Application Notes for Low-Voltage Brick Modules （24V input）

Typical Application Circuit Diagram

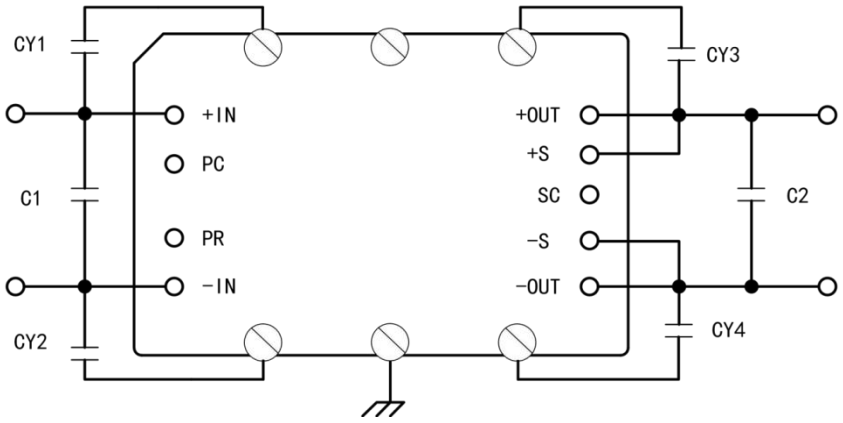

Figure 1 Typical Standalone Application Circuit

Capacitors C1 、C2	
Capacitance Value	(10~20)μF/A
Recommended Capacitor Type(s)	Ceramic Chip Capacitors, Solid Aluminum Electrolytic Capacitors or Tantalum Capacitors
Safety Capacitors	
CY1、CY2 Capacitance Value	4.7nF
CY3、CY4 Capacitance Value	10nF

Note 1: It is recommended to select the output capacitor value based on the output current, typically (10~20) μF/A. For example, for a module output current of 10A, the recommended output capacitor is (100~200) μF.

Note 2: When using liquid aluminum electrolytic capacitors, the impact of temperature on capacitance must be fully considered to ensure the actual capacitance meets the above requirements across all temperature ranges. Improper capacitor value configuration may cause stability issues.

Note 3: The input and output capacitors specified above can ensure stable operation of the power supply under various conditions. If the application involves inductive or extreme dynamic loads, the output capacitance should be increased appropriately, and confirmation with the manufacturer's technical personnel is required.

Note 4: A single type of capacitor, such as ceramic chip capacitors, or a combination of capacitor types, such as ceramic chip capacitors paired with solid aluminum electrolytic or tantalum capacitors, can be used for both input and output capacitors.

Note 5: The temperature rise caused by the capacitor ESR must be fully considered when selecting the output filter capacitor

Pin Functions

+IN，-IN

Input power pins. -IN also serves as the reference ground for the module control signals. To minimize the impact of voltage drop caused by current on -IN, it is recommended to use a Kelvin connection between the external control circuit and -IN.

+OUT， -OUT

Output power pins.

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PC（(Primary Control Pin)

Module Enable/Disable

The module is enabled when the PC pin is left floating. The module is disabled when the PC voltage is pulled below 2.3V (relative to IN). This function can be implemented using a transistor, relay, or optocoupler, refer to Figure 3. To disable multiple modules, redundant diodes can be used with a single optocoupler, transistor, or relay. When using an optocoupler for control, ensure its secondary-side current capability is greater than the maximum PC current of 4.5mA to guarantee PC is reliably pulled low.

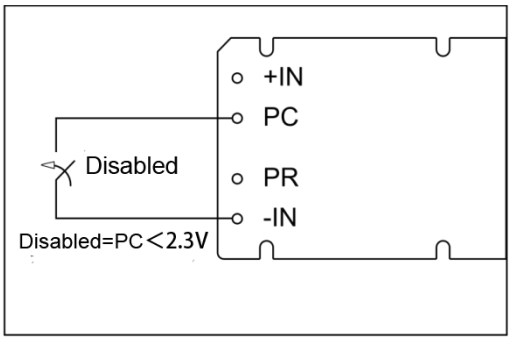

Figure 3 Module Disable and Enable

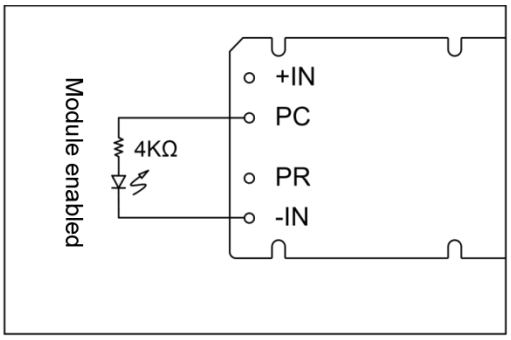

Figure 4 Power-On Indicator

Primary Auxiliary Power Supply

PC can provide a current no less than 2.5mA. In the example shown in Figure 4, PC supplies power to an LED to indicate module enable status.

Module Alarm

The module incorporates comprehensive protection circuits to monitor input voltage, operating temperature, and internal operating parameters. If any of these parameters exceeds its allowable operating range, the module will stop operating, and SC will be pulled low. Except for output over/under-voltage protection, PC will also be pulled low. Once the anomaly is cleared, PC and SC will be reset high, and the module will resume operation (except for output overvoltage). Refer to Figures 5 and 6.

PC can provide power-on/off indication. For isolated power-on indication, refer to Figure 7.

SC can be used to monitor alarm signals, refer to Figure 8.

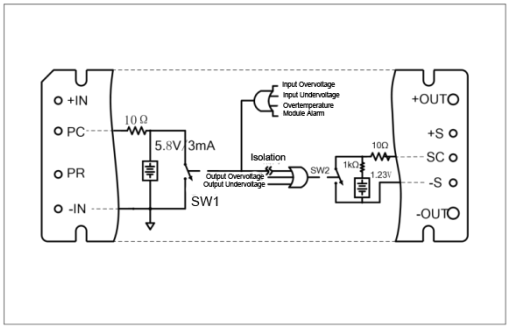

Figure 5 Protection Block Diagram

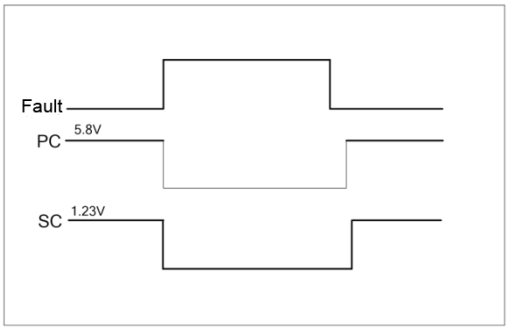

Figure 6 Protection Timing

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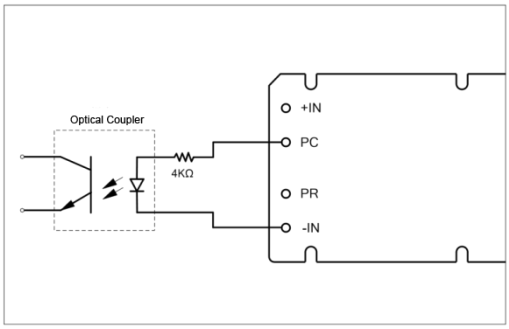

Figure 7 Isolated Power-On Indicator

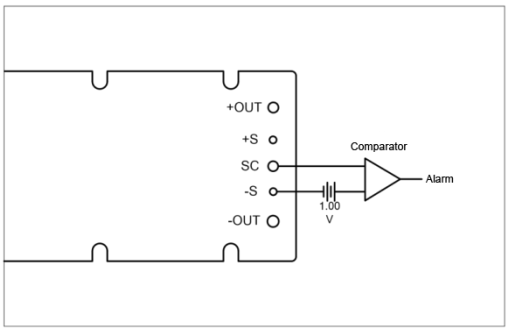

Figure 8 Alarm Signal Monitoring

PR（Parallel Pin）

Parallel Operation

The PR pin carries the module input current signal. Using the PR pin allows forming parallel arrays to increase output power. Connecting the PR pins of identical power supply modules enables current sharing. Refer to Figure 9. Capacitor selection in the diagram refers to Figure 1.

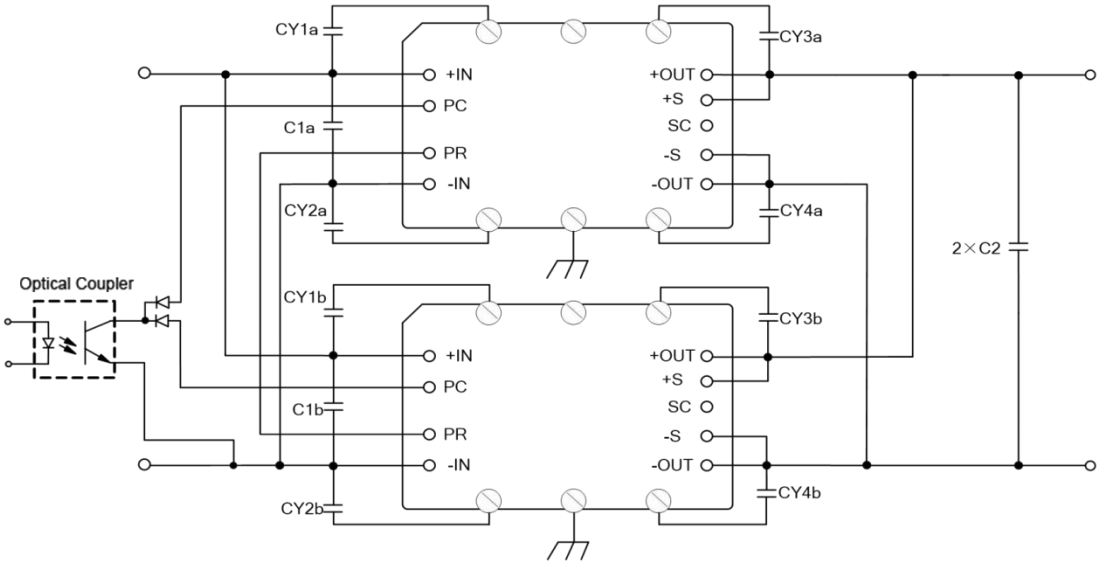

Figure 9 Module Parallel Circuit

Parallel Operation Notes

When operating in parallel, it is recommended to connect all PC pins to ensure all modules start simultaneously. Alternatively, use an external circuit to control the PC pins of all modules within the parallel array, enabling them at the same time, as shown in Figure 9. When using an optocoupler for control, ensure its secondary-side current capability is greater than the maximum PC current to guarantee PC is reliably pulled low.

In parallel operation of power modules, it must be ensured that the PR signal can propagate to all modules within the parallel array. Modules in the array that do not receive the PR signal will not achieve current sharing and may be damaged due to overload.

All modules in a parallel array must be of the same model. Mixing modules from different manufacturers in parallel is strictly prohibited, as it may not achieve the intended current-sharing effect.

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Redundancy Circuit

If the module is used in a redundancy backup circuit, connect the +S pin of the module to the anode of the redundancy diode, as shown in the figure below. D1a and D1b can be diodes or MOSFETs implemented with a redundancy controller. When using standard diodes, the module output voltage can be increased by adjusting the trim resistor Ru to compensate for the diode voltage drop. The PR signals between modules can be shorted together or left floating.

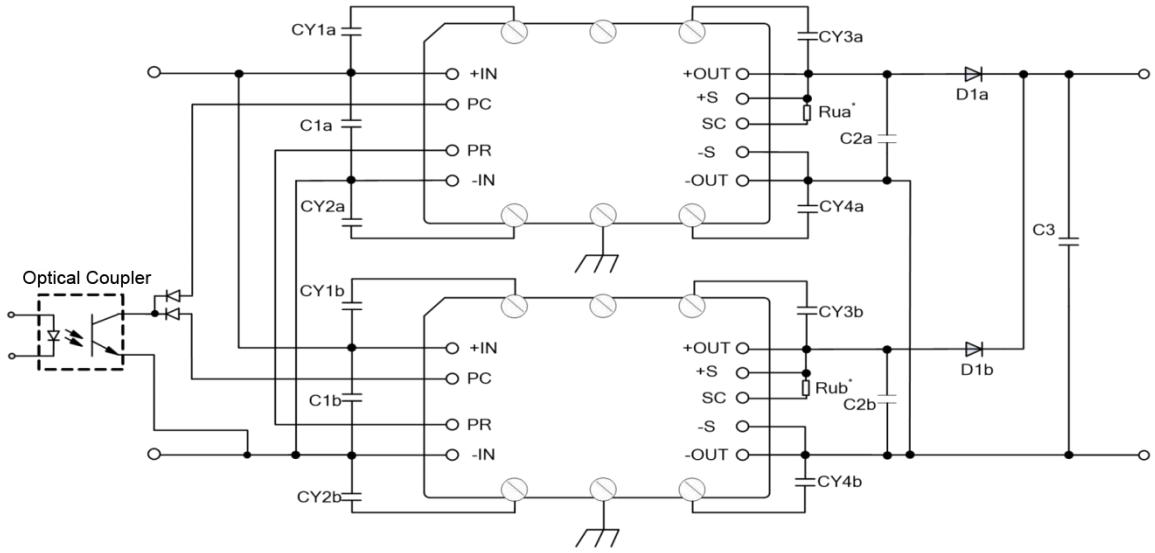

Figure 10 Redundancy Circuit

SC（Secondary Control Pin）

Output Voltage Adjustment

The output voltage can be adjusted using fixed resistors, a potentiometer, DAC output voltage, or programmable power supply module output voltage.

Decrease (Trim Down)

The power module does not have constant output power; it has a maximum output current limit. Therefore, when decreasing the output voltage, the output power decreases by the same percentage. Exceeding the maximum rated operating current is prohibited. The trim-down resistor must be connected to the -S pin. Refer to Figure 11.

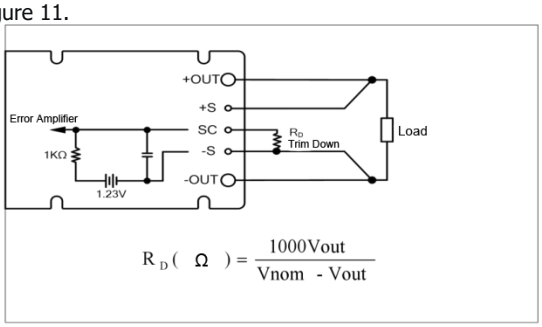

Figure 11 Output Voltage Trim-Down Circuit

Increase (Trim Up)

The module has a maximum rated output power. To ensure the output power does not exceed the rated value, when increasing the output voltage, the rated output current should be reduced proportionally by the same percentage. The trim-up resistor must be connected to the +S pin. Refer to Figure 12. Do not trim the module above the maximum adjustment range (+10%), as this may trigger the output overvoltage protection

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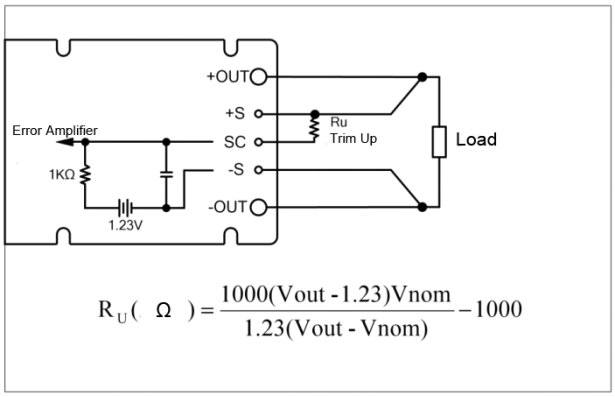

Figure 12 Output Voltage Trim-Up Circuit

Voltage Adjustment Notes

If an external circuit, such as an operational amplifier and digital-to-analog converter (DAC), is used to directly drive the SC pin for programmable output voltage control, the voltage that may be applied to the SC pin should be limited. Consider also the voltage offset caused during the startup of the external circuit. The external circuit must be referenced to the -S pin.

For systems requiring adjustable output voltage, the highest adjustable output voltage should be limited to slightly above the required voltage.

It is not recommended to connect external capacitors to SC.

+S，-S（Sense Compensation Pins）

The module's sense compensation pins must be connected directly to the output pins or at the final load point. When using sense compensation, the output wiring impedance combined with the load impedance may cause significant phase margin loss and lead to oscillation, potentially resulting in module damage, poor dynamic response, or triggering output overvoltage protection. Long sense lines may require compensation circuits to improve stability.

The voltage difference between the sense pins (+S and -S) and the output pins (+OUT and -OUT) must not exceed 1V.

The PCB traces for +S and -S should avoid creating large loop areas. For PCB routing, the Kelvin connection method is recommended; if using leads, the leads should be twisted together.

Do not exceed the module's rated power. The output power at the module's power output pins must not exceed the module's output power rating

Protection Mode Description

Input Undervoltage Lockout (UVLO)

The module has input undervoltage lockout protection. If the input voltage is below the UVLO threshold, the module cannot be enabled/started until the input voltage rises above the UVLO recovery point. If the input voltage falls below the UVLO threshold during operation, the module enters a protection state and the output voltage will drop.

After entering the protection state, the output voltage is shut off until the input voltage climbs above the UVLO recovery point, at which point the protection state is cleared. If the module is in the enabled state, it will start normally.

Input Overvoltage Lockout (OVLO)

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After entering the protection state, the output voltage is shut off until the input voltage decreases below the OVLO recovery point, at which point the protection state is cleared. If the module is in the enabled state, it will start normally.

If the input voltage transiently rises to 50V from the rated value and then falls back, and the duration at 50V is less than 100ms, the module will not enter the protection state.

Output Overvoltage Protection(OVP)

If the module detects that the output voltage is above the OVP threshold, it will enter an overvoltage protection state, and the output voltage will drop.

The module's output overvoltage protection is a latch-off type. The module cannot restart until the latch-off state is cleared. There are two methods to clear the latch-off state: disabling the module via the PC pin, or lowering the module's input voltage below the input undervoltage lockout (UVLO) point.

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Output Current Limit Protection(OVP)

When the output current increases beyond the maximum current, the output voltage remains constant until the current limit point is reached, after which the output voltage drops, exhibiting current limit protection mode. If the output voltage continues to drop below 50% of the rated output voltage, the protection mode transitions to "hiccup" mode. Once the overcurrent condition is removed, the module automatically resumes operation.

Overtemperature Protection (OTP)

The module has overtemperature protection. If the internal temperature is detected to be above the OTP threshold, the module enters an overtemperature protection state and the output voltage will drop. When the internal temperature is detected to be below the OTP threshold, the protection state is cleared. If the module is in the enabled state, it will start normally.

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