HESION 禾信

Technical Specification V2.0   **2020.07**

RAQS50-24B24   DC-DC Converters

Input 9V~36V, Output 24V/2.1A, Industry Standard Quarter Brick

Contents

Features

◆ Quarter Brick（60.6mm×39.01mm×12.7mm）

◆ Input Under Voltage Protection（6.5V to 8.9V 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 87%（24V，full load）

◆ 1500Vac 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: Industry, Railway & Rail transit.

Ordering Information

See Contents for individual product ordering numbers.

Suffix	Description	Ordering No.
--	Shown as the specification, Positive Logic Control	RAQS50-24B24
P	Negative Logic Control: 3.5V～15V or floating, turn off; 0V～1.5V, turn on	RAQS50-24B24P
B	Positive Logic Control: Equipped with metal Heatsink.	RAQS50-24B24B
PB	Negative Logic Control: Equipped with metal Heatsink	RAQS50-24B24PB

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Outline Diagram

Outline Diagram without Heatsink：   **Outline Diagram with Heatsink：**
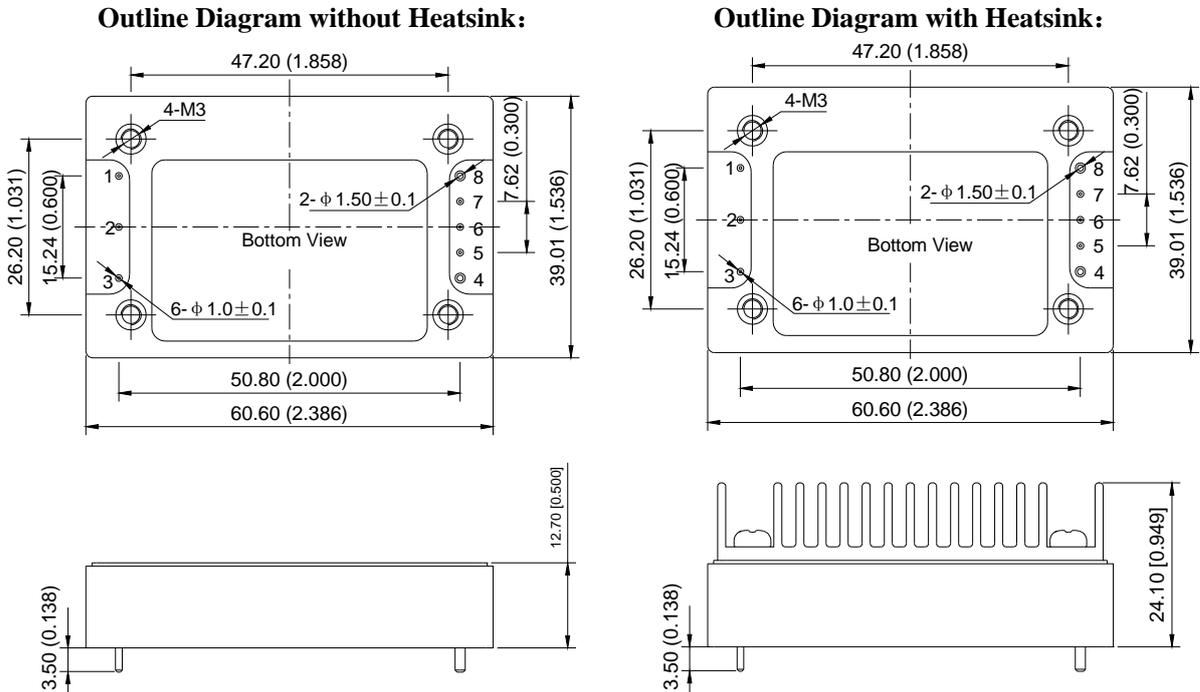
Pin	Symbol	Function
1	-Vin	Negative Input
2	CNT	Remote Control, turn on/off the converter without cutting off the power supply
3	+Vin	Positive Input
4	+Vo	Positive Output
5	+S	Positive Remote Sense, connected to +Vo pin when not in use
6	TRIM	Output Voltage Trim, voltage be trimmed up or down by applying 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 alloy with gold plating;Aluminum baseplate can be connected to Protective Earth by M3 screw.
Notes:all dimensions in mm(inches)   Tolerances:X.X±0.5 (X.XX±0.02)   X.XX±0.25 (X.XXX±0.010)

Specification

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

Input		Symbol	Min	Typ	Max	Unit	Conditions
Input Voltage		V_{in}	9	24	36	V	—
Input Current		I_{in}	—	—	7	A	—
Positive Logic Control	On	—	3.5	—	15.0	V	Refer to -V_{in}；Turn on when CNT floating
	Off	—	0	—	1.5	V	Refer to -V_{in}
	Current	—	—	—	1.0	mA	CNT source current when turn off

Continue

RAQS50-24B24　　DC-DC Converters

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Input		Symbol	Min	Typ	Max	Unit	Conditions
Negative Logic Control	On	—	0	—	1.5	V	Refer to -V_{in}
	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}	—	10	—	ms	—
Under Voltage Threshold		V_{UVLO}	6.5	—	8.9	V	—
Under Voltage Protection Hysteresis		$\triangle V_{UVLO}$	1	—	2	V	—

Output		Symbol	Min	Typ	Max	Unit	Conditions
Output Voltage		V_O	23.76	24.00	24.24	V	—
Output Current		$I_{O,nom}$	—	2.1	—	A	—
Output Voltage Adjust Range		V_{trim}	21.6	—	26.4	V	$I_O \leq 2.1A$ $P_O \leq 50W$
Line Regulation		S_V	—	—	±0.2	% V_O	V_{in}：9V～36V, I_O=2.1A
Load Regulation		S_I	—	—	±0.5	% V_O	V_{in}=24V, I_O: 0A～2.1A
Output Over Voltage Protection Set Point		$V_{ov,set}$	28.8	—	33.6	V	—
Output Over Current Protection Range		$I_{O,lim}$	2.3	—	4.2	A	—
Output Short-circuit Protection		Hiccup mode,automatic recovery					
Peak to Peak Ripple and Noise		$\triangle V_{pp}$	—	—	200	mV	20MHz bandwidth
Rise Time		T_{rise}	—	10	—	ms	$I_{O,nom}$, pure resistive load
Output Overshoot		V_{TO}	0	—	1.2	V	—
Capacitive Load		C_O	0	—	1000	μF	—
Remote Sense Compensation Range		V_{sense}	0	—	0.5	V	+S and -S twisted Pair，length is less than 20cm
Load Transient	Recovery Time	$\triangle V_{tr}$	—	—	400	μs	25%～50%～25%Io,nom or 50%～75%～50% $I_{O,nom}$; 0.1A/μs
	Voltage Deviation	t_{tr}	—	—	±720	mV	

General	Symbol	Min	Typ	Max	Unit	Conditions
Efficiency	η	86	87	—	%	V_{in}=24V, $I_{O,nom}$
Switching Frequency	f_s	—	250	—	kHz	—
Isolation Resistance	R_{iso}	50	—	—	MΩ	—
Operating Ambient Temperature	—	-40	—	85	℃	—
Operating Baseplate Temperature	—	-40	—	100	℃	—
MTBF	—	—	2×10^6	—	h	BELLCORE TR-332

Continue

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General	Symbol	Min	Typ	Max	Unit	Conditions
Isolation Voltage	V_{iso}	1500	—	—	Vac	Input to output; Leakage current≤5mA
		1500	—	—	Vac	Input to case; Leakage current≤5mA
		1500	—	—	Vac	Output to case; Leakage current≤5mA
		All the input pins are shorted and all the output pins are shorted.				
Vibration and Shock	Meets EN50155					
Storage Temperature	—	-55	—	+125	℃	—
Temperature Coefficient	S_T	—	—	±0.02	%/℃	—
Over Temperature Protection Reference Point	T_{ref}	110	115	125	℃	Baseplate Temperature
Over Temperature Protection Hysteresis	$\triangle T_{ref}$	—	10	—	℃	
Thermal resistance	$R_{\theta CA}$	—	11.6	—	℃/W	Natural Convection Without Heatsink
	$R_{\theta CA}$	—	8.0	—	℃/W	Natural Convection With Heatsink
	$R_{\theta CA}$	—	8.7	—	℃/W	100LFM Convection Without Heatsink
	$R_{\theta CA}$	—	4.2	—	℃/W	100LFM Convection With Heatsink
	$R_{\theta CA}$	—	7.3	—	℃/W	200LFM Convection Without Heatsink
	$R_{\theta CA}$	—	2.8	—	℃/W	200LFM Convection With Heatsink
	$R_{\theta CA}$	—	5.9	—	℃/W	300LFM Convection Without Heatsink
	$R_{\theta CA}$	—	2.0	—	℃/W	300LFM Convection With Heatsink
	$R_{\theta CA}$	—	4.5	—	℃/W	400LFM Convection Without Heatsink
	$R_{\theta CA}$	—	1.4	—	℃/W	400LFM Convection With Heatsink
Hand Soldering	Maximum soldering Temperature < 425℃，and duration < 5s					
Wave Soldering	Maximum soldering Temperature < 255℃，and duration < 10s					
Weight	—	—	49	—	g	Without Heatsink
	—	—	81	—	g	With Heatsink

EMC Specifications	Standards＆Conditions		Level
EMI Conducted Emission	EN55032	(See Page9)	Class A
Surge Immunity	IEC/EN61000-4-5 GB/T 17626.5	line to line(±1kV/2Ω)；line to ground(±2kV/12Ω) (See Page9)	B
Fast Transient	IEC/EN61000-4-4 GB/T 17626.4	±2kV(5/50ns, 5kHz) (See Page9)	A

Characteristic Curves

Load Transient Response
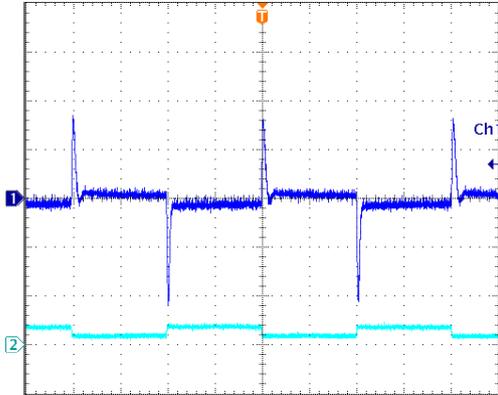
Load change:25%～50%
～25% $I_{O,nom}$, 0.1A/μs
Vin=24Vdc

Trace1: 0.2V/div
Trace2: 6A/div
Time scale: 1ms/div

Load Transient Response
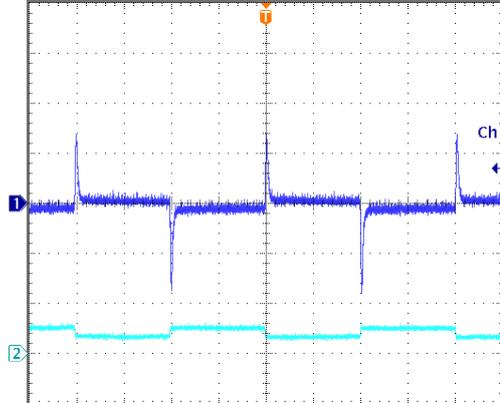
Load change:50%～75%
～50% $I_{O,nom}$, 0.1A/μs
Vin=24Vdc

Trace1: 0.2V/div
Trace2: 6A/div
Time scale: 1ms/div

Output Ripple and noise
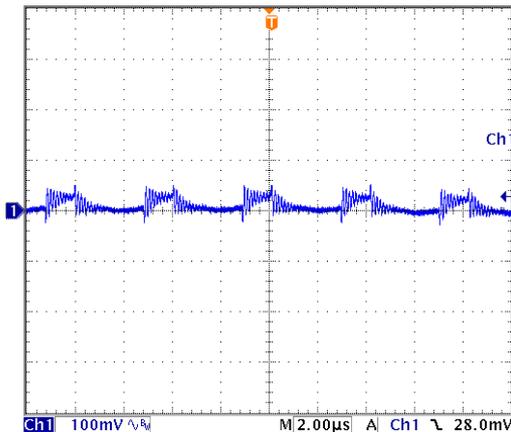
Vin=24V, Io=2.1A

Start-up Delay Time
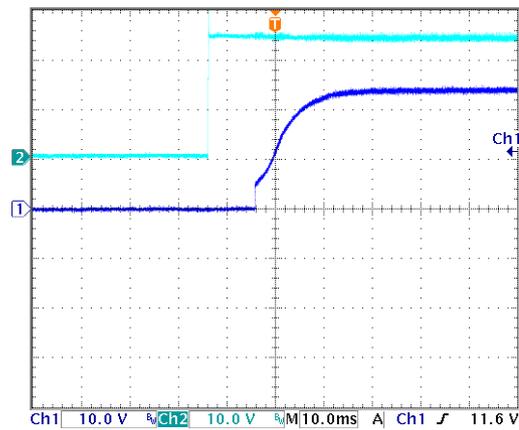
Vin=24V, Io=2.1A

Rise Time
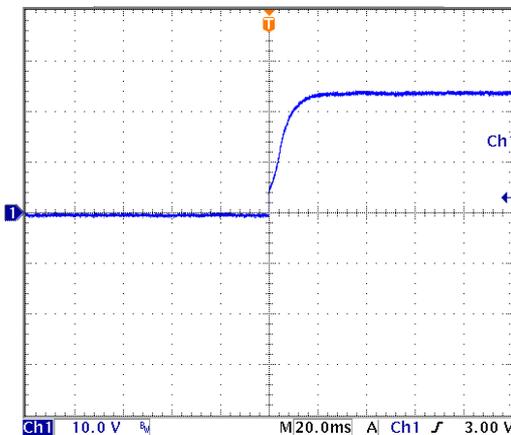
Vin=24V, Io=2.1A

Turn-off
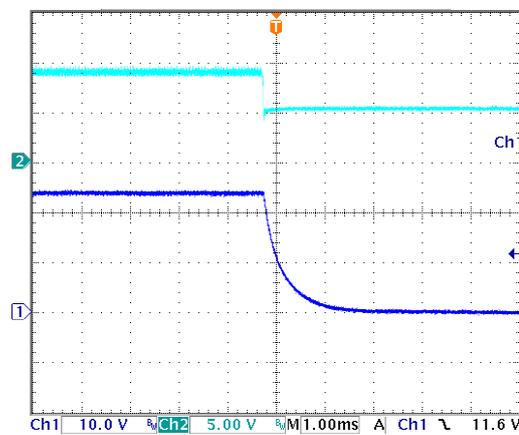
Vin=24V, Io=2.1A

Derating curve with 0.45″ HS Heatsink
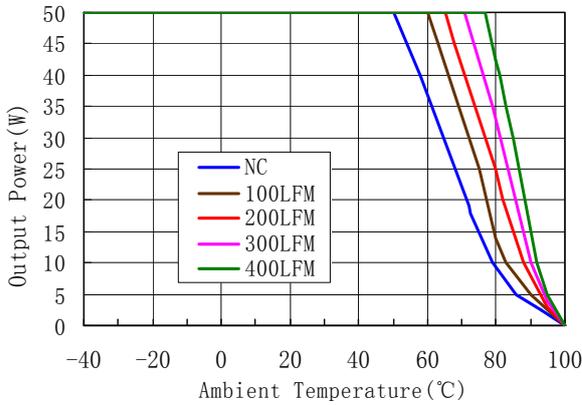
Derating curve without Heatsink
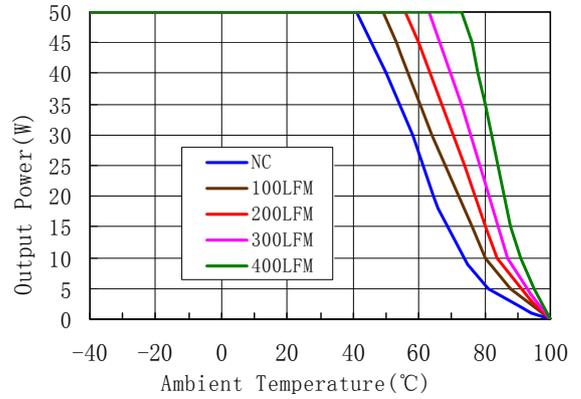
Efficiency vs Load Current
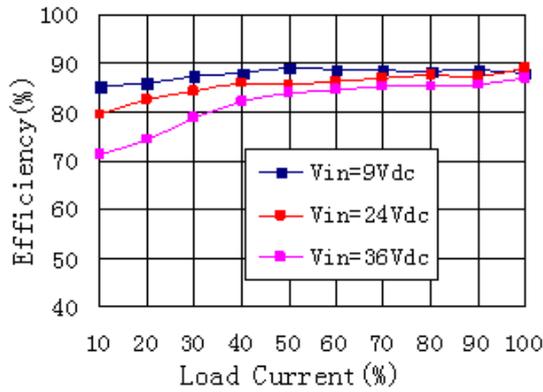
Design Considerations

Basic Connection
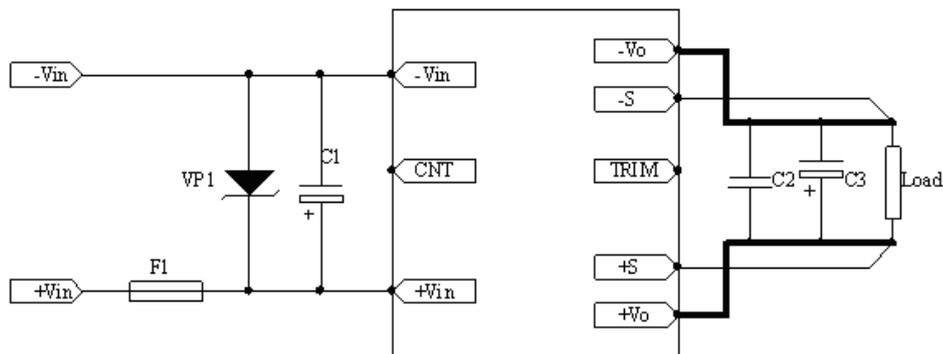
Notes: The basic connection indicates the basic requirements that the power module can provide rated output voltage and rated power only, Please refer the instruction followed for further information.

Parameter description:

No.	Model	No.	Model
F1	15A	C2	1uF
VP1	P6KE39A	C3	100uF
C1	220uF	——	——

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Recommended Layout

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          47.2
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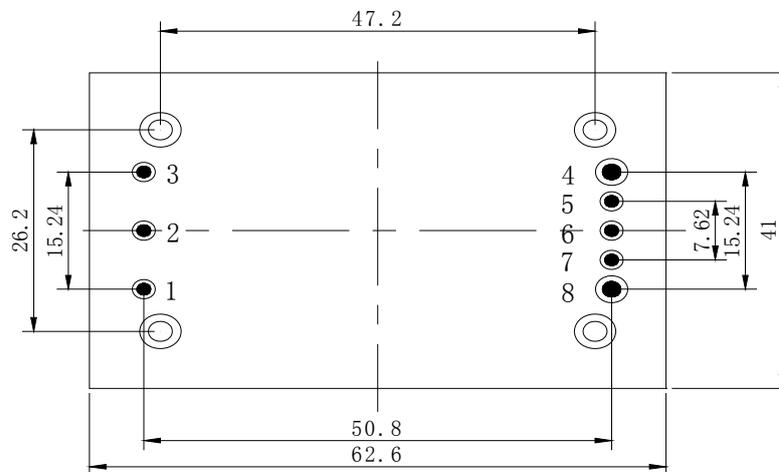
NO.	Recommendation & Notes
Pad Design	4 and 8 Pad holes:1.9 mm，pad diameter including hole:3.5mm in the X direction,2.3mm in the Y direction; the rest are 1.5mm, pad diameter including hole:2.5 mm in the X direction,2.1mm in the Y direction; the diameter of fixed holes at the four corners is 3.6mm, to ensure insulation resistance, 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 fixed holes 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

Input Voltage Range

The input voltage range of the DC/DC converter is 9V～36V. 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. RAQS50-24B24 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.

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.

Internal Circuit Diagram For Positive Logic Control

RAQS50-24B24P is provided with negative logic remote control. It has the same characteristic as RAQS50-24B24, 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.
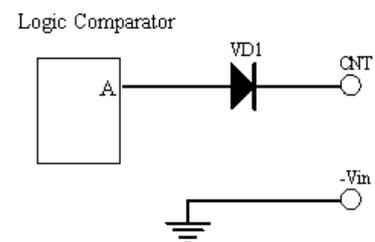
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In some applications, extra controls will be designed for the converter in user's PCB, such as output short circuit protection, over voltage protection, under voltage protection, synchronous control to the converter output voltage, and so on, remote 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.

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 maximum 0.5 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.

External Capacitance

Unless special purpose (i.e. prolonging hold-up time, input impedance matching), the recommended input filter's capacitance ranges 220μF to 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.

The recommended output filter's capacitance is at least 100μF(less than the maximum Capacitive Load of the product), which can reduce the ripple noise.

Over Temperature Protection

The over temperature protection feature is used to protect the converter, and the sensor locates in the baseplate. If the temperature of the baseplate exceeds the threshold of 115℃, the converter will shut down.

The converter will stop until safe operating temperature is restored. Hysteresis temperature between OTP trig point and restart is approx 10°C. Time between OTP and restart is dependent on cooling of the regulator ,and radiation to the surrounding environment. If the surrounding environment does not change, restart will work cycle by cycle.

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 if it can not be repaired timely. Avoid the continuous resetting of the unit because that will damage 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 50W at increased output voltages, and the output current can not exceed 2.1A.

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.
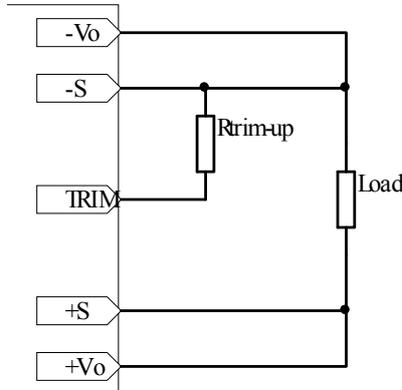
**Connection of Trimming Up**   **Connection for Trimming Down**
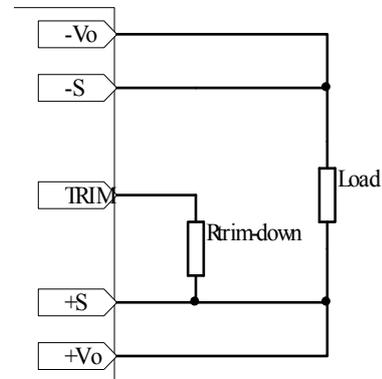
Resistance for trimming up ： $R_{Trim-up} = \left(\dfrac{21.5 \times 2.5}{\Delta Vo} - 5.11 \right) \ (k\Omega)$

Resistance for trimming down：$R_{Trim-down} = \left(\dfrac{21.5^2}{\Delta V_O} - 26.61 \right) \ (k\Omega)$

$R_{Trim-up}$、$R_{Trim-down}$:Resistance for trimming up or down, Unit:kΩ;

$\triangle$Vo：Change rate, divide output voltage by rated output voltage;

For example：trimmed down voltage to 22V,then $R_{Trim-down}$=21.5*21.5/2-26.61=204.5(kΩ), it can be taken as 200 kΩ.

EMC Solution

Recommendation circuit for EMI Conducted emission、Fast transient/burst immunity、Surge immunity.
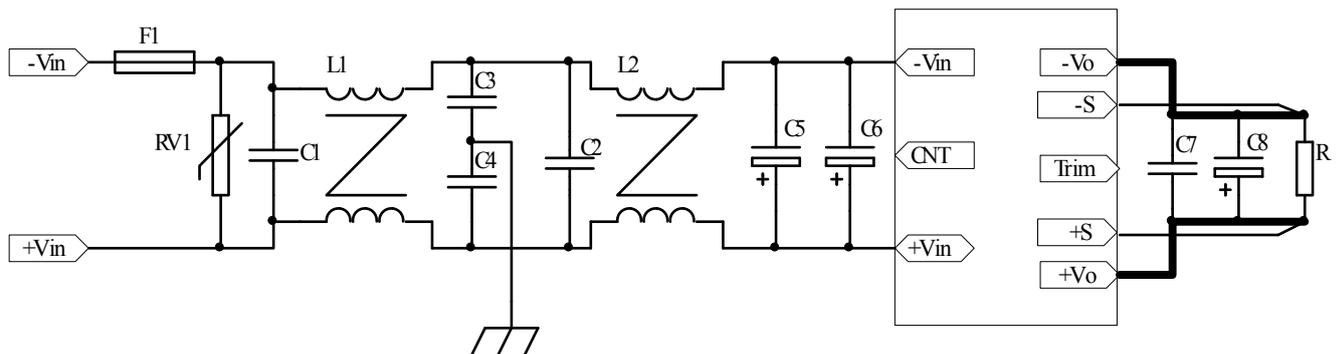
Part No.	Components	Part No.	Components
F1	quick break type insurance pipe of 15A	C5, C6	220μF electrolytic capacitor
RV1	470KD20 piezoresistor	C7	1μF film capacitor
C1,C2	0.33μF film capacitor	L1,L2	3.3mH Common Mode Inductor
C3,C4	1000pF/400VAC safety capacitor of CLASS Y1	C8	100μF electrolytic capacitor

Thermal Consideration

The converters operate in a variety of thermal environments,however, sufficient cooling should be provided to ensure reliable operation of the unit. Heat is removed by conduction, convection and radiation to the surrounding environment. 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.

For the specified ambient temperature, user can increase airflow and change the size of heatsink to improve the heat dissipating for the module with baseplate,neither airflow nor heatsink ,the derating curves should be referred or external heat dissipation measures.

Product Installation

The product can be installed in user board, suggest using M3 cross slotted head screw with GB823-88 to fix the product 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 0.6N.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 enhances 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.

Delivery Package Information

RAQS50-24B24   DC-DC Converters
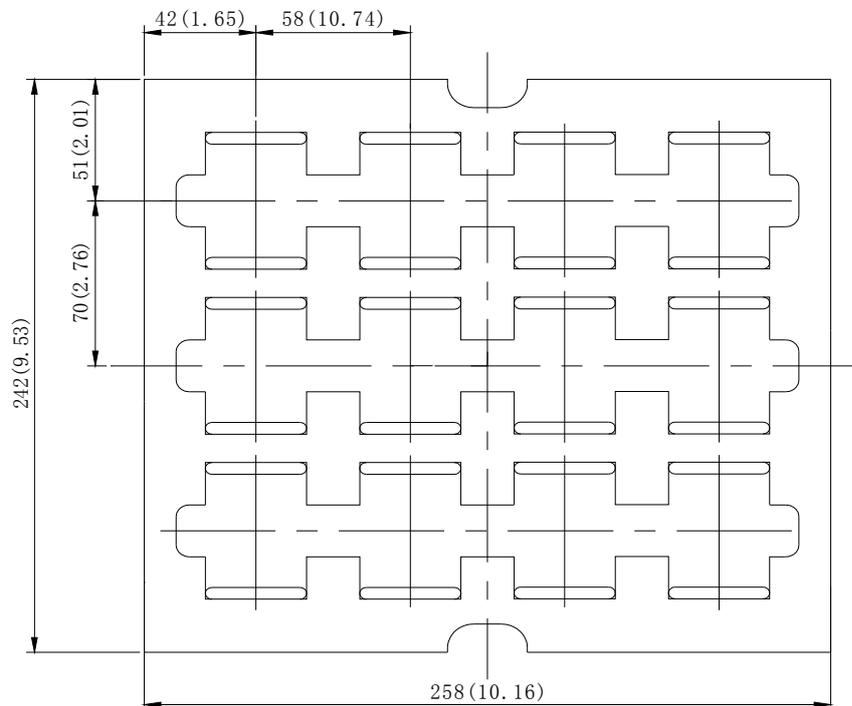
Input 9V~36V, Output 24V/2.1A, Industry Standard Quarter Brick
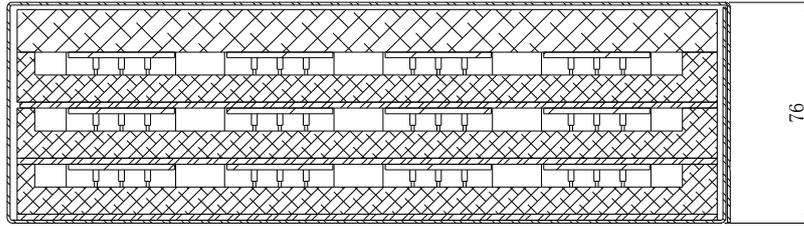
Package material is multiple wall corrugated，internal material is anti-static foam，it's surface resistance is from $10^5\,\Omega$ to $10^{12}\,\Omega$。Tray capacity: 3×12=36 PCS/box，Tray weight: 1.86kg；Carton capacity:4×36=144 PCS，Carton weight: 7.5kg.

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.

Contact Information

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