HLW8012 User Manual

REV 1.3

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History modification record

Time modification record	Version
2013-1-2 Initial version 2014-6-20	REV 1.0
Update company address 2014-8-01	REV 1.1
Change chip pin diagram VIN to V1N, VIP to V1P 2015-11-11 Change digital	REV 1.2
characteristic table typo: DCLK change It is MCLK; Add the content of the pin description table: the differential voltage of the current and voltage channels is VPeak	REV 1.3

1 chip function description

HLW8012 is a single-phase multi-function metering chip, which provides high-frequency pulse CF for energy metering and high-frequency CF1 for indicating current RMS or voltage RMS. The chip is packaged in SOP8.

1.1 Main features and functions of the chip

ÿHigh -frequency pulse CF, indicating active power, meeting the accuracy requirements of the 50/60Hz IEC 687/1036 standard, within the range of 1000:1 Accuracy of ±0.2% within the range.

ÿHigh -frequency pulse CF1, which can be configured as the output current RMS or voltage RMS, which can reach ±0.5% in the range of 500:1 precision.

ÿBuilt -in power supply monitoring circuit, when the power supply voltage is as low as 4V, the chip enters the reset state.

ÿ Built-in 2.43V voltage reference source.

ÿ 5V single power supply, the working current is less than 3mA.

ÿMain application areas: occasions that need to measure voltage, current and power, such as single-phase multi-functional energy meters, smart sockets, Digital display meters, street lamps, small household appliances, etc.

1.2 Chip Structure Description

The functional block diagram of HLW8012 is shown in Figure 1

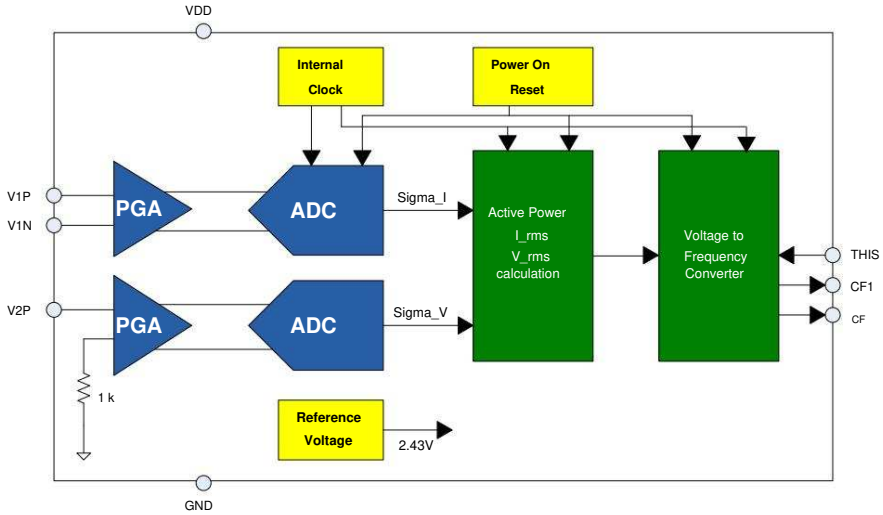

Figure 1 Functional block diagram of the chip

1.3 Chip pin description

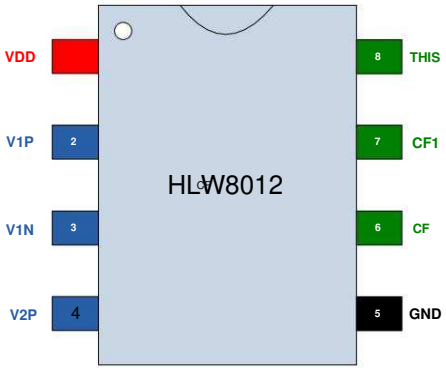

Figure 2 chip pin diagram

Table 1 HLW8012 pin description

Pin No. Pin Name	Input/Output		illustrate
1	VDD chip power chip power		
2ÿ3	V1P, V1N input input		Current differential signal input terminal, the maximum differential input signal (VPeak)
4	V2P		±43.75mV voltage signal positive input terminal. Maximum input signal (VPeak) ±700mV
5	GND chip ground chip ground		
6	CF	output	Output active high frequency pulse, duty cycle 50%
7,	CF1	output	SEL=0, output current effective value, duty cycle 50%; SEL=1, the effective value of the output voltage, the duty cycle is 50%;
8	THIS	enter	configure the effective value output pin, with pull-down

2 chip characteristics description

2.1 Recommended working conditions

parameter	Symbol	Min	Typ	Max	Unit
Positive power supply	VDD	4.5	5.0	5.5	IN
temperature range	FACING	-40	·	+85 ÿ	

2.2 Analog Features

VDD = 5V ± 10%ÿGND = 0V

parameter	Symbol	Min	Typ	Max	Unit
precision					
active power Full Gain Range Input range 0.1%~100%	PActive	·	±0.2	·	%
Current RMS full gain range Input range 0.2%~100%	IRMS	·	±0.5	·	%
Voltage RMS full gain range Input range 0.2%~100%	VRMS	·	±0.5	·	%
Analog input (all channels)					
common mode signal		-1	·	1	IN
analog input					
Crosstalk to voltage channel at full scale (50, 60Hz)		·	-100	·	dB
input capacitance	IC	·	6.4	·	pF
Equivalent Input Impedance Current Channel voltage channel	EII		500 6	·	kÿ Mÿ
Equivalent Input Noise Current Channel voltage channel	IN	· ·	· ·	2 20	µVrms µVrms
power supply					
current consumption IT+ID			3	·	mA
power consumption (VDD = 5V)	PC	·	15		mW
Brownout Detection Low Voltage Threshold	PMLO	·	4	·	IN
Brownout detection high voltage threshold	PMHI	·	4.3	·	IN

2.3 Built-in reference voltage

parameter	Symbol Min Typ Max Unit				
The reference voltage	VREF	+2.3	+2.43	+2.55	IN
temperature drift	TCVREF	·	25	·	ppm/ÿ

2.4 Digital characteristics

VDD = 5VÿGND = 0V

parameter	Symbol Min Typ Max Unit				
master clock					
master clock frequency	mclk	3.04	3.579	4.12	MHz
Master Clock Duty Cycle		30	50	70	%
filter					
Input sampling rate (DCLK=MCLK/4)		·	MCLK/4	·	Hz
Digital filter output code rate	OWR	·	MCLK/128	·	Hz
High-pass filter corner (-3dB) frequency		·	0.543	·	Hz
input Output					
High level input voltage VDD=5V	HIV	0.8VDD	·	·	IN
Low level input voltage VDD=5V,	WILL	·	·	0.8	IN
High level output voltage Iout = +5 mA	VOH	VDD-0.5	·	·	IN
Low level output voltage Iout=-5 mA	VOL	·	·	0.5	IN
input leakage current	Iin	·	±10	·	µA
Digital Output Pin Capacitance	COUT	·	5	·	pF

2.5 Switching characteristics

SEL is the input port, and the pulse duty cycle of CF and CF1 output is 50%.

2.6 Limiting Ratings

parameter	Symbol Min Typ Max Unit				
digital power	VDD	-0.3	·	+6.0	IN
Analog power	VDD	-0.3	·	+6.0	IN
VDD to GND		-0.3	·	+6.0	IN
V1P, V1N, V2P		-2		+2	IN
Analog input voltage	WINES	-0.3	·	VDD+0.3	IN
Digital input voltage	FIND	-0.3	·	VDD+0.3	IN
Digital output voltage	VOUTD	-0.3	·	VDD+0.3	IN
Working temperature	FACING	-40	·	85	°C
storage temperature	Tstg	-65	·	150	°C

3 chip application

3.1 Typical application of HLW8012

As shown in Figure 4, at the power supply end of HLW8012, two small capacitors should be connected in parallel to filter out high-frequency and low-frequency noise from the power grid. electricity

The flow signal is sampled by a manganese copper resistor and connected to HLW8012, and the voltage signal is input to HLW8012 after passing through a resistor network. CF,

CF1 and SEL are directly connected to the input of the CPU, and the power value and current effective value are calculated by calculating the pulse period of CF and CF1

and the size of the effective value of the voltage.

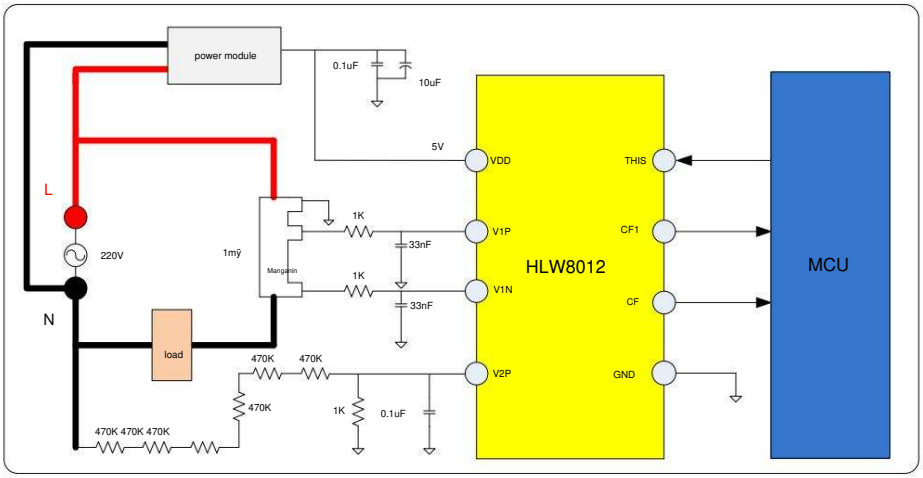

Figure 3 Typical application of HLW8012

3.2 Frequency of **CF and CF1**

The internal DSP of HLW8012 has a certain gain. After the frequency conversion module, the active power, current effective value and voltage have

The output frequency of RMS can be calculated by the following formula:

(1) Active power calculation formula: = $\frac{1\times 2\times 48\times}{2}\frac{}{128}$

(2) Calculation formula of current effective value: = $\frac{1\times 24}{}\times\frac{}{512}$

(3) Calculation formula of voltage effective value: = $\frac{2\times 2}{}\times\frac{}{512}$

V1: Voltage signal on current channel pin

V2: Voltage signal on voltage channel pin

: Built-in crystal oscillator, the typical frequency is about 3.579MHz

: Built-in reference source, typical voltage is 2.43V

3.3 Chip startup threshold and creep prevention

HLW8012 uses a new anti-creep algorithm, as long as the power value of the input signal is greater than the internal noise value, the metering module will start

Normal metering.

3.4 Built-in oscillator

The frequency of the built-in oscillator used by HLW8012 is about 3.579M, and the power supply voltage rejection ratio is <0.01/V.

3.5 Built-in reference source

HLW8012 has a built-in high-precision bandgap reference source, and the typical output voltage of the reference source is 2.43V.

4 HLW8012 package

HLW8012 uses SOP8 package, the specific package information is shown in the figure below:

尺寸 / 标注	最小 （mm）	最大 （mm）	尺寸 / 标注	最小 （mm）	最大 （mm）
A	4.95	5.15	C3	0.05	0.20
A1	0.37	0.47	C4	0.20TYP	
A2	1.27TYP		D	1.05TYP	
A3	0.41TYP		D1	0.40	0.60
B	5.80	6.20	R1	0.07TYP	
B1	3.80	4.00	R2	0.07TYP	
B2	5.0TYP		θ1	17°TYP	
C	1.30	1.50	θ2	13°TYP	
C1	0.55	0.65	θ3	4°TYP	
C2	0.55	0.65	θ4	12°TYP	

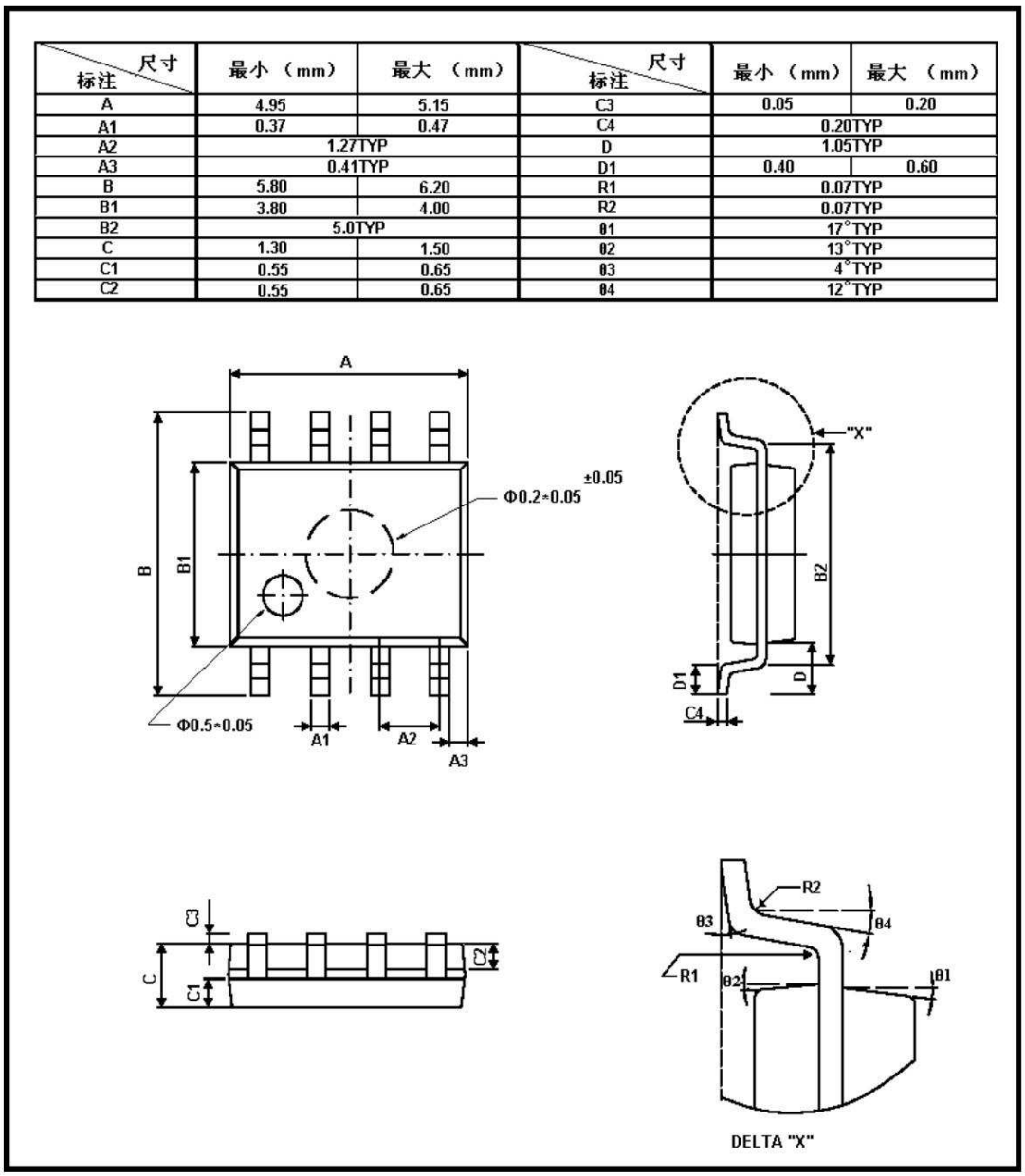

Figure 4 HLW8012 package information diagram