



# LOW-POWER HIGH PRECISION CC/CV PRIMARY SIDE SWITCHING REGULATOR

### DESCRIPTION

The UTC **UC1100** 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 **UC1100** 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 UTC **UC1100** achieves excellent regulation and high average efficiency, yet meets the requirement for no-load consumption less than 30mW.

The UTC **UC1100** 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.

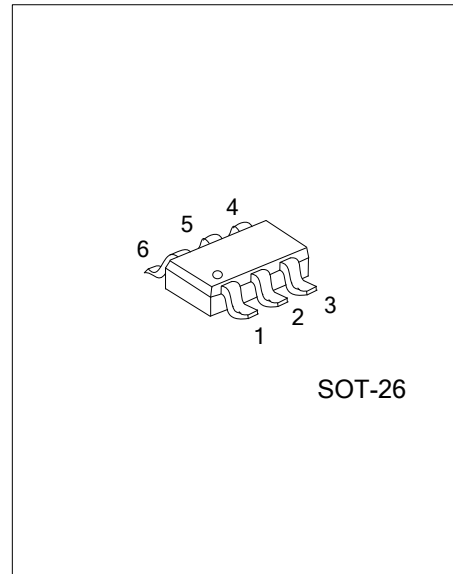
### FEATURES

- \* Primary side control for rectangular constant current and constant voltage output
- \* 30mW no-load input power feasible
- \* Tight CC regulation performance
- \* Sub-microampere start-up current
- \* Eliminates control loop compensation circuitry
- \* Eliminates opto-coupler and secondary CV/CC control circuitry
- \* Random frequency modulation to reduce system EMI
- \* Flyback topology in DCM operation
- \* Open feedback protection
- \* Built-in soft start
- \* Short circuit protection

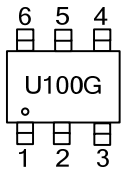
### ORDERING INFORMATION

Ordering Number	Package	Packing
UC1100G-AG6-R	SOT-26	Tape Reel

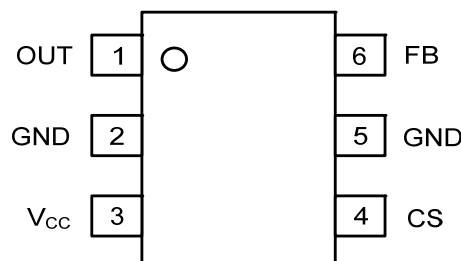
<p>UC1100G-AG6-R</p>	<p>(1) R: Tape Reel (2) AG6: SOT-26 (3) G: Halogen Free and Lead Free</p>
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MARKING INFORMATION



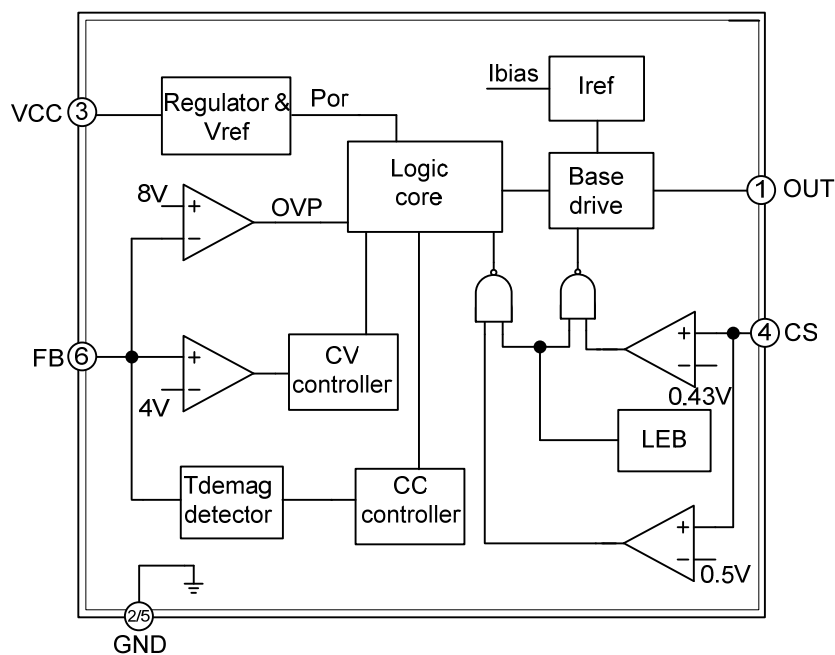
PIN CONFIGURATION



PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUT	This pin drives the base of external power NPN switch
2, 5	GND	Ground
3	V <sub>CC</sub>	Supply voltage
4	CS	The primary current sense
6	FB	The voltage feedback from the auxiliary winding

BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V_{CC}$	-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
ESD (Machine Model)		200	V
ESD (Human Body Model)		1000	V
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	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	250	°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	$V_{TH(ST)}$		16	18.5	21	V
Minimal Operating Voltage	$V_{OPR(min)}$		7.2	9	10.2	V
<b>STANDBY CURRENT SECTION</b>						
Start-Up Current	$I_{ST}$	$V_{CC}=V_{TH(ST)}-0.5V$ , Before Start-Up			3	$\mu A$
Operating Current	$I_{CC(OPR)}$	Static		350	400	$\mu A$
<b>DRIVE OUTPUT SECTION</b>						
OUT Maximum Current	Sink	$I_{OUT}$	50			mA
	Source		40	60	80	mA
<b>CURRENT SENSE SECTION</b>						
Current Sense Threshold	$V_{CS}$		455	510	545	mV
Equivalent Current Sense Voltage Accuracy	$\frac{\Delta V_{CS,eq}}{V_{CS,eq}}$	Note 1			3	%
Pre-Current Sense	$V_{CS(PRE)}$		365	410	455	mV
Leading Edge Blanking				500		ns
<b>FEEDBACK INPUT SECTION</b>						
Feedback Pin Input Leakage Current	$I_{FB}$	$V_{FB}=4V$	2.0	2.5	3.1	$\mu A$
Feedback Threshold	$V_{FB}$		3.59	3.83	4.07	V

Note: The output current is given by  $I_{OUT} = \frac{V_{CS,eq}}{R_{CS}} \times \frac{N_P}{N_S}$

## ■ OPERATION DESCRIPTION

The UTC **UC1100** 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  $V_{CC}$  pin of UTC **UC1100** is connected to the line input through a resistor. A large value startup resistor can be used to minimize the power loss in application because the start current of UTC **UC1100** is very low. When the  $V_{CC}$  voltage reaches  $V_{TH(ST)}$ , the internal startup circuit is disabled and the IC turns on.

### Operating Current

The Operating current of UTC **UC1100** is as low as 320uA. 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 **UC1100** 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:

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

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

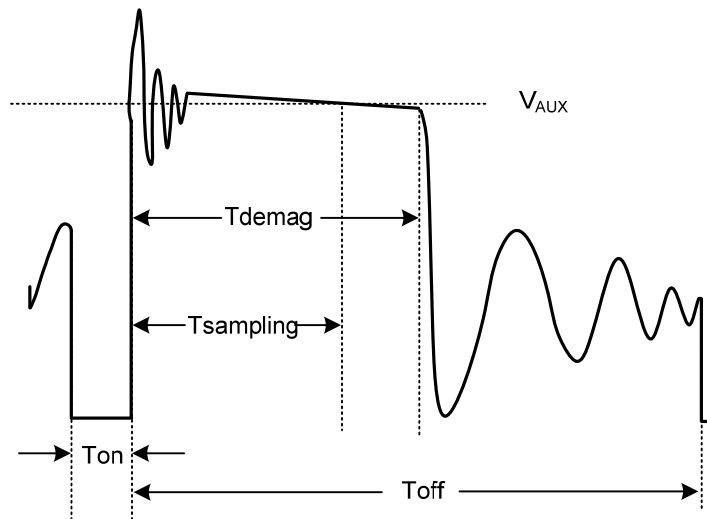


Figure1. Auxiliary voltage waveform

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.

### Constant Current Operation

When the sampled voltage is below 4V reference voltage and the error amplifier output reaches its maximum, thus UTC **UC1100** 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.)

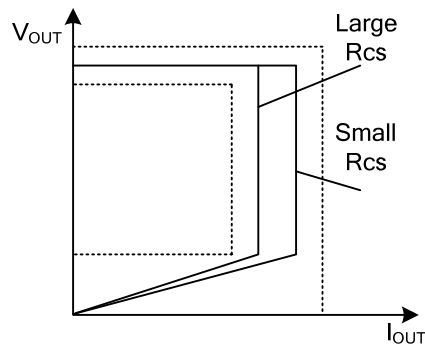


Figure2. Adjustable output power by changing Rcs

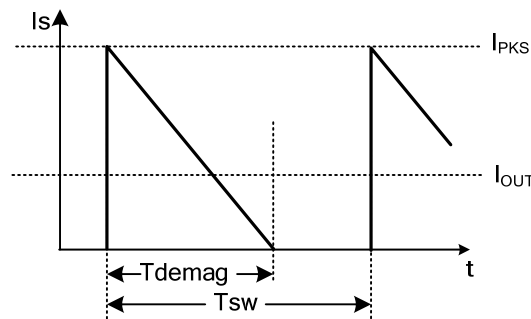


Figure3. Secondary current waveform

In CC operation, the CC loop control function of UTC **UC1100** will keep a fixed proportion between secondary inductance de-magnetization time (Tdemag) and switching cycle time (Tsw). 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 **UC1100**. 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 750ns 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**

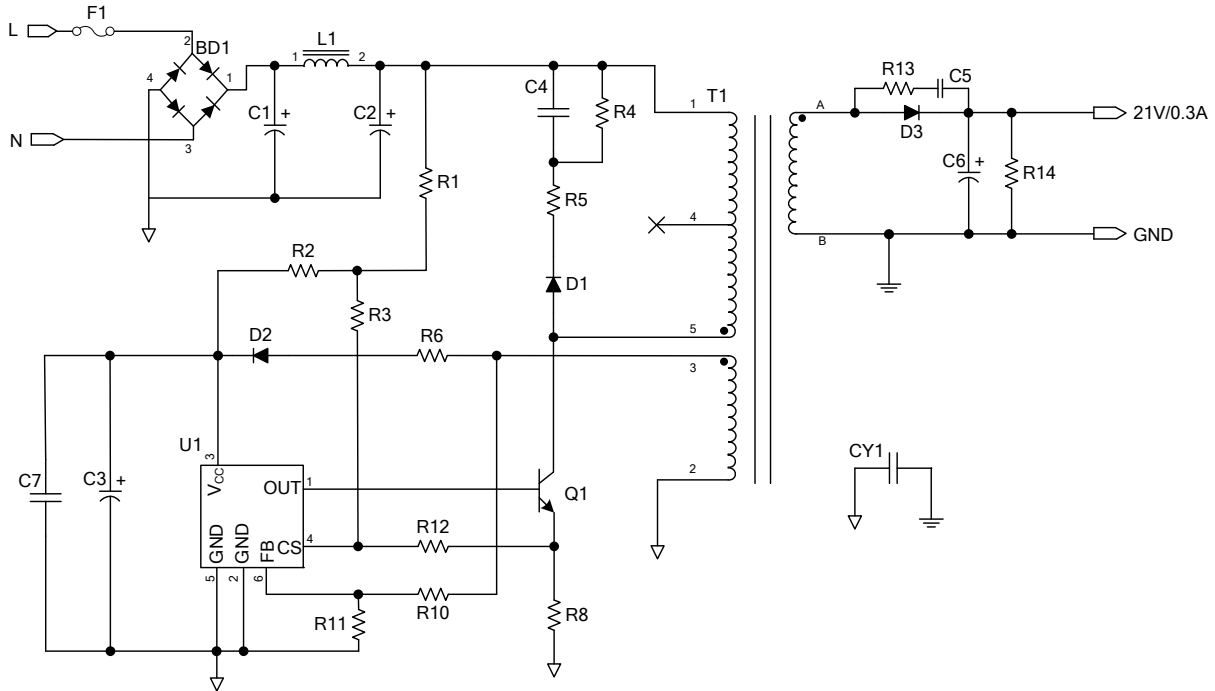
The driver is a push pull stage with the supply voltage VCC. It provides the driving current for the external power bipolar transistor. The output signal is current-limited to IOUT(SOURCE).

**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.

VCC is supplied by transformer auxiliary winding output. The output of UTC **UC1100** is shutdown when VCC drops below VOPR(MIN) and the power converter enters power on start-up sequence thereafter.

■ TYPICAL APPLICATION CIRCUIT



BOM

Reference	Component	Reference	Component
F1	0.5A/250V	U1	UC1100, SOT-26
BD1	B6S	R1, R2	1MΩ 1206
C1, C2	EC 4.7μF/400V 105°C	R3	1.5MΩ 1206
C3	EC 4.7μF/50V 105°C	R4	200kΩ 1206
C4	CC 102P/1KV	R5	22Ω 0805
C5	NC	R6	3.9Ω 0805
C6	EC 220μF/35V 105°C	R8	940mΩ 1206
C7	NC	R10	20kΩ 0805
L1	1.2mH	R11	4.3kΩ 0805
T1	EE-16	R12	1kΩ 0805
D1	1N4007, SMA	R13	NC
D2	BAV21, SOD-123	R14	24kΩ 1206
D3	MGBR3200, DO-201AD	CY1	Y1 102P/400V
Q1	MJE13003, TO-126		

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