Description

The AP3039 is a current mode high voltage low-side N-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 range of AP3039 is from 5V to 27V. Its operation frequency is adjustable from 150kHz to 1MHz.

The AP3039 has UVLO (Under Voltage Lock Out) circuit. It uses two external resistors to set the UVLO voltage. The AP3039 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, when the output voltage drops to the OVP low threshold point, it will enable the driver. It also features a soft start to reduce the inrush current when power on, the soft start time can be set through an external capacitor.

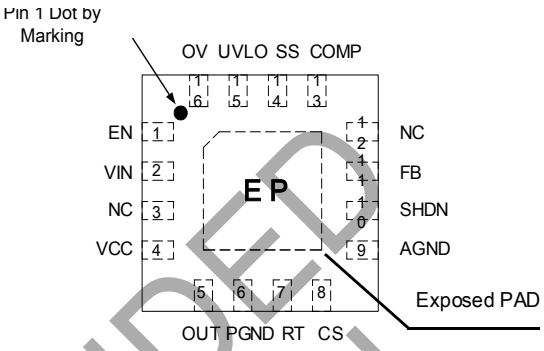
The AP3039 is available in QFN-3x3-16 and SOIC-14 packages.

Features

- Input Voltage Range 5V to 27V
- 0.6A Peak MOSFET Gate Driver
- 20ns Quick MOSFET Gate Driver
- Duty Cycle Limit of 90%
- Programmable UVLO
- Programmable Over Voltage Protection
- Cycle by Cycle Current Limit
- Adjustable Soft-Start
- Adjustable Operation Frequency from 150kHz to 1MHz

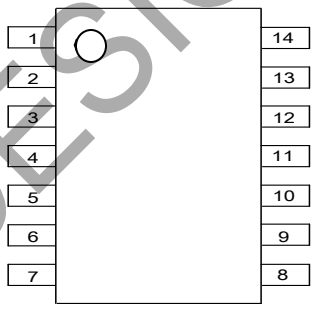
Pin Assignments

(Top View)



QFN-3x3-16

(Top View)

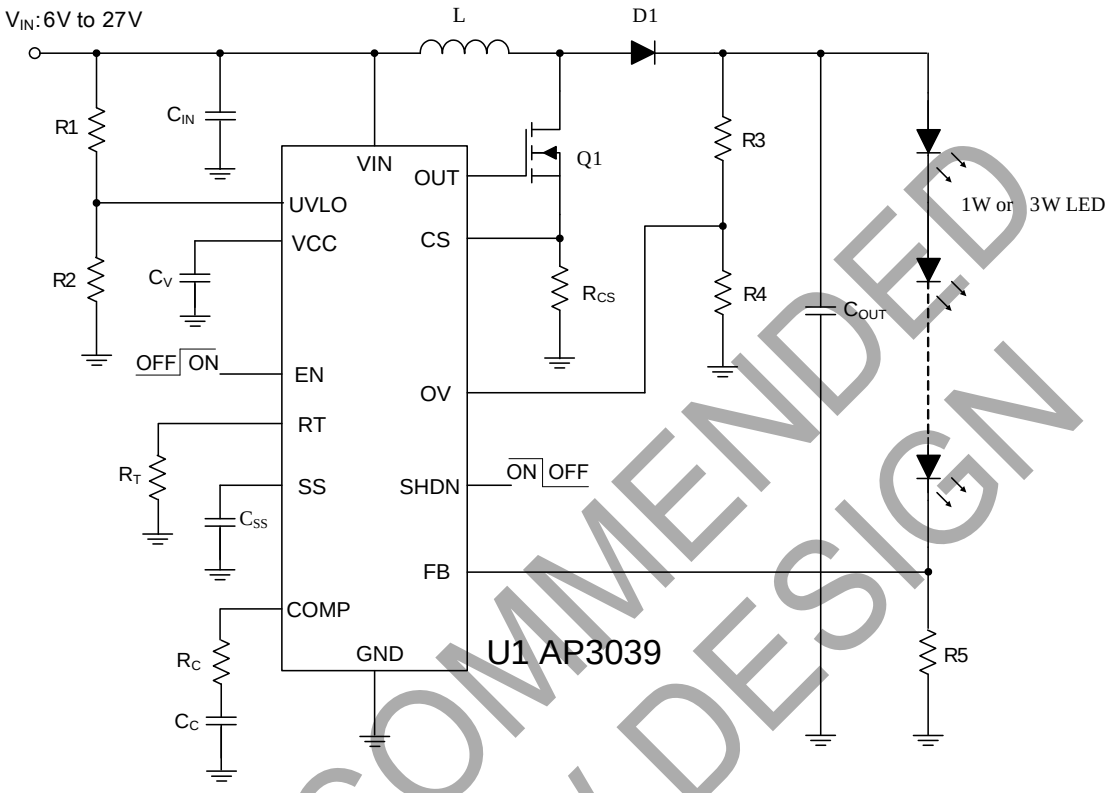


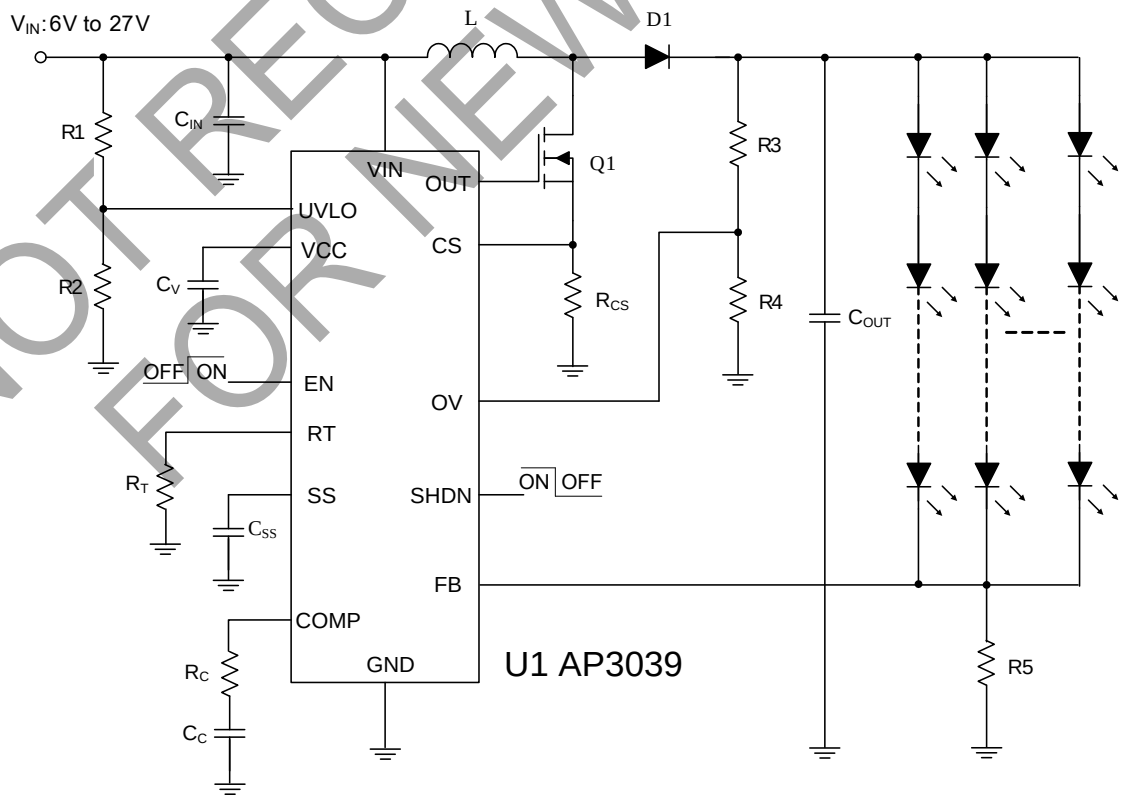
SOIC-14

Applications

- LED Lighting
- Notebook
- LCD Display Modules

Typical Applications Circuit





Typical Applications Circuit (Cont.) (Note 1, 2 and 3)

Note 1: The output voltage is decided by R5, R6 and the internal 0.5V reference. The output voltage accuracy is determined by the accuracy of R5 and R6, for which the precise resistors are preferred.

$$V_{OUT}=\frac{0.5V}{R6}*(R5+R6)$$

Note 2: In this application, the LED current is controlled by the feedback resistor R5. LEDs current accuracy is determined by regulator's feedback threshold accuracy and is independent of the LEDs forward voltage variation. So the precise resistors are the better choices. The resistance of R5 is in inverse proportion to the LED current since the feedback reference is fixed at 0.5V. The relation of R5 and the LED current can be expressed as below:

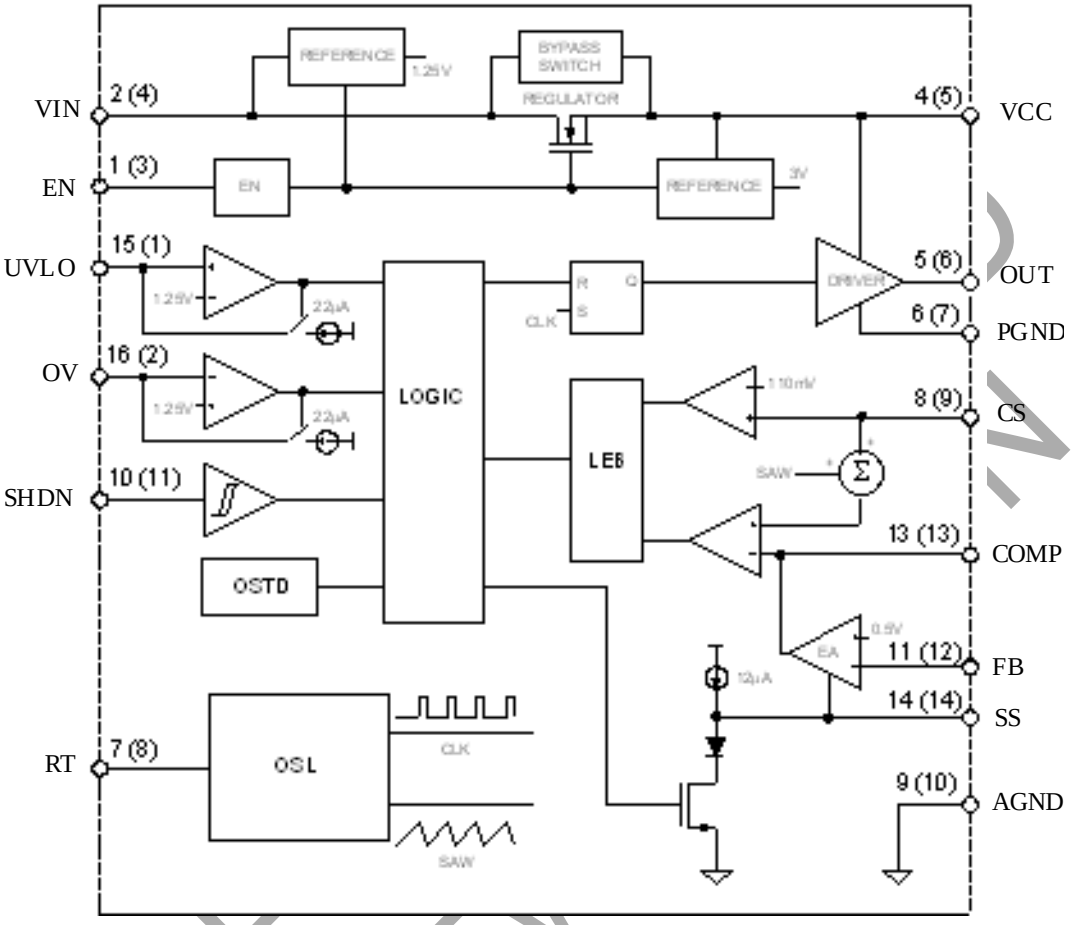
$$R5=\frac{0.5V}{I_{LED}}$$

Note 3: The summation of LED current is determined by R5 and internal 0.5V reference same as the illustration in Figure 22.
More detailed application information please refer to application note.

Pin Descriptions

Pin Number		Pin Name	Function
16-pin	14-pin		
1	3	EN	Enable pin
2	4	VIN	Input supply pin, must be locally bypassed
3, 12	_	NC	No connection (for QFN-3x3-16 package only)
4	5	VCC	6V linear regulator output pin. VCC is used to bias the gate driver for the external MOSFET. If VIN is less than 8.5V, the VCC is equal to VIN minus drop voltage across bypass switch. If VIN is less than 6V, connect VCC to VIN. This pin should be bypassed to GND (recommend to connect with AGND pin) with a ceramic capacitor
5	6	OUT	Connect this pin to the gate of external MOSFET, the gate driver has 0.6A peak current capability
6	7	PGND	Power ground
7	8	RT	An external resistor connected from this pin to GND to set the operating frequency
8	9	CS	Sense switch current pin, which is used for current mode control and for current limit
9	10	AGND	Reference ground
10	11	SHDN	This pin can be connected to current matched chip and receives error signal used to shut down the system
11	12	FB	Voltage Feedback Pin. The reference voltage is 500mV
13	13	COMP	Compensation Pin. This pin is the output of the internal Error Amplifier
14	14	SS	An external soft start time capacitor is connected from this pin to ground and is charged by internal 12mA current source to control regulator soft start time
15	1	UVLO	Two resistors connected from this pin to ground and the VIN pin respectively to set start up and shutdown level
16	2	OV	Over output voltage protection pin
_	_	EP	Exposed backside pad. Solder to the circuit board ground plane with sufficient copper connection to ensure low thermal resistance (for QFN-3x3-16 package only)

Functional Block Diagram



A (B)
A QFN-3x3-16
B SOIC-14

Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Value		Unit
V_{IN}	Input Voltage	30		V
V_{CC}	VCC Pin Voltage	10		V
V_{OUT}	OUT Pin Voltage	10		V
V_{FB}	Feedback Pin Voltage	7		V
V_{UVLO}	UVLO Pin Voltage	7		V
V_{CS}	CS Pin Voltage	7		V
V_{SHDN}	SHDN Pin Voltage	7		V
V_{EN}	Enable Pin Voltage	V_{IN}		V
V_{OV}	OV Pin Voltage	7		V
θ_{JA}	Thermal Resistance (Junction to Ambient, no Heat sink)	QFN-3x3-16	60	°C/W
		SOIC-14	102	
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)	200		V
_	ESD (Human Body Model)	2000		V

Note 4: 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
V_{IN}	Input Voltage	5	27	V
f	Operating Frequency	150	1000	kHz
T_A	Operating Temperature	-40	+85	°C

Electrical Characteristics (V_{IN}=12V, V_{EN} =V_{IN}, T_A=+25°C, unless otherwise specified.)

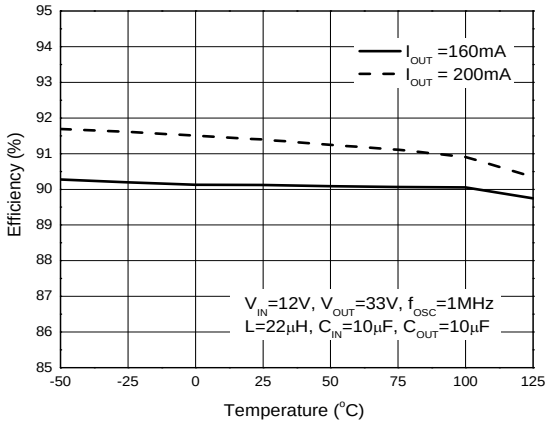
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	V_{CC}=V_{IN}	5	_	6	V
		V_{CC} bypassed to GND through a 0.47μF capacitor	6	_	27	
V_{FB}	Feedback Voltage	_	490	500	510	mV
I_{FB}	FB Pin Bias Current	_	_	35	100	nA
I_Q	Quiescent Current	No switching	_	3	5	mA
I_{SHDN}	Shutdown Quiescent Current	V_{EN}=0V	_	1	2	μA
V_{CC}	VCC Voltage	9V≤V_{IN}≤27V	5.5	6	6.5	V
		6V≤V_{IN}≤9V	5	_	_	
I_{CC-LIM}	VCC Current Limit	_	_	50	_	mA
V_{IN}-V_{CC}	Drop Voltage Across Bypass Switch	I_{CC}=0mA, f_{OSC}≤200kHz, 6V≤V_{IN}≤8.5V	_	300	_	mV
V_{BYP-HI}	Bypass Switch Turn-off Threshold	V_{IN} increasing	_	8.7	_	V
$V_{BYP-HYS}$	Bypass Switch Threshold Hysteresis	V_{IN} decreasing	_	260	_	mV
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	Adjustable, R_T=51kΩ to 470kΩ	150	_	1000	kHz
V_{UVLO}	UVLO Threshold	_	1.22	1.25	1.28	V
I_{HYS}	UVLO Hysteresis Current Source	_	_	22	_	μA
V_{CS}	Current Limit Threshold Voltage	_	90	110	130	mV
V_{RT}	RT Voltage	_	1.20	1.25	1.30	V
G_S	Error Amplifier Transconductance	_	_	470	_	μA/V
V_{EH}	EN Pin Threshold Voltage	_	2.0	_	_	V
V_{EL}		_	_	_	0.5	
V_{IH}	SHDN Pin Threshold Voltage	_	2.0	_	_	V
V_{IL}		_	_	_	0.5	

Electrical Characteristics (Cont. V_{IN}=12V, V_{EN} =V_{IN}, T_A=+25°C, unless otherwise specified.)

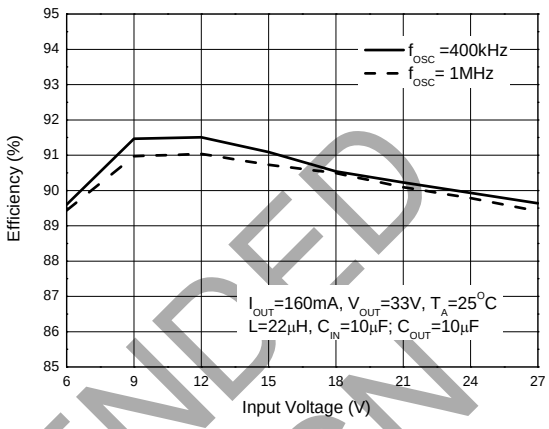
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OV}	OV Threshold	_	_	1.25	_	V
I_{OV-HYS}	OV Hysteresis Current Source	_	_	22	_	μA
D_{MAX}	Maximum Duty Cycle	_	_	90	93	%
I_{SS}	Soft Start Current Source	_	_	12	_	μA
t_{RISE}	Out Pin Rise Time	Out Pin Load =1nF	_	20	_	ns
t_{FALL}	Out Pin Fall Time	Out Pin Load =1nF	_	20	_	ns
V_{OUT-H}	OUT Dropout Voltage (V_{CC}-V_{OUT})	I_{OUT}=50mA	_	0.25	0.75	V
V_{OUT-L}	OUT Low Voltage Level (V_{OUT})	I_{OUT}=100mA	_	0.25	0.75	V
T_{OTSD}	Thermal Shutdown Temperature	_	_	+160	_	°C
T_{HYS}	Thermal Shutdown Hysteresis	_	_	+20	_	°C

Performance Characteristics

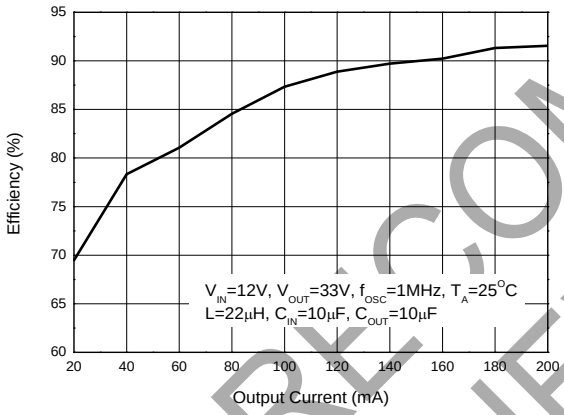
Efficiency VS. Case Temperature



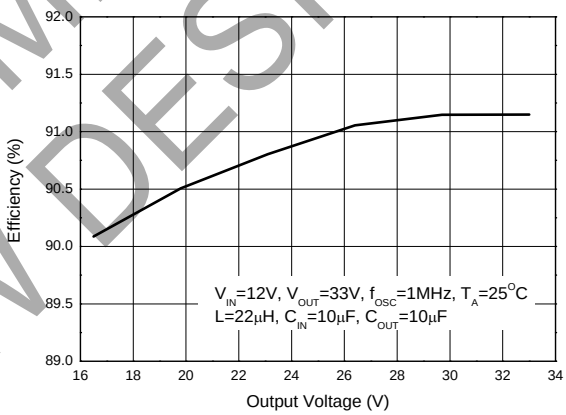
Efficiency VS.Input Voltage



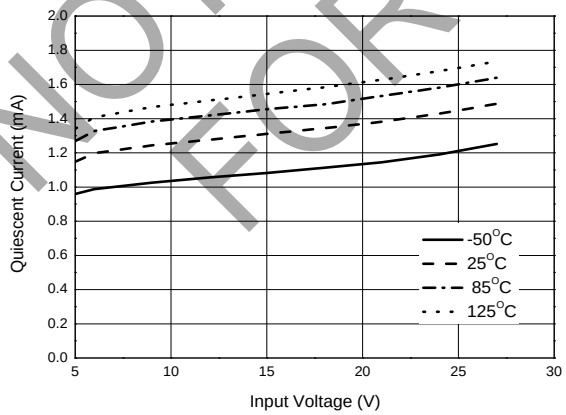
Efficiency VS. Output Current



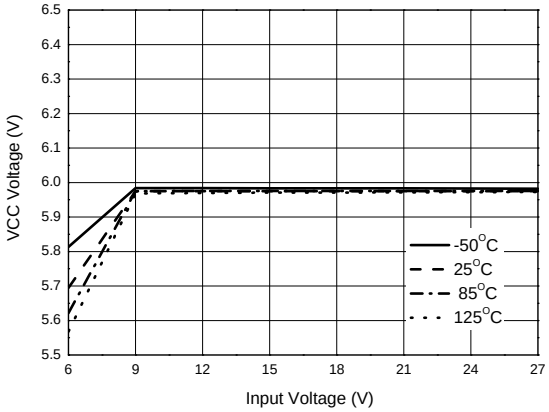
Efficiency VS. Output Voltage



Quiescent Current VS. Input Voltage

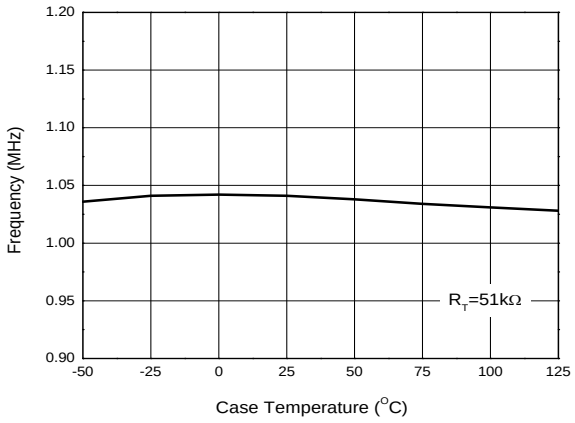


VCC Voltage VS. Input Voltage

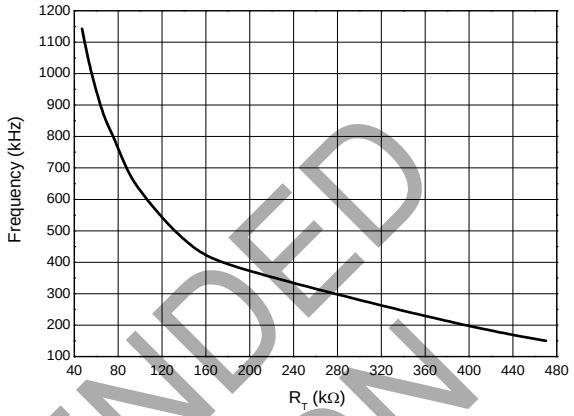


Performance Characteristics (Cont.)

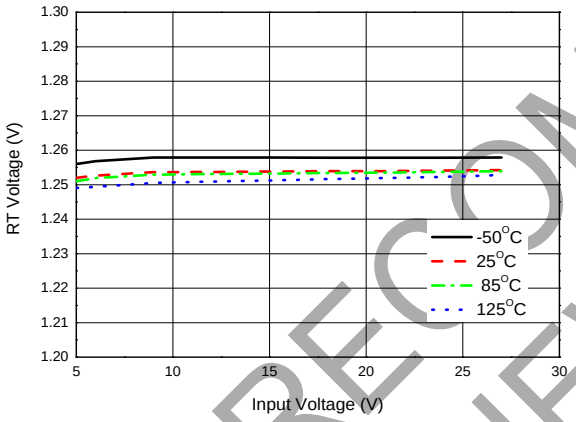
Switching Frequency VS. Case Temperature



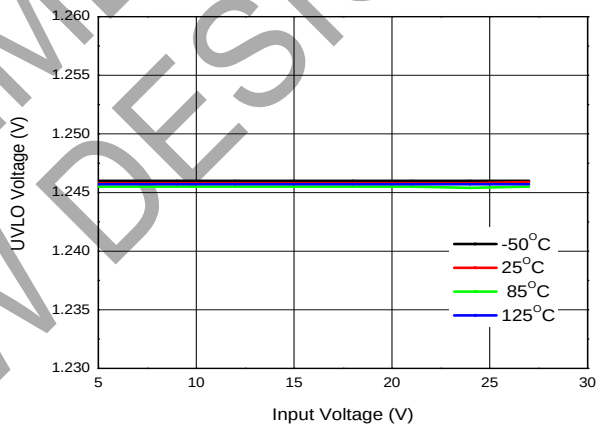
Switching Frequency VS. R_T Value



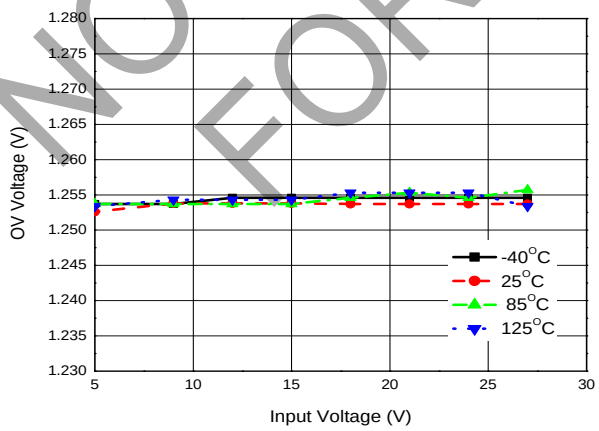
RT Voltage VS. Input Voltage



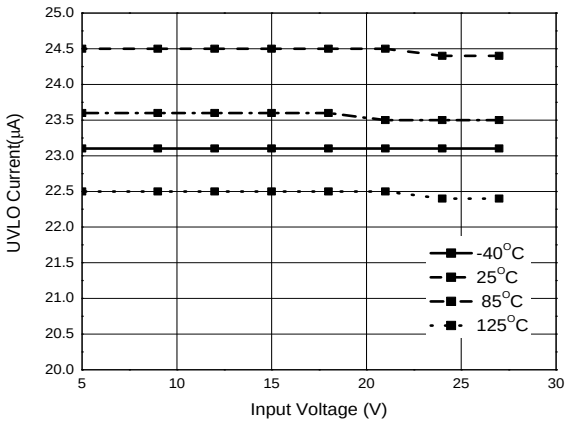
UVLO Voltage VS. Input Voltage



OV Voltage VS. Input Voltage

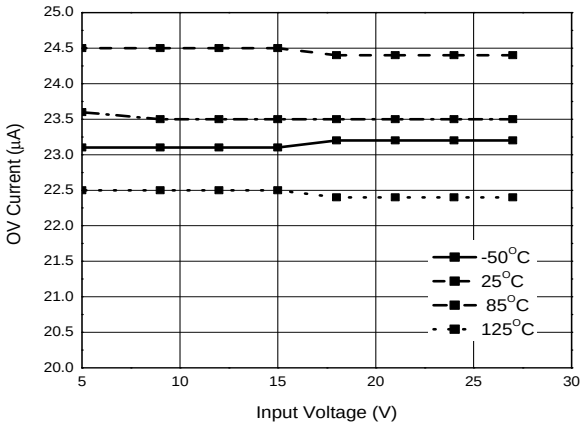


UVLO Current VS. Input Voltage

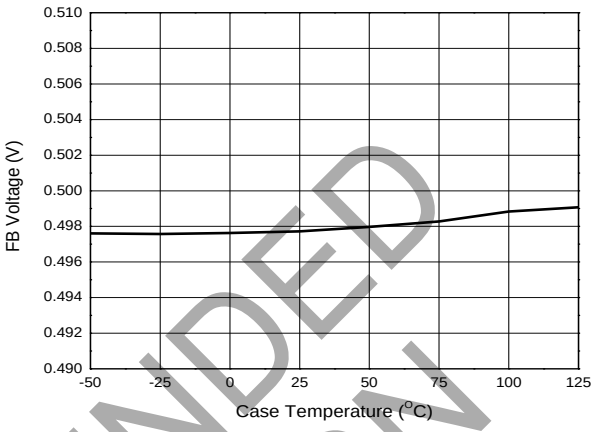


Performance Characteristics (Cont.)

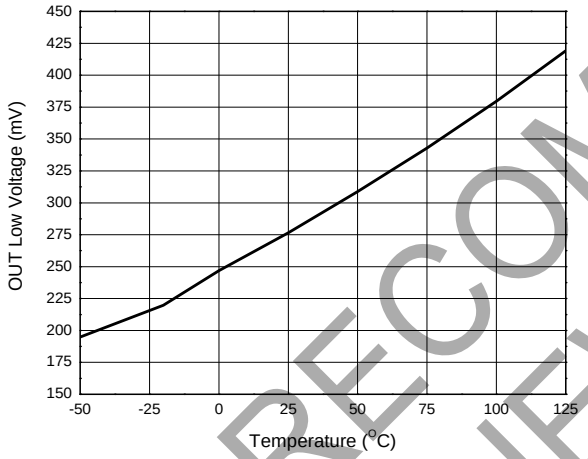
OV Current VS. Input Voltage



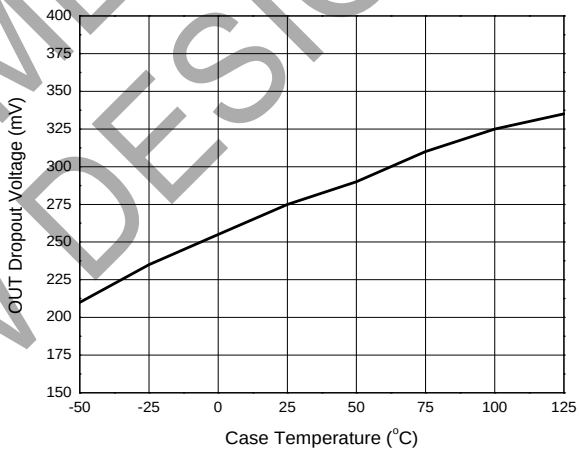
Feedback Voltage VS. Case Temperature



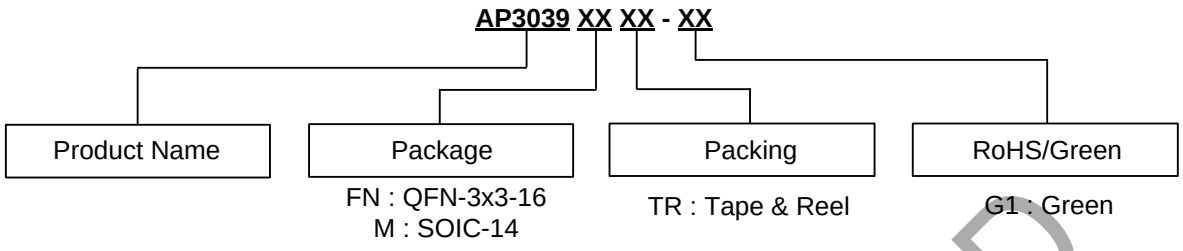
OUT Low Voltage VS. Case Temperature



OUT Dropout Voltage VS. Case Temperature



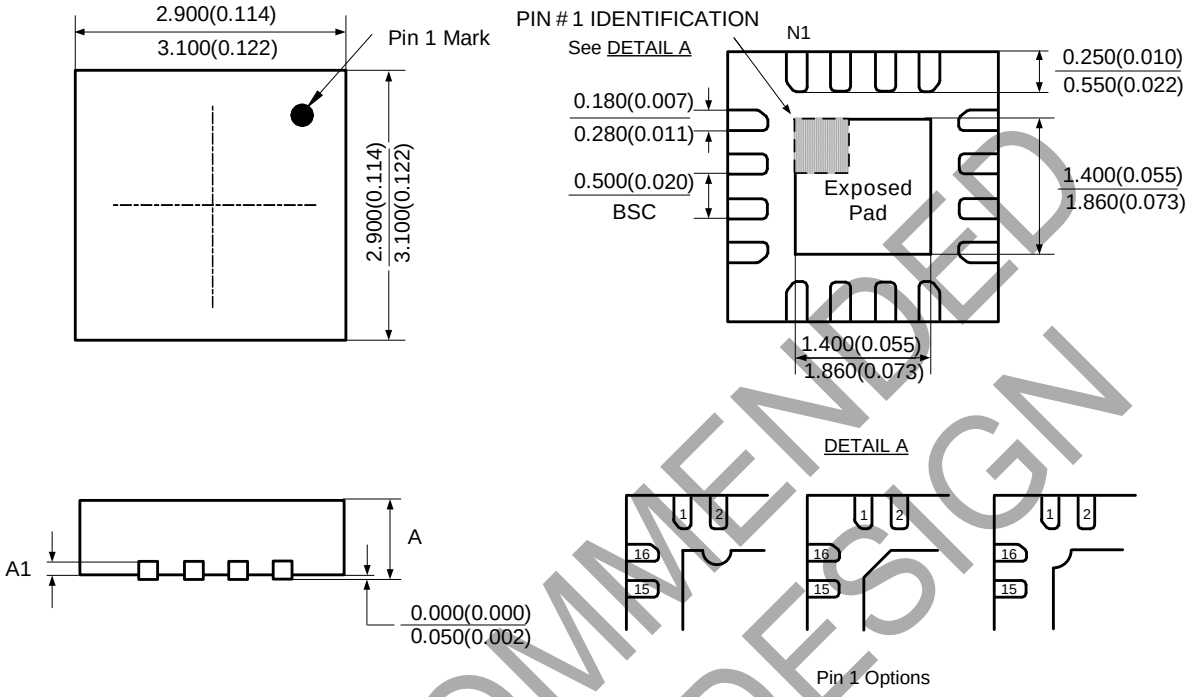
Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing
QFN-3x3-16	-40 to+ 85°C	AP3039FNTR-G1	B2A	Tape & Reel
SOIC-14		AP3039M-G1	3039M-G1	Tube
		AP3039MTR-G1	3039M-G1	Tape & Reel

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

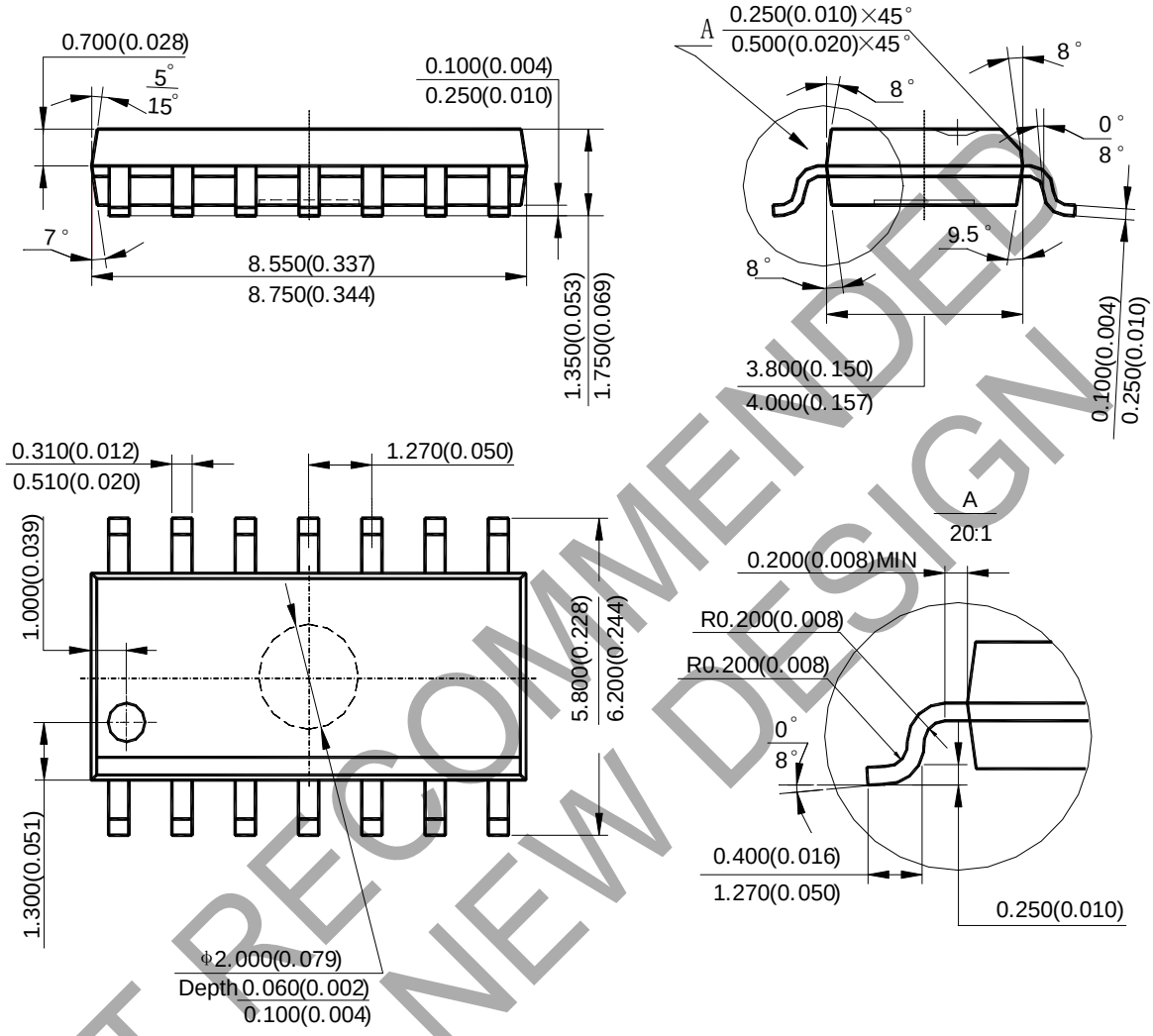
(1) Package Type: QFN-3x3-16



Symbol	A				A1			
	min(mm)	max(mm)	min(inch)	max(inch)	min(mm)	max(mm)	min(inch)	max(inch)
Option1	0.700	0.900	0.028	0.035	0.178	0.228	0.007	0.009
Option2	0.550	0.650	0.022	0.026	0.150 (TYP)		0.006 (TYP)	

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

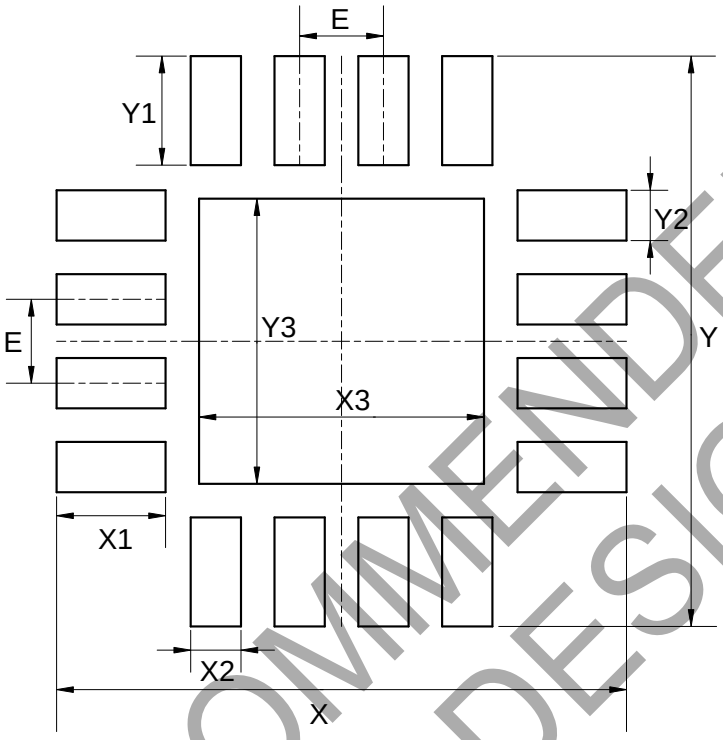
(2) Package Type: SOIC-14



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

Suggested Pad Layout

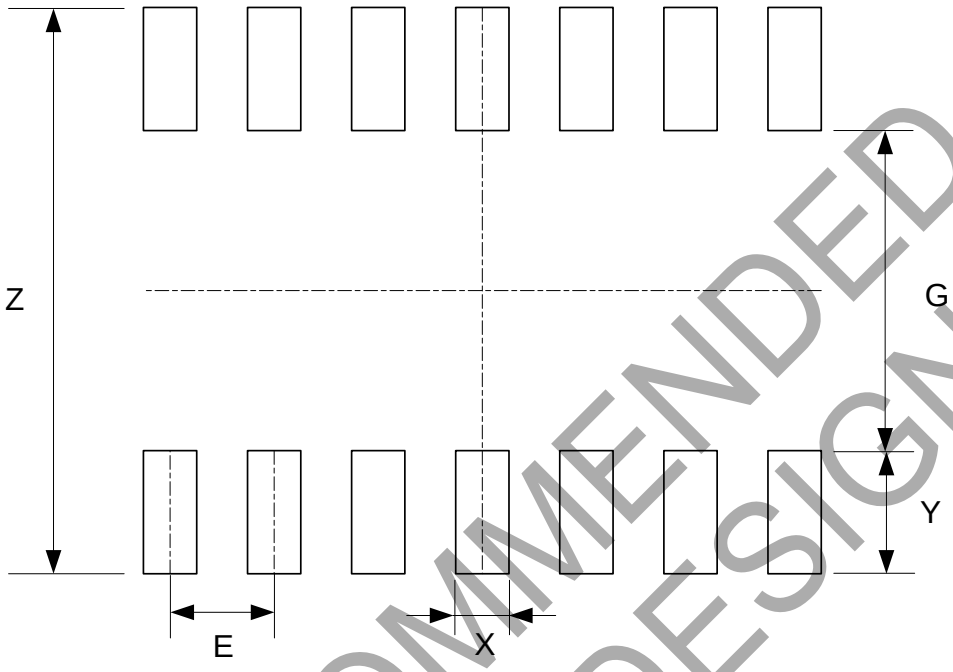
(1) Package Type: QFN-3x3-16



Dimensions	X=Y (mm)/(inch)	X1=Y1 (mm)/(inch)	X2=Y2 (mm)/(inch)	X3=Y3 (mm)/(inch)	E (mm)/(inch)
Value	3.400/0.134	0.650/0.026	0.300/0.012	1.700/0.067	0.500/0.020

Suggested Pad Layout (Cont.)

(2) Package Type: SOIC-14



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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