HLW8012 User Manual

REV 1.3

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content

History modification record

Time modification record	Version
2013-1-2 Initial version	REV 1.0
2014-6-20 Updated company address	REV 1.1
2014-8-01 Changed chip pin diagram VIN changed to V1N, VIP changed to V1P	REV 1.2
2015-11-11 Changed digital characteristic table typo: DCLK changed is MCLK; Added the contents 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 value or voltage rms value. This chip adopts SOP8 package.

1.1 Main features and functions of the chip

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

ÿ**High** -frequency pulse CF1, which can be configured as output current RMS or voltage RMS, within the range of 500:1 to ±0.5% precision.

ÿ**Built** -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.

ÿ**Main** application areas: occasions where voltage, current and power need to be measured, such as single-phase multi-function energy meters, smart sockets, Digital display, street lights, small appliances, etc.

1.2 Chip structure description

The functional block diagram of HLW8012 is shown in Figure 1

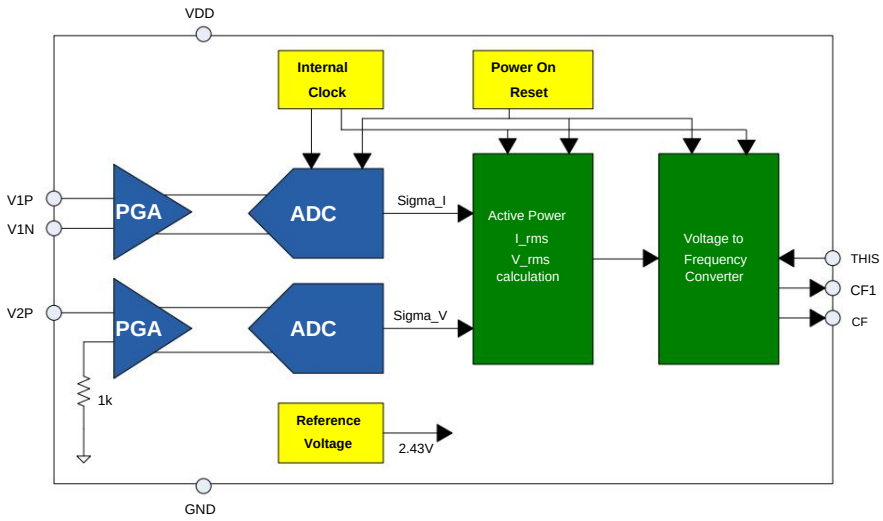

Figure 1 Chip functional block diagram

1.3 Chip pin description

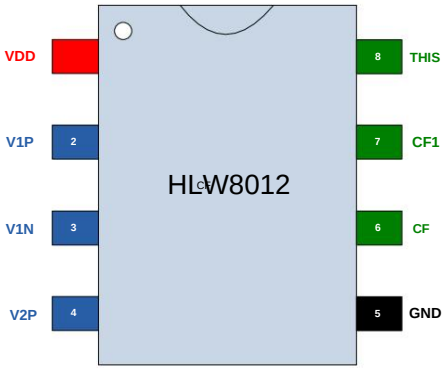

Figure 2 Chip Pin Diagram

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, maximum differential input signal (VPeak) ±43.75mV
4	V2P	Positive input terminal of voltage signal. 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 RMS, duty cycle 50%; SEL=1, output voltage RMS, duty cycle 50%;
8	THIS enter	Configure RMS output pin with pull-down

2 Chip Feature Description

2.1 Recommended working conditions

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

2.2 Simulation characteristics

VDD = 5 V ± 10% ÿ GND = 0 V

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 IA+ID			3	·	mA
Power consumption (VDD = 5 V)	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
Warm drift	TCVREF	·	25	·	ppm/ÿ

2.4 Digital Characteristics

VDD = 5 V ÿ GND = 0 V

parameter	Symbol	Min	Typ	Max	Unit
master clock					
Master clock frequency	MCLK	3.04	3.579	4.12	MHz
Main clock duty cycle		30	50	70	%
filter					
Input sampling rate (DCLK=MCLK/4)		·	MCLK/4	·	Hz
Digital filter output bit 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 ratio of CF and CF1 output is 50%.

2.6 Limit 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	WINE	-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	PER	-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 the manganin resistor and then connected to the HLW8012, and the voltage signal is input to the HLW8012 after passing through the resistor network. CF,

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

and the magnitude of the rms voltage.

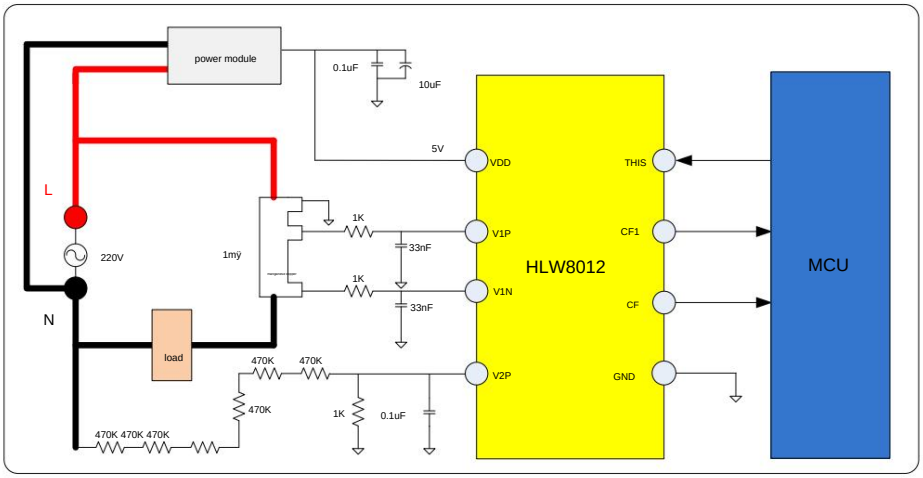

Figure 3 Typical application of HLW8012

3.2 Frequency of CF and CF1

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

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

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

(2) The formula for calculating the effective value of the current: = $\frac{1\times 24}{\times}$ $\frac{}{512}$

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

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-creeping 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 the HLW8012 is about 3.579M, and the power supply voltage rejection ratio is <0.01/V.

3.5 Built-in reference source

The 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 following figure:

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	

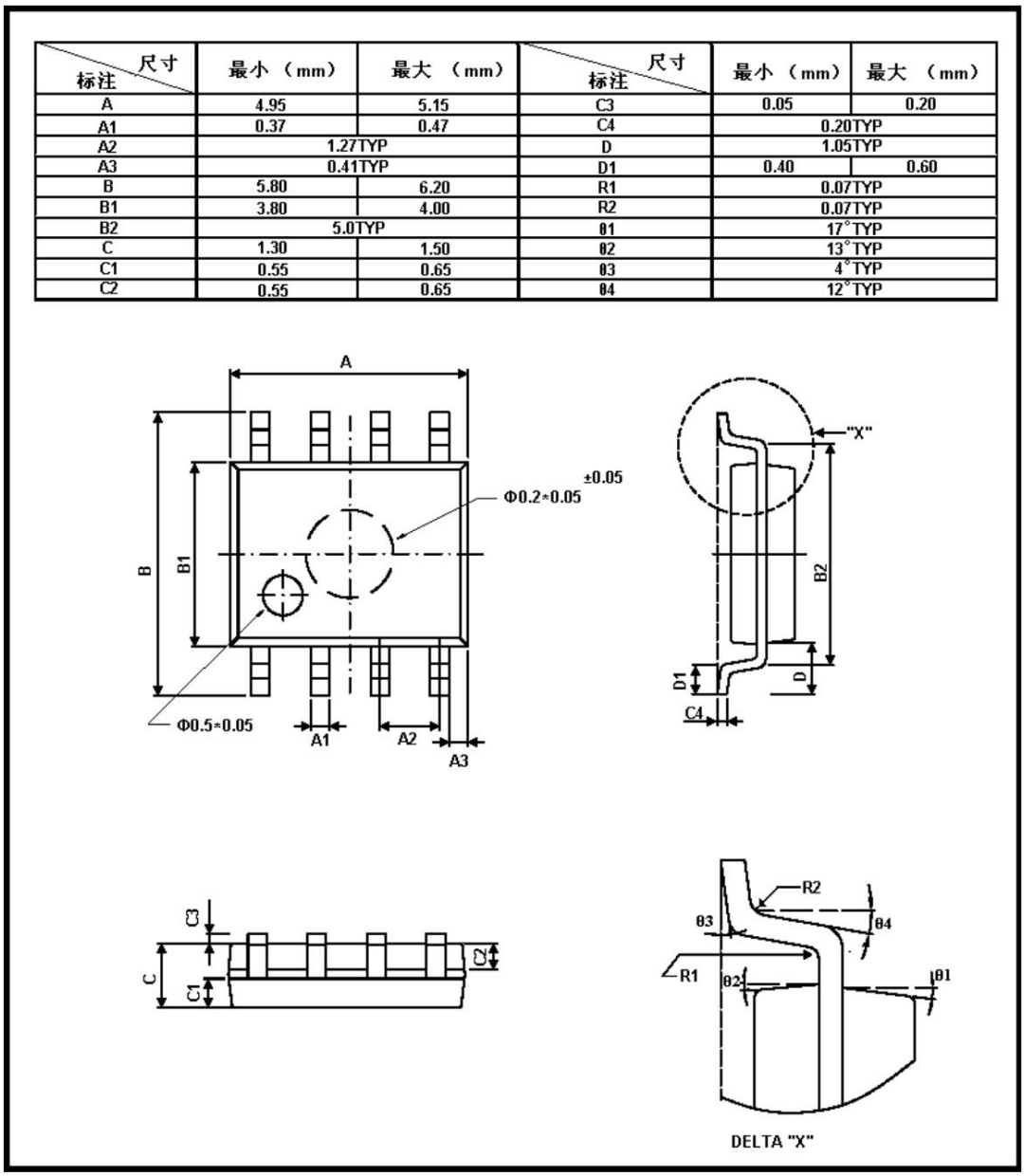

Figure 4 HLW8012 package information diagram