AMOLED Power Solution

1 General Description

The BV6802/A is a highly integrated power solution for AMOLED Display application, which uses a single-inductor-bipolar-output (SIBO) converter and three linear low-dropout regulators (LDO) to generate two positive and one negative voltage outputs. It does not need an extra charge pump circuit to generate the negative voltage output so that external capacitors required by the charge pump circuit can be eliminated and the pcb space can be achieved with very small.

The output voltages can be adjusted by SWIRE pin. Compared with the scheme of generating negative voltage by a charge pump circuit, the best energy conversion efficiency can only be obtained near the negative voltage ratio provided by its charge pump circuit. This SIBO architecture can provide a stable high conversion efficiency throughout the entire negative voltage adjusting range. Therefore, this solution can provide the optimal negative voltage output value according to different brightness requirements to reduce the power consumption of the AMOLED display significantly. This is the best solution that can optimize the solution form factor as well as display power consumption.

With its input voltage range from 2.9V to 5.5V, BV6802/A is optimized for products powered by single-cell batteries with output currents up to 80mA. The BV6802/A is available in the WL-CSP-16B 1.64mm x 1.64mm package.

2 Features

- Input Voltage Range: 2.9V to 5.5V
- Positive Output Voltage AVDD: 2.6V to 3.5V
  (BV6802 Default is 2.8V±1%)
  (BV6802A Default is 3.3V±1%)
- Positive Output Voltage OVDD Range: 2.6V to 5.3V (Default is 4.6V±1%)
- Negative Output Voltage OVSS Range: -0.6V to -4.7V (Default is -2.4V±1%)
- Low Quiescent Current: 70μA
- AVDD Max. Loading is 20mA, OVDD and OVSS Max. loading is 100mA
- Low Output Ripple
- Built-in Internal Soft start
- UVLO, UVP, SCP, OCP, OTP, and SSP protection

3 Applications

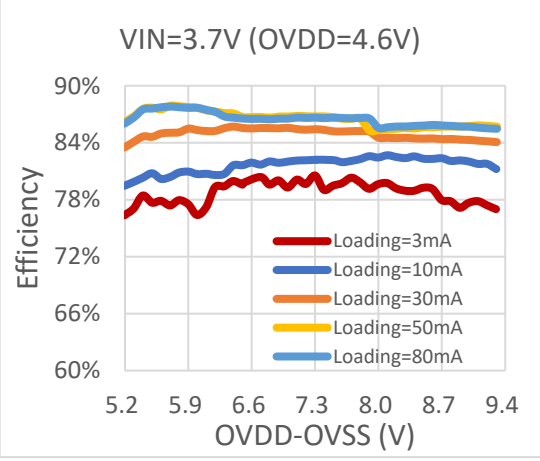
- Wearable AMOLED Product

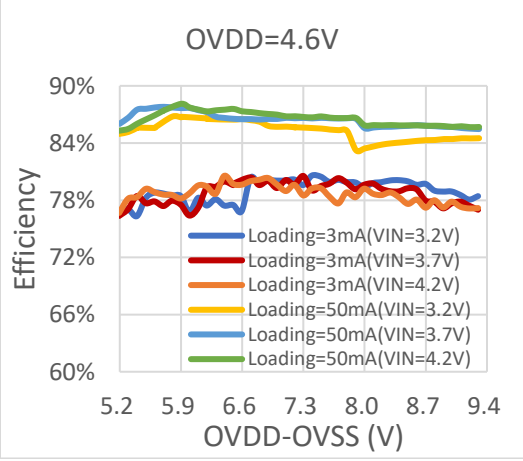
4 Ordering Information

BV6802(A)W

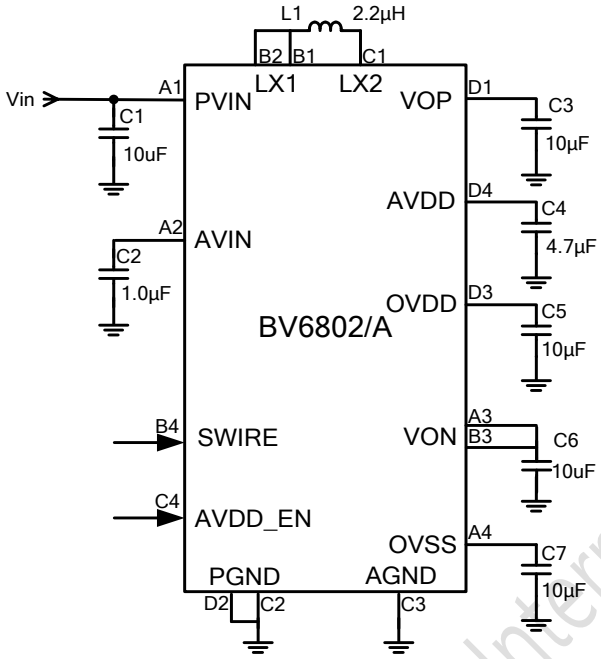
- Package Type
  W: WL-CSP-16B 1.64mmx1.64mm
- Default: AVDD is 2.8V.
  A: AVDD is 3.3V

Note:
Bravotek products are RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020Package Information





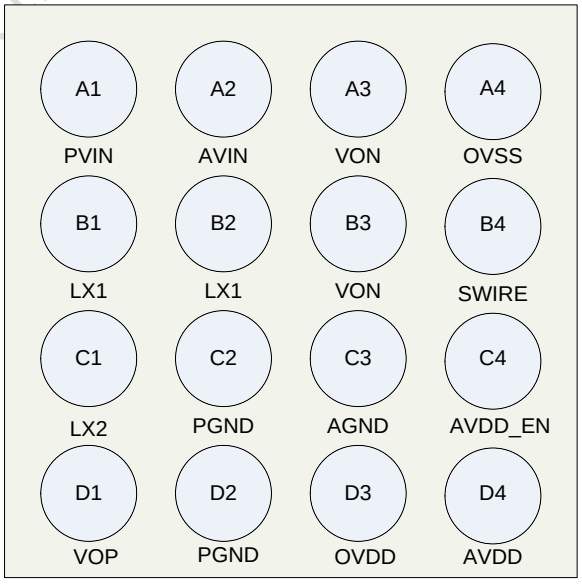
5 Application Circuit



Selectable Model

Model	Output Voltage
BV6802	AVDD(VCI)=2.8V, OVDD(ELVDD)=4.6V, OVSS(ELVSS)=-2.4V
BV6802A	AVDD(VCI)=3.3V, OVDD(ELVDD)=4.6V, OVSS(ELVSS)=-2.4V

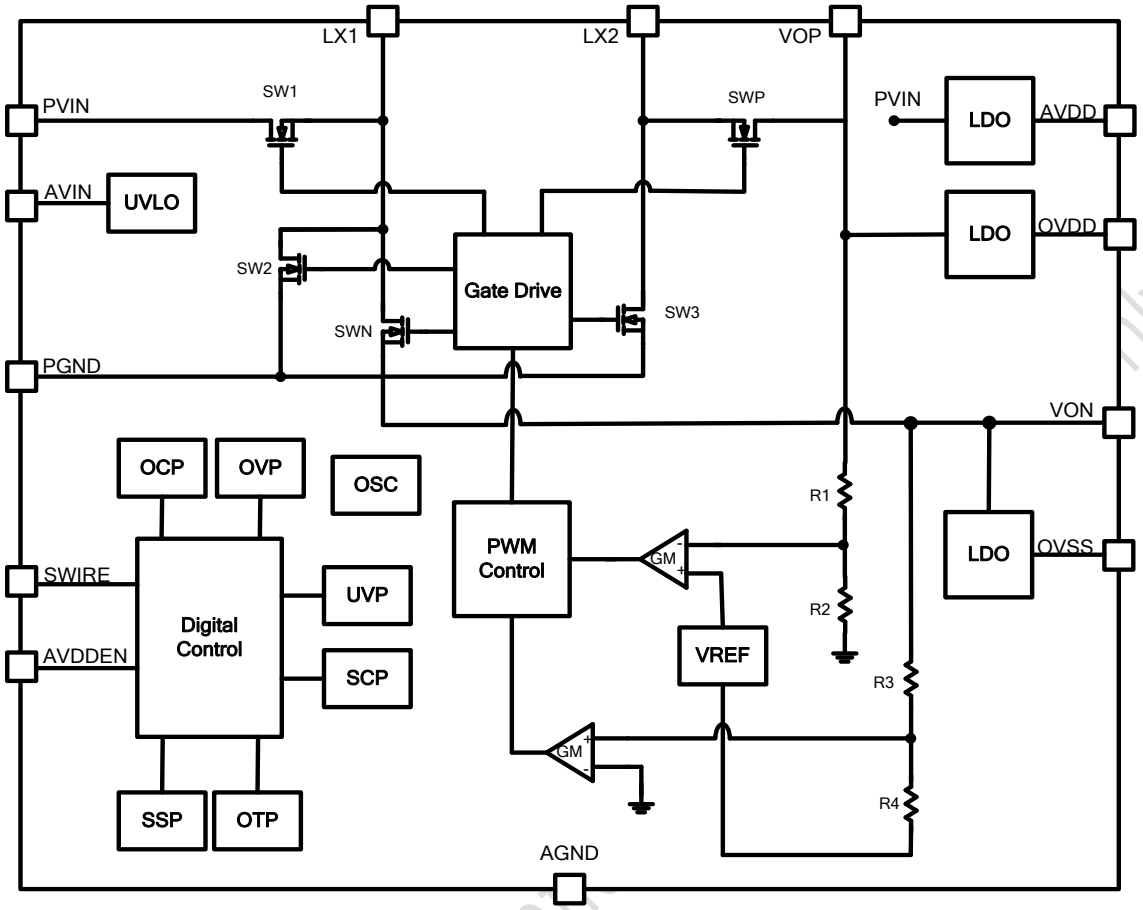
6 Pin Configuration and Function



Top View

Pin	Name	Function
A1	PVIN	Power Input for SIBO
A2	AVIN	Analog Power Input for IC
A3, B3	VON	SIBO Negative Output.
A4	OVSS	OVSS LDO Output
B1, B2	LX1	LX1 switching node for SIBO
B4	SWIRE	SWIRE Control Interface
C1	LX2	LX2 switching node for SIBO
C2, D2	PGND	Power Ground
C3	AGND	Analog Ground
C4	AVDD_EN	Enable for AVDD
D1	VOP	SIBO Positive Output
D3	OVDD	OVDD LDO Output
D4	AVDD	AVDD LDO Output

7 Functional Block Diagram



8 Absolute Maximum Ratings

- Supply Input Voltage: AVIN, PVIN to ANGD, PGND .....-0.3V to 6.0V
- VOP, AVDD, OVDD, SWIRE, AVDDEN to AGND, PGND .....-0.3V to 6.0V
- VON, OVSS to ANGD, PGND .....-6.0V to 0.3V
- Power Dissipation, PD@ TA=25°C
  WL-CSP-16B 1.96W
- Package Thermal Resistance
  WL-CSP-16B, θ_{JA} ..... 51°C/W
- Lead Temperature (Soldering, 10sec.) ..... 260°C
- Junction Temperature ..... 150°C
- Storage Temperature .....-65°C to 150°C
- ESD Susceptibility
  HBM(Human Body Model) 2KV
  MM(Machine Model) 200V

9 Recommended Operating Conditions

- BV6802 Supply Input Voltage ..... 2.9V to 5.5V
- BV6802A Supply Input Voltage ..... 3.4V to 5.5V
- Junction Temperature Range ..... -40°C to 125°C
- Ambient Temperature Range ..... -40°C to 85°C

Note:

1. Stresses beyond 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–rated conditions for extended periods may affect device reliability.
2. The device is not guaranteed to function outside its recommended operating conditions.

10 Components Selection

10.1 Inductor

Reference	Value	Component supplier	Package	Isat / DCR
L1	2.2uH	ALPS GLULK2R201A	2.5mm x 2.0mm x 1.0mm	1.8A / 85mΩ
L1	2.2uH	Cyntec HTQA20161T-2R2MSRG	2.0mm x 1.6mm x 1.0mm	2.6A / 100mΩ

10.2 Capacitors

Reference	Value	Component supplier	Package
C1, C3, C5, C7, C6	10uF/6.3V	GRM188R60J106ME84	0603
C4	4.7uF/6.3V	GRM188R60J475KE19	0603
C2	1uF/6.3V	GRM155R60J105ME19	0402

11 Electrical Characteristics

V_{IN}=3.7V, AVDD=2.8V or 3.3V, OVDD=4.6V, OVSS=-2.4V, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Input Power Supply						
Input Supply Voltage	V_{IN}	BV6802	2.9	3.7	5.5	V
		BV6802A	3.4	3.7	5.5	V
Quiescent Current	I_Q	SWIRE=High, AVDD_EN=High, measured into VIN pin. No load	-	70	-	µA
Standby Current	$I_{Standby}$	AVDD_EN =High and SWIRE = low	-	20		µA
Shutdown Current	I_{SHDN}	AVDD_EN and SWIRE = low	-	0.1	1	µA
Under-Voltage Lockout Threshold	V_{UVLOH}	VIN Rising	--	2.75	2.85	V

	V_{UVLOL}	VIN falling	--	2.5	2.6	V
Thermal Shutdown	T_{SD}		--	140	--	˚C
Thermal Shutdown Hysteresis	ΔT_{SD}		--	10	--	˚C
SWIRE						
SWIRE Logical High-Level Voltage	V_{SRH}	V_{IN}=2.9V to 5.5V	1.2	-	-	V
SWIRE Logic Low-Level Voltage	V_{SRL}	V_{IN}=2.9V to 5.5V	0	-	0.4	V
SWIRE Turn-off Detection	T_{OFF_DLY}		300	-	-	µs
SWIRE Signal Stop Indicate Time	T_{STOP}		300	-	-	µs
SWIRE Rising Time	T_r		-	-	200	ns
SWIRE Falling Time	T_f		-	-	200	ns
Clocked SWIRE High	T_{ON}		2	-	20	µs
Clocked SWIRE Low	T_{OFF}		2	-	20	µs
Input Clocked SWIRE Frequency	F_{SWIRE}		25	-	250	KHz
AVDDEN						
AVDD Enable Input Voltage	V_{IH}	V_{IN}=2.9V to 5.5V	1.2	-	-	V
	V_{IL}	V_{IN}=2.9V to 5.5V	0	-	0.4	V
SIBO						
Positive Output Voltage Range	V_{OP}		2.7	-	5.4	V
Negative Output Voltage Range	V_{ON}		-4.8	-	-0.7	V
Switching Frequency	F_{SW}		1.2	1.5	1.8	MHz
Over Current Protection	I_{OCP}			0.75		A
AVDD LDO						
Positive Output Voltage Range	V_{AVDD_RANGE}	BV6802	2.6	2.8	3.5	V
		BV6802A	2.6	3.3	3.5	V
Positive Output Voltage Accuracy	V_{AVDD_ACC}		-1	-	1	%
Output Current Capability	I_{AVDD}		-	10	20	mA
Line Regulation	V_{AVDD_LINE}	V_{IN}=2.9 to 5.5V, I_{AVDD}=1mA	-	2	5	mV
Load Regulation	V_{AVDD_LOAD}	I_{AVDD} = 0 to 10mA	-	2	5	mV
Output Ripple	V_{AVDD_RIPPLE}	I_{AVDD} = 5mA	-	-	10	mV
Current Limit	I_{AVDD_LIMIT}		-	30	50	mA
Discharge Resistance	R_{AVDD_RDIS}			100		Ω
Under Voltage Protection				80		%
UVP Detection Time				1.35		ms
OVDD LDO						
Positive Output Voltage Range	V_{OVDD_RANGE}		2.6	4.6	5.3	V

Positive Output Voltage Accuracy	V_{OVDD_ACC}		-1	-	1	%
Output Current Capability	I_{OVDD}		-	80	100	mA
Line Regulation	V_{OVDD_LINE}	V_{IN}=2.9 to 5.5V, I_{OVDD}=1mA	-	2	5	mV
Load Regulation	V_{OVDD_LOAD}	I_{OVDD} = 0 to 10mA	-	2	5	mV
Output Ripple	V_{OVDD_RIPPLE}	I_{OVDD} = 30mA	-	-	10	mV
Current Limit	I_{OVDD_LIMIT}		-	150	200	mA
Discharge Resistance	R_{OVDD_RDIS}		-	100	-	Ω
Under Voltage Protection				80		%
UVP Detection Time				1.35		ms
OVSS LDO						
Negative Output Voltage Range	V_{OVSS_RANGE}		-4.7	-2.4	-0.6	V
Negative Output Voltage Accuracy	V_{OVSS_ACC}		-1	-	1	%
Output Current Capability	I_{OVSS}		-	80	100	mA
Line Regulation	V_{OVSS_LINE}	V_{IN}=2.9 to 5.5V, I_{OVSS}=1mA	-	2	5	mV
Load Regulation	V_{OVSS_LOAD}	I_{OVSS} = 0 to 10mA	-	2	5	mV
Output Ripple	V_{OVSS_RIPPLE}	I_{OVSS} = 30mA	-	-	10	mV
Current Limit	I_{OVSS_LIMIT}		-	150	200	mA
Discharge Resistance	R_{OVSS_RDIS}			100		Ω
Under Voltage Protection				80		%
UVP Detection Time				1.35		ms

12 Detail Descriptions

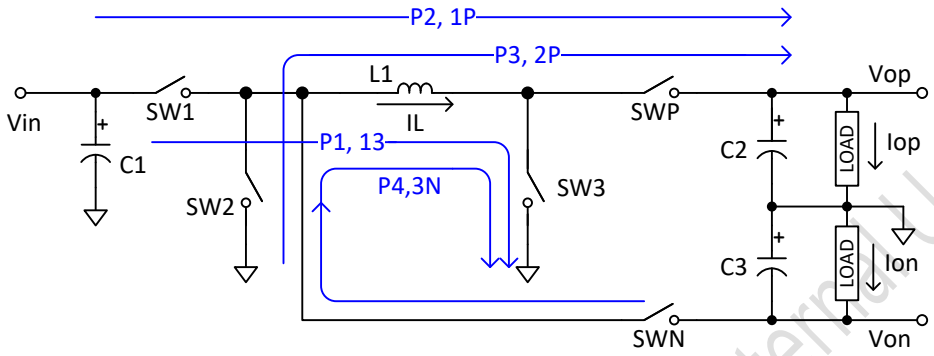
The BV6802/A operates with a five-switch buck-boost converter topology to generation a negative and positive output voltage with a single inductor. The IC have the best efficiency over the entire load-current range. It is implemented by reducing the converter switching frequency into the PSM mode for light load. The output voltage can be set by SWIRE pin, OVDD voltage is from 2.6V to 5.3V, OVSS voltage is from -0.6V to -4.7V, and AVDD voltage is from 2.6V to 3.5V. BV6802/A can supply the maximum output current up to 80mA for high luminance application.

The convertor generates the positive voltage (VOP) and the negative voltage (VON) by the several phase switching. Please see the below table to show switch control phase.

Phase	SW1	SW2	SW3	SWP	SWN
P1	ON	OFF	ON	OFF	OFF
P2	ON	OFF	OFF	ON	OFF
P3	OFF	ON	OFF	ON	OFF
P4	OFF	OFF	ON	OFF	ON
P5(From P3)	OFF	ON	OFF	OFF	OFF
P5(From P4)	OFF	OFF	ON	OFF	OFF

Switch Control Phase

During the phase 1, SW1 and SW3 is turn on, connecting the inductor form VIN to GND for charge. During phase 2 and phase3, the inductor discharges to the positive voltage and phase 4, the inductor discharges to the negative voltage. If the loop only charges to the positive voltage, the phase 1 will switch to phase 3 in one cycle when the positive voltage is light load, and the phase 1 will switch to phase 2 then phase 3 in one cycle when the positive voltage is heave load. If the loop only charges to the negative voltage, the phase 1 will switch to phase 4 in one cycle. The phase 1 will switch phase 2 the phase 4 if the loop charges the positive and negative simultaneously. The charge and discharge current path could be referenced the below picture.



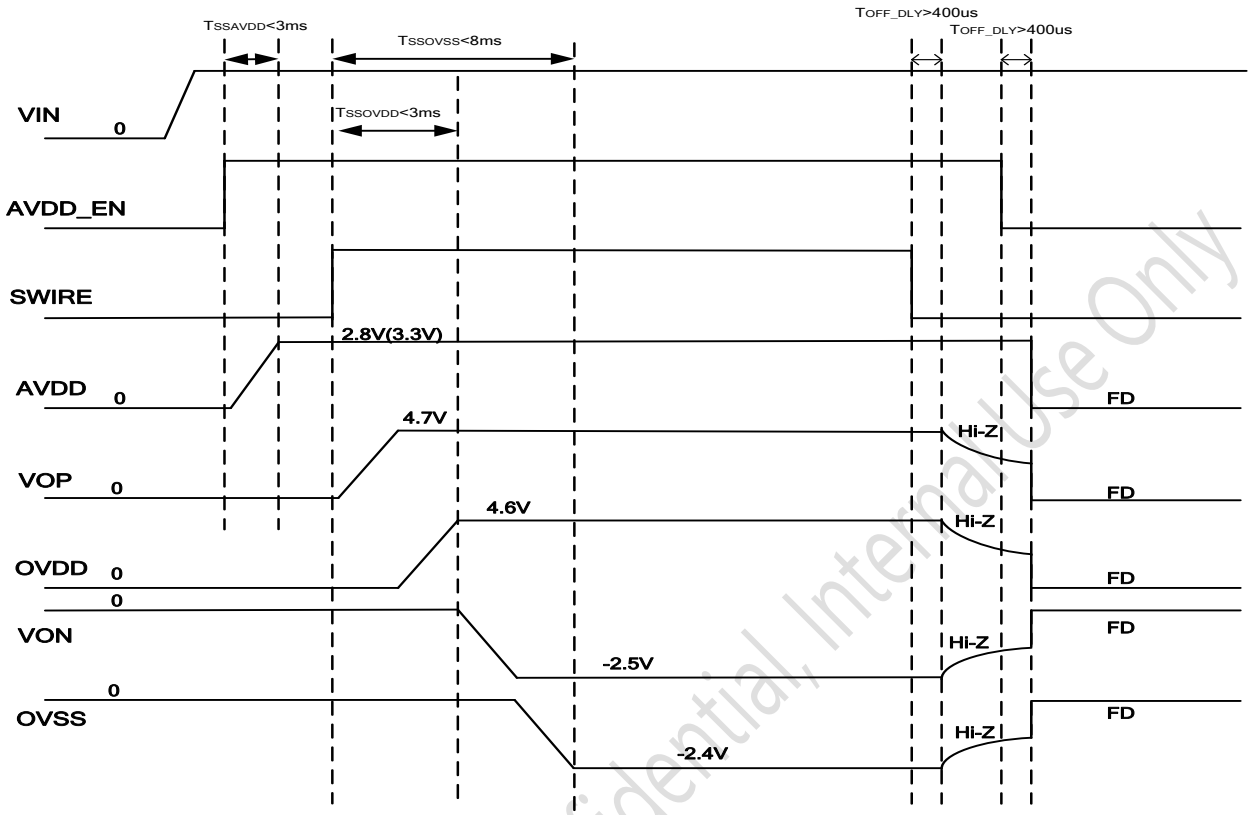
. Iop & Ion with load @ CCM, (P1→P2→P4)→(P1→P2→P4→)...
. Iop & Ion with load @ DCM, (P1→P2→P4→P5)→(P1→P2→P4→P5)...
. Ion with load only, (P1→P4→P5)→(P1→P4→P5)...
. Iop with load only, (P1→P2→P3→P5)→(P1→P2→P3→P5) OR (P1→P3→P5)→(P1→P3→P5)...

There are three LDOs inside in the BV6802/A to generate the low noise voltage to supply the wearable OLED power (AVDD, OVDD and OVSS). The AVDD LDO's supply power is PVIN, OVDD LDO's supply power is VOP and the dropout voltage is 100mV. The OVSS LDO's supply power is VON and the dropout voltage is 100mV too. The VOP and VON voltage will be adjusted automatically when the LDO output voltage is adjusted to keep the same dropout voltage.

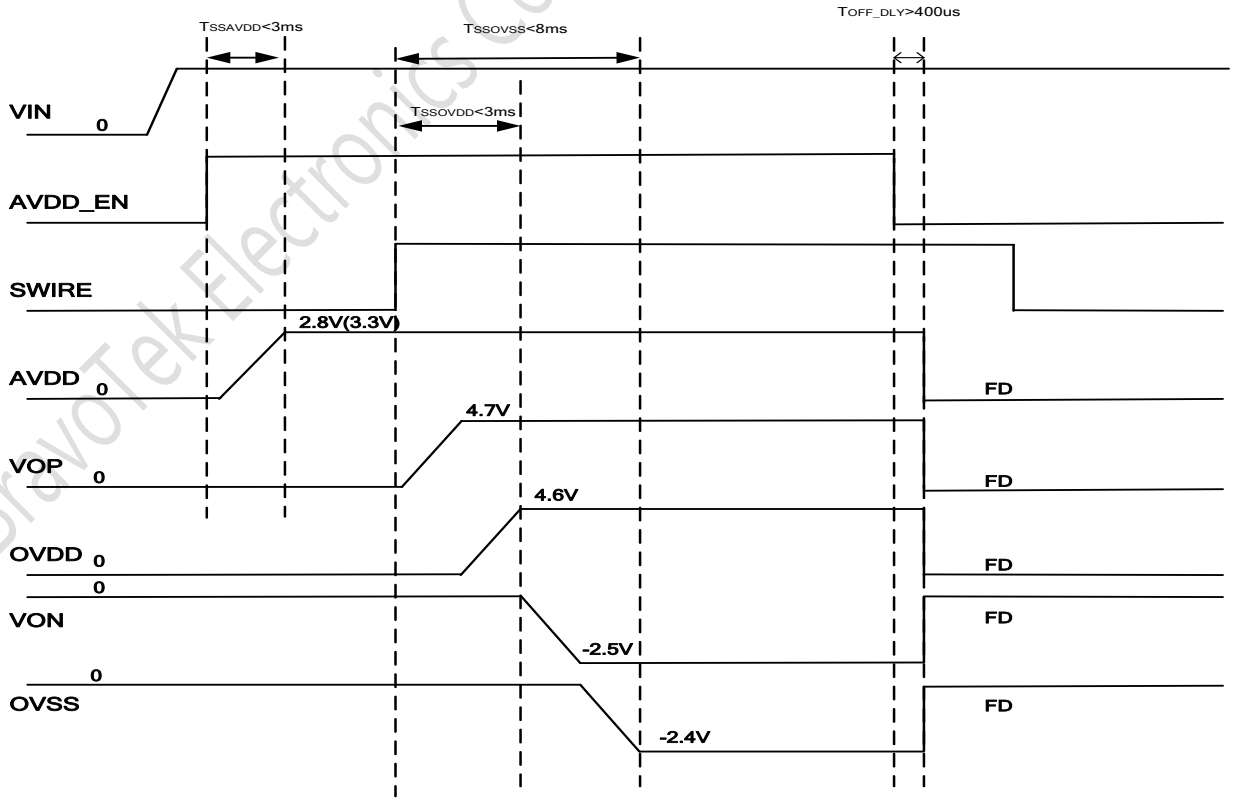
The BV6802/A provides the Under-Voltage Protection (UVP), Short-Circuit Protection (SCP), Over-Temperature Protection (OTP), Over-Current Protection (OCP) and Startup-Short Protection (SSP).

12.1 Power Sequence

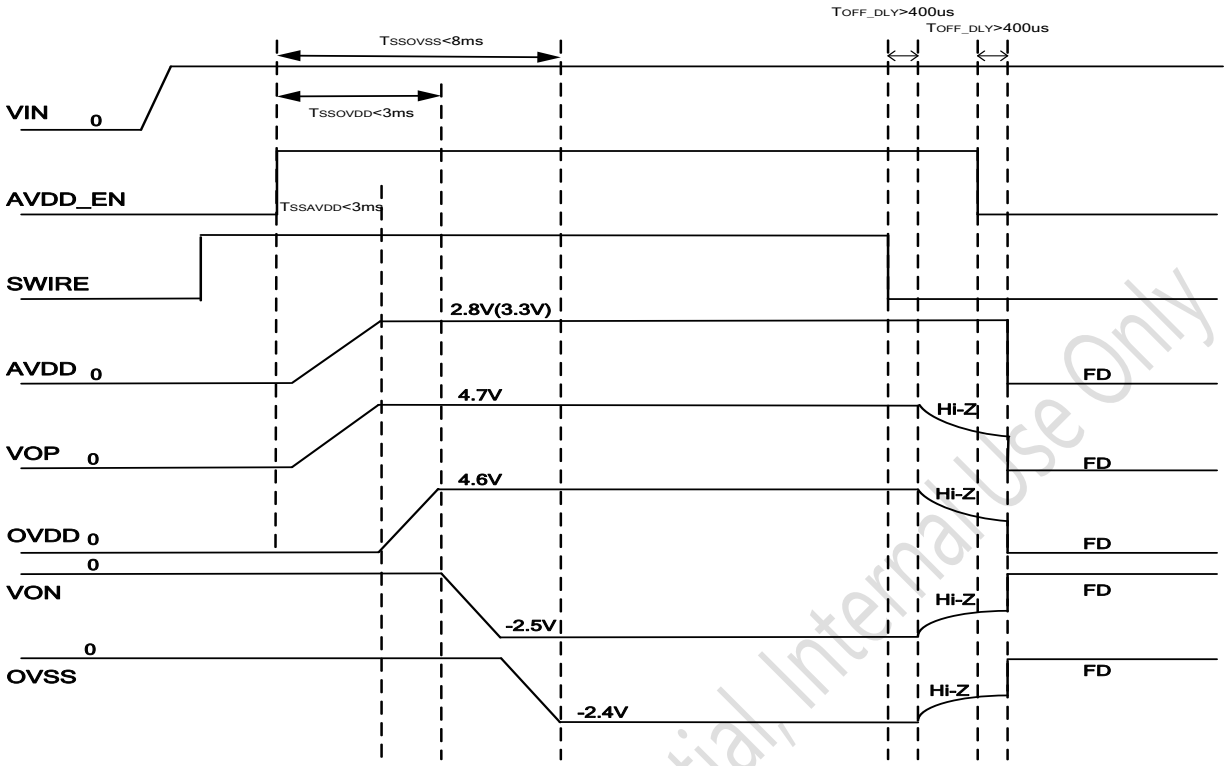
12.1.1 AVDDEN = ON ➡ SWIRE=ON ➡ SWIRE=OFF ➡ AVDDEN=OFF



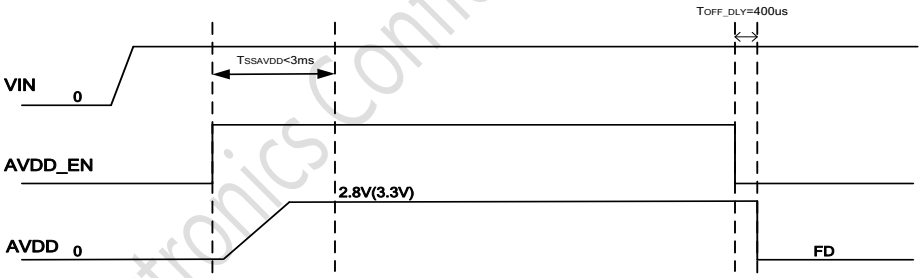
12.1.2 AVDDEN = ON ➡ SWIRE=ON ➡ AVDDEN=OFF ➡ SWIRE=OFF



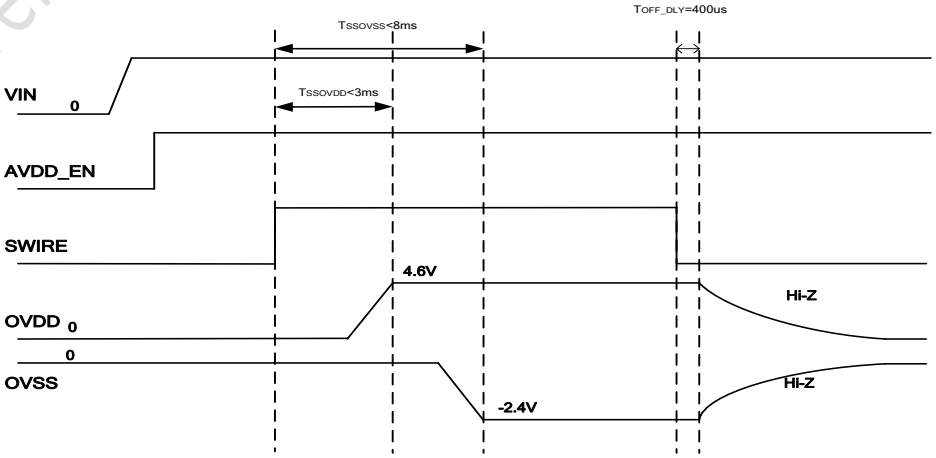
12.1.3 SWIRE = ON ➡ AVDDEN=ON ➡ SWIRE=OFF ➡ AVDDEN=OFF



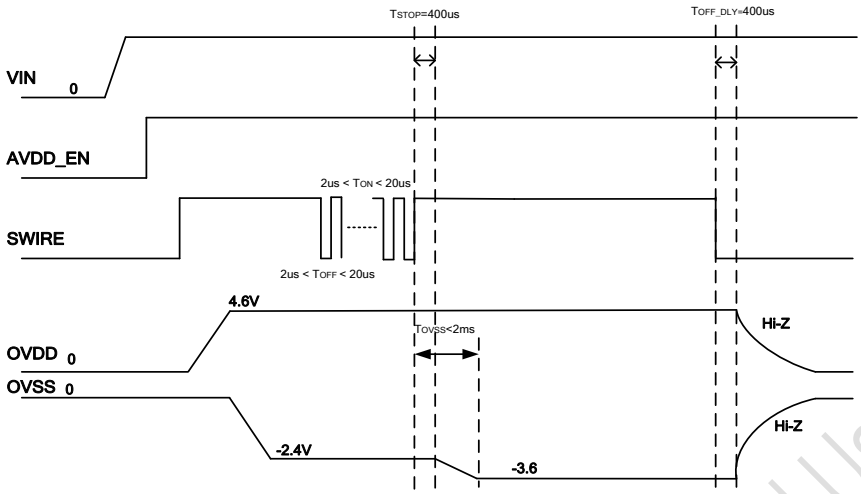
12.1.4 AVDDEN Power ON-OFF Sequence



12.1.5 SWIRE Power ON-OFF Sequence



12.1.6 OVSS Voltage setting by SWIRE



12.2 Protection Functions

12.2.1 Under-Voltage Protection

All outputs are protected against short circuits either to GND. The IC will go into shutdown mode when the output voltage is under the limit level (80% and keep 1.35ms). The IC can only restart normal operation after re-power on.

12.2.2 Over-Temperature Protection

The BV6802/A include an over temperature protection circuit to prevent overheating. The IC will disable positive and negative output when the junction temperature exceeds 140°C. Once the junction temperature drops down 10°C approximately, IC will automatically recovery into normal operation.

12.2.3 Short-Circuit Protection

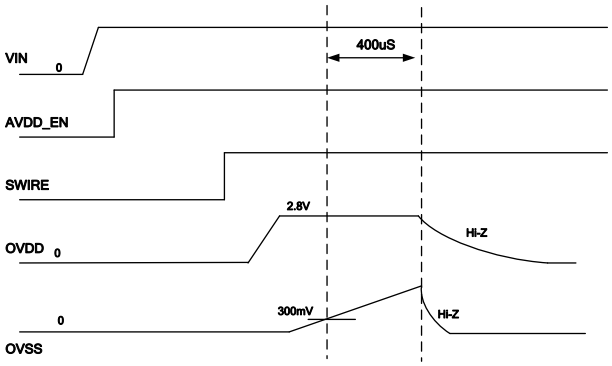
All outputs are protected against short circuits either to GND. The IC will go into shutdown mode immediately when the output short to ground, and the output voltage is under the limit level (20%). The IC can only restart normal operation after re-power on.

12.2.4 Over-Current Protection

The BV6802/A includes a cycle-by-cycle current limit function which monitor the inductor current during Phase 1 period. The power switch will be forced off to avoid large current damage IC when the current is over the limit level (0.75A).

12.2.5 Startup-Short Protection (Optional) (Default is disable)

The BV6802/A provides the function to check OVDD and OVSS short when power on. The OVDD and OVSS will disable when OVSS voltage large than 300mV and keep 400us. The detect period is between OVDD start-up to OVSS start-up. Please see the detail on the below curve.



12.3 SWIRE Setting

Pulse	Function Description
0	Clear all setting to default code (AVDD, OVDD, and OVSS voltage setting doesn't)
10-12	OVSS transient time method
13-17	OVSS transient time setting
22-31	AVDD setting (2.6V to 3.5V)
36-63	OVDD setting (2.6V to 5.3V)
70-111	OVSS setting (-4.7V to -0.6V)
124	OVDD and OVSS fast discharge when SWIRE pull low
125	AVDD, OVDD and OVSS Hi-Z when AVDD_EN pull low
126	OVDD turn on
127	OVSS and VON turn on
128	OVDD turn off (Hi-Z)
129	OVSS and VON turn off (Hi-Z)
130	OVSS and VON discharge to GND then Hi-Z when SWIRE pull low
131	Soft-Reset, clear all setting to default code (AVDD, OVDD, and OVSS voltage setting doesn't)

124 and 125 Pulse – Discharge function

Default				
AVDD_EN	SWIRE	AVDD	OVDD	OVSS
0	0	FD	FD	FD
0	1	FD	FD	FD
1	0		Hi-Z	Hi-Z

124 Pulse				
AVDD_EN	SWIRE	AVDD	OVDD	OVSS
0	0	FD	FD	FD
0	1	FD	FD	FD
1	0		FD	FD

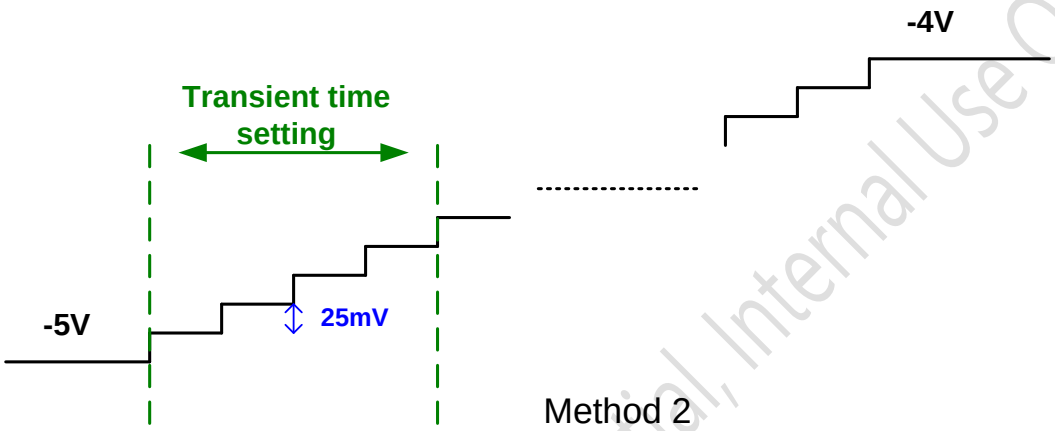
125 Pulse				
AVDD_EN	SWIRE	AVDD	OVDD	OVSS
0	0	Float	Hi-Z	Hi-Z
0	1	Float	Hi-Z	Hi-Z
1	0		Hi-Z	Hi-Z

124 Pulse + 125 Pulse				
AVDD_EN	SWIRE	AVDD	OVDD	OVSS
0	0	Float	Hi-Z	Hi-Z
0	1	Float	Hi-Z	Hi-Z
1	0		FD	FD

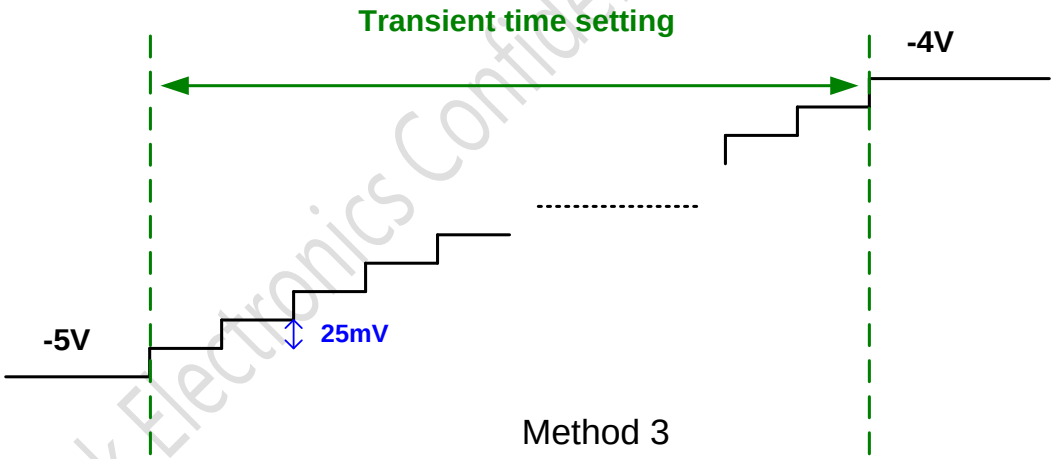
10~12 Pulse – OVSS transient time method

Pulse	OVSS transient time method	Description
10	Method 1	Direct change (40uS/0.1V)
11	Method 2	4 division change (25mV) during transient time setting per 100mV
12	Method 3	Smoothly change within transient time setting

Ex. OVSS transient from -5V to -4V



Method 2



Method 3

Pulse	OVSS transient time setting
13	5ms
14	10ms
15	15ms
16	20ms
17	25ms

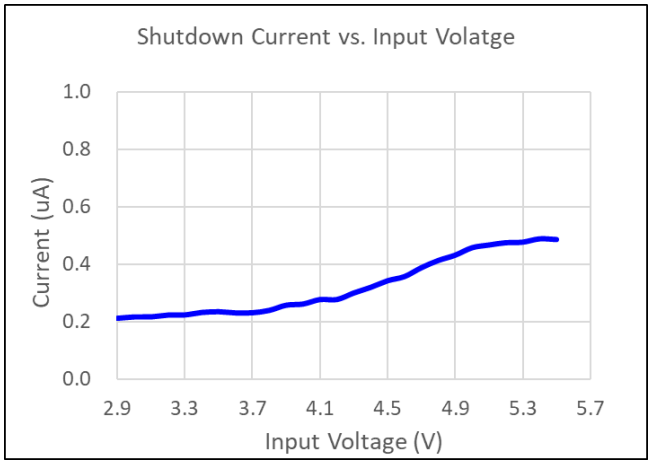
Pulse	AVDD
22	2.6V
23	2.7V
24	2.8V
25	2.9V
26	3.0V
27	3.1V
28	3.2V
29	3.3V
30	3.4V
31	3.5V

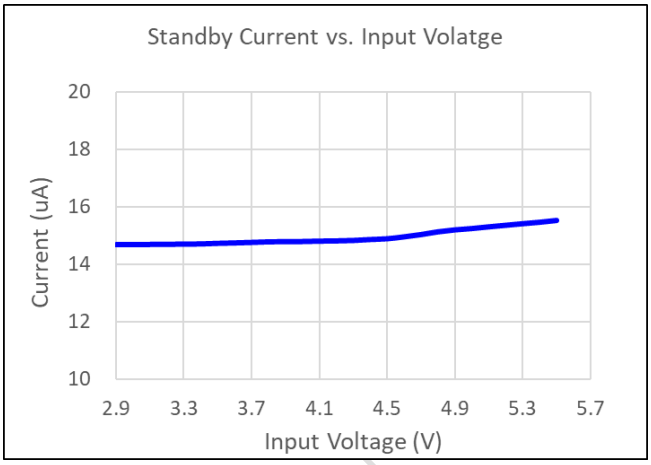
Pulse	OVDD
36	2.6V
37	2.7V
38	2.8V
39	2.9V
40	3.0V
41	3.1V
42	3.2V
43	3.3V
44	3.4V
45	3.5V
46	3.6V
47	3.7V
48	3.8V
49	3.9V
50	4.0V
51	4.1V
52	4.2V
53	4.3V
54	4.4V
55	4.5V
56	4.6V
57	4.7V
58	4.8V
59	4.9V
60	5.0V
61	5.1V
62	5.2V
63	5.3V

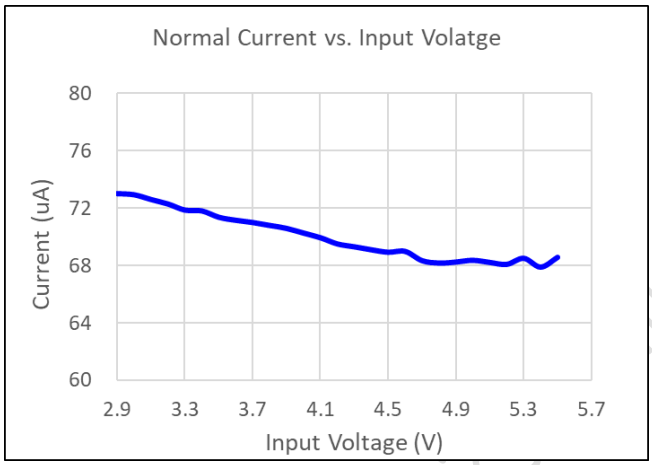
Pulse	OVSS	Pulse	OVSS
70	-4.7V	91	-2.6V
71	-4.6V	92	-2.5V
72	-4.5V	93	-2.4V
73	-4.4V	94	-2.3V
74	-4.3V	95	-2.2V
75	-4.2V	96	-2.1V
76	-4.1V	97	-2.0V
77	-4.0V	98	-1.9V
78	-3.9V	99	-1.8V
79	-3.8V	100	-1.7V
80	-3.7V	101	-1.6V
81	-3.6V	102	-1.5V
82	-3.5V	103	-1.4V
83	-3.4V	104	-1.3V
84	-3.3V	105	-1.2V
85	-3.2V	106	-1.1V
86	-3.1V	107	-1.0V
87	-3.0V	108	-0.9V
88	-2.9V	109	-0.8V
89	-2.8V	110	-0.7V
90	-2.7V	111	-0.6V

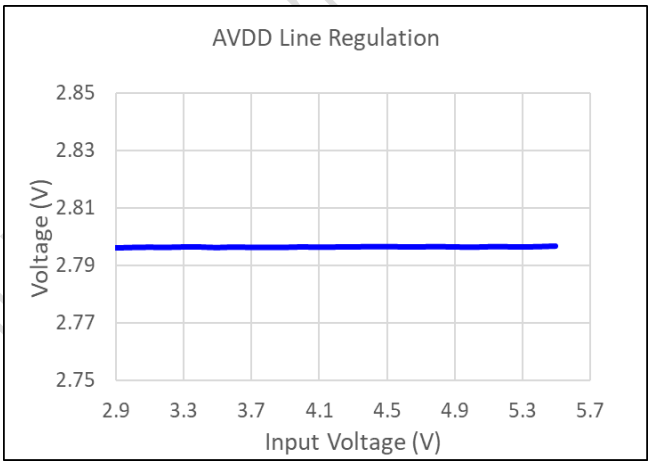
13 Typical Operating Curve

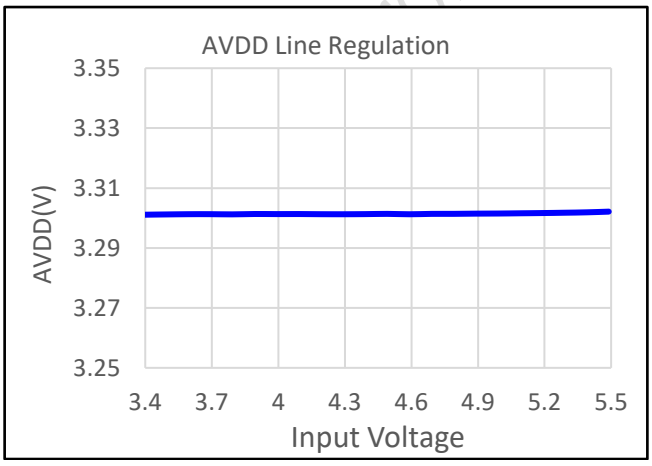
V_{IN}=3.7V, AVDD=2.8V or 3.3V, OVDD=4.6V, OVSS=-2.4V, T_A=25°C, unless otherwise specified

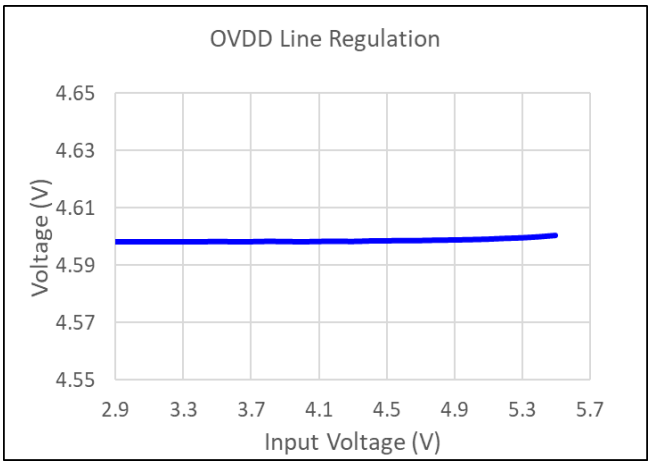


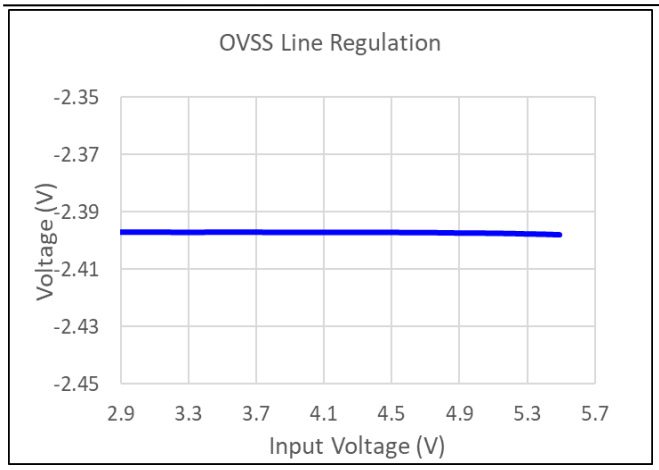


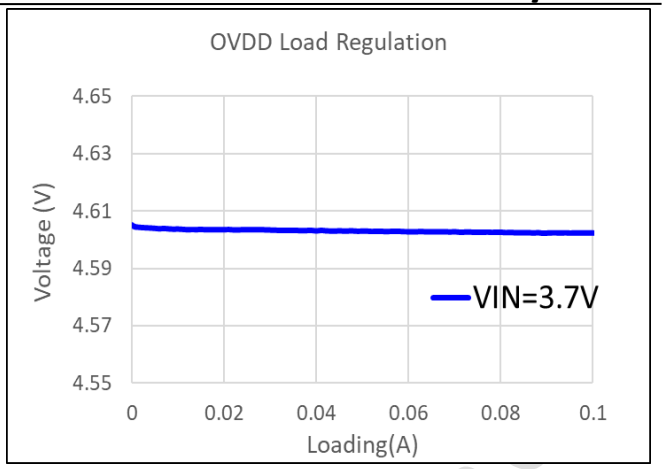


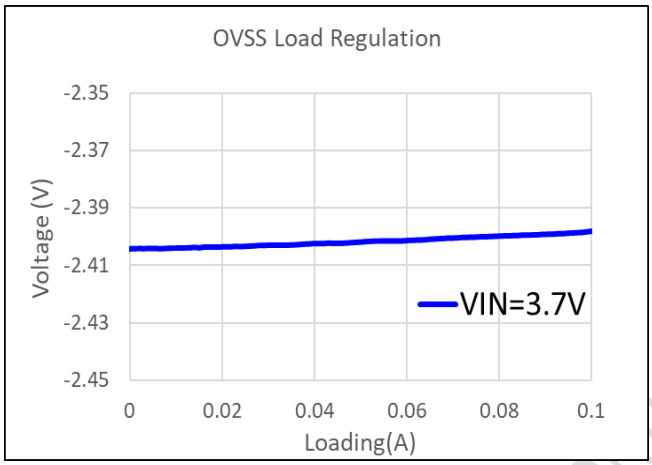


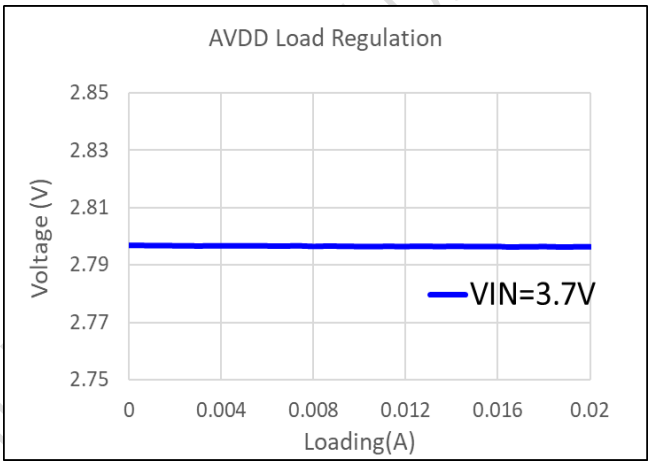


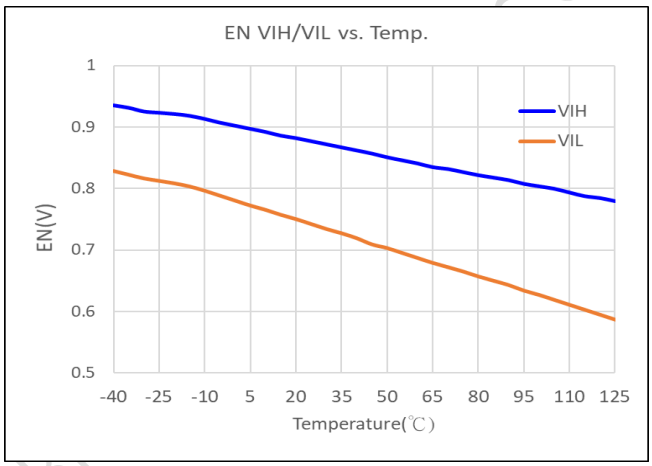


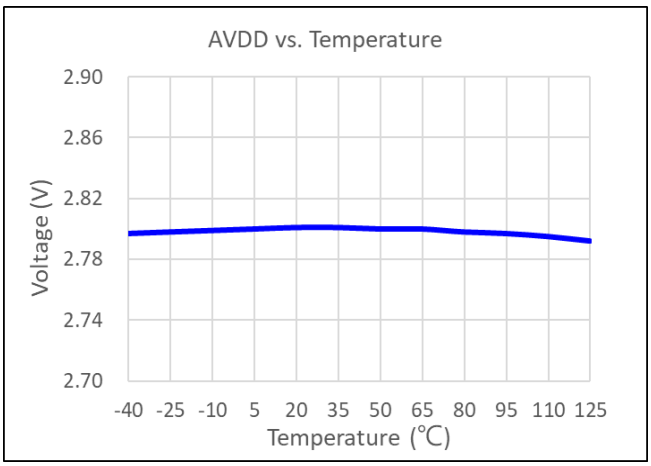


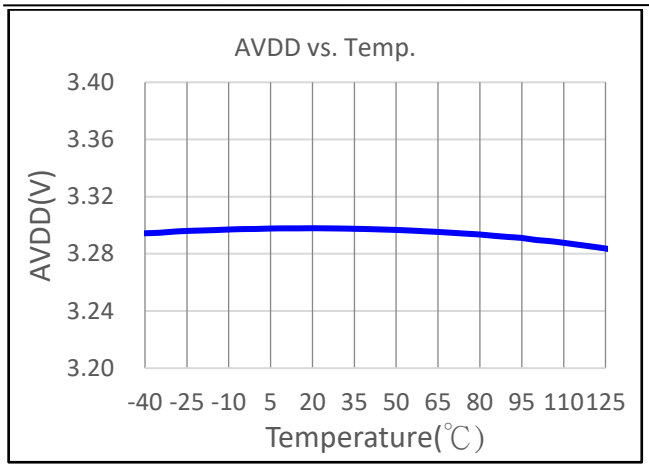


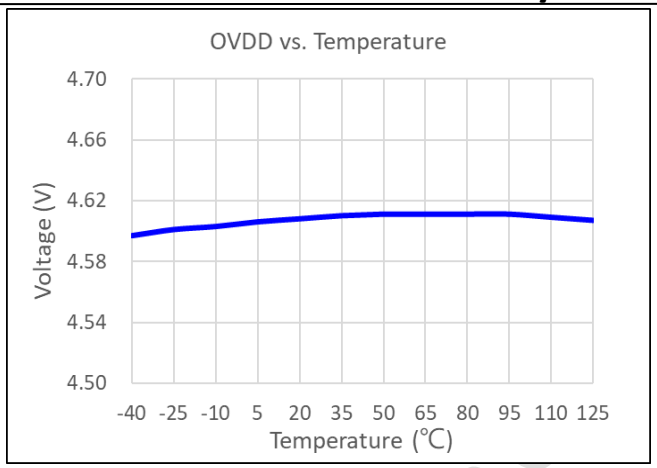


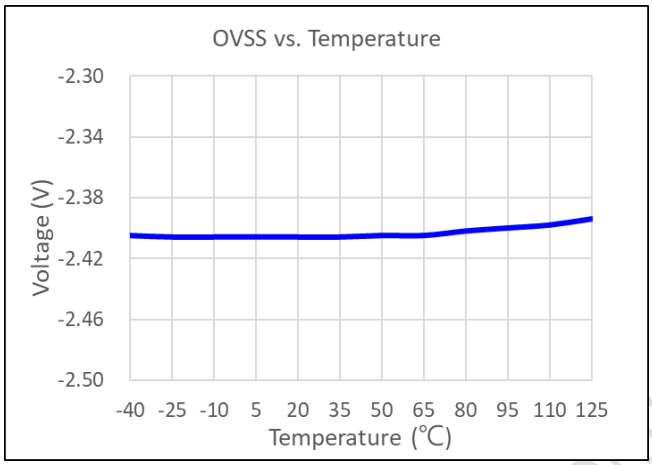


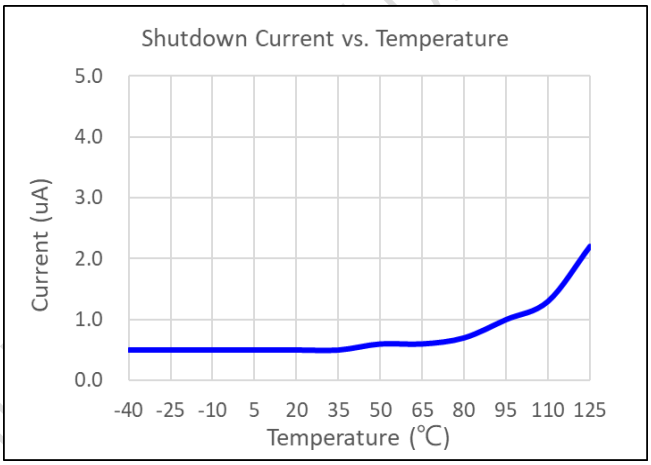


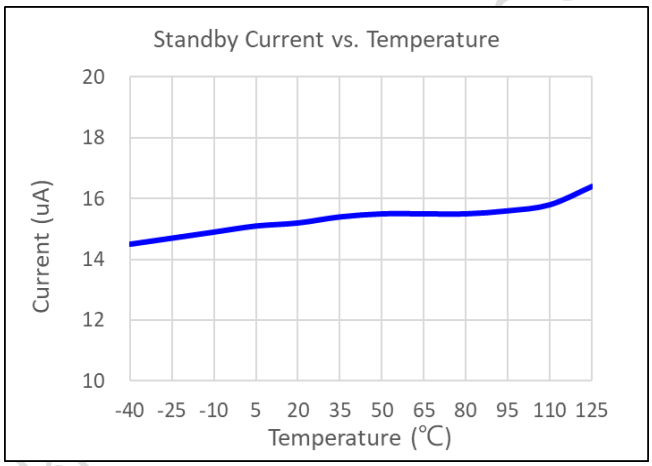


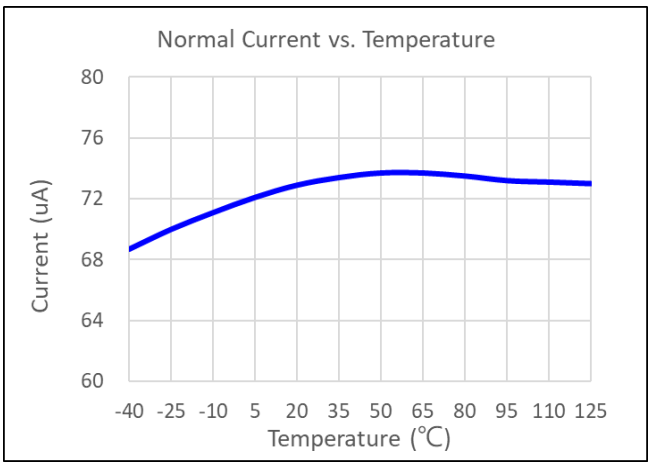


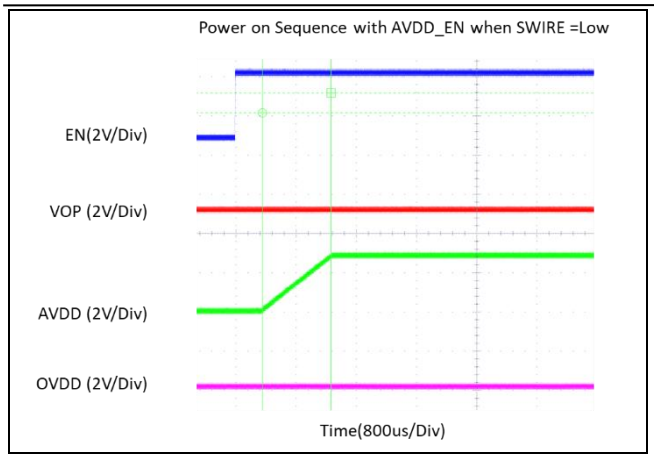


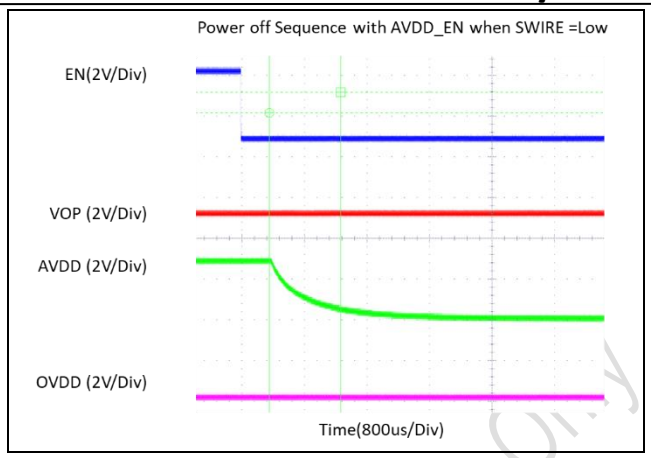


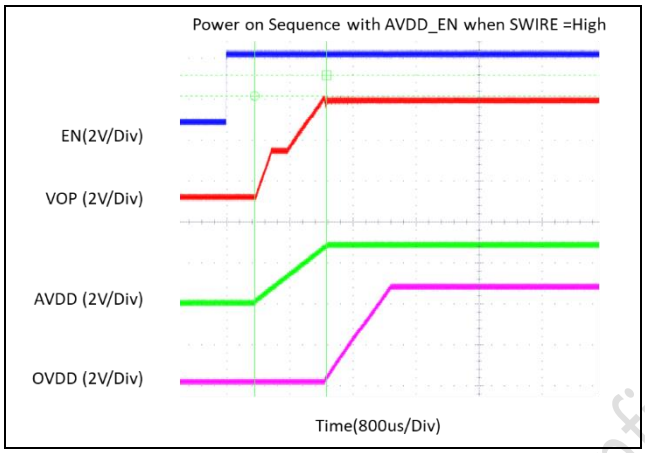


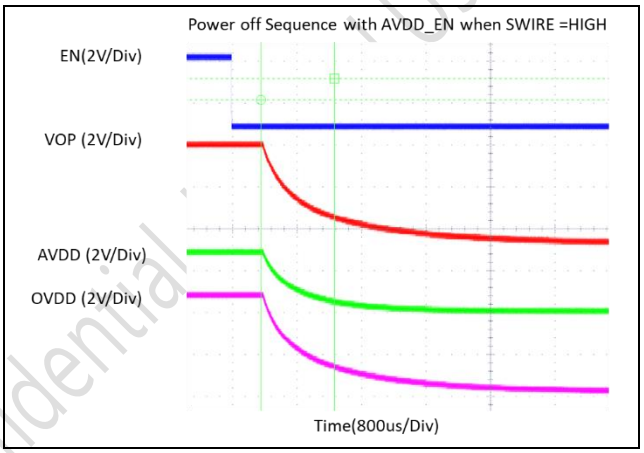


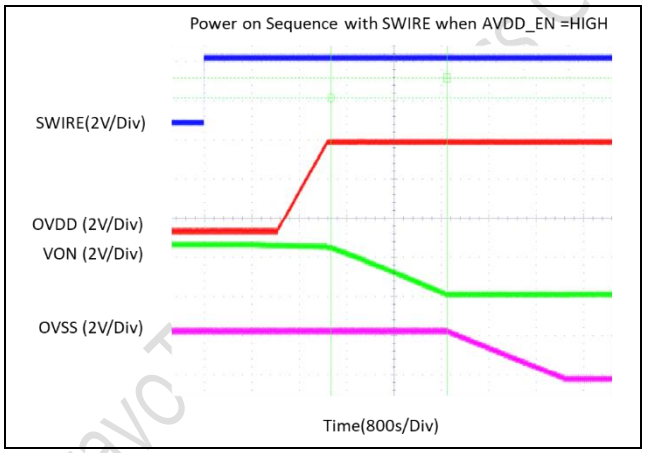


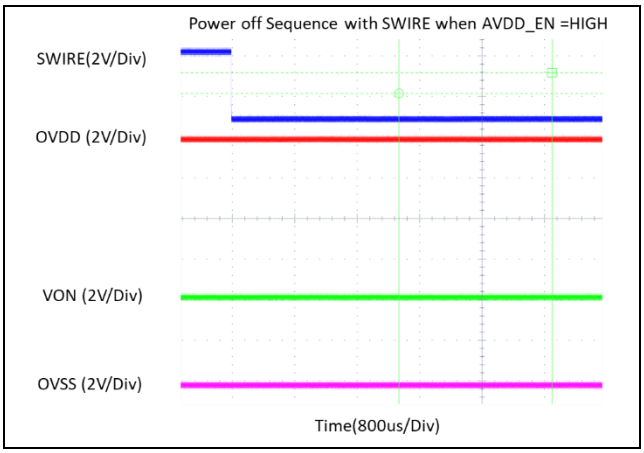


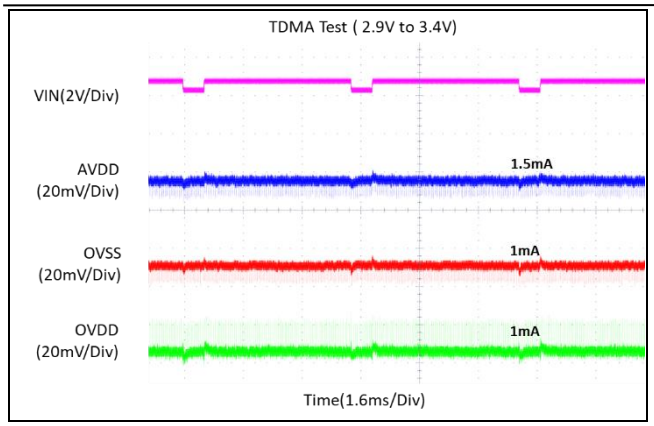


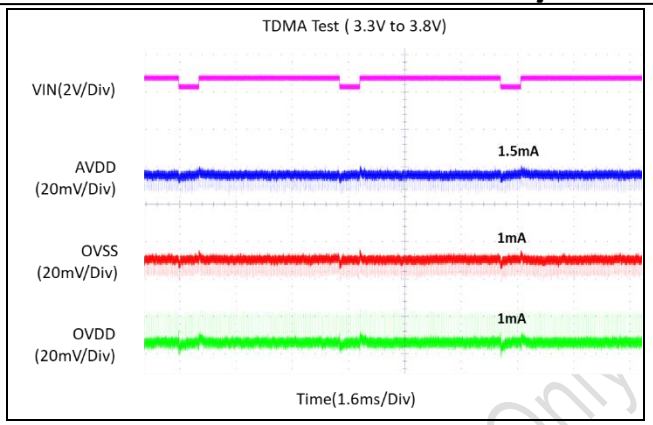


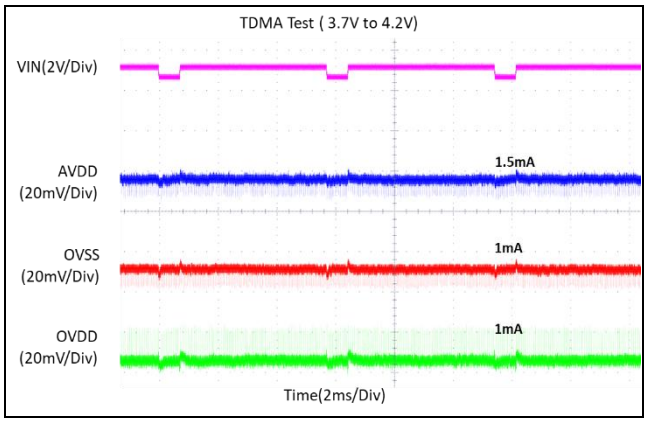


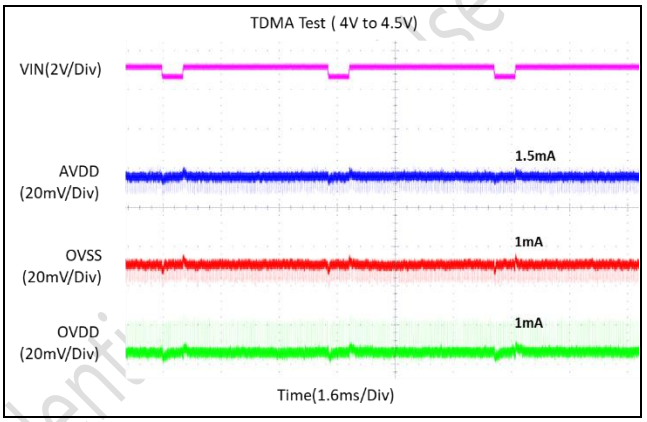


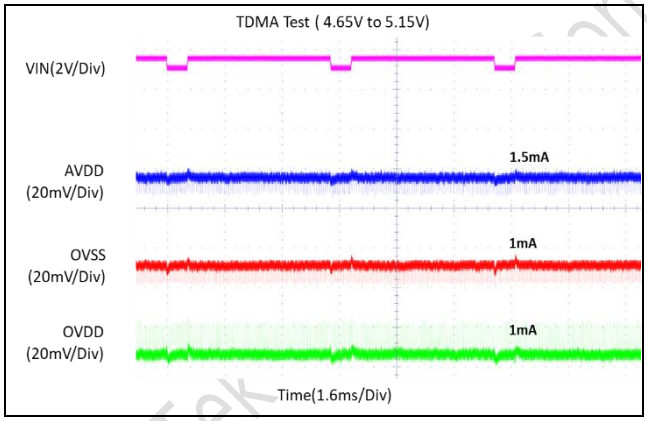


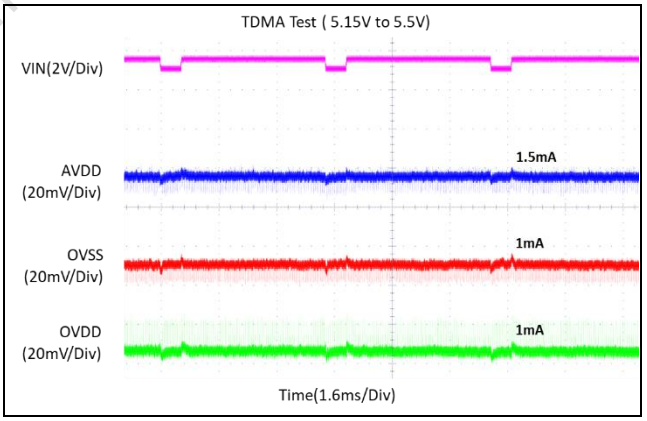








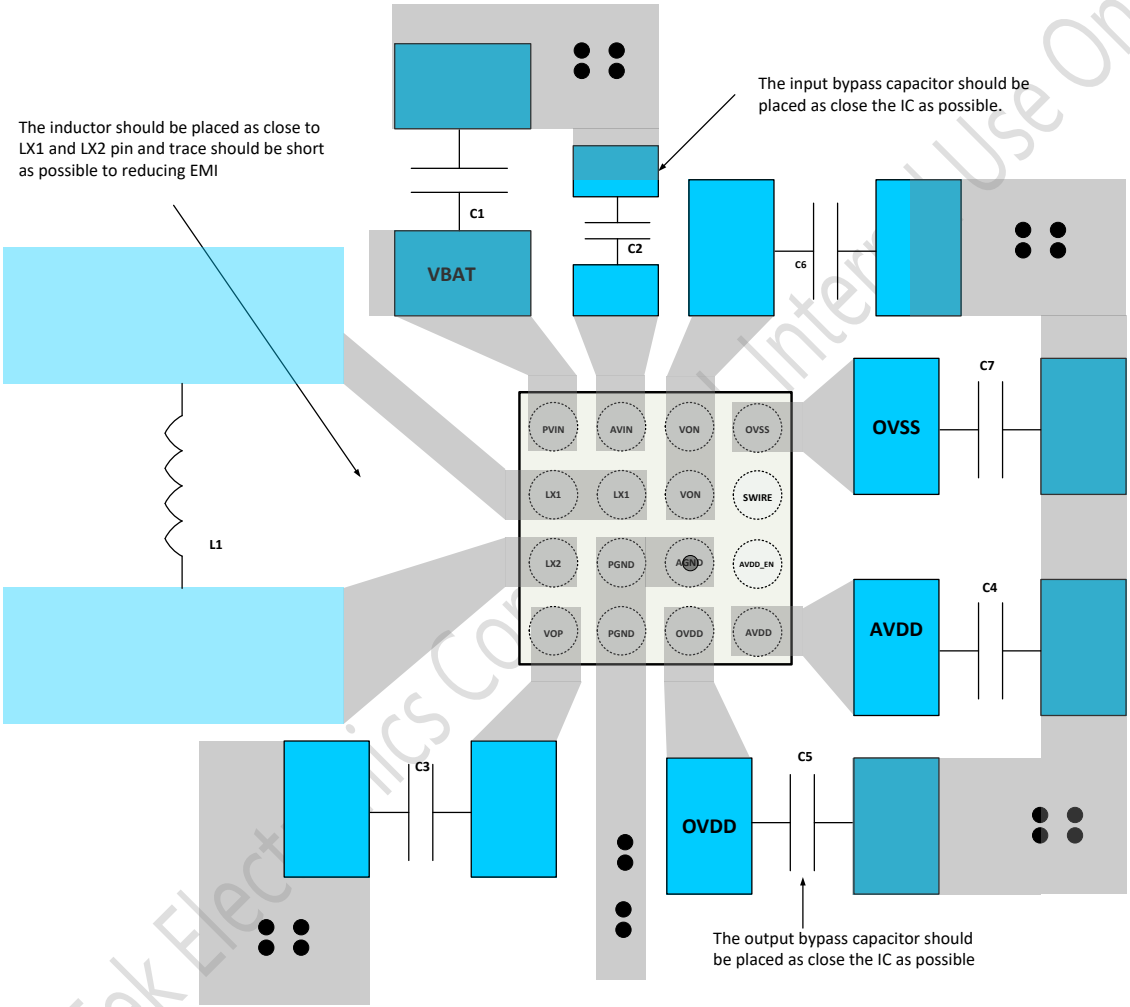




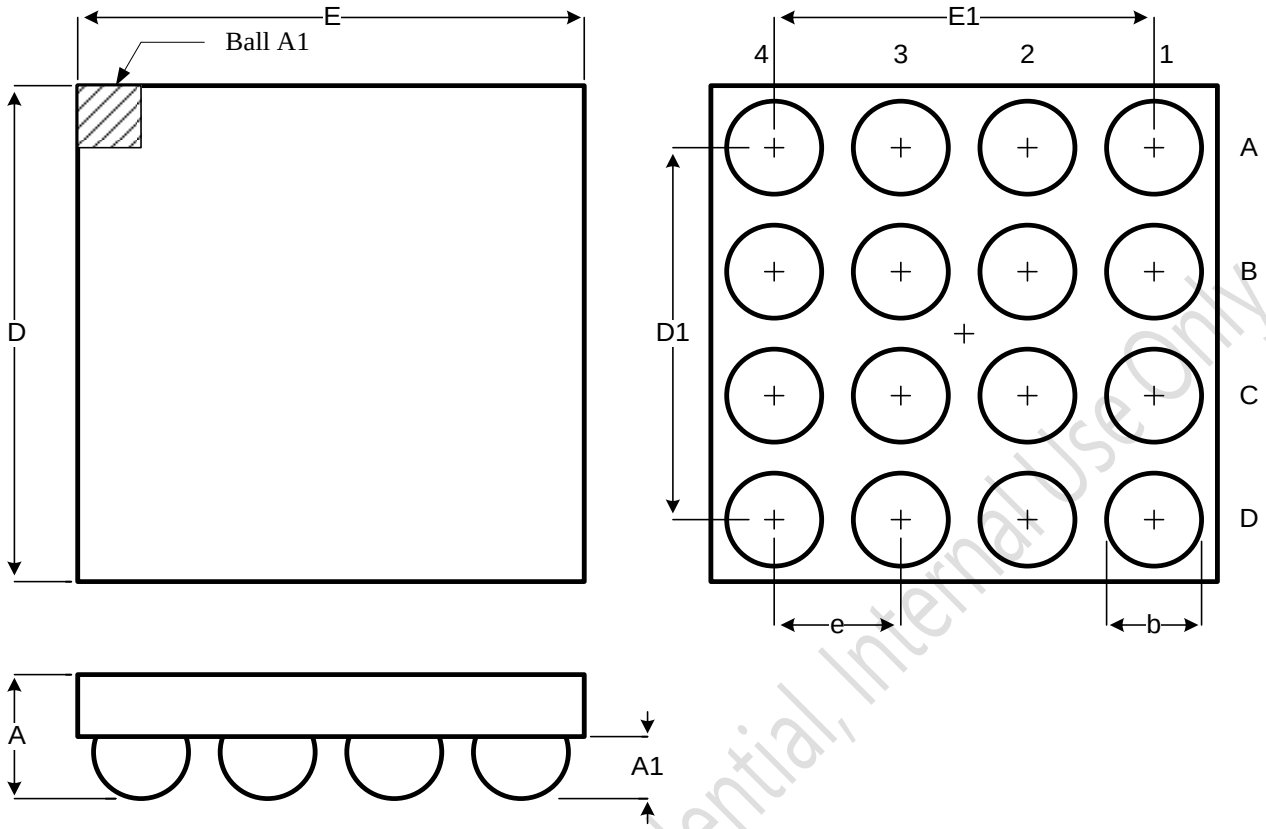
14 Layout Guidelines

For the best performance of the BV6802/A, the basic principles listed should be strictly followed.

- Place C1 and C2 as close as possible to the PVIN and AVIN pins respectively.
- Place C3 and C6 as close as possible to the VOP and VON pins respectively
- Place C4, C5 and C7 as close as possible to the AVDD, OVDD and OVSS pins respectively
- Place L1 as close as possible to the LX1 and LX2 pins
- For good regulation, the traces should be wide and short especially for the high current output loop



15 Outline Dimension



Symbol	Dimensions(mm)		Dimensions(inch)	
	Min.	Max.	Min.	Max.
A	0.527	0.621	0.021	0.024
A1	0.175	0.213	0.007	0.008
b	0.228	0.308	0.009	0.012
D	1.620	1.660	1.552	0.065
D1	1.200		0.047	
E	1.620	1.660	0.064	0.065
E1	1.200		0.047	
e	0.400		0.016	

16 Packaging Information

Orderable Device	Status (1)	Package Type	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4)
BV6802W	ACTIVE	WLCSP	16	3,000	Green (RoHS & no Sb/Br)	SN	Level-1-260C-1 YEAR	-40 to 85	6802
BV6802AW	ACTIVE	WLCSP	16	3,000	Green (RoHS & no Sb/Br)	SN	Level-1-260C-1 YEAR	-40 to 85	6802A

1. The status is to reflect current situation in marketing.
   ACTIVE: The product currently is on sale.
   LAST TIME BUY in EOL: Bravotekcorp announced this product will be discontinued. Only last time buy supported within a half of a year.
   SAMPLES BY REQUEST: The product is still in developing. Samples may or may not be available.
   OBSOLETE: Bravotekcorp has terminated the production of this product.

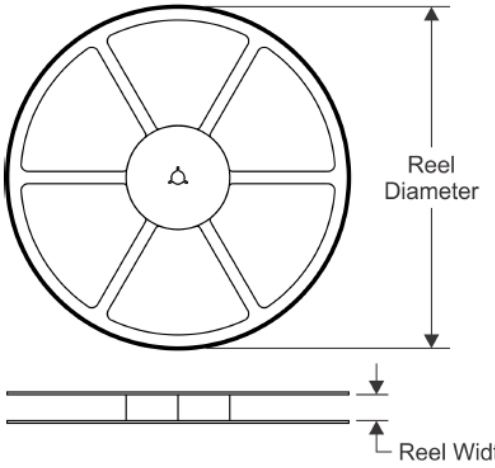
2. Green: Bravotekcorp defines that the product follow JS709B low halogen requirements of <= 1,000 ppm.
   RoHS: Bravotekcorp defines that the product follows current EU RoHS requirements.

3. MSL, Peak Temp.: The Moisture Sensitivity Level rating was based on JEDEC industry standard classification, and peak solder temperature.

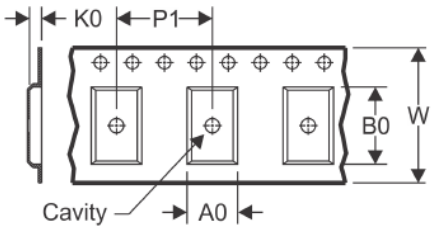
4. Device marking: The device marking of the product will follow Bravotekcorp's marking rule that may contain multiple information for tracing.

18 Tape and Reel Information

REEL DIMENSIONS

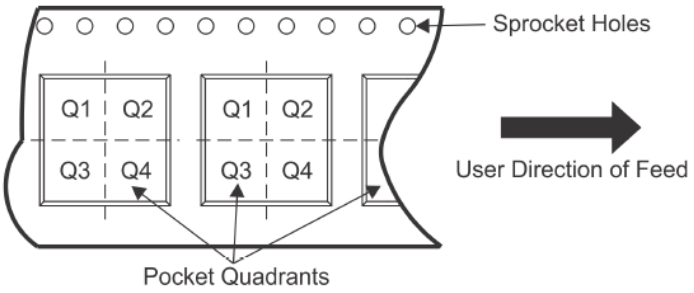


TAPE DIMENSIONS



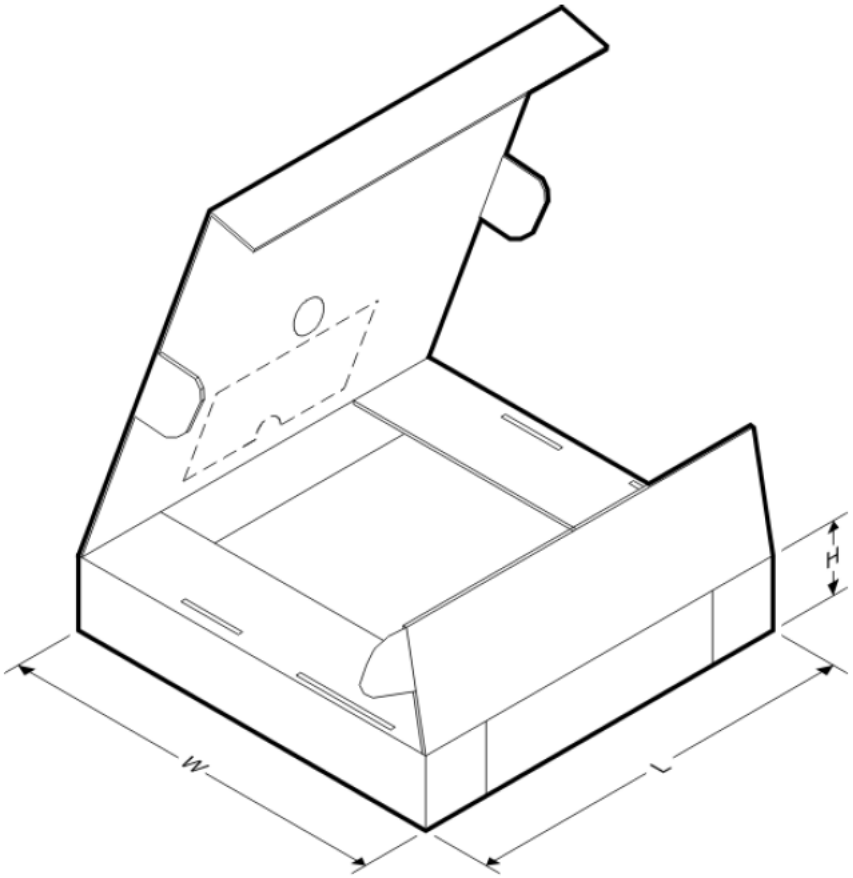
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Pins	SPQ	Reel Diameters (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
BV6802W	WLCSP	16	3000	180	9	1.77+/-0.05	1.77+/-0.05	0.75+/-0.05	4	8	Q1
BV6802AW	WLCSP	16	3000	180	9	1.77+/-0.05	1.77+/-0.05	0.75+/-0.05	4	8	Q1

19 Tape and Reel Box Dimension



Device	Package Type	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BV6802W	WLCSP	16	3000	183+/-3	183+/-3	85+/-3
BV6802AW	WLCSP	16	3000	183+/-3	183+/-3	85+/-3

20 VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
0.1	Stanley	11.25.2019			Initial Design Definition draft
0.2	Stanley	06.29.2020			Final Datasheet
0.3	Stanley	09.07.2020			Add Efficiency Curve on Page One
0.4	Stanley	12.02.2020			Add Packaging information, Tape and Reel information and box dimension
0.5	Stanley	05.24.2021			Application Circuit Modified
0.6	Stanley	11.29.2021			Add BV6802A for AVDD=3.3V

Template Version: 09/09, 2019

单击下面可查看定价，库存，交付和生命周期等信息

>>BravoTek