Description

The APL0501ASTA device is a low R_{ON} MOSEFT controlled by external logic pin, allowing optimization of battery life, and portable device autonomy. It includes a P-channel MOSFET that operates over an input voltage range of 1.5V to 5.5V. An on/off input (EN) controls the switch that can interface with low voltage control signals. A 130Ω on chip load resistor is added for output quick discharge when the switch is turned off.

The APL0501ASTA is packaged in compact SOT-23-6L. It is characterized for operation over the free-air temperature range of -40°C to 85°C.

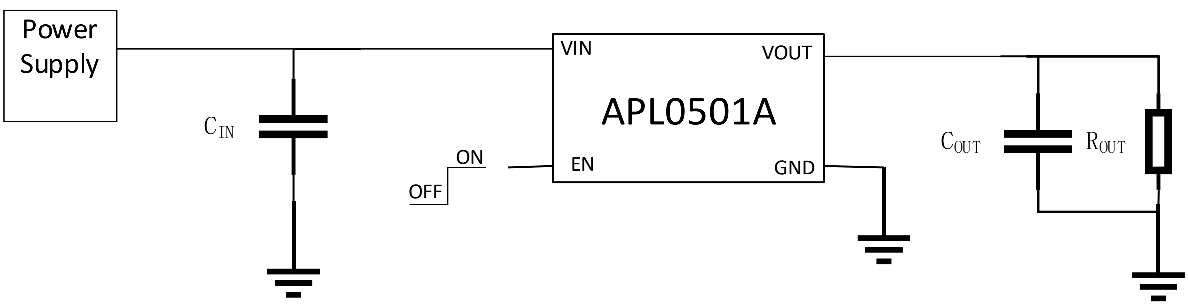
Applications

- Cellular Phones
- GPS Devices
- Digital Cameras
- Peripheral Ports
- Portable Instrumentation
- RF Modules
- Personal Digital Assistants (PDAs)
- MP3 Players

Features

- Low-Input Voltage: 1.2V to 5.5V
- ON-State Resistance
  - R_{ON}=150mΩ at VIN=5.0V
  - R_{ON}=153mΩ at VIN=4.2V
  - R_{ON}=156mΩ at VIN=3.6V
  - R_{ON}=168mΩ at VIN=2.5V
  - R_{ON}=192mΩ at VIN=1.8V
  - R_{ON} =260mΩ at VIN=1.2V
- DC Current Up to 1.5A
- Ultra-Low Quiescent Current: 80nA at 1.8V
- Ultra-Low Shutdown Current: 7.5nA at 1.8V
- Low Control Input Thresholds Enable Use of 1.2V/1.8V/3.6V/4.2V/5.0V Logic
- Controlled Slew Rate to Decrease Input Inrush Current
- Reverse Current Protection
- Package: SOT-23-6L

Typical Application

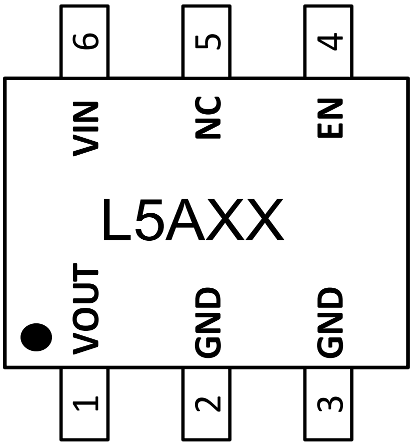


Package and Order Information

Part Number	Package Description	Temperature Range	Packaging Option	Marking Information
APL0501ASTA	SOT-23-6L	-40°C ~ 85°C	3000/Tape & Reel	L5AXX

Pin Configuration and Top Mark

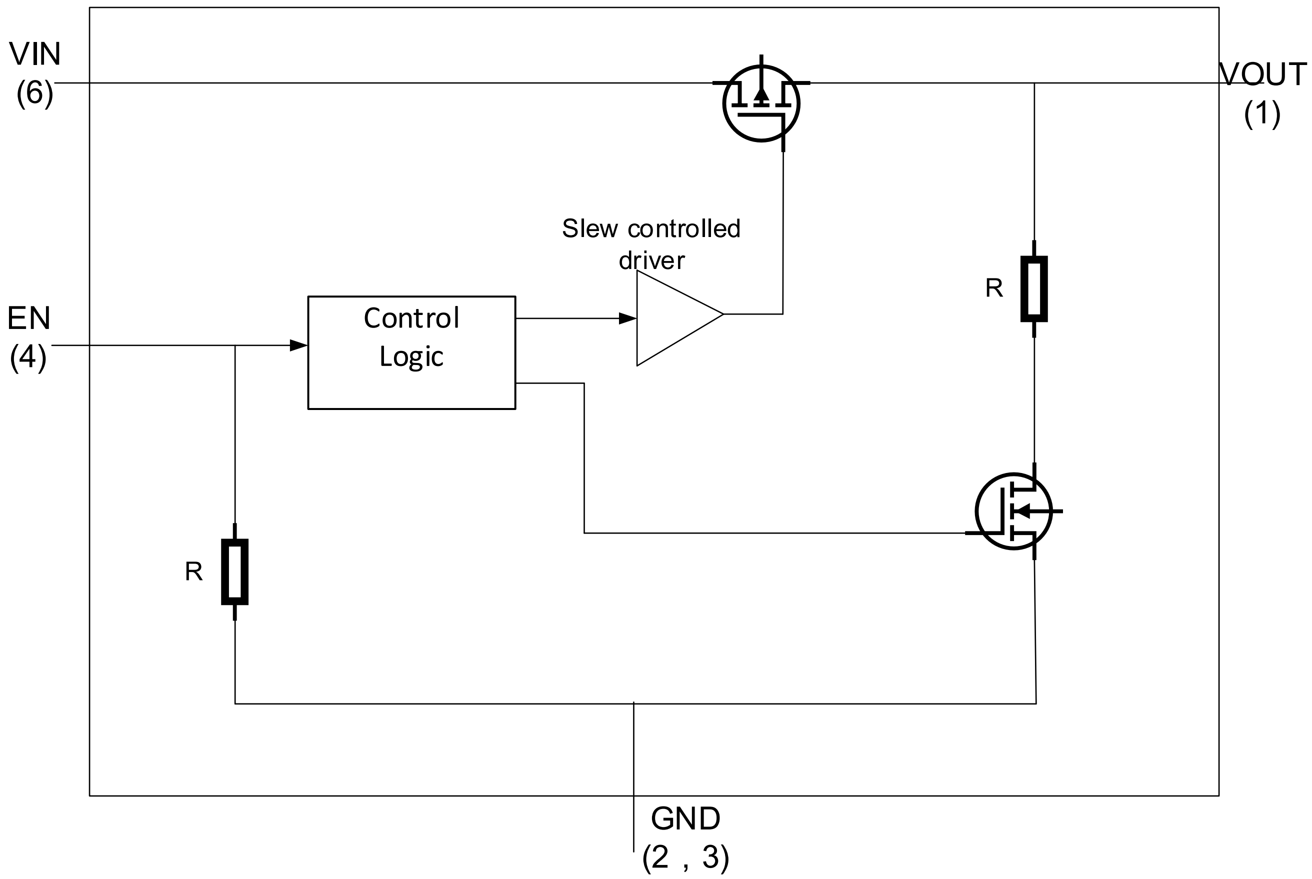
Top View



Pin Assignments

Name	Pin NO.	Description
VOUT	Pin1	Switch output
GND	Pin2	GND
GND	Pin3	GND
EN	Pin4	Switch control input, active high
NC	Pin5	No connect
VIN	Pin6	Switch input, a bypass capacitor should be connected to ground together with it

Functional Block Diagram



Symbol	Parameter		Rating	Unit
V_{IN}	Input voltage		-0.3 to 6	V
V_{OUT}	Output voltage		V_{IN} + 0.3	V
V_{ON}	Input voltage		-0.3 to 6	V
P_D	Power dissipation at T_A=25°C		0.48	W
I_{MAX}	Maximum Continuous Switch Current	VIN≥1.8V	1.5	A
		1.5V≤VIN<1.7V	1.4	
		1.3V≤VIN<1.4V	1.2	
		VIN=1.2V	1.0	
T_A	Operating free air temperature range		-40 to 85	ºC
T_{LEAD}	Maximum lead temperature (10s soldering time)		300	ºC
T_{STG}	Storage temperature		-45 to 145	ºC
$θ_{JA}$	Thermal Resistance		185	ºC/W
ESD	HBM: All Pins		±4000	V
	CDM		±1000	
Latch up			±200	mA

Recommend Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Input voltage range	1.2 to 5.5	V
V_{OUT}	Output voltage range	V_{IN}	V
C_{IN}	Input capacitor	1	μF

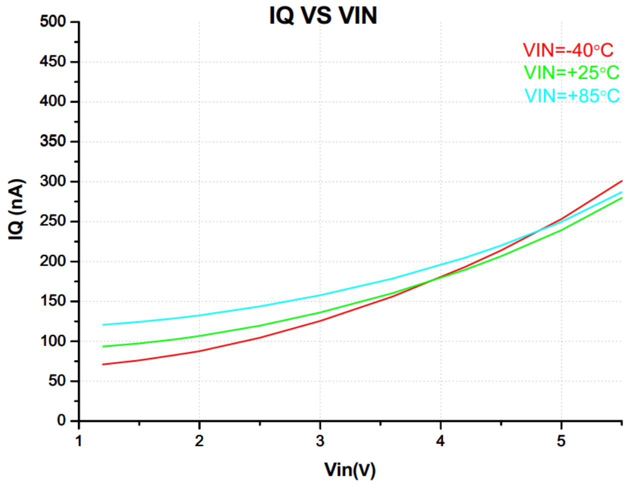
Electrical Characteristics (T_A = 25°C unless otherwise specified)

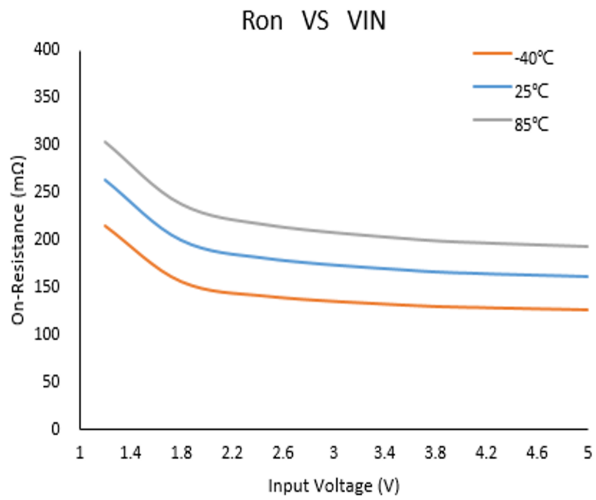
Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
I_Q	Quiescent current	I_{OUT}=0, V_{IN}=V_{EN}	V_{IN}=1.2V	40	75	130	nA
			V_{IN}=1.8V		80		
			V_{IN}=3.6V	90	119	250	
			V_{IN}=4.2V		142		
			V_{IN}=5.0V	150	188	350	
I_{SD}	OFF-state supply current	V_{EN}=GND, V_{OUT}=Open	V_{IN}=1.2V		7	20	nA
			V_{IN}=1.8V		7.5		
			V_{IN}=3.6V		10	30	
			V_{IN}=4.2V		12		
			V_{IN}=5.0V		20	50	
I_{LKG}	OFF-state supply current	V_{EN}=GND, V_{OUT}=0	V_{IN}=1.2V		7.5		nA
			V_{IN}=1.8V		8		
			V_{IN}=3.6V		10		
			V_{IN}=4.2V		12.5		
			V_{IN}=5.0V		20.5		
R_{ON}	ON-state resistance	I_{OUT}=-100mA	V_{IN}=1.2V		260		mΩ
			V_{IN}=1.8V		192		
			V_{IN}=2.5V		168		
			V_{IN}=3.6V		156		
			V_{IN}=4.2V		153		
			V_{IN}=5.0V		150		
I_{REV}	Reverse current during disable	V_{OUT}=5.0V, V_{EN}=0, V_{IN}=0V			14		nA
R_{ON_PD}	EN pull down resistance				100		MΩ
R_{PD}	Output pull down resistance	V_{IN}=3.3V, V_{ON}=0			130	150	Ω
V_{IH}	High level input voltage	V_{IN}=1.5V to 5.5V		1.0			V
V_{IL}	Low level input voltage	V_{IN}=1.5V to 5.5V				0.5	V

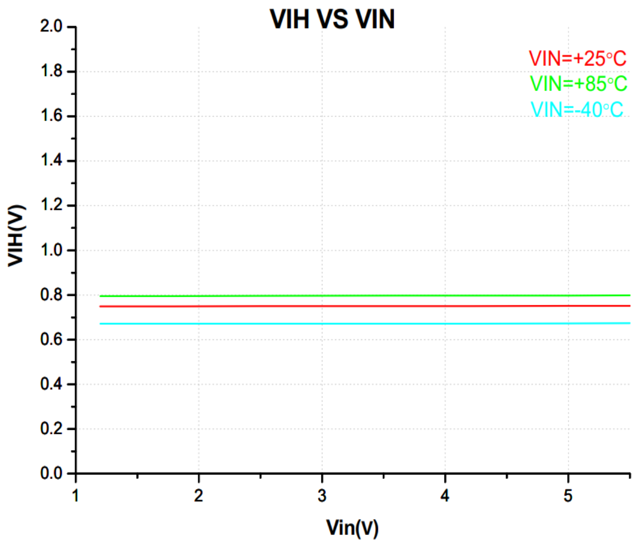
Switching Characteristics (T_A = 25°C unless otherwise specified)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{IN}=1.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		370		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		10		μs
t_R	VOUT rise time	R_L=500Ω	C_L=0.1μF		29		μs
t_F	VOUT fall time	R_L=500Ω	C_L=0.1μF		26		μs
V_{IN}=1.8V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		145		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		13		μs
t_R	VOUT rise time	R_L=500Ω	C_L=0.1μF		46		μs
t_F	VOUT fall time	R_L=500Ω	C_L=0.1μF		27		μs
V_{IN}=3.6V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		117		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		14		μs
t_R	VOUT rise time	R_L=500Ω	C_L=0.1μF		110		μs
t_F	VOUT fall time	R_L=500Ω	C_L=0.1μF		26		μs
V_{IN}=4.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		119		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		14		μs
t_R	VOUT rise time	R_L=500Ω	C_L=0.1μF		130		μs
t_F	VOUT fall time	R_L=500Ω	C_L=0.1μF		26		μs
V_{IN}=5V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		119		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		14		μs
t_R	VOUT rise time	R_L=500Ω	C_L=0.1μF		140		μs
t_F	VOUT fall time	R_L=500Ω	C_L=0.1μF		25		μs

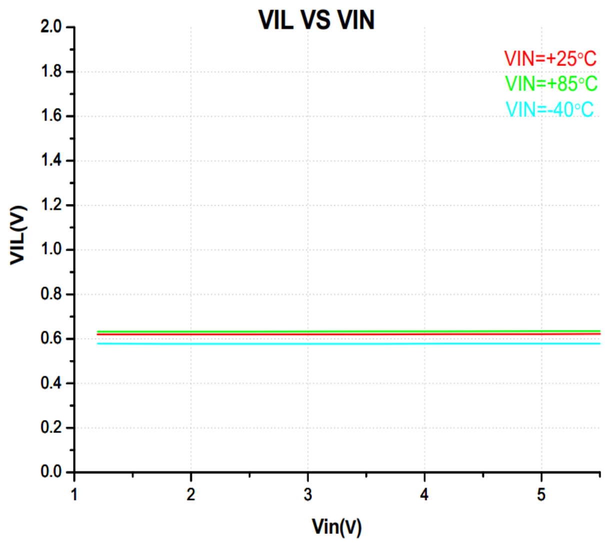
Typical Performance Characteristics (C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)







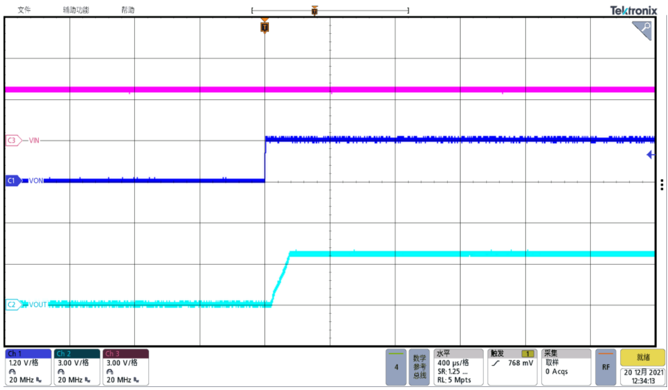
V_{IH} vs VIN



V_{IL} vs VIN

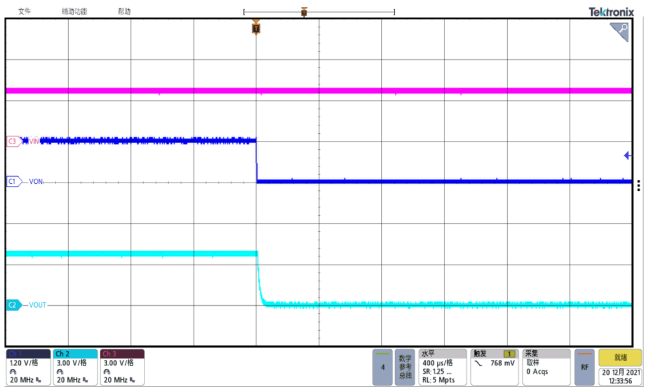
Typical Performance Characteristics (C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{EN} ON Response w/o load



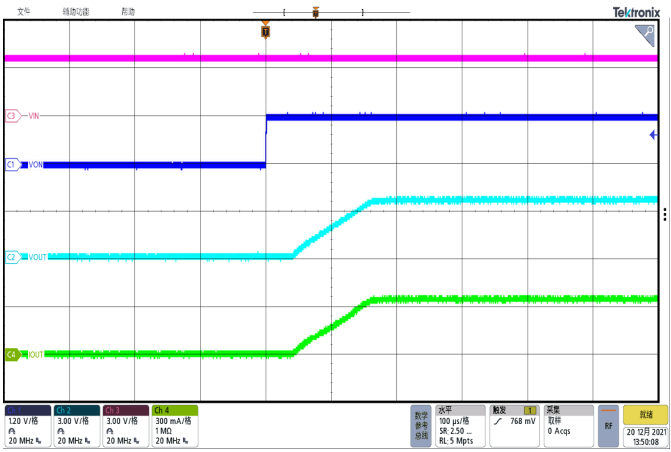
V_{IN}=3.7V, V_{EN}=1.2V

V_{EN} OFF Response w/o load



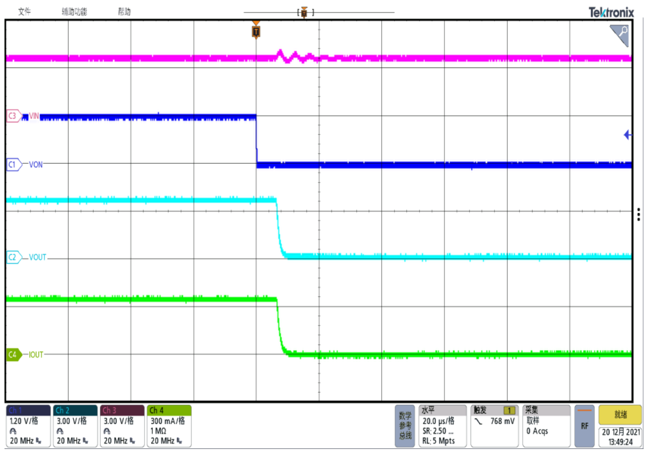
V_{IN}=3.7V, V_{EN}=1.2V

V_{EN} ON Response with 10Ω load



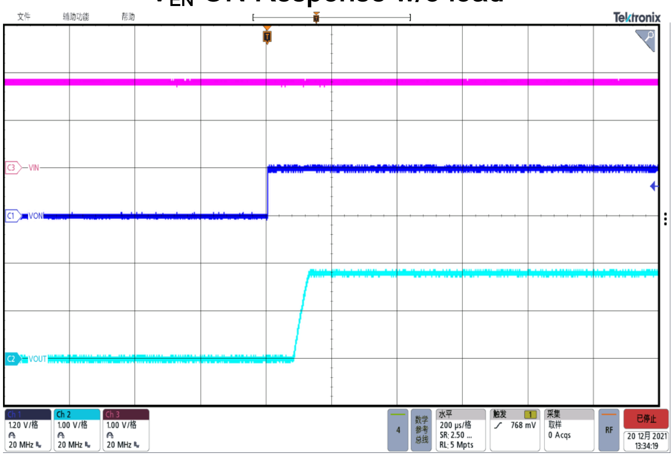
V_{IN}=3.7V, V_{EN}=1.2V

V_{EN} OFF Response with 10Ω load



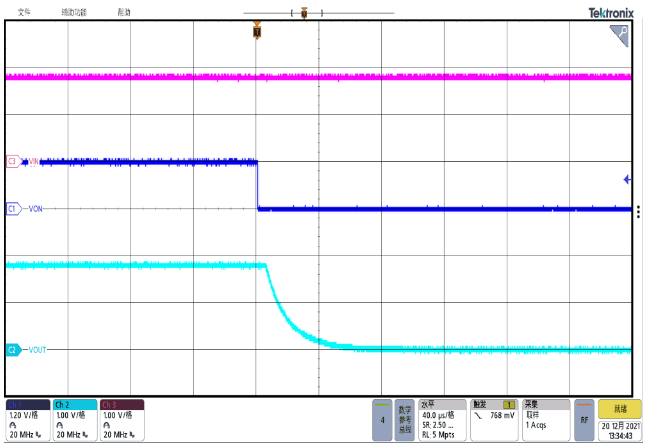
V_{IN}=3.7V, V_{EN}=1.2V

V_{EN} ON Response w/o load



V_{IN}=1.8V, V_{EN}=1.2V

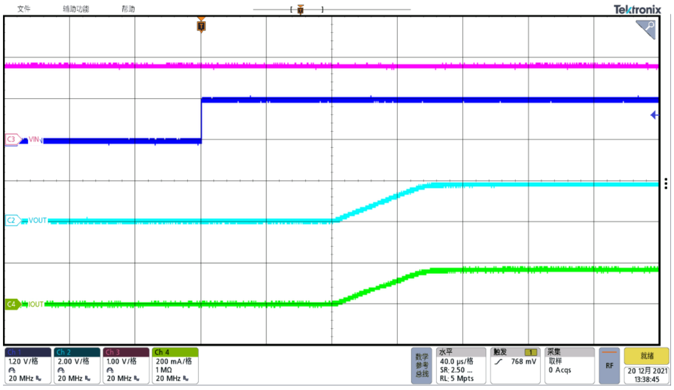
V_{EN} OFF Response w/o load



V_{IN}=1.8V, V_{EN}=1.2V

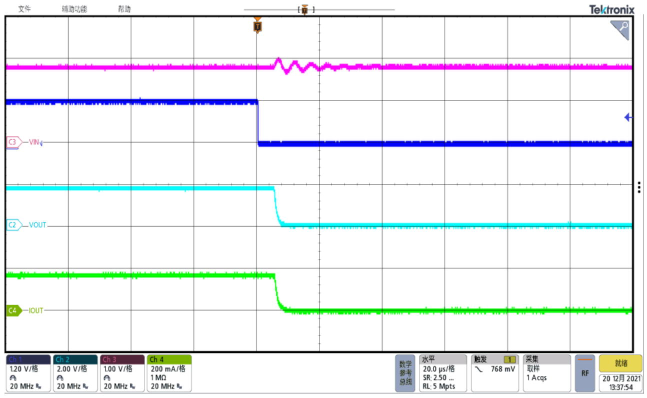
Typical Performance Characteristics (C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{EN} ON Response with 10Ω load



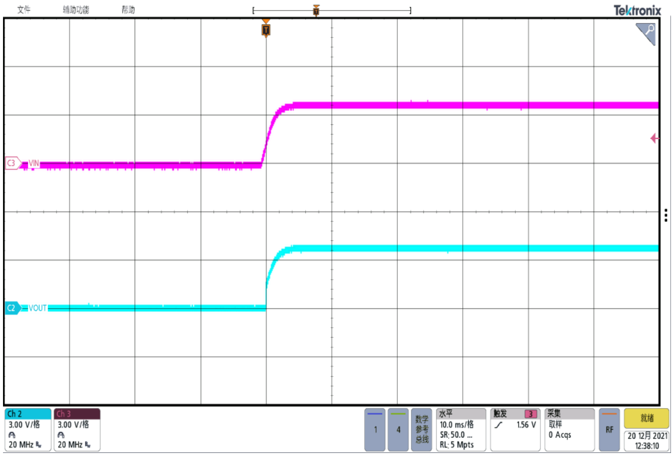
V_{IN}=1.8V, V_{EN}=1.2V

V_{EN} OFF Response with 10Ω load



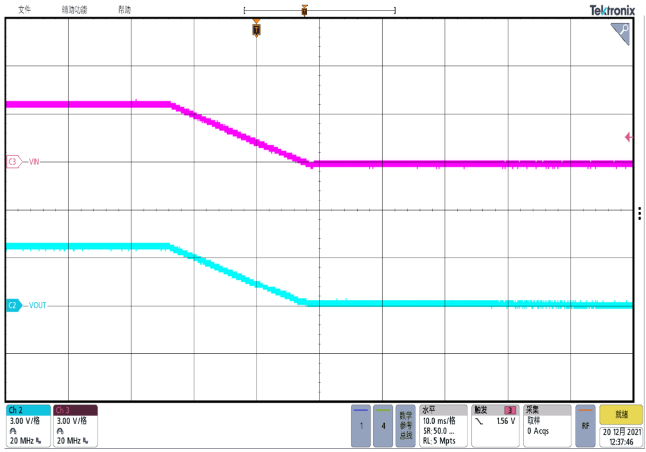
V_{IN}=1.8V, V_{EN}=1.2V

V_{IN} Power ON w/o load



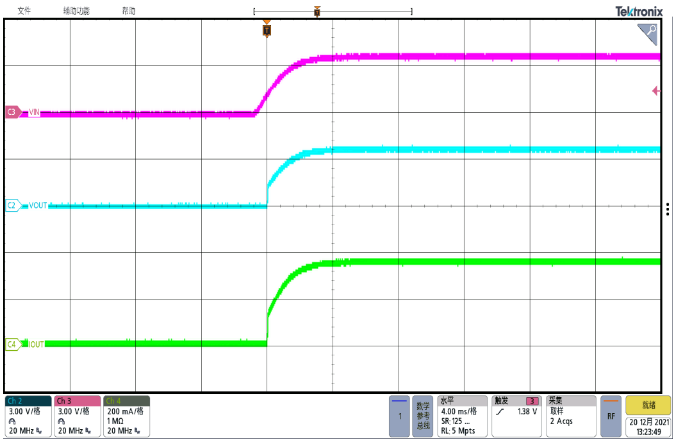
V_{IN}=V_{EN}=3.7V

V_{IN} Power OFF w/o load



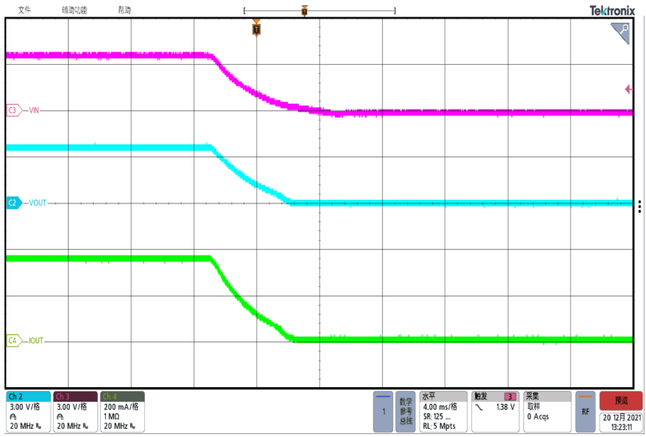
V_{IN}=V_{EN}=3.7V

V_{IN} Power ON with 10Ω load



V_{IN}=V_{EN}=3.7V

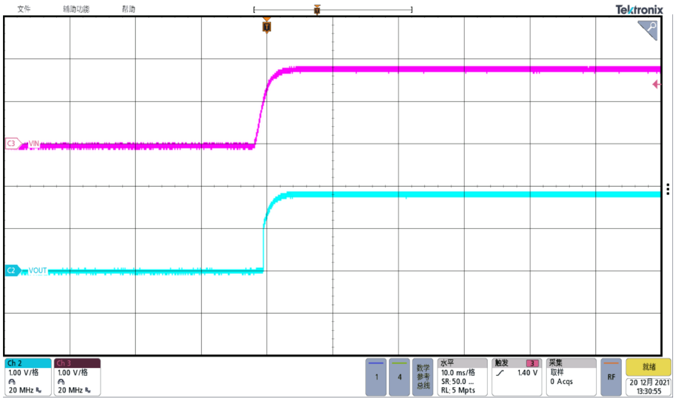
V_{IN} Power OFF with 10Ω load



V_{IN}=V_{EN}=3.7V

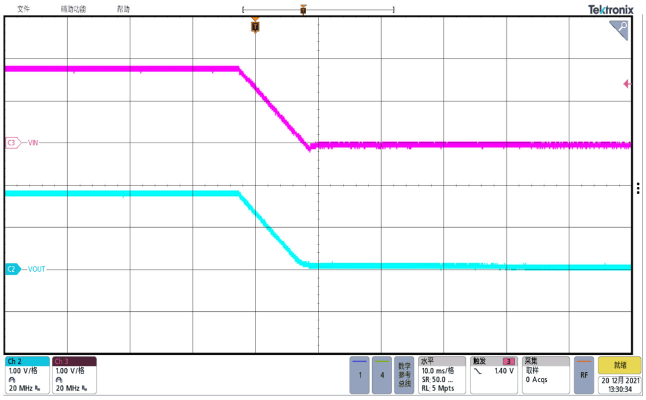
Typical Performance Characteristics (C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{IN} Power ON w/o load



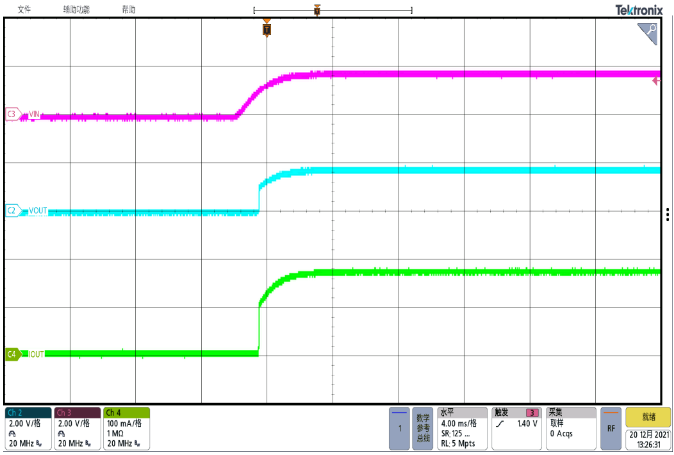
V_{IN}=V_{EN}=1.8V

V_{IN} Power OFF w/o load



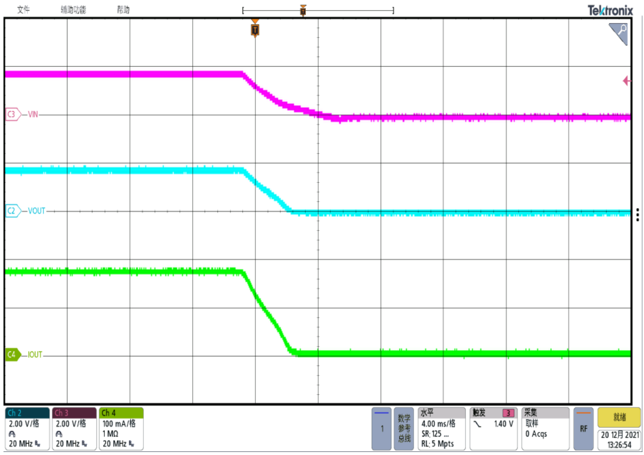
V_{IN}=V_{EN}=1.8V

V_{IN} Power ON with 10Ω load



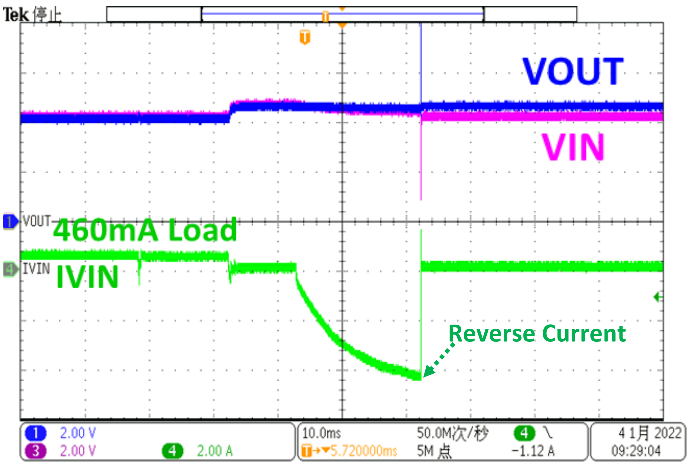
V_{IN}=V_{EN}=1.8V

V_{IN} Power OFF with 10Ω load



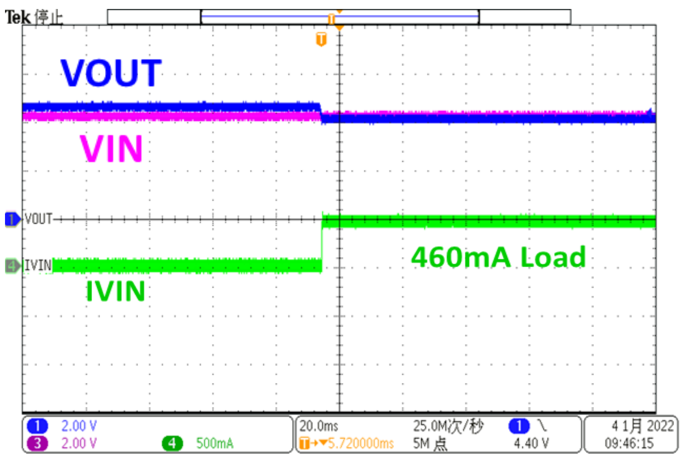
V_{IN}=V_{EN}=1.8V

Reverse Protection with 10Ω load



V_{IN}=V_{EN}=4.2V

Reverse Protection Recovery with 10Ω load



V_{IN}=V_{EN}=4.2V

Functional Description

Device Operation

The APL0501ASTA is a low on-resistance (R_{ON}) load switch with controlled turn on, up to 1.5A output current. It contains a P-channel MOSFET and can be turned on with a wide range application of battery from 1.5V to 5.5V. An on/off input (EN) controls the switch, which can interface with low-threshold 1.2V GPIO control signal. A 130Ω on-chip output resistor is added for output quick discharge when the switch is switched off.

ON/OFF Control

The pin of EN controls the state of the switch. EN is active HI pin and has a low threshold making it capable of interfacing with low voltage GPIO control signals. It can be used with any microcontroller with 1.2V, 1.8V, 2.5V, 3.3V GPIOs. Applying VIH on the EN pin will put the switch in the on-state and VIL will put the switch in the off-state.

EN (Control Input)	VIN to VOUT	Quick Output Discharge
L	OFF	Yes
H	ON	No

Reverse Current Protection

The device includes a reverse current protection circuit, which stops a reverse current flowing from the VOUT pin to the VIN or GND pin when the voltage on VOUT becomes higher than VIN. This feature is particularly useful when the output of device needs to be driven by another voltage source, whichever device is both disabled and enabled (for example in a power multiplexer application). In order for this feature to work, device has to be disabled, and either of the following conditions shall be met: VIN > 1.2V or VOUT > 1.2V. Meanwhile considering of heat dissipation , VIN input voltage should be limited less than 4.8V voltage when VEN is active high.

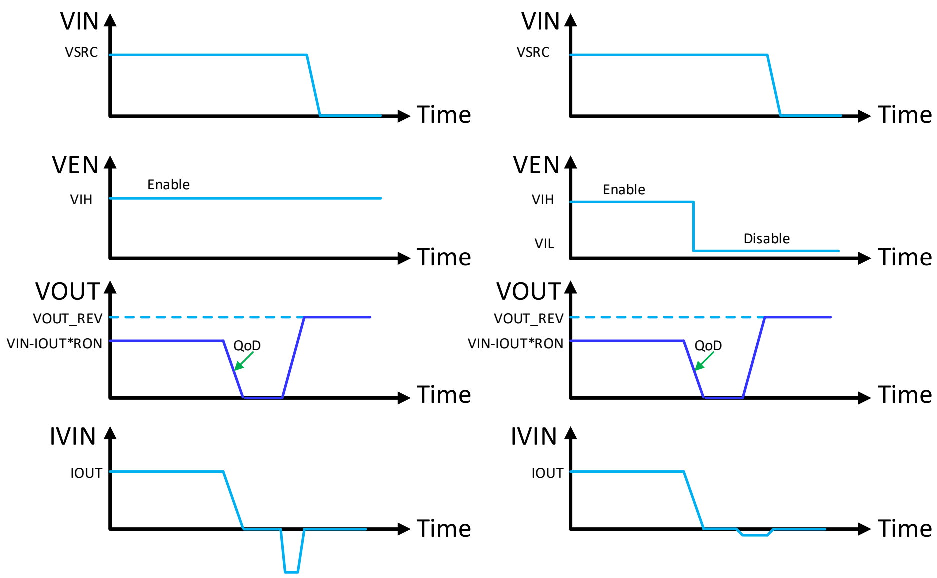


Figure 1

Functional Description (Continued)

Quick Output Discharge

The APL0501ASTA integrates the quick output discharge (QOD) feature. When the switch is disabled, a discharge resistance with a typical value of 130Ω is connected between the output and ground. This resistance pulls down the output and quickly discharges output capacitor charge, and prevents it from floating when the device is disabled.

Input Bypass Capacitor

A low ESR ceramic capacitor, X5R or X7R, needs to be placed between VIN and GND to limit the voltage drop on the input supply caused by transient in-rush currents. A typical 1μF ceramic capacitor, C_{IN}, placed close to the pins is usually needed. C_{IN}'s higher values can be used to further reduce the voltage drop during high current output application. It is recommended that the input capacitor is approximately 10 times higher than the output capacitor to prevent excessive voltage drop when switching heavy loads.

Output Bypass Capacitor

A low ESR ceramic capacitor, X5R or X7R, should be placed between VOUT and GND. A 0.1μF ceramic capacitor that is placed close to the IC pins is usually sufficient. This capacitor will prevent parasitic board inductances from forcing VOUT below GND when the switch turns off. It is recommended that C_{IN} is 10times higher than C_{OUT} so that once the switch is turned on, COUT can be charged up to VIN without VIN dropping significantly.

Power Supply Sequencing without a GPIO Input Control Port

In many terminal devices, each module needs to be powered up in a pre-determined manner. The device can solve the power sequencing problem without increasing any complexity to the overall system. Figure 2 shows the configuration required to power up the two modules in a fixed sequence. The output of the first load switch is tied to the enable of the second load switch, so when load1 is powered, the second load switch is enabled and load2 is powered.

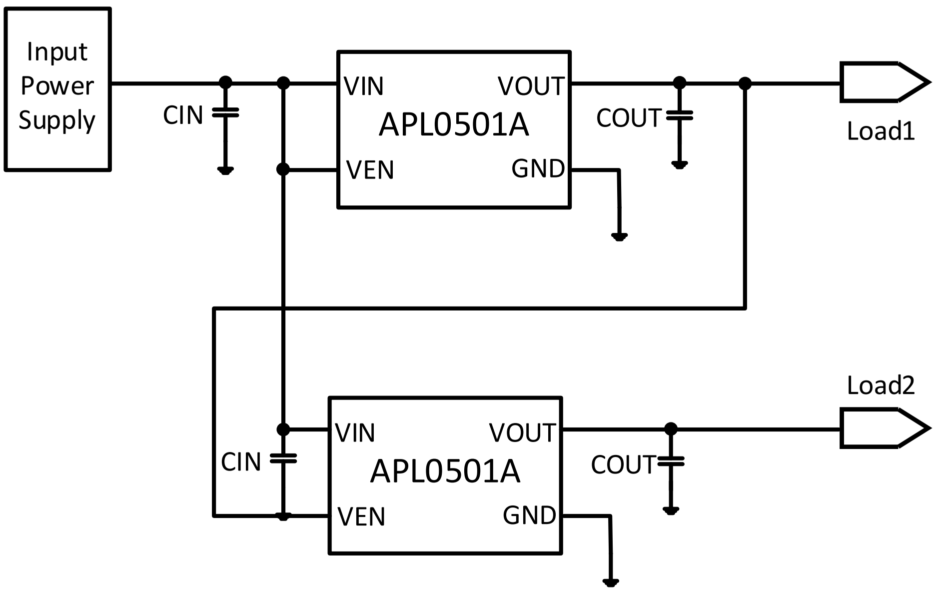
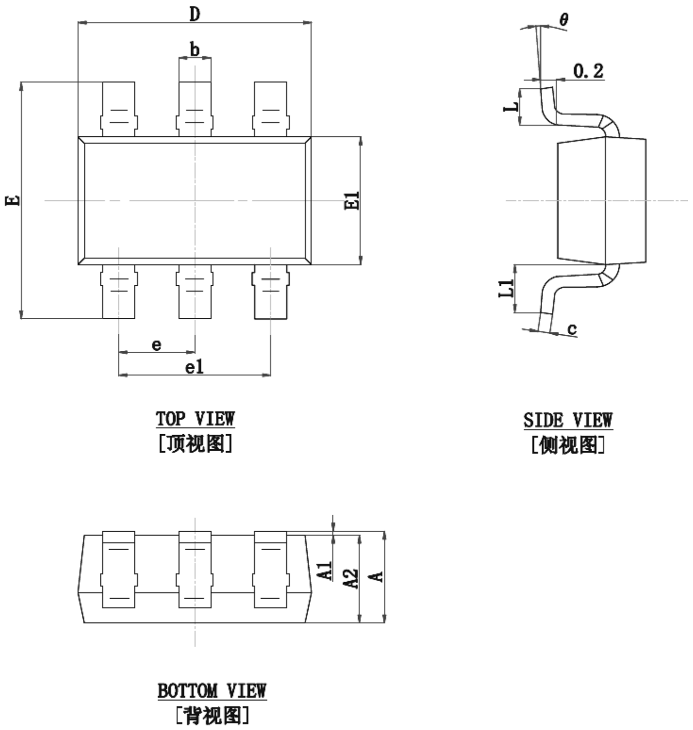


Figure 2

Package Outline Drawing



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC.)		0.037(BSC.)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600REF.		0.024REF.	
θ	0°	8°	0°	8°

Contact Information

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