SPECIFICATIONS

Specifications Related to Inputs/Outputs

● Inputs to A and B Channels

Item	Specifications	
Input impedance*1	50 Ω /1 MΩ (input capacitance: 20 pF)	
Frequency characteristics (-3 dB)*1	100 MHz	
Input coupling	DC/AC (input impedance: 1 MΩ: cutoff frequency 35 Hz; : 50 Ω: cutoff frequency 680 kHz)	
Operating voltage range	–5 to + 5 V	
Maximum input voltage	50 Ω: 5 Vrms 1 MΩ: 40 V (DC + ACpeak) (DC ≤ input frequency ≤ 100 kHz) 3.5/f (MHz) + 5 V (DC + ACpeak) (100 kHz < input frequency ≤ 100 MHz)	
Amplifier noise*1	400 µVrms	
Sensitivity	100 mVp-p	
Minimum input pulse width	10 ns	
Trigger level	Voltage rangesetting	+5 to –5 V
	Accuracy *2	±(10 mV + 4% of setpoint)
	Resolution	5 mV
Auto trigger	Input signal condition	1 kHz to 50 MHz
	Method	Singe/Repeat
	Setpoint time*1	0.7 s

● External Arming Input (the terminal is shared by external gating inputs)

Item	Specifications
Impedance*1	10 kΩ
Coupling	DC
Trigger level	TTL
Maximum voltage range	–8 to +13 V (DC+ ACpeak)
Minimum input pulse width	30 ns
Setup time	70 ns (In order for arming input to be valid, it must precede the measured signal by no less than 70 ns.)

● External Inhibit Input

Item	Specifications
Input impedance*1	10 kΩ
Input coupling	DC
Trigger level	TTL
Maximum input voltage range	–8 to +13 V (DC + ACpeak)
Minimum input pulse width	30 ns
Setup time	70 ns (In order for inhibit input to be valid, it must precede the measured signal by no less than 70 ns.)

● Monitor Outputs A and B

Item	Specifications
Outputs impedance*1	50 Ω
Outputs signal level*3	Approximately 1/4 of the input signal (within ±5 V)

● Reference Input

Item	Specifications
Frequency range	10 MHz ± 10 Hz
Impedance	1 kΩ min.
Coupling	AC
Voltage level	1 Vp-p min.
Maximum voltage range	–10 to + 10 V

● Reference Output

Item	Specifications
Frequency*1	10 MHz
Impedance*1	50 Ω min.
Coupling	AC
Voltage level*1	1 Vp-p min.

Note: All inputs are diode-protected and terminal grounds are connected to the enclosure's ground.
*1: Typical value.
*2: The value when the warm-up time has expired under the reference operating conditon with the coupling and input impedance set at DC and 1 MΩ, respectively.
*3: The value when the output is received into 50 Ω at a 1 MΩ input impedance.

Specifications Related to Measurement

● Sampling Modes

Item	Specifications
Time stamp mode	Acquires measurements along with "time stamp" data, which represent the time that the respective measurements occurred, to record a set of these data as time-series data.
Hardware histogram mode	Records measurements as the frequency data for a histogram.

● Sampling

Item	Specifications	
	Time stamp mode	Hardware histogram mode
Maximum sampling rate	Continuous 14 M samples/s (71-ns intervals); 7 M samples/s (142-ns intervals) in the case of phase difference and duty ratio measurements	
Sampling period	MIN (71ns) 1, 2, 4, 10, 20, 40, 100, 200, 400 µs, 1, 2, 4 ms. The total sampling time is 320 seconds, including the time for arming.	The total sampling time is 320 seconds.
Maximum sample size	Duty ratio and phase difference measurements: 16,000 samples Other emasurements: 32,000 samples	99,999,999 samples, (10^8-1) excluding duty ratio and phase difference measurements

● Measurement Refresh Rate (hardware histogram mode only)

Item	Specifications
Refresh rate*1, *2	400 ms

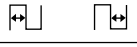
● **Period**

Item	Specifications	
	Time stamp mode	**Hardware histogram mode**
Measuring range	30 ns to 100 ms	30 ns to 3.2 µs
Display resolution	100ps	The larger value, either 100 ps or $\frac{\text{the histogram span setting}}{200}$
Resolution*1	±300 ps rms ± $\sqrt{2}$ × trigger error	The larger value, either ±300 ps rms or display resolution, ± $\sqrt{2}$ × trigger error
Accuracy*1	±300 ps rms ±$\sqrt{2}$ × trigger error ±(timebase frequency stability × measured period) ±300-ps systematic error	
Trigger slopes		

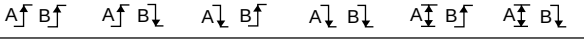
● **Pulse Width**

Item	Specifications	
	Time stamp mode	**Hardware histogram mode**
Measuring range	30 ns to 100 ms	30 ns to 3.2 µs
Display resolution	100 ps	The larger value, either 100 ps or $\frac{\text{the histogram span setting}}{200}$
Resolution*1, *3	±300 ps rms ± rising trigger error ± falling trigger error	The larger value, either ±300 ps rms or display resolution, ± rising trigger error ± falling trigger error
Accuracy*1	±300 ps rms ±(timebase frequency stability × measured pulse width) ± trigger level timing error ±1-ns systematic error	
Trigger slopes	 22T*4	

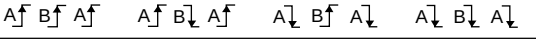
● **Duty Ratio (time stamp mode only)**

Item	Specifications
Measuring range	0 to 99.999% (pulse width: 71 ns to 100 ms)
Display resolution	The larger value, either 0.001% or $\frac{\text{loops}}{\text{Period}} \times 100\%$
Resolution*1	$\pm\left(\frac{\text{measured pulse width} + \lvert\text{pulse-width resolution}\rvert}{\text{measured period} - \sqrt{2} \times \lvert\text{pulse-width resolution}\rvert} - \text{measured duty ratio}\right)$
Accuracy*1	$\pm\left(\frac{\text{measured pulse width} + \lvert\text{pulse-width accuracy}\rvert}{\text{measured period} - \sqrt{2} \times \lvert\text{pulse-width accuracy}\rvert} - \text{measured duty ratio}\right)$
Trigger slopes	

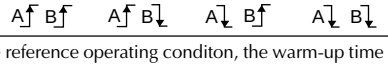
● **A-to-B Interval**

Item	Specifications	
	Time stamp mode	**Hardware histogram mode**
Measuring range	5 ns to 100 ms	5 ns to 3.2 µs
Display resolution	100 ps	The larger value, either 100 ps or $\frac{\text{the histogram span setting}}{200}$
Resolution*1, *5	±300 ps rms ±A-input trigger error ±B-input trigger error	The larger value, either ±300 ps rms or the display resolution, ± A-input trigger error ±B-input trigger error
Accuracy*1	±300 ps rms ±(timebase frequency stability × measured A-to-B interval) ± trigger level timing error ±1-ns systematic error	
Trigger slopes		
Conditon for continuous measurement*6	The B-to-A interval must be greater than 30 ns.	

● **A-to-B-to-A Interval**

Item	Specifications	
	Time stamp mode	**Hardware histogram mode**
Measuring range	A to B: 30 ns to 100 ms; B to A: 30 ns to 100 ms	A to B: 30 ns to 3.2 µs; B to A: 30 ns to 3.2 µs
Display resolution	100 ps	The larger value, either 100 ps or $\frac{\text{the histogram span setting}}{200}$
Resolution*1	±300 ps rms ± A-input trigger error ±B-input trigger error	The larger value, either ±300 ps rms or display resolution, ± A-input trigger error ± B-input trigger error
Accuracy*1	±300 ps rms ±(timebase frequency stability × measured A-to-B-to-A interval) ± trigger level timing error ±1-ns systematic error	
Trigger slopes		

● **Phase Difference (time stamp mode only)**

Item	
Measuring range	0 to 360 degrees (where, A to B: MIN (71 ns); B to A: 30 ns min.)
Display resolution	0.01 degree
Resolution*1	$\pm\left(\frac{\text{measured A-to-B interval} + \lvert\text{A-to-B interval resolution}\rvert}{\text{measured A-input period} - \sqrt{2} \times \lvert\text{A-to-B interval resolution}\rvert} - \text{measured phase difference}\right)$
Accuracy*1	$\pm\left(\frac{\text{measured A-to-B interval} + \lvert\text{A-to-B interval resolution}\rvert}{\text{measured A-input period} - \sqrt{2} \times \lvert\text{A-to-B interval resolution}\rvert} - \text{measured phase difference}\right)$
Trigger slopes	

*1: The value when, under the reference operating conditon, the warm-up time has expired.

*2: The value when the period of a 1-MHz sine wave is measured with an event size of 1000.

*3: The specificatin changes as shown below if the trigger slope makes a transition represented as ↔

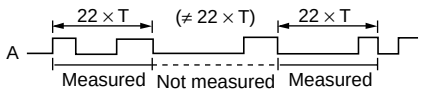
Time Stamp Mode	Hardware Histogram Mode
±300 ps rms ± rising trigger error ± falling trigger error ± trigger level timing error	The larger value, either ±300 ps rms or display resolution, ± rising trigger error ± falling trigger error ± trigger level timing error

The specification changes as shown below if the trigger slope is "22T":

Time Stamp Mode
±300 ps rms ± √N × (rising trigger error + falling trigger error + trigger level timing error)

N: The number of edges that has passed through during a time interval of 22× T.

*4: Measurement takes place only when an interval between the edges of a 22T input signal matches the time interval of 22× T.

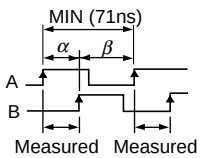


T: any value of time keyed in

*5: The specification changes as shown below if the trigger slopes make transitions represented as A↑ B↑ A↑ B↓ :

Time Stamp Mode	Hardware Histogram Mode
300 ps rms ± A-input trigger error ± B-input trigger error ± trigger level timing error	The larger value, either ±300 ps rms or the display resolution, ±A-input trigger error ± B-input trigger error ± trigger level timing error

*6: Conditions for continuous measurement



α: The A-to-B interval must be greater than 5 ns.
β: The B-to-A interval must be greater than 30 ns.

If the trigger slopes make transitions represented as A↑ B↑

Notes: The trigger error, rising trigger error, falling trigger error, A-input trigger error, and B-input trigger error are represented by:

$$\frac{\sqrt{X^2 + En^2}}{S.R}$$

X: Noise of the input amplifier
En: Signal noise at a frequency within the bandwidth (100 MHz)
S.R: The slew rate of a signal being measured [V/s]

The trigger level timing error is represented by:

±(15 mV/start signal's slew rate – 15 mV/stop signal's slew rate) ± trigger level setting accuracy/start signal's slew rate ± trigger level setting accuracy/stop signal's slew rate

Specifications Related to Functions

● Display Formats

Item	Specifications	
	Time stamp mode	Hardware histogram mode
Display formats	Histogram *1 Time variation*2 List (time stamps, measurements and data numbers)*2 Statistics (statistical data)*3	Histogram*1 List (measurements and their frequencies) Statistics (statistical data)*3

● Statistical Computation (for statistics and histogram formats only)

Item	Specifications	
	Time stamp mode	Hardware histogram mode
Maximum value	MAX = [Xi] max	MAX = [Xi] max
Minimum value	MIN = [Xi] min	MIN = [Xi] min
Average	$AVE = \frac{1}{n}\sum_{i=1}^{n} Xi$	$AVE = \frac{1}{n}\sum_{i=1}^{n} Xi \times probability_i$
Sandard deviation*4	$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (Xi–AVE)^2}$, where n = the number of samples	$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (Xi–AVE)^2 \times probability_i}$ where n = the number of histograms
Peak-to-peak	P–P = MAX – MIN	P–P = MAX – MIN
Flutter	$\sigma/AVE = \frac{\sigma}{AVE} \times 100\%$	$\sigma/AVE = \frac{\sigma}{AVE} \times 100\%$
Jitter 1*5	$\sigma/T = \frac{\sigma}{Ts} \times 100\%$	$\sigma/T = \frac{\sigma}{Ts} \times 100\%$
Jitter 2*5	$MELE = \frac{\lvert AVE–X_{CENTER}\rvert}{Ts} \times 100\%$	$MELE = \frac{\lvert AVE–X_{CENTER}\rvert}{Ts} \times 100\%$

*1: The user can view up to two statistical values.

*2: The time resolution in the time stamp mode is 100 ns both for the X-axis of the time-based variation format and for the time stamps of the list format.

*3: Allows the display of all statistical values and viewing of a bar-graph representation of standard deviations.

*4: Standard deviation–when in pulse width measurement with a trigger slope of ↔

$$\frac{\sigma p + \sigma a}{2}$$

σ_a = Standard deviation for a fransition represented as "↓ to ↑"
σ_p = Standard deviation for a transition represented as "↑ to ↓"

*5: Ts = Any constant keyed in

X_{CENTER}: The center value in a window in a case where the multi-window function is in use

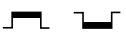
● **Arming (a function that specifies the time to begin one-block measurement)**

Item	Specifications	
	Time Stamp Mode	Hardware Histogram Mode
Arming source		
Internal	Measurement begins when the internal system of measurement goes into the ready state.	
External	Measurement begins as triggered by the edge of an external input signal.	
Arming delay	Measurement begins, after a delay as long as the preset number of events or event time, only when the arming source is external.	
Range of event delay setpoint	Measurement begins after a delay as long as the preset number of event. 1/ 2/ 3/ 4/ 5/ 6/ 7/ 8/ 9/ 10/ 20/ 30/ 40/ 50/ 60/ 70/ 80/ 90/ 100/ 200/ 300/ 400/ 500/ 600/ 700/ 800/ 900/ 1,000/ 2,000/ 3,000/ 4,000/ 5,000/ 6,000/ 7,000/ 8,000/ 9,000/ 10,000/ 20,000/ 30,000	
Range of time delay setpoint	Measurement begins after a delay as long as the preset time. 1 µs to 5 ms (exclusive) (in 200-ns increments) 5 ms to 1 s (in 1-ms increments)	
Slopes		

● **Gating (a function that specifies the range of one-block measurement to be carried out)**

Item	Specifications	
	Time Stamp Mode	Hardware Histogram Mode
Event gating	The analyzer measures as many data items as the preset number of events.	
Configurable Number of events	Duty ratio and phase difference measurements: 1 to 16,000 Other measurements: 1 to 32,000	1 to 99,999,999
End of measurement	Sampling ends if 320 seconds elapse before the preset number of events is reached.	
Time gating	The analyzer measures data for as long a period as the preset gate time.	
Onfigurable setpoint of time	1 µs to 5 ms (exclusive) (in 200-ns increments) 5 ms to 10 s (in 1-ms increments)	
End of measurement	Sampling ends if the number of samples reaches 32,000 before the gate time expires.	Sampling ends if the number of samples reaches 99,999,999 (10^8-1) before the gate time expires.
External gating	The timeframe of measurement is determined by a signal applied to the arming terminal.	
Allowable timeframe	1 µs to 320 s	
End of measurement	Sampling ends if the number of samples reaches 32,000 before the gate time expires.	Sampling ends if the number of samples reaches 99,999,999 (10^8-1) before the gate time expires.
Polarities		

● **Inhibit** (a fuction that specifies the timeframe during which the analyzer inhibits input signals from being captured)

Item	Specifications
Allowable timeframe	1 µs to 320 s
Polarities	

● **Multi-window** (a function that presents two or more different histogram windows–available only in the hardware histogram mode)

Item	Specifications
Functions	Period, pulse width, A-to-B interval and A-to-B-to-A interval
Configurable number of windows	1 to 16
Setup of center value and span	AUTO/MANUAL

● **Histogram Data Addition** (hardware histogram mode only)

Item	Specifications
Histogram data addition	The user can add data values to a histogram a round its center value for display on the screen only when the multi-window function (AUTO) is selected. The statistical computation is implemented according to a new array of data including the added data values.

Timebase

Item	Specifications
Internal reference frequency	10-MHz temperature-compensated crystal oscillator (TCXO)
Frequency stability	Aging rate: ±1.5 ppm/year Temperature characteristics: ±2.5 ppm over 5 to 40°C (with the reference point a +25°C)
External adjustment	Available

General Spacifications

Item	Specifications
Memory	Non-volatile memory, allowing storage of and access to ten kinds of panel information.
Floppy disk drive	Size: 3.5" Quantity: 1 Format: MS-DOS (640, 720 KB, 1.2 or 1.44 MB)
GP-IB communication	Compatible with IEEE Standard 488-1978 (JIS C 1901-1987) Functional specifications: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1 and C0 Protocol: Compatible with IEEE Standard 488.2-1987
Reference operating condition	Ambient temperature: 23±2°C Ambient humidity: 50±10%RH Supply voltage: Within 1% of rated voltage
Warm-up time (Approx.)	30 minutes (until all specifications are fulfilled)
Operating temperature range	5 to 40°C
Operating humidity range	20 to 80%RH
Torage temperature range	-20 to 60°C
Ated supply voltage range	100 to 240 V AC
Range of supply voltage variation	90 to 264 V AC
Rated supply frequency range	50 to 60 Hz
Range of rated supply frequency variation	48 to 63 Hz
Power consumption	125 VA max.
External dimensions (Approx.)	213(W)×132(H)×392(D) (mm) 8-3/8(W)×5-1/4(H)×15-1/2(D) (inch)
Weight (Approx.)	5 kg (main unit only)
Display	4.7" STN monochromeLCD (320×240 pixels)

Application Software Specifications

● **Optional Disk Analysis Software for the TA320**

Readable data: Binary type data measured with the **TA320**(WVF), Binary data saved using this software

Data acquisition: Via floppy disk or communications through GP-IB interface

Display of analysis results: Histogram display (graph display), vertical scale: log or linear, Delta average table, Jitter value (standard deviation) table, Judgment line display, and Independent/overlapping display for Pit/Land measured values

Analysis range: Start cycle is limited to 1 to 3T.
End cycle ranges from 1 to 16T.

Save/load functions: Analysis data and the software settings can be saved or loaded.
Saving or loading of average values only is also available.

Database function: Data for each Pit/Land and the title to be given to the data can be controlled as a bundle.

Printing function: Histograms, graphs, and tables can be printed out.
The printing direction can be specified.

Judgment function: This function sets the median and allowable range for a delta average and the criterion for standard deviation.
With the judgment function, the judgment line is displayed on the graph and the data exceeding the criterion (NG) are marked in a different color.

Comments: Comments can be attached to the analysis result.

Personal computer: Those running Windows 3.1, Windows 95, or Windows NT workstation

GP-IB board: Those made by NATIONAL INSTRUMENTS.

■ BLOCK DIAGRAM OF THE TA320

