PJLink Projector

PJLink Projector Control Notes

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Introduction

PJLink is a unified standard for operating and controlling data projectors. The PJLink Standard is controlled and maintained by the Japan Business Machine and Information Systems Industrial Association (JBMIA). The current standard as of this date is defined as PJLink Class 2.

PJLink Verison 1.00 Specifiation was originally published 2005-07-04 specified as Class 1. The latest version of Class 1 Specification document is Version 1.04 published on 2013-12-10.

PJlink Version 2.00 Specification was originally published 2017-01-31 specified as Class 2.

Disclaimer

The PJLink Communications Specification as defined by JBMIA is the official documented standard and will override any deviations between this document and official standards.

This document is written as my notes on controlling a PJLink-compatible projector and is in no way a representative document recognized by, association with, or even known about by JBMIA or their representatives.

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Communication Protocol

This section outlines the communication protocol for communicating with client software.

Command Communication Method

Normal communication between server (projector or terminal) and client (controller) software will be the TCP network protocol using port 4352.

Since the PJLink specification does not specify the number of controllers that can connect to a projector (it is listed as "undefined behavior"), assume that only 1 controller can connect at a time.

NOTE: This is dependent upon the hardware manufacturer; there are some projectors that allow more than one controller to connect at the same time, although behavior may appear erratic if multiple controllers attempt to change the same setting at the same time.

Status Notification Communication Method

PJLink Class 2 extends some communication using UDP port 4352 for status information. In this case, the projector is notifying the controller of a state change.

Once a controller has obtained a connection to the projector, the following non-definitive state changes will be sent to the controller:

- Lamp power state transition (POWR)
  - Standby (off) -> warmup
  - Warmup -> on
  - On -> cooldown
  - Cooldown -> standby (off)
- Error condition change (ERST)
- Change of video source (input) switching is complete (INPT)
- When PJLink communication is ready (?)

NOTE:

Not sure about the last one since the definition sounds like controller already must be connected before state change notifications can occur. However, if the flowchart is describing UDP broadcast rather than UDP unicast then this would be good. Need to see how some projectors accomplish this one.

Packet Format

The following table defines selected ASCII codes:

Code	Mnemonic	Description
0x0d	<cr>	Carriage Return
0x20	<space>	Space
0x3d	=	Equals character

Packet size will not exceed 136 bytes in length including the terminating <cr> byte.

All PJLink commands will be ASCII codes unless otherwise noted.

NOTE: Header is defined as the start byte plus the class byte.

Structure of the packet will consist of the following:

Start	Class	Command	Separator	Transmission Body	Terminator
1 byte	1 byte	4 bytes	1 byte	128 bytes or less	1 byte

Start: All PJLink command lines, without exception, will start with "%" (percent) character.

Class: Indicate which PJLink class the command belongs to.

Command: ASCII string indicating command. All commands will be case-insensitive.

Separator: <space> for commands from controller

"=" (equal) character for replies from projector.

Transmission: Command option from controller or status/reply from projector. Arbitrary strings will be treated in a case-insensitive manner in accordance with command specification.

Terminator: Terminator, without exception, will be the carriage return <cr> character code.

Packets can be broadly defined into three categories: set commands, get commands, and replies.

- Set commands: Command from the controller to change some aspect of the projector.
- Get commands: Command from the controller to return information or status about the projector.
- Replies: Responses that the projector returns to the controller after a command.

Some commands are both set and get commands; the only difference is the transmission body parameter that is used.

Example command/query packet:

Start	Class	Command	Separator	Transmission Body	Terminator
%	1	....	<space>	...	<cr>

Example string: "%1CLSS<space>?<cr>"

Example response packet:

Start	Class	Command	Separator	Transmission Body	Terminator
%	1	....	=	...	<cr>

Example string: "%CLSS=1<cr>"

Response Packets

Response packets are packets sent back from projector after a command has been received. The following table defines the response packets that are not information request packets:

Response	Definition	Notes
OK	Successful execution	NOTE: some commands may actually return 'OK' while still in the process of completing command.
ERRA	Authentication Failure	This will only be seen if PJLink authentication is required and authentication failed.
ERR1	Undefined Command	Command received is not a valid command.
ERR2	Out of Parameter	One or more parameters of command are not within specifications.
ERR3	Unavailable Time	Projector is currently busy with the previous command or a change of function. Try again later.
ERR4	Projector/Display Failure	There is a problem with the projector/display and cannot continue to operate properly.

Example 1: Set lamp power to ON

Controller sends command: '%1POWR<space>1<cr>'

Projector possible relies: '%1POWR=OK<cr>' (Successful)

'%1POWR=ERR3<cr>' (Projector is busy, try command again later)

'%1POWR=ERR4<cr>' (Projector failure – call technicial)

CommandDetails

The table below list the commands defined for PJLink packets that projectors will accept.

Command: Command from controller to projector

Class: PJLink class of command

Protocol: TCP or UDP

Parameter: Parameter of command

Description: Description of command and parameter usage

Command	Class	Protocol	Parameter	Description
AVMT	1	TCP	?	Query current shutter and audio status
			10	Shutter open (video mute off)
			11	Shutter close (video mute on)
			20	Audio off (audio mute on)
			21	Audio on (audio mute off)
			30	Shutter open and autdio on (video and audio mute off)
			31	Shutter close and audio off (video and audio mute on)
CLSS	1	TCP	?	Query PJLink class support
ERST	1	TCP	?	Query current erorr status
FILT	1	TCP	?	Query filter usage time (in hours)
FREZ	2	TCP	?	Query freeze (static picture) status
			0	Unfreeze screen
			1	Freeze screen (static display)
INF1	1	TCP	?	Query manufacturer name
INF2	1	TCP	?	Query product name
INFO	1	TCP	?	Query other information (usually set by end-user)
INNM	2	TCP	?TN	Query input (video source) name. See INPT for TN description TN will be the same as returned from INST command. Class 1 defines video source names in PJLink Terminal Guidelines. Class 2 allows manufacturers to set names assigned to video sources.
INPT	1,2	TCP	?	Query current video source input

			TN	Select input source T = Input type N = Input number of type T T = 1 (RGB) T = 2 (Video) T = 3 (Digital) T = 4 (Storage) T = 5 (Network) T = 6 (Internal) (Class 2 only) N = [1..9] (Class 1) N = [1..9a..z] (Class 2 only)
INST	1,2	TCP	?	Query installed input sources (video inputs)
IRES	2	TCP	?	Query current input resolution
LAMP	1	TCP	?	Query lamp(s) status (in hours) and lamp on/off status.
MVOL	2	TCP	0	Decrease microphone volume by 1 level
			1	Increase microphone volume by 1 level
NAME	1	TCP	?	Query projector/display name (set by end-user)
POWR	1	TCP	?	Query current lamp power status
			0	Turn lamp power off/standby
			1	Turn lamp power on
RFIL	2	TCP	?	Query filter replacement model
RLMP	2	TCP	?	Query lamp replacement model
RRES	2	TCP	?	Query recommended display resolution
SNUM	2	TCP	?	Query projector serial number
SRCH	2	UDP	<none>	Search start. Packet will only contain "%2SRCH<cr>" NOTE: Response packet is 'ACKN'
SVER	2	TCP	?	Query projector software version
SVOL	2	TCP	0	Decrease speaker volume by 1 level
			1	Increase speaker volume by 1 level

Response Detail

The following table describes the replies that the controller can receive after sending the command:

Reply: Reply from projector to controller

Class: PJLink class of command

Protocol: TCP or UDP

Parameter: Parameter of command

Description: Description of command and parameter usage

Command	Class	Protocol	Parameter	Description
ACKN	2	UDP	<MAC address>	Reply to 'SRCH' command only. Parameter is the MAC address of the projector fomratted as xx:xx:xx:xx:xx:xx
AVMT	1	TCP	OK ERR2 ERR3 ERR4	After set command
			NN ERR3 ERR4	After query command: 11 – Shutter closed (video mute on) 21 – Audio off (audio mute on) 30 – Shutter open/audio on (Video/audio mute off) 31 – Shutter closed/audio off (Video/audio mute ON)
CLSS	1	TCP	N ERR3 ERR4	After query command: N = 1 (PJLink class 1) N = 2 (PJLink class 2) NOTE: Although specification is to send only a digit indicating PJLink class, some projector manufacturers have deviated: Standard: "%1CLSS=1<cr>" BenQ: "%1CLSS=Version1<cr>" Optoma: "%1CLSS=Class<space>1<cr>"
ERST	1	TCP	ABCDEF ERR3 ERR4	After query command: A – Fan B – Lamp C – Temperature D – Cover open E – Filter F – Other Value will be one of: 0 – No error or no error detected during function 1 – Warning 2 - Error
	2	UDP	ABCDEF	Status notification from projector. See class 1 query for ABCDEF description

FILT	2	TCP	HHHHH ERR1 ERR3 ERR4	After query command. Filter usage in hours. H = hours of usage from 1 to maximum of 5 digits. H = 0 if not counted by projector. ERR1 if no filter present.
FREZ	2	TCP	OK ERR1 ERR2 ERR3 ERR4	After set command. ERR1 returned if not supported.
			X ERR1 ERR3 ERR4	After query command. ERR1 returned if not supported. X = 0 (Un-freeze screen, continue normal) X = 1 (Freeze screen, show single image)
INF1	1	TCP	<ASCII> ERR3 ERR4	After query command. Manufacturer name. Maximum 32 bytes in parameter. If no manufacturer response is "%1INF1=<cr>"
INF2	1	TCP	<ASCII> ERR3 ERR4	After query command. Model/Equipment name. Maximum 32 bytes in parameter. If no model response is "%1INF2=<cr>"
INFO	1	TCP	<ASCII> ERR3 ERR4	After query command. Other information described by manufacturer. Maximum 32 bytes in parameter. If no information response is "%1INFO=<cr>"
INNM	2	TCP	<UTF-8> ERR2 ERR3 ERR4	After query command. Input terminal name. Maximum 128 bytes in parameter. If no name response is "%2INNM=<cr>" Example 51 (Digital input #1) query: "%2INNM<space>?51" Example 51 reply: "%2INNM=HDMI1<cr>"
INPT	1,2	TCP	OK ERR2 ERR3 ERR4	After set command
			TN ERR3 ERR4	After query command See INPT command for TN description
	2	UDP	NN	Status notification from projector. NN = new video source (input) currently in use.
INST	1,2	TCP	TN ERR3 ERR4	After query command. List of installed video sources (inputs). Each input is separated by a <space>. See INPT for TN description. Maximum of 50 inputs can be listed.

				Maximum 95 bytes in parameter.
IRES	2	TCP	- * WxH ERR3 ERR4	After query command. Current input resolution. Maximum 128 bytes in parameter. W = horizontal resolution in pixels x = lowercase-X (character code 78) H = Vertical resolution in pixels No input reply will be a dash (character code 2d) "%2IRES=-" Unknown signal reply will be an asterisk (character code 2a) "%2IRES=*"
LAMP	1	TCP	HHHHH<space>X ERR1 ERR3 ERR4	Single lamp response. ERR1 indicates no lamp installed. H = lamp hours X = 0 Lamp off X = 1 Lamp on For multiple lamps, repeat above with <space> between lamp status for each installed lamp. NOTE: HHHHH is variable 1 to maximum of 5 digits specifying lamp hours.
LKUP	2	UDP	MAC Address	Status notification from projector – linkup response. MAC address of the projector fomratted as xx:xx:xx:xx:xx:xx
MVOL	2	TCP	OK ERR1 ERR2 ERR3 ERR4	After set command. If volume is maximum and increase requested OR volume is minium and decrease is requested, return is OK. ERR1 returned if no microphone/audio input jack installed.
NAME	1	TCP	<UTF-8 string> ERR3 ERR4	If no name set, then reply is "%1NAME=<cr>" Maximum 64 bytes in parameter.
POWR	1	TCP	OK ERR2 ERR3 ERR4	After set command
			N ERR3 ERR4	After query command N = 0 (Power off/standby) N = 1 (Power on) N = 2 (Cooling down) N = 3 (Warming up)
	2	UDP	N	Status notification from projector N = 0 Cooling down or power off (standby) N = 1 Warming up or power on
RFIL	2	TCP	<UTF-8 ?> ERR3	After query command. Filter replacement model number.

			ERR4	Maximum 128 bytes in parameter. If multiple filter model numbers, separate model numbers by <space>. If no replacement model number reply is "%2RFIL=<cr>"
RLMP	2	TCP	<UTF-8 ?> ERR3 ERR4	After query command. Lamp replacement model number. Maximum 128 bytes in parameter. If multiple lamp model numbers, separate model numbers by <space>. If no replacement model number reply is "%2RLMP=<cr>"
RRES	2	TCP	WxH ERR3 ERR4	After query command. Recommended resolution. Maximum 128 bytes in parameter. W = horizontal resolution in pixels x = lowercase-X (character code 78) H = Vertical resolution in pixels
SNUM	2	TCP	<ASCII> ERR3 ERR4	After query command. Model/Equipment serial number. Maximum 32 bytes in parameter. If no serial response is "%2SNUM=<cr>"
SVER	2	TCP	<ASCII> ERR3 ERR4	After query command. Software version. Maximum 32 bytes in parameter. If no s/w version response is "%2SVER=<cr>"
SVOL	2	TCP	OK ERR1 ERR2 ERR3 ERR4	After set command. If volume is maximum and increase requested OR volume is minium and decrease is requested, return is OK. ERR1 returned if no speaker/audio jack installed.

Import/Export File Format

Import and export of information about projectors will use XML format.

Manufacturer file format

The PJLink format allows for defining characteristics of a projector for inclusion into the program. All tags/labels will be strings in lowercase.

Filename

The file naming convention will be:

<manufacturer>.xml

where <manufacturer> will be lowercase manufacturer name as returned by the INF1 command. If there are spaces in the name, the spaces will be converted to underscores.

Example: Ricoh International

Filename: ricoh_international.xml

File Structure

```
<?xml version="1.0" encoding="utf-8"?>
<pjlink version="1.0">
    <manufacturer name="<str>">
        <model name="<str>" pjlink_class="<str>">
            <lamp model="<str>" count="<int>" />
            <filter model="<str>" count="<int>" />
            <input>
                <installed list="<str>" />
                <input_11 type="<str>">string</input_11>
                    ...
            </input>
        </model>
    </manufacturer>
</pjlink>
```

- pjlink – Requried root element
  - version – Version of PJLink XML file format (not PJLink class)
- manufacturer – One manufacturer per file
  - name – String name of manufacturer as returned from INF1 command
- model – One or more model elelments per file
  - name – String name of model as returned by INF2 commande
  - pjlink_class – Pjlink class projector supports
- lamp – One element per model
  - model – String replacement model as returned by RLMP
  - count – Integer indicating number of lamps in projector
- filter – One element per model
  - model – String replacement model as returned by RFIL
- input – One element per model. Video source inputs available to projector.
  - Installed - One element per input
    - list – List of installed source inputs as returned by INST
  - input_NN – One or more entries with information about a specific input
    - NN = input number as shown in installed->list
    - Class 1: Entry as defined by PJLink Terminal Guidelines
    - Class 2: Entry as returned by INNM command

File Example

NOTE: File assumes Class 1 terminal so defined input types are describes as in PJLink Terminal Guidelines. Once I can find a Class 2 terminal I'll update to include how that would look.

```
<?xml version="1.0" encoding="utf-8"?>
<pjlink version="1.0">
    <manufacturer name="EIKI">
        <model name="LC100" pjlink_class="1">
            <lamp model="LC100 Lamp" count="1" />
            <filter model="LC100 Filter" count="1" />
            <input>
                <installed list="11 12 21 22 23 31 32" />
                <input_11 type="RGB">BNC</input_11>
                <input_12 type="RGB">SCART</input_12>
                <input_21 type="Video">Composite RCA</input_21>
                <input_22 type="Video">Composite BNC</input_22>
                <input_23 type="Video">S-Terminal</input_22>
                <input_31 type="Digital">HDMI</input_31>
                <input_32 type="Digital">DVI</input_32>
            </input>
        </model>
        <model name="LC200" pjlink_class="1">
            <lamp model="LC200 Lamp" count="1" />
            <filter model="LC200 Filter" count="1" />
            <input>
                <installed list="11 12 21 22 23 31 32" />
                <input_11 type="RGB">BNC</input_11>
                <input_12 type="RGB">SCART</input_12>
                <input_21 type="Video">Composite RCA</input_21>
                <input_22 type="Video">Composite BNC</input_22>
                <input_23 type="Video">S-Terminal</input_22>
                <input_31 type="Digital">HDMI</input_31>
                <input_32 type="Digital">DVI</input_32>
            </input>
        </model>
    </manufacturer>
</pjlink>
```

Revisions

2107-08-01 - Initial specifications

Acknowledgements

ASCII – American Standard Code for Information Interchange

Creative Commons – Maintains the CC license for creative works

IETF – Internet Engineering Task Force

JBMIA – Japan Business Machine Information Systems Industries Association

JSON – JavaScript Object Notation

OpenLP – Open Source church projection software

PJLink – Unified standard for operating and conrtolling data projectors

PJLink Class 1 Documentation

PJLink Class 2 Documentation

Python – Cross-platform programming language

Python JSON – Python 3 JSON standard library module

PyQt – Python support for Qt application framework

Qt – Appliication framework for Graphical User Interface (GUI)

W3C – World Wide Web Consortium

XML – Extensible Markup Language