RAQS150-110B24K DC-DC Converter

Input 40V-160V, Output 24V/6.25A, Industry Standard Quarter Brick

Contents

RoHS

Features

- Quarter Brick（60.6mm×39.01mm×12.7mm）
- Input Under Voltage Protection（32V to 39V Turn off）
- Positive Logic Control（3.5V to 15V Turn on）
- Output Over Voltage Protection（28.8V to 33.6V）
- Output Voltage Adjust Range: ±10% of the rated output voltage
- High Efficiency up to 89%（110V，full load）
- **3000Vac Isolation Voltage**
- Operating Ambient Temperature -40℃ to 85℃
- Operating Baseplate Temperature -40℃ to 100℃
- 115℃ Typ. Over Temperature Protection （Baseplate Temperature）
- Conforming to the EN50155 Standard Test
- Applications: Telecommunication electronic data processing, distributed power architecture and Rail transit& railway application

Ordering Information

See Contents for individual product ordering numbers.

Suffix	Meaning	Ordering Model
--	Basic Model	RAQS150-110B24K
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	RAQS150-110B24PK

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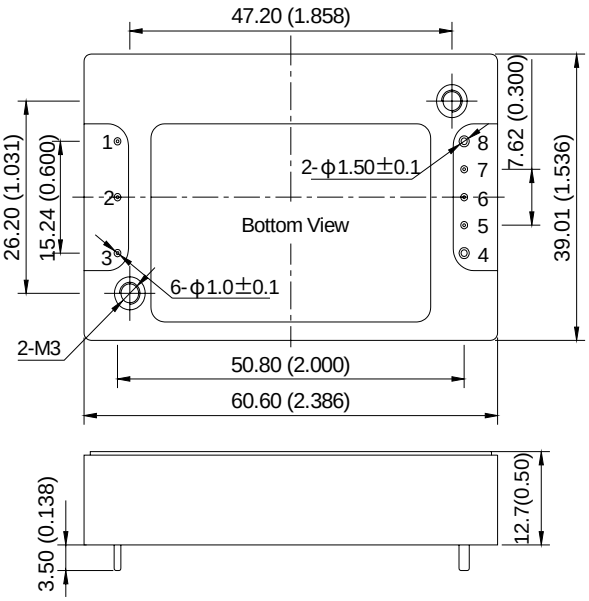
OutlineDiagram



Pin	Symbol	Function
1	-Vin	Negative Input
2	CNT	Remote Control, turn on/off the converter without cutting off the power supply
3	+Vin	Positive Input
4	+Vo	Positive Output
5	+S	Positive Remote Sense, connected to +Vo pin when not in use
6	TRIM	Output Voltage Trim, voltage be trimmed up or down by applying external resistor connected to +S or -S output
7	-S	Negative Remote Sense, connected to -Vo pin when not used
8	-Vo	Negative Output

Case material: Black flame retardant Plastic; Pins: copper with gold plating

Aluminum baseplate can be connected to Protective Earth pin by M3 screw.

Notes: all dimensions in mm(inches)

Tolerances:X.X±0.5mm(X.XX±0.02) X.XX±0.25mm(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}	40	110	160	V	—
Maximum Input Current		I_{in}	—	—	4.26	A	—
Positive Logic Remote Control	Current	—	—	—	1.0	mA	CNT source current when turn off
	On	—	3.5	—	15.0	V	Refer to $-V_{in}$; Also turn on when CNT floating.
	Off	—	0	—	1.5	V	Refer to $-V_{in}$
Negative Logic Control	On	—	0	—	1.5	V	Refer to $-V_{in}$
	Current	—	—	—	1.0	mA	CNT source current when turn on
	Off	—	3.5	—	15.0	V	Refer to $-V_{in}$；Turn off when CNT floating
	Current	—	—	—	1.0	mA	CNT sink current when turn off.
Start-up Delay Time		T_{delay}	—	280	—	ms	—
Under Voltage Threshold		V_{UVLO}	32	—	39	V	—

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Output		Symbol	Min	Typ	Max	Unit	Conditions
Output Voltage		V_o	23.76	24.00	24.24	V	—
Output Current		I_o	—	6.25	—	A	—
Output Voltage Adjust Range		V_{trim}	21.6	—	26.4	V	I_o≤6.25A
Remote Sense Compensation Range		V_{sense}	28.8	—	33.6	V	—
Line Regulation		S_V	—	—	±0.2	$\%V_O$	V_{in}:40V～160V, I_o=6.25A
Load Regulation		S_I	—	—	±0.5	$\%V_O$	V_{in}=110V, I_o:0A～6.25A
Peak to Peak Ripple and Noise		$\triangle V_{pp}$	—	—	200	mV	20MHz bandwidth, Output equipped 10μF tantalum capacitor and 1μF ceramic capacitor
Load Transient	Recovery Time	t_{tr}	—	—	400	μs	Load change:25%～50%～25% & 50%～75%～50%; Current change: 0.1A/μs
	Voltage Deviation	$\triangle V_{tr}$	—	—	±1200	mV	
Capacitive Load Range		C_o	0	—	2200	μF	—
Output Overshoot		V_{T0}	—	—	2.4	V	—
Rise Time		T_{rise}	—	28	—	ms	$I_{o,nom}$ ， pure resistive load
OVP Set Point		$V_{ov,set}$	0	—	0.5	V	+S and -S twisted Pair，length is less than 20cm
Current Limit Inception		$I_{o,lim}$	7	—	12.5	A	—
Output Short-circuit Protection		Hiccup mode, automatic recovery					

General	Symbol	Min	Typ	Max	Unit	Conditions
Efficiency	η	—	89	—	%	V_{in}=110V, $I_{o,nom}$
Switching Frequency	f_s	—	265	—	kHz	—
Isolation Resistance	R_{iso}	50	—	—	MΩ	—
Isolation Voltage	V_{iso}	3000	—	—	Vac	Input to output ,Leak Current≤5mA
		2000	—	—	Vac	Input to case ,Leak Current≤5mA
		1000	—	—	Vac	Output to case ,Leak Current≤5mA
		All pins on the input side are shorted during the test,Output side all pinshort connection				
Operating Baseplate Temperature	—	-40	—	100	℃	—
Operating Ambient Temperature	—	-40	—	85	℃	—
OTP Set Point	T_{ref}	—	115	—	℃	Baseplate Temperature
Over Temperature Protection Hysteresis	$\triangle T_{ref}$	—	10	—	℃	
Storage Temperature	—	-55	—	125	℃	—

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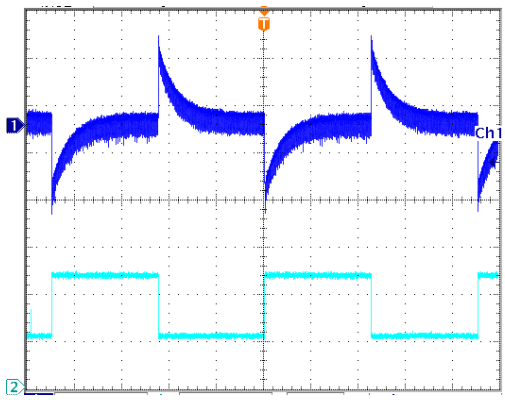
Continue

General	Symbol	Min	Typ	Max	Unit	Conditions
Temperature Coefficient	S_T	—	—	±0.02	%/℃	—
MTBF	—	—	2×10^6	—	h	BELLCORE TR-332
Thermal resistance	$R_{\theta CA}$	—	9.0	—	℃/W	Natural Convection Without Heatsink
	$R_{\theta CA}$	—	5.0	—	℃/W	Natural Convection With Heatsink
	$R_{\theta CA}$	—	6.3	—	℃/W	100LFM Convection Without Heatsink
	$R_{\theta CA}$	—	3.2	—	℃/W	100LFM Convection With Heatsink
	$R_{\theta CA}$	—	5.5	—	℃/W	200LFM Convection Without Heatsink
	$R_{\theta CA}$	—	2.8	—	℃/W	200LFM Convection With Heatsink
	$R_{\theta CA}$	—	4.3	—	℃/W	300LFM Convection Without Heatsink
	$R_{\theta CA}$	—	2.1	—	℃/W	300LFM Convection With Heatsink
	$R_{\theta CA}$	—	3.7	—	℃/W	400LFM Convection Without Heatsink
	$R_{\theta CA}$	—	1.5	—	℃/W	400LFM Convection With Heatsink
Hand Soldering	Maximum soldering Temperature < 425℃,and duration < 5s					
Wave Soldering	Maximum soldering Temperature < 255℃,and duration < 10s					
Weight	—	—	68	—	g	—
Shock	Meets EN50155					
Vibration	Meets EN50155					

EMC SPECIFICATIONS	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)

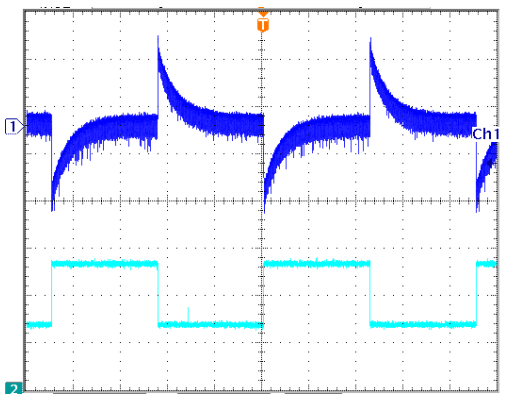
Characteristic Curves

Load Transient Response



Load change:25%～50%～25% $I_{o,nom}$, 0.1A/μs
V_{in} =110Vdc
Trace1: 0.1V/div
Trace2: 1.2A/div
Time scale: 10ms/div

Load Transient Response



Load change:50～75%～50% $I_{o,nom}$, 0.1A/μs
V_{in} =110Vdc
Trace1: 0.1V/div
Trace2: 1.2A/div
Time scale: 10ms/div

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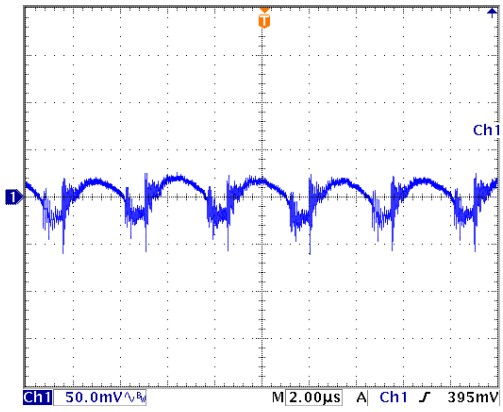
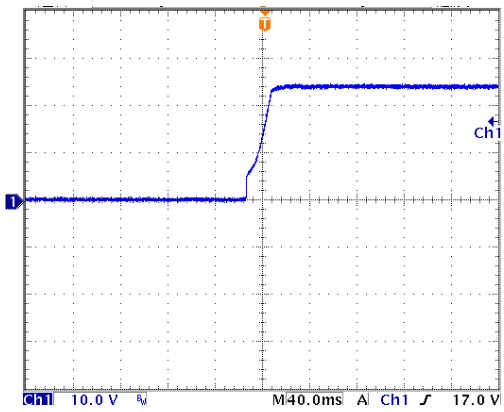
Output Ripple and noise



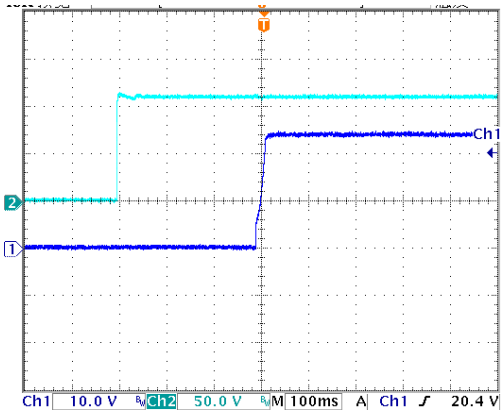
V_{in}=110Vdc, I_o=6.25A

Rise Time



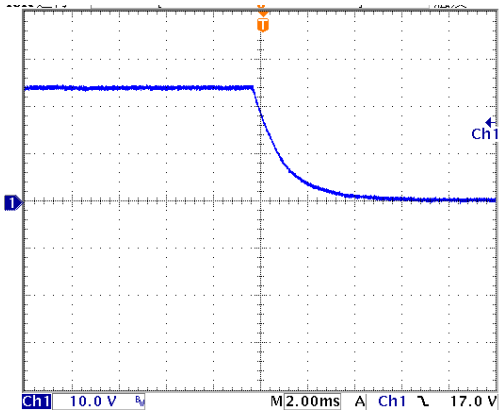
V_{in}=110Vdc, I_o=6.25A

Start-up Delay Time



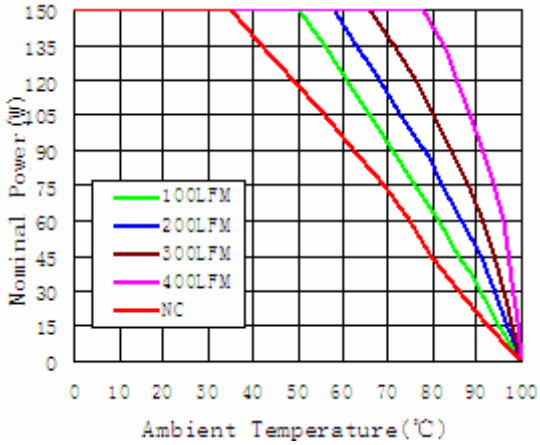
V_{in}=110Vdc, I_o=6.25A

Turn-off

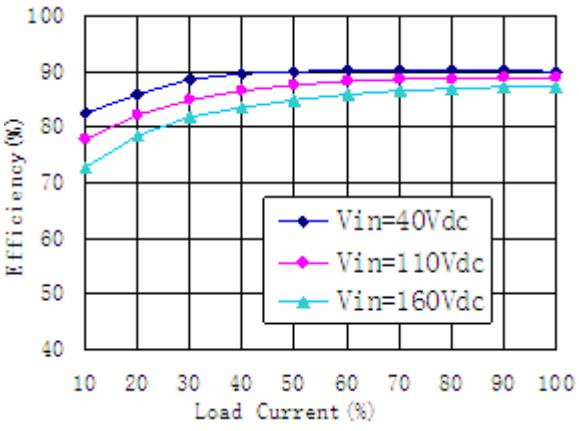


V_{in} =110 Vdc；I_o=6.25A

Derating curve with 0.95℃/W HS radiator



Efficiency vs Temperature and current



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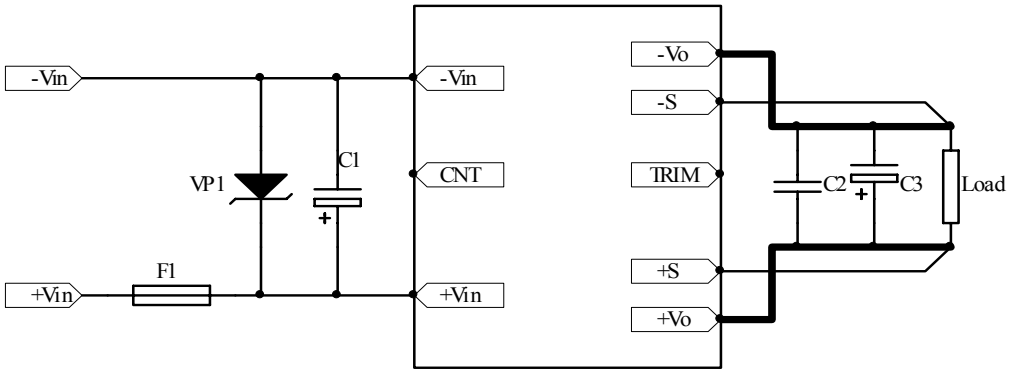
Design Considerations

Basic Connection

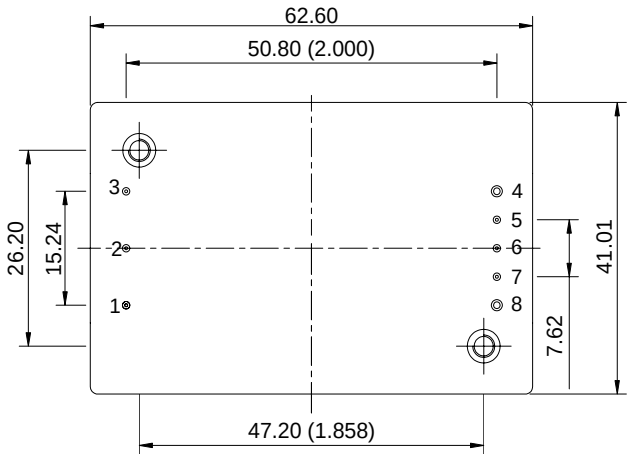


Notes: The basic connection indicates the basic requirements. Please refer to the instruction followed for further information.

parameter declaration:

Part No.	Components	Part No.	Components
F1	quick break type insurance pipe of 10A	C2	1μF ceramic capacitor
VP1	P6KE180A Transient Voltage Suppressor	C3	220μF electrolytic capacitor
C1	100μF electrolytic capacitor	—	—

Recommended Layout



NO.	Recommendation & Notes
Pad Design	4 and 8 Pad holes:1.9 mm, pad diameter including hole:3.5mm in the X direction, 2.3mm in the Y direction; the rest are 1.5mm, pad diameter including hole:2.5 mm in the X directn, 2.1mm in the Y direction; the fixed holes at the two corners are metallized, the diameter of the diagonal fixed hole is recommended to be 3.6mm;to ensure insulation withstand voltage, it is recommended to select the M3 cross slotted head screw with GB823-88, and make slots with a width of at least 1.5mm between flxing hole and Pad of pins.
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

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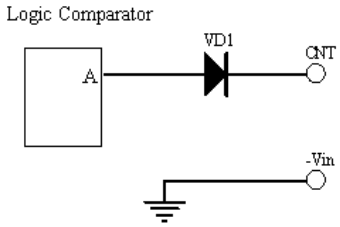
Input Voltage Range

The input voltage range of the DC/DC converter is 40V～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.

Remote Control

Remote control can be offered by setting right control voltage level (floating , high resistance)to CNT pin. RAQS150-110B24K is provided with positive logic remote control. The circuit diagram is shown as "Internal Circuit Diagram for Positive Logic 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 turn off.



Internal Circuit Diagram For Positive Logic Control

Due to the logic comparator is semiconductor integrated chip, they have low endurance to surge. Care should be taken to prevent CNT from surge, A TVS should be used in some cases.

RAQS150-110B24PK is provided with negative logic remote control. It has the same characteristic as RAQS150-110B24K, 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. Like positive logic control converters, care should be taken to prevent CNT from surge.

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. The controls can be achieved by external circuit applied to the CNT pin.

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 Yihongtai for more information.

External Capacitance

Unless special purpose (i.e. prolonging hold-up time, input impedance matching), the recommended input filter's capacitance ranges 100μF～680μF, 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 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 up to 0.5V drop between the sense voltage and the voltage at the output pins. If the remote sense is not needed, the –S should be connected to -Vo and +S should

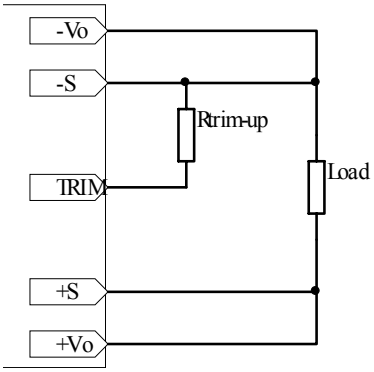
be connected to +Vo.

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.

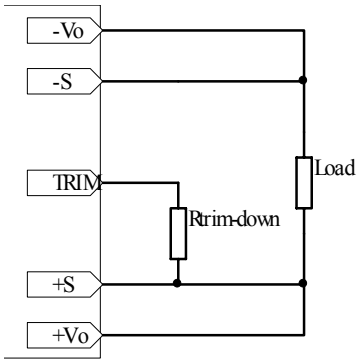
The sense leads only can carry very little current, and are not used for converter power output. Care should be taken in operation to avoid damaging the converter.

Output 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.The maximum value of the trimmed up is 10%, even +S and –S pins are used to compensate the voltage simultaneously, the sum of the trimmed up and the compensation should not be more than 10%, or the characteristics will not be assured in compliant with the specification, even the over voltage protection may be triggered. The output power can not exceed 150W at increased output voltages, and the output current can not exceed 6.25A.



Connection for Trimming Up



Connection of Trimming Down

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.

Resistance for trimming up ：$R_{Trim-up} = \left(\frac{53.75}{\Delta V} - 15 \right) (k\Omega)$

Resistance for trimming down：$R_{Trim-down} = \left(\frac{21.5V_0 - 15\Delta V - 53.75}{\Delta V} \right) (k\Omega)$

Output Over Voltage Protection

The converter is designed with clamped over voltage protection, when output voltage exceeds 28.8V to 33.6V (the set point is between 28.8V to 33.6V, there is the difference based on the specific parameters, but not beyond the range), the output voltage will be clamped and attempt to restart periodically. Be advised that to shut down the converter by using remote control(CNT) if it can not be repaired timely. Avoid the continuous resetting of the unit because that will damage the converter.

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Thermal Consideration

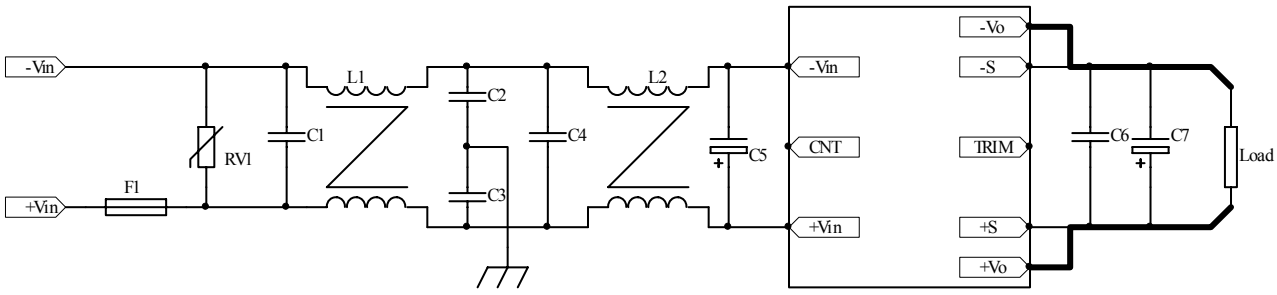
The loss of the converters in normal operation will be converted into heat which can cause the converters itself to rise in temperature. RAQS150-110B24K is provided with Over Temperature Protection Feature.The temperature sensor is located on the aluminum baseplate. The converters will be off when the 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.

EMC Solution

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



Parameter Declaration

Part No.	Components	Part No.	Components
F1	quick break type insurance pipe of 10A	C5	100μF electrolytic capacitor
RV1	221KD14 piezoresistor	C6	1μF ceramic capacitor
C1	1μF film capacitor	C7	220μF electrolytic capacitor
C2,C3	1nF safety capacitor of CLASS Y	L1,L2	1.5mH Common Mode Inductor
C4	0.33μF film capacitor	—	—

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.

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Safety Consideration

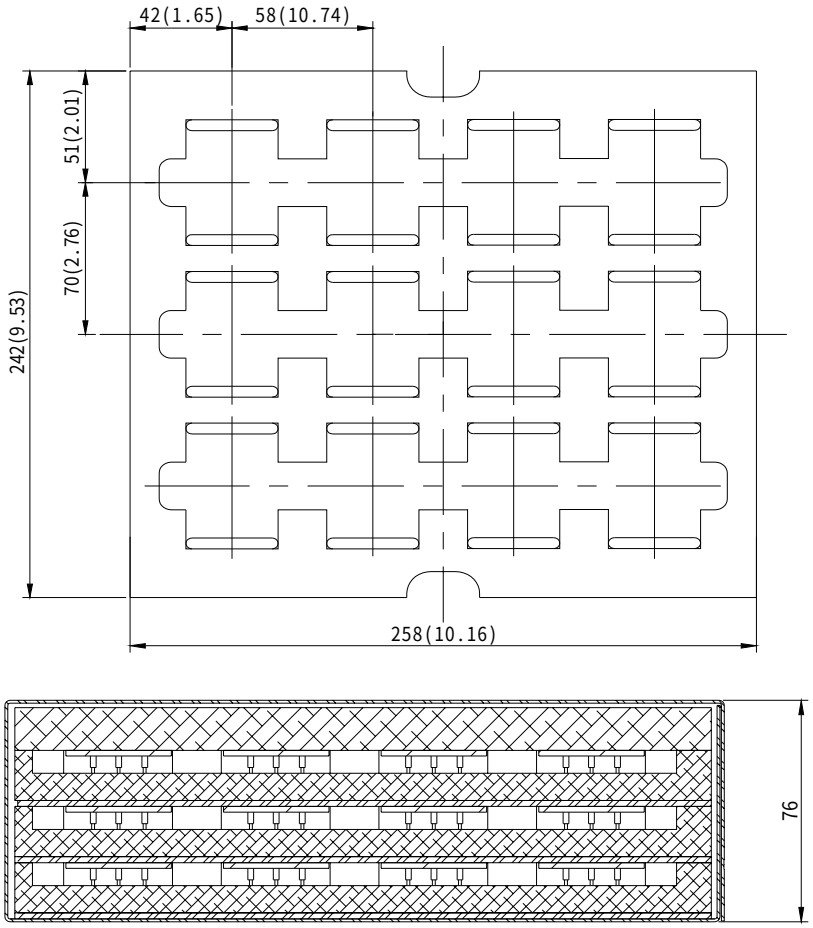
The converter, as one component for the end user, should be installed into the equipment, and all the safety considerations are achieved under certain condition. It is required to meet safety requirements in system design for the user.

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).

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.

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: 3×12=36 PCS/box ,Tray weight: 2.5kg; Carton capacity:4×36=144 PCS ,Carton weight:10.5kg.

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Quality Statementc

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.

Contact Information

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