



VIA Labs, Inc.

## Datasheet

VP300

USB PD Type-C Controller for SMPS

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Revision 0.6

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## Revision History

Revision No.	Draft Date	History	Initial
0.60	Aug. 30 2016	Preliminary Release	TH

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## VP300

### USB PD Type-C Controller for SMPS

#### General Description

The VP300 is an USB Power Delivery (USB PD) type-C controller with highly integrated function for Switching Mode Power Supply (SMPS).

One 8051 MCU is embedded to support PD 3.0 and QC 3.0 protocol. VP300 could work under wide input range from 3.6V to 30V. The shut regulator is built in and 2 operational amplifiers are built in for CV and CC loop for high accuracy output for easy design. Programmable cable compensation is built in and CC pins could provide the Vconn power for E-Marker IC. Integrated discharge MOSFET and build in Vbus PMOS pre-drive control to save external components.

Fully integrated protect function including UVP, OVP, OCP, SCP, and over temperature protection.

#### Product Feature

- Type-C and USB PD Support
  - Compliant to USB Type-C Cable and Connector Specification Revision 1.2
  - Compliant to USB Power Delivery Specification Revision 3.0
  - Integrated USB Type-C baseband transceiver PHY
  - Support USB PD all power profile
  - Integrate Vconn power switch
- Fast 8051 Macro cell 80C32-Compatible Microcontroller
  - Standard 1T 8051 instruction set
  - Embedded OTP and SRAM
- Built-in Voltage Regulators
  - 30V to 5V LDO
  - 5V to 3V LDO
  - 5V to 1.8V LDO
- Protection functions
  - Over voltage protection, Under voltage protection
  - Over current protection
  - Short circuit protection
  - Chip internal over temperature protection
- High Integration
  - Build-in TL431 shunt regulator for voltage output control
  - CC and CV control
  - Programmable cable compensation
  - Build-in discharge MOSFET

- Build-in PMOS pre-drive
- Support BC1.2 & QC3.0 charge function
- Package
  - SOP 16 green package (9.9x3.9x1.4 mm)
  - QFN 24 green package (5x4x 0.85 mm)
- Certification
  - TID: 1000017
  - Ambient operating temperature: -40°C to 85°C
- Applications
  - USB PD Type-C Wall adapters and chargers

### Function Block Diagram

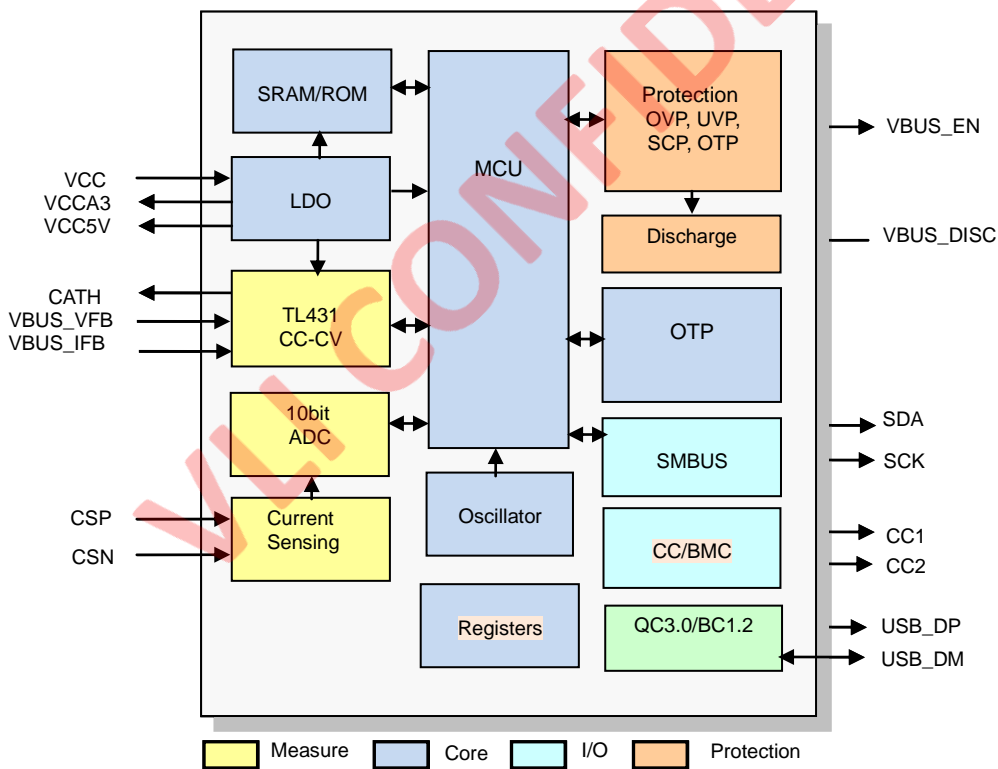


Figure 1 – VP300 Block Diagram

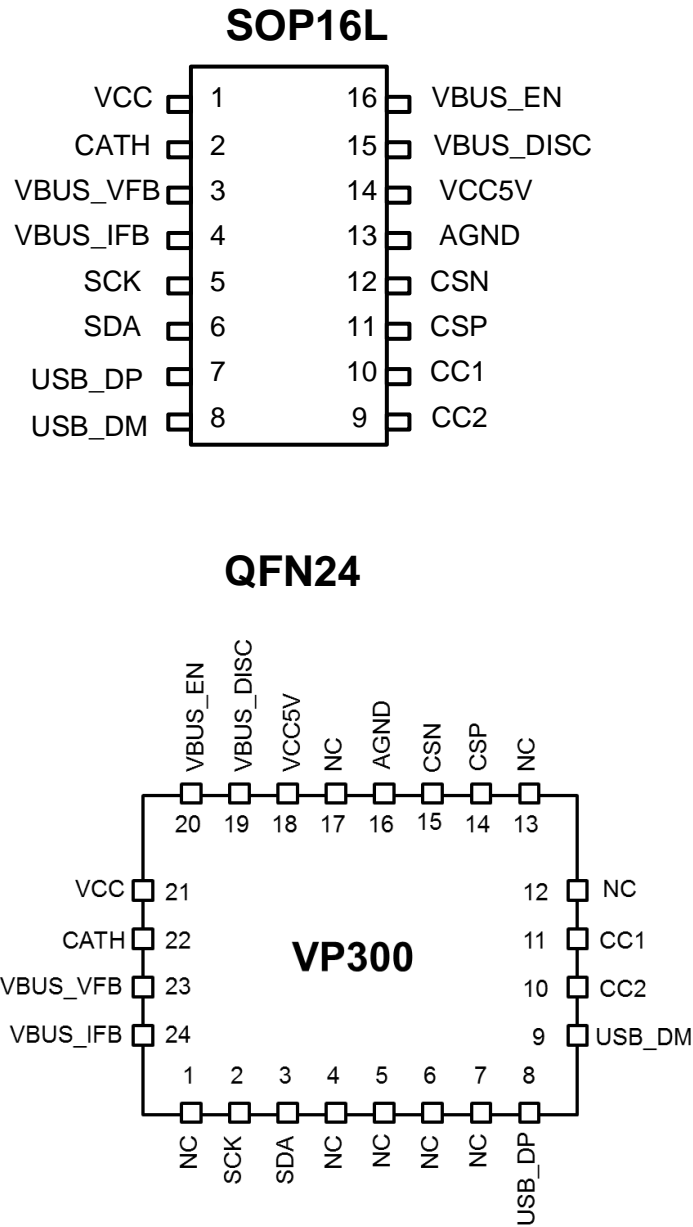


Figure 2 – VP300 Pin Diagram

## Pin Descriptions

### SOP16L

Pin Name	Pin	I/O	TYPE	Description
VCC	1	IO	Power	FLYBACK control power, connect to VBUS PMOS switch
CATH	2	IO	Analog	Connection to PHOTO-Diode output
VBUS_VFB	3	IO	Analog	FLYBACK compensation for CV mode
VBUS_IFB	4	IO	Analog	FLYBACK compensation for CC mode
SCK	5	IO	CMOS	3V I2C IO pin
SDA	6	IO	CMOS	3V I2C IO pin
USB_DP	7	IO	Analog	USB Charge pin
USB_DM	8	IO	Analog	USB Charge pin
CC2	9	IO	Analog	PD2.0 Type-C pin
CC1	10	IO	Analog	PD2.0 Type-C pin
CSP	11	I	Analog	Pin for Current sensing
CSN	12	I	Analog	Pin for Current sensing
AGND	13	IO	Ground	Ground pin
VCC5V	14	IO	Power	5V regulated or bypass power
VBUS_DISC	15	O	Analog	VBUS discharge
VBUS_EN	16	O	Analog	VBUS PMOS switch enable

**QFN24**

Pin Name	Pin	I/O	TYPE	Description
NC	1			No Connection
SCK	2	IO	CMOS	3V I2C IO pin
SDA	3	IO	CMOS	3V I2C IO pin
NC	4			No Connection
NC	5			No Connection
NC	6			No Connection
NC	7			No Connection
USB_DP	8	IO	Analog	USB Charge pin
USB_DM	9	IO	Analog	USB Charge pin
CC2	10	IO	Analog	PD3.0 Type-C pin
CC1	11	IO	Analog	PD3.0 Type-C pin
NC	12			No Connection
NC	13			No Connection
CSP	14	I	Analog	Pin for Current sensing
CSN	15	I	Analog	Pin for Current sensing
AGND	16	IO	Ground	Ground pin
VCCA3	17	IO	Power	3V regulated power
VCC5V	18	IO	Power	5V regulated or bypass power
VBUS_DISC	19	O	Analog	VBUS discharge
VBUS_EN	20	O	Analog	VBUS PMOS switch enable
VCC	21	IO	Power	FLYBACK control power, connect to VBUS PMOS switch
CATH	22	IO	Analog	Connection to PHOTO-Diode output
VBUS_VFB	23	IO	Analog	FLYBACK compensation for CV mode
VBUS_IFB	24	IO	Analog	FLYBACK compensation for CC mode





## Electrical Specification

### Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit	Note
VCC	Supply voltage	-0.3	30	V	
V <sub>ESD</sub>	Electrostatic Discharge	-8000	8000	V	HBM
$\theta_{jc}$	Thermal resistance between junction and case	TBD		°C/W	SOP16
$\theta_{jc}$	Thermal resistance between junction and case	TBD		°C/W	QFN24
T <sub>STG</sub>	Storage Temperature	-55	125	°C	

Note: Stress above conditions may cause permanent damage to the device. Functional operation of this device should be restricted to the conditions described.

Note: About thermal factors, T<sub>a</sub> is the concerned ambient temperature, and

$$\theta_{ca} = \theta_{ja} - \theta_{jc}$$

$$T_J = \theta_{ja} * P_D + T_a$$

$$T_c = \theta_{ca} * P_D + T_a$$

### Electrical Characteristics

Items	Descriptions	Test conditions	min	type	max	unit
<b>Vcc Status</b>						
VCC	Operating Voltage		3.6		30	V
ICC	Active current	After PD negotiation			6	mA
I <sub>qq</sub>	Suspend current			800		uA
Central Clock			21.6	24	26.4	MHz
<b>Internal Bias</b>						
VCC5V	6V < Vcc < 30V		4.5	5	5.5	V
Load Regulation	VCC5V=5V				50	mV
<b>Current Sense Amplifier</b>						
Gain				15		V/V
Unit Gain BW				20		kHz
Current Sense Range			40		640	mV
<b>Regulation Section</b>						
Off-State CATH Current			500			nA
CATH Turn On Impedance	The minimum current ~1mA		1K			Ω
Maximum Sinking Current of CATH					30	mA



<b>VBUS_DISC Pin</b>						
Pull Low Impedance				10	15	$\Omega$
Maximum Sinking Current			0.5			A
Pull Low Duration				300		mS
<b>D+, D- Section</b>						
Switch Spec between D+/D-					20	$\Omega$
<b>VBUS_EN Section</b>						
Maximum Sinking Current						mA
Pull Low Impedance			400		2K	$\Omega$

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## Function Description

### Power Structure

VP300 is biased by VCC, and there are a regulator output VCC5V to supply Vconn power and the analog circuit. The output capacitor is necessary to improve the stability of LDO inside also reduce the ripple noise.

### CV/CC Regulator

The shunt regulator have two operational amplifiers for constant-voltage(CV) and constant-current(CC) with adjustable reference voltage are implemented. The CC loop also have programmable gain amplifier(PGA) to sense fly-back converter output current. CV and CC loop outputs are tied together in open drain structure and deal with 3.6V to 20V VBUS voltage range.

VBUS\_VFB and VBUS\_IFB are the reference for the voltage and current feedback.

### Current Amplifier

To minimize the power loss of current sense resistor, the sense voltage could be adjusted from 40mV~640mV, also the gain of amplifier can be adjusted among 5/10/15/20. The current signal is feedback though VBUS\_IFB by 10bit ADC to report the current status to MCU.

### Interface of D+/D-

D+ and D- pins are used for BC 1.2 and QC 3.0 communication.

### Interface of CC1/CC2

CC1 and CC2 pins are used for USB PD 3.0 communication. 3 current profile (80μA, 180μA, 330μA) are provided to broadcast the source capability of SMPS.

### Open Drain Driver of VBUS\_DISC / VBUS\_EN

VBUS\_DISC is used to discharge output capacitor upon removal of connected device or to discharge the output voltage to a lower desired value after received a command. One external power resistor between VOUT and VBUS\_DISC is recommended to minimum the power consumption of VP300.

VBUS\_EN is an open drain driver to enable/disable P-channel MOSFET of the VBUS. The PMOS is enable by pull low through VBUS\_EN. VBUS\_EN will pull high when the device is not connected or when abnormal conditions (OVP, UVP, OCP, SCP, OTP) happen.

### Package Mechanical Specifications

#### SOP16L Package

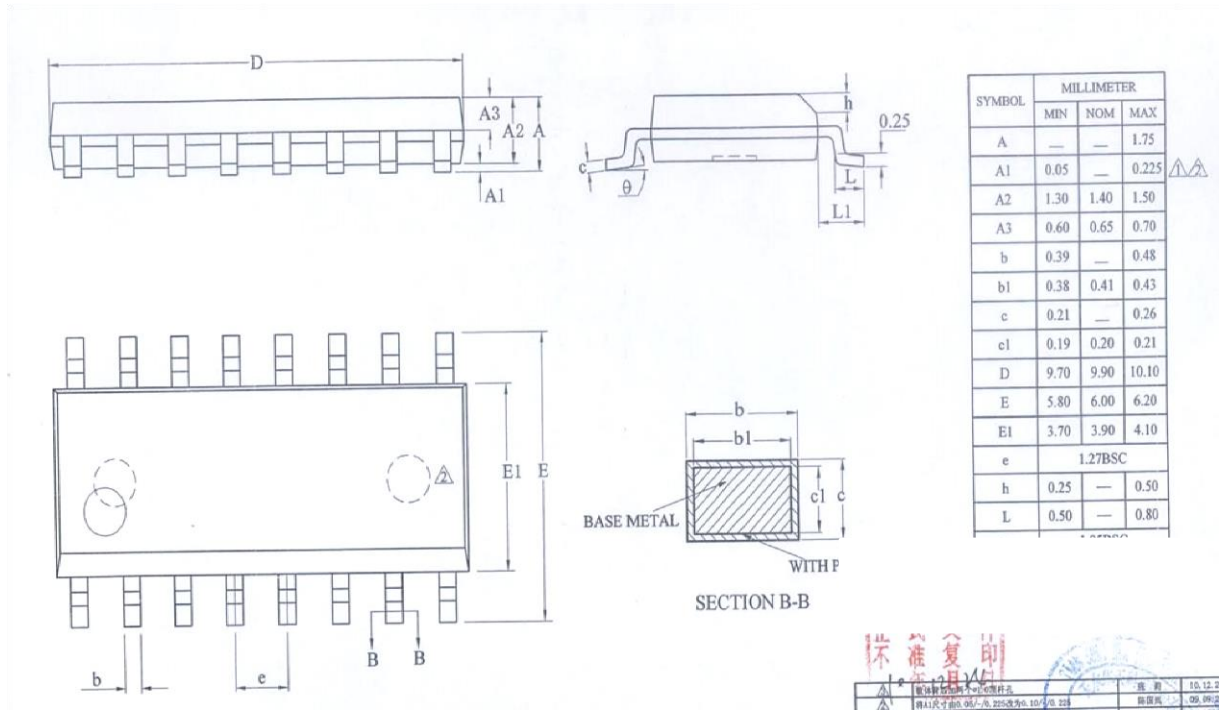
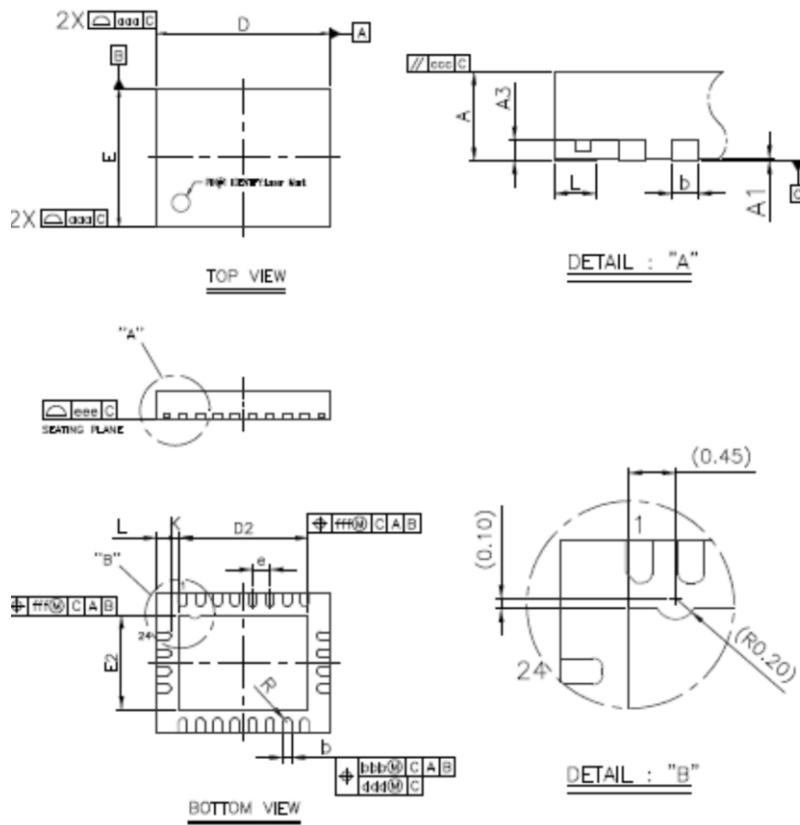


Figure 4 - Mechanical Specification SOP16

**QFN24 package**



Symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.85	0.90	0.031	0.033	0.035
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.20 REF			0.008 REF		
b	0.18	0.25	0.30	0.007	0.010	0.012
D	4.90	5.00	5.10	0.193	0.197	0.201
E	3.90	4.00	4.10	0.154	0.157	0.161
D2	3.60	3.70	3.80	0.142	0.146	0.150
E2	2.60	2.70	2.80	0.102	0.106	0.110
e	0.50 BSC			0.020 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020
K	0.20	---	---	0.008	---	---
R	0.09	---	0.14	0.004	---	0.006
aaa	0.15			0.006		
bbb	0.10			0.004		
ccc	0.10			0.004		
ddd	0.05			0.002		
eee	0.08			0.003		
fff	0.10			0.004		

NOTE:

1. CONTROLLING DIMENSION : MILLIMETER
2. REFERENCE DOCUMENT: JEDEC MO-220.

**Figure 5 - Mechanical Specification QFN24**

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