CHIPNORTH 芯北电®

Primary Feedback Constant Voltage and Constant Current Converter

1 Description

The CN1812 is a primary-side feedback control chip that meets six levels of energy efficiency and integrates a 650V/2A high-voltage power MOS internally with a maximum power of 12 W. With primary-side voltage and current sampling technology, the CN1812 eliminates the need for optocouplers and secondary-side control circuits, simplifying the design of CV/CC-mode switching power supplies and featuring precise output voltage and current regulation.

The CN1812's multiple modes of operation achieve a standby power consumption of 75mW, high efficiency and no noise. Frequency dithering technology can greatly reduce the cost of EMI filters. Built-in line voltage compensation in constant voltage mode and externally adjustable line loss compensation.

Precision adjustable CV/CC in SOP-7 package features low cost and high reliability. The chip integrates a variety of protection functions including: cycle-by-cycle peak current limit, VCC undervoltage lockout (UVLO), overvoltage protection (OVP) and clamping, VS overvoltage protection, VS undervoltage protection, over-temperature protection, and when an abnormality occurs, the controller continually attempts a soft restart until the fault condition is removed.

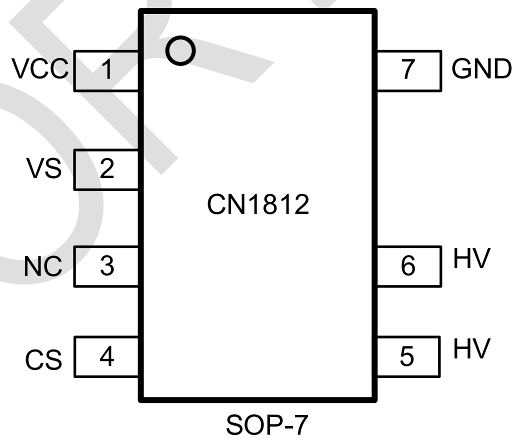
2 Features

- CV/CC adjustment error ±%5
- No need for optocoupler and 431
- Built-in line compensation for more accurate CC adjustment
- Built-in Leading Edge Blanking (LEB)
- Cycle-by-cycle current limit
- Output short circuit protection
- Output overcurrent protection
- OTP protection
- VCC undervoltage and overvoltage protection
- Maximum power 12W
- Meets Grade 6 energy efficiency standards
- Standby power consumption less than 75mW

3 Applications

- Single-phase meter
- Chargers, adapters

4 Pinout



5 Ordering information

Product Number	Package	Quantity/Tape
CN1812	SOP7	4000/Tape

6 Marking

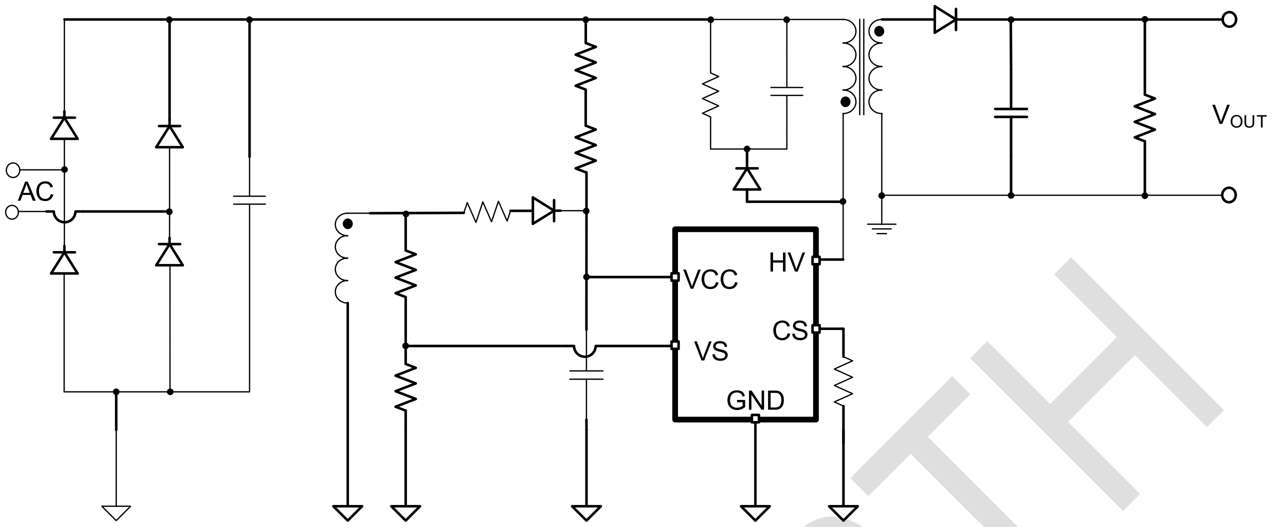
Product Number	Marking
CN1812	CN1812 YYWW

Note: YY=Year WW=Week.

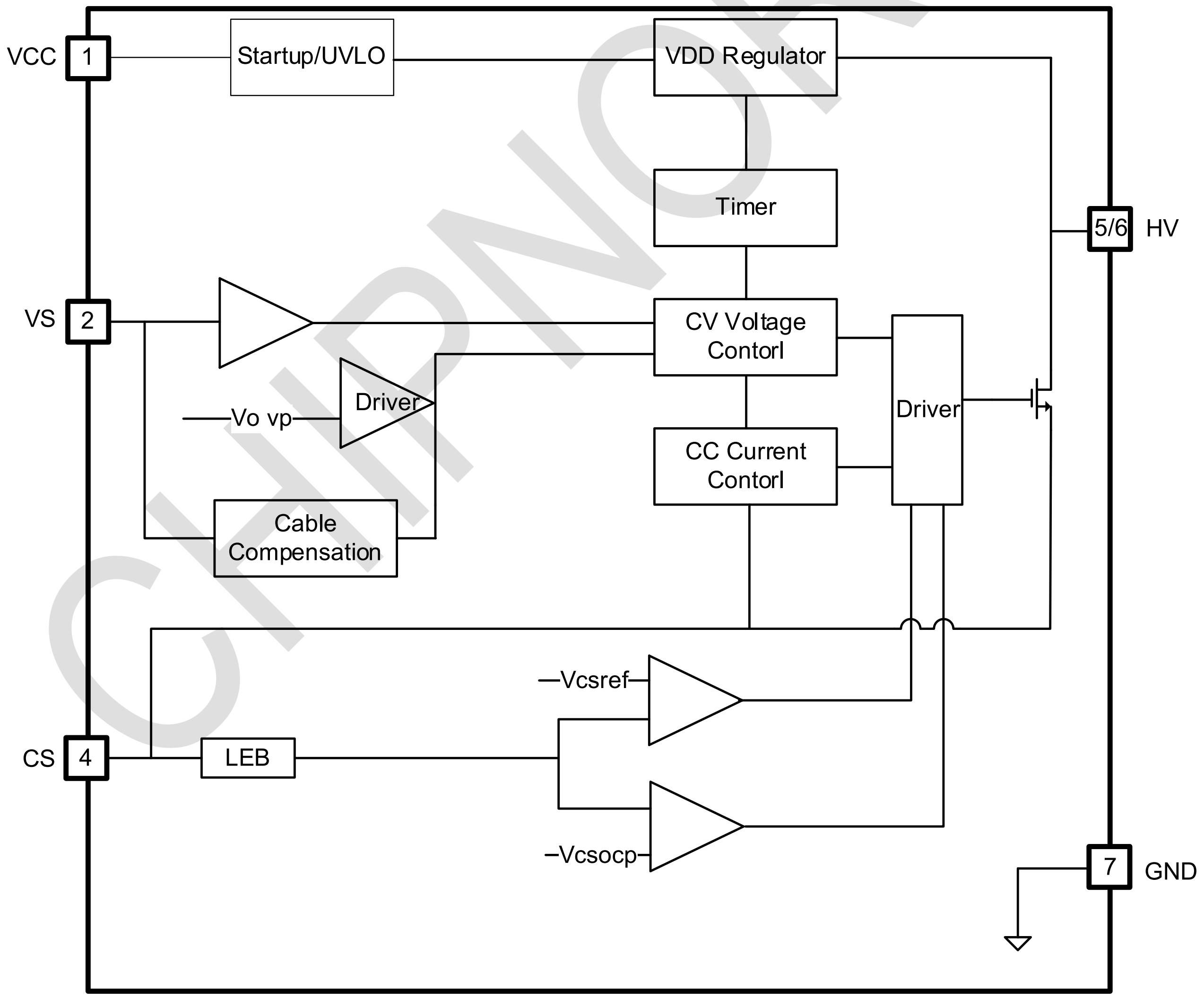
Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your CHIPNORTH representative directly.

Moisture sensitivity level(MSL):3

7 Typical Application



8 Block Diagram



9 Pin Descriptions

Pin No.		Descriptions
Pin Name	CN1812	
VCC	1	Power supply input pin of the chip
VS	2	Output voltage feedback input
NC	3	Dangling
CS	4	Connected to the power MOS tube source stage. Primary current sampling input
HV	5,6	High voltage MOS drain pin
GND	7	Chip ground

10 Specifications

10.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Input Voltage Limit Range	VCC	-0.5~+40	V
Feedback Voltage Sampling Input	VS	-0.5~+6	V
Current Sampling Pin	CS	-0.5~+6	V
Power Tube MOS Drain	HV	-0.5~+650	V
Storage Temperature	TSTG	-55~150	°C
Operating Temperature	TA	-40~105	°C
Soldering Temperature	T_{LEAD}	260（soldering,10s）	°C

Note1: Stress exceeds these ratings listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Expose to absolute-maximum-rated conditions for extended periods may affect device reliability.

10.2 ESD Ratings

Discharge mode	Standardize	Value	Units
HBM	ESDA/JEDEC JS-001-2017	±4000	V
CDM	ANSI/ESDA/JEDEC JS-002-2022	±2000	V

10.3 Thermal Information

Parameter	Package	Value	Unit
θ_{JA}	SOP7	100	°C/W

10.4 Electrical Characteristics

Test conditions: (V_{DD}=5V, T_A=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Chip power supply VCC part						
VCC working protection voltage	V_{CCOVP}		33	36	39	V
Undervoltage latch exit	V_{DDON}		10.8	12.8	14.8	V
Undervoltage latch in	V_{DDOFF}		6.8	7.5	8.2	V
Startup Current	I_{ST}	VCC=V_{ST}-0.5V	0	0.5	1	uA
Output Feedback VS Section						
VS Reference Voltage	V_{VS}		1.97	2	2.03	V
Minimum Off Time	T_{min}			1.5		mS
Current Sampling CS Section						
Turn-off voltage @full load	V_{CSMAX}		580	600	620	mV
Shutdown Voltage @Light Load	V_{CSMIN}			200		mV
Fading Time	T_{LEB}			300		nS
Secondary Maximum Duty Cycle	D_{SMAX}		0.47	0.5	0.53	
Power MOS HV Part						
Drain-Source Breakdown Voltage	B_{VDS}	I_{SW}=250uA，T_J=25°C	650			V
MOSFET On-Resistance	$R_{DS(ON)}$	I_{SW}=0.5A，T_J=25°C		3		Ω
Protection function part						
Over-temperature protection temperature	T_{SD}		130	150		°C
Over-temperature protection hysteresis temperature	T_{HYST}			30		°C
Output overvoltage protection	$V_{VS\text{-}OVP}$		2.2	2.5	2.8	V
Short circuit voltage	$V_{VS\text{-}HICCUP}$		0.7	0.85	1	V

11 Detailed Description

11.1 Overview

The CN1812 is an innovative AC-DC controller which utilizes a proprietary primary-side control technology to eliminate the opto-coupler-isolated feedback and secondary control circuitry required in conventional designs. This effectively improves cost-effectiveness and enhances reliability. In addition, the CN1812 utilizes several new technologies to further improve performance.

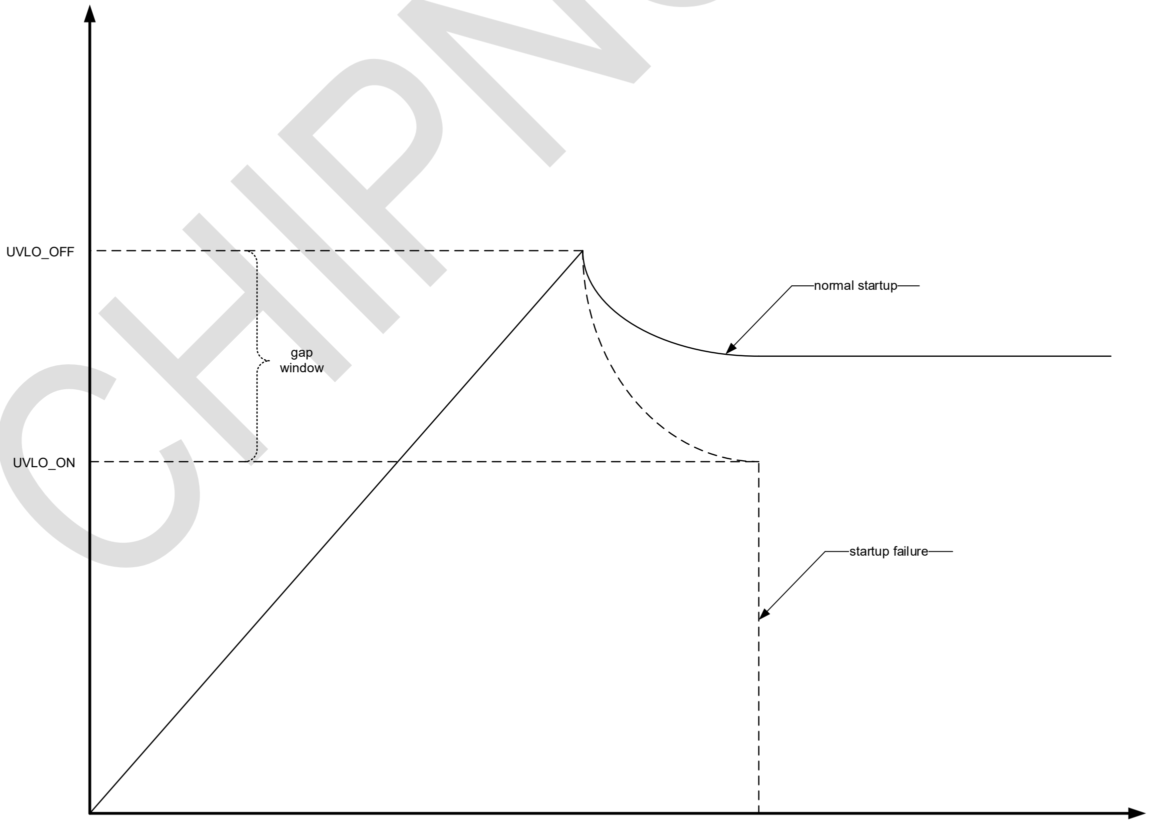
11.2 Startup

When the system circuit built by the CN1812 is powered on, the voltage of the storage capacitor on the VCC pin can be charged higher than $U_{VLO\ (OFF)}$ through a large resistance starter resistor (>6MΩ), so that the CN1812 can enter into the startup and reach the normal working state.

The startup process is as follows: In the initial stage of startup, the startup current consumed by CN1812 is supplied by the startup resistor to charge the storage capacitor of VCC pin, and when the storage capacitor of VCC pin is charged, CN1812 will start to operate normally.

In the initial stage, the CN1812 consumes startup current to charge the VCC pin storage capacitor by the startup resistor.

When the VCC Pin storage capacitor voltage is charged to the chip's startup voltage by the startup resistor (U_{VLO_off}), the chip starts to start up, thus instantly drawing current from the VCC Pin storage capacitor, and then the CN1812 starts to oscillate and the system starts to operate, and the storage capacitor of the VCC Pin is replenished by the auxiliary coil in the absence of any abnormal state, and then maintains a normal operating voltage, please refer to the startup timing diagram of the CN1812 in the following diagram for details.



Startup Timing Diagram

11.3 Constant Voltage (CV) Mode

In order to achieve accurate output voltage regulation, it is necessary to implement the detection of output and load variations.The VS pin of the CN1812 detects the feedback signal from the auxiliary winding through R_{VS1} and R_{VS2} to detect feedback signals from the auxiliary winding. During power-on, the power supply output voltage VS is mapped to the auxiliary coil turns ratio of N_{AUX}/N_S. its voltage can be expressed as:

$$V_{AUX}=V_S*N_{AUX}/N_S$$

Where N_{AUX} is the number of turns in the auxiliary winding and N_S is the number of turns in the secondary output.

During power shutdown, the voltage in the secondary winding is mapped to the auxiliary winding, denoted as:

$$V_{AUX}=(V_O+V_D)\cdot N_{AUX}/N_S$$

Where N_S is the number of turns in the secondary winding and V_D is the voltage drop across the rectifier diode.

In the typical application diagram, the auxiliary winding voltage V_{AUX} is sent to the VS pin of the CN1812 through R_{VS1}, R_{VS2}. The duty cycle is adjusted to keep the output voltage constant by comparing it with the reference voltage V_{VS} inside the chip.

The regulated final output voltage is equal to:

$$V_O=N_S/N_{AUX}*V_{VS}(1+R_{VS1}/R_{VS2})-V_D$$

where the internal reference current V_{VS} is equal to 2 V (typical)

11.4 Constant Current (CC) Mode

The chip detects the peak current of the inductor cycle by cycle, and the CS terminal is connected to the input of the internal peak current comparator to compare it with the internal threshold voltage, and the power tube is turned off when the external voltage of CS reaches the internal detection threshold. The expression for the inductor peak current at full load is:

$$I_{ppk}=V_{cs}/R_{cs}(mA)$$

The output of the CS comparator also includes a 300nS forward fading time.

Output current calculation method:

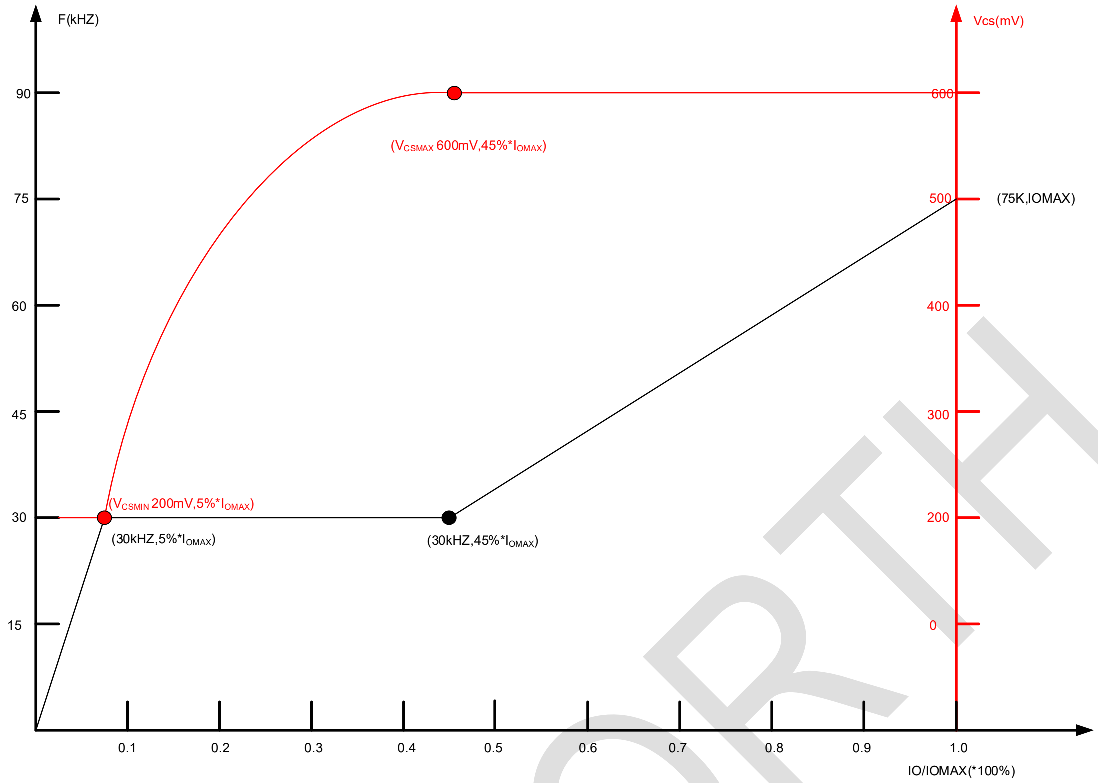
$$I_O=1/4*I_{ppk}*N_P/N_S$$

Where N_P is the number of turns in the main stage of the transformer, N_S is the number of turns in the secondary stage of the transformer and I_{ppk} is the peak current on the main stage side.

11.5 PWM/PFM Mixed Mode

In order to make a compromise between different characteristics such as efficiency, no-load and standby, noise, ripple, etc., a hybrid PWM/PFM mode is used in the CN1812.

In constant voltage (CV) mode, from medium to full load, the CN1812 system operates in pure PWM mode; from medium to no load, the system operates in a hybrid PWM/PFM mode. The graphs illustrate the trend of frequency and output current after a load change.



Fosc and Io versus load

11.6 Protection functions

The CN1812 integrates a complete range of protection functions including built-in OVP, OTP, U_{VLO}, OCP, output short/open circuit protection and open loop protection.

Using pins, the CN1812 is able to monitor the primary measured peak current via the CS pin. This allows cycle-by-cycle peak current control and limiting. When the voltage at the CS pin reaches the internal OCP threshold, the CN1812 detects overcurrent and immediately shuts down the power MOS switch until the next pulse is generated.

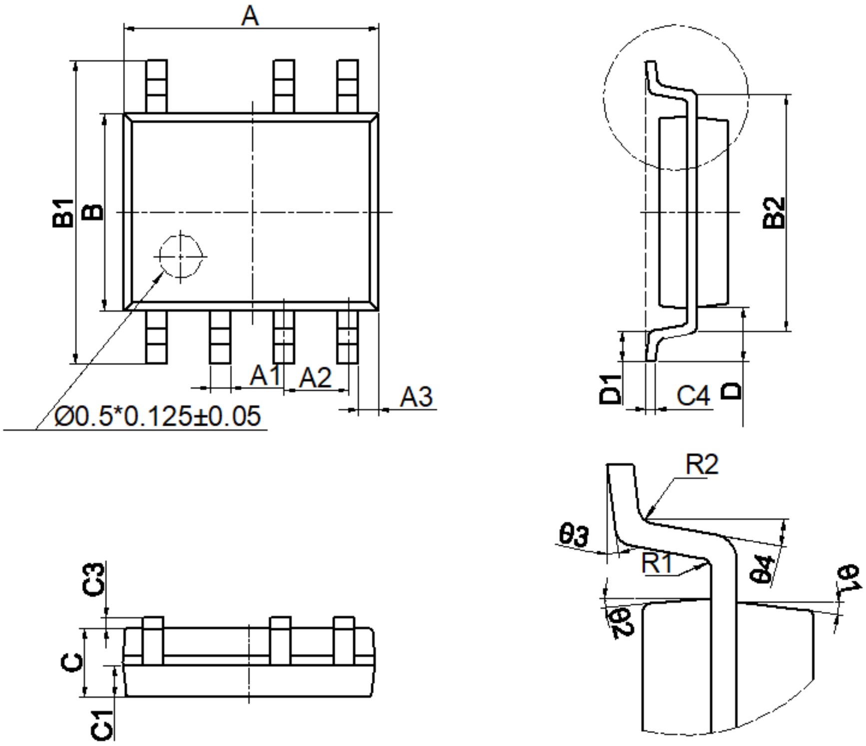
VCC protection is realized by U_{VLO} and OVP. When the VCC voltage drops below the $U_{VLO(ON)}$ threshold or rises above the OVP threshold and the power system enters an automatic restart sequence, the output of the CN1812 turns off. $U_{VLO(ON)}$ and OVP can also be triggered in the event of a shorted or disconnected output and the CN1812 can shut down and enter an automatic restart sequence.

The Over Temperature Protection (OTP) circuit detects the chip temperature. the OTP threshold is usually set at 150°C. The OTP threshold is set at 150°C. The OTP threshold is set at 150°C. When the chip temperature rises above the threshold, the CN1812 shuts down and enters an automatic restart sequence.

If an open loop occurs, the CN1812 can detect a fault condition and shut down and enter an automatic restart sequence.

12 Package Information

SOT23-6



Dimension / Symbol	Min (mm)	Max (mm)	Dimension / Symbol	Min (mm)	Max (mm)
A	4.80	5.00	C3	0.05	0.20
A1	0.356	0.456	C4	0.203	0.233
A2	1.27TYP		D	1.05TYP	
A3	0.345TYP		D1	0.40	0.80
B	3.80	4.00	R1	0.20TYP	
B1	5.80	6.20	R2	0.20TYP	
B2	5.00TYP		θ1	17°TYP4	
C	1.30	1.60	θ2	13°TYP4	
C1	0.55	0.65	θ3	0°~8°	

13 Important Statement

Chipnorth Electronic Technology (Nanjing) Co., Ltd. and its subsidiaries reserve the right to make modifications, improvements, corrections, or other changes to this document and to any of the products described herein at any time without notice. Chipnorth Electronic Technology (Nanjing) Co., Ltd. disclaims any liability arising out of the use of this document or any of the products described herein; Chipnorth Electronic Technology (Nanjing) Co., Ltd. does not transfer any license to its patents or trademarks or other rights. Any customer or user using this document or any of the products described herein assumes all risk and agrees to hold harmless Chipnorth Electronic Technology (Nanjing) Co., Ltd. and all companies whose products are displayed on Chipnorth Electronic Technology (Nanjing) Co., Ltd.

Chipnorth Electronic Technology (Nanjing) Co., Ltd. makes no warranty and assumes no responsibility for any products purchased through unauthorized sales channels. In the event that a customer purchases or uses a product from Chipnorth Electronic Technology (Nanjing) Co., Ltd. for any unintended or unauthorized use, the customer shall indemnify and hold harmless Chipnorth Electronic Technology (Nanjing) Co., Ltd. and its representatives from and against all claims, damages, and attorney's fees arising from any personal injury or death, directly or indirectly, arising out of or in connection with such purchase or use.