

# Control Systems

Your control system (electrical and pneumatics) is one of the most important aspects of a moving robot. Through this system, code can be transferred from team programmers to robot motors and sensors. Having a solid system allows for easy access to fix robot problems, convenience for programmers and builders, and an overall great robot. Please review the follow guides before completing these sheets.

- [Intro to FIRST<sup>®</sup> Robotics Competition Robot Wiring](#)
- [Control Systems Hardware](#)

## Controls Systems

- ❑ Go through this workbook and its questions with your team.
- ❑ **This worksheet will be split into 2 parts: Electrical and Pneumatics**
- ❑ This worksheet includes the **following sections**:

01. Planning the System + Helpful Table (Electrical)
02. Building the System (Electrical)
03. Testing the System (Electrical)
04. Troubleshooting (Electrical)
05. Planning the System (Pneumatics)
06. Building the System (Pneumatics)
07. Troubleshooting (Pneumatics)

# 01

## PLANNING THE SYSTEM (ELECTRICAL)



### DISCUSSION

Do this before you place any components.

1. How many motors do you plan on having? Do you have enough motor controllers for them? If you plan to use pneumatics, do you have a PCM (Pneumatics Control Module) or REV PH (Pneumatics Hub)?

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2. Do you have all the required components? Check the table on the next page for a list. Only fill out the first 2 columns. It only needs to be a yes/no but more detail can help.

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3. What robot parts do you need to work around? Be sure to coordinate your system to fit around the moving parts other build groups are planning as well as making sure you can work on the panel.

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<b>Component (<a href="#">Component Overview</a>)</b>	<b>Is it in the system?</b>	<b>Does it fit <i>FIRST</i>® regulations?</b>	<b>Is it Securely Mounted?</b>	<b>Are the Wires Tied Down?</b>
Battery				
RoboRio				
Radio & control Module				
Main Breaker (120A)				
PDH (Power Distribution Hub)				
VRM (Voltage Regulator Module)				
RSL (Robot Signal Light)				
PCM (Pneumatics Control Module)				
Motor Controllers (Talon SRX, SPARK/SPARK MAX, VICTOR SPX)				

# 02

## BUILDING THE SYSTEM (ELECTRICAL)



### DISCUSSION ([How to wire Guide](#) & [Video](#))

Now that you've planned the system, it's time to put it in place

1. Where does the CAN system start and end? Is it continuous (going through all components without any breaks)?

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2. What gauge wire is connecting components? Does this meet the rules set in the [Game Manual](#)?

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3. Are the appropriate breakers in the PDH used? How many motors need 40A? 30A? 20A?

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# 02

## BUILDING THE SYSTEM (ELECTRICAL)



### DISCUSSION

Don't worry about wiring too much, do it right once and you are all set.

1. Are your components secured? Try to pull them out and wiggle them around. If they stay still, they're secured.
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2. Are all wires organized/tied up? Loose floating wires can be a recipe for disaster. Keep all wires away from moving parts using electrical tape, zip ties, or anything legal you may have.

Head back to the table . Fill out the “Secured” and “Wires Tied Down” column.

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3. Check your inventory. Are there enough supplies to last a whole season? If not, list the low supplies here to buy later.
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# 03

## TESTING THE SYSTEM (ELECTRICAL)

### DISCUSSION

Now your system is ready. It's time to see if your system works or needs additional tweaking

1. Before turning on your robot, make one final inspection tracing all the red and black wires. Also check that the frame is isolated by using a multimeter between the ground terminal and anywhere on the frame.

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2. Turn on the robot using the circuit breaker. What do you notice? If the system is smoking or hear any breakers tripping, turn it off immediately.

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3. You should see flashing light patterns on most of the components. Note the patterns you see. [Reference Guide](#)

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If everything seems fine, your system is ready to be programmed!

# 04

## TROUBLESHOOTING (ELECTRICAL)

### DISCUSSION

When your system doesn't work, check here

1. If lights can be seen on components but motors aren't moving:

Are all the CAN wires connected properly? Check for breaks in the wire or in the chain. If no breaks are found, use a voltage meter to check for continuity.

2. If there are no lights on components showing:

This means there isn't power being supplied. Check your battery connections/circuit breaker to make sure they aren't broken. Also, you may try replacing the battery. If necessary, you may need to examine the leads on the battery to make sure they aren't corroded.

3. The blinking lights on the components code for certain messages. You may want to check the manufacturer's user guides for more information

# 05

## PLANNING THE SYSTEM (PNEUMATICS)



### DISCUSSION (Pneumatics Guide)

This is before you place any components.

1. What are the goals of your system? What kind of cylinders and tanks would be fit to achieve those goals?

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2. What components do you need? Do you have the space allotted for the pneumatic system?

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3. Are you following all the safety regulations in the game manual? What are the most important takeaways here?

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# 06

## BUILDING THE SYSTEM (PNEUMATICS)



### DISCUSSION

Now that you've planned the system, it's time to put it in place.

1. Are your metal to metal connections wrapped with teflon and connected securely?

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2. Are your tubes cut perpendicular and connections plugged in securely? Are your tubes placed in such a way that airflow will not be impeded?

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3. Check to make sure the pressure switch is working correctly.

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## DISCUSSION

When your system doesn't work, check here

1. Can you locate the leak through listening or feeling?  

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2. How could you isolate parts of the system to make locating the leak easier? Check area with a small amount of soapy water.  

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3. Are the electrical signals in the right state to actuate the solenoids? How do you check this?  

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4. After the system is activated, do the gauges indicate the pressure that you expect?  

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5. If you are using a compressor, how would you make sure it is not faulty?  

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