SmartSwitch™

Introduction

This document discusses the AAT4291 RGB EVAL evaluation board and the application of the AAT4291 as an RGB LED driver. Advanced RGB LED control is realized without having to use multiple discrete MOSFET switches controlled by multiple I/O pins from the system processor. Only one digital I/O pin is needed for complete, independent brightness control of each of the R, G, and B LEDs.

The AAT4291 SmartSwitch™ is a member of AnalogicTech's Application Specific Power MOS-FET™ (ASPM™) product family. The AAT4291 has three P-channel MOSFETs configured for use as a microprocessor I/O expander. Having independent drain outputs and a common input, the AAT4291 operates with an input voltage ranging from 1.8V to 5.5V, making it ideal for 2.5V, 3.3V, or 5V systems, as well as systems powered by lithium-ion/polymer batteries. Each switch features a fast 500ns turn-

on time. The switch states are controlled by the Simple Serial Control™ (S²Cwire™) serial digital interface. The quiescent supply current is very low, typically 5µA. In shutdown mode, the supply current is reduced to less than 1µA.

Using RGB LEDs to generate various colors presents unique challenges. Among them is a requirement to pulse width modulate (PWM) three independent LED currents to accurately control the brightness for each LED color. The AAT4291 is well suited for this. Using only one GPIO pin from the system processor, a high PWM rate can be achieved with complete brightness control for each LED.

The following material describes the hardware and software platform used to generate many colors of light from RGB LEDs. In addition to this literature, the reader is encouraged to also consult the AAT4290/4291 product datasheet.

Schematic

Figure 1: Evaluation Board Schematic.

Getting Started

The evaluation board comes with a battery pack attached. In this configuration, V_{IN} is supplied from three standard "AAA" alkaline batteries. Under new conditions for the batteries, the input voltage is generally 4.7V ~ 4.8V and falls off depending on the degree of discharge and load conditions. If desired, the batteries can be removed and an independent, DC supply can be used.

There are five buttons on the board. Their functions are as follows:

- SW1: Increments through the eight Output Setting states (Table 2 in the product datasheet).
- SW2: Increments B_LED duty cycle.
- SW3: Increments G_LED duty cycle.
- SW4: Increments R_LED duty cycle.
- SW5: Brings EN/SET low (shuts down the AAT4291 device).

Notes:

1. Buttons 1 through 4 will automatically increment if held down.
2. Buttons 2 through 4 are set up so that a user can independently control the corresponding R, G, or B LED brightness. This is done by incrementing the PWM duty cycle through the following states: 0%, 25%, 50%, 75%, 100%, 0%, …

The PIC microcontroller toggles the EN/SET line high and low at 500kHz. The rise and fall times of the EN/SET signal are small relative to the period, so T_{HI} and T_{LO} are roughly 1µs (see Figure 1). T_{HI} and T_{LO} depend on the µC's internal RC oscillator, so the 1µs reference is an approximate figure and subject to the precision of the RC oscillator.
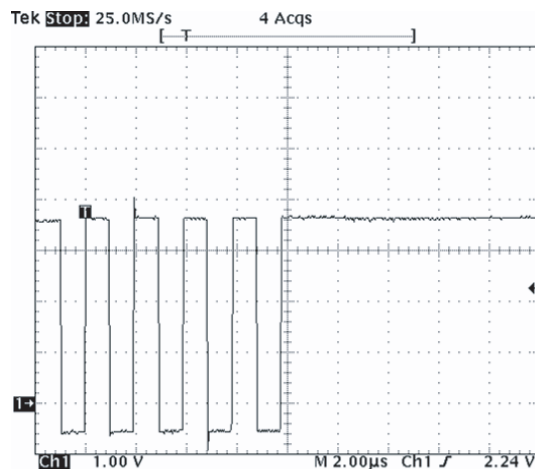
Figure 2: Typical EN/SET Signal.

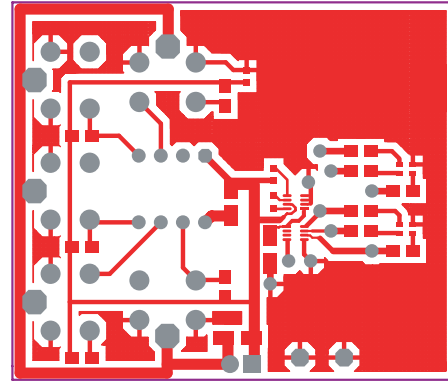## Printed Circuit Board
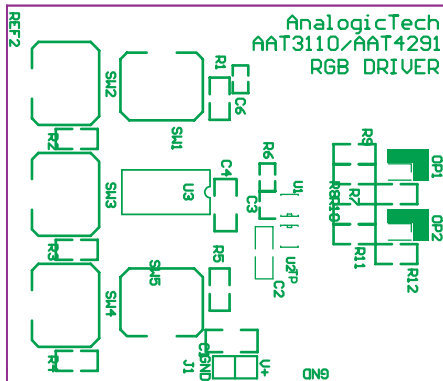
Figure 3: Top Layer Silkscreen (not to scale).
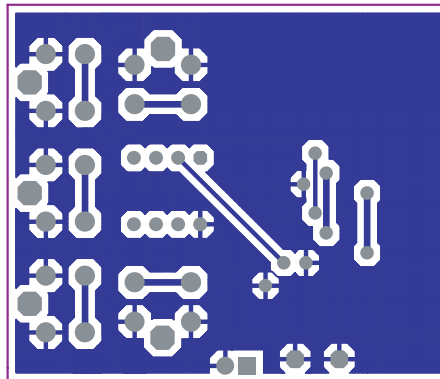

Figure 4: Top Layer (not to scale).

Figure 5: Bottom Layer (not to scale).

AAT4291 EVAL-RGB Component Listing

Component	Part#	Description	Manufacturer
U1	AAT3110	µPower Regulated 4.5V CP; SC70JW-8 Package	AnalogicTech
U2	AAT4291	I/O Expander Load Switches; SC70JW-8 Package	AnalogicTech
U3	PIC12C671	8-Bit CMOSµC; 8-Pin PDIP Package	Microchip
OP1, OP2	1615 SMD	RGB LED, Common-Cathode; 1615 SMD	Lasemtech
C1, C2, C4	GRM31CR70J106KA01L	10µF, 6.3V, X7R, 10%; 1206	Murata
C3	ECJ-1VB1A105K	1µF, 10V, X5R, 10%; 0603	Panasonic-ECG
C6	ECJ-1VB1C104K	0.1µF, 16V, X7R, 10%; 0603	Panasonic-ECG
R1 - R5	Chip Resistor	1K, 5%, 1/8W; 0805	Vishay
R6	Chip Resistor	100K, 5%, 1/10W; 0603	Vishay
R7, R12	Chip Resistor	249, 1%, 1/10W; 0805	Vishay
R8, R11	Chip Resistor	249, 1%, 1/10W; 0805	Vishay
R9, R10	Chip Resistor	60.4, 1%, 1/10W; 0805	Vishay
SW1 - SW5	PTS645TL50	Switch Tact, SPST, 5mm	ITT Industries