LINEEYE

OPTIONAL KIT
FOR MULTI PROTOCOL ANALYZER LE-3500XR

Firmware for High-speed HDLC/SPI Communications

OP-FW10XR

Instruction Manual

The First Edition

Instruction

Thank you for your purchase of OP-FW10XR.

To use it correctly, you are advised to read and understand this instruction manual thoroughly.

Keep this together with the warranty. If you encounter any problems, you will find helpful information in this manual.

🕮 Notice

- It is prohibited to reprint or duplicate any part of the whole of this instruction manual without prior permission from LINEEYE.
- The content of this instruction manual and specifications of the products are subject to change without any notice.
- This instruction manual has been designed and edited with great care to give you all necessary information. If you have any questions, feel free to direct your inquiries to LINEEYE.
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🕮 User Limitation

This product has been developed for the purpose of using as the analyzer only.

When you use this product with the following devices that are required to function with a high degree of reliability, safety and accuracy, use it under considering the safe design of the system in order to maintain reliability and safety for that system;

*Devices that are directly related to transportation such as airplanes, trains, cars etc.

*Devices for crime prevention and disaster prevention.

*Each kind of safety devices and so on.

This product has not been developed for the use that needs exclusivey high reliability and safety:

aerospace apparatus, trunk communication apparatus, nuclear control apparatus, medical apparatus related with life maintenance etc. Therefore, do no use for those purposes.

🕮 Firmware

Firmware for high-speed HDLC/SPI communications (OP-FW10XR) is contained in the CD-ROM. Please note that the CD-ROM is not attached to the "pre-installed version OP-FW10XR" which is installed in the analyzer at the factory and sold for specific users.

Firmware License Agreement

LINEEYE CO., LTD. (LINEEYE) grants you to use the firmware program and the documents under the terms of this license agreement. And you are consenting to be bound by and are becoming a party to this agreement.
To use the firmware, you need to agree to this license agreement.

1. Copyright
   LINEEYE holds the copyright on this firmware.
2. Grant of License
   LINEEYE grants you to use this firmware on only one analyzer (LE-3500XR) by agreeing this license agreement. Therefore, you shall not rent, lease and loan to a third party.
3. Copy, Analysis, Modification
   This firmware must not be reproduced, analyzed or modified in any form unless prescribed in the manual.
4. Upgrade
   This firmware may be upgraded without any advance notice because of technical progress of hardware or software.
   LINEEYE provides the upgraded firmware with the upgrade fee. For upgrade, only licensed user can have upgrades.
5. Limitation of Liability
   In no event shall LINEEYE be liable for any loss of business or profits, or for any direct, indirect, incidental or consequential damages arising from products of this firmware or analyzer. Besides LINEEYE shall not be liable damages arising from the equipment.
6. General
   If any provision of the agreement is held invalid, such provision shall be removed from this license agreement.
7. Support
   LINEEYE supports functions, operation and only the problem on this firmware.
8. Notice
   Any matter not specified in this agreement will be governed by and constructed in accordance with copy right law and related laws.

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Safety Information

Read this first !!

Here, for users of the object products, the important contents to the way which previously prevents hazard to the human and damage of the property and teaches safely use has been described. Before using, please read the main contents after you understand the following contents (symbols & marks).

:Prohibition

⚠Warning :	Should the device be used without followings, there is a possibility of accidents, such as a death or a serious injury, occurring.
	● Stop using the analyzer immediately when smoke or smells emanate from itself. Continuous use may result in an electric shock, a burn and/ or fire.
	● Stop using the analyzer when a liquid or foreign substance get into the analyzer. This may result in an electric shock or fire. Immediately switch off the analyzer and unplug it.
	● Do not disassemble, modify or repair the analyzer. This may result in a injury, an electric shock, fire, explosion and/or a breakdown due to overheating.
	● Do not put the analyzer in fire or heat them. This may result in a injury and fire due to overheating or explosion.

⚠Caution :	Should the device be used without followings, there is a possibility of accidents, such as a injury , and material damage occurring.
	●Do not leave the analyzer in the following conditions. Strong magnetic field, static electricity or dusty place. Temperature and humidity above the specification or where dew condensation occurs. Not flat, or shaking place. Place with leaking water or electricity. Place affected by direct sun or near the fire. *Please do not leave the analyzer in a car during a heat summer.

Contents

Chapter 1 Before Using the Product

1.1 Unpacking

When you unpack the product, make sure of the following:

- The product has not been damaged during the transit.
- You have received all the standard accessories listed below.
  - Firmware (CD-ROM) 1
  - Instruction Manual (This book) 1
  - Registration Card / Warranty 1 each

⚠ Preinstalled version OP-FW10XR does not include CD-ROM.
Please keep the CD-ROM at the safe place. You will need it when upgrading.
Please let us know if you find any damage to the product caused by the transit, or if there are any accessories lacking.

The card packed with the product is the user registration card for Japanese customers. For overseas customers, there is a registration page on our web site. (https://www.lineeye.com)

1.2 Introduction

OP-FW10XR is the firmware to monitor and simulate the bit-sync communications (HDLC/SDLC/X.25/CC-Link) and SPI communications at high speed.

Please read the manual of the analyzer for details.

Functions

- On-line Monitor Function
  Monitor HDLC/SPI Communications at On-line (max. speed 10Mbps).
  Support full duplex (～ 5Mbps) / half duplex(～ 10Mbps), time stamp display, ID Filter, trigger function.
- Simulation Function
  You can send arbitrary data at up to 10Mbps by one touch.

Due to the interface specifications, high-speed communication over 1Mbps is not guaranteed for RS-232C.

If the speed exceeds 1Mbps, select RS-422/RS-485 or TTL interface to use.

Chapter 2 Basic Operation

2.1 Preparation Before Measuring

2.1.1 Installation of Firmware

First, you need to install the OP-FW10XR firmware on the analyzer.

<Attention>
To use the USB port of the analyzer, you need to install the USB driver.
Refer to the analyzer instruction manual for how to install the USB driver.

■ Connect the analyzer to the PC
Connect the analyzer connect the USB ports of the analyzer and the PC.

■ Setting of the analyzer
Turn off the power of the analyzer and then turn on the power while pressing [Shift] + [STOP]
Firmware loader of the analyzer will start.

■ Execute the transferring software “le8firm.exe”.
Click “le8firm.exe” in CD-ROM attatched to the analyzer twice.

■ Transfer the firmware
1) Select a connection method from“USB.”
2) Click [Next].
3) Click [Select] and select the firmware file “OPFW10XR.FW2.”
4) Click [Start] to start transmission. “Complete” will appear when completing the transmission.
5) Click [Close] to close the transferring software.

■ Reboot the analyzer
“Firmware write succeeded” will appear when completing the transmission of firmware.

Reboot the analyzer to use OP-FW10XR firmware.

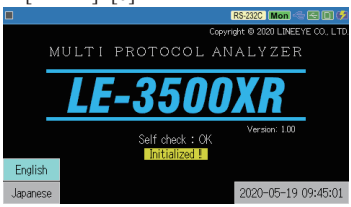
<Attention>
Do not disconnect the USB cable while transferring the firmware. If you disconnect the USB cable during it, the analyzer system may be damaged and not be able to start. In this case you may need to send back the analyzer to the factory for firmware rewriting.

2.1.2 Choosing Firmware

After installing OP-FW10XR firmware, you can choose ordinary mesurement mode (standard firmware for the analyzer), or OP-FW10XR mode.

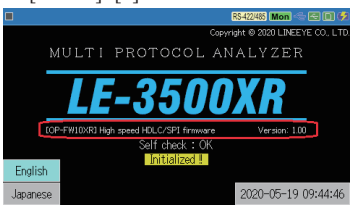
■ Ordinaly mesurement mode

Turn on the analyzer, while pushing [SHIFT]+[0].



■ High-speed mesurement mode

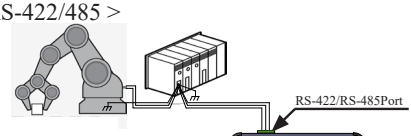
Turn on the analyzer, while pushing [SHIFT]+[3].



Save your important data in the SD cards before changing the firmware mode. It will initialize the analyzer and erase all data when the analyzer changes the measuring mode.

2.1.3 Connection to the Target Devices

<RS-422/485 >



e.g.) RS-485

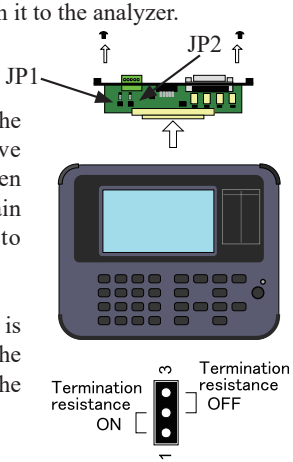
Device		Analyzer
TX/RX +	------	TXD+
TX/RX -	------	TXD-
GND	------	GND

Branch the line of transmission paired wires for send/receive data by using proper cable and connect it with the RS-422/485 terminal. The terminal is detachable. Detach it and connect the cable, then attach it to the analyzer.

■ Method of connecting terminators

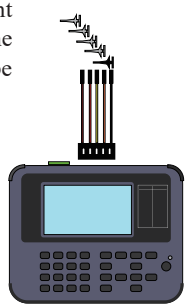
When connecting the analyzer at the end of the line, connect a terminating resistor. Remove the two screws on the side of the board, then remove the interface sub board from the main unit, and set the jumper to the “1” side to connect the terminating resistor.

JP1 is the pin to set resistor for TXD and JP2 is the pin to set resistor for RXD. After setting the jumper, set the sub-board again and tighten the screws.



<TTL>

Connect the analyzer to the TTL signal of the measurement target devise by using the 5-wire TTL probe included with the analyzer. Connect so that the green one of the TTL cables to be the GND terminal side of the analyzer's TTL port.



● Connection example of HDLC monitoring

Signal	Lead wire	Signal of target device	
		Monitor	Simulation
TXD	Brown	TXD	RXD
RXD	Red	RXD	TXD
GND	Green	Signal GND	Signal GND

Both TXD and RXD are the input during monitoring, TXD is the output and RXD is the input during simulation.

● Connection example of SPI monitoring

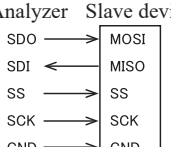
Signal	Lead wire	Signal of target device		
		Monitor	Simulation	
			Master	Slave
SDO	Brown	MOSI	MOSI	MISO
SDI	Red	MISO	MISO	MOSI
SS	Orange	SS	SS	SS
SCK	Yellow	SCK	SCK	SCK
GND	Green	Signal GND	Signal GND	Signal GND

All are the input during monitoring. SDO, SS, and SCK are the output during master simulation. Only SDO is the output during slave simulation.

[Connection in simulation]

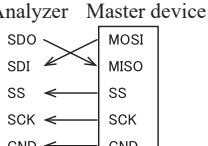
In Master mode

Analyzer Slave device



In Slave mode

Analyzer Master device



● Connection of external trigger

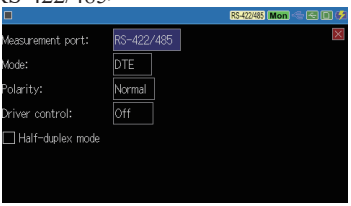
Signal	Lead wire	Signal
TRG OT2	Red	External trigger output 2
TRG OT1	Orange	External trigger output 1
TRG IN	Yellow	External trigger Input
GND	Green	Signal GND

When connecting with TTL signal at the same time, purchase additional 5-wire TTL probe.

2.2 Analyzer Setting

2.2.1 Interface Port Setting

<RS-422/485>



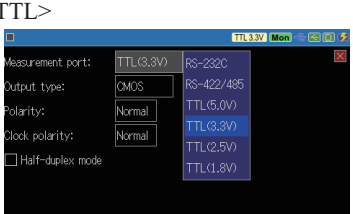
From the top menu screen, touch "Interface" or press [1] to configure at the interface port setting screen.

- Measurement port : Select "RS-422/485".
- Mode : When you make it output to TXD in the simulation mode select DTE and make it to output to RXD select DCE.
- Polarity : Select "normal".
- Driver control : Select driver control when simulating.

Setting	Driver Control
Off	Always become active when simulation starts.
Manual	It becomes inactive after the simulation starts. Press [SHIFT] + [F] to activate the driver. Press [SHIFT] + [F] again to deactivate it.
Auto	Become non-active when simulation starts. Become active when transmitting data and become non-active after finishing data transmission.

- Half-duplex mode:
  When the box is checked, only the communication data input to the TXD line is targeted, and by combining with the address filter, the data can be distributed and displayed on two lines, TXD side and RXD side. When unchecked, it is displayed corresponding to the input TXD and RXD data lines.

<TTL>

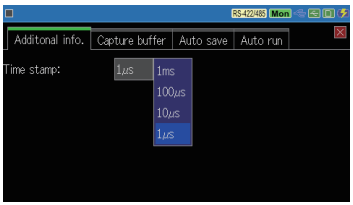


From the top menu screen, touch "Interface" or press [1] to configure at the interface port setting screen.

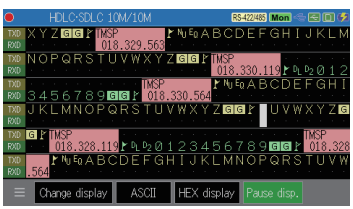
- Measurement port : Select from TTL (5.0V) to TTL (1.8V) according to the signal level of the measurement target.
- Output type : Select CMOS during SPI simulation. It is optional because it is invalid during monitoring.
- Polarity : Set the polarity of all signals. Normal is selected generally. On Invert, polarities of all signals will be inverted.
- Clock Polarity : Set the polarity for clock.
- Half-duplex mode : Same as RS-422/485. It is invalid for SPI measurement.

2.2.2 Time Stamp

The time when the top flag of the frame is monitored is recorded and displayed as data of the elapsed time (time stamp) from the start of measurement.



From the top menu screen, touch "Record control" or press [3] to set at the additional information setting screen.



eg.) If selecting 1μs;
18.330564sec

The maximum time stamp value is 134217727. When it exceeds this value, it will return to 0 and then continue measuring the time.

2.2.3 Setting of Communication Conditions

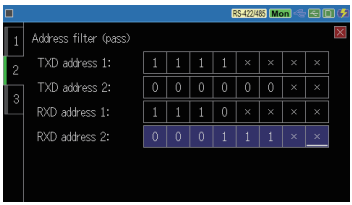
You need to set the communication conditions according to the communication conditions such as the communication line specification and the communication speed of the device to be tested. Set the communication conditions at the configuration screen by touching "Configuration" or pressing [0] at the top menu screen.

＜ HDLC ＞

Either touch the setting item or the setting tab, or select by [▼], [▲].

- ■ TXD speed : Set the communication speed in the TXD side. (RXD will be automatically set)
  Set any 4 effective digits speed.
- ■ RXD speed : Set the communication speed in the RXD side (only different from TXD side).
- ■ Data code : Set the display code to display in the LCD.
- ■ Format : Select the format either from NRZ/NRZI.

Set the address filter which only measures specific ID frame with 0, 1, and *(don't care).
Address filter targets two continuous data after the starting flag.

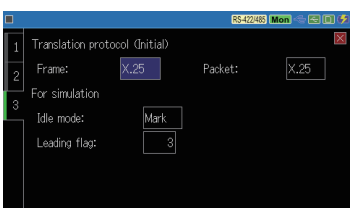


■ Address filter (pass)
TXD address1 : Set the filter for the first received data in the TXD side in bit.

TXD address2 : Set the filter for the second received data in the TXD side in bit.

RXD address1 : Set the filter for the first received data in the RXD side in bit.

RXD address2 : Set the filter for the second received data in the RXD side in bit.



■ Frame : Set the specification of the frame translation. Select from SDLC, SDLCE, X.25, X.25E or LAPD.

■ Packet : Set the specification of packet translation. Select from X.25 or LAPD.

■ Idle mode : Set output conditions of IDLE signal between frames when simulating.
Select from MARK(mark condition), or FLAG(flag sequence).

■ Leading flag : Set numbers of starting flags when simulating(range: 1 to 10).

● Address Filter and Half-duplex mode setting

- Following table describes the relationship between receiving frames and Address filter / Half-duplex mode ON, OFF.
- When proceeding simulation and Half-duplex mode is OFF, every frames transmitted by analyzer are monitored regardless of Adress Filter setting.

Half-duplex mode	Adress Filter	LCD display
Off	Don't care setting in both TXD and RXD.	Display TXD in the TXD, and RXD in the RXD.
	Non-don't care setting either in TXDor RXD, or both TXD and RXD.	Display TXD matched with Address Filter in the TXD. Display RXD matched with Address Filter in the RXD.
On	Don't care setting in both TXD and RXD.	Display TXD frames in the TXD.
	Non-don't care setting either in TXD or RXD.	Display TXD matched with Adress Filter in the TXD or RXD. Everything else is displayed at where don't care was set.
	Set except don't care in both TXD and RXD.	Display TXD matched with Adress Filter in the TXD or RXD.

e.g.) TXD/RXD monitor display when Half-duplex mode is On and Adress Filter is as follows.

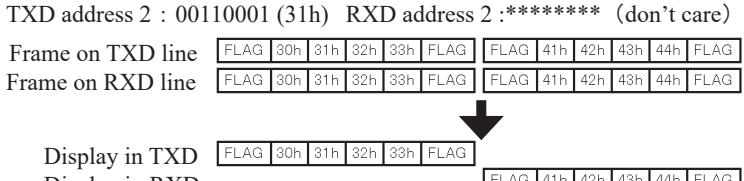
TXD adress 1 : 00110000 (30h)　RXD address 1 :******** （don't care）

TXD adress 2 : 00110001 (31h)　RXD address 2 :******** （don't care）

e.g.) TXD/RXD monitor display when Half-duplex mode is Off (full duplex) and Adress Filter is as follows.

TXD address 1 : 00110000 (30h)　RXD address 1 :0100****　(4*h)

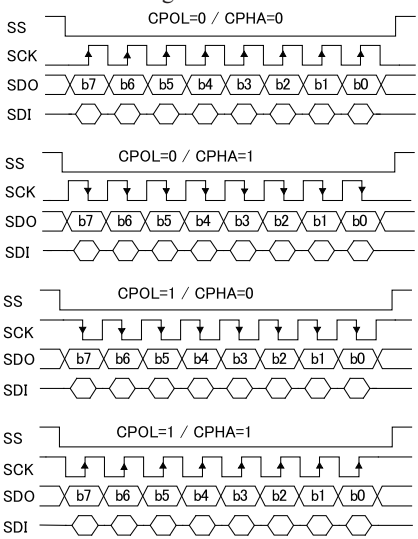
TXD address 2 : 00110001 (31h)　RXD address 2 :******** （don't care）



< SPI >

From the top menu screen, touch "Configration" or press [0] to configure at the configuration display.

- Speed :Set speed up to 10Mbps. This setting is required for the simulation master mode. (No need to set for monitoring.)
- Data code : Set the display code to display in the LCD.
- Clock polarity : Depending on the settings of CPOL and CPHA the timing
- Clock phase : will be as shown in the figure below.



- Frame end time : Set the frame end time (unit: 0.1μs).
  This is used in the case in which SS signal does not change per one frame.
  At the moment when the clock signal does not change for the time set here, time stamp will be added to the data. When "0" is set here, this function will not work.
- Simulation mode : Select Master or Slave for simulation. (No need to set for monitoring.)

Chapter 3 Starting Measurement

3.1 Start/Stop

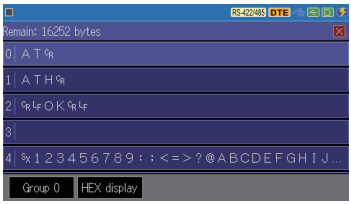
From top menu, select a function and press [RUN]. To stop measuring, press [STOP].

■ Function
Monitor : Online Monitor Function.
Simulation : Simulation Function.

3.2 Register Transmission Data for Simulating

Select the simulation function and touch “Tx-data registration” to display the table list screen. Select the table number and register the transmission data.

For more details, please read the instruction manual of the analyzer.

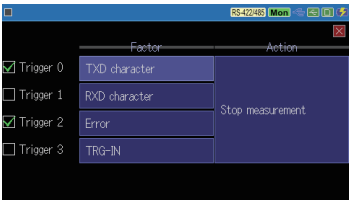


3.3 Simulation

Press [RUN] to start the simulation. After starting, press the number key corresponding to the frame you want to send and then the frame will be sent. Also, you can touch “Function” on the “Advanced settings” setting screen to set repeat transmission.

■ Repeat : When this item is checked, it transmits repeatedly. When unchecked it transmits only once.
■ Idle time : Select the interval of transmittion from 0 to 99999ms (for repeat).

Even if you set the idle time to 0, it cannot transmits without gaps. The following data is sent after delay of the analyzer’s internal processing time (the time differs depending on the amount of data etc.).



It can automatically stop the measurement when a specific trigger factor is detected during measurement operation. From the top menu screen, touch “Trigger” or press [2] to display the trigger selection screen.

To change the setting, touch the item, or select it by [▲][▼][►][◄] and press [ENTER] to call the setting screen.

Factor setting

The effective (with the check mark) factor functions on trigger factor of the following 4 sets under the OR condition.

□Trigger0 : Match character line in TXD.

□Trigger1 : Match character line in RXD.

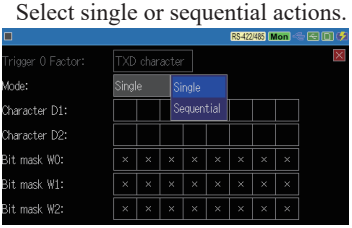
□Trigger2 : Find errors in TXD and RXD.

□Trigger3 : Detects signal change of external trigger input (TRG IN)

< Trigger 0, 1 >

■ Mode

Select single or sequential actions.



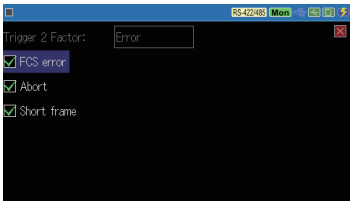
Single action means when Character D1 or D2 happens, the trigger will work.

Sequential action means when D2 happens after D1 happened, the trigger will work.

■ Character(D1,D2)

Set the character string. Up to 8 characters can be set for each of D1 and D2, and * (don’t care) and bit mask (don’t care by bit unit and 3 types of W0 to W2) can be set.

< Trigger 2 >



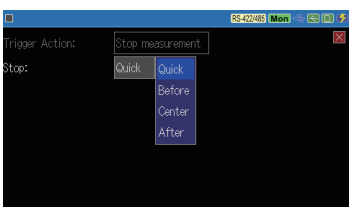
FCS (Frame Check Sequence) error, Abort (continuous 1 more than 7bits) and Short frame (less than 3 characters) are the trigger factor. Selected errors will be detected.

<Trigger 3>

Detecting signal change on IN terminal (external trigger input) on TTL port is the trigger factor.

Action Setting

Set the amount of capturing data when the trigger was found. 4 kinds of Actions can be set.



Quick : Stop after capturing about 16 data.
Before : Stop after capturing 64K data.
Center : Stop after capturing 50% of the capture memory.
After : Stop after capturing the amount of capture memory minus 64K data.

- Selecting one Action is set for all triggers (Trigger 0-3).
- Output low pulse for about 2µs from TRG OT1 on TTL port when the trigger factor is satisfied.

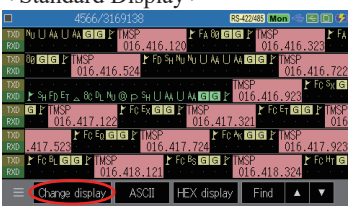
Chapter 4 Data Use

4.1 Change the Screen Display

■ HDLC

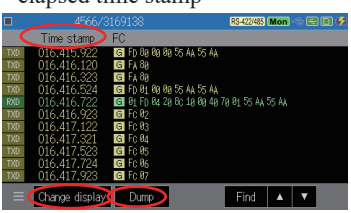
You can switch the display format each time you touch “Change display” on the screen.

< Standard Display >



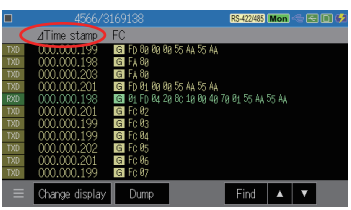
< Dump Display >

elapsed time stamp



< Dump Display >

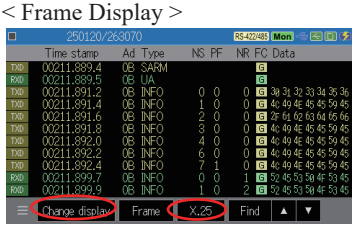
time difference between two data



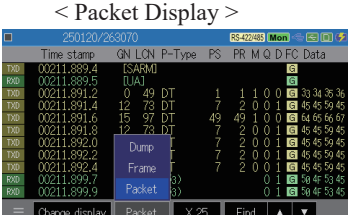
You can switch the time stamp display by touching “Time stamp” on the screen.

You can switch the display format by touching “Dump” at the bottom of the screen.

< Frame Display >



< Packet Display >



It is possible to touch “X.25” switch the display to translation display.

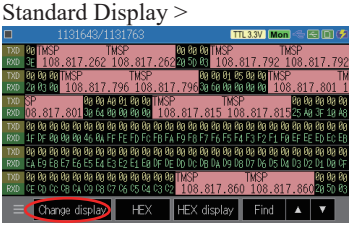
Character	Description
F	HDLC starting flag sequence (7Eh) is detected
F	HDLC ending flag sequence (7Eh) is detected
G	Frame Check Sequence($X^{16}+X^{12}+X^5+1$) result is correct
E	Frame Check Sequence($X^{16}+X^{12}+X^5+1$) result is error
SF	Shart Frame (frame length is short)
A	Abort (7bits or more of "1" is continuously detected) (*)

*: Abort A character on RS-485 line

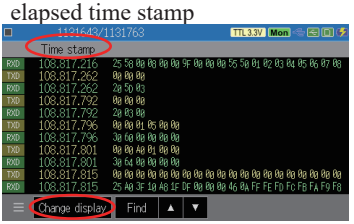
On an RS-485 half-duplex line, if the line goes into a high-impedance state within 8 bit time after the completion of HDLC (NRZI) frame transmission,the line may go into the A state. In an actual communication system, such an Abort frame will be discarded and no error will occur.

■ SPI

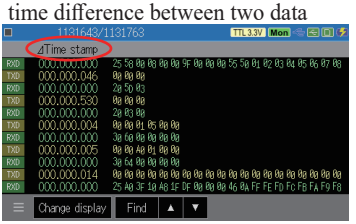
< Standard Display >



< Dump Display >
elapsed time stamp

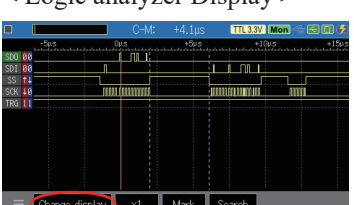


< Dump Display >
time difference between two data



You can switch the time stamp display by touching "Time stamp" on the screen.

< Logic analyzer Display >



To change to logic analyzer display, touch "Change Display". (Set and measure the wave monitor in advance.)

4.2 Data Search

Search the specific data from recorded data.

< Search Condition >

Trigger : Search the data matched Trigger Factor.
Error : Search FCS, abort and short frame.(set individually ON/OFF)
Character : Search the matched character lines (*(don't care), bit masks). Select the target line at "Target line" (Both, TXD, RXD).
Idle time : Search Idle time.
Time stamp : Select the range of time stamp.

The idle time can be searched only when it loaded and displays the measurement data of the standard firmware.

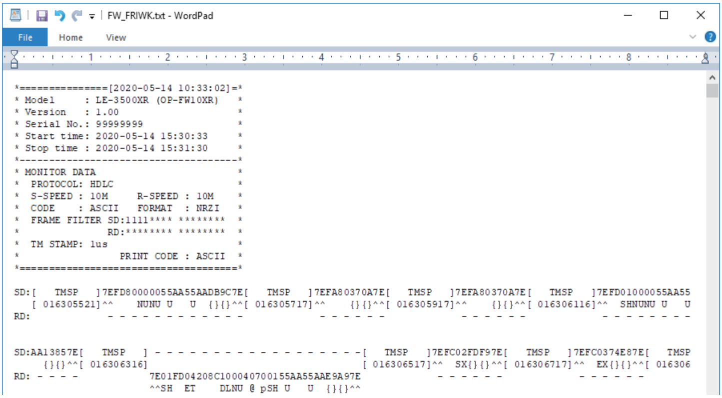
< Action >

Count : Display the numbers of matched data on the right side of the bottom in the LCD.
[▲] [▼] : Display the matched data on the top of LCD.

4.3 Text and CSV Conversion

It is able to convert measured data into text or CSV on the PC installed the PC link software.

<Example of text conversion of HDLC data>



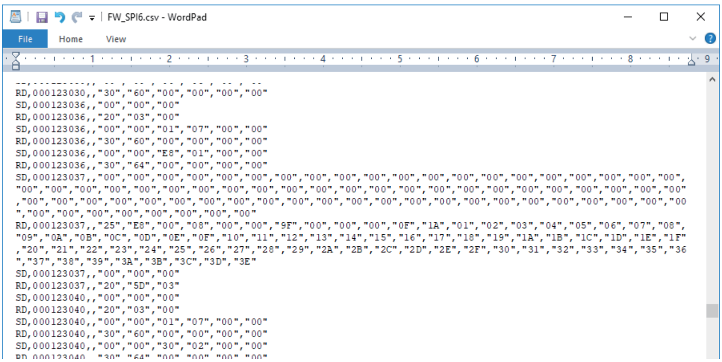
```
FW_FRIWK.txt - WordPad

*===============[2020-05-14 10:33:02]=*
* Model      : LE-3500XR (OP-FW10XR)   *
* Version    : 1.00                    *
* Serial No.: 99999999                 *
* Start time: 2020-05-14 15:30:33      *
* Stop time : 2020-05-14 15:31:30      *
*--------------------------------------*
* MONITOR DATA                         *
*  PROTOCOL: HDLC                      *
*  S-SPEED : 10M     R-SPEED : 10M     *
*  CODE    : ASCII   FORMAT  : NRZI    *
*  FRAME FILTER SD:1111**** ********   *
*               RD:******** ********   *
*  TM STAMP: 1us                       *
*                 PRINT CODE : ASCII   *
*======================================*

SD:[   TMSP   ]7EFD80000055AA55AADB9C7E[   TMSP   ]7EFA80370A7E[   TMSP   ]7EFA80370A7E[   TMSP   ]7EFD01000055AA55
   [ 016305521]^^    NUNU U   U  {}{}^^[ 016305717]^^    {}{}^^[ 016305917]^^    {}{}^^[ 016306116]^^  SHNUNU U   U
RD:             - - - - - - - - - - - -             - - - - - -             - - - - - -             - - - - - - - -


SD:AA13857E[   TMSP   ] - - - - - - - - - - - - - - - - - -[   TMSP   ]7EFC02FDF97E[   TMSP   ]7EFC0374E87E[   TMSP
     {}{}^^[ 016306316]                                    [ 016306517]^^  SX{}{}^^[ 016306717]^^  EX{}{}^^[ 016306
RD: - - - -                7E01FD04208C10004070015 5AA55AAE9A97E            - - - - - -             - - - - - -
                           ^^SH  ET    DLNU @ pSH U   U  {}{}^^
```

<Example of CSV conversion of SPI data>



```
FW_SPI6.csv - WordPad

RD,000123030,,"30","60","00","00","00","00"
SD,000123036,,"00","00","00"
RD,000123036,,"20","03","00"
SD,000123036,,"00","00","01","07","00","00"
RD,000123036,,"30","60","00","00","00","00"
SD,000123036,,"00","00","E8","01","00","00"
RD,000123036,,"30","64","00","00","00","00"
SD,000123037,,"00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00",
"00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00"
,"00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00","00
","00","00","00","00","00","00","00","00"
RD,000123037,,"25","E8","00","08","00","00","9F","00","00","00","0F","1A","01","02","03","04","05","06","07","08",
"09","0A","0B","0C","0D","0E","0F","10","11","12","13","14","15","16","17","18","19","1A","1B","1C","1D","1E","1F"
,"20","21","22","23","24","25","26","27","28","29","2A","2B","2C","2D","2E","2F","30","31","32","33","34","35","36
","37","38","39","3A","3B","3C","3D","3E"
SD,000123037,,"00","00","00"
RD,000123037,,"20","5D","03"
SD,000123040,,"00","00","00"
RD,000123040,,"20","03","00"
SD,000123040,,"00","00","01","07","00","00"
RD,000123040,,"30","60","00","00","00","00"
SD,000123040,,"00","00","30","02","00","00"
RD,000123040,,"30","64","00","00","00","00"
```

Chapter 5 Specification

5.1 Analyzer Specification

Item	Specification	
Interface	RS-422/485,TTL[*1],SPI[*1]	
Protocol	HDLC, SDLC, X.25, CC-Link (NRZ/NRZI format, AR clock), SPI	
Speed	Half duplex	115.2kbps-10Mbps
	Full duplex	115.2kbps-5Mbps
	SPI	115.2kbps-10Mbps [*2]
	Setting steps	Arbitrary: four significant digits
Error check function	FCS Error (CRC-ITU-T: $X^{16}+X^{12}+X^5+1$) , Abort , Short frame	
Online monitor function	Time stamps	You can switch between the difference time display from the previous frame and the elapsed measurement time display. 1ms, 100 µs, 10 µs, 1 µs units (Max 134217727)
	Pass filter (HDLC)	2 characters soon after a flag can be set (Don't care and bit mask is available)
	Half-duplex mode	Filter matching frames and non-matching frames are assigned to TXD and RXD
Simulation function	Send data table	16k data (can be divided into 10 groups x 16 types and registered)
	MANUAL mode	It transmits the registered data which corresponds with the key. Repeat transmission and repeat interval are available. Slave mode and master mode are available for SPI.
Trigger function	It can automatically stops monitoring (number of offsets until the stop can be set) as a trigger action for the following conditions - Detection of single or sequencial match of two specified character strings (max 8 characters, don't care and bit mask are available) at TXD side or RXD side, detection of a communication error, or the signal change of the external trigger input.	
Trigger output	It outputs a pulse to TRG OT1 pin when trigger factor matches (L level of about 2µs).	
Record control	Auto Save function, Auto Run function, Auto Backup function.	
Data search function	Search of trigger data, error data, and character line, idle time*3, and time stamp are available.	

∗1: Standard TTL measurement port of the analyzer. OP-SB5GL is also available.

∗2: Up to 20 Mbps (clock duty 40 to 60%) when monitoring short frames of 2Kbytes or less. Up to 6 Mbps during SPI slave simulation.

∗3: Only available when reading the communication log file measured with standard firmware.

LINEEYE CO., LTD.

Marufuku Bldg. 4F, 39-1 Karahashi Nishihiragaki-cho, Minami-ku,
Kyoto, 601-8468 Japan
Phone: 81-75-693-0161 Fax: 81-75-693-0163

URL: https://www.lineeye.com

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