AP3156 Evaluation Module

HIGH EFFICIENCY CHARGE PUMP WHITE LED DRIVER

Features

- V_{IN} Range: 2.7V to 5.5V
- Fully Programmable Current with Single Wire
  - 32-Step Logarithmic Scale
  - 20/25mA Max Current per Channel
  - Four Low Current Settings Down to 50µA
  - Low IQ (50µA) for Low Current Mode
- Tri-Mode 1X, 1.5X, and 2X Charge Pump for Maximum Efficiency and V_F Coverage
- Drives up to Six Channels of LEDs
- Individual Main/Sub-Group Control
- No Inductors, Low Noise Operation
- 0.5/1/2MHz Constant Switching Frequency
- Built-In Thermal Protection
- Built-In Auto-Disable For Open Circuit
- Automatic Soft Start
- IQ <1µA in Shutdown
- Thermally-Enhanced QFN4040-16 Package: Available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish / RoHS Compliant

Description

The AP3156 is a low noise, constant frequency charge pump DC/DC converter that uses a tri-mode (1X, 1.5X and 2X) conversion to maximize efficiency for white LED applications. It is capable of driving LEDs at a total of 120mA maximum from a 2.7V to 5.5V input. The six channels may be operated individually or in parallel for driving higher-current LEDs.

A low external parts count (two 1µF flying capacitors and two small 1µF capacitors at V_{IN} and V_{OUT}) makes this device ideally suited for small, battery-powered applications. A serial digital input is used to enable, disable and set current for each LED with a 32-level logarithmic scale plus four low-current settings down to 50µA for optimal efficiency, with a low quiescent current of only 50µA. Each output of the AP3156 is equipped with built-in protection for V_{OUT} short circuit and auto-disable for LED failure conditions. Built-in soft-start circuitry prevents excessive inrush current during start-up. A shutdown feature disconnects the load from VIN and reduces quiescent current to less than 1µA.
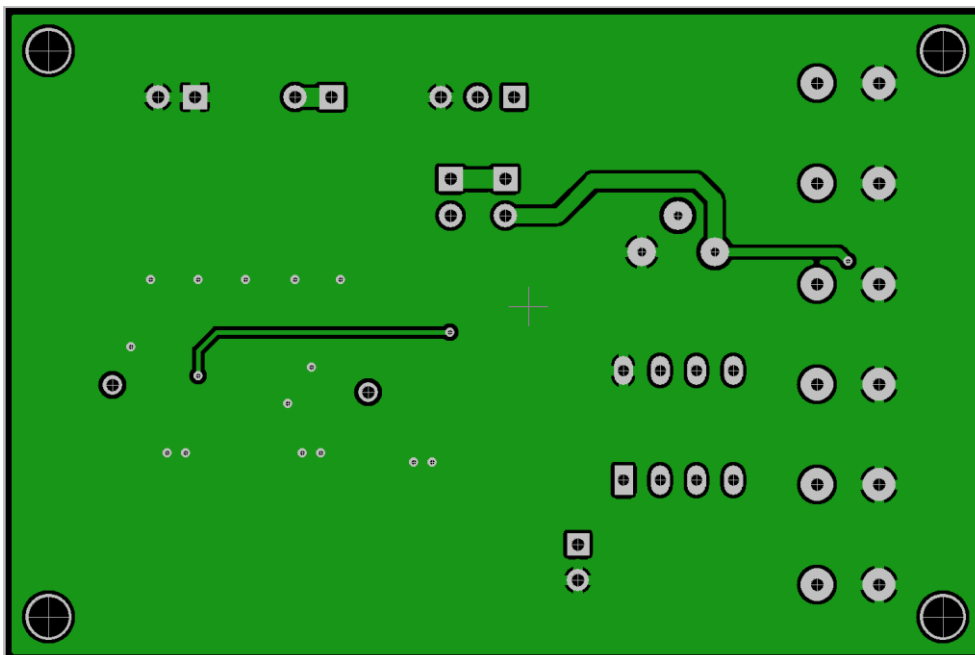
Ordering Information

Device	Package Code	Packaging	EVM Part Number
AP3156FVG	FV	QFN4040-16	AP3156FVG-EVM

Schematic

PCB Layout
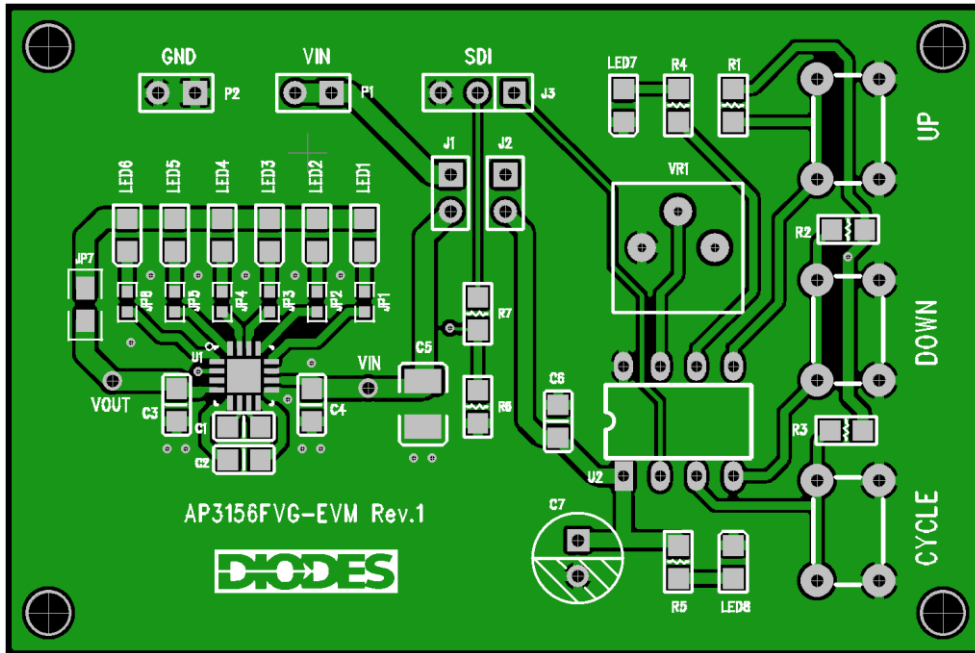
Top Layer Layout of AP3156FVG-EVM

Bottom Layer Layout of AP3156FVG-EVM

Bill of Material

Bill of Material for AP3156FVG-EVM

Ref	Count	Size	Mfr	Part Number	Description
P1, P2	2	0.1"	STD	STD	0.1" x2 headers
J1, J2	2	0.1"	STD	STD	0.1" x2 headers and jumpers
J3	1	0.1"	STD	STD	0.1" x3 header and jumper
JP1-JP6	6	0603	STD	STD	0 Ω resistor/jumper
JP7	1	0805	STD	STD	0 Ω resistor/jumper
C1-C4	4	0805	STD	STD	1 µF/10V ceramic capacitors
C5	1	1210	STD	STD	10 µF ceramic capacitor
C6	1	0805	STD	STD	0.1 µF ceramic capacitor
C7	1	TH	STD	STD	100 µF electrolytic capacitor
R1-R3	3	0805	STD	STD	1 kΩ resistors
R4, R5, R7	3	0805	STD	STD	330 Ω resistors
R6	1	0805	STD	STD	100 kΩ resistor
LED1-LED6	6	0805	STD	STD	White LEDs
LED7	1	0805	STD	STD	Green LED
LED8	1	0805	STD	STD	Red LED
CYCLE, DOWN, UP	3		Omron	B3F-1022	Tactile switches
VR1	1		Bourns	3362R	2 kΩ potentiometer
U1	1	QFN4040-16	Diodes	AP3156FVG	Charge Pump 6 channels LED driver
U2	1	PDIP8	Microchip	PIC12F1822	8-bit microcontroller

I/O Terminals and Test Points

Terminals and Jumpers for AP3156FVG-EVM

I/O and Test Points	Description	Comments
P1 (VIN), P2 (GND)	Power Supply and Ground	Connect to input power supply
J1	Input Jumper to AP3156	Jumper for connecting V_{IN} to the AP3156
J2	Input Jumper to SDI	Jumper for connecting V_{IN} SDI controller circuit
J3	SDI Connecter/Jumper	Select onboard or external SDI signal
VIN, VOUT	Voltage Test Points	Input and output voltage test points

Quick Start Guide

1. Insert jumper J1 to connect VIN to the AP3156 and J2 to connect VIN to the onboard SDI controller. Also insert a jumper between pin 1 and pin 2 of J3 to use the onboard controller to send SDI commands to the AP3156.
2. Connect a +2.7V~+5.5V power supply between VIN (P1) and GND (P2) headers. Turn on the power supply. The red power indicator LED (LED8) will be on.
3. The SDI controller will enter State 3, where SDI commands are sent to the AP3156 to set the current levels of all six channels. All six white LEDs will be dimming from bright to dark and from dark to bright. The following table shows the SDI controller States and associated SDI commands.
4. Press the CYCLE button to change the SDI controller state to the next state. Every time the SDI controller enters a new state between States 3 and 14, the corresponding LED(s) will be dimming automatically while the other LEDs will stay at the current levels set in the previous States. Adjust VR1 to change the repetition rate at which the LEDs are auto-dimmed.
5. While in any state between State 3 and State 14, press the UP or DOWN button to stop the auto-dimming. Then use the UP button to manually increase the current level of the LED(s) and DOWN button to decrease it. Press the CYCLE button again to resume auto-dimming.
6. Press the CYCLE button while in State 14 will bring the SDI controller to State 1, where the AP3156's switching frequency can be set by using the UP and DOWN buttons. The green LED (LED7) will flash slowly for lower switching frequency and faster for higher switching frequency.
7. Press the CYCLE button while in State 1 will advance to State 2, where the maximum LED current can be set by using the UP and DOWN buttons.
8. Press and hold the CYCLE button at any time will force the SDI controller to enter State 0 and soft-reset the AP3156. In this state, all white LEDs (LED1-6) will be turned off. So will the green LED (LED7). Press the CYCLE button in State 0 will change the SDI controller state to State 1.
9. If an external SDI controller is to be used, remove the jumper on J3 and connect the external SDI signal to between pin 2 and pin 3 (GND) of J3. The jumper on J2 can also be removed.

Table: SDI Controller Machine States

SDI Controller State	Green LED (LED7)	First SDI Sequence	Second SDI Sequence	Description
0	Off	33	-	Soft Reset: 1) 1MHz switching frequency 2) 20mA Constant Current Mode 3) All Channels in Current Level 32 (0mA)
1	Flashing	8	1 2 3	Switching frequency selected to 0.5MHz Switching frequency selected to 1MHz (default) Switching frequency selected to 2MHz
2	On	9	2 1 3	2mA Low Current Mode, 4 current levels supported 20mA Current Mode, 32 levels supported (default) 25mA Current Mode, 32 current levels supported
3	On	10	1~32*	Set current level for all 6 Channels
4	On	11	1~32*	Set current level for CH1, CH2, CH3
5	On	12	1~32*	Set current level for CH4, CH5, CH6
6	On	13	1~32*	Set current level for CH1, CH2, CH3, CH4
7	On	14	1~32*	Set current level for CH5, CH6
8	On	15	1~32*	Set current level for CH1, CH2, CH3, CH4, CH5
9	On	16	1~32*	Set current level for CH6
10	On	17	1~32*	Set current level for CH5
11	On	18	1~32*	Set current level for CH4
12	On	19	1~32*	Set current level for CH3
13	On	20	1~32*	Set current level for CH2
14	On	21	1~32*	Set current level for CH1

* Only 1~5 in Low Current Mode.