

Total Solution for PD Fast Charge Application

1. General Description

The SW3516S is a highly integrated power management IC for PD fast charge application, and passes PD3.0 certification with TID 1583. It integrates high efficiency synchronous buck, CC/CV mode, PD and Type-C protocol controller. With simple external components, The SW3516S provides a turn-key high efficiency solution for PD fast charge application.

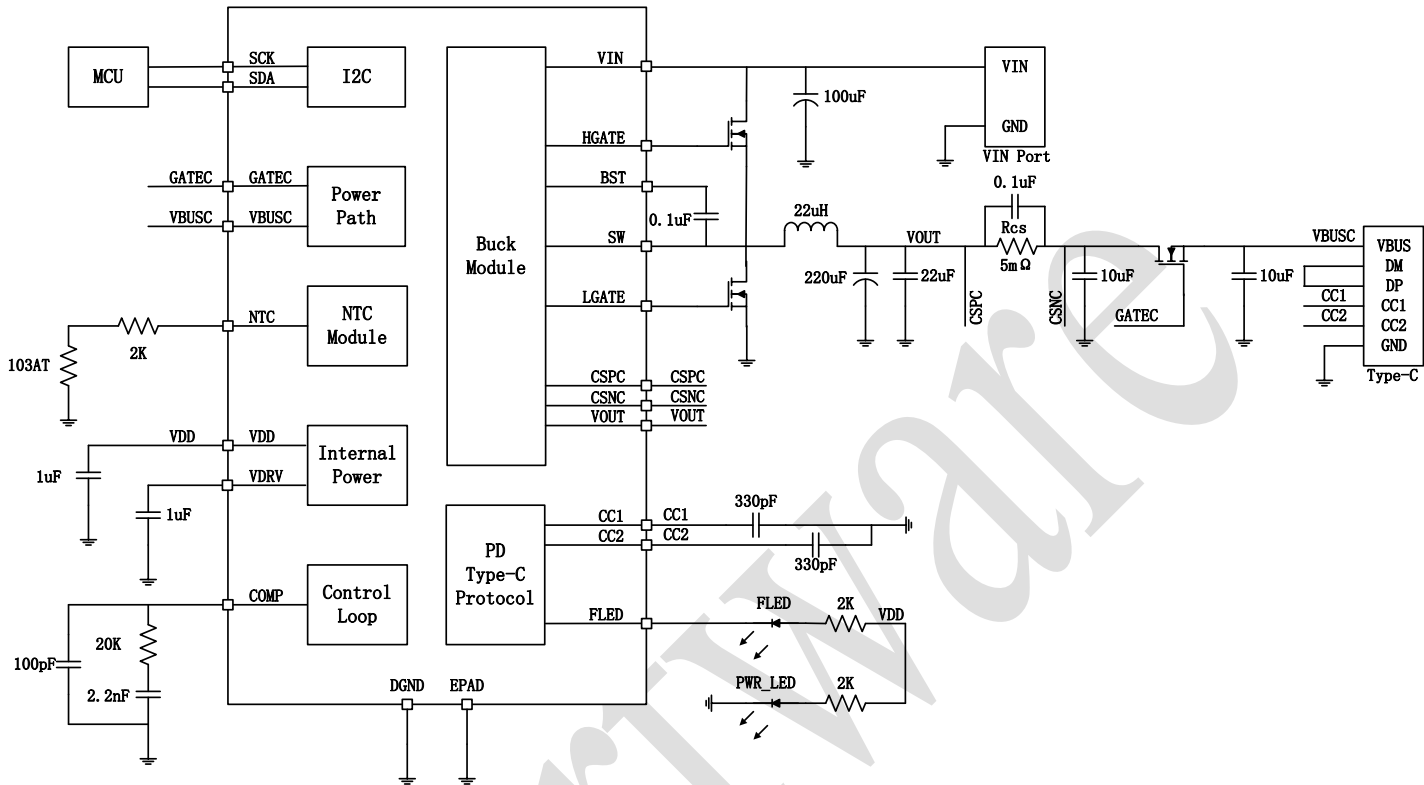
2. Applications

- Car Charger
- Adapter

3. Features

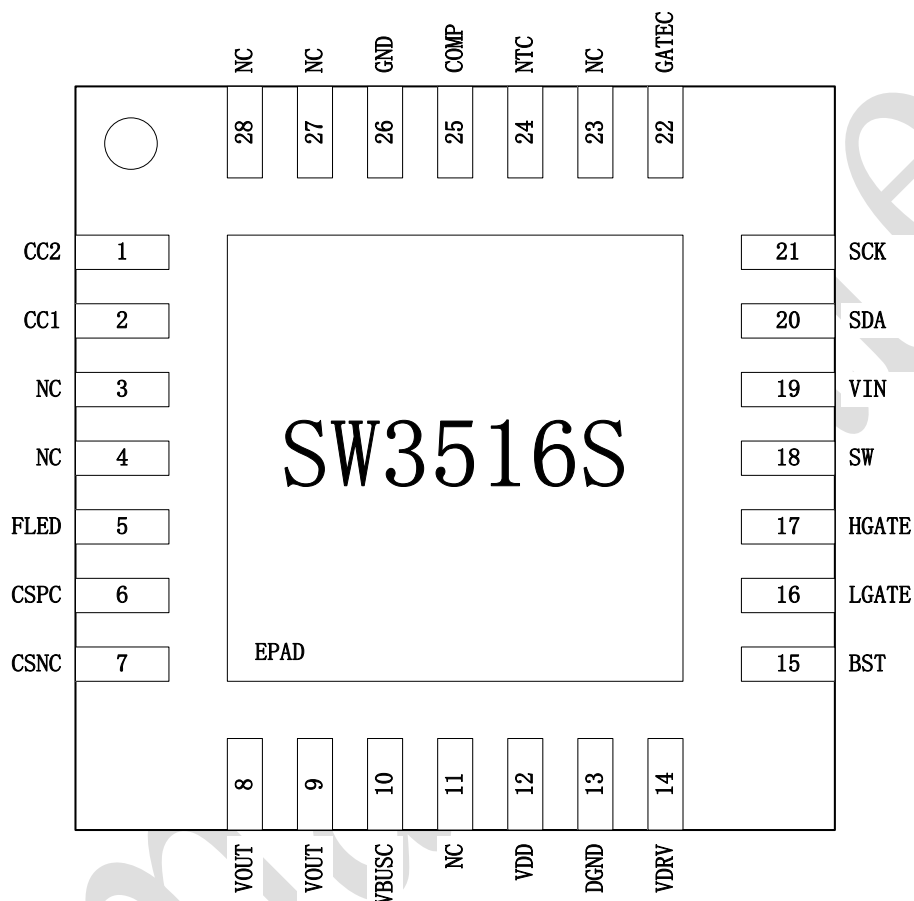
- **Synchronous Buck**
 - Input Voltage 6~36V
 - Support CC/CV Mode
 - Support Wire Drop Compensation
 - Thermal Regulation
- **Output Fast Charge Protocol**
 - Support PD3.0/PD2.0 (PD3.0 Certification, TID:1583)
- **Type-C Interface**
 - Support USB Type-C Specification
 - Support DFP Role
- **Fast Charge LED**
 - Support Fast Charge LED Driver
- **Protection**
 - Softstart
 - Input Over Voltage Protection
 - Input Under Voltage Protection
 - Output Over Current Protection
 - Output Short Protection
 - Over Temperature Protection
- **I2C Interface**
- **QFN-28(4x4mm) Package**

4. Functional Block Diagram



5. Pin Configuration and Function

5.1. Pin Configuration



5.2. Pin Descriptions

Pin	Name	Function Description
1	CC2	Type-C configure channel CC2.
2	CC1	Type-C configure channel CC1.
3, 4, 11, 23, 27, 28	NC	Floating.
5	FLED	Fast charge led driver.
6	CSPC	Type-C port current sense positive pin.
7	CSNC	Type-C port current sense negative pin.
8, 9	VOUT	Output voltage sense pin.
10	VBUSC	Type-C port load detect pin.

12	VDD	Internal power.
13	DGND	Digital ground.
14	VDRV	Driver power.
15	BST	Bootstrap pin for high side NMOS.
16	LGATE	Low side NMOS driver.
17	HGATE	High side NMOS driver.
18	SW	Switching node.
19	VIN	Input power.
20	SDA	I2c data.
21	SCK	I2c clock.
22	GATEC	Type-C port power path control pin.
24	NTC	Negative temperature coefficient (NTC) thermistor input.
25	COMP	External compensation pin.
26	GND	Ground pin.
	EPAD	Exposed pad.

6. Absolute Maximum Ratings

Parameters	Symbol	MIN	MAX	UNIT
Input Voltage	VIN	-0.3	50	V
Output Voltage	CSPC/CSNC/ VOUT/VBUSEC	-0.3	30	V
SW Voltage	SW	-0.3	40	V
BST/HGATE Voltage	BST/HGATE-SW	-0.3	6	V
Power Path Control Voltage	GATEC	-0.3	27	V
Other Pin Voltage		-0.3	6	V
Junction Temperature		-40	+150	°C
Storage Temperature Range		-60	+150	°C
ESD (HBM)		-4	+4	KV

【Notice】 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.

7. Recommended Operating Conditions

Parameters	Symbol	MIN	Typical	MAX	UNIT
Input Voltage	VIN	5		36	V

8. Electrical Characteristics

($V_{IN} = 12V$, $T_A = 25^{\circ}C$, unless otherwise specified.)

Parameters	Symbol	Test Conditions	MIN	TYP	MAX	UNIT
Power Supply						
VIN Input Voltage	V_{IN}		5		36	V
VIN Input UVLO Threshold	V_{IN_UVLO}	VIN Voltage Falling	4.9	5	5.1	V
VIN Input UVLO Hysteresis	$V_{IN_UVLO_HYS}$	VIN Voltage Rising	0.85	1	1.15	V
VIN Input OVP Threshold	V_{IN_OVP}	VIN Voltage Rising	36	37.5	39	V
VIN Input OVP Hysteresis	$V_{IN_OVP_HYS}$	VIN Voltage Falling	1.2	1.5	1.8	V
VDD Output Voltage	V_{DD}	$V_{IN}=12V$	4.9	5	5.1	V
VDD Output current	I_{DD}	$V_{IN}=12V$		50		mA
VDRV Output Voltage	V_{DRV}	$V_{IN}=12V$	4.9	5	5.1	V
Quiescent Current	I_Q	$V_{IN}=12V, I_{OUT}=0mA$		2	4	mA
Synchronous Buck						
Switching Frequency	F_{CHG}		110	125	140	KHz
Output Voltage	V_{OUT}	$V_{OUT}=5V$	5.0	5.1	5.2	V
		$V_{OUT}=9V$	8.9	9.1	9.3	V
		$V_{OUT}=12V$	11.7	12.1	12.3	V
		$V_{OUT}=15V$	14.6	15.1	15.4	
		$V_{OUT}=20V$	19.5	20.1	20.5	V
CC Current Limited	I_{CC}	$R_{CS}=5m\Omega$	3.0	3.3	3.6	A
Wire Drop Compensation	V_{OUT_WDC}	$R_{CS}=5m\Omega$	50	65	80	mV/A
Thermal Regulation Threshold	T_{REGU_CHG}		105	120	135	$^{\circ}C$
Type-C						
CC Current Source	I_{CC_SOURCE}	Power Level=3.0A	310	330	350	uA
I2C						
Rate	f_{CLK}			100	400	Kbit/S
Thermal Shutdown						
Thermal Shutdown Threshold	T_{SHDT}	Temperature Rising	135	150	165	$^{\circ}C$
Thermal Shutdown Hysteresis	T_{SHDT_HYS}	Temperature Falling	35	50	65	$^{\circ}C$

9. Functional Description

9.1. Synchronous Buck

The SW3516S integrates a high efficiency synchronous buck and efficiency up to 96%(VIN=12V, VOUT=5V, IOU=3A).

The synchronous buck works in PSM/PWM mode with switching frequency of 125KHz. It works in PSM mode when in light load and in PWM mode in heavy load to make a better efficiency. It will automatically change in these two modes base on output current.

The synchronous buck supports CC/CV mode. When output current is lower than CC limited current, output voltage will keep constant. When output current reaches CC limited current, output voltage will drop to keep output current constant.

The synchronous buck supports wire drop compensation. Output voltage will linear increase according to output current and the increased voltage is 65mV/A.

The synchronous buck integrates thermal regulation. When die temperature rises to 120°C, output voltage will automatically fall down so as die temperature stop increasing. If die temperature still rises to 150°C, buck will stop and turn off. When die temperature falls to thermal shutdown hysteresis, buck will automatically restart.

The synchronous buck integrates input over voltage, input under voltage, output over current and short protection.

9.2. Type C Interface

The SW3516S integrates Type-C logic controller and supports DFP/SOURCE role. When UFP is attached, Type-C port will automatically turn on to supply device. When UFP is detached, Type-C port will automatically turn off.

When SINK is attached and Type-C port turns on , the SW3516S will broadcast power level of 3A.

9.3. PD Fast Charge

The SW3516S integrates PD3.0/PD2.0 fast charge protocol. PD3.0/PD2.0 supports 5V/9V/12V/15V/20V@3A output voltage.

9.4. Fast Charge Led

The SW3516S integrates fast charge LED driver through FLED pin. FLED pin will drive low to turn on fast charge led in fast charge status.

9.5. ADC

The SW3516S integrates 12 bit ADC, and samples input voltage/output voltage/output current/board temperature. Board temperature can be calculated using NTC thermistor of 103AT.

ADC channel	Range	Step
Input voltage	0~40.96V	10mV
Output voltage	0~24.576V	6mV
Output current	0~10.24A	2.5mA
NTC voltage	0~2.048V	0.5mV

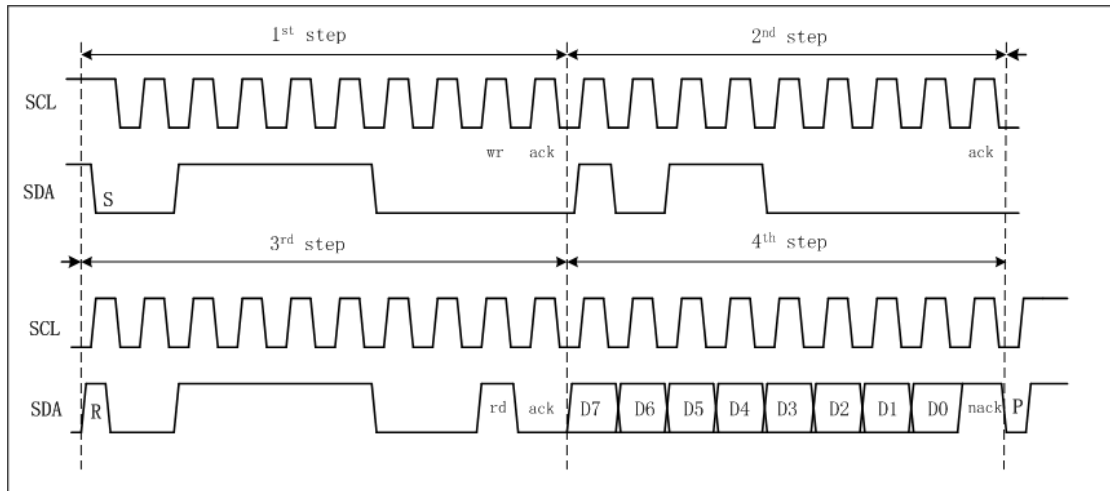
9.6. I2C Interface

The SW3516S integrates I2C interface, and supports 100K/400K rate.

Read Timing:

Slave address : 0x3C

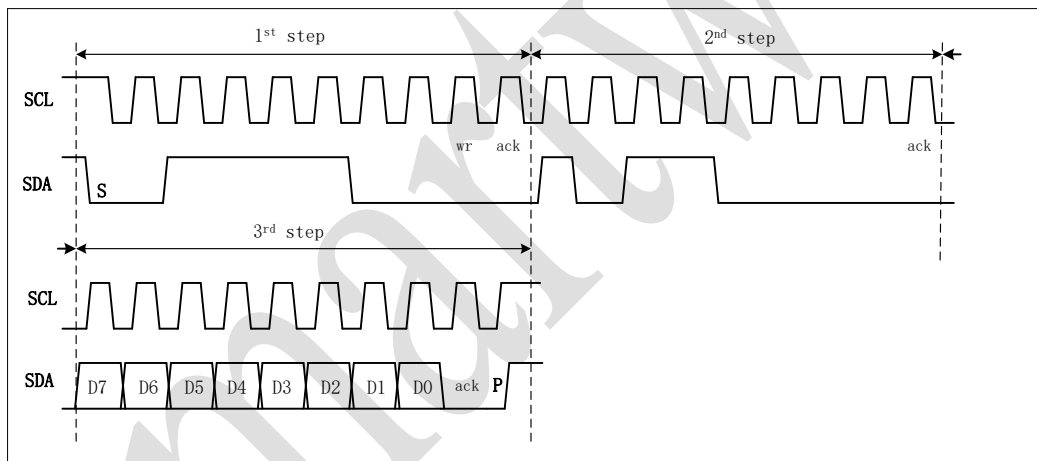
Register address: 0xB0



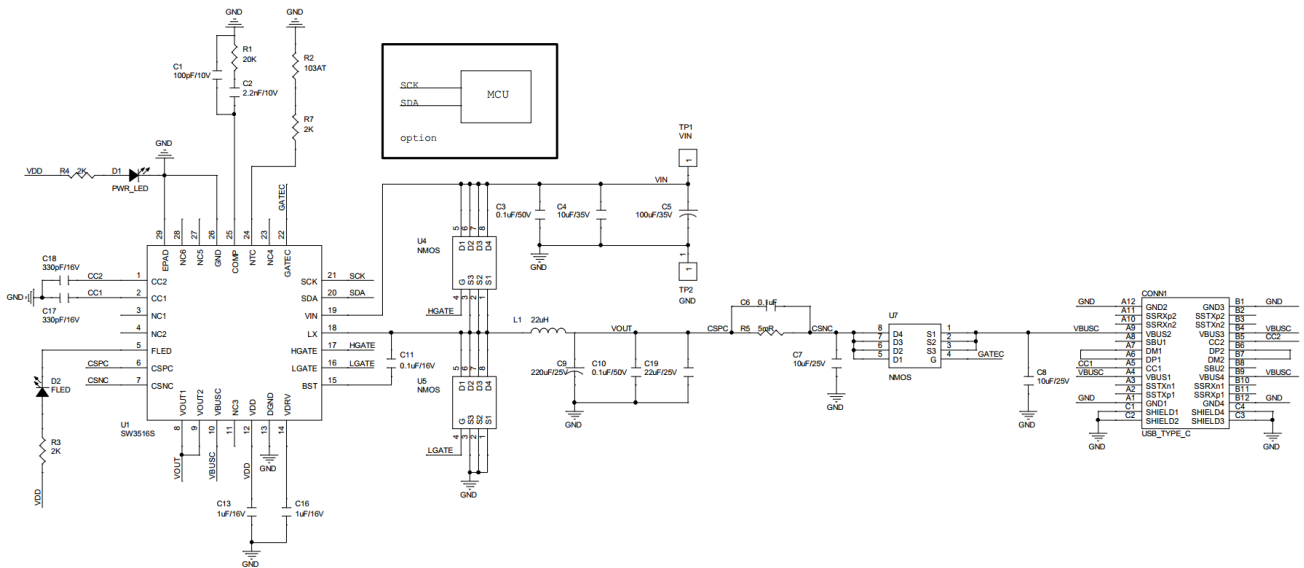
Write Timing:

Slave address : 0x3C

Register address: 0xB0

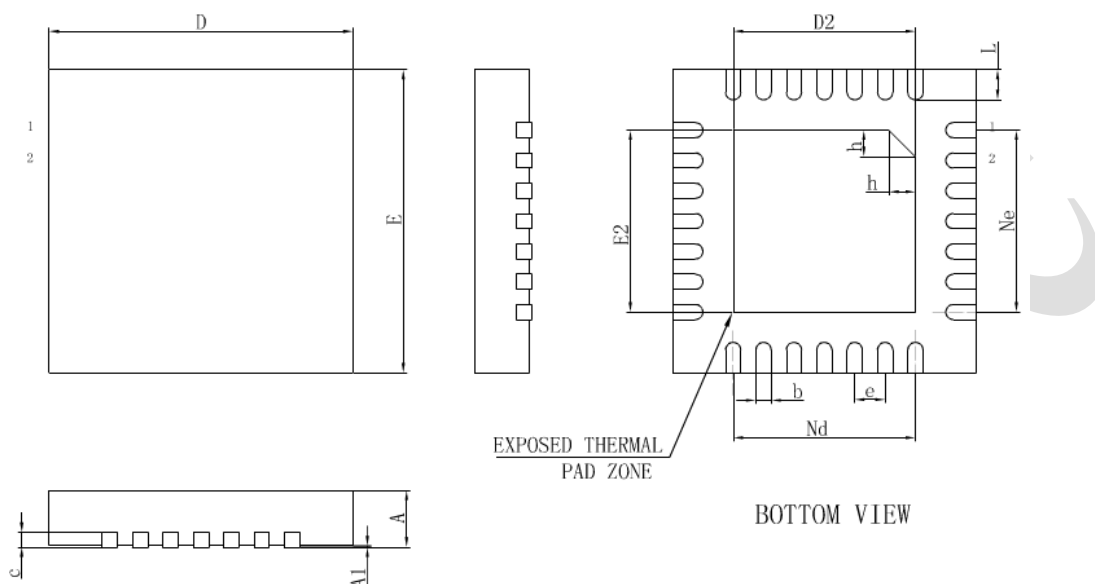


10. Typical Application Circuits



11. Mechanical and Packaging

11.1. Package Summary



11.2. Package Outline and Dimensions

Symbol	Dimension in Millimeters		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.30	2.40	2.50
e	0.40BSC		
Nd	2.40BSC		
E	3.90	4.00	4.10
E2	2.30	2.40	2.50
Ne	2.40BSC		
L	0.35	0.40	0.45
h	0.30	0.35	0.40

12. Revision History

- V1.0 Initial version.
- V1.1 Modify range of out voltage.
- V1.2 Modify wire drop compensation voltage.
- V1.3 Modify company logo.
- V1.4 Modify maximum input voltage.
- V1.5 Modify output withstand voltage.
- V1.6 Update document template.

Disclaimer

Zhuhai iSmartWare Technology Co., Ltd. (hereinafter referred to as "iSmartWare") may modify or update the products, services and this document provided at any time without prior notice. Customers should obtain the latest relevant information before placing an order and confirm that such information is complete and up-to-date.

The information contained in this document is for your convenience only, and iSmartWare makes no representations or warranties, express or implied, written or oral, statutory or otherwise, for such information, including but not limited to the purpose, characteristics, conditions of use, merchantability of the product. etc. iSmartWare does not assume any responsibility for this information and the consequences caused by the unreasonable use of this information.

iSmartWare assumes no obligation for application assistance or customer product design. Customers are solely responsible for their products and applications using iSmartWare. Customers should provide sufficient design and operation security verification, and guarantee that when integrating iSmartWare products into any application, they will not infringe third-party intellectual property rights, and iSmartWare will not be responsible for any infringements.

When resale of iSmartWare products, if there are differences or false components compared with the product parameters and their statements, all express or implied authorizations of iSmartWare related products will be automatically lost, and this is unfair and fraudulent. For business behavior, iSmartWare reserves the right to protect its rights in all legal ways. iSmartWare assumes no responsibility or liability for any such misrepresentation.

This document is only allowed to be reproduced without any tampering with the content and with relevant authorizations, conditions, restrictions and statements, otherwise iSmartWare has the right to pursue its legal responsibility. iSmartWare assumes no responsibility or liability for such tampered documents. Reproduction of information involving third parties is subject to additional restrictions.