SK1826A Ultra-Small, Low-Input Voltage, Low RON Load Switch

General Description

The SK1826A series of devices are low RON 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 1.2V to 5.5V. An on/off input (ON) controls the switch that can interface with low voltage control signals.

For SK1826A and SK1826AS, a 130Ω on chip load resistor is added for out-put quick discharge when the switch is turned off.

The SK1826AS and SK1826ASN are available in SOT23-6 package, and the SK1826A and SK1826AN are available in WLCSP-4 with 0.4mm pitch.

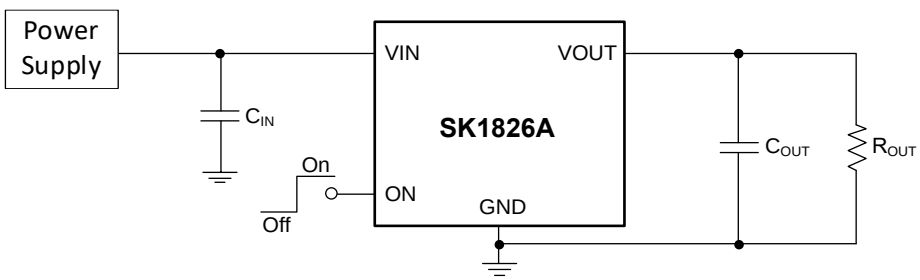
Features

- Low-Input Voltage: 1.2V to 5.5V
- Ultra-Low ON-State Resistance of CSP4
  R_{ON}=48mΩ at V_{IN}=5.0V
  R_{ON}=53mΩ at V_{IN}=4.2V
  R_{ON}=56mΩ at V_{IN}=3.6V
  R_{ON}=67mΩ at V_{IN}=2.5V
  R_{ON}=87mΩ at V_{IN}=1.8V
  R_{ON}=160mΩ at V_{IN}=1.2V
- DC Current Up to 1.5A
- Ultra-Low Quiescent Current: 80nA @1.8V
- Ultra-Low Shutdown Current: 7.5nA @1.8V
- Low Control Input Thresholds Enable Use of 1.2V/1.8V/3.6V/4.2V/5.0V Logic
- Controlled Slew Rate to Avoid Inrush Current
- Reverse Current Protection

Applications

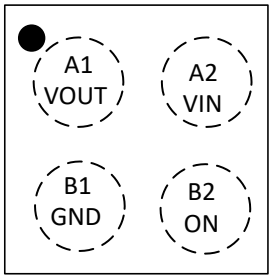
- Cellular Phones
- GPS Devices
- Digital Cameras
- Peripheral Ports
- Portable Instrumentation
- RF Modules
- Personal Digital Assistants (PDAs)

Typical Application Circuit



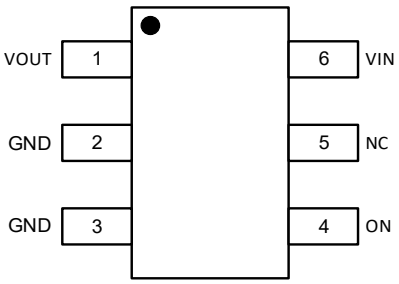
Pin Configuration

TOP VIEW



WLCSP-4B

TOP VIEW



SOT23-6

Pin Description

PIN No.		PIN Name	Description
CSP4	SOT23-6		
A1	1	VOUT	Output
A2	6	VIN	Input, a bypass capacitor should be connected to ground together with it.
B1	2/3	GND	Ground
B2	4	ON	Switch control input, active high
-	5	NC	Not connect

Ordering Information

Part Number	Package	Output Discharge	Tape & Reel
SK1826A	WLCSP4	Yes	3000 PCS
SK1826AN	WLCSP4	No	3000 PCS
SK1826AS	SOT23-6L	Yes	3000 PCS
SK1826ASN	SOT23-6L	No	3000 PCS

Absolute Maximum Ratings

(T_A = 25°C unless otherwise specified)

Symbol	Parameter		Rating		Unit
			SOT23-6	CSP4	
VIN	Input voltage		-0.3 to 6		V
V_{OUT}	Output voltage		VIN + 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	V_{IN}≥1.8V	1.5	2.0	A
		1.5V≤V_{IN}<1.7V	1.4		
		1.3V≤V_{IN}<1.4V	1.2		
		V_{IN}=1.2V	1.0		
T_A	Operating free air temperature range		-40 to 85		°C
T_{LEAD}	Maximum lead temperature (10s soldering time)		300		°C
T_{STG}	Storage temperature		-45 to 145		°C
θ_{JA}	Thermal Resistance		185	190	°C/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
C_{IN}	Input capacitor	1	µF
T_A	Operating Ambient Temperature	-40 to 85	°C

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_{ON}	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_{ON}=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_{ON}=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 (CSP4) For SK1826A and SK1826AN	I_{OUT}=-200mA	V_{IN}=1.2V	140	160	190	mΩ
			V_{IN}=1.8V		87		
			V_{IN}=2.5V		68		
			V_{IN}=3.6V		56		
			V_{IN}=4.2V		53		
			V_{IN}=5.0V	30	48	70	
R_{ON}	ON-state resistance (SOT23-6) ForSK1826AS	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_{ON}=0, V_{IN}=0V			14		nA
R_{ON_PD}	ON pull down resistance				100		MΩ

Electrical Characteristics (Cont.)

(FOR SK1826A and SK1826AS, T_A= 25°C unless otherwise specified)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
R_{PD}	Output pull down resistance	V_{IN}=3.3V, VON=0			130	150	Ω
V_{IH}	High level input voltage	V_{IN}=1.2V to 5.5V		1.0			V
V_{IL}	Low level input voltage	V_{IN}=1.2V to 5.5V				0.5	V
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		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		29		μs
t_F	V_{OUT} 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		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		46		μs
t_F	V_{OUT} 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		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		110		μs
t_F	V_{OUT} 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		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		130		μs
t_F	V_{OUT} 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		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		140		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		25		μs

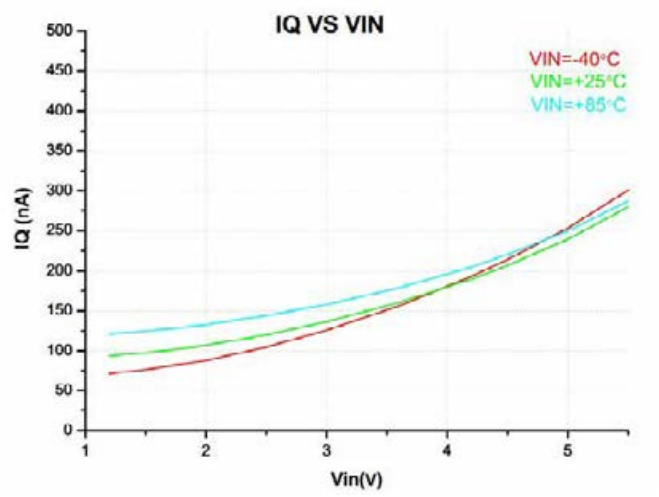
Electrical Characteristics (Cont.)

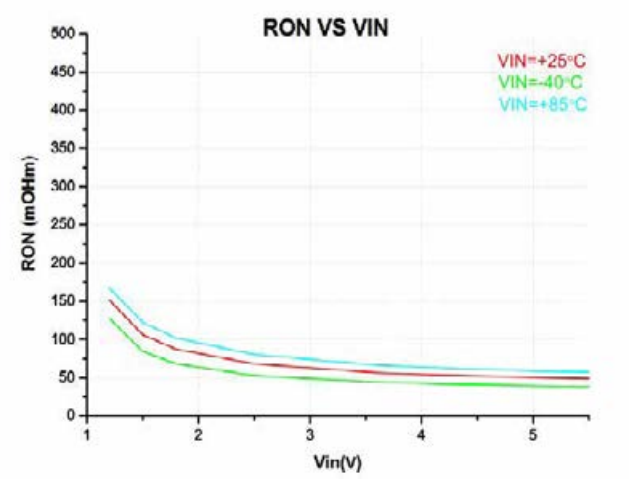
(FOR SK1826AN and SK1826ASN, T_A= 25°C unless otherwise specified)

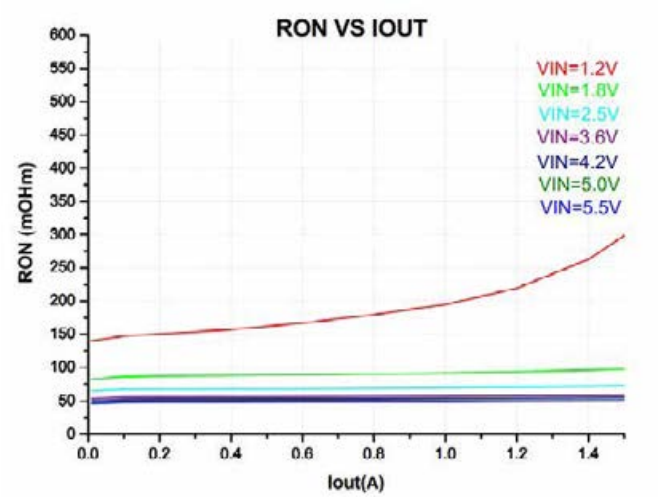
Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{IH}	High level input voltage	V_{IN}=1.2V to 5.5V		1.0			V
V_{IL}	Low level input voltage	V_{IN}=1.2V to 5.5V				0.5	V
V_{IN}=1.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		162		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		40		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		7		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		123		μs
V_{IN}=1.8V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		70		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		44		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		10		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		122		μs
V_{IN}=3.6V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		41		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		46		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		26		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		132		μs
V_{IN}=4.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		40		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		44		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		32		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		135		μs
V_{IN}=5V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		42		μs
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		47		us
t_R	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		37		μs
t_F	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		136		μs

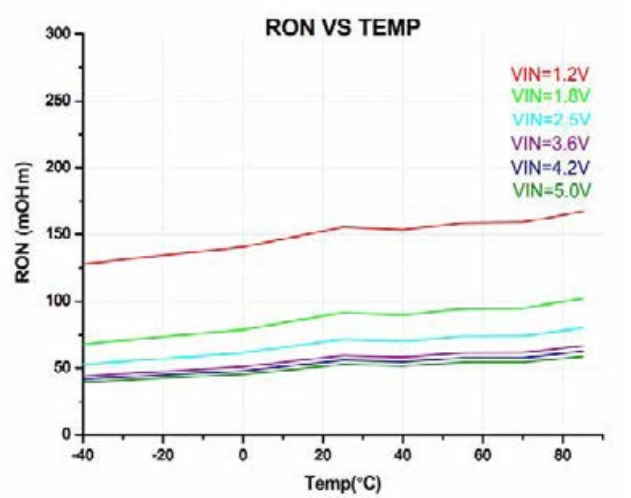
Typical Performance Characteristics

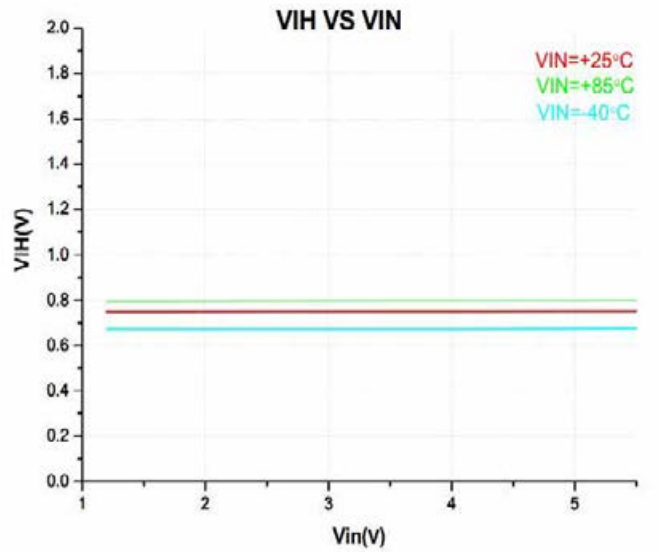
(C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

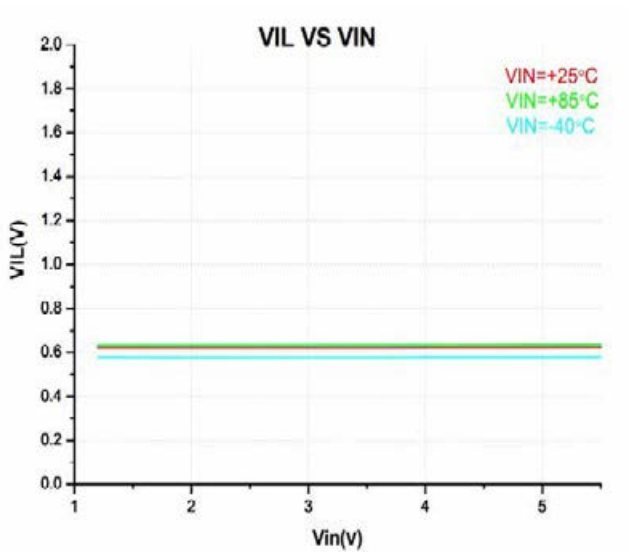








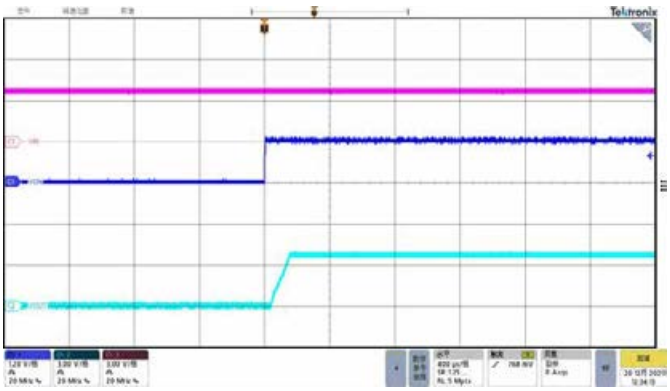




Typical Performance Characteristics

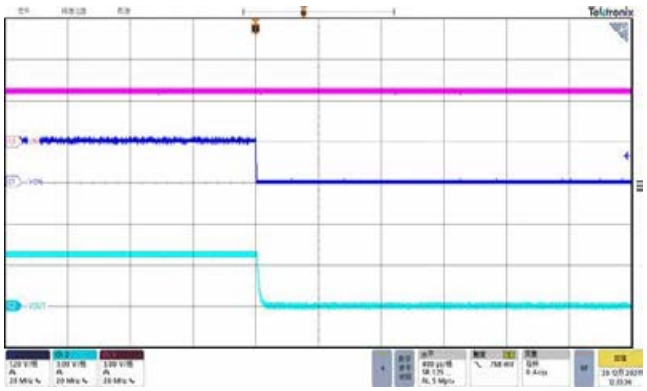
(C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{ON} ON Response w/o load



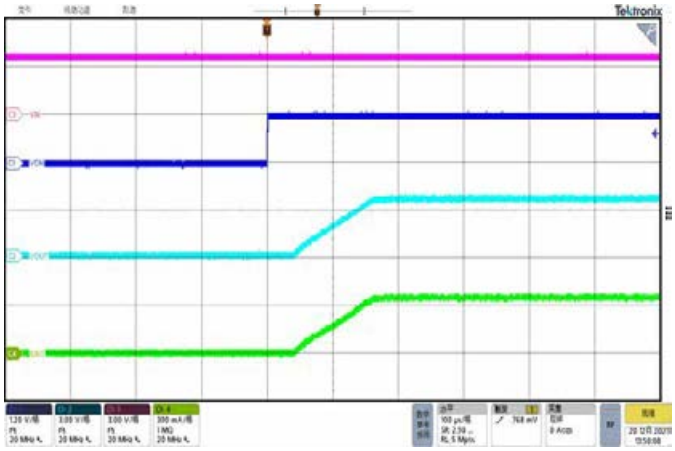
V_{IN}=3.7V, V_{ON}=1.2V

V_{ON} OFF Response w/o load



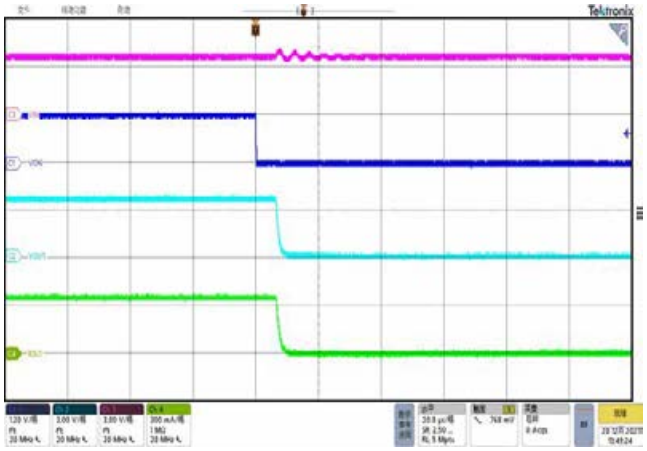
V_{IN}=3.7V, V_{ON}=1.2V

V_{ON} ON Response with 10Ω load



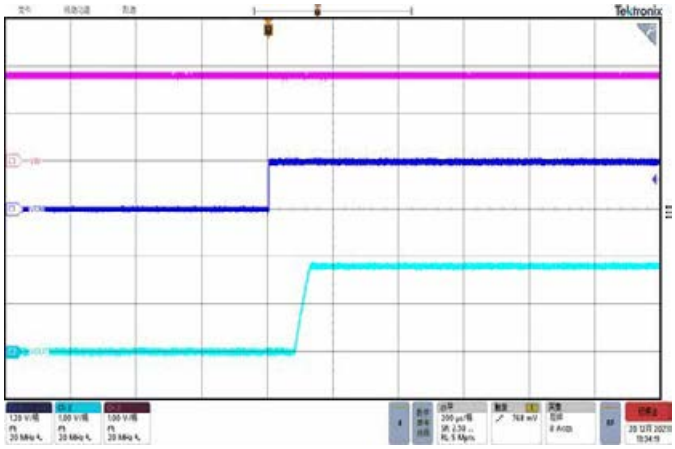
V_{IN}=3.7V, V_{ON}=1.2V

V_{ON} OFF Response with 10Ω load



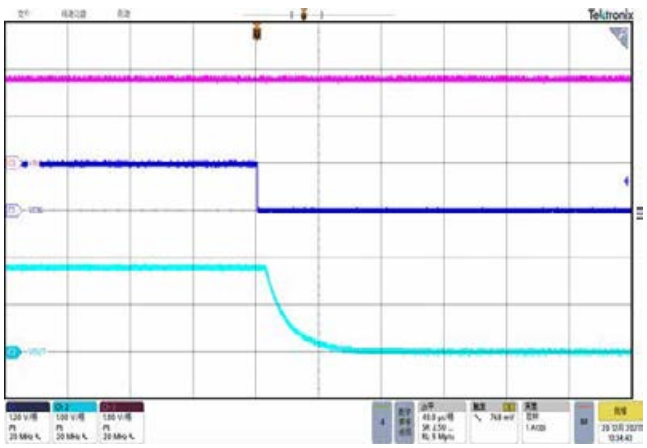
V_{IN}=3.7V, V_{ON}=1.2V

V_{ON} ON Response w/o load



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

V_{ON} OFF Response w/o load

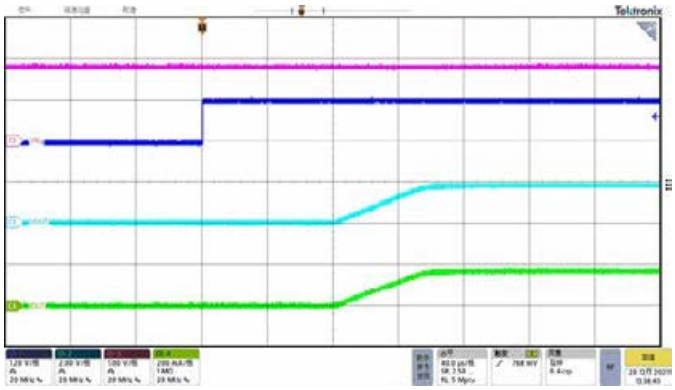


V_{IN}=1.8V, V_{ON}=1.2V

Typical Performance Characteristics

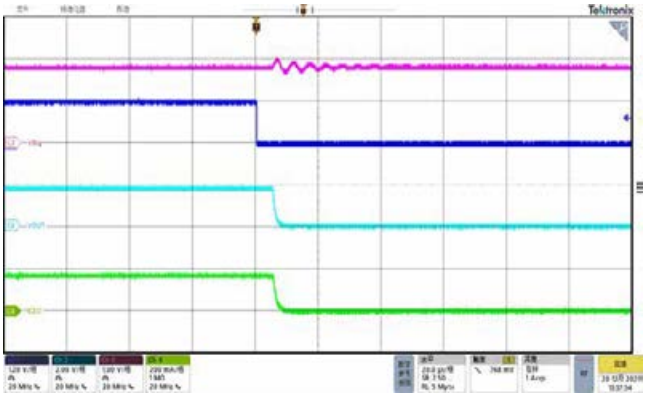
(C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{ON} ON Response with 10Ω load



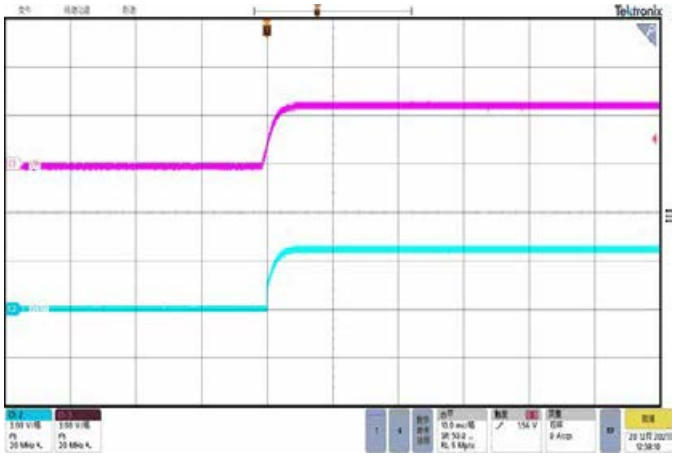
V_{IN}=1.8V, V_{ON}=1.2V

V_{ON} OFF Response with 10Ω load



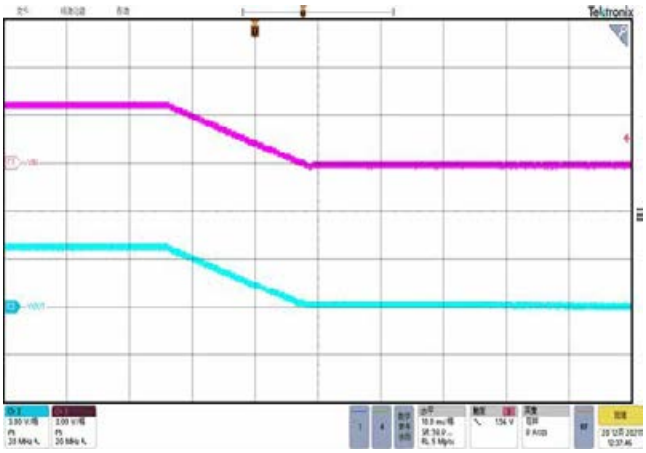
V_{IN}=1.8V, V_{ON}=1.2V

V_{IN} Power ON w/o load



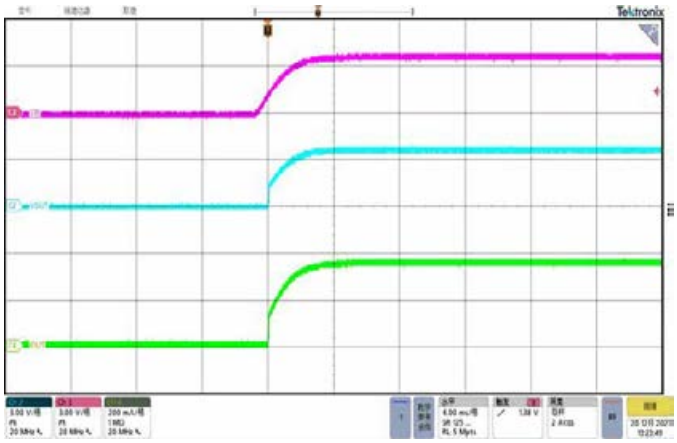
V_{IN}=V_{ON}=3.7V

V_{IN} Power OFF w/o load



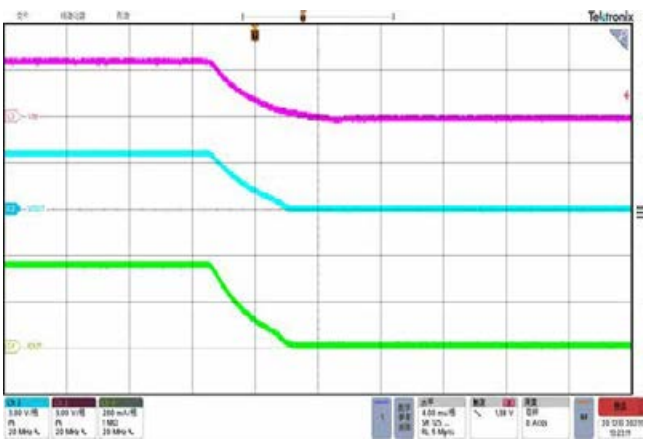
V_{IN}=V_{ON}=3.7V

V_{IN} Power ON with 10Ω load



V_{IN}=V_{ON}=3.7V

V_{IN} Power OFF with 10Ω load

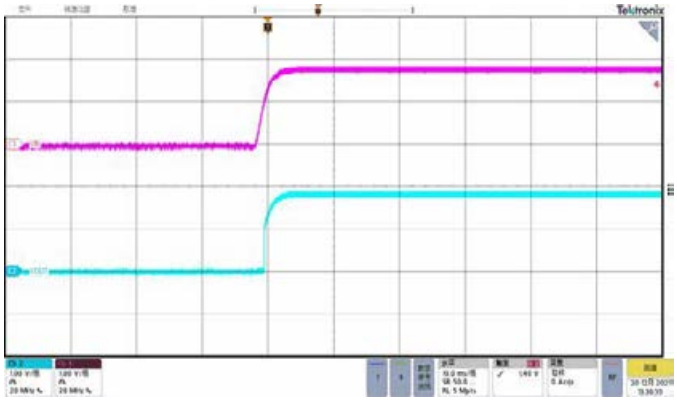


V_{IN}=V_{ON}=3.7V

Typical Performance Characteristics

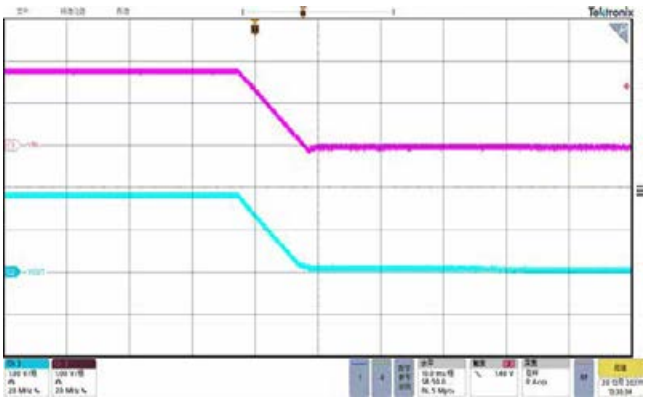
(C_{IN} = 1μF, C_{OUT} = 0.1μF, R_{OUT} = 10Ω, T_A = 25°C unless otherwise specified)

V_{IN} Power ON w/o load



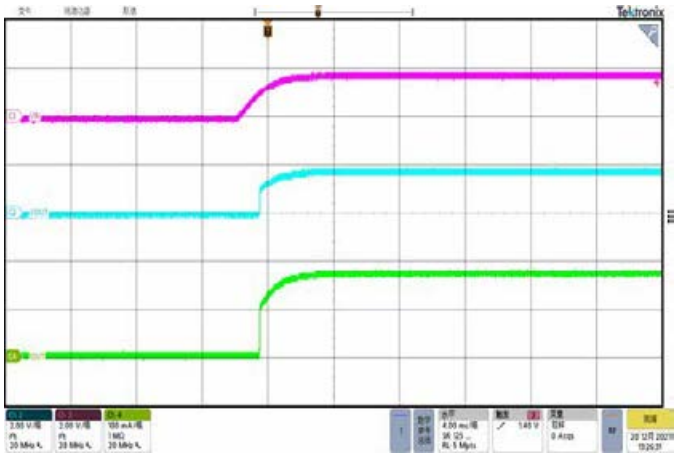
V_{IN}=V_{ON}=1.8V

V_{IN} Power OFF w/o load



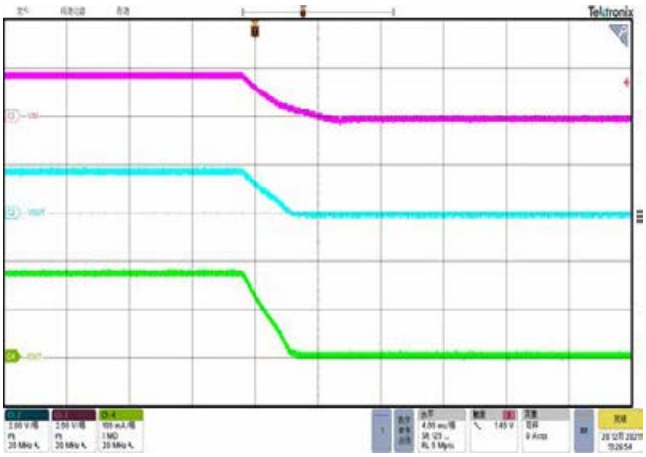
V_{IN}=V_{ON}=1.8V

V_{IN} Power ON with 10Ω load



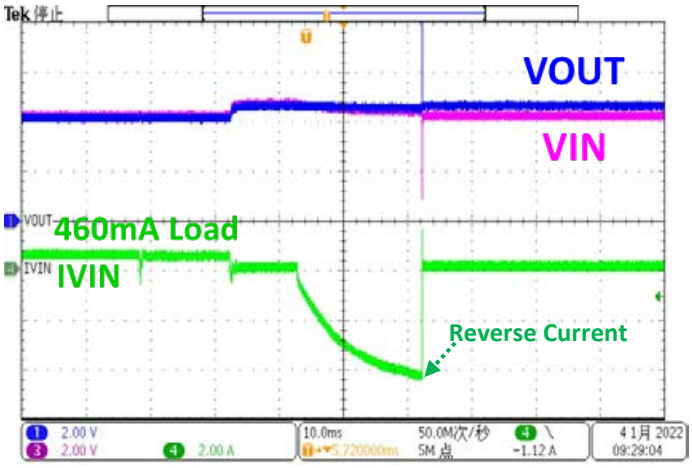
V_{IN}=V_{ON}=1.8V

V_{IN} Power OFF with 10Ω load



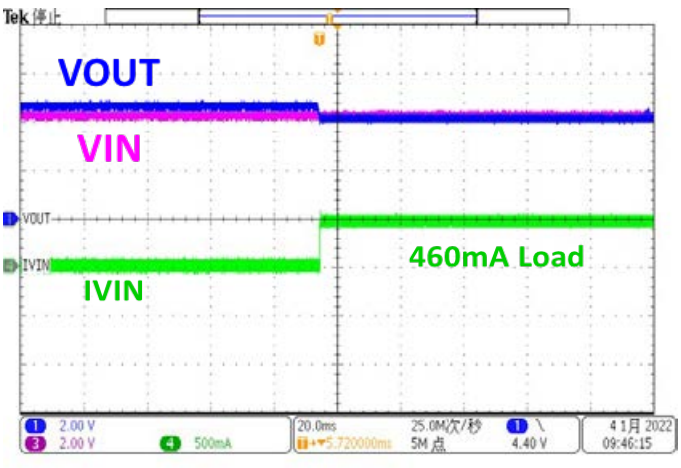
V_{IN}=V_{ON}=1.8V

Reverse Protection with 10Ω load



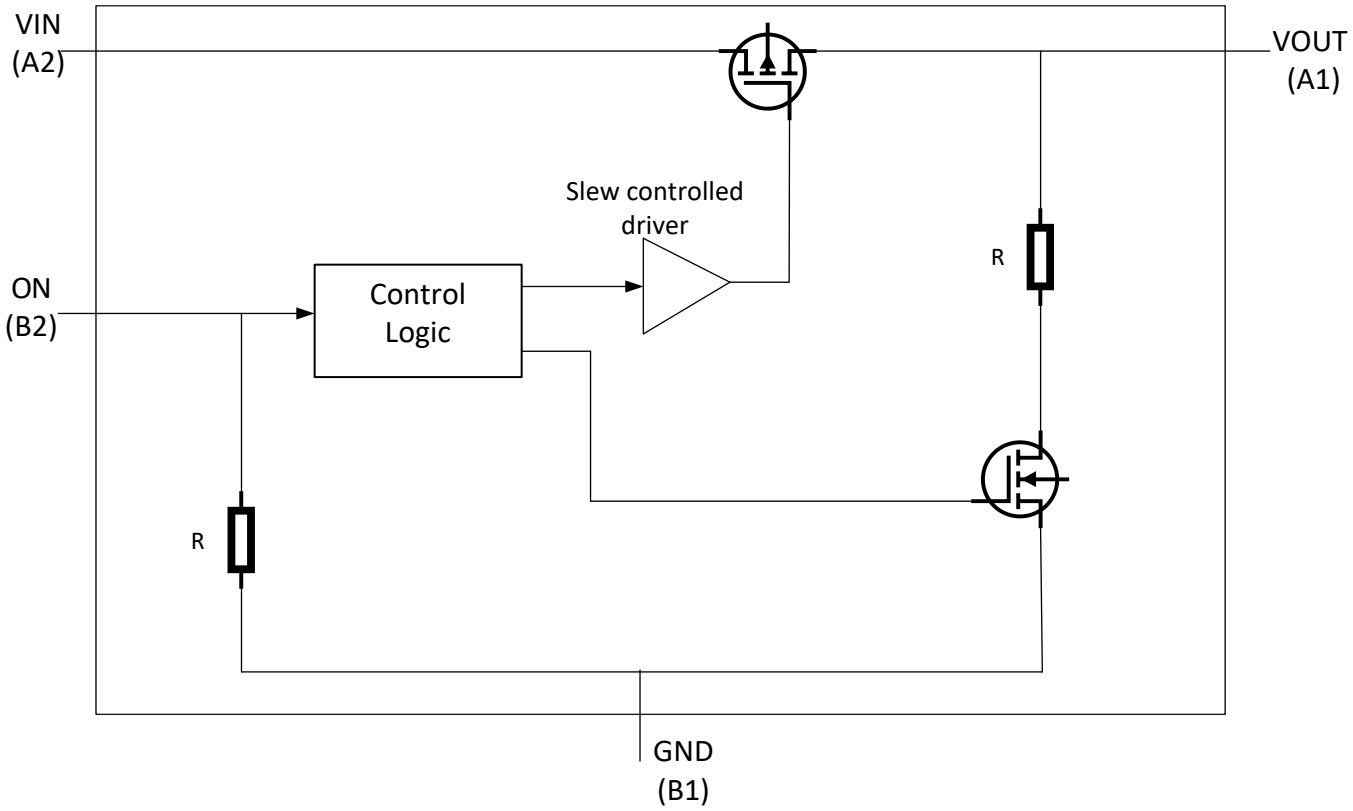
V_{IN}=V_{ON}=4.2V

Reverse Protection Recovery with 10Ω load

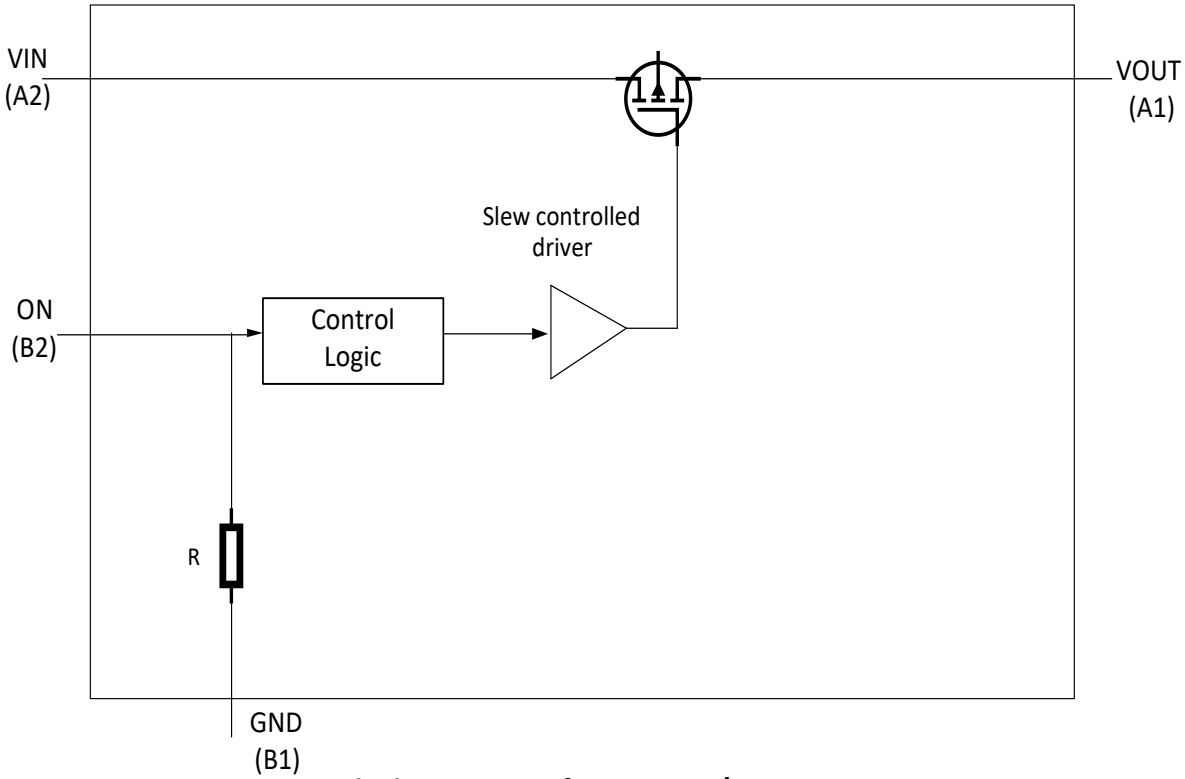


V_{IN}=V_{ON}=4.2V

Block Diagram



Block Diagram of SK1826A/SK1826AS



Block Diagram of SK1826AN/SK1826ASN

Functional Description

Device Operation

The SK1826A Series are 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 1.2V to 5.5V. An on/off input (ON) controls the switch, which can interface with low-threshold 1.2V GPIO control signal. For SK1826A and SK1826AS, a 130Ω on-chip output resistor is added for output quick discharge when the switch is switched off.

ON/OFF Control

The pin of ON controls the state of the switch. ON is active high 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 V_{IH} on the ON pin will put the switch in the on-state and V_{IL} will put the switch in the off-state.

ON (Control Input)	V_{IN} to V_{OUT}	Quick Output Discharge (FOR SK1826A and SK1826AS)
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 V_{OUT} pin to the V_{IN} or GND pin when the voltage on V_{OUT} becomes higher than V_{IN}. 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: V_{IN} > 1.2V or V_{OUT} > 1.2V. Meanwhile considering of heat dissipation , V_{IN} input voltage should be limited less than 4.8V voltage when V_{ON} is active high.

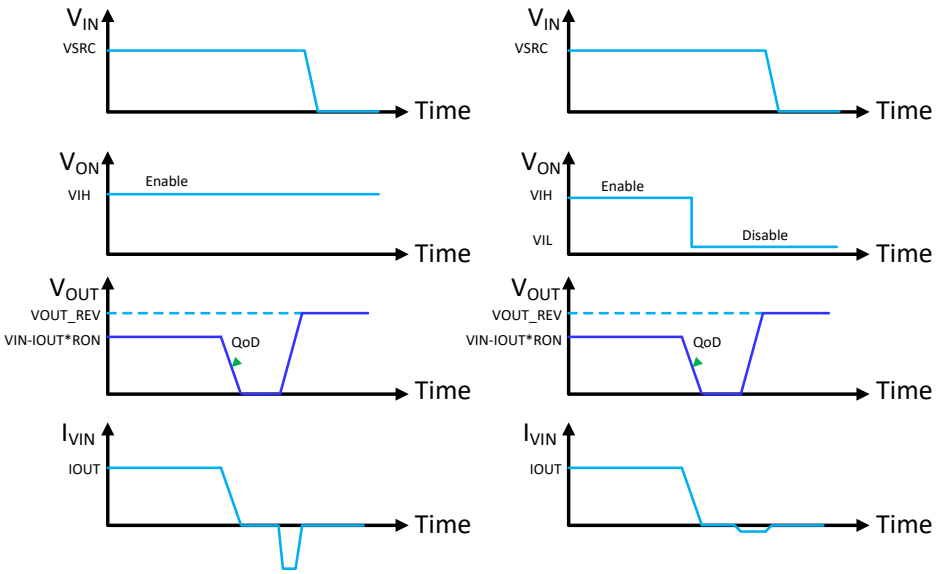


Figure 1

Quick Output Discharge

The SK1826A and SK1826AS integrate 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 V_{OUT} 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 V_{OUT} 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, C_{OUT} 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 predetermined 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.

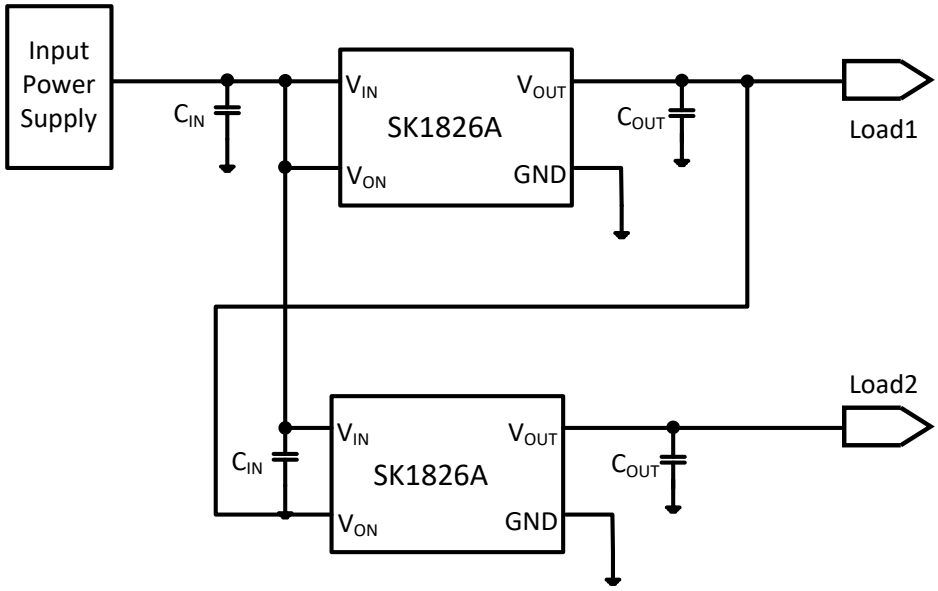
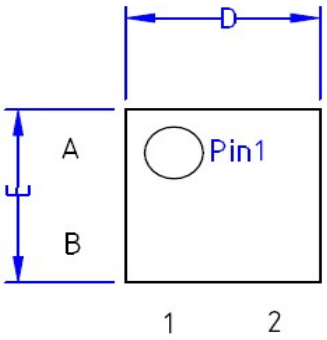
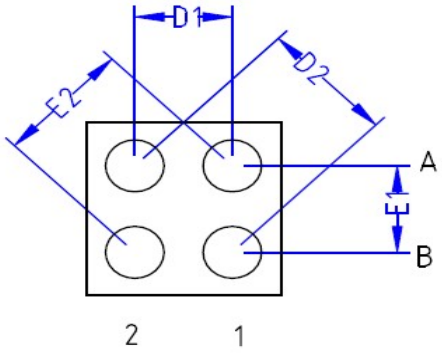


Figure 2

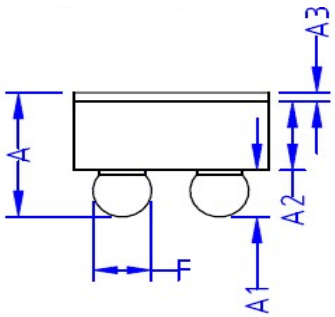
Package Dimensions: WLCSP4B



TOP VIEW
Ball Down



BOTTOM VIEW
Ball Up

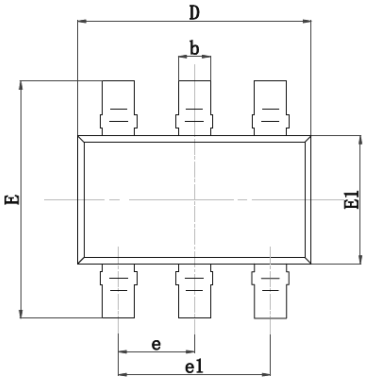


SIDE VIEW

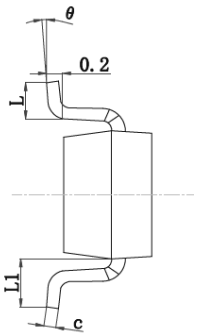
Unit:mm

		NO.	Mean	Tolerance
Top Thickness		A	0.449	±0.036
Ball Height+UBM Thickness		A1	0.194	±0.023
Wafer/Grinding Thickness		A2	0.215	±0.0125
Backside Coating Thickness		A3	0.04	±0.005
Pkg Die Size	X	D	0.775	±0.025
	Y	E	0.775	±0.025
Ball Size afer reflow		F	0.268	±0.020
Ball Pitch		D1	0.4	NA
		D2	0.565	NA
		E1	0.4	NA
		E2	0.565	NA

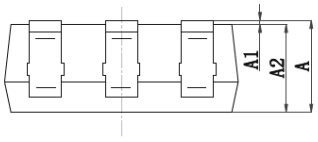
Package Dimensions: SOT23-6



TOP VIEW



SIDE VIEW



FRONT VIEW

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°