

Communication Interface Barco DP Projectors

SHORT LIST

Revision	Description	Date
Revision 0	Initial release.	05/04/2006
Revision 1	Update on ethernet communication settings, answer prefix and UDP broadcast	14/08/2008
Revision 2	Update on series 2 projectors	03/08/2009
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Communication protocol

The base for all communication to Barco DP projectors is the Barco LCD/DLP protocol. This protocol has been used on serial communication but is now also used for network based communication. This section explains this protocol.

Communication protocol summary

Start byte	\xfe
Projector address	
Command byte(s)	
Data bytes ^(OPTIONAL)	
Checksum byte	
Stop byte	\xff

- Start byte

The "start byte" informs the projector (in case of transmission) or the computer (in case of reception) that a new data transfer will take place.

- Projector address :

The "projector address" defines the address of the projector the computer wants to talk to (in case of transmission) or the address of the projector that answers (in case of reception).

For Ethernet communication the projector address should be set to \x00. For Serial communication the projector should be set to \x01

- Command byte(s) :

There is at least one command byte to define the action to be performed. Commands that are not often used or complex commands can take more than one byte.

All command bytes that are sent by the computer to get information out of the projector are repeated in the answer-data-transfer of the projector.

- Data bytes^(OPTIONAL) :

Whether the command bytes are followed by one or more data bytes depends on the contents of the command bytes.

(Some commands are not followed by data bytes at all !)

- Checksum byte :

The "checksum byte" is used to detect errors during transmission or reception.

Formula :

Checksum byte

= (Projector address + Command bytes + Data bytes) modulo 256

- Stop byte :

The "stop byte" informs the projector (in case of transmission) or the computer (in case of reception) that the data transfer is complete and that the interpretation of the command and data bytes can start.

Any command byte, data byte or checksum byte that equals \x80, \xfe or \xff has to be converted !

Transmission :

- Instead of \x80, send \x80 followed by \x00.
- Instead of \xfe, send \x80 followed by \x7e.
- Instead of \xff, send \x80 followed by \x7f.

Reception :

- Replace \x80 followed by \x00 with \x80.
- Replace \x80 followed by \x7e with \xfe.
- Replace \x80 followed by \x7f with \xff..

Syntax

■ Characters:

In this manual, all characters are expressed using the C-language syntax :

decimal values	<i>ddd</i>	<i>ddd</i> = 0..255
hexadecimal values	<i>\xhh</i>	<i>hh</i> = 00..ff

■ Negative values/numbers:

The 2s complement number system is used to express negative numbers.

■ Pascal-language string:

A Pascal-language string consists of one or more characters. The first character of the string contains the length of the string. Therefore, a Pascal-language string is limited to 255 characters.

Example : "hello world"

length	\x0b
'h'	\x68
'e'	\x65
'l'	\x6c
'l'	\x6c
'o'	\x6f
' '	\x20
'w'	\x77
'o'	\x6f
'r'	\x72
'l'	\x6c
'd'	\x64

■ C-language string:

A C-language string consists of one or more characters.

The last character of the string is always the NULL (\x00) character. Therefore, the length of a C-language string is determined by the position of the NULL character.

Example : "hello world"

'h'	\x68
'e'	\x65
'l'	\x6c

'l'	\x6c
'o'	\x6f
' '	\x20
'w'	\x77
'o'	\x6f
'r'	\x72
'l'	\x6c
'd'	\x64
NULL	\x00

■ Multi-byte value:

A multi-byte value consists of more than one byte. The first byte is the MSB (see abbreviations).

Example for a 4-byte value:

$$\text{\x01}\text{\x20}\text{\x50}\text{\x30} = \text{\x01} * 256^3 + \text{\x20} * 256^2 + \text{\x50} * 256 + \text{\x30} = 536956976$$

RS 232 or Serial Communication settings

Communication settings summary

Baud rate	115200
Data bits	8
Parity	No
Stop bits	1

- Baud Rate :
Defines the speed of the data transfer.
For DP projectors, this baud rate has a fixed rate of 115200
Data Bits :
Eight data bits are used for each character of the data transfer.
- Parity :
There is NO parity bit used to perform error checking.
- Stop Bits :
One stop bit is used to define the end of a character.

Ethernet communication settings

Introduction

It is possible to communicate with a DP projector over a TCP/IP network. The communication follows a Client/Server model where the projector is the server. This means that the projector responds on requests that are sent by a client.

The projector will not send out requests on its own initiative.

The communication is blocking which means that when a request is sent to the projector, no other requests can be sent until the projector has responded on the first request. The communication blocks for each request.

Making connection with the projector

Overview

Series 1 projectors

Series 1 projectors are listening on TCP port **0xAAA0 (43680)** for incoming connections. The projector IP address can be retrieved by using the Communicator software or Communicator touch panel. Note that the Series 1 DP projectors (DP100, DP90, DP1200, DP1500, DP2000, DP3000), have two IP addresses. One for the main projector controller and one for the Texas Instruments DLP Cinema® front end. The IP address of the projector (main controller) should be used.

To make a connection, you need to create a TCP socket connection with the projector on port 0xAAA0.

Series 2 projectors

Series 2 projectors have a single IP Address. In fact the Texas Instruments DLP Cinema® front end and Barco electronics still have their own IP addresses, but they are behind a router which is embedded into the projector. The internal router is used to forward messages to the appropriate internal board based on the port of the incoming message.

The port number for the Barco protocol is **0xAAD0 (43728)**.

A series 2 projector will close the socket connection after 15 minutes of inactivity on a specific connection.

Sending a message

Messages should be send in the protocol format described above. This means that each command needs to be structured in the correct way, before it is being sent to the projector:

- The projector address must be set to 0.
- A correct checksum value must be generated for the command, based on all the bytes between the start byte and the checksum byte.

Receiving an answer

When receiving the answer from the projector, you should always first read the acknowledgement of the request. Only when the request has been acknowledged, you can expect the actual response (if any).

Macro – preset handling

DP projectors hold presets. These presets are also referred to as macro files. A macro file holds a series of commands which can be executed. The macro files themselves can be edited by using the Barco Communicator software. The macro files are associated with a button on the keypad of the projector. They are executed by pressing one of the numeric buttons on the keypad of the projector.

A macro can be executed by sending the command *macro, execute*. To know which macro was the last macro which was executed you use the command *macro, read (1)* or *macro, read (2)*.

To know which macro is associated with a certain keypad button, use *button, read macro*. To change the macro which is associated with a certain button, use *button, write macro*.

On series 1 projectors, macros reside on the Texas Instruments DLP Cinema® front end. On series 2 projectors macros reside on the Barco controller.

On series 1 and series 2, macros can be executed by sending the command *macro, execute*. Independent of where the macro file resides, the macro file will be executed.

On series 1, there was an option to send a command to execute a macro, direct through the Texas Instruments DLP Cinema® front end (by using the Texas Instruments DLP Cinema® protocol). On series 2, only use the Barco command *macro, execute* to execute macros, do not go through the Texas Instruments DLP Cinema® front end, which in fact will not host any macro files any more.

Commands

acknowledge – no acknowledge

■ Description :

When the projector receives a command, the command format is checked (see communication protocol), including the projector address and the checksum. If the command format contains an error, the command is ignored.

If the command format is correct, the projector checks if the command is a valid command. If so, the projector answers with an acknowledge and starts executing the command. If not, the projector answers with a no acknowledge.

■ Acknowledge command :

Command[0]	\x00
Command[1]	\x06

No acknowledge command :

Command[0]	\x00
Command[1]	\x15

■ Example :

Acknowledge received of a projector with address \x01.

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

button, read macro

- Description:

Read the name of the macro/preset that is linked to a button on the keypad

- Command:

Command[0]	\xe8
Command[1]	\x05

- Data:

Data[0] = Macro-Button number

	Data[0]
Macro-Button 1	\x01
Macro-Button 2	\x02
...	...

Data[1] = OPTIONAL

In this case, Data[0] indicates "From" Macro-Button number and Data[1] indicates "To" Macro-Button number.

- Return Data:

In case the optional Data[1] wasn't sent:

Data[0] = Macro-Button number.

Data[1..] = Macro name(s) as C-language string(s) (see syntax).

In case the optional Data[1] was sent:

Data[0] = From Macro-Button number.

Data[1] = To Macro-Button number.

Data[2..] = Macro name(s) as C-language string(s) (see syntax).

- Projector type:

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

- Example:

Read the macro name attached to macro-button 2 of a projector with address \x01. Suppose the macro name is "ABC".

button, read macro

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\xe8
Command[1]	\x05
Data[0]	\x02
Checksum	\xf0
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

Receive (answer)	
Start	\xfe
Projector address	\x01
Command[0]	\xe8
Command[1]	\x05
Data[0]	\x02
Data[1]	\x41 (= 'A')
Data[2]	\x42 (= 'B')
Data[3]	\x43 (= 'C')
Data[4]	\x00
Checksum	\xb6
Stop	\xff

button, write macro

- Description:

Write the name of the macro to be attached to a button.

- Command:

Command[0]	\xe8
Command[1]	\x85

- Data:

Data[0] = Macro-Button number

Data[1..] = Macro name as a C-language string (see syntax).

	Data[0]
Macro-Button 1	\x01
Macro-Button 2	\x02
...	...

- Projector type:

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

- Example:

Write the macro name to be attached to macro-button 2 of a projector with address \x01. Suppose the macro name is "ABC".

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\xe8
Command[1]	\x85
Data[0]	\x02
Data[1]	\x41 (= 'A')
Data[2]	\x42 (= 'B')
Data[3]	\x43 (= 'C')
Data[4]	\x00
Checksum	\x36
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

lamp, write on/off

lamp, write on/off

■ Description :

Write lamp on/off.

■ Command :

Command[0]	\x76
Command[1]	\x1a

■ Data :

	Data[0]
Off	\x00
On	\x01

■ Projector type :

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

■ Example :

Set the lamp on of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\x76
Command[1]	\x1a
Data[0]	\x01
Checksum	\x91
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

- Description:
Focus the lens.

- Command:

Command[0]	\xf4
Command[1]	\x83

- Data:
Data[0] = direction.

Direction	Data[0]
Near	\x00
Far	\x01

- Projector type:
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors

- Example:
Focus the lens of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\xf4
Command[1]	\x83
Data[0]	\x00
Checksum	\x78
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

lens, shift

- Description:
Shift the lens up, down, left or right.

- Command:

Command[0]	\xf4
Command[1]	\x81

- Data:

Data[0] = direction.

Direction	Data[0]
Up	\x00
Down	\x01
Left	\x02
Right	\x03

- Projector type:

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

- Example:

Shift the lens up of of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\xf4
Command[1]	\x81
Data[0]	\x00
Checksum	\x76
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

- Description:
Zoom the lens.

- Command:

Command[0]	\xf4
Command[1]	\x82

- Data:
Data[0] = direction.

Direction	Data[0]
In	\x00
Out	\x01

- Projector type:
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors

- Example:
Lens-zoom-in of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\xf4
Command[1]	\x82
Data[0]	\x00
Checksum	\x77
Stop	\xff

macro, execute (1)

- Description:
Execute a macro.

- Command:

Command[0]	\xe8
Command[1]	\x81

- Data:

Data[]	C-language string
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- Projector type:

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

The answer prefix cannot be used on this command to know if a macro has been executed. On series 2, use the macro read (2), to poll the macro execution status, if you want to know when a macro has finished execution.

macro_read (1)

- Description:
Read the name of the last macro that has been executed.
- Command:

Command[0]	\xe8
Command[1]	\x01

- Return data:

Data[]	C-language string
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- Projector type:
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors

macro_read (2)

- Description:
Read the name of the last macro that has or is being executed.
- Command:

Command[0]	\x82
Command[1]	\x00
Command[2]	\x00
Command[3]	\x00
Command[4]	\x1a
Command[5]	\x03

- Return data:

[macro name][line executed][line failed]
where [macro name] = C-language string = The macro name which is being executed.
where [line executed] = 4 bytes-signed = line number of the command within the macro that has been executed
where [line failed] = 4 bytes-signed = line number of the command within the macro that has failed

Note: When the macro execution starts, [line failed] is set to zero.
When the macro has finished, [line executed] is set to \x7f \xff \xff \xff
The first line in a macro is line 1 (not zero based)
If [line failed] is zero, no error has occurred (yet)
When several lines fail, [line failed] only indicates the first line that has failed

No return data will be returned in case of an error.

- Projector type:
Series 2 projectors

Shutter-dowser, close

- Description :
Close the mechanical shutter, dowser.
- Command :

Command[0]	\x23
Command[1]	\x42
Command[2]	\x00

- Projector type :
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors
- Example :

Close the shutter of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\x23
Command[1]	\x42
Data[0]	\x00
Checksum	\x66
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

Shutter-dowser, open

- Description :
Open the mechanical shutter, dowser
- Command :

Command[0]	\x22
Command[1]	\x42
Command[2]	\x00

- Projector type :
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors

- Example :
Open the shutter of a projector with address \x01.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\x22
Command[1]	\x42
Data[0]	\x00
Checksum	\x65
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

Shutter-dowser, read

- Description :
Read the actual shutter position

- Command :

Command[0]	\x21
Command[1]	\x42

- Data :
No data bytes.

- Return data :
Data[0] = shutter position.

	Data[0]
Closed	\x00
Open	\x01
Undetermined	\x02

- Projector type :
Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000
Series 2 projectors

- Example :
Read the actual shutter position of a projector with address \x01. The shutter is open.

Transmit	
Start	\xfe
Projector address	\x01
Command[0]	\x21
Command[1]	\x42
Checksum	\x64
Stop	\xff

Receive (acknowledge)	
Start	\xfe
Projector address	\x01
Command[0]	\x00
Command[1]	\x06
Checksum	\x07
Stop	\xff

Receive (answer)	
Start	\xfe
Projector address	\x01
Command[0]	\x21
Command[1]	\x42
Data[0]	\x01
Checksum	\x65
Stop	\xff

Errors, read count, read

- Description :

Read the projector number of errors, warnings and notifications.
This number indicates the number of error messages, warning messages and notification messages, which are currently active on the projector.

- Command :

Command[0]	\x81
Command[1]	\x04
Command[2]	\x17

- Data :

No data bytes.

- Return data :

[notification count][warning count][error count]
where [notification count] = 4 bytes - unsigned
where [warning count] = 4 bytes - unsigned
where [error count] = 4 bytes - unsigned

- Projector type :

Series 2 projectors

Answer prefix

- Description :

The projector always responds when a question is asked (query or read operation) but in case of write operation the projector will not send back a response. If you want to get an answer about whether the write operation was OK or not, you should add the 'answer' prefix to the command.

- Prefix Code :

Prefix [0]	\x00
Prefix [1]	\x03
Prefix Data [0]	\x02

When this prefix is used, the projector will respond with the prefix as command and a data byte to indicate the result.

Response on a command with answer prefix:

- Return data :

	Data[0]
No success	\x00
success	\x01

- Projector type :

Series 1 projectors: DP100, DP90, DP1200, DP1500, DP2000, DP3000

Series 2 projectors

- Example :

Write the lamp on, with answer prefix, to know the lamp has really powered on.

Transmit	
Start	\xfe
Projector address	\x00
Prefix [0]	\x00
Prefix [1]	\x03
Prefix [2]	\x02
Command[0]	\x76
Command[1]	\x1a
Data [0]	\x01
Checksum	\x96
Stop	\xff

Answer prefix

Receive (acknowledge)	
Start	\xfe
Projector address	\x00
Command[0]	\x00
Command[1]	\x06
Checksum	\x06
Stop	\xff

Receive (answer)	
Start	\xfe
Projector address	\x00
Command[0]	\x00
Command[1]	\x03
Data[0]	\x01
Checksum	\x04
Stop	\xff

UDP broadcast

■ Description :

The digital cinema projectors support a discovery mechanism over the network using UDP broadcast. To discover the projectors, send a datagram packet to the broadcast address 255.255.255.255 and port 0xA001. The packet should contain 1 byte: \x3F, which is the ASCII character '?'.

■ Command :

Command[0]	\x3F
------------	------

■ Data :

No data bytes.

■ Return data :

The projectors that support the broadcast feature, will answer with an array of C-language strings. Each string represents a key-value pair with specific information about the projector that has been discovered.

Typically, following strings will be returned:

- hostname=value : the hostname of the projector
- ip-address=value : the IP address of the projector
- mac-address=value : the MAC address of the NIC on the projector
- type=value : the projector type (not for DP90/DP100 projectors)

Remarks:

- The size of the array is undetermined, but in most cases it will contain 4 strings. However, this is open to future expansion, so more strings may be added later.
- The strings normally appear in this order: hostname, ip-address, mac-address and type, but this cannot be guaranteed.

■ Projector type :

Series 1 projectors

DP90 and DP100 (but they do not return the type)
DP1200, DP1500, DP2000 and DP3000 projectors

Series 2 projectors

Do not return the MAC address.