MP-69D Scoreboard Controller Data Protocol

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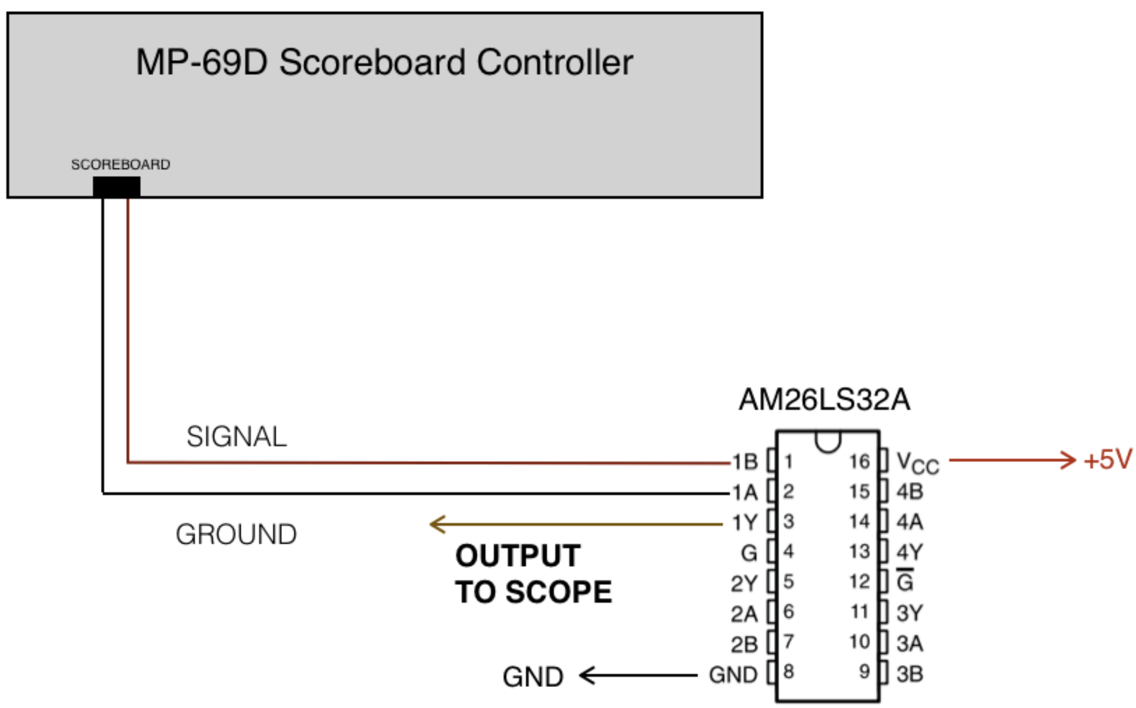
I. Data Transmission Scheme

The MP-69D has two dual output channels on its back panel, two outputs for scoreboard data, and two for shot clock/timer data. Both of these outputs are standard 1/4" phone jack connectors, and, as presumed from the original Fair-Play documentation for the MP-69D [1], driven by Texas Instruments 88C30 differential line driver chips [2]. Each of these outputs simply has two wires, a GROUND and a SIGNAL line. Since these outputs seem to be differential signals the distinction between GROUND and SIGNAL is not particularly meaningful. In order to decode these signals, a newer Texas Instruments differential line receiver chip was used, the AM26LS32A [3]. This chip is essentially an op-amp wired as a differential receiver. The two GROUND and SIGNAL lines are brought into two input pins on the chip and there is a third output pin that outputs the voltage difference between the two input lines in reference to the GND pin of the receiver chip. The schematics of this setup are seen below:



To analyze the signals, an Agilent 54622A digital oscilloscope was used. The data signals are sent in packets, in ~50ms intervals (fig. 1). It seems that each packet consists of 130(?) bits of data that contains all the relevant sports statistics data.

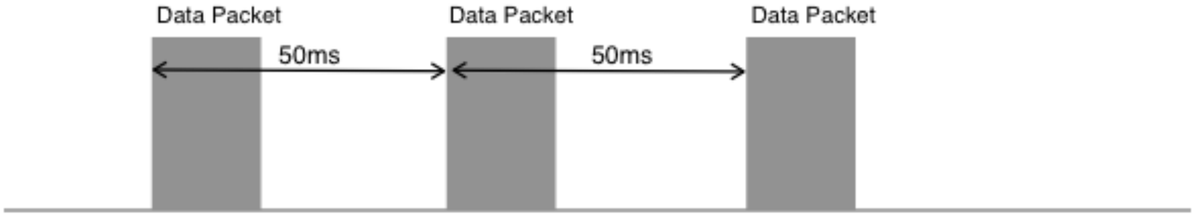


Fig. 1

The composition of each data packet is as follows. Each packet is simply a sequence of bits, 0s or 1s. Fig. 2 demonstrates what constitutes a zero and what constitutes a 1 in this data packet.

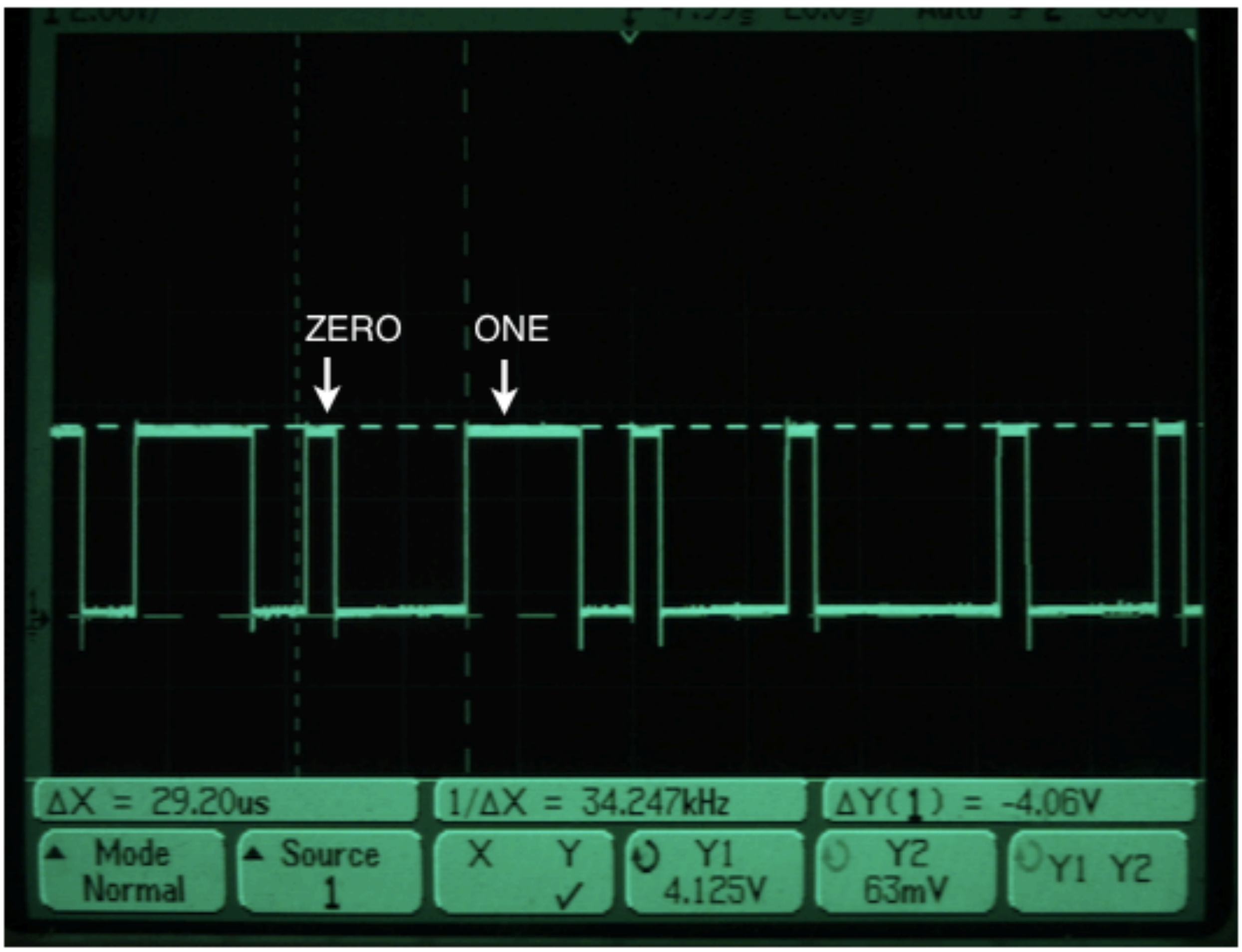


Fig. 3

The voltage of the signals is around 4 Volts, coming from the TI differential receiver chip on +5V power. As can be seen from the screen capture of a portion of the signal on the oscilloscope, every bit, either zero or one, is signaled by a rising edge. The rising edges occur approximately every 29μs. This translates to a baud rate of approximately 34.4K bits per second.If the bit is a ZERO, as can be seen in fig. 3, the signal goes low after ~5μs. If the bit is a ONE, the signal stays high for ~20μs after the initial rising edge. This is the foundation of the data transmission protocol employed in the MP-69D. The next section will discuss how to translate the string of bits contained in each data packet into meaningful values.

II. Sports Data

Each data packet contains 130 bits. The first 30 of these bits, it seems, are not used for data transmission, and always follow the same pattern. All the bits following these initial 30 however, are split into 4-bit chunks. Each sequential 4-bit chunk represents a binary-coded decimal digit, that is an element of some data value. For example, the first 4-bits in Basketball mode are the first digit of the number of Visitor Team Fouls. So if the first 4-bits were (0110), the number of fouls that the Visitor Team has would have a 6 as its first digit. This is how score data is encoded in the bit stream. You can see the Python script in the Github repository for how the binary coded values map to score data values for different sports.

[1] http://www.fair-play.com/literature/discontinued_models/MP-69_Manual.pdf

[2] http://www.ti.com/lit/ds/symlink/mm78c29.pdf

[3] http://www.ti.com/lit/ds/slls115e/slls115e.pdf