High-Precision TIA Jitter Measurement

Digital Jitter Meter

TA 120F

- High-precision, high-repeatability measurements using the TIA measurement principle
- High-speed measurements (maximum speed: 50 ms)
  - Applicable to CD/DVD
- External synchronization enabled by inhibit and external arming functions
- Bi-Phase measurement (optional)
- External I/O control (optional)
- Level measurement (optional)
High-precision, high-speed measurements and CD/DVD compatibility!

Fully compatible with TA320/TA520 high-end Time Interval Analyzers

The TA120F digital jitter meter is an optical disk (CD/DVD) jitter meter with a limited functions found on the former models (the TA320 and TA520). The internal measurement method is based on the same TIA system as in the former models, so the TA120F can provide high-precision measurements that are fully compatible with former models within the continuous-search range (DVDx1.1). Measurements can be displayed on a seven-segment LED and an analog meter for production line applications. The maximum speed for a single measurement is 50 ms (for DVD with 10^6 sampling), making the TA120F suitable for production line applications which have test time requirements. A GP-IB interface, a jitter DC-OUT, an equalizer (DVDx1), and a PLL circuit (27 MHz) are standard features. In addition, Bi-Phase measurement and level measurement functions are offered as optional features.

Features

- **High precision**: High-precision, high-repeatability measurements using the TIA system
- **High speed**: 50 ms measurement cycle
- **Support for a variety of optical disk types**: CD (x1 to x10), DVD-ROM (x1 for continuous measurement; maximum x2.2 for discontinuous measurement)
- **Bi-Phase measurement (optional)**: Bi-Phase jitter measurements for up to x32 CD-R/RW
- **Level measurement (optional)**: Measurements of RF level (Vp–p) for DVD and CD
- **Equalizer boost value setting**: Numerical entry in the range from 2.0 to 6.0 dB (in 0.1 dB steps).

Front panel

<table>
<thead>
<tr>
<th>Measurement Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CD jitter measurements</strong>: For measuring 3T jitter of CD (x1 to x10 speed, in steps of x0.1).</td>
</tr>
<tr>
<td><strong>DVD jitter measurements</strong>: For measuring data-to-clock phase difference jitter of DVD, and jitter of x1 to x2.2 DVD (DVD-RAM 4.7G) with two inputs.</td>
</tr>
<tr>
<td><strong>Bi-Phase jitter measurements</strong>: For measuring CD-R/RW Bi-Phase jitter (up to x32 speed)</td>
</tr>
</tbody>
</table>

Built-in equalizer (DVDx1)

Jitter measurement for an RF signal before and after passing the equalizer by switching on/off the built-in equalizer.

Built-in PLL clock regeneration circuit (DVDx1)

Measurement of data-to-clock phase difference jitter with one RF signal input.

Phase adjustment function

Adjust the phase difference between the clock signal and the RF signal while viewing it on the meter with two inputs.

Simultaneous meter and LED display

Simultaneous viewing of measurements on an analog meter and a seven-segment LED (numerical display).

Presetting

Up to seven sets of measurement settings can be saved to and loaded from memory. Switchover to one of these saved sets of preset settings can be performed remotely by means of optional external I/O control.

Rear panel

<table>
<thead>
<tr>
<th>GP-IB interface:</th>
<th>Conforms to IEEE standard 488-1978</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXT I/O:</td>
<td>External I/O control signal connector</td>
</tr>
<tr>
<td>JITTER DC OUT:</td>
<td>Jitter D-A converted output</td>
</tr>
<tr>
<td>LEVEL DC OUT:</td>
<td>Level D-A converted output</td>
</tr>
<tr>
<td>EQUALIZED RF/MONITOR OUT:</td>
<td>Equalized RF signal monitor or probe adjustment output</td>
</tr>
<tr>
<td>SLICED RF OUT:</td>
<td>TTL50 Ω</td>
</tr>
<tr>
<td>CLOCK OUT:</td>
<td>TTL50 Ω</td>
</tr>
<tr>
<td>EXT ARM IN:</td>
<td>External arming input</td>
</tr>
<tr>
<td>INHIBIT IN:</td>
<td>Measurement inhibit time gate input</td>
</tr>
<tr>
<td>KEY LOCK:</td>
<td>Disabling/enabling keys on the front panel</td>
</tr>
<tr>
<td>Power supply inlet:</td>
<td>100–240 V AC, 50/60 Hz</td>
</tr>
</tbody>
</table>
Standard features include Equalizer, Auto-slicer, and PLL clock regenerator circuit!

The T A120F offers diverse ways of measurement, such as direct measurement of a signal immediately after the pickup output and high-precision measurement by binarizing a signal in the same way as with Yokogawa time interval analyzers.

**DVD Jitter Measurement Examples with TA120F**

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**Measurement with one RF signal**

**Settings in TA120F:**
- Equalizer: On
- PLL clock: On
- Auto-slicer: On

Measures the data-to-clock phase difference jitter with one input of an RF signal immediately after the pickup output.

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**Measurement with one equalized RF signal**

**Settings in TA120F:**
- Equalizer: Off
- PLL clock: On
- Auto-slicer: On

Measures the data-to-clock phase difference jitter with one input of an RF signal that has passed the equalizer.

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**Measurement with one binary signal**

**Settings in TA120F:**
- Equalizer: Off
- PLL clock: On
- Trigger: Manual

Measures the data-to-clock phase difference jitter with one input of a binarized EFM data signal.

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**Measurement with two signals**

**Settings in TA120F:**
- Equalizer: Off
- PLL clock: Off
- Trigger: Manual

Measures the data-to-clock phase difference jitter with two inputs of a binarized EFM data signal and clock signal.

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**Measurement with a Bi-Phase signal (demodulated ATIP signal) input**

**Settings in TA120F:**
- Function: Bi-Phase xN
- Trigger: Manual

Measures the 1T jitter on a binarized Bi-Phase signal input.

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**RF signal level measurement**

Measures the levels of an RF signal at the pickup output and after equalizer simultaneously with jitter measurement.
Time interval analyzer method does high-precision measurements!

- **High-precision measurements ensuring data compatibility from development to production**

The TA120F is a precision jitter meter adopting the same TIA system as that found in the high-end TA320 and TA520 time interval analyzers. The TA120F’s internal TIA measurement mechanism has a continuous sampling rate of 10 MS/s. Measurements are fully compatible with the TA320 and TA520, so high-precision measurements can be maintained from development to production.

(The graph on the right shows data-to-clock phase difference jitter measurements for DVDx1)

- **High speed measurements improved production efficiency**

The TA120F has a fast calculation time needing only 20 ms for calculations. For DVD standard-speed EFM data (10^5 samples) measurements, this enables high-speed measurements at nearly 20 ms measurement time plus 20 ms calculation time. In other words, measurements are updated in approximately 40-ms intervals. This makes it possible to significantly reduce the measurement and testing time on production lines.

In addition, jitter values are converted to 0.2 V/% before being output through DC OUT on the rear panel. This eliminates the need for a communications interface when transferring data to a computer since measurements can be uploaded as analog voltage values.

- **Self-diagnosis and self-calibration: Reduction of Labor and calibration costs**

The TA120F’s time measurement unit and jitter calculation unit are fully digital and capable of standalone self-diagnosis and self-calibration. The self-diagnostic function utilizes an internal reference voltage and signal source for standalone calibration of trigger level, T-V converter, clock input phase compensation, and circuit-system delay.

It is recommended that the TA120F be calibrated once a year. However, if precision is checked using a jitter-free signal generator (such as a frequency synthesizer) and a high-precision DC voltage generator (to check the trigger level), then you can perform the calibration at your factory. This significantly reduces on-site costs, such as shipping costs, calibration costs, shipping labor, and repair time.
Extensive features provide superb jitter measurement support!

**Bi-Phase measurement function (option code /BP1)**

With the optional Bi-Phase measurement function, the TA120F can measure the jitter on a Bi-Phase signal (i.e., an FM-demodulated wobble signal) of x1 to x32 speed CD-R/RW. In addition, it can:

- Calculate the jitter ratio \( \sigma/T \) from the clock signal \( T \) (158.730 \( \mu \)s/N where \( N \) is the multiple of speed from 1 to 32), in the Bi-Phase signal;
- Display the digital value of the average of the \( 1T \) pulse widths in the Bi-Phase signal and;
- Output Bi-Phase jitter values as an analog voltage signal and output the judgment signal from the rear panel, not merely displaying them.

A groove is engraved on the substrate of each of CD-R and CD-RW disks along the circumference. The minute meandering of this groove (i.e., changes in distance from the center of the disk) is called wobbling. The push-pull channel signal detected by the drive is called wobbling signal or absolute time in pre-groove (ATIP) signal, and after being FM-demodulated, it is called Bi-Phase signal or demodulated ATIP signal.

**Preset function and external I/O control function (option code /E1)**

You can previously save up to 7 sets of settings for your TA120F to memory and load a desired set from memory. These preset settings include all necessary settings except for the GP-IB address—very convenient for switching among settings for different measured objects such as when you have to measure jitters for CD and DVD disks.

With the optional external I/O control function, the settings can be switched by simply selecting the preset No. remotely.

**Level measurement function (option code /L1)**

The level measurement function enables measurement of the amplitude (Vp–p) of an input RF or Bi-Phase signal simultaneously with jitter measurement. The measurements are shown as digital values on the LED display as well as output as an analog voltage signal from the connector on the rear panel. In addition, the judgment signal can be output via the optional external control I/O connector.

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**General Specifications of External I/O Control**

- **Connector:** D-sub 9 pins (female)
- **Input/output level:** TTL level
- **Input/output signals:** On/off of remote control
- **PRESET No.:** 3 bits (up to 7 sets of settings)
- **Jitter judgment output**
- **Level judgment output**

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**Measurement outputs from rear panel**

- **JITTER DC OUT:** Analog voltage signal of or judgment signal for jitter measurements
- **LEVEL DC OUT:** Analog voltage signal of or judgment signal for level measurements
- **EXT I/O:** Judgment signal for jitter or level measurements

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Rear panel of TA120F provided with optional level measurement and external I/O control functions.
### Inhibit and external arming functions

The TA120F features the inhibit and external arming functions for synchronization with an external signal. This allows for jitter measurements on only the data part or only the pre-pit part of each sector of optical disks. Since the TA120F calculates the jitter value based on the measured values stored to memory just like the time interval analyzers do, the TA120F can perform jitter measurements even when the standby period is long such as when performing pre-pit jitter measurements.

#### Example of jitter measurement for data and pre-pit parts using inhibit and external arming functions

![Diagram of jitter measurement](image)

- **Index signal from motor**
- **Data part/pre-pit part discrimination signal**
- **Binary data part/pre-pit part signal**
- **Clock signal**
- **External arming input**
- **Inhibit signal**

### Measured-jitter correction

The measured jitter ratios can be corrected using a linear equation with preset factors $a$ and $b$ such that:

\[ \text{Corrected jitter ratio} (%) = a \times \text{measured jitter ratio} + b \%
\]

All of the LED’s digital indication, meter reading, and jitter DC output show the corrected jitter ratio.

### Indication of moving average jitter

The TA120F can calculate the moving average for a specified number (1 to 10) of the most recently measured jitter or level values. The calculated average can be displayed in the LED digital indicator and meter (only at jitter measurements) as well as output as the jitter DC output.

### Use free Histogram Viewer for jitter histogram analyses on PC!

With Histogram Viewer for TA120 (free software), you can transfer TA120F’s histogram data (data-to-clock phase difference jitter, $3\sigma$) to a PC through the GP-IB interface, analyze the jitter histograms, and check measurement reliability. Histogram Viewer for TA120 can be downloaded from Yokogawa’s web site at http://www.yokogawa.com/tm/Bu/TA120F/. (This software is for TA120, TA120-S1, TA120E and TA120F.)

![Diagram of Histogram Viewer](image)
### Standard Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling rate</td>
<td>10 MS/s at data-to-clock phase difference jitter measurements</td>
</tr>
<tr>
<td>Internal jitter</td>
<td>3T jitter: 300 ps rms; data-to-clock phase difference jitter: 400 ps rms</td>
</tr>
<tr>
<td>Sample size</td>
<td>100,000 samples/100 ms/500 ms/100 ms/1000 ms (1.0 ms to 1 second, in steps of 0.1 ms)</td>
</tr>
<tr>
<td>Measurement update rate</td>
<td>50 ms (100,000 samples, DVDx1, measurement on both edges)</td>
</tr>
<tr>
<td>Input specifications</td>
<td>RF input: Input signal: RF signal before/after passing equalizer, sliced signal (minimum input pulse width: 15 ns) Input: DC coupled, 1 MΩ, 35 pF (typical) Input sensitivity: 100 mV/p (equalizer on, Auto-slicer ON: AC-coupled) Input range: -5 V to +5 V (equalizer, Auto-slicer ON: 4 V-p) Trigger level: MANual = +5 V, MANual = -5 V ± 5 V (1 mV steps); Level precision: Setting ±(4% + 10 mV) AUTO = Auto-slicer ON Auto = MANual = AUTO + set voltage (1 V to +1 V) Maximum input voltage: 40 V (DC + ACpeak) (DC ≤ input frequency ≤ 100 kHz) Clock input: Input: AC coupled, 1 MΩ, 35 pF (typical) Input sensitivity: 100 mV/p Input range: -5 V to +5 V Maximum input voltage: 40 V (DC + ACpeak) (DC ≤ input frequency ≤ 100 kHz) Trigger level: 0V fixed, ±1 V (select) Maximum input frequency: 25 MHz to 60 MHz (Duty: 45 to 55%) Phase adjustment: 0 to 40 ns (in steps of 0.1 ns) Arm input: Setting: Internal/External (select) Arming delay: 0 ms to 1 second, in steps of 0.1 ms Inhibit input: Setting: POS/NEG (select) Input: Zin = 10 kΩ TTL level</td>
</tr>
<tr>
<td>Other functions</td>
<td>GP-IB interface preset function: Up to 7 settings can be saved. The desired setting can be loaded (remotely by optional external I/O control, too) JITTER DC OUT: 50 Ω Output mode: Jitter ratio output/judgment output (select) Output level: 0 to +5 V DC (0.2% deviation ± 1 ppm) (can be set arbitrarily). Judgment output level: TTL level (Upper and lower judgment level can be set) Output accuracy: ±0.1 mV Output filter: Moving average of 1 to 10 most recently measured values EQUALIZED RF/MONITOR OUT: Equalized RF output: 1 V-p-p, 50 Ω Monitor output: 0.5 V, 50 Ω SLICED RF OUT: 50 TTL level CLOCK OUT: 50 Ω TTL level PLL clock regeneration 8-16 modulation setting equivalent to base clock of 27 MHz ±10% INHIBIT EXT ARM IN: Equalizer (DVDx1) Equalizer circuit ON/OFF switching capability Frequency characteristics: +3.2 ± 0.3 dB (at 5.16 MHz, 300 kHz bandwidth ±1% deviation) Group delay characteristic: Maximum group delay deviation: 6 ns (typical) (range: 0.7 MHz ≤ f ≤ 6.7 MHz) Slope value setting range: ±2 to 6.0 dB (0.1 dB steps) Rated supply voltage: 100 V AC to 240 V AC Rated supply frequency: 46 Hz to 63 Hz Maximum power consumption: 100 VA Display Analog meter and seven-segment LED External dimensions Approximately 213 (W) × 132 (H) × 350 (D) (excluding protrusions) Weight Approximately 5 kg</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Model code</th>
<th>Suffix code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>704430</td>
<td>D</td>
<td>TA120F digital jitter meter</td>
</tr>
<tr>
<td>Power cord</td>
<td>F</td>
<td>UL, CSA standard</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>SAA standard</td>
</tr>
<tr>
<td></td>
<td>J</td>
<td>BS standard</td>
</tr>
</tbody>
</table>

Options:
- /E1 External I/O control function
- /L1 Level measurement function
- /B1 Bi-Phase measurement function

Optional Accessories

<table>
<thead>
<tr>
<th>Part</th>
<th>Model code</th>
<th>Suffix code</th>
<th>Specification</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNC cable</td>
<td>366924</td>
<td>BNC-BNC (1 m)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BNC cable</td>
<td>366925</td>
<td>BNC-BNC (2 m)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>50Ω terminator</td>
<td>700976</td>
<td></td>
<td>For-pass-through</td>
<td>1</td>
</tr>
<tr>
<td>Rack mounting kit</td>
<td>751533</td>
<td>-E3</td>
<td>EIA standalone (one TA120F unit)</td>
<td>1</td>
</tr>
<tr>
<td>Rack mounting kit</td>
<td>751534</td>
<td>-E3</td>
<td>EIA linked (two TA120F units)</td>
<td>1</td>
</tr>
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<td>JIS standalone (one TA120F unit)</td>
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<td>1</td>
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</table>

Model code: 366924
Suffix code: BNC-BNC (1 m)
Description: For-pass-through

Model code: 751533
Suffix code: -E3
Description: EIA standalone (one TA120F unit)

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.