Using FastSOC FSFA Device for Fast Charger Applications

Introduction

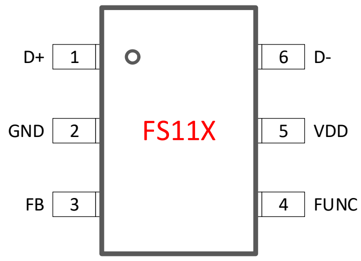
FSFA device family is used for fast charger applications like car charger, power bank, power adapter etc. It is used to manage USB-A port fast charge requirement from smart phone. Almost all popular smart phones are supported, whatever fast charge protocol they used, for example, Apple, Samsung, Huawei, Xiaomi, Oppo etc.

In this document, how to select the right device for your application will be introduced, it also includes how to use the FSFA device and example are given.

FSFA device selection

FSFA single channel device is named with FS11x, with package SOT23-6.

The package and pin assignment are shown as below.



SOT23-6

The FSFA family is shown in below table.

Name	Compatible Protocols								Max voltage	Max current	Package
	Apple 2.4A	BC1.2	QC2.0	QC3.0	FCP	AFC	SCP	LVHC			
FS111	√	√	√	√	√	√	√		12	5	SOT23-6
FS112	√	√	√	√	√	√	√	√	12	4	SOT23-6
FS113	√	√	√	√	√	√	√		12	4	SOT23-6
FS117	√	√	√	√	√	√			12		SOT23-6

* Max voltage is used for QC/FCP/AFC depends on the voltage output capability of the DC/DC and AC/DC.
* Max current is used for SCP protocol, and depends on the current output capability of the DC/DC and AC/DC.
* LVHC(Low Voltage High Current) can used for OPPO Oneplus smart phone.

FS111 and FS113 can support almost all protocols except LVHC.
FS113 can let high current protocol apply for up to 4A current for SCP, while FS111 is 5A for SCP. Select of FS111 and FS113 is depends on your power system's output current capability.
FS112 can work with all protocols.
FS117 only work for high voltage charge protocols, not include SCP and LVHC.

Normally, the maximum output voltage announced to the mobile phone is 12v for QC/FCP/AFC. While, user can using a resistor connect to FUNC pin to the GND with 200KΩ to become 9v max. for QC/FCP/AFC. This feature is very useful for low-cost power system.

Absolute Maximum Ratings

Parameters	*Values*
VDD	-0.3v~6.5v
D±	-0.3v~13v
FUNC, FB	-0.3v~6v
ESD（HBM）	±4000V

* Stresses greater than those listed as absolute maximum rating could cause permanent damage to the device.

Recommended Operating Conditions

Parameters	*Values*
VDD	2.9v~5.5v
D±	0v~3.3v
FUNC, FB	0v~3.3v
Temperature	-40° ~105°
Working Current	80uA~136uA

Usage

VDD

FSFA using shunt regulator, VDD can not connect to USB/VBUS directly as VBUS can up to 12v in fast charge. VDD should connect to VBUS through a resistor, the typical value is 2KΩ or 2.2KΩ, and with a capacitor to GND, which value is typically 470nF or 1uF.
One limit is, the voltage of the VBUS that VDD connected, should step from 0v to 6v by at least 1ms. As VBUS is always the output of the power system, the limit is easy to satisfied.
The working range of VDD is 2.9~5.5v.

FUNC

If the pin is connected to GND or less than 0.3v, which is logic 0, all fast charge protocol will be disabled immediately until the pin connect to logic 1 again, which is voltage bigger than 2.5v.
FUNC can be switched between logic 0 and 1 at any time as system need. The feature is powerful especially for application that multiple USB ports sharing same power rail. If more than one port has smart phone connected, the system may want the power rail limited to 5v, as the power rail is shared by all ports, otherwise when one smart phone applies for high voltage while another smart phone can only work at low voltage, if the power rail tuned to the high voltage, the low voltage smart phone may be damaged. In this situation, FUNC may connected to a system controller, which is typically an MCU.

Connect FUNC to GND through 200KΩ resistor will let the power delivery object become 9v max. from 12v max. for protocol like QC, AFC and FCP.

If the pin is not used, just let it float.

D±

D± should connect to USB port, both has tolerant up to 13v voltage. The feature safe the chip even D± pin short to VBUS.

FB

FB can connect to power system to control the voltage output to USB/VBUS. Smart phone using specified fast charge protocol negotiated with FSFA based on D±, FSFA then confirm if the voltage that the smart phone required is legal, and then tune FB to control the power system output the right VBUS providing to the smart phone.

The accuracy of the FB control is 20mv, the slew rate is 200mv/500us. Which means if smart phone wants 9v from current voltage 5v, after 10ms it will get 9v with voltage boost up step by step, each step with 200mv and consume 500us.

FB may connect a 100KΩ resistor, named R1, to VBUS and with another resistor R2 to GND. To determine R2 value, using following formula.

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

Where,

V_{VBUS} is 5v

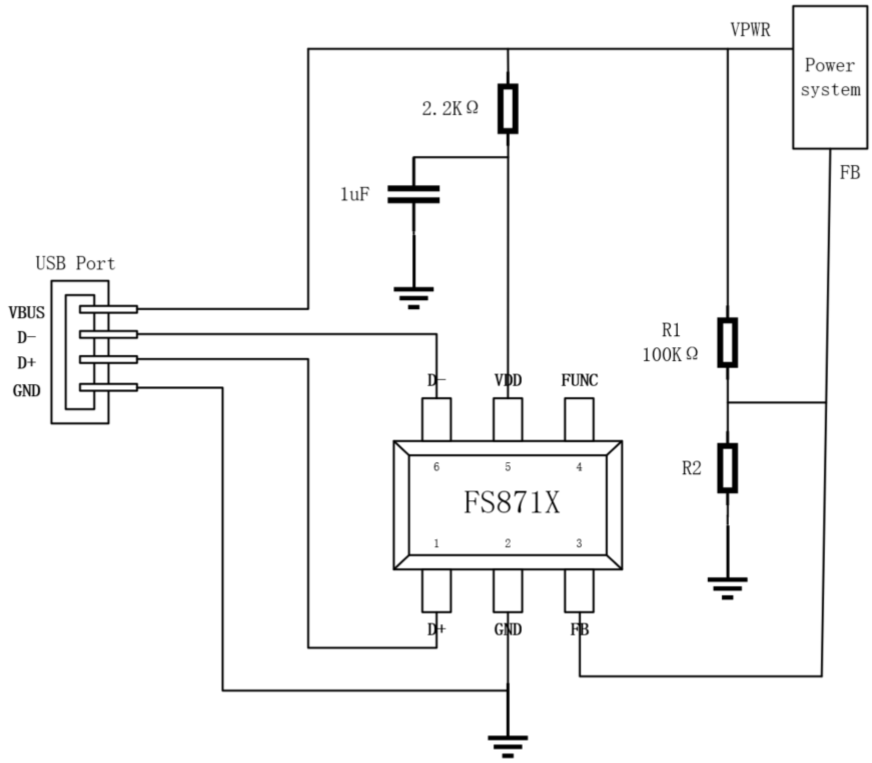
V_{FB} can be found from power control IC specification.

R_1 is 100KΩ, the accuracy is recommended with 1%, its value can changed depends on application requirement.

Example

A typical application schematic is shown below. Where, one USB-A port is used, the D± and GND should connect to USB-A port. FUNC pin is leaved floating without using to disable all fast charge protocols. VDD is connect to VPWR/VBUS with a 2.2KΩ resistor, and a 1uF capacitor to GND. FB is connected to power system for tune VPWR/VBUS.

The power system maybe DC/DC, where FB can connect with FB pin of DC/DC chip directly. If power system is AC/DC, FB may connect to TL431/2 reference pin. If user select TL431, then V_{FB} should be 2.5v, if using TL432 then V_{FB} should be 1.25v.



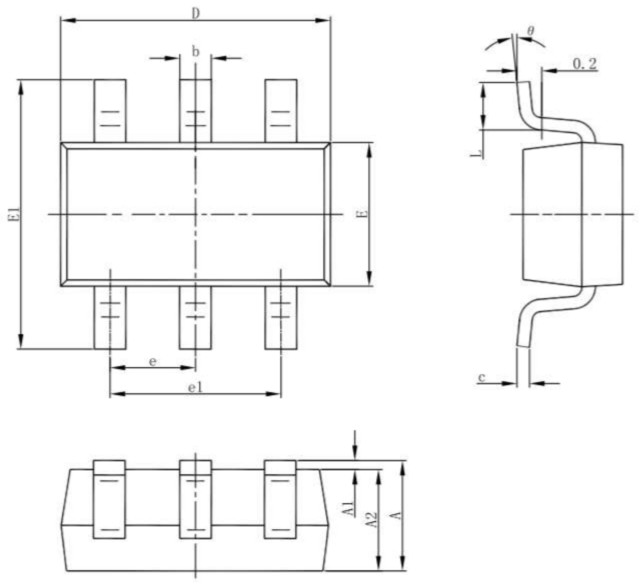
As an example, to calculate R2, we select a DC/DC, which has a formula like,

$$Vout = \frac{R1 + R2}{R2} \times 0.8V$$

Where, we let Vout=V_{VBUS}=5v, V_{FB}=0.8v, R1=100KΩ, then R2 =19KΩ. User can select 18KΩ, to let V_{VBUS}=5.24v at USB port with concern of VBUS line dissipation.

Appendix A

SOT23-6



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

About FastSOC

FastSOC Microelectronics Co., Ltd is a fabless IC design company focus on high performance mixed-signal, SOC integrated circuits especially in power application area.
Our products include fast charge protocol chip, power bank management chip, battery management chip, wireless charge management chip, general purpose MCU etc.
FastSOC now is a member of USB-IF and WPC organization.

FastSOC
Corporate Headquarters
A409-3, Building 530, Wuxi University Technology Park of Sensing. Wuxi, Jiangsu.
Shanghai Research Center
Room210, Building 2, No.1690 Cailun Road. Zhangjiang Hi-tech Park, Shanghai.

Phone: (86)1800-185-3071
Mail: gpp@fastsoc.com
www.fastsoc.com