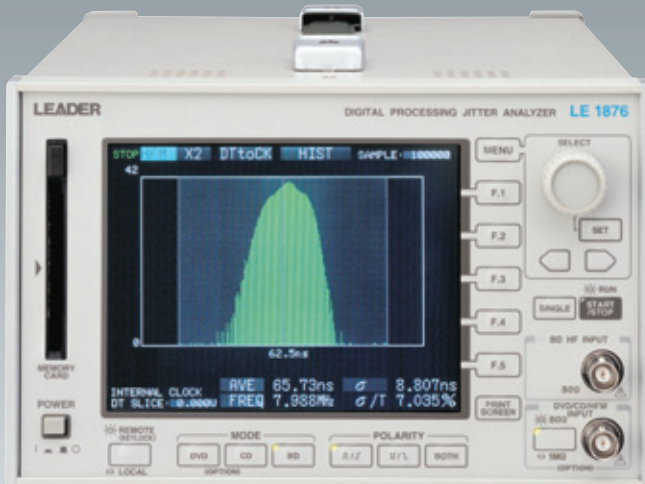


AUDIO DIGITAL PROCESSING JITTER ANALYZER

Applicable to Blu-ray Disc, Ideal for Analyzing Jitter of x1, x2-Speed Disc and Optical Pickup



LE 1876 DIGITAL PROCESSING JITTER ANALYZER

GENERAL

The LE 1876 Jitter Analyzer is designed to measure the jitter conforming to Blu-ray Disc (Part 1, version 1.0, June 2002) standards.

Since the Limit Equalizer (applicable to x2 speed of Blu-ray Disc standards), PLL clock regenerator, and jitter measurement section are provided as standard, x2 speed of HF signal can be measured.

A large LCD panel displays jitter in histogram format, this instrument can be used for analyzing jitter.

Jitter measurement units for a DVD/CD or HFM are optionally available. Thus, jitter of DVD and CD, and HF and HFM of Blu-ray Disc can be measured using a single unit.

Optional GPIB and LAN are convenience to construct an automatic measurement system and ensure quality control.

FEATURES

[Features on Blu-ray Disc measurement]

- **Equipped with the Equalizer conforming to Blu-ray Disc standards**
The Conventional Equalizer and Limit Equalizer conforming to x1 speed described in Blu-ray Disc standards are provided as standard. The Conventional Equalizer mode and Limit Equalizer mode are selectable. The boost level of pre-equalizer can be varied.
- **Applicable to three types of media**
Jitter of Blu-ray Disc with disc capacity of 23.3 GB, 25.0 GB, and 27.0 GB can be measured.
- **Measures the jitter of all-T components conforming to Blu-ray Disc standards (Also applicable to x2 speed)**
Measures all components of 2T to 8T and 9T of the HF (DATA) signal with respect to the CLOCK signal, then displays it as jitter in sigma format.
Various jitter measurement modes (e.g., sum of all-T components, each T in pulse width mode) are also provided.
- **Confirming to x2 speed prescribed in Blu-ray Disc standards**
The equalizer applicable to the x2 speed conforming to Blu-ray Disc standards is provided to measure jitter of x2 speed HF (DATA) signal.
- **Three polarity modes**
Rising edge, falling edge, and both edges of HF (DATA) signal can be selected.
- **Applicable dual-layer disc**
The 2T component can be eliminated in DATA to CLOCK measurement mode used when inspecting a dual-layer disc.

[Features on measurement]

- **High sensitivity**
The HF (DATA) with a signal level between 0.1 Vp-p and 2.0 Vp-p can be measured.
- **Various monitor outputs**
Input signal and equalized signal can be monitored.
DC voltage in proportion to the meter indication is output.
- **Frequency check mode**
Clock signal frequency regenerated by the PLL can be measured.
- **Auto slicer**
Auto slicer conforming to Blu-ray Disc standards is provided.
- **Displaying jitter in unit of ns or %**
The absolute jitter value can be displayed in units of nanoseconds (ns). Jitter can also be displayed in units of percentage (%) measured with respect to the clock signal.
No period setting is required since the clock is automatically regenerated from the HF (DATA) signal.
- **Jitter measurement in time domain format**
Jitter of all-T components in the HF (DATA) signal is displayed in histogram format.
- **Simultaneous display of jitter in histogram format and sigma value**
Jitter can be simultaneously displayed on the large color LCD panel in histogram format, sigma value, and average value. The clock frequency can also be displayed simultaneously.
- **Jitter variation measurement mode**
Since jitter in sigma value and average value can be displayed in time domain format, long-term measurement and management are possible.
- **ARMING/INHIBIT capabilities**
Two useful modes are provided: INHIBIT function to inhibit jitter measurement of faulty block (e.g., track jumping) on a disc, ARMING function to set the block to be measured.
The delay time, measurement time, and number of gating operations with respect to the ARMING/INHIBIT signal applied can be set.
The gating status can be monitored on the oscilloscope through the monitor output.
- **One-shot measurement mode**
Repetition and one-shot measurement modes are provided.

[Features on Production Line]

- **GO/NO GO judgment mode convenient for production line**
HF (DATA) signal jitter measurement results are compared with the preset judgment limits, then results are displayed on the LED. The result can also be output.
- **Simple operation**
Speed, judgment reference, number of sampling, response time, and slice level can easily be set with a jog dial.
- **Universal voltage**
Since this instrument operates on 90 to 250 V, it can be used throughout the world.

SPECIFICATIONS

LE 1876

Input Section

HF INPUT (1-7 modulation signal input)

Input Coupling:	AC
Measurement Voltage Range:	0.1 to 2.0 Vp-p
Input Range:	3 ranges 0.3 V range: 0.1 to 0.3 Vp-p 0.9 V range: 0.3 to 0.9 Vp-p 2.0 V range: 0.9 to 2.0 Vp-p
Input Impedance:	50 Ω
Auto Slicer:	AUTO (Response time constant x1 speed: 10 kHz x2 speed: 20 kHz)
Maximum Input Voltage:	±2.5 V
Measurement Control (ARMING IN/INHIBIT IN)	
Input Impedance:	10 kΩ
Input Signal Level:	0/+5 V
Maximum Input Voltage:	-0.7 V/+5.7 V

Equalizer Section

(1) x1 Speed

Conforms to Blu-ray Disc (Part 1, version 1.0) standards.	
Applicable Format:	1-7 PP modulation
Channel Bit Rate:	66 MHz
Equalizer Mode:	Conventional Equalizer Mode or Limit Equalizer Mode, selectable
Conventional Equalizer	
Gain Variable Range:	0 to 8 dB (36 steps)
Gain Accuracy:	±0.5 dB
Group Delay Deviation:	≤2.0 nsp-p (5.8 dB: 3 MHz to 16.5 MHz)

(2) x2 Speed (Undecided)

Applicable Format:	1-7 PP modulation
Channel Bit Rate:	132 MHz
Equalizer Mode:	Conventional Equalizer Mode or Limit Equalizer Mode, selectable
Conventional Equalizer	
Gain Variable Range:	0 to 8 dB (36 steps)
Gain Accuracy:	±0.5 dB
Group Delay Deviation:	≤2.0 nsp-p (5.8 dB: 6 MHz to 33 MHz)

Jitter Measurement Section

Applicable Speed:	Applicable Speed
HF:	Clock frequency x1 speed: 66 MHz ±4 % x2 speed: 132 MHz ±4 %
Measurement Mode:	DATA to CLOCK, PERIOD mode, sum of all-T data in PERIOD mode, PULSE WIDTH mode, sum of all-T data in PULSE WIDTH mode, D to C2E
Measurement Resolution:	12.5 ps min.
Display Resolution	
max. min:	12.5 ps min.
σ, AVERAGE:	10 ps min.
σ/T:	0.01% min.
Measurement Accuracy	
Sigma Value:	±5 %
Polarity Selection	
DATA:	┌/┐, └/┘, BOTH
CLOCK:	┌ (fixed)
Measurement Item:	AVERAGE, max, min, σ, σ max, σ min, σ/T, σ/T max, σ/T min
Unit Displayed:	ns, %
Measurement Results Display:	Numeric value, bar graph, histogram, TIME DEVIATION, BOTH for separate display
Number of Samples:	1,000,000 max.

Measurement Control Section (ARMING/INHIBIT function)

Measurement Control:	ARMING mode/INHIBIT mode
Electrical Characteristics	
Input Impedance:	10 kΩ
Input Signal Level:	0/+5 V
Maximum Input Voltage:	-0.7 V/+5.7 V
INHIBIT	
ENABLE:	HIGH/LOW
COUNT:	1 to 50, in 1 steps
ARMING	
SLOPE:	RISE/FALL
COUNT:	1 to 50, in 1 steps
START DLY:	0 to 999999 μs (in 1 μ steps min.)
LENGTH MODE:	SAMPLE/TIME
LENGTH:	0.01 to 999999 μs (in 1 μ steps min.)(TIME only)

Clock Regenerator (DATA to CLOCK mode only)

Regenerates reference clock signal from DATA signal input.	
HF:	x1 speed: 66 MHz ±8 %, x2 speed: 132 MHz ±8 %

Clock Frequency Measurement Section (DATA to CLOCK mode only)

Measurement Range	
HF:	x1 speed: 60.72 MHz to 71.28 MHz x2 speed: 121.44 MHz to 142.56 MHz
Measurement Accuracy:	±0.1 %

Judgment Section

Outputs GO/NO GO results of jitter and frequency measured with respect to the preset value.	
LCD Panel:	Judgment results for selected measurement item Selected item: σ, σ max, σ min, σ/T, σ/T max, σ/T min, max, min, AVE, DEV, DEV max, DEV min, FREQUENCY

Output Section

MONITOR OUT

To monitor the HF signal input.	
Output Impedance:	50 Ω
Output Amplitude:	Up to 2.0 Vp-p ±30 % (into 50 Ω, in proportion to input signal)
Output Connector:	BNC

EQUALIZER OUT

To monitor equalized HF signal input.	
Output Impedance:	50 Ω
Output Amplitude:	0.8 Vp-p ±30 % (into 50 Ω)
Output Connector:	BNC

DIGITAL OUT (DATA, CLOCK)

Outputs binarized DATA signal and clock signal regenerated by PLL.	
Output Signal:	DATA signal, CLOCK signal
Output Amplitude:	0.15 Vp-p (into 50 Ω)
Output Offset Voltage:	0.34 V (into 50 Ω)
Output Connector:	BNC

DC OUT

Output Accuracy:	±2 %
Output Item:	Jitter (full scale voltage variable)
Maximum Input Voltage:	2 V

GATE MONITOR

To monitor arming/inhibit control signals.	
Output Amplitude:	TTL level
Output Impedance:	1 kΩ

Remote Control Section

Dedicated Remote Control Connector

Communicates judgment results and front panel settings.

Front Panel Setting Pins

Input Level:	0/5 V (pulled-up with 47-kΩ resistor)
Maximum Input Voltage:	-0.7/+5.7 V

Judgment Results Output Pins

GO:	+5 V (open drain output, pulled-up with 47-kΩ resistor)
NO GO:	0 V

Maximum Current Output:	10 mA
RS232C Interface	
Communication:	Controls function, outputs data.
Baud Rate:	38400 bps max.
Others	
Display Mode:	HIST: Histogram BAR: Bar graph DATA: Statistical value TIME: Time deviation JUDGE: GO/NO GO judgment
Store/Recall	
Media:	Internal memory, memory card
Items Stored:	Measurement data (waveform), internal settings
Printing Screen Data	
Print Media:	Memory card
Memory Card	
Applicable Card:	Interface: Conforms to PC CARD ATA standards
Card Manufacturers Recommended:	SanDisk
Display:	5.7" STN LCD, color, 1/4 VGA
Environmental Conditions	
Operating Temperature:	0 to 40 °C
Operating Humidity:	≤ 85 % RH (without condensation)
Spec-Guaranteed Temperature:	10 to 30 °C
Spec-Guaranteed Humidity:	≤ 85 % RH (without condensation)
Storage Temperature:	0 to 50 °C
Operating Environment:	Indoor use
Operating Altitude:	Up to 2,000 m
Overvoltage Category:	II
Pollution Degree:	2
Power Requirements	
	90 to 250 VAC, 50/ 60 Hz, 35 Wmax.
Dimensions and Weight	
	213 (W) x 132 (H) x 300 (D) mm, 4.7 kg
Accessories	
	power cord1 Instruction manual1

OPTION

OP71 DVD/CD Measurement

Input Section

DATA INPUT (EFM/8-16 modulation signal input)

Input Coupling:	AC (2 Hz/1 kHz, selectable)
Measurement Voltage Range:	50 mV to 5 Vp-p
Input Impedance	1 MΩ/50 Ω, selectable
Slice Level	VARIABLE:
AUTO (ASYMMETRY ON):	±2.5 V
Maximum Input Voltage	20 Hz/1 kHz/5 kHz/10 kHz, selectable

Jitter Measurement Section

Applicable Speed	
DVD:	Clock Frequency PW, PD: 24.3 MHz to 59.4 MHz DT to CK: x1 speed: 27 MHz ±10 % x2 speed: 54 MHz ±10 %
CD:	x1, x2, x4, x6, x8, x10, x12 speed

Measurement Mode

DVD:	PERIOD mode, sum of all-T data in PERIOD mode, PULSE WIDTH mode, sum of all-T data in PULSE WIDTH mode, DATA to CLOCK
CD:	PULSE WIDTH mode, sum of all-T data in PULSE WIDTH mode
Unit Displayed:	ns, %
Measurement Resolution:	50 ps
Display Resolution:	0.01 ns
Measurement Accuracy	
Sigma Value:	±4 % ±0.15 ns
Average Value:	±1 ns
Polarity Selection	
DATA:	┌/┐, └/┘, BOTH
CLOCK:	+ , -
Measurement Item:	AVERAGE, max, min, σ, σ max, σ min, σ/T, σ/T max, σ/T min
Measurement Results Display:	Numeric value, bar graph, histogram, TIME DEVIATION, BOTH for separate display
Number of Samples:	1,000,000 max.

Clock Frequency Measurement Section (DVD, DATA to CLOCK mode only)

Clock Regenerator (DVD, DATA to CLOCK mode only)

Regenerates reference clock signal from DATA signal input.	
HF:	x1 speed: 27 MHz ±8 %, x2 speed :54 MHz ±8 %

OP72 HFM Measurement

Input Section

Input Coupling:	AC
Measurement Voltage Range:	50 mV to 5 Vp-p
Input Impedance:	1 MΩ/50 Ω, selectable
Frequency Range:	x1 speed: 8 MHz, x2 speed: 16 MHz
Slice Level:	±2.5 V (VARIABLE)
Maximum Input Voltage:	±5 V

Jitter Measurement Section

Measurement Range:	Clock Frequency PW: 3.37 MHz to 7.92 MHz DT to CK: x1 speed: 3.667 MHz ±8 % x2 speed: 7.333 MHz ±8 %
--------------------	---

Measurement Mode:

	DATA to CLOCK, PERIOD mode, sum of all-T data in PERIOD mode, PULSE WIDTH mode, sum of all-T data in PULSE WIDTH mode
--	---

Measurement Resolution:

Display Resolution	
max. min:	50 ps
σ, AVERAGE:	10 ps
σ/T:	0.01 %

Measurement Accuracy

Sigma Value:	±5 %
--------------	------

Polarity Selection

DATA:	┌/┐, └/┘, BOTH
CLOCK:	┌ (fixed)
Measurement Item:	AVERAGE, max, min, σ, σ max, σ min, σ/T, σ/T max, σ/T min
Unit Displayed:	ns, %
Measurement Results Display:	Numeric value, bar graph, histogram, TIME DEVIATION, BOTH for separate display
Number of Samples:	1,000,000 max.

Clock Regenerator (DATA to CLOCK mode only)

Regenerates reference clock signal from DATA signal input.	
HFM:	x1 speed: 3.667 MHz ±8 %, x2 speed: 7.333 MHz ±10 %
Clock Frequency Measurement Section (DATA to CLOCK mode only)	
Measurement Range:	x1 speed: 3.37364 MHz to 3.96036 MHz x2 speed: 6.74636 MHz to 7.91964 MHz
Measurement Accuracy:	±0.1 %

OP73 GPIB (IEEE 488.1)

Function: Transfers data, controls front panel settings.

OP74 LAN

Function: Transfers data, controls front panel settings.

OP71 and OP72 can not be installed together.
OP73 and OP74 can not be installed together.

AUDIO Selection Guide

Applicable to Blu-ray Disc and DVD/CD (LE 1871/LE 1876)

		JITTER METER		JITTER ANALYZER			
							
		DVD/CD LE 1870	Blu-ray Disc LE 1871	DVD/CD LE 1875	Blu-ray Disc LE 1876		
Applicable Speed	Blu-ray Disc	x1 speed		○		○	
		x2 speed				○	
	DVD	x1 speed	○	Option	○	Option	
		x2 speed	○	Option	○*4	Option	
	DVD-RAM	2.6 G, 4.7 G			○*1	Option	
	CD	x1 speed	○	Option	○	Option	
		x2, x4, x6, x8, x10, x12 speed	○*2	Option	○	Option	
CD-R (Bi-Phase)	x1, x2, --- x32 speed	Option	Special order	Option	Special order		
Measurement Mode	Blu-ray Disc	HF DATA to CLOCK		○		○	
		HFM DATA to CLOCK		Option		Option	
	DVD (ROM)	DATA to CLOCK	○	Option	○	Option	
		DATA to CLOCK (2 inputs)		Special order	○	Special order	
		PULSE WIDTH mode (3-11, 14T)	○*2	Option*2	○	Option	
		DVD-R/RW	Sum of all-T data in PULSE WIDTH mode			○	Option
			PERIOD mode (6-25T)			○	Option
			Sum of all-T data in PERIOD mode			○	Option
	DVD-RAM	DATA to CLOCK (2 inputs)			○	Special order	
		PULSE WIDTH mode (3-11, 14T)			○	Option	
		Sum of all-T data in PULSE WIDTH mode			○	Option	
		PERIOD mode (6-25T)			○	Option	
		Sum of all-T data in PERIOD mode			○	Option	
	Equalizer	Blu-ray Disc	Conventional Equalizer		○		○
Limit Equalizer				Option		○	
DVD (ROM)		Fixed boost level (3.2 dB)	Option		Option		
		DVD-R/RW	Variable boost level (3.2 to 6.0 dB)	Option	Option *3	Option	Option *3
DVD-RAM		2.6 G (for x1 speed)			Special order	Special order *3	
	4.7 G (for x2 speed)			Special order	Special order *3		
Interface	GPIB		Option	Option	Option	Option	
	RS232C		○	○	○	○	
	LAN			Option		Option	

*1 DVD-RAM equalizer is required.

*2 For the LE 1870/LE 1871, 3T can only be measured in PULSE WIDTH mode; it cannot be selected via the front panel.

*3 Digital system is used.

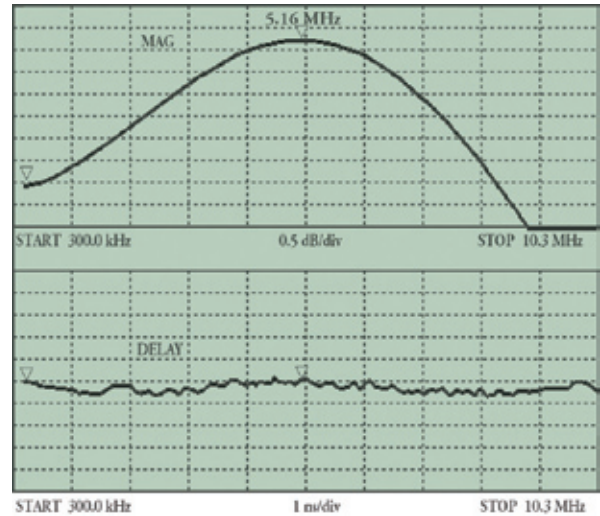
*4 For the LE 1875, x1 and x2 speeds can be measured in PULSE WIDTH mode.

DVD Fixed Equalizer Option

■ 3.2-dB boost level equalizer conforming to DVD book

■ Usable for inspecting pickups

- Channel Bit Rate 27 MHz
- Boost Level 3.2 dB
- Boost Level Accuracy $\pm 3\%$ (at 5.16 MHz)
- Group Delay Drift 2.5 ns max.

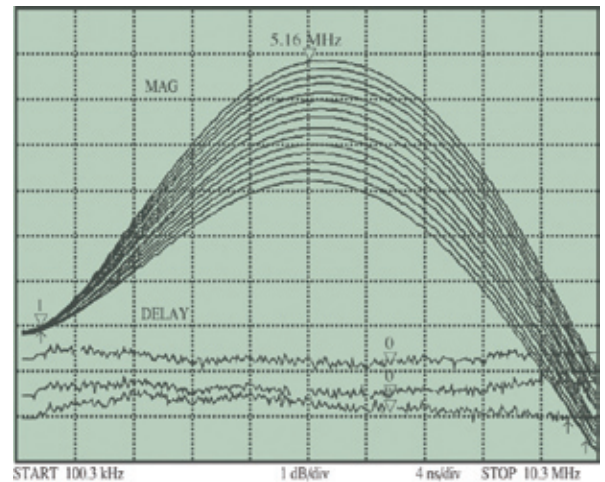


DVD Variable Equalizer Option

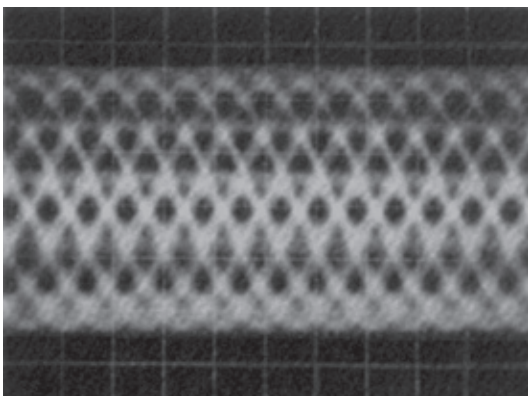
■ Variable boost level equalizer for jitter measurements

■ Using an equalizer with a fixed boost level of 3.2 dB is recommended by DVD Book, however, applying a suitable boost level to an optical pickup ensures accurate jitter measurement and better productivity.

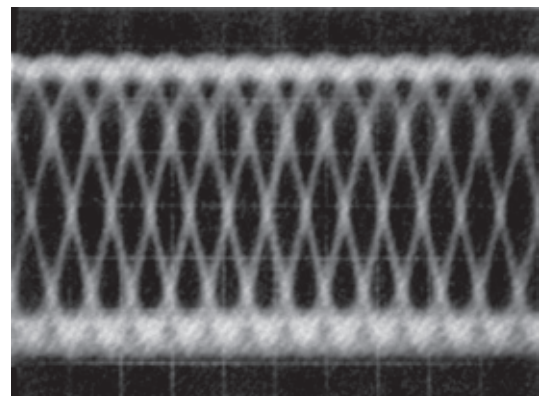
- Channel Bit Rate 27 MHz
- Valuable Boost Level 3.2 to 6.0 dB, in 0.2 dB steps
- Boost Level Accuracy $\pm 3\%$ (in each step, at 5.16 MHz)
- Group Delay Drift 4 ns max.



Effectiveness of Blu-ray Disc Limit Equalizer



RF waveform without limit equalizer



RF waveform with limit equalizer