Agenda

1 Philosophy / Convictions

2 7854 Comparisons

3 Major Characteristics

4 Human Interface Example

5 Basic Architecture

6 Relevant Technologies

7 Modularity for Future

How we're going to do it

Design

Implementation

# TEK INTER-OFFICE COMMUNICATION

TO: Distribution DATE: January 19, 1983

FROM: Thor Hallen

SUBJECT: Reschedule on 7K+ Presentations

From our meeting on January 18, the schedule of presentations works out as follows:

| | |
|---|---|
| 1:00 - 1:15 | Introduction / Jim |
| 1:15 - 1:45 | Market Dynamics / Peter |
| 1:45 - 2:00 | Family Overview / Thor |
| 2:00 - 2:30 | Conventional Mainframes / Greg |
| 2:30 - 3:00 | E.T. Mainframes / Tom |
| 3:00 - 3:30 | T.D. Mainframes / Gene |
| 3:30 - 3:45 | Plug-Ins / Cliff |
| 3:45 - 4:00 | H.R. Sampling / Stu |
| 4:00 - 4:15 | Project Estimates / Thor (as needed) |
| 4:15 - 4:30 | Firmware Plan / Don (as needed) |
| 4:30 - 5:00 | Discussion / All |

The "dry runs" that we went through required over 6 hours to cover all the material, indicating that we will need to be crisp and stick to the key points that need to be made. We can schedule additional time with Wim and/or Phil if they would like to explore specific topics in more detail. Please accept some suggestions to help us maintain schedule discipline and as a courtesy to other presenters:

* Commit your concluding time to memory before starting your presentation.

* Pace your material during the presentation by periodically observing the time. There is a clock on the east wall of C.R. S-1 that can easily be seen from where you will be standing.

* If Wim or Phil ask excessive questions, comment that you would like to make a note of the question, so that it will be answered during the discussion period. (Have access to a notepad and pencil.) This should solve the problem without offending anyone.

If you can tolerate a final suggestion, please consider this:

** Plan your presentation as if it is intended for a banker that you hope will finance a business venture for you.

Thor

TH/lcw

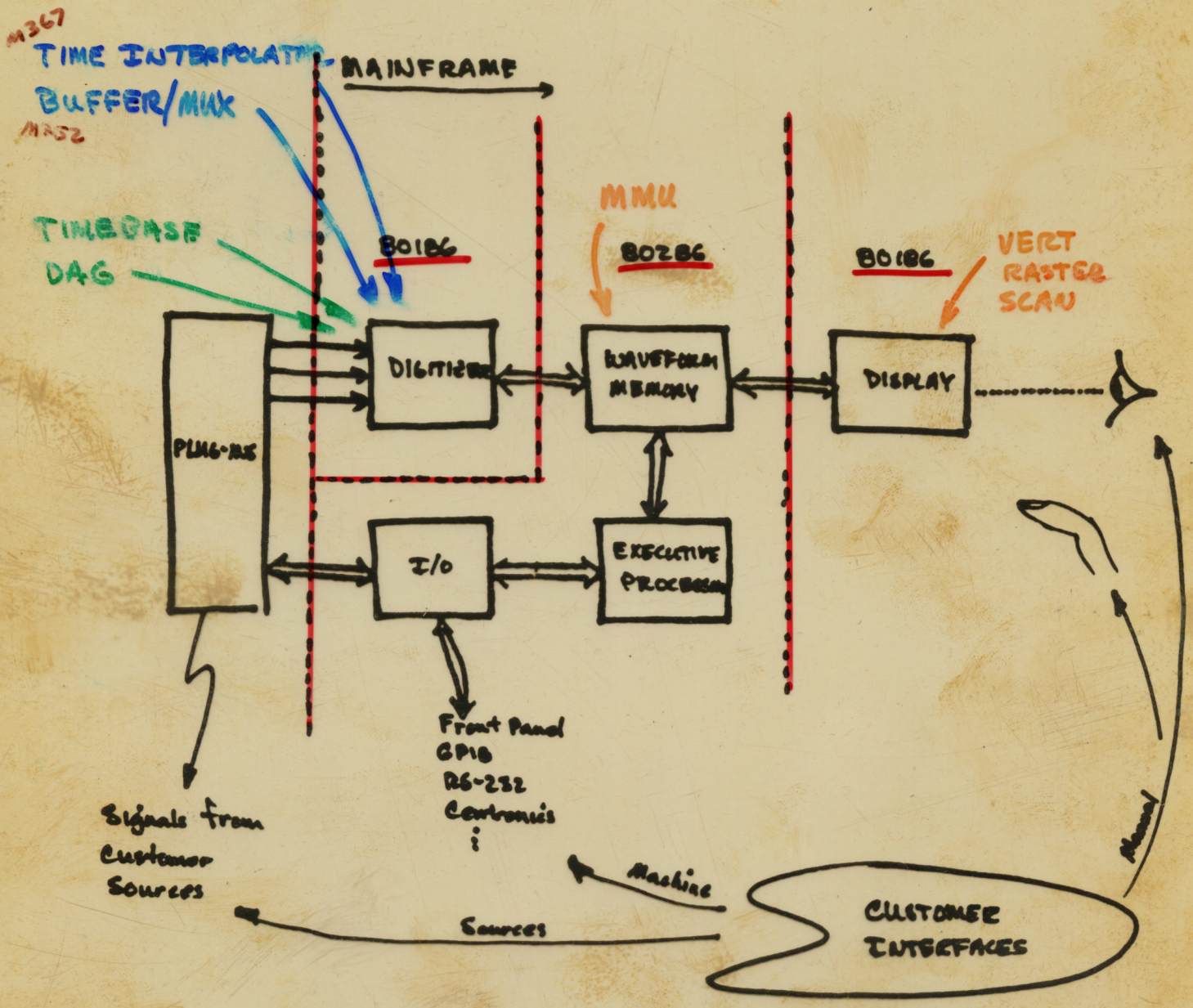
Tektronix
COMMITTED TO EXCELLENCE

DISTRIBUTION: Jim Cavoretto
Peter Schot
Greg Rogers
Tom Rousseau
Gene Andrews
Cliff Baker
Stu McNaughton
Don Williams
cc: Thor Hallen

14 Jun 84

# TECHNICAL DESCRIPTION:

## Block Diagram:




* NEC - CMOS
* TEK - GHz
* ??? - HMOS

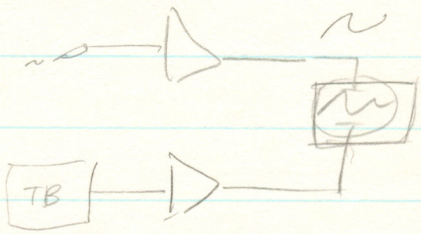
Introduction:

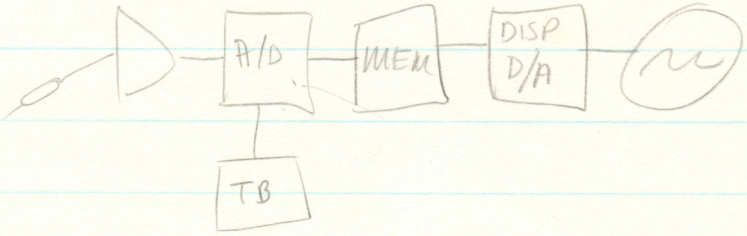
Overview of my talk

ET Mainframe Program (DSO's)

Digital Scopes

Simple Comparison to Analog




Program Des

Primary Goals: - develop modular architecture for a basis of many DSO products
- HW
- Data/Comm protocols
relation to Gens 4 Shis box
- Get 1st product out the door in 2 yrs
- Follow on SW + Digitizer + Display products beyond.
- Develop SW capabilities to support new dimension of osc products
- Upgrade 7K Capabilities

Product Description

- Primary Efforts
  - Develop a modular architecture
  - Improve and extend measurement capabilities
  - Easier to use

These are interrelated & covarity will be developed simultaneously

- Significant Characteristics

- Front Panel Description

- HIF Examples

Tek Components

- 7 ics Show overlay onto Architecture Chart + 2 Hybrids
- Touch Panel

We call this the equivalent time mainframe in order to distinguish it from other digital scopes which are optimized for transient signals.

At the risk of stating the obvious, I'd like to contrast the digital & analog scopes in order to emphasize the differences in technology requirements

Modular architecture ⇒ Mfgable

Human Interface

- New design, in parallel with HW prototyping
- redirect users thought process to think solely in terms of making measurements — not operating the scope.
- Applies to the other products

7854 219 knobs/buttons to access 267 commands & functions

ET Focus attention
Selecting waveforms
Getting display can be as simple as pushing a single button

Simulator

# Relevant Technologies

**SHF III** — Quantizer, Comparator, Sampler Buffer } George Wilson TV Products (14 wks)
Jack → 30MS/s

**HMOS** — Custom Gate Arrays and IC's
Digitizer Timebase and Control
Display Vector Generator and Control } Several

**ITO Transparent Touch Keys** Waveform Calculator

**Color Shutter on high resolution raster display**

**Hybrids**

Applying existing state-of-the-art Technologies to solve problem timely

Gene's box is actually driving technology to advance the state of the art

TR/hk (CPM/020/RELTECH)

# Characteristics

Display up to eight waveforms at one time

"Soft" key labeling

Text: ASCII and special Tek characters

50 characters per line, 27 lines

640 X 480 pixels

Electronic Graticule

Zooming, panning

Auto-scaling of display

Continuous display of selected parameters

Color option (red, green, yellow) with shading

Normal and Reverse video

Interactive Display

may start to flicker or jerk, but degrades gracefully,

< high resolution, becoming popular ⇒ available MW

windowing

Like to give an example of the Human interface.

Not precisely defined at this time,
rather, dealing with concepts.
General Goal is to minimize the users concern with
setting up the scope, allow to concentrate on his task

TR/hk (CPM/020/CHARACT3)

# Characteristics

Popular because of Single button answers

**Waveform Parameters** (Standard)

Min, Max, P-P, RMS, Mean, Risetime, Falltime, Width, Freq, Period, Area, Cursors.

Many 7854's sold in spite of other deficiencies

**Waveform Calculator** (Optional)

LCD Soft Keys ITO touch area

Parameters
Functions (Diff, Intg, Interp, Smooth)
Operators (+, -, /, *, Sqrt, Log, Exp, Abs, Sin, Cos)
Programming linked sequences of commands

Same as 7854 set, except added ____ due to customer requests

can totally drive scope from KB. (repeat FP Soft keys — user Selectable)

**Extended Processing**

FFT, Amplifier Error Correction, Hardcopy Driver, Special Applications

also uses the soft keys of the KB.

# Characteristics

**20MS/s, 10 bit, 2-stage flash converter**

**475MHz ET BW (300MHz @ probe tip)**

existing technologies
state of the art performance

**Adjustable Record Length to 10,001 points**

1001 Standard; Option up to 10,001

Adjustable 101 to 10k,
125 sequence

**Accuracies < 0.5% Vert, 0.02% or 20ps Horiz**

**Signal Averaging and Envelope acquisition modes**

**Continuous Acquire or Roll modes, with acquire stop**

Hold Button is missing on the Front Panel!

TR/hk (CPM/020/CHARACT1)

# Comparison

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| EASE OF USE | | Fewer Controls<br>Auto-Scope<br>Thoughtful Menus |
| SELF-CAL | No | DC Gains, Offsets |
| DIAGNOSTICS | Extensive - external<br>Simple PUP Self-test | Extensive - internal<br>Complete PUP Self-test<br>(reports specific failures; allows override) |
| MODULARITY | Plug-ins<br>Memory<br>Waveform Calculator<br>Power Supply | Plug-ins<br>Memory<br>~~Waveform Calculator~~<br>~~ROM-Paks~~<br>Digitizer<br>Display<br>I/O Ports<br>Power Supply |
| PHYSICAL | Upright,<br>Bench only | Low-Profile,<br>Bench & Rack |
| COST | $4500 | $3600 |

TR/hk (CPM/020/COMPARE3)

# Comparison

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| EASE OF USE | | Fewer Controls (not traps (eg trig source)<br>Auto-Scope — ONE BUTTON!<br>Thoughtful Menus<br>(in that their not inconvenient only 2 layers at most |
| SELF-CAL | No | DC Gains, Offsets<br>On user command only<br>improves confidence |
| DIAGNOSTICS | Extensive - external<br>Simple PUP Self-test | Extensive - internal<br>Complete PUP Self-test<br>(reports specific fail-ures; allows override) |
| MODULARITY | Plug-ins<br>Memory<br>Waveform Calculator<br>Power Supply | Plug-ins<br>Memory<br>Waveform Calculator<br>ROM-Paks<br>Digitizer<br>Display<br>I/O Ports<br>Power Supply<br>more flexibility for Tek to reconfigure or offer prod Variations without starting From Scratch |
| PHYSICAL | Upright,<br>Bench only | Low-Profile,<br>Bench & Rack<br>one design mfgability, serviceability important. for thrust into ~~System~~ Automated Applications |
| COST | $4500 | $3600<br>FY300 Frozen Std. Haven't built one yet<br>Very Preliminary! |

TR/hk (CPM/020/COMPARE3)

# Comparison

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| DISPLAY | Analog, DC-400MHz<br>Digital (from memory only)<br>Text 40 char, 16 lin<br>5 inch diagonal | Digital (from memory or continuous acquire - emulates realtime display)<br>Text ~~50~~ 55 char, ~~27~~ 44 lines<br>7.5 inch diagonal<br>Color Optionable |
| ACCURACY | 2%, Vert & Horiz | <0.5%, Vert<br>0.02% or ~~20~~ 10ps max, Horiz |
| FUNCTIONAL PROGRAMABILITY | Vert & Horiz Modes (MF only; nothing in plug-ins) | All functions, including plug-ins |
| I/O PORTS | GPIB | GPIB<br>RS-232C<br>Hardcopy<br>Expandable |

TR/hk (CPM/020/COMPARE2)

# Comparison

- Fast digitizer + multiprocessor design allows ET to appear as "realtime" display most of the time.
- Save $1100 with virtually no loss of general purpose performance (high speed transient lost)

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| DISPLAY | Analog, DC-400MHz<br>Digital (from memory only)<br>Text 40 char, 16 lin<br>5 inch diagonal | Digital (from memory or continuous acquire - emulates realtime display)<br>Text 50 char, 27 lines<br>7.5 inch diagonal<br>Color Option<br>(improves ease of use by correlating displayed data distinction) |
| ACCURACY | 2%, Vert & Horiz | <0.5%, Vert<br>0.02% or 20ps max, Horiz |
| FUNCTIONAL PROGRAMABILITY | Vert & Horiz Modes (MF only; nothing in plug-ins) | All functions, including plug-ins<br>Single most frequent complaint on 7854 |
| I/O PORTS | GPIB | GPIB<br>RS-232C<br>Hardcopy<br>Expandable<br>more flexible<br>not locked out of future ports |

TR/hk (CPM/020/COMPARE2)

# Comparison

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| WAVEFORM ACQUISITION | Integral A/D<br>250KS/s, 10 bit<br>ET BW 475 MHz<br>Linear Ramp TB | Modular A/D<br>20MS/s, 10 bit<br>ET BW 475MHz<br>Digital TB |
| DIGITAL STORAGE | 5120 points, max<br>1024 pt, max rec | ~220,000<br>~~10,001~~ points, max<br>~~10,001~~ pt, max rec<br>10,240 |
| MEASUREMENTS/ PROCESSING | Waveform Parameters<br>Waveform Calculator | Waveform Parameters<br>~~Waveform Calculator~~<br>~~Extended Functions~~<br>~~(via ROM Paks, I/O)~~<br>Extended via external PC. |

TR/hk (CPM/020/COMPARE1)

Of course, 7K plug-ins,

Since we are building on the 7854, I want to do a comparison to show how we're capitalizing on the 7854's strengths correcting weaknesses.

# Comparison

Like the 7854, ET is a digital Storage Osc

Analog Plug-ins precondition the signal.
A Digitizer converts to Ost is for storage in memory.
From there it's available for processing and display

| ATTRIBUTE | 7854 | ET |
|---|---|---|
| WAVEFORM ACQUISITION | Integral A/D<br>250KS/s, 10 bit<br>ET BW 475 MHz<br>Linear Ramp TB | Modular A/D<br>20MS/s, 10 bit<br>ET BW 475MHz<br>Digital TB |
| DIGITAL STORAGE | 5120 points, max<br>1024 pt, max rec | 10,001 points, max<br>10,001 pt, max rec |
| MEASUREMENTS/ PROCESSING | Waveform Parameters<br>Waveform Calculator | Waveform Parameters<br>Waveform Calculator<br>Extended Functions<br>(via ROM Paks, I/O) |

- better transient perf
- faster acquisition time ⇒ realtime display

crystal controlled w/counter much greater accuracy

customer requests longer rec

optional

Very Popular with customers
advantage over HP
copied by others

allows additional functions later.

A deficiency with 7854
⇒ FFTs
Trigs

but can't due to lack of modularity

Data 6000
Trace
Nicholet adding

TR/hk (CPM/020/COMPARE1)

# Philosophy

My Groups came up with this philosophy.

WE WANT...

TO MAKE THE WORLD'S BEST VALUED LABORATORY GRADE OSCILLOSCOPES FOR GENERAL WAVEFORM MEASUREMENTS.

usually repetitive
DC to 300 MHz

TO THAT END...

WE WILL PROVIDE FEATURES WHICH CLEARLY AND DIRECTLY ENHANCE WAVEFORM MEASUREMENTS:

- INCREASE MEASUREMENT ACCURACY
- REDUCE INSTRUMENT IMPOSED COMPLEXITIES.

my group came up with the

May seem like a motherhood statement, but is real for us because it helps keep us in touch with reality

Means our foremost goal is to provide the balanced best solutions to ~~uniform~~ measurement problems

Every feature we put into the box has real value towards improving measurements, & we don't intend to deviate.

TR/hk (CPM/020/PHILOSOP)

ET Mainframe

**DEVELOP MODULAR ARCHITECTURE FOR 7K DIGITAL SCOPES**

Design Flexibility
Manufacture Flexibility
Product Configuration Flexibility
SW and HW

**IMPROVE AND EXTEND MEASUREMENT CAPABILITIES**

Accuracy
Local Processing
Remote Control
SW Applications

**SIMPLIFY THE HUMAN INTERFACE**

Reduce Unnecessary Clutter
Friendly to the Neophyte
Effective for the Expert
Instrument should be Helpful

TR/hk (CPM/125/ETEFFORT)

# ET Program Goals:

**DEVELOP SALABLE PRODUCTS**

ET Mainframe (20 MS/s Digitizer)
100 MS/s Digitizer
Color Option
SW Applications

**GET ET MAINFRAME TO MARKET BY AP 610**

**DEVELOP MODULAR ARCHITECTURE FOR DIGITAL SCOPES**

**UPGRADE 7K CAPABILITIES**

Fully Programmable Hardware
Digital Data/Control Communications
Modular SW/FW
Simplified Human Interface

TR/hk (CPM/125/PRIMGOAL)

# CHARACTERISTICS OF CUSTOMERS SERVED

**7703P 300MHZ CONVENTIONAL REAL TIME**

**FOR CUSTOMERS THAT:**

- **ARE COMFORTABLE WITH THE TRADITIONAL OSCILLOSCOPE.**
- **WANT PLUG-IN FLEXIBILITY IN A STAND-ALONE INSTRUMENT BUT DO NOT PERCEIVE THE NEED FOR PROCESSING.**
- **REQUIRE SIMPLIFIED MEASUREMENT CAPABILITY**
- **REQUIRE THE ABILITY TO VIEW HIGHER SPEED GLITCHES AND INTERMITTENT OR LOW REP RATE HIGH SPEED SIGNALS.**

**MARKET TREND: FLAT**

**7753DP 300MHZ R.T. 20MS/S @ 10 BITS**

**FOR CUSTOMERS THAT:**

- **REQUIRE ANALYSIS OF REPETITIVE SIGNALS TO 300MHZ AND TRANSIENTS TO 5MHZ.**
- **REQUIRE A HIGHER LEVEL OF QUANTITATIVE MEASUREMENT SOLUTION.**
- **REQUIRE GREATER ACCURACY AND RESOLUTION.**
- **WANT INCREASED LEVELS OF WAVEFORM MEASUREMENT AUTOMATION AND SOFTWARE/FIRMWARE TAILORING.**

**MARKET TREND: STRONG GROWTH.**

**7765DP 500MS/S DIGITIZING OSCILLOSCOPE**

**FOR CUSTOMERS THAT:**

- **REQUIRE SINGLE EVENT UP TO 150MHZ AND REPETITIVE UP TO 300MHZ SIGNAL ACQUISITION.**
- **REQUIRE EXTENDED RESOLUTION AT REDUCED BANDWIDTH FOR SINGLE EVENT OR AT FULL BANDWITH FOR REPETITIVE EVENTS.**
- **REQUIRE REAL-TIME PROCESSING LO-PASS FILTERING, MIN-MAX, AVERAGING, WAVEFORM QUALIFICATION.**
- **REQUIRES THE COMPUTATIONAL CAPABILITIES OF THE 7753DP.**

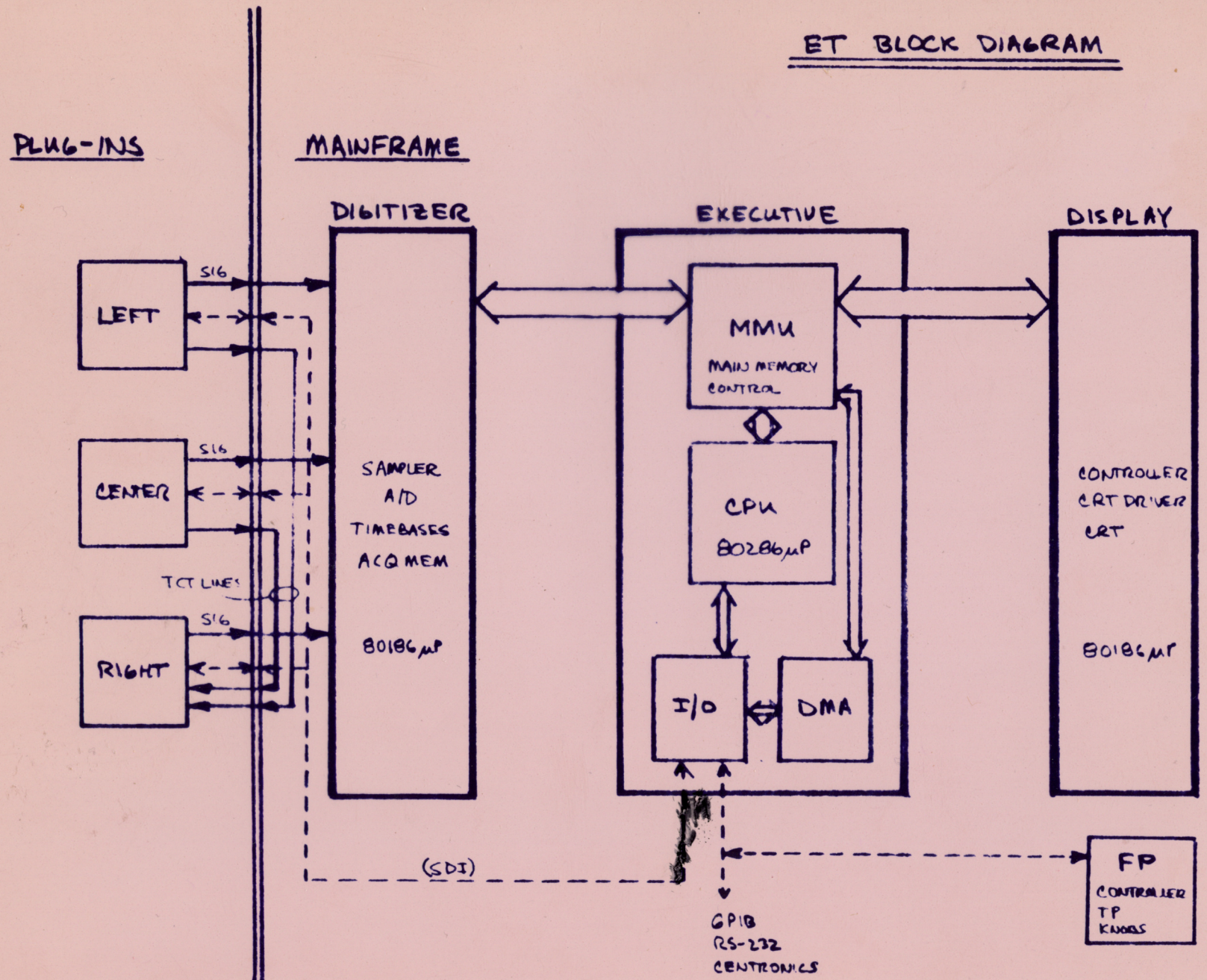
**MARKET TREND: MODERATE GROWTH.**

D= 82.5%
O = 84.8%
S = 84.8%
FGI = 88.1%

Demand / output, though less than plan were roughly in balance.
FGI somewhat stable.

⇒ short fall in output is passing thru to shipment, $ sales.

# ET BLOCK DIAGRAM




14 Aug 85
TR

23 Oct 85

# 11331 DIGITAL OSCILLOSCOPE

## "EQUIVALENT TIME" MAINFRAME

## GENERAL DESCRIPTION

The 11331 is a digital oscilloscope offering many features which make it a versatile instrument for general purpose waveform measurements:

* Digital-only design (without HF analog display path) provides significantly improved measurement accuracy and flexibility at a much lower cost, when compared to conventional scopes.

* 20 MS/s, 10 bit, 700 MHz digitizer satisfies most general purpose needs.

* High resolution large screen video display for ease of viewing of up to eight waveforms.

* "Live" operation for normal scope-like viewing of signals.

* "Storage" operation for retention and recall of signals.

* Friendly manual operation from the front panel.

* Simplified operation when user invokes Auto-Range mode; provides automatic triggering and scaling of vertical and horizontal display factors.

* Soft-labeled functions significantly reduce front panel clutter and simplify operation...for the novice and expert alike.

* 100% functionally programmable for complete remote control of all functions and controls (ideal for system applications).

* High speed data and control I/O ports, including IEEE-488 (aproximately 100K bytes/s with DMA option) and RS-232C, with expansion capabilities to others.

* Continuous waveform parameter measurement and processing functions with on screen annotations for accurate and repeatable answers.

* Signal Averaging, Envelope, and Point Accumulate acquisition capabilities.

* Enhanced Accuracy mode improves vertical measurement accuracy to better than 1% when selected. Self-cal feature insures instrument accuracy on user command after warm-up.

* Three hardware plug-in compartments allow the user to configure the acquisition front-end for specific measurements (LEFT and CENTER for vertical signals, and RIGHT for trigger conditioning as well as vertical signals); these compartments also allow for possible future analog/digital special purpose plug-ins.

* Internal expansion sockets provide the ability to enhance or alter measurement/processing capabilities with firmware Option ROMs.

* Built-in timebases for improved accuracy and reduced cost; provides functionality which is equivalent to a five plug-in compartment mainframe.

* Modular construction of both hardware and software means the scope never becomes obsolete, since the basic mainframe can be added to or updated as technology evolves (specifically applies to the digitizer, display, and measurement/processing capabilities).

* Dual windowing of live waveforms during acquisition (similar to delaying-delayed alternate timebase operation).

* High resolution (10pS), accurate (50pS) timing measurements using trigger-to-trigger time interval measurement capability.

* Multiple cursor measurement and annotation capability.

* YT and XY displays, live and stored waveforms.

* Storage of up to 10 front panel settings for automatic set-ups and easy recall. Retains settings during power off periods.

* Hardcopy capability when coupled with the Tek 4644 copier (Centronics hardware, Epson software compatible).

* Mass storage of waveform data and measurement configurations (front panel settings) when coupled to appropriate personal computer.

* Simplified construction techniques for ease of manufacture and high reliability.

* Fully compatible with 11K plug-ins. Limited compatibility with selected 7K plug-ins.

TR/hk (CPM/125/S1R4.GD)

23 Oct 85

# CHARACTERISTICS:

## Signal Acquisition:

| | |
|---|---|
| Sampling Rate: | 20MS/s. |
| A/D Resolution: | 10 bits. |
| Equivalent Time Bandwidth: | 700 MHz, mainframe only. System bandwidth depends on plug-in; 350 and 500 MHz, with popular plug-ins. |
| Equivalent Time Transient Response: | 500 ps risetime with less than 3% aberrations, mainframe only. |
| Vertical Accuracy: | 1.0% of FS, mainframe only. System accuracy depends on plug-in. |
| Analog Input Channels: | Three plug-in compartments (all equivalent). Total number of input channels depends on plug-ins, but can be as many as 12. |
| Timebases: | Two built-in timebases allow for main sweep and windowing (delaying/delayed) operation. |
| Minimum Time Resolution: | 10 ps |
| Timebase Accuracy: | +/- 0.01%, or 50 ps, whichever is greater. |
| Record Duration: | 5.12 ns to 1024 s (0.5 ns/div to 100 s/div), user selectable (no variable timebase). Window duration < or = to main record duration. |
| Record Length: | User selectable: 512, 1024, 2048, 4096, 5120, 8192, or 10240 points. |
| Acquisition Memory: | 4K points standard, optionally expandable to 16K points. Architecture allows for future expandability to 64K points, as memory density and power allow. |

| | |
|---|---|
| Trigger: | Each timebase has full trigger facilities, with the main trigger point being zero time reference. Includes pre-trigger, delay by time, delay by events, and triggerable after delay. |
| Pre-Trigger: | Allows viewing and/or storage of signals, + to - 100% of the main record duration, as measured from the main trigger point; > 100% for triggered window records. |
| Trigger Delay by Events: | Allows viewing/storage of signals by a user determined number of events after the main trigger point. Maximum event frequency is 200 MHz; maximum event count is 10E9 events. |
| Trigger Modes: | Auto-Level, Normal, Single. |
| Trigger Source: | Any plug-in compartment (A13/B13) or line. (Note: external source must be routed via an unused Vertical channel). |
| Deskewing: | Any two channels can be matched for signal delay to within 10 ps at 100 ns or less record durations. |

**Display:**

| | |
|---|---|
| CRT: | 4.8 inch (Horiz) x 6.1 inch (Vert) useable display area, monochrome, P-31 phosphor, crisp spot, electromagnetically deflected. |
| Technique: | Vertical Raster Scan, non-interlaced; bit-mapped static display with vertical scan dynamic display; 552 horiz by 704 vert pixels. |
| Color: | Not available on base product at initial introduction. Architecture allows for shadow mask color to be added later. |
| Intensity: | 64 levels. |
| Contrast: | Four levels: black, dim, normal, bright. |
| Scanning Freq: | 37 kHz horiz, 60 Hz vert. |
| Characters: | 7 x 11 dot matrix; 55 characters per row, 44 rows; full ASCII set plus Tek specials. |
| Waveforms: | Fixed display at 512 points per waveform (longer records are compressed for display purposes only...retain full resoulution in main memory); maximum of 8 waveforms displayed at a time; X-Y (2 max) and Y-T (8 max). |
| Graticule: | One or two electronically generated; linear and histogram standard (others are possible as option...as market applications and development resources are identified) |

**Storage:**

| | |
|---|---|
| Waveform Memory: | Approximately 44K points standard, expandable to approximately 102K points; maximum will depend on memory densities and power. Numbers are approximate due to uncertainty of mix between fixed point and floating point formats. |
| "Front Panel" Set-ups: | 10 measurement configurations, maximum (internally stored). |
| Power down: | 16K bytes of non-volatile RAM is used to store front panel settings (including plug-ins). |

**Storage:**

| | |
|---|---|
| Waveform Memory: | Approximately 50K points standard, expandable to approximately 220K points; maximum will depend on memory densities and power. Numbers are approximate due to uncertainty of mix between fixed point and floating point formats. |
| "Front Panel" Set-ups: | 10 measurement configurations, maximum (internally stored). |
| Power down: | 16K bytes of non-volatile RAM is used to store front panel settings (including plug-ins). |

**Waveform Processing:**

| | |
|---|---|
| Cursors: | Four types of cursors are provided: 1) coordinate cursors are intensified dots appearing on waveforms, with corresponding numeric readout of absolute and relative coordinate values; 2) measurement zone delineator cursors are vertical lines used to establish boundry conditions for measurements; 3) vertical bars and 4) horizontal bars for screen relative measurements between waveforms. |
| Acquisition: | Average, Envelope, Point Accumulate, [redacted]. |
| Waveform Parameters: | Amplitude: Max, Min, P-P, RMS, Mean, Mid;<br>Pulse: Rise, Fall, Width, Delay, Freq, Per, YT Area, XY Area, YT Energy, XY Energy, [redacted]; |
| Waveform Functions: | Diff, Integ, Interp (linear), Smooth, Average, Envelope, Log, Ln, Exp, Sqrt, 1/x, [redacted], Abs, Signum, [redacted] |
| Arithmetic Operators: | +, -, /, *; |
| Numeric Entry: | 0 thru 9, pi, . , exponent, change sign. |

**Waveform Processing:**

| | |
|---|---|
| Cursors: | Four types of cursors are provided: 1) coordinate cursors are intensified dots appearing on waveforms, with corresponding numeric readout of absolute and relative coordinate values; 2) measurement zone delineator cursors are vertical lines used to establish boundry conditions for measurements; 3) vertical bars and 4) horizontal bars for screen relative measurements between waveforms. |
| Acquisition: | Average, Envelope, Point Accumulate, Ground, Scale Factors. |
| Waveform Parameters: | Amplitude: Max, Min, P-P, RMS, Mean, Mid;<br>Pulse: Rise, Fall, Width, Delay, Freq, Per, YT Area, XY Area, YT Energy, XY Energy, Cross, Slope; |
| Waveform Functions: | Diff, Integ, Interp (linear), Smooth, Average, Envelope, Log, Ln, Exp, Sqrt, 1/x, Sin, Cos, Tan, Arcsin, Arccos, Arctan, Abs, Signum, Histogram; |
| Arithmetic Operators: | +, −, /, *; |
| Numeric Entry: | 0 thru 9, pi, . , exponent, change sign. |

**Human Interface:**

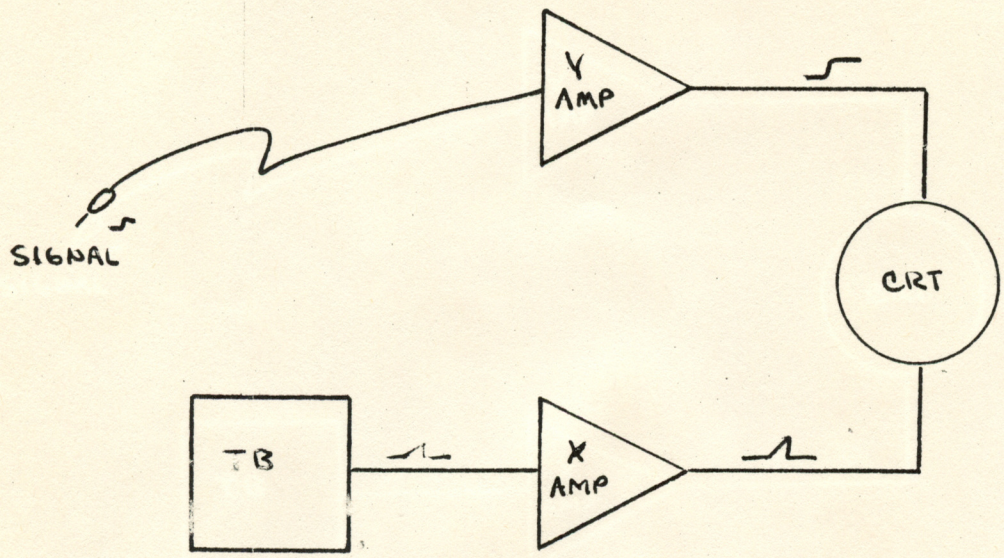
| | |
|---|---|
| Method: | All functionality is controlled via software. Since there is no "hot switching", new software techniques are used to significantly simplify operations by reducing panel clutter and eliminating user traps. Software also insures future expandability of functionality.<br><br>Primary means of human input is via a touch screen matrix and two control knobs. Most commands are soft labeled, and appear on the display screen only when they are needed and appropriate, including numeric input. Selection is made by the user by simply touching the command on the display. Further, some commands may require setting a numeric value, alternatively with a knob or the pop-up numeric keypad. |
| Touch Screen: | LED array provides an 11 X 22 matrix of touch zones overlaying the display area. Commands are labeled on the screen at the location of user input (either by mnemonics or icons). Commands are identified by the microprocessor whenever the user breaks a light beam path; the command is executed after the user withdraws his finger. |
| Knobs: | Two programmable knobs with assigned functionality displayed on the CRT directly adjacent the knobs, for easy association. |
| Keypad: | Pop-up memu appears only when applicable for alternate means of numeric entry. |

| | |
|---|---|
| Menus: | Nominally three levels, four maximum; all levels visible simultaneously to reduce confusion. A low level menu can be directly exited to a high level without making intermediate steps. Levels: 1) Hard labeled major MENU keys along right side of display; 2) Normal displayed soft labeled touch zones at bottom of display area; 3) Pop-up menus, occasionally activated on selection within level 2; 4) seldom used secondary pop-ups; normally, once a choice is made in the pop-up, it is executed and the pop-up disappears. |
| Plug-ins: | Fully compatible with 11K plug-ins. [redacted] |
| ROM Based: | The entire Human Interface is software based and can be modified thru software engineering. Interactive touch screen information is loaded to RAM from 11K plug-ins or via external I/O ports (eg, GPIB, RS-232, etc). |
| Panel Lockout: | All human inputs can be locked out thru software control. |
| Touch Screen Disable: | A front panel facility is provided to manually disable the touch screen so that the user can point at the screen without activating the touch commands. |

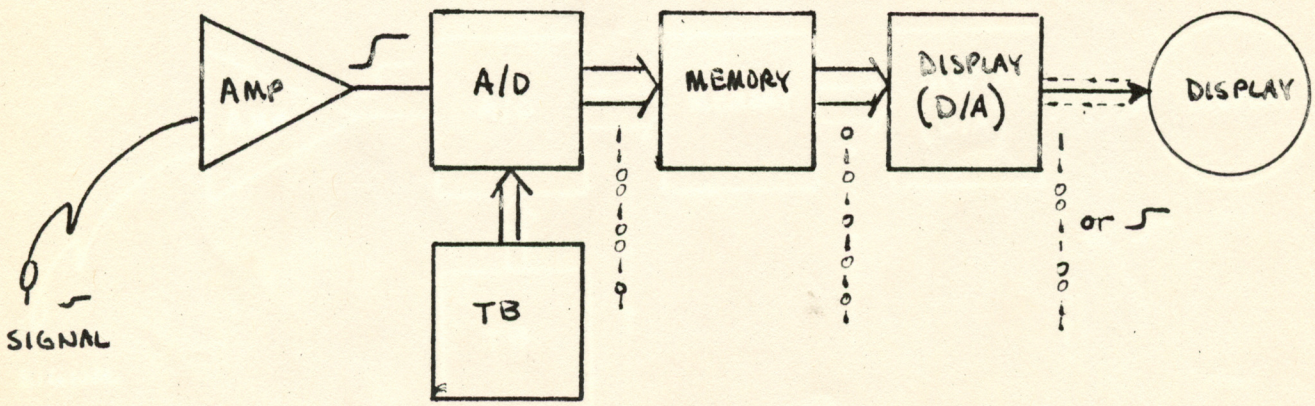
| | |
|---|---|
| Menus: | Nominally three levels, four maximum; all levels visible simultaneously to reduce confusion. A low level menu can be directly exited to a high level without making intermediate steps. Levels: 1) Hard labeled major MENU keys along right side of display; 2) Normal displayed soft labeled touch zones at bottom of display area; 3) Pop-up menus, occasionally activated on selection within level 2; 4) seldom used secondary pop-ups; normally, once a choice is made in the pop-up, it is executed and the pop-up disappears. |
| Plug-ins: | Fully compatible with 11K plug-ins. Limited, awkward, but useable with selected 7K plug-ins (functional programability, self-cal are meaningless, and there is no readout of scale factors). |
| ROM Based: | The entire Human Interface is software based and can be modified thru software engineering. Interactive touch screen information is loaded to RAM from 11K plug-ins or via external I/O ports (eg, GPIB, RS-232, etc). |
| Panel Lockout: | All human inputs can be locked out thru software control. |
| Touch Screen Disable: | A front panel facility is provided to manually disable the touch screen so that the user can point at the screen without activating the touch commands. |

| | |
|---|---|
| Self-cal: | Invoked on user command or automatically to calibrate all possible settings of selected channels whenever time and/or temperature change beyond specified limits. Mainframe controls process, calibrating mainframe and plug-in DC balances, offsets, and low frequency gains. Self-cal is inhibited during warm-up and is normally activated on command by the user, though an automatic mode may be selected. Self-cal may require up to 30 s to complete, depending on the number of channels selected. Self-cal is locked out whenever instrument is in the single-shot mode (correction factors are determined and available after a single-shot event is completed). |
| Auto-range: | Provides automatic ranging of acquisition vertical and horizontal scale factors, and triggering. Also provides automatic scaling of stored waveforms. Feature can be invoked at will by the user. |
| Diagnostics: | Extensive built-in diagnostics provide two general levels of trouble shooting support: first level localizes problems to a specific ECB assembly; most useful for on-site and/or board swap repair of instrument. Second level locates problem to specific function within a particular ECB, usually to within a few ICs, and frequently to a specific IC; most useful for component level trouble shooting (in the field or at the plant). Diagnostics are operated via the touch screen, accessed thru the Utilities menu. |

## ANALOG SCOPE:




## DIGITAL SCOPE:




18 Oct 83
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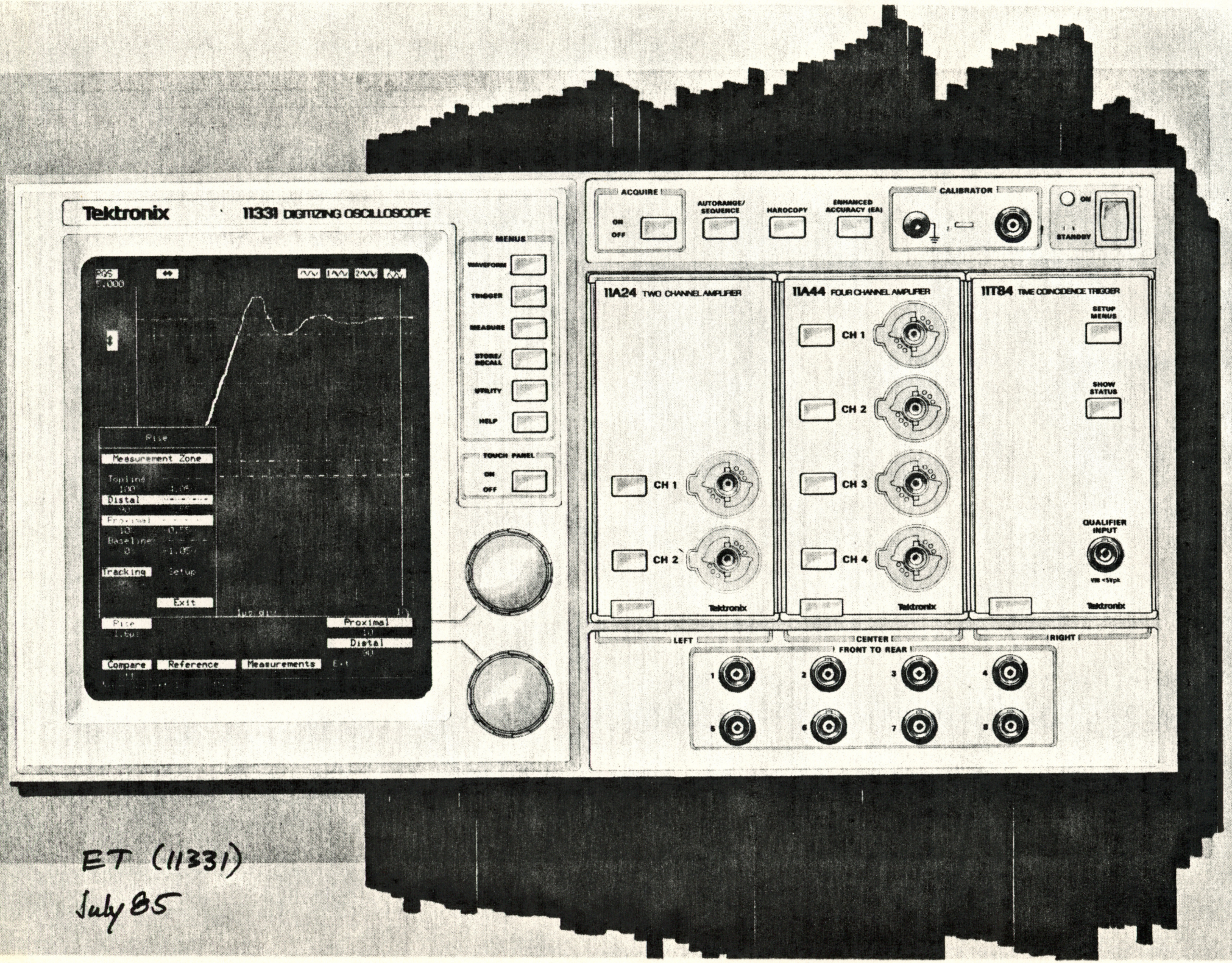



ET (11331)
July 85

**Other:**

| | |
|---|---|
| Plug-in compatibility: | Fully compatible with all programmable 11K plug-ins; g[redacted]. |
| Power: | 90-132 or 180-250 VAC, 48-440Hz.<br><br>330 Watts maximum line, fully loaded mainframe under worst case load conditions, including 11K active probes. |
| Size: | 8.75 (H) x 16.75 (W) x 21 (D) cubic inches (bench);<br>8.75 (H) x 19.00 (W) x 21 (D) cubic inches (rack). |
| Reliability: | 6,000 Hrs MTBF at 25^C, mainframe only at product introduction, increasing to 10,000 Hrs in AP 001 (dependent on component quality improvements). |
| Hardcopy: | Device drivers optional for output to a specified hardcopy unit via standard Centronics hardware and Epson software interfaces (specified to Tek 4644 printer). |
| Mass Storage: | Device drivers (SW & HW) are not available for the mainframe. However, external storage of waveform data and measurement configurations (front panel settings) can be effectively accomplished by transfering files to a personal computer connected to an RS-232 port (or IEEE-488, if available). Tek IG to have communications SW available for selected PC's, in disk format. (to be developed by Marketing Applications group). |

**Other:**

| | |
|---|---|
| Plug-in compatibility: | Fully compatible with all programmable 11K plug-ins; guaranteed functional operation (readout excluded) with the following 7K plug-ins: 7A22, 7S12. |
| Power: | 90-132 or 180-250 VAC, 48-440Hz.<br><br>330 Watts maximum line, fully loaded mainframe under worst case load conditions, including 11K active probes. |
| Size: | 8.75 (H) x 16.75 (W) x 21 (D) cubic inches (bench);<br>8.75 (H) x 19.00 (W) x 21 (D) cubic inches (rack). |
| Reliability: | 6,000 Hrs MTBF at 25^C, mainframe only at product introduction, increasing to 10,000 Hrs in AP 001 (dependent on component quality improvements). |
| Hardcopy: | Device drivers optional for output to a specified hardcopy unit via standard Centronics hardware and Epson software interfaces (specified to Tek 4644 printer). |
| Mass Storage: | Device drivers (SW & HW) are not available for the mainframe. However, external storage of waveform data and measurement configurations (front panel settings) can be effectively accomplished by transfering files to a personal computer connected to an RS-232 port (or IEEE-488, if available). Tek IG to have communications SW available for selected PC's, in disk format. (to be developed by Marketing Applications group). |

**Options:**

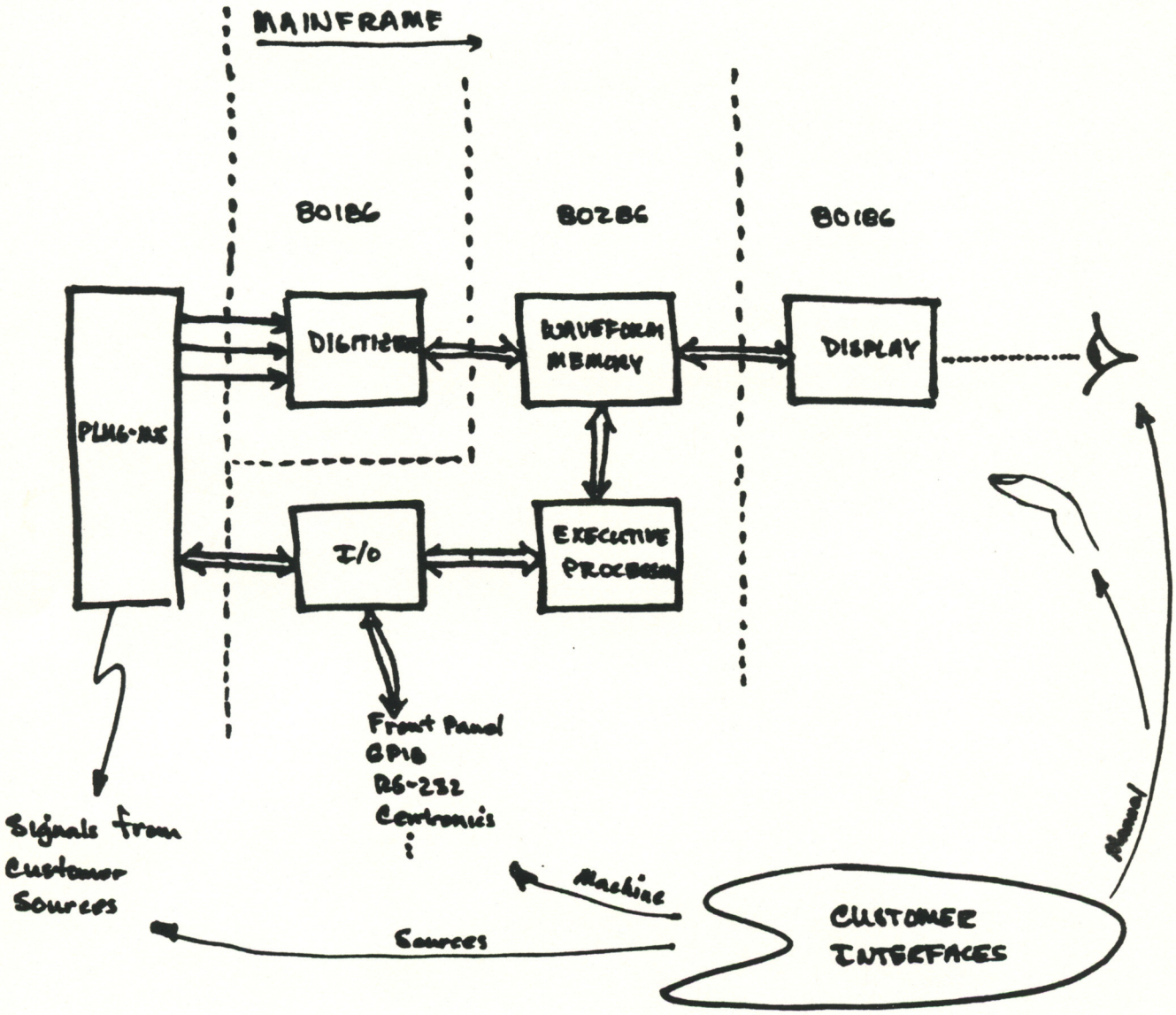
| | |
|---|---|
| Memory: | Extends digitizer to 16K points and waveform storage to 220K points. |
| Device Drivers: | Printer driver(s) for Tek model 4644 hardcopy unit, via parallel port. |
| Color: | Not a planned option. Architecture has provisions 8 color shadow mask for possible future needs. |
| Option ROMs: | Available for future software requirements as applications develop, such as additional processing capabilities or marketing demo aids. No such applications have been sanctioned to date. |
| Rack Adapter: | Slide rail and rack mounting hardware to convert standard bench instrument for rack mounting. |
| Loop-thru BNC's: | Adds 8 BNC's to front and rear panels for looping front panel plug-in input signals to rear panel; most useful for rack mount applications. |

TR/hk (CPM/125/S2R6.GD)

23 Oct 85

# TECHNICAL DESCRIPTION:

Block Diagram:



**Description:**

***Modularity:***

The mainframe is highly modular for three reasons:

1) Allows for considerable flexibility in product configuration. As product needs evolve with technology, we will only need to develop appropriate new modules instead of whole new products. This modularity covers both hardware (digitizers, display, memory, plug-ins, card cage) and software (human interface, peripheral options, user applications).

   For Example:

   Suppose we wish to offer a faster digitizer sometime in the future. We simply delete the 20 MS/s, 10 bit digitizer, and bolt in the new one.

   Suppose we wish to offer a color display. We simply delete the present one, and bolt in the new one.

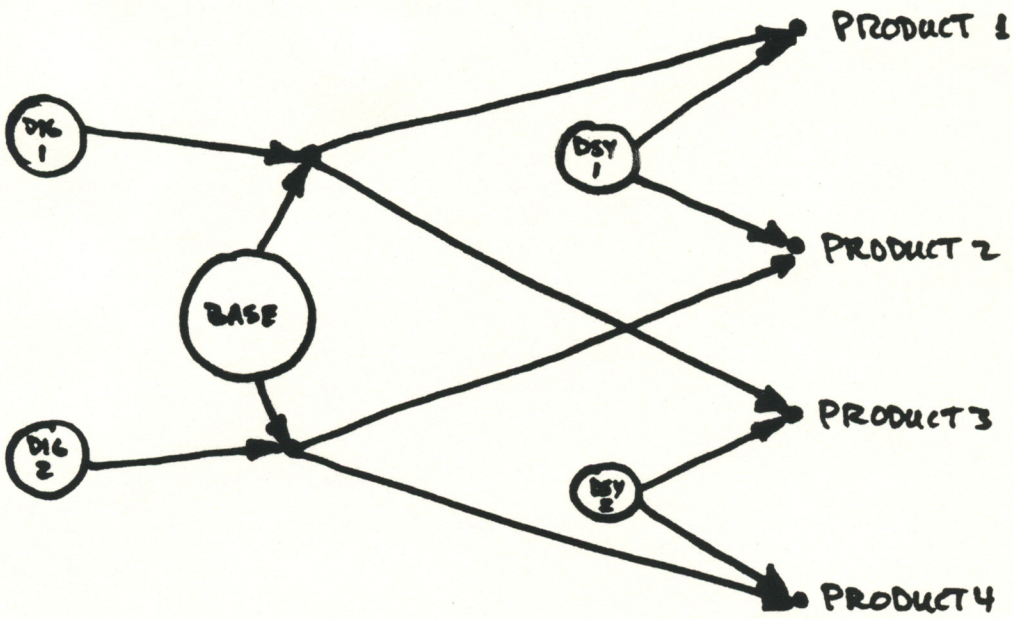
   Suppose we wish to enhance the user interface (such as taking advantage of color in a different manner). We simply replace the EPROMs with new ones containing the new code. Since the human interface is soft labeled, for the most part, new "controls" displace old ones.

   Suppose a new market application develops a few years after the product is introduced. We can address the new needs by offering the new application software in the form of internal Option ROMs or via distribution disks for specified personal computers.

2) The above described configurability extends to Manufacturing. Bills of materials can be arranged around the modules. So can assembly:

   Several different product types can be built by selecting the appropriate modules. The base chassis (with power supply, card cage, plug-in cage) is built up to the different products by simply adding the appropriate modules (eg, digitizer, display, ROMs, or whatever). See diagram on the next page.

Figure illustrating manufacturing benifits of modularity:




3) Time to market on future products is significantly reduced because whole new products don't need to be developed... only the new modules.

***Modules:***

The architecture includes six major modules: Plug-in compartments, Digitizer, Waveform Memory, Executive Processor, Display, I/O.

The modules are loosely coupled to each other in order to preserve autonomy for flexibility of design, manufacture, and field support. Therefore, each module can be treated separately. Strict electrical and data/control communication protocols are prescribed at the interface between modules.

Multiple microprocessors are used to implement the modular architecture; they insure loose coupling, high data thru-put rates (due to multi-tasking), and segmentation of tasks for more efficient software design. Microprocessors used: one in each plug-in; an 80186 in the digitizer; an 80286 for the executive processor, I/O, and waveform memory; and an 80186 in the display.

The **Plug-in** compartments allow for up to three plug-in units. Plug-ins are used to condition signals prior to delivery to the mainframe. Preconditioned signals are passed to the mainframe via two paths: the analog interface and the serial data digital interface (each has it's own interface requirement).

The analog interface connects directly to the Digitizer for conversion to digital format. The digital interface connects to the Executive Processor via the I/O (NOTE: exclusive use of this path obviates the need for the analog path...and hence the Digitizer, such as use with Sampling plug-ins. This concept suggests another possible product: a mainframe without a Digitizer for digital-only plug-ins). The digital interface is used for bi-directional control and data communications.

The **Digitizer** module converts the analog signal to a digital representation. The digital representation is delivered from acquisition memory in the Digitizer via a 16 bit bus to Waveform Memory. The Digitizer contains several circuits to do this: a precision sample and hold; a 10 bit 2-stage flash converter running at 20 MS/s; two precision digital timebases; and fast acquisition memory. Critical new circuits include the sampling bridge and buffer/multiplexer, which are incorporated on a custom hybrid. Digitizer performance is dependent on several new custom ICs: Channel Switch (Tek SHF3), Timebase (VTI CMOS), Time-interpolator (Tek SHF3), and Destination Address Generator (VTI CMOS). Other digitizers having different characteristics can be substituted for this one.

**Waveform Memory** is the heart of all waveform data storage. It is from this point that waveforms are accessed for the particular needs of the other modules. Access is controlled by the Memory Management Unit, which is largely integrated in a new CMOS gate array.

The **Executive Processor** module provides number crunching (user processing), and control of data and control communications. It also interfaces the I/O module to the rest to the instrument.

The **Display** module receives data from the Waveform Memory. The microprocessor is fully utilized to provide "live" waveform displays (so as to look realtime to a human operator) and timely human interface information. The monitor consists of a high resolution, inexpensive, non-Tek, electromagnetically deflected CRT, non-interlaced method. Overall display resolution is 552 horiz by 704 vert pixels, with the waveform display area fixed at 512 by 512 pixels. A Custom character set is generated in this module. Static data and XY waveforms are displayed from a two plane bit-mapped memory. Dynamic data is displayed from the vertical scan circuitry for faster presentation, and is based on a new CMOS gate array.

The **I/O** module services data and control communications between the instrument and it's external environment: front panel, plug-in digital interface, GPIB, RS-232C, Centronics, knobs, and

whatever else we may conjure up in the future. Performance allowing, portions of this this module may be combined as part of the Executive Processor.

***Physical:***

The instrument is configured in a low-profile package which is easily convertable between bench-top and rack mount use. It's physical modularity closely parallels the architecture.

The power supply module (common with the analog RT scope and the High-Res Sampler) sits behind the plug-in cage, on the right hand side. The digital card cage sits behind the CRT on the left hand side; it contains the Executive Processor, Waveform Memory, I/O, and future expansion slots. The Display controller sits above the plug-ins and power supply. The Digitizer occupies the bottom 1.7 inch plane in the bottom of the instrument; this arrangement provides proper shielding and cooling.

There are 18 ECB's total in the base instrument. The card cage allows for additional expansion of ECB's. The three power supply and plug-in interface boards are common with the analog RT scope.

The instrument is fan cooled by drawing air in thru vent holes in strategic locations and exhausting out the back through the power supply.

The metal work is optimized for 11K in order to achieve cost and manufacturability goals. Several pieces are common with the analog scope.

Most ECB's are virtually 100% machine insertable, except for a few special ICs and odd components.

The only adjustments are a few in the Digitizer and Display. Most circuits either do not require adjustment, or are done automatically by the Self-cal feature.

Manual human interfacing is to be done via soft-labeled transparent touch panels overlaying the display CRT. The touch panel operation is based on an LED/photo transistor matrix providing 242 touch zones; finger coordinates are determined by identifying which scanned vertical and horizontal IR beams are broken.

TR/hk (CPM/125/S3R4.GD)

11 Jun 84

# 7853DP DIGITAL OSCILLOSCOPE

## "EQUIVALENT TIME" MAINFRAME

## GENERAL DESCRIPTION

The 7853DP is a digital oscilloscope offering many features which make it a versatile instrument for general purpose waveform measurements:

* Digital-only design (without HF analog display path) provides significantly improved measurement accuracy and flexibility at a much lower cost, when compared to conventional scopes.

* 20 MS/s, 10 bit, 500 MHz digitizer satisfies most general purpose needs.

* "Live" operation for normal scope-like viewing of signals.

* "Storage" operation for retention and recall of signals.

* Friendly manual operation from the front panel.

* Simplified operation when user invokes Auto-Scope mode; provides automatic triggering and scaling of vertical and horizontal display factors.

* Soft-labeled functions significantly reduce front panel clutter and simplify operation...for the novice and expert alike.

* 100% functionally programmable for complete remote control of all functions and controls (ideal for system applications).

* High speed data and control I/O ports, including IEEE-488 (approximately 100K bytes/s) and RS-232C, with expansion capabilities to others.

* Waveform parameter measurement and processing functions for accurate and repeatable answers.

* Signal Averaging and Envelope acquisition capabilities.

* Automatic Self-cal (internal time/temp algorithm) for high accuracy measurements...even from a cold start.

* Three hardware plug-in compartments allow the user to configure the acquisition front-end for specific measurements (LEFT and RIGHT for vertical signals, and AUX for trigger conditioning as well as vertical signals); these compartments also allow for possible future analog/digital special purpose plug-ins.

* Internal expansion sockets provide the ability to enhance or alter measurement/processing capabilities with firmware Option ROMs.

* Built-in timebases for improved accuracy and reduced cost; provides functionality which is equivalent to a five plug-in compartment mainframe.

* Modular construction of both hardware and software means the scope never becomes obsolete, since the basic mainframe can be added to or updated as technology evolves (specifically applies to the digitizer, display, and measurement/processing capabilities).

* Hardcopy capability when coupled with the Tek xxxx ink jet copier.

* Mass storage of waveform data and measurement configurations (front panel settings) when coupled to appropriate personal computer.

* Simplified construction techniques for ease of manufacture and high reliability.

* Fully compatible with 7K+ plug-ins; limited compatibility with selected 7K plug-ins.

TR/hk (CPM/125/S1R3.GD)

14 Jun 84

# CHARACTERISTICS:

## Signal Acquisition:

| | |
|---|---|
| Sampling Rate: | 20MS/s. |
| A/D Resolution: | 10 bits. |
| Equivalent Time Bandwidth: | 500 MHz, mainframe only.<br>300 MHz, with popular plug-ins. |
| Equivalent Time Transient Response: | 700 ps risetime with less than 3% aberrations, mainframe only. |
| Vertical Accuracy: | 0.4% of FS DC to 1 MHz, 1.4% of FS 1 MHz to 30 Mhz, mainframe only. |
| Analog Input Channels: | Three plug-in compartments, all equivalent (allows for up to 12 input channels with 4-trace plug-ins, of which up to 8 can be displayed at one time). |
| Timebases: | Two built-in timebases allow for main sweep and windowing (delaying/delayed) operation; input BNC provided for qualified external clocking source. |
| Minimum Time Resolution: | 10 ps |
| Timebase Accuracy: | + or - 0.01% |
| Record Duration: | 5.12 ns to 1024 s (0.5 ns/div to 1000 µs/div), user selectable (no variable timebase). Window duration < or = to main record duration. |
| Record Length: | User selectable: 512, 1024, 2048, 4096, 5120, 8192, or 10240 points. |
| Acquisition Memory: | 4K points standard, optionally expandable to 16K points. Architecture allows for future expandability to 64K points, as memory density and power allow. |

| | |
|---|---|
| Trigger: | Each timebase has full trigger facilities, with the main trigger point being zero time reference. Includes pre-trigger, delay by time, delay by events, and triggerable after delay. |
| Pre-Trigger: | Allows viewing and/or storage of signals, + to - 100% of the main record duration, as measured from the trigger point. |
| Trigger Delay by Events: | Allows viewing/storage of signals by a user determined number of events after the main trigger point. Maximum event frequency is 200 MHz; maximum event count is 10E9 events. |
| Trigger Modes: | PP-Auto, Auto, Normal, Single Sweep |
| Trigger Source: | Any plug-in compartment (A13/B13) or line. (Note: external source must be routed via an unused Vertical channel). |

**Display:**

| | |
|---|---|
| CRT: | 4.3 inch (Horiz) x 5.3 inch (Vert) useable display area, monochrome, P-31 phosphor, crisp spot, electromagnetically deflected. |
| Technique: | Vertical Raster Scan, non-interlaced; bit-mapped static display with vertical scan dynamic display; 552 horiz by 704 vert pixels. |
| Color: | Not available on base product at initial introduction. Architecture allows for LCCS or shadow mask color to be added later, though technical problems remain to be solved in either case. |
| Intensity: | 256 levels. |
| Contrast: | Four levels: black, dim, normal, bright. |
| Scanning Freq: | 37 kHz horiz, 60 Hz vert. |
| Characters: | 7 x 11 dot matrix; 55 characters per row, 44 rows; full ASCII set plus Tek specials. |
| Waveforms: | Fixed display at 512 points per waveform (longer records are compressed for display purposes only...retain full resoulution in main memory); maximum of 8 waveforms displayed at a time; X-Y and Y-T |
| Graticule: | One or two electronically generated; linear and histogram standard (others are possible as option...as market applications and development resources are identified) |

**Storage:**

| | |
|---|---|
| Waveform Memory: | Approximately 50K points standard, expandable to approximately 220K points; maximum will depend on memory densities and power. Numbers are approximate due to uncertainty of mix between fixed point and floating point formats. |
| "Front Panel" Set-ups: | 10 measurement configurations, maximum (internally stored). |
| Power down: | 8K bytes of non-volatile RAM is used to store front panel settings (including plug-ins). Due to limited NV RAM, when both are being internally stored, it may be possible that maximum capabilities may not be achieved. |

**Waveform Processing:**

| | |
|---|---|
| Cursors: | Two types of cursors are provided: 1) coordinate cursors are intensified dots appearing on waveforms, with corresponding numeric readout of absolute and relative coordinate values; 2) measurement zone delineator cursors are vertical lines used to establish boundry conditions for measurements. |
| Acquisition: | Average, Envelope, Ground, Scale Factors. |
| Waveform Parameters: | Amplitude: Max, Min, P-P, RMS, Mean, Mid;<br>Pulse: Rise, Fall, Width, Delay, Freq, Per, Energy, YT Area, XY Area, Prop Delay;<br>Histogram;<br>Window Searching. |
| Waveform Functions: | Diff, Integ, Interp (linear), Smooth, Set Waveform Point, Recall Waveform Point, Cross. |
| Arithmetic Operators: | +, -, /, *, Sqrt, Log, Ln, Exp, Abs, Sin, Cos, Tan, Arcsin, Arccos, Arctan, Signum, 1/x. |
| Numeric Entry: | 0 thru 9, pi, . , exponent, change sign. |

**Human Interface:**

| | |
|---|---|
| Method: | All functionality is controlled via software. Since there is no "hot switching", new software techniques are used to significantly simplify operations by reducing panel clutter and eliminating user traps. Software also insures future expandability of functionality.<br><br>Primary means of human input is via a touch screen matrix, two control knobs, and a keypad. Most commands are soft labeled, and appear on the display screen only when they are needed and appropriate. Selection is made by the user by simply touching the command on the display. Further, some commands may require setting a value, alternatively with a knob or the keypad. |
| Touch Screen: | LED array provides an 11 X 22 matrix of touch zones overlaying the display area. Commands are labeled on the screen at the location of user input (either by mnemonics or icons). Commands are identified by the microprocessor whenever the user breaks a light beam path; the command is executed after the user withdraws his finger. |
| Knobs: | Two programmable knobs with assigned functionality displayed on the CRT directly above the knobs, for easy association. |
| Keypad: | Hard keys for numeric entry. |
| Menus: | Nominally two levels, four maximum; all levels visible simultaneously to reduce confusion. A low level menu can be directly exited to a high level without making intermediate steps. Levels: 1) Hard labeled mode keys along right side of display; 2) Normal displayed soft labeled touch zones in display area; 3) Pop-up menus, occasionally activated on selection within level 2; 4) seldom |

used secondary pop-ups; normally, once a choice is made in the pop-up, it is executed and the pop-up disappears.

**Plug-ins:** Fully compatible with 7K+ plug-ins. Limited, awkward, but useable with selected 7K plug-ins (functional programability, self-cal are meaningless, and there is no readout of scale factors).

**ROM Based:** The entire Human Interface is software based and can be modified thru software engineering. Interactive touch screen information is loaded to RAM from 7K+ plug-ins or via external I/O ports (eg, GPIB, RS-232, etc).

**Panel Lockout:** All human inputs can be locked out thru software control.

**Touch Screen Disable:** A front panel facility is provided to manually disable the touch screen so that the user can point at the screen without activating the touch commands.

**Other:**

| | |
|---|---|
| Plug-in compatibility: | Fully compatible with all programmable 7K+ plug-ins; guaranteed functional operation (readout excluded) with the following 7K plug-ins: 7A22, 7S12.<br><br>Expect useful but limited operation with the following 7K plug-ins (readout excluded)...caveat emptor: 7D20, 7A15A, 7A16A, 7A18A, 7A26, 7A17, 7A13, 7A11, 7A24, 7A19, 7A29, 7S11/7T11 (with 7854 mod), 7M11, 7S14, 7L14, 7L18, 7L12, 7K11 (Note: all 7K plug-ins are non-programmable, and therefore have inherently limited functionality). |
| Power: | 90-132 or 180-250 VAC, 48-440Hz.<br><br>315 Watts maximum line, fully loaded mainframe under worst case load conditions, including 7K+ active probes. |
| Size: | 8.75 (H) x 16.75 (W) x 20 (D) cubic inches (bench);<br>8.75 (H) x 19.00 (W) x 20 (D) cubic inches (rack). |
| Reliability: | 10,000 Hrs MTBF at 25^C, mainframe only. |
| Hardcopy: | Device drivers optional for output to a specified hardcopy unit via standard Centronics interface (a Tek ink-jet copier with Tek interface is tentatively planned). |
| Mass Storage: | Device drivers (SW & HW) are not available for the mainframe. However, external storage of waveform data and measurement configurations (front panel settings) can be effectively accomplished by transfering files to a personal computer connected to an RS-232 port (or IEEE-488, if available). Tek IG to have communications SW available for selected PC's, in disk format. (to be developed by Marketing Applications group). |

| | |
|---|---|
| Self-cal: | Invoked automatically or on user command to calibrate present settings whenever time and/or temperature change beyond specified limits, or when a setting is changed. Total self-cal time is less than 100 ms. Mainframe controls process, calibrating mainframe and plug-in DC balances, offsets, and low frequency gains. User may defeat Self-cal feature. Self-cal is locked out whenever instrument is in the single-shot mode (correction factors are determined and available after a single-shot event is completed). |
| Auto-scope: | Provides automatic ranging of acquisition vertical and horizontal scale factors, and triggering. Feature can be invoked at will by the user. |

**Options:**

| | |
|---|---|
| Expansion Acquisition Memory: | Extends digitizer to 16K points. |
| Main Memory: | Extends waveform storage to 220K points. |
| Device Drivers: | Printer driver(s) for Tek model xxxx hardcopy unit, via Centronics port. |
| Color: | Not a planned option. Architecture has provisions for 2/3 color LCCS and/or 8 color shadow mask for possible future needs. |
| Option ROMs: | Available for future software requirements as applications develop, such a additional processing capabilities or marketing demo aids. No such applications have been sanctioned to date. |
| Rack Adapter: | Slide rail and rack mounting hardware to convert standard bench instrument for rack mounting. |
| Loop-thru BNC's: | Adds 12 BNC's to front and rear panels for looping front panel plug-in input signals to rear panel; most useful for rack mount applications. |

TR/hk (CPM/125/GD_S2R5)

ET MAINFRAME: MAJOR MILESTONE SCHEDULE 23 Jul 84

| AP | MILESTONE |
|---|---|
| 505 | FSC Operating System |
| 506 | FSC Display System |
| 507 | FSC Digitizer System |
| | |
| 507 | MDC Product |
| 507 | HDC Display System, Power Supply |
| 509 | HDC Executive System, Digitizer System |
| 509 | HDC Product |
| 513 | FDC Product |
| | |
| 601 | MPR Product |
| 605 | MER Product |
| | |
| 605 | FIR Phase I |
| 605 | HER Display System, Power Supply |
| | |
| 607 | HER Executive System |
| 608 | FIR Phase II |
| 609 | HER Digitizer System |
| 609 | HER Product |
| 610 | FIR Phase III |
| 613 | FER Product |
| | |
| 701 | PSR |

TR/hk (CPM/121/SKEDULE)