CHS50-110E24K DC-DC Converter

Input 16V~160V, Output 24V/2.1A, Half-Brick Series

Contents

Features

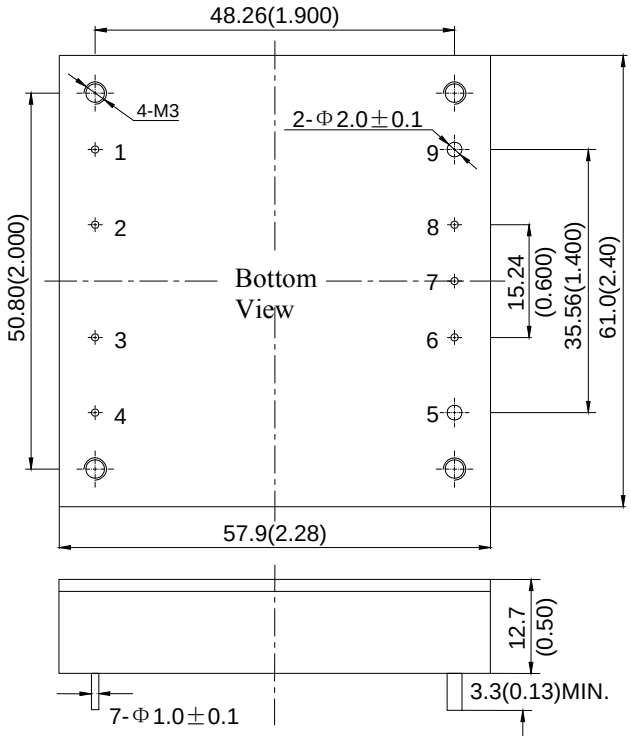
- *Half-Brick（61.0mm×57.9mm×12.7mm）*
- *Positive Logic Control（3.5V to 15V or floating turn on）*
- *Input Under Voltage Protection（12V to 15V turn off）*
- *Input Over Voltage Protection（180V~190V turn off）*
- *Output Over Voltage Protection（clamping，30V~34.8V）*
- *Output Voltage Adjust Range: ±10 % of the rated output voltage*
- *Output Short-circuit Protection: hiccup, auto-recovery*
- *Efficiency : 88% Typ.（110V, full load）*
- *3000Vac Isolation Voltage*
- *Operating Baseplate Temperature:-40℃ to+100℃*
- *Operating Ambient Temperature: -40℃ to +85℃*
- *Over Temperature Protection: 120℃ Typ.*
- *Applications: Industrial, railway & Rail transit application, Conforming to the EN50155 Standard Test*

Ordering Information

See Contents for individual product ordering numbers.

Suffix	Meaning	Ordering Model
--	Basic Model	CHS50-110E24K
P	Negative Logic Control. Turn off when CNT pin is applied to 3.5～15V voltage or kept floating; Turn on when CNT pin is applied to 0～1.5V voltage	CHS50-110E24PK

Outline Diagram



Case material: black flame retardant plastic;
Pins: copper with gold plating.Aluminum baseplate can be connected to Protective Earth pin by M3 screw.

Pin	Symbol	Function
1	-Vin	Negative Input
2	NC	No connect
3	CNT	Remote Control, turn on/off the converter without cutting off the power supply
4	+Vin	Positive Input
5	+Vo	Positive output
6	+S	Positive Remote Sense, connected to +Vo pin when not used
7	TRIM	Output Voltage Trim, output voltage be trimmed up or down by applying external resistor connected to +S or -S output
8	-S	Negative Remote Sense, connected to -Vo pin when not used
9	-Vo	Negative Output
Notes: all dimensions in mm(inches) Tolerances:X.X±0.5(X.XX±0.02) X.XX±0.25(X.XXX±0.010)		

Specifications

Unless otherwise specified, all values are given at room temperature and standard atmosphere pressure, pure resistive load and basic connection.

Input		Symbol	Min	Typ	Max	Unit	Conditions
Input Voltage		V_{in}	16	110	160	V	—
Input Current		I_{in}	—	—	4.2	A	V_{in}=16V，I_o=2.1A
Positive Logic Remote Control	ON	—	3.5	—	15.0	V	Refer to $-V_{in}$; Also turn on when CNT floating
	Current	—	—	—	1	mA	CNT sink current when turn on
	OFF	—	0	—	1.5	V	Refer to $-V_{in}$
	Current	—	—	—	1	mA	CNT source current when turn off
Negative Logic Remote Control	ON	—	0	—	1.5	V	Refer to $-V_{in}$; Also turn on when CNT links to $-V_{in}$
	Current	—	—	—	1	mA	CNT source current when turn on
	OFF	—	3.5	—	15.0	V	Refer to $-V_{in;}$ Turn off when CNT floating
	Current	—	—	—	1	mA	CNT sink current when turn off
Start-up Delay Time		T_{delay}	—	7	—	ms	V_{in} =110V，I_o=2.1A
Over Voltage Threshold		V_{OVLO}	180	—	190	V	—
Under Voltage Threshold		V_{UVLO}	12	—	15	V	—

Continue

Output	Symbol	Min	Typ	Max	Unit	Conditions
Output Power	P_o	0	—	50	W	—
Output Voltage	V_o	23.76	24.00	24.24	V	—
Output Voltage Adjust Range	V_{trim}	21.6	—	26.4	V	P_o≤50W, I_o≤2.1A
Output Current	I_o	—	2.1	—	A	—
Line Regulation	S_V	—	—	±0.2	%V_O	V_{in}:16V～160V，I_o=2.1A
Load Regulation	S_I	—	—	±0.5	%V_O	V_{in}=110V，I_o：0～100% $I_{o,nom}$
Current Limit Inception	$I_{o,lim}$	2.31	—	5.04	A	V_{in}=110V
OVP Set Point	$V_{ov,set}$	30	—	34.8	V	—
Output Overshoot	V_{TO}	0	—	10	%V_O	V_{in}=110V, pure resistive load
Output Short-circuit Protection	Hiccup mode, automatic recovery					
Peak to Peak Ripple and Noise	△Vpp	—	—	200	mV	20MHz bandwidth,see “basic connection”
Rise Time	T_{rise}	—	8	—	ms	V_{in}=110V, pure resistive load
Capacitive Load Range	C_O	0	—	2200	μF	pure resistive load
Remote Sense Compensation Range	V_{sense}	0	—	0.5	V	—
Load Transient — Recovery Time	t_{tr}	—	—	200	μs	Load change:25%～50%～25% & 50%～75%～50%; Current change: 0.1A/μs
Load Transient — Voltage Deviation	△V_{tr}	—	—	±960	mV	Load change:25%～50%～25% & 50%～75%～50%; Current change: 0.1A/μs

General	Symbol	Min	Typ	Max	Unit	Conditions
Efficiency	η	86	88	—	%	V_{in}=110V, I_o=2.1A
Switching Frequency	f_s	—	200	—	kHz	—
Isolation Resistance	R_{iso}	50	—	—	MΩ	Under normal atmospheric pressure, Relative humidity:90%, Test voltage:500Vdc
MTBF	—	—	2×10^6	—	h	BELLCORE TR-332
Operating Baseplate Temperature	—	-40	—	100	℃	—
Operating Ambient Temperature	—	-40	—	85	℃	—
Thermal resistance	$R_{\theta CA}$	—	7.58	—	℃/W	Natural Convection Without Heatsink
	$R_{\theta CA}$	—	3.53	—	℃/W	Natural Convection With Heatsink
	$R_{\theta CA}$	—	6.31	—	℃/W	100LFM Convection Without Heatsink
	$R_{\theta CA}$	—	2.56	—	℃/W	100LFM Convection With Heatsink
	$R_{\theta CA}$	—	4.93	—	℃/W	200LFM Convection Without Heatsink
	$R_{\theta CA}$	—	1.72	—	℃/W	200LFM Convection With Heatsink

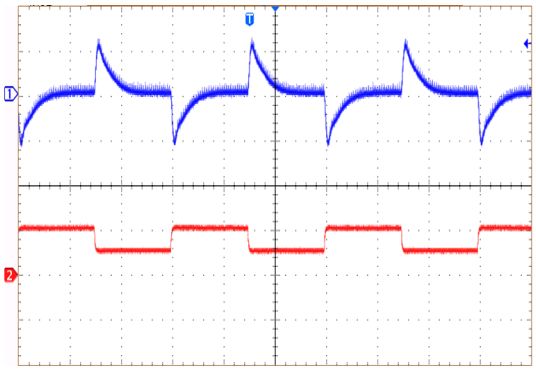
Continue

General	Symbol	Min	Typ	Max	Unit	Conditions
Thermal resistance	$R_{\theta CA}$	—	3.77	—	℃/W	300LFM Convection Without Heatsink
	$R_{\theta CA}$	—	1.43	—	℃/W	300LFM Convection With Heatsink
	$R_{\theta CA}$	—	3.22	—	℃/W	400LFM Convection Without Heatsink
	$R_{\theta CA}$	—	1.23	—	℃/W	400LFM Convection With Heatsink
Isolation Voltage	V_{iso}	3000	—	—	Vac	Input to output;Leak Current: 5mA
		3000	—	—	Vac	Input to case ;Leak Current: 5mA
		1500	—	—	Vdc	Output to case ;Leak Current: 1mA
OTP Set Point	T_{ref}	115	120	125	℃	Baseplate Temperature
Storage Temperature	—	-55	—	125	℃	—
Temperature Coefficient	S_T	—	—	±0.02	%/℃	—
Shock and Vibration	Meets EN50155					
Hand Soldering	Maximum soldering Temperature < 425℃,and duration < 5s					
Wave Soldering	Maximum soldering Temperature < 255℃,and duration < 10s					
Weight	—	—	63	—	g	—

EMC	Conditions	Level
EMI Conducted emission	EN55032	CLASS A(See Page 9)
Fast transient/burst immunity	IEC/EN61000-4-5 line to line(±1kV/2Ω); GB/T 17626.5 line to ground(±2kV/12Ω)	Perf. Criteria B(See Page 9)
Surge immunity	IEC/EN61000-4-4 ±2kV(5/50ns, 5kHz) GB/T 17626.4	Perf. Criteria A(See Page 9)

Characteristic Curves

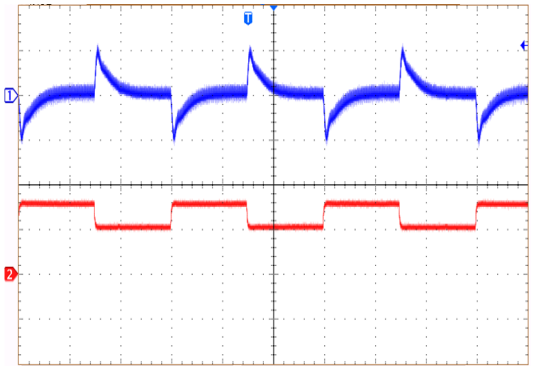
Load Transient Response



Load change:25%～50%
～25% Io,max, 0.1A/μs
Vin=110Vdc

Trace1: 200mV/div
Trace2: 1.0A/div
Time scale: 1ms/div

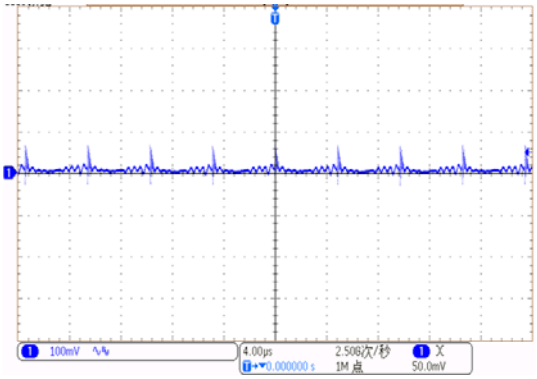
Load Transient Response



Load change:50～75%
～50% Io,max, 0.1A/μs
Vin=110Vdc

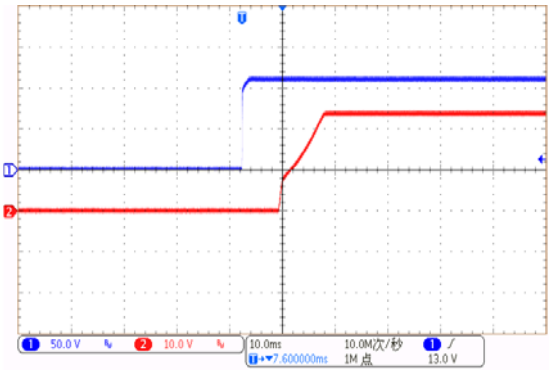
Trace1: 200mV/div
Trace2: 1.0A/div
Time scale: 1ms/div

Output Ripple and noise



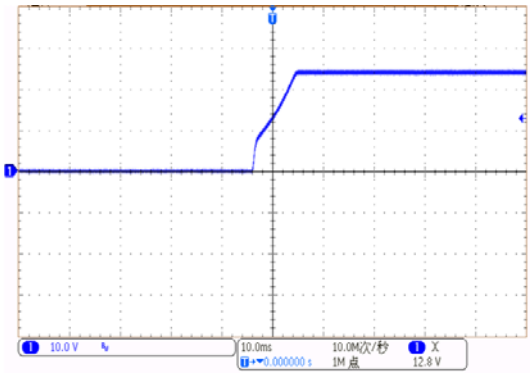
V_{in}=110Vdc，I_o=2.1A（20MHz）

Start-up Delay Time



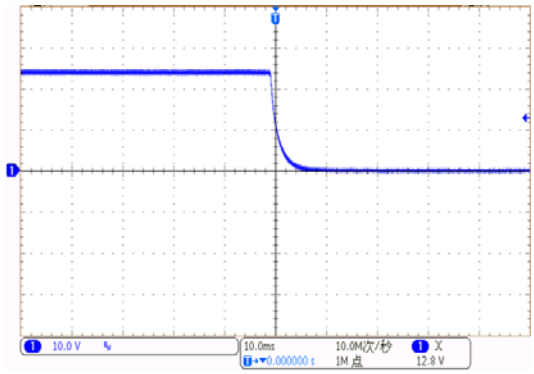
V_{in}=110Vdc，I_o=2.1A

Rise Time



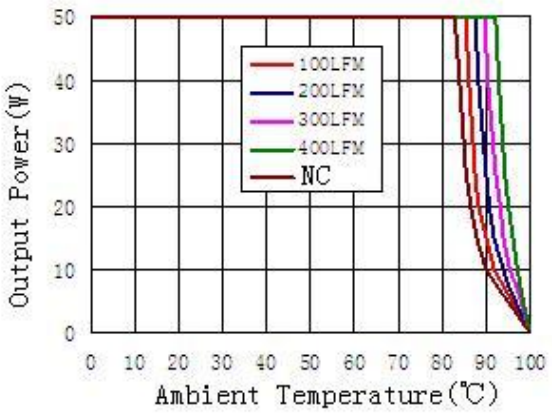
V_{in}=110Vdc，I_o=2.1A

Turn off

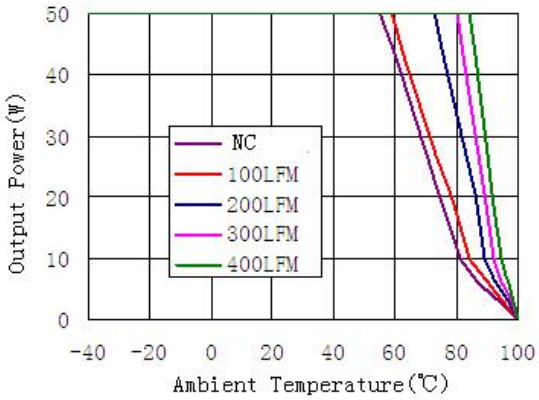


V_{in}=110Vdc，I_o=2.1A

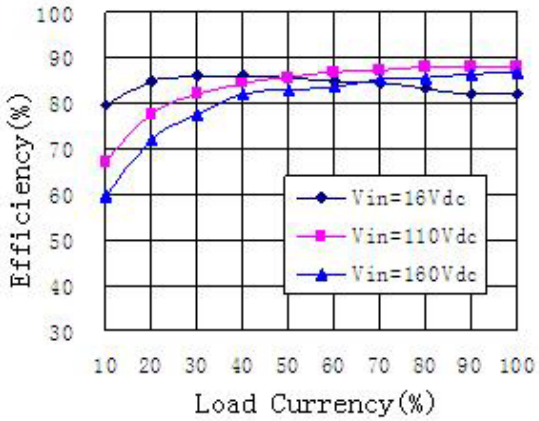
Derating curve with 0.95″ HS radiator



Derating curve

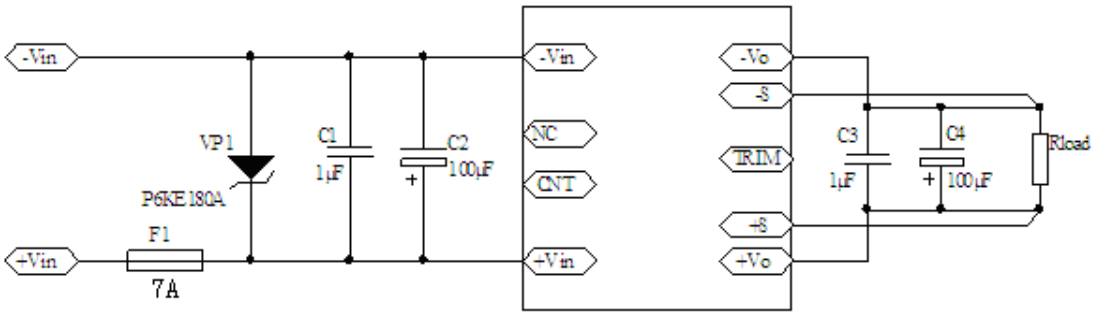


Efficiency vs Temperature and current



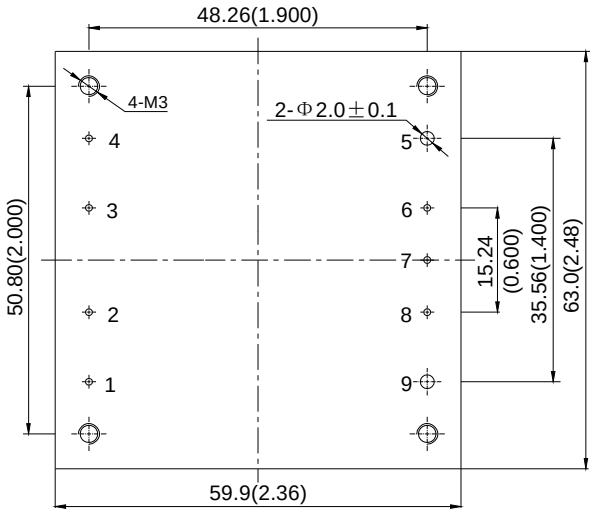
Design Considerations

Basic Connection



Notes : The basic connection indicates the basic requirements. Please refer to the instruction followed for further information.

Recommended Layout



NO.	Recommendation & Notes
Pad Design	5、9 Pad holes: 2.5mm,pad diameter including hole:5.0mm; others Pad holes: 1.5mm, pad diameter including hole:3.0 mm; the fixed holes at the four corners are metallized, with diameter of 4.1mm and pad diameter including hole of 8.5mm is keep out layer
Airflow Direction	The air should flow along the direction of the heat sink
Safety	Isolated Converters, care to the spacing between input and output, input and protective ground、output and protective ground
Electrical	The Vin(-) and Vo(-) planes should be placed under of the converter separately. Avoid routing sensitive signal or high disturbance AC signal under the converter

Input Voltage Range

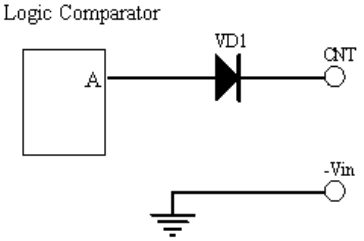
The input voltage range of the DC/DC converter is 16V～160V.The input impedance of the converter looks like a negative resistor, which can interact with the reactance of the power bus (including any filter elements that have been added to the input of the converter), causes an unstable condition.
The method to determine whether the impedance of the power bus too high or not is to decrease the converter's input voltage from higher to lower gradually, if the output voltage decreases (unstable sometime) with the lower input voltage, it will be considered the impedance too large. For further confirmation, one electrolytic capacitor can be paralleled to the converter pins after the converter shuts down (one 1μF ceramic capacitor may be required to be paralleled with the electrolytic capacitor), if the output getting better, it will be sure that the impedance is too large.

External Capacitance

Unless special purpose (i.e. prolonging hold-up time, input impedance matching), the recommended input filter's capacitance ranges 100μF～220μF, which not only offers a stable system, and reduces the cost, but also lessens the inrush current when the power supplies.
When larger capacitance is required, a circuit of suppressing the inrush current is recommended when the regulator start-up and a discharge circuit is recommended when the output dropped, ensuring the reliability and safety of other equipments in the system.

Remote Control

Remote control can be offered by setting right control voltage level (floating , high resistance) to CNT pin. The circuit diagram is shown as " internal circuit diagram for remote control".
CHS50-110E24K is provided with positive logic remote control. When the pin is left floating or the voltage of the pin is 3.5V-15V, the converter will turn on. When the level is less than 1.5V, the converter will be off.
Due to VD1 is signal diode, and the logic comparator is semiconductor integrated chip with low resistance to surge. Care should be taken to prevent CNT from surge, A TVS should be used in some cases.
In some applications, extra controls will be designed for the converter in user's PCB, such as output short circuit protection, over voltage protection, under voltage protection, synchronous control to the converter output voltage, and so on, remote control will give you help.

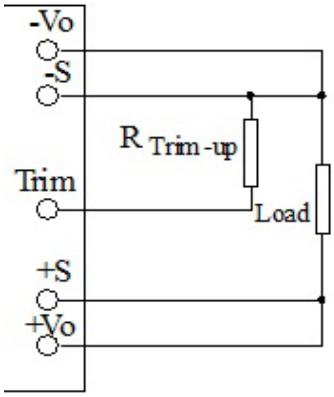


Internal circuit diagram for remote control

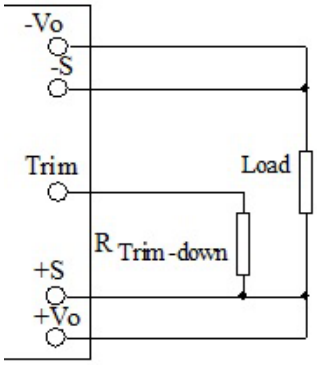
The controls can be achieved by external circuit applied to the CNT pin.
CHS50-110E24PK is provided with negative logic remote control. It has the same characteristic as CHS50-110E24K, except control logic. When the pin is left floating or the voltage of the pin is 3.5V-15V, the converter will turn off. When the level is less than 1.5V, the converter will turn on.
When the signal from the system is beyond 3.5V-15V, or it can be enabled only within a very narrow control level, the aux circuit will be required. Please contact us for more information.

Output Voltage Adjust

The converters have an Output Voltage adjust pin (Trim). This pin can be used to adjust the output voltage above or below Output voltage initial setting. When increasing the output voltage, the voltage at the output pins (including any remote sense offset) must be kept below the maximum output adjust range, or the characteristics will not be assured in compliant with the specification, even the over voltage protection may be triggered. Also note that at increased output voltages the maximum power rating of the converter 50W remains the same, and the output current capability will decrease correspondingly, at decrease output voltages the maximum current should not exceed 2.1 A. When the trim pins are not used, they should be floated.
External circuit is connected as the figure shown, the resistance is calculated as the formula below, please note that the formula will be invalid when $R_{Trim-up}$、$R_{Trim-down}$ are used simultaneously, users adjust the value based on the resistance applied.



Connection for Trimming Up



Connection of Trimming Down

Resistance for trimming up ： $R_{Trim-up}=\left(\frac{21.5\times 2.5}{\Delta V}-15\right)(k\Omega)$

Resistance for trimming down： $R_{Trim-down}=\left(\frac{(V_O-\Delta V-2.5)\times 21.5}{\Delta V}-15\right)(k\Omega)$

Vo:rated output voltage,24V; ΔV:change rate,divide output voltage by rated output voltage;
$R_{Trim-up}$、$R_{Trim-down}$:resistance for trimming up or down， Unit: kΩ.

Remote Sense

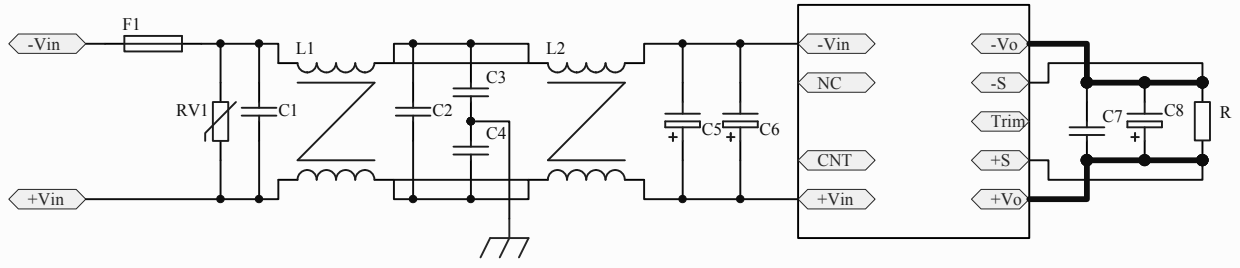
The remote sense can be used to compensate for the voltage drop between the output pins of the converter and the load input pins by +S、-S pins. The +S and –S pins should be connected to the input pins of the load respectively. The remote sense circuit will compensate for 0.5V voltage drop between the sense voltage and the voltage at the output pins.
The anti-interference design should be considered when the +S、-S pins are connected to the pins to be compensated. The +S、-S traces should be located close to a ground trace or ground plane, and the area they surrounded should be minimized (just for electrical isolation); If cable connection presents, twisted pair wires should be used, EMI core are equipped with the twisted pair wires to reduce common mode noise when necessary, the sense leads should not be longer than 200mm,or the system characteristics may not be assured.
The sense leads only can carry very little current, and are not used for converter power output. Care should be taken in operation to avoid damaging the converter.

Output Over Voltage Protection(OVP)

The clamp type over voltage protection feature is used to protect the converter, when output voltage exceeds 125% to145% of the rated output voltage (the set point is between 125% to145%, there is the difference based on the specific parameters, but not beyond the range), the output voltage will clamped.

EMC Solution

Recommendation circuit for EMI Conducted emission、Fast transient/burst immunity、Surge immunity.



Part No.	Components	Part No.	Components
F1	7A fuse	C1，C2	1μF High Voltage Ceramic Capacitors
L1，L2	2.8mH Common Mode Inductors	C3，C4	1000pF/400VAC Y-Safety Capacitors
C5，C6	100μF Electrolytic Capacitors	C7	1μF Ceramic Capacitor
RV1	221KD14 Varistor	C8	100μF Electrolytic Capacitors

Thermal Consideration

The loss of the converters in normal operation will be converted into heat which can cause the converters itself to rise in temperature. CHS50-110E24K is provided with Over Temperature Protection Feature.The temperature sensor is located on the aluminum baseplate. The converters will be off when the average temperature of the baseplate is higher than that of the over temperature protection point.
In order to ensure that the converter can work normally at rated power, the client system needs to ensure that the aluminum baseplate temperture is less than 100℃. When aluminum baseplate temperture is higher than 100℃, the derating curves should be referred or external heat dissipation measures. Forced air cooling or heatsink should be used. The air tunnel should be considered for forced air cooling, to avoid heated air be hindered or forming swirl; when heatsink used, it should be attached the converter closely, through double-side thermal conductivity insulation adhesive or thermal conductivity silicone for heat exchange. It is necessary to select the appropriate radiator according to the heat resistance of the radiator without air cooling.

Safety Consideration

The converter, as one component for the end user, should be installed into the equipment, and all the safety considerations are achieved under certain condition. It is required to meet safety requirements in system design for the user.
To avoid fire and be protected when short circuit occurred, it is recommended that a fast blow fuse with rating 2.5～3 times of converter continuous input peak current is used in series at the input terminal.(Inrush current suppression circuit is required for greater filter capacitance at input terminal, or it will result in the misoperation of the fuse).

Product Installation

The product can be installed in user board, suggest using M3 screw to fix the products in user board, in order to enhance the bearing ability when impact and vibration coming. Note that, when you hammer the product using screws, this product shall be first fixed, again a needle pin welding, prevent strain soldered dot. Moreover the biggest torque of fastening screw cannot exceed 0.6 N.m, otherwise it will likely damage. the structural related to studs.

Metal surface of this product structured by aluminum PCB which has good thermal conductivity , mapping the overburden with heat conduction medias or thermal gaskets, then install proper radiator.
Proper radiator and flows through radiator wind will greatly enhance products cooling capacity. when you install radiator ,you should be paid attention to the length of the bolt, ensure that has no relevant relatives with the screws fixed on PCB.

ESD Control

The converters are processed and manufactured in an ESD controlled environment and supplied in conductive packaging to prevent ESD damage from occurring before or during shipping. It is essential that they are unpacked and handled using an ESD control procedures. Failure to do so affects the lifetime of the converter.

Cleaning Notice

The converter is suitable for water washing, because it does not have any pockets where water could be trapped long-term. Users should ensure that the drying process is adequate and of sufficient duration to remove all water from the converter after washing, do not power up the unit until it is completely dry.

Delivery Package Information

Package material is multiple wall corrugated ,internal material is anti-static foam ,it's surface resistance is from 10^5 Ω to 10^{12} Ω. Tray capacity: 2×6=12 PCS/box ,Tray weight: 0.93kg;Carton capacity:15×12=180 PCS ,Carton weight:14.5kg.

Quality Statement

The converters are manufactured in accordance with ISO 9001 system requirements, in compliant with EN50155, and are monitored 100% by auto-testing system, 100% burn in.
The warranty for the converters is 5-year.