Introduction

The Pixblasters™ MS1 Video LED Controller can control immense video displays built of hundreds of thousands of perfectly synchronized LEDs that can be shaped in very unusual forms. For example, the LED strips can be curved and glued to different surfaces to form giant video installations that span entire buildings.

Flexible and big video sizing sometimes require the Pixblasters MS1 controller position that is far from the beginning of display's LED strips. The LEDs use the single-ended signaling and large cable distances between the controller and the LED may cause unwanted flickering and other sorts of video artifacts on the LED screen.

To help LED display designers overcome those challenges, the Pixblasters team has conducted specific measurements on a bigger video LED screen shown in Figure 1. Our goal was the definition of the maximum length of control signals' wiring from the Pixblasters LED outputs to LED strips inputs.

Figure 1. One half of the video LED display used for measurements

The complete video screen used for measurements is made of two halves (res 120 x 60) for the total resolution of 120x120 and size of exactly four (4) square meters. Due to its size and 14,400 integrated LEDs, the control wires from the Pixblasters controller to the LED strips are bit longer than usual. Each Pixblasters LED digital output controls four rows of the screen (segmented operation mode).

Figure 1 shows that we use signal wiring even longer than necessary for the specific LED display. We did that to produce the worst case situation.

This document describes Pixblasters tests with the 3-wire WS2812B LED diodes that work with the maximum control signal clock frequency of 800 kHz!

The 4-wire APA102-like LEDs work with much faster clock inputs (possibly measured in tens of MHz, i.e. 25 MHz). Consequently, the test results presented in this document are not applicable to such LEDs. General rule: faster data rates require shorter cabling!

How We Measured?

Figure 2. Regular wires twisted to form the control signal line

To check the quality of control signals received by the first LED diode in the strip, we initially used the signal lines made by 4 meters long twisted wires. We used regular wires (i.e. 22AWG), with no shield, and twisted them by hand. The wire twisting is highly recommended in Pixblasters controlled video installations. It reduces electromagnetic radiation from the signal-ground wire pair and the crosstalk between the neighboring pairs.

To simulate regular installation wiring, we grouped four twisted signal lines. It is a good practice to make a neat wiring harness that consists of multiple and physically separated wire groups.

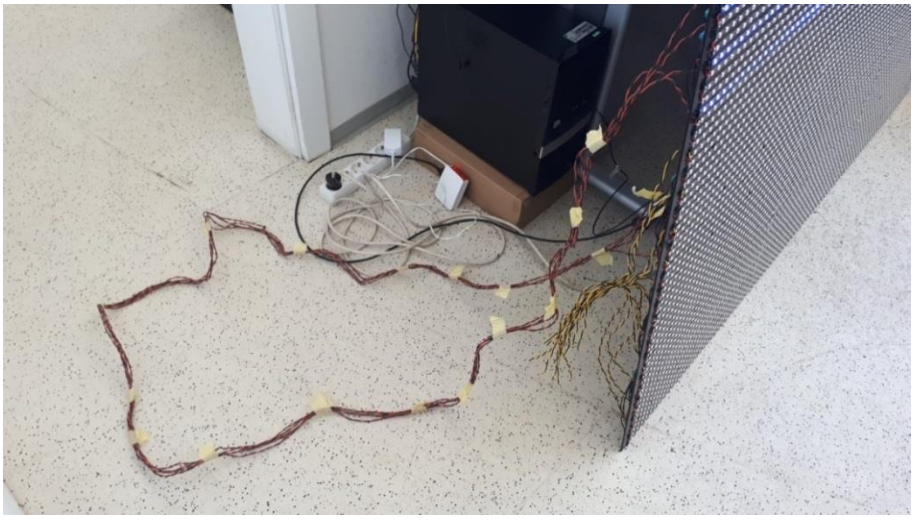

Figure 3. 4-meters long twisted signal lines in a group of four

The quality of the video image was observed optically. Also, we controlled the data signals' integrity by oscilloscope probes connected to the first LED in the strip. As soon as the first LED's driver chip receives a quality and reliable control digital signal, it internally re-shapes it. The next LED in the LED strips then receives the control signal of increased quality.

Measurement Results

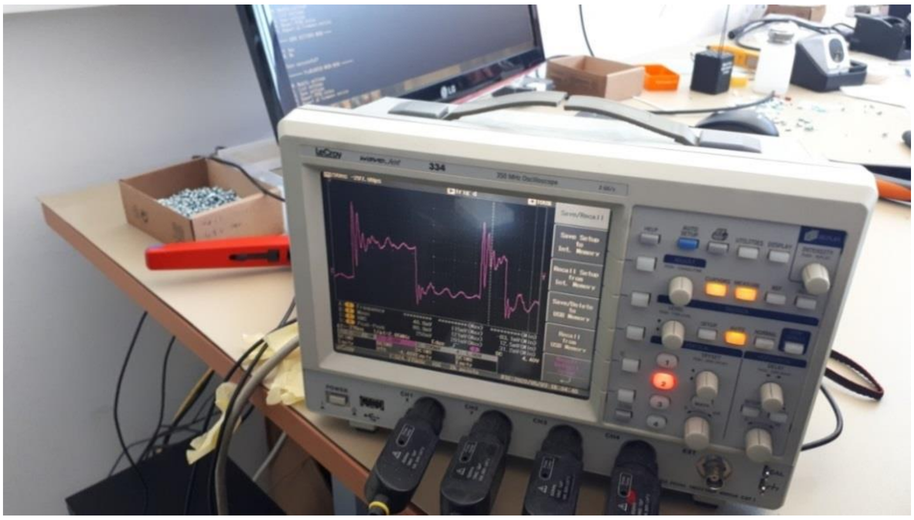

Figure 4. Digital control signal with a visible noise (ringing)

Irregularities in the form of screen flickering are easily spotted when wires are in a “ball” shown and enclosed by a yellow line in Figure 1. With the wires placed in a “cleaner” and more organized way, such as in Figure 3, the flickering is very rare or totally removed.

A check with the oscilloscope probe shows significant “ringing” on the data line – see Figure 4.

To reduce the reflection and to damp the signal ringing, we introduced the termination resistor at the source of the LED digital output. Figures 5 and 6 show the termination resistor inserted in the digital output connector. The signal wire is soldered to the other side of the resistor.

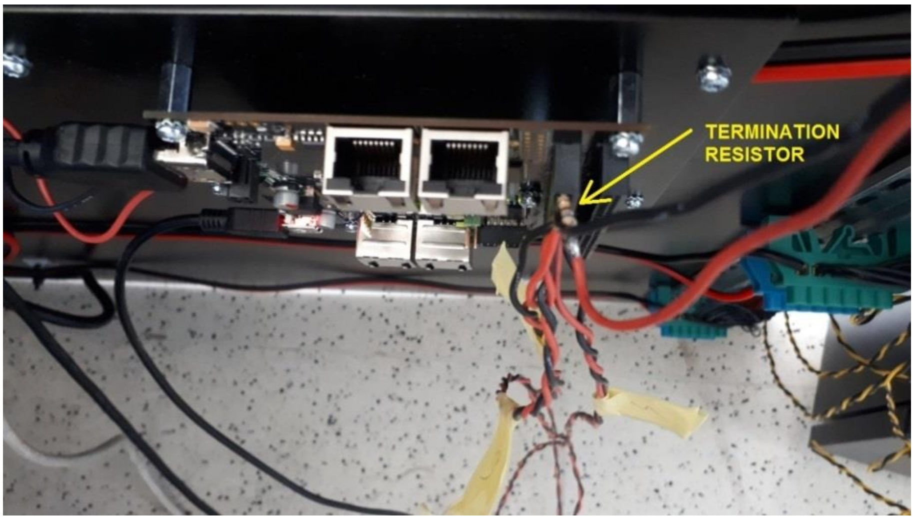

Figure 5. 68 Ohm termination resistor plugged in the digital output connector

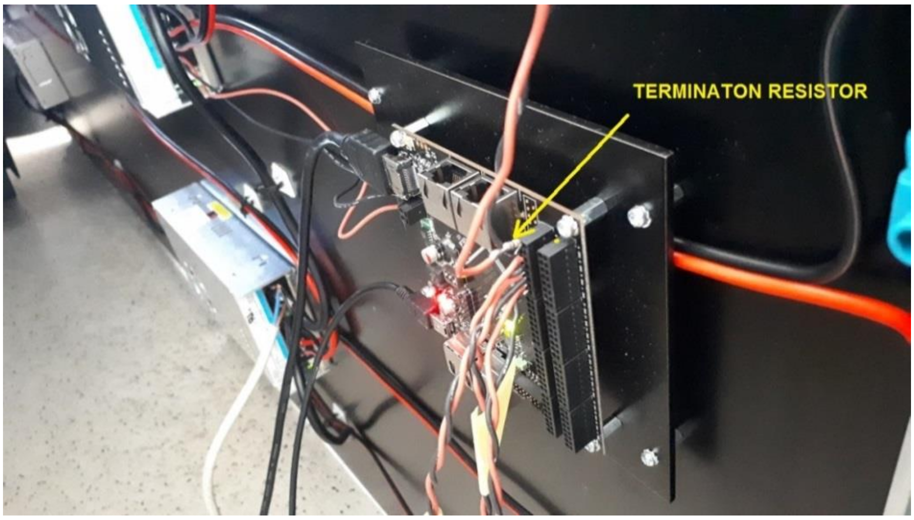

Figure 6. 68 Ohm termination resistor plugged in the digital output connector

The 68Ω resistor's color coding is shown in Figure 7: blue, grey, black, and 5% tolerance golden ring.

Figure 7. 68 Ohm resistor – the coloring coding

The following photo shows how the termination resistor influences the signal quality. The measurement is taken on 2 meters long wire with termination. The oscillogram shows a quality digital signal with significantly reduced ringing.

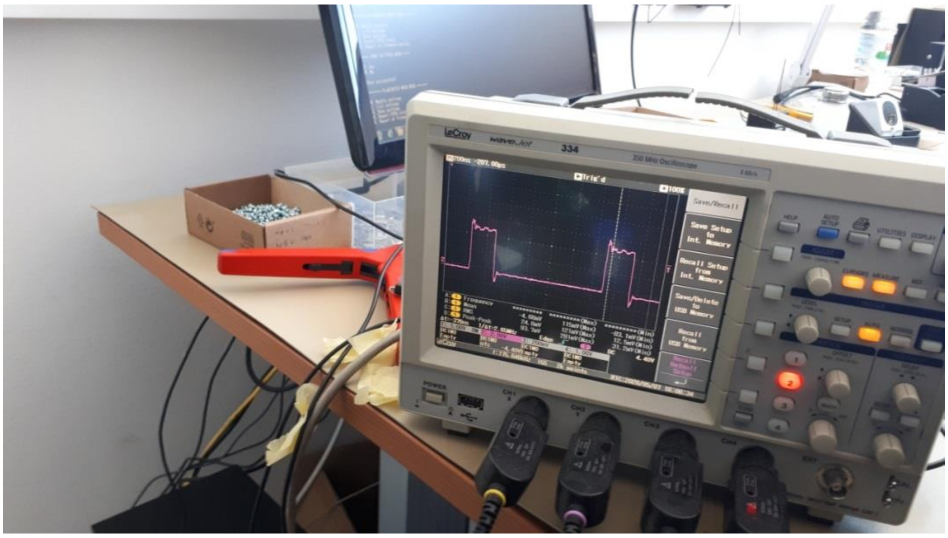

Figure 8. Digital control signal with no visible noise

Integrated Digital Outputs Termination

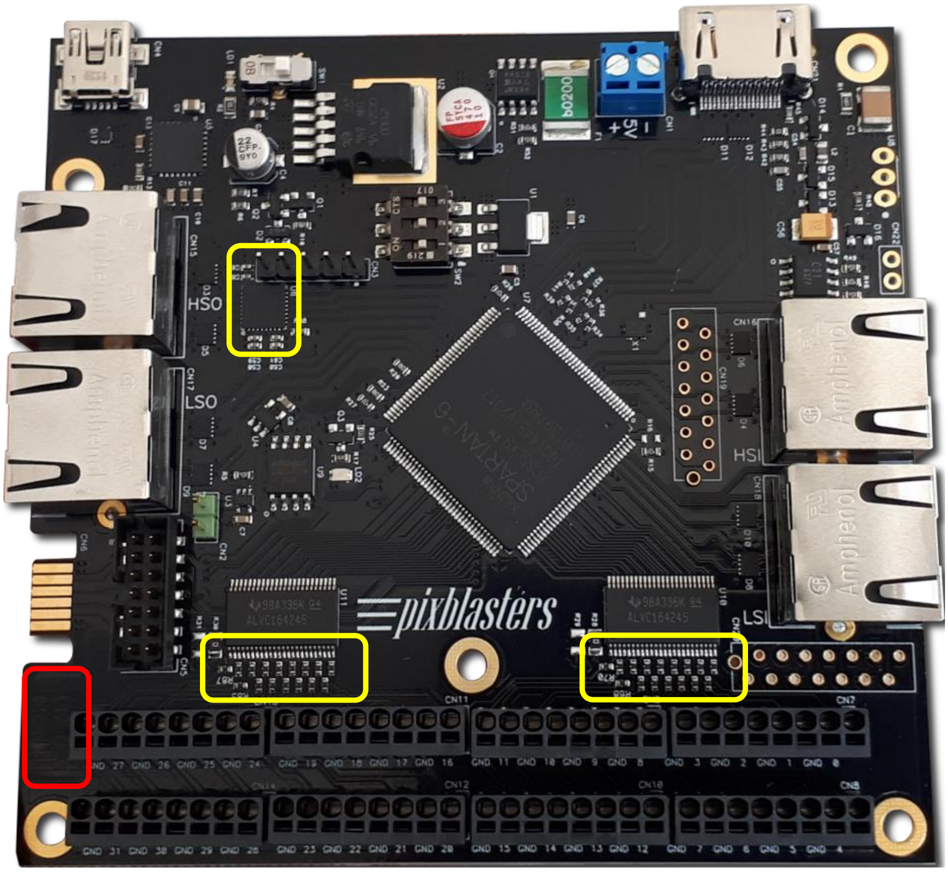

Figure 9. The second MS1 board revision with integrated termination resistors

The described tests initiated the PCB redesign and the second board's revision (labeled 0502) integrates on-board termination 68Ω resistors. The on-board integrated resistors make the soldering of additional external resistors unnecessary and make the Pixblasters controller easier to use.

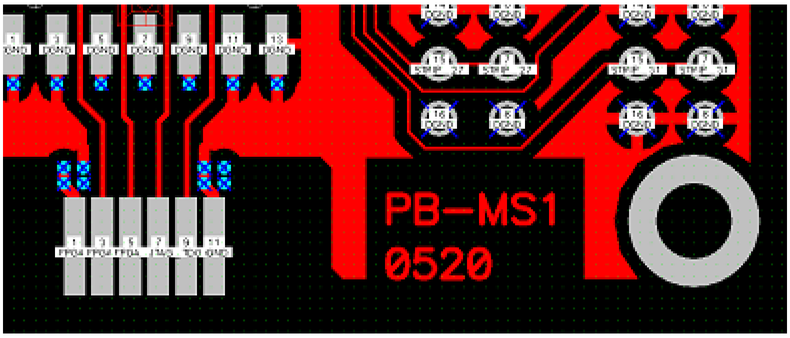

Figure 9. The 0502 mark indicates the second PCB revision with integrated termination resistors

The exact position of the PCB board's revision mark is enclosed by the red line shown in the Figure 9.

Recommendations and Conclusion

- To support longer wiring distances with the Pixblasters MS1 boards from the first lot (before 0520 revision), we recommend the described line termination by 68Ω resistor (Figure 5-7)
- Wire twisting is also highly recommended
- In case of visible display flickering, it is highly recommended to keep wires in bulks of four. The neighboring bulks should be kept separated. Separation of 2 cm is enough to eliminate crosstalk between bulks.

> The Pixblasters controller has been successfully tested with properly terminated twisted pair interconnects with lengths of up to 3m.

Revision History

Version	Date	Description of Revisions
1.00	18.01.2021.	Initial public release.