



Overview of Electronics

I425 Wilsonville Robotics

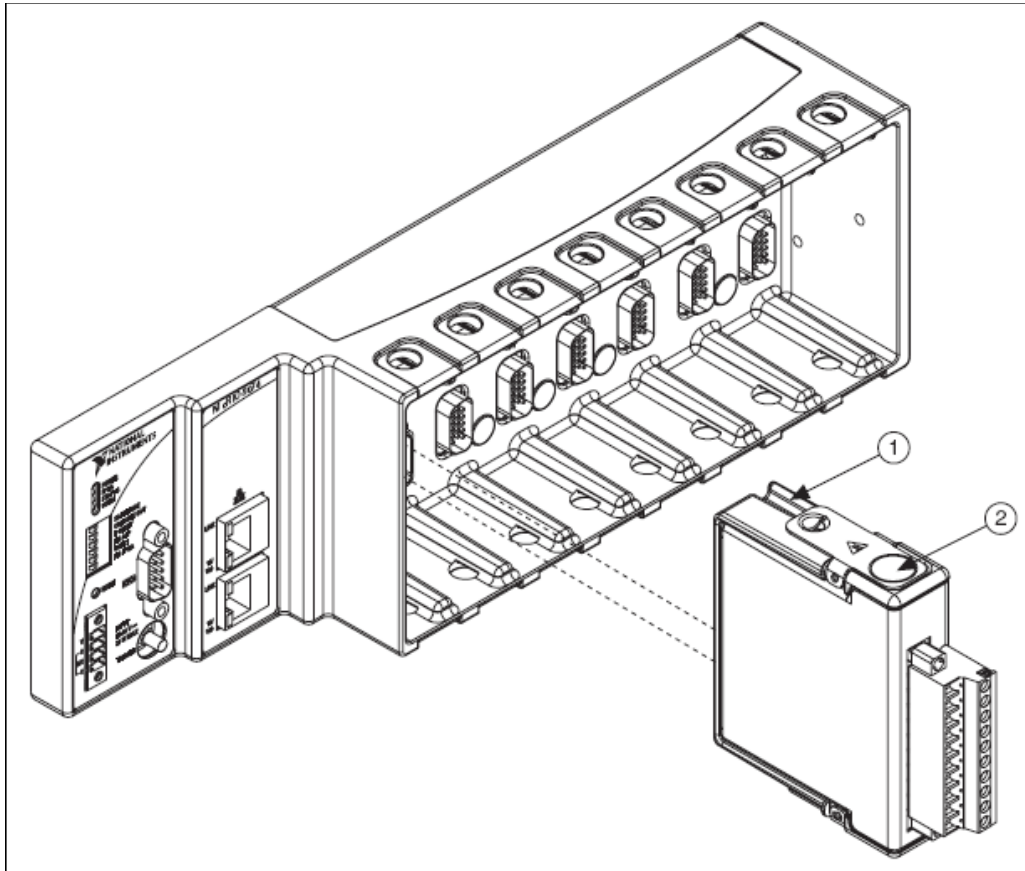
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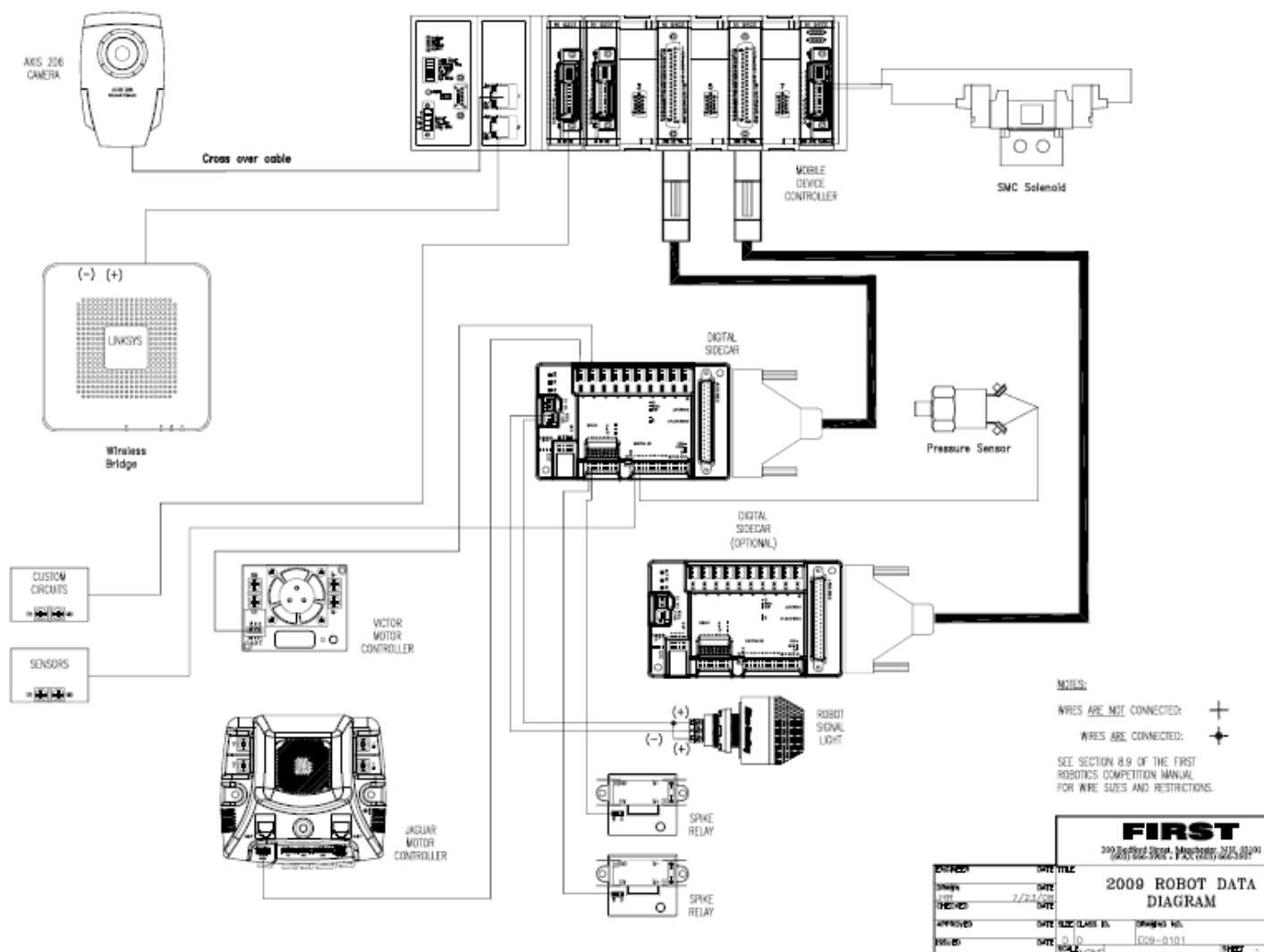
(503) 449-9507

At a glance

- Second year with NI controller (cRIO)
- New Driver's Station Approach



Robot Schematic - 2009





Elements of the System

- National Instruments cRIO
- Digital Sidecar
- Power Distribution Board
- Analog Bumper
- Pneumatics Bumper
- Driver Station – NEW!
- Wireless Interface (802.11)
- Camera
- Jaguar Speed Controller



cRIO

- Modular Controller, Industrial Strength
- Comes with multiple interface modules
 - 2 Analog Input Modules
 - Plus 2 Analog Bumpers
 - 2 Digital Input/Output Modules
 - Connect via really big cable to Digital Sidecar
 - 1 Digital Output Module
 - Use with Solenoid Bumper
- Veteran teams will get fewer parts

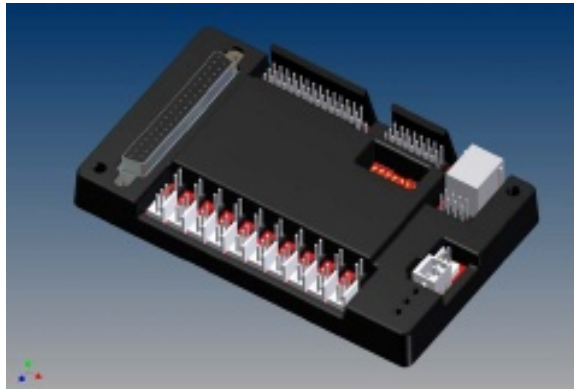
cRIO and Modules



Digital Sidecar

- Connects to cRIO9403 with 32-pin cable
- Provides
 - 10 PWM outputs (Victors, Jaguars, RC servos)
 - Can be configured on a per-output basis to drive 6V RC servos with jumpers
 - 14 GPIO with +5V on each
 - 16 Relay Outputs
 - I²C headers (Standard and NXT-compatible)
 - 12V supply,
 - Provides +5V output
 - Reverse polarity protected

Digital Sidecar



GPIO and spare power connections
(the pin closest to the PCB edge is hidden by the locking tab)

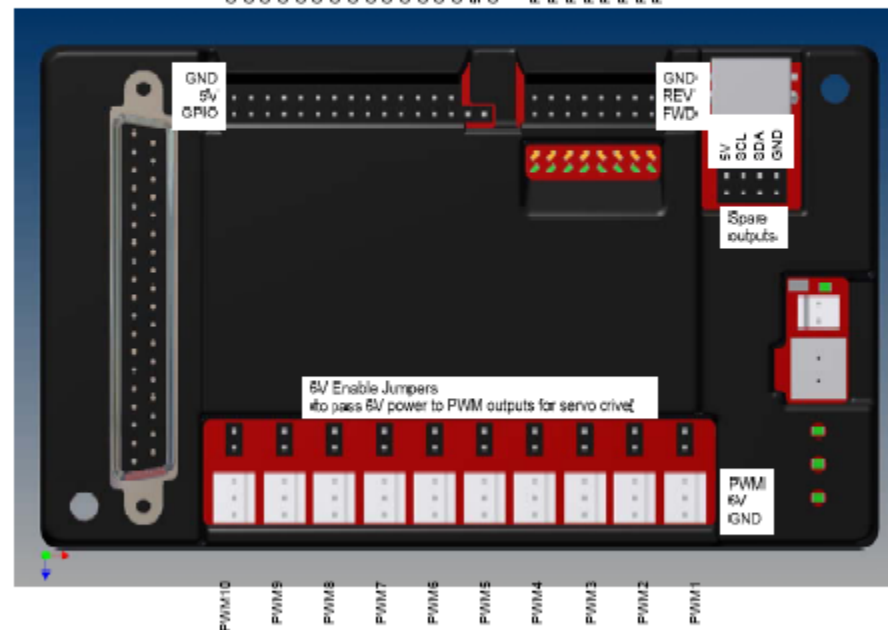
Relay Outputs
(the pin closest to the PCB edge is hidden by the locking tab)

NXT-compatible Port and Spare I2C Header

GPIO14
GPIO13
GPIO12
GPIO11
GPIO10
GPIO9
GPIO8
GPIO7
GPIO6
GPIO5
GPIO4
GPIO3
GPIO2
GPIO1
5V (spare)
GND (spare)

RELAY8
RELAY7
RELAY6
RELAY5
RELAY4
RELAY3
RELAY2
RELAY1

DB37 to cRIO 9403 Digital I/O Module



Light+ Light- **Indicator Light**

Power GND **Power Input (6-15V)**

"Power Input" good

5V supply good

6V supply good

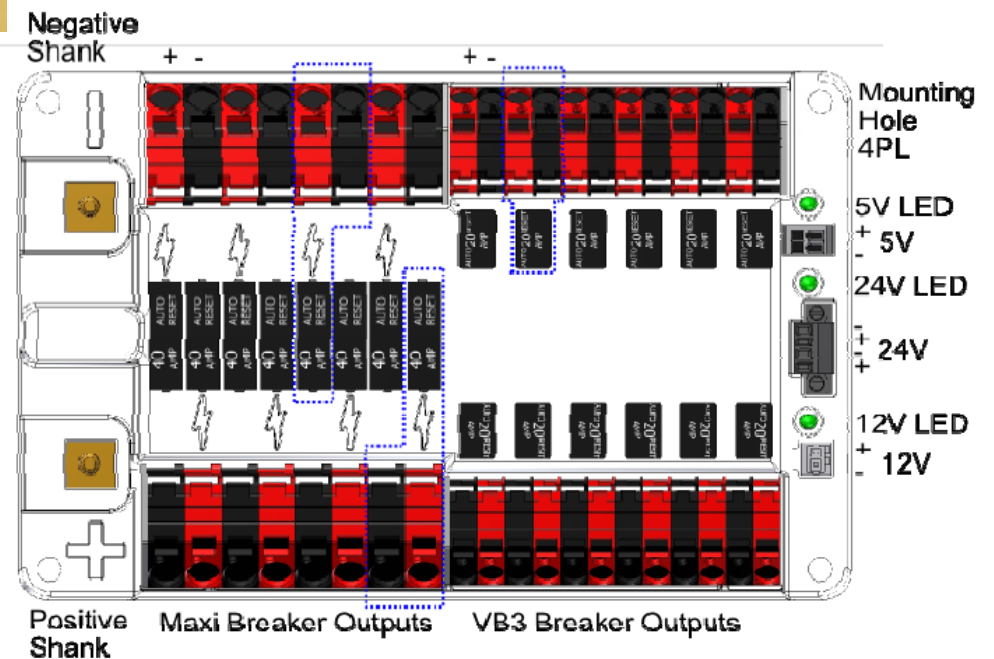
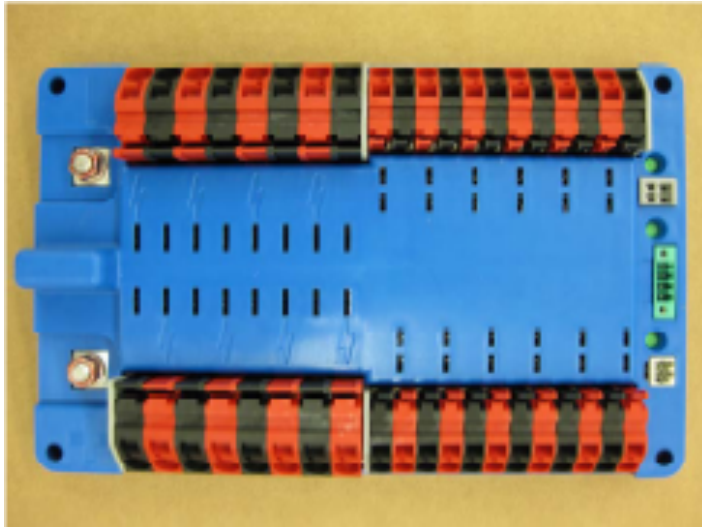
PWM Outputs (and 6V Power Enable Jumpers)



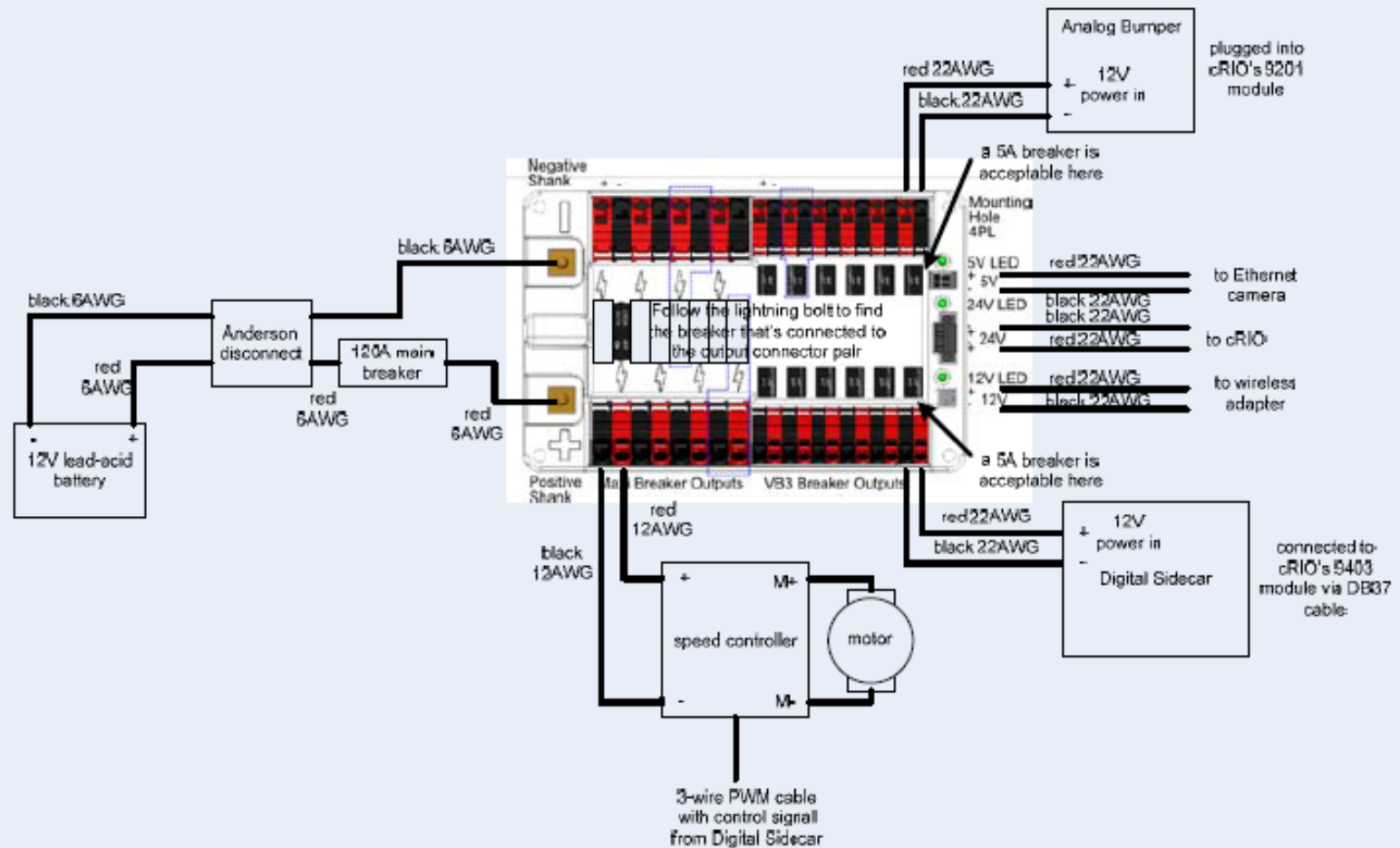
Power Distribution Module

- Custom Design by FIRST
- 6-15 VDC, reverse polarity protected
- Metric shanks, not SAE!
- 8 outputs for 40A breakers
- 12 outputs for 30A/20A breakers
- 24VDC output for CompactRIO
- 12V output for gaming adapter
- 5V output for camera or other devices
- LED's for power supplies and open breakers

Power Distribution Module



Power Distribution Diagram

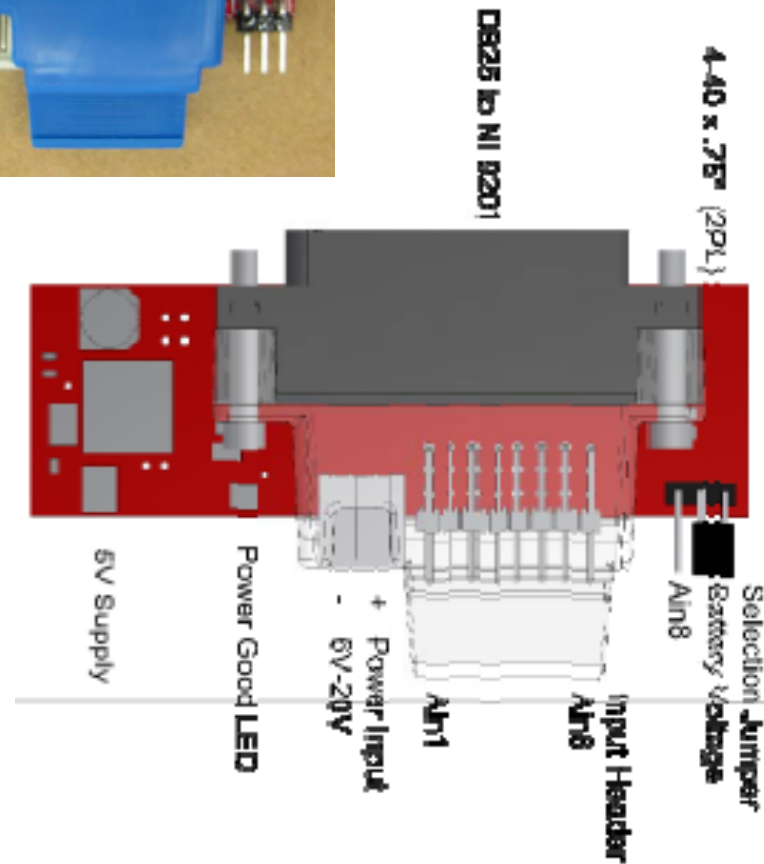
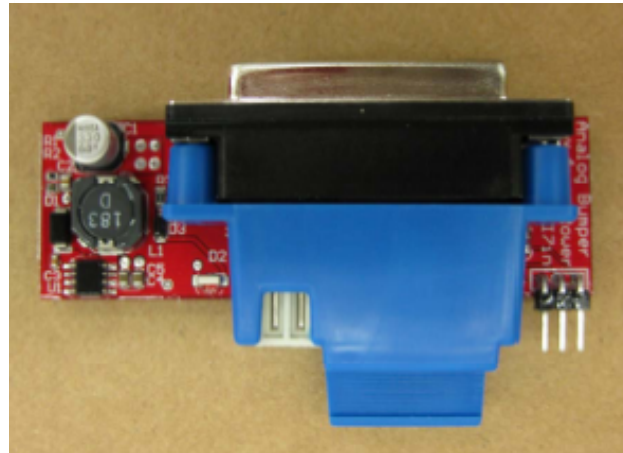




Analog Bumper

- 5V/3A for powering sensors
- 8 Analog Inputs, 3 pin PWM cable config.
- Mounts to NI 9201 Analog Module
- Configurable to make one input capable of measuring battery voltage
- LED to indicate bumper has power
- Power to bumper requires wiring to power distribution module

Analog Bumper



Place jumper on the top 2 pins for connecting battery voltage to AI8 or jumper on the bottom 2 pins for connecting AI8 from the 3x8 connector

8 analog inputs

6-15V power supply connection



Battery voltage via resistor divider
AI8 input to the NI 9201
AI8 from the 3x8 connector

AI8
AI7
AI6
AI5
AI4
AI3
AI2
AI1

+ power supply input
- power supply return

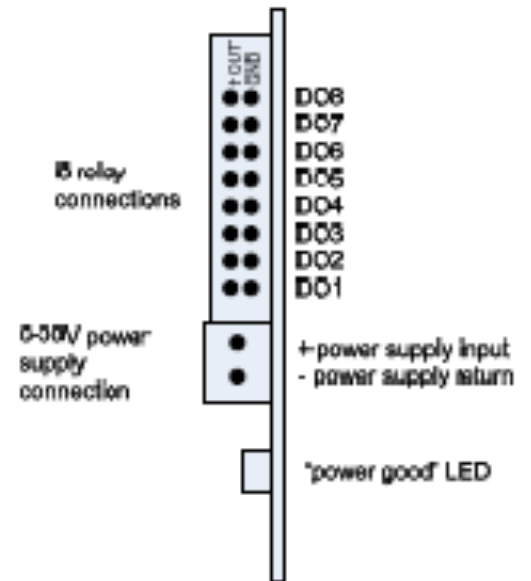
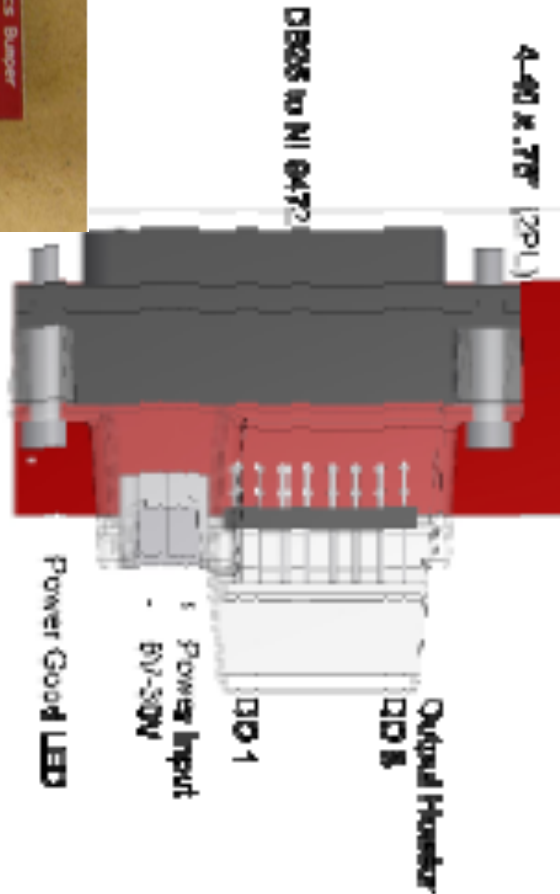
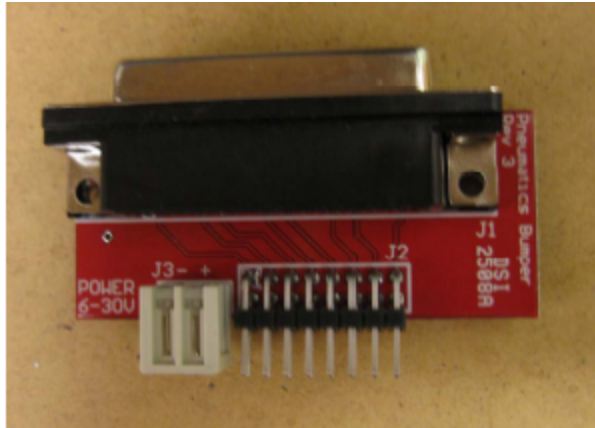
"power good" LED



Pneumatics Bumper

- Reverse-battery protection
- 8 Outputs to directly drive solenoids
- Mounts to NI 9472 Digital Module
- Means you don't have to use Spikes to drive solenoids anymore
 - Save weight, space and money
- LED to indicate bumper has power
- Power to bumper requires wiring to power distribution module

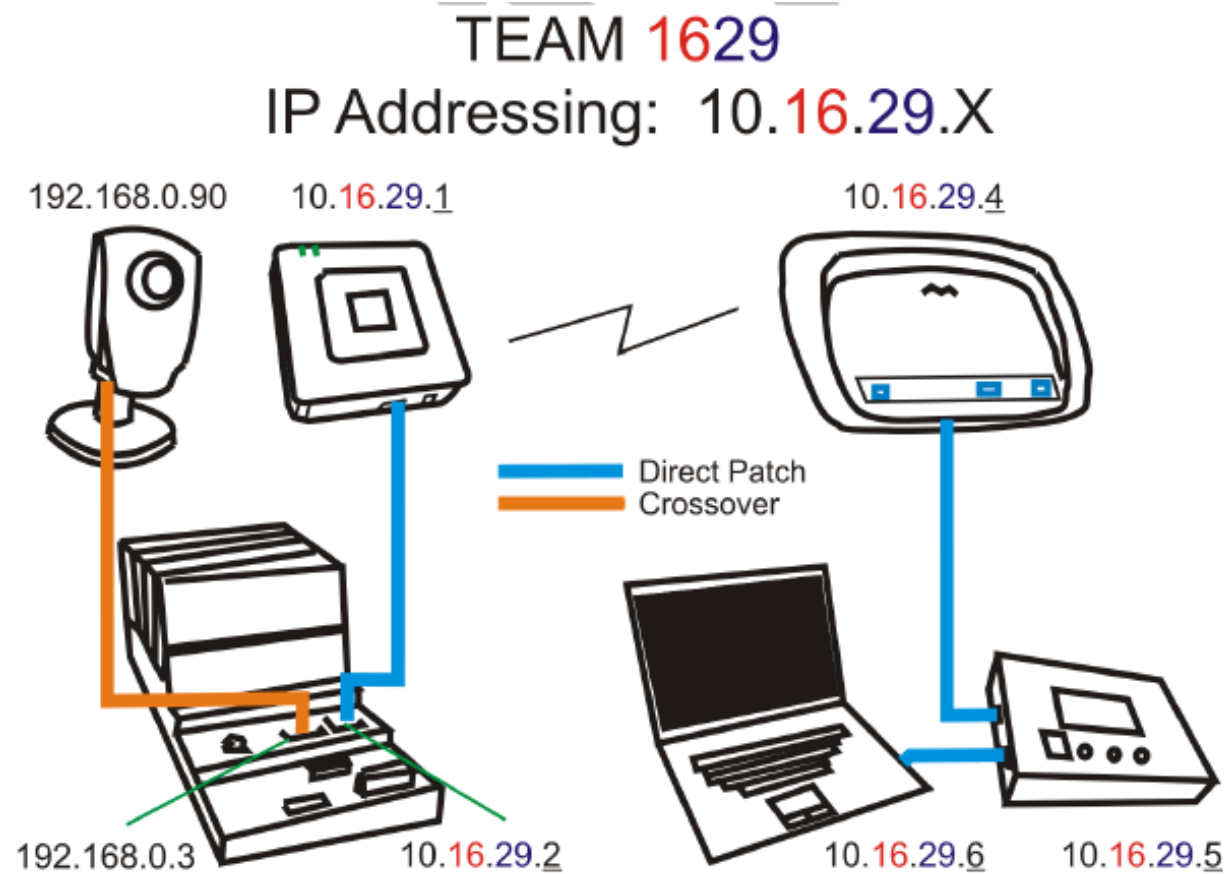
Pneumatics Bumper



Wireless Interface – 802.11

- Radio on the robot is 802.11 gaming adapter
 - Wireless bridge: cRIO and Access Point
- You will assign fixed IP addresses to your components, using team number
- Use an AP during build season, connect to the wired network at the competition
- Field will use 5 GHz band (802.11 a) to avoid overlap and interference

Network Diagram – 2009



2009 FRC: Example IP address allocation.

Ethernet Camera – Axis 206

- Streaming color video
- Connects to RJ45 on cRIO
- Plays video on laptop
 - Axis application
 - Labview video viewer



Jaguar Motor Controller

- Replaces the venerable Victor
- Do NOT remove the power screws
- They are “swaged” on the end, which is meant to keep them from coming out
- Removing them drops metal shavings into the guts

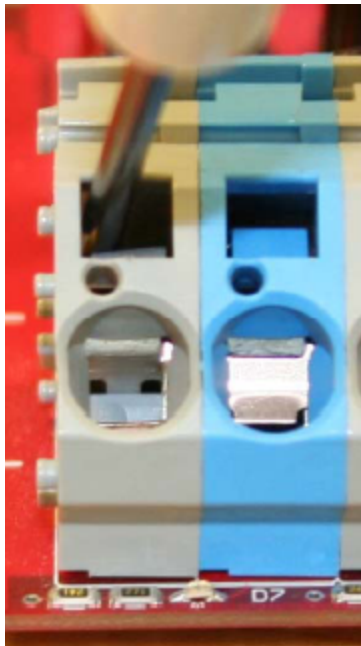


Helpful Hints

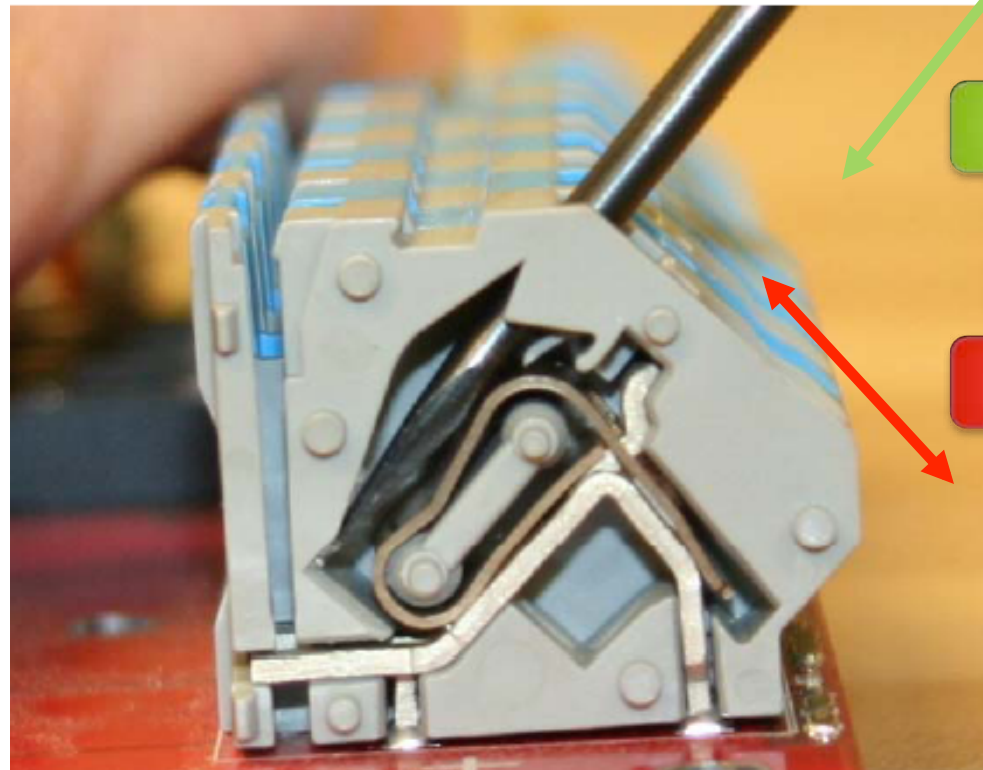


Working the Wago

- Use the Wago tool provided
- Take care to insert directly at a fixed angle, pressing straight in
- Do not pry. The goal is to open the spring by pressing in the screwdriver, not by prying



End View





802.11 Radio Link

- AP and gaming adapter are yet to be determined
- Learn how to set static IP addresses on your PC, and how to log into AP and adapter to configure them manually
- Turn off “Wireless Protection”, so that inadvertent presses of external buttons don’t change settings unexpectedly



Other ideas worth remembering

- Solder your terminals – prevent failure
- Make a battery charging record
 - During tournaments, know which one is charged
- Read the inspection rules early – a great “cheat sheet” for guiding you
- Label your wires or use color markings, to make troubleshooting easier



Other things to keep in mind

- Go to the FIRST website, navigate
 - FRC
 - Game and Season Info
 - Competition
 - Competition Manual and Related Docs
- Check out the schematics, rules and manuals from last year
 - Wire gauge requirements, terminals, etc.