



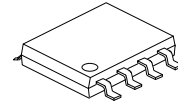
# HIGH PRECISION CC/CV PRIMARY SIDE SWITCHING REGULATOR

### DESCRIPTION

The UTC **UC1103** is a primary control unit for switch mode charger and adapter applications. The controlled variable is transferred by an auxiliary winding from the secondary to the primary side. The device integrates PWM controller to enhance the performance of discontinuous conduction mode (DCM) flyback converters.

The UTC **UC1103** operates in primary-side sensing and regulation. Opto-coupler and TL431 could be eliminated. It also provides off-time modulation to linearly decrease PWM frequency under light-load conditions so that low standby power can be achieved.

The UTC **UC1103** achieves high precision CV/CC regulation and high power efficiency. It offers comprehensive protection coverage with auto-recovery features including Cycle-by-cycle current limiting,  $V_{DD}$  over voltage protection,  $V_{DD}$  clamp, OTP, leading edge blanking,  $V_{DD}$  under voltage lockout, etc.



SOP-8

### FEATURES

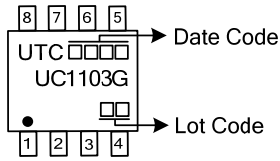
- \* High voltage startup
- \*  $\pm 5\%$  constant voltage regulation at universal AC input
- \* High precision constant current regulation at universal AC input
- \* Primary side control without TL431 and opto-coupler
- \* Programmable CV and CC regulation
- \* Programmable cable compensation in CV mode
- \* Flyback topology in DCM operation
- \* Frequency hopping to reduce system EMI
- \* Driver MOSFET switch
- \* Built-in leading edge blanking
- \* Built-in primary winding inductance compensation
- \* Gate output maximum voltage clamped at 15V
- \* Cycle-by-cycle current limiting
- \* Over voltage protection
- \*  $V_{DD}$  under-voltage lockout

### ORDERING INFORMATION

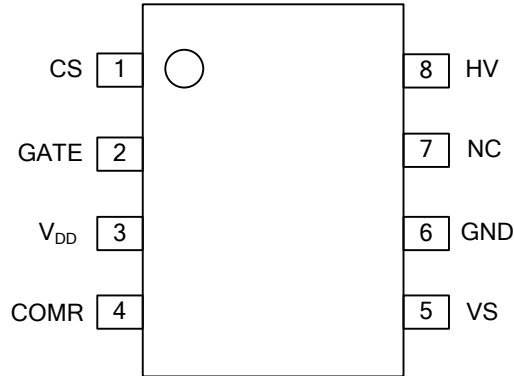
Ordering Number	Package	Packing
UC1103G-S08-R	SOP-8	Tape Reel

<p>UC1103G-S08-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) S08: SOP-8</li> <li>(3) G: Halogen Free and Lead Free</li> </ul>
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■ MARKING



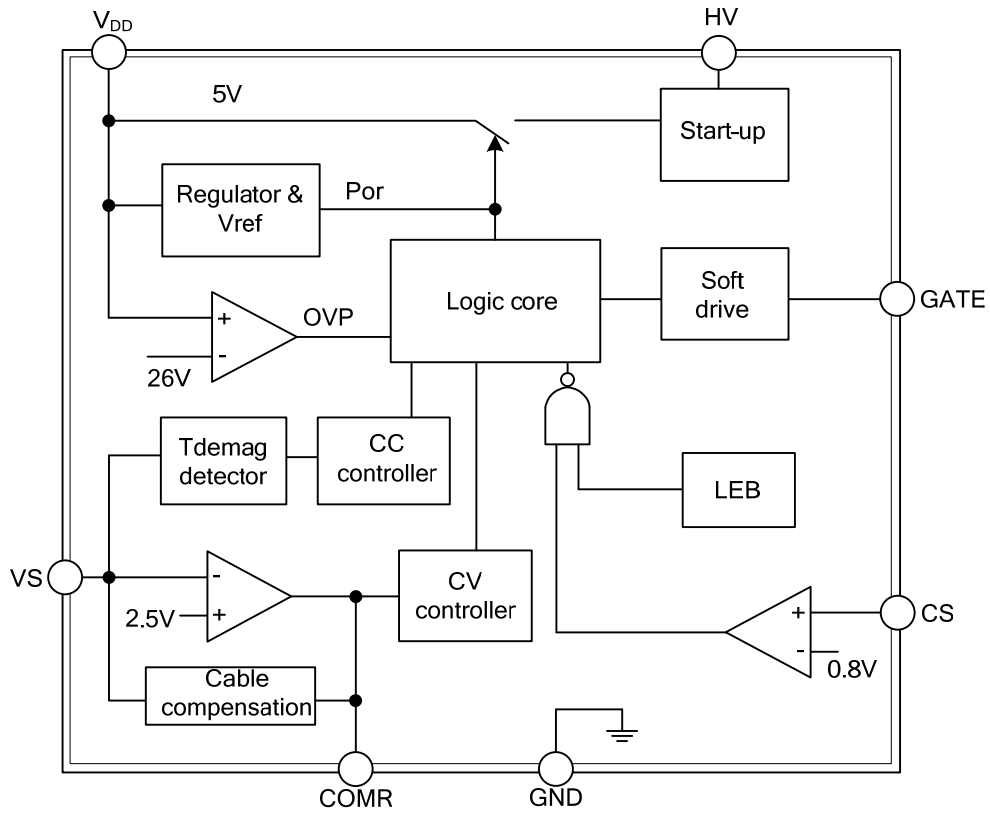
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	CS	Current sense input.
2	GATE	Gate drive for power MOSFET.
3	V <sub>DD</sub>	Power supply.
4	COMR	Cable compensation.
5	VS	The voltage feedback from the auxiliary winding.
6	GND	Ground
7	NC	No connect
8	HV	High-voltage startup.

■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
HV Pin Input Voltage	$V_{HV}$	500	V
Supply Voltage	$V_{DD}$	30	V
Voltage at VS, CS, COMR to GND		-0.3~7.0	V
Power Dissipation ( $T_A < 50^\circ\text{C}$ )	$P_D$	660	mW
Operating Ambient Temperature	$T_A$	-40~+105	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	-40~+150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-55~+150	$^\circ\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ THERMAL RESISTANCES CHARACTERISTICS

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
Junction to Case	$\theta_{JC}$	39	$^\circ\text{C}/\text{W}$

### ■ ELECTRICAL CHARACTERISTICS ( $V_{DD}=15\text{V}$ , $T_A=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SUPPLY SECTION</b>						
Turn-on Threshold Voltage	$V_{TH(ON)}$		15	16	17	V
Turn-off Threshold Voltage	$V_{TH(OFF)}$		8	9	10	V
$V_{DD}$ OVP Protection	$V_{DD\_OVP}$			28		V
Operating Current	$I_{DD-OP}$			1.6	2	mA
Green-Mode Operating Current	$I_{DD-GREEN}$			1.5		mA
<b>HV START-UP SECTION</b>						
Minimum Startup Voltage on HV Pin	$V_{HV-MIN}$				50	V
Supply Current Drawn from Pin HV	$I_{HV}$	$V_{DC}=100\text{V}$		0.6		mA
Leakage Current after Startup	$I_{HV-LC}$	$HV=500\text{V}$ , $V_{DD}=V_{DD-OFF}+1\text{V}$		0.5		$\mu\text{A}$
<b>OSCILLATOR SECTION</b>						
Maximum Frequency	$f_{OSC}$		47	50	53	kHz
Minimum Frequency at CCM	$f_{OSC-CM-MIN}$			13		kHz
Minimum Frequency at No-load	$f_{OSC-N-MIN}$			300		Hz
Frequency Hopping Range	$\Delta f/\text{freq}$		$\pm 1.5$	$\pm 2.0$	$\pm 2.5$	kHz
Frequency Hopping Period	$t_{FHR}$			3		ms
Frequency Variation vs. $V_{DD}$ Deviation	$f_{DV}$	$V_{DD}=10\sim 25\text{V}$		1	2	%
<b>VOLTAGE SENSE SECTION</b>						
Reference Voltage for EA	$V_{VR}$		2.475	2.525	2.625	V
Reference Voltage for CCM	$V_{VR\_CCM}$			0.5		V
Max. Cable Compensation Current	$I_{CABLE\_MAX}$			25		$\mu\text{A}$
<b>CURRENT SSENSE SECTION</b>						
Current Sense Threshold Voltage	$V_{CS}$			800		mV
OCP Propagation Delay	$t_{D\_OC}$			90	200	nS
Leading Edge Blank Time	$t_{LEB}$			600		nS
Soft Start Time	$t_{SS}$			10		mS

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>GATE DRIVE SECTION</b>						
Output Voltage Low	$V_{OL}$	$V_{DD}=15V, I_{o\_sink}=20mA$			1.5	V
Output Voltage High	$V_{OH}$	$V_{DD}=15V, I_{o\_source}=20mA$	5			V
Rising Time	$t_R$	$C_L=1nF$		200	250	nS
Falling Time	$t_F$	$C_L=1nF$		60	100	nS
Output Clamp Voltage	$V_{CLAMP}$	$V_{DD}=25V$		16	18	V
<b>OTP SECTION</b>						
Threshold Temperature of OTP (Note)	$T_{OTP}$			+150		°C

Note: When the over-temperature protection is activated, the power system enters auto restart mode and output is disabled.

■ OPERATION DESCRIPTION

The UTC **UC1103** is a primary control unit for switch mode charger and adapter applications. It operates in primary-side sensing and regulation. Opto-coupler and TL431 could be eliminated. Proprietary built-in CV and CC control can achieve high precision CV/CC performance. The device integrates PWM controller to enhance the performance of discontinuous conduction mode (DCM) flyback converters.

**High-Voltage Startup control**

The HV pin of UTC **UC1103** is connected to the line input through a resistor (100K is recommended). During startup, the internal startup circuit in UTC **UC1103** is enabled. Meanwhile, line input supplies a constant current to charge the hold-up capacitor through the resistor. When the  $V_{DD}$  voltage reaches  $V_{TH(ON)}$ , the internal startup circuit is disabled and the IC turns on.

**Operating Current**

The operating current of UTC **UC1103** is as low as 1.6mA. Good efficiency and very low standby power can be achieved.

**Constant Voltage Operation**

The output voltage is defined by the transmission ratio between the secondary and auxiliary winding. The UTC **UC1103** captures the auxiliary winding feedback voltage at VS pin and operates in constant-voltage (CV) mode to regulate the output voltage. The auxiliary voltage reflects the output voltage is given by:

$$V_{AUX} = \frac{N_A}{N_S} \times (V_O + \Delta V) \tag{1}$$

Where  $\Delta V$  indicates the drop voltage of the output diode.

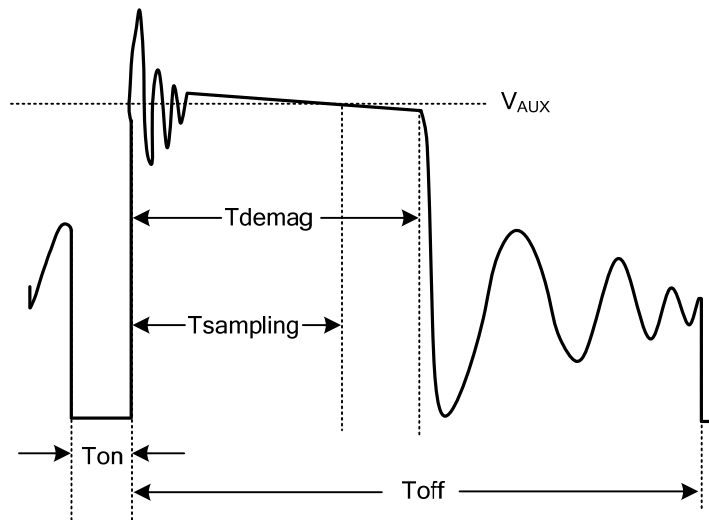


Figure2. Auxiliary voltage waveform

Via a resistor divider connected between the auxiliary winding and VS, the  $V_{AUX}$  is sampled at the  $T_{sampling}$  end and it is hold until the next sampling. The sampled voltage is compared with 2.5V reference voltage and the error is amplified. The error amplifier output reflects the load condition and controls the  $T_{off}$  time and the  $I_{pk}$  to regulate the output voltage, thus constant output voltage can be achieved.

**Constant Current Operation**

When the sampled voltage is below 2.5V reference voltage and the error amplifier output reaches its maximum, thus UTC **UC1103** operates in constant-current (CC) mode. The CC point and maximum output power can be externally adjusted by external current sense resistor  $R_{cs}$ . The larger  $R_{cs}$ , the smaller CC point is, and the smaller output power becomes.

■ OPERATION DESCRIPTION(Cont.)

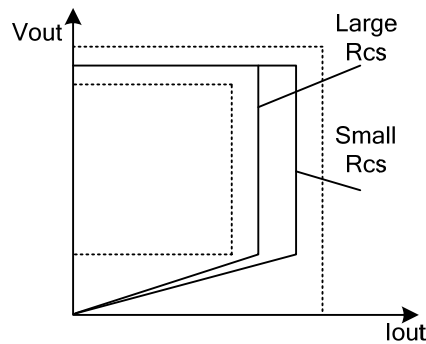


Figure3. Adjustable output power by changing Rcs

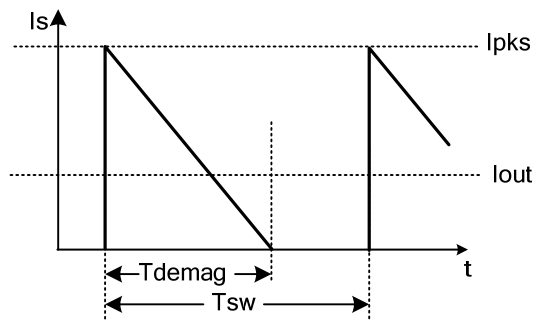


Figure4. Secondary current waveform

In CC operation, the CC loop control function of UTC **UC1103** will keep a fixed proportion between secondary inductance de-magnetization time ( $T_{demag}$ ) and switching cycle time ( $T_{sw}$ ). The fixed proportion is

$$\frac{T_{demag}}{T_{sw}} = \frac{1}{2} \tag{2}$$

Thus the output current is given by:

$$I_{out} = \frac{1}{2} \times \frac{N_p}{N_s} \times I_{pk} \times \frac{T_{demag}}{T_{sw}} = \frac{1}{4} \times \frac{N_p}{N_s} \times I_{pk} \tag{3}$$

**Programmable Cable Drop Compensation**

UTC **UC1103** has a built-in cable voltage drop compensation to achieve good load regulation. An offset voltage is generated at VS pin by an internal current flowing into the resistor divider. The current is inversely proportional to the voltage of COMR pin. As a result, it is inversely proportional to the output load current. The voltage drop across the cable is compensated by this offset voltage at VS pin. It can also be programmed by adjusting the resistance of the divider to compensate the drop for various cable lines used.

**Current Sensing and Leading Edge Blanking**

Cycle-by-cycle current limiting is offered in UTC **UC1103**. The switch current is detected by a sense resistor into the CS pin. When the power switch is turned on, a turn-on spike will occur on this resistor. A 500ns leading-edge blanking is built in to avoid false-termination of the switching pulse so that the external RC filtering is no longer needed.

## ■ OPERATION DESCRIPTION(Cont.)

**Gate Output**

The UTC **UC1103** output stage is a fast totem-pole gate driver. Cross conduction has been avoided to minimize heat dissipation, increase efficiency, and enhance reliability. The output driver is clamped at 15V to protect power MOSFET transistors against undesired over-voltage gate signals.

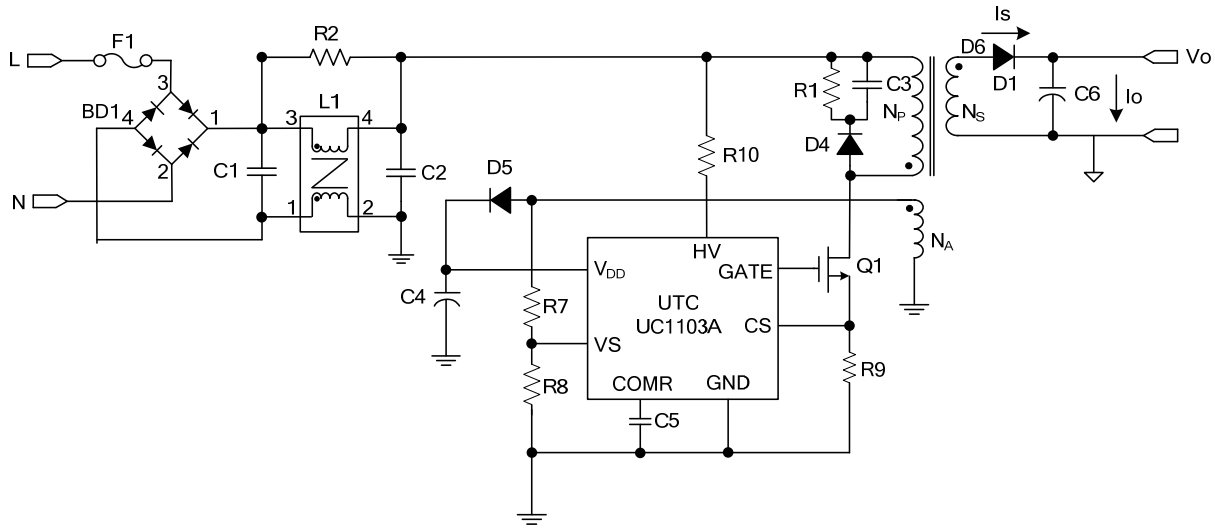
**Protection Control**

Good power supply system reliability is achieved with its comprehensive protection features including  $V_{DD}$  over-voltage protection,  $V_{DD}$  Clamp, GATE Clamp, Power on soft start, Cycle-by-cycle current limiting, short circuit protection, leading edge blanking, OTP and UVLO, etc.

$V_{DD}$  is supplied by transformer auxiliary winding output. The output of UTC **UC1103** is shutdown when  $V_{DD}$  drops below  $V_{TH(OFF)}$  and the power converter enters power on start-up sequence thereafter.



■ TYPICAL APPLICATION CIRCUIT (5V/2.4A)



BOM

Reference	Component	Reference	Component
BD1	BD 2A/600V	R1	R 200kΩ 1206 ±5%
L1	Choke	R2	R 2.4kΩ 1206 ±5%
C1	EC 10μF/400V 105°C	R7	R 39kΩ 0805 ±1%
C2	EC 10μF/400V 105°C	R8	R 10kΩ 0805 ±1%
C3	CC 1nF/1000V 1206	R9	R 1Ω 1206 ±5%
C4	EC 22μF/50V 105°C	R10	R 100kΩ 1206 ±5%
C5	CC 68nF/50V 0805	T1	RM-6
C6	EC 1500μF/10V 105°C	F1	FUSE 1A 250VAC
D4, D5	Diode UTC 1N4007	Q1	N-channel UTC 6N60L
D6	Diode UTC MGBR10L45C		

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