United States Institute for Theatre Technology, Inc.

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DMX512/1990 DIGITAL DATA TRANSMISSION STANDARD FOR DIMMERS AND CONTROLLERS

APRIL 1990

A Revision of the DMX512 Standard Published in August 1986

A Project of the USITT Engineering Commission

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DMX512/1990 Digital Data Transmission

1.0 SCOPE

This Standard describes a method of digital data transmission between controllers and dimmers. It covers electrical characteristics, data format, data protocol, connector type, and cable type.

2.0 APPLICABILITY

This Standard is intended as a guide for:

1. Equipment manufacturers and system specifiers who wish to integrate systems of dimmers and controllers made by different manufacturers.
2. Equipment manufacturers seeking to adopt a standard controller-dimmer digital transmission protocol.

Although widespread adoption of this standard is sought by USITT, compliance with the standard is strictly voluntary. Furthermore, it is not intended as a replacement for existing protocols already manufactured, but rather as an addition to existing protocols which will broaden the installed base of controllers and dimmers that can communicate with each other.

3.0 CROSS REFERENCE

See EIA standards EIA-422A and EIA-485 available from:

Electronic Industries Association
Standards Sales Office
2001 Eye Street NW
Washington, D.C. 2006
202-457-4900

4.0 ELECTRICAL SPECIFICATIONS

This standard shall follow EIA Standard EIA-485 (an enhanced version of EIA-422A) with regard to all electrical characteristics including line driver and receiver selection, line loading, and multi-drop configurations.

4.1 COMMON MODE VOLTAGES

Equipment designers are advised to pay particular attention to the Common Mode voltage provisions of EIA-485 in the choice of transmitter and receiver components and general system implementation.

4.2 ELECTRICAL ISOLATION

This standard and EIA-485 make no general provisions for electrical isolation.
However, suitable optical isolation, transformer isolation, or other means may be
employed to prevent the undesirable propagation of voltages which exceed the Common
Mode limits of EIA-485. The inclusion of such isolation does not, however, alter
the requirement that a transmitter or receiver conform to EIA-485.

5.0 DATA PROTOCOL

Data transmitted shall be in asynchronous serial format. Dimmer level data shall be transmitted sequentially, beginning with dimmer 1 and ending with the last implemented dimmer, up to a maximum of 512. Prior to the first level transmitted, a RESET signal shall be transmitted followed by a NULL START code. Valid dimmer levels shall be 0 to 255 decimal (00 to FF hexadecimal) representing dimmer control input levels of OFF to FULL in a linear relationship. These numeric values shall not necessarily have any relationship to actual dimmer output, which shall be determined within the dimmer itself.

5.0.1 RESET SIGNAL

The RESET signal (Timing Diagram, Designation #1) shall consist of a BREAK lasting 88 uSeconds (two frame times) or any longer duration. A BREAK shall be defined as a high-to-low transition followed by a low of at least 88 uSeconds. All dimmers and other receiving devices shall interpret any such BREAK as a terminator for any pending transmission/data packet and its end as the start of the MARK AFTER BREAK and START code sequence at the beginning of the next packet.

5.0.1.1 MARK AFTER BREAK

The duration of the MARK seperating the RESET/BREAK and the START code (Timing Diagram, Designation #2) shall be not less than 8 uSeconds and not greater than 1 Second. All DMX512/1990 transmitters shall produce a MARK AFTER BREAK of not less than 8 uSeconds. All receivers shall recognize an 8 uSecond MARK AFTER BREAK. Receivers capable of also recognizing the shorter 4 uSecond MARK AFTER BREAK (as specified in the 1986 DMX512 Standard) may be identified and marked as having this capability as per paragraph 11.0

5.0.2 NULL START CODE

The NULL START code shall be defined as a properly framed NULL character (all zeros) following a RESET. The NULL START identifies subsequent data as sequential 8-bit dimmer level information.

5.0.3 OTHER OPTIONAL START CODES

In order to provide for future expansion and flexibility, this

Standard makes
provision for 255 additional START codes (1 through 255 decimal, 01 through FF
hexadecimal). For this reason, a dimmer receiver must not accept as 8-bit level
data any data packet with a START code other than NULL START
following the RESET.

5.0.4 MAXIMUM NUMBER OF DIMMERS

Each data link shall support up to 512 dimmers. Multiple links shall be used where
larger numbers of dimmers are required.

5.0.5 MINIMUM NUMBER OF DIMMERS

There shall be no minimum number of dimmers on the data link. DMX512 data packets with levels for less than 512 dimmers may be transmitted, provided that the conditions of this Standard, including Paragraphs 5.0 through 5.0.8, are observed.

5.0.6 DEFINED LINE STATE BETWEEN FRAMES

The time between any two frames of a data packet (Timing Diagram, Designation #8) may vary between 0 uSeconds and 1 Second. The line must remain in a "marking" state during any such idle period greater than 0 uSeconds. A receiver must be capable of accepting a data packet having no idle time (0 uSeconds) between any of its frames.

5.0.7 DEFINED LINE STATE BETWEEN DATA PACKETS

Every data packet transmitted on the data link, regardless of START code or length, must begin with a RESET, MARK AFTER BREAK, and START code sequence as defined above. The time between the second stop bit of the last data byte/frame of one data packet and the falling edge of the beginning of the RESET for the next data packet (Timing Diagram, Designation #9) may vary between 0 uSeconds and 1 Second. The line must remain in an idle ("marking") state throughout any such period greater than 0 uSeconds. Transmitters, therefore, must not produce multiple BREAKs between data packets. Receivers, however, must be capable of recovering from multiple BREAKs produced by data link errors.

5.0.8 MINIMUM BREAK SPACING

The period between the falling edge at the start of any one BREAK shall be not less than 1196 uSeconds from the falling edge at the start of the next BREAK.

6.0 DATA FORMAT

The data transmission format for each level transmitted shall be as follows:

BIT POSITION	DESCRIPTION
1	Start Bit, Low or SPACE
2 through 9	Dimmer level Data bits, Least Significant Bit to Most Significant Bit Positive logic
10, 11	Stop Bits, High or MARK
Parity	Not transmitted

7.0 DATA RATE

The data rate and associated timing shall be as follows:

Data Rate	250 Kilobits per second
Bit Time	4.0 uSeconds
Frame Time	44.0 uSeconds
Maximum Update Time for 512 dimmers	22.67 milliseconds
Maximum Update Rate for 512 dimmers	44.11 times per second

7.1 TIMING DIAGRAM

See Figure 1 for the DMX512/1990 timing diagram.

Figure 1

8.0 LOSS OF DATA TOLERANCE

The receiving device must maintain, for a minimum of 1 Second, the last valid level received for each connected dimmer. Designers of transmitters are reminded that a low number of dimmer level (START CODE 00) updates may be interpreted by a receiver as a loss of data.

8.1 RECEIVER DATA RATE TOLERANCE

DMX512/1990 is intended to make possible the interconnection of lighting control equipment by different manufacturers. It does not specify the minimum performance levels of connected equipment, either by requiring a minimum number of level updates per second be produced by a transmitter, or by requiring that all level updates on the data link be used by the receiver.

The performance of any device incorporating a DMX512/1990 receiver must, however, not be degraded by the presence at its input of the continuous

transmission of data
packets containing any number of dimmer levels up to the maximum
update rates
specified in Section 5 and Paragraph 7.0 above.

9.0 CONNECTORS

Where connectors are used, the data link shall utilize 5-pin "XLR" style microphone connectors. Some manufacturers of this connector are:

- Switchcraft
- ITT Cannon
- Neutrik

9.0.1 CONNECTOR SEX

Female connectors shall be utilized on controllers or other transmitting devices and male connectors shall be utilized on dimmers and other receiving devices. In cases where an optional second data link is implemented using the spare pins of the connector for bi-directional transmission, female connectors shall still be utilized on the controller.

9.0.2 CONNECTOR PIN DESIGNATION

Connector Pin Designations shall be as follows:

PIN 1 - Signal Common (Shield)
PIN 2 - Dimmer Drive Complement (Data 1 -)
PIN 3 - Dimmer Drive True (Data 1 +)
PIN 4 - Optional Second Data Link Complement (Data 2 -)
PIN 5 - Optional Second Data Link True (Data 2 +)

10.0 CABLE

Cable shall be shielded twisted pair approved for EIA-422/EIA-485 use. Examples of suitable cables are:

- Belden 9841
- Alpha 5271 (one pair, no spares provided)
- Belden 9842
- Alpha 5272 (two pairs, one as a spare)

11.0 MARKING AND IDENTIFICATION

Equipment conforming to this Standard may be marked and identified with "USITT DMX512/1990" or "DMX512/1990".

Only receivers also capable of accepting a 4 uSecond MARK AFTER BREAK may be marked and identified as "USITT DMX512/1990 (4uSec)" or "DMX512/1990 (4uSec)".

Compliance with this Standard is the responsibility of the manufacturer, and such marking and identification does not constitute certification or approval by the USITT.

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