



SUMMARY OF LIGHTWARE'S OPEN API ENVIRONMENT

Introduction

What is an API?

An Application Programming Interface (API) is a set of protocols, commands, functions and objects that programmers can use to create software or interact with an external system.

The API developed by Lightware Visual Engineering for its video signal management equipment is an open environment protocol, where every bit of data is openly available for higher level management, control and monitoring systems. The protocol descriptions are openly available and the set of protocols typically used in a given device is always included in the product's User's Manual.

LW2 and LW3 Protocol Sets

There are two sets of protocols of Lightware API system: LW2 is a simpler, but very definite set of protocols, while LW3 is more sophisticated, allowing fine-tuning of processes in more detail. These protocols are present in the Lightware devices, no additional purchase or subscription are necessary to use them. To check the current LW2 or LW3 communication in the devices, the freely downloadable Lightware Device Controller software can be used to connect to the Lightware device over one of the available connections. The current communication and settings will appear in the terminal window.

Lightware API Development

The LW2 protocol set is released in 2006 with the first generation matrix switchers and distribution amplifiers. In most of Lightware's more recent products a reduced set of LW2 reference is included to maintain backwards compatibility.

LW3 is a newer and much more capable protocol first released in 2012, it is transparent, browsable, queryable and can be parametrized, and was created to serve new technologies demanding a wider scale of parametrization. LW3 has a tree structure and based on a very similar principle, basically most function works the same way, as the commands, paths and parameters are the same.

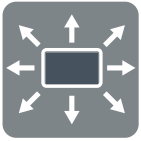
The commands can be sent over various types of connections including Ethernet, serial RS-232 and USB – depending on the capabilities of the given device.

Safe and Simple

The applicable parameters are adjustable on a wide scale, nevertheless for safety and security limits are also set, in order to avoid causing permanent harm to a device. Both sets of protocol are uncomplicated and designed to be very user friendly, it is only at the most rare occasions when in extreme cases longer command lines need to be used. Both LW2 and LW3 can query and modify the most important properties and settings of a device by sending commands:



10 Advantages of the Lightware Protocols



Complex controlling and monitoring the features of Lightware devices

From the Input port switching to the hexadecimal-formatted message sending.



Live protocol browsing by the freely available Lightware Device Controller (LDC) software

From the live terminal to the tree structure.



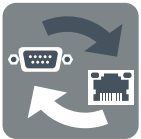
All-in-one commands

Changing the same property at all ports by sending only one command (e.g. changing the I/O crosspoint).



Transparent Ethernet

Direct connection to remote Ethernet devices (e.g. source or sink devices).



Serial-Ethernet bi-directional signal conversion

Use the Command Injection mode to extend RS-232 serial data.



Subscription

Getting a change message automatically if a parameter is changed in the background.



Monitoring and identifying potential twisted pair cable issues

By the TPS Cable Diagnostic Tools.



Monitoring the status of the connected devices, cables, and signals of each I/O port

Signal present, +5V present, hotplug detection.



Querying and changing the video parameters of the signals

Timing, frequencies, scan mode, HDCP encryption, color space, audio sample rate, and many more.



Configurable analog audio parameters

Volume, Gain, Balance, Treble, Bass settings.

Lightware Protocol #2 (LW2)

The protocol is based on a fixed set of commands which is open and available in the User's Manual of the devices. LW2 protocol can be found mainly in the first generation of Lightware matrix switchers, distribution amplifiers, and in many new products – for compatibility reasons. The user can connect to the desired device through Ethernet, RS-232, or USB port.



Protocol Rules

- Commands are accepted by surrounding curly brackets - {}.
- The response data is surrounded by round brackets - () - only if a command was successfully executed.
- All input commands are converted to upper-case, but the response may contain upper and lower-case letters.
- Carriage Return (Cr) and Line Feed (Lf) are followed by the responses.
- Use the TCP port no. 10001 when using LW2 protocol over Ethernet.

Sent command is **red**, response is **blue** in the following examples.

Please note: The commands may differ in the devices as the parameters and values are set to the given device. If you need the exact syntax of a command please refer to the Programmer's Reference chapter in the User's Manual of the device.

LW2 Commands (Extraction)

Switching an Input to an Output

```
▶ {1@5}
◀ (005 101)CrLf
```

Explanation: Input 1 is switched to the Output 5.

Batch Switching

The device is able to switch multiple outputs exactly at the same time. To do this, the normal switch commands have to be used. If the switch commands arrive at the device with less than 10 milliseconds delay, then the commands are collected and the changes are executed together. Example for batch switching:



```
▶ {02@01}{+06}{05@04}
◀ (001 102)CrLf
◀ (0MT06)CrLf
◀ (004 105)CrLf
```

Explanation: Three commands have been sent together to the device: switching Input 2 to Output 1, unmuting Input 6 and switching Input 5 to Output 4. The responses are sent separately.

Displaying the Crosspoint Status (View Connections)

Viewing all outputs' connections results in different response length, because it depends on the number of the outputs. Below example is about a matrix router with 8 outputs.

```
▶ {vc}
◀ (ALL M01 L01 01 01 02 02 02 U02)CrLf
```

Explanation: The eight groups mean the eight output ports from Output 1 to Output 8. In this particular example Input 1 is connected to Output 1-4 and Input 2 is connected to Output 5-8. M: muted; L: locked; U: muted and locked output.

Loading a Preset

Crosspoint presets can be saved and loaded which allow changing the desired I/O connections by pre-programmed settings. Preset loading does not affect the locked outputs.

```
▶ {%4}
◀ (LPR04)CrLf
```

Explanation: Preset nr. 4 has been loaded.

Querying the Status of the Input Ports

```
▶ {isd}
◀ (ISD 110000001)CrLf
```

Explanation: The response length depends on the device. Above response shows the device has nine input ports (Input 1 to Input 9 in order). '1' means source is connected to the input port (+5V is present). Thus, sources are connected to Input 1, Input 2, and Input 9. No source is connected to the other ports.



Querying the IP Address Settings

```
▶ {ip_config=?}
◀ (IP_CONFIG=0 192.168.2.106 10001 255.255.000.000 192.168.002.001)CrLf
```

Explanation: Static IP address is set ('0'), followed by the current IP address, the TCP port number, subnet mask and gateway address. The settings can be changed by the same command defining the necessary parameters.

Querying the Health Status

```
▶ {st}
◀ (ST CPU 3.32V 5.03V 3.05V 5.03V 12.11V 31.6C)CrLf
◀ (ST FAN#1 1530RPM)CrLf
◀ (ST FAN#2 1530RPM)CrLf
```

Explanation: The response depends on the device type. Above response shows the measured 3V, 5V, and 12V values as well as the internal temperature (31.6°C). Two fans are installed in the device, their measured speed is listed.

Querying the Product Type

The identification of the device (read-only) can be queried as follows:

```
▶ {}
◀ (I: MX-FR17)CrLf
```

Changing the EDID on the Input Port

```
▶ {e5:f10}
◀ (E_SW_OK)CrLf
...delay...
◀ (E_S_C) CrLf
```

Explanation: Above examples shows the EDID nr. F10 has been emulated on the E5 (Input 5) port. F10 is a factory pre-programmed EDID that is read-only but you can create a custom EDID or copy an EDID from a sink device.

Lightware Protocol #3 (LW3)

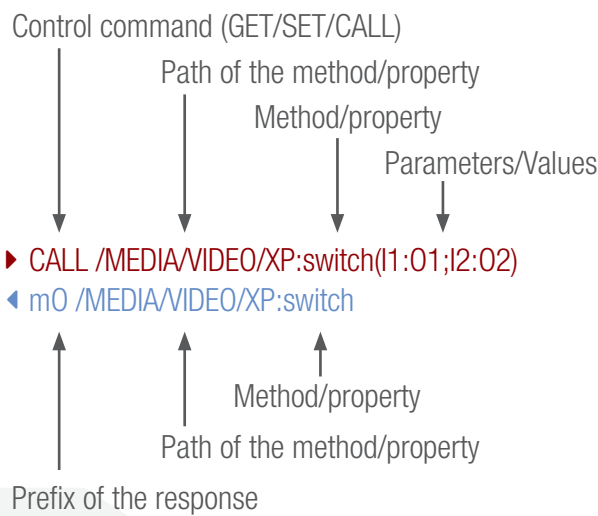
The Lightware Protocol #3 (LW3) is implemented in almost all new Lightware devices (matrix switchers, signal extenders and distribution amplifiers) since 2012. The protocol is ASCII-based and all commands are terminated with a carriage return (Cr, 'r') and line feed (Lf, 'n') pair. It is organized as a tree structure that provides outstanding flexibility and user-friendly handling with 'nodes', 'properties' and 'methods'. The Advanced View of the Lightware Device Controller software is the perfect tool for browsing and learning how the LW3 protocol can be used in practice.



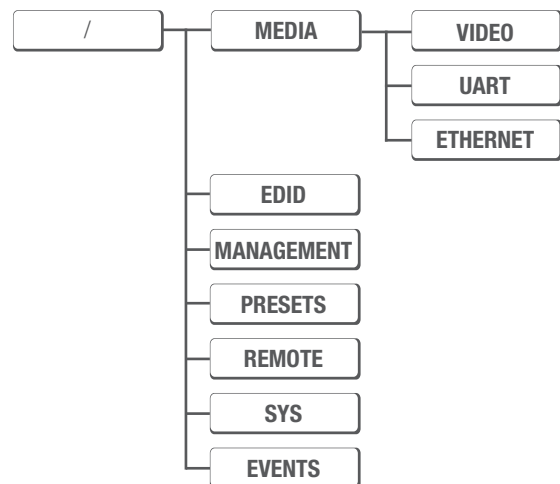
Protocol Rules

- All names and values are case-sensitive.
- The nodes are separated by a slash ('/') character.
- The node name can contain the elements of the English alphabet and numbers.
- Use the TCP port no. 6107 when using LW3 protocol over Ethernet.
- When a command is issued by the device, the received response cannot be processed by the CPU.
- The path of a node has to contain all parent nodes from the root node.

The LW3 Command Structure



The LW3 Tree Structure (HDMI20-OPTC-TX series)



Control Commands

- **GET:** It can be used to get the child nodes, properties, and methods of a node or the value of a property.
- **SET:** The setter command can be used to modify the value of a property.
- **CALL:** A method can be executed by the 'CALL' command.

The Prefix of the Response

The prefixes are defined to supply information about the response and the executed command like:

- **m0:** A successful method execution ('method OK').
- **mE:** Unsuccessful method execution (an error code is followed).
- **pR:** Read-only property (e.g. when querying a parameter).

Lightware's Open API Environment

Subscription

Subscribing to a node means that the user will get a notification if any of the properties of the node is changed. These notifications are asynchronous messages and hence, they are useful to keep the client application up to date without receiving any unwanted information. Example:



▶ OPEN /MEDIA/VIDEO/*

◀ o- /MEDIA/VIDEO/*

If a property is changed under the /MEDIA/VIDEO node (including all child nodes) a 'change message' will be sent:

◀ CHG /MEDIA/VIDEO/QUALITY.QualityMode=video

(Sending the 'OPEN' command without the * character the child nodes will not be checked, only the /MEDIA/VIDEO node.)

The Manual

For every node, property and method in the tree there is a manual. The manual is a human readable text that describes the syntax and provides a hint how to use the primitives:

▶ MAN /MEDIA/VIDEO/O1.Pwr5vMode

◀ pm /MEDIA/VIDEO/O1.Pwr5vMode ["0" | "1" | "2"] 0 - Auto, 1 - Always On, 2 - Always Off

The Appearance in Lightware Device Controller (Advanced View)

Terminal Window

Listing all the executed commands and responses.

LW3 Protocol Tree

Showing the whole structure of the nodes and child nodes in the LW3 tree.

Properties and Methods

Listing the available properties and methods with the current values.

LW3 Commands (Extraction)

Querying the Crosspoint Status (View Connections)

- ▶ `GET /MEDIA/VIDEO/XP.DestinationConnectionList`
- ◀ `pr /MEDIA/VIDEO/XP.DestinationConnectionList=1;3;1;3`

Example: The response shows four outputs are in device: Input 1 is connected to Output 1 and Output 3, while Input 3 is connected to Output 2 and Output 4.

Switching an Input to an Output

- ▶ `CALL /MEDIA/VIDEO/XP:switch(4:01)`
- ◀ `m0 /MEDIA/VIDEO/XP:switch`

Explanation: Input 4 is switched to Output 1. The whole crosspoint can be changed by sending this commands as more switching parameters can be inserted in the round brackets.



Querying the Input Video Signal Presence

- ▶ `GET /MEDIA/VIDEO/I1.SignalPresent`
- ◀ `pr /MEDIA/VIDEO/I1.SignalPresent=1`

Explanation: '1' means signal is present at Input 1. When the response value is '0', no signal is present.



Querying the HDCP State

- ▶ `GET /MEDIA/VIDEO/I1.HdcpState`
- ◀ `pr /MEDIA/VIDEO/I1.HdcpState=1`

Explanation: The value of the property is '1' which means HDCP encryption is enabled at Input 1. (HDCP is disabled when the value is '0'.) Use the SET command to change the value of the property.

Muting one or more Input ports

- ▶ `CALL /MEDIA/VIDEO/XP:muteSource(1;4)`
- ◀ `m0 /MEDIA/VIDEO/XP:muteSource`

Explanation: Sending the above command the Input 1 and Input 4 ports will be muted.

Querying the Status of the Input Ports

- ▶ `GET /MEDIA/VIDEO/XP.SourcePortStatus`
- ◀ `pr /MEDIA/VIDEO/XP.SourcePortStatus=T000F;M000A;T00EF;L00AA;U000A;T000A`

Explanation: The status of the input ports can be queried by one single command. Above response contains six groups (Input 1-6) separated by semicolons carrying the following information:

- **Letter:** T=unmuted and unlocked; M=muted; L=locked; U=locked and muted
- **HEX code** (2 bytes): showing different statuses of audio embedding, HDCP, connection, and signal presence.

The above response contains the 'T00EF' value which refers to the Input 3 (this is the third group):

- **T:** the port is unmuted and unlocked
- **00:** reserved characters
- **E:** embedded audio is present
- **F:** source is connected, signal is present

Querying the Health Status (CPU Temperature)

▶ GET /MANAGEMENT/STATUS.CpuTemperature

◀ pr /MANAGEMENT/STATUS.CpuTemperature=42 C; 0;75; 0;79;22;54;

Explanation: According to the first value the current temperature of the CPU is 42°C.

Querying the Health Status (5V)

▶ GET /MANAGEMENT/STATUS.5VMain

◀ pr /MANAGEMENT/STATUS.5VMain=5.06 V;4.50;5.50;4.28;5.77;4.12;5.09;

Explanation: According to the first value the current Voltage of the '5V' is 5.06V.

Cable Diagnostics

▶ GET /REMOTE/S1.HdbtStat

◀ pr /REMOTE/S1.HdbtStat=-22; -22; -23; -21

Explanation: The response contains the measured error rates of the four transmission channels (twisted pair) in the CATx cable. The values are in dB; the lowest the best. ('S1' node means Source 1 = Input 1).



▶ GET /REMOTE/S1.TxBer

◀ pr /REMOTE/S1.TxBer=1e-10

Explanation: The value of the property is the Bit Error Ratio (BER) of the transmitter side. The 1e-10 (10^{-10}) value means there is 1 bad pixel on average after transmitting 10^{10} pixels; e.g. there is 1 bad pixel in every 80 seconds when the transmitted signal is 1920x1080p @ 60 Hz.

Querying the Video Input Autoselection Settings

The feature means that the output port can be set to select an input port automatically. The settings allow different approach how an input is selected to the output. See more information in the User's Manuals of the devices.

▶ GET /MEDIA/VIDEO/XP.DestinationPortAutoselect

◀ pr /MEDIA/VIDEO/XP.DestinationPortAutoselect=EL

Explanation: 'E' means the Autoselect feature is enabled, 'L' means 'Last detect mode' is the active mode. The setting means: always the last connected signal will be selected to the given output automatically.

Changing the Video Input Autoselection Settings

▶ CALL /MEDIA/VIDEO/XP:setDestinationPortAutoselect(O1:EP)

◀ mO /MEDIA/VIDEO/XP:setDestinationPortAutoselect

Explanation: The Autoselect mode has been set at Output 1 as follows:

- **E:** Autoselect is enabled.
- **P:** Priority mode is active (always the highest priority active input is selected to the output).

Setting the Volume Level of the Analog Audio Output Port

▶ SET /MEDIA/AUDIO/O2.VoluedB=-15

◀ pw /MEDIA/AUDIO/O2.VoluedB=-15.00

Explanation: The above command can be used to set the volume level to a specific value. You can also change the volume between 0% and 100% by using the 'VolumePercent' property.



Lightware's Open API Environment

Querying the Product Name

- ▶ GET /.ProductName
- ◀ pr /.ProductName=VINX-120-HDMI-ENC

Explanation: The response contains the product name (read-only parameter).

Resetting the Device

- ▶ CALL /SYS:reset()
- ◀ m0 /SYS:reset

Explanation: The device is restarted, the current connections (Ethernet, RS-232, USB) are terminated.

Querying the DHCP State (Dynamic IP Address Setting)

- ▶ GET /MANAGEMENT/NETWORK.DhcpEnabled
- ◀ pw /MANAGEMENT/NETWORK.DhcpEnabled=true

Explanation: The property is 'true' that means the IP address of the device is set by the DHCP server of the LAN.

Setting a Static IP Address

- ▶ SET /MANAGEMENT/NETWORK.StaticIpAddress=192.168.0.85
- ◀ pw /MANAGEMENT/NETWORK.StaticIpAddress=192.168.0.85

Explanation: A static IP address is set; it will be valid only if the 'DhcpEnabled' property is set to 'false'.

Setting the BAUD Rate of the RS-232 Port

- ▶ SET /MEDIA/UART/P1.Baudrate=2
- ◀ pw /MEDIA/UART/P1.Baudrate=2

Explanation: The BAUD rate setting is '2' which means 9600 BAUD; the '0' and '7' values mean different BAUD rates.

Message Sending over the RS-232 Port

- ▶ CALL /MEDIA/UART/P1.sendMessage(C00/r/n)
- ◀ m0 /MEDIA/UART/P1.sendMessage

Explanation: A message will be sent out via the P1 (local) serial port; the message is 'C00' and closed by /r/n. It can be also sent via another serial port over the TPS connection, thus, remote devices can be controlled by sending commands.

Toggle the Level of a GPIO Pin

Certain devices contain a GPIO (General Purpose Input/Output) port with adjustable pins. If the GPIO pin direction is set to Output, the Output level can be toggled between high and low:

- ▶ CALL /MEDIA/GPIO/P1.toggle(1)
- ◀ m0 /MEDIA/GPIO/P1.toggle

Explanation: the output level has been toggled. The feature can be used as a trigger e.g. for a connected relay.

Message Sending over Ethernet

- ▶ CALL /MEDIA/ETHERNET:tcpText(192.168.0.11:9715=C00)
- ◀ m0 /MEDIA/ETHERNET:tcpText

Explanation: The 'C00' message will be sent over Ethernet to the indicated IP:port address.



LW3 Programmer's Reference – Locations

More or less the protocol is the same in the devices but since they contain different features the available parameters, the path of certain nodes may be also different. Therefore, we always recommend to open the LW3 Programmer's Reference chapter in the User's Manual of the given device. Below you can find direct links to the corresponding chapters in the documents:

MX2-8x8-HDMI20-AUDIO	Chapter 8
MMX6x2-HT200 series	Chapter 7
MMX4x2 series	Chapter 7
UMX-TPS-TX100 series	Chapter 7
HDMI-TPS-TX200 series	Chapter 7
HDMI-TPS-RX110AY	Chapter 7
HDMI20-OPTC-TX/RX series	Chapter 6
HDMI-3D-OPT-TX/RX series, SW4-OPT-TX240RAK	Chapter 7
VINX series	Chapter 5
MODEX series	Chapter 7
25G series	Chapter 5