ALD118 RS-485/232 communications specification

Version 1.0

February 20th, 2003

Introduction

This document describes the communication protocol between the ALD118 controller (master) and the individual ALD118 devices (slaves).

The controller is assigned an RS-485 address of 255. The addresses of the individual displays are configured by the DIP switches located on each ALD118. Address 0 is reserved for broadcast messages. All individual displays will respond to broadcast messages. The controller needs to wait for the display to acknowledge the message before sending another. All messages should be responded to within 1 second.

This protocol is also used for RS-232 communications. Since RS-232 is used for single serial line applications, all controller messages should be broadcast, so that the display will not ignore the message due to RS-485 address differences.

The ALD118 will rotate through a number of “screens.” Each screen will be displayed for a specified amount of time, and then the display will move to the next screen. Each screen comprises 1 or 2 “frames.” Each frame describes a color, an intensity, and which pixels are lit for all rows of the display. Note that a frame can be a mix of red and green rows of varying intensities, but to get both red and green on the same row, the screen must use two frames.

Screens can also be stored in memory on the display (available after a power cycle). A “transient” screen is displayed, but lost when power is lost. ***A “stored” screen is written into the on-board non-volatile memory, which is then available after a power cycle***. ***The memory can be written to a large number of times, but continual changing of the display will cause the memory to fail fairly quickly. Therefore, screens which will be changed often (hourly or faster) should be sent as “transient”, while semi-permanent screens (only two or three changes per day) can be easily stored.***

A “scrolling” message can also be sent. This is for large messages that do not fit on the screen. This message is also “transient”, and will be lost on a power cycle.

General message format

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<SOH> <Destination RS-485 address> <Source RS-485 address>
<Protocol version> <message length> <message> <checksum>
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All data enclosed in angle brackets “<>” is a single byte unless specified otherwise.

Hexadecimal (base 16) numbers are prepended with the characters “0x”.

Definitions

- **<SOH>** = ASCII 0x01
- **<RS-485 address>** is the 8-bit address (1-254) that is assigned to the device. Address 0 is reserved for broadcast messages. The controller will use address 255 (0xFF).
- **<ACK>** = ASCII 0x06
- **<NAK>** = ASCII 0x15
- **<checksum>** = the exclusive-or of all the previous bytes in the entire message (starting at the <SOH>).
- **<message length>** = the number of bytes in the message (counting from the byte after the message length value up to, but not including, the checksum.)
- **<display type>** = the behavior of the display (0 –stored messages displayed, 1 – transient messages displayed, 2 –scrolling data displayed).
- **<display destination>** = the display destination of the message (0 – stored display, 1 – transient display, 2 – scrolling display)
- **<color/intensity>** = color is the 2 most significant bits of the 8-bit byte. 01 for red, 10 for green, and 00 for off. Intensity is the least significant 6 bits. 0 lowest, 63 (0x3F) highest.
- **<return code>** = 0 for a successful operation, 1 for a configuration problem (typically a parameter outside the defined bounds), and 255 (0xFF) for a hardware failure.

Message Overview

Message 0	Checksum failure (display → controller, only)
Message 1	Sends the display configuration to the display.
Message 2	Sends a string to be output on the display
Message 3	Sends a bitmap row to be output on the display
Message 4	Start the display
Message 5	Stop the display
Message 6	Retrieves the display configuration to the display.
Message 7	Retrieves a string being output on the display
Message 8	Retrieves a bitmap row being output on the display
Message 9	Retrieves firmware version

Detailed protocol messages

Message 1

Display screen configuration.

This message configures the screens that will be displayed on the ALD118. The type of display (stored, transient, or scrolling), the number and size of the screens and fields and the display duration of each screen are set in this message. For stored and transient displays, the duration defines the amount of time that a message will be displayed before moving on to the next. For scrolling displays, the duration defines the time that the display stays in one place before moving to the next. If any of the parameters exceed the device specifications, an error code will be returned. If the checksum fails, a checksum error will be returned.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (6+2*n*)> <message ID (1)>
<display width (in pixels)> <display height (in pixels)>
<display type> <number of screens (*n*)>
<number of frames per screen>
<big endian 2-byte display duration for screen 1 (msec)> …
<big endian 2-byte display duration for screen *n* (msec)>
<checksum>

A duration value of 0 disables the display of that screen while keeping the screen in memory.

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (1)> <return code> <ACK>
<checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Note: For the ALD118 V1.2.0, the display quality degrades when the scrolling display duration is less than 25 msec.

Message 2

Load screen string

This message allows the controller to send a string value for a frame that is to be displayed on the ALD118. The number of frames specified must match the number that has been defined for the display in the “display configration” message, and the screen

number must be valid, as defined by the “display configration” message. If the length of the string exceeds the device capability, the message will not be accepted. The string characters are 1 byte (an octet), and represented by the Basic Latin and Latin-1 Supplement portions of the Unicode 3.0 standard (character codes 0000-00FF). Other displayable characters (replacing the C0 and C1 controls) are described in Appendix 1.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (7+*pm*+*n*)> <message ID (2)> <font number>
<display destination> <screen number> <number of frames (*p*)>
<number of rows per frame (*m*)> <string length (*n*)>
<string character 1> … <string character *n*>
<frame 1 row 1 color/intensity> …
<frame 1 row *m* color/intensity> …
<frame *p* row 1 color/intensity> …
<frame *p* row *m* color/intensity> <checksum>

If the display destination is scrolling data, the screen number is ignored (but still must be in the message).

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (2)> <return code> <ACK>
<checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 3

Load frame row bitmap

This message allows the controller to send a bitmap description of a frame row that is to be displayed on the ALD118. If any of the parameters exceed the device specifications, or if this message specifies a frame that has not been defined as valid by the “display screen configuration” message, an error will be returned. If the checksum fails, a checksum error will be returned.

The data bitmap row has two parts: a one byte row color/intensity, and a binary code where the bits describe the status of the LED’s (1 on, 0 off). The binary code describes each pixel along that row from left to right, using the number of bytes needed to complete the row. Any extra bits (least significant bits of the last data byte) are ignored.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (7+*n*)> <message ID (3)> <display destination>
<screen number> <frame number> <frame row number>
<frame row color/intensity> <data length (*n*)> <data byte 1> …
<data byte *n*> <checksum>

Bitmaps cannot be sent to the scrolling data destination.

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (3)> <return code> <ACK>
<checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 4

Start display

This message tells the ALD118 to start displaying its graphics according to the display type pased in.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (2)> <message ID (4)> <display type> <checksum>

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (4)> <return code> <ACK>
<checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 5

Stop display

This message tells the ALD118 to stop displaying its graphics.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (1)> <message ID (5)> <checksum>

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (5)> <return code> <ACK>
<checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 6

Get display configuration

This message lets the controller query the ALD118 for its configuration.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (1)> <message ID (6)> <checksum>

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (8+2*n*+2*m*)> <message ID (6)>
<return code success (0)> <display width (in pixels)>
<display height (in pixels)> <number of stored screens (*n*)>
<number of transient screens (*n*)> <number of frames per screen>
<big endian 2-byte display duration for stored screen 1 (msec)> …
<big endian 2-byte display duration for stored screen *n* (msec)>
<big endian 2-byte display duration for transient screen 1 (msec)> …
<big endian 2-byte display duration for transient screen *n* (msec)>
<ACK> <checksum> — Message Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Known Problems

The number of frames for stored and transient screens can be different. The ALD118 will return the number of frames for the currently active display.

The scrolling display duration cannot be returned.

Message 7

Get string

This message lets the controller query the ALD118 for its string data.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (3)> <message ID (7)> <display destination>
<screen number> <checksum>

The data will be correct as of the last string write.

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (9+*mp*+*n*)> <message ID (7)>
<return code success (0)> <display destination> <screen number>
<number of frames (*p*)> <number of rows (*m*)>
<frame 1 row 1 color/intensity> …
<frame 1 row *m* color/intensity> …
<frame *p* row 1 color/intensity> …
<frame *p* row *m* color/intensity> <font number>
<string length (*n*)> <string character 1> … <string character *n*>
<ACK> <checksum> — Success

A string length of 0xFF (255) means that the screen/frame requested does not contain a string, and 0 string characters will be returned.

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (7)> <return code failure (1)>
<ACK> <checksum> — Configuration failure (invalid screen/frame number)

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 8

Get frame bitmap row

This message lets the controller query the ALD118 for its frame bitmap data. Empty data will be returned if the screen or frame is not valid.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (5)> <message ID (8)> <display destination>
<screen number> <frame number> <frame row number> <checksum>

You cannot get a frame bitmap from both transient and stored display destinations (destination code 2). They must be done separately. Bitmaps are not available from scrolling data.

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (9+*n*)> <message ID (8)>
<return code success (0)> <display destination> <screen number>
<frame number> <frame row number> <frame row color/intensity>
<number of data bytes (*n*)> <data byte 1> … <data byte *n*> <ACK>
<checksum> — Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (3)> <message ID (8)> <return code failure (1)>
<ACK> <checksum> — Configuration failure

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Message 9

Get firmware version

This message lets the controller query the ALD118 for a string describing its firmware version number and other configuration information.

Controller → display

<SOH> <display RS-485 addr> <0xFF> <protocol version (1)>
<message length (1)> <message ID (9)> <checksum>

Display → controller

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (11+*n*)> <message ID (9)>
<return code success (0)> <highest protocol version supported>
<maximum number frames per screen>
<maximum number stored frames> <maximum number transient frames>
<maximum string length> <2-byte big-endian maximum scrolling
string length> <version string length (*n*)> <version
string character 1> … <version string character *n*> <ACK>
<checksum> — Success

<SOH> <0xFF> <display RS-485 addr> <protocol version (1)>
<message length (2)> <message ID (0)> <NAK> <checksum> —
Checksum failure

Appendix A

Supplemental font characters

These are the characters that are currently defined as replacements for the Unicode C0 and C1 controls to allow the display to show more characters that just the Basic Latin and Latin-1 Supplement portions of the Unicode 3.0 standard. Currently there is 1 supplemental character defined.

Character	Code
Euro currency symbol (€) – Unicode U+20AC	128 (0x80)