

## Description

The AP3041 is a current mode high voltage low-side channel MOSFET controller, which is ideal for boost regulators. It contains all the features needed to implement single-ended primary topology DC/DC converters.

The input voltage of AP3041 ranges from 5V to 27V. Its operation frequency is adjustable from 100kHz to 1MHz.

The AP3041 has UVLO (Under Voltage Lock Out) circuit. It uses two external resistors to set the UVLO voltage. The AP3041 also has an over output voltage protection to limit the output voltage. The OVP voltage can be set through external resistors. If the output voltage is higher than the OVP high threshold point, it will disable the driver and the system is latched up. The output short circuit protection as well as LED low side short to ground detection function can be applied in system.

The AP3041 has other protection functions, such as LED short protection, LED high side short to ground protection, diode short protection, over current protection, over temperature protection and so on.

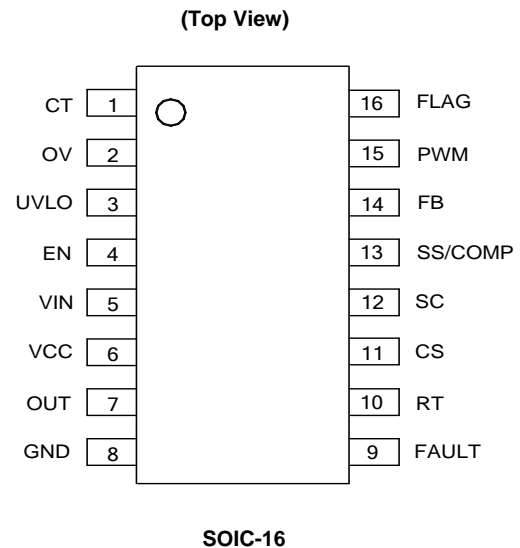
The AP3041 is available in SOIC-16 package.

## Features

- Input Voltage Range: 5V to 27V
- 1A Peak and 10V MOSFET Gate Driver
- 20ns Quick MOSFET Gate Driver
- Duty Cycle Limit of 90%
- Programmable UVLO
- PWM Dimming Control
- Programmable Over Voltage Protection
- LED Open Protection
- LED Short Circuit Protection
- Diode Short Circuit Protection
- Output Short Circuit Protection
- LED Low-Side Short to Ground Detection
- OV Pin Under Voltage Protection
- Over Current Protection
- Programmable Slope Compensation
- Adjustable Soft-Start
- Adjustable Protection Delay
- Fault Status Indication
- Adjustable Operation Frequency from 100kHz to 1MHz
- Over Temperature Protection
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.  
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.  
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

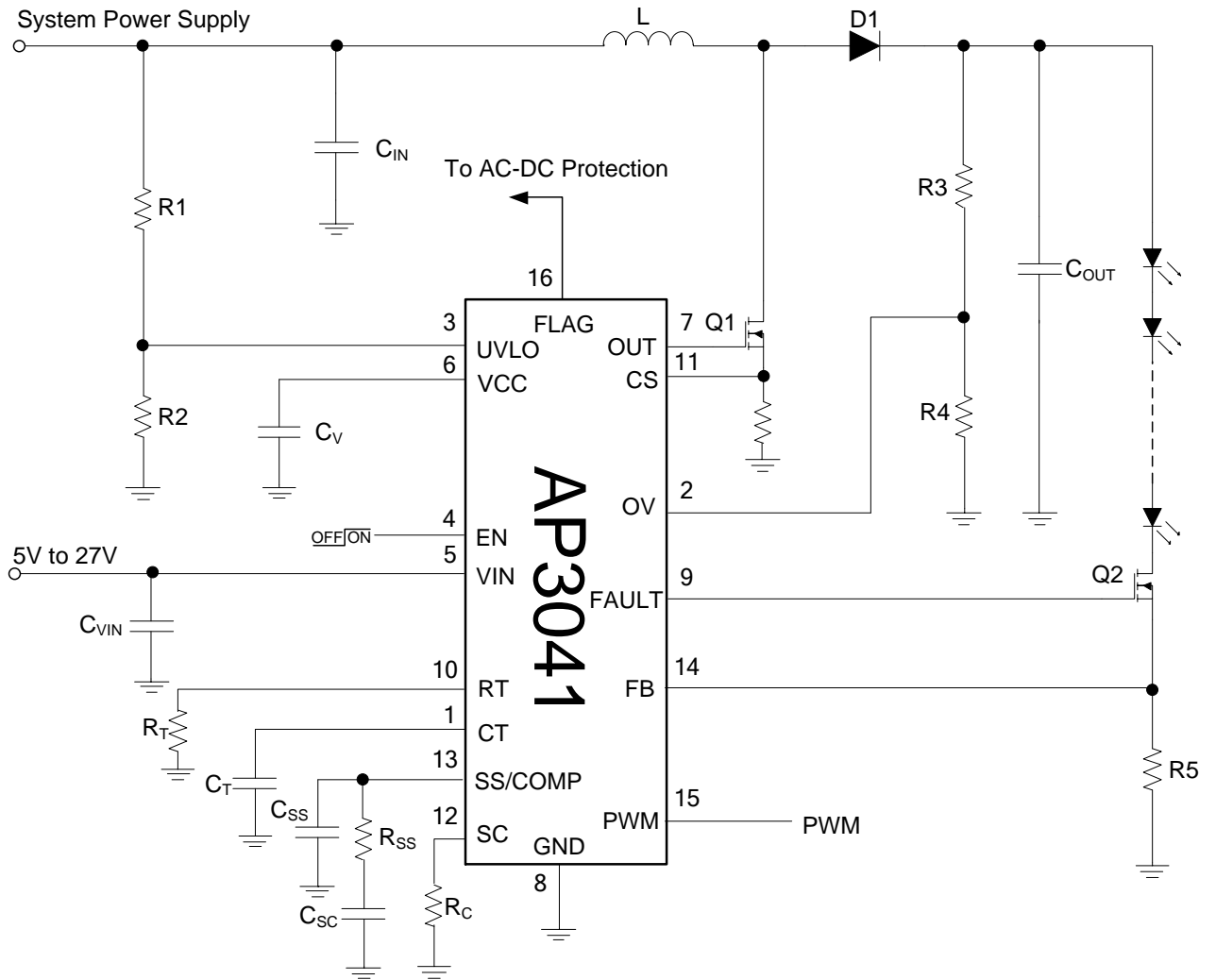
## Pin Assignments



## Applications

- LED Lighting
- LED TV
- LCD Display Modules

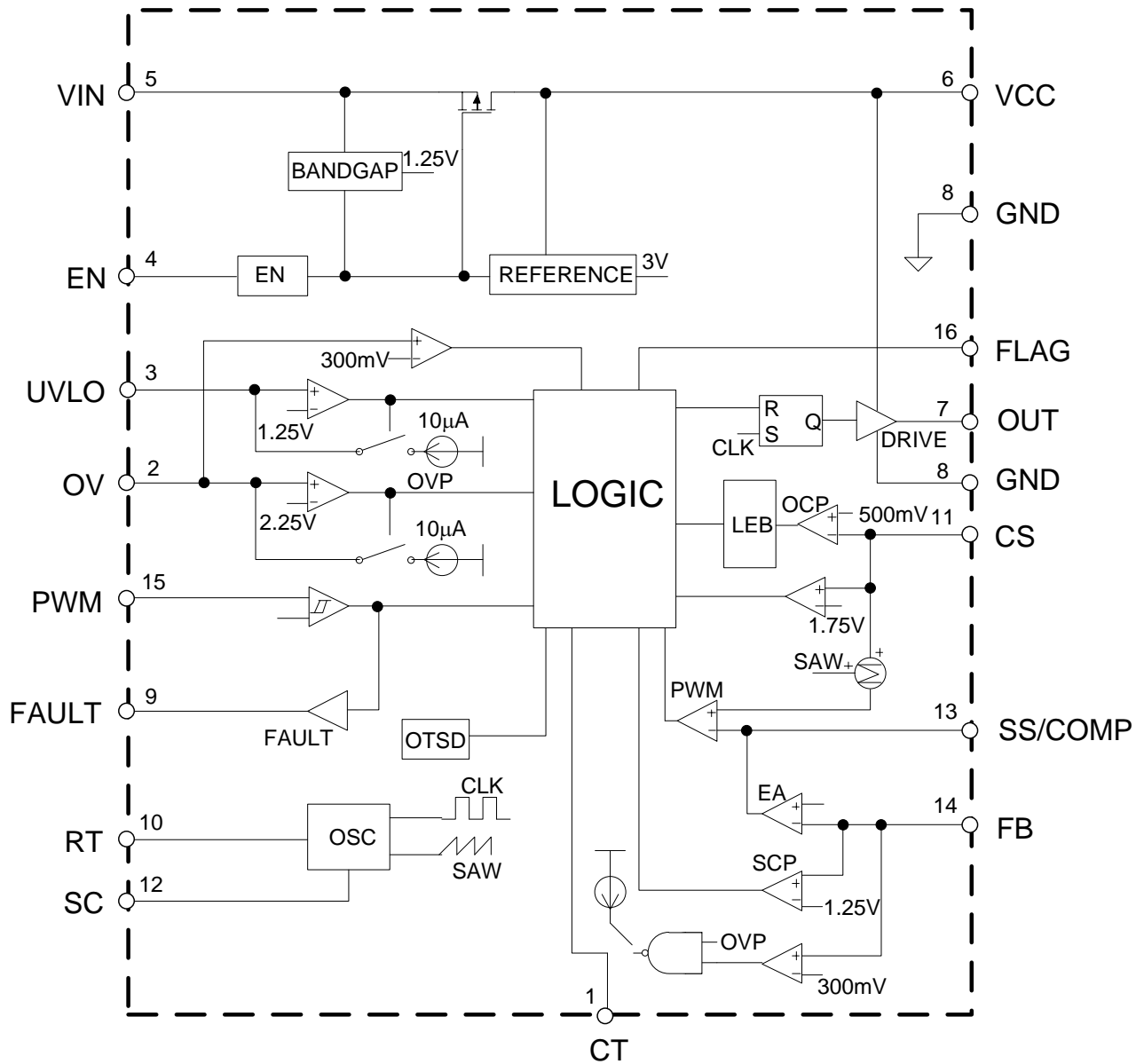
**Typical Applications Circuit**



## Pin Descriptions

Pin Number	Pin Name	Function
1	CT	Capacitor Setting Shut Down Delay Time
2	OV	Over Output Voltage Protection Pin
3	UVLO	Two resistors connected from this pin to GND and the power supply respectively is used to set start-up and shutdown level.
4	EN	Enable Pin
5	VIN	Input supply pin. This pin must be locally bypassed.
6	VCC	This pin should be bypassed to GND with a ceramic capacitor.
7	OUT	Connect this pin to the gate of external MOSFET, the gate driver has 1A peak current capability.
8	GND	Ground
9	FAULT	This pin can be used to drive the external MOSFET. The logic of the driver signal is controlled by that of PWM pin and the signal phase of them is the same. This pin is pulled to ground under fault condition of OVP, UVLO, OTP, diode short circuit and LED short circuit.
10	RT	An external resistor connected from this pin to GND is used to set the operating frequency.
11	CS	Sense switch current pin, which is used for current mode control and for current limit. The current limit voltage is 500mV.
12	SC	Slope compensation for current sense. A resistor between SC and GND will program the slope compensation.
13	SS/COMP	An external soft-start time capacitor is placed from this pin to GND and is charged by an internal 20 $\mu$ A current source to control regulator soft-start time. Compensation pin. This pin is the output of the internal error amplifier.
14	FB	Voltage feedback pin. The reference voltage is 500mV.
15	PWM	This pin can be connected to current matched chip and receives error signal used to shut down the system.
16	FLAG	Fault condition output pin. When the output is in short circuit condition, the FLAG outputs logic low to shut down the power path. Please refer to the application circuit.

**Functional Block Diagram**



## Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Value	Unit
$V_{IN}$	Input Voltage	30	V
$V_{CC}$	VCC Pin Voltage	20	V
$V_{OUT}$	OUT Pin Voltage	20	V
$V_{FAULT}$	FAULT Pin Voltage	20	V
$V_{FB}$	FB Pin Voltage	20	V
$V_{UVLO}$	UVLO Pin Voltage	7	V
$V_{CS}$	CS Pin Voltage	20	V
$V_{SC}$	SC Pin Voltage	7	V
$V_{FLAG}$	FLAG Pin Voltage	7	V
$V_{SS/COMP}$	SS/COMP Pin Voltage	7	V
$V_{RT}$	RT Pin Voltage	7	V
$V_{PWM}$	PWM Pin Voltage	7	V
$V_{EN}$	EN Pin Voltage	30	V
$V_{OV}$	OV Pin Voltage	7	V
$\theta_{JA}$	Thermal Resistance (Junction to Ambient, No Heat Sink, Free Air)	82	°C/W
$T_J$	Operating Junction Temperature	+150	°C
$T_{STG}$	Storage Temperature	-65 to +150	°C
$T_{LEAD}$	Lead Temperature (Soldering, 10s)	+260	°C
—	ESD (Human Body Model)	2000	V
—	ESD (Machine Model)	200	V

Note: 4. Stresses greater than those listed under *Absolute Maximum Ratings* can 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 can affect device reliability.

## Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
$V_{IN}$	Input Voltage	5	27	V
f	Operating Frequency	0.1	1	MHz
$T_J$	Operating Temperature Range	-40	+85	°C

**Electrical Characteristics** ( $V_{CC}=12V$ ,  $V_{EN}=3.3V$ ,  $T_A=+25^{\circ}C$ , unless otherwise specified.)

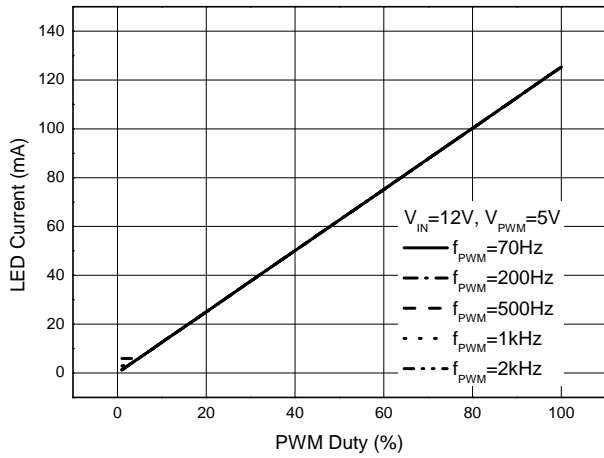
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{IN}$	Input Voltage	—	5	—	27	V
$V_{FB}$	Feedback Voltage	—	490	500	510	mV
$I_{CC}$	Supply Current	$V_{FB}=V_{IN}$ , No Switching	—	1.5	5	mA
$I_Q$	Shutdown Supply Current	$V_{EN}=0$	—	1	2	$\mu A$
$V_{CC}$	VCC Pin Voltage	$11V \leq V_{IN} \leq 27V$	9.5	10.0	10.5	V
		$5V \leq V_{IN} \leq 10V$ , $I_{CC}=5mA$	$V_{IN}-0.5$	—	—	V
$I_{CC-LIM}$	VCC Pin Current Limit	—	—	35	—	mA
$V_{CC-HI}$	VCC Pin UVLO Rising Threshold	—	—	4.7	—	V
$V_{CC-HYS}$	VCC Pin UVLO Falling Hysteresis	—	—	300	—	mV
$f_{OSC}$	Oscillator Frequency	—	0.1	—	1	MHz
$V_{SC\_PK}$	SC Peak Voltage	—	530	—	680	mV
$V_{UVLO}$	UVLO Threshold	—	1.20	1.25	1.30	V
$I_{UVLO-HYS}$	UVLO Hysteresis Current Source	—	—	10	—	$\mu A$
$V_{CS}$	Current Limit Threshold Voltage	—	0.48	0.5	0.52	V
$V_{RT}$	RT Voltage	—	1.20	1.25	1.30	V
$G_V$	Error Amplifier Voltage Gain	—	—	680	—	V/V
$G_S$	Error Amplifier Transconductance	—	—	500	—	$\mu A/V$
$V_{EH}$	EN Pin Threshold Voltage	—	2.5	—	—	V
$V_{EL}$		—	—	—	0.5	
$V_{IH}$	PWM Pin Threshold Voltage	—	2.5	—	—	V
$V_{IL}$		—	—	—	0.5	
$V_{OV}$	OV Threshold	—	—	2.25	—	V
$I_{OV-HYS}$	OV Hysteresis Current Source	—	—	10	—	$\mu A$
$V_{FB\_LOW}$	LED- Short to GND Detection Level	—	—	0.3	—	V
$V_{FB\_HIGH}$	LED+ Short to LED-Detection Level	—	—	1.25	—	V
$V_{OV\_LOW}$	LED+ Short to GND Detection Level	—	—	0.3	—	V
$V_{CS\_HIGH}$	Diode Short Detection Level	—	—	1.75	—	V
$I_{CT}$	CT Current Source	—	—	5	—	$\mu A$
$V_{CT}$	CT Threshold Voltage	—	—	2.6	—	V

**Electrical Characteristics** (continued,  $V_{CC}=12V$ ,  $V_{EN}=3.3V$ ,  $T_A=+25^{\circ}C$ , unless otherwise specified.)

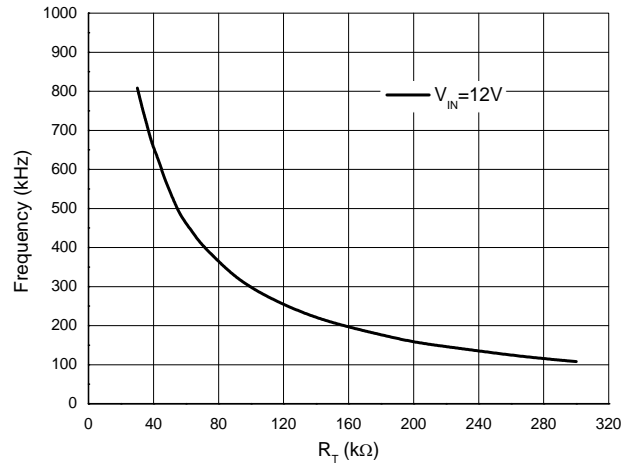
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$D_{MAX}$	Maximum Duty Cycle	$f=200kHz$	80	90	—	%
$I_{SS}$	Soft-Start Current Source	—	16	22	28	$\mu A$
$t_{RISE}$	OUT Pin Rising Time	$C_{OUT}=1nF$	—	20	—	ns
$t_{FALL}$	OUT Pin Falling Time	$C_{OUT}=1nF$	—	20	—	
$V_{OUT-H}$	OUT High Voltage Level ( $V_{CC}-V_{OUT}$ )	$I_{OUT}=50mA$	—	0.25	0.75	V
$V_{OUT-L}$	OUT Low Voltage Level ( $V_{OUT}$ )	$I_{OUT}=50mA$	—	0.25	0.75	V
$t_{RISE}$	FAULT Pin Rising Time	$C_{FAULT}=1nF$	—	100	—	ns
$t_{FALL}$	FAULT Pin Falling Time	$C_{FAULT}=1nF$	—	100	—	
$V_{FAULT-H}$	FAULT High Voltage Level ( $V_{CC}-V_{FAULT}$ )	$I_{FAULT}=10mA$	—	0.25	0.75	V
$V_{FAULT-L}$	FAULT Low Voltage Level	$I_{FAULT}=10mA$	—	0.25	0.75	V
$t_D$	FAULT Minimum Pulse Width	Oscillator Frequency=200kHz	—	20	—	$\mu s$
$V_{FLAG-H}$	FLAG High Voltage Level	$I_{FLAG}=500\mu A$	—	2	—	V
$V_{FLAG-L}$	FLAG Low Voltage Level	$I_{FLAG}=500\mu A$	—	0.25	0.75	V
$T_{OTSD}$	Thermal Shutdown Temperature	—	—	+160	—	$^{\circ}C$
$T_{HYS}$	Thermal Shutdown Hysteresis	—	—	+20	—	$^{\circ}C$

**Performance Characteristics**

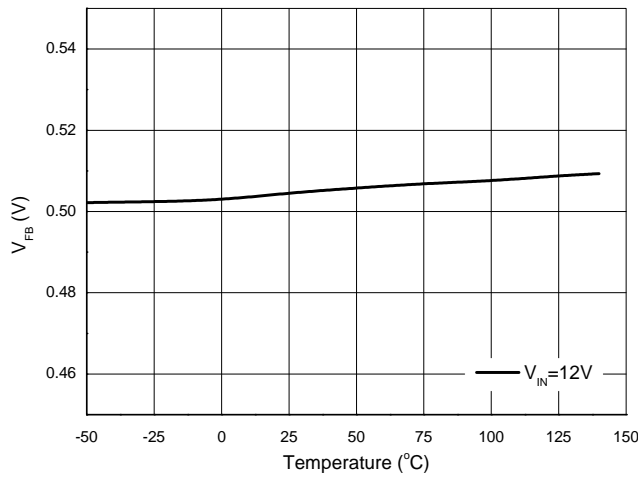
**LED Current vs. PWM Duty**



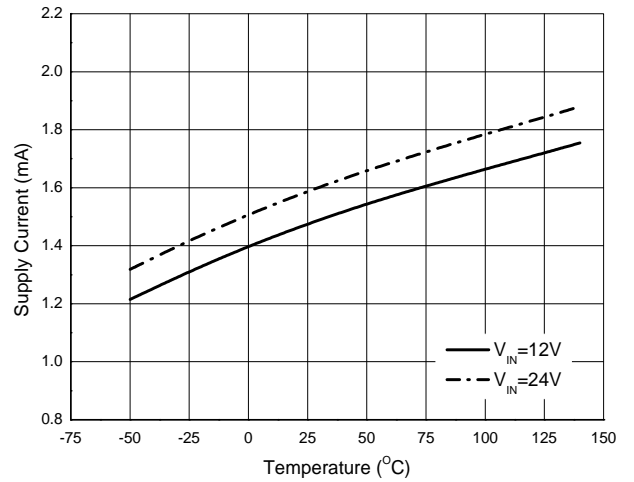
**Frequency vs.  $R_T$**



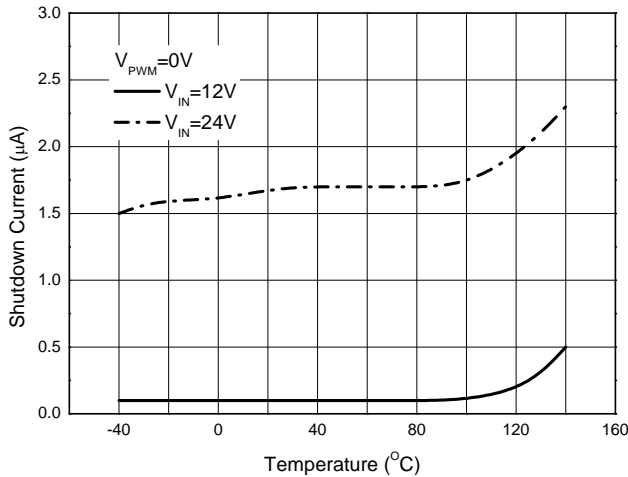
**$V_{FB}$  vs. Temperature**



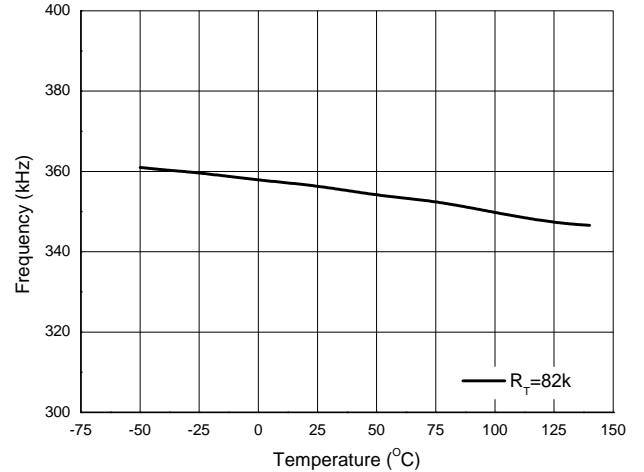
**Supply Current vs. Temperature**



**Supply Current vs. Temperature**



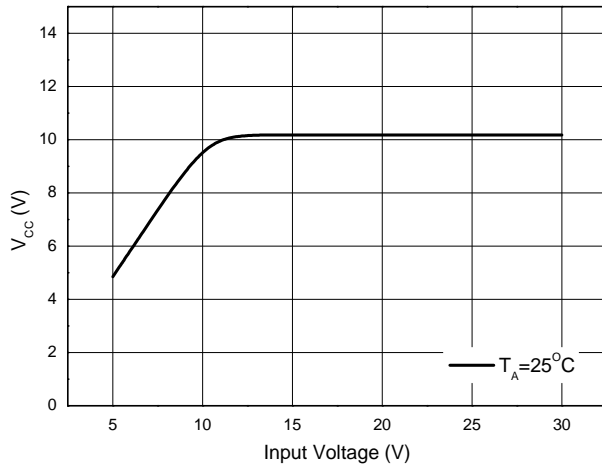
**Frequency vs. Temperature**



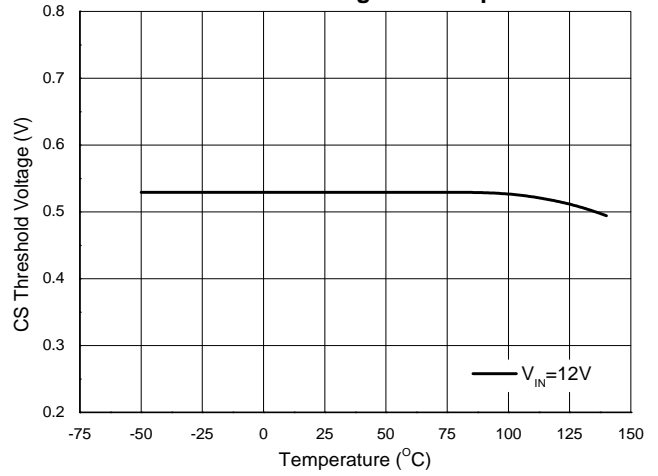


**Performance Characteristics** (continued)

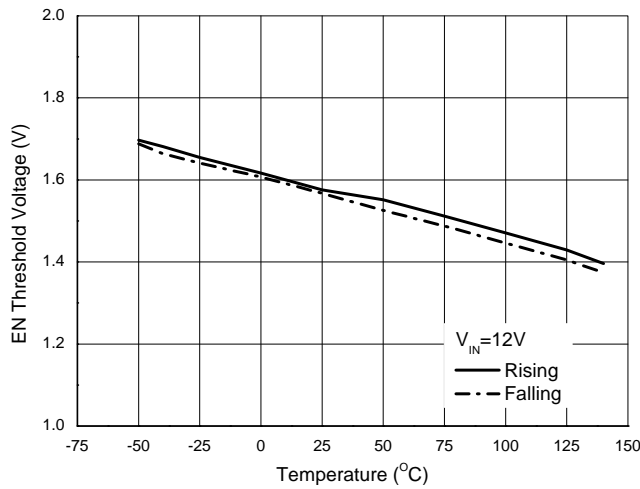
**V<sub>CC</sub> vs. Input Voltage**



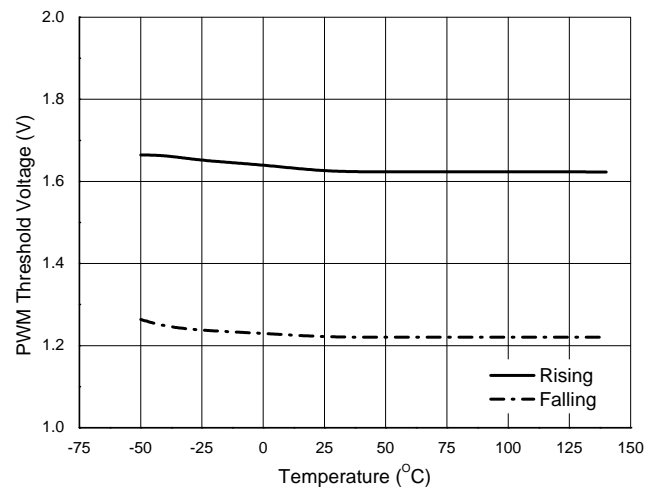
**CS Threshold Voltage vs. Temperature**



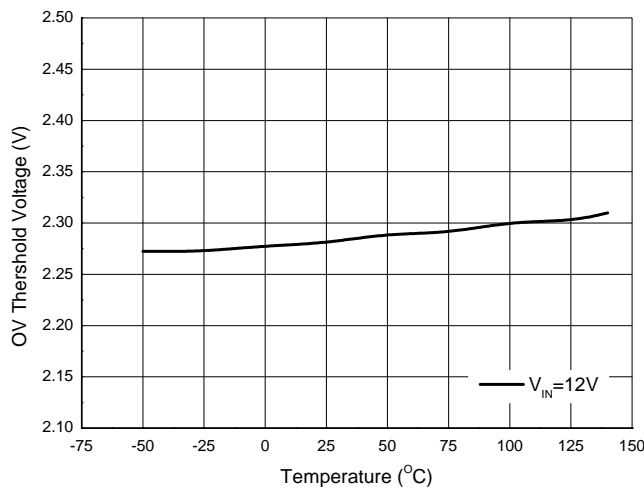
**EN Threshold Voltage vs. Temperature**



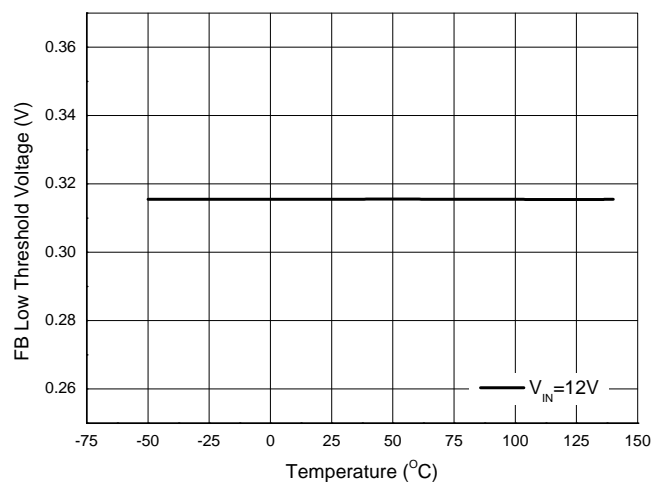
**PWM Threshold Voltage vs. Temperature**



**OV Threshold Voltage vs. Temperature**

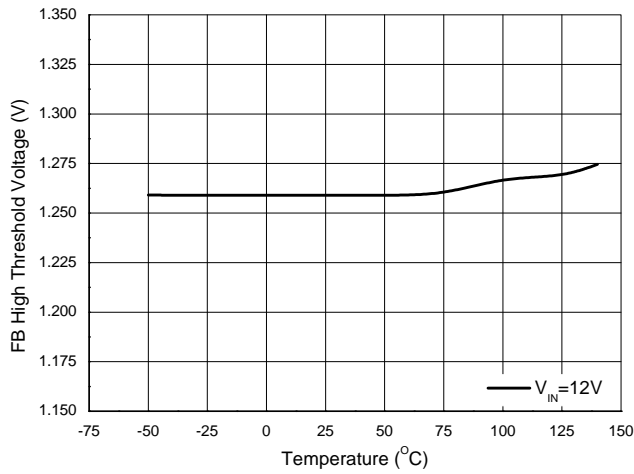


**FB Low Threshold Voltage vs. Temperature**

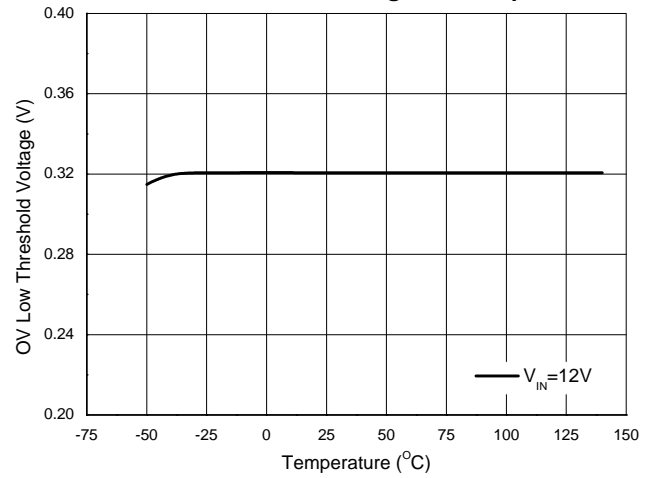


**Performance Characteristics** (continued)

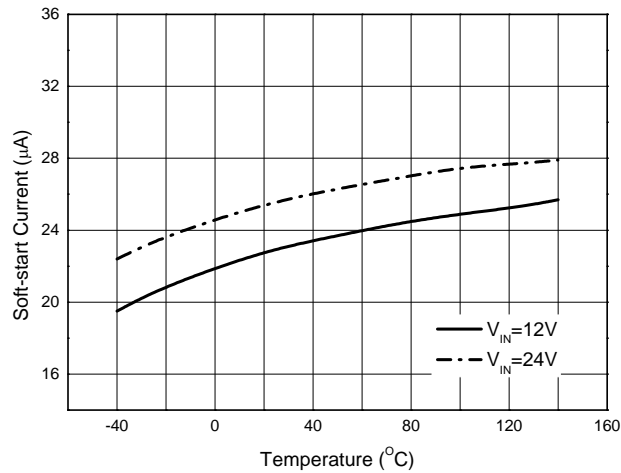
**FB High Threshold Voltage vs. Temperature**



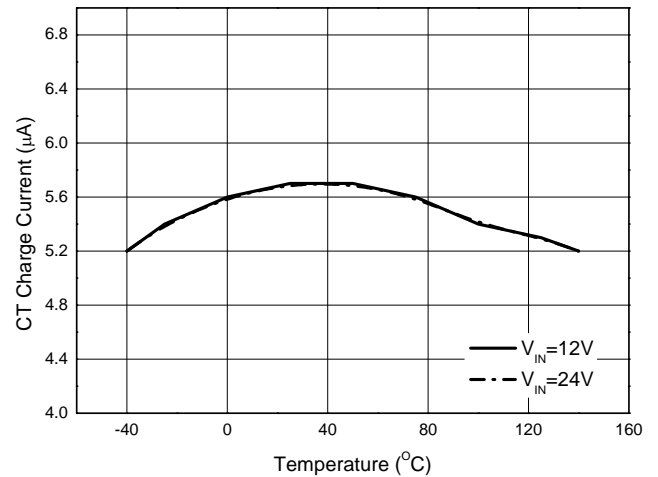
**OV Low Threshold Voltage vs. Temperature**



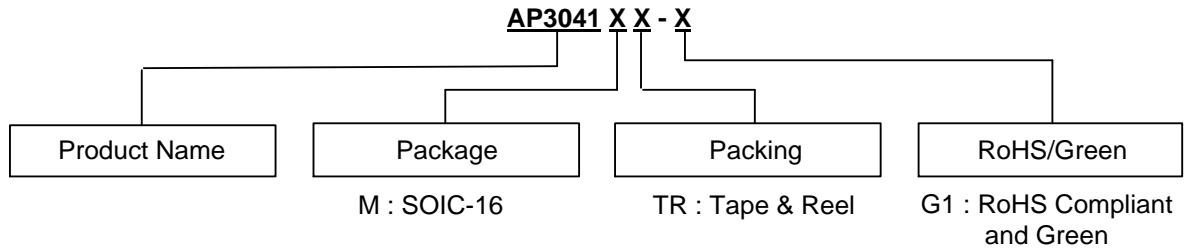
**Soft-start Current vs. Temperature**



**CT Charge Current vs. Temperature**

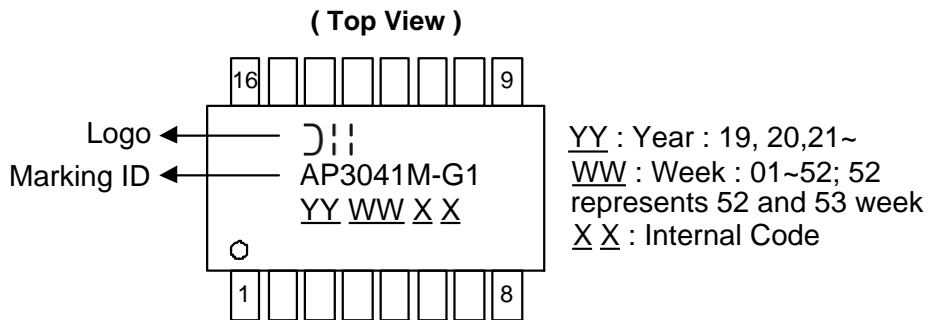


**Ordering Information**



Package	Temperature Range	Part Number	Marking ID	Packing
SOIC-16	-40 to +85°C	AP3041MTR-G1	AP3041M-G1	4,000/13" Tape & Reel

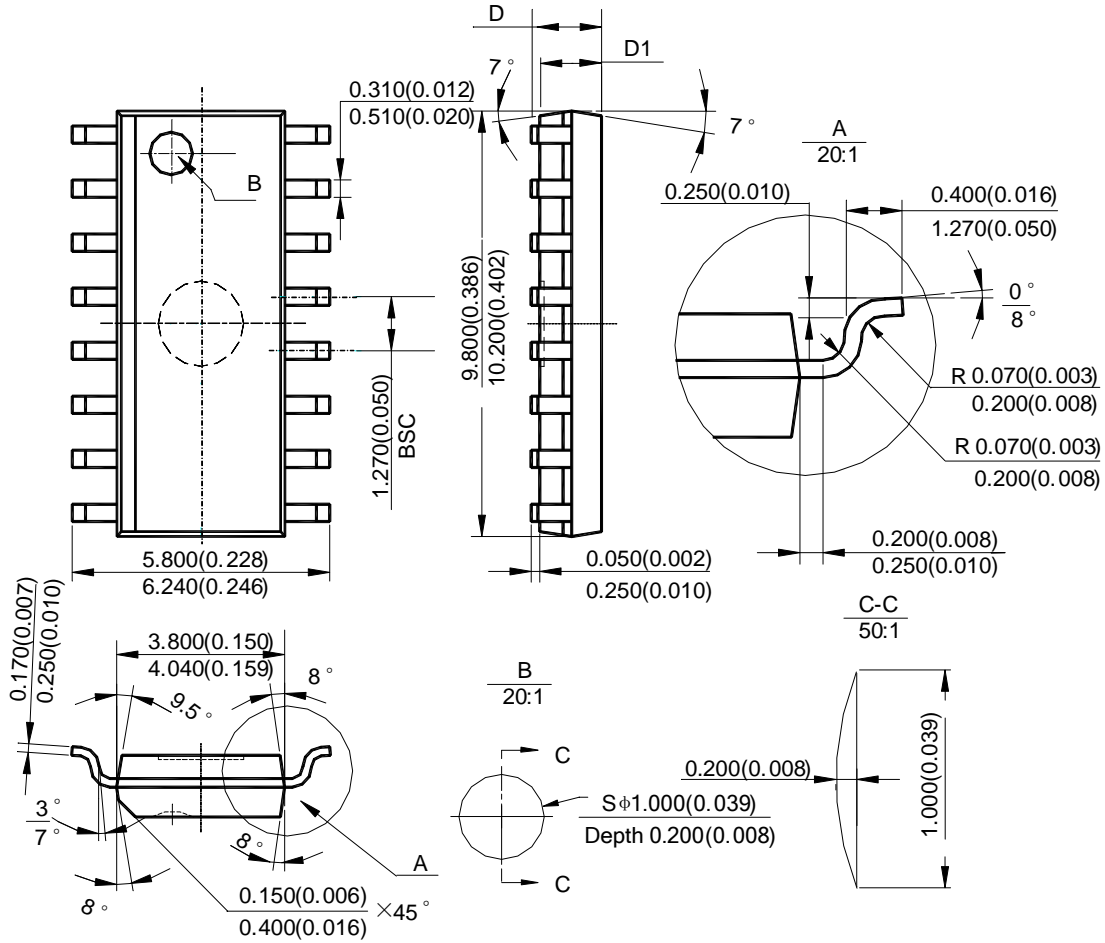
**Marking Information**



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

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOIC-16



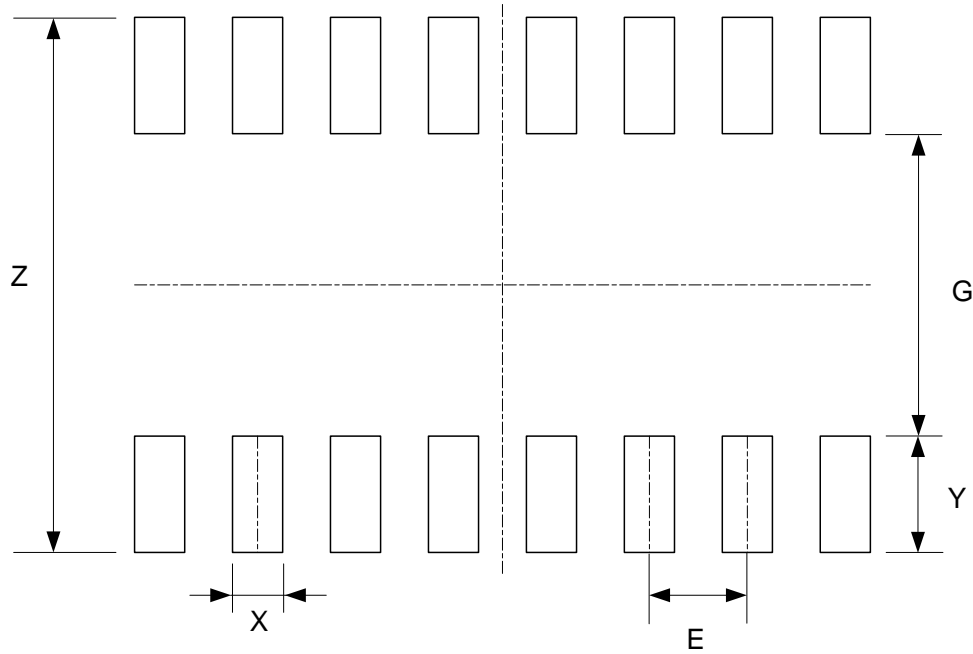
Note: Eject hole, oriented hole and mold mark is optional.

Symbol	D				D1			
	min(mm)	max(mm)	min(inch)	max(inch)	min(mm)	max(mm)	min(inch)	max(inch)
Option1	1.350	1.750	0.053	0.069	1.250	1.650	0.049	0.065
Option2	-	1.260	-	0.050	1.020	-	0.040	-

**Suggested Pad Layout**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOIC-16



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050

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