Description

The AP3421/A/B is a fully integrated dual output voltage regulator. The two converters are current mode and internally compensated. The converters include integrated control and synchronous rectifier switches. The outputs are both rated for up to 1A. Both outputs are adjustable using external resistors.

The step-down converters operate at 1.3MHz fixed switching frequency under normal load and in a pulse skipping mode for light loads. The switching clock is shifted 180° for SW2. The E/S pin provides an enable function and allows the converter to be synchronized to an external clock. With E/S held low, the AP3421/A/B draws less than 10μA current.

In the start-up sequence, the VO1 output is designed to precede the VO2 output. The two outputs have controlled start-up sequence.

Power On Reset (POR) function is provided by means of an open-drain output present on the POR pin. The POR function monitors VMON, FB1 and FB2, and pulls low if any of these begin to drop out. The POR is internally deglitched and provides a delayed recovery/reset time.

The AP3421/A/B provides peak over-current protection, short circuit protection and thermal shutdown. Discharge-Before-Turn-On discharges the outputs completely before soft-starting to always bring them up in the proper sequence at start-up or after a POR (For AP3421/A only).

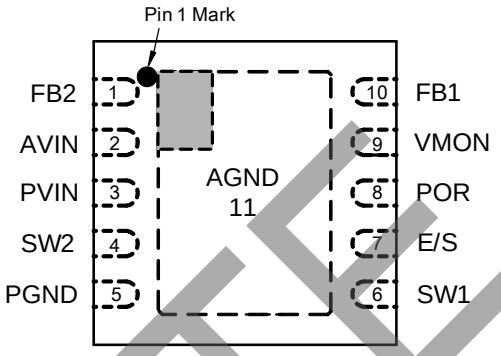
The AP3421/A/B is available in DFN-3×3-10 package.

Features

- VO1=1.8 to 3.6V at 1A
- VO2=1.0 to 3.6V at 1A
- Switching Frequency: 1.3MHz
- 180° Phase Shifted Switching
- No Rectifier Diode Required
- Optional External Clocking (2× Clock Required)
- Light Load Pulse Skipping
- Enable/Sleep State
- Internal Soft-start
- Open-drain Power On Reset Monitors Input and
- Outputs
- Discharge-Before-Turn-On (For AP3421/A)
- Pre-bias Function (For AP3421B)
- Peak Over Current Protection
- Short Circuit Protection
- Over Temperature Shutdown

Pin Assignments

(Top View)

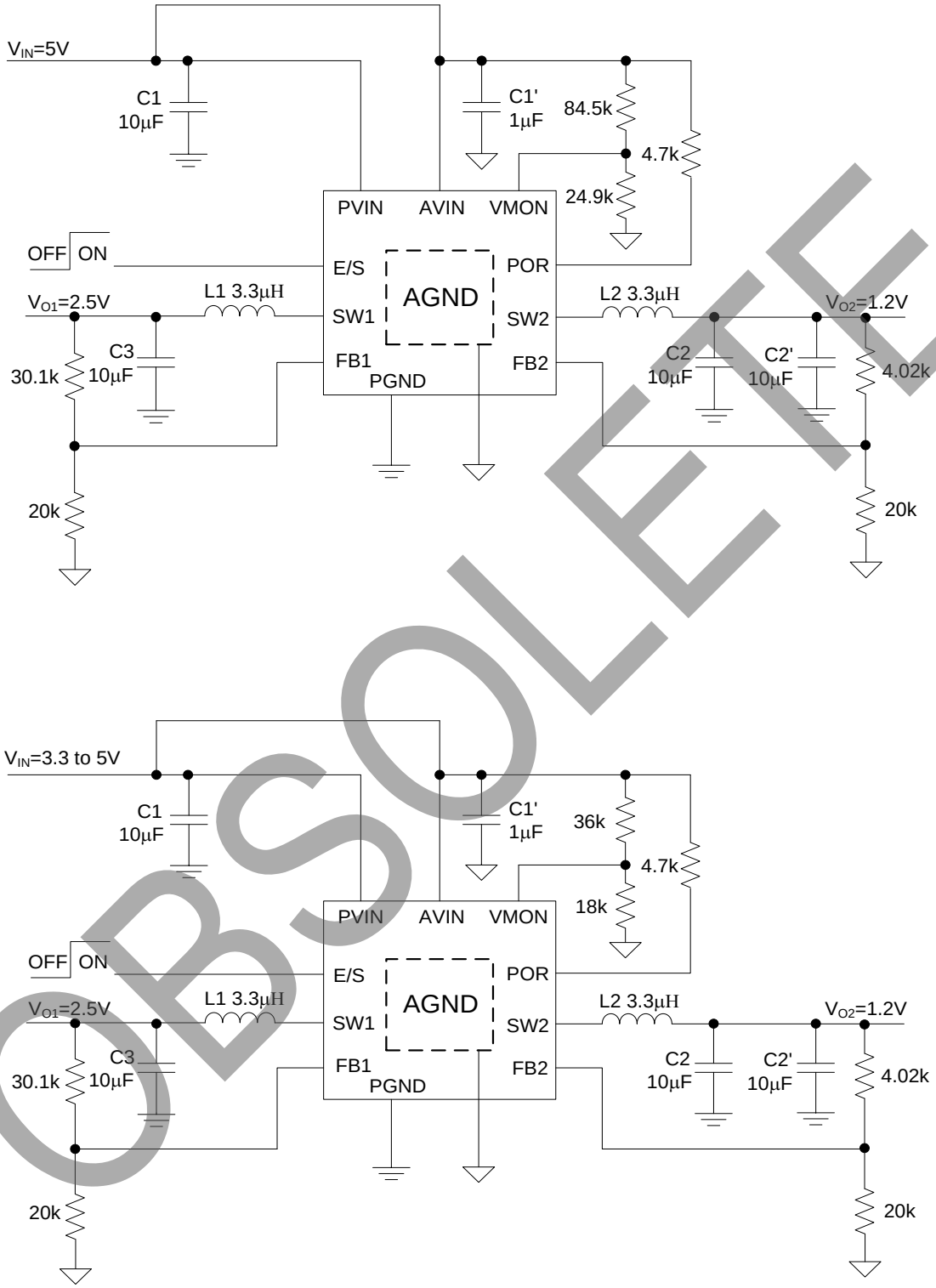


DFN-3×3-10

Applications

- Hard Disk Drivers
- Set Top Boxes

Typical Applications Circuit (Note 1)



Note 1: AVIN and PVIN pin should not be connected together directly to avoid disturbance between them in PCB layout:

1) Place a 1.0µF capacitor between AVIN pin and AGND for power filtering

2) Place a 10µF capacitor between PVIN pin and PGND for power filtering.

Pin Descriptions

Pin Number	Pin Name	Function
1	FB2	Feedback from VO2. Connect voltage divider to the load side of VO2 output inductor-capacitor filter
2	AVIN	Analog power input. Connect a 1 F ceramic capacitor between this pin and AGND
3	PVIN	Control MOSFET switch power input. Connect a 10 F ceramic capacitor between this pin and PGND, as close to the IC as possible
4	SW2	VO2 synchronous buck switching output. Connect to VO2 inductor
5	PGND	Power ground connection. Synchronous rectifier MOSFET source. Provide a star connection between this pin, VO1, VO2 filter capacitor returns, VIN input capacitor return, and AGND. Keep the star connection as close to the IC as possible
6	SW1	VO1 synchronous buck switching output. Connect to VO1 inductor
7	E/S	Enable/Synchronization. Pulling this pin high statically enables the IC and pulling the pin low statically will shut down the IC. Applying a pulse to this pin will synchronize SW1 and SW2 switching frequency to ½ the external clock frequency
8	POR	Power on reset output pin. Monitors FB1, FB2 output voltage levels and V_{IN}. POR is pulled low if an output voltage drop is detected on FB1 or FB2 or VIN, and is Hi-Z during normal operation
9	VMON	Voltage monitor–supervisor for one external voltage (could be input voltage). The POR output is triggered if this output falls below the VMON threshold
10	FB1	Feedback from VO1. Connect voltage divider to the load side of VO1 output inductor-capacitor filter
11	AGND	Signal ground connection. Provide a star connection between this pin and PGND pin

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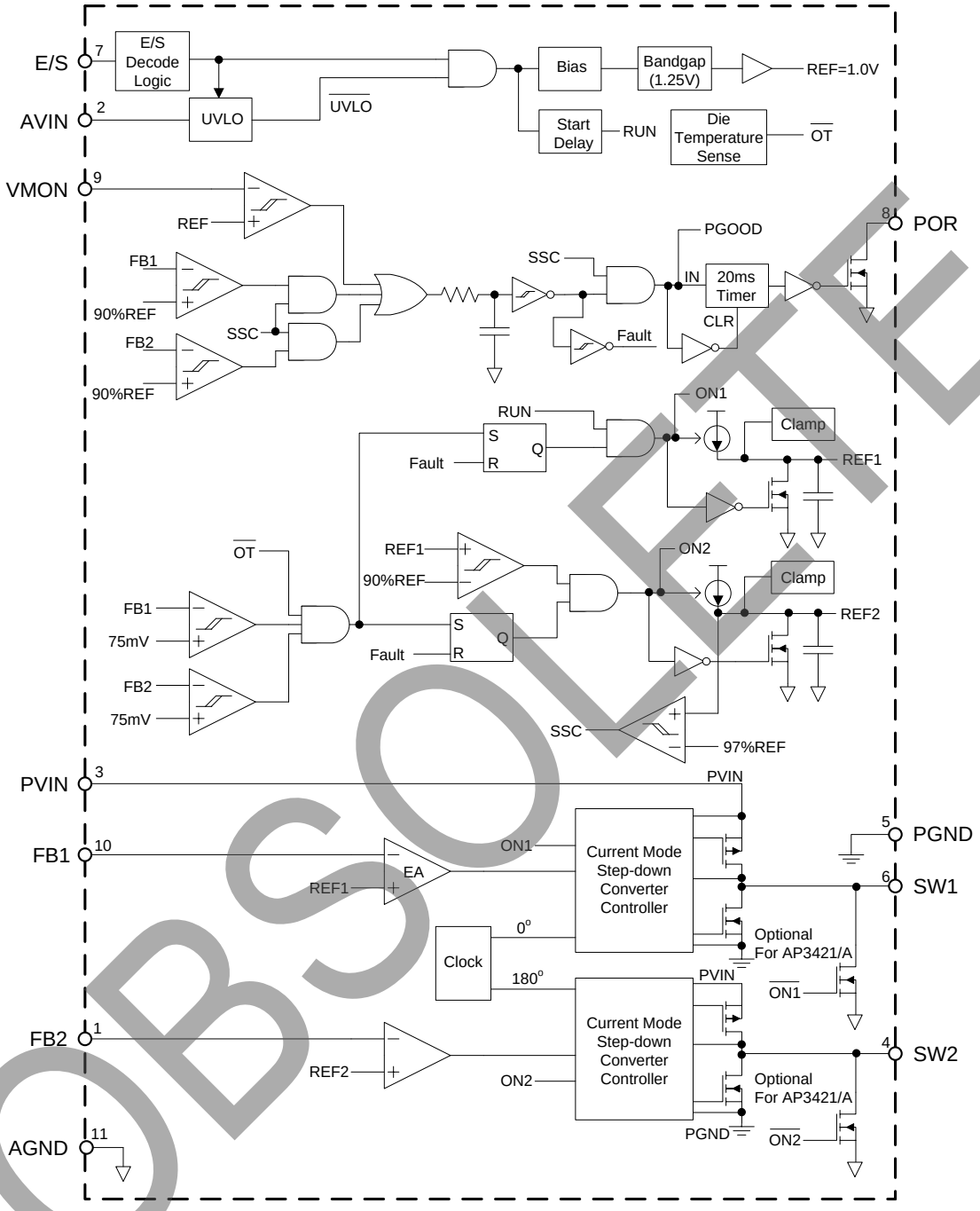
Functional Block Diagram



Absolute Maximum Ratings (Note 2)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3 to 7	V
Feedback Voltage	V_{FB}	-0.3 to V_{IN}+0.3	V
E/S Pin Voltage	$V_{E/S}$	-0.3 to V_{IN}+0.3	V
SW1, SW2 Pin Voltage	V_{SW}	V_{PGND}-1 to V_{IN}+1	V
Thermal Resistance	$_{JA}$	33	ºC /W
Operating Junction Temperature	T_J	+150	ºC
Storage Temperature	T_{STG}	-25 to +150	ºC
Lead Temperature (Soldering, 10sec)	T_{LEAD}	+260	ºC

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

Parameter	Symbol		Min	Max	Unit
Input Voltage	V_{IN}	AP3421	4.5	5.5	V
		AP3421A/B	3.0	5.5	
VO1 Maximum Output Current	I_{O1} (Max)		1	_	A
VO2 Maximum Output Current	I_{O2} (Max)		1	_	A
Operating Ambient Temperature	T_A		-40	+85	°C

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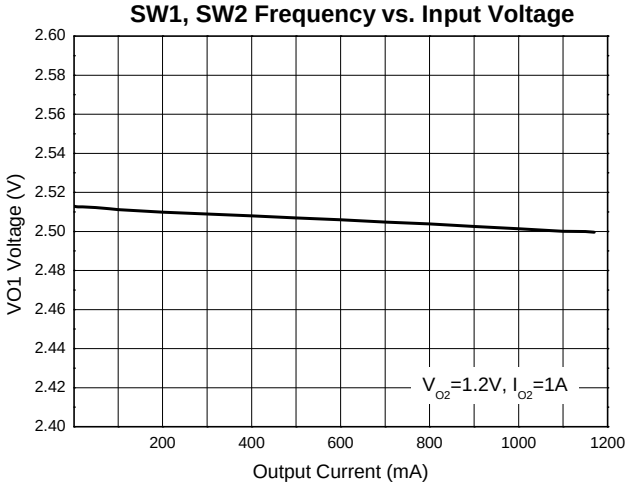
Electrical Characteristics (V_{IN} =$V_{E/S}$=5V, T_A=+25℃, unless otherwise specified.)

Parameter	Symbol		Conditions	Min	Typ	Max	Unit
Operating Input Voltage	V_{IN}	AP3421	_	4.5	5.0	5.5	V
		AP3421A/B	_	3.0	3.3	5.5	
Supply Current	I_{CC}		V_{FB1}=V_{FB2}=1.2V	_	_	1.0	mA
Shutdown Supply Current	I_{SHDN}		$V_{E/S}$=0V, V_{IN}=5.0V	_	_	10	μA
Under Voltage Lockout Threshold	_	AP3421	Rising Edge	3.0	3.5	4.0	V
		AP3421A/B		2.4	2.7	3.0	
Under Voltage Lockout Hysteresis	V_{HUVLO}		_	_	300	_	mV
POR Threshold VMON	V_{VMON_POR}		V_{VMON} Falling	0.97	1.00	1.03	V
Feedback Voltage	V_{FB1}, V_{FB2}		_	0.975	1.0	1.025	V
Switch Current Limit	I_{LIM1}		_	1.2	1.6	_	A
	I_{LIM2}		_	1.2	1.6	_	
Oscillator Frequency	f_{OSC1}, f_{OSC2}		_	1.0	1.30	1.60	MHz
Soft-start Time	t_{SS_FB1}		_	0.5	1.0	2.0	ms
POR Threshold FB1	V_{FB1_POR}		FB11Falling1	86	89	92	$\%V_{FB1}$
POR Threshold FB2	V_{FB2_POR}		FB21Falling1	86	89	92	$\%V_{FB2}$
Discharge Complete Threshold (AP3421/A)	V_{FB1_DCT}		FB1 Level Where Discharge Cycle Is Terminated	50	75	100	mV
E/S Pin Threshold	V_{EN_L}		_	0.6	_	_	V
	V_{EN_H}			_	_	1.5	_
Frequency Lock-in Range	f_{E/S_MIN}		$f_{SWITCHING}$=50%×$f_{E/S}$ When Externally Clocked	_	_	1.5	MHz
	f_{E/S_MAX}			3.0	_	_	
POR Assert Delay Time	t_{POR_DELAY}		Fault Flag Set to POR Pull Low	10	25	40	μs
POR Release Delay Time	t_{POR_HOLD}		Fault Flag Reset to POR Hi-Z State	10	20	30	ms
POR Low Voltage	V_{POR_LOW}		POR Sinking 4mA	_	_	300	mV
VO2 Start Threshold (AP3421/A)	V_{FB1_ST}		FB1 Rising Voltage for FB2 to Initiate Soft-start	86	89	92	$\%V_{FB1}$
SW1, SW2 Discharge Resistance	$R_{STOP\_SW1,2}$		Discharge1Resistan-ce for SW1, SW2	15	30	45	Ω
Internal MOSFET on Resistance	AP3421, AP3421A/B	$R_{DS\_SW1\_U}$	V_{IN}=5.0V I_{SW}=100mA	_	277	_	mΩ
		$R_{DS\_SW2\_U}$		_	260	_	
		$R_{DS\_SW1\_L}$	V_{IN}=5.0V I_{SW}=-100mA	_	249	_	
		$R_{DS\_SW2\_L}$		_	160	_	
	AP3421A/B	$R_{DS\_SW1\_U}$	V_{IN}=3.3V I_{SW}=100mA	_	300	_	
		$R_{DS\_SW2\_U}$		_	280	_	
		$R_{DS\_SW1\_L}$	V_{IN}=3.3V I_{SW}=-100mA	_	260	_	
		$R_{DS\_SW2\_L}$		_	180	_	
Thermal Shutdown Threshold	T_{OTSD}		_	_	160	_	ºC
Thermal Shutdown Hysteresis	T_{HYS}		_	10	20	30	ºC

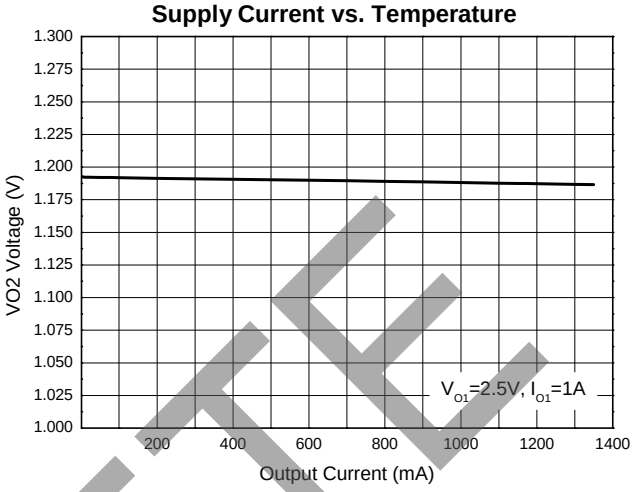
OBSOLETE – PART DISCONTINUED

Performance Characteristics (V_{IN}=$V_{E/S}$=5V, V_{O1}=2.5V, V_{O2}=1.2V, L1=L2=3.3μH, C1=C3=10μF, C2=C2'=10μF, T_A=+25°C, unless otherwise specified.)

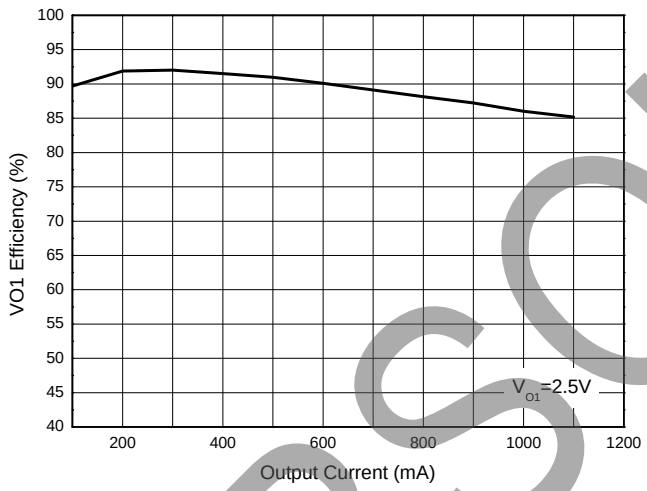
SW1, SW2 Frequency vs. Input Voltage



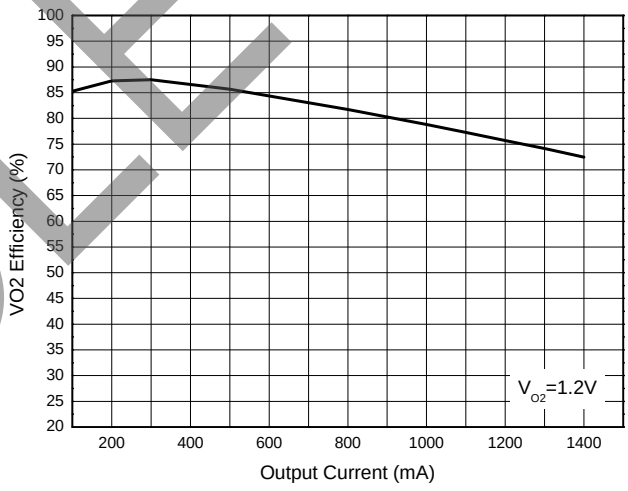
Supply Current vs. Temperature



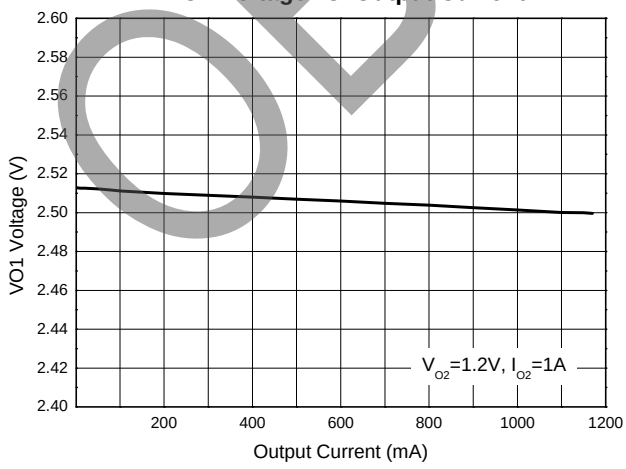
Current Limit 1 vs. Temperature



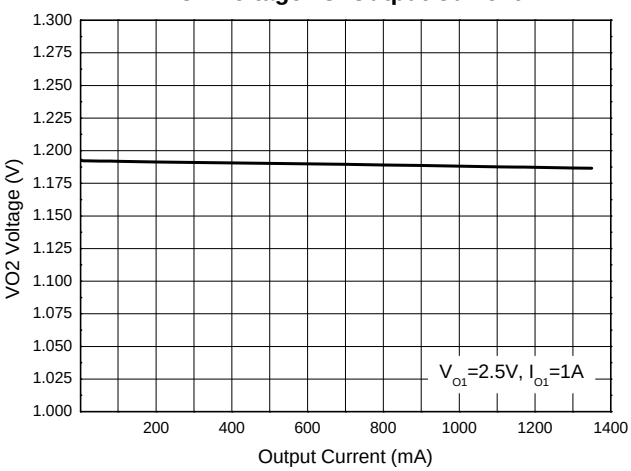
Current Limit 2 vs. Temperature



VO1 Voltage vs. Output Current

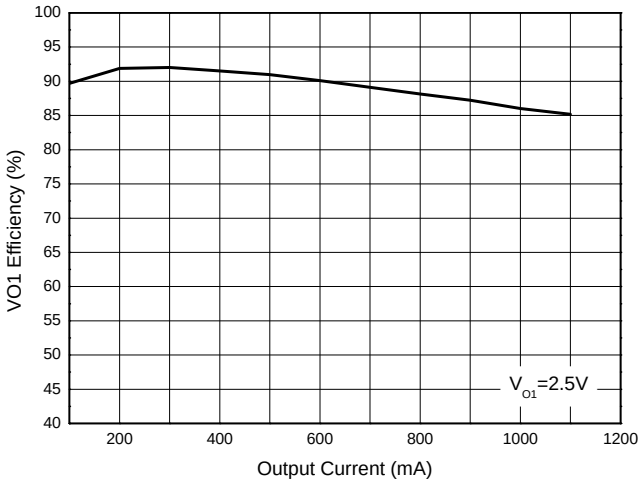


VO2 Voltage vs. Output Current

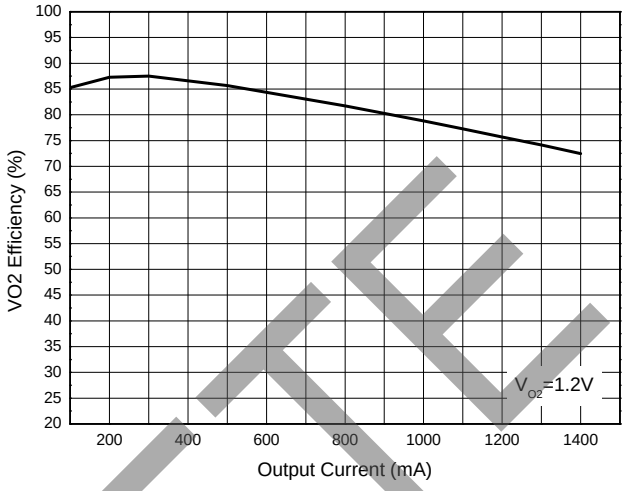


Performance Characteristics (Cont. V_{IN}=$V_{E/S}$=5V, V_{O1}=2.5V, V_{O2}=1.2V, L1=L2=3.3μH, C1=C3=10μF, C2=C2'=10μF, T_A=+25°C, unless otherwise specified.)

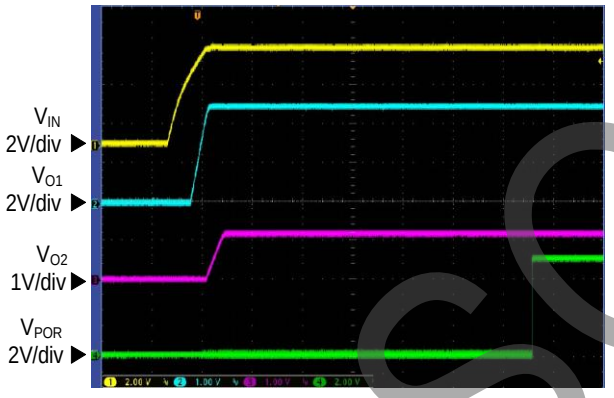
VO1 Efficiency vs. Output Current



VO2 Efficiency vs. Output Current

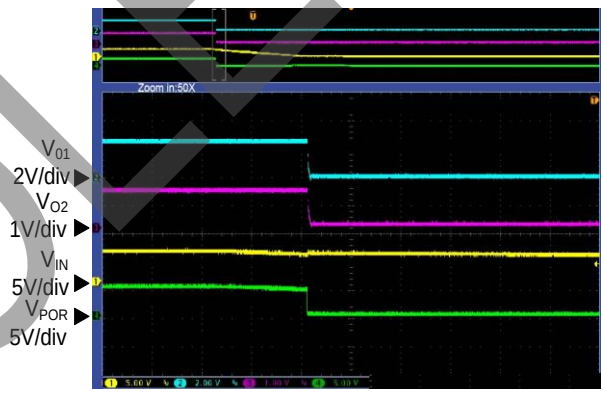


Start-up from VIN



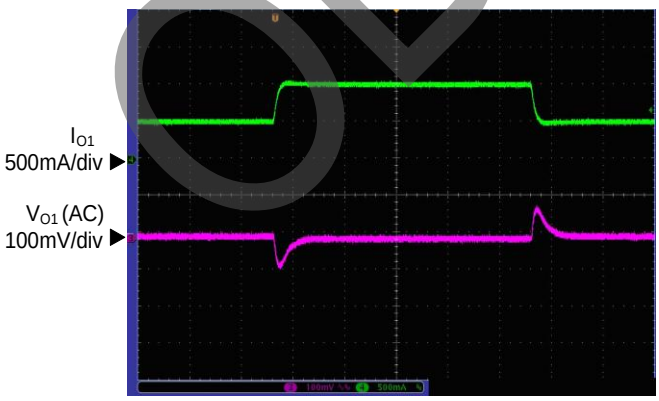
Time 4ms/div

Power-down from VIN



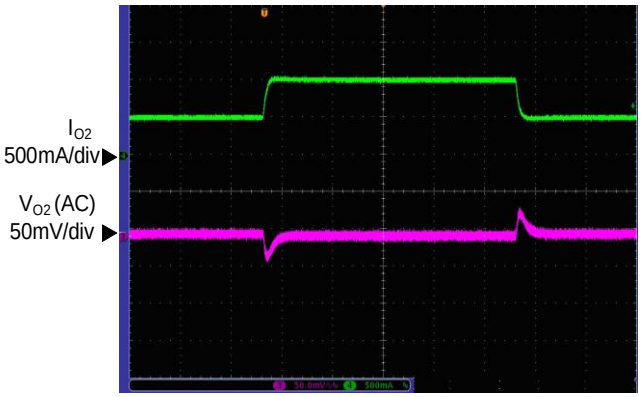
Time 400μs/div

Load Transient
(V_O=2.5V I_O=0.5A to 1.0A)



Time 100μs/div

Load Transient
(V_O=1.2V I_O=0.5A to 1.0A)



Time 100μs/div

Performance Characteristics (Cont. V_{IN}=$V_{E/S}$=5V, V_{O1}=2.5V, V_{O2}=1.2V, L1=L2=3.3μH, C1=C3=10μF, C2=C2'=10μF, T_A=+25°C, unless otherwise specified..)

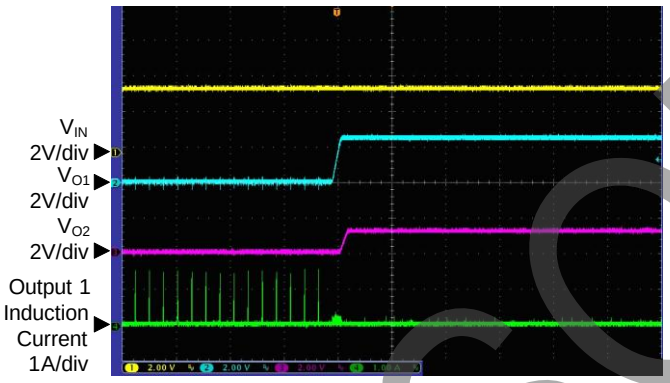
Short Protection for Output 1

Time 40μs/div

Short Protection for Output 2

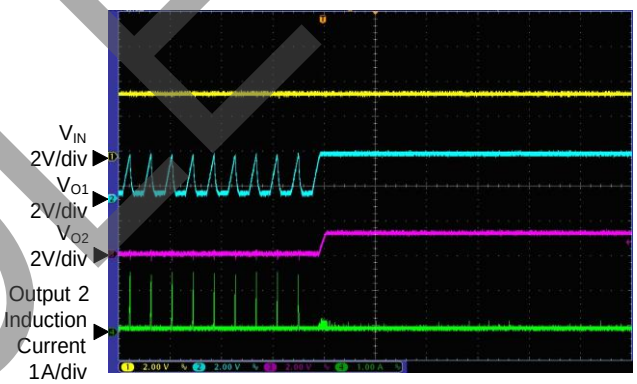
Time 40μs/div

Output 1 Short Recovery



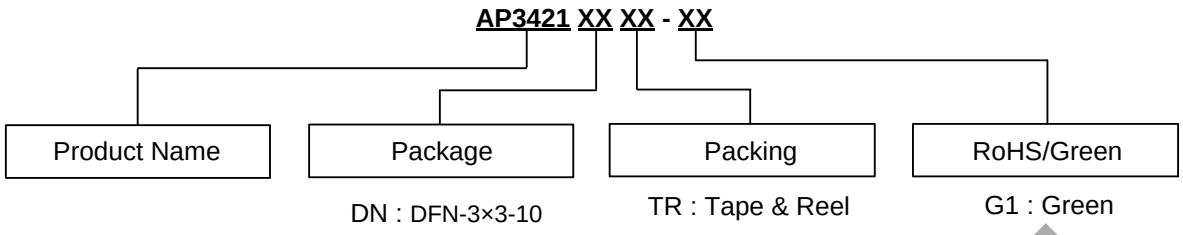
Time 10ms/div

Output 2 Short Recovery



Time 10ms/div

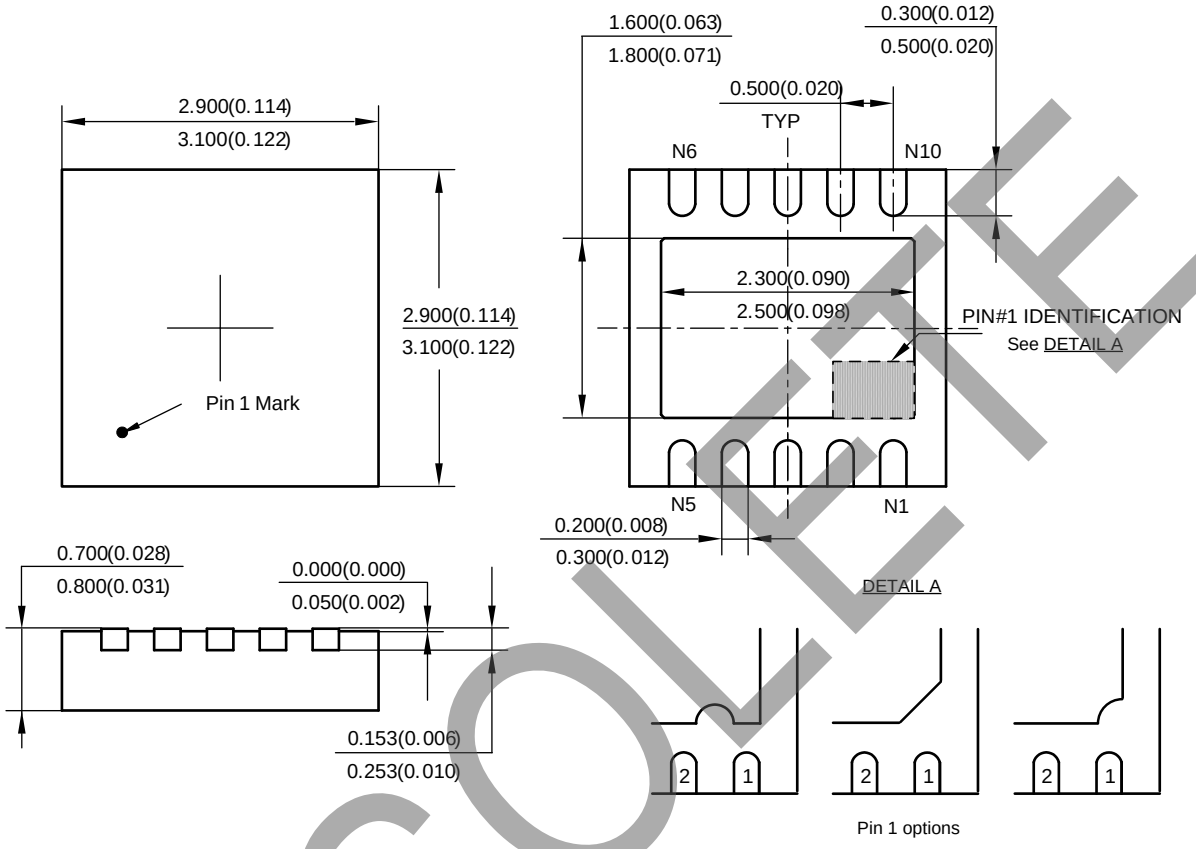
Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
DFN-3×3-10	-40 to +85°C	AP3421DNTR-G1	BCB	Tape & Reel
		AP3421ADNTR-G1	BDD	
		AP3421BDNTR-G1	BDE	

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

(1) Package Type: DFN-3×3-10



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