

## **General Description (产品描述)**

SE103 is a USB mobile device charger interface IC which implements the Qualcomm's Quick Charge 3.0 specification for adaptive voltage battery charging. It incorporates all necessary functions to add Quick Charge 3.0 capability to circuits incorporating Power Integrations' switcher ICs such as InnoSwitch™, TinySwitch™, TOPSwitch™ and other charger solutions employing traditional secondary-side feedback schemes.

SE103 supports the full output voltage range of Quick Charge 3.0, including 200 mV micro-stepped voltage levels from 3.6 V to 12 V (Class A) and up to 20 V (Class B). SE103 provides a suite of system level protection features protecting the power supply and connected Powered Device (PD) from excessive output voltages, secondary side thermal overload, and faulty power delivery while adapter is unplugged. Additionally it allows the PD to remotely shutdown the power supply through USB data lines.

SE103 automatically detects whether a connected PD is Quick Charge 3.0 or Quick Charge 2.0 capable before enabling output voltage adjustment. If a PD that is not compliant to Quick Charge 2.0 or 3.0 is detected, the SE103 disables output voltage adjustment to ensure safe operation with legacy 5 V only USB PDs.

## **Features(产品特性)**

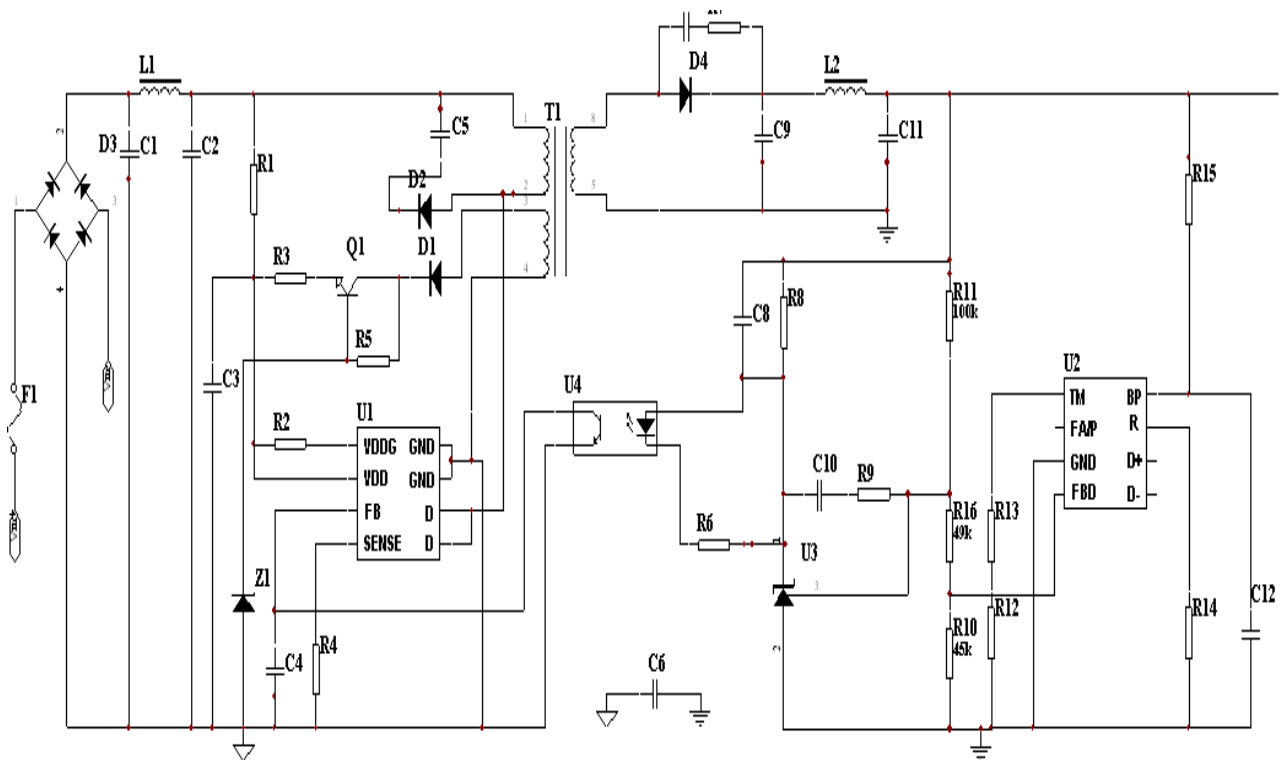
- Supports Quick Charge 3.0 Class A and Class B specification
- Adaptive output overvoltage protection
- Secondary over-temperature protection
- BC1.2 DCP support
- Apple DCP support
- Power consumption below 1mW at 5V output
- Supports InnoSwitch™, TinySwitch™, and TOPSwitch™

## **Applications(产品应用)**

- Battery chargers for smart phones, tablets, netbooks, digital cameras, and bluetooth accessories
- USB power output ports such as battery banks or car chargers

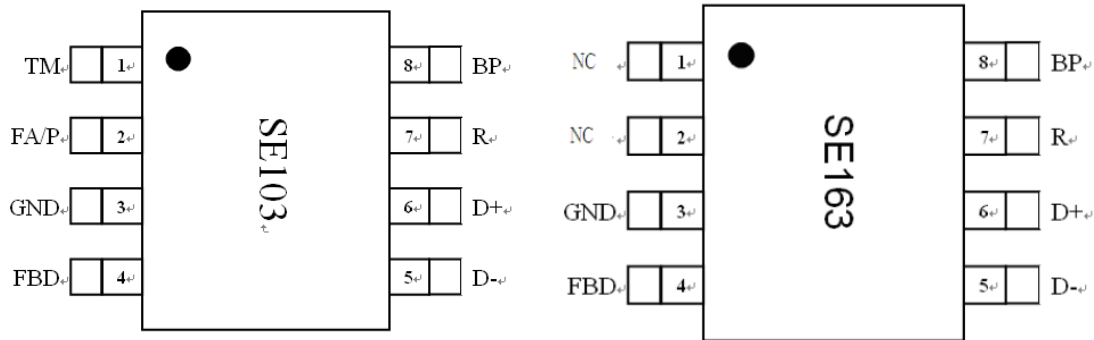


Typical Application (典型应用电路)





### Pin Configuration (管脚排列)

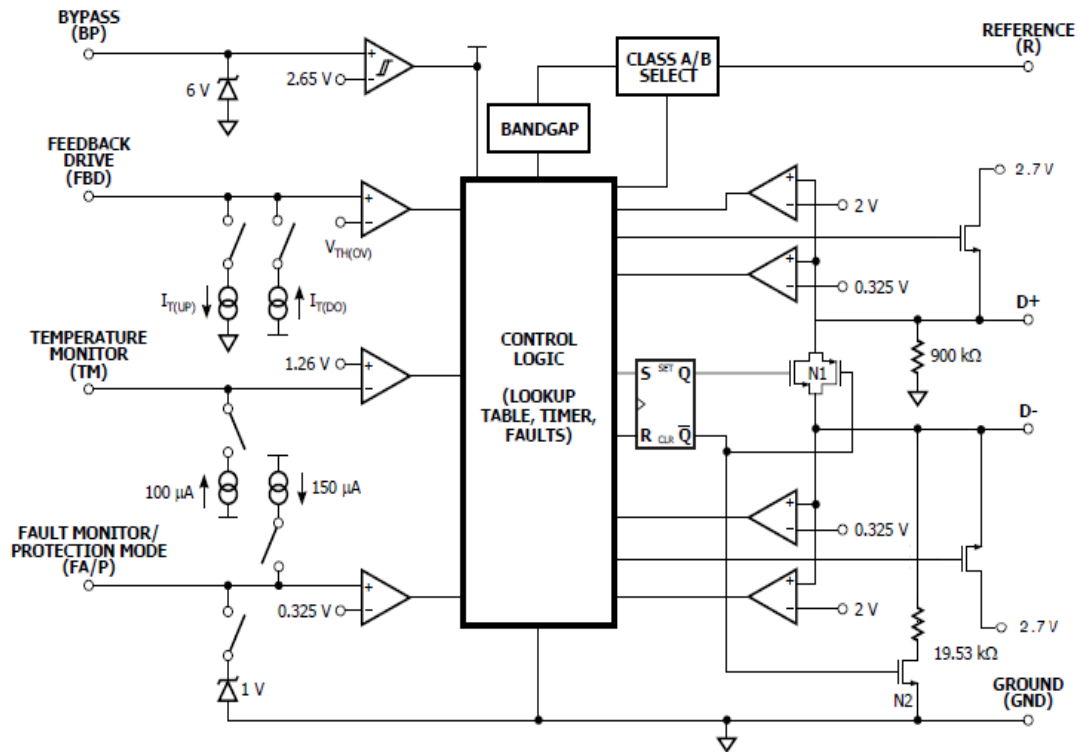


### Pin Description (管脚功能描述)

NO.	Pin Name	Pin Function Description
1	TM	Connection point for optional external temperature sensor (NTC resistor).
2	FA/P	Protection mode output driving external shutdown circuitry in case a fault is detected.
3	GND	Ground.
4	FBD	Feedback loop drive output and monitors output voltage.
5	D-	USB D- data line input.
6	D+	USB D+ data line input.
7	R	Provides reference current and output voltage range.
8	BP	Connection an external bypass capacitor for the internally generated supply voltage.



### Functional Block Diagram (功能框图)



### Ordering Information (订货信息)



### Absolute Maximum Ratings(最大额定参数)

Symbol	Parameter	Maximum	Units
$V_{BP}$	BYPASS Pin Voltage	5.6	V
$V_R$	REFERENCE Pin Voltage	5	V
$V_{FBD}$	FBD Pin Voltage	$V_{BP}+0.7V$	V
$V_{D+/D-}$	D+/D- Pin Voltage	5	V
$V_{TM}$	TM Pin Voltage	5	mA
$V_{BP}$	BYPASS Pin Current	25	mA
$I_{D+/D-}$	D+/D- Pin Current	1	mA

### Recommended Operating Conditions(推荐工作条件)

Symbol	Parameter	Maximum	Units
$T_J$	Operating Junction Temperature	-20 to 125	°C
$T_A$	Operating Ambient Temperature	-20 to 85	°C
$T_s$	Storage Temperature	-65 to 150	°C
	Lead Temperature (less than 15 seconds)	260	°C

### Electrical Characteristics(电气参数)

( $V_{CC}=5V$ ;  $T_J=25^\circ C$  unless otherwise specified)

Symbol	Test Conditions	Min	Typ	Max	Unit
$V_{BP}$		4	5		V
$V_{BP}(\text{reset})$		3.8			V
$I_{BPSC}$	$V_{BP} = 4.3 V, R_{REF} = 38.3 k\Omega, T_J = 25^\circ C$				$\mu A$
$V_{BP}(\text{SHUTDOWN})$	$I_{BP}=8mA$				V
$V_R$	$R_{REF}=38.3K\Omega$				V
	$R_{REF}=12.4K\Omega$				
$V_{DAT(REF)}$			0.325		V
$V_{SEL(REF)}$			2		



$T_{DAT(SHORT)}$	$V_{OUT} \geq 0.8V$			20	ms	
$T_{GLITCH(BC)DONE}$		1000		1500	ms	
$T_{GLITCH(DM)LOW}$		1			ms	
$T_{GLITCH(V)CHANGE}$		20	40	60	ms	
$T_{GLITCH(CONT)CHANGE}$		100		200	$\mu s$	
$R_{DAT(LKG)}$	$V_{BP}=4.3V, V_{D+}=0.5-3.6V, N1$ is off	300		1500	$K \Omega$	
$R_{DM(DWN)}$		14.25	19.53	24.5	$K \Omega$	
$R_{DS(N1)}$	$V_{BP}=4.3V, V_{D+} \leq 3.6V, I_{DRAIN}=200 \mu A$		20	40	$\Omega$	
$I_{T(UP)}$			2		$\mu A$	
$I_{T(DO)}$			2		$\mu A$	
$V_{TH(OV)}$	QC2.0 Mode ClassA/ClassB	$I_{(UP)}=0$ (5V)	1.44	1.52	1.60	V
		$I_{(UP)}=40 \mu A$ (9V)	1.60	1.72	1.84	
		$I_{(UP)}=70 \mu A$ (12V)	1.74	1.87	2.00	
		$I_{(UP)}=150 \mu A$ (20V)	2.12	2.28	2.44	
	QC3.0 Mode Continuous Mode	$R_{REF}=38.3K$ ClassA	1.74	1.87	2.00	
		$R_{REF}=12.4K$ ClassB	2.12	2.28	2.44	
$T_{D(OV)}$			50		ms	
$T_{B(OV)}$		500			ms	
$V_O$	$I_{CLAMP}=100 \mu A$		1		V	
$T_{TH(TM)}$			1.2		V	
$T_{D(TM)}$			1		ms	
$I_{TM}$			100		$\mu A$	
$T_{ON(ITM)}$			12		ms	
$D_{ITM}$			1		%	
$I_P$		100	150	200	$\mu A$	

## Functional Description (功能描述)

SE103 is a USB high-voltage dedicated charging port (HVDCP) interface IC for the Quick Charge 3.0 specification. It incorporates all necessary functions to add Quick Charge 3.0 capability to Power Integrations' switcher ICs such as InnoSwitch, TinySwitch, and TOPSwitch.

SE103 also supports other solutions with traditional secondary-side feedback schemes such as SE431 for instance.

CHY103 supports the full output range of Quick Charge 3.0 Class A (3.6 V to 12 V) or Class B (3.6 V to 20 V) and its subset Quick Charge 2.0 Class A (5 V, 9 V, or 12 V) or Class B (5 V, 9 V, 12 V, and 20 V). It automatically detects either Quick Charge 3.0 or Quick Charge 2.0 capable powered devices (PD) or legacy PDs compliant with USB Battery Charging Specification revision 1.2 and only enables output voltage adjustments accordingly.

### Shunt Regulator

The internal shunt regulator clamps the BYPASS pin at 5.2 V when current is provided through an external resistor. This facilitates powering SE103 externally over a wide output voltage range of 3.6 V to 20 V. Recommended values are  $R_{BP} = 2.21 \text{ k}\Omega \pm 1\%$  and  $CBP = 470 \text{ nF}$ .

### BYPASS Pin Undervoltage

The BYPASS pin undervoltage circuitry resets the SE103 when the BYPASS pin voltage drops below 2.9 V. Once the BYPASS pin voltage drops below 2.9 V it must rise back to 3.1 V to commence correct operation.

### Reference and Output Voltage Range Selection Input

Resistor  $R_{REF}$  at the REFERENCE pin is connected to an internal band gap reference and provides an accurate reference current for internal timing circuits. Resistor  $R_{REF}$  is furthermore used to select the output voltage range.  $R_{REF} = 38.3 \text{ k}\Omega \pm 1\%$  selects Class A (12 V maximum output voltage) and  $R_{REF} = 12.4 \text{ k}\Omega \pm 1\%$  selects Class B (20 V maximum output voltage).

### Quick Charge 3.0 Interface

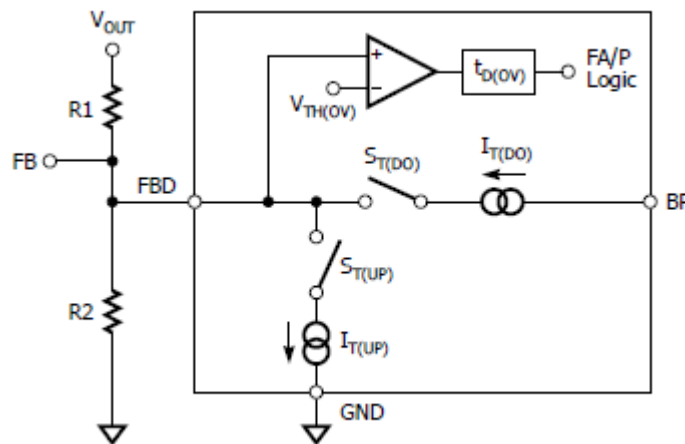
At power-up SE103 turns on switch N1 short-circuiting USB data lines D+ and D- for the initial handshake between AC-DC adapter (DCP) and powered device (PD) as described in the USB Battery Charging specification revision 1.2. After the USB BC 1.2 handshake is completed, SE103 will turn off switch N1 if it detects a Quick Charge 3.0 or Quick Charge 2.0 compliant PD. At this point the Quick Charge 2.0 handshake followed by the Quick Charge 3.0 handshake can take place as described in the Quick Charge 2.0 and Quick Charge 3.0 protocol specification. Upon completion of the Quick Charge 2.0 and Quick Charge 3.0 handshakes, CHY103 will turn on switch N2 connecting a 19.53 k $\Omega$  pull-down resistor to USB data line D-.



Portable Device (PD)		SE 103	
D+	D-	Power Supply Output	Note
0.6 V	0.6 V	12 V	Class A
3.3 V	0.6 V	9 V	Class A
0.6 V	3.3 V	Continuous Mode	Class A/B with $\pm 0.2$ V step size
3.3 V	3.3 V	20 V	Class B
0.6 V	GND	5 V	Default mode

### Feedback Loop Drive

CHY103 sets the respective output power supply voltage regulation point by directly driving the reference input of the power supply control loop error amplifier through an internal current sink  $I_{T(UP)}$  and source  $I_{T(DO)}$

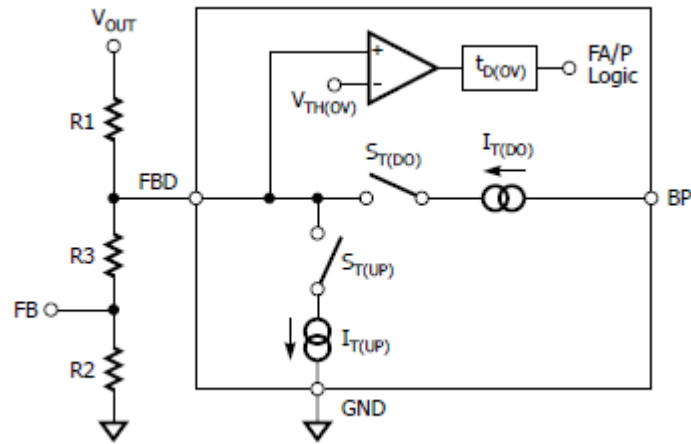


In default mode with a 5 V output both, the internal current source and current sink are off. To meet the output voltage step size requirement of  $\pm 0.2$  V in Quick Charge 3.0 continuous mode, the mandatory value for the upper resistor in the output sensing voltage divider is  $R1 = 100.0 \text{ k}\Omega \pm 1\%$ . For a FEEDBACK pin reference voltage of 1.265 V for instance used by Power Integrations' InnoSwitch switcher IC the resulting value for  $R2 = 34.0 \text{ k}\Omega \pm 1\%$  to set the default output voltage to 5 V.





SE103 can also interface with power supply control loop reference voltages lower than 1.265 V by adding resistor R3.



The output voltage is determined at default 5 V output as follows:

$$V_{OUT} = \frac{V_{FB} \times R1}{R2} \times \frac{V_{FB} \times (R2 + R3)}{R2}$$

### Protection Mode

In case SE103 detects a fault it activates its protection mode by pulling the FAULT MONITOR/PROTECTION pin high to the BYPASS pin through a 150  $\mu$ A current source.

The FA/P pin is clamped internally to 1 V during normal operation.

### Adaptive Output Overvoltage Protection

SE103 monitors the voltage present at the FEEDBACK DRIVE pin in order to prevent excessive output voltage levels in case the power supply control loop lost regulation. The OV comparator threshold  $V_{TH(OV)}$  is adapted to the set output voltage level (5 V, 9 V, 12 V, or 20 V) outside Quick Charge 3.0 continuous mode. As soon as the output voltage reaches 120% of the set output voltage CHY103 activates the protection mode if the OV fault is present for at least 50  $\mu$ s. Adaptive OVP is blanked for 500 ms when set output voltage is stepped down outside of continuous mode (for instance from 9 V to 5 V).

In Quick Charge 3.0 continuous mode the OV comparator threshold is fixed to the respective maximum output voltage set by resistor RREF. The resulting actual output OV level  $V_{OUT(OV)}$  in continuous mode depends on the respective voltage  $V_{OUT(SET)}$  and is as follows:

$$V_{OUT(OV)} = V_{OUT(SET)} + 2.4V$$

### Temperature Sensing

SE103 can optionally monitor temperature through an NTC resistor as depicted in Figure 10. The NTC resistor could be for instance positioned at the adapter output socket or plastic enclosure.



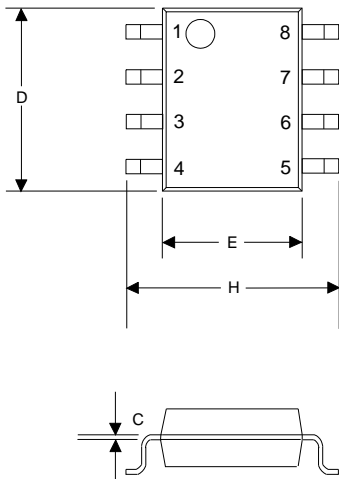
Current source ITM is periodically turned on and the resulting voltage level at the TEMPERATURE MONITOR pin is compared to the internal threshold  $V_{TH(TM)}$ . SE103 will activate the protection mode if the voltage level present at the TEMPERATURE MONITOR pin is below 1.20 V for at least 1 ms. Resistor R4 is used for tuning the shutdown temperature threshold to the desired level. For a NTC resistance value  $R_{NTC(TSD)}$  at the desired shutdown temperature TSD R4 is chosen as follows:

$$R4 = 12 \text{ k}\Omega - R_{NTC(TSD)}$$

The thermal protection function can be disabled by pulling the TEMPERATURE MONITOR pin high to the BYPASS pin through a 200 k $\Omega$  resistor.



**Outline Drawing For SOP-8**



DIMENSIONS				
DIM <sup>N</sup>	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.0532	0.0688	1.35	1.75
A1	0.0040	0.0098	0.10	0.25
B	0.0130	0.0200	0.33	0.51
B1	0.050 BSC		1.27 BSC	
C	0.0075	0.0098	0.19	0.25
D	0.1890	0.1968	4.80	5.00
H	0.2284	0.2440	5.80	6.20
E	0.1497	0.1574	3.80	4.00

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