

Fast Charging Physical Layer IC for USB Interfaces

TypeC PD2.0/PD3.0/PPS, QC3.0/QC2.0, FCP, SCP, AFC, MTK PE+ 2.0/1.1, Apple 2.4A, BC1.2

1. Features

- Support 12 charging standards including :
 - USB PD2.0/PD3.0/PPS DFP
 - QC3.0/QC2.0, AFC, SCP, FCP, MTK PE2.0/1.1
 - Apple 2.4A, Samsung 2.0A and BC1.2
- Support USB PD2.0/PD3.0/PPS
 - Auto detect USB PD device plug in or out
 - 18w SRC_CAP package broadcast
 - 5V/9V/12V SRC_CAP package broadcast
 - 3V~12V PPS SRC_CAP package broadcast
 - VBUSG open power rail after CC connection
- Support Qualcomm® QC3.0/QC2.0 Class A
 - QC3.0 Class A: 3.6V~12V(0.2V/step)
 - QC2.0 Class A: 5V, 9V, 12V
- MTK PE2.0/1.1
 - PE+ 2.0: 5V~20V(0.5V/step)
 - PE+ 1.1: 5V/7V/9V/12V
- Support Samsung® AFC
- Support Huawei® SCP
- Support Huawei® FCP
- Support Apple 2.4A: DP=2.7V, DM=2.7V
- Support Samsung 2.0A: DP=1.2V, DM=1.2V
- Support BC1.2: DP short DM automatically
- Default 5 V mode operation
- Support auto-detect and auto-switching fast charging standards
- FB for voltage regulation
- Support DP,DM,CC1,CC2 overvoltage protection
- Support DP,DM weak short to GND protection
- VIN working voltage: 3.3V~20V
- Package: SSOP10

2. Description

IP2188 is a fast charging Physical Layer IC dedicated for USB ports, which supports 12 kinds of fast charging standards, including USB PD2.0/PD3.0 /PPS (Programmable Power Supply), HVDCP QC2.0/QC3.0 (Quick Charge), AFC (Samsung® Adaptive Fast Charge), SCP (Hisilicon® Super Charge Protocol) and FCP (Hisilicon® Fast Charge Protocol), MTK PE+2.0/PE+1.1(MediaTek Pump Express Plus 2.0/1.1), Apple 2.4A, BC1.2 and Samsung 2.0A.

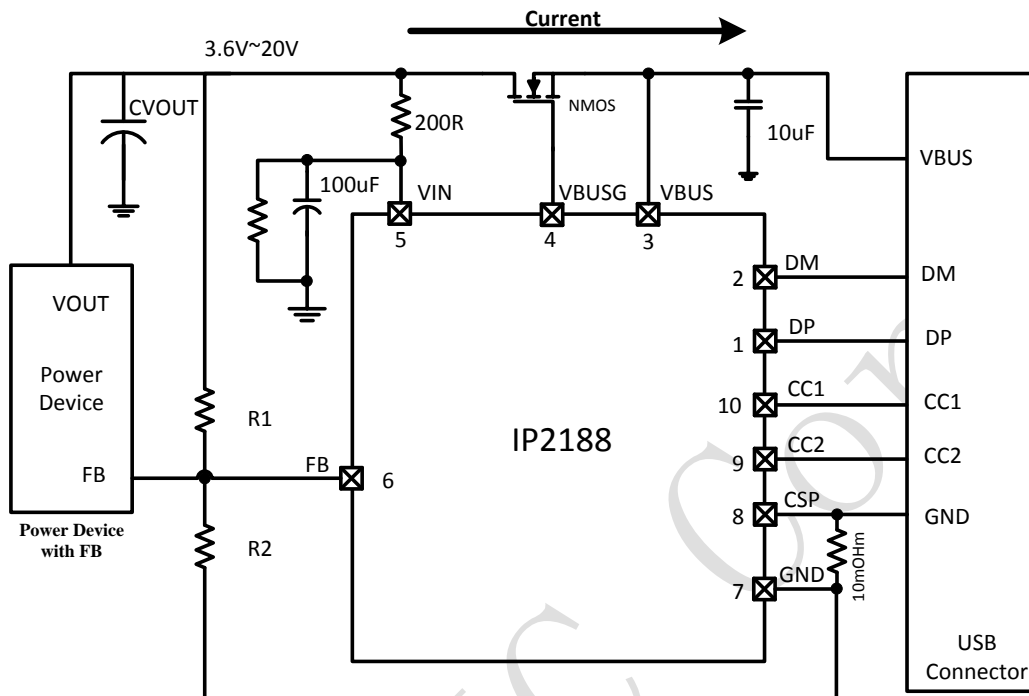
IP2188 support automatically detecting the connected device's type and switching standards type to responding for fast charging requirements.

FB control line support sink or source current (2uA/step) for accurate voltage regulation.

3. Typical Applications

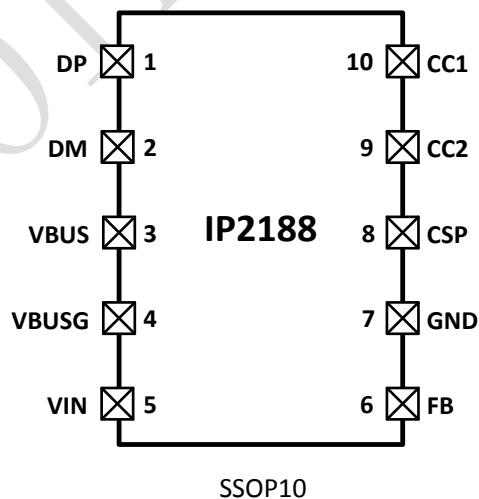
- USB power output ports for AC adapters, Power Bank, Car chargers
- Battery chargers for smart phones, tablets, netbooks, digital cameras, and Bluetooth accessories

4. Typical Application Schematic



R1 recommend: 100kOhm(1%)
 R2 value refer to the power device
 R3 value is equivalent to dummy load
 CVOUT recommend: 1000uF

5. PIN Description



Pin No.	Pin name	Pin description
1	DP	Connect to the DP pin of the USB port
2	DM	Connect to the DM pin of the USB port
3	VBUS	Connect to the VBUS of the USB port
4	VBUSG	VBUS output path control on the NMOS
5	VIN	Power Input

6	FB	Connect to the FB line of Regulator or opto-coupler, current source/sink for voltage regulation
7	GND	Ground
8	CSP	Current sense node
9	CC2	Connect to the CC2 pin of the USB port
10	CC1	Connect to the CC1 pin of the USB port

6. IP Series Products List

USB Charging Port Control IC

IC Part No.	Channel Num	Standard Supported											Package	
		BC1.2 & APPLE	QC3.0 & QC2.0	FCP	SCP	AFC	SFCP	MTK PE+ 2.0&1.1	Type C	NTC	QC Certificate	PD3.0	PKG	P2P
IP2110	1	√	-	-	-	-	-	-	-	-	-	-	SOT23-5	
IP2111 IP2111A	1	√	-	-	-	-	-	-	-	-	-	-	SOT23-6	
IP2112 IP2112A	2	√	-	-	-	-	-	-	-	-	-	-	SOT23-6	
IP2161	1	√	√	√	-	√	√	-	-	-	√	-	SOT23-6	
IP2163	1	√	√	√	-	√	√	√	-	√	√	-	SOP8	PIN2 PIN
IP2183	1	√	√	√	√	√	-	√	-	-	-	-	SOP8	
IP2188	1	√	√	√	√	√	-	√	√	-	-	√	SSOP10	
IP2701	1	√	√	√	-	√	√	-	√	-	-	-	SOP8	
IP2703	1	√	√	√	-	√	√	√	√	√	-	-	DFN10	
IP2705	1	√	√	√	-	√	√	√	√	√	-	-	DFN12	
IP2707	2	√	√	√	-	√	√	√	√	√	-	-	QFN16	
IP2712	1	√	√	√	√	-	-	1.1	√	-	√	√	TSSOP20L	
IP2716	1	√	√	√	√	√	-	1.1	√	-	√	√	QFN32	
IP2723	1	√	√	√	√	√	-	√	√	-	-	√	TSSOP16	
IP2721	1	-	-	-	-	-	-	-	-	-	-	√ SINK	TSSOP16	

Power Bank IC

IC Part No.	Charge /Discharge		Features								Package	
	Charge	Discharge	LED Num	Lighting	Key	I2C	DCP	Type-C	QC Certificate	PD3.0/PPS	PKG	P2P
IP5303	1.0A	1.2A	1,2	√	√	-	-	-	-		eSOP8	

IP5305	1.0A	1.2A	1,2,3,4	✓	✓	-	-	-	-		eSOP8	PIN2PIN
IP5306	2.4A	2.1A	1,2,3,4	✓	✓	-	-	-	-		eSOP8	
IP5206	2A(Max)	1.5A	3,4,5	✓	✓	-	-	-	-		eSOP16	
IP5108E	2.0A	1.0A	3,4,5	✓	✓	-	-	-	-		eSOP16	
IP5108	2.0A	2.0A	3,4,5	✓	✓	✓	-	-	-		eSOP16	
IP5207	1.2A	1.2A	3,4,5	✓	✓	-	-	-	-		QFN24	
IP5207T	1.2A	1.2A	1,2,3,4	✓	✓	✓	✓	-	-		QFN24	PIN2PIN
IP5109	2.1A	2.1A	3,4,5	✓	✓	✓	-	-	-		QFN24	
IP5209	2.4A	2.1A	3,4,5	✓	✓	✓	✓	-	-		QFN24	
IP5219	2.4A	2.1A	1,2,3,4	✓	✓	✓	✓	✓	-		QFN24	
IP5310	3.1A	3.0A	1,2,3,4	✓	✓	✓	✓	✓	-		QFN32	
IP5312	15W	3.6A	2,3,4,5	✓	✓	✓	✓	-	-		QFN32	
IP5318Q	18W	4.0A	2,3,4,5	✓	✓	✓	✓	-	✓		QFN40	PIN2 PIN
IP5318	18W	4.0A	2,3,4,5	✓	✓	✓	✓	✓	✓		QFN40	
IP5322	18W	4.0A	1,2,3,4	✓	✓	✓	✓	-	✓		QFN32	
IP5328	18W	4.0A	1,2,3,4	✓	✓	✓	✓	✓	✓		QFN40	PIN2P IN
IP5328P	18W	4.0A	1,2,3,4	✓	✓	✓	✓	✓	✓		QFN40	

7. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
VCC Input Voltage Range	V _{IN}	-0.3 ~ 30	V
VBUS Input Voltage Range	V _{BUS}	-0.3 ~ 30	V
VBUSG Input Voltage Range	V _{BUSG}	-0.3 ~ 30	V
DP, DM Input Voltage Range	V _{DP} , V _{DM}	-0.3~15	V
CC1,CC2 Input Voltage Range	V _{CC1} , V _{CC2}	-0.3~30	V
Other Pins Input Voltage Range	V _{other}	-0.3~10	V
Junction Temperature Range	T _J	-40 ~ 150	°C
Storage Temperature Range	T _{STG}	-60 ~ 150	°C
Lead Temperature Range (Soldering, 10sec)	T _s	260	°C
Package Thermal Resistance	θ _{JA}	90	°C
Package Thermal Resistance	θ _{JC}	39	°C
Human Body Model (HBM)	ESD	2	KV

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

*Voltages are referenced to GND unless otherwise noted.

8. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	V _{IN}	3		25	V
Ambient Temperature	T _A	-40		85	°C

*Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

9. Electrical Characteristics

Unless otherwise specified, T_A = 25°C, 4.5V ≤ V_{CC} ≤ 5.5V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V _{IN}	Supplied directly	3		25	V
Input UVLO Threshold	UVLO	V _{IN} Falling	2.5		2.9	V
Quiescent Current	I _q	No load, V _{IN} =5V	1			mA
		No load, V _{IN} =20V			1.6	mA
Startup Time	T _s		20	37	50	us
HVDCP (QC2.0&QC3.0)						
Data Detect Voltage Threshold	V _{DATA_REF}		0.25	0.325	0.4	V
Output Voltage Selection Reference	V _{SEL_REF}		1.8	2	2.2	V
DP High Glitch Filter Time	T _{GLITCH(BC)_DP_H}		1000	1250	1500	ms
DM Low Glitch Filter Time	T _{GLITCH(BC)_DM_L}			2		ms
Output Voltage Glitch Filter Time	T _{GLITCH(V)_CHANGE}		20	40	60	ms
Continuous Mode Glitch Filter Time	T _{GLITCH_CONT_CHANGE}		100		200	us
DM Pull-down Resistance	R _{DM_DOWN}	V _{DP} =0.6V		20		kOhm
DP Pull-down Resistance	R _{DAT_LKG}	V _{DP} =0.6V		500		kOhm
FB Current Step	I _{UP} , I _{DOWN}	40uA(9V); 70uA(12V); 150uA(20V)		2		uA
DCP						
Samsung DP/DM Output Voltage			1.08	1.2	1.32	V

Samsung	DP/DM	Output Impedance				100		kOhm
Apple	2.4A	DP/DM	Output Voltage		2.64	2.7	2.76	V
Apple	2.4A	DP/DM	Output Impedance			30		kOhm

10. Function Description

Charging Standards

IP2188 is a high-voltage, fast charging Physical Layer IC dedicated for charging applications where charging standards required to be negotiated between USB ports. IP2188 is needed at the host-side, when the attached portable client-side device negotiate the power allotment from the power source host-side, IP2188 can auto-detect and respond to the those charging standards and may grant or deny the request based on the available voltage/current. IP2188 will inform the power source host-side to adjust the output voltage by FB line once charging request granted.

IP2188 support analysis several charging standards, including USB PD3.0 PPS, HVDCP QC3.0 (Quick Charge), AFC (Adaptive Fast Charge), SCP (Super Charge Protocol) and FCP (Fast Charge Protocol).

IP2188 detects both CC pins for USB PD protocol and monitors the real-time voltage on DP line and DM line for other fast charge protocol detection. Once the attached device fast charge type is determined, the negotiation will be accomplished on CC lines or DP and DM lines accordingly. IP2188 will analysis the protocol and fulfill the power requirements, source/sink current on FB line to grant the request voltage. When the output voltage is default 5V, FB line neither source nor sink current.

IP2188 is in control of the charging power loop, support overcurrent and under voltage and output short protection, VBUSG can shut the power path in those abnormal situations. And support VBUS line compensate and soft start. The charging current is determined by the host-side power source and the client-side USB port device.

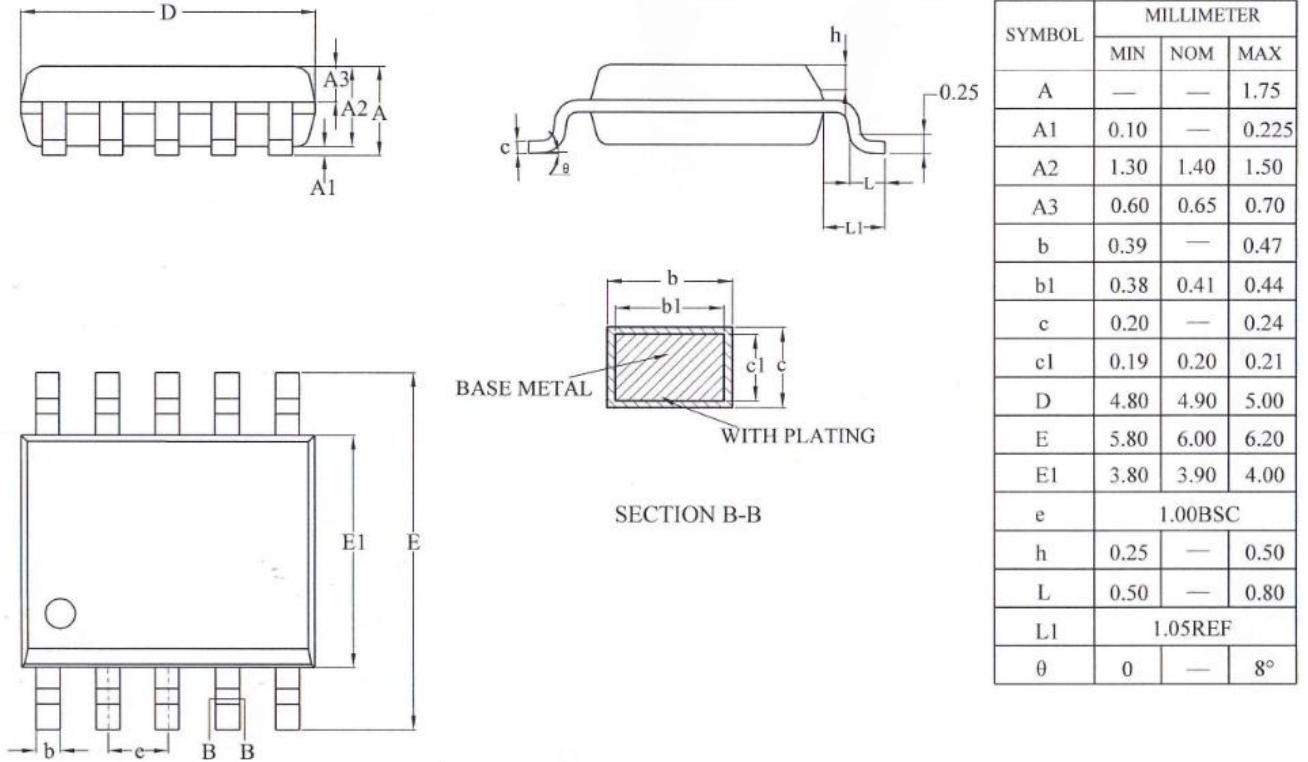
FB

IP2188 integrated FB control line used for accurate voltage regulation by source/sink current with precise 2uA/step in minimum. FB sink 40uA current for 9V output voltage; FB sink 70uA current for 12V output voltage; FB sink 150uA current for 20V output voltage; when the output voltage is default 5V, FB neither source nor sink current.

In typical applications, IP2188 FB connects to the regulator's FB line, resistor (R1) between VOUT and FB should apply 100kOhm with high precision (1%), resistor (R2) value between FB and GND should refer to the regulator adopted, resistance of R2 can be calculated by equation:

$$V_{FB} = \frac{V_{OUT}}{R1+R2} * R2$$

11. Package



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