Center for Embedded Systems

An NSF Industry/University Cooperative Research Center

All-optical embedded fiber-optic up/down-links for motor controller

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Project Overview and Description

- **Project Description**

Design of all-optical bi-directional linkage of the power switches (PS) and sensors which are embedded in a harsh environment (125^{o}c) to the control/gate drives (CD) electronics in a benign environment (70^{o}c).

Gate Drive Requirement	
Von	20v
Voff	-5v
Drive Power	1w
Peak Gate current	3A
Drive frequency	100 kHz
Min max duty cycle	5%-95%
Ambient temp	-55C 125C

Current Sensor Requirement	
Max Amplitude	300 A
Frequency	200 kHz
dI/dt	100 A/us
Ambient Temperature	-55C 125C

Voltage Sensor Requirement	
Max Amplitude	1000 V
Frequency	10 kHz
dv/dt	1000 V/uS
Ambient Temperature	-55C 125C

Approach

- Implementation of optical links connecting the Control Drives (CD) plate to the Power Switches (PS) plate through the typical light sources (LEDs) located in CD side and the high-temperature photodetectors located in PS side .
- Implementation of the optical down-links from the harsh environment through the high-temperature LEDs to the benign environment (CD side) via photodetectors.

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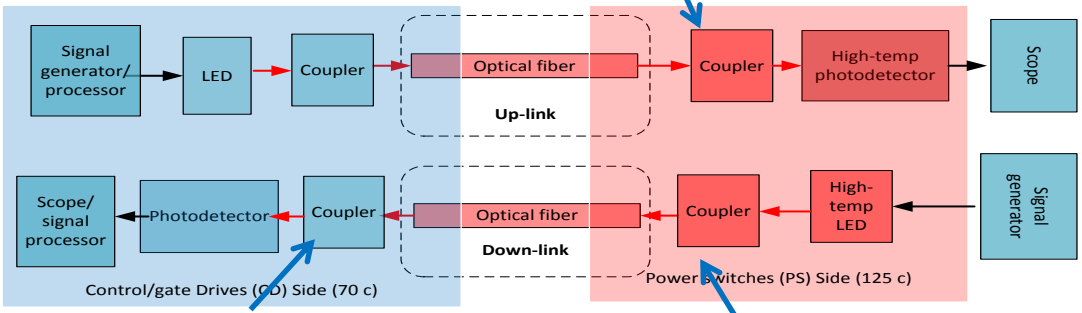

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Project Status

- **Phase I:**
- **Study the existing off-the-shelf optical components for the up-link. – done**

- **Study the existing off-the-shelf optical components for the down-link. – done**

- **Prepare a proposal for a follow-up project to address an architecture of the optical uplink and downlink. – done**

- **Phase II:**
- **Design, build, and test the up-link and down-link according to the industry specifications. If needed, apply the back-error propagation network for reduce the unwanted disturbances. – planned**

Project Tasks/ Deliverables

	Tasks Description	Date	Status
1	Design the up-link according to the industry specifications.	Aug. – Dec. 2013	planned
2	Build the up-link where the detector is in the harsh environment.	Aug. – Dec. 2013	planned
3	Test the up-link for noise and nonlinearity. If needed, apply the back-error propagation network for reduce the unwanted disturbances.	Jan. – March 2014	planned
4	Design the down-link according to the industry specifications.	April – May 2014	planned
5	Build the down-link where the LED is in the harsh environment.	June – July 2014	planned
6	Test the down-link for noise and nonlinearity. If needed, apply the back-error propagation network for reduce the unwanted disturbances.	August 2014	Planned
7	Report	August 2014	Planned

- **Deliverables: A report with the detail design, build, and test results of the fiber-optic links will be given.**

Executive Summary

- This project is to design, build, and test an all-optical bi-directional embedded linkage for the power switches (PS) and sensors which are placed in a harsh environment to the control/gate drives (CD) electronics in a benign environment.

- The optical isolation of the high-temperature power switches from the control/gate drives will enhance the performance and cost-effectiveness of the state-of-the-art high power motors. The embedded optical links will provide a high-temperature tolerant, EM interference free, and light-weight linkage.

- High-temperature (< 225^{o}c) AlGaAs photodiodes are used to convert the optical signal to electrical one.

- To convert the sensory data to the optical form, a GaAlAs high-temperature (<125^{o}c) LED is directly modulated.