Serial 7-Segment Display
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Overview

The Serial 7-Segment Display turns the thirteen pins necessary to control a 4-digit 7-segment display into just one or three. The display will give you full control of all digits, decimal points, the colon and the apostrophe. At the heart of the display is an ATMega168 which controls all the serial communications and the 4-digit 7-segment display.

Features

- 4 digit alpha-numeric display with serial or SPI interface
- Display Numbers (0-9) and Letters (A-F)
- Control multiple decimal points, apostrophe, and colon
- Selectable baud rate (4800 to 57600 bps)
- Selectable brightness (255 different levels)

Interface Specifications

The Serial 7-Segment Display can be controlled in one of two ways: (1) serial TTL communication or (2) SPI serial communication. Regardless of which method you use to communicate with the display, you must always send your display data in 4-byte packets, and special commands in 2-byte packets.

Displaying Numbers

The first byte you send will correspond to the left-most digit on the display, the second byte corresponds to the second digit and so on.

The display can represent all numbers 0-9 and letters A-F. To display a number, you can send either the binary representation or the ASCII representation.

Example: To Display '12AB'

The user can send numbers in binary representation:

(0x01)(0x02)(0x0A)(0x0B)

ASCII representation: (0x31)(0x32)(0x41)(0x42)

Any combination of the two will work as well.

To display a blank digit send the special character 'x' (0x78).

Example: To Display '42'

(Blank followed by 42 followed by blank) send (0x78)(0x04)(0x02)(0x78).

NOTE: You must always send your data in 4-byte packets

Special Commands

There are three special commands that can be sent to the Serial 7-Segment Display. Each special command consists of sending a command character followed by a data byte.

Decimal Point Command

To turn on or off any of the decimal points, colons, or apostrophes on the Serial 7-Segment Display, first send the special command character 0x77, followed by a data byte. Each of the seven least significant bits in the data byte represent one decimal point; a 1 will turn the decimal point on, a 0 will turn it off. The most significant bit in the data byte has no effect on the display. The following figure shows the bit representation for each decimal point; 0 is the least significant bit.
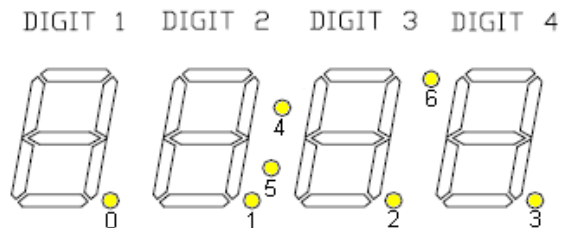
Example: To turn solely the colon on, first send the special character 0x77. The 4th and 5th bits in the data byte should be 1, everything else should be 0, the byte would look like: 00110000. So, send: (0x77)(0x30).

To turn the colon off, send the special character, 0x77, and set all bits in the data byte to 0. So, send: (0x77)(0x00).

Brightness Command

To control the brightness of the Serial 7-Segment Display, first send the special command character

0x7A, followed by a data byte. The data byte can be a number between 0 and 255; the lower the number the brighter the display.

After the screen receives the brightness command the brightness value is written into the processors non-volatile memory, so it will retain the same brightness level upon power cycling.

Example: to set the display to its dimmest level, send the special character, 0x7A, followed by 255. So send: (0x7A)(0xFF)

Baud rate control

By default the UART baud rate of the Serial 7-Segment Display will be 9600. This can be adjusted by first sending the special command character 0x79, followed by a binary number between 0 and 6. The table below shows corresponding baud rates to data bytes:

Baud Rate	Data Byte Value
2400	0
4800	1
9600	2
14400	3
19200	4
38400	5
57600	6

If the data byte is not between 0 and 6 nothing will be changed.

After the baud rate is adjusted the value is written into the processors non-volatile memory, so it will retain the same rate upon power cycling.

Example: to change the baud rate to 4800 first enter the special command character 0x79, followed by the binary number 1. So, send: (0x79)(0x01)

Hardware Specifications

There are two methods of sending serial data to the Serial 7-Segment Display, TTL level serial communication or SPI.

TTL Level Serial Communication

When using this method of communication only one wire is needed to interface with the display – RX. RX is a serial input of the display. By default, communications will occur at 9600bps, with 8 data bits, no parity, and 1 stop bit. The baud rate is adjustable, as discussed above in section 3.3.

SPI Communications

When using SPI to communicate with the display, three wires are used – MOSI, CSN, SCK. CSN, selects the display in a multiple slave SPI bus, SCK is the serial data clock, and MOSI is the data line between the master and slave. MOSI, CSN and SCK are all inputs. The Serial 7-Segment Display is configured to be the SPI slave.

Electrical Characteristics

The backbone of the Serial 7-Segment Display is Atmel's ATMega168, and as such, most of the electrical specifications are derived from that. The display can be powered at anywhere between 2.6 to 5.5V, however, there is no on-board voltage regulator, so anything outside that range could damage the display. A logical high voltage on all serial lines should not exceed VCC+0.5 V.

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