LED Matrix controller

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Contents

1 LED matrix

32 columns, cathode, and 12 rows, anode.

2 Boards

Two connection boards with TLCs. One controller board with ATmega8 and peripherals. Flat cable connections.

Place all TLC pins on one side of ATmega8 and demultiplexer pins on the other.

Pin no.	Driver	Controller
1	VPRG	PC3
7	SIN(A)	PB3
5	SCLK	PB5
3	XLAT	PC1
4	BLANK	PC0
9	GND	GND
10	VCC	VCC
2	DCPRG	PC2
8	GSCLK	PB1
6	SOUT(B)	PB4
11	XERR	PB2
12	R0	R0
...	...	...
23	R11	R11

Table 1: Flat cable pinout

3 MCU

ATmega8

3.1 Resources

3.2 Rates

SPI rate: 8 Mbit/s.

12*32/8 = 48 B/row

48*12 = 576 B/frame

16 instr/byte max SPI speed

768 instr/row transfer.

$4096 * 2 = 8192$ ticks needed between blanking. Row speed of 1.95 kHz yields 162 Hz framerate.

Pins	Usage
PD0-1	RX TX
PD2-6	Demux addr, enable
PD7	XERR
PB0	
PB1	OC1A, TLC gsclk
PB2-5	SPI
PB6-7	X TAL
PC0-PC3	TLC xlat, blank, vprg, dcprg
PC4-5	I2c
PC6	Reset

Table 2: Pin reservations (rough)

Timer	Usage
Timer1	gsclk
Timer2	blanking interrupt

Table 3: Timer reservations

4 Communication

Requests are initated by the host by sending a command and waiting for acknowledgement. The display acknowledge that the command is valid and that it is ready to process the command. The host transmit the command data (if any) and waits for response. The display process the command and transmit the response.

5 Linear intensity

To achieve intensity percieved as linear PWM cycles must be adjusted. Since the human vision is logarithmic an exponential model is used.

$$p(i) = A(e^{\lambda i} - 1) \tag{1}$$

Use full span, 0 to P_{max} and specify a value P_{mid} where half intensity is reached.

$$\begin{array}{lcl} p(0) & = & 0 \\ p(I_{max}) & = & P_{max} \\ p(I_{max}/2) & = & P_{mid} \end{array} \tag{2}$$

yeilds

$$\frac{P_{max}}{P_{mid}} = \frac{A(e^{\lambda I_{max}} - 1)}{A(e^{\lambda I_{max}/2} - 1)} = \frac{(e^{\lambda I_{max}/2} + 1)(e^{\lambda I_{max}/2} - 1)}{(e^{\lambda I_{max}/2} - 1)} = e^{\lambda I_{max}/2} + 1 \tag{3}$$

Solving for λ

$$\lambda = \frac{2}{I_{max}} \ln(\frac{P_{max}}{P_{mid}} - 1) \tag{4}$$

and finally A

$$A = \frac{P_{max}}{e^{\lambda I_{max}} - 1} = \frac{P_{max}}{e^{2\ln(\frac{P_{max}}{P_{mid}} - 1)} - 1} = \frac{P_{max}}{(\frac{P_{max}}{P_{mid}} - 1)^2 - 1} = \frac{P_{max}}{((\frac{P_{max}}{P_{mid}} - 1) + 1)((\frac{P_{max}}{P_{mid}} - 1) - 1)} = \frac{P_{max}}{(\frac{P_{max}}{P_{mid}})(\frac{P_{max}}{P_{mid}} - 2)} = \frac{P_{mid}}{(\frac{P_{max}}{P_{mid}} - 2)} \tag{5}$$