InspeCO2

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IMPRESS Lidar Control Interface

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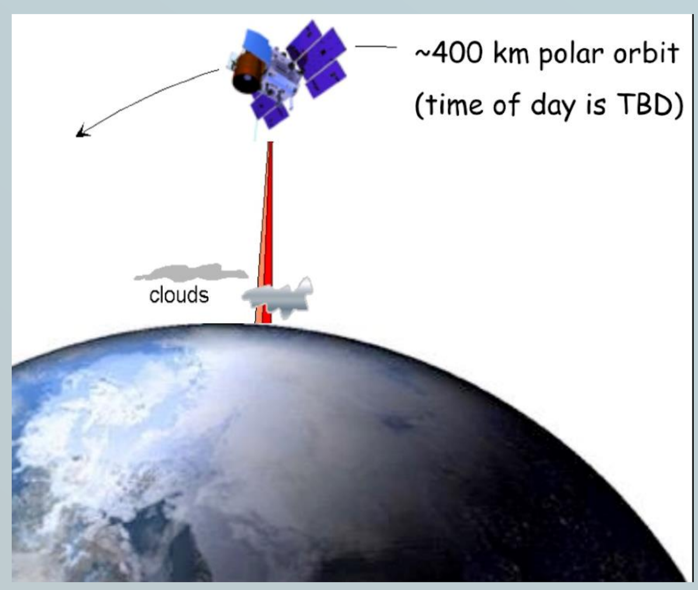
Background

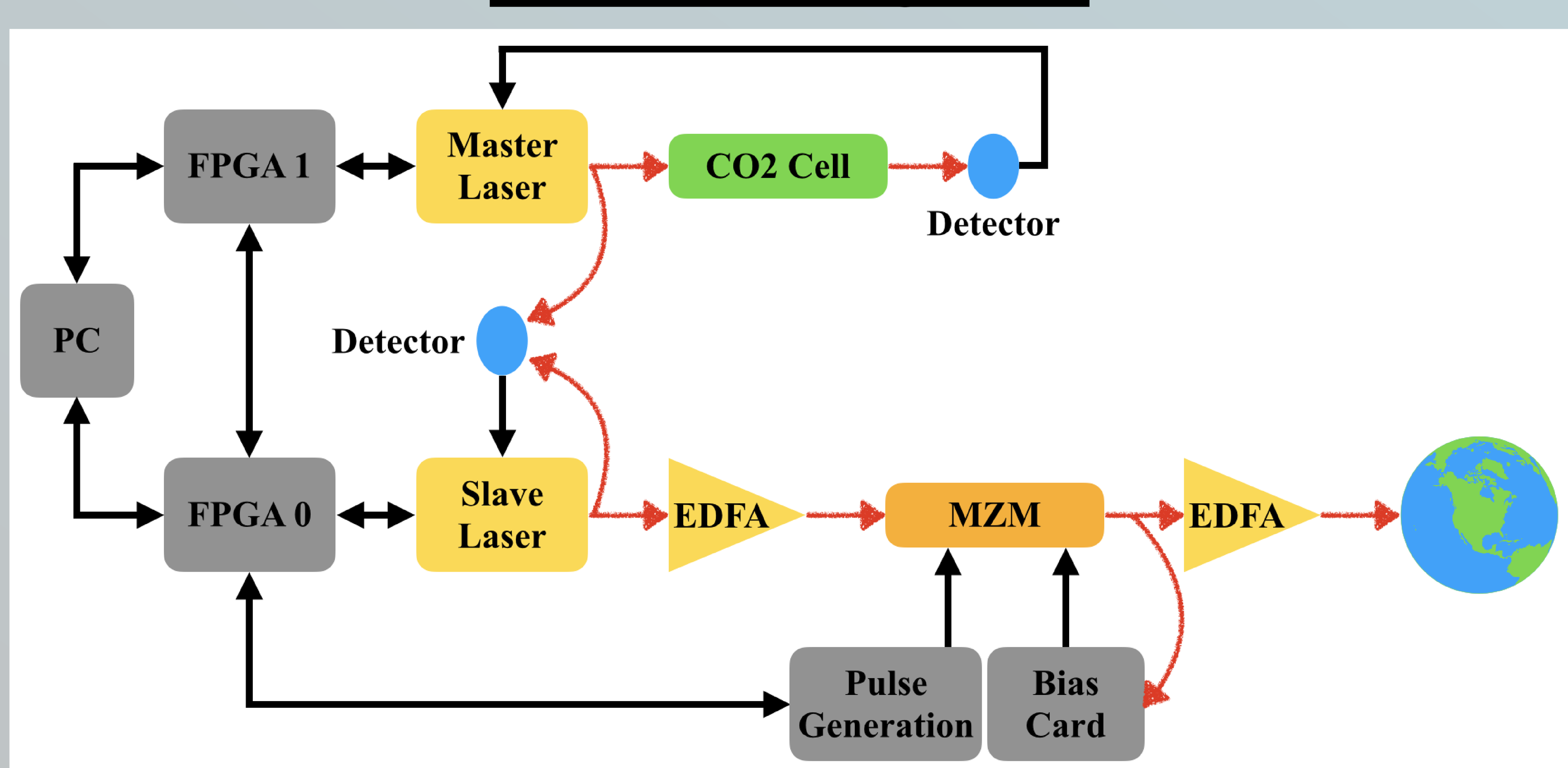
Global warming is an issue that affects the earth and is being addressed by gas sensing systems to monitor greenhouse gases. IMPRESS Lidar is a lidar system used to sense CO_2 in the Earth's atmosphere using photonic integrated circuit technologies and has a major need for a control system. InspeCO$_2$ is a control system designed to be user friendly while offering complete control over the photonic integrated circuit.

Overview



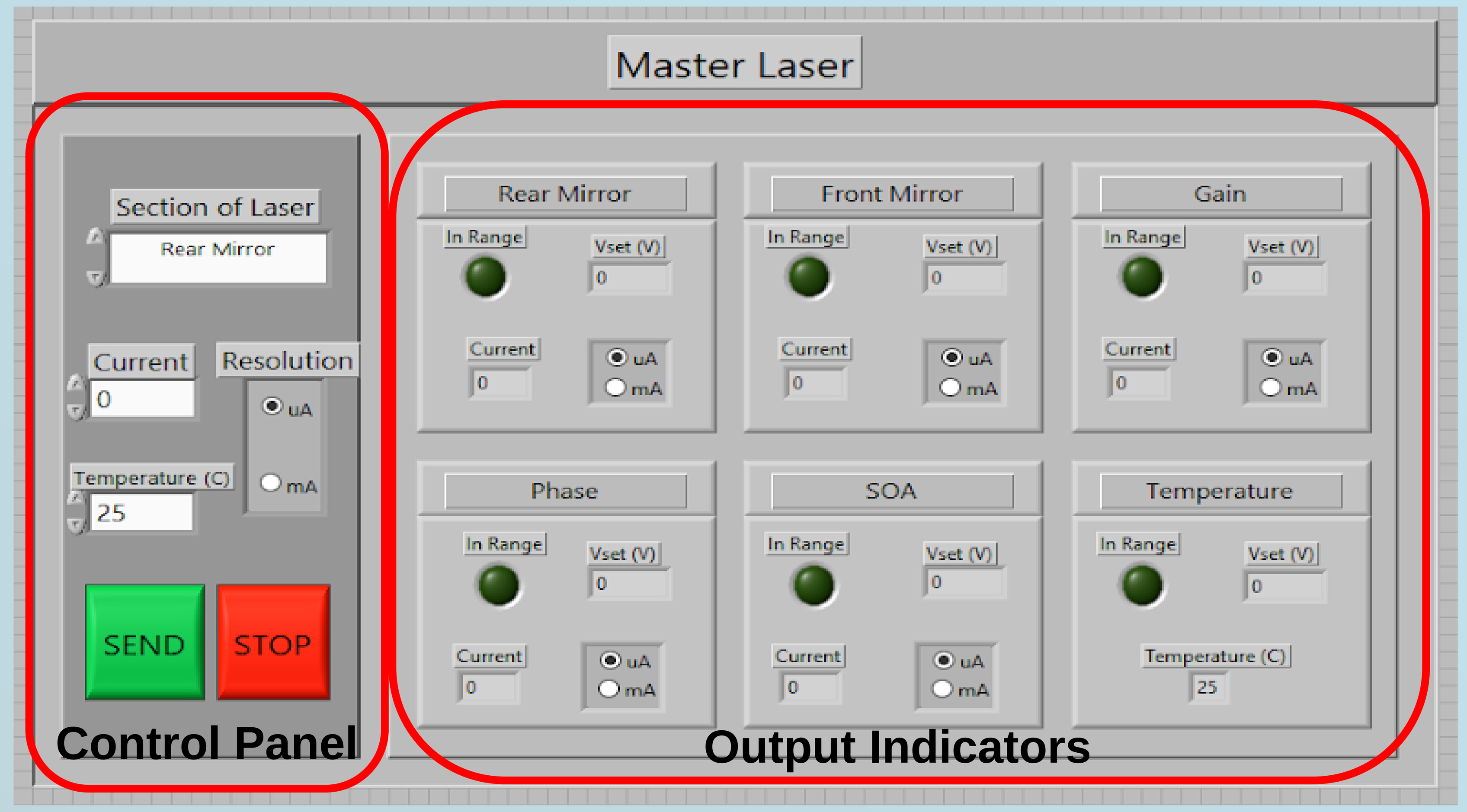
The IMPRESS Lidar system is designed to measure the concentration of atmospheric CO_2. Small enough to fit on a satellite, it includes a master and slave laser integrated on a single photonic integrated circuit (PIC) along with associated electronics. The master laser is locked to a CO_2 cell phase locked to the slave laser. The slave laser emits pulses of light which are reflected off the Earth's surface. The atmospheric CO2 concentration is determined through measurements of the reflected light.

Block Diagram



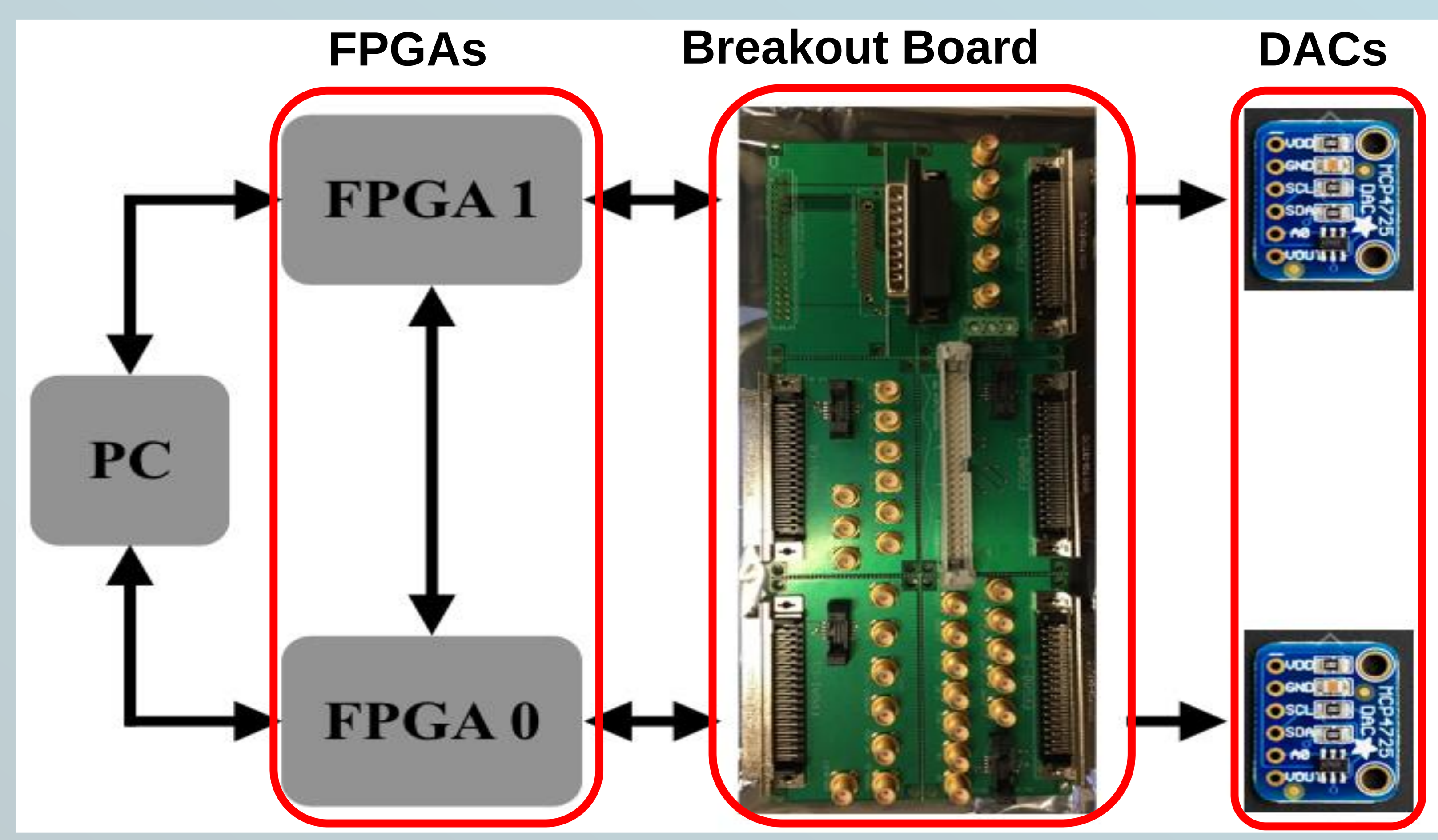
- System controls/monitors the PIC
- Photonic components of PIC (yellow and orange) are controlled by electronic components (grey)
- Black arrows show electrical signals while red arrows show optical signals

User Interface



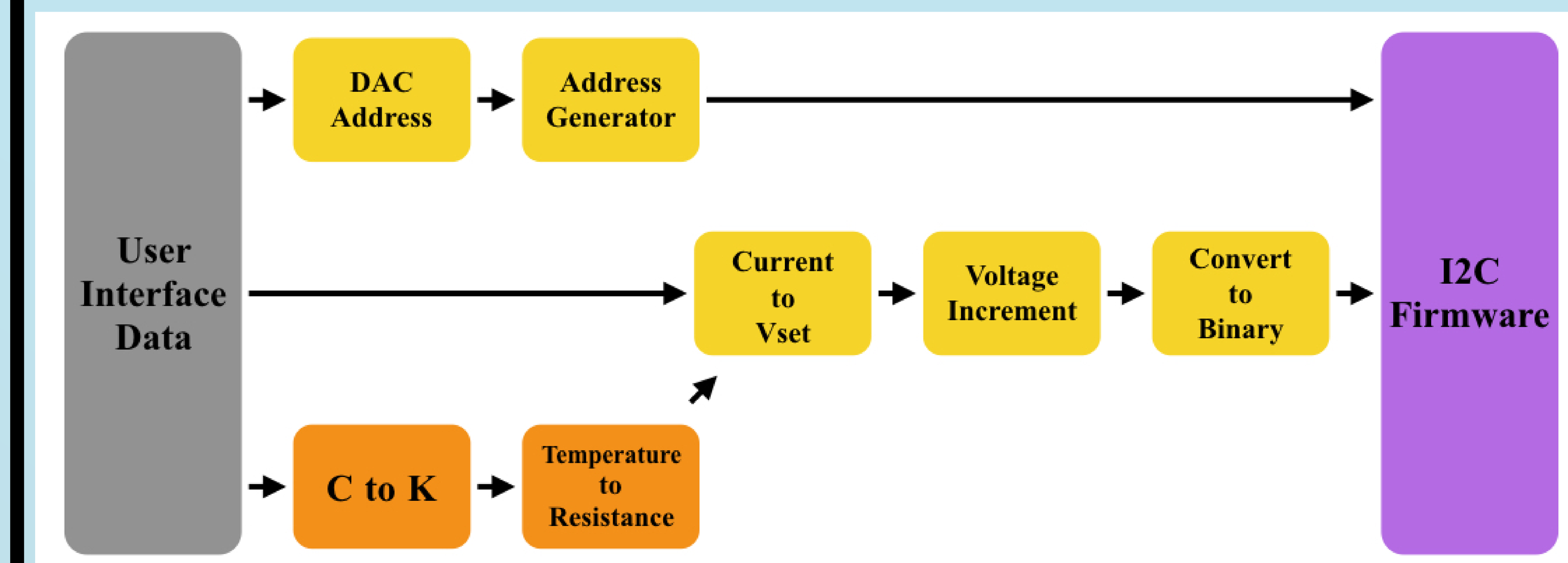
- **Control Panel** - Enter current for laser drivers (LD) or temperature for temperature controller (TEC) and section of PIC, then send information to firmware
- **Output Indicators** - Shows the voltage levels that are set by the DACs

Hardware



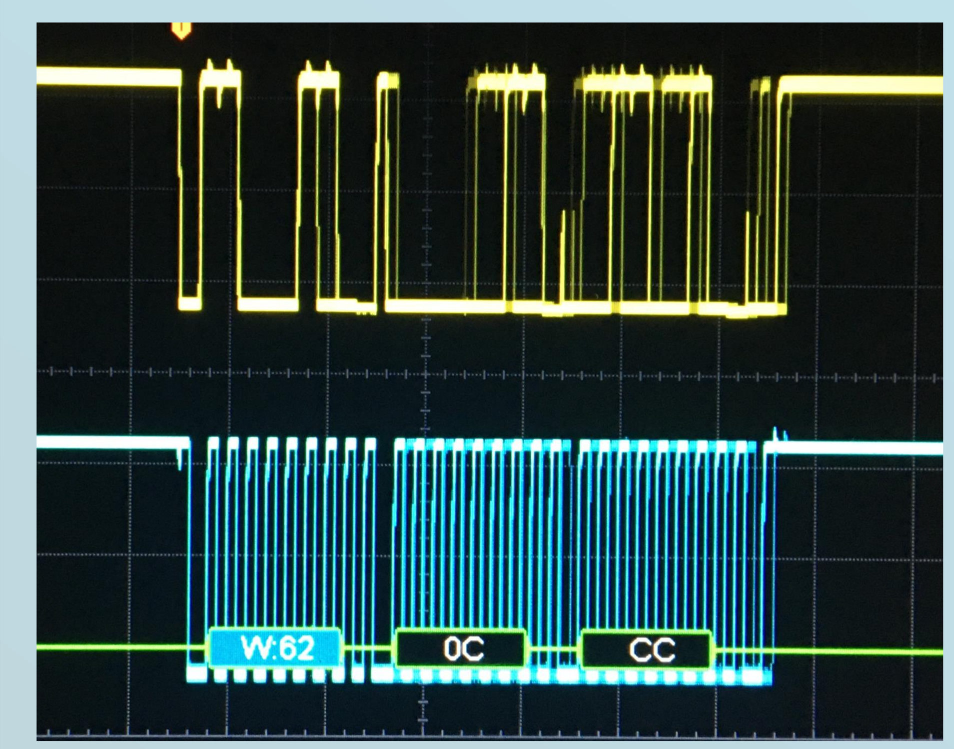
- **PC** - Develop/run firmware and user interface
- **FPGAs** - Sends/receives data using I^{2}C Communication between PC and DACs
- **Breakout Board** - Provides access to digital/analog signals from the FPGAs to the DACs
- **DACs** - Sets voltage to LDs and TECs
- **PIC** - Hosts photonic components of the system

Software/Firmware



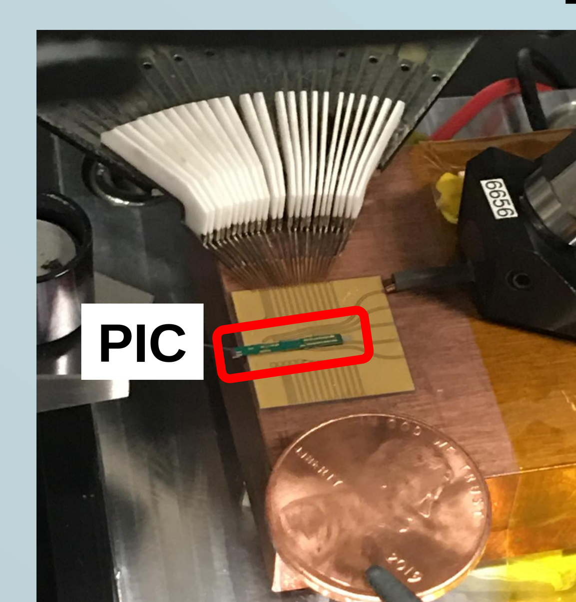
- **Section of the laser** selected is processed by finding the specific DAC and generating an address for it
- **Temperature** is converted to find resistance, then used to calculate voltage for temperature controller
- **Current** is used to calculate voltage for laser drivers
- DAC address and voltage are converted into binary data which are sent to the I^{2}C firmware to communicate with the corresponding DACs

Results



- Decoded SDA(top) & SCL(bottom) signals seen on oscilloscope
- Image proves a functional user interface and successful firmware

Future Work



- Image shows a green PIC on gold carrier compared to a penny
- Test using the PIC
- Develop automated test program
- Incorporate more modules into user interface

NASA Goddard Space Flight Center | iPL Integrated Photonics Laboratory

Acknowledgements: We would like to thank our sponsors and mentors
Dr. Ilan Ben-Yaacov, Dr. Reza Abdolee, Evan Blasband
Professor Jonathan Klamkin, Joseph Fridlander and the Integrated Photonics Laboratory (iPL)

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