

Problem statement

ArcelorMittal requires a signal to be transmitted up to one half mile between substation and control room within their facility continuously. The project will serve as an alternative system to the current transmission system which is over 50 years old.

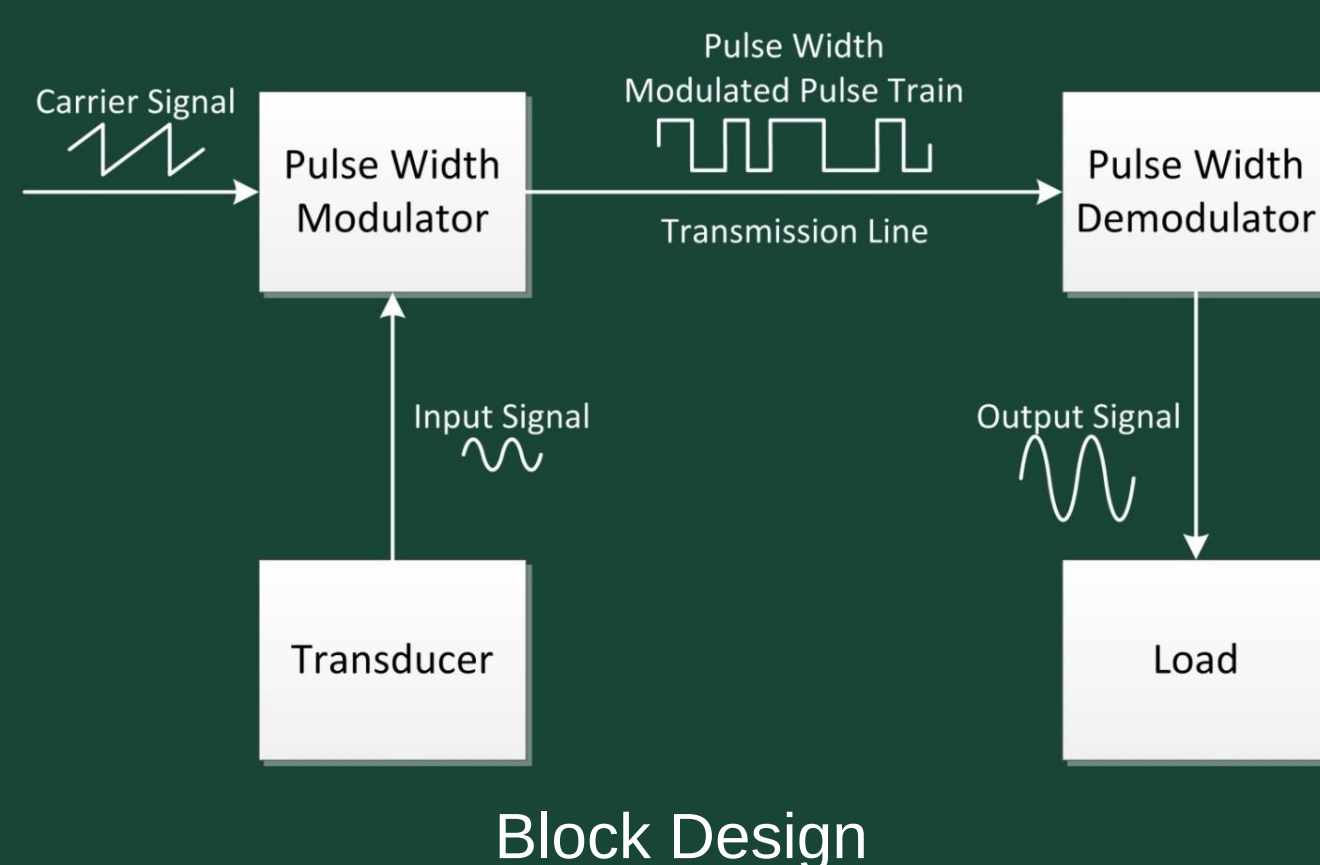


Design Requirements

- Transmit load signal up to one half mile with minimal error
- Utilize the existing 0-100mV input signal from the transducer
- Output a signal in a range of 1-5V, 4-20mA to a programmable logic controller
- **Achieve high standard of reliability**

Design Approach

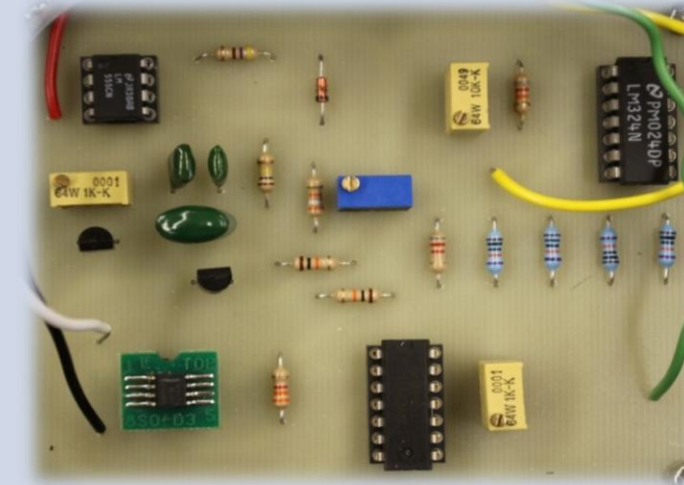
Pulse Width Modulation (PWM) was chosen as the method of signal transmission. PWM was selected due to its ability to maintain a high degree of integrity of transmitted data regardless of potential signal noise over transmission line lengths. PWM, as a design solution, can also be implemented within the project's \$500 budget limitation.



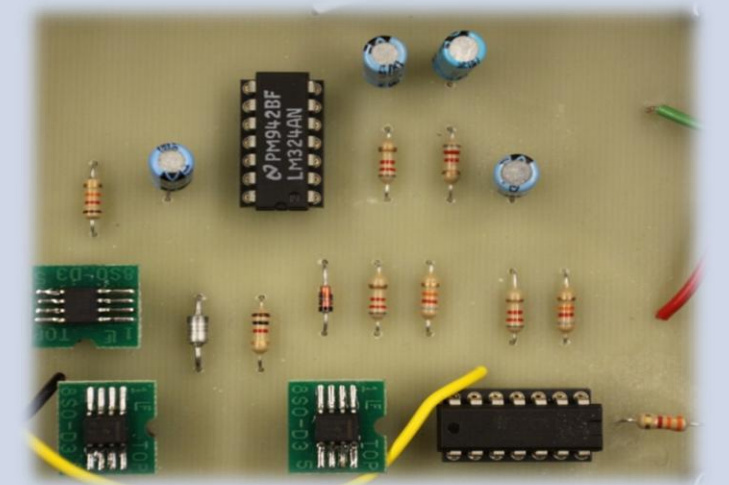
Block Design

Circuit Design

The PWM circuit consists of a transmitter and receiver. The transmitter modulates the transducer input with a sawtooth carrier converting the input signal into a pulse train for transmission. The receiver demodulates the pulse train and converts the signal into a linear analog voltage variation between 2-4V representing the linear 0-100mV transducer input variation.



Transmitter

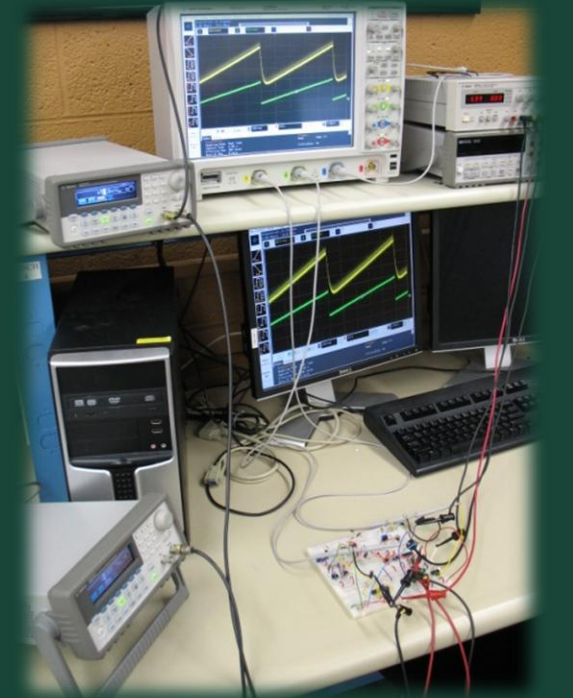


Receiver



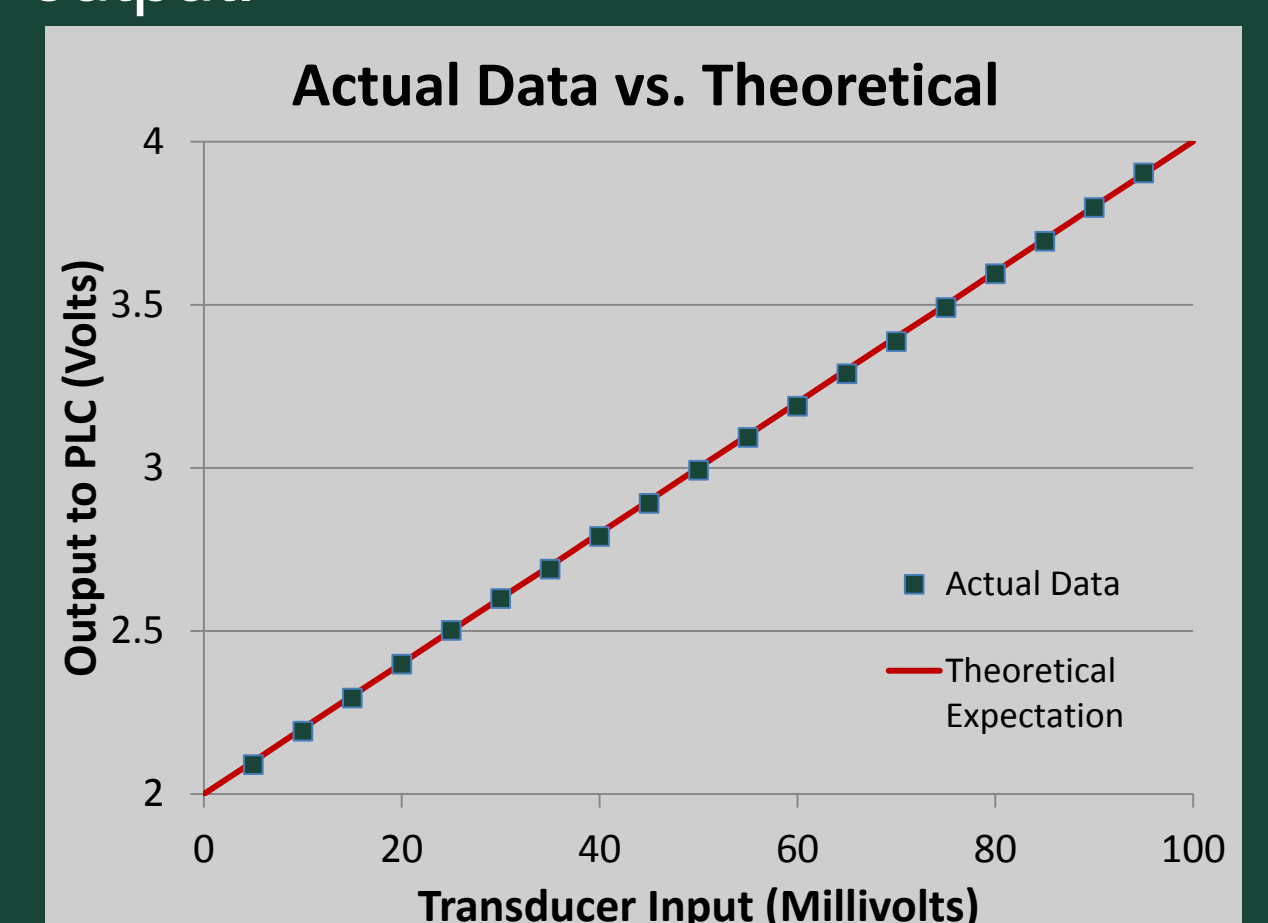
Testing

The final PWM transmission circuit underwent several tests to determine the maximum and average amount of errors presented in transmitting from the transmitter to the receiver using a 500 foot long twisted-pair transmission line in the laboratory.



Conclusion

During multiple tests, the average error was 0.27% and the maximum error was 0.94% from the desired linear output. The figure below displays actual tested data vs. theoretical expectation, which is ideally 0% error in linear relation between the input and receiver output.



Final Cost

Final Project Cost		
Items	Qt.	Total Cost
OPA140 (adapter)	4	\$48
Precision resistors	4	\$2
Twisted cable (500ft)	1	\$12
Project box	2	\$13
Insulate Stands (4 pc)	2	\$7
Total		\$82

*PCB fabrication and other transistors are donated by ECE shop

Future work

- Use high precision components
- Use better shielded twisted cable for transmission
- Develop a better noise/vibration-resilient enclosure
- Attach a digital voltage meter for maintenance monitoring

Team 5

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