USB Type-C PD3.2 A+C fast charging protocol intelligent management chip

Product Features

- Be compatible with various of USB Type-A port Fast charge protocol, can intelligently identify the protocol of mobile phone, including: (BC1.2), (Apple2.4A), (QC2.0 Class A), (QC3.0 Class A/B), (FCP), (SCP), (AFC), (low voltage direct charge), etc.

- Be compatible with various USB Type-C protocols, including Type-C protocol, Type-C PD2.0, Type-C PD3.0, Type-C PD3.2, QC4.0 protocol.

- Integrated VBUS path power switch

- Support A+C dual port operation, the voltage automatically reverts to 5V When dual port connecting at the same time

- The maximum output current is optional

- D± BV is 15V

- CC BV is 27V

- 5mΩ sampling resistor

- Constant voltage and constant current function (optional)

- Adjustable voltage accuracy 20mV/step

- VBUS voltage range 3~14V

- Working voltage 20~24V

- Supports current compensation, 1A/100mV

- Customization refer to Type-C PD PDO

- Integrate over temperature/over current/over voltage/undervoltage/discharge functions

- Package：QFN4x4-32L

Product Overview

FS8638 belongs to FASTSOC FSFC series，the chip selectively compatible with the mainstream charging protocols. The chip intelligently identifies the type of Mobile and selects the most appropriate protocol for the mobile needs.

The chip integrates a VBUS path power switch tube.

The D± and CC Break down voltage of the chip are higher than 15V and 27V, with high reliability. At the same time, FS8638 have over temperature, over current, over voltage, under voltage, discharge and other protection functions.

The FS8638 has a minimum power supply range of 3V and a maximum of 14V, and can adapt to the output voltage of various fast charging protocols.

FS8638 gives the user the choice of common Type-C PDO Settings. Users can select different system Settings by configuring the external resistor of the FUNC pin according to the application needs.

FS8638 provides a rich PDO configuration for users.

FS8638 provides QFN4x4-32L package type，very convenient for you to arrange reasonable scheme.

Application field

- Charger
- USB panel

V1.3(202411)

Order information

Part No	Package	Pcs/Reel
FS8638-XYZ	QFN4X4-32L	3000

comment：XYZ is selected according to specific function, refer to "device selection

Chip packaging and pin definition
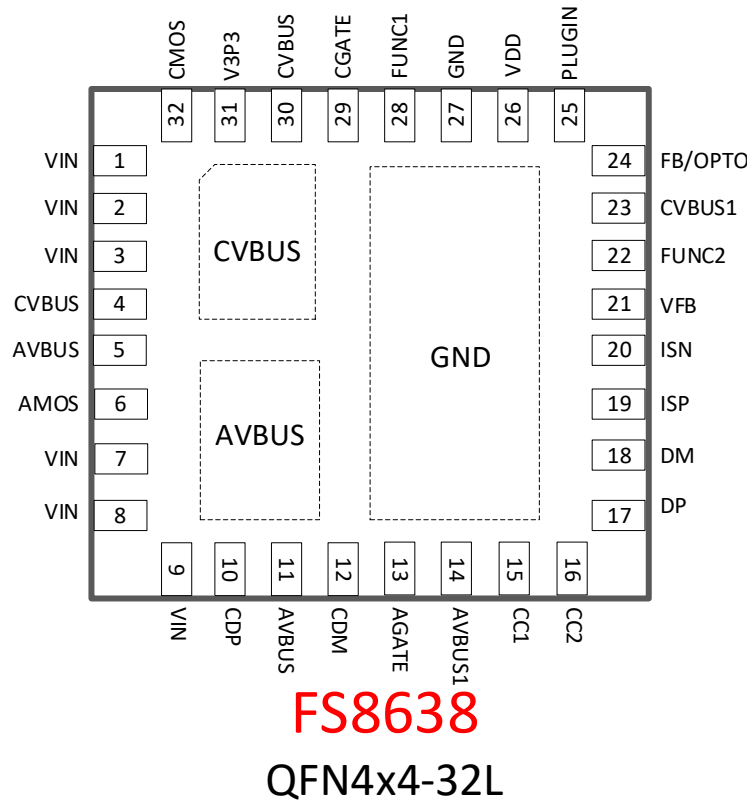
Pic 1. Pin definition

Table 1.　FS8638-XYZ Pin function description

QFN4X4-32L	Name of the pin	Description
1	VIN	The input of the power MOS, which is usually connected to the output of the power supply system
2	VIN	The input of the power MOS, which is usually connected to the output of the power supply system
3	VIN	I The input of the power MOS, which is usually connected to the output of the power supply system
4	CVBUS	The output of the power MOS is usually connected to the VBUS of the TEPY-C/USB-A
5	AVBUS	The output of the power MOS is usually connected to the VBUS of the TEPY-C/USB-A
6	AMOS	The drive end of the power MOS
7	VIN	The input of the power MOS, which is usually connected to the

		output of the power supply system
8	VIN	The input of the power MOS, which is usually connected to the output of the power supply system
9	VIN	The input of the power MOS, which is usually connected to the output of the power supply system
10	CDP	Connect the USB Type-C DP pin
11	AVBUS	The output of the power MOS is usually connected to the VBUS of the TEPY-C/USB-A
12	CDM	Connect the USB Type-C DM pin
13	AGATE	Control whether the Type-A port AVBUS has a voltage output and control the PMOSFET
14	AVBUS1	The external resistor is connected to the VBUS pin of the Type-A port
15	CC1	Connect the USB Type-C CC1 pin
16	CC2	Connect the USB Type-C CC2 pin
17	DP	Connect USB Type-A DP pin
18	DM	Connect USB Type-A DM pin
19	ISP	Current sampling + terminal
20	ISN	Current Sampling - terminal
21	VFB	FB application, grounding; OPTO application, connected to optocoupler.
22	FUNC2	External resistor, set PDO for Type-C PD
23	CVBUS1	External resistor connected to Type-C port VBUS pin
24	FB/OPTO	FB feedback, connecting 431/2, etc; OPTO feedback, connected to optocoupler
25	PLUGIND	Insert instructions
26	VDD	Chip power supply, usually connected to the output of the power system
27	GND	Grounding
28	FUNC1	External resistor, set PDO for Type-C PD
29	CGATE	Control whether there is voltage output from Type-C port CVBUS and control PMOSFET
30	CVBUS	The output terminal of the power MOS is usually connected to the VBUS of TEPY-C/USB-A
31	V3P3	Internal 3.3V LDO, external 1uF capacitor
32	CMOS	Driver end of power MOS

Extreme operating range

Table 2. Maximum working range

Parameter	value
VIN，CVBUS，CGATE，FB	-0.3V~27V
CC1, CC2	-0.3V~27V
DP, DM	-0.3V~15V
ISP, ISN	-0.3V~5.5V
ESD（HBM）	±2KV

The maximum operating range listed in the table above, if the limit is exceeded, the chip may be permanently damaged. Users should try to avoid it.

Normal operating range

Table 3. Normal operating range

Parameter	value
VIN	20V~24V
D± CC1 CC2	0V~3.3V
FUNC, FB	0V~3.3V
Operating temperature range	-40°~85°
Working current	<1mA

电气特性

Special note：T_A=25℃

Parameter	Symbol	Test conditions	minimum value	Typical values	Maximum value	Unit
Drain-Source Breakdown Voltage	$V_{(BR)\,DSS}$	V_{GS}=0V, I_D=-250uA	-20			V
Static Drain-Source On-Resistance	$R_{DS\,(ON)}$（FT）	V_{GS}=-4.5V, I_D=-5.4A		24	30	mΩ

Device Configuration

FSFC series IC have plenty of configuration options that include several broad categories: protocol type, declared power and voltage, and system current capability. List as following.

Protocol type

The FSFC series is compatible with various protocols of port A and port C. FASTSOC will provide commonly used chip types for users to choose, but users can still customize the type of agreement, please contact the sales for details.

Table 4. List of compatible protocol types

Port A protocol								Port C protocol				
Apple 2.4A	BC1.2	QC2.0	QC3.0	FCP	AFC	SCP	Low voltage charging	Type-C	PD2	PD3	PPS	QC4

Declared power and voltage

The IC offers a variety of power and voltage options for customers.

The first type related to C port protocol，such as QC4.0 and PD etc，divided into power and maximum Voltage.

PD power supports to 18W、24W、36Wetc；

PD maximum voltage supports to 9V、12V；

In addition, FSFC series provides a special FUNC Pin, the user can set part of the PDO by external resistor to the ground, improve the application flexibility of the chip. The ettings made by the FUNC Pin always have the highest priority.

For the CC threshold, Fixed PDO is set to 115% of the broadcast current and PPS PDO is set to 105% of the request current.

Protection function

If OCP protection is enabled, the OCP threshold is 120% of the maximum current capacity.

The OVP guard point is 125% of the set voltage.

For Fixed PDO, the UVP is set to 60% of the set voltage, and for PPS PDO, the UVP is set to Fixed 3.1V.

OTP is set to 140 ° C to 100 ° C for hysteresis.

Device selection

The identification method for FS8638 is: FS8638-YZ. Formally named, for example: FS8638-20W12V-C
For example, 20W9V represents PDO: power 20W, maximum voltage 9V, including 5V/3A, 9V/2.22A

What chip protocol feature is Y used for, usually type C.

Z is used for selecting other models.

Pin definition and instructions

VDD
VDD provides power to the chip, supporting a minimum of 3V and a maximum of 14V.
VDD can be directly connected to the output of the power system.

VIN
The input terminal of the power MOS is directly connected to the output of the power system.

V3P3
Connect external 1uF capacitor

FUNC1/FUNC2
You can choose different PDOs and system characteristics, as shown in the table below. If an external resistor is connected with a resistance of 100K Ω, it is recommended to use a resistor with 1% accuracy.
For FS8638, the FUNC function settings are as follows:

Table 10. FUNC Foot Functions

FUNC2	FUNC1	PDO0	PDO1	PDO2	PDO3	PDO4	备注
NC	NC	OTP settings					
Grounding	NC	5V3A	9V2.22A				20W
Grounding	Resistance	5V3A	9V2.22A	12V1.67A			20W
Resistance	NC	5V3A	9V2A	12V1.5A	3.3~5.9V3A	3.3~11V1.5A	18W
Resistance	Resistance	5V3A	9V2.77A	12V2.1A	3.3~5.9V3A	3.3~11V2.45A	25W
Resistance	Grounding	5V3A	9V2A				18W
NC	Resistance	5V3A	9V2.77A	3.3~5.9V3A	3.3~11V2.25A		25W
NC	Grounding	5V3A	9V3A	12V2.25A	3.3~5.9V3A	3.3~11V2.45A	27W
Grounding	Grounding	Block fast charging，5V/3A					

DP and DM

Both DP and DM withstand voltage are greater than 15V, improving the stability of system plugging and unplugging.

DP/DM is used to connect Type-A ports.

CDP and CDM

Both CDP and CDM withstand voltages greater than 15V, improving the stability of system plugging and unplugging.

CDP/CDM is used to connect to Type-C ports.

CC1 and CC2

CC1 and CC2 Connect to CC1 and CC2 in the Type-C port. CC1 and CC2 BV is above 27V, which improves the stability of system insertion and removal.

ISP and ISN

ISP and ISN are used for current sampling and are connected to 5 mΩ sampling resistors.

A sampling network is usually used in conjunction with the sampling resistance, refer to the application example for the network structure.

The GND on the type-C port needs to be connected to the ISP, but cannot be connected to the system Ground directly.

ISP and ISN in PCB design will affect the accuracy of current sampling value, should be connected to the sampling network, ISN connected to the sampling resistor end, cannot be directly connected to the system ground.

VFB

FB application, grounding; OPTO application, connected to optocoupler.

FB

As a FB application, the FB is connected to the power supply system and used to control the VBUS voltage of the USB. After the mobile phone and FSFC negotiate the protocol through D±/CC and the required voltage, FSFC initiates voltage regulation through FB. The Voltage regulating accuracy of FB is 20mV, and the voltage regulating speed is 200mV / 500us.

Assume that FB is connected with an external resistor R1 to VBUS and an external resistor R2 to ground. The usual calculation formula is as follows,

$$R_2 = \frac{R_1 V_{FB}}{V_{VBUS} - V_{FB}}$$

For instance,

V_{VBUS} take 5 V

V_{FB} can be found in the manual of the power IC, for example, take 0.8V

The typical value of R_1 is 100 KΩ. The precision must meet system requirements, for example, 1%

So we can figure out R2.

As an OPTO application, direct drive optocoupler.

AGATE

Control the circuit switch between VIN and AVBUS.

CGATE

Control the circuit switch between VIN and CVBUS.

AVBUS1

Connect the external resistor to the VBUS pin of Type-A port.

CVBUS1

Connect the external resistor to the VBUS pin of the Type-C port.

PLUGIND

Insert indicator, OD output.

AVBUS/CVBUS

The output terminal of the power MOS is connected to the VBUS of TYPE-C/USB-A.

AMOS/CMOS

The control terminal of power MOS.

Application example

The typical application of FS8638 is shown in the figure, where the chip is powered by the output of AC/DC.

Functional settings are made using an external resistor for FUNC.

FB is connected to the VFB of DC/DC or to the R terminal of 431/432. It is recommended to use 432.
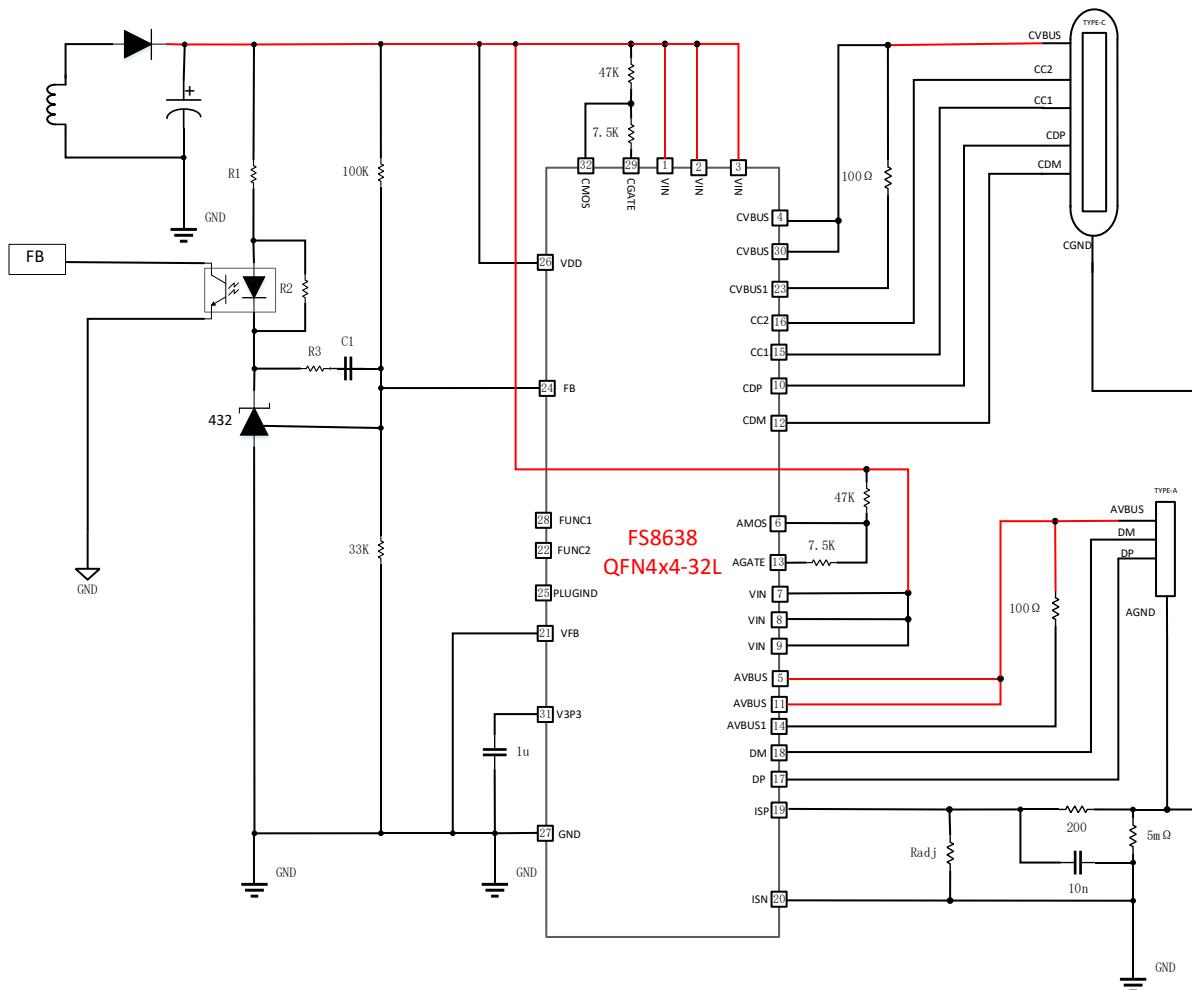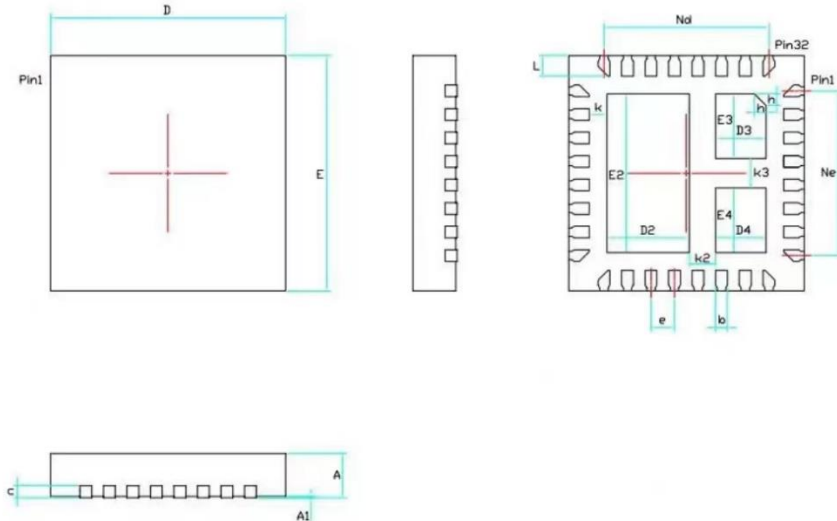

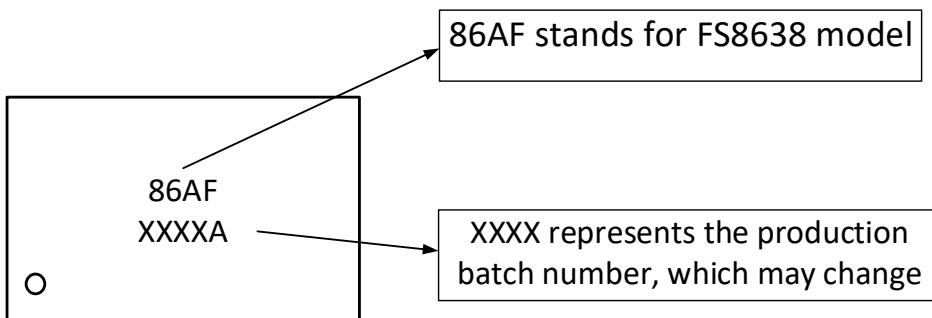Figure 3. Application diagram of FS8638

Package outline drawing

QFN32L （0404X0.75-0.40）产品外形图

SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	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	1.30	1.40	1.50
D3	0.75	0.85	0.95
D4	0.75	0.85	0.95
e	0.40 BSC		
Ne	2.80 BSC		
Nd	2.80 BSC		
E	3.90	4.00	4.10
E2	2.60	2.70	2.80
E3	1.00	1.10	1.20
E4	1.00	1.10	1.20
L	0.30	0.35	0.40
K	0.25	0.30	0.35
K2	0.40	0.45	0.50
K3	0.45	0.50	0.55
h	0.15	0.20	0.25

Screen printing instructions:

86AF stands for FS8638 model

86AF
XXXXA

XXXX represents the production batch number, which may change

1. FS8638 model information: 86AF, fixed and unchanged

2. The production batch number code is used to distinguish the batch number information each time, based on changes in the production batch

Company information and statement

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