

Description

The AP3036/A is an inductor-based DC/DC converter designed to drive up to eight white LEDs in series for backlight. Only one feedback resistor is needed to control the LED current and obtain required brightness.

A constant frequency 1.0MHz PWM control scheme is employed in this IC, which means tiny external components can be used. Specifically, 1mm tall inductor and 0.22 μ F output capacitor for a typical application is sufficient. Additionally, the Schottky diode in boost circuit is integrated on this chip. The AP3036/A also provides a disable pin to ease its use for different systems.

The output over-voltage protection is implemented in AP3036/A. When any LED is broken or in other abnormal conditions, the output voltage will be clamped.

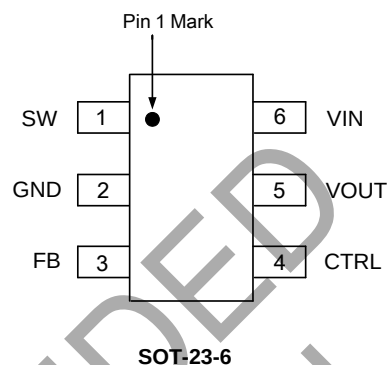
The AP3036/A is available in standard SOT-23-6 and TSOT-23-6 packages.

Features

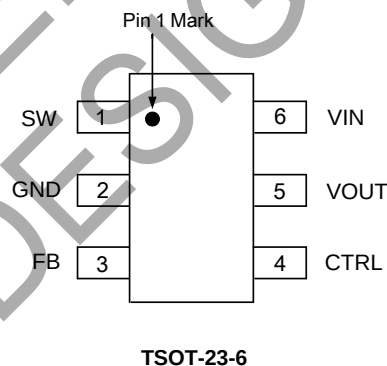
- Inherently Uniform LED Current
- High Efficiency up to 84%
- No Need for External Schottky Diode
- Output Over-voltage Protection (OVP)
- Fixed 1.0MHz Switching Frequency
- Uses Tiny 1mm Tall Inductor
- Requires Only 0.22 μ F Output Capacitor
- High Frequency Dimming Control

Pin Assignments

(Top View)



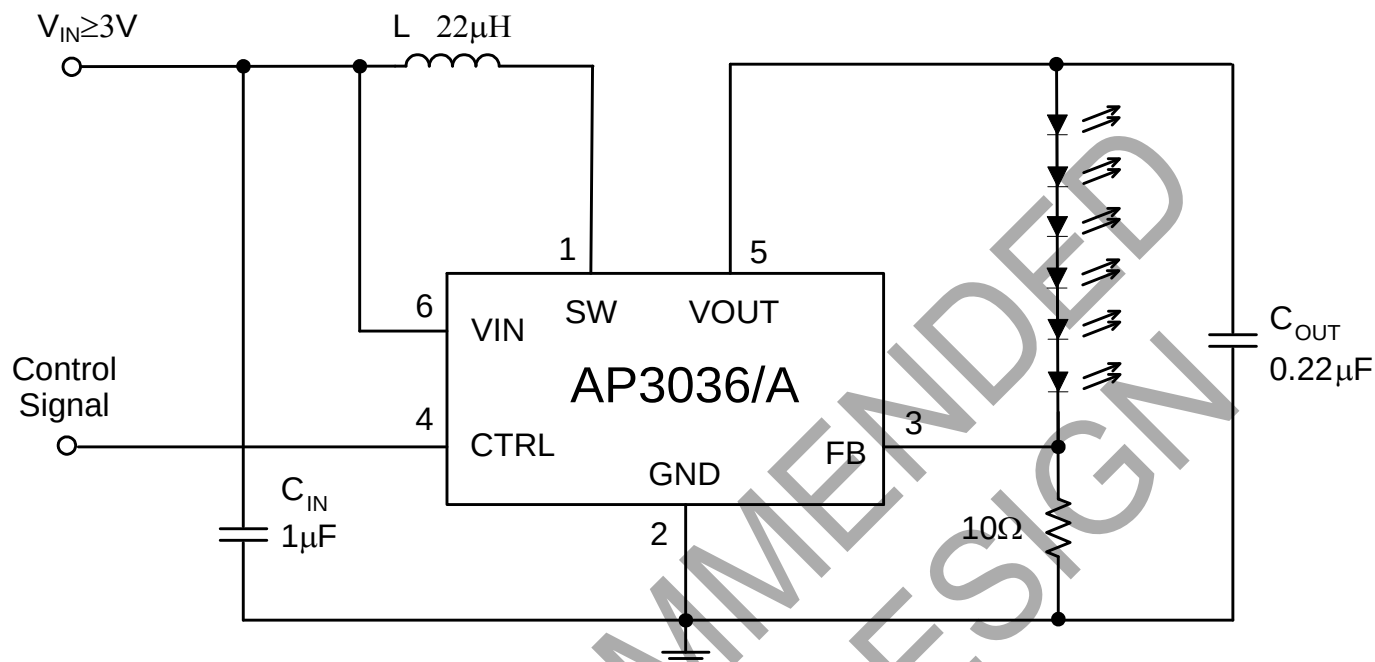
(Top View)



Applications

- Cellular Phones
- Digital Cameras
- LCD Modules
- GPS Receivers
- PDAs, Handheld Computers

Typical Applications Circuit (Note 1)

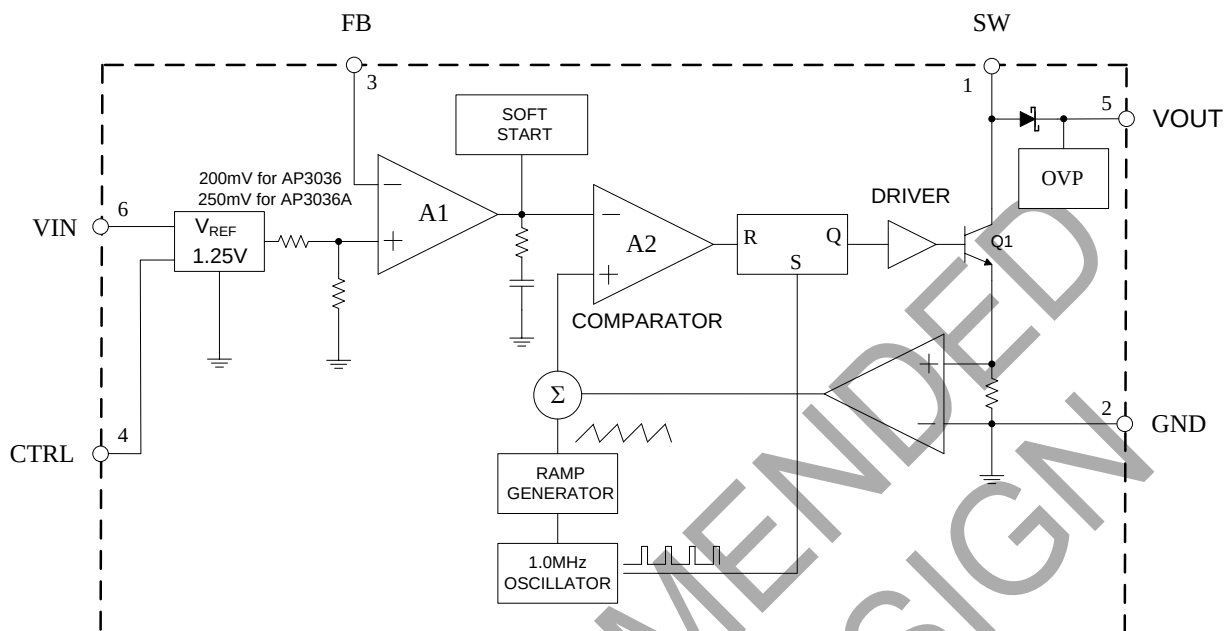


Note 1. C: X5R or X7R type dielectric, L: SUMIDA CDRH5D28R-220NC or equivalent. And, this circuit can work in full temperature.

Pin Description

Pin Number	Pin Name	Function
1	SW	Switch pin. Connect external inductor
2	GND	Ground
3	FB	Voltage feedback pin. The reference voltage is 200mV for AP3036 and 250mV for AP3036A
4	CTRL	Shutdown and dimming pin. Connect to 1.8V or higher to enable device; Connect to 0.4V or less to disable device; Connect to a PWM signal to achieve LEDs brightness dimming
5	VOUT	Output pin. Connect to the cathode of internal Schottky diode
6	VIN	Input supply pin. Must be connected to a local bypass capacitor

Functional Block Diagram



Absolute Maximum Ratings (Note 2)

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	20	V
V_{SW}	SW Pin Voltage	38	V
V_{FB}	Feedback Voltage	20	V
V_{CTRL}	CTRL Pin Voltage	20	V
θ_{JA}	Thermal Resistance (Junction to Ambient, No Heat Sink)	265	°C/W
T_J	Operating Junction Temperature	+150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering, 10sec)	+260	°C
—	ESD (Machine Model)	250	V
—	ESD (Human Body Model)	2000	V

Note 2. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
T_{OP}	Operating Temperature Range	-40	+85	°C
V_{IN}	Input Voltage	2.5	16	V
V_{CTRL}	CTRL Pin Voltage	–	16	V

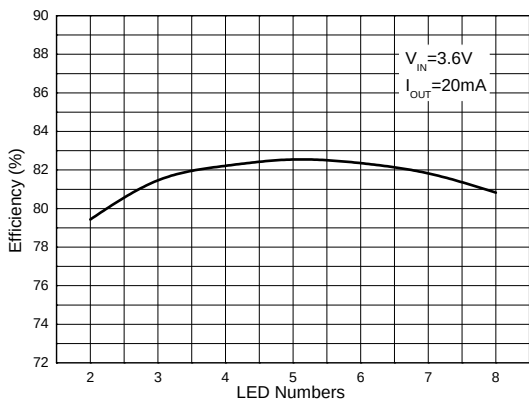
Electrical Characteristics (@ $V_{IN}=3V$, $V_{CTRL}=3V$, $T_A=+25^{\circ}C$, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{IN(Min)}$	Minimum Operating Voltage	–	2.5	–	–	V
$V_{IN(Max)}$	Maximum Operating Voltage	–	–	–	16	
V_{FB}	AP3036	$I_{OUT}=20mA$, 4 LEDs	188	200	212	mV
	AP3036A		235	250	265	
I_{FB}	FB Pin Bias Current	–	–	35	100	nA
I_Q	Quiescent Current	$V_{FB}=V_{IN}$, no switching	1.6	3.1	3.9	mA
I_{SHDN}	Shutdown Quiescent Current	$V_{CTRL}=0V$	–	45	75	μA
f	Switching Frequency	–	–	1.0	–	MHz
D_{MAX}	Maximum Duty Cycle	–	90	93	–	%
I_{LIMIT}	Switch Current Limit (Note 3)	$D=40\%$ or 80%	–	550	–	mA
V_{CESAT}	Switch V_{CE} Saturation Voltage	$I_{SW}=250mA$	–	360	–	mV
–	Switch Leakage Current	$V_{SW}=5V$	–	0.01	5	μA
V_{CTRL}	CTRL Pin Voltage	High	1.8	–	–	V
		low	–	–	0.4	
I_{CTRL}	CTRL Pin Bias Current	–	–	100	–	μA
V_{OV}	OVP Voltage	–	–	30	–	V
V_{DROP}	Schottky Forward Drop	$I_D=150mA$	–	0.7	–	V
–	Schottky Leakage Current	$V_R(\text{Reverse Voltage})=23V$	–	0.1	4	μA
		$V_R(\text{Reverse Voltage})=27V$	–	–	150	
t	Soft Start Time	–	–	100	–	μs
θ_{JC}	Thermal Resistance (Junction to Case)	SOT-23-6	–	60	–	°C/W
		TSOT-23-6	–	60	–	

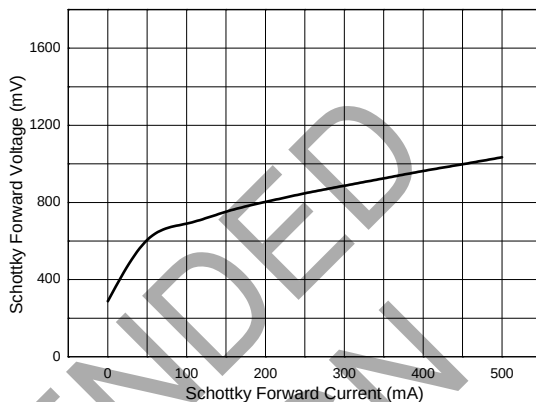
Note 3: The switch current limit is related to duty cycle. Please refer to Figure **LED Current vs. Duty** for detail.

Performance Characteristics (The WLED forward voltage (V_F) is 3.45V at $I_F=20\text{mA}$, unless otherwise noted.)

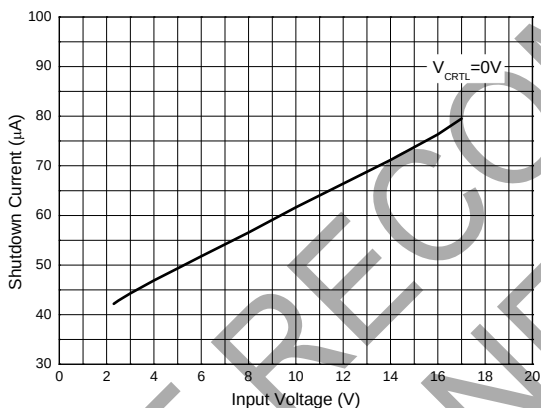
Efficiency vs. LED's Number



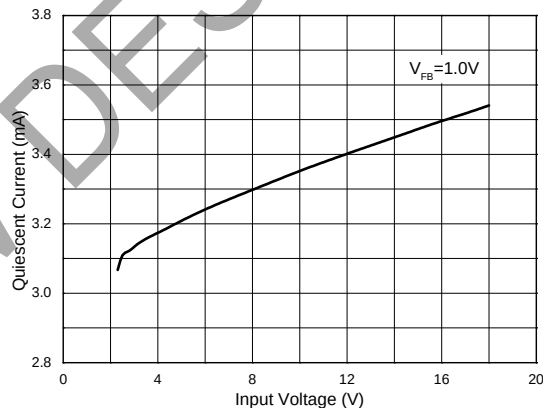
Schottky Forward Voltage vs. Schottky Forward Current



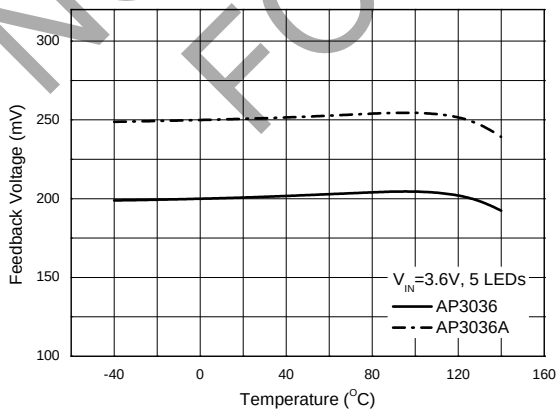
Shutdown Current vs. Input Voltage



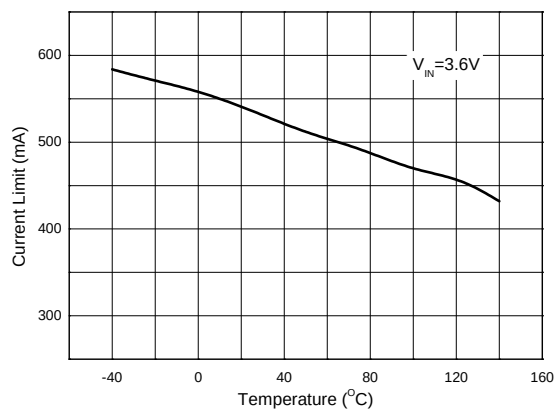
Quiescent Current vs. Input Voltage



Feedback Voltage vs. Temperature

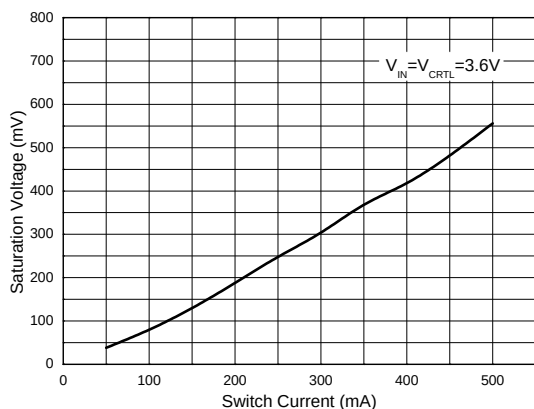


Current Limit vs. Temperature

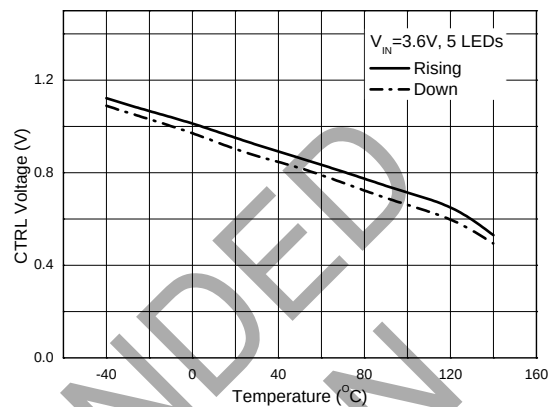


Performance Characteristics (The WLED forward voltage (V_F) is 3.45V at $I_F=20\text{mA}$, unless otherwise noted.) (Cont.)

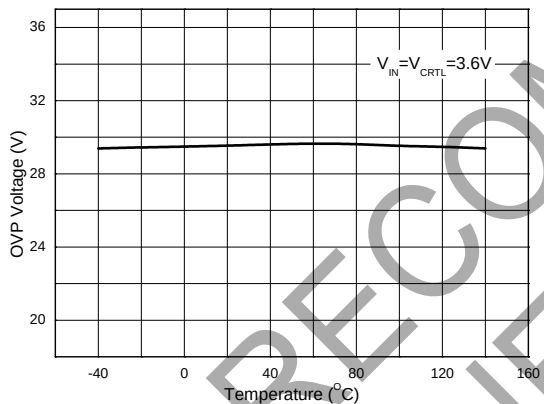
Saturation Voltage vs. Switch Current



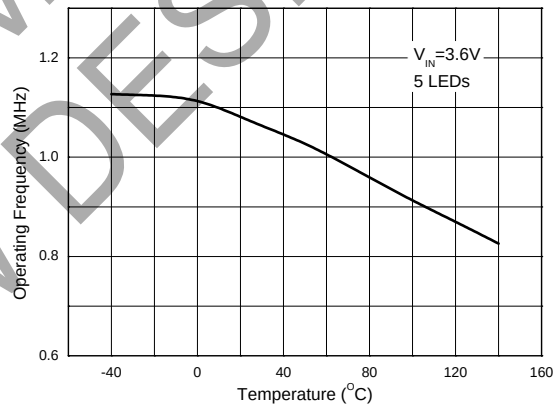
CTRL Pin Voltage vs. Temperature



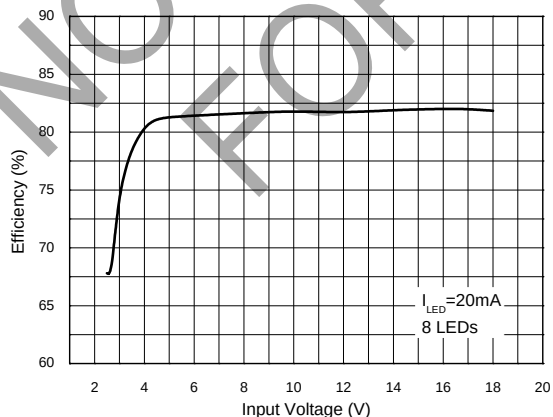
OVP Voltage vs. Temperature



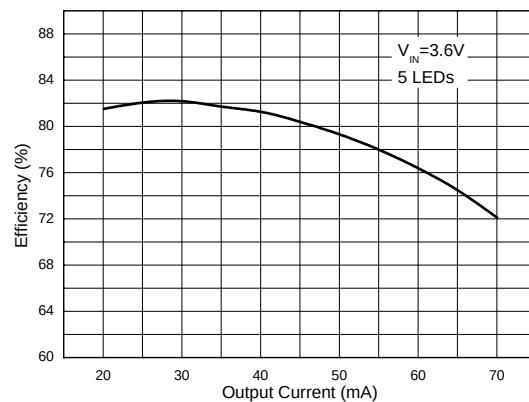
Operating Frequency vs. Temperature



Efficiency vs. Input Voltage

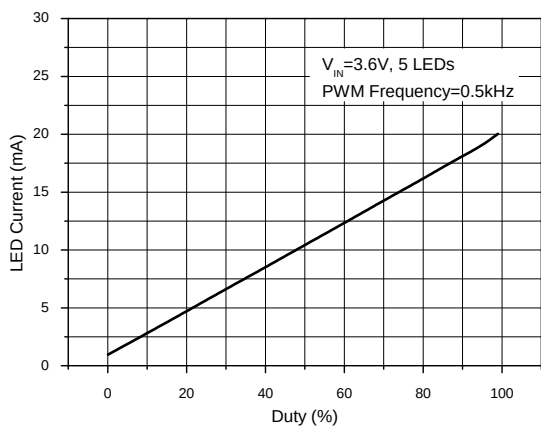


Efficiency vs. Output Current

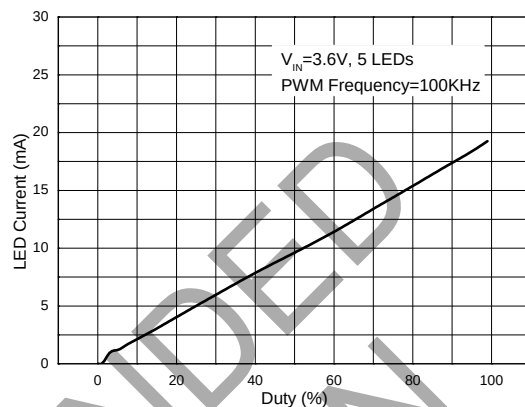


Performance Characteristics (The WLED forward voltage (V_F) is 3.45V at $I_F=20\text{mA}$, unless otherwise noted.) (Cont.)

LED Current vs. Duty

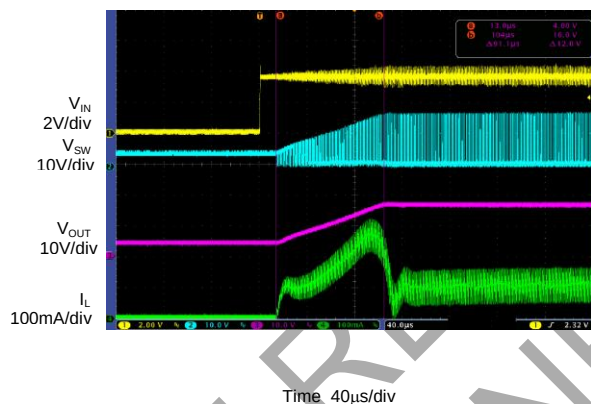


LED Current vs. Duty



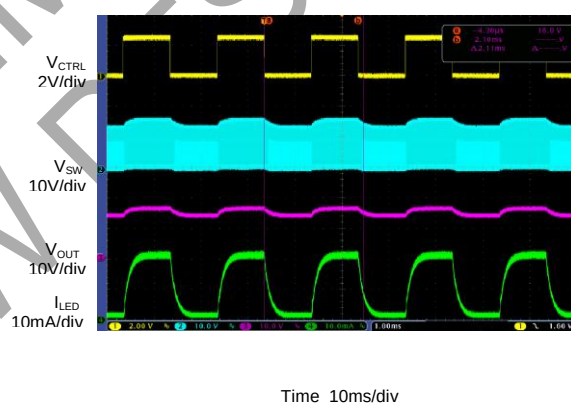
Powering On

($V_{IN}=3.6\text{V}$, $V_{CTRL}=2.5\text{V}$, $I_{LED}=20\text{mA}$, 5 LEDs)



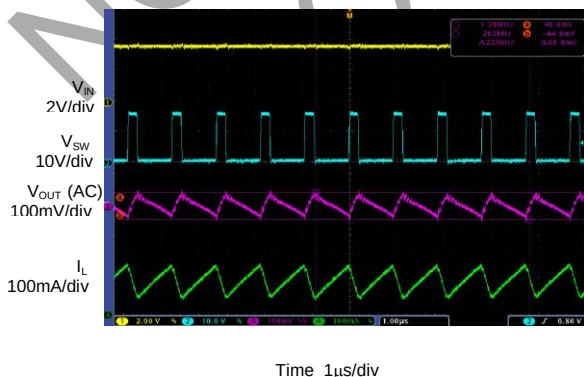
PWM Dimming

($V_{IN}=3.6\text{V}$, $V_{PWM}=2.5\text{V}$, $f_{PWM}=0.5\text{kHz}$, Duty=50%, 5 LEDs)



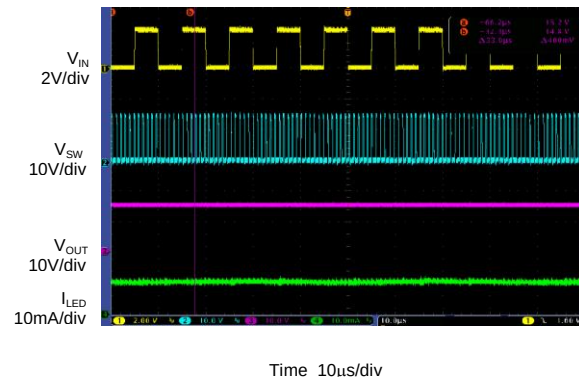
Output Voltage Ripple

($V_{IN}=V_{CTRL}=3.6\text{V}$, $I_{LED}=20\text{mA}$, 5 LEDs)

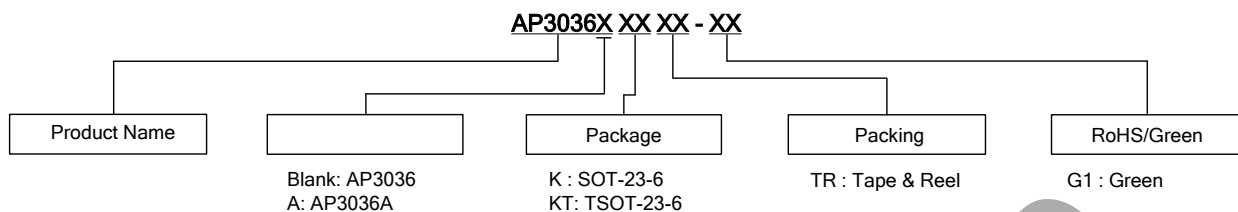


PWM Dimming

($V_{IN}=3.6\text{V}$, $V_{PWM}=2.5\text{V}$, $f_{PWM}=100\text{kHz}$, Duty=50%, 5 LEDs)



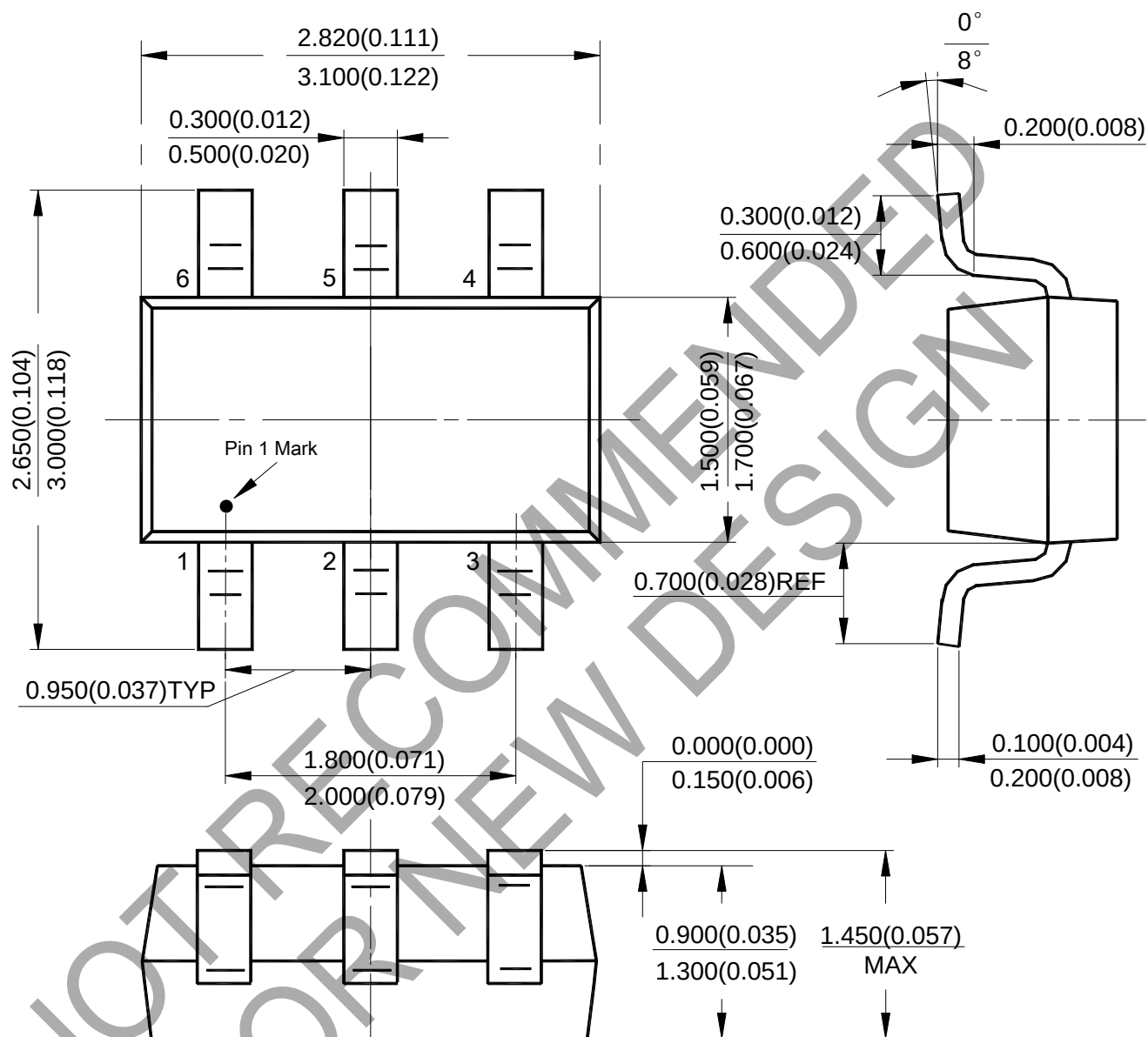
Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-6	-40 to +85°C	AP3036KTR-G1	GHI	Tape & Reel
		AP3036AKTR-G1	GJE	Tape & Reel
TSOT-23-6		AP3036KTTR-G1	L2C	Tape & Reel
		AP3036AKTTR-G1	L3C	Tape & Reel

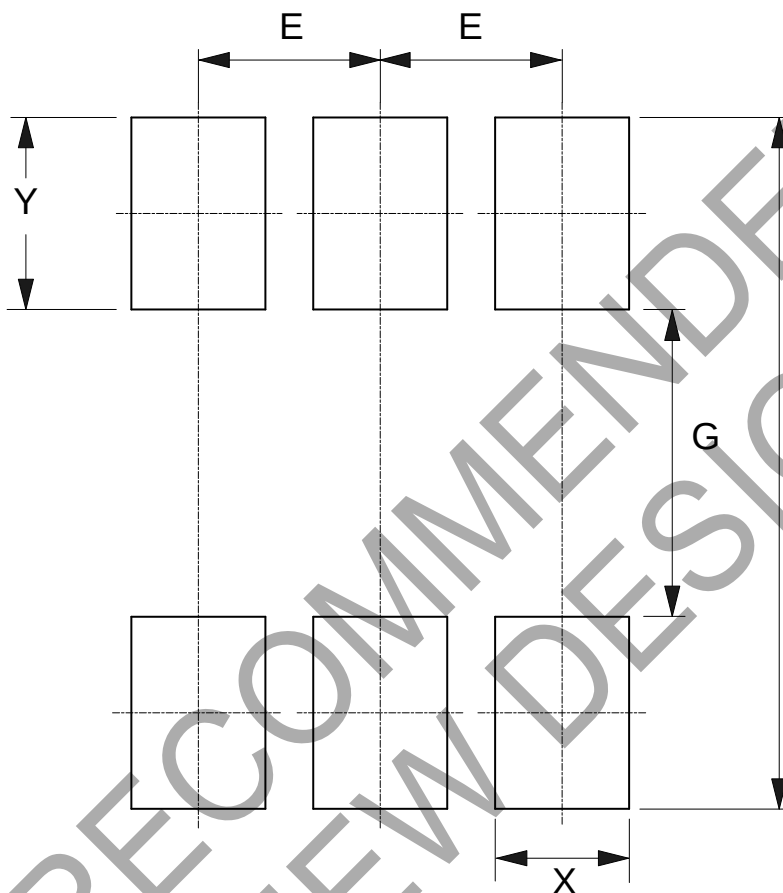
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SOT-23-6



Suggested Pad Layout

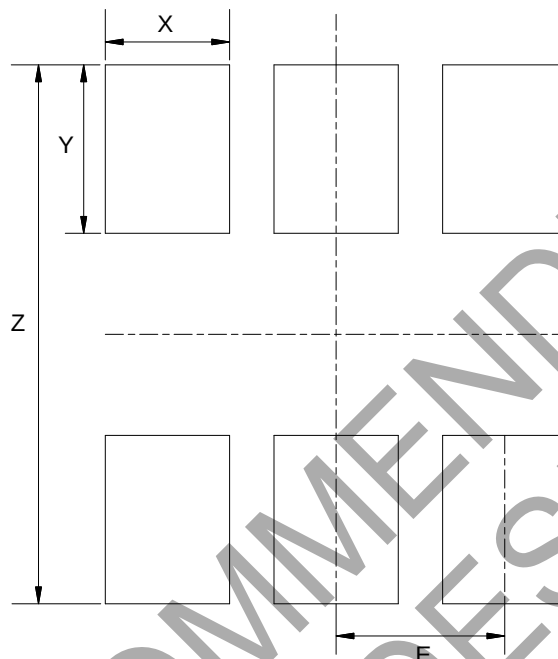
(1) Package Type: SOT-23-6



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037

Suggested Pad Layout (Cont.)

(2) Package Type: TSOT-23-6



Dimensions	E (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	Z (mm)/(inch)
Value	0.950/0.037	0.700/0.028	1.000/0.039	3.199/0.126

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