WP1310 backs 400 MHz oscilloscope measurements with computing power

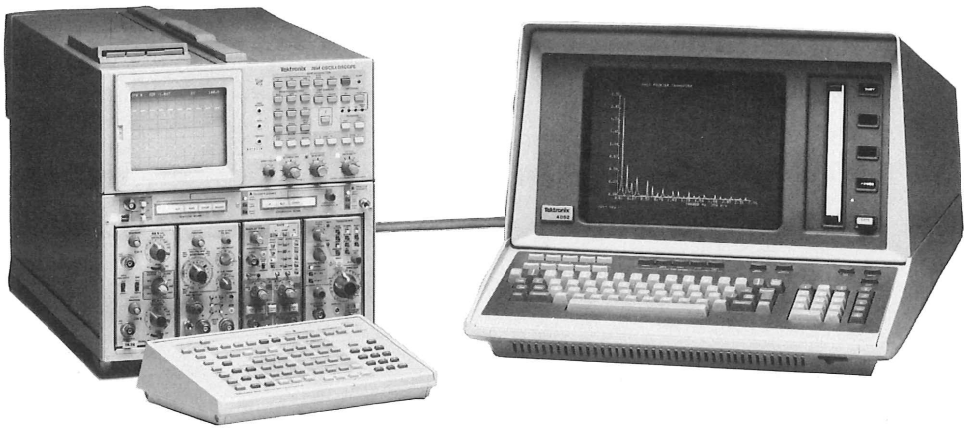

Fig. 1. *The TEKTRONIX WP1310 interfaces the 7854 Oscilloscope with the 4052 Graphic Computing System for a combination of modern digital oscillography with BASIC language waveform processing and graphics capabilities.*

Oscilloscope measurements with a new level of flexibility and power—that's the purpose of the WP1310 Waveform Processing System shown in Fig. 1. This new system uses the IEEE 488 bus to tie desk-top computing power to the recently developed 7854 Oscilloscope. The result is a new measurement tool offering you anything from standard oscilloscope measurements, through push-button measurement of pulse parameters, to programmed waveform analyses including operations such as fast Fourier transformations, convolution, and correlation.

Putting power into oscilloscope measurements

The system drawing in Fig. 2 points out some of the many WP1310 features. It also identifies the major system components, an acquisition unit (7854 Oscilloscope) and a system controller (4052 Graphic Computing System).

Basically, system operation begins with the acquisition unit, the 7854 Oscilloscope. This 400 MHz oscilloscope is not like your usual oscilloscope. Although it can be operated just like an oscilloscope, the WP1310 acquisition unit also contains a waveform digitizer, memory for storing digitized waveforms, and microprocessor power for some standard waveform calculations. As part of the WP1310 system, its function is to capture and digitize your waveforms, speedily preprocess them when necessary, and hand them to the WP1310 system controller for further analysis.

The WP1310 system controller provides high-speed processing as well as instrument control under BASIC language programs. Additionally, with the Signal Processing ROM Packs installed, the WP1310 system controller extends your selection of waveform analysis tools to include such things as

- Data windowing
- Fast Fourier transformation (FFT)
- Inverse Fourier transformation (IFT)
- Auto- and cross-correlation
- Convolution

Plus, the high-resolution graphics capability of the WP1310 allows formatting of results to your specific application needs. Would you like

- Bode plots

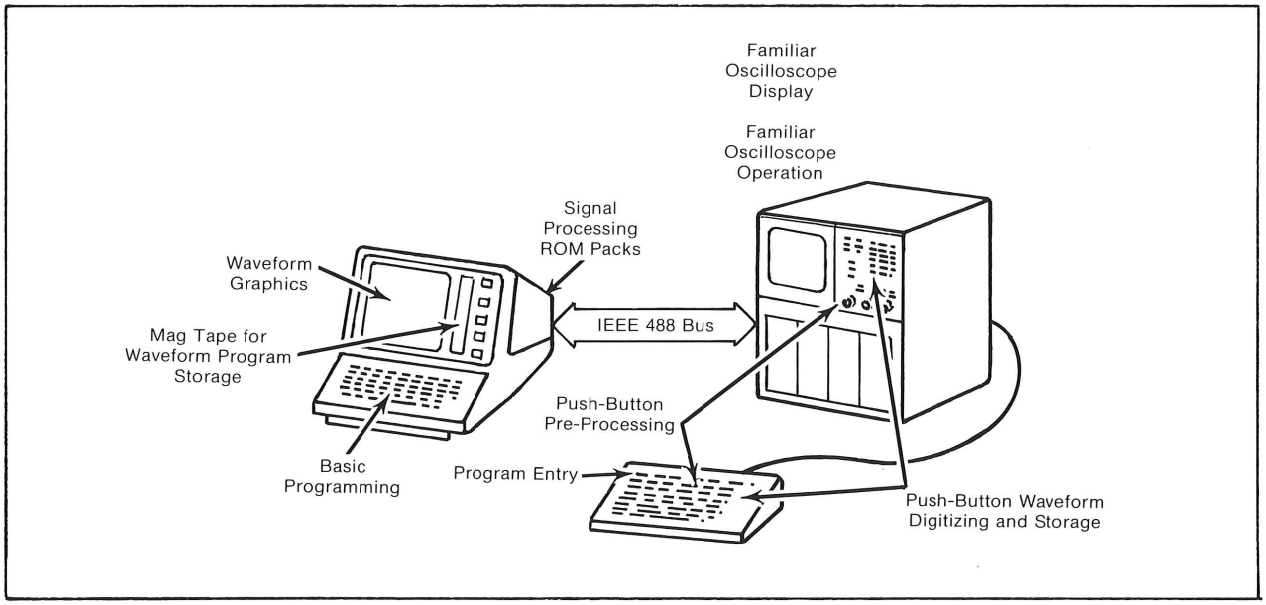

Fig. 2. *The WP1310 system components have a variety of features that combine for maximum benefits in waveform acquisition, processing, and storage.*

- Log and log-log displays
- Displays of system operating instructions
- Program listings and hard-copy capabilities

You can have them with the WP1310 system.

And there's still more. The WP1310 acquisition unit recognizes commands for changing the vertical and horizontal modes of mainframe operation. For example, you can send commands from the WP1310 controller over the bus to switch the acquisition unit from left vertical plug-in to right vertical plug-in. This allows you to have two different tests set up, one for each acquisition unit plug-in set, and to switch between them.

Of course the programs for doing these more complex processing and instrument control tasks can become lengthy. However, the WP1310 system controller has memory capabilities of up to 64 kilobytes with option 24. So there is plenty of room for program and waveform storage in the controller. Also, the WP1310 system controller has a tape drive which gives you access to an additional 300 kilobytes of magnetic tape storage. This latter feature is particularly important for permanent waveform and program storage since the WP1310 acquisition unit has volatile memory (the memory contents are lost if power is interrupted). The controller's magnetic tape will keep your data and programs secure.

Oscilloscope simplicity, digital resolution

With the WP1310, you set up for waveform measurements just like you would with a general-purpose laboratory oscilloscope. But then, instead of looking at the CRT display of the waveform and counting divisions to measure time or amplitude, press one of the acquire buttons (AQR for repetitive signals or AQS for single shot). This causes the acquisition unit to digitize the waveform supplied to its input and store the amplitude values in memory. Once in digital memory, a variety of high-resolution waveform measurements can be made quickly, easily, and automatically—often by pressing a single button on the instrument. The instrument does the division counting and scaling for you. And it does it quite well.

Because of the acquisition unit's 10-bit digitizer, vertical waveform values can be resolved to 1 part in 1024. Or in terms of a waveform display, that means you'll have the ability to detect amplitude differences as small as 0.01 division (based on a full scale of five vertical divisions above and below the center line). That's vertical resolution!

For horizontal or time resolution, you have a number of choices. You can digitize at 128, 256, 512, or 1024 points equally spaced in time on the

waveform. With 1024 points selected and using the fastest calibrated time-base sweep of 0.5 nanoseconds per division, you can detect time differences as small as five picoseconds. Or, for really fast requirements such as evaluating optical fibers, a 7S12 Sampler plug-in can be used with the acquisition unit. With the 7S12 at its fastest rate of 20 picoseconds per division and using 1024 points, the sample interval then becomes 0.2 picoseconds.

The only requirement for such high degrees of time resolution is that the acquired waveform be repetitive. This is necessary for the asynchronous sampling (equivalent-time sampling) of the acquisition unit to build up a full complement of 1024 amplitude samples over several horizontal sweeps.

Since sampling is asynchronous at a 3.5 microsecond rate, the emphasis of the WP1310 system is on acquiring repetitive waveforms. However, provisions have also been added for sequential sampling of low-speed transients. This provision is made via the internal clock of a 7B87 time base. The 7B87 clock is used to gate sequential real-time sampling when the AQS (acquire single sweep) button on the acquisition unit is used for waveform acquisition. In this single-sweep mode, full sequential sampling (128, 256, 512, or 1024 points) with a minimum sample interval of about four microseconds can be obtained. Or, with an external clock, it is possible to obtain a two-microsecond sample interval. And, as a further benefit of sequential real-time sampling, pre-triggering becomes possible (see Fig. 3).

Digitizing in either the repetitive or single-sweep mode is accompanied by storage of the digitial waveform values and vertical and horizontal scale factors in the acquisition unit's memory. With the full memory option (option 2D), there are eight kilowords available in the acquisition unit for storing waveforms, constants, and analysis programs. The number of waveforms that can be stored varies according to the points per waveform. In the eight kilowords, space is provided for storing five 1024-point waveforms, or ten 512-point waveforms, or twenty 256-point waveforms, or forty 128-point waveforms.

Once in memory, any of the waveforms can be called up again, along with its scale factor information, for display on the acquisition unit's CRT. Up to nine waveforms can be displayed at one time. Also provided along with waveform storage in the eight-kiloword memory option is room for 100 constant registers and 2000 program elements (line numbers or commands). These storage areas can also be accessed for display on the acquisition unit's CRT.

Front-end processing power

Beyond just containing a waveform digitizer

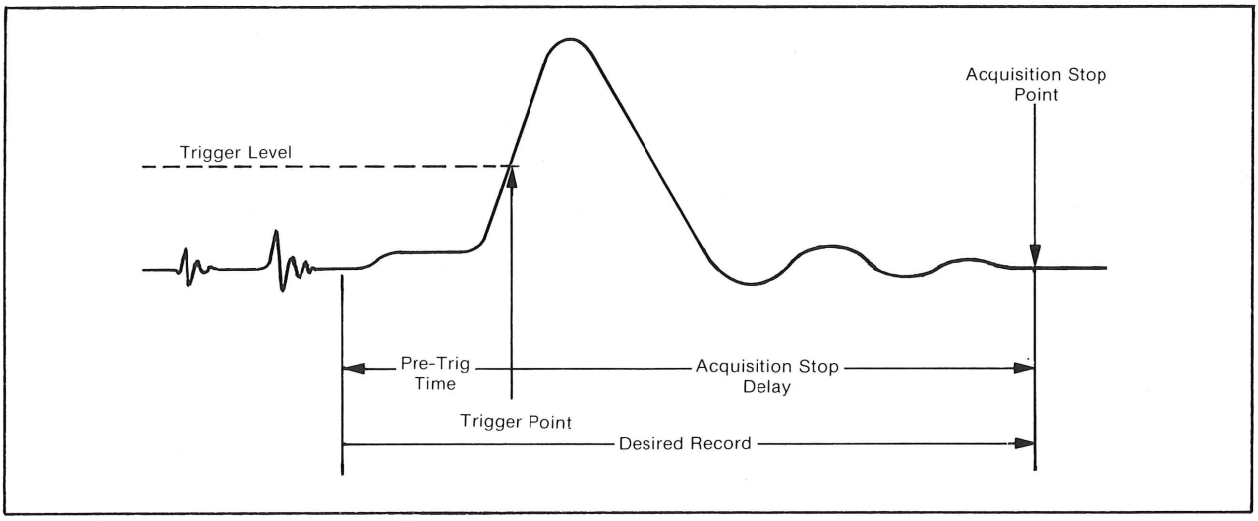

Fig. 3. *Pre-trigger: Unlike the repetitive mode where pseudorandom digitizing begins with the sweep trigger, the single-sweep acquisition mode using the 7B87 time base digitizes sequentially and continuously feeds samples to memory. This goes on until an "Acquisition Stop" freezes the most current samples in memory. By properly adjusting the "Acquisition Stop Delay" of the 7B87, those current samples can be made to include waveform data preceding the set trigger point. One benefit of this is that trigger levels can be set far above noise while still allowing capture of an entire leading edge in the pre-trigger zone.*

WP1310 backs 400 MHz oscilloscope...

and memory for waveform storage, the WP1310 acquisition unit also has an internal microprocessor with firmware for controlling waveform acquisition and processing. Push buttons on the front panel and the Waveform Calculator keypad put a variety of measurement processes at your fingertips.

- Waveforms can be captured with signal averaging to improve signal-to-noise ratio (AVG).
- A variety of general parameters can be computed from stored waveforms (MAX, MIN, P-P, MEAN, MID, ENERGY, AREA and frequency or period).
- Pulse parameters can be determined (FALL, RISE, DELAY, WIDTH).
- And a variety of other computations and manipulations can be made.

All by simply pressing buttons, just like a calculator and the results are conveniently displayed on the oscilloscope CRT (Fig. 4).

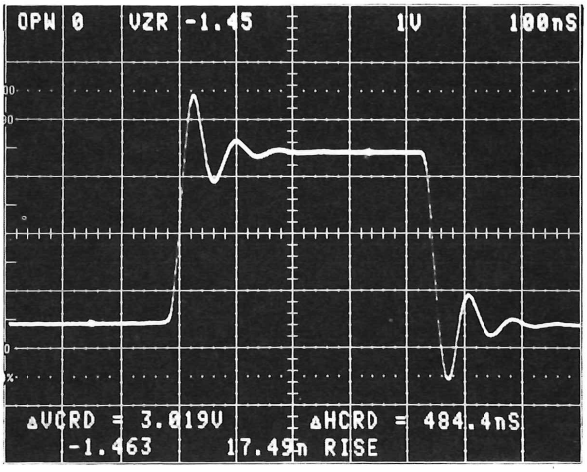

Fig. 4. *Stored waveforms can be recalled from WP1310 memory for redisplay at any time in a familiar oscilloscope fashion. Also, the displays are augmented by labels and waveform parameters computed by firmware.*

The 7854 Oscilloscope, a closer look

The acquisition unit of the WP1310 Waveform Processing System is the new TEKTRONIX 7854 Oscilloscope. Based on the Tektronix line of high-performance 7000-Series oscilloscopes, the new 7854 Oscilloscope takes a significant step beyond standard oscilloscope capabilities. Waveforms acquired through its 400 MHz bandwidth mainframe can be viewed in real time or digitized in equivalent time and stored in digital memory for later viewing and analysis.

Waveform analysis is provided in the 7854 through visible screen cursors and push buttons that invoke internal microprocessor routines for computing a variety of waveform parameters and mathematical functions. There are buttons for:

Delay time	Smooth
Pulse width	Integrate
Rise time	Differentiate
Fall time	Interpolate
Period	Recall ordinate
Frequency	Change ordinate
Maximum	Square root
Minimum	Natural log
Vertical midpoint	Exponential
Root mean square	Absolute value
Average value	Signum— +1, 0, or -1
Area under curve	+, -, *, /
Energy	., 0-9, and EEX

These are some of the more important function keys. Plus, there are additional keys for program entry, program execution control, and waveform acquisition, positioning, display, and expansion. And there are still more capabilities and features—including GPIB (IEEE 488) compatibility.

For a complete description of the 7854 Oscilloscope, contact your local Tektronix Field Office. Or request WP1310 information, which includes a 7854 Oscilloscope data sheet, via the reply card bound into this issue of HANDSHAKE.

Being able to make a measurement at the touch of a button is a great time saver. Counting squares, multiplying by scale factors, and other finger, visual, mental, and graphic gymnastics are reduced or completely avoided. Minutes are saved on simple measurements. Hours can be saved on more complex operations.

Additionally, multi-stepped measurement sequences can be programmed from the Waveform Calculator keypad, stored in the acquisition unit's memory, and recalled for execution. This means that even more time can be saved. Instead of re-pushing many buttons in sequence to perform each iteration of an analysis series, the buttons can be pushed once in the PROGRAM ENTRY mode. Then the entire sequence can be run automatically, as often as you like, in the EXECUTE mode. Not only does the button sequence run faster as a program, but measurement errors associated with manually executed sequences are dramatically reduced. Programs execute button functions the same every time—they don't forget steps or inadvertantly execute button functions out of the established sequence. That means a dramatic increase in measurement repeatability.

IEEE 488 compatibility

Once a waveform has been acquired and pre-processed by the WP1310 acquisition unit, it can be transferred to the WP1310 system controller for high-level processing. The transfer is over an IEEE 488 bus.

The same bus, because of IEEE 488 compatibility, can be used to tie more acquisition units into the WP1310 Waveform Processing System. You could have the WP1310 controlling up to 14 acquisition units in a multiple station test area for example. The programs could be down loaded to each acquisition unit according to the test needs at each station. With the WP1310 processing distributed between the system controller and the acquisition unit...well, you have just the measurement power you need when you need it and where you need it.

By Bob Ramirez
HANDSHAKE Staff

New TEK SPS BASIC releases offer more capabilities, more memory

Two new releases of TEK SPS BASIC software, V02-02 and V02XM-02, are now available for updating your signal processing system. Both releases retain the previous capabilities of TEK SPS BASIC as well as offer the additional capabilities of

- A high-level GPIB driver
- Support for additional peripherals
- Additional programming convenience
- A 7612D commands package

And, beyond these features, V02XM-02 offers extended memory for handling large waveform arrays such as those that can come from the new 7612D Programmable Digitizer or many smaller arrays such as might come from any other digitizer.

The importance of these new capabilities becomes apparent in taking a closer look at each of them. For owners of the new 7612D Programmable Digitizer, the 7612D commands package and the extended memory version will be of particular interest.

High-level GPIB driver

The low-level GPIB driver is still a part of the TEK SPS BASIC monitor. And it still offers the greatest flexibility in dealing with a wide variety of interpretations and implementations of the GPIB standard.

The new high-level GPIB driver, however, can make life a lot easier when dealing with certin standardized data transfers over the GPIB. It reduces the number of program lines necessary for communicating with many GPIB instruments, and the commands are simpler and easier to remember. With the high-level GPIB driver, a single command is all that is necessary now to acquire data from either the 7612D or 7912AD Programmable Digitizers.