芯海科技
CHIPSEA

CSE7759B User Manual

Calibration-free Electric Energy Measuring Chip

Rev.1.2

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Revision History

Revision Number	History	Time
Rev.1.0	Initially issued	September 11, 2017
Rev.1.1	1. table 3-4,Added adj.3 2. Added 3.5 chip reset	November 13, 2017
Rev.1.2	1. Change the 3.6.2 voltage and power formula 2. Change 3.7.2 F'_{CF} formula 3. Change the voltage and power formula in the 3.8.1 and 3.8.3 flow charts	December 25, 2017

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1 Functional Description of the Chip

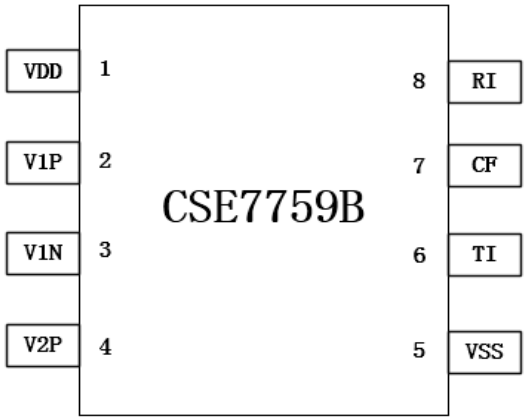
CSE7759B is a single-phase multi-function measuring chip, provides high-frequency pulse CF for measuring electric quantity and may read relevant parameters of current, voltage and power (such as coefficient, cycle) directly through UART; baud rate of serial port is 4800bps (± 2%) 8-bit data with 1 even parity check and 1 stop bit. This chip is packaged in SOP8.

1. 1 Main Characteristic Function of the Chip

1. The cumulative error of the charge is ±2%.
2. For current RMS, voltage RMS and power error range, see section 2.3
3. Baud rate of UART communication protocol of serial port is 4800bps.
4. Built-in power supply monitoring circuit; the chip will be enter reset state when power supply voltage is lower to 4V.
5. Built-in 2.43V voltage reference source.
6. 5V single power supply; operating current is smaller than 5mA.
7. Main application area: Occasions needing to meter voltage, current and power, such as single-phase multifunction watt-hour meter, measuring socket and data display instrument etc.

1. 2 Pin Description of the Chip

CSE7759B is packaged in SOP8.



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Figure 1: Chip Pin Diagram

Table 1.1 CSE7759B Pin Description

Pin No.	Pin Name	Input/ Output	Description
1	VDD	Chip- power supply	Chip- power supply
2,3	V1P, V1N	I	Current differencing signal input terminal. Maximum differencing input signal is ±43.75mV When the current signal is not used, the VIP and V1N shall be short received VSS
4	V2P	I	Voltage signal positive input terminal. Maximum input signal is ±700mV When the voltage signal is not used, the V2P shall be short connected to VSS
5	VSS	Chip- ground	Chip- ground
6	TI	O	UART transmit port
7	CF	O	Output active high-frequency pulse; duty ratio of 50%
8	RI	I	UART receive port; reserved.

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2 Characteristic Description of the Chip

2.1 Absolute Maximum Ratings

Parameters	Symbol	Min. Value	Typical Value	Max. Value	Unit
power supply	VDD	-0.3	-	+6.0	V
V1P, V1N, V2P		-2		+2	V
Analog input voltage	V_{INA}	-0.3	-	VDD+0.3	V
Digital input voltage	V_{IND}	-0.3	-	VDD+0.3	V
Digital output voltage	V_{OUTD}	-0.3	-	VDD+0.3	V
Operating ambient temperature	T_A	-40	-	85	℃
Storage temperature	T_{stg}	-65	-	150	℃

2.2 Recommended Operating Conditions

Parameters	Symbol	Min. Value	Typical Value	Max. Value	Unit
power range	VDD	4.5	5.0	5.5	V
Temperature range	T_A	-40	-	85	℃

2.3 Analog Characteristics

VDD = 5V，GND = 0V，25℃ (unless otherwise stated)

Parameters	Symbol	Min. Value	Typical Value	Max. Value	Unit
Analog input (all channels)					
Common-mode signal		-1	-	1	V
Analog input					
Crosstalk to voltage channel in full range (50, 60Hz)		-	-100	-	dB

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Input capacitance	IC	-	6.4	-	pF
Equivalent input impedance: Current channel Voltage channel	EII		500 6	-	kΩ MΩ
Equivalent input noise: Current channel Voltage channel	N_I	- -	- -	2 20	μVrms μVrms
Power supply					
Current consumption (VDD = 5 V)	I		4	- -	mA mA
Power consumption (VDD = 5 V)	PC	-	20		mW
Low voltage threshold for power failure detection	PMLO	-	4	-	V
High voltage threshold for power failure detection	PMHI	-	4.3	-	V
Built-in reference voltage					
Reference voltage	VREF	2.3	2.43	2.55	V
Temperature excursion	TC_{VREF}	-	25	-	ppm/℃

Measurement accuracy (measuring relative error and absolute error of the parameter)

Parameters	Symbol	Min. Value	Typical Value	Max. Value	Unit
Current: 1mR sampling resistance (ideal value, without resistance error), full range of the current is 30.9A					
30.9A~250mA (relative error)		-2	1	2	%
249mA~60mA (absolute error)			10	15	mA
Min. measured value of current (to be determined by overall noise)			60		mA

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No-load current (to be determined by overall noise)			60		mA
Voltage: 1MR divider resistance (ideal value, without resistance error)					
Voltage measurement range: 80V~260V(relative error)		-2	1	2	%
Power: (ideal value, without current sampling resistance error and divider resistance error)					
Above 55W (relative error)		-2	1	2	%
Below 55W (absolute error)			1	2.5	W
Min. measured value of power (to be determined by overall noise)			3		W
No-load power (to be determined by overall noise)			0		W

2. 4 Digital Characteristics

VDD = 5V, GND = 0V, 25℃(unless otherwise stated)

Parameters	Symbol	Min. Value	Typical Value	Max. Value	Unit
Master clock					
Frequency of master clock	MCLK	3.04	3.579	4.12	MHz
Duty ratio of master clock		30	50	70	%
Filter					
Input sampling rate (DCLK=MCLK/K)		-	MCLK /4	-	MHz
Output bit rate of digital filter	OWR	-	MCLK /128	-	MHz
Corner frequency of high-pass filter (-3dB)		-	0.543	-	Hz
Input/output					
High level output voltage Iout	V_{OH}	VDD-0.5	-	-	V

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= +5 mA					
Low level output voltage Iout=-5mA	V_{OL}	-	-	0.5	V
Input leakage current	I_{in}	-	±10	-	μA
Capacitance of digital output pin	C_{OUT}	-	5	-	pF
UART					
4800bps		-2		+2	%

2.5 Switching Characteristics

Pulse duty factor of CF output is 50%

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3 Application of the Chip

3. 1 Typical Application of CSE7759B

As shown in Figure 2, two small capacitors shall be connected in parallel on power supply terminal of CSE7759B to filter out high-frequency and low-frequency noise from power grid. The current signal is connected to CSE7759B after being sampled by manganin resistor and the voltage signal is inputted into CSE7759B after passing through resistor network. CSE7759B must be connected to the current signal and the voltage signal simultaneously but shall not be connected only to either signal.

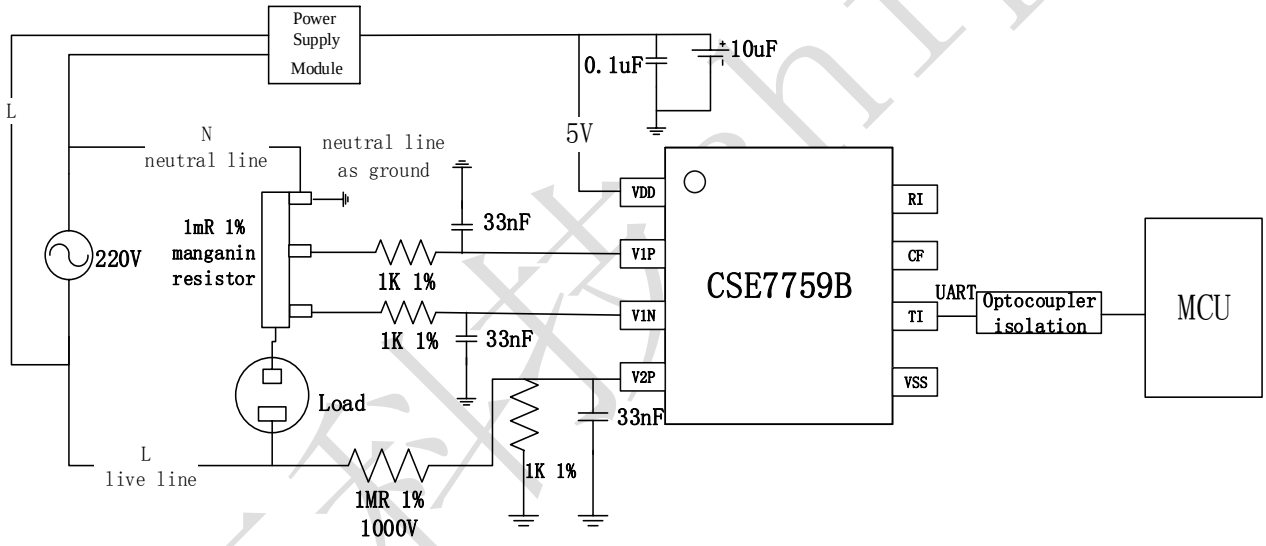


Figure 2: Typical Application of CSE7759B (Isollation)

Note:

CSE7759B is a calibration-free electric energy measuring chip. The error of calibrated chip is ±2% upon delivery. Thus, final accuracy of external devices will influence overall accuracy of the products of the client. As for the device with accuracy of 1% indicated in Figure 2, the higher the accuracy is, the overall accuracy of the client will be.

As shown in Figure 2, it is the 1mR manganin resistor in current channel which influences current accuracy and it is 1M resistor and 1K resistor connected with it in voltage channel which influences voltage accuracy. When the accuracy of all three devices is within ±1%, the overall

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error of CSE7759B without calibration may be controlled within ±3%.

1M resistor in voltage channel shall select high pressure resistant 1000V 1% resistor (or with higher accuracy); otherwise, it is necessary to divide into five 0805 1% (or with higher accuracy) resistors. It is necessary to protect complete machine being damaged in the process of use due to insufficient withstanding voltage of resistor.

CSE7759B section collects strong current signal. As specified in safety regulation, the positions accessible to anybody shall be isolated. As shown in Figure 2, opto-isolator is used (the client may select isolation method of its own option and it is not limited).

Select neutral line or live line as ground. It is recommended to use neutral line as ground.

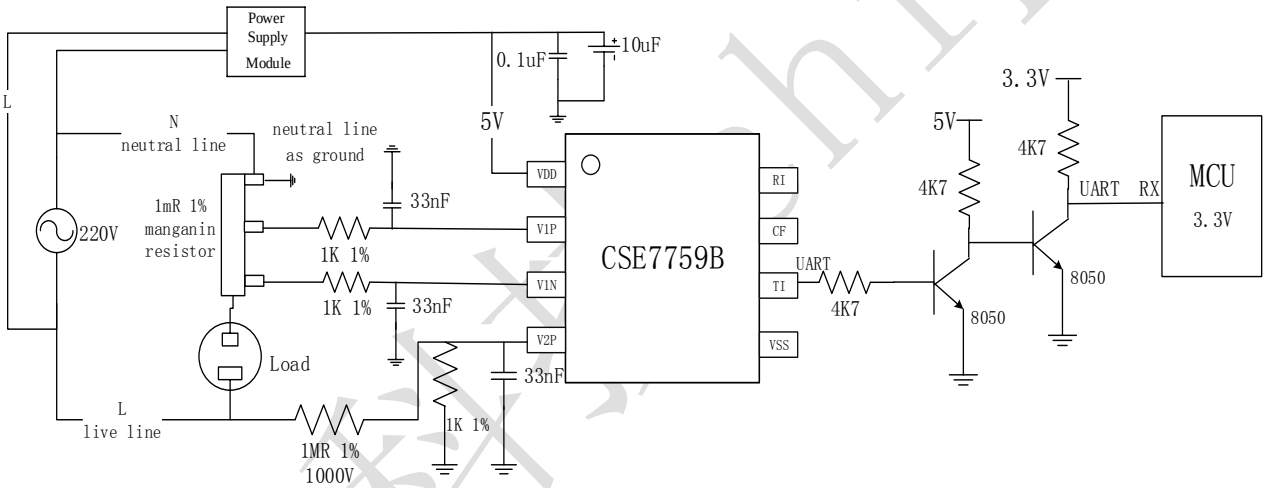


Figure 3: Typical Application of CSE7759B (Non-isollation)

Figure 3 shows CSE7759B non-isolation scheme. Operating voltage of MCU is 3.3V. If operating voltage of MCU is 5V, 200R resistor may be connected between TI and MCU.

3. 2 Signal Frequency of Active Power F_{CF}

Internal DSP of CSE7759B has certain gain. Output frequency of active power may be calculated through the following formula after passing through frequency conversion module:

$$F_{CF}=\frac{V1\times V2\times 48}{V_{REF}^2}\times\frac{f_{osc}}{128}$$

V1: Voltage signal on current channel pin;

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V2: Voltage signal on voltage channel pin;

f_{osc}: Built-in crystal oscillator; typical frequency is about 3.579MHz;

V_{REF}: Built-in reference source; typical frequency is about 2.43V;

Note: There exists noise in CSE7759B. Therefore, for the purpose of ensuring the amplitude of properly measured effective values of current and voltage without signal input, current effective value applied on channel V1P\V1N shall not be lower than 40uv and voltage applied on channel V2P shall not be lower than 480uv. Please consult to technical support of the Company when using.

3. 3 **Measuring Range**

Different manganin resistors (1mR manganin resistor is recommended) selected will influence current measuring range of CSE7759B directly.

The formula is as follows:

$$\text{Full current measuring range(A)} = \frac{43.75(\text{mV})}{\sqrt{2} * \text{manganin resistance（mR）}}$$

Such as: 1mR manganin resistor

$$\text{Full current measuring range(A)} = \frac{43.75\text{mV}}{\sqrt{2} * 1\text{mR}} \approx 30.9\text{A}$$

The current will reach ±2% accuracy within the scope of 500:1; namely, the current will reach ±2% accuracy within current measuring range of 1mR manganin resistor 30.9A~0.0618A; the accuracy will be larger than ±2% when the current is smaller than 0.0618A.

If there is noise in PCB, such noise will influence the measuring accuracy. Thus, accuracy deviation caused by the noise in actual application should be taken into consideration as the influence of the noise on the signal is high (Consult to the Company before printing PCB).

The influence of PCB noise on the signal may be detected at the CF pin (pin7) of CSE7759B. Short-circuit at the manganin resistor. Observe when the current input signal is zero.

The larger manganin resistance is, the larger the signal frequency will be and the smaller the cycle will be.

Voltage accuracy is ±2%.

Power measuring range will be determined by the current if the voltage is constant.

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3. 4 **Serial Port Protocol**

Relevant parameters of voltage, current, power and electric quantity could be read by the user through UART serial port protocol (RI and TI) and voltage, current, power and electric quantity could be obtained through calculation. At present, this serial port only supports baud rate of 4800bp (with allowable error of ±2%). Receive port RI is reserved temporarily and does not have actual function. The serial port will transmit data pockets of voltage coefficient, voltage cycle, current coefficient, current cycle, power coefficient, power cycle, calibration times and number of CF pulses through TI (transmit data in hexadecimal system).

Specific format of the data pocket is composed of: Packet header (2*(1byte data+1bit even parity check))→voltage coefficient (3*(1byte data +1bit even parity check))→voltage cycle (3*(1byte data +1bit even parity check))→current coefficient (3*(1byte data +1bit even parity check))→current cycle (3*(1byte data +1bit even parity check))→power coefficient (3*(1byte data +1bit even parity check))→power cycle (3*(1byte data +1bit even parity check))→calibration times (1*(1byte data +1bit even parity check))→number of CF pulses (2*(1byte data +1bit even parity check))→Packet tail(1bytedata +1bit even parity check).

24byte totally; 54.912ms is used at 4800bps.

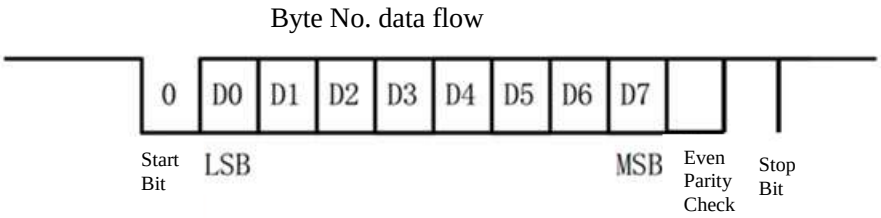


Figure 4: Schematic Diagram of UART Data

Table 3-1

Data Symbol / Data Name	High Byte	Medium Byte	Low Byte
Voltage coefficient	Ukh	Ukm	Ukl
Voltage cycle	Uth	Utm	Utl
Current coefficient	Ikh	Ikm	Ikl

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Current cycle	Ith	Itm	Itl
Power coefficient	Pkh	Pkm	Pkl
Power cycle	Pth	Ptm	Ptl
Adj			Adj
Number of CF pulses		CFm	CFl

The voltage coefficient, current coefficient and power coefficient are fixed values.

Specific data transmitted from the serial port is as follows:

Table 3-2

No.	Data Content	Byte Occupied	Not Calibrated	Calibrated	Abnormal
1	Packet header 1	1	0AAH	055H	0FxH
2	Packet header 2	1	05AH	05AH	05AH
3	Ukh	1	0FFH	0xxH	0xxH
4	Ukm	1	0FFH	0xxH	0xxH
5	Ukl	1	0FFH	0xxH	0xxH
6	Uth	1	0xxH	0xxH	0xxH
7	Utm	1	0xxH	0xxH	0xxH
8	Utl	1	0xxH	0xxH	0xxH
9	Ikh	1	0FFH	0xxH	0xxH
10	Ikm	1	0FFH	0xxH	0xxH
11	Ikl	1	0FFH	0xxH	0xxH
12	Ith	1	0xxH	0xxH	0xxH
13	Itm	1	0xxH	0xxH	0xxH
14	Itl	1	0xxH	0xxH	0xxH
15	Pkh	1	0FFH	0xxH	0xxH
16	Pkm	1	0FFH	0xxH	0xxH
17	Pkl	1	0FFH	0xxH	0xxH
18	Pth	1	0xxH	0xxH	0xxH

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19	Ptm	1	0xxH	0xxH	0xxH
20	Ptl	1	0xxH	0xxH	0xxH
21	Adj	1	0xxH	0xxH	0xxH
22	CFm	1	0xxH	0xxH	0xxH
23	CFl	1	0xxH	0xxH	0xxH
24	Packet tail checksum1	1	0xxH	0xxH	0xxH

x=0~F

（1） When packet header 1 is FxH(x=1~F), it indicates:

Table 3-3

Packet header 1	Description
Packet header 1.bit7~bit4	=1111, fixed value.
Packet header 1.bit3	=1 indicates voltage cycle exceeds the range; =0 indicates voltage cycle does not exceed the range;
Packet header 1.bit2	=1 indicates current cycle exceeds the range; =0 indicates current cycle does not exceed the range;
Packet header 1.bit1	=1 indicates power cycle exceeds the range; =0 indicates power cycle does not exceed the range;
Packet header 1.bit0	=1 indicates coefficient storage area (3n0h~3nFh) is abnormal (n=A, B, C, D, E, F). =0 indicates coefficient storage area is normal.

Note: Maximum measurement is about 16s for current cycle, voltage cycle and active power cycle. It will prompt that the measuring range of corresponding cycle is exceeded after exceeded, as shown in Table 3-3.

The voltage or current signal cycle that is out of range, the 3byte signal is periodic and the corresponding values as invalid (voltage and current channel when there is no signal input, CSE7759B to about 2Hz voltage, current signal, so the detection of voltage and current when the cycle is out of range, generally abnormal situation, the chip itself damaged or external circuit problem).

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The power cycle is out of range, and the voltage and current are out of range, the active power is 0, the current is about 0.

(2) Give prompt through packet header 1 whether the chip is calibrated according to the standard (0AAH indicates it has not been calibrated; 055H indicates it has been calibrated).

(3) Checksum1 is the sum of all data except for packet header and packet tail lowering by 8bit and is used to verify whether the data received is correct after the data is received by the user.

(4) The unit for voltage cycle, current cycle and power cycle is us. When signal cycle is larger than 1s, the signal cycle will be outputted to the user immediately, and it will prompt through Adj.4(5 or 6) that it is an incomplete cycle. (For example, if signal cycle is 3.5s, 1s signal cycle will be outputted to the user when the accumulated cycle counts to 1s, and 1.5s signal cycle will be outputted to the user when the accumulated cycle counts to 1.5s instead the message is received by the user after reaching 3.5s so that the response speed is improved. When the signal amplitude to be measured declines, the signal cycle will increase.)

(5)Adj:

Table 3-4

<table>
<tr><td>Adj</td><td>Description</td></tr>
<tr><td>Adj.0
Adj.1
Adj.2</td><td>Calibration Address Selection 3n0H~3nFH(n=A,B,C,D,E,F)
<table>
<tr><td>Adj.2</td><td>Adj.1</td><td>Adj.0</td><td>Remarks</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>n=F</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>n=E</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>n=D</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>n=C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>n=B</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>n=A</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Calibration disabled</td></tr>
</table></td></tr>
<tr><td>Adj.3</td><td>Adj.3=1 indicates coefficient loading error;
Adj.3=0 indicates coefficient loading is correct;</td></tr>
<tr><td>Adj.4</td><td>Adj.4=1 indicates power cycle of serial port outputted is a complete cycle;</td></tr>
</table>

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	Adj.4=0 indicates power cycle of serial port outputted is an incomplete cycle;
Adj.5	Adj.5=1 indicates current cycle of serial port outputted is a complete cycle; Adj.5=0 indicates current cycle of serial port outputted is an incomplete cycle;
Adj.6	Adj.6=1 indicates voltage cycle of serial port outputted is a complete cycle; Adj.6=0 indicates voltage cycle of serial port outputted is an incomplete cycle;
Adj.7	Number of pulses is overflowing; Simultaneous Adj.7 inversion

◆Adj0~2: is used to judge calibration data writing address when calibrating. For example Adj0~2=2, it indicates calibration address is 3D0H~3DFH in this time. The delivery calibration address is Adj0~2=0- namely, start from 3F0H~ 3FFH.

◆Adj.3: Used to determine whether the coefficient load is correct.

◆Adj.4: When power signal cycle is larger than 1s, present cycle counting time will be transmitted to the user. This flag bit is used to identify whether the power cycle outputted at this moment is complete power cycle or power cycle counting larger than 1s.

◆Adj.5: When current signal cycle is larger than 1s, present cycle counting time will be transmitted to the user. This flag bit is used to identify whether the current cycle outputted at this moment is complete current cycle or current cycle counting larger than 1s.

◆Adj.6: When voltage signal cycle is larger than 1s, present cycle counting time will be transmitted to the user. This flag bit is used to identify whether the voltage cycle outputted at this moment is complete voltage cycle or voltage cycle counting larger than 1s.

◆Adj.7: Number of CF pulses will increase by 1 each time when one pulse signal is generated at CF pin (pin 7); when accumulated number of CF pulses is overflowing (overflowing when CFm: CFl=0FFFFH+1), negation will occurs to the value of calibration coefficient Adj.7 once.

3.5 Chip Reset

After the chip reset, all the data is initialize, that is, the same as the initial power, waiting for about 550 ms, the serial port output signal starts to sample. How to judge the chip to generate the reset? When the current cycle value is 0, the initial power or reset of the chip is explained,

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because the voltage and current are sampled in the chip, at least 800 ms time. Therefore, after the chip reset, at least 800 ms time current cycle is 0.

As shown in fig.5: current cycle is 8 times for 0.

55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	45	51	0	A4	36
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	48	51	1	58	EE
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	46	51	2	0C	A1
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	47	51	2	C0	56
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	49	51	3	73	0C
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	46	51	4	27	BE
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	47	51	4	DB	73
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	0	0	4B	97	90	0	2	47	51	5	8F	28
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	46	71	6	43	F4
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	49	71	6	F7	AB
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	48	71	7	AA	5E
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	45	71	8	5F	11
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	48	71	9	12	C8
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	47	71	9	C6	7B
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	48	71	0A	7A	31
55	5A	2	C6	F0	0	2	83	0	3C	0F	0	1	F7	4B	97	90	0	2	48	71	0B	2E	E6
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	46	71	0B	E1	95
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	48	71	0C	96	4D
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	46	71	0D	49	FF
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	47	71	0D	FD	B4
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	49	71	0E	B1	6B
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	46	71	0F	65	1D
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	47	71	10	19	D3
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	47	71	10	CD	87
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	46	71	11	80	3A
55	5A	2	C6	F0	0	2	81	0	3C	0F	0	1	F7	4B	97	90	0	2	49	71	12	34	F2

Figure 5

3. 6 **Calibration Mode**

3. 6. 1 **Calibration Address Selection**

After CSE7759B is powered on for the first time, calibration process shall be applied (when packet header 1: 0AAH, it indicates the chip shall be used after calibration. The chip will be calibrated once when being delivered): Read serial port data to obtain voltage cycle, current cycle and power cycle. Write the results into 3n0h~3nFh addresses (n=A, B, C, D, E, F) of the chip after calculation in upper computer in combination with calibration device. Details are as follows:

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Table 3-5

Address	Data Storage
3nFH	(Calibration voltage cycle* calibration voltage) high 8bit
3nEH	(Calibration voltage cycle* calibration voltage) medium 8bit
3nDH	(Calibration voltage cycle* calibration voltage) low 8bit
3nCH	(Calibration current cycle* calibration current) high 8bit
3nBH	(Calibration current cycle* calibration current) medium 8bit
3nAH	(Calibration current cycle* calibration current) low 8bit
3n9H	(Calibration power cycle* calibration power) high 8bit
3n8H	(Calibration power cycle* calibration power) medium 8bit
3n7H	(Calibration power cycle* calibration power) low 8bit
3n6H	Reserved
3n5H	Reserved
3n4H	Reserved
3n3H	Reserved
3n2H	Reserved
3n1H	Reserved
3n0H	Checksum2, 8bit

Note: Checksum2 = Sum of 3n7H~3nFH data; lowering by 8 bits.

◆Adj.bit2~bit0 (calibration times) calibration address selection:

Table 3-6

2 Bit	1 Bit	0 Bit	Remarks
0	0	0	n=F
0	0	1	n=E
0	1	0	n=D
0	1	1	n=C
1	0	0	n=B
1	0	1	n=A

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1	1	0	Calibration disabled

Allowable calibration times are 6 at present. The chip will be calibrated before it is delivered.

3.6.2 Delivery Calibration Parameters as Well as Current, Voltage and Power Formula of the Chip

Delivery calibration parameter of CSE7759B is 1mR manganin resistor (resistor at V1P and V1N will be identified as V1R hereunder) at V1P and V1N, and is 1M resistor at V2P (resistor at V2P will be identified as V2R hereunder) and input load signal is 5A, 220V(see Figure 2). Thus, V1R and V2R may be neglected when calculating if external hardware is consistent with calibration parameter upon delivery.

◆Current calculation formula:

$$\text{Measured current Ix(A)} = \frac{\text{current coefficient （hexadecimal number）}}{\text{current cycle (hexadecimal number)} * \text{V1R}}$$

◆Voltage calculation formula:

$$\text{Measured voltage Ux(V)} = \frac{\text{voltage coefficient （hexadecimal number）} * \text{V2R}}{\text{voltage cycle (hexadecimal number)}}$$

◆Power calculation formula:

$$\text{Measured power Px(W)} = \frac{\text{Power coefficient（hexadecimal number）} * \text{V2R}}{\text{Power cycle (hexadecimal number)} * \text{V1R}}$$

Note: If the parameter at V1P and V1N is 1mR manganin resistor, V1R=1; if the parameter at V1P and V1N is 2mR manganin resistor, V1R=2 and so forth; if the parameter at V2P is 1M resistor, V2R=1; if the parameter at V2P is 2M resistor, V2R=2 and so forth.

It is only the chip that is calibrated upon delivery calibration rather than complete machine. Thus, little error will exist (different from the noise generated by PCB; the error range is different tool). If the error is unacceptable to the user after testing, it may be calibrated by the user. Consult to the Company for details.

3.7 Electric Quantity Calculation

3.7.1 Frequency of CF

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Internal DSP of CSE7759B has certain gain. Output frequency of active power may be calculated through the following formula after passing through frequency conversion module:

$$F_{CF}=\frac{V1\times V2\times 48}{V_{REF}^2}\times\frac{f_{osc}}{128}$$

V1: Voltage signal on current channel pin;

V2: Voltage signal on voltage channel pin;

f_{osc}: Built-in crystal oscillator; typical frequency is about 3.579MHz;

V_{REF}: Built-in reference source; typical frequency is about 2.43V;

Note: There exists noise in CSE7759B. Therefore, for the purpose of ensuring the amplitude of properly measured effective values of current and voltage without signal input, current effective value applied on channel V1P\V1N shall not be lower than 40uv and voltage applied on channel V2P shall not be lower than 480uv. Please consult to technical support of the Company when using.

For example: If the current is 5A, it will be a 1mR manganin resistor; if the voltage is 200V, it will be a 1k divider resistor (Refer to circuit of Figure 2).

$$F_{CF}=\frac{1mR\times 5A\times 200V\times 1K/1M\times 48}{2.43V^2}\times\frac{3.579MHz}{128}\approx 227\text{Hz}\quad\text{（Theoretical value）}$$

3.7.2 Current Example of Electric Quantity Calculation

The serial port outputs overflow flags of 2byte number of pulses and 1bit number of pulses (Adj.bit7). Value negation will occur to Adj.bit7 once when number of pulses is overflowing. The user could calculate current electric quantity by accumulating number of pulses.

Note: Overflowing times of number of pulses =n; number of 2byte pulses =y

$$\text{Current Electric Quantity Theoretical Value(kW.h)}=\frac{\text{Total number of pulses}}{\text{Number of pulses a kilowatt hour}}$$

$$=\frac{n\times 65536+y}{227Hz\times 3600s}$$

As for fixed hardware (manganin), one kilowatt hour generates fixed pulses. Thus, number of pulses generated by kilowatt hour is a fixed value.

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According to power coefficient= Calibration power cycle* Calibration power, power frequency of at 1000W is:

$$F_{CF}'（Hz）= \frac{V1R * 10\text{^}9}{\text{Power coefficient} * V2R}$$

(Note: Refer to 3.5.2 for valuing of V1R and V2R)

Then, actual value of electric quantity at present is:

$$\text{Current power (kW. h)} = \frac{\text{total number of pulses}}{\text{Number of pulses a kilowatt hour}} = \frac{n \times 65536 + y}{F_{CF}' \times 3600s}$$

It is one kilowatt hour when 1000W load operates by one hour. F_{CF}' x 3600s in the above example is the number of pulses after 1000W load operates by one hour. It means the number of pulses generated by one kilowatt hour. Operating time of the load will change if the load varies when the number of pulses in one kilowatt hour remains unchanged.

As for different hardware, theoretical value of number of pulses in one kilowatt hour deviates from the actual value. If higher measuring accuracy is required, actual F_{CF}' must be used for calculation.

3. 8 voltage, current, active power calculation reference flow chart

In order to represent the voltage, current and active power flow, a typical application flow chart is introduced.

3. 8. 1 voltage operation reference flow chart

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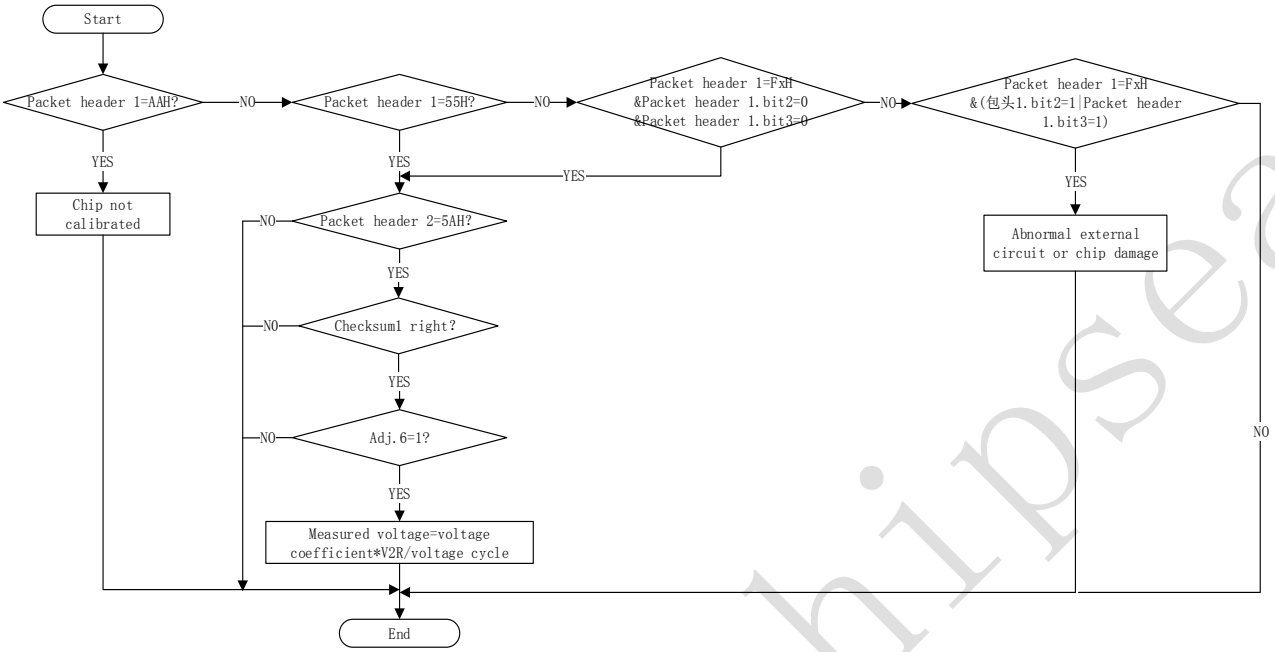


Figure 6: voltage operation flow chart

3.8.2 current operation reference flow chart

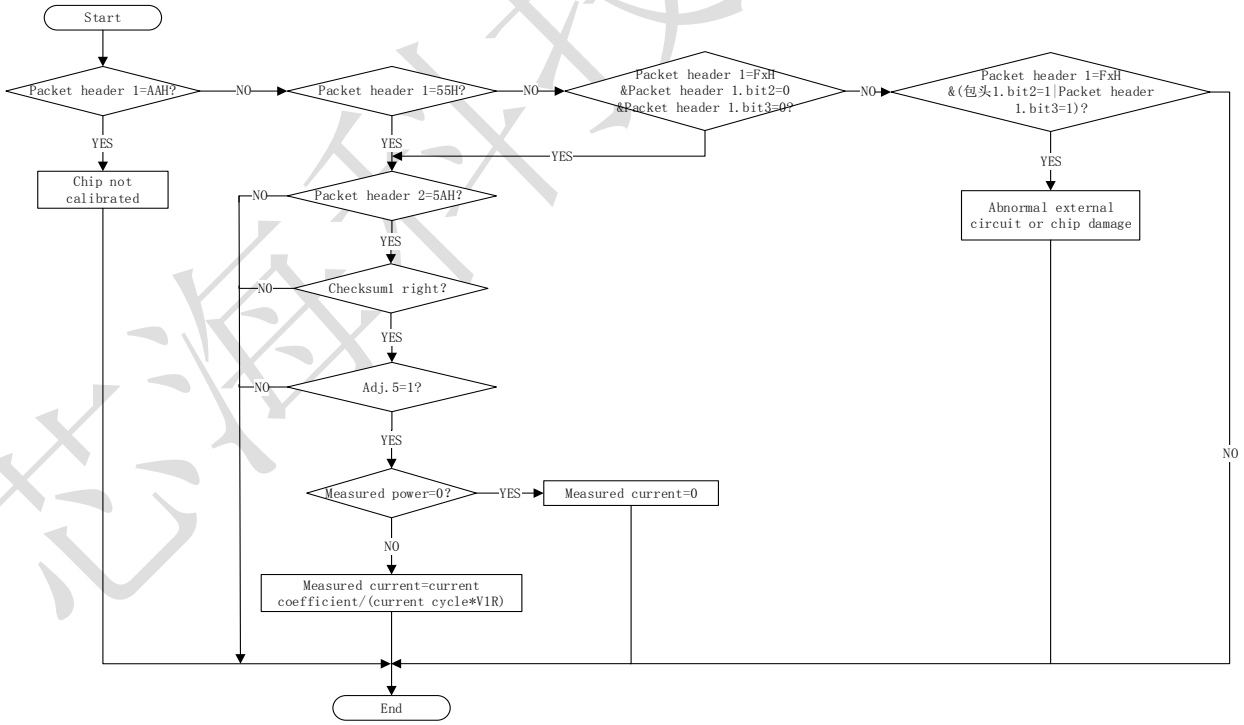


Figure 7: current operation flow chart

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3.8.3 Active power operation reference flow chart

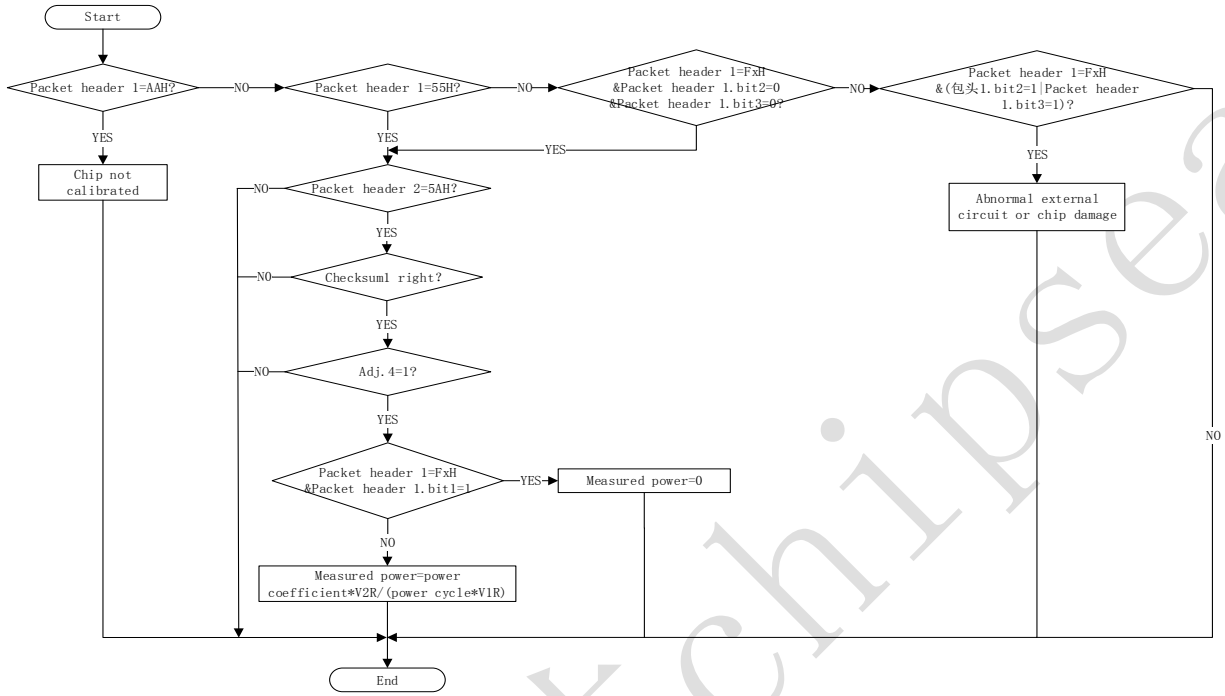


Figure 8: active power flow charts

3.9 Boot Threshold and Shunt Running Prevention of the Chip

CSE7759B adopts new-type shunt running prevention algorithm. Only if power value of input signal is larger than internal noise value, will the measuring module will start measuring normally.

3.10 Built-in Oscillator

Frequency of built-in oscillator used on CSE7759B is about 3.579M. Power supply rejection ratio is <0.01/V.

3.11 Built-in Reference Source

CSE7759B is fitted with built-in high-accuracy bandgap reference source. Typical voltage outputted by reference source is 2.43V.

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4 Packaging of CSE7759B

CSE7759B is packaged in SOP8. Refer to the following figure for specific packaging information:

Label	Min. (mm)	Max. (mm)	Label	Min. (mm)	Max. (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	

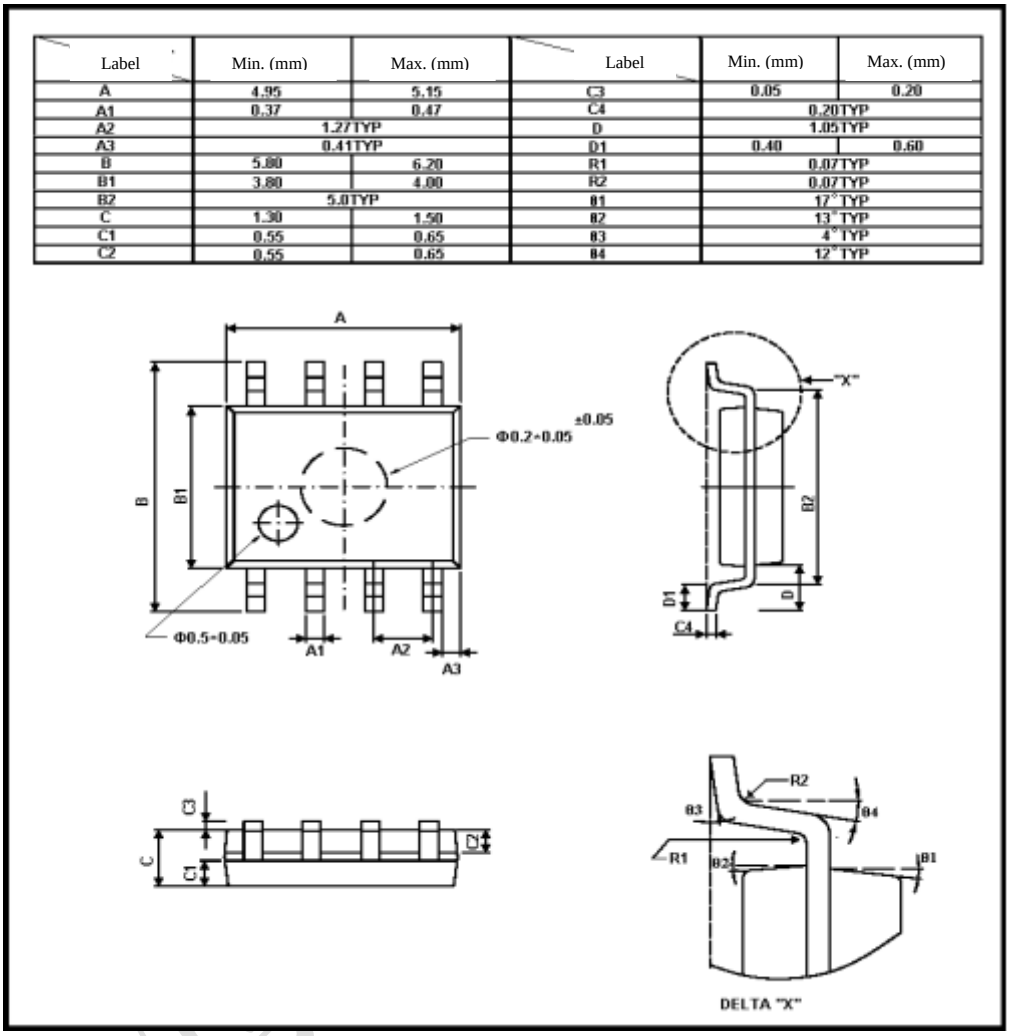


Figure 9: Packaging of CSE7759B Information Graph

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