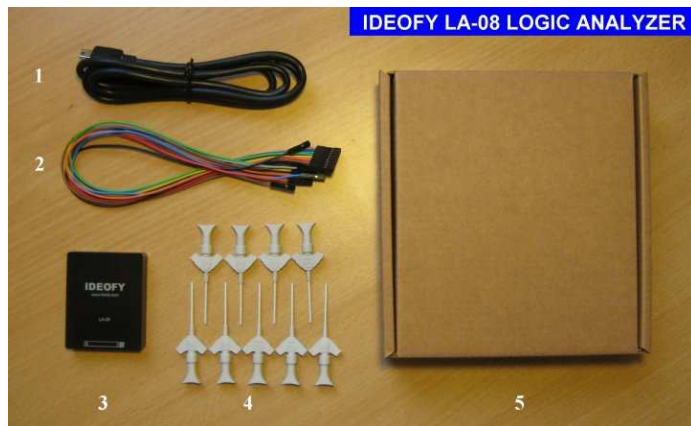# LA-08 Logic Analyzer

User Guide

LA-08 Package

Thank you for choosing LA-08 Logic Analyzer. An LA-08 package contains (1)USB cable, (2)9-pin color test lead, (3)LA-08 base unit, (4) set of nine PA-619 SMT test clips, and (5) a paper carrying case.

Software Download

The latest software can be downloaded at our website http://www.ideofy.com. The software is compressed in a zip file, which contains the following files and folders:

`LA-08.exe`	LA-08 main program
`driver\`	USB device driver, folder
`   3.4.1.92s\`	driver version, folder
`      win_xp\`	driver for Windows XP (both 32- and 64-bit versions)
`      win7_vista\`	driver for Win 7 and Vista (both 32- and 64-bit versions)
`demo.iwf`	sample waveform file

LA-08.exe is green software, meaning that it does not need to be setup or installed, and it does not write anything to the registry. Just save it to a folder you like and double click to lunch it. The USB device driver, however, has to be explicitly installed.

Device Driver Installation

The device driver supports Windows XP, Vista, and Win 7. To install the driver, connect LA-08 to the PC's USB port and follow windows' directions. The driver is signed by our kernel mode code signing certificate.

Connecting to device under test

Below   `[ 8        1 G ]`   markings on the LA-08's aluminum case there are nine 2.54mm pins, where the test leads can be attached. The test leads are color coded. Black, indicating the number 0, representing ground and should be aligned to the letter G. Other leads, colored brown, red, orange, yellow, green, blue, purple, and grey, indicating channel 1 to 8, respectively.

The black (G,) lead has to be connected to the ground (GND) of the device under test (DUT).

The PA-619 SMD clips can be used to attach test lead to pins on the DUT.

LA-08.exe Program

LA-08.exe does not need to be installed (setup). Save the file in a folder you like and double click the icon to lunch LA-08.exe. Multiple instances of LA-08.exe can be run at the same time. Only the one which has (Active) shown in the windows title bar can connect to LA-08 hardware. The other instances can be used to review previous saved waveforms.
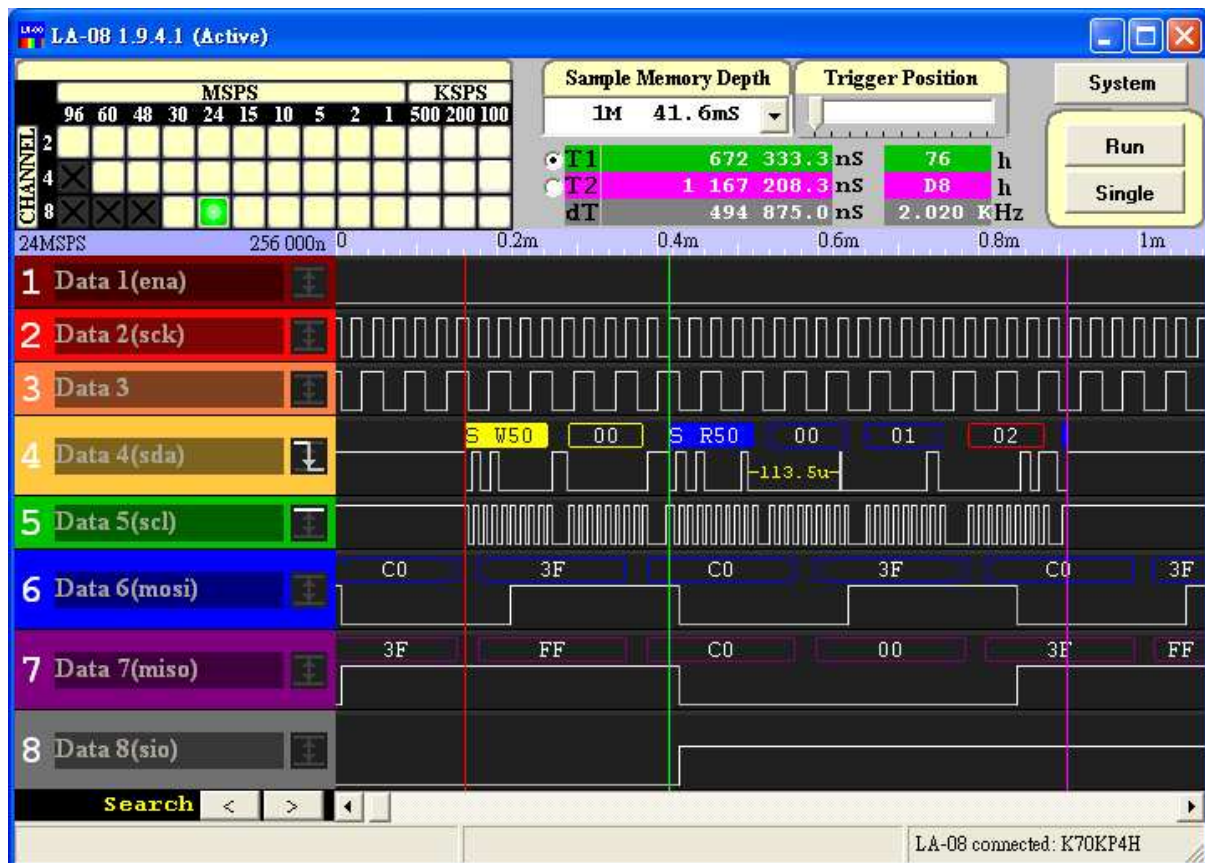
System Button
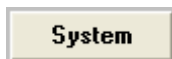
System Click the system button to activate the system menu, on which one can do: (1)**Open**: a .iwf waveform file, (2)**Save** current waveform to a file, and (3)setup protocol analyzers, (4)active **I2C Master** control panel, and (5) **About**: read version information.

Sampling Rate and Number of Channels

This control panel sets and displays sampling rate and number of channel. Current setting is indicated by the green light. On the top of the panel, MSPS (Mega Samples Per Second) and KSPS (Kilo Samples Per Second) are units for sampling rate. LA-08 supports 96 MSPS fastest sampling rate and 100KSPS slowest sampling rate.

On the left CHANNEL 2, 4, 8 means two, four, or eight channels are enabled, respectively. When two channels are enabled, only Data 1 and Data 2 are used for sampling; when four channels are enabled, Data 1, 2, 3, 4 are used for sampling, and when all right channels are enabled, Data 1 to Data 8 are all used for sampling.

When only two or four channels are enabled, the unused channels can be used by I2C Master

Move the mouse pointer to the position for a sampling rate/number of channels and click to set.

A faster sampling rate acquires more accurate waveforms, at the cost of shorter sampling time (waveform length). To proper acquire a waveform of frequency f, sampling rate should be set to at least 4 times of f, or even $10f$ to obtain a more accurate waveform.

Sample Memory Depth
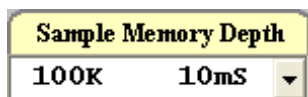
Sample memory depth is the number of sample points for acquired waveforms. For each sample memory depth in the pull-down menu, there is an associated waveform length in time at current sampling rate. Note that **waveform length** = **sample memory depth** / **sampling rate**.

The minimum sample memory depth is 100K point; the maximum depth is 50M points at single mode or 20M at run mode.

Signal name and trigger conditions

The LA-08 has eight signal channels. For each channel, the signal name and trigger condition can be set independently. To change a signal's name, double click to edit. Press enter when finished.

Setting Trigger Condition

A trigger point is a sample point that satisfies trigger conditions of all channels. For each channel, to the right of the signal name there is a trigger setting button. There are six trigger conditions:

|		
	Don't Care	any condition
	Low Level	low level (logical 0)
	High Level	high level (logical 1)
	Rising Edge	previous point is low and current point is high
	Falling Edge	previous point is high and current point is low
	Either Edge	either rising or falling edge

Click the button to alter the channel's trigger condition. Right click also alters the trigger condition but in the opposite sequence. Click the mouse's middle button (the scrolling wheel) to reset trigger condition to don't care. At most one channel can set its trigger condition to an edge trigger condition.

Trigger position

Sets the trigger point location relative to the acquired waveforms.

Waveform Acquisition
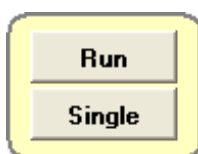
Run: To start acquisition.

Single: To start a single-shot acquisition.

Cursor position display

There are two cursors **T1** and **T2** that are shown as vertical bars in green and pink color, respectively.

The current position in time (nS relative to waveform start) for each cursor is shown in the cursor position display. Time difference, denoted by **dT**, between the two cursors is also shown. To the right there are signal values displays on which the signal values corresponding to two cursors are shown in hexdecimal (h), decimal (d), or binary (b). The signal values is calculated using channel 1 (data 1) as the least significant bit (lsb). The associated frequency calculated based on dT is also displayed.

Click the cursor position display to toggle current cursor. Click the signal value display to change the number base.

The Ruler

The left part of the ruler shows the sampling rate (ex. 10MSPS) and the starting time (ex. 0n) of the part of waveform being displayed. The right part of the ruler shows horizontal time scale, which can be second (S), mini-second (m), micro-second (u), or nano-second (n).

Viewing and Manipulation the Waveform

(1) **Place cursor**. Click the waveform display to place the current cursor.

(2) **Glue to an edge**. When placing a cursor it's placed at a nearby rising or falling edge (if one exists).

(3) **Toggle between two cursors.** Click the mouse's middle button (the wheel) or click the cursor position display.

(4) **Zoom in**. Dragging the mouse to highlight the portion of the waveform you'd like to zoom into. You can also use hot key: **shift-Z**.

(5) **Zoom out**. Right click the mouse, or press **Z**.

(6) **Pan**. Scroll the mouse wheel, or press **shift** and then drag the mouse.

(7) **Pulse width display**. Move the mouse pointer over inside a pulse then the pulse width (time duration) will be shown.

Protocol Analyzers
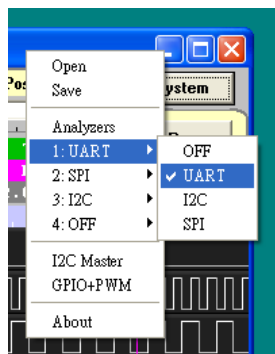
LA-08 has four protocol analyzers, each of which can be configured to decode UART, I2C or SPI protocol. To enable or disable an analyzer: (1)click System button, (2)pick one of the 4 analyzers, (3)pick a protocol to enable the analyzer, (4)pick OFF to disable the analyzer.

Settings for each protocol analyzers are described below.

UART Analyzer

UART (Universal Asynchronous Receiver/Transmitter) is a simple and widely used serial communication protocol. UART is sometimes called serial io (sio), or serial port. RS-232 is a similar but different protocol. LA-08 can handle both UART and RS-232. Settings for the UART analyzer are as follow.
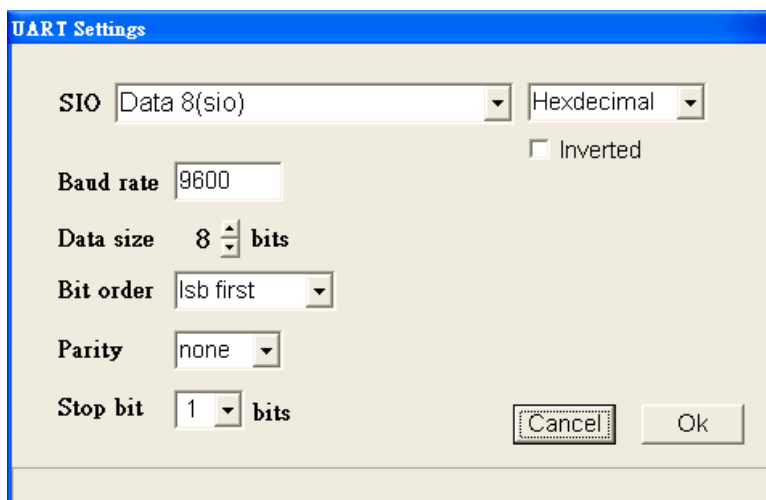
SIO: select a channel for SIO, and choose a format for displaying decoded data,

Inverted: inverse signal, this is for RS-232,

Baud Rate: baud rate, (note that sampling rate should be at least 10 times faster then baud rate),

Data Size: specify data size in bits,

Bit order: can be lsb (lease significant bit) first or msb (most significant bit) first,

Parity: none, odd, or even parity check,

**Stop bit**: stop bit with of 1, 1.5or 2 bit time.

Decoded data will be shown as a rectangle with the decoded value above the original SIO waveform. The left side of the rectangle is

aligned to the first data bit, instead of the start bit; the right side is aligned to the end of the last data bit.

Please note that the UART analyzer need to find a proper start bit, that is a start bit immediately after a long-enough idle time, to start parsing the waveform. To avoid this, do not set the trigger position too close to the start of acquisition waveform.

If there's parity error then the rectangle will be shown in solid-filled red color.

I2C Analyzer
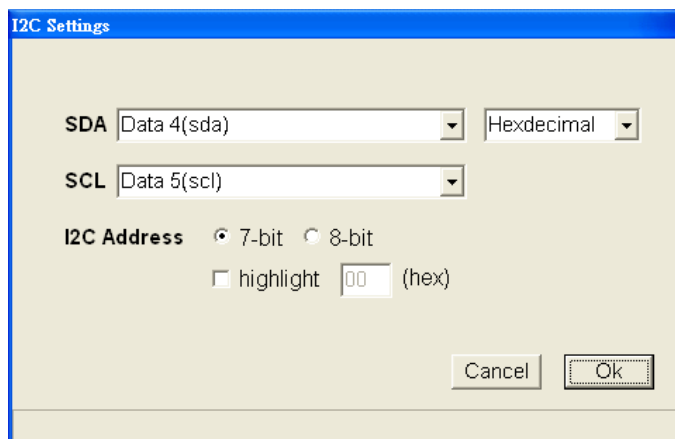
I2C (Inter-Integrated Circuit) bus is a low speed bidirectional serial bus developed by Philips (now NXP). Only two signals, SDA (Serial Data Line) and SCL (Serial Clock), are used by I2C bus. I2C has standard, fast, and high speed transfer modes, supporting transfer rates up to 100Kbps, 400Kbps, and 3.4Mbps, respectively. LA-08 can decide all mentioned modes. I2C uses 7-bit address so there can be at most 128 slaves connect to the same master (host). 8-bit address is sometimes used.

I2C analyzer settings includes (1) choose signal sources for SDA and SCL, (2) choose hex or ASCII for decoded data, (3) choose 7- or 8-bit address format, and optional (4) highlight transfers of a specific I2C slave.

Decoded data is shown above SDA signal waveform. Solid-filled rectangles represent start condition (including address) or stop condition. A yellow rectangle means writing and a blue rectangle means reading; a red rectangle, however, means NACK (Not Acknowledge). Below is an example of decoded I2C transfer.

SPI Analyzer
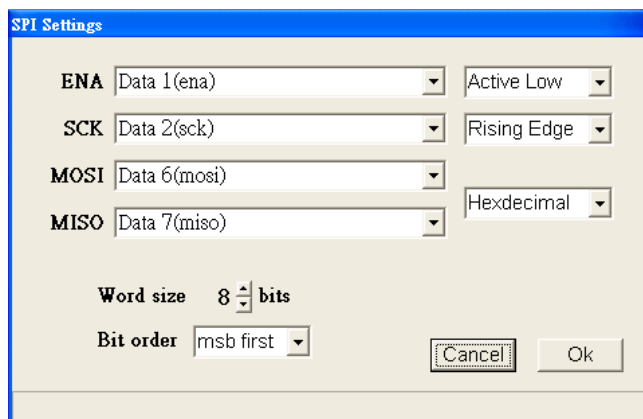
SPI (Serial Peripheral Interface) is a synchronous full-duplex serial transfer protocol. SPI employs four signals: ENA (enable, also called SS–Slave Select), SCK (Serial Clock), MOSI (Master Out Slave In), and MISO (Master Out Slave In).

SPI analyzer settings includes: (1)ENA signal select and polarity (active low or active high) setting, (2)SCK signal select and active edge (rising or falling edge) select, (3) MOSI/MISO signals select and data format, (4)word size in bits, and (5) bit order. The following figure is an example of decodes SPI MOSI/MISO data.


1-Wire Analyzer
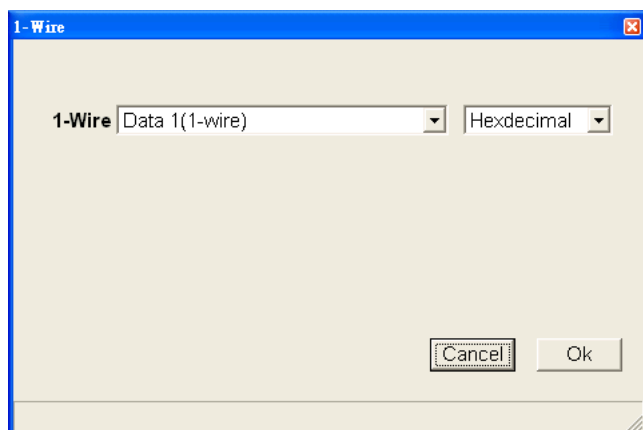
1-wire is a bus protocol that provides low-speed data, signaling, and power over a single signal. LA-08 decodes data bits and groups eight bits into one byte. The SearchROM (0xF0) command is recognized by LA-08. If one is seen by LA-08, the subsequent selected address will be decoded accordingly.

LA-08's 1-Wire analyzer supports 1-wire communication in over drive speed.

DCC Analyzer
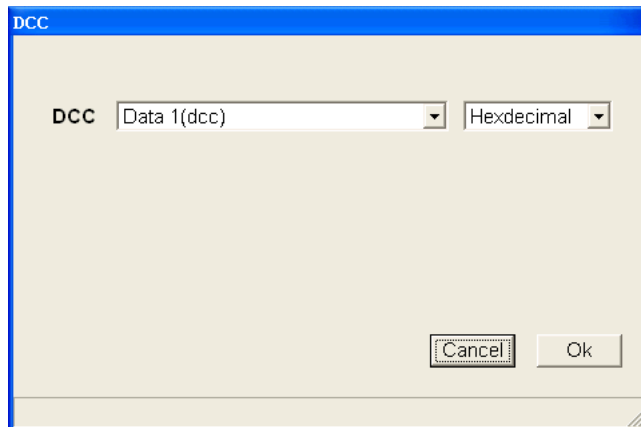
DCC (Digital Command Control) is a protocol to operate model railways digitally. Note that DCC signal voltage can be as high as ±27V. Using an optocoupler to isolate the high voltage from LA-08 is recommended. Please contact us for more detail.

CAN Analyzer

CAN (Control Area Network) uses differential signal pair. A transceiver IC, such as Microchip MCP2551 or NXP (Philips) TJA1050, is needed for LA-08 to correctly acquire CAN signal.

Connect one of LA-08's data input pin to the transceiver's receive data out (RXD) pin. LA-08 supports CAN bit rate up to 1Mbps. LA-08 sampling rate should be at least 10 times faster than CAN bus bit rate.

An example of decoded CAN traffic is as follow.

   CAN identifier (id). An 11-bit standard id is shown as a 3-digit hex number; whereas a 29-bit extended id is shown as an 8-digit hex number. A remote frame is denoted by yellow color.

`8`   DLC, data-length code

`00`   Data byte

`3A1B`   15-bit CRC represented by a 4-digit hex number

Error conditions, such as bit-stuffing error, CRC error, and no acknowledge are denoted by red nodes.

I2C Master

I2C Master is to emulate an I2C host (controller) and to provide a user interface for the user to send read/write commands to slaves using LA-08. I2C master employs a fixed SCK rate of about 10kHz. Use system menu to activate I2C Master's control panel.

You have to connect two pins of LA-08 to the SDA and SCL pins of the I2C slave. LA-08's ground pin has to be connected to the slave, too. LA-08 has internal pull-up resistors so there's no need to add external pull-up resistors. The I2C slave, however, has to be properly powered by some DC source..

Left part of the panel contains settings for SDA and SCL signal sources and I2C address format (7- or 8-bit). There is also a command input box, where one can type in I2C commands, and hit ENTER key to send the command to I2C slaves. The result of the command will be shown above.
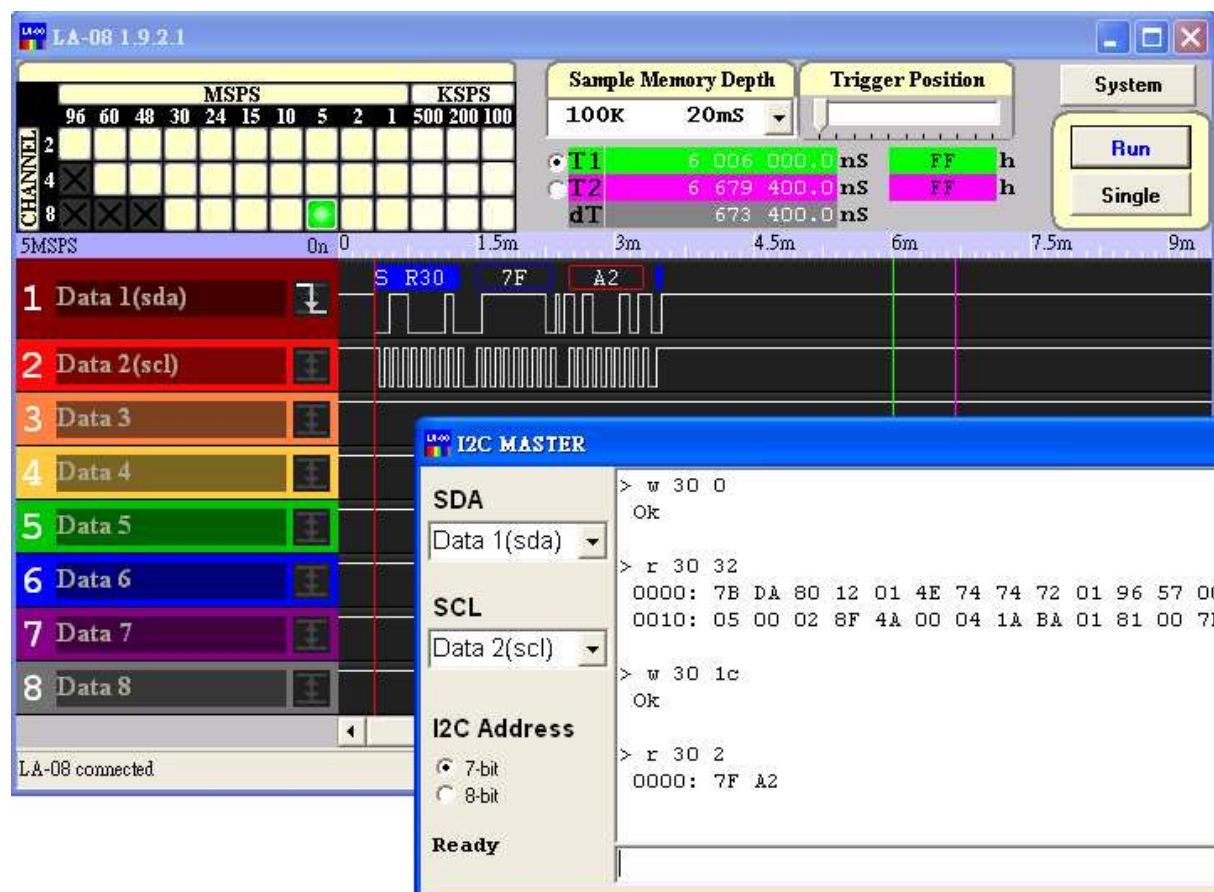
There are two commands, `r` and `w`, meaning read from and write to an I2C slave, respectively.

`w <addr> <data byte(s)>`

    The `w` command writes data to the I2C slave with address `<addr>`. `<addr>` is `7 or 8-bit hexadecimal.` `<data byte>` is a sequence of one or more data bytes in hexadecimal.

`r <addr> <n>`

    The `r` command reads *<n>* bytes from the I2C slave with address *<addr>*, where `<n> is a decimal number.`

Above figure depicts a demo that four commands are issued to an OmniVision OV9655 camera module. The camera module has an I2C-like bus called SCCB and responses to (7-bit) address 0x30.

(1) w 30 0   write 0,
(2) r 30 32   read 32 bytes; get 78 DA 80 12…
(3) w 30 1c   write data bye 1C,
(4) r 30 2   read two bytes; get 7F A2.

1-Wire Master

1-Wire is a device communications bus system that provides low-speed data, signaling, and power over a single signal. LA-08's 1-Wire Master emulates a 1-Wire host (controller). For some systems, a 5KΩ external pull-up resistor may be needed for the 1-Wire bus to work properly.

LA-08's 1-Wire Master supports the following commands.
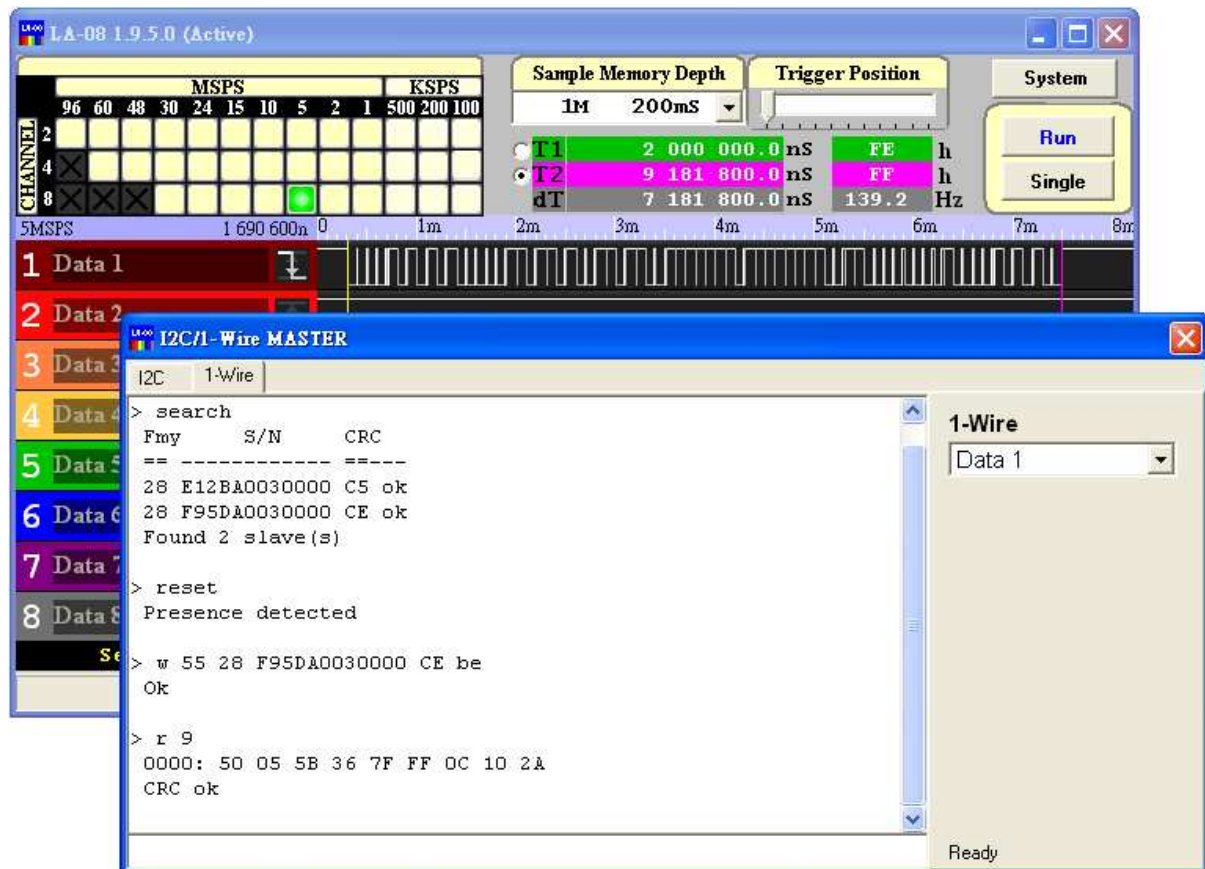
(1) **RESET**

   Send a reset pulse (500 uS) over the bus, and wait for a presence pulse.

(2) **SEARCH**

   Search and list the ROM Registration Number of each device, by performing a number of
   Search ROM (0xF0) commands. A ROM Registration Number is 64-bit long, containing a
   one-byte family code (Fmy), a 6-byte device-unique serial number (S/N), and a one-byte CRC.
   Each CRC will be checked automatically.

(3) **W <data byte(s)>**

   Write one or more data bytes to the device(s), where <data byte(s)> is a sequence of hex numbers.
   Total number of data cannot exceed 32 bytes.

(4) **R <_n_>**

   Read _n_ bytes from a device, where n is a decimal number between 1 and 32. CRC verification is
   enabled automatically if _n_>4, and the last byte is assumed to be the CRC byte.

(5) **Wb <data bit(s)>**

   Write bit string <data bit(s)> to the device.

(6) **Rb <_n_>**

Read *n* bits from the device.

Note that all characters are case insensitive. There is also a CLS command which clears output display.

1-Wire Master does not support overdrive mode.

GPIO+PWM

Each of LA-08's right pins can be configured to be an output pin or an input pin. If a pin is to be used as an output pin, the associated Output Enable checkbox has to be checked, and the Master Output Enable button has to be switched on, too. Any pin that is not output enabled is an input pin.


LA-08 can also generate PWM (pulse width modulation) waveforms of 1.25KHz frequency on any of the eight pins. The 800 us period of the PWM waveform consists of a high pulse and a following low pulse. A value between 0 and 16 is associated with each PWM channel, which sets the width of the high pulse to (*value*/16)*800uS. A value of 0 is all low; and a value of 16 is all high.

GPIO or PWM pins output 3.3V for logic 1 and 0V for logic 0, with output V_{OH} at 2.4V@2mA and V_{OL} at 0.8V@2mA. PWM time accuracy is ±1.5uS.
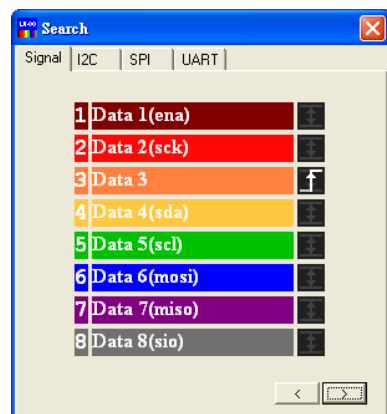
Search

You can search a certain signal pattern or decoded value if an analyzer is enabled. To search a certain signal pattern you click the Signal tab and set the pattern you'd like to look for. Setting of signal pattern is similar to that of the trigger condition. You can also search an analyzer's decoded data at one of five conditions, <, <=, =, >=, and >, meaning less than, less than or equal to, equal to, greater than or equal to, and greater than. For I2C, you can search only the data of a specific slave.
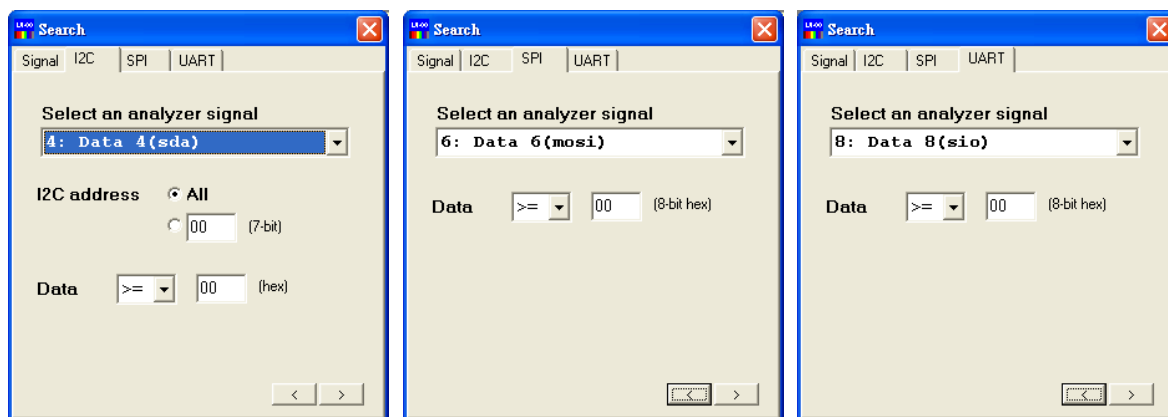
Click the > button to find the next match and < for the previous match. If a match is found, the current cursor will be moves to that point.

Notices For Using High Sampling Rate

LA-08 supports fastest sampling rates of 30MSPS@8ch, 60MSPS@4ch, and 96MSPS@2ch, which are the fastest among similar products. When LA-08 is acquiring data at such a high sampling rate, sometimes there might be spontaneous delays on the USB, causing LA-08 failed to acquire data in time. Spontaneous delays can be minimized:

※ Connect LA-08 directly to the PC. Do no use a USB hub.

※ Disable power management or power saving features that slows down CPU speed.

※ Avoid using other USB device on the same root hub.

If unfortunately a spontaneous delay occurs, LA-08 will discard acquired sample points and automatically restart data acquisition procedure.

Contact Us

※ If you have any question or problem, please feel free to contact us: contact@ideofy.com