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A Study for Improvement of Power Distribution Component (PDC)

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1. Introduction

The process control cabinet consists of several sub-racks. Each sub-rack power delivered by backplane through power distribution component located in each sub-rack from main power. This power distribution component dissipates power like resistor between main power supply and cards. So some voltage drops are occurred.

This paper studies power distribution component improvement to reduce damage by over voltage, over current, voltage drop and to keep reverse polarity protection, power switching.

2. Simulation of Circuits

The power distribution component provides electrical inter-connection and protection circuitry for connecting the rack power supply to the nest field and component power buses [3].

It consists of two output channels, each with designed protection and alarm circuitry and output terminal. Two fuses (1 per channel) in the +5V and +15Vdc inputs protect the rack power supply component circuitry and the nest power buses from destructive overloads. Zener diodes across, a low voltage or power failure condition, including a blown fuse, releases the holding relays disconnecting the nest buses and actuating the power failure alarm. The Power status lamps on the front plate are lit when the corresponding +5V and +15Vdc outputs are functioning properly. If Fuses are blown, each fuse status lamps are lit [4].

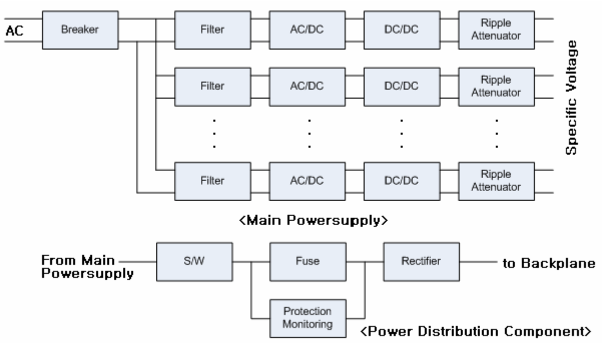

Figure 1. Block diagram of Main Power Supply and Power Distribution Component.

2.1 Electrical Solution

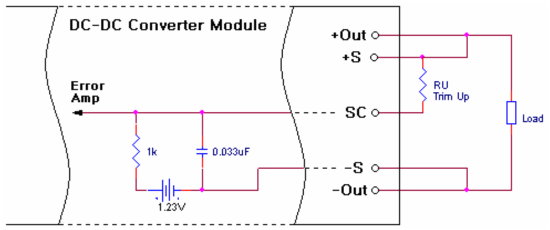

Figure 2. Output Voltage values can be adjusted for fixed trim up circuit and variable resistor cases for generation converters.

I) The output voltage of the converter can be adjusted or programmed via fixed resistors. Trim resistor values calculate like below (1).

$$R_U(Ohm) = \frac{1{,}000(V_{OUT} - 1.23)V_{NOM}}{1.23(V_{OUT} - V_{NOM})} - 1{,}000 \qquad (1)$$

The converter is rated for a maximum delivered power. To ensure that maximum rated power is not exceeded, reduce maximum output current by the same percentage increase in output voltage.
The trim up resistor must be connected to the +Sense pin.
Do not trim the converter above maximum trim range (typically +10%) or the output over voltage protection circuitry may be activated.

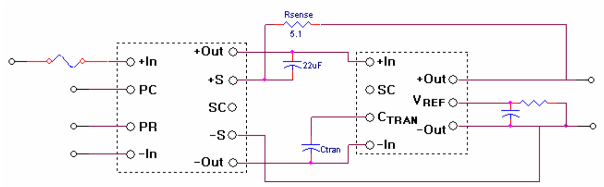

Figure 3. Configured ripple attenuation circuit using remote sensing and affixed optional component to make stable.

II) Output ripple attenuation combines both active and passive filtering to achieve greater than 40dB of noise attenuation from 60Hz to 1MHz. Some of the optional component can be optimized performance by addition. Allowable ripple voltage on the bus (or ripple current in the capacitors) may define the capacitance requirement. Consideration should be given to converter ripple rejection and resulting output ripple voltage. The ripple rejection(R) of converter is specified as a function of the input/output voltage ratio (2):

$$R = 30 + 20\log\left(\frac{V_{in}}{V_{out}}\right) \qquad (2)$$

The capacitors must hold up the bus voltage for the time interval(Δt) between peaks of the rectified line as (3):

$$\Delta t = (\pi - \theta)/2\pi f \qquad (3)$$

Where : f = line frequency
θ = rectifier conduction angle

The approximate conduction angle is given by (4):

$$\theta = \cos^{-1} V_2 / V_1 \qquad (4)$$

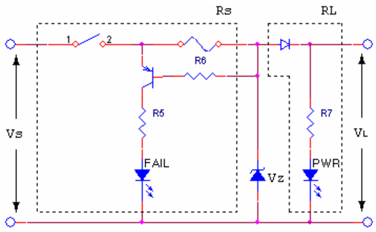

Figure 4. Typical configuration of power distribution component what applied zener diode to protect over voltage.

III) The same voltage of series resistor as subtract zener voltage from power supply voltage, flowing current to resistor can solves like below.

$$P_Z = V_Z \cdot I_{z\max} \qquad (5)$$

$$\frac{V_L}{R_L} = I_Z = \frac{(V_S - V_Z)}{R_S} \qquad (6)$$

$$V_L = V_Z = \frac{R_L \cdot (V_S - V_Z)}{R_S} \qquad (7)$$

Figure 4 is a kind of single loop circuit. The current that flow all parts is equal. Therefore, if series current is known, zener current can know too. The more increase power supply voltage, the more increase zener current, but output voltage fixed zener voltage regularly [1].

2.2 Mechanical Solution

According to UL 796 Printed-Wiring Boards [2],

1) Rigid printed-wiring in board must place minimum 1/64 inch(0.4 mm).

2) Valid maximum conductor width is 50.8mm, if it adopt conductor which more wild width pattern, it have to take away mask.

3) Must have gap over 1.0mm between machine hole and conductor.

4) Wiring route thick and short as much as possible.

5) Make wide diameter hole for parts fix.

Experiment and got data as follows integrating method to refer over. Complex test environment is below Figure 5. Figure 6 & 7 are data of V/I rate when simulate and test.

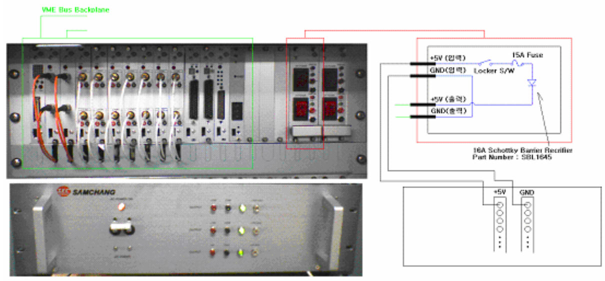

Figure 5. The examination of integrated system is consists of power distribution component and main power supply.

Following graphs are data that experiment circuit does not apply method to present before.

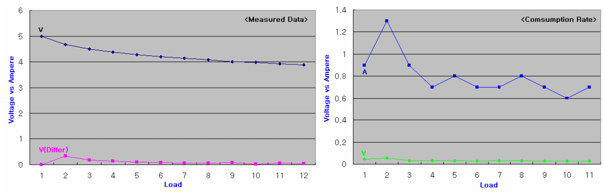

Figure 6. The data of Power Distribution Component by increase load and voltage, current consumption.

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Following graphs are data that simulated and experiment circuit apply method to present before.

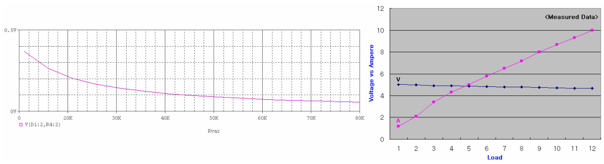

Figure 7. The comparison of the data due to simulation and experiment by improved circuit.

3. Conclusion

In this paper, we will provide power distribution component improvement methods. It proposed methods improvement performance by electrical and mechanical solution. So these methods contribute to reduce the expected noise and voltage drops of a system.

REFERENCES

[1] Malvino, Electronic Principles Fifth Edition, p.131, 1996.
[2] UL(Underwriters Laboratories Inc.) 796, Safety Standard of PCB.
[3] Foxboro SPEC 200 Systems User's Manual. TI200-256 Page1-4.
[4] Foxboro Composite Instruction Manual(No.97-1060) S.O.NO.97F53252, MI 280-325, October 1995.