High Speed

Continuous Measurement at up to 80 MS/s

Time Interval Analyzer
TA720

- Maximum Continuous Sampling Rate 80 MS/s
- Dual Measurement Function
- Inter-Symbol Interference Analysis Function, Built-in Printer, and GP-IB Interface are all standard features
- Ethernet and PC Card Interface (optional)

A new, High-Speed, Multifunction Addition to the TA Series

Continuous Measurement at up to 80 MS/s and Inter-Symbol Interference Analysis with Dual Measurement Function

The TA720 Time Interval Analyzer has larger memory capacity and is faster than the highly regarded TA520 and TA320. It has a maximum sampling rate of 80 MS/s, and maximum memory capacity of 1024 k samples (in Time stamp mode). In addition, the TA720 has a variety of completely new functions, such as a dual measurement function, inter-symbol interference analysis function, and an optional Ethernet and PC card interface. This time interval analyzer is the ideal analysis tool for jitter analysis of high-speed optical disk signals and recording characteristic evaluations.

Built-in printer

3.5-inch floppy drive

TFT color LCD screen
(backlight can be turned ON/OFF)

Input channels A/B
(CHB phase setting function included)

External arming input, Inhibit input

● High-Speed Continuous Measurement at up to 80 MS/s

The TA720 can continuously measure signals as fast as eight times DVD speed. It continuously measures high-speed signals from sources such as fast-rotating CDs and DVDs, and next-generation optical disks without dropping measurements. This makes accurate jitter analysis possible.

● Dual Measurement Function

This function enables two measurements to be done simultaneously. The available measurement combinations are Period A & Period B, Period A & A-to-B time interval, Pulse A & Pulse B, and Pulse A & A-to-B time interval. During optical disk jitter measurement, for example, it is possible to perform two types of jitter measurements (data-data jitter and data-clock jitter).

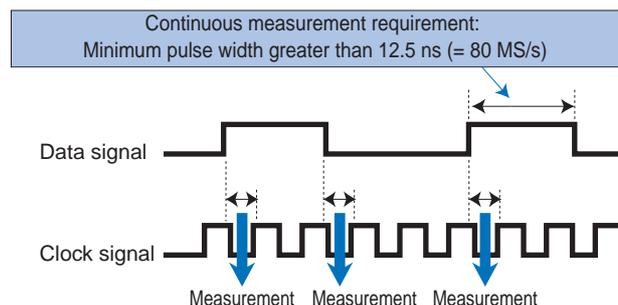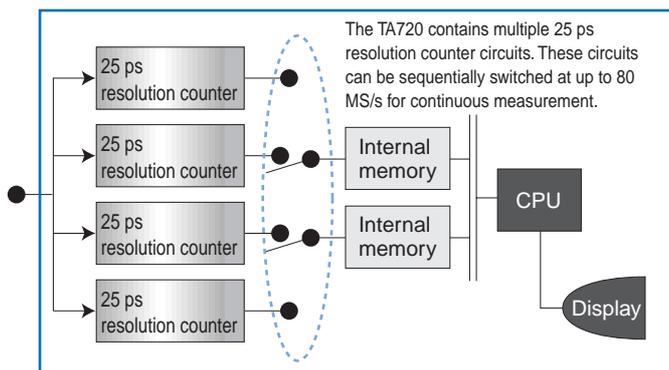## ● Inter-Symbol Interference Analysis Function

With this function, it is possible to extract and analyze data corresponding to set code conditions (such as all T spaces between 3T marks). The distribution of the extracted data and related statistics can also be displayed and compared against all of the data at the same time. When combined with the dual measurement function, the inter-symbol interference analysis function enables even faster jitter analysis through techniques such as extracting data-clock data using pulse width as a condition.

● Ethernet and PC Card Interface (optional)

Data transmitted to the TA720 through an Ethernet connection can be saved to the PC card or shared over a network. In addition, measurement conditions can be set and controls such as starting and stopping measurements can be entered over the network when an Ethernet connection is used.

High-Speed (80 MS/s) Continuous Measurement

The TA720 contains multiple counter circuits with 25 ps resolution. When these circuits are switched at high speed, the TA720 is capable of time measurement at up to 80 MS/s (12.5 ns period; see below). For example, the TA720 can continuously measure 1-7 modulation signals without dropping data, if the minimum 2T pulse width is 12.5 ns or greater. (Note: This does not apply during dual measurement function)

The TA720 contains multiple 25 ps resolution counter circuits. These circuits can be sequentially switched at up to 80 MS/s for continuous measurement.

25 ps resolution counter

25 ps resolution counter

25 ps resolution counter

25 ps resolution counter

Internal memory

Internal memory

CPU

Display

Continuous measurement requirement:
Minimum pulse width greater than 12.5 ns (= 80 MS/s)

Data signal

Clock signal

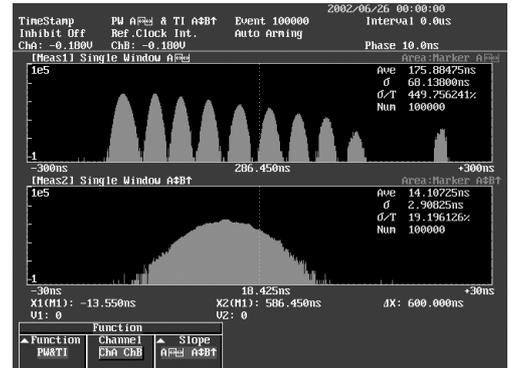Measurement   Measurement   Measurement

2

Meeting the Needs of Developers in the Optical Disk Market

The TA720 has a variety of functions that are useful in optical disk jitter measurements. These functions can be combined for even greater efficiency in jitter measurements.

■ Dual Measurement Function

Simultaneous Measurement of Data-Data Jitter and Data-Clock Jitter

The dual measurement function can be used to simultaneously measure an optical disk's data-data jitter and data-clock jitter. In the past, it was necessary to do these measurements separately, so there was a need for steps such as synchronization using an index signal from a spindle motor as a measurement-start control signal. With the TA720, however, these two measurements can be done simultaneously, so data-data jitter and data-clock jitter from the same measurement area are obtained at the same time.
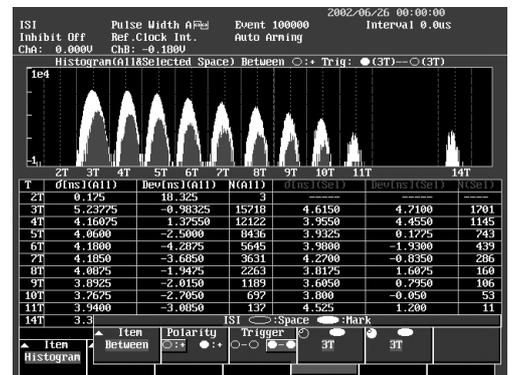
■ Inter-Symbol Interference Analysis Function

This function extracts data corresponding to specified conditions, such as jitter for each space length immediately following a 3T mark, and jitter in each space length between one 3T mark and another. This data can be used to analyze the effects of the code on jitter.

The inter-symbol interference analysis function is useful for evaluating recording strategies, such as recording power control and phase control, and recording waveforms. The distribution of the extracted data and related statistics can also be displayed and compared against all of the data at the same time.
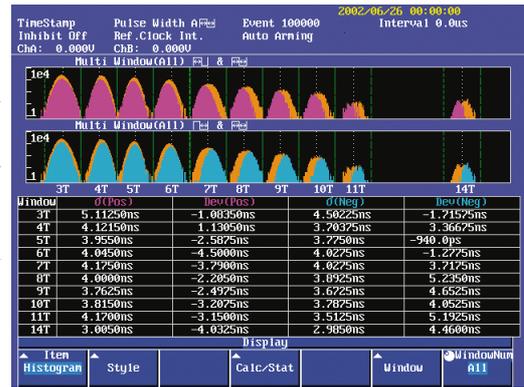
Code length settings that can be selected include arbitrary code length (nT), length shorter than a specified code (nT>), and length longer than a specified code (nT<). With these settings, for example, it is possible to measure jitter for each space length immediately following marks which are 6T or longer, and jitter following long recording lengths.

Examples of Pulse Width Data Extraction

Example of simultaneous measurement of pulse width and data-clock jitter

Example of jitter measurement for each space length between 3T marks

Single
Extract data immediately before or immediately after a specified code length.

Specified code — **Extracted**

Combination
Specify consecutive code and extract data immediately preceding or following them.

Specified code — Specified code — **Extracted**

Between
Specify codes preceding and following the data to be extracted.

Specified code — **Extracted** — Specified code

Data-Clock Time Difference Jitter Analysis Based on Recording Length

Using the Dual Measurement Function and Inter-Symbol Interference Analysis Function in Combination
The inter-symbol interference analysis function can be used in combination with the dual measurement function (Pulse A & A-to-B time interval) to extract data-clock time difference data at each recording length (pulse width).

Examples of data-clock data extraction in case of EFM+ data.

Data-Clock Data Immediately Following 3T

3TM   3TM

Extracted   **Extracted**

Data-Clock Data Immediately Following 4-14T

3TM   3TM

Extracted   **Extracted**

Data-Clock Data Excluding 3T Marks and Spaces

3TM   3TS

Extracted   **Extracted**

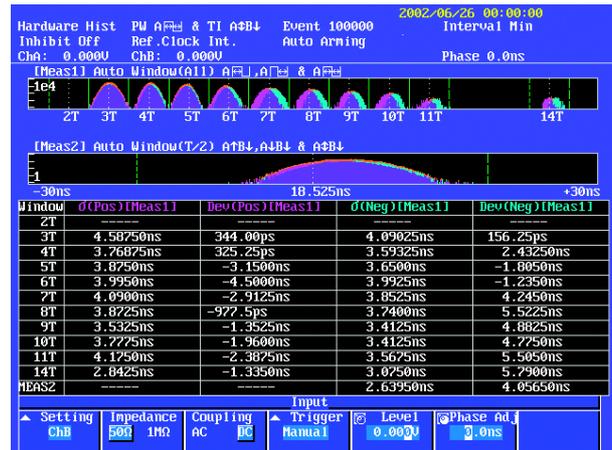## ■ Simultaneous Display of Pulse Width Bipolarity

The TA720 can simultaneously display histograms and statistics for both the positive and negative pulse widths. Numerical individual jitter values, distributions (difference between average value and ideal value for each pulse width), and the like can be checked while comparing the positive and negative histograms. In addition, it is possible to display bipolar histograms and statistics.

Pulse width (positive) histogram →

Pulse width (negative) histogram →

List of statistics for positive and negative pulse widths →

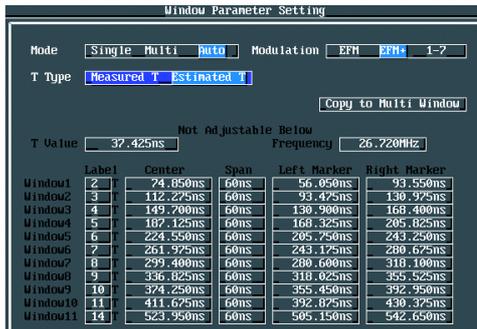| Window	σ(Pos)	Dev(Pos)	σ(Neg)	Dev(Neg)
3T	5.11250ns	−1.00350ns	4.50225ns	−1.71575ns
4T	4.12150ns	1.13050ns	3.70375ns	3.36675ns
5T	3.9550ns	−2.5875ns	3.7750ns	−940.0ps
6T	4.0450ns	−4.5000ns	4.0275ns	−1.2775ns
7T	4.1750ns	−3.7900ns	4.0275ns	3.7175ns
8T	4.0000ns	−2.2050ns	3.8925ns	5.2350ns
9T	3.7625ns	−2.4975ns	3.6725ns	4.6525ns
10T	3.8150ns	−3.2075ns	3.7875ns	4.0525ns
11T	4.1700ns	−3.1500ns	3.5125ns	5.1925ns
14T	3.0050ns	−4.0325ns	2.9850ns	4.4600ns

■ Multi-Window Function

This function allows you preset up to 14 windows for simultaneous analysis and display of histograms and statistics in those windows. During dual measurement function, data-data and data-clock histograms and statistics can be displayed at the same time. In cases where the CAV control is used and the data rate changes according to disk position, the auto-window function is useful for automatically adjusting the window setting. This function provides an Estimated T method, in which the clock period is estimated from the average data signal value; and a Measured T method, in which the clock period is measured from the CHB input signal. The clock period is measured to automatically adjust the window position.

Window	σ(Pos)[Meas1]	Dev(Pos)[Meas1]	σ(Neg)[Meas1]	Dev(Neg)[Meas1]
2T	―――	―――	―――	―――
3T	4.58750ns	344.00ps	4.09025ns	156.25ps
4T	3.76875ns	325.25ps	3.59325ns	2.43250ns
5T	3.8750ns	−3.1500ns	3.6500ns	−1.8050ns
6T	3.9950ns	−4.5000ns	3.9925ns	−1.2350ns
7T	4.0900ns	−2.9125ns	3.8525ns	2.4250ns
8T	3.8225ns	−977.5ps	3.7400ns	5.5225ns
9T	3.5325ns	−1.3525ns	3.4125ns	4.8825ns
10T	3.7275ns	−1.9600ns	3.4125ns	4.2750ns
11T	4.1750ns	−2.3875ns	3.5675ns	5.5050ns
14T	2.8425ns	−1.3350ns	3.0750ns	5.7900ns
MEAS2	―――	―――	2.63950ns	4.05650ns

Example of multi-window screen
Simultaneous display of data-data and data-clock histograms

Window Parameter Setting

Mode: Single Multi **Auto**   Modulation: EFM **EFM+** 1-7

T Type: Measured T **Estimated T**

Copy to Multi Window

Not Adjustable Below

T Value: 37.425ns   Frequency: 26.720MHz

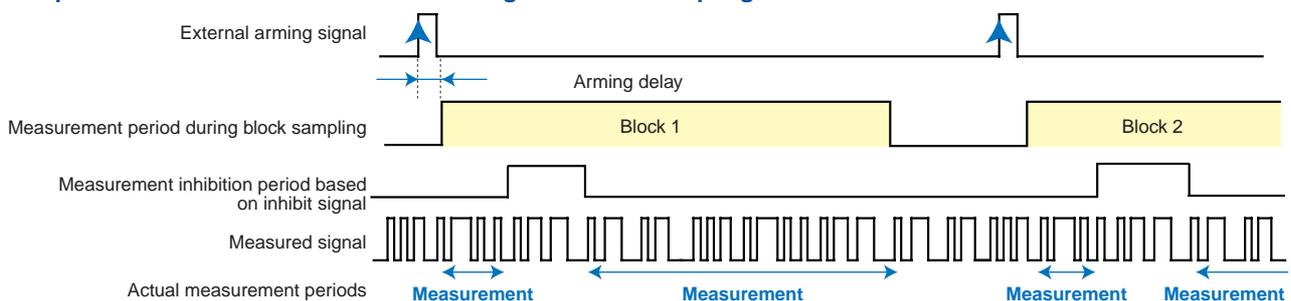|	Label	Center	Span	Left Marker	Right Marker
Window1	2	74.850ns	60ns	56.050ns	93.550ns
Window2	3	112.275ns	60ns	93.475ns	130.975ns
Window3	4	149.700ns	60ns	130.900ns	168.400ns
Window4	5	187.125ns	60ns	168.325ns	205.825ns
Window5	6	224.550ns	60ns	205.750ns	243.250ns
Window6	7	261.975ns	60ns	243.175ns	280.675ns
Window7	8	299.400ns	60ns	280.600ns	318.100ns
Window8	9	336.825ns	60ns	318.025ns	355.525ns
Window9	10	374.250ns	60ns	355.450ns	392.950ns
Window10	11	411.675ns	60ns	392.875ns	430.375ns
Window11	14	523.950ns	60ns	505.150ns	542.650ns

Example of multi-window setting screen

■ External Synchronization Auxiliary Input

For Measuring just the Data Part or just the Header Part on and Optical Disk

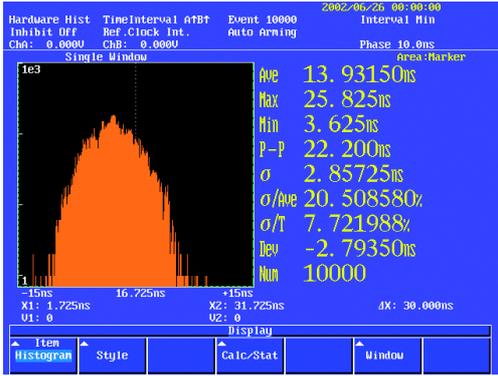The TA720 has the following functions for synchronization with the exterior:
• External Arming
• External Gate (connector shared with external arming)
• Inhibit

The inhibit and external arming functions can be used to separate the data part from the header part during jitter measurement. In addition, a block sampling function can be used to divide the internal memory into as many as 1000 blocks (250 blocks during time stamp mode) for data acquisition. In cases where the recording area is small, such as during media material evaluations, the block sampling function can be used to accumulate samples by performing multiple block measurements with a small amount of data in each measurement (block).

Example of Combined Use of External Arming and Block Sampling Functions

External arming signal

Arming delay

Measurement period during block sampling — Block 1 — Block 2

Measurement inhibition period based on inhibit signal

Measured signal

Actual measurement periods — **Measurement**   **Measurement**   **Measurement**   **Measurement**

## ■ TA720 Screen Displays for Various Types of Analysis

Histogram Display (Half Size)
When the histogram is set to half size, the statistics display is enlarged.
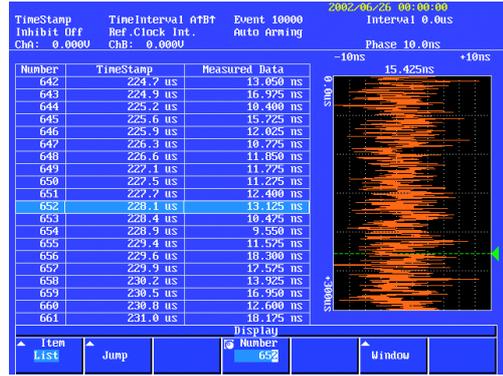
List Display
During time stamp mode, the individual measurement values and the time elapsed from the start of measurement are displayed. The graph is displayed at the same time so detailed data can be checked while viewing the broader trend.
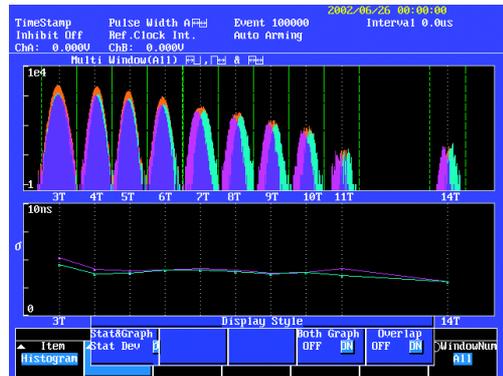

Statistics Display
During bipolar pulse width measurement, statistics for both positive and negative pulse widths are displayed at the same time.
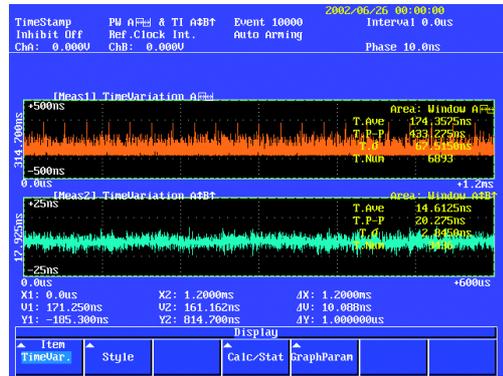
Time Variation Display (Dual Measurement Example Shown)
This display can be used to display and analyze trends in measurement values over time. During dual measurement, it is possible to separately display data trends for two measurement functions.

Symbol Search Function
In time stamp mode or inter-symbol interference analysis mode, as many as four consecutive symbols (recording length nT) can be specified to search for data matching the symbol conditions.

Jitter and Deviation Graph Display
In this type of display, a histogram display is shown on top, and a jitter graph, deviation graph, or statistics list (selected by user) is displayed on the bottom. This type of display is useful for evaluating trends for each recording length nT on an optical disk.

Rear Panel

- ● **Ethernet and PC Card Interface (optional)**
- ● **GP-IB Interface (standard feature)**
- ● **Probe Power Jacks (2)**
- ● **10 MHz Reference Clock I/O**
- ● **Monitor Output: CHA/CHB**
- ● **Gate Output** (measurement period timing output)
- ● **Supply Voltage:** 100-200 VAC, 50/60 Hz

Ethernet and PC Card Interface (optional)

The Ethernet and PC card interface let you access the TA720 from a PC through a LAN in order to download data from the TA720's floppy drive or PC card. You can also transfer waveform data and screenshots from the TA720 to the PC for saving.

FTP Client Function

Save data and screenshots to a network drive

You can save, delete, and copy waveform data and settings on storage media such as the internal floppy drive or a hard drive located on a networked PC or workstation. These operations work the same way as when you handle data on the PC card. In addition, screenshot data can also be saved. The TA720's FTP client function can be used to save, delete, and copy waveform data and settings on PCs and workstations running the FTP server function.

FTP Server Function

Access a drive on the TA720 from a PC to download files from the internal floppy drive or PC card

You can download files from the TA720's internal floppy drive or PC card to a networked PC or workstation. The TA720's FTP server function can be used by PCs and workstations running the FTP client function.

Setting TA720 Measurement Conditions and Controlling the Start of Measurement

A PC can be used to set measurement conditions on the TA720 and control when measurement starts and stops.

10BASE-T hub or router

The TA720's Ethernet connector is a 10BASE-T connector. Connect it to your network through a hub or router as shown.

10BASE-T cable

TA720

PC
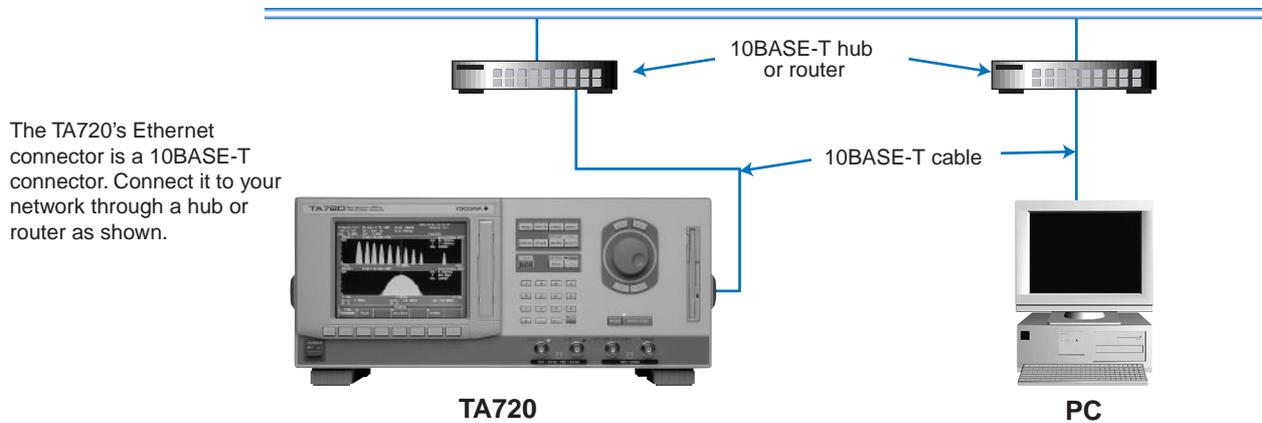
Storage Media Evaluation Systems—Example Setups Using the TA720

DDU-1000

Blue-violet laser phase change optical disk evaluation system
Courtesy of PULSTEC INDUSTRIAL Co., Ltd.

LM330A Blue High-NA

- Transfer rate: 200 Mbps; Tr/Tf: 700 ps -
Courtesy of ShibaSoku Co., Ltd.

6

Specification

Item	Specifications
Sampling Modes	Time stamp mode (T.S. Mode), Hardware histogram mode (H.H. Mode), Inter-symbol interference analysis mode (ISI mode)
Display Resolution	The larger value, either 25 ps or (the histogram X-axis span) /600
Internal Jitter	100 ps rms
Sampling Rate	80 MS/s continuous (at Single measurement function) A-to-B time interval continuous measurement condition: At least 0 ns to edge of next signal A following A-to-B time interval measurement 50 MS/s continuous (at Dual measurement function) A-to-B time interval continuous measurement condition: At least 13 ns to edge of next signal A following A-to-B time interval measurement
Maximum Sample Size	<T.S. mode> Single measurement function: 1,024,000 samples, Dual measurement function: 512,000 samples <H.H mode> Single measurement function: 10^9 samples, Dual measurement function: 10^9 samples <ISI mode> Single measurement function: 1,024,000 samples, Dual measurement function: 512,000 samples
Measurement Update Rate	400 ms (when measuring the period of a 1 MHz sine wave with the sampling size set to 1000 in H.H. Mode)
Function	<T.S. Mode/H.H. mode> Single measurement function: Period (↑/↓) A-to-B time interval (A↑B↑/ A↓B↑/ A↕B↑/A↑B↓/A↓B↓/A↕B↓) Pulse width (⌐╌⌐/ ⌐╌ / ╌╌) Dual measurement function: Period A & Period B (A↑ & B↑/A↓ & B↓) Period A & A-to-B time interval (A↑ & A↑B↑/ A↓ & A↓B↑) Pulse width A&A-to-B time interval (CHA-⌐╌ & A↑ to B↑/CHA-╌╌ & A↕ to B↓) Pulse width A &Pulse width B (CHA-⌐╌ & CHB-⌐╌) <ISI mode> Single measurement function: Pulse width (⌐╌ only) Dual measurement function: Pulse width A & A-to-B time interval (CHA-⌐╌ & A↑B↑/CHA-⌐╌ & A↓B↑/CHA-⌐╌ & A↕B↑/CHA-⌐╌ & A↑B↓/CHA-⌐╌ & A↓B↓/CHA-╌╌ & A↕B↓) Pulse width A &Pulse width B (CHA-⌐╌ & CHB-⌐╌)
Measuring Range	<T.S. mode> Period: 6 ns to 20 ms A-to-B time interval: 0 ns to 20 ms Pulse width: 6 ns to 20 ms <H.H. mode> Period: 6 ns to 3.2 µs A-to-B time interval: 0 ns to 3.2 µs Pulse width: 6 ns to 3.2 µs <ISI mode> A-to-B time interval: 0 ns to 3.2 µs Pulse width: 10 ns to 3.2 µs
Sampling Interval	min or 1 µs to 1 s (1 µs step) (T.S. Mode only)
Inputs to A and B Channels	Coupling: AC/DC Impedance: 50 Ω/1 MΩ Frequency characteristics: DC to 250 MHz (DC coupling) Minimum input pulse width: 3 ns (2.2 ns at CHB input in A-to-B time interval measurement) Operating Voltage range: -5 V to + 5 V Maximum input voltage: 40 V (DC+ACpeak, DC ≤ input frequency ≤ 100 kHz) Trigger level: MAN; -5 V to +5 V (1 mV step) ; Accuracy: ± (10 mV + 1% of setting value) AUTO=0% to 100% (1% step) ; (Single Auto Trigger / Repeat Auto Trigger) Sensitivity: 100 mVp-p Input amplifier noise: 400 µVrms (Typical value) Crosstalk: -40 dB (typical value) Phase setting: 0.0 to 10.0 ns (0.1 ns step) (function permitting CHB phase difference to be set on CHA) Maximum sampling time: 320 s (T.S. mode) 3200 s (H.H. mode)
Statistical Values	<T.S. mode> When histogram is calculated Average, Maximum, Minimum, Peak-Peak, σ, σ/Average, σ/T, Deviation, Deviation/T, Median, Mode, Number When time variation is calculated T.Average, T.Maximum, T.Minimum, T.Peak-Peak, T.σ, T.(σ/Average), T.(P-P/Average) , T.RF, T.Number <H.H. Mode/ISI mode> Average, Maximum, Minimum, Peak-Peak, σ, σ/Average, σ/T, Deviation, Deviation/T, Median, Mode, Number
Inter-Symbol Interference Analysis Function	Extraction condition: nT/nT to maxT/minT to nT (n is any value) Measurement condition: Minimum Pulse width: 10 ns, Cannot use the Inhibit function with Dual measurement function. Extraction mode: Single, Combination and Between Missed sample detection: Maximum 256 (a function to interpolate missed samples when using dual measurement functions) Condition: At least 100 ns between missed samples
Display Format	<T.S. mode> Select from Histogram, Time variation, List and Statistics (statistical data) <H.H. mode> Select from Histogram, List and Statistics (statistical data) <ISI mode> Select from Histogram and List

Item	Specifications
Block Sampling	<T.S. Mode> Number of blocks: 2 to 250 (available within the maximum sampling size, when Arming source is EXT and Rest Mode is OFF, or when Arming source is AUTO and Rest Mode is EVENT or TIME.) 2 to 1000 (available within the maximum sampling size, when Arming source is AUTO and Rest Mode is OFF.) <H.H. mode> Number of blocks: 2 to 1000 (determined by the maximum sampling size) <ISI mode> Cannot use this function with ISI mode. • Cannot use this function with Dual measurement function • Cannot use this function with EXT gate • Cannot use the EXT Arming when Rest Mode is EVENT or TIME.
Arming	Arming source: select from AUTO or EXT EXT setting: Trigger level: TTL(1.4 V), TTL/10, 0 V Time delay: 1 µs ≤ delay time ≤ 1 s (Resolution: 100 ns) Separate settings can be made on each channel when using dual measurement functions (Period A & Period B, Pulse Width A & Pulse Width B). Event delay: 1 to 10^6 (1 step) cannot use set the event delay when Dual measurement function) Slope: ↑/↓
Inhibit	select from ╌╌ or ⌐╌ (Trigger level: TTL (1.4 V), TTL/10, 0 V)
Gate	select from EVENT, TIME or EXT <T.S. mode> Event gate: Single measurement function: 2 to 1024000, Dual measurement function: 1 to 512000 Time gate: 1 µs ≤ gate time ≤ 10 s (100 ns step) EXT gate: 1 µs to 320 s <H.H. mode> Event gate: Single measurement function: 2 to 10^9, Dual measurement function: 1 to 10^9 Time gate: 1 µs ≤ gate time ≤ 10 s (100 ns step) EXT gate: 1 µs to 320 s <ISI mode> Event gate: Single measurement function: 2 to 1024000, Dual measurement function: 1 to 512000 Time gate: 1 µs ≤ gate time ≤ 10 s (100 ns step) EXT gate: 1 µs to 320 s
Ethernet and PC Card Interface (optional)	Ethernet communication Transfer method: Ethernet (10BASE-T) Transfer rate: 10 Mbps maximum Supported services: FTP server, FTP client (network drive), DHCP, DNS PC card interface Supported card type: Flash ATA card (PC card TYPE II) Functions: Saving settings, measurements, and screenshots
Display	6.4 inch , color TFT LCD (back light On/Off Function)
Internal Memory	Store and recall 32 sets of setup information in the nonvolatile memory
Reference Input	input frequency range: 10 MHz ± 10 Hz Input level: 1 Vp-p or greater
Monitor Output (CHA/CHB)	Output level: 1/4 of measurement input signal (with 50 Ω load)
Gate Output	Timing output for internal measurement period (rear panel BNC connector, TTL level)
Other Function	3.5-inch floppy disk (720 KB, 1.44 MB, MS-DOS compatible) GP-IB interface (Protocol: conforms to IEEE St'd 488.2 1992) Built-in Printer: Thermal dot method, Recording width: 104 mm 2 probe power terminals (rear panel, usable FET probe (model 700939), output voltage: ±12 V)
General Specification	Source voltage: 100 to 120 VAC, 200 to 240 VAC Power supply frequency: 50/60 Hz Maximum power consumption: 250 VA External dimensions: Approx. 426(W) × 177(H) × 300(D)mm (excluding projections) Weight: Approx. 12 kg (main unit only)

The above performance specifications are obtained after warm-up under the reference operating condition. Reference operating conditions: 23 °C ± 5 °C ambient temperature, 50% ± 10% (RH) ambient humidity, within 1% of supply voltage rating.

■ Dimensions

Unit: mm (inch)

13(0.51) 426(16.77) 13(0.51) 177(6.97)
12(0.47) 23(0.91) 277(10.91) 28(1.10) 20(0.79)
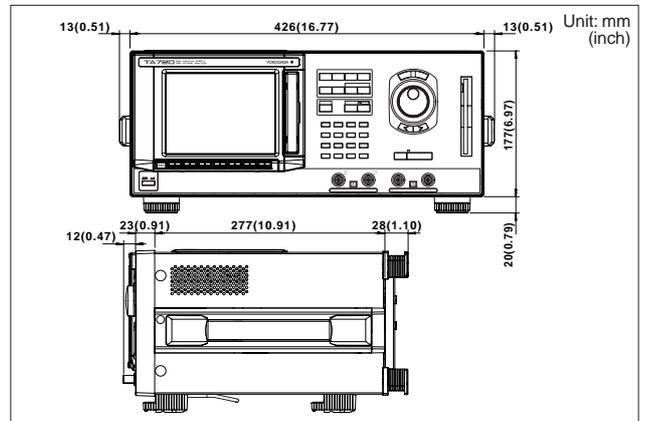
Microsoft, MS-DOS, and Windows are either trademarks or registered trademarks of Microsoft Corporation in the US and/or other countries.

■ Model and Suffix Codes

Model	Suffix code		Description
704510			TA720 Time Interval Analyzer
Power cable	-D		UL, CSA Standard
	-F		VDE Standard
	-R		AS Standard
	-Q		BS Standard
Option		/C10	Ethernet and PC card interface
		/E3	Two FET probes

■ Optional Accessories

Part	Model	Specifications	Order quantity
BNC cable	366924	BNC–BNC (1 meter)	1
BNC cable	366925	BNC–BNC (2 meters)	1
FET probe	700939	900 MHz bandwidth	1
Printer paper (roll)	B9850NX	30 meters (1 roll = 1 unit)	5
Rack mounting kit	751535-E4	For EIA	1
Rack mounting kit	751535-J4	For JIS	1

FET Probe (700939)

Related Models

TA520 Time Interval Analyzer

- Maximum continuous sampling rate: 43 MS/s
- Maximum sampling size: 10^9
- Measurement resolution: 25 ps
- Internal jitter: 100 ps rms

TA320 Time Interval Analyzer

- Maximum continuous sampling rate: 14 MS/s
- Maximum sampling size: 99,999,999
- Measurement resolution: 100 ps
- Internal jitter: 300 ps rms

TA120F Digital Jitter Meter

- Highly accurate, highly reproducible measurements
- High-speed measurement (50-ms measurement period)
- Supports various optical disk formats (CD, DVD-ROM)
- Bi-phase measurement (optional)

Optical Disk Jitter Analysis Software
for TA320/TA520
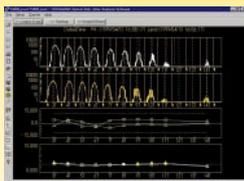
- Histogram, deviation, jitter, and trend displays
- Applicable to CD/DVD/MO/MD
- Requires National Instruments GP-IB board
- Runs under Windows 95/98/NT

Optical Disk Inter-symbol Interference Analysis Software
for TA320/TA520
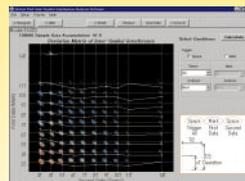
- Inter-symbol interference analysis
- Deviation matrix analysis
- Applicable to CD/DVD/MO/MD
- Requires National Instruments GP-IB board
- Runs under Windows 95/98/NT

DL1740 Digital Oscilloscope

- Maximum sampling rate: 1 GS/s
- 500 MHz analog bandwidth
- Maximum record length: 1 MW
- Ethernet Interface 100 BASE-TX (optional)

DL7200 Digital Oscilloscope

- Maximum sampling rate: 2 GS/s
- 500 MHz analog bandwidth
- Maximum record length: 16 MW
- 4 channels analog input and 16-bit logic input

NOTICE
- ● Before operating the product, read the instruction manual thoroughly for proper and safe operation.
- ● If this product is for use with a system requiring safeguards that directly involve personnel safety, please contact the Yokogawa sales offices.

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