offer greater operability. Hereafter this paper shall collectively refer to them as DL1600 since there is no difference between their performance except the maximum record length—8 MW for the DL1640 and 32 MW for the DL1640L.

Table 1 compares the DL1640L's key performance with that of DL1540CL, and Figure 1 shows an external view of DL1640.

SYSTEM CONFIGURATION

Figure 2 shows a block diagram of DL1600. Measured signals input at each channel are adjusted by an attenuator (ATT) to such a level as can be handled by a preamplifier, and passed on to the custom IC (hereafter referred to as WINGAD), which is a combination of the preamplifier and an AD converter (ADC) and will be described later. The preamplifier applies a preset offset voltage to the measured signals, increases them with a gain determined from a vertical sensitivity setting, limits bandwidth usage for them according to each channel's bandwidth setting,

Table 1 Performance Differences between DL1640L and DL1540CL

Model	DL1640L	DL1540CL
Frequency characteristic	200 MHz	150 MHz
Maximum sampling rate	200 MS/s when four channels are used	200 MS/s when two channels are used.
Maximum record length	32 MW when four channels are used	2 MW when two channels are used.
Maximum power consumption	100 VA max.	280 VA max.
Weight	Approx. 3.9 kg	Approx. 5.2 kg
External dimensions	220 (W) × 266 (H) × 224 (D) mm	216 (W) × 268 (H) × 295 (D) mm

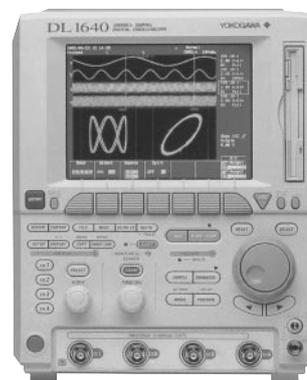


Figure 1 External View of DL1640

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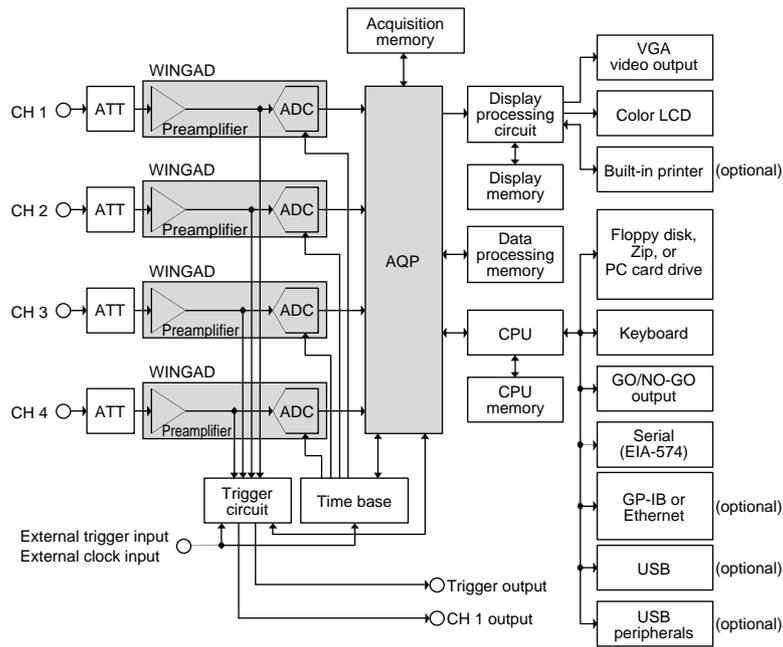


Figure 2 DL1600 Block Diagram

and then outputs them to the ADC. The preamplifier's outputs are also used by a trigger circuit outside WINGAD. The ADC is capable of converting signals at 200 MS/s with an 8-bit resolution by time-interleaving the operation of two 1.5-bit, 100 MS/s, six-stage pipeline ADC systems. Then the digitized signals are input to the data acquisition custom IC (hereafter referred to as the AQP [Acquisition Processor]). The AQP digitally filters the signals as specified, decimates them or operates them in the envelope mode according to the sampling rate, and then stores them to the acquisition memory. DL1640 incorporates an 8 MW memory for each channel, and DL1640L incorporates 32 MW per channel. Meanwhile, the trigger circuit detects trigger conditions in the input signal level and notifies the AQP of them. It is the AQP that verifies the occurrence of triggers against the settings. If a trigger condition is actually met, the AQP re-reads the data stored in the acquisition memory and loads them to the data processing memory. The AQP uses the data to calculate averages, retrieve waveforms parameters, and generate necessary data for displaying waveforms. These waveform data are transferred to the display processing circuit, which displays waveforms with grid patterns and relevant menu items on an LCD. As this sequence of operations is performed through pipeline processing technology, users can continue to collect data after a trigger occurrence is confirmed without having to wait for the processing of trigger data or display processing to finish.

In the meantime, the CPU deals with various processes in response to setting instructions from the keyboard and communication interfaces. To facilitate data exchange between the large-capacity acquisition memory and personal computers, not only a conventional floppy disk drive but also a Zip drive and a PC card drive can be selected for external storage. In addition,

DL1600 has an internal 2-Mbyte RAM disk, which its predecessor did not have, and this enables the saving of some data without external media. It comes standard with an EIA-574 serial communication interface, and can be added as an option in combination with GP-IB and USB or Ethernet and USB, as well. For the USB interface, there is a special port for controlling DL1600 from a personal computer, and two other ports that work with USB peripherals comprising a keyboard and mouse which are compliant with the USB Device Class Definition for Human Interface Devices (HID), Version 1.1. A USB Printer Class Version 1.0 compliant LIPS III or PCL5 printer can be connected. Needless to say, a built-in printer can also be selected optionally as with the DL1500 series.

HARDWARE

This chapter describes the hardware features of DL1600—WINGAD, the AQP, and the power supply circuit.

WINGAD

To increase the scale of the DL1600's analog circuitry integration, we developed a special IC, WINGAD, which combines a preamplifier, an essential element for digital oscilloscopes, with the ADC. With DL1600, achieving high input impedance, a broad bandwidth, and a high gain is required for the preamplifier, while noise which realizing a monolithic IC in combination with the 200-Ms/s ADC causes ADC performances generate must be reduced.

WINGAD is comprised of a 0.6- μm gate length CMOS process, approximately 68,000 transistors, and a 156-pin BGA. To reduce the diffraction noise as mentioned above, the following

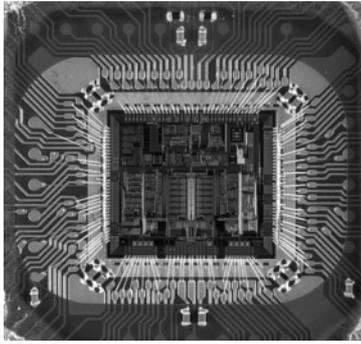


Figure 3 WINGAD



Figure 4 External View of the AQP

measures were taken:

- Adoption of a BGA package with minimum substrate impedance
- Reduction of power supply noise with decoupling condensers mounted on the chip and in the BGA package
- Configuration of all the process from input to output by differential amplification
- Conduction of concurrent engineering by IC development and product development departments

Figure 3 shows the interior of the WINGAD package.

AQP (Acquisition Processor)

We developed this ASIC to increase the scale of the DL1600's digital circuitry integration. A single AQP package includes all the data acquisition, trigger logic, display data generation, and control blocks for analog circuits, each of which with DL1500 was realized by several individual ICs. The following gives an outline of the AQP:

- A 0.18- μm gate length CMOS process and a 479-pin BGA
- Data acquisition control
- Acquired data processing
- Trigger logic processing
- Display data generation
- Analog block control

Figure 4 shows an external view of the AQP.

As was mentioned in the previous chapter regarding the configuration, one of the DL1600's features is that input signals from the ADC are digitally filtered before being stored to the acquisition memory. General purpose oscilloscopes are customarily used for developing switching power supplies or other equipment. However, as power supplies' switching frequencies are approximately 100 kHz and the accompanying noise ranges from several MHz to tens of MHz, the existing models in general offered a function to limit bandwidth usage only to 20 MHz or more, which was not enough for eliminating the noise. On the other hand, DL1600 can restrict a bandwidth of 20 MHz or less with its digital filter.

The AQP has two types of such filters. One is a three-tap FIR (finite impulse response) filter with fixed cutoff frequency which exhibits uniform linear phase characteristics by making all the filter coefficients symmetrical. This filter runs at a sampling

clock setting of 200 MHz, and it is cascaded to WINGAD's second-order analog LPF (low-pass filter) when the bandwidth is restricted to 20 MHz. The other digital filter is a second-order IIR (infinite impulse response) filter with variable cutoff frequency, which is comprised of two filters operating in parallel at a sampling clock setting of 100 MHz. It is cascaded to the WINGAD's second-order analog LPF and the FIR filter mentioned above when the bandwidth is restricted to 1.28 MHz or less. WINGAD's analog LPF acts as an anti-aliasing filter for both of the two digital filters.

Power Supply Circuit

As digital oscilloscopes require various types of voltage, the existing models employ custom power supplies, which involves prolonged development times and a great deal of prototyping costs. With DL1600, we were successful in developing a low-cost power supply block by combining a standard single-output unit by a power supply manufacturer with our original DC/DC converter circuit. This DC/DC converter uses a synchronous rectifier to improve efficiency and reduce heat dissipation, thereby facilitating the attainment of the downsized, power-thrifty circuit.

FIRMWARE

This chapter describes features of DL1600's Web server function.

Web Server Overview

The Web server aims at enabling users to easily collect and view the DL1600's screen, acquired data, measurements, and other internal data.

Without writing special programs, users can collect and view the DL1600 data on their personal computer's Web browser. Figure 5 shows the Web server's software structure and Figure 6 a Web browser window on a personal computer. The following provides an outline of the Web server functions.

- IEEE 488.2 communication function

This component chiefly performs the measurement trends display function and the control scripts function. In other words, it interprets and executes IEEE 488.2 commands, and

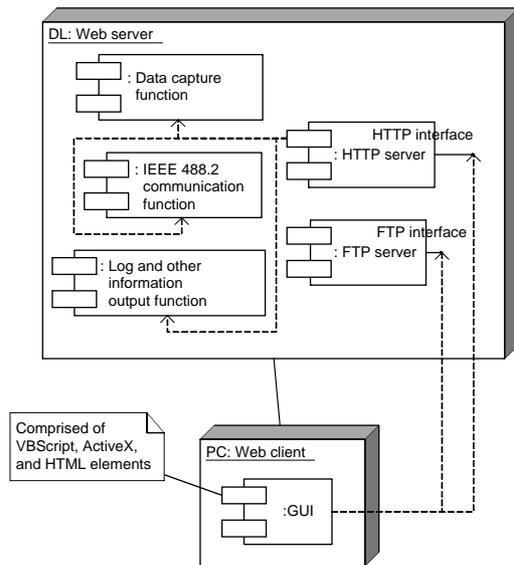


Figure 5 Web Server Software Configuration



Figure 6 Web Browser Screen

then creates the necessary responses.

- HTTP server
This component communicates with Web clients through HTTP. Specifically, it mainly handles CGI processes.
- FTP server
This component transfers files through FTP. It performs the file manipulation function and the Setup upload function.
- GUI
This component is downloaded from DL1600 when the Web server is invoked, and is comprised of VBScript, ActiveX, and HTML elements. It communicates with the Web server through HTTP protocols, usually using a CGI interface, and sends and receives IEEE 488.2 commands. The ActiveX controls are used by the user interface on the front panel and are downloaded by the version control mechanism only when they are used for the first time or upgraded.

Web Server Functions

- (1) File Manipulation
This function enables the access of files stored on storage media that DL1600 incorporates.
- (2) Data Capture
This function enables the acquisition of current DL1600 screen images and captured measurement data, in a variety of file formats, such as binary, ASCII, Setup data, etc. As the screen images can be collected and displayed at specified intervals, it is possible to use the Web server as a remote monitor. The Setup data can also be uploaded to DL1600.
- (3) Measurement Trends Display
This function periodically gathers the DL1600 measurement results—automatically measured waveform parameters or marker-to-marker measurements—and graphs them in an Excel file on a personal computer. This greatly helps observe measurement trends over a long period. The collected data

can be statistically processed and saved in an Excel file.

- (4) Control Scripts
This function accepts instructions and queries using IEEE 488.2 commands.
- (5) Log Output
The following types of logs can be browsed:
Error messages, GO/NO-GO output, and Action Triggers
In the GO/NO-GO output, data files which were saved by judgments can be retrieved from log outputs. Also, in the Action-on Trigger, data files which were saved by trigger conditions can be retrieved from log outputs.

CONCLUSION

This paper has chiefly focused on the key aspects of achieving greater performance, downsizing, and weight reduction with DL1600, namely—WINGAD, the AQP, and a more efficient power supply circuit—together with the enhanced operability offered by the Web server function. As general purpose oscilloscopes continue to require the balancing of compactness, light weight, and high performance, we believe that DL1600 will superlatively/more than meet these demands. ◆

REFERENCE

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