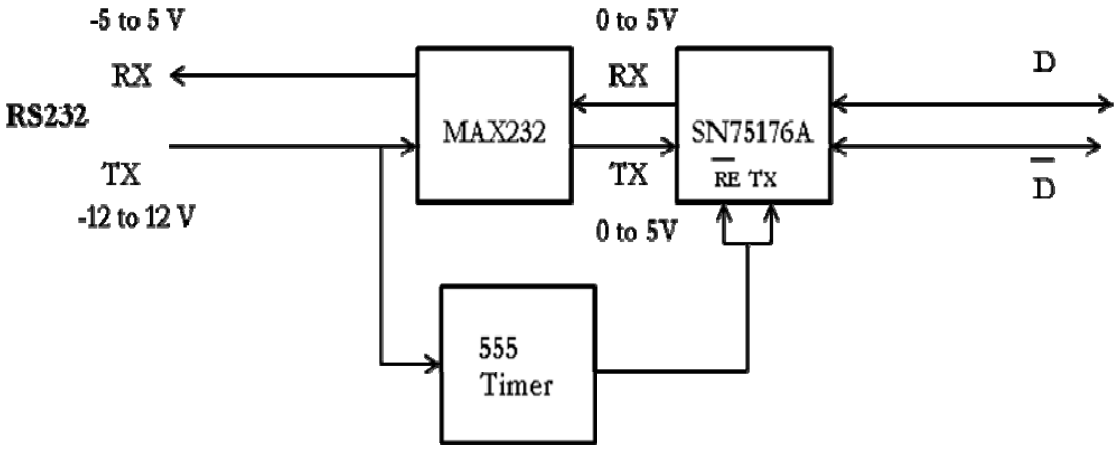
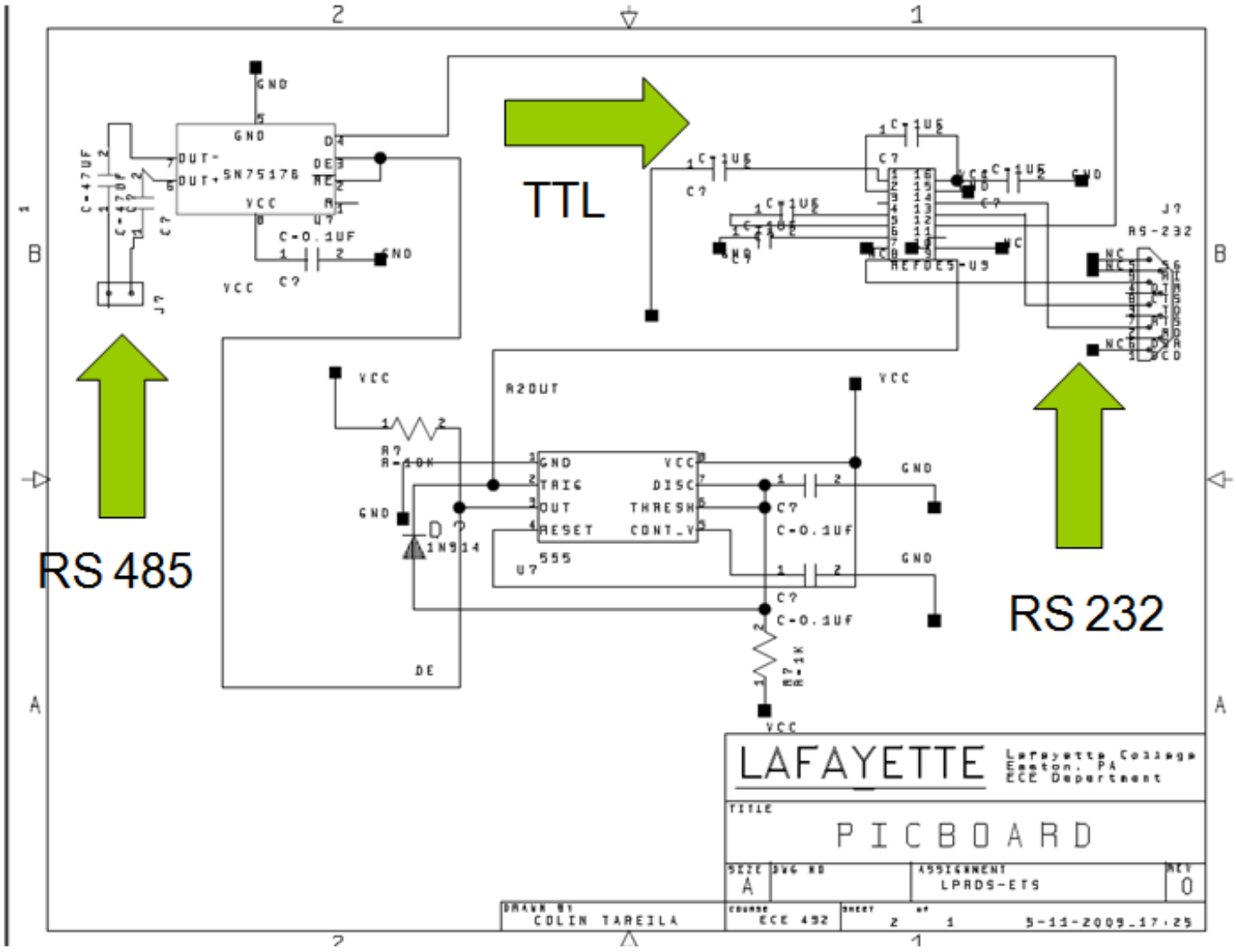
LPRDS Communications and Protocol

Design Topology

The team decided on a half duplex differential transmission bus for communicating information. Two different types of drivers were chosen to meet the specified requirements of separating out the high voltage and low voltage sides of the system. To summarize the EDS, ESS, and RPI PIC sit in a high voltage area of the boards thus the communication line had to be isolated from this potentially dangerous hazard. An IL3285/IL3222 bidirectional differential bus transceiver using magnetic isolation and 40mW power consumption was chosen for the several reasons. It provides 2500 V_{rms} protection for up to one minute, it has an internal bias circuit to ensure a high receive signal in the event of a break in the transmission line, it supports a data rate of 5 Mbps, and converts the 0-5V serial transmission from the PIC into a differential signal and converts a received differential signal into 0-5 for the PIC.

On the flip side a non isolated SN75176Achip was used as the differential bus transceiver on the SCADA board since the absence of high voltage was seen on it. It was realized that this could not function as a standalone transceiver on the SCADA board because this is where an RS232 conversion was needed. The SCADA PC is limited to generating a standard ±12 V RS232 signal that is not usable by the differential transceiver itself. The voltage first had to be converted to TTL using a MAX232 IC with a 555 timer to act as the transmit/receive enable signal to the transceiver chip. A data flow diagram and circuit has been provided

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Communications Protocol

The communications protocol emulates an RS422/485 system operating at 38400 bps. It is a half duplex master/slave domain with the SCADA PC as the master and PICs as slaves where the PIC communicates with the SCADA PC only when asked. Each active PIC sensor, analog or digital, is polled at least once per second for their value. The communications network is also used for writing to various digital pins that carry out functions configuring the system, sounding an alarm, silencing an alarm, and writing to LEDs. In addition, the communications line is watched by the SCADA board PIC to ensure that there is a continuous stream of communications. If it sees a break in the communications signal for 2 seconds it with trip the system by breaking the safety switch. A command protocol was designed to meet the above requirements as shown below.

2009 LPRDS Communications Protocol

38400 bps Half Duplex Differential Bus

Master/Slave Domain Base

Destination Address
Source Address
Check Sum

Error Type	
0x00	No Error
0x01	No Sensor
0x02	Check Sum Error
0x03	Invalid Opcode
0x04	Packet Short
0x05	Packet Long
0x06	Wrong Pin Type
0x07	Port OB

Supervisor Op	
0x00	System Startup
0x01	System Shutdown
0x02	Simulate Fault
0x03	Force Disconnect of Load
0x04	Force Disconnect of PV Power
0x05	Force Disconnect ESS
0x06	Reprogram EDS Warning

Get Analog Value

Sent			#bytes	Command 0	Channel 1-12		
Return			#bytes	Error Type	MSB	LSB	

Set Pin High

Sent			#bytes	Command 2	Pin		
Return			#bytes	Error Type	Byte Stuff	Byte Stuff	

Supervisory Control

Sent			#bytes	Command 4	SOP		
Return			#bytes	Error Type	Byte Stuff	Byte Stuff	

Get Digital Value

Sent			#bytes	Command 1	Pin		
Return			#bytes	Error Type	Value	Byte Stuff	

Set Pin Low

Sent			#bytes	Command 3	Pin		
Return			#bytes	Error Type	Byte Stuff	Byte Stuff	