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Description

The AP3433 is a current mode, PWM synchronous buck (step-down) DC-DC converter, capable of driving a 3A load with high efficiency, excellent line and load regulation.

The device integrates two N-channel power MOSFETs with low on-resistance. Current mode control provides fast transient response and cycle-by-cycle current limit.

The switching frequency of AP3433 can be programmable from 300kHz to 2MHz, which allows small-sized components, such as capacitors and inductors. A standard series of inductors from several different manufacturers are available. This feature greatly simplifies the design of switch-mode power supplies.

Under voltage lockout is internally set at 2.6V, but can be increased by programming the threshold with a resistor network on the enable pin. The output voltage startup ramp is controlled by the soft-start pin. An open drain power good signal indicates the output is within 93% to 107% of its nominal voltage.

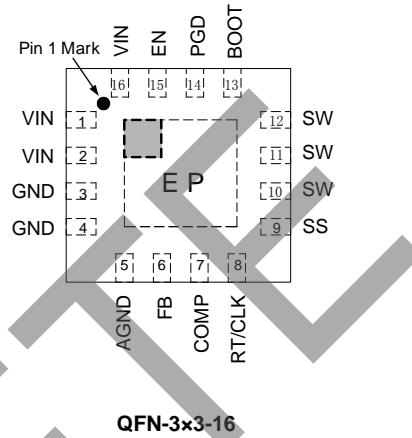
The AP3433 is available in QFN-3x3-16 package.

Features

- Input Voltage Range: 2.95V to 5.5V
- 0.827V Reference Voltage with $\pm 3\%$ Precision
- Two 45m Ω (typical) MOSFETs for High Efficiency at 3A Load
- High Efficiency: up to 94%
- Output Current: 3A
- Programmable Frequency: 300kHz to 2MHz
- Current Mode Control
- Synchronizes to External Clock
- Adjustable Soft-start
- Soft Start-up into Pre-biased Output
- UV and OV Power Good Output
- Built-in Over Current Protection
- Built-in Thermal Shutdown Function
- Programmable UVLO Function
- Built-in Over Voltage Protection
- Thermally Enhanced 3mmx3mm 16-pin QFN

Pin Assignments

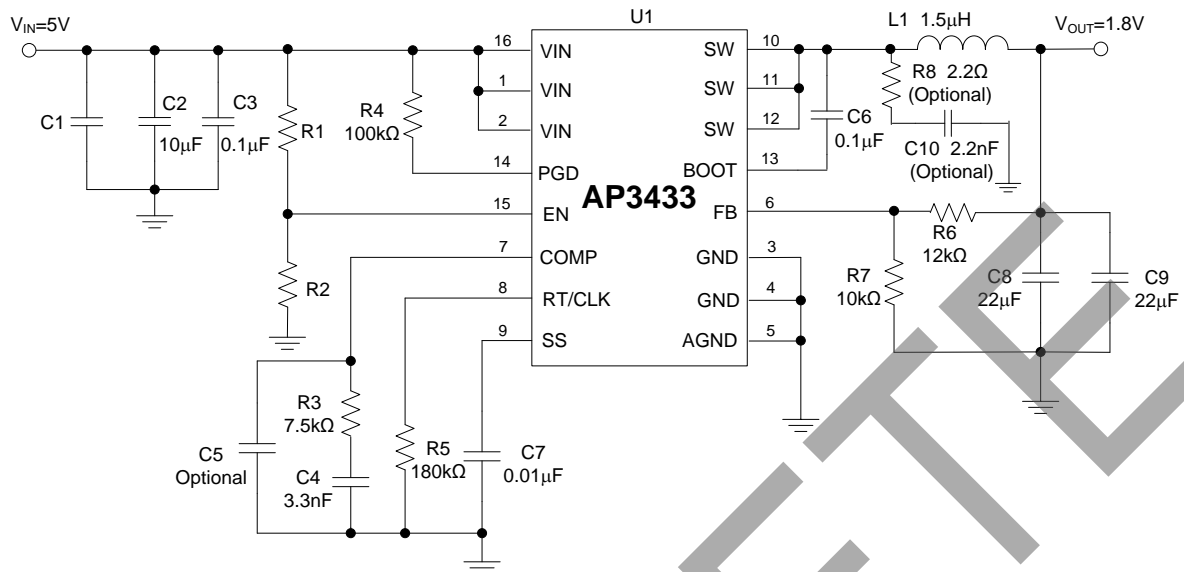
(Top View)



Applications

- Low-voltage, High-density Power Systems
- Point of Load Regulation for Consumer Applications such as Set Top Boxes, LCD Displays, CPE Equipment

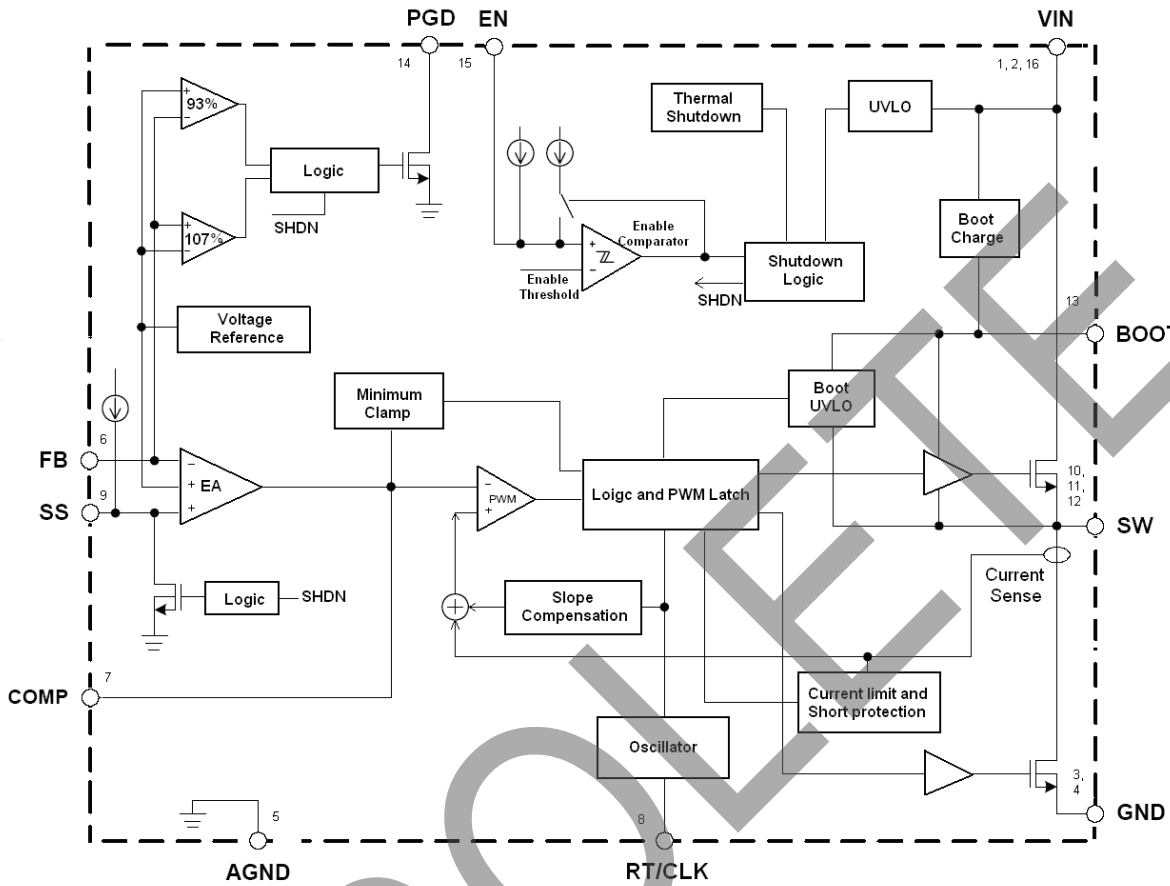
Typical Applications Circuit



Pin Descriptions

Pin Number	Pin Name	Function
1,2,16	VIN	Supply input pin. A capacitor should be connected between the VIN and GND pin to keep the DC input voltage constant
3,4	GND	Power ground. This pin should be electrically connected to the power pad under the IC
5	AGND	Analog ground. This pin should be electrically connected to GND close to the device
6	FB	Feedback pin. Inverting node of the transconductance error amplifier
7	COMP	Compensation pin. This pin is the output of the transconductance error amplifier and the input to the current comparator. Connect external compensation elements to this pin to stabilize the control loop
8	RT/CLK	Resistor timing or external clock input pin
9	SS	Soft-start pin. An external capacitor connected to this pin sets the output voltage rise time. This pin can also be used for tracking
10,11,12	SW	Internal power switch output pin. This pin is connected to the inductor and bootstrap capacitor
13	BOOT	Bootstrap pin. A bootstrap capacitor is connected between the BOOT pin and SW pin. The voltage across the bootstrap capacitor drives the internal high-side power MOSFET
14	PGD	Power good indicator output. Asserts low if output voltage is low due to thermal shutdown, over-current, over/under-voltage or EN shut down
15	EN	Enable pin, internal pull-up current source. Pull below 1.2V to disable. Float to enable. Can be used to set the on/off threshold (adjust UVLO) with two additional resistors

Functional Block Diagram



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Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V_{IN}	VIN Pin Voltage	-0.3 to 6.5	V
V_{EN}	EN Pin Voltage	-0.3 to 6.5	V
V_{SW}	SW Pin Voltage	-0.3 to $V_{IN}+0.3$	V
V_{FB}	FB Pin Voltage	-0.3 to 6.5	V
V_{COMP}	COMP Pin Voltage	-0.3 to 6.5	V
V_{PGD}	PGD Pin Voltage	-0.3 to 6.5	V
$V_{RT/CLK}$	RT/CLK Pin Voltage	-0.3 to 6.5	V
V_{SS}	SS Pin Voltage	-0.3 to 6.5	V
θ_{JA}	Thermal Resistance (Junction to Ambient)	70	°C/W
$\theta_{JC (BOTTOM)}$	Thermal Resistance (Junction to Case)	5	°C/W
T_J	Operating Junction Temperature	-40 to +125	°C
T_{STG}	Storage Temperature	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering, 10sec)	+260	°C
–	ESD (Machine Model)	200	V
–	ESD (Human Body Model)	2000	V

Note 1: 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	2.95	5.5	V
$I_{OUT(MAX)}$	Maximum Output Current	3	–	A
T_A	Operating Ambient Temperature	-40	+85	°C

Electrical Characteristics ($V_{IN}=2.95$ to $5.5V$, $T_A=25^\circ C$, unless otherwise specified. Specifications with boldface type apply over full operating temperature range from -40 to $+85^\circ C$.)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
SUPPLY VOLTAGE (VIN PIN)						
V_{IN}	Input Voltage	–	2.95	–	5.5	V
I_Q	Quiescent Current	$V_{FB}=0.9V, V_{IN}=5V, T_A=25^\circ C, R_T=400k\Omega$	–	360	575	μA
I_{SHDN}	Shutdown Supply Current	$V_{EN}=0V, T_A=25^\circ C, 2.95V \leq V_{IN} \leq 5.5V$	–	2	5	μA
ENABLE AND UVLO (EN PIN)						
V_{EN_H}	Enable Threshold	Rising	1.16	1.25	1.37	V
V_{EN_L}		Falling	–	1.18	–	V
V_{UVLO}	Internal Under Voltage Lockout Threshold	–	–	2.6	2.8	V
V_{HYS}	Internal Under Voltage Hysteresis	–	–	150	–	mV
VOLTAGE REFERENCE (FB PIN)						
V_{REF}	Voltage Reference	$2.95V \leq V_{IN} \leq 5.5V$	0.802	0.827	0.852	V
MOSFET						
R_{ON_H}	High Side Switch On-resistance	$V_{BOOT-SW}=5V$	–	45	81	m Ω
		$V_{BOOT-SW}=2.95V$	–	64	110	m Ω
R_{ON_L}	Low Side Switch On-resistance	$V_{IN}=5V$	–	42	81	m Ω
		$V_{IN}=2.95V$	–	59	110	m Ω
CURRENT LIMIT						
I_{LIMIT}	Current Limit Threshold	–	4.2	6.6	–	A
THERMAL SHUTDOWN						
T_{TSD}	Thermal Shutdown	–	–	+140	–	$^\circ C$
–	Hysteresis	–	–	+20	–	$^\circ C$

Electrical Characteristics (Cont. $V_{IN}=2.95$ to $5.5V$, $T_A=25^\circ C$, unless otherwise specified. Specifications with boldface type apply over full operating temperature range from -40 to $+85^\circ C$.)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
TIMING RESISTOR AND EXTERNAL CLOCK (RT/CLK PIN)						
–	Switching Frequency Range (RT Mode)	–	300	–	2000	kHz
–	Switching Frequency Range (CLK Mode)	–	300	–	2000	kHz
f_s	Switching Frequency	$R_T=400k\Omega$	400	500	600	kHz
–	Minimum CLK Pulse Width	–	75	–	–	ns
–	RT/CLK Voltage	$R_T=400k\Omega$	–	0.5	–	V
–	RT/CLK High Threshold	–	–	1.6	2.2	V
–	RT/CLK Low Threshold	–	0.4	0.6	–	V
BOOT (BOOT PIN)						
R_{BOOT}	BOOT Charge Resistor	$V_{IN}=5V$	–	16	–	Ω
–	BOOT-SW UVLO	$V_{IN}=2.95V$	–	2.2	–	V
SOFT START (SS PIN)						
I_{SS}	Charge Current	$V_{SS}=0.4$	–	2.2	–	μA
V_{SS}	SS to Reference Crossover	98% Nominal	–	1.1	–	V
POWER GOOD (PGD PIN)						
$V_{FB TH}$	Feedback Threshold	V_{FB} Falling (Fault)	–	91	–	%VREF
		V_{FB} Rising (Good)	–	93	–	
		V_{FB} Rising (Fault)	–	107	–	
		V_{FB} Falling (Good)	–	105	–	

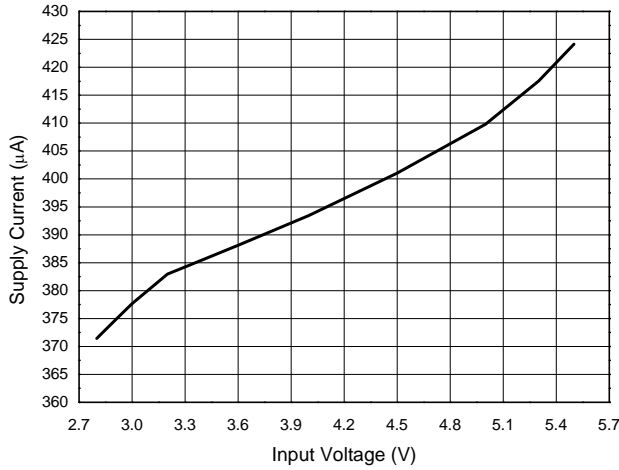
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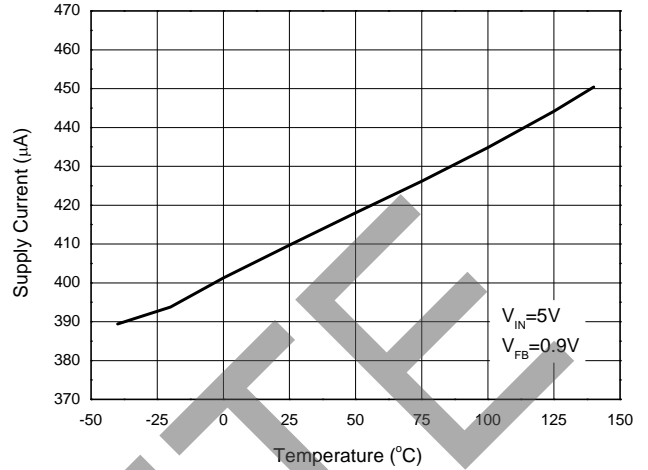
Performance Characteristics

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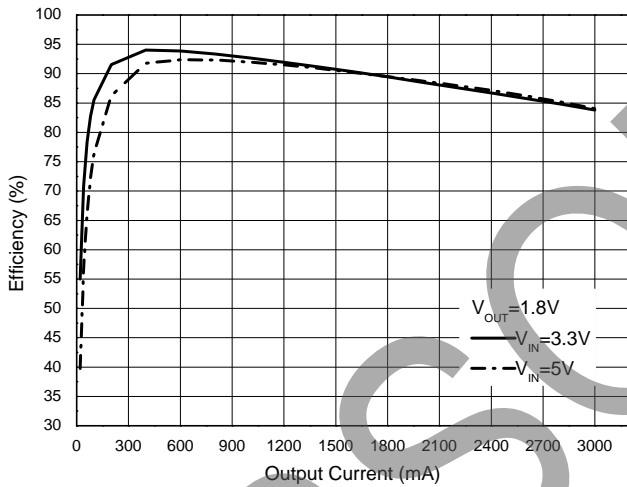
Supply Current vs. Input Voltage



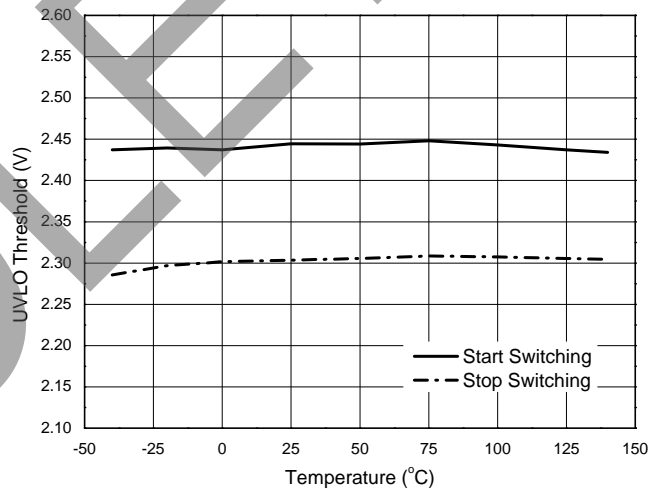
Supply Current vs. Temperature



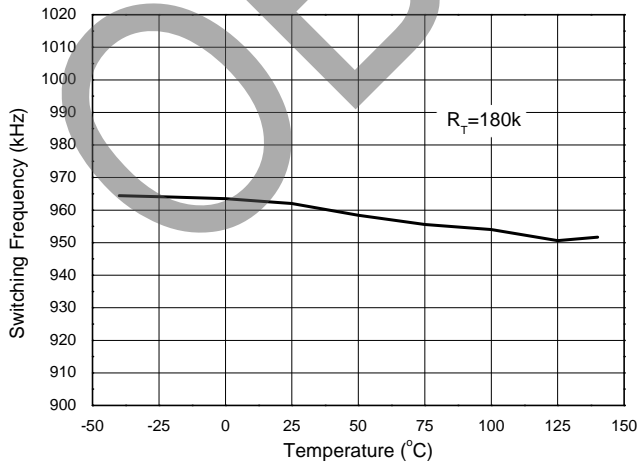
Efficiency vs. Output Current



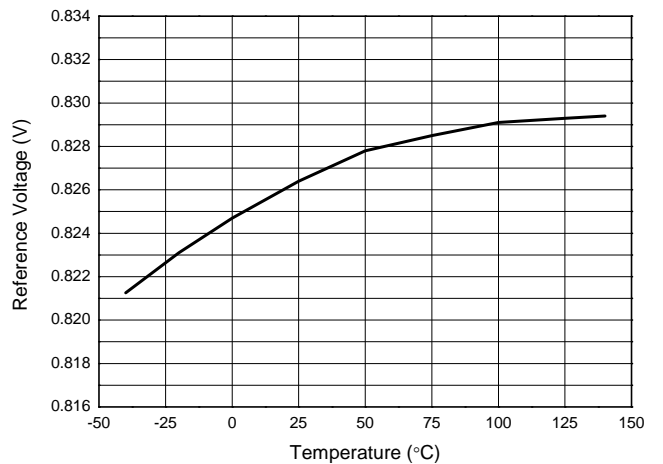
UVLO Threshold vs. Temperature



Switching Frequency vs. Temperature

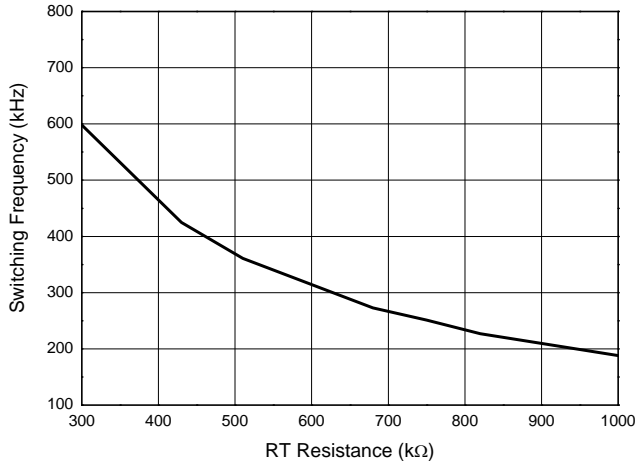


Reference Voltage vs. Temperature

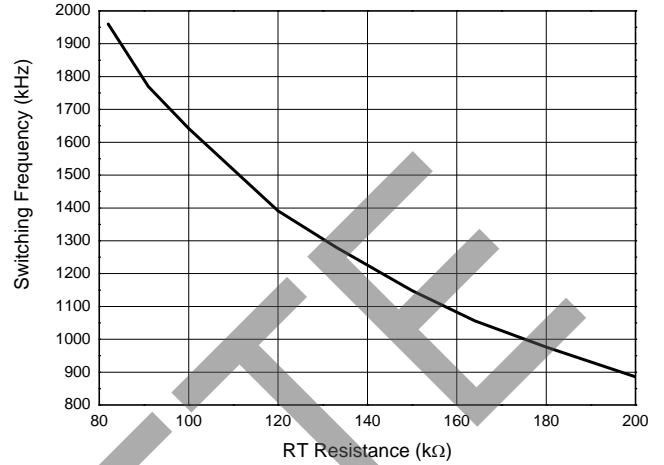


Performance Characteristics (Cont.)

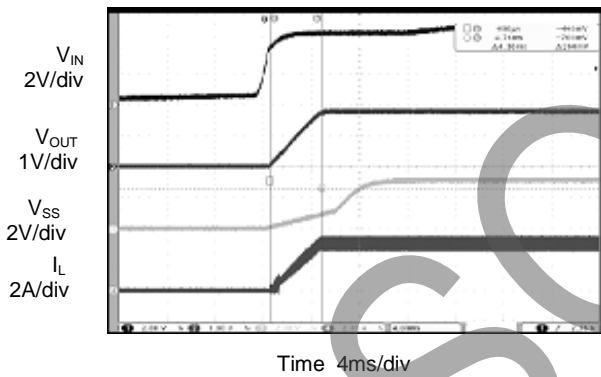
**Switching Frequency vs. RT Resistance
Low Frequency Range**



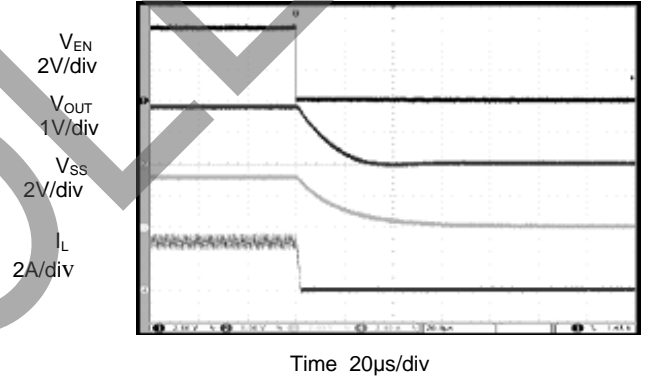
**Switching Frequency vs. RT Resistance
High Frequency Range**



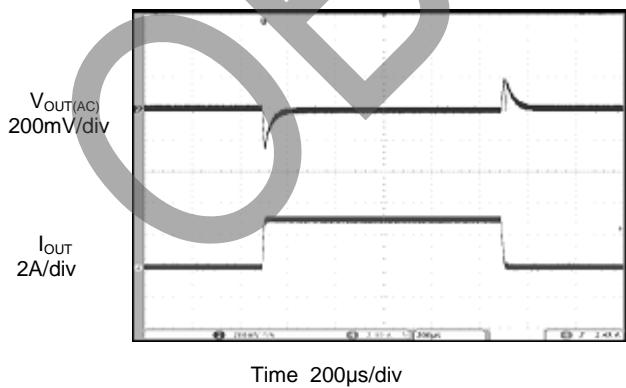
Start up from V_{IN} (V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A)



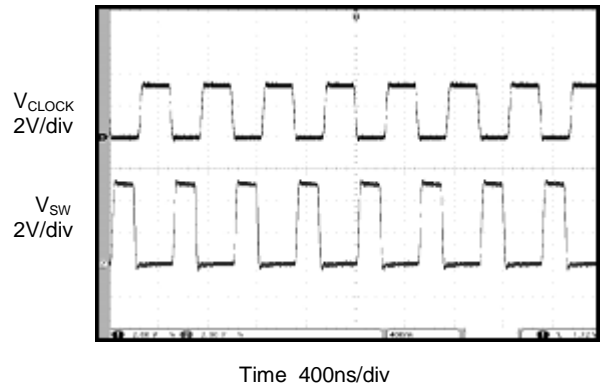
Disable IC (V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A)



**Load Transient Response
(V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=0 to 3A)**



**Synchronizing to External Clock
(f_{CLOCK}=2MHz)**

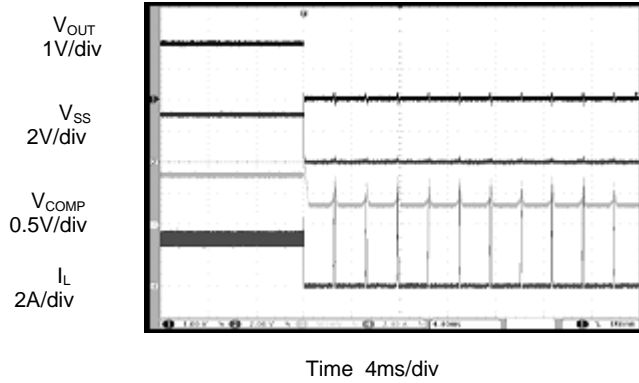


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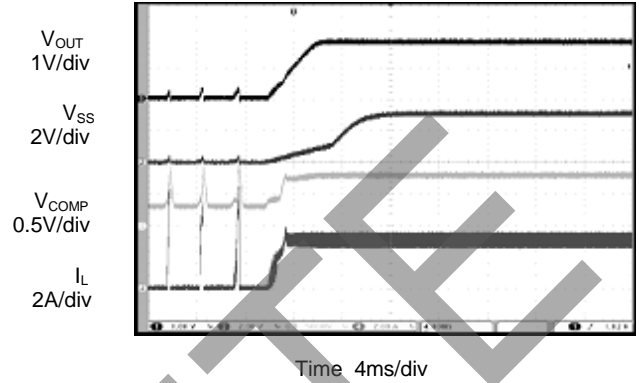
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Performance Characteristics (Cont.)

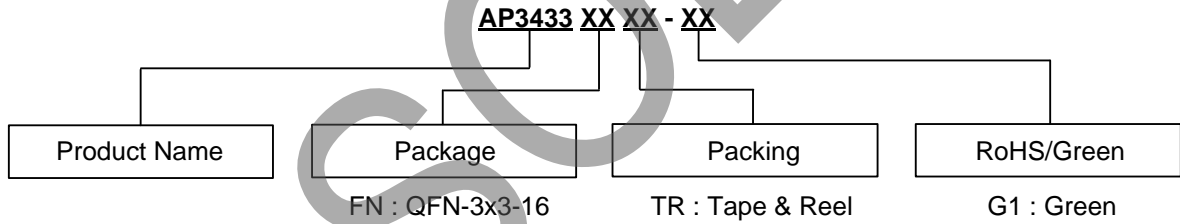
Short Circuit Protection
($V_{IN}=5V$, $V_{OUT}=1.8V$, $I_{OUT}=3A$)



Short Circuit Recovery
($V_{IN}=5V$, $V_{OUT}=1.8V$, $I_{OUT}=3A$)



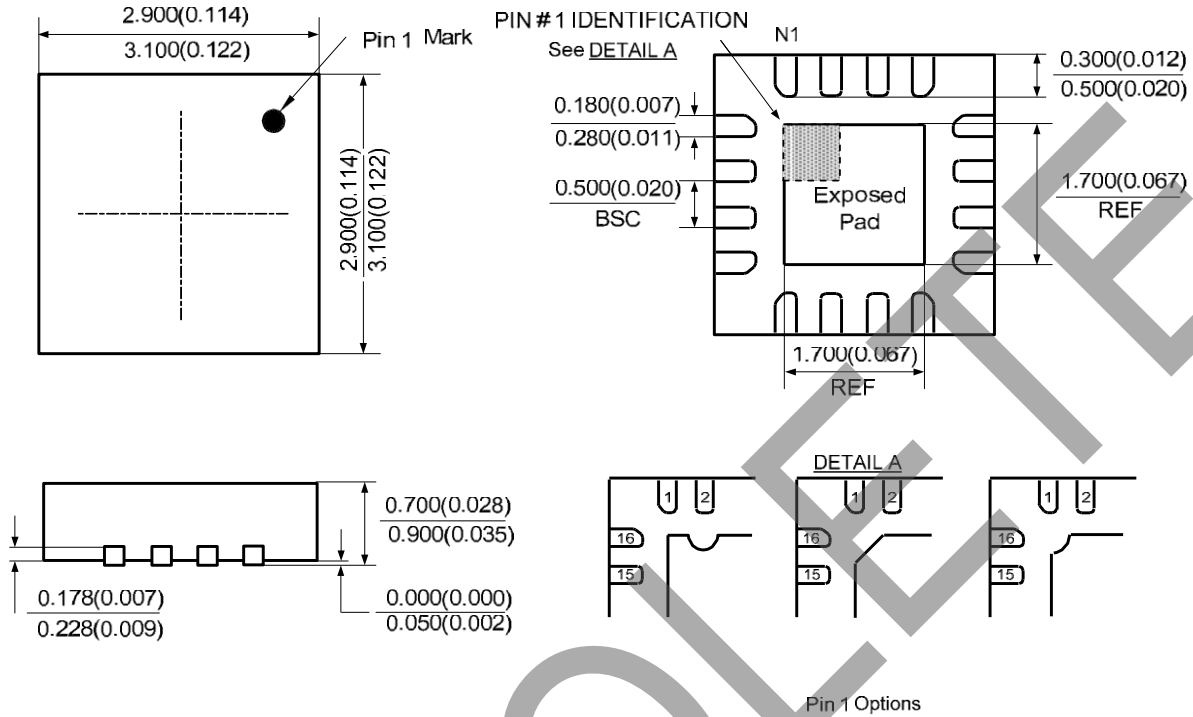
Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing
QFN-3x3-16	-40 to +85°C	AP3433FNTR-G1	B1D	Tape & Reel

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

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



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