WP1111 Overvoltage and Overcurrent Protection IC and Li+ Charger Front-End Protection IC

General Description

WP1111 provides protection to Li-ion batteries from failures of the charging circuit. The IC continuously monitors the input voltage, the input current, and the battery voltage. In case of an input overvoltage condition, the IC immediately removes power from the charging circuit by turning off an internal switch. In the case of an overcurrent condition, it limits the system current at the threshold value, and if the overcurrent persists, switches the pass element OFF after a blanking period. Additionally, the IC also monitors its own die temperature and switches off if it becomes too hot.

The input overcurrent threshold is user-programmable.

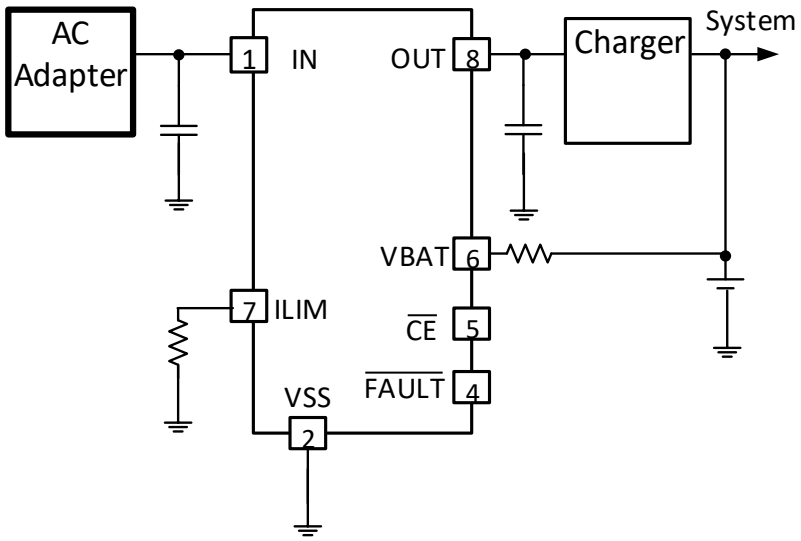
Features

- Input Overvoltage, With Rapid Response in < 1μs
- User-Programmable Overcurrent With Current Limiting
- Battery Overvoltage
- 30V Maximum Input Voltage
- Support up to 1.5A Input Current
- Robust Against False Triggering Due to Current Transients
- Thermal Shutdown
- Enable Input
- Status Indication – Fault Condition
- Available in Space-Saving Small 8-Pin 2×2 DFN Packages

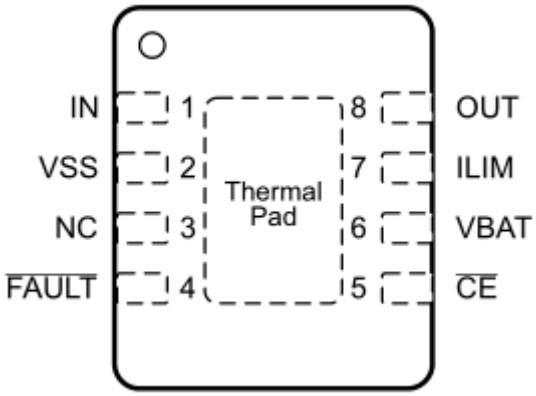
Applications

- Smart Phones
- Tablets
- Handheld Devices

Typical Application



Pin Configuration



Pin Description

Pin Name	Pin Number	I/O	Description
$\overline{CE}$	5	I	Chip enable input. Active low. When $\overline{CE}$ = High, the input FET is off. Internally pulled down.
$\overline{FAULT}$	4	O	Open-drain output, device status. $\overline{FAULT}$ = Low indicates that the input FET Q1 has been turned off due to input overvoltage, input overcurrent, battery overvoltage, or thermal shutdown.
ILIM	7	I/O	Input overcurrent threshold programming. Connect a resistor to VSS to set the overcurrent threshold.
IN	1	I	Input power, connect to external DC supply. Connect external 1-μF ceramic capacitor (minimum) to VSS. For the 12-pin (DSJ-suffix) device, ensure that pins 1 and 2 are connected together on the PCB at the device.
NC	3	—	These pins may have internal circuits used for test purposes. Do not make any external connections at these pins for normal operation.
OUT	8	O	Output terminal to the charging system. Connect external 1-μF ceramic capacitor (minimum) to VSS.
Thermal PAD	—	—	There is an internal electrical connection between the exposed thermal pad and the VSS pin of the device. The thermal pad must be connected to the same potential as the VSS pin on the printed-circuit board. Do not use the thermal pad as the primary ground input for the device. The VSS pin must be connected to ground at all times.
VBAT	6	I	Battery voltage sense input. Connect to pack positive terminal through a resistor.
VSS	2	—	Ground terminal

Absolute Maximum Ratings (NOTE1)

Parameter		Min	Max	Unit
Input voltage	IN (with respect to VSS)	–0.3	30	V
	OUT (with respect to VSS)	–0.3	20	
	ILIM, $\overline{\text{FAULT}}$, $\overline{\text{CE}}$, VBAT (with respect to VSS)	–0.3	7	
Input current	IN		2	A
Output current	OUT		2	A
Output sink current	$\overline{\text{FAULT}}$		15	mA
Junction temperature, TJ		-40	150	ºC
Storage temperature, Tstg		-65	150	ºC

NOTE 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ESD Ratings—JEDEC Specification

Parameter		Value	Unit
Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101 (2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±2000 V may actually have higher performance.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Pins listed as ±500 V may actually have higher performance.

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

symbol	Parameter	Min	Max	Unit
V_{IN}	Input voltage	3.3	26	V
I_{IN}	Input current, IN pin		1.5	A
I_{OUT}	Output current, OUT pin		1.5	A
R_{ILIM}	OCP programming resistor	15	90	kΩ
TJ	Junction temperature	0	125	°C

Electrical Characteristics

(Over operating free-air temperature range, unless otherwise noted)

symbol	Parameter	Test Condition	Min	Typ	Max	Unit
IN						
UVLO	Undervoltage lockout, input power detected threshold	$\overline{CE}$ = Low, V_{IN} increasing from 0 V to 3V	2.6	2.7	2.8	V
$V_{HYS-UVLO}$	Hysteresis on UVLO	$\overline{CE}$ = Low, V_{IN} decreasing from 3V to 0V	200	260	300	mV
$TDGL_{(PGOOD)}$	Deglitch time, input power detected status	$\overline{CE}$ = Low. Time measured from V_{IN} 0V→5V, 1-µs rise-time, to output turning ON		8		ms
IDD	Operating current	$\overline{CE}$ = Low, No load on OUT pin, V_{IN} = 5V, R_{ILIM} = 25 kΩ		400	600	µA
I_{STDBY}	Standby current	$\overline{CE}$ = High, V_{IN} = 5V		65	95	µA
INPUT TO OUTPUT CHARACTERISTICS						
V_{DO}	Drop-out voltage IN to OUT	$\overline{CE}$ = Low, V_{IN} = 5V, I_{OUT} = 1A		170	280	mV
INPUT OVERVOLTAGE PROTECTION						
V_{OVP}	Input overvoltage protection threshold	$\overline{CE}$ = Low, V_{IN} increasing from 5V to 7.5V	5.8	5.95	6.1	V
$V_{HYS-OVP}$	Hysteresis on OVP	$\overline{CE}$ = Low, V_{IN} decreasing from 7.5V to 5V	40	200	300	mV
INPUT OVERCURRENT PROTECTION						
I_{OCP}	Input overcurrent protection threshold range		300		1500	mA
I_{OCP}	Input overcurrent protection threshold	$\overline{CE}$ = Low, R_{ILIM} = 25 kΩ,	1050	1125	1200	mA
BATTERY OVERVOLTAGE PROTECTION						
B_{VOVP}	Battery overvoltage protection threshold	$\overline{CE}$ = Low, V_{IN} > 4.4 V		4.4		V
$V_{HYS-BOVP}$	Hysteresis on BV_{OVP}	$\overline{CE}$ = Low, V_{IN} > 4.4 V	200	275	320	mV
I_{VBAT}	Input bias current on VBAT pin	V_{BAT} = 4.4 V, T_J = 25°C			10	nA
THERMAL PROTECTION						
$T_{J(OFF)}$	Thermal shutdown temperature			130	150	°C
$T_{J(OFF-HYS)}$	Thermal shutdown hysteresis			20		°C

symbol	Parameter	Test Condition	Min	Typ	Max	Unit
LOGIC LEVELS ON $\overline{CE}$						
V_{IL}	Low-level input voltage				0.4	V
V_{IH}	High-level input voltage		1.4			V
IIL	Low-level input current	V_{CE} = 0 V			1	µA
IIH	High-level input current	V_{CE} = 1.8 V			15	µA
LOGIC LEVELS ON $\overline{FAULT}$						
VOL	Output low voltage	I_{SINK} = 5 mA			0.2	V
IHI-Z	Leakage current, $\overline{FAULT}$ pin HI-Z	V_{FAULT} = 5 V			10	µA

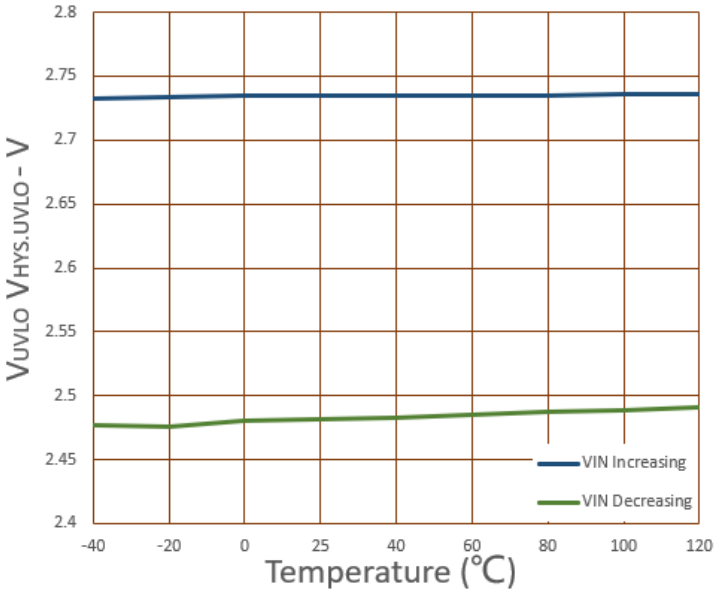
Timing Requirements

symbol	Parameter	Test Condition	Min	Nom	Max	UNIT
IN						
$t_{DGL(PGOOD)}$	Deglitch time, input power detected status	$\overline{CE}$ = Low. Time measured from V_{IN} 0 V→5 V, 1-µs rise-time, to output turning ON		8		ms
INPUT OVERVOLTAGE PROTECTION						
$t_{PD(OVP)}$	Input OV propagation delay(1)	$\overline{CE}$ = Low			1	µs
$t_{ON(OVP)}$	Recovery time from input overvoltage condition	$\overline{CE}$ = Low, Time measured from V_{IN} 7.5V→5 V, 1-µs fall-time		8		ms
INPUT OVERCURRENT PROTECTION						
$t_{BLANK(OCP)}$	Blanking time, input overcurrent detected			176		µs
$t_{REC(OCP)}$	Recovery time from input overcurrent condition			64		ms
BATTERY OVERVOLTAGE PROTECTION						
$t_{DGL(BOVP)}$	Deglitch time, battery overvoltage detected	$\overline{CE}$ = Low, V_{IN} > 4.4 V. Time measured from V_{VBAT} rising from 4.1 V to 4.4 V to $\overline{FAULT}$ going low.		176		µs

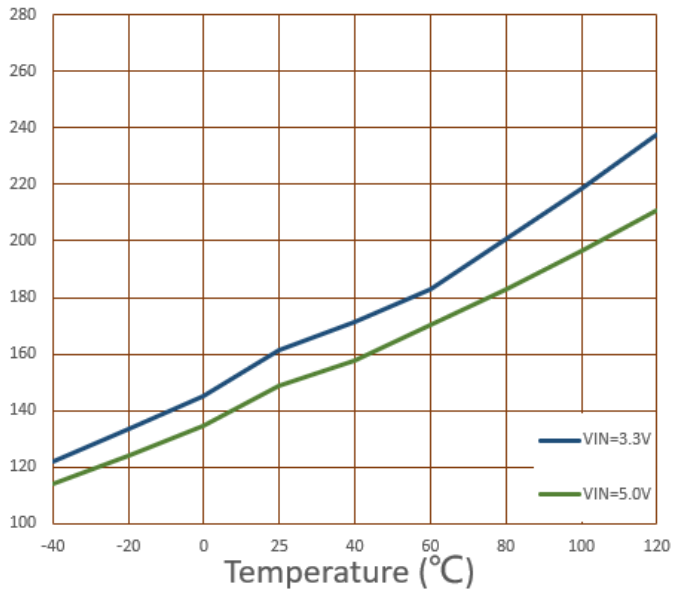
(1) Not tested in production. Specified by design.

Typical Characteristics

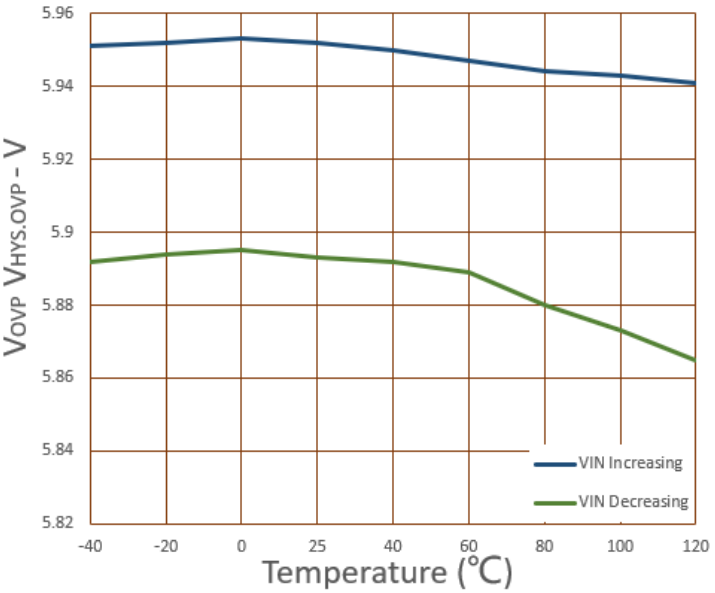
Test conditions (unless otherwise noted) for typical operating performance: VIN = 5 V, CIN = 1 µF, COUT = 1 µF,R_{ILIM} = 25 kΩ, RBAT = 100 kΩ, TA = 25°C, VPU = 3.3 V



Undervoltage Lockout vs Free-Air Temperature

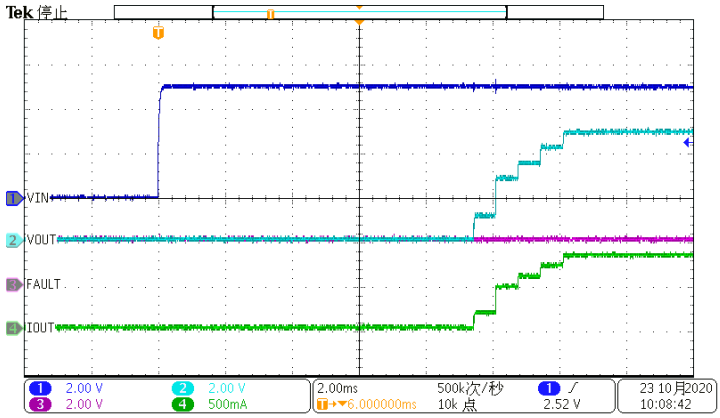


Dropout Voltage (IN to OUT) vs Free-Air Temperature



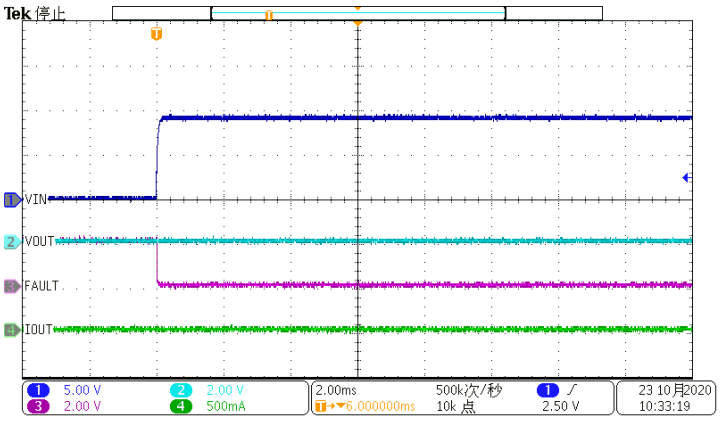
Overvoltage Threshold Protection vs Free-Air Temperature

Application Curves



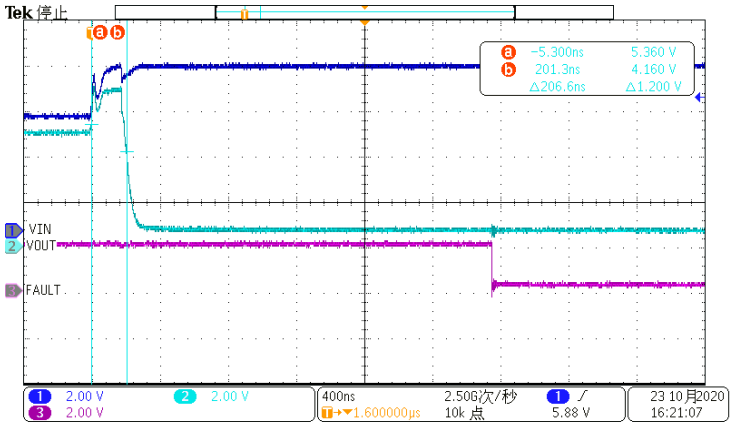
R_{OUT}= 6Ω

Normal Power-On Showing Soft-Start



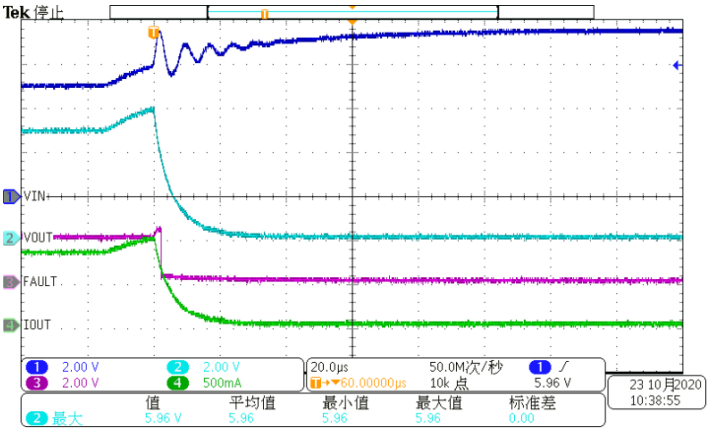
V_{IN}= 0V to 9V t_r=100 μ s

OVP at Power-On



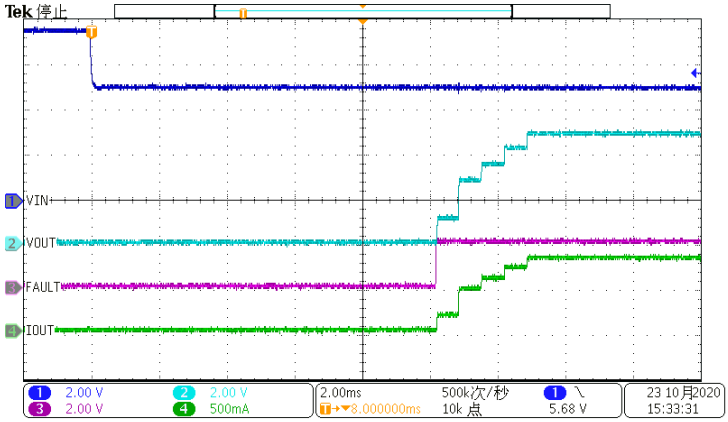
V_{IN}= 5V to 7.5V t_r= 20ns

OVP Response for Input Step
No capacitance, No load



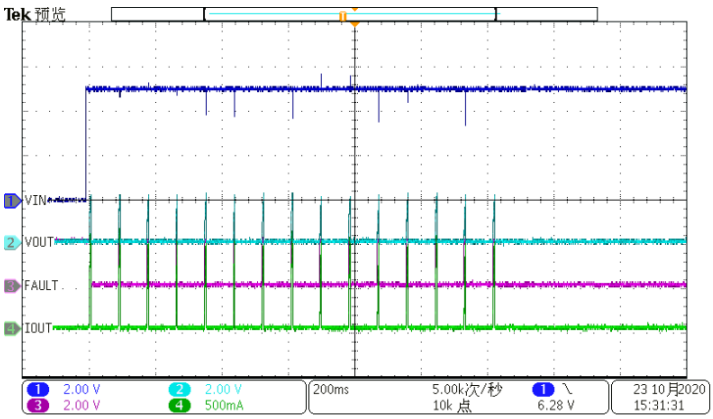
V_{IN}= 5V to 7.5V t_r= 100 μ s

OVP Response for Input Step

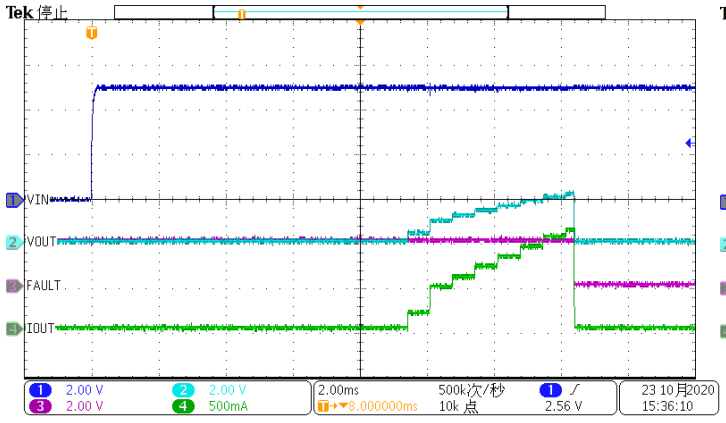


V_{IN}=7.5Vto5V t_f= 400 μ s

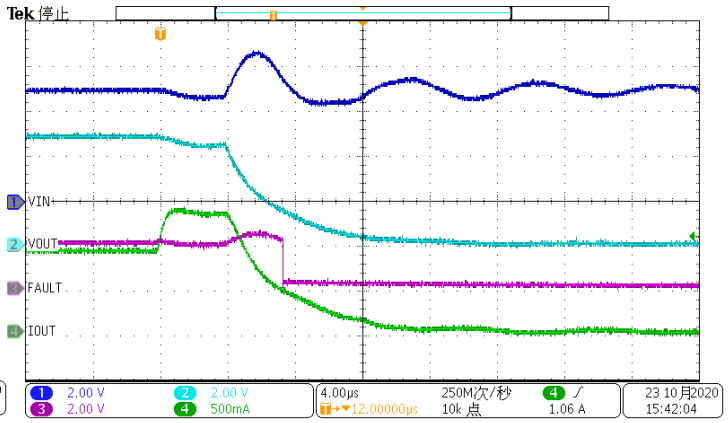
Recovery from OVP



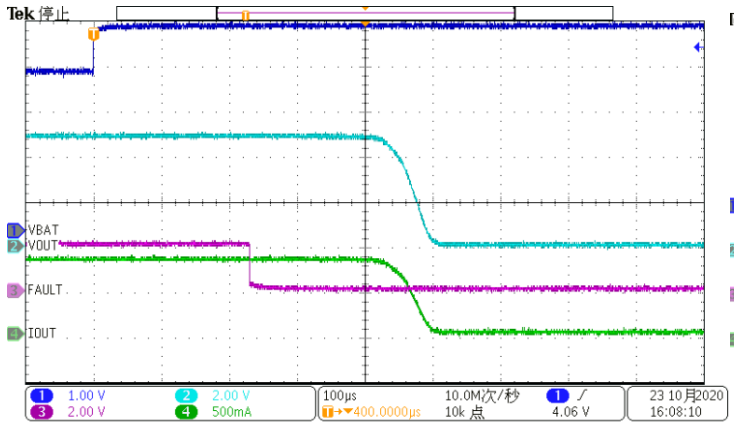
OCP, Powering Up into a Short Circuit on OUT Pin OCP,Counter Counts to 15 Before Switching OFF the Device



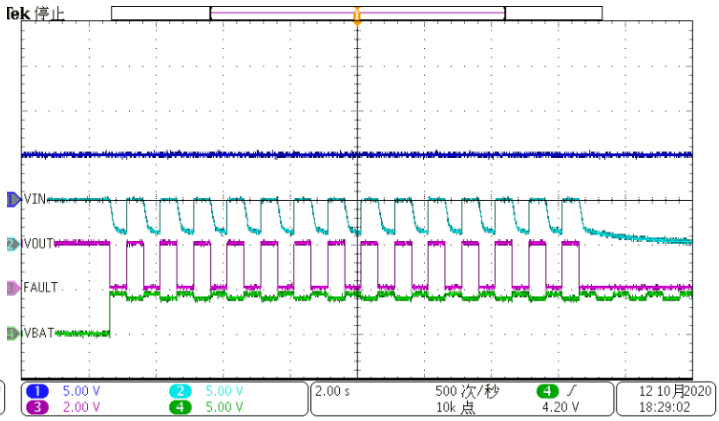
OCP, Zoom-in



OCP, R_{OUT} Switches from 6 Ω to 3Ω, Shows Current Limiting and Soft-Stop

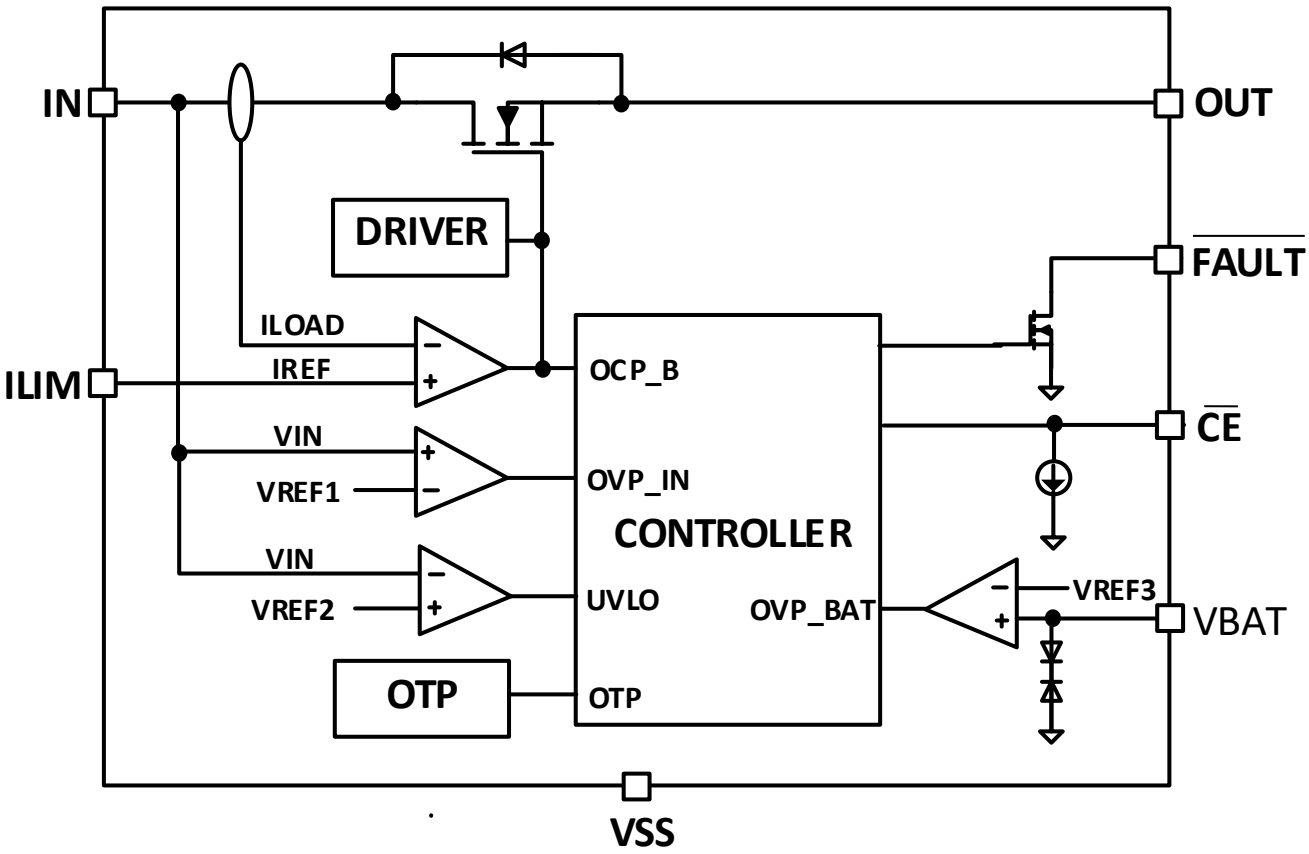


BAT-OVP, VVBAT Steps from 3.5 V to 4.4 V, Shows tDGL(BAT-OVP) and Soft-Stop

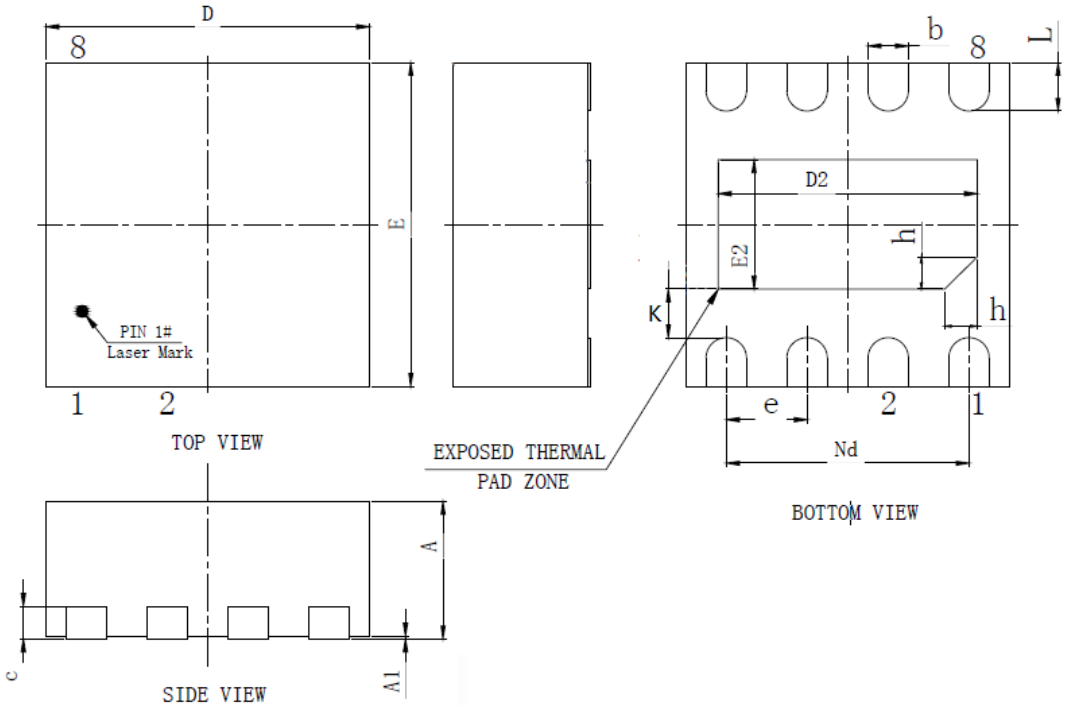


BAT-OVP, VVBAT Cycles Between 3.5 V and 4.4 V, Shows BAT-OVP Counter

Block Diagram



Package Information



DFN-8

SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.20	0.25	0.30
c		0.203REF	
D	1.95	2.00	2.05
D2	1.55	1.60	1.605
e		0.50BSC	
Nd		1.50BSC	
E	1.95	2.00	2.05
E2	0.75	0.80	0.85
L	0.25	0.30	0.35
K	0.25	0.30	0.35
R		0.20 REF	

Ordering Information

Part Number	Package	Packing Quantity	Marking
WP1111-F28R	DFN2*2-8L	3k/Reel	WP1111 XXXX

Contact Information

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WAYON website: **http://www.way-on.com**

For additional information, please contact your local Sales Representative.

Specifications are subject to change without notice.

The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time

Users should verify actual device performance in their specific applications.