Application Note

Low R_{on} Multiplexers in PLC Applications

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ABSTRACT

This application note goes over the beyond the supply multiplexer TMUX4821 implementation in PLC applications and how the application offers a design that maintains precision signals and reduces BOM count. The TMUX4821 accomplishes so by having a very low on resistance (R_{on}), on resistance mismatch between channels (ΔR_{on}), and on resistance drift across temperature (R_{drift}). Allowing this to switch between voltage and current mode readings removing the need for two ADCs.

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Trademarks

1 Introduction

In industrial environments where many systems are operating, it is important to monitor the state of the systems. A common solution is to use Programmable Logic Controllers (PLC). They capture data from the system, which is checked by a program logic and then outputs the appropriate response. To do so, PLCs function with analog I/O modules. Analog Input Modules (AIM) send analog readings to the PLC containing an Analog Output Module (AOM), which performs an action based on those readings. This system includes two ADCs to read the sensor signals in current and voltage modes. These signals have to be accurate and retain the integrity to read the precise state of the device being monitored. Instead of having two ADCs (one for each mode), the TMUX4821 can be implemented. This results in the need for only one ADC to read in both modes. This reduces the BOM count and still maintains precise signal integrity, due to the TMUX4821s very low R_{on} profile**.**

2 Application

A common design of PLCs includes Analog to Digital Converters (ADC) where they sample analog readings from the monitored devices and output a digital response. They usually read current or voltage inputs from the sensors. A design implementation is shown where two ADCs are used, one for current readings and the other for voltage readings. The burden resistor is there to convert the current to voltage, which is then sampled by the ADC.

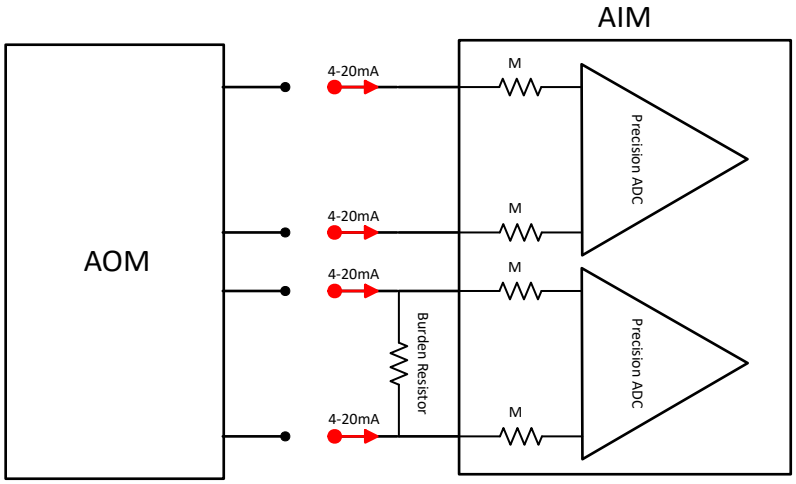

Figure 2-1. ADCs Implementation in PLCs

Having two ADCs is common for this application, but they do substantially increase the footprint of the PLC. A potential design is to remove one of them and reroute the signals in such a way where one ADC can sample both current and voltage readings. That is where the TMUX4821 can provide a design. It is a very low Ron (0.19Ω typical) beyond the supply multiplexer with powered off protection. Implementing this on the signal path of the burden resistor allows the ADC to switch between the current and voltage modes. When the switch is closed there is a path for the current to flow through the burden resistor allowing current mode readings by the ADC. The very low on resistance of the multiplexer results in a trivial change on the total resistance on the line preventing any additional error in measurements, while allowing for more functionality. With the switch open and the mux disconnecting the burden resistor path, the precision ADC can operate in voltage mode. With the switch closed there is a path to the burden resisting allowing to operate in current mode.

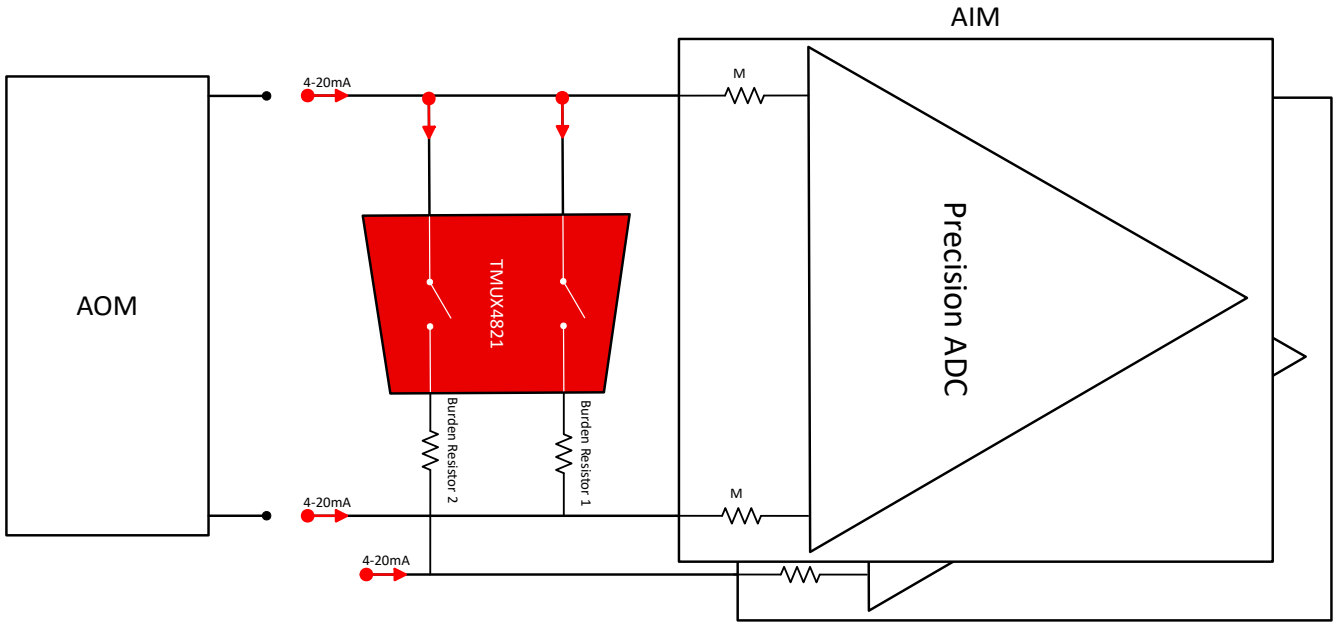

Figure 2-2. TMUX4821 Implemented With Two PADCs

A single TMUX4821 can support two precision ADCs. Without the TMUX4821, four ADCs must be used, increasing the BOM greatly. Implementing the mux in such a way cuts in half the amount of PADCs in PLC systems.

3 Summary

The TMUX4821 has low R_{on}, ΔR_{on}, and R_{drift} which allows this to be implemented in the AOM and AIM systems of the PLC, while maintaining precision voltage signaling and reducing the size of the PLC. The low R_{on} helps to minimally affect the total resistance of the burden resistor line. Additionally, it can switch between the current and voltage modes of the PLC, removing the requirement for two PADCs to be implemented in the system for each mode. This greatly reduces the footprint of the PLC, while maintaining accurate readings from the sensors monitored by the PLC.

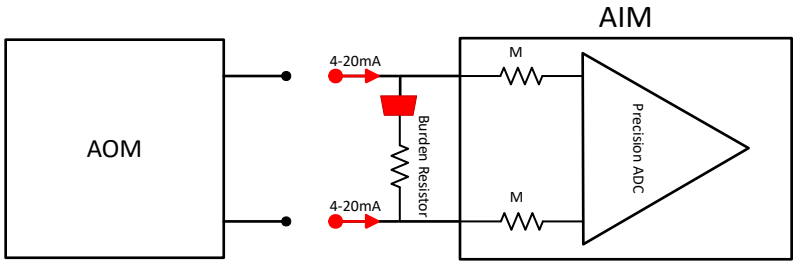

Figure 3-1. Mux Design in PLCs

4 References

- Texas Instruments, Multiplexers and Signal Switches Glossary application note.
- Texas Instruments, Selecting the Correct Texas Instruments Signal Switch application note.

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