REGULATED CHARGE PUMP DC/DC CONVERTERS

FEATURES

- Monitored Output Voltage

  (AAT1501: $V_O = 5V \pm 4\%$)

  (AAT1501A: $V_O = 4.5V \pm 4\%$)

- Output Current: 120mA ($V_{DD} = 3.3V$)

  150mA ($V_{DD} = 3.6V$)

- Input Voltage Range: 2.7V to 5.0V

- A Power-Saving Shutdown Current of less than 1μA

- Internal Oscillation Frequency : 750kHz

- Compact SOT-23-6 Package

PIN CONFIGURATION

TOP VIEW

V_O	1	6	C_{F+}
GND	2	5	V_{DD}
$\overline{SHDN}$	3	4	C_{F-}

SOT-23-6 PACKAGE
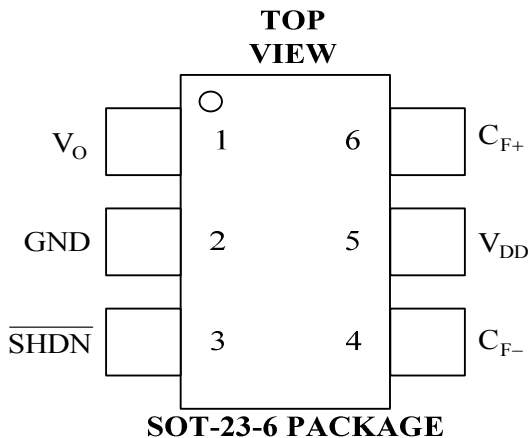
GENERAL DESCRIPTION

The AAT1501/A is a charge pump DC/DC converter mainly used for white LED backlighting. It operates with an input voltage ranging from 2.7V to 5.0V to generate constant 5.0V (AAT1501) or 4.5V (AAT1501A) output. The regulated output is produced by using an internal feedback switched capacitor voltage doublers.

The AAT1501/A requires no external inductor when operating. By using a flying capacitor, the AAT1501/A can deliver up to 120mA ($V_{DD} = 3.3V$) output current for the system. The AAT1501/A's typical ultra low operating current, and compact external parts make it an ideal component for small, portable, battery-powered applications.

AAT1501/A comes in a compact 6-pin SOT-23 package to offer users optimal and economical power management solution.

PIN DESCRIPTION

PIN NO.	NAME	I/O	DESCRIPTION
1	V_O	O	Output Voltage
2	GND	-	Ground
3	$\overline{SHDN}$	I	Shutdown Input Pin
4	C_{F-}	O	Flying Capacitor Negative Terminal
5	V_{DD}	-	Supply Voltage
6	C_{F+}	I	Flying Capacitor Positive Terminal

ABSOLUTE MAXIMUM RATINGS

CHARACTERISTICS	SYMBOL	VALUE	UNIT
Supply Voltage	V_{DD}	6	V
Output Voltage (V_O , V_{CF+} , V_{CF-})	V_O	6	V
Input Voltage ($V_{\overline{SHDN}}$)	V_I	6	V
Storage Temperature Range	$T_{storage}$	-45 to $+125$	^oC
Operating Temperature Range	T_C	-40 to $+85$	^oC

ELECTRICAL CHARACTERISTICS,

$T_C = -40°C$ to $+85°C$, V_{DD} =3.3V (Unless Otherwise Specified)

OPERATING CONDITION

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage	V_{DD}		2.7		5.0	V
Supply Current	I_{DD}	V_{DD} =2.7V to 5.0V, I_O =0 , $\overline{SHDN}$ = V_{DD}	-	1.5	2.0	mA
Shutdown Current	$I_{\overline{SHDN}}$	V_{DD} =2.7V to 5.0V, I_O =0 , $\overline{SHDN}$ = 0V	-	0.01	1.00	μA
Oscillation Frequency	f_{OSC}		-	750	-	kHz
Thermal Shutdown	T_{SHDN}		-	160	-	°C
Thermal Shutdown Hysteresis	T_{HYS}		-	20	-	°C

OUTPUT PERFORMANCE

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	AAT1501	4.8	5.0	5.2	V
		AAT1501A	4.3	4.5	4.7	V
Output Current	I_O	V_{DD} =3V, $\overline{SHDN}$ = V_{DD}	80	-	-	mA
Short Current			-	150	-	
Output Ripple	V_{OR}	V_{DD} =3V, I_O =50mA	-	50	-	mV
		V_{DD} =3V, I_O =30mA	-	18	-	
Efficiency	η	V_{DD} =2.7V, I_O =30mA	-	83	-	%
		V_{DD} =3V, V_O =5V / I_O =10 mA	-	93	-	

CONTROL INPUT

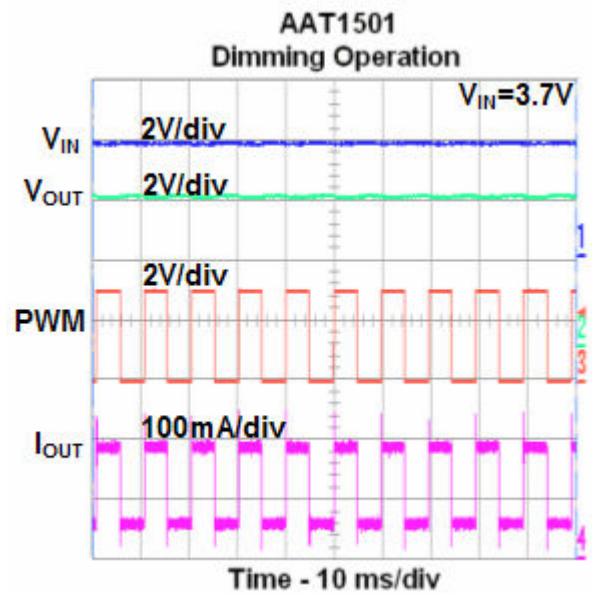| PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Input Current	$I_{\overline{SHDN}}$	$\overline{SHDN}$ = 0 ~ V_{DD}	-	±0.1	±1	μA
$\overline{SHDN}$ High Voltage	V_{IH}		1.1			V
$\overline{SHDN}$ Low Voltage	V_{IL}		-		0.5	V

BLOCK DIAGRAM

TYPICAL OPERATING CHARACTERISTICS

AAT1501
Efficiency vs. Output Current

AAT1501
Output Voltage vs. Output Current

AAT1501
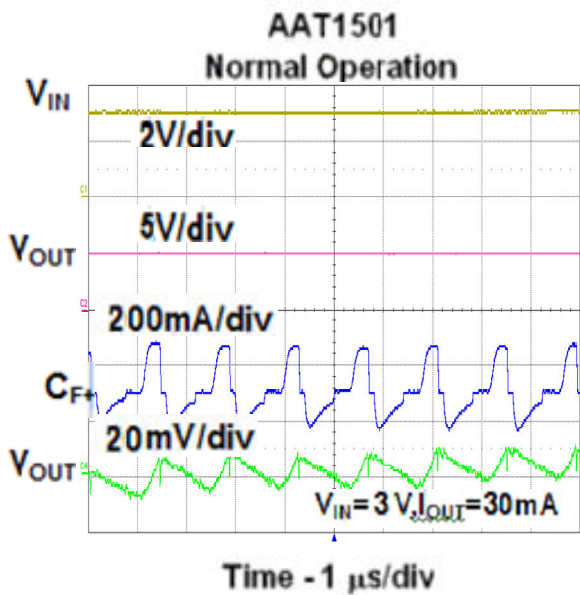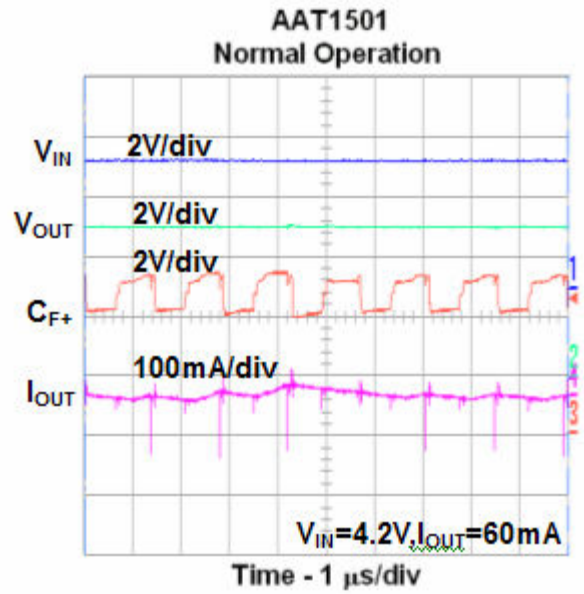Inrush Current

AAT1501
Inrush Current
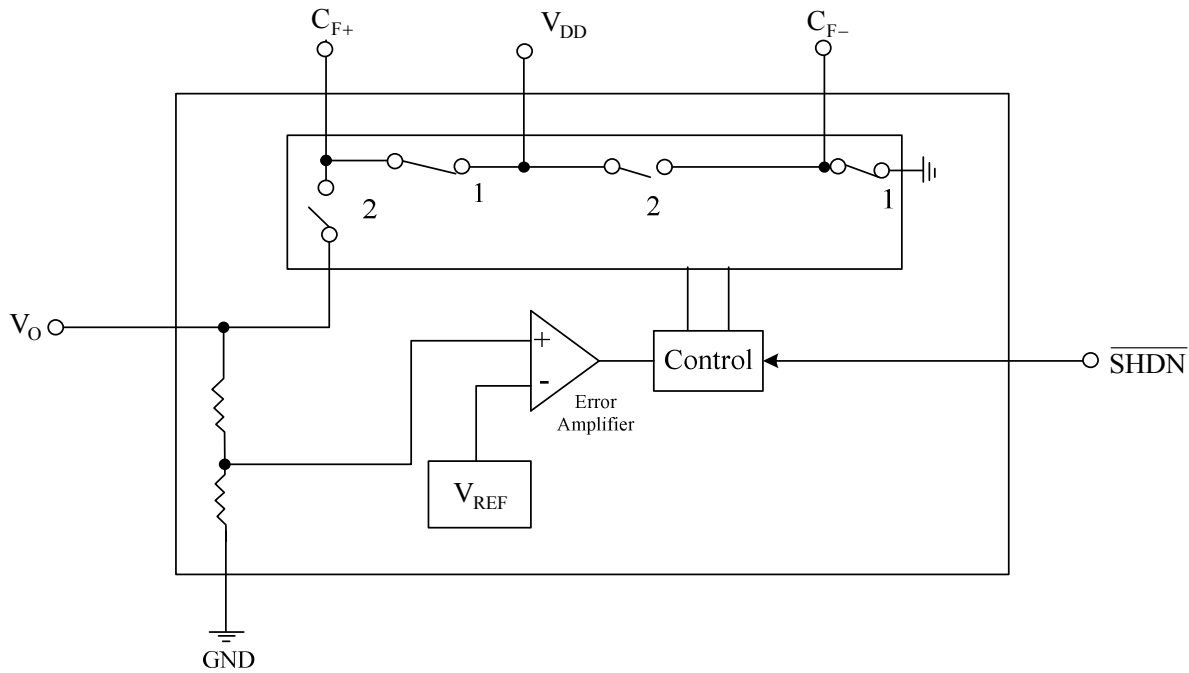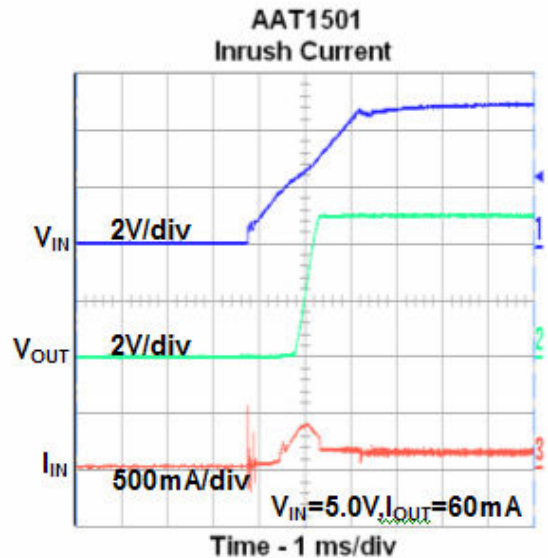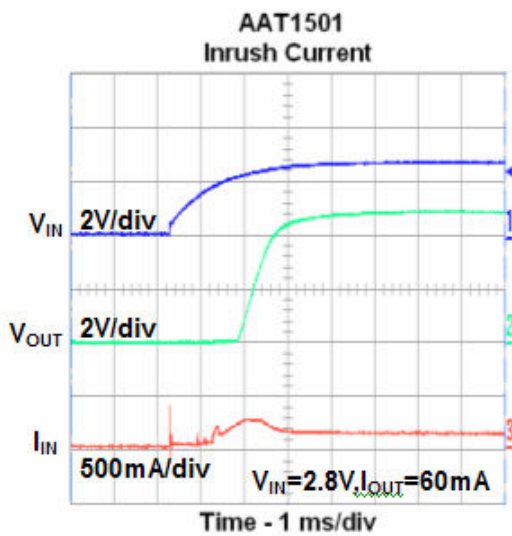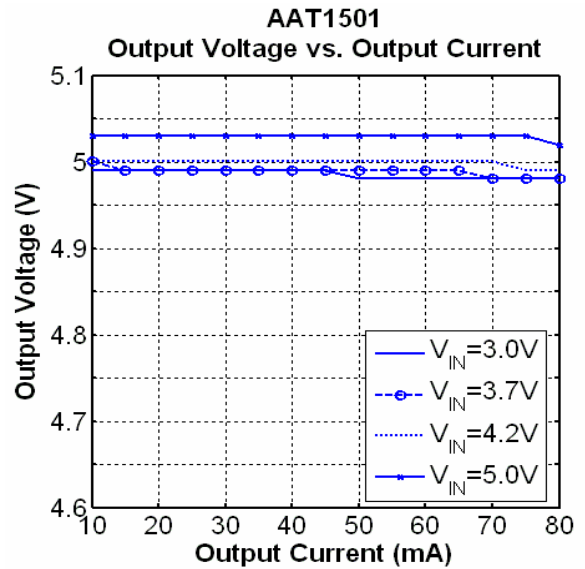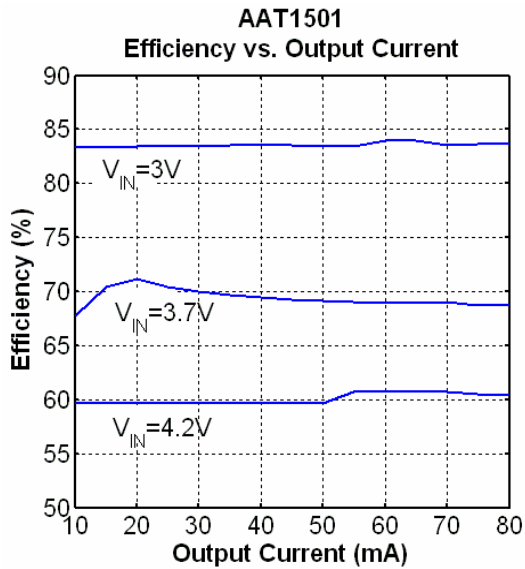
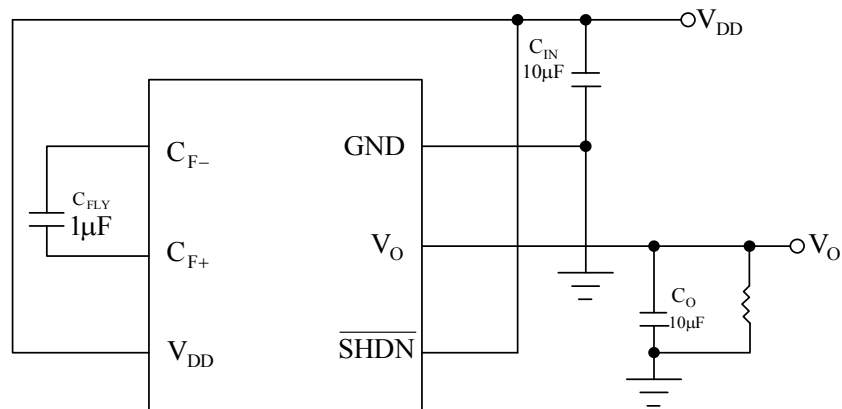## TYPICAL OPERATING CHARACTERISTICS

TYPICAL OPERATING CHARACTERISTICS
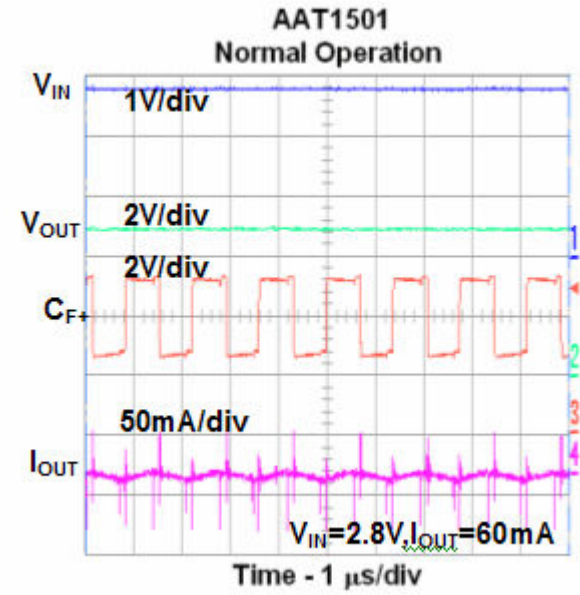
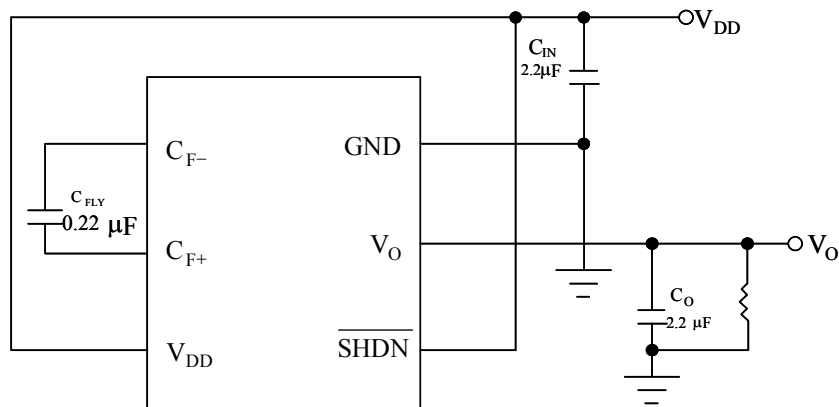AAT1501 Dimming Operation
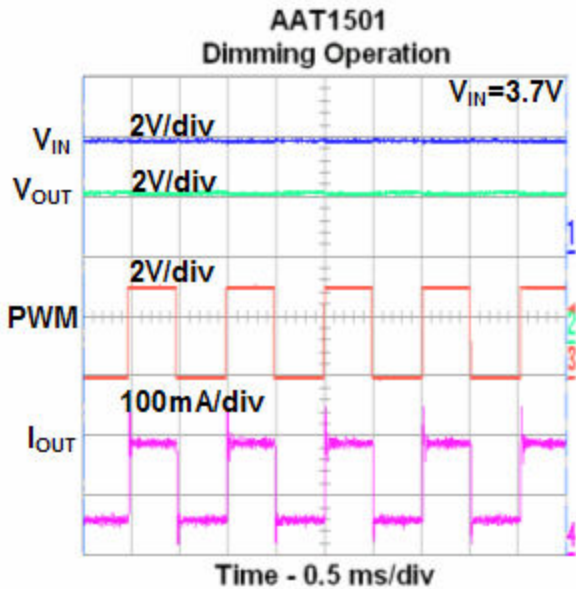
APPLICATION CIRCUIT
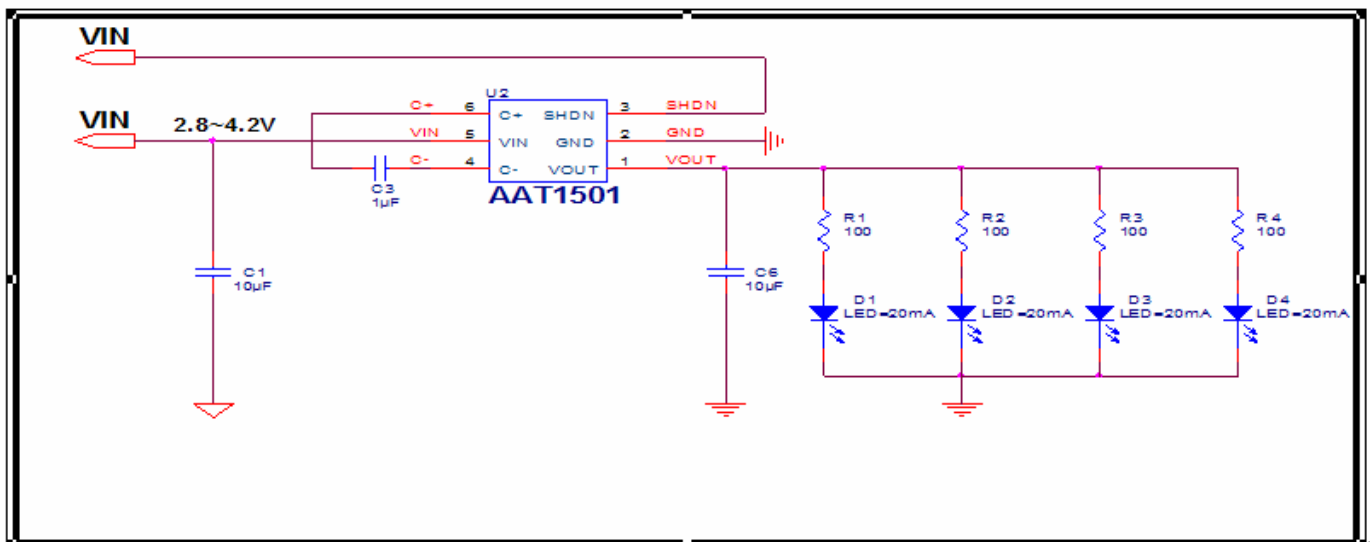
1. Heavy Load Circuit

APPLICATION CIRCUIT
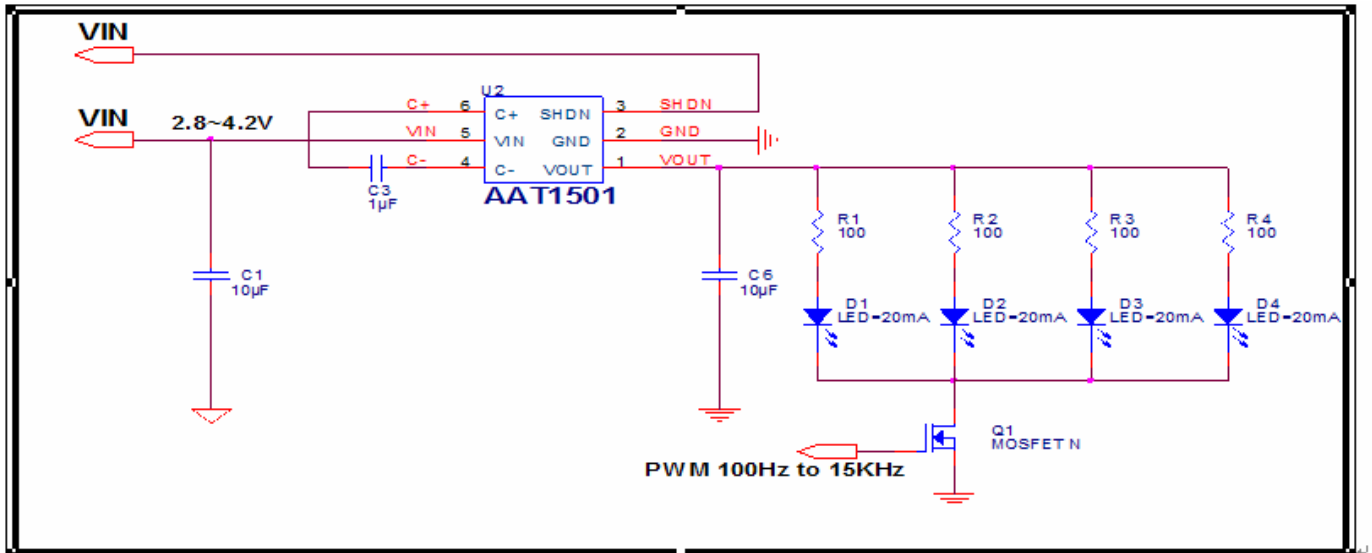
2. Light Load Circuit

APPLICATION CIRCUIT FOR LEDS

APPLICATION CIRCUIT FOR BACKLIGHT DIMMING

APPLICATION INFORMATION

Operation

AAT1501 is a simple white LED driver.   It uses charge pump to generate output voltage 2 times larger than input voltage and keeps the output voltage stable by using the comparator of the device. The current of the white LED could be set by an external resistor.

Short Circuit Protection

AAT1501/A includes a current-limit circuit.   Whenever excessive current is generated, the mechanism takes over the output regulation circuit and reduces output current to a typical level of 150mA.

LED Current Setting

A LED current ($I_{LED\_}$) is set by a resistor, as follows:

$$R_\_ = \frac{V_O - V_F}{I_{LED\_}}$$

where:

V_O is the Monitored Output Voltage (AAT1501:5V, AAT1501A:4.5V).

V_F is the LED Forward Voltage.

Dimming Control

1. Dimming Using PWM at SHDN Pin

A PWM signal applied to SHDN can control the LED brightness in direct dependence on the duty cycle. The recommended PWM signal frequency is about 100Hz to ensure a good match between the input signal duty cycle and the LED average current.

2. Dimming Using PWM by a NMOS

The additional NMOS can control the LED brightness in direct dependence on the duty cycle as shown in application circuit for backlight dimming, The PWM signal frequency can be up to kHz level.

Thermal Shutdown

The AAT1501/A includes a thermal-limit circuit that shuts down the IC at approximately +160°C. The device turns on after the IC cools by approximately 20°C.

Capacitor Selection

For LED applications, input ripple is more important than output ripple. Input ripple depends on the source supply's impedance. Adding a lowpass filter to the input further reduces input ripple. A charge pump flying capacitor of value between 0.1μF to 1μF, should be connected from C+ to C−. The recommended capacitor's type is X5R or X7R ceramic capacitor.

PACKAGE DIMENSIONS

Advanced Analog Technology, Inc.
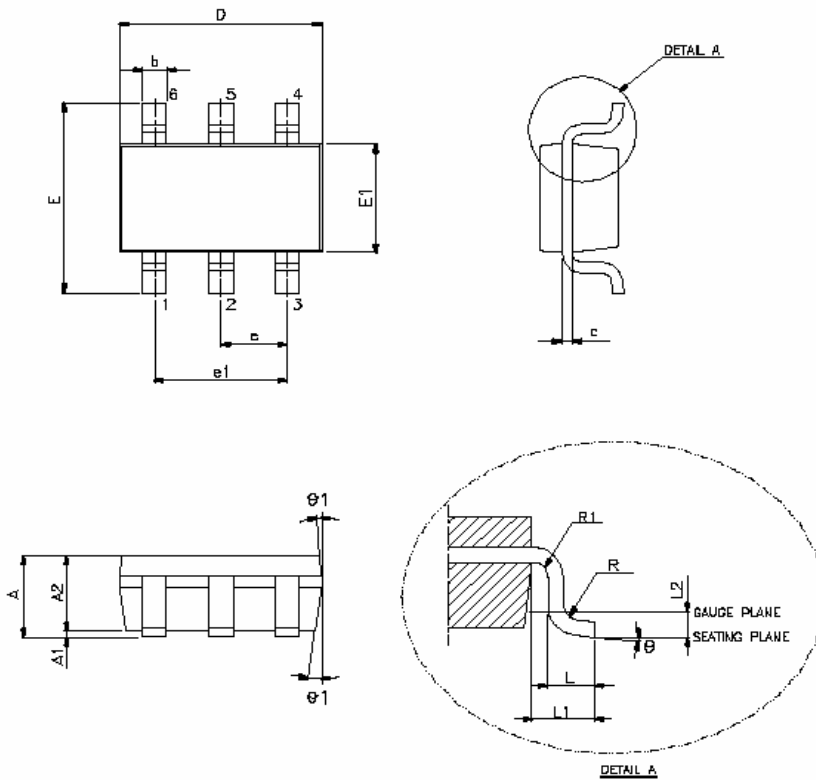
PACKAGE DIMENSIONS (Cont.)

VARIATION (ALL DIMENSIONS SHOWN IN MILLIMETERS)

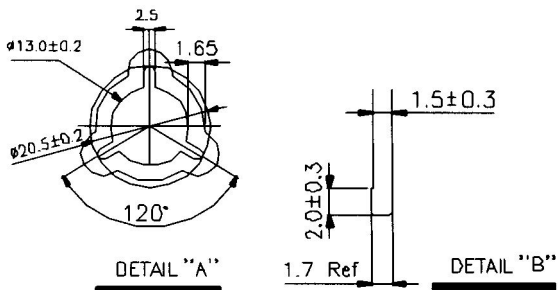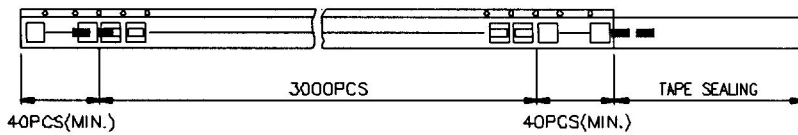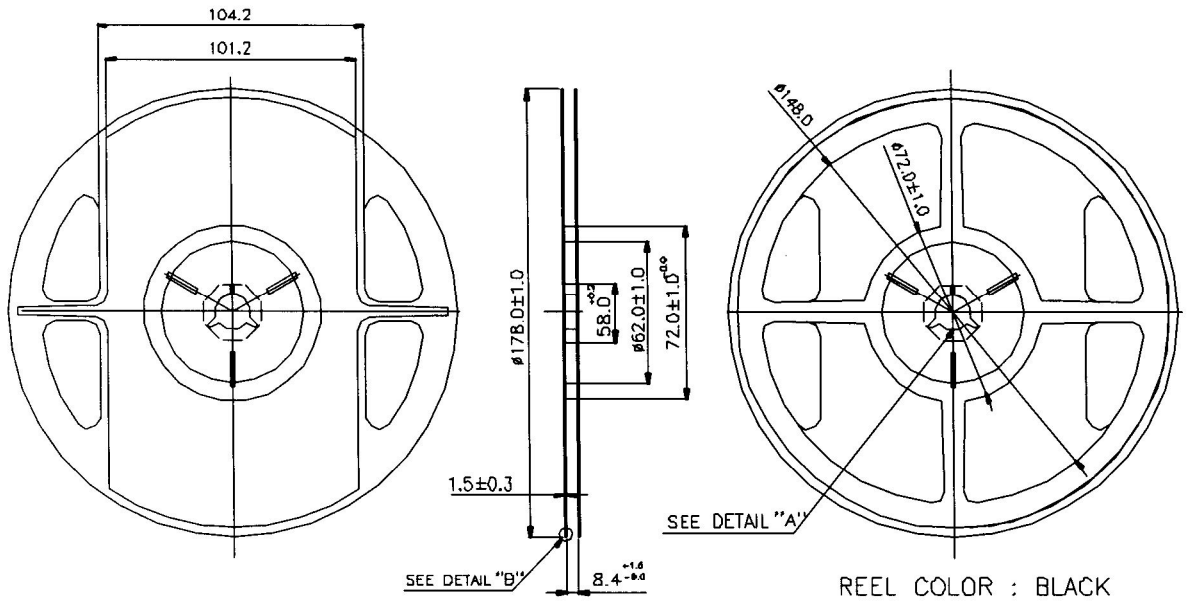| SYMBOL	MIN	TYP	MAX
A	------	------	1.45
A1	------	------	0.15
A2	0.90	1.15	1.30
b	0.30	------	0.50
c	0.08	------	0.22
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 BSC		
R	0.10	------	------
R1	0.10	------	0.25
θ	0°	4°	8°
$\theta1$	5°	10°	15°

NOTE:

1 JEDEC OUTLINE: MO-178 AB

Tape and Reel

Packing Method: 3,000pcs/reel, 5 reels/box

REEL COLOR : BLACK

3000PCS   TAPE SEALING

40PCS(MIN.)   40PCS(MIN.)

DETAIL "A"   DETAIL "B"

Tape and Reel (Cont.)
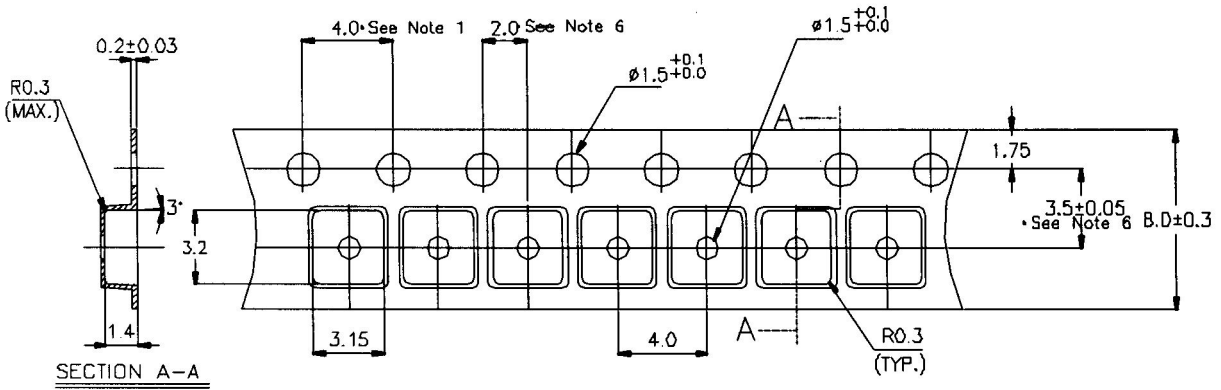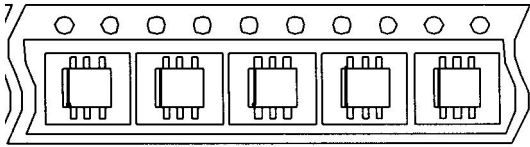
X.XXX X	± 0.0025
X.XXX	± 0.006
X.XX	± 0.025
X.X	± 0.10
X	± 0.25

UNIT: MILLIMETERS

PART MARKING

SOT23-6 TOP MARKING

AXX
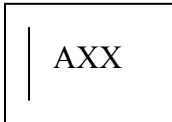
NOTE: SOT23-6 HAS NO BACK MARKING.