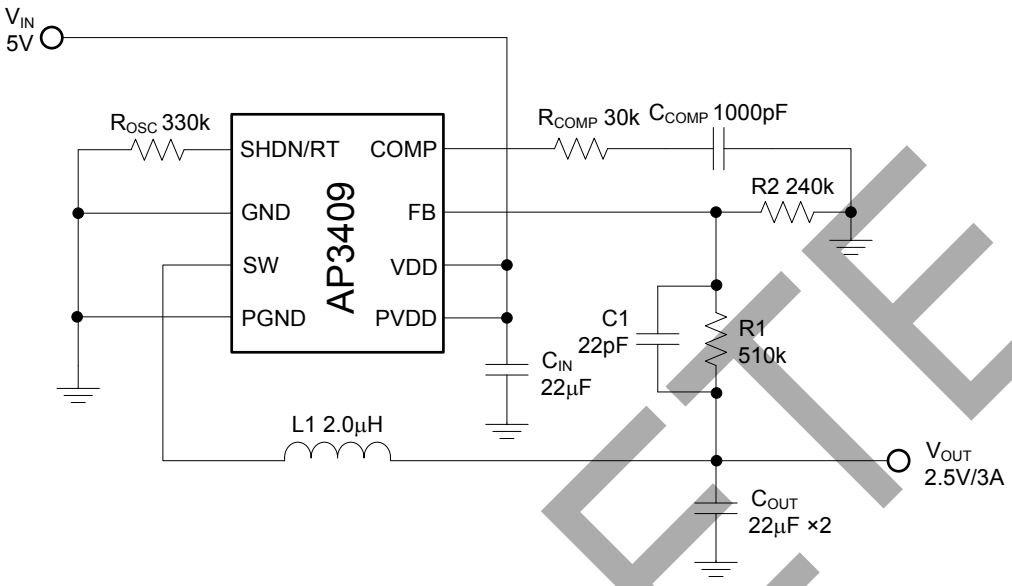
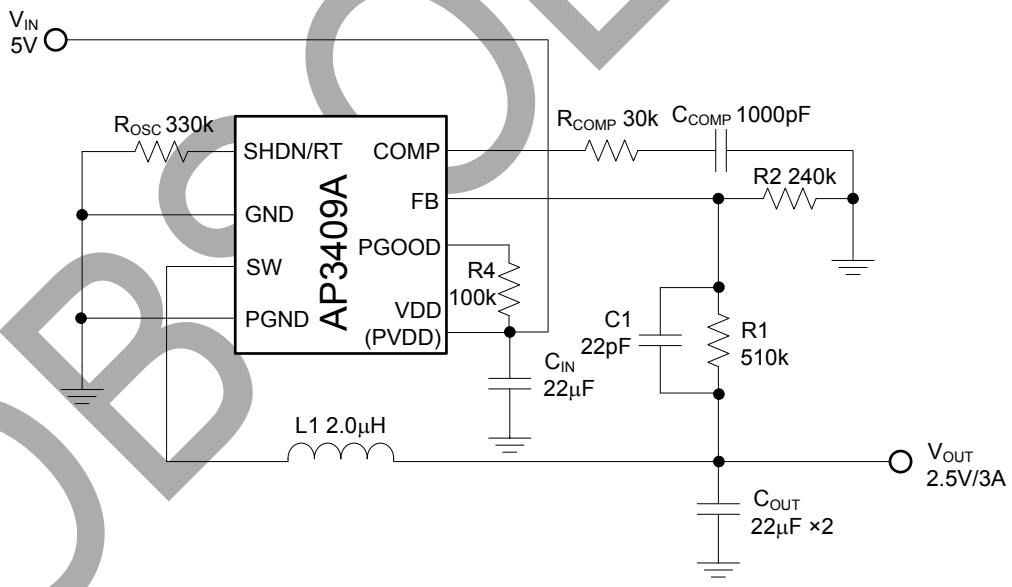
Typical Applications Circuit (Note 4)



Typical Application of AP3409



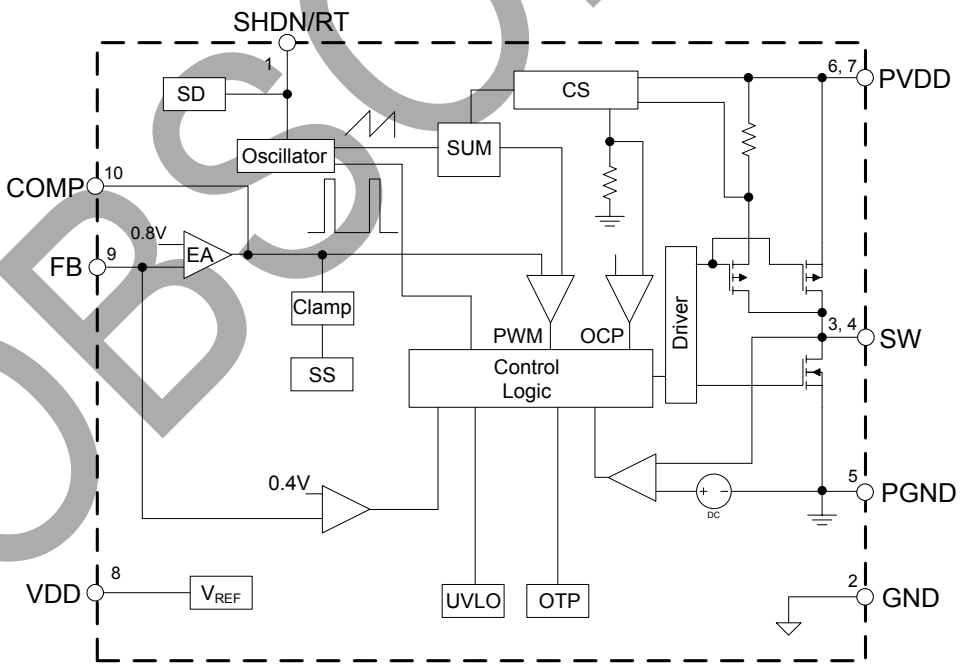
Typical Application of AP3409A

Notes 4: $V_{OUT} = \frac{V_{FB} \times (R1 + R2)}{R2}$

Pin Descriptions

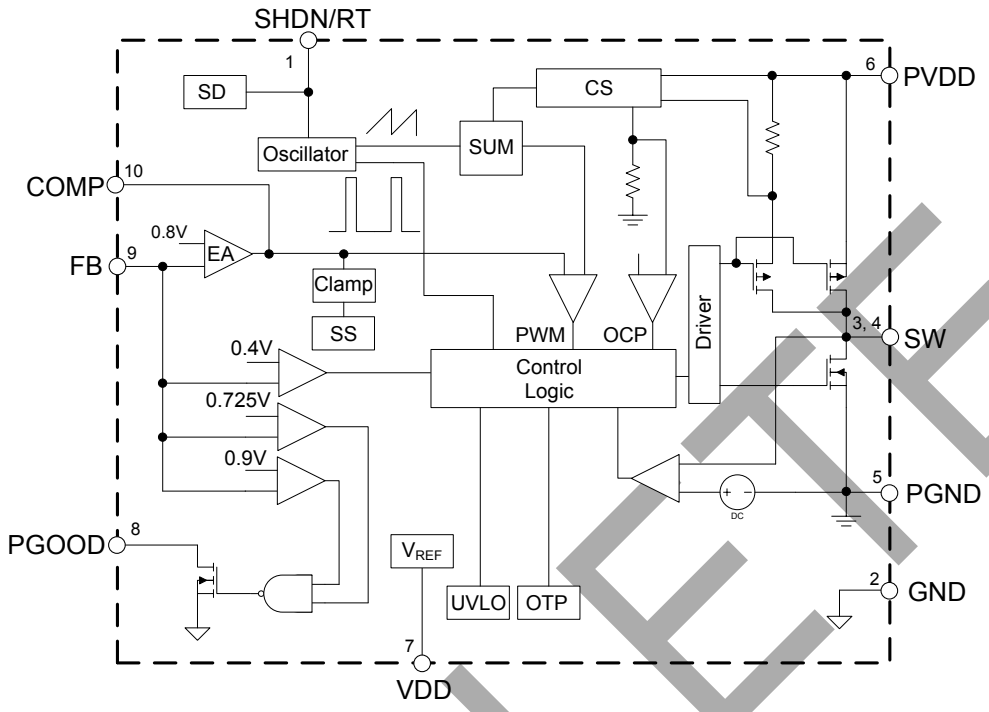
Pin Number		Pin Name	Function
AP3409	AP3409A		
1	1	SHDN/RT	Oscillator resistor input. Connect a resistor to GND from this pin to set the switching frequency. Forcing this pin to V_{DD} to shutdown the device
2	2	GND	Signal ground. All small-signal ground, such as the compensation components and exposed pad should be connected to this, which in turn connects to PGND at one point
3, 4	3, 4	SW	Internal power switch output. Connect this pin with one terminal of the inductor
5	5	PGND	Power ground. Connect this pin as close as possible to C_{IN} and C_{OUT}
6, 7	6	PVDD	Power Input Supply. Decouple this pin to PGND with a capacitor
8	7	VDD	Signal input supply. Decouple this pin to GND with a capacitor. Normally V_{DD} is equal to V_{PVDD}
–	8	PGOOD	Power good indicator. This pin is open-drain logic output that is pulled to ground when the output voltage is not within ±12.5% of regulation point
9	9	FB	Feedback voltage. This pin is the inverting input of internal error amplifier. It senses the converter output voltage through an external resistor divider. The internal reference voltage is 0.8V, which determines the output voltage through the resistor divider
10	10	COMP	Compensation input. This pin is the output of internal error amplifier. Connect external compensation elements to this pin to stabilize the control loop

Functional Block Diagram



Functional Block Diagram of AP3409

Functional Block Diagram (Cont.)



Functional Block Diagram of AP3409A

Absolute Maximum Ratings (Note 5)

Symbol	Parameter	Rating	Unit
V_{DD}	VDD Pin Voltage	-0.3 to 6	V
V_{PVDD}	PVDD Pin Voltage	-0.3 to 6	V
V_{FB}	FB Pin Voltage	-0.3 to 6	V
V_{COMP}	COMP Pin Voltage	-0.3 to 6	V
V_{SW}	SW Pin Voltage	-0.3 to V_{IN}+0.3	V
V_{RT}	SHDN/RT Pin Voltage	-0.3 to 6	V
θ_{JA}	Thermal Resistance (Junction to Ambient)	110	°C/W
θ_{JC}	Thermal Resistance (Junction to Case)	3	°C/W
T_J	Operating Junction Temperature	+150	°C
T_{STG}	Storage Temperature	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering, 10 sec)	+260	°C
–	ESD (Machine Model)	200	V
–	ESD (Human Body Model)	2000	V

Note 5: 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

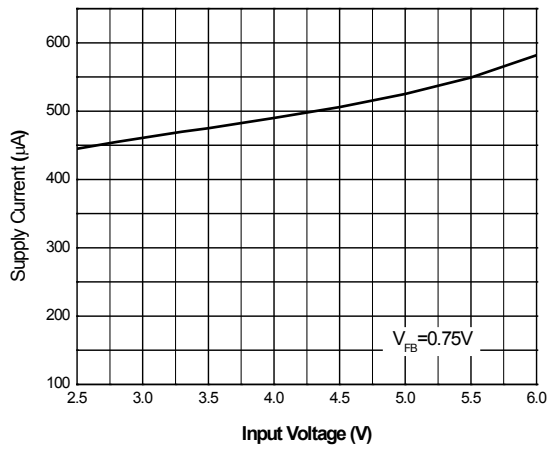
Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	2.6	5.5	V
$I_{OUT\ (MAX)}$	Maximum Output Current	3	–	A
T_J	Operating Junction Temperature	-40	+125	ºC

Electrical Characteristics (V_{IN}=V_{DD}=V_{PVDD}=3.3V, T_A=+25°C, unless otherwise specified.)

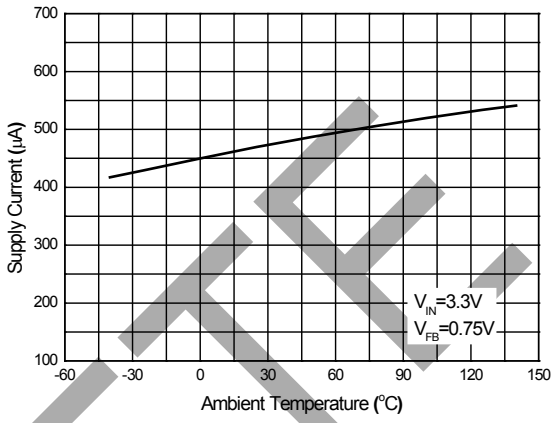
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
INPUT SECTION						
V_{DD}	Input Voltage Range		2.6	–	5.5	V
I_Q	Supply Current	V_{FB}=0.75V, No Switching	–	460	–	μA
I_{SHDN}	Shutdown Supply Current	Shutdown, V_{IN}=5.5V	–	–	1	μA
V_{UVLO}	Under Voltage Threshold Lockout	V_{DD} Rising	–	2.2	–	V
V_{HUVLO}	Under Voltage Hysteresis Lockout	–	–	300	–	mV
FEEDBACK SECTION						
V_{FB}	Feedback Voltage	–	0.784	0.8	0.816	V
I_{FB}	FB Pin Bias Current	–	–	0.1	0.4	μA
R_T	Current Sense Trans-resistance	–	–	0.2	–	Ω□
–	Switching Leakage Current	$V_{SHDN/RT}$=V_{IN}=5.5V	–	–	1	μA
G_V	Error Gain Amplifier Voltage	–	–	800	–	–
G_S	Error Amplifier Trans-conductance	–	–	800	–	μA/V
OSCILLATOR SECTION						
V_{RT}	RT Pin Voltage	–	0.76	0.8	0.84	V
f_{OSC}	Switching Frequency	R_{OSC}=330kΩ□	0.8	1	1.2	MHz
		ADJ Frequency	0.3	–	4	MHz
D_{MAX}	Maximum Duty Cycle	V_{FB}=0.75V	100	–	–	%
POWER SWITCH SECTION						
I_{LIMIT}	Switch Current Limit	AP3409, V_{FB}=0.75V	3.2	4.2	–	A
		AP3409A, V_{FB}=0.75V	3.5	4.2	–	A
R_{PDSON}	Internal P-FET On Resistance	I_{SW}=500mA	–	0.11	0.16	Ω
R_{NDSON}	Internal N-FET On Resistance	I_{SW}=-500mA	–	0.11	0.17	Ω
SHDN/RT SECTION						
–	Shutdown Threshold	–	–	V_{DD}-0.7	V_{DD}-0.4	V
PGOOD SECTION (Only for AP3409A)						
–	PGOOD Voltage Range	–	–	±12.5	±15	%
–	PGOOD Pull Down Resistance	–	–	–	120	Ω
TOTAL DEVICE						
I_{OUT}	Output Current	V_{DD}=2.6V to 5.5V, V_{OUT}=2.5V	3	–	–	A
LNR	Output Voltage Line Regulation	V_{DD}=2.7V to 5.5V, I_{OUT}=100mA	–	0.4	–	%/V
LOD	Output Voltage Load Regulation	I_{OUT}=0.01A to 3A	–	±0.2	–	%
t_{SS}	Soft-start Time	I_{OUT}=10mA	–	1.5	–	ms
T_{OTSD}	Thermal Shutdown Temperature	–	–	+160	–	ºC
T_{HYS}	Thermal Shutdown Temperature Hysteresis	–	–	+20	–	ºC

Performance Characteristics (V_{IN}=V_{DD}=V_{PVDD}=3.3V, T_A=+25°C, unless otherwise specified.)

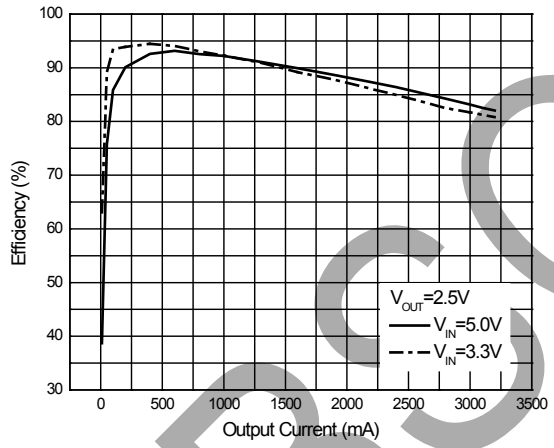
Supply Current vs. Input Voltage



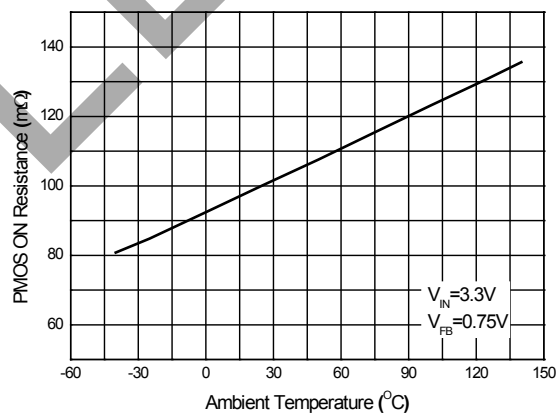
Supply Current vs. Ambient Temperature



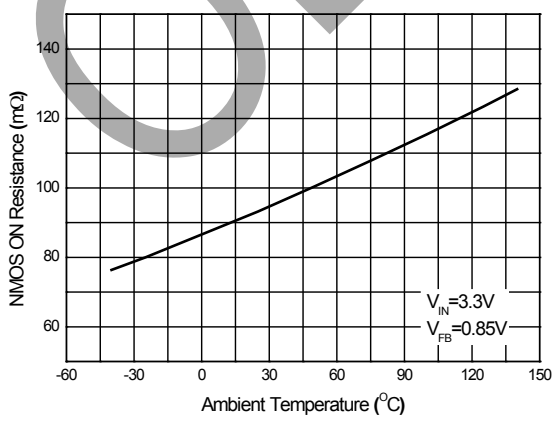
Efficiency vs. Output Current



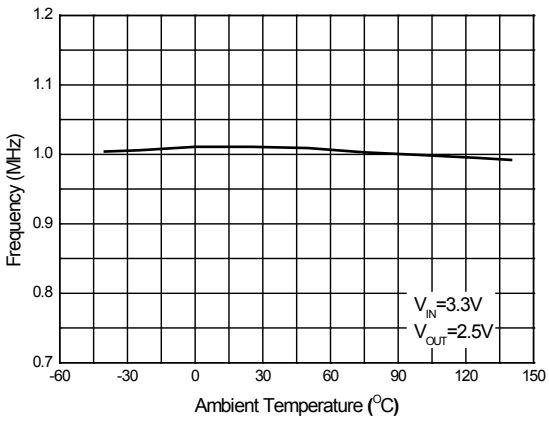
PMOS ON Resistance vs. Ambient Temperature



NMOS ON Resistance vs. Ambient Temperature

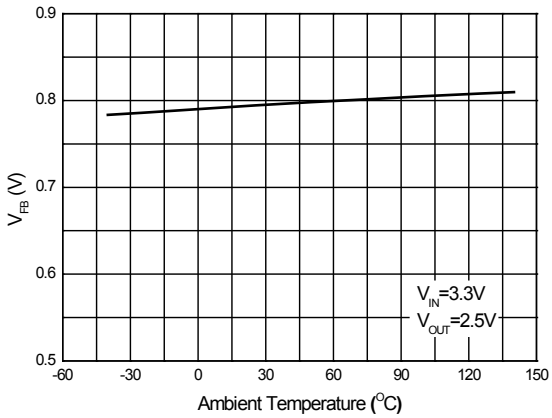


Frequency vs. Ambient Temperature

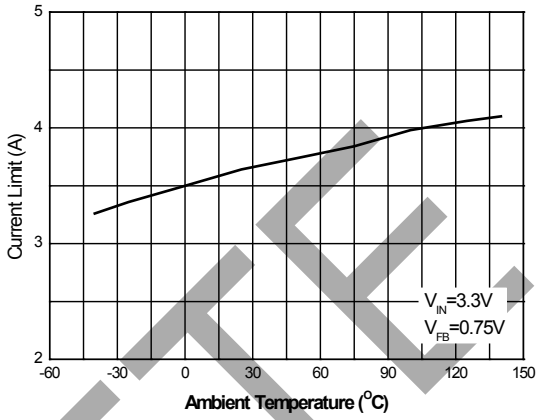


Performance Characteristics (Cont. $V_{IN}=V_{DD}=V_{PVDD}=3.3V$, $T_A=+25^{\circ}C$, unless otherwise specified.)

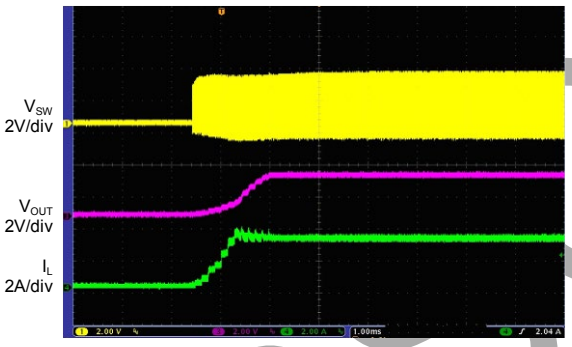
V_{FB} vs. Ambient Temperature



Current Limit vs. Ambient Temperature

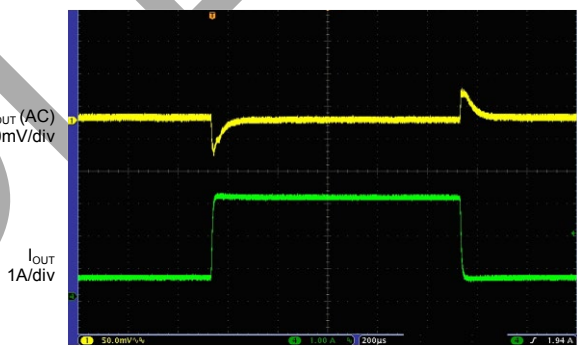


Start-up from VIN ($V_{IN}=3.3V$, $V_{OUT}=2.5V$, $I_{OUT}=3A$)



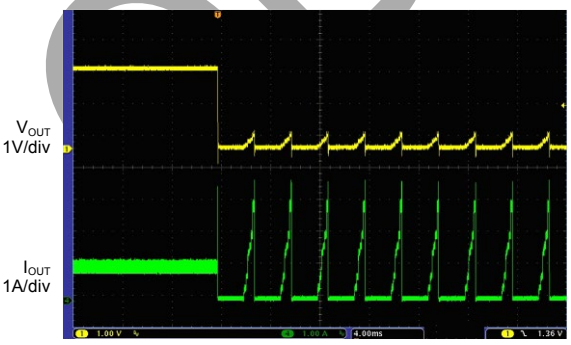
Time 1ms/div

Load Transient Response ($V_{IN}=3.3V$, $V_{OUT}=2.5V$, $I_{OUT}=0.5A$ to $3A$)



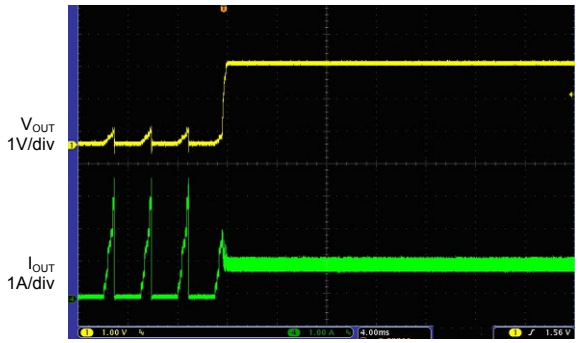
Time 200µs/div

Short Circuit Protection ($V_{IN}=3.3V$, $V_{OUT}=2.5V$)



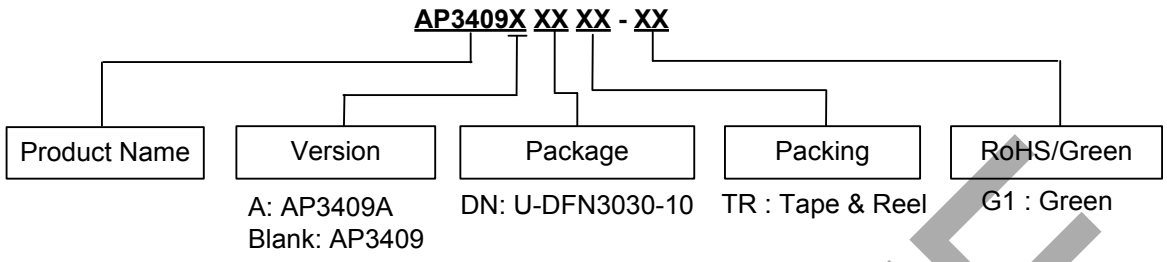
Time 4ms/div

Short Circuit Recovery ($V_{IN}=3.3V$, $V_{OUT}=2.5V$)



Time 4ms/div

Ordering Information

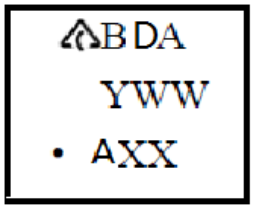


Diodes IC's Pb-free products with "G1" suffix in the part number, are RoHS compliant and green.

Package	Temperature Range	Part Number	Marking ID	Packing
U-DFN3030-10	-40 to +125°C	AP3409DNTR-G1	BDA	5000/Tape & Reel
		AP3409ADNTR-G1	BCA	5000/Tape & Reel

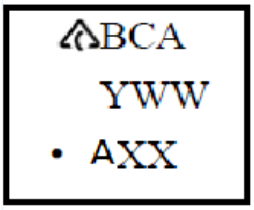
Marking Information

AP3409 (Top View)



First Line: Logo and Marking ID
Second and Third Lines: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

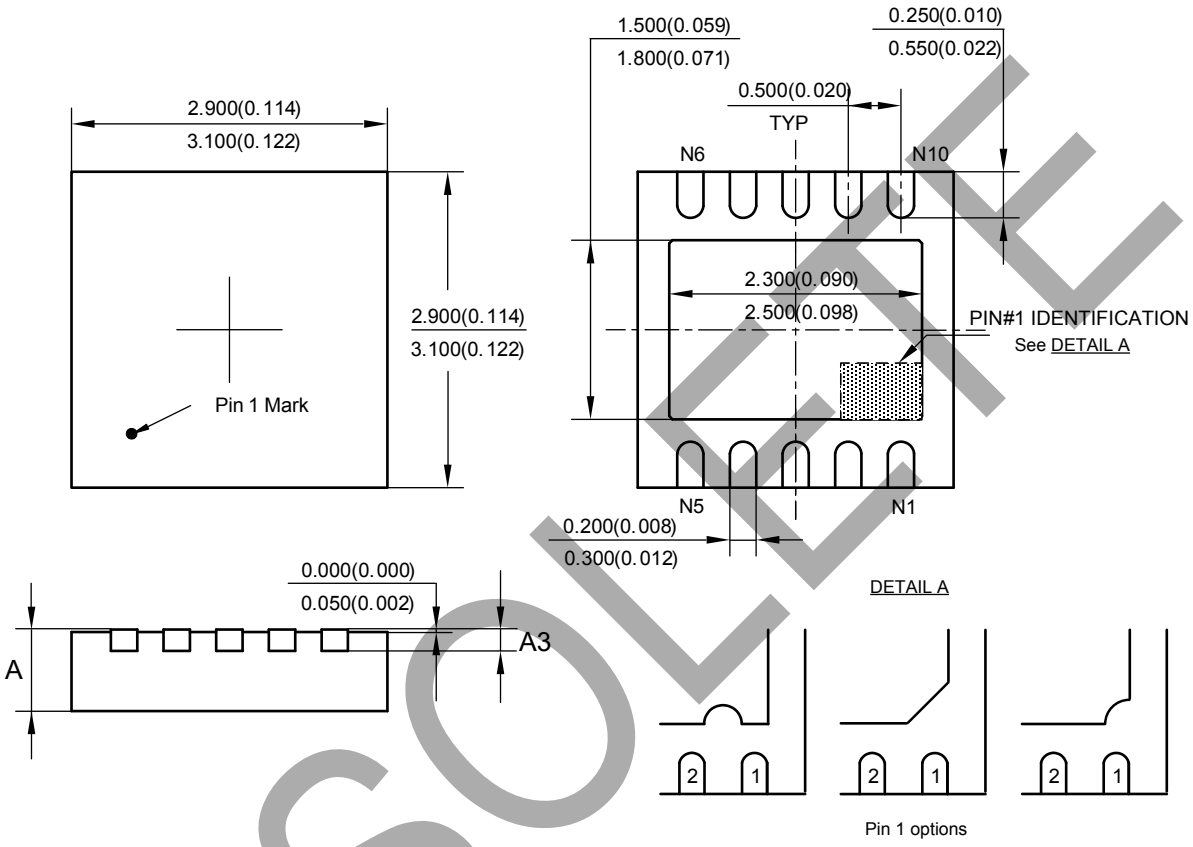
AP3409A (Top View)



First Line: Logo and Marking ID
Second and Third Lines: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

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

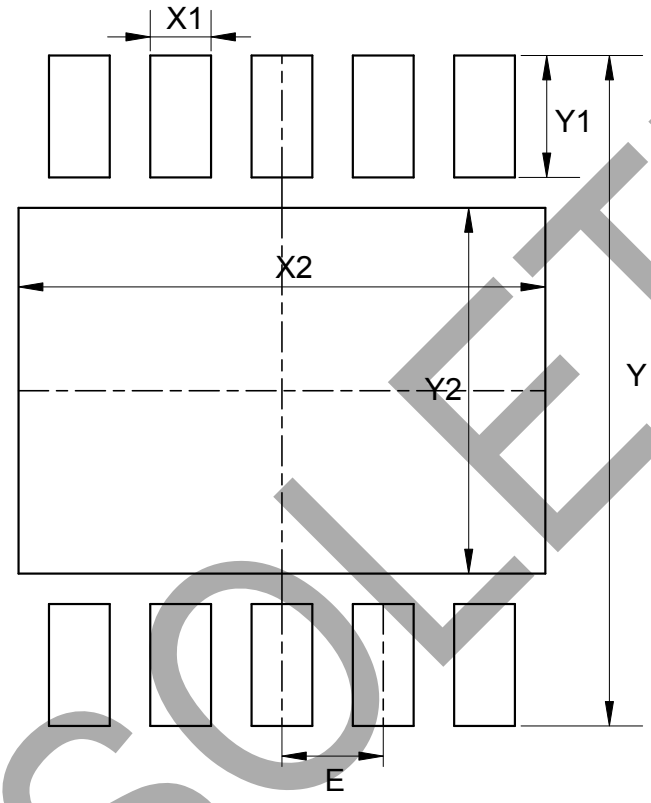
(1) Package Type: U-DFN3030-10



Symbol	A				A3			
	min(mm)	max(mm)	min(inch)	max(inch)	min(mm)	max(mm)	min(inch)	max(inch)
Option 1	0.700	0.800	0.028	0.031	0.153	0.253	0.006	0.010
Option 2	0.570	0.630	0.022	0.025	0.150 (Typ)		0.006 (Typ)	

Suggested Pad Layout

(1) Package Type: U-DFN3030-10



Dimensions	Y (mm)/(inch)	X1 (mm)/(inch)	Y1 (mm)/(inch)	X2 (mm)/(inch)	Y2 (mm)/(inch)	E (mm)/(inch)
Value	3.300/0.130	0.300/0.012	0.600/0.024	2.600/0.102	1.800/0.071	0.500/0.020

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