LINEEYE®

USB2.0 Protocol Analyzer

LE-650H2

Record Max 40GB Continuously
For Developing Firmware and Driver of USB Products

Two Models Dedicated for Various Uses

Standard Model
Max. 10GB Recording

LE-650H2

Advance Model
Max. 40GB Recording
Support VBUS High-speed logging

LE-650H2-A

CE

- Small, Light-weight, Low cost
- Detailed Translation Display
- Powerful Trigger Function
- VBUS-power Measurement

LINEEYE®

USB2.0 Protocol Analyzer
LE-650H2

RoHS Directive Compatible

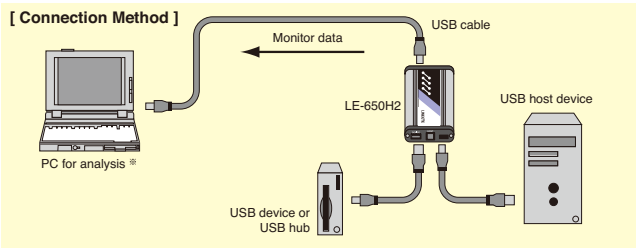
A product incorporating features for the protection of the global environment, such as the elimination of toxic substances, and a power-saving design.

LE-650H2 is the USB protocol analyzer dedicatedly designed for monitoring and used in connection with the PC through a USB port. The analyzer continuously records the details of USB2.0/1.1 communication on the hard disk of the PC in real time, while displaying the details on the screen of the PC in an easy-to understand fashion.

Auto Tracking of High-speed USB Transmission

Without affecting the communication carrying data between the analyzer and target devices, the analyzer internally records large amounts of data and simultaneously transfers it to a connected PC via USB. The analyzer automatically detects the speed of the target devices (480/12/1.5 Mbps), so a speed setting is unnecessary. And if the device is connected through a hub of differing speed, measurement can be started by simply pressing the space bar of the PC.

[Connection Method]



※If the USB host used for measurement is a PC supporting the operating conditions of the analyzer, the PC can be used for analysis purposes as well.

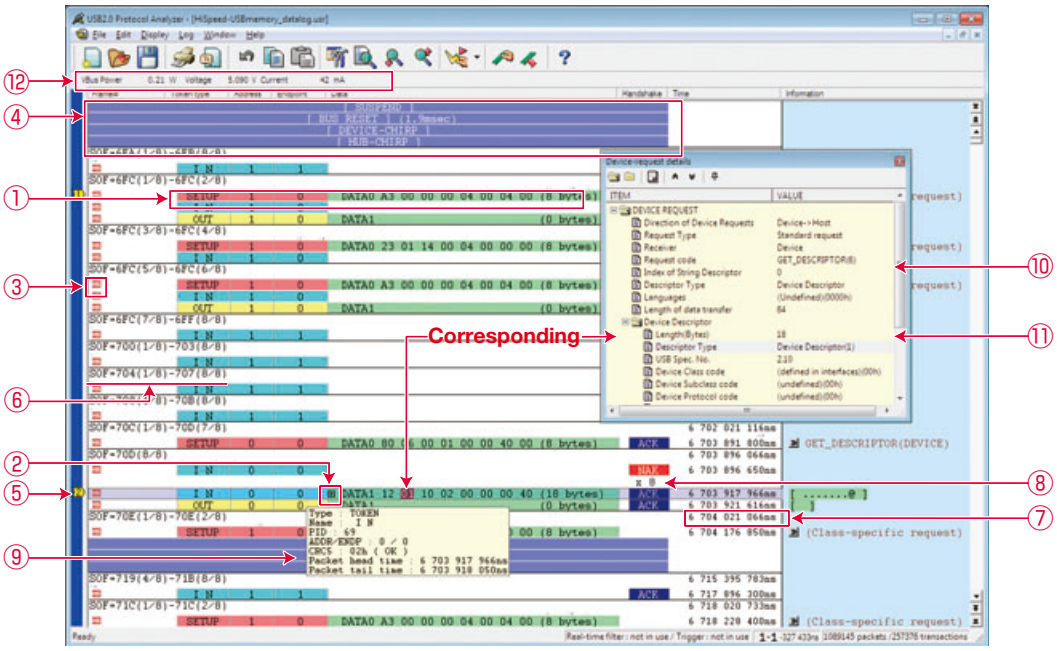
Continuous Recording of Measurement Data on HDD or SSD

Measured data is continuously transferred to the PC and recorded as log files with a maximum of 2GB (Can be specify every 1MB) on the HDD or SDD of the PC. Furthermore, it is possible to form a ring buffer to record multiple log files continuously by using repetitive recording mode. The measurement log data can be displayed and scrolled during measurement, which is effective for an extended analysis of rare communications failures.

Model	Number of log files while in repeat mode	Maximum recording capacity
LE-650H2	**2 to 5**	**10Gbytes**
LE-650H2-A	**2 to 20**	**40Gbytes**

Clearly Detailed Monitor Display

USB packets are clearly displayed by transaction. The device can identify PING and the split transaction at high-speed.
Standard descriptors, device requests, descriptors of Communication/Printer class, and peculiar device requests of HUB/HID/Audio/Communication/Mass storage class are translated and displayed in detail, therefore the difficult-to-understand USB protocols can be intuitively understood.



① Multiple packets are grouped as a transaction and displayed on a single line.

② Only the first 8 bytes of data packets are displayed. Clicking the [+] mark displays all data.

③ Displays the speed of each transaction.

④ The USB bus state (Bus Reset, Suspend, Disconnect, Chirp) is recorded and displayed with communication data.

⑤ The target transaction can be marked with 1 to 99, and can jump to the marked positions.

⑥ Displays the SOF (Start of Frame) frame number. At high speed, microframes are displayed as (1/8) to (8/8). At low speed, nothing is displayed in this column because no SOF packets are generated.

⑦ Records and displays the time stamp at a resolution of 16.7 ns.

⑧ Visibility of continuous NAK packets is improved by displaying only those times.

⑨ Displays the details of each transaction and frame.

Token Packet	Packet type, packet name, PID, address/end point, CRC5, packet start/end time
Data Packet	Packet type, packet name, PID, payload, CRC16, packet start/end time
Frame	Frame period, packet start/end time

⑩ Clicking the [>>] mark displays a detailed translation window of the device request. Descriptors are displayed as a tree view to show their hierarchical structure.

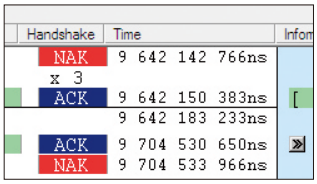
⑪ When a device request item is selected, the corresponding data in the data packet is highlighted.

⑫ Displays power consumption, voltage and current of USB device in real time.

High-precision Time Stamps

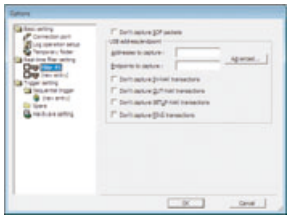
The built-in hardware timer of the analyzer records the time stamps at the packet start and end at a resolution of 16.7 ns based on the log start point as a reference point*1. The time stamps are displayed in the elapse time column and packet position bar. If the cursor points to the packet, the time stamps are displayed on the tool tip window as well.

*1:The time stamp count is reset to zero approx. 5 hours after the start of the log, and it continuously records the time stamp.



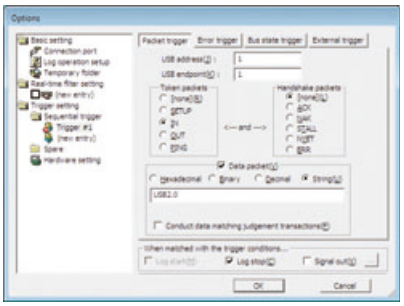
Real-time Filter

The real-time filter reduces the quantity of log file data and improves the efficiency of analysis. It is possible to specify not to capture continuous NAK response transactions such as IN-NAK and OUT-NAK. You can also specify particular addresses and end points under AND condition in order to record only transactions which meet the condition, or to eliminate them from the targets of recording.

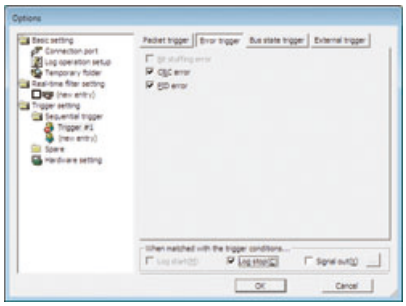


Powerful Sequential Trigger

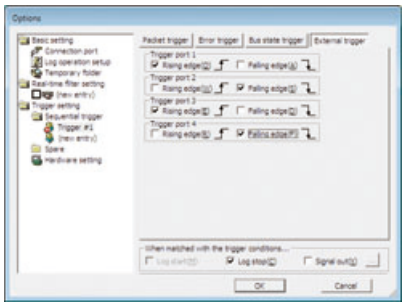
It is possible to specify up to 16 trigger conditions (e.g., trigger conditions of particular transfer data and external signal conditions) in combination with actions to be taken at the time the conditions are satisfied, and execute the actions in sequence. Furthermore, this feature enables logging control in synchronization with external signals and linking with other measuring instruments by turning on an external trigger signal upon detection of particular data, thus making significant improvement in the efficiency of program development.



[Packet trigger setting example]



[Error trigger setting example]



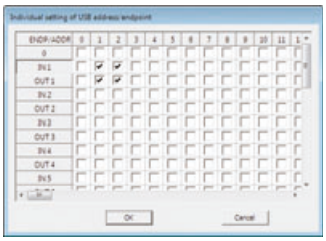
[External trigger setting example]

Perfect Offline Analysis Features

Data can be easily found amongst the huge volume of recorded data by using the filter and search features. Development efficiency is boosted to a higher level by using color-coded customization features for packet types and mark/jump features. Detailed translation is possible by specifying the class for the data without emulation information.

[Filter condition setting window example]

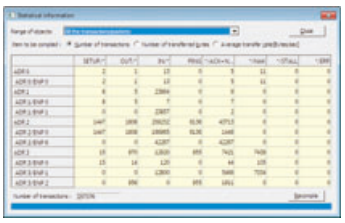
[Search condition setting window example]



[Search address/end point combination condition example]

Statistics Information Totaling Feature

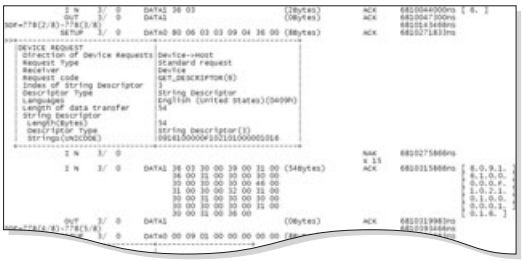
It is possible to total and check the number of transactions, the number of transfer bytes, and the average transfer rate in the measurement log. The totaling range can be specified with the mouse or the mark feature. The results of totaling can be pasted to the spreadsheet software through the clipboard.



Effective Use of Data Saved in Text File Format

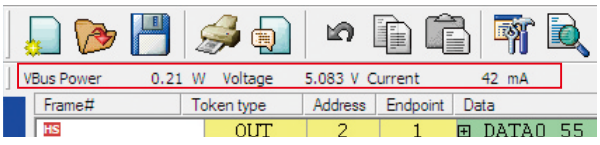
Users can copy, paste, and save selected ranges of measured data as compact text files. The files can be attached to reports or e-mailed to experts for professional analysis.

[Saved text example]



VBUS Measurement Function

The analyzer monitors USB transferring and displays VBUS data (Voltage, Current, Power consumption) in real time. An onerous probing is not necessary.



[Real time display of VBUS measurement]

VBUS logger mode can record VBUS data at specified cycle in the PC, and have detailed analysis in graph and CSV format. LE-650H2-A (advance model) supports high-speed measurement, and able to use in the unstable condition such as right after turning on the power of USB device.

*VBUS logger mode will be ready by April, 2013.

Model	VBUS Measurement Cycle
LE-650H2	100ms to 1s
LE-650H2-A	0.1ms to 1s

Support International Use

The PC software supporting both Japanese and English Windows are included. It can be downloaded from LINEEYE website and used as a viewer software. For example, the log data measured abroad can be seen in Japan for engineers to analyze.

USB2.0 Protocol Analyzer *LE-650H2*

Specifications

Model		LE-650H2	LE-650H2-A
Standard		USB2.0/1.1	
Speed		HIGH (480Mbps)/ FULL (12Mbps)/ LOW (1.5Mbps) Automatically detect and run	
Storage Capacity	Analyzer	Capture memory: 128MB	
	PC	HDD/SDD: Max.10GB (Can be specified every 1MB)	HDD/SDD: Max.40GB (Can be specified every 1MB)
Recording Method		Record data on the HDD/SSD of the PC (can be record multiple log files continuously.) Record USB packet and USB device status *1 (Bus Reset, Suspend, Disconnect, Device Chirp, Hub Chirp) along with time stamp.	
VBUS Measurement Accuracy		Voltage: range 0 to 8V, Accuracy ±1%FS Current: range -0.9A *2 to 1A, Accuracy ±1%FS	
VBUS Measurement Cycle		100ms - 1ms (4 steps)	0.1ms – 1ms (13 steps)
Time Stamp		16.7ns for 5 hours max., then start from 0 again.	
Packets		SOF, IN, OUT, SEUP, DATA0, DATA1, DATA2, ACK, NAK, STALL, PRE, PING, MDATA, SPLIT, ERR, NYET, Unknown.	
Speed Display		Display communication speed per transaction in HS, FS or LS.	
Filter	Log	Record (or do not record) SOF, IN-NAK, OUT-NAK, SETUP-NAK, PING, multiple particular address/end points.	
	Display	Display (or do not display) SOF, IN-NAK, OUT-NAK, SETUP-NAK, PING, multiple particular address/end points.	
Trigger	Condition	Particular address/end points, packet type (Token/ Hand shake packets in combination), errors (CRC/ PID), data packets (8byte max, Hex/Decimal/Binary or character input, with or without bit mask.) and bus state (Bus Reset, Suspend, Disconnect), external trigger (edge or level specification possible).	
	Action	Possible to specify actions enable with log stop, and external trigger output (with or without levels or pulses) in sequence (up to 16 sequence).	
	External	4 external trigger input (TTL level) and 4 external trigger output (LVTTL level). Connector: 10pin male (2.54mm pitch 961210-5604 or equivalent)	
Search Function		SOF, IN, OUT, SETUP, PING, ACK, NAK, STALL, NYET, ERR, idle status more than specified value, error (CRC, PID, DATA toggle sequence, transaction structure), MassStorage (SCSI, ATAPI, SFF-8070i), PTP/MTP, Audio, HID, HUB, Printer, Video, Communication, USBTMC class command, unknown log information, specific address/end points in combination, standard request, data search (Hex/Decimal/Binary, character), trigger point, mark.	
Color Display Customization		Packets can be color-coded separated.	
Detailed Display		Standard requests, peculiar device requests to HUB/HID/Audio/Communication/MassStorage (Bulk Only Transport)/Printer/USBTMC class, standard descriptors, each descriptors in HUB/HID/Audio/Printer/USBTMC/Communication class, command of MassStorage/Bulk Only Transport (SCSI transparent command set, supporting SFF-8070i), Operations of MTP/PTP, Responses, events, Video class can be displayed in detail.	
Statistic analysis function		The total number of transactions, transfer bytes, and the average transfer rate of specified data for each address/end point.	
Mark/Jump function		Up to 99 marks can be set (Able to make comments on each mark)	
Save		Save log file data, export in text/CSV/binary for data payload, copy/paste via a clipboard. (Able to make comments on saved data.)	
Print function		Specified ranges of recorded data can be printed.	
Measurement port		USB standard A/B receptacle: 1 each	
USB2.0 port		USB standard B receptacle, Connect to the analysis PC	
LED Indicator		2-colored LED, POWER/RUN, VBUS, DATA, SPEED (High:red, Full:green)	
Power Supply		USB Bus power (current consumption: 400mA max)	
Ambient Temperature		In operation: 0 to 40°C In storage: -20 to 60°C	
Ambient Humidity		In operation：20 to 80%RH In storage：10 to 85%RH (No condensation)	
Dimensions, weight		86(W)×130(D)×30(H)mm, approx.210g	
Accessories		Analyzer, PC software CD, USB cable x2 (1.8m/0.9m), Instruction manual, Warranty	
System Requirement		OS: Windows® XP/Vista/7(Japanese/English Windows®) CPU: Recommend to use upper model than "Core 2 Duo"(Upper than "Core i series") RAM: More than 1GB. USB port: USB2.0 *3 Additional Memory: HDD or SSD. 30MB plus enough capacity to record log data.	

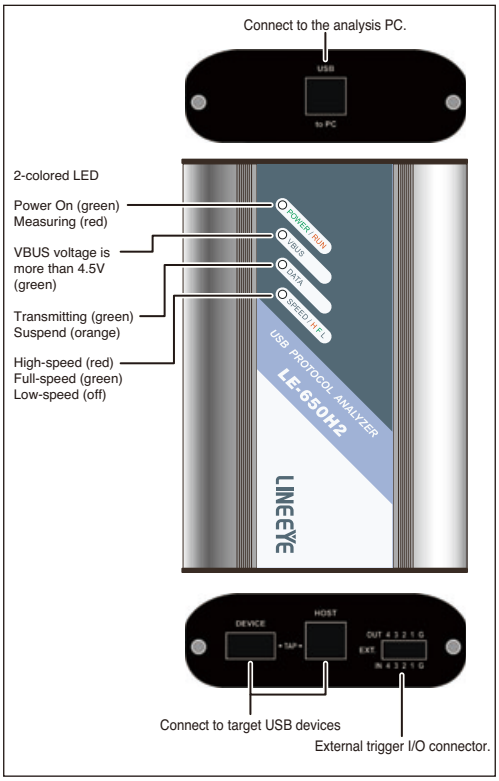
*1: Bus Reset, Suspend, Disconnect are recorded under the following condition.

Bus Reset	The SEO status of D+/D- signals is detected within a range between 2.5us and 139.8ms.
Suspend	A non-communication period not in the SEO status is detected for 3ms or over.
Disconnect	The SEO status of D+/D- signals is detected for 139.8ms or over.

Note: The USB device status may not coincide with the actual bus state of the applicable device at the time of USB cable connection or disconnection because the D+/D- signals will be unstable.

*2: Display a minus value when VBUS current flows from the device to the host.
*3: Need to have a USB2.0 port, which supports High-speed transfer.

Nomenclature



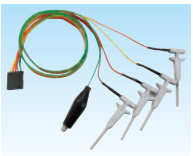
Product Lines

Product Name	Model	Note
USB2.0 Protocol Analyzer Standard Model	**LE-650H2**	Max memory: 10GB VBUS measurement cycle: Min.100ms
USB2.0 Protocol Analyzer Advance Model	**LE-650H2-A**	Max memory: 40GB VBUS measurement cycle: Min.0.1ms
H2-A Upgrading	**LE-H2-A001**	Upgrade LE-650H2 to LE-650H2-A (*1)
U2 Updating License	**LE-H2-UP01**	Remove the lock to start measurement from the analyzer (*1)(*2)

(*1): Need to apply the serial number.
(*2): It is necessary to update the PC software in the future. For 12 months from the purchased date, the latest version of software is available without this licence. It is not necessary when using the PC software as a viewer of measured data.

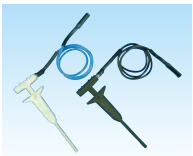
OPTIONS

5-wire probe cable
LE-5LP2



A cable with test clips suitable to the external trigger of 4 inputs or 4 outputs connector. Length: 0.5m

Test clip with harness
LE-62BG



A cable with test clip suitable to the external trigger I/O connector. In a set of 2. Length: 0.5m

SAFETY WARNING

Read the instruction manual provided with the product before use and use the product as explained in that manual. Using the product in ways not guaranteed in the manual, connecting it to systems outside of the specified ranges and remodeling can all cause trouble and damage. LINEEYE CO. LTD. will assume no responsibility whatsoever for trouble or damage arising because of unauthorized ways of use.

LINEEYE CO., LTD.

■ Head Office/Sales Office
Marufuku Bldg 4F, 39-1 Karahashi Nishihiragaki-cho, Minami-ku, Kyoto, 601-8468
PHONE: 81-75-693-0161 FAX:81-75-693-0163

●URL http://www.lineeye.com
●E-mail : info@lineeye.co.jp

* LINEEYE CO. LTD. is a venture company founded by electronic equipment development members of the former Sekisui Chemical Co., Ltd. with investment from the Sekisui Venture Fund. The electronic equipment business of Sekisui Electronic Co. Ltd. was transferred to LINEEYE CO. LTD. in October 2000.

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