1 Purpose

Documentation for etimer, microcontroller program to drive a photographic enlarger timer

3. Index

List of Figures

2 Features

- Runs on cheap, common hardware (AVR microcontrollers) with out-of-the-box configuration (no crystals, fuse bits or bootloaders needed)
- Runs on readily-available 5V supply (think USB cell phone charger)
- Measures exposures in units of $log_2 T$ like God intended
- Dual-channel for split-grade printing
- White-light controller which corrects white light source for enlarger head height according to inverse square law

3 Microcontroller hardware

The microcontroller used is an ATMEGA328 8-bit AVR© microcontroller which is widely available for about 3 USFRN in convenient packages. It was selected for its availability in my toolbox. The firmware would run on other AVR microcontrollers with minimal modification. The microcontroller is powered by 5V and runs at 1MHz, which is how it's configured out-of-the-box. No external crystal is needed, just apply 5V on the Vcc pin and pull up RESET (refer to figure **??**). Note that if you use a 5V cell-phone power supply, you don't need any voltage regulator.

Flashing this firmware to the microcontroller will require an in-system-programmer such as the AVRISPV2 or USBTinyISP. Instructions on programming AVR microcontrollers is outside the scope of this document.

Time pots

Pot 0 sets the exposure time from 0 to 128 seconds on a logarithmic scale. Pot 1 is a fine-adjustment which allows +/- 1 stop of exposure adjustment to be dialed in with resolution of 1/16th stop or less. Thus, setting 8 seconds time on Pot 0 and turning Pot 1 all the way to +1 stop, is the same thing as setting 32 on Pot 0 and dialing Pot 1 all the way to -1 stop.

Meters

The use of dials simplifies implementation by combining input and display. However, dials do not give any feedback as to the progress of the exposure in progress. For feedback the panel meters sweep linearly from full-scale to zero as the exposure progresses. This allows dodges/burns/filter changes/etc. to be conveniently and repeatably timed and effectively extends the timer from a 2-channel timer.

4 White light control

Non-image, actinic light can be a very useful control. The most convenient place to mount a white-light source is to the enlarger head. This poses the problem that the white light will have a different intensity every time you adjust the enlarger head height, according to the inverse-square law, thus repeatability is difficult to achieve. The white-light output provides a 16-bit, 8kHz, 5V PWM output which can vary the intensity of the white-light source. AVRs can directly drive 10mA loads, or the output can be buffered with a transistor. The adjustment dial can be manually calibrated to one's enlarger. By setting the dial to match the current enlarger-head height, a constant intensity of white light is delivered to the baseboard.

5 Perhipheral hardware options

Input Item	AVR Pin	Voltage details	Function notes
Dial A0	PC0	0V-5V analog in	set timer A base exposure
Dial A1	PC1	0V-5V analog in	set timer A fine exposure
Dial B0	PC2	0V-5V analog in	set timer B base exposure
Dial B1	PC3	0V-5V analog in	set timer B fine exposure
Button A start	PB3	GND=button pressed	start/stop exposure countdown
Button B start	PB9	GND=button pressed	start/stop exposure countdown
Button A reset	PB4	GND=button pressed	start/stop exposure countdown
Button B reset	PB4	GND=button pressed	start/stop exposure countdown
Dial W0	PC3	0V-5V analog in	set white light intensity

Figure 1: Table Of Inputs

Output Item	AVR Pin	Voltage details	Function notes
Meter A	PB6	PWM to panel meter	visualizes exposure
Meter B	PB6	PWM to panel meter	visualizes exposure
SSR	PB2	Hook to SSR	5V=bulb on

Figure 2: Table Of Outputs

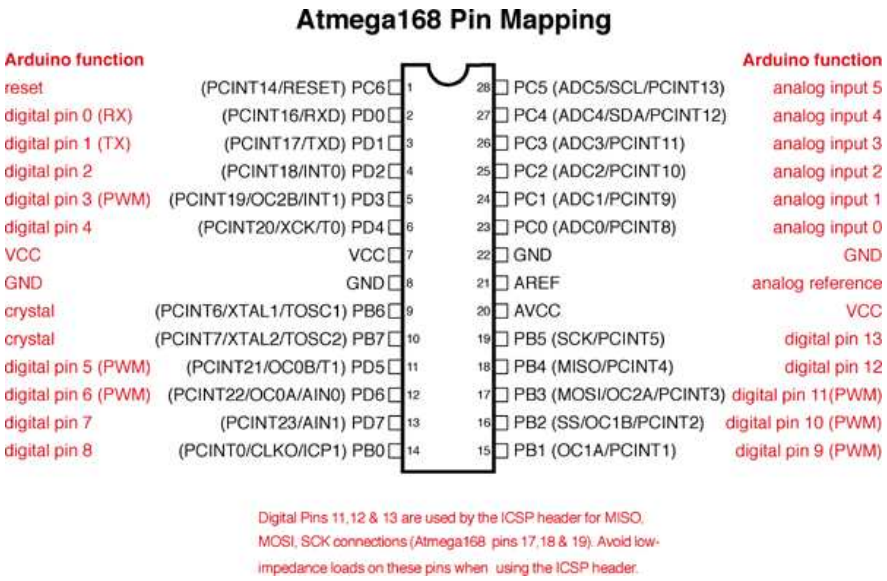

Figure 3: Pinout for ATMEGA168/328 DIP package