

TCD-SERIES CLOCK SERIAL PROTOCOL SPECIFICATION

Document version 2.0c

Copyright ©2005 Masterclock, Inc.

- 1 Introduction2
- 2 Message Structure2
 - 2.1 Command messages - to the TCD-series clock from the user application.....2
 - 2.2 Responses - from the TCD-series clock to the user application.....2
 - 2.3 Request-Response limitations.....3
- 3 Message Types3
- 4 Saved Configuration Parameters3
- 5 Physical connections to the TCD-series clock.....4
- 6 Mode-Type Command Set.....6
 - 6.1 Time/Date Broadcast Control (01, 02).....6
 - 6.2 Decoder Information Control (03, 04) (Masterclock only)9
- 7 Query-Type Command Set.....10
 - 7.1 Time/Date Request (10).....10
 - 7.2 Decoder Information Request (11) (Masterclock only)13
 - 7.3 Firmware Version Request (12).....14
- 8 Configuration Type Command Set.....16
 - 8.1 Set Configuration to Default (20)16
 - 8.2 Set Brightness Level (21).....17
 - 8.3 Time Zone Configuration (22)18
 - 8.4 Set Date/Time (23).....19
 - 8.5 Pre-Set Counter (24).....21
 - 8.6 Pre-Set Timer (25).....22
 - 8.7 Counter Control (26, 27).....24
 - 8.8 Timer Control (28, 29).....26
 - 8.9 Set Display Mode (30).....29
- 9 ACK/Error Response Format30

TCD-SERIES CLOCK SERIAL PROTOCOL SPECIFICATION

Document version 2.0c

Copyright ©2005 Masterclock, Inc.

1 Introduction

Serial communication with the TCD-series clock Firmware version 2.0 and greater is accomplished by the exchange of messages. A command message is sent to the clock from the user application. A response message is returned to the user application from the clock. A response message will consist of a single response for query-type messages or multiple responses on some specified interval for mode-type commands.

A message will be defined as a group of bytes including a start character (<STX>, 0x02), ID, data, and end character (<ETX>, 0x03). All data is sent using the ASCII character set (no binary data).

In this document all numbers are in decimal notation except for those preceded by '0x'. Such numbers are in hexadecimal notation. References to **local time** mean the time displayed on the face of the clock.

2 Message Structure

2.1 Command messages - to the TCD-series clock from the user application

The format for transmitting command messages to the clock is as follows:

<STX><msg id>[<data bytes>]<checksum><ETX>

The TCD-series clock knows the required number of data bytes for each command message. If a command message is transmitted without the appropriate number of data bytes it will be rejected.

An 8-bit checksum is required for all messages sent to the clock. The checksum is calculated by adding together the ASCII characters from the <msg id> up to but not including the <checksum>. This 8-bit hex result is then converted to two ASCII characters.

For example:

checksum calculation: '5' + '6' + '7' =
 $0x35 + 0x36 + 0x37 = 0xA2$ convert to ASCII → 'A' (0x41), '2', 0x32)

If the checksum is a 0xA2 it will be sent as the ASCII character 'A' (0x41) followed by the ASCII character '2' (0x32).

The <STX> is not included in the checksum calculation.

All data except the checksum is sent as its decimal representation. For example, the decimal number 255 is sent as:

'2' '5' '5' = 0x32 0x35 0x35

All fields are fixed width so leading zeros may be necessary.

2.2 Responses - from the TCD-series clock to the user application

Preliminary – functionality and implementation may change

Responses from the TCD-series clock to the user application can take three forms, an ACK (0x06) character, a response message, or an error response message.

ACK response

If the response to the command message does not require any data a single character ACK is returned. However, if the Command Message has an error in it an Error Response Message is returned with the error status.

Response message

The format for a response message from the clock is as follows:

```
<STX><msg id><data bytes ... ><checksum><ETX>
```

The message ID indicates to which command message the response is directed. All response messages contain at least one data byte.

Error Response message

The format for an error response message from the clock is as follows:

```
<STX><error msg id><original msg id><data bytes ... ><checksum><ETX>
```

The original message ID indicates to which command message the error response is directed.

2.3 Request-Response limitations

The TCD can only process one request at a time. After sending a request the user must either wait for a response to the request or a minimum of 100 msec. before sending the next request. Once a response to a request is received the user may immediately send the next request.

3 Message Types

There are three types of messages the user can send to the TCD clock. They are:

Mode-type message

Mode-type messages enable or disable clock actions, which are repeated at a given interval. For example, the clock can broadcast a time stamp every second over the serial port. When enabled they output on a given interval, usually once per second at the valid start of the second. All mode-type messages have an equivalent Query-type message from which a response can be obtained at any time.

Query-type message

These messages return a one-time response.

Configuration- type message

These messages cause the TCD-series clock to alter operation in some way.

4 Saved Configuration Parameters

The external DIP-switches are used as the default settings unless the user modifies those setting by sending a command over the serial port. DIP-switch settings may be changed while the TCD is powered up unless the DIP switch setting has been overridden by a command over the serial port. Time and date are saved through restarts and power downs as long as the battery is operational.

5 Physical connections to the TCD-series clock

The clock has the following I/O connections on the rear DB-9 connector:

- pin 1 - +5 volt (TTL voltage level, 50-millisecond minimum pulse width, maximum pulse rate 10 Hz).

A pulse is created by the user connecting pin 1 of the DB-9 to pin 5 of the DB-9 (ground) for a minimum of 50 msec. and then opening the connection. This may be done with a simple switch closure or a TTL low signal.

Pulses affect both the timer and the counter.

A pulse will toggle the current timer state (running to stopped or stopped to running) within 50 msec. after the falling edge.

Each pulse will be counted by the counter within 50 msec. after the falling edge.

- pin 2 - transmit (TX) RS-232 voltage level
- pin 3 - receive (RX) RS-232 voltage level
- pin 4 – reserved for future use
- pin 5 - ground
- pin 6 - +5 volt (TTL voltage level) mode button input.
- pin 7 - +5 volt (TTL voltage level) up button input.
- pin 8 - +5 volt (TTL voltage level) down button input.
- pin 9 – unused
- All communications with the clock are at 19200 baud, 8 data bits, 1 stop bit, no parity.

For connecting the TCD to a host computer the user must either build a custom cable or purchase a cable from Masterclock, Inc.. **DO NOT USE A SERIAL CABLE WHICH WILL CONNECT PINS 1, 4, 6, 7, OR 8 TO THE HOST RS-232 VOLTAGE LEVELS. DOING SO WILL DAMAGE THE TCD.**

For communications with the TCD-series clock from a standard IBM PC or compatible computer a null modem cable (**3 wires only: pin 2,3, 5**) should be used. For communications with other types of hosts please observe the following requirements:

- Connect the transmit (TX) line of the clock (pin 2 of the DB-9 connector) to the receive (RX) line of the host system.
- Connect the receive (RX) line of the clock (pin 3 of the DB-9 connector) to the transmit (TX) line of the host system.
- Connect the ground line of the clock (pin 5 of the DB-9 connector) to the ground of the host system.
- Be sure the host system is capable of communicating by standard RS-232 at 9600 baud, 8 data bits, 1 stop bit, no parity. Pins 2 and 3 must use RS-232 voltage levels. The clock cannot decode TTL-level serial communications at pin 2 and 3 of the DB-9 connector.
- Be sure that any cable you are using for communication with the clock is within RS-232 standard length and is a working cable.

6 Mode-Type Command Set

6.1 Time/Date Broadcast Control (01, 02)

Description: Enable or disable automatic transmission of the TCD clock's time and date once per second at the start of the second. The mode is disabled after a reset of the saved configuration. The date/time will default to starting at 1/1/1980 00:00:00 after a reset configuration. Note: 12:xx a.m. must be sent and received as 00:xx a.m.

ID: 01 (Time/Date Broadcast Control)

Type: Mode

Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x30	'0' command ID, 1st digit
3	0x31	'1' command ID, 2nd digit
4	0x??	'0' to disable , '1' to enable this mode
5	0x??	'0' return local time, '1' return UTC time
6	0x??	checksum, 1st digit
7	0x??	checksum, 2nd digit
8	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

Format of Time Code Broadcast (once per second at top of second):

ID: 02 (Time/Date Broadcast Control broadcast response at 1 second interval)

Byte	Value	Description
1	0x02	<STX> start of text
2	0x30	'0' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x??	'0' return local time/date, '1' return UTC time/date
5	0x??	12/24 hour time, '0' 12 hour time. '1' 24 hour time
6	0x??	am/pm ('0' if 12 hour time disabled), '0' == AM. '1' == PM
7	0x??	hour, 1st digit
8	0x??	hour, 2nd digit
9	0x??	minute, 1st digit
10	0x??	minute, 2nd digit
11	0x??	second, 1st digit
12	0x??	second, 2nd digit
13	0x??	month, 1st digit
14	0x??	month, 2nd digit
15	0x??	day, 1st digit
16	0x??	day, 2nd digit
17	0x??	year , 1st digit
18	0x??	year , 2nd digit
19	0x??	year , 3rd digit

20	0x??	year 4th digit
21	0x??	time validity flag == '0' free-running from internal clock == '1' locked to time code on the time code input
22	0x??	daylight savings time status == '0' not in DST or DSTadjustment disabled == '1' DST currently active
23	0x30	'0' reserved
24	0x30	'0' reserved
25	0x30	'0' reserved
26	0x30	'0' reserved
27	0x??	checksum
28	0x??	checksum
29	0x03	<ETX> end of text

 Example: Enable Time Broadcast Control

Request (from host to TCD):

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x30	'0' command ID, 1st digit
3	0x31	'1' command ID, 2nd digit
4	0x31	'1' enable this mode
5	0x31	'1' return UTC time
6	0x43	'C' checksum, 1st digit
7	0x33	'3' checksum, 2nd digit
8	0x03	<ETX> end of text

Response (from TCD to host):

<ACK>

 Example: Time Broadcast Response for 01/02/2005 15:04:05:

Response (from TCD to host, once per second):

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x30	'0' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x31	'1' UTC time/date
5	0x31	'1' 24 hour time
6	0x30	'0' am/pm ('0' if 12 hour time disabled)
7	0x31	'1' hour, 1st digit
8	0x35	'5' hour, 2nd digit
9	0x30	'0' minute, 1st digit
10	0x34	'4' minute, 2nd digit
11	0x30	'0' second, 1st digit
12	0x35	'5' second, 2nd digit
13	0x30	'0' month, 1st digit
14	0x31	'1' month, 2nd digit
15	0x30	'0' day, 1st digit

16	0x32	'2' day, 2nd digit
17	0x32	'2' year , 1st digit
18	0x30	'0' year , 2nd digit
19	0x30	'0' year , 3rd digit
20	0x35	'5' year 4th digit
21	0x31	'1' locked to time code
22	0x30	'0' not in DST or DST disabled
23	0x30	'0' reserved, '0'
24	0x30	'0' reserved, '0'
25	0x30	'0' reserved, '0'
26	0x30	'0' reserved, '0'
27	0x43	'C' checksum
28	0x45	'E' checksum
29	0x03	<ETX> end of text

6.2 Decoder Information Control (03, 04) (Masterclock only)

Description:

ID: 03
Type: Mode
Firmware: 2.0

7 Query-Type Command Set

7.1 Time/Date Request (10)

Description: Requests a one-time transmission of the time/date. The user may select if the time/date is returned as UTC time or local time. The time and date is transmitted upon request and does not wait for the top of a second. It will be accurate to within +/- 1 second. The date/time will default to starting at 1/1/1980 00:00:00 after a reset configuration. Note: 12:xx a.m. must be sent and received as 00:xx a.m.

ID: 10
 Type: Request
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x??	'0' return local time/date, '1' return UTC time/date
5	0x??	checksum, 1st digit
6	0x??	checksum, 2nd digit
7	0x03	<ETX> end of text

Response format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x??	'0' local time/date, '1' UTC time/date
5	0x??	12/24 hour time, '0' 12 hour time. '1' 24 hour time
6	0x??	if 12 hour time enabled, am/pm indicator, '0' == AM. '1' == PM
7	0x??	hour, 1st digit
8	0x??	hour, 2nd digit
9	0x??	minute, 1st digit
10	0x??	minute, 2nd digit
11	0x??	second, 1st digit
12	0x??	second, 2nd digit
13	0x??	month, 1st digit
14	0x??	month, 2nd digit
15	0x??	day, 1st digit
16	0x??	day, 2nd digit
17	0x??	year , 1st digit
18	0x??	year , 2nd digit
19	0x??	year , 3rd digit
20	0x??	year 4th digit
21	0x??	time validity == '0' free-running from internal clock) == '1' locked to time code on the time code input
22	0x??	daylight savings time status == '0' not in DST or DSTadjustment disabled)

== '1' DST currently active

23	0x30	'0' reserved
24	0x30	'0' reserved
25	0x30	'0' reserved
26	0x30	'0' reserved
27	0x??	checksum
28	0x??	checksum
29	0x03	<ETX> end of text

 Example: Time/Date Request Command

Request (from host to TCD):

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x31	'1' request UTC time
5	0x39	'9' checksum, 1st digit
6	0x32	'2' checksum, 2nd digit
7	0x03	<ETX> end of text

Response (from TCD to host):

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x31	'1' UTC time/date
5	0x30	'0' 12 hour time format
6	0x31	'1' PM
7	0x31	'1' hour, 1st digit
8	0x35	'5' hour, 2nd digit
9	0x30	'0' minute, 1st digit
10	0x34	'4' minute, 2nd digit
11	0x30	'0' second, 1st digit
12	0x35	'5' second, 2nd digit
13	0x30	'0' month, 1st digit
14	0x31	'1' month, 2nd digit
15	0x30	'0' day, 1st digit
16	0x32	'2' day, 2nd digit
17	0x32	'2' year , 1st digit
18	0x30	'0' year , 2nd digit
19	0x30	'0' year , 3rd digit
20	0x35	'5' year 4th digit
21	0x31	'1' locked to time code
22	0x30	'0' not in DST or DST disabled
23	0x30	'0' reserved
24	0x30	'0' reserved
25	0x30	'0' reserved
26	0x30	'0' reserved
27	0x43	'C' checksum
28	0x44	'D' checksum

29 0x03 <ETX> end of text

7.2 Decoder Information Request (11) (Masterclock only)

Description:

ID: 11
Type: Request
Firmware: 2.0

7.3 Firmware Version Request (12)

Description: Returns firmware version information for the clock.
 ID: 12
 Type: Request
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x31	'1' return full version information
5	0x39	'9' checksum, 1st digit
6	0x34	'4' checksum, 2nd digit
7	0x03	<ETX> end of text

Response format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x??	Major version 1st digit
5	0x??	Major version 2nd digit
6	0x??	Minor version 1st digit
7	0x??	Minor version 2nd digit
8	0x??	Revision 1st digit
9	0x??	Revision 2nd digit
10	0x30	'0' reserved
11	0x30	'0' reserved
12	0x30	'0' reserved
13	0x30	'0' reserved
14	0x30	'0' reserved
15	0x30	'0' reserved
16	0x??	checksum
17	0x??	checksum
18	0x03	<ETX> end of text

Example for software version 01.02.03 :

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x31	'1' return full version information
4	0x39	'9' checksum, 1st digit
5	0x34	'4' checksum, 2nd digit
6	0x03	<ETX> end of text

Response:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x31	'1' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x30	Major version 1st digit
5	0x31	Major version 2nd digit
6	0x30	Minor version 1st digit
7	0x32	Minor version 2nd digit
8	0x30	Revision 1st digit
9	0x33	Revision 2nd digit
10	0x30	'0' reserved
11	0x30	'0' reserved
12	0x30	'0' reserved
13	0x30	'0' reserved
14	0x30	'0' reserved
15	0x30	'0' reserved
16	0x??	'A' checksum
17	0x??	'9' checksum
18	0x03	<ETX> end of text

8 Configuration Type Command Set

8.1 Set Configuration to Default (20)

Description: Sets the configuration back to the default state. For configuration values, which can be set by the external DIP-switches, the current DIP-switch setting will be used as the default. The date/time will default to starting at 1/1/1980 00:00:00 after a reset configuration. The time code input will recalibrate and re-lock to the time code data.

ID: 20
 Type: Request
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x31	'1' reset configuration
5	0x39	'9' checksum, 1st digit
6	0x33	'3' checksum, 2nd digit
7	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example:

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x31	'1' reset configuration
6	0x39	'9' checksum, 1st digit
7	0x33	'3' checksum, 2nd digit
8	0x03	<ETX> end of text

Response:

<ACK>

8.2 Set Brightness Level (21)

Description: Set brightness level of clock display. Overrides DIP switch settings until the configuration is reset to defaults.

Name: Brightness Control

ID: 21

Type: Configuration

Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x31	'1' command ID, 2nd digit
4	0x??	brightness level (0 [dimmest] – 15 [brightest]) 1st digit
5	0x??	brightness level 2nd digit
6	0x??	checksum, 1st digit
7	0x??	checksum, 2nd digit
8	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example, set brightness to level 12:

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x31	'1' command ID, 2nd digit
4	0x31	'1' brightness level 1st digit
5	0x32	'2' brightness level 2nd digit
6	0x43	'C' checksum, 1st digit
7	0x36	'5' checksum, 2nd digit
8	0x03	<ETX> end of text

Response:

<ACK>

8.3 Time Zone Configuration (22)

Description: Set the time zone offset to use for local time. The display always shows local time. The offset range is -12 to +13 hours.

ID: 22
 Type: Configuration
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x??	'0' == positive offset, '1' == negative offset
5	0x??	time offset in hours 1st digit
6	0x??	time offset in hours 2nd digit
7	0x??	time offset in minutes 1st digit
8	0x??	time offset in minutes 2nd digit
9	0x??	enable US/Canada daylight time adjustments ('1' = yes, '0' = no)
10	0x??	checksum, 1st digit
11	0x??	checksum, 2nd digit
12	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example of Time Zone Configuration for offset of -6.5 hours:

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x32	'2' command ID, 2nd digit
4	0x31	'1' == negative offset
5	0x30	'0' time offset in hours 1st digit
6	0x36	'6' time offset in hours 2nd digit
7	0x33	'3' time offset in minutes 1st digit
8	0x30	'0' time offset in minutes 2nd digit
9	0x31	'1' enable US/Canada daylight time adjustments ('1' = yes, '0' = no)
10	0x38	'8' checksum, 1st digit
11	0x46	'F' checksum, 2nd digit
12	0x03	<ETX> end of text

Response:

<ACK>

8.4 Set Date/Time (23)

Description: Set the internal date and time. This time may be either local time or UTC time, and either 12-hour time or 24-hour time. The TCD will derive the respective time based on the current settings in the TCD. For example, if the user sends local time, UTC time will be derived based on the current settings. All internal calculations are done using UTC time. Note: Valid time code being received on the Time Code Input will override the date/time set by this command. The setting for displaying 12-hour time vs. 24-hour time does not change with this command. If the display was set to 24-hour time and this command sends the time as 12-hour time the time is converted to 24-hour time. 12:xx a.m. must be sent and received as 00:xx a.m.

ID: 23
 Type: Mode
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x33	'3' command ID, 2nd digit
4	0x??	'0' local time/date, '1' UTC time/date
5	0x??	12/24 hour time, '0' 12 hour time. '1' 24 hour time
6	0x??	am/pm indicator ('0' if 12 hour time disabled), '0' == AM. '1' == PM
7	0x??	hour, 1st digit
8	0x??	hour, 2nd digit
9	0x??	minute, 1st digit
10	0x??	minute, 2nd digit
11	0x??	second, 1st digit
12	0x??	second, 2nd digit
13	0x??	month, 1st digit
14	0x??	month, 2nd digit
15	0x??	day, 1st digit
16	0x??	day, 2nd digit
17	0x??	year , 1st digit
18	0x??	year , 2nd digit
19	0x??	year , 3rd digit
20	0x??	year 4th digit
21	0x30	'0' reserved
22	0x30	'0' reserved
23	0x30	'0' reserved
24	0x30	'0' reserved
25	0x30	'0' reserved
26	0x30	'0' reserved
27	0x??	checksum
28	0x??	checksum
29	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

Example for date/time 01/02/2005 03:04:05 PM:

Request:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x33	'3' command ID, 2nd digit
4	0x30	'0' local time/date
5	0x30	'0' 12 hour time
6	0x31	'1' PM
7	0x30	'0' hour, 1st digit
8	0x33	'3' hour, 2nd digit
9	0x30	'0' minute, 1st digit
10	0x34	'4' minute, 2nd digit
11	0x30	'0' second, 1st digit
12	0x35	'5' second, 2nd digit
13	0x30	'0' month, 1st digit
14	0x31	'1' month, 2nd digit
15	0x30	'0' day, 1st digit
16	0x32	'2' day, 2nd digit
17	0x32	'2' year , 1st digit
18	0x30	'0' year , 2nd digit
19	0x30	'0' year , 3rd digit
20	0x35	'5' year 4th digit
21	0x30	'0' <i>reserved</i>
22	0x30	'0' <i>reserved</i>
23	0x30	'0' <i>reserved</i>
24	0x30	'0' <i>reserved</i>
25	0x30	'0' <i>reserved</i>
26	0x30	'0' <i>reserved</i>
27	0x43	'C' checksum
28	0x43	'C' checksum
29	0x03	<ETX> end of text

Response:

<ACK>

8.5 Pre-Set Counter (24)

Description: Pre-sets the value to be used as either the count limit or the initial count depending on whether the counter is counting up or down. The range for the reload/stop value is 000000 to 999999. Pin 1 on the DB-9 is the input to the counter.

ID: 24
 Type: Mode
 Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x34	'4' command ID, 2nd digit
4	0x??	'0' count up, '1' count down
5	0x??	reload value/stop value digit 1
6	0x??	reload value/stop value digit 2
7	0x??	reload value/stop value digit 3
8	0x??	reload value/stop value digit 4
9	0x??	reload value/stop value digit 5
10	0x??	reload value/stop value digit 6
11	0x??	checksum
12	0x??	checksum
13	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example of reload/stop value of 123456:

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x34	'4' command ID, 2nd digit
4	0x30	'0' count up
5	0x31	'1' reload value/stop value digit 1
6	0x32	'2' reload value/stop value digit 2
7	0x33	'3' reload value/stop value digit 3
8	0x34	'4' reload value/stop value digit 4
9	0x35	'5' reload value/stop value digit 5
10	0x36	'6' reload value/stop value digit 6
11	0x43	'C' checksum
12	0x42	'B' checksum
13	0x03	<ETX> end of text

Response:

<ACK>

8.6 Pre-Set Timer (25)

Description: Pre-sets the value to be used as either the timer limit or the initial time depending on whether the timer is counting up or down. The preload time may range from 0-23 hours, 0-59 minutes, 0-59 seconds, and 0-30 frames. The time is displayed as hour:minute:second or minute:second:frame. See the timer control command. Note: 12:xx a.m. must be sent and received as 00:xx a.m.

ID: 25
 Type: Mode
 Firmware: 2.0

Command format:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x35	'5' command ID, 2nd digit
4	0x??	'0' time increment, '1' time decrement
5	0x??	'0' 10 frames per second, '1' 25 frames per second, '2' 30 frames per second
6	0x??	hour digit 1
7	0x??	hour digit 2
8	0x??	minute digit 1
9	0x??	minute digit 2
10	0x??	second digit 1
11	0x??	second digit 2
12	0x??	frame digit 1
13	0x??	frame digit 2
14	0x??	checksum
15	0x??	checksum
16	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example of preload 01:02:03.00

Request:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x35	'5' command ID, 2nd digit
4	0x30	'0' time increment
5	0x31	'1' 25 frames per second
6	0x30	'0' hour digit 1
7	0x31	'1' hour digit 2
8	0x30	'0' minute digit 1
9	0x32	'2' minute digit 2
10	0x30	'0' second digit 1
11	0x33	'3' second digit 2
12	0x30	'0' frame digit 1

13	0x30	'0' frame digit 2
14	0x34	'4' checksum
15	0x45	'E' checksum
16	0x03	<ETX> end of text

Response:

<ACK>

8.7 Counter Control (26, 27)

Description: This command controls the counter option in the TCD. The clock, timer and counter may all be active at the same time. The user selects which one is displayed on the TCD clock face. All counter parameters may be changed during a count sequence. The counter may be set to count up or down. If counting down, the counter may be stopped when zero is reached or reload the preset value and continue counting. If the counter is counting up, the counter may be stopped when the preload value is reached or reset to zero and continue counting. The counter may be paused/stopped, resumed/started, and reset/restarted. The preload value may be changed while the counter is counting.

ID: 26
Type: Mode
Firmware: 2.0

Command format:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x36	'6' command ID, 2nd digit
4	0x??	'0' count up, '1' count down
5	0x??	'0' stop on zero or when counter limit is reached '1' if count up reset to zero, if count down reload and continue counting
6	0x??	'0' do nothing, '1' pause/stop counter
7	0x??	'0' do nothing, '1' resume/start counter
8	0x??	'0' do nothing, '1' reset/restart counter
9	0x??	'0' do not send broadcast on completion, '1' send broadcast on completion
10	0x??	checksum
11	0x??	checksum
12	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

Broadcast Response Command format (sent when count completed):

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x37	'7' command ID, 2nd digit
4	0x31	'1' counter event completed
5	0x39	'9' checksum
6	0x41	'A' checksum
7	0x03	<ETX> end of text

 Example of pre-set value == 123456

-the counter will count down from 123456, stop when zero is reached and a broadcast response is then sent.

Request:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x36	'6' command ID, 2nd digit
4	0x31	'1' count down
5	0x30	'0' stop on zero or when counter limit is reached
6	0x30	'0' do nothing
7	0x31	'1' resume/start counter
8	0x30	'0' do nothing
9	0x31	'1' send broadcast on completion
10	0x38	'8' checksum
11	0x42	'B' checksum
12	0x03	<ETX> end of text

Response:

<ACK>

Example of Broadcast Response Command format:

Response (upon event completion):

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x36	'7' command ID, 2nd digit
4	0x31	'1' counter event completed
5	0x39	'9' checksum
6	0x41	'A' checksum
7	0x03	<ETX> end of text

8.8 Timer Control (28, 29)

Description: This command controls the timer option in the TCD. The clock, timer and counter may all be active at the same time. The user selects which one is displayed on the TCD clock face. All timer parameters may be changed during a timing sequence. The timer may be set to increment or decrement. If decrementing, the timer may be stopped when zero is reached or reload the preset value and continue decrementing. If the timer is incrementing, the timer may be stopped when the preload value is reached or reset to zero and continue incrementing. The timer may be paused/stopped, resumed/started, and reset/restarted. The preload value may be changed while the timer is running. The trigger time (referenced to local time) may range from 0-23 hours, 0-59 minutes, 0-59 seconds, and 0-30 frames. If a frame value is sent which is greater than the maximum possible frame number the maximum frame value is used in its place. Note: 12:xx a.m. must be sent and received as 00:xx a.m.

ID: 28
Type: Mode
Firmware: 2.0

Command format:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x38	'8' command ID, 2nd digit
4	0x??	'0' time increment, '1' time decrement
5	0x??	'0' 10 frames per second, '1' 25 frames per second, '2' 30 frames per second
6	0x??	'0' stop on zero or when timer limit is reached '1' if time increment reset to zero, if time decrement reload and continue counting
7	0x??	'0' do nothing, '1' pause/stop timer, the timer may be stopped and started without reloading the preset value.
8	0x??	'0' do nothing, '1' resume/start timer, this starts the timer from whatever value is currently has
9	0x??	'0' do nothing, '1' reset/restart timer, this reloads the timer with the preset value. If the timer is incrementing this will reset it to zero, If the timer is decrementing this will load the preset value. This occurs before the resume/start timer above.
10	0x??	'0' do not send broadcast on completion, '1' send broadcast on completion
11	0x??	'0' display as HH:MM:SS, '1' display as MM:SS:FF
12	0x??	'0' trigger time is not to be used, '1' use trigger time specified
13	0x??	hour trigger (24 hour format, local time) digit 1
14	0x??	hour trigger digit 2
15	0x??	minute trigger digit 1
16	0x??	minute trigger digit 2
17	0x??	second trigger digit 1
18	0x??	second trigger digit 2
19	0x??	frame trigger digit 1
20	0x??	frame trigger digit 2
21	0x??	checksum
22	0x??	checksum
23	0x03	<ETX> end of text

Broadcast Response Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x39	'9' command ID, 2nd digit
4	0x31	'1' timer event completed
5	0x39	'9' checksum
6	0x42	'B' checksum
7	0x03	<ETX> end of text

 Example Timer Control command:

A typical sequence of commands could be:

- 1) Pre-set Timer (25)
- 2) Set Display Mode (30) – set the display mode to the timer
- 3) Timer Control (28) – control the timer with the following values:
 - stop the timer (this is done in case the timer was still running)
 - start the timer (start the timer after this request is processed. The timer may be stopped and started without reloading the preset values)
 - restart the timer (have the timer reload the preset value. This does not start the timer)

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x38	'8' command ID, 2nd digit
4	0x30	'0' time increment
5	0x30	'0' 10 frames per second
6	0x30	'0' stop when timer limit is reached
7	0x30	'0' do nothing
8	0x31	'1' resume/start timer
9	0x30	'0' do nothing
10	0x31	'1' send broadcast on completion
11	0x30	'0' display timer as HH:MM:SS
12	0x31	'1' use trigger time specified
13	0x30	'0' hour start (24 hour format, local time) digit 1
14	0x38	'8' hour start digit 2
15	0x30	'0' minute start digit 1
16	0x30	'0' minute start digit 2
17	0x30	'0' second start digit 1
18	0x30	'0' second start digit 2
19	0x30	'0' frame start digit 1
20	0x30	'0' frame start digit 2
21	0x41	'A' checksum
22	0x35	'5' checksum
23	0x03	<ETX> end of text

Response:

<ACK>

 Broadcast Response Command format:

Response (upon event completion):

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x32	'2' command ID, 1st digit
3	0x39	'9' command ID, 2nd digit
4	0x31	'1' timer event completed
5	0x39	'9' checksum
6	0x43	'C' checksum
7	0x03	<ETX> end of text

8.9 Set Display Mode (30)

Description: Sets the display mode to clock, timer, or counter.

ID: 30

Type: Mode

Firmware: 2.0

Command format:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x33	'3' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x??	'0' == display clock, '1' == display timer, '2' == display counter

The following fields will only be set in the TCD if clock was selected above

5	0x??	'0' == display local time, '1' == display local date
6	0x??	'0' US format date, '1' EU format date
7	0x??	12/24 hour time, '0' 12 hour time. '1' 24 hour time
8	0x??	checksum
9	0x??	checksum
10	0x03	<ETX> end of text

Response format:

(See ACK/Error Response Format)

 Example of setting the display mode to clock:

Request:

Byte	Value	Description
1	0x02	<STX> start of text
2	0x33	'3' command ID, 1st digit
3	0x30	'0' command ID, 2nd digit
4	0x30	'0' == display clock
5	0x30	'0' == display time
6	0x30	'0' display local time/date
7	0x30	'0' 12 hour time
8	0x46	'F' checksum
9	0x33	'3' checksum
10	0x03	<ETX> end of text

Response:

<ACK>

9 ACK/Error Response Format

Description: If no errors were detected and no data was requested an <ACK> (0x06) is returned. If an error was detected in the User command the Error Response Format described below is returned.

ID: 99
 Type: Error Response
 Firmware: 2.0

Error Response format:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x39	'9' command ID, 1st digit
3	0x39	'9' command ID, 2nd digit
4	0x??	command ID of original command, 1st digit
5	0x??	command ID of original command, 2nd digit
6	0x??	error code (major) ¹
7	0x??	error code (minor) ² – <i>to be determined</i>
8	0x??	error code (auxiliary) ² – <i>to be determined</i>
9	0x??	checksum, 1st digit
10	0x??	checksum, 2nd digit
11	0x03	<ETX> end of text

 Example of Error Response format for Time/Date Broadcast Control (02) command with invalid checksum:

<u>Byte</u>	<u>Value</u>	<u>Description</u>
1	0x02	<STX> start of text
2	0x39	'9' Error command ID, 1st digit
3	0x39	'9' Error command ID, 2nd digit
4	0x30	'0' command ID of original command, 1st digit
5	0x32	'2' command ID of original command, 2nd digit
6	0x32	'2' error code (major) ¹
7	0x30	'0' error code (minor) ² – <i>to be determined</i>
8	0x30	'0' error code (auxiliary) ² – <i>to be determined</i>
9	0x36	'6' checksum, 1st digit
10	0x36	'6' checksum, 2nd digit
11	0x03	<ETX> end of text

¹ Major error codes are as follows:

- '1' = invalid command id
- '2' = checksum error
- '3' = data parameter invalid/out of range
- '4' = invalid number of bytes in the command
- '5' = received ETX without starting STX

² To Be Determined:

- '0' = null error code

