ENGINEERING NEWS

Company Confidential

September 1978

THE 7912AD PROGRAMMABLE DIGITIZER

Shipment in July of the first production unit 7912AD Programmable Digitizer system from the Walker Road plant culminated a two-year design effort. At first this seems like a small accomplishment since the 7912AD bears such a strong family resemblance to its forerunner—the R7912 Transient Digitizer. However, much of the resemblance ends at the outside covers. Using the proven concept and analog circuitry of the R7912, the 7912AD adds several Tektronix "firsts".

- a fully-programmable test and measurement instrument.

- the most complete implementation of the IEEE 488-1975 interface standard (commonly called the GPIB) in a test and measurement instrument.

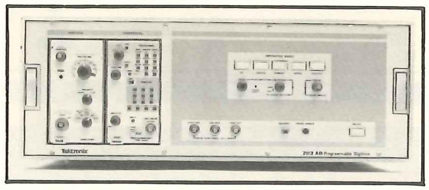
- on-board signal processing to ease the load on the external computer and software.

- use of several microprocessors as a "team".

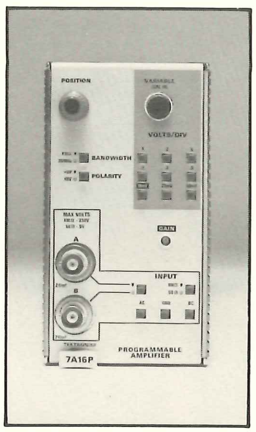
The long-run significance of each of these "firsts" is hard to assess now. But at least one of them may be as important as some of the other "firsts" pioneered by Tektronix. Imagine where measurement instruments would be today if Tektronix had not introduced the plug-in concept to oscilloscopes in 1953!

WHY BUILD A NEW MODEL?

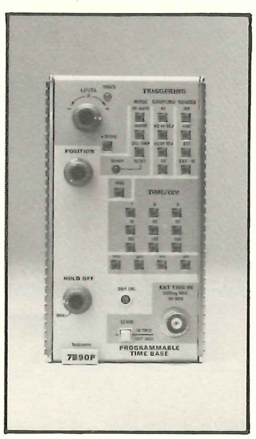
The R7912 Transient Digitizer was the world's fastest digitizer when introduced five years ago. There are no serious pretenders to this title and the R7912 is still considered the ultimate measurement instrument in many industries. In fact, Lawrence Livermore Labs recently formally recognized Tektronix' contributions to their fusion research program, and the R7912 played an important role in the success of the program.



The 7912AD Programmable Waveform Digitizer is a fully programmable waveform acquisition and digitizing instrument. This model is useful for recording fast transients (up to 350ps rise time with the direct-access plug-in), providing automatic or remote signal acquisition (fully programmable up to 200 MHz) and for other highspeed waveform digitizing tasks.



The 7A16P Programmable Amplifier Plug-In is a 225 MHz fully programmable amplifier for the 7912AD. Calibrated sensitivities range from 10mV/div to 5V/div. The input impedance is switchable between 50 ohms and 1 Megohm, and input coupling may be ac, dc or ground for reference...all under program control if required.



The 7B90P Programmable Time Base Plug-In is a programmable time base for the 7912AD. Calibrated sweep rates may be selected in 1-2-5 sequence from 500 ps/div to 500 ms/div.

WHY FOOL WITH SUCCESS?

The answer can be found by examining R7912 applications in detail. While many specific uses of the R7912 are restricted information for national security reasons, some general characteristics of 7912 users' measurement needs can be noted.

- Multiple instrument-systems are required.

- Large volumes of data are collected from each test.

- Tests often are expensive and difficult-to-repeat.

- Test area environment is hostile.

- The electronics industry is moving toward capital investment and away from labor investment.

These and other factors influenced the decision to improve the R7912 concept by adding features. As a result, we have introduced the 7912AD Waveform Digitizer and the 7A16P Amplifier and 7B90P Time Base plug-ins. And if present interest is an indication, the 7912AD and its plug-ins will have a successful product lifetime.

DON'T CHANGE A WINNER

The 7912AD, 7A16P, and 7B90P are largely adapted from field-proven instruments. After all, why change what's aleady doing the job? For example, the heart of the 7912AD is the Tektronix-developed and R7912-proven T7910 scan-converter tube (see *figure 1*). The vertical and horizontal deflection systems are virtually unchanged from the R7912. Likewise, the analog circuits of the 7A16P and the 7B90P are nearly identical to the 7A16A Amplifier and the 7B80 Time Base.

A PEEK UNDER THE COVERS

Details of the circuitry used in the 7912AD, 7A16P, and the 90P are

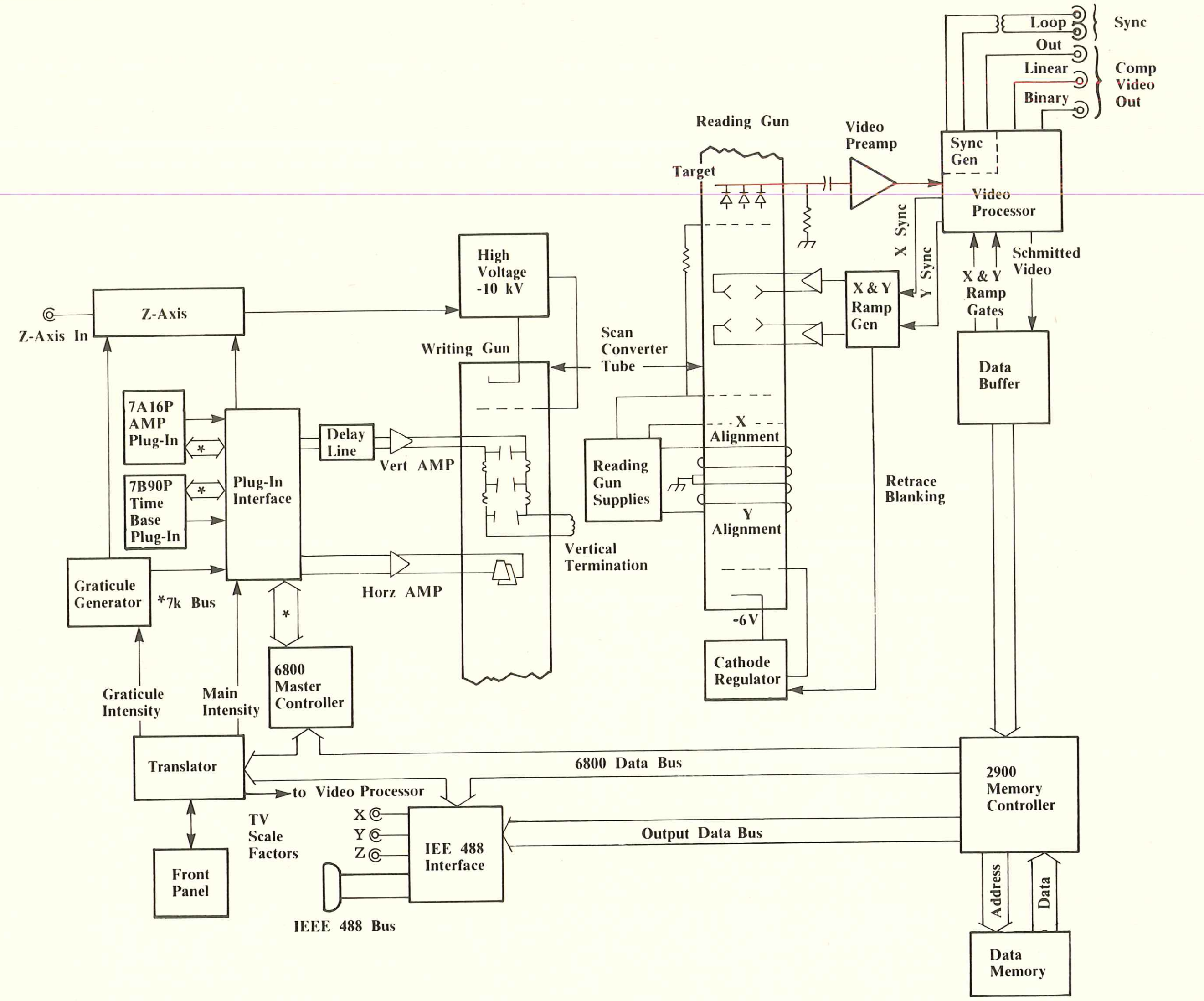


Figure 1. Block diagram of (left) write circuitry and (right) read circuitry for the 7912AD Programmable Digitizer.

described in technical journals and in the instrument manuals. However, we will look at some of the major design features.

A Microprocessor Team. The 7912AD uses two microprocessors to control the intrument and to preprocess and store measurement data. *Figure 2* shows a block diagram of this microprocessor system. The 6800 microprocessor is the master controller. It decodes IEEE 488 bus commands, delegates tasks to other blocks, and controls signal processing. Each of the plug-ins also has a microprocessor addressed by the master controller over the Bus for communications such as scale-factor readout or control-setting queries. The 7K Bus is defined in the TEK Series Plug-in Standard to facilitate communication with programmable plug-ins.

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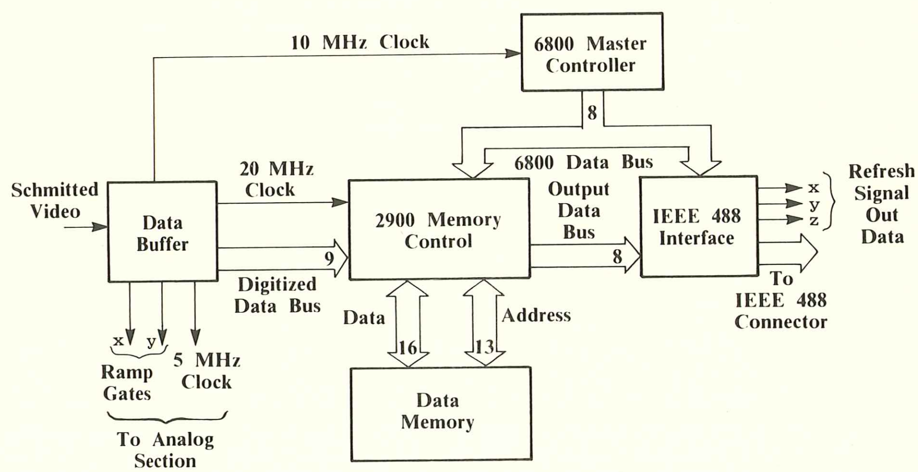

Figure 2. The 7912AD microprocessor team.

SCAN CONVERSION

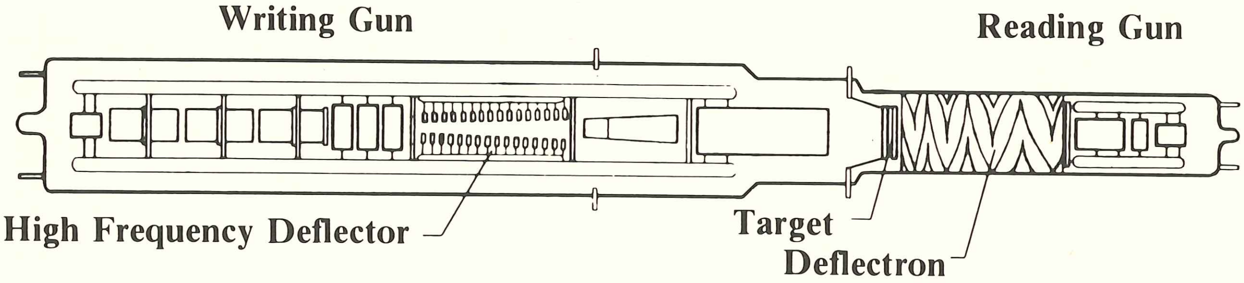

Figure A. The 7912AD scan converter tube.

Scan conversion converts a signal from one data rate to another. In the 7912AD, scanning converts a very high speed analog input signal to one of two output formats. In the TV format, the high-speed input signal can be viewed on a relatively low-frequency TV monitor. In the digital format, a computer can process the signal.

The 7912AD uses two scanning systems to convert the input signal to the desired output signal. Figure A shows the T7910 scan converter tube which consists of two facing electron guns with a scan converter target positioned between them.

The target is an array of diodes formed on a silicon wafer. See figure B. The low-speed reading beam continuously scans the target. The beam reverse biases each diode.

When a high-speed input signal is applied to the 7912AD, the writing gun writes the waveform on the target.

As the high-speed writing gun scans the target, the beam forward-biases the target diodes. If the reading gun scans a "written" diode, more beam current is required to reverse bias the diode. The 7912AD senses this change in beam current and uses the change to reconstruct the high-speed signal in a more usable, low-speed format.

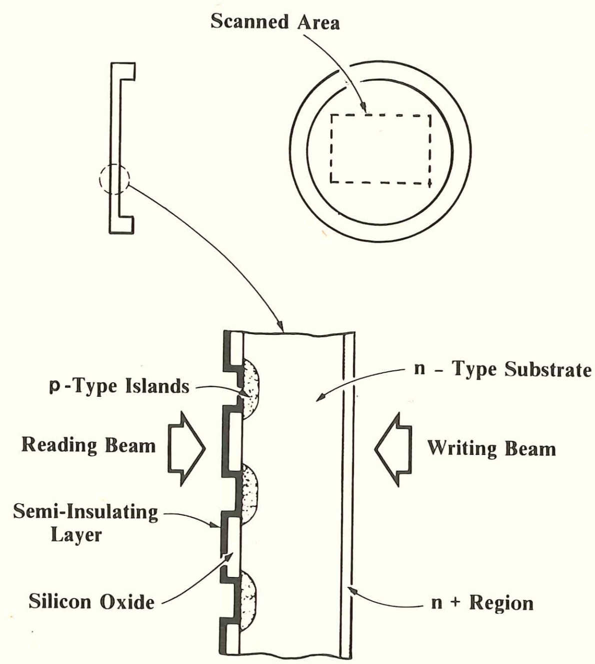

Figure B. The 7912AD scan converter read and write beams scan a 1.3-by-0.95 centimeter area of the target. The target density is about 800 diodes per square centimeter.

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The second microprocessor in the mainframe, a 2900, operates in a slave mode to unscramble the data pouring out of the scan converter. Using firmware algorithms, the 2900 acquires data in response to a "digitize" command, stores the raw data in memory, performs signal processing on this raw data, and outputs data either to the IEEE 488 bus or to the X-Y-Z signal outputs (refreshed mode).

A direct-memory-access type of data transfer over the IEEE 488 Bus is available upon command. The IEEE interface sets up bus handshakes for a maximum data transfer rate of 500K bytes. This is faster than the rates for most listeners now operating on the IEEE 488 bus.

The 2900 microprocessor deserves a closer look. This device (actually a seven-chip set) is a bipolar bit-slice microprocessor which uses a pipeline register to shorten cycle time. The 2900 was chosen because it allows designers to tailor an instruction set for an optimum design. As a consequence, the 2900 performs its assigned functions much faster than if a microprocessor with a defined instruction set were used. In fact, the 2900 is even faster at its assigned signal processing tasks than the DEC PDP-11 minicomputer.

Data Handling Eases the Computer Load. One of the major deficiencies of the R7912 was the data format at the output connector. Any software designed to process this data must first decode the data and then put it into order—a major task. Another problem is the way the scan-converter tube detects signals. Normally, the tube outputs two digital values for each location of the vertical trace—one for the top edge and one for the bottom edge. To provide meaningful information for signal processing, these two edge-values must be reduced to a single value (their average).

Our 7912AD designers assigned averaging to the mainframe 2900 microprocessor. Using firmware algorithms, the 2900 formats and preprocesses the data to ease the load on the external computer. Among the data formatting and signal processing tasks accomplished by this microprocessor are:

- Reformatting the data so the first data value output corresponds to the left side of the target.
- Flagging any defects in the scan-converter target so they can later be removed from the waveform data.
- Performing an average-to-center trace computation so that only one vertical output per horizontal point is produced regardless of beam width.
- Interpolating missing data points.
- Identifying waveform edges.
- Signal-averaging up to 64 times (only 5 seconds are required for averages).

ALL UNDER PROGRAM CONTROL

Programmability allows the 7912AD, 7A16P, and 7B90P to perform complex tasks according to a program stored in a computer. Programmability also allows instruments to be operated from a computer terminal (often a Tektronix graphic terminal). Customers are asking for programmable instruments, and there is strong, early interest in the 7912AD, 7A16P, and 7B90P. Some of the reasons for this are:

- Hostile Environments. Test instruments are often located in areas where human control is undesirable or impossible—for example, near a large laser system.
- Remote Locations. Test instruments are often located great distances from the control console. With programmability, these instruments can be set or checked from a remote location.
- Automatic Test and Control. As part of a complete test system, the 7912AD and plug-ins can gather data for analysis by the central computer. Based on this data, the computer can issue control commands to the 7912AD and plug-ins or to other system equipment.
- Pre-Test Calibration. With programmability, the entire test system can be automatically tested and readjusted just before the experiment is run. This saves time and money since many tests may be impossible to repeat.
- Multiple Instrument Systems. Some systems have 30 or more instruments, each of which can be set or checked from a central control console.
- Less Human Intervention. A single operator can control many instruments from one control console. This frees personnel for other tasks requiring the human touch.

GETTING ON THE BUS

One of the major advances in the 7912AD's design is letting it converse with other instruments over the IEEE 488 bus. The bus standard specifies the connector to be used, the voltage and current limits at the connector, and the timing and message protocol for control and data transfer between instruments and the controller (computer). Beyond this, the standard allows for flexibility of design.

Recognizing the chaos that could result if each Tektronix instrument used a different programming format, a move is afoot to further standardize Tektronix-designed intruments which use the IEEE 488 bus. Since their projects were the first test and measurement instrument to use this interface, the 7912AD, 7A16P, 7B90P designers had to break a lot of new ground in programming standards and formats.

The 7912AD system combines internal buffering and extended addressing to allow use of the maximum number of instruments with each computer. The IEEE 488 standard limits the number of device loads (instruments) on the bus to 15. Instead of allowing the 7912AD, 7A16P, and 7B90P to each represent an individual load on the bus for a maximum of five systems, internal buffering is used to isolate the plug-ins from the IEEE bus. The 7912AD communicates with the plug-ins via the 7K Bus. As a result, each 7912AD system represents only one load on the bus.

Extended addressing provides similar expansion of the addressing capabilities. The IEEE 488 standard allows only 30 individual addresses on the bus. If each 7912AD, 7A16P, and 7B90P had a separate address, only ten 7912AD systems could be connected to each bus. Extended addressing assigns a primary address to each 7912AD system. Then a secondary address is used to access either the mainframe programmable functions, the 7A16P or the 7B90P. However, the 7912AD is transparent to communications between the IEEE bus and the plug-ins. The 6800 Master Controller determines which commands are intended for the 7912AD, 7A16P, or the 7B90P and directs them to the correct unit.

As a bonus, using the IEEE 488 bus allows the 7912AD, 7A16P, and 7B90P to talk with many of the more than 100 instruments available with a similar interface. And the number of IEEE 488 compatible instruments is growing rapidly, making compatibility even more important for the future.

HOW DOES THAT WORK AGAIN?

The old saying of "When all else fails, read the manual" may be a cliche. But when you do read the manual and find what you were looking for, it can be gratifying. Not everything you ever wanted to know about the 7912AD, 7A16P, and 7B90P appears in the manuals, but a special effort has been made to thoroughly document these products.

Of particular note is the programming information. Since the IEEE 488 standard is relatively new, the tutorial side of programming with IEEE 488 is emphasized. Next are instructions for running the instrument through its paces. This is

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at a fairly basic level and, since the 7912AD is designed to be used with a variety of computers, the programming is described independently of any specific computer or system software. A reference manual tells how to design the 7912AD/computer software interface and how to use the system with specific software packages such as TEK SPS BASIC.

ACKNOWLEDGEMENTS

The 7912AD, 7A16P, and 7B90P were developed within SPS, but they required the dedicated effort of people throughout Tektronix. A list of all those who contributed to the success of the design effort would read like the Tektronix phone book. However, we'd like to acknowledge significant contributions from the following areas:

SPS Engineering: Electrical Design, Mechanical Design, Firmware Design, Etched Circuit Board Design. Prototype Support. Documentation. SPS Marketing. SPS Manfacturing. Service Support. Tek Lab's CRT Design.

But organizations don't make instruments—people do! So, to each of you who had a hand in making the 7912AD, 7A16P, and 7B90P project a success, we offer a well-deserved THANK YOU!☐

FOR MORE INFORMATION

IEEE 488 Interface Bus

Kimball, J., "The IEEE 488 Bus - Going Your Way," **TEKSCOPE,** Vol. 10, No. 2.

Conway, J., "What You Should Know About the 488 and 583 Interface Standards." **EDN,** August 5, 1976.

IEEE Std. 488-1975. **IEEE Standard Digital Interface for Programmable Instrumentation.** The Institute of Electrical and Electronics Engineers, Inc., 1975.

HANDSHAKE, Vol. 3, No. Published by SPS Documentation Group.

7912AD Programmable Digitizer

"A New Way to Look at Transients." **TEKSCOPE,** Vol. 5, No. 6, Nov./Dec. 1973.

Hayes, R., Cutler, R., and Hawken, K., "Storage Tube with Silicon Target Captures Very Fast Transients." **Electronics,** August 30, 1973.

HANDSHAKE, Vol. 3, No. published by SPS Documentation group.

IN-ORBIT MANUFAC-TURING TECHNIQUES

Companies such as TRW, Grumman, and Hughes are preparing experiments that will be carried by the National Aeronautics and Space Administration's Space Shuttle and Skylab into orbit around the Earth. NASA has selected electronics applications for 10 of the first 17 experiments. Experiment results may affect materials processing for semiconductors, battery electrolytes, and electro-optics.

A short news item on page 59 of the June 8, 1978 issue of **Electronics** discusses the experimental program.

If you are interested in possibly applying in-orbit manufacturing techniques to Tektronix products, please call Eric Geislinger (Accessories Engineering) on ext. 5307.☐

DATA REDUCTION AND DISPLAY IN AUTOMATED TEST SYSTEMS

Trent Cave (STS Manufacturing)and Douglas Smith (STS Marketing) were authors of a May, 1978 **Computer Design** article entitled "Data Reduction and Display in Automated Test Systems." For a copy of the article, call Trent (ext. 1203) or Douglas (ext. 1223) at Walker Road.☐

GPIB-PRODUCT INFORMATION

Al Zimmerman (Digital Product Coordination group manager) has announced a library of information on products using the IEEE 488 1975 interface (General Purpose Interface Bus) The library includes manuals for competitors' as well as Tektronix GPIB products. These manuals can be useful for quick answers to questions about service problems and GPIB applications. For product designers, examining these manuals may make the difference between "one-up" and "me-too."

Besides manuals, the library has other information about Tektronix products: new products coming (and who's in charge), performance specifications, who is building GPIB *systems* (and why), and five ways Tektronix designers are using GPIB.

For more information, call Al Zimmerman on ext. 7095.☐

ELECTRON RADIATION DAMAGE IN ZINC ORTHOSILICATE PHOSPHOR

Jere Marrs (Materials Research, Tektronix Laboratories) authored "Electron Radiation Damage in Zinc Orthosilicate Phosphor," an article that appeared in the March, 1978 **Journal of the Electrochemical Society.** For a copy of the article, call Jere on ext. 5008.☐

MODULAR PACKAGING SYSTEM—A LESS EXPENSIVE WAY TO PACKAGE

After nearly two years of design effort, the Advanced Electro-Mechanical Design group has developed a packaging system which promises to cut packaging costs significantly.

This Modular Packaging System (MPS) provides different-sized packaging units with common parts and requires only a fraction of the number of fasteners used in previous systems.

DESIGN

MPS is compatible with the electronic industry's standard 19" rack cabinet. MPS packages are available in standard cabinet heights of 1-3/4 inches, 3-1/2 inches, 5-1/4 inches, and so on.

Currently, MPS units are available in two widths: half-rack and full-rack. Half-rack MPS units accomodate three 7000- or 5000-series plug-ins, while full-rack units hold six plug-ins. If necessary, one-sixth, one-third-rack and two-thirds-rack will be developed.

For monolithic instrument applications, the MPS can also be described as a rack-and-stack system, because units can be stacked or positioned side-by-side. Units can be locked together with metal strips in the factory or with plastic strips in the field.

MPS units use common parts: structural parts, feet, flip stands, handles, covers and crt bezels. (See figures 1 and 2.) Much of the chassis and crt mounting hardware used in previous systems is not used in MPS units. For example, circuit boards mount to component mounting brackets attached to the corner extrusions (where possible.) A flanged corner extrusion makes direct attachment to corner extrusions possible. Crt s' mount to the front casting only, eliminating mounting-hardware further back in the instrument.

MPS units require fewer fasteners. For example, 16 fasteners are eliminated from the bottom-feet and handle attachments, because no screws, rivets or spot welds are required. The basic MPS unit requires 16 fasteners instead of the average 38. (See figure 3.)

The Advanced Electro-Mechanical Design group's ultimate goal is establishing a stock of common MPS parts which designers can order from. Documentation of this is still under development by two groups. The Technical Standard's group is devising a set of standards which will describe the parts. The Cataloging group is developing a list of parts with their accompanying part numbers.

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	604 Low Cost Display Monitor	620 Display Monitor With MPS
Materials	$7.74	$8.89
Labor	24.59	13.95
Total Manufacturing Costs	32.08	22.84

Use of the Modular Packaging System (MPS) has significantly reduced packaging costs. For example, packaging costs for the 620 Display Monitor are about 30% lower than the 604 Low Cost Display Monitor's packaging costs. Materials cost for the 620 Monitor are slightly higher, but MPS cuts labor costs dramatically because many fasteners are eliminated. Holes for remaining fasteners are either cast or extruded in place. By using thread forming screws (where possible), the expensive task of drilling and tapping (10 cents per hole) is virtually eliminated. Designing labor saving details into the parts means using sophisticated tooling, which slightly drives up materials cost.

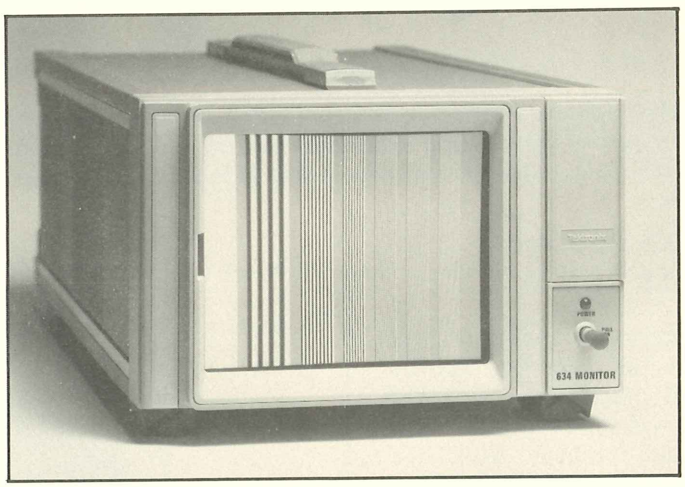


Figure 1. The recently released 634 Video Display which uses the Modular Packaging System.

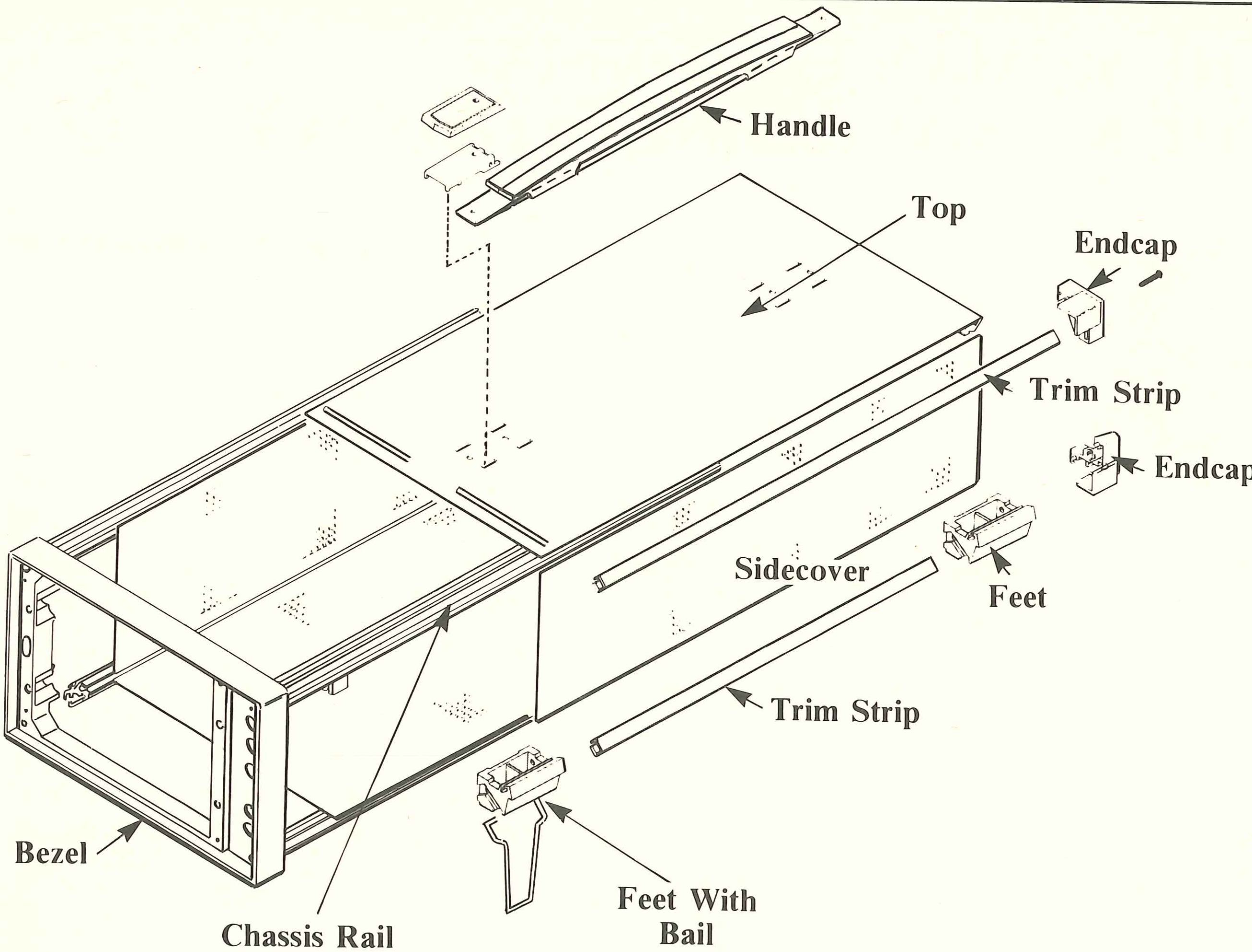


Figure 2. The Modular Packaging System (MPS) dramatically cuts down the number of parts used in a typical enclosure compared to previous packaging methods. For example, this exploded view of a 634 Video Display's MPS packaging has approximately 12 parts and is half-rack width. It is a basic enclosure made up of MPS parts, which will be used for many instruments.

SIMPLIFIED PRODUCT PROPOSALS

Product proposals will be less complicated for Tektronix groups using MPS packaging since the proposals will not include new tooling and other associated packaging costs. All these tooling and design costs are absorbed into a single Capital Commitment Authorization (CCA) and eventually divided among the instrument divisions. Tooling is not charged to specific instruments. This approach allows small and large quantity users to obtain MPS parts at the same price.

MPS FOR NEW PRODUCTS

Two Tektronix products using MPS packaging were recently released: the 634 Video Display and the 620 Display Monitor.

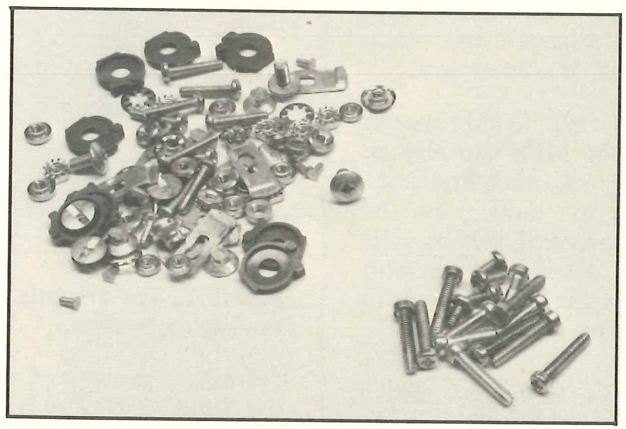
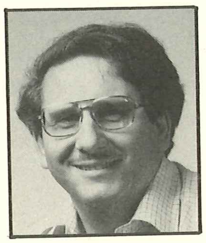


Figure 3 The Modular Packaging System (MPS) also cuts down the amount of fasteners used in packaging compared to previous systems. For example, on the left is a pile of 38 fasteners needed in some previous packaging systems. On the right is a pile of 16 fasteners used in a typical MPS enclosure.

Because of substantial savings in packaging costs, all T & M engineering departments (except portables) are required to use MPS. Exceptions must be approved by Bill Walker at the products proposal stage. For more information, call Casey Veenendaal at ext. 7045.□

THE HUMAN FACTOR IN THE MAN-MACHINE INTERFACE



Joe Morabito, LDP Human Factors Engineering, ext. 7161.

In the May, 1978 ***Engineering News****, Gale Morris (LDP Human Factors Engineering) surveyed the three basic concerns of human factors engineering: man, machine and environment. This article, first in a series on those concerns, briefly examines the human component.*

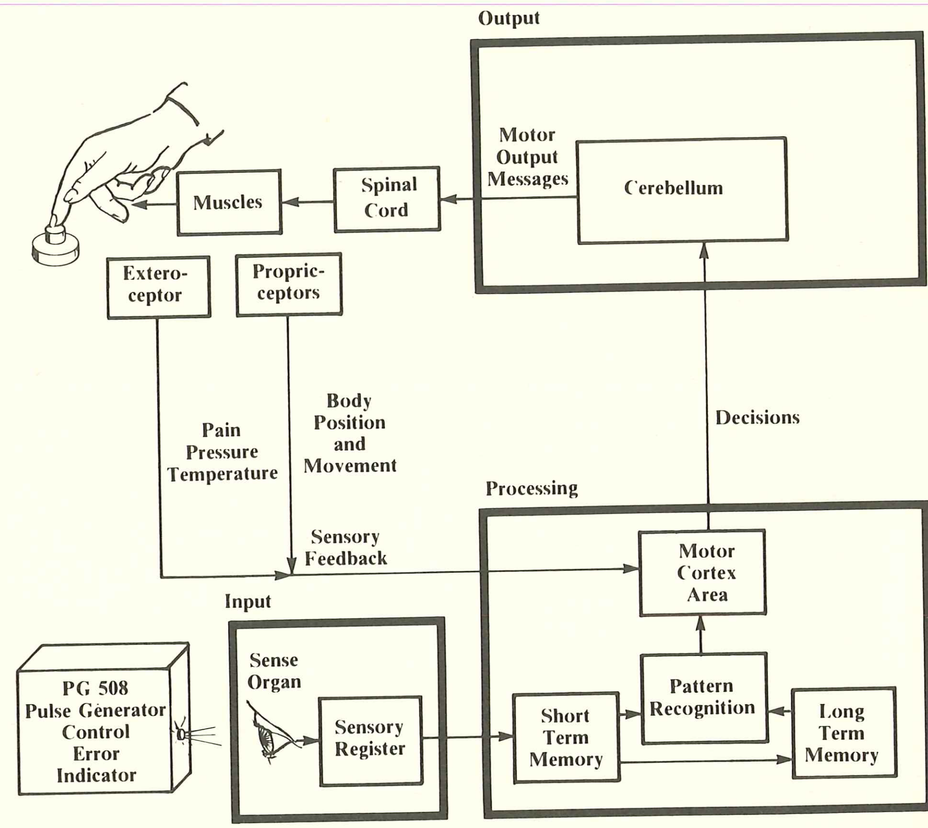
The success of an instrument depends not only on its electrical and mechanical design but also on how easily the instrument is operated. And inexpensive microprocessors are allowing designers to raise the level of interaction between instrument and user. These two factors make the role of human factors engineering in instrumentation design increasingly important.

THE SYSTEM ANALOGY

The interaction of user and product is an interface of a human system and a machine. The role of human factors engineering is optmizing that interface.

In the case of interaction between operators and computers, a common interface is a crt display. In this case, human factors include room illumination, character size, and the operator's information processing ability.

Both humans and computers are information processors ... both have inputs, processors and outputs. For the human system, the analogy may be carried further as shown in figure 1.



If the operator of a PG 508 Pulse Generator misadjusts the controls, the control error indicator flashes. The eye passes this data to the sensory register. The pattern recognition compares the data in the sensory register to knowledge stored in long term memory. A decision results from the comparison. Then the brain outputs messages that stimulate muscle movement.

INPUT

Consider vision as an example of input. Usually vision is explained with comparisons to cameras, but that's misleading because vision is dynamic and the photographic process is not. Light strikes the eye in a pattern of high and low energy levels that are translated into electrochemical nerve impulses. The impulses are transmitted to an area in the brain we can call the "sensory register." The sensory register can hold raw data for no more than a second and then new data overwrites the old. But before it is overwritten, data in the register passes to the higher processing centers of the brain.

PROCESSING

In our model of the human system, the central processing block includes three major areas: short-term memory, long-term memory, and pattern recognition.

Compared to long-term memory, **short-term memory** has a very limited capacity and what it does hold decays rapidly unless the information is rehearsed ("refreshed"). Information capacity and decay are important factors to be considered when designing an interactive crt display. For example, the amount of information displayed and the time it is on the screen affect the user's retention and therefore performance. continued on page 10 continued from page 9

Long-term memory stores information the user doesn't need to retain consciously but which can be recalled (most of the time).

Pattern recognition matches information in the sensory register with information already in long-term memory. Matching leads to decisions that, in turn, initialize motor responses (the "output" in our model of the human system).

OUTPUT

Prior to any action, the brain simultaneously processes inputs from many sources. Using decision information from the pattern recognition area, the motor cortex (a region of the brain) creates a "template" of the required action. (The template is a pattern representing a movement in time and space.) Then the cortex transfers coded information about the movement to the cerebellum which converts it into motor output messages, sending them (via the spinal cord) to the associated body muscles. These nerve impulses are integrated into a system already in motion (controlling posture, balance, and reflexes). Simultaneously, **reafference** (sensory feedback) tells the motor cortex that the action is underway. **Proprioceptors** (receptors in the tissue surrounding joints) tell the motor cortex the body's position and movement. **Exteroceptors** (sensors under the skin) provide pain, pressure and temperature information to the motor cortex area. The cerebellum processes many actions: the movement's amplitude, speed, fineness and steadiness; the force required; and the spatial location of the moving body part.

If the action is not correct, the motor cortex relays signals to the cerebellum to correct the movement. Interestngly, in this feedback loop the cerebellum even accounts for time lost in nerve impulse transmission (some nerve impulses travel as slow as 5 meters per second). As a further example of our computer analogy, the human system apparently stores templates of commonly-used actions and reflexes. These templates are accessed as if they were subroutines.

EXTERNAL FACTORS

External factors can affect information processing. When a person is emotional or motivated, there is an associated change in the nervous system called **activation.** Any change in the outside world many change the activation level. This change affects sensory inputs and therefore affects motor outputs which in turn affect attention, reaction time and performance. This human/environment interaction must also be considered when optimizing the man-machine interface.

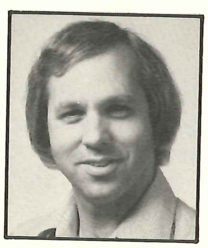
APPLICATION

We have briefly examined the *human* aspect of the man-machine interface. It is one of the three general areas that human factors specialists must consider. The simultaneous processing of all the factors we have just discussed makes the human system far more complex than any man-made system.

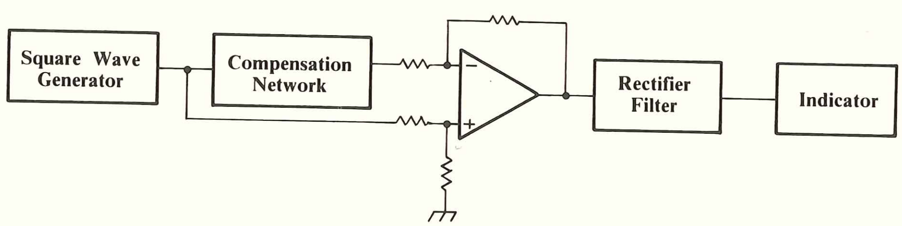
Research is continuing. As we learn more about the brain's information-processing ability, human factors' specialists will be able to apply this knowledge directly to Tektronix products.□

PATENTS RECEIVED

COMPENSATION INDICATOR FOR ATTENUATOR PROBE



Roland Crop, Service Instruments Division Engineering, ext. 6105.



To make a X10 probe (having 10-megohm input resistance) compatible with an instrument's input resistance-capacitance product, the probe must be capacitively compensated. For an oscilloscope, the probe input must be a square wave calibrator signal and the operator must adjust the X10 probe to obtain a flat square wave on the scope's screen.

If the instrument doesn't have an analog display, the procedure is different. For example, on a universal counter/timer, one can attach a scope probe to a point in the counter/timer's circuitry where the probe won't load the counter/timer's input characteristics, and then adjust the X10 probe (connected to the counter/timer input) for flatness. However, the adjustment for flatness requires an oscilloscope, a square wave source, and a scope probe connected to the no-load point in the counter/timer's circuitry.

The patented design shown here provides circuitry in the counter/timer that allows the operator to simply attach the counter/timer X10 probe to the instrument's CAL signal while adjusting the probe for maximum brightness of a light-emitting diode. Both the CAL signal and the indicator are on the front panel of the counter/timer.□

PROFILE
ANALYTICAL SUPPORT LAB

The Analytical Support Lab, part of Tektronix Laboratories, serves all engineering areas as well as manufacturing, corporate safety and water treatment facilities. The lab performs wet chemical and instrumentation analyses of plating, cleaning, photoprocessing and metal treatment solutions and materials. The lab also maintains a chemical and laboratory equipment supply area for all groups in the company.

Laboratory personnel have expertise in organic, inorganic and physical chemistry, and in some facets of physics and semiconductor materials and processes.

The lab has standard wet chemical analysis equipment, but most of the lab's work requires instrumentation. Their instruments include an emission spectrograph, an atomic absorption spectrophotometer, a gas chromatograph, ultraviolet and visible spectrophotometers, an X-ray diffractor, carbon and sulfur analyzers and physical analyzers for measurements of viscosity, density and surface tension. The lab also provides chemical and physical evaluations of silicon wafers and silicon devices.

Seated: Kay Dimond, secretary. From left to right: Bob Bechtold, Frazier Rohm, Jolanta Armstrong, Marion Peterson (acting Lab manager), Doug Jones, Hal Frame, Eleanor Patterson, and Mike Mathews. Not shown are: Heidi Darnell and Les Keisling.

The Analytical Support Lab manager is Gene Hanson. Other staff are: Jolanta Armstrong, Robert Bechtold, Heidi Darnell, Harold Frame, Doug Jones, Les Keisling, Mike Matthews, Eleanor Patterson, Marion Peterson, and Frazier Rohm.

For more information about the Analytical Support Lab, call Gene Hanson on ext. 7456.☐

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Why EN?

Engineering News serves two purposes. Long-range, it promotes the flow of technical information among the diverse segments of the Tektronix engineering and scientific community. Short-range, it publicizes current events (new services available and notice of achievements by members of the technical community).

Contributing to EN

Do you have an article or paper to contribute or an announcement to make? Contact the editor on ext. 6792.

How long does it take to see an article appear in print? This is a function of many things (the completeness of the input, the review cycle and the timeliness of the content). But the *minimum* is five weeks for simple announcements and about eight weeks for major articles.

The most important step for the contributor is to put his message on paper so that the editor will have something to work with. Don't worry about organization, spelling and grammar. The editor will take care of those when he puts the article into shape for you.

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