



# LOW-POWER OFF-LINE PRIMARY SIDE REGULATION CONTROLLER

### DESCRIPTION

The UTC **UC1108** 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 uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

The UTC **UC1108** operates in primary-side sensing and regulation. Opto-coupler and TL431 could be eliminated. It also eliminates the need of loop compensation circuitry while maintaining stability. The **UC1108** achieves excellent regulation and high average efficiency, yet meets the requirement for no-load consumption less than 30mW.

The UTC **UC1108** has the built-in programmable cable voltage drop compensation function, which make it flexible to accommodate various cables with different gauges and lengths

The UTC **UC1108** 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, output over voltage protection, feedback loop open protection, short circuit protection, leading edge blanking,  $V_{CC}$  under voltage lockout, etc.

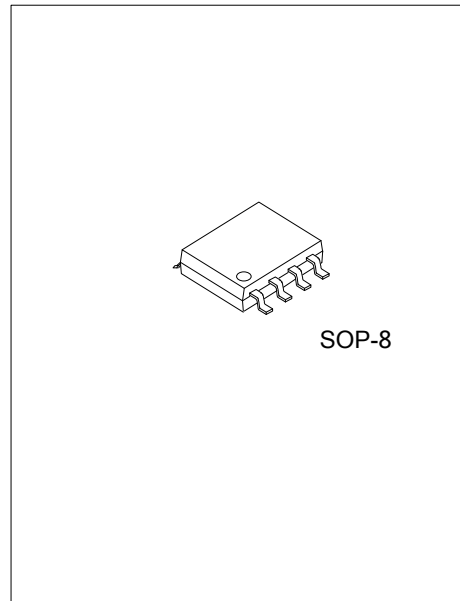
### FEATURES

- \* 30mW No-load Input Power
- \* Primary side control for eliminating opto-coupler and secondary CV/CC control circuitry
- \* Proprietary CC tightening technique to achieve vertical CC profile
- \* Programmable output cable voltage drop compensation
- \* Compensation for external component temperature variations
- \* Random frequency adjustment to reduce system EMI
- \* Flyback topology in DCM operation
- \* Built-in soft start
- \* Over voltage protection
- \* Short circuit protection

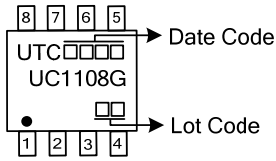
### ORDERING INFORMATION

Ordering Number	Package	Packing
UC1108G-S08-R	SOP-8	Tape Reel

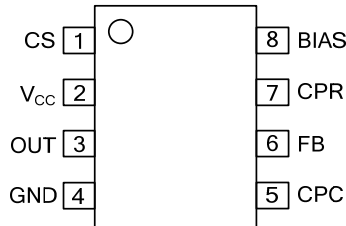
<p>UC1108G-S08-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) S08: SOP-8</li> <li>(3) G: Halogen Free and Lead Free</li> </ul>
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MARKING



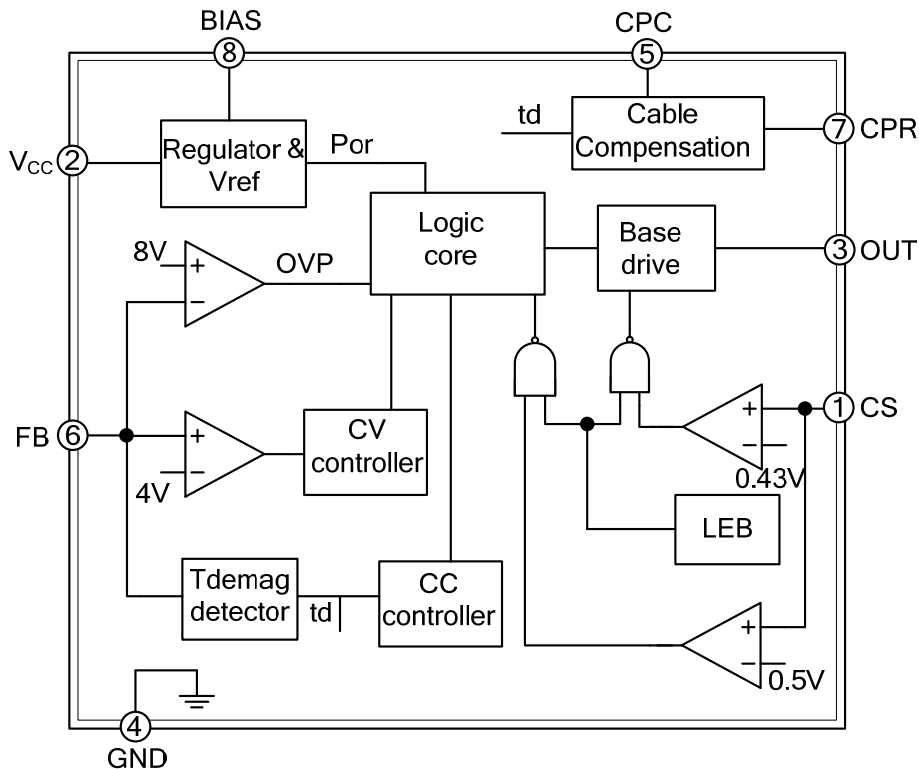
PIN CONFIGURATION



PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	CS	The primary current sense
2	V <sub>CC</sub>	Supply voltage
3	OUT	This pin drives the base of external power NPN switch
4	GND	Ground
5	CPC	This pin connects a capacitor for output cable compensation
6	FB	The voltage feedback from the auxiliary winding
7	CPR	Connects a resistor to FB pin for adjustable output cable compensation
8	BIAS	This pin sets the bias current inside <b>UC1108</b> with an external resistor to GND

BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Voltage at $V_{CC}$ Pin to GND		-0.3~36	V
Voltage at CS, OUT to GND		-0.3~7	V
FB Input		-40~10	V
Output Current at OUT		Internally limited	A
Operating Junction Temperature	$T_{OPR}$	150	°C
Storage Temperature	$T_{STG}$	-65~150	°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	RATING	UNIT
Junction to Ambient	$\theta_{JA}$	190	°C/W

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>UVLO SECTION</b>						
Start-Up Threshold	$V_{TH(ST)}$		17	18.5	21	V
Minimal Operating Voltage	$V_{OPR(min)}$		8.2	9.2	10.2	V
<b>Reference Voltage</b>						
BIAS Pin Voltage	$V_{BIAS}$	$R_{BIAS}=200k\Omega$ , After Turn On	1.0	1.1	1.2	V
<b>STANDBY CURRENT SECTION</b>						
Start-Up Current	$I_{ST}$	$V_{CC}=V_{TH(ST)}-0.5V$ , $R_{BIAS}=200k\Omega$ , Before Start-Up			0.6	$\mu A$
Operating Current	$I_{CC(OPR)}$	$R_{BIAS}=200k\Omega$		390	480	$\mu A$
<b>DRIVE OUTPUT SECTION</b>						
OUT Maximum Current Source	$I_{OUT}$	$R_{BIAS}=200k\Omega$	28	36	44	mA
<b>CURRENT SENSE SECTION</b>						
Current Sense Threshold	$V_{CS}$		490	513	535	mV
Pre-Current Sense	$V_{CS(PRE)}$		390	413	435	mV
Leading Edge Blanking				500		ns
<b>FEEDBACK INPUT SECTION</b>						
Feedback Pin Input Leakage Current	$I_{FB}$	$V_{FB}=4V$	1.8	2.4	3.0	$\mu A$
Feedback Threshold	$V_{FB}$		3.97	4.03	4.09	V
Enable Turn-on Voltage	$V_{FB(EN)}$		-2.0	-1.7	-1.4	V
<b>OUTPUT VOLTAGE COMPENSATION SECTION</b>						
CPR Voltage	$V_{CPR}$	Dons (Tons/T): From 55% to 0.02%	1.5		3.5	V
CPR Sink Current	$I_{CPR}$				200	$\mu A$
<b>PROTECTION SECTION</b>						
Over Voltage Protection	$V_{FB(OVP)}$		7	8	9	V

■ OPERATION DESCRIPTION

The UTC **UC1108** 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. It uses Pulse Frequency Modulation (PFM) method to build discontinuous conduction mode (DCM) flyback power supplies.

**Startup control**

The voltage regulator provides the internal power supply  $V_{DD}$ . For  $V_{CC}$  and  $V_{DD}$  external capacitors are required. The current biasing of UTC **UC1108** is adjustable by an external resistor. Internal time constants, thresholds and the output current depend from the value of this resistor. The startup circuit activates the IC after startup and deactivates the IC in case of UVLO.

**Operating Current**

The Operating current of UTC **UC1108** is as low as 400uA. 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 **UC1108** captures the auxiliary winding feedback voltage at FB 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.

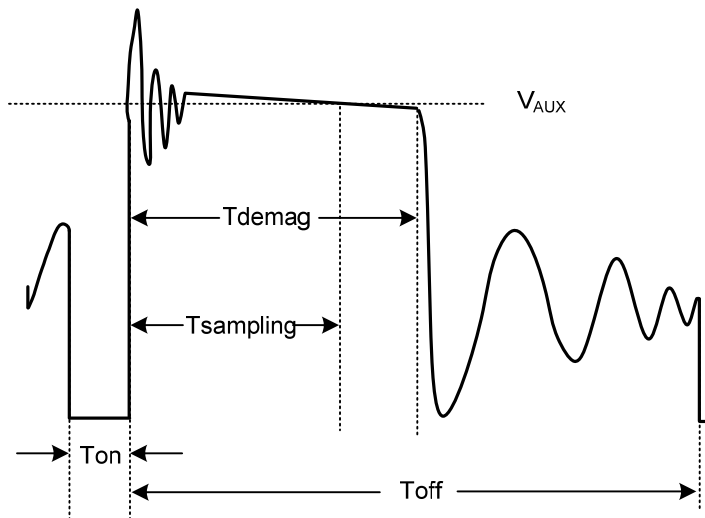


Figure2. Auxiliary voltage waveform

Via a resistor divider connected between the auxiliary winding and FB, the  $V_{AUX}$  is sampled at the  $T_{sampling}$  end and it is hold until the next sampling. The sampled voltage is compared with 4V reference voltage and the error is amplified. The error amplifier output reflects the load condition and controls the  $T_{off}$  time to regulate the output voltage, thus constant output voltage can be achieved.

■ OPERATION DESCRIPTION (Cont.)

**Constant Current Operation**

When the sampled voltage is below 4V reference voltage and the error amplifier output reaches its maximum, thus UTC **UC1108** 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.

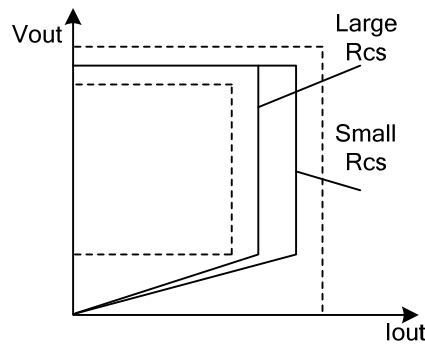


Figure3. Adjustable output power by changing  $R_{cs}$

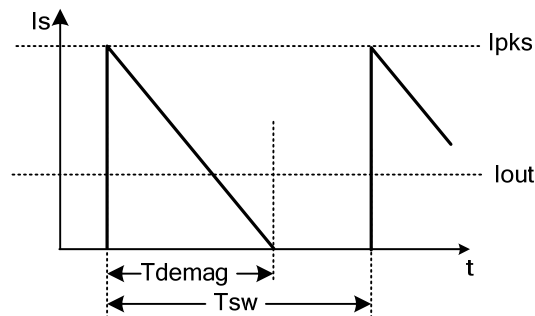


Figure4. Secondary current waveform

In CC operation, the CC loop control function of UTC **UC1108** will keep a fixed proportion between secondary inductance de-magnetization time ( $T_{demag}$ ) and switching cycle time ( $T_{sw}$ ). The fixed proportion is

$$\frac{T_{demag}}{T_{sw}} = \frac{4}{7} \tag{2}$$

Thus the output current is given by:

$$I_{out} = \frac{1}{2} \times \frac{N_p}{N_s} \times I_{pk} \times \frac{T_{demag}}{T_{sw}} = \frac{2}{7} \times \frac{N_p}{N_s} \times I_{pk} \tag{3}$$

**Current Sensing and Leading Edge Blanking**

Cycle-by-cycle current limiting is offered in UTC **UC1108**. 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.

**Drive BJT**

The driver is a push pull stage with the supply voltage  $V_{CC}$ . It provides the driving current for the external power bipolar transistor. The output signal is current-limited to  $I_{OUT(SOURCE)}$ .

## ■ OPERATION DESCRIPTION (Cont.)

**Output Cable Compensation**

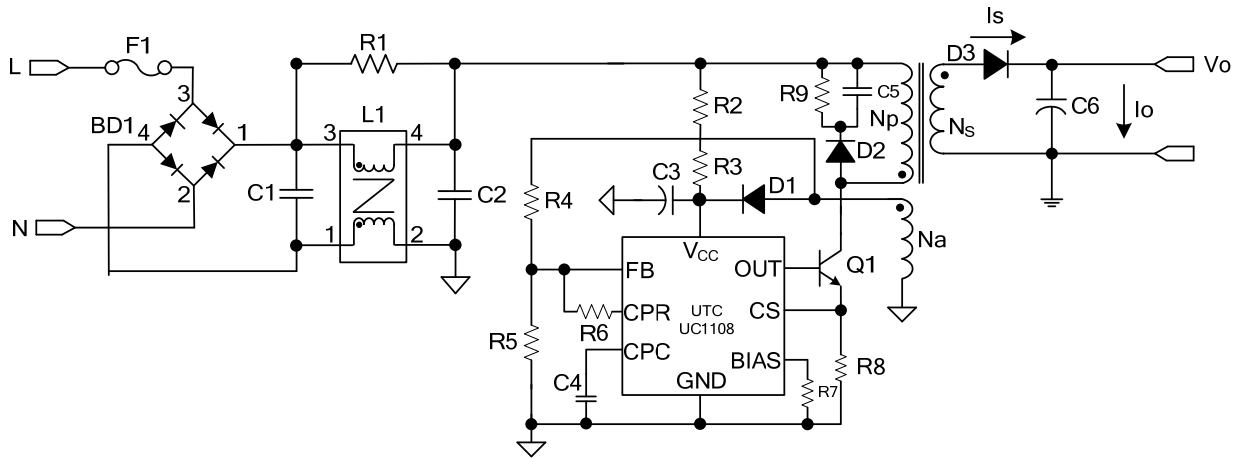
The UTC **UC1108** senses the auxiliary winding feedback voltage at FB pin and operates in constant-voltage (CV) mode to regulate the output voltage. In CV mode, FB pin voltage  $V_{FB}$  is a constant of 4.0V. The CPR pin voltage  $V_{CPR}$  is generated by the internal circuit of UTC **UC1108**. It linearly decreases with the rise of the output load directly. Where  $D_{ons}$  is the duty cycle of secondary diode, and is equal to  $T_{demag}/T_{sw}$ , which is directly proportional to the output loading. The maximum  $D_{demag}$  is 4/7 and the minimal  $D_{demag}$  is close to zero in CV mode of UTC **UC1108**.

**Protection Control**

Good power supply system reliability is achieved with its comprehensive protection features including output over-voltage protection, feedback loop open protection, Cycle-by-cycle current limiting, short circuit protection, leading edge blanking and UVLO, etc.

$V_{CC}$  is supplied by transformer auxiliary winding output. The output of UTC **UC1108** is shutdown when  $V_{CC}$  drops below  $V_{TH(OFF)}$  and the power converter enters power on start-up sequence thereafter.

■ TYPICAL APPLICATION CIRCUIT (5V/1A)



BOM

Reference	Component	Reference	Component
BD1	BD 1A/600V	R2	R 6.8MΩ 1206 ±5%
L1	Inductor, com-choke	R3	R 6.8MΩ 1206 ±5%
C1	EC 4.7u F 400V 105°C	R4	R 30KΩ 0805 ±1%
C2	EC 4.7u F 400V 105°C	R5	R 9.1KΩ 0805 ±1%
C3	CC 2.2u F 50V 105°C	R6	R 27KΩ 0805 ±5%
C4	CC 0.47u F 50V 0805	R7	R 200KΩ 0805 ±5%
C5	CC 1n F 1000V 1206	R8	R 1.0Ω 1206 ±5%
C6	EC 1000u F 10V 105°C	R9	R 200KΩ 1206 ±5%
D1,D2	Diode UTC 1N4007	T1	EE-16
D3	Diode UTC SB340	F1	FUSE 1A 250VAC
R1	R 2.4KΩ 1206 ±5%	Q1	NPN Transistor UTC MJE13003

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