Total Solution Include PD for Dual Ports Fast Charge Application

1. General Description

The SW3518S is a highly integrated power management IC for dual ports fast charge application, and supports dual ports of Type-C and Type-A. It integrates 5A synchronous buck, PPS/PD/QC/AFC/FCP/SCP/PE/SFCP/VOOC fast charge protocol, PD 100W(20V@5A) maximum output power, CC/CV mode and dual ports controller. With simple external components, The SW3518S provides a turn-key high efficiency solution for dual ports fast charge application.

2. Applications

- Car Charger
- Adapter

3. Features

- **Synchronous Buck**
  - Current up to 5A
  - Input Voltage 6~36V
  - Support CC/CV Mode
  - Support Dual Ports Current Limited
  - Support Wire Drop Compensation
  - Thermal Regulation
- **Output Fast Charge Protocol**
  - Support PPS/PD3.0/PD2.0
  - Support QC4+/QC4/QC3.0/QC2.0
  - Support AFC
  - Support FCP
  - Support SCP
  - Support PE2.0/PE1.1
  - Support SFCP
  - Support VOOC
- **Type-C Interface**
  - Support USB Type-C Specification
  - Support DFP Role

- **BC1.2 Module**
  - Support BC1.2 DCP
  - Support Apple & Samsung Device
- **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
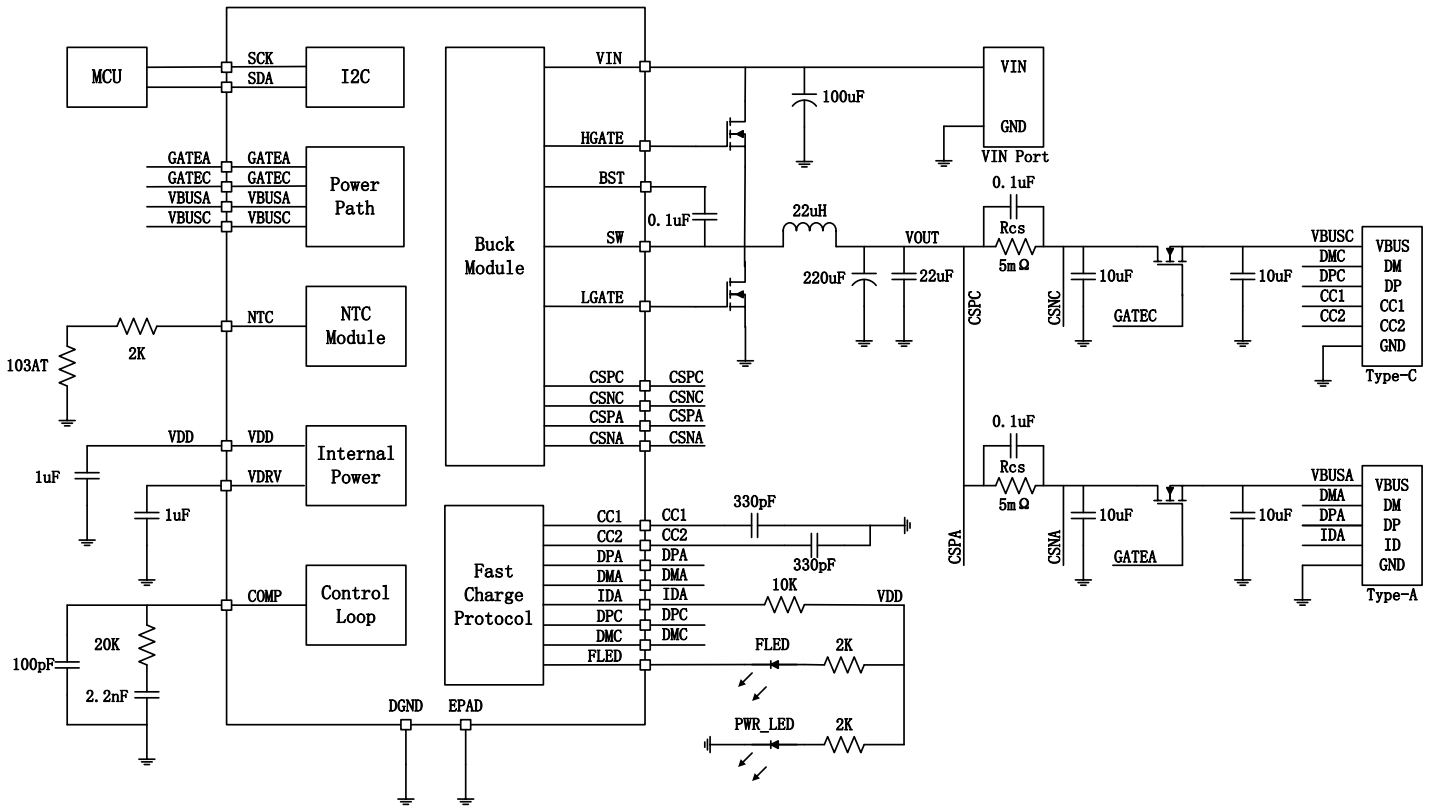
5. Pin Configuration and Function

5.1 Pin Configuration
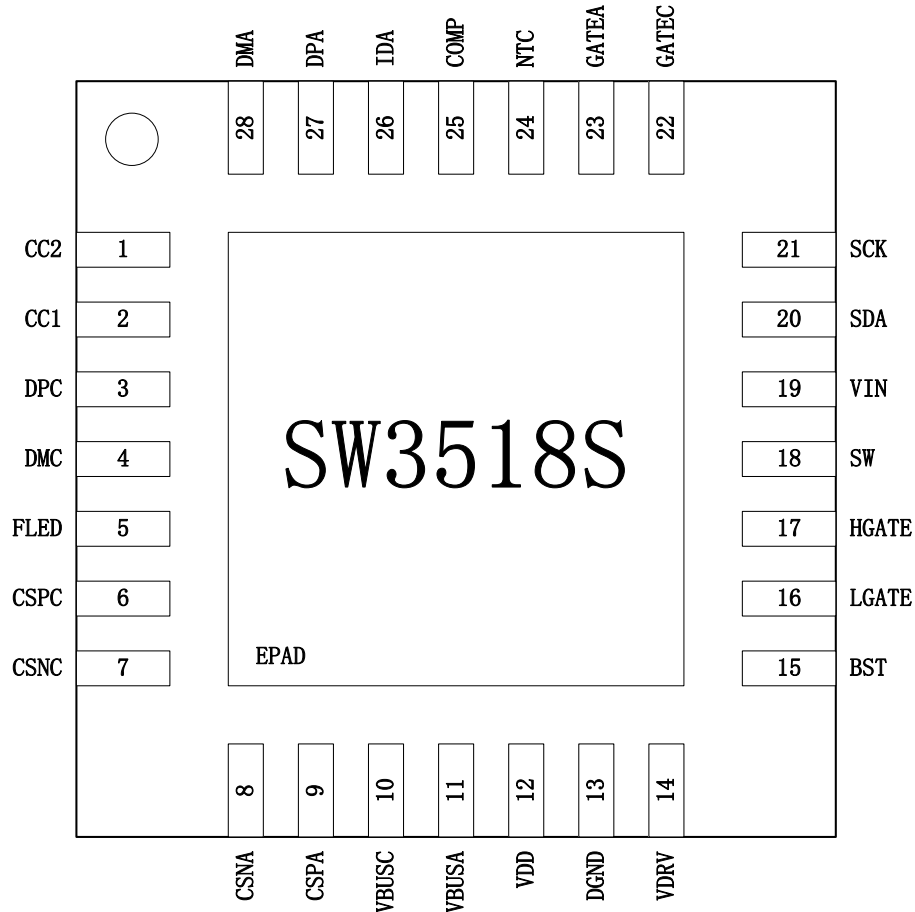
5.2 Pin Descriptions

Pin	Name	Function Description
1	CC2	Type-C configure channel CC2.
2	CC1	Type-C configure channel CC1.
3	DPC	Type-C port DP pin.
4	DMC	Type-C port DM pin.
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	CSNA	Type-A port current sense negative pin.
9	CSPA	Type-A port current sense positive pin.
10	VBUSC	Type-C port load detect pin.
11	VBUSA	Type-A 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.
23	GATEA	Type-A port power path control pin.
24	NTC	Negative temperature coefficient (NTC) thermistor input.
25	COMP	External compensation pin.
26	IDA	Type-A port ID pin.
27	DPA	Type-A port DP pin.
28	DMA	Type-A port DM pin.
	EPAD	Exposed pad.

6. Absolute Maximum Ratings

Parameters	Symbol	MIN	MAX	UNIT
Input Voltage	VIN	-0.3	50	V
Output Voltage	CSPA/CSNA/CSPC/ CSNC/VBUSA/VBUSC	-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	GATEA/GATEC	-0.3	27	V
Other Pin Voltage		-0.3	6	V
Junction Temperature		-40	+150	℃
Storage Temperature Range		-60	+150	℃
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 my 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 ℃, 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}=5mΩ	Single Port	3.0	3.3	3.6	A
			Dual Ports	2.4	2.7	3.0	A
Wire Drop Compensation	V_{OUT_WDC}	R_{CS}=5mΩ		50	65	80	mV/A
Thermal Regulation Threshold	T_{REGU_CHG}			105	120	135	℃
Light Load Detect							
Light Load Current	I_{LIGHT_LOAD}	R_{CS}=5mΩ		10	15	25	mA
Light Load Time	t_{LIGHT_LOAD}			1.5	2	3	S
Type-C							
CC Current Source	I_{CC_SOURCE}	Power Level=3.0A		310	330	350	uA
BC1.2							
DP/DM Voltage	DP	Apple 2.4A Mode		2.55	2.7	2.85	V

DM	Apple 2.4A Mode	2.55	2.7	2.85	V
PE						
Current Threshold	I_{REF}		150	250	350	mA
Quit Time	t_{PLUG_OUT}		160	200	240	mS
I2C						
Rate	f_{CLK}			100	400	Kbit/S
Thermal Shutdown						
Thermal Shutdown Threshold	T_{SHDT}	Temperature Rising	135	150	165	℃
Thermal Shutdown Hysteresis	T_{SHDT_HYS}	Temperature Falling	35	50	65	℃

9. Functional Description

9.1 Synchronous Buck

The SW3518S integrates a high efficiency synchronous buck with output current up to 5A and efficiency up to 95%(VIN=12V, VOUT=5V, IOUT=5A).

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. When single port outputs, CC limited current is set to 3.3A. When dual ports outputs, CC limited current is set to 2.7A for each port.

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℃, output voltage will automatically fall down so as die temperature stop increasing. If die temperature still rises to 150℃, 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 Power Path

The SW3518S supports Type-A+Type-C dual ports output, and each port supports fast charge output.

Type-A port supports QC3.0/QC2.0/AFC/FCP/SCP/PE2.0/PE1.1/SFCP/VOOC fast charge output.

Type-C port supports PPS/PD3.0/PD2.0/QC4+/QC4/QC3.0/QC2.0/AFC/FCP/SCP/PE2.0/PE1.1/SFCP fast

charge output.

Type-A port turns on and outputs 5V while Type-C port turns off in default mode. When single port outputs, it supports fast charge output. When dual ports outputs, it supports 5V output and current limiting for each port.

When load inserts, Type-A port will turn on to power supply extern device. When Single port outputs, Type-A port will return to default mode and output 5V if light load detection; When dual ports output, Type-A port will turn off if light load detection. The light load current will be about 15mA.When SINK is attached, Type-C port will turn on to supply device. When SINK is detached, or light load is detected, Type-C port will turn off.

9.3 Type C Interface

The SW3518S 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 SW3518S will broadcast power level of 3A.

9.4 PD Fast Charge

The SW3518S integrates PPS/PD3.0/PD2.0 fast charge protocol. PPS supports 3.3~21V@3A output voltage. PD3.0/PD2.0 supports 5V/9V/12V/15V@3A、20V@5A output voltage, and 100W maximum output power.

9.5 QC Fast Charge

The SW3518S integrates QC4+/QC4/QC3.0/QC2.0 fast charge protocol. It supports Class A/Class B, while QC2.0 supporting 5V/9V/12V/20V output voltage and QC3.0 supporting 3.6V~20V output voltage, 200mV/Step.

QC2.0/QC3.0 will output voltage base on DP/DM voltage:

Device		SW3518S	
DP	DM	VOUT	Note
3.3V	3.3V	20V	
0.6V	0.6V	12V	
3.3V	0.6V	9V	
0.6V	3.3V	continuous mode	0.2V/Step

0.6V	GND	5V	

9.6 AFC Fast Charge

The SW3518S integrates AFC fast charge protocol, and supports 5V/9V/12V output voltage.

9.7 FCP Fast Charge

The SW3518S integrates FCP fast charge protocol, and supports 5V/9V/12V output voltage.

9.8 SCP Fast Charge

The SW3518S integrates SCP fast charge protocol, and supports 5V@4.5A and 4.5V@5A output voltage.

9.9 PE Fast Charge

The SW3518S integrates PE2.0/PE1.1 fast charge protocol. PE1.1 supports 5V/7V/9V/12V output voltage. PE2.0 supports 5V~12V output voltage, 500mV/Step.

9.10 SFCP Fast Charge

The SW3518S integrates SFCP fast charge protocol, and supports 5V/9V/12V output voltage.

9.11 VOOC Fast Charge

The SW3518S integrates VOOC fast charge protocol, and supports 5V@4.25A output voltage.

9.12 BC1.2 Module

The SW3518S integrates BC1.2 controller, and automatically detects apple and samsung devices:

Apple 2.4A mode: DP=2.7V, DM=2.7V;

Samsung 2A mode: DP=1.2V, DM=1.2V;

9.13 Fast Charge Led

The SW3518S integrates fast charge LED driver through FLED pin. FLED pin will drive low to turn on fast charge led in fast charge status.

9.14 ADC

The SW3518S integrates 12 bit ADC, and samples input voltage/output voltage/Type-A output current/Type-C output current/board temperature. Board temperature can be calculated using NTC thermistor of 103AT.

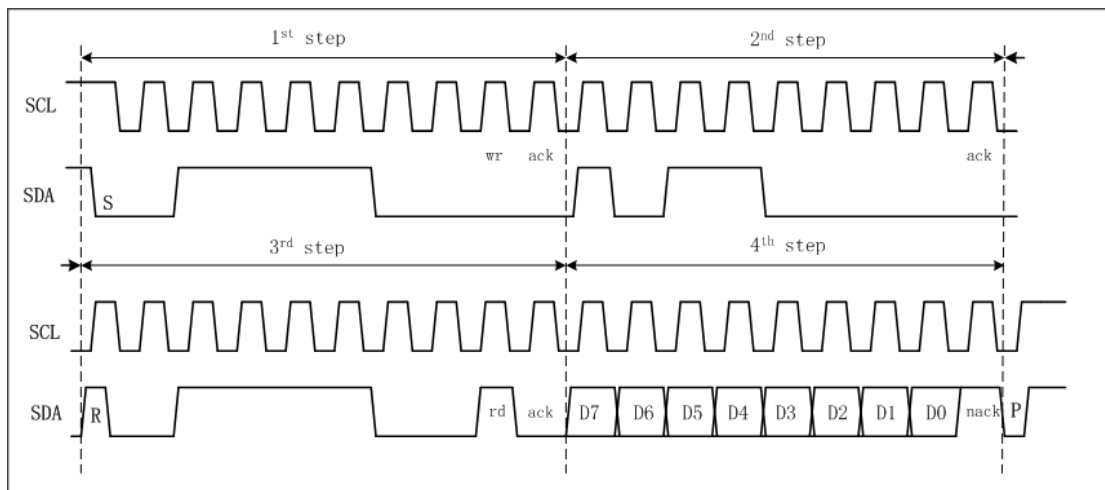| ADC channel	Range	Step
Input voltage	0~40.96V	10mV
Output voltage	0~24.576V	6mV
Type-A output current	0~10.24A	2.5mA
Type-C output current	0~10.24A	2.5mA
NTC voltage	0~2.048V	0.5mV

9.15 I2C Interface

The SW3518S integrates I2C interface, and supports 100K/400K rate.
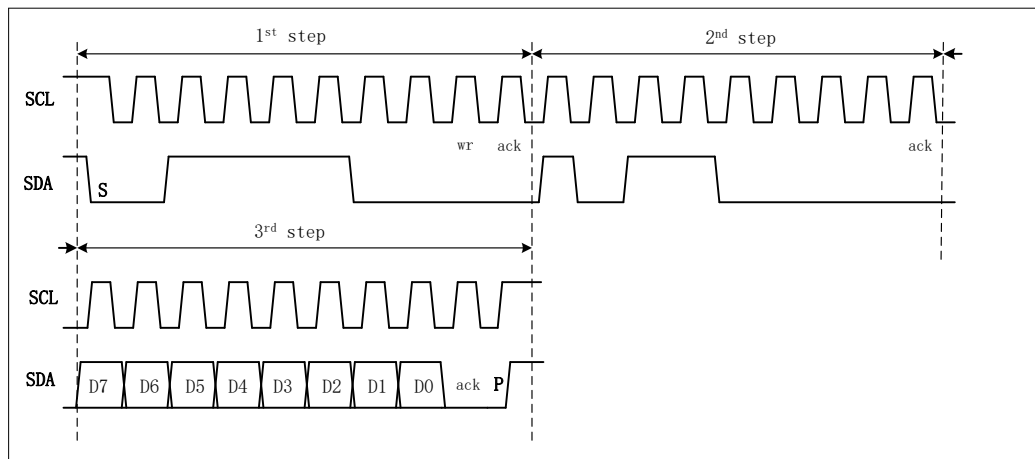
Read Timing:

Slave address ：0x3C
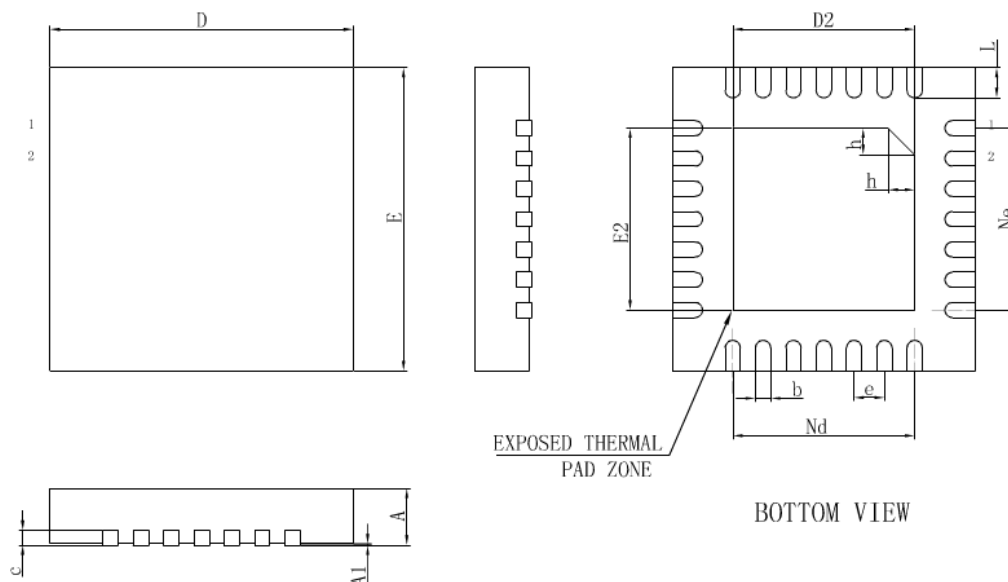Register address：0xB0

Write Timing:

Slave address ：0x3C
Register address：0xB0

10. Typical Application Circuits

11. Mechanical and Packaging

11.1 Package Summary

EXPOSED THERMAL PAD ZONE

BOTTOM VIEW

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.