

## GENERAL DESCRIPTION

The OB2603x is a highly integrated secondary-side constant voltage and constant current (CV/CC) controller supporting both Qualcomm Quick Charge QC3.0 protocol and Media Tek Pump Express Plus 2.0 PE+2.0 protocol. It is used in application that requires constant voltage (CV) and constant current (CC) regulation. Two operational amplifiers are built in for voltage loop (CV) and current loop (CC) regulation with programmable voltage reference to provide adaptive CV and CC in high precision. The high gain current sense amplifier minimizes the offset for decreasing power loss of sense resistor.

The OB2603x automatically detects QC3.0 or PE+2.0 or BC1.2 and enables output voltage adjustments accordingly. It supports the multi-level output voltage range from 3.6V to 12V in 0.2V increments for QC3.0 protocol. And it provides the output voltage from 5V to 9V in 0.5V increments and 12V voltage for MTK PE+2.0 protocol. If quick charge protocol is not detected, the OB2603x disables the output voltage adjustment to ensure safe operation with default 5V output voltage. I-V curve is shown in Figure 1.

OB2603x can achieve lower standby power consumption and fast voltage transition while works together with On-Bright GreenEngine™ based AC/DC off-line PWM ICs.

The OB2603x offers comprehensive protection coverage including constant current limiting, over voltage protection at different output voltage levels and under voltage protection.

OB2603x is offered in SOP8 package.

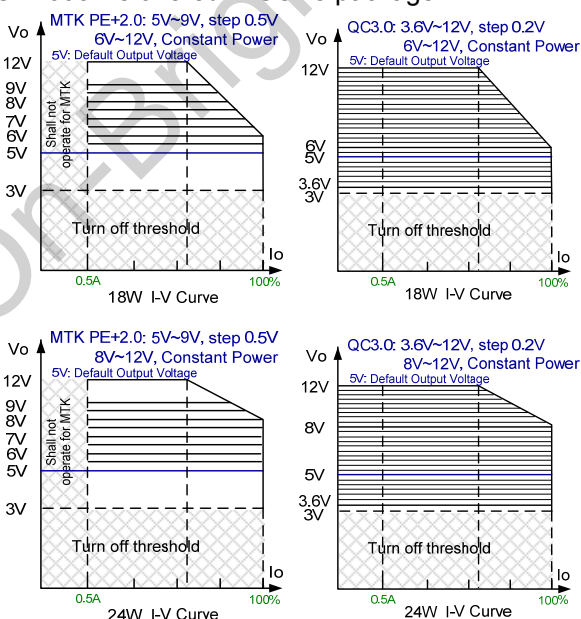


Figure1. Typical I-V Curve

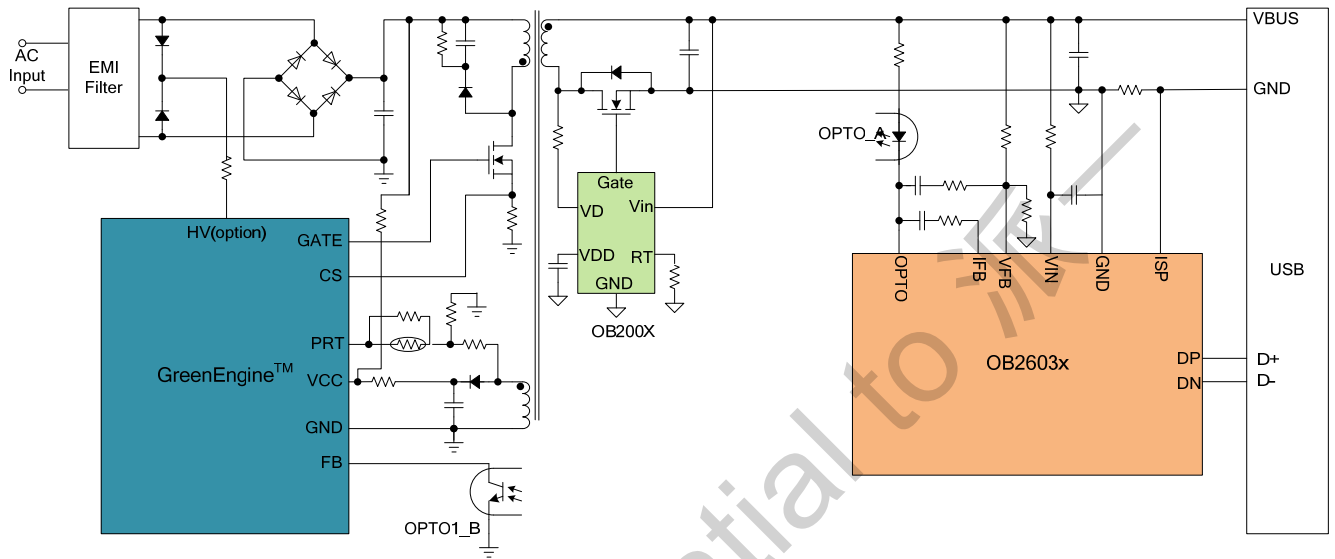
## FEATURES

- Protocol Support
  - USB BC 1.0&1.2
  - Qualcomm Quick Charge 2.0 & 3.0 (QC2.0 & QC3.0)
  - Media Tek Pump Express 1.0& 2.0 (PE+1.0 & PE+2.0)
  - Automatic Identification of Protocols
- Highly Integration
  - Secondary—Side Constant Voltage (CV) and Constant Current (CC) Regulation
  - Built-in Two Operational Amplifiers for Dual CV/CC control
  - Built-in Unplug Fast Discharging Control
  - Programmable Cable Drop Compensation
  - Built-in opto-coupler driver
  - Support 18W and 24W constant power
- Low Operating Current
- Wide operation voltage range from 3V to 12V.
- Comprehensive protection coverage
  - Output over voltage protection (OVP)
  - Output under voltage protection (UVP)
  - Internal over temperature protection (OTP)

## APPLICATIONS

- Quick-charging AC/DC charges for cell phones, tablets and other portable devices
- AC/DC Adapters for Portable Devices that Requires CV/CC control

## TYPICAL APPLICATION

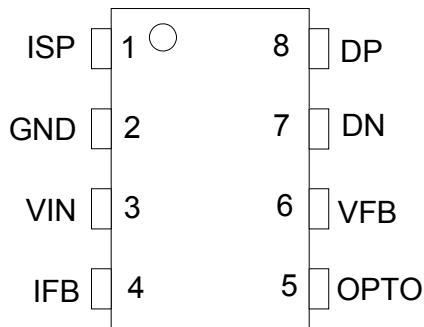


Note: Using GreenEngine™ as Primary-Side Controller

## GENERAL INFORMATION

### Pin Configuration

The pin map is shown as below for SOP8



### Ordering Information

Part Number	Description
OB2603ACP	SOP8, Halogen-free in Tube
OB2603ACPA	SOP8, Halogen-free in T&R
OB2603BCP	SOP8, Halogen-free in Tube
OB2603BCPA	SOP8, Halogen-free in T&R

### Package Dissipation Rating

Package	R $\theta$ JA (°C/W)
SOP-8	150

### Absolute Maximum Ratings

Parameter	Value
ISP/DP/DN/IFB/RT Voltage	-0.3 to 7V
VIN/VFB/OPTO Voltage	-0.3 to 30V
Min/Max Operating Junction Temperature T <sub>J</sub>	-40 to 150 °C
Operating Ambient Temperature T <sub>A</sub>	-20 to 85 °C
Min/Max Storage Temperature T <sub>stg</sub>	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

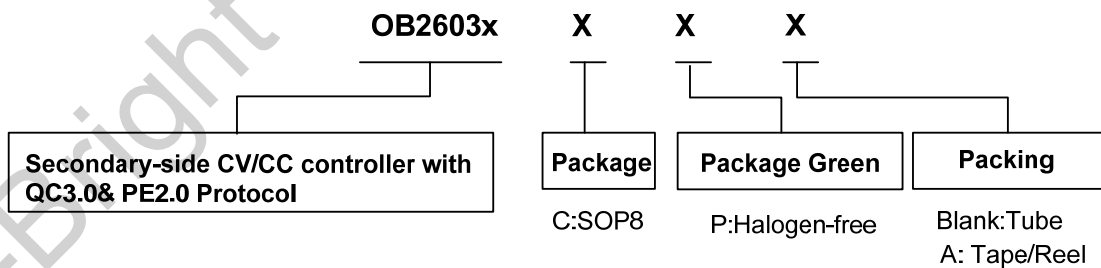
**Note:** Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

### Recommended operating condition

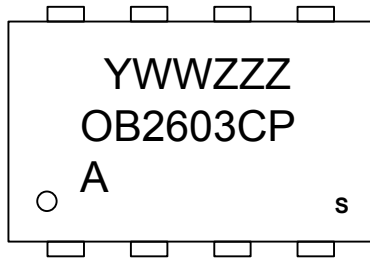
Symbol	Parameter	Range
VIN	VIN Supply Voltage	3 to 25V

### Recommended output power

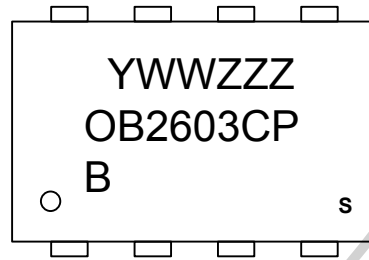
Product	Power
OB2603A	24W
OB2603B	18W



### Marking Information



Y:Year Code  
 WW:Week Code(01-52)  
 ZZZ:Lot Code  
 C:SOP8 Package  
 P:Halogen-free Package  
 A:Character Code  
 S:Internal Code(Optional)

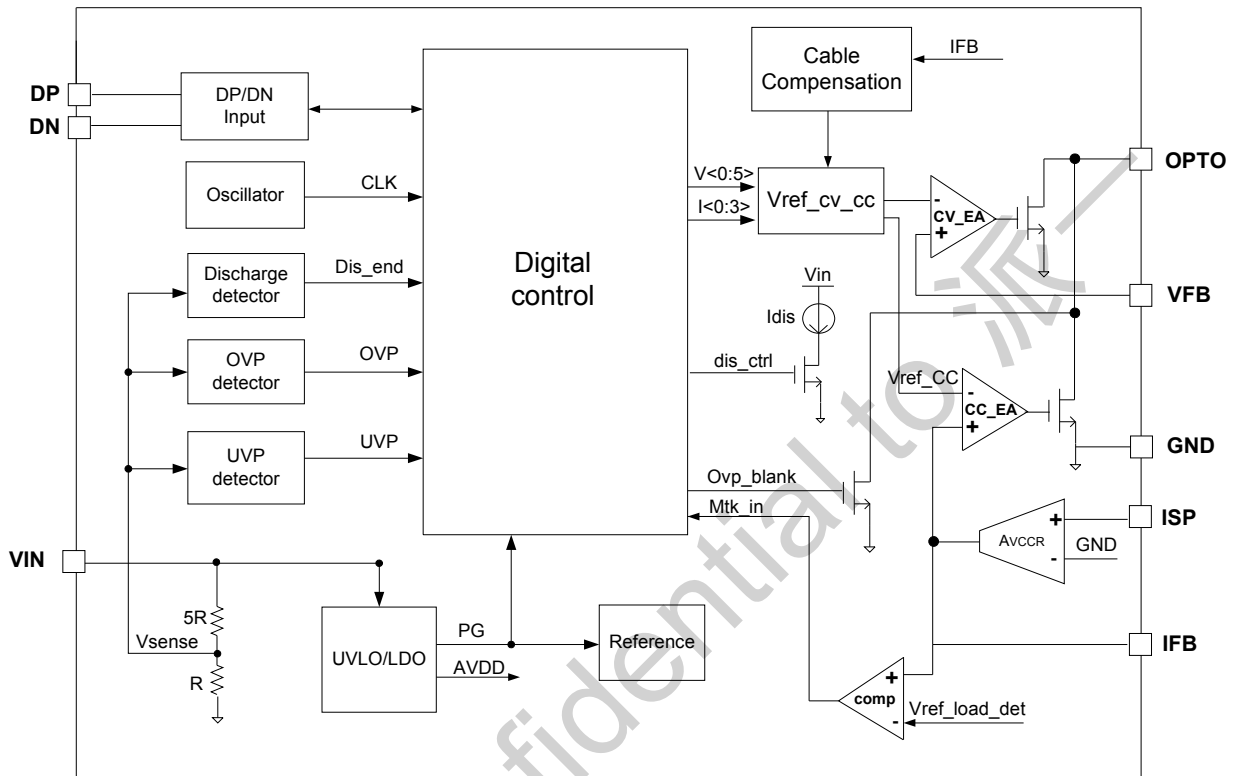


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### TERMINAL ASSIGNMENTS

Pin Num	Pin Name	I/O	Description
1	ISP	I	Output current sensor (positive)
2	GND	I	GND (Output current sensor (negative))
3	VIN	I	Output voltage sensor and discharger
4	IFB	I	Output current feedback input
5	OPTO	I	Opto driver
6	VFB	I	Output voltage feedback input
7	DN	I	D- signal of USB
8	DP	I	D+ signal of USB

**BLOCK DIAGRAM**



## ELECTRICAL CHARACTERISTICS

(TA = 25°C, if not otherwise noted)

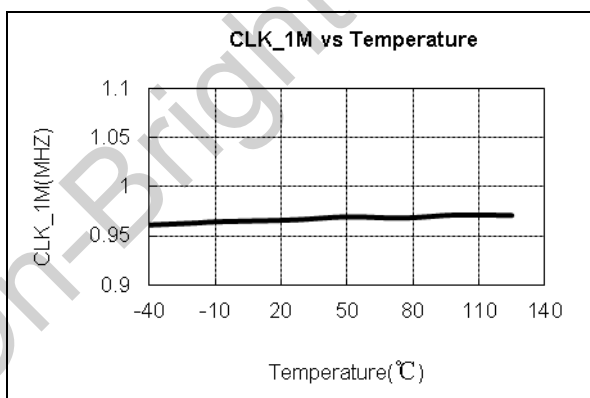
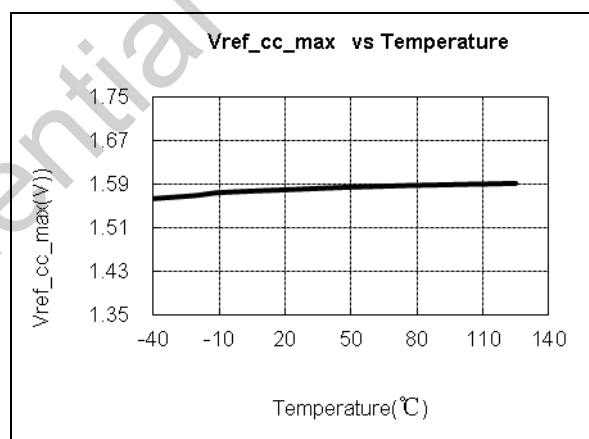
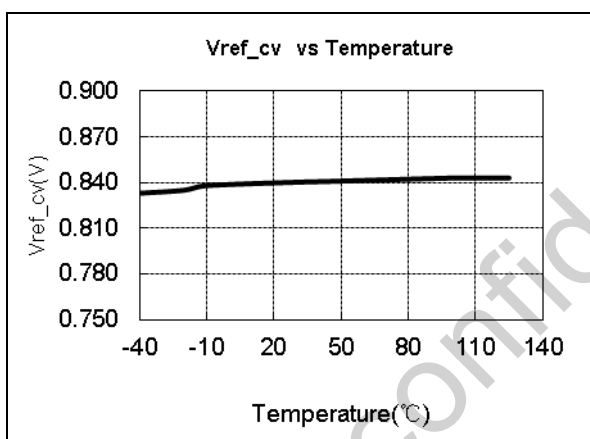
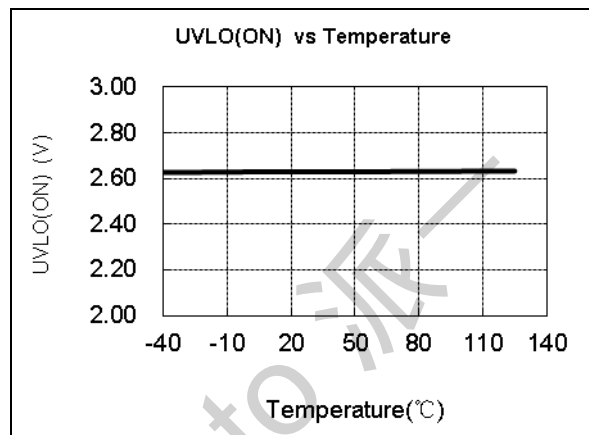
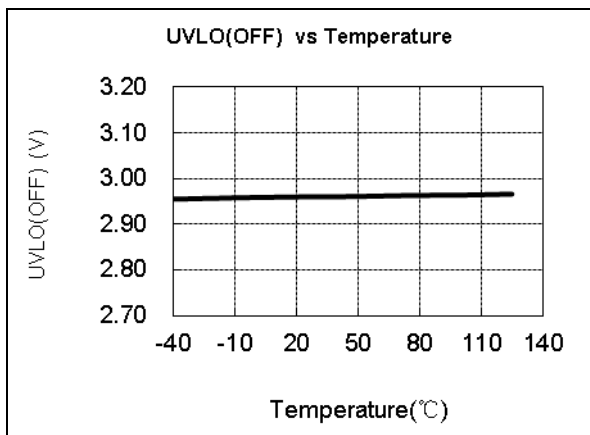
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
<b>Supply Voltage (VIN) Section</b>						
I <sub>start-up</sub>	Start-up Current	VIN=2V		0.5		mA
I <sub>ops</sub>	Standby operation current	VIN=5V		1		mA
UVLO(OFF)	Start-up threshold	VIN rising		3.0		V
UVLO(ON)	Undervoltage lockout threshold	VIN falling		2.65		V
<b>Quick charge Section (DP/DN pin)</b>						
V <sub>bus_cont_range</sub>	Class A wall adapter range		3.6		12	V
V <sub>bus_cont_step</sub>	Voltage tolerance per step in continuous mode		0.15	0.2	0.25	V
V <sub>slew</sub>	Maximum slew rate on V <sub>bus</sub>		-	-	30	mV/us
V <sub>dat_ref</sub>	Date detect voltage		0.25	0.325	0.4	V
V <sub>sel_ref</sub>	Output voltage selection reference		1.8	2	2.2	V
R <sub>dat_lkg</sub>	DP data line leakage resistance		300	450	600	KΩ
R <sub>DCP_dat</sub>	DP\DN short resistance			15	25	Ω
R <sub>DN-DWM</sub>	DN pull down resistance		14.25	19.53	24.80	kΩ
T <sub>glitch_bc_done</sub>	DP high glitch filter time		1	1.25	1.5	S
T <sub>glitch_dm_low</sub>	DN low glitch filter time		1	1.4		ms
T <sub>glitch_dm_high</sub>	DN high glitch filter time		40	60		ms
T <sub>glitch_v_change</sub>	output voltage glitch filter time		20	40	60	ms
T <sub>v_new_request</sub>	New voltage request time				200	ms
T <sub>unplug</sub>	unplug glitch filter time		20	25	30	ms
T <sub>glitch_mode_change</sub>	Glitch filter on voltage mode requests		20	40	60	ms
T <sub>glitch_cont_change</sub>	Rising and falling edge glitch filter on pulses in continuous		100		200	us
T <sub>active</sub>	Active pulse time in continuous mode		0.2		15	ms
T <sub>inactive</sub>	Time between pulses in continuous mode		200			us
T <sub>V_cont_change</sub>	Time for an HVDCP change its output voltage to within V <sub>bus_5V</sub> or V <sub>bus_HV</sub> from the voltage mode request is made		-	2	60	ms
T <sub>glitch_UVLO</sub>	Time HVDCP must allow VBUS to collapse below the threshold		20			ms
T <sub>V_unplug</sub>	Time for VBUS to discharge to V <sub>bus_5V</sub> when DP goes below V <sub>dat_vref</sub>				500	ms
T <sub>V_unplug_C</sub>	Time for VBUS to discharge to V <sub>bus_5V</sub> when DP goes below V <sub>dat_vref</sub> for a USB type-c output				275	ms

Vuvp_5V	UVP threshold of 3.6V ~8.5V output of non-continuous mode	VIN=3.6V~8.5V output		3		V
Vuvp_9V	UVP threshold of 9V ~11.5V output of non-continuous mode	VIN=9V~11.5V output		7.2		V
Vuvp_12V	UVP threshold of 12V output of non-continuous mode	VIN=12V output		9.6		V
Points A and B in continuous mode	UVP threshold of continuous mode			3		V
<b>Discharge Section (VIN pin)</b>						
Tdis_timeout	maximumu discharge time			500		ms
I_dis	Mirror discharge current	VIN<12V		120		mA
T_otp	Discharge over temperature protection			150		°C
T_otp_res	Discharge over temperature protection release			120		°C
<b>CV Error Amplifier(VFB/OPTO pin)</b>						
Vref_cv	Eamp positive reference	QC3.0		0.6+0.1*k/3, k=0,1,...,42		V
		MTK PE+2.0		0.833+0.5*k/6, k=0,1,...,14		V
Vdis	Discharge threshold (Start)			1.1*Vref_cv		V
	Discharge threshold (End)			Vref_CV		V
Vovp	Ovp voltage			1.25*Vref_cv		V
Tdbb_ovp	OVP debounce time				30	us
Tdbb_uvp	UVP debounce time			200		ms
Tblk_ovp	Ovp blanking time	High voltage to low voltage		200		ms
<b>CLK</b>						
CLK_1M	internal clk		0.9	1	1.1	M
<b>Current sense Section(ISP pin)</b>						
Ka	multiple of the sense resistor voltage			45.4		V/V
Vos	offset voltage		-0.5		0.5	mV
Vref_cc_max	Maximum eamp positive reference	VIN=3.6V~6.0V output for 18W VIN=3.6V~8.5V output for 24W		1.567		V
Vref_cc_min	Minimum eamp positive reference	VIN=12V output		1.05		V
Vth_mtk PE+_det	threshold to detect the loading of MTK PE+			100		mV
<b>MTK Pump Express Plus protocol section(ISP pin)</b>						
Load Current control timing of MTK PE+	On time A		430	500	570	ms
	On time B		240	300	360	ms
	On time C		81	100	130	ms
	On time D		85	100	130	ms
	On time E		145	200	250	ms

	On time F		85	100	120	ms
	On time G		20	50	70	ms
	On time H		20	50	70	ms
Iload_det	I_control_H		300			mA
	I_control_L				130	mA
Iomin	Minimum load current of MTK PE+ control			70		mA
WDT	Current plug-out detection watch dog timer of MTK PE+ control		180	210	240	ms
T_DET	Disable cable drop compensation or output current detection time		70	100	130	ms



### CHARACTERIZATION PLOTS



## OPERATION DESCRIPTION

OB2603x is a highly integrated secondary-side constant voltage and constant current (CV/CC) controller supporting both Qualcomm Quick Charge QC3.0 protocol and Media Tek Pump Express Plus 2.0 PE+2.0 protocol. It is used in application that requires constant voltage (CV) and constant current (CC) regulation.

### Quick charge pattern detection of QC3.0 control

OB2603x supports QC3.0 quick charge protocol. OB2603x integrates QC3.0 quick charge pattern detection block, it can detect pattern from DP and DN PIN. OB2603x outputs 5V by default, it supports 3.6V to 12V output as shown in Figure 1. OB2603x outputs 5V as default after startup, and can switch to other outputs freely after USB BC1.2 detection finished by different DP and DN voltage pattern.

OB2603x can operate at different output voltage with no load condition.

### Quick charge pattern detection of MTK PE+2.0 control

OB2603x supports MTK PE+2.0 Quick charge protocol. OB2603x detects pattern sent by equipment via loading change. OB2603x outputs 5V by default, it supports up to 12V output for higher output power as shown in Figure 1.

OB2603x outputs 5V as default after startup, and can switch to other outputs by different loading pattern of MTK PE+2.0

When OB2603x operates at any outputs rather than 5V, if load current is below  $I_{load\_det}$  and the time lasts for WDT time, OB2603x will switch to 5V output.

### Startup

OB2603x implements UVLO function during startup. When  $V_{IN}$  voltage rises above UVLO(OFF), the IC wakes up from under voltage lock out state and enter normal operation to regulate the output voltage as 5V. When  $V_{IN}$  voltage drops below UVLO(ON), the IC enter under voltage lock out state again. In addition, there is a hysteresis window between UVLO(OFF) and UVLO(ON) to make system work reliably.

### Output voltage regulation and current regulation

OB2603x implements error amplifiers (EA) inside to regulate the constant output voltage and constant output current, refer to Fig.2.

The  $V_{OUT}$  is determined as:

$$V_o = V_{ref\_cv} * \frac{R_1 + R_2}{R_2}$$

The CC is determined as:

$$I_{o\_cc} = \frac{V_{ref\_cc}}{K_a * R_{cs}}$$

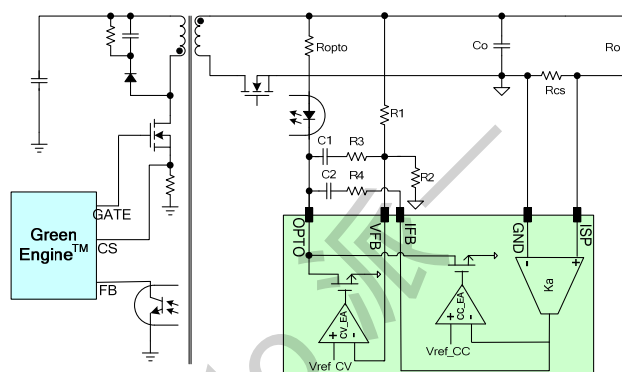


Fig.2 voltage regulation and current regulation block

### Programmable cable compensation

OB2603x integrates programmable cable compensation by current sensing results and can be adjusted by external VFB upside resistor R1. The external resistor R1 can be calculated by:

$$R_1 = \frac{R_{cable} * R_{int}}{R_{cs} * K_a}$$

Where  $R_{cable}$  is the external real USB cable resistor,  $R_{int}$  is a fixed internal resistor which is 100k,  $R_{cs}$  is the external current sense resistor,  $K_a$  is the multiple of the sense resistor voltage.

### Discharge function description

When the output voltage transits from a high level voltage to a expected low level voltage, it requires a discharge current to fulfill the transition time specification of quick charge. When the  $V_{IN}$  voltage is higher than expected output voltage, the discharge function is enabled. The OB2603x sets the discharge current as 120mA. The maximum discharge time is 500ms.

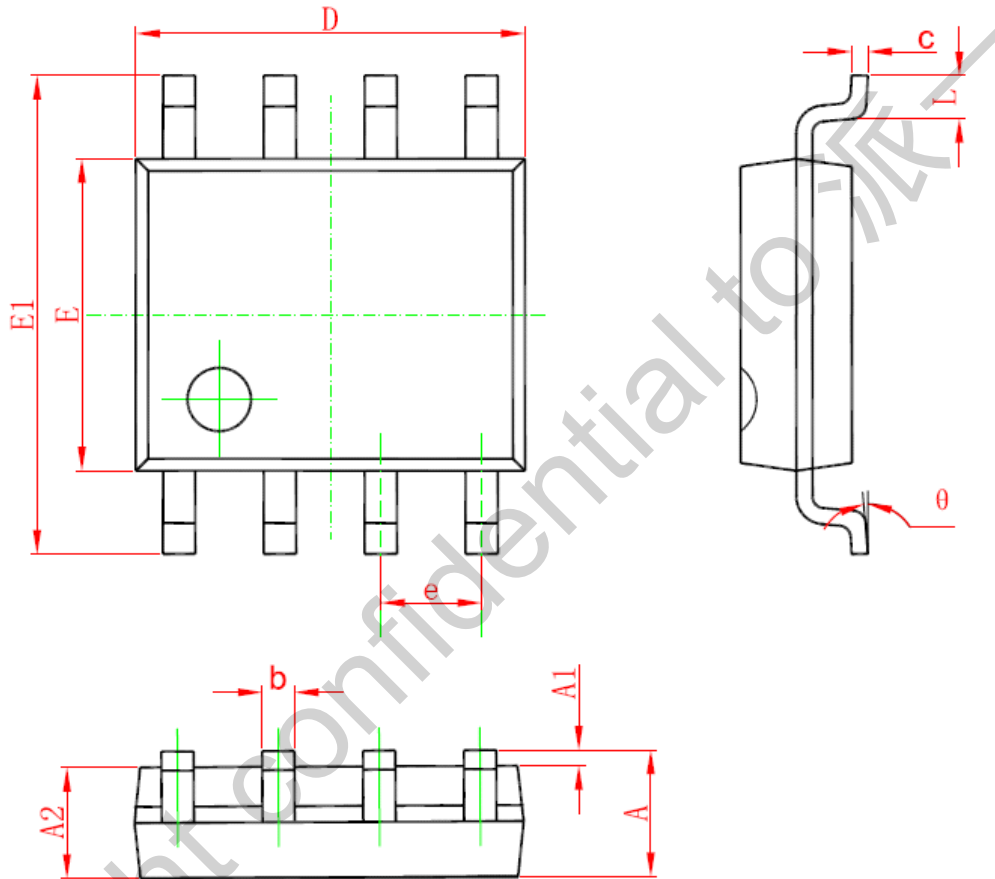
This discharge function also be controlled by on-chip over temperature detection, if the chip temperature is higher than 150 °C during discharging, the discharging will be terminated; until the chip temperature falls below 120°C, the discharge function can be enabled again.

### Protection description

OB2603x offers comprehensive protection coverage including constant current limiting, different output voltage levels over voltage and under voltage protection. When the protection is detected, the IC immediately reset the  $v_{ref\_cv}$  to 0.833V(typical), the reference for 5V output voltage and the  $V_{out}$  goes back to 5V default output.

## PACKAGE MECHANICAL DATA

### SOP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.150	0.185	0.203
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.05 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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