Training I

Electrical Tools & Processes

Safety Considerations

Safety glasses are required.

Wash hands after handling solder.

Consider heat guns and soldering irons to be hot.

Objectives

Understand:

- Wire and wire gauge
- Tools to wire the robot

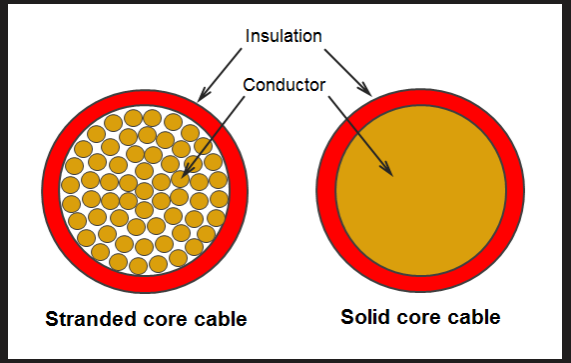
Demonstrate:

- Crimping a wire
- Splicing and soldering a wire
- Measuring voltage, resistance, and amperage

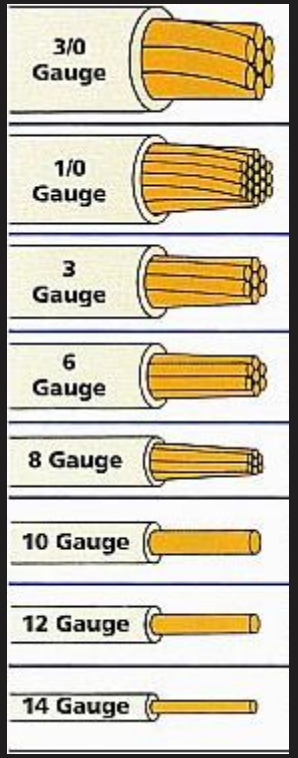
Understand Electrical Design Process

Understand how to develop Electrical Schematics

Wire and Wire Gauge



Copper **Aluminum**

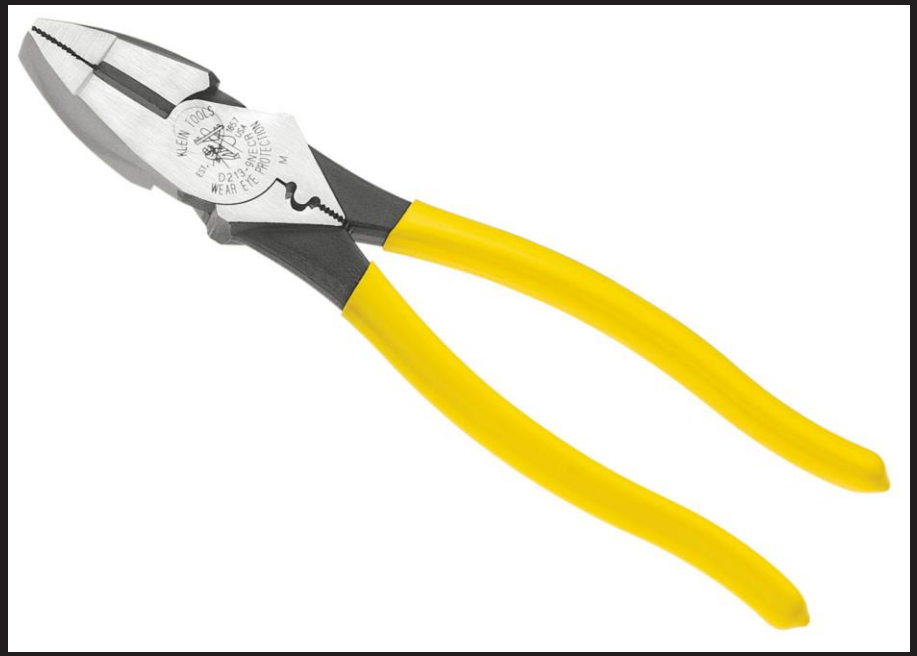


FRC General Guideline		
6 AWG	Battery	120A
10 AWG	Motors	40A
12 AWG		
14 AWG	Custom Circuit	30A 20A
16 AWG		
18 AWG	Controls	20A
22 AWG	RoboRIO	10A
<22 AWG	Signal	<10A
AWG - American Wire Gauge		

Cutting Wire

Diagonal cutters

Small gauge wire



Lineman pliers

Large gauge wire

Stripping Wire

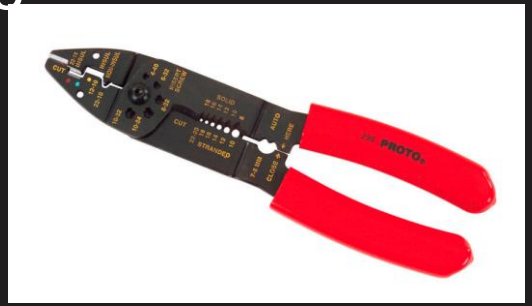
- Only strip off the correct amount of insulation

- Do not nick the conductor

- Twist the strands to prevent fraying

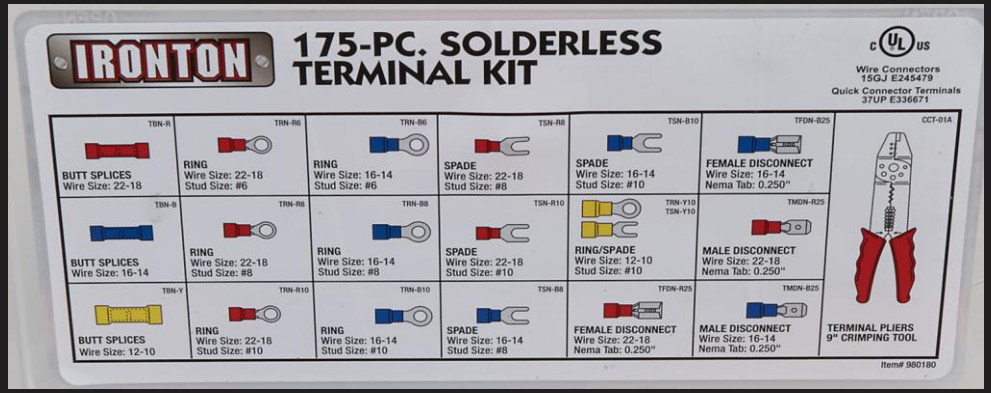
Manual

Automatic



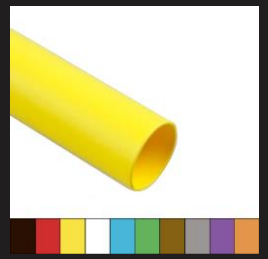
Crimping a Connector

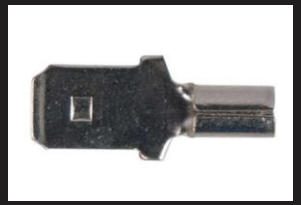
1. Match wire size, crimp connector size, and crimp tool
2. Strip so wire extends slightly through connector and insulation touches sleeve
3. Place crimper on front part of connector
4. Push the handles together until the crimp is flattened
5. Pull test the wire

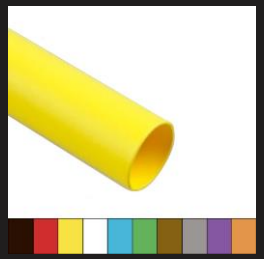


10-12
14-16
18-22

Crimping Motor Connectors





Power Side ← | → **Motor Side**

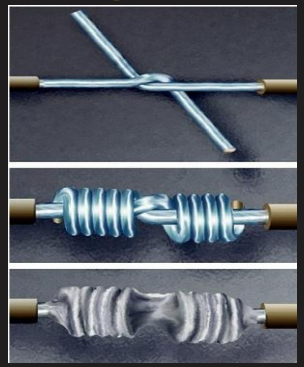
1. Strip wire
2. Put heat shrink on wire
3. Crimp wire to terminal (10-12)
4. Solder wire to terminal
5. Shrink - heat shrink over terminal and wire

Soldering a Splice

1. Use correct size iron and appropriate temperature
2. Mechanically join wires
3. Support workpiece
4. Clean soldering iron tip and add a small amount of solder to the tip
5. Heat workpieces, not the solder
6. Touch solder to the heated work, allow it to flow throughout work
7. Remove solder, then the iron

Soldering Iron

Lineman Splice

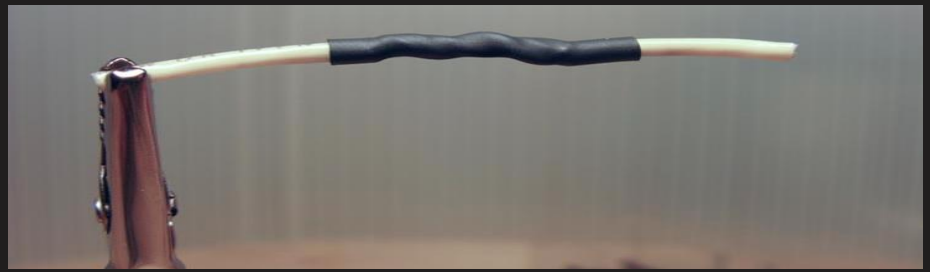


Solder

Third Hand

Heat Shrinking a Splice

1. Use a size that goes on easy but is not too loose
2. **Slide on heat shrink on before soldering**
3. Ensure heat shrink covers the conductor and provides mechanical support
4. Use a heat gun to heat tubing until it shrinks to tightly cover



Desoldering

Solder Wick

Wicks up solder

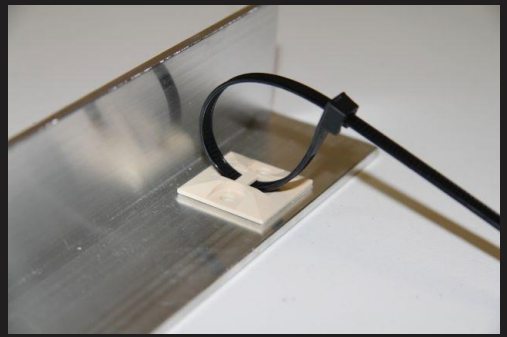
Desoldering Pump

Pulls solder into tube

Heat solder until it flows

Securing Your Wires

Tie Wraps



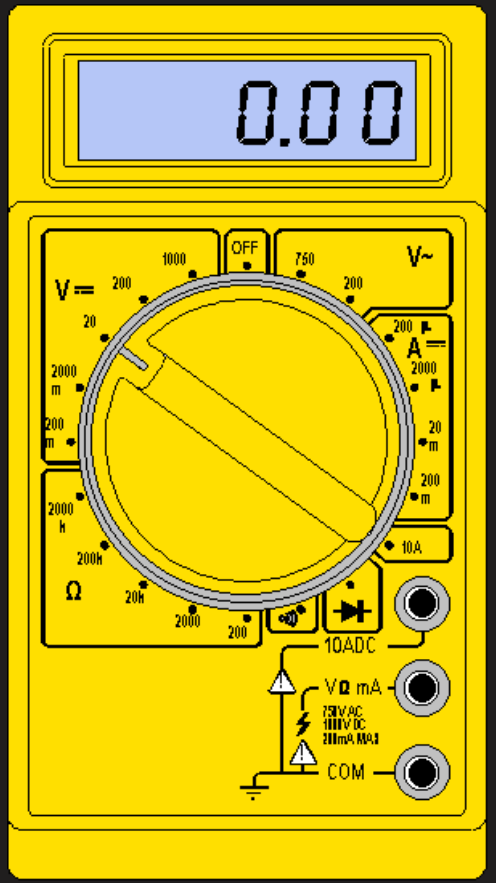
Tie Wrap Mounts

Tie Wrap Gun

Measuring a Circuit

Volts DC

Resistance



Volts AC

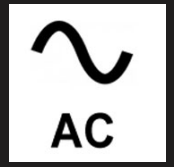
Amperage

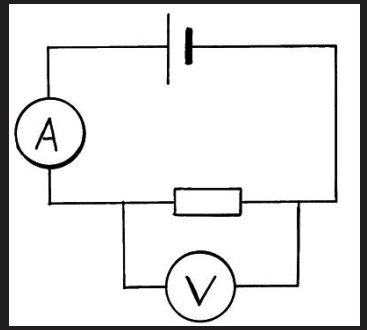
Continuity

Amps

Volts/Resistance/Continuity

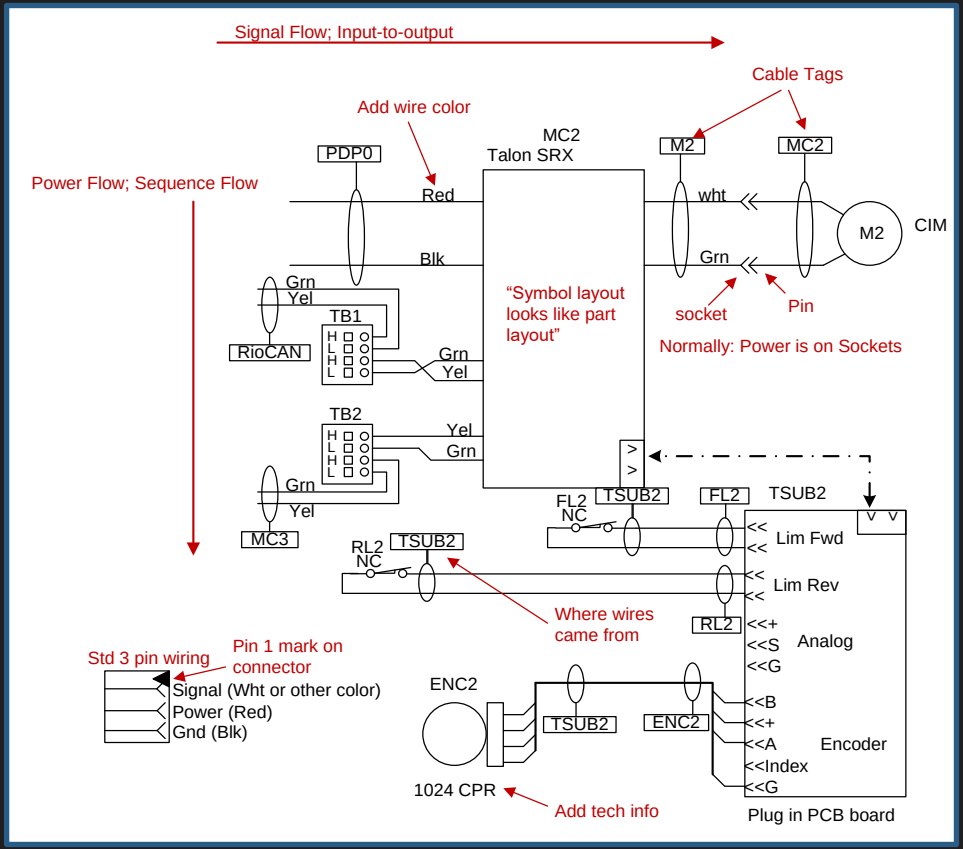
Common





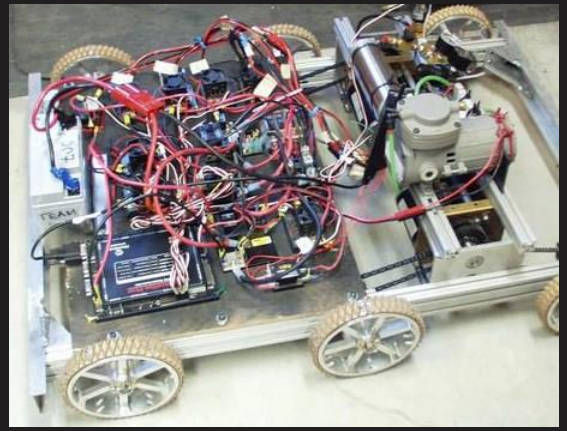
Schematic - Best Practices

- Power: Top To Bottom
- Signal: Left to Right
- Symbol Inputs: From Left
- Symbol Outputs: To Right

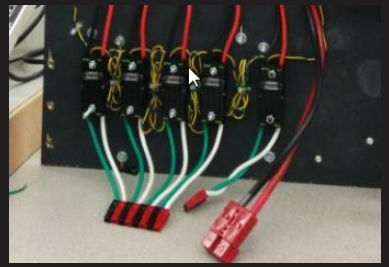


Robot Wiring

This



or THIS



Knowledge Challenge

1 What two tools can burn you?
2 What do you test after crimping a wire to a lug?
3 How do you clean your soldering iron tip?
4 What goes on the wire first before soldering two wires together?
5 What three things does a multimeter measure?
5 The smaller awg number is the bigger the …..
6 What do you do with excess wire on a robot?
7 What is a schematic?

Labs

Crimping

Cut and strip a wire. Crimp a terminal to this wire.

Soldering

Cut and strip two wires. Splice them back together.

Electrical Schematics

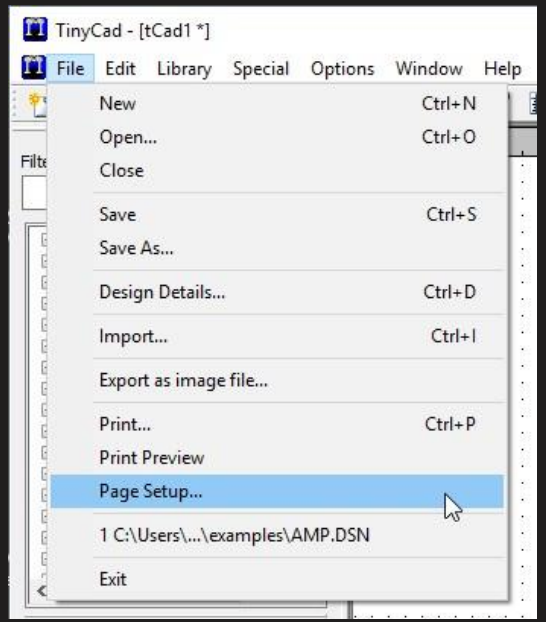
Two types of CAD programs are used for electrical schematics:

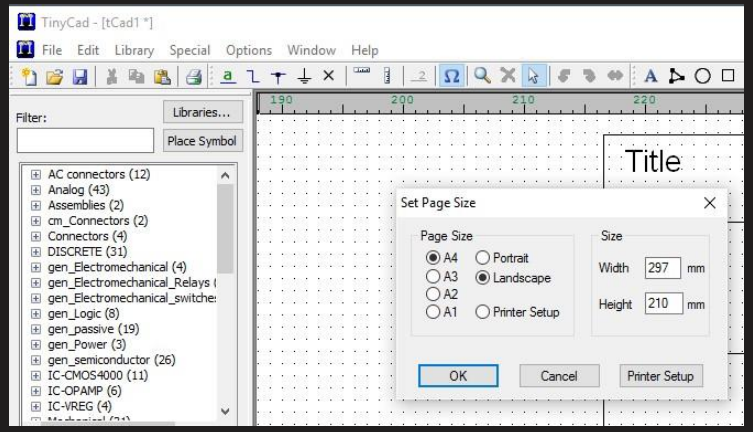
- Industrial Control wiring: AutoCAD or AutoCAD Electrical
  - Used 2D CAD using text and lines or special control software

- Electronic Wiring(EDA): Tiny CAD, Eagle, DesignSpark, Web based: EasyEDA, Schemelt(Digikey)
  - Schematics are drawn in a power point environment with intelligence in symbols and wires
  - EDA software allows the user to interface to printed circuit board(PCB) software, circuit simulation software(SPICE)

EDA – Electronic Design Automation

Schematic – Page Setup





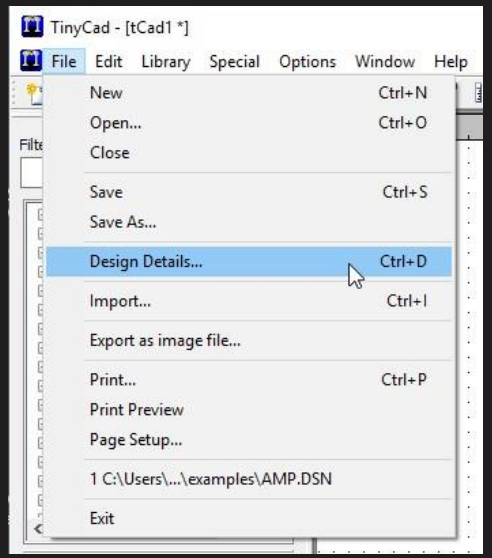
ANSI-ISO-Size
A-A4 – 8 ½ x 11
B-A3 – 11 x 17

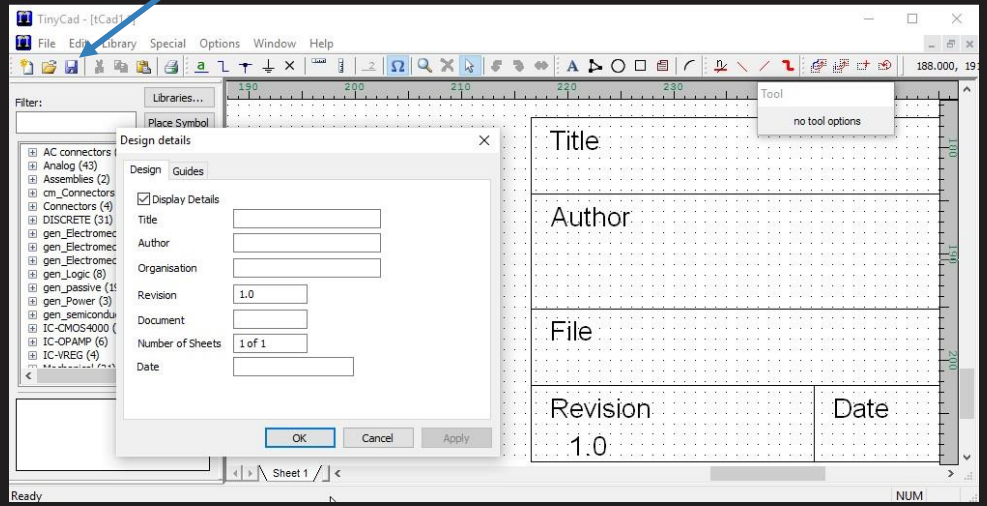
C-A2
D-A1
E-A0

Use A4 or A3. For A3 print: “Scale to Fit Paper”

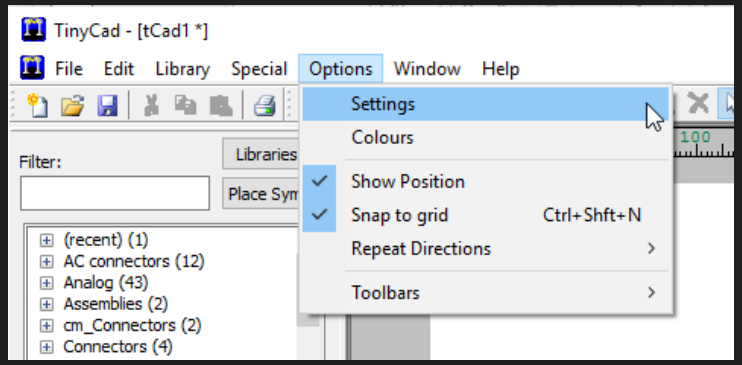
Schematic – Setup Title Block

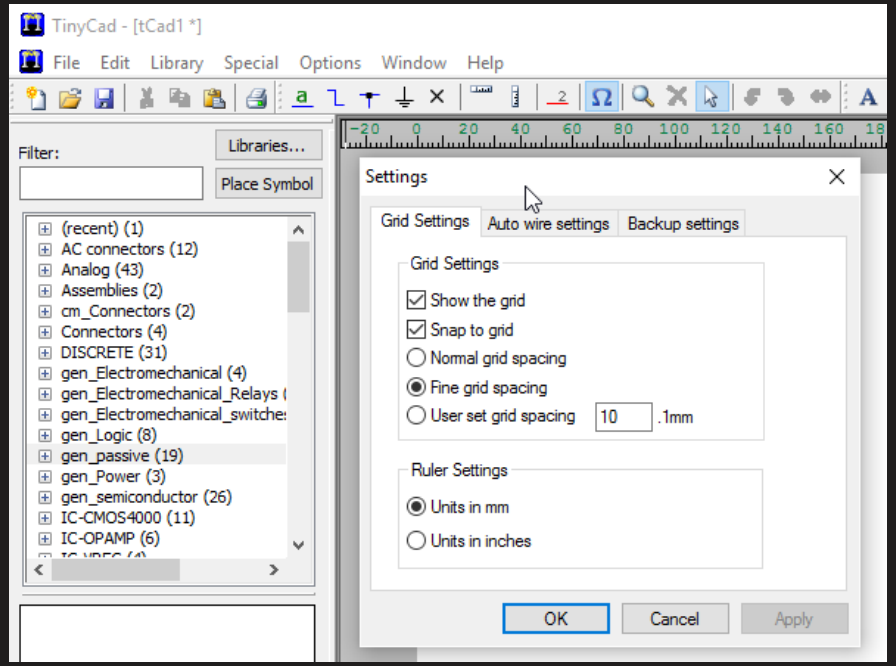
After filling in the title save drawing.





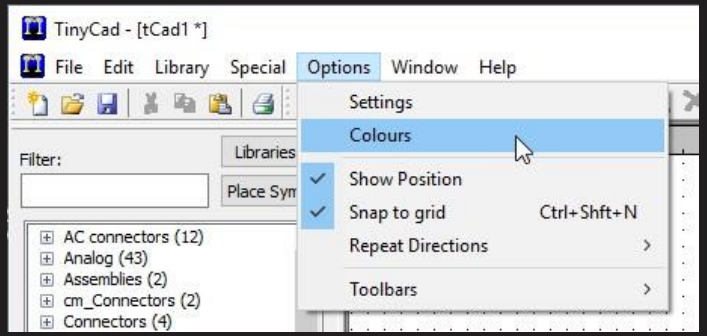
Schematic – Drawing setup

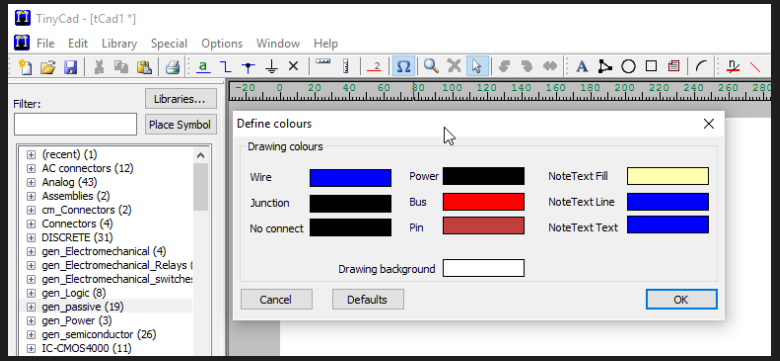




Select Ruler mm units and fine grid spacing

Schematic – Drawing Colors





Use default colors

Schematic – Tool Bar

Rotates a selection

Open/Close Library list

Zoom; also mouse wheel will zoom

To Pan drawing Horz/Vert use scroll bars or press down on mouse wheel

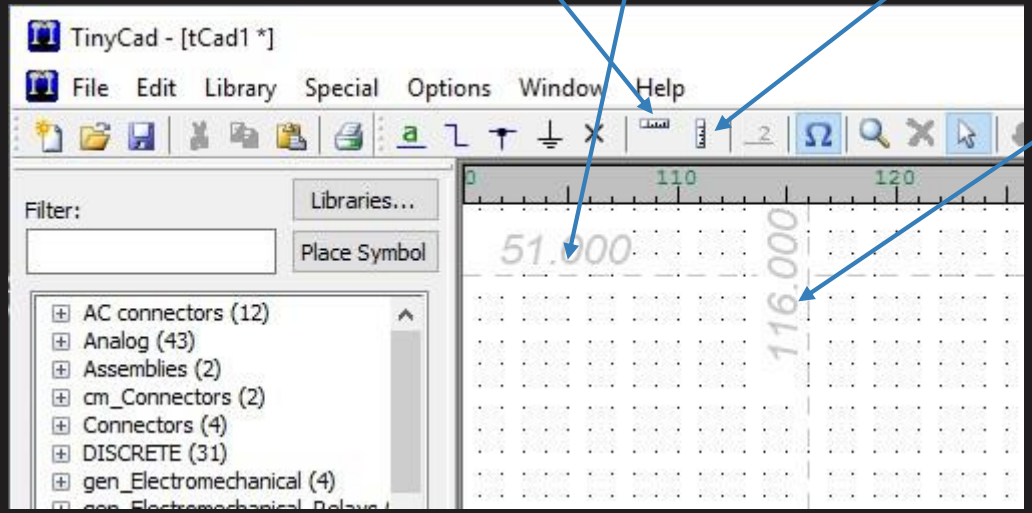
Delete selection; also “Del” key

Exit an operation; also “ESC” will exit an operation

Schematic – Horz/Vert Guide lines

- Click on Horizontal rule
- Then click on drawing to add a guide

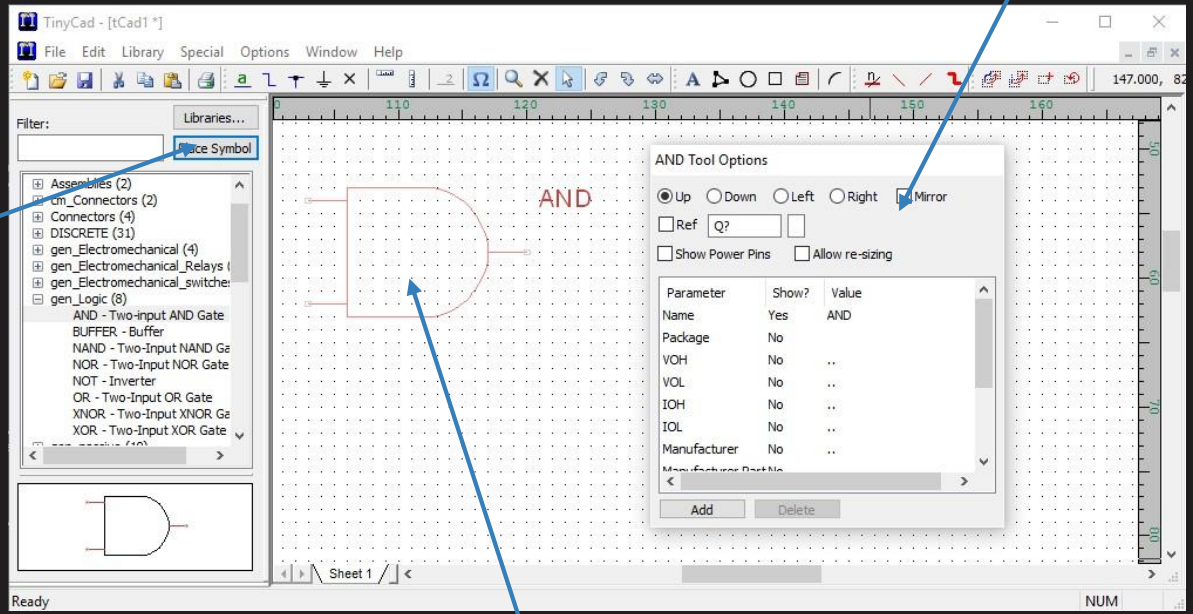
- Click on Vertical rule
- Then click on drawing to add a guide



To delete guide: select guide and Delete

Schematic – Place a Symbol

Symbol Characteristics

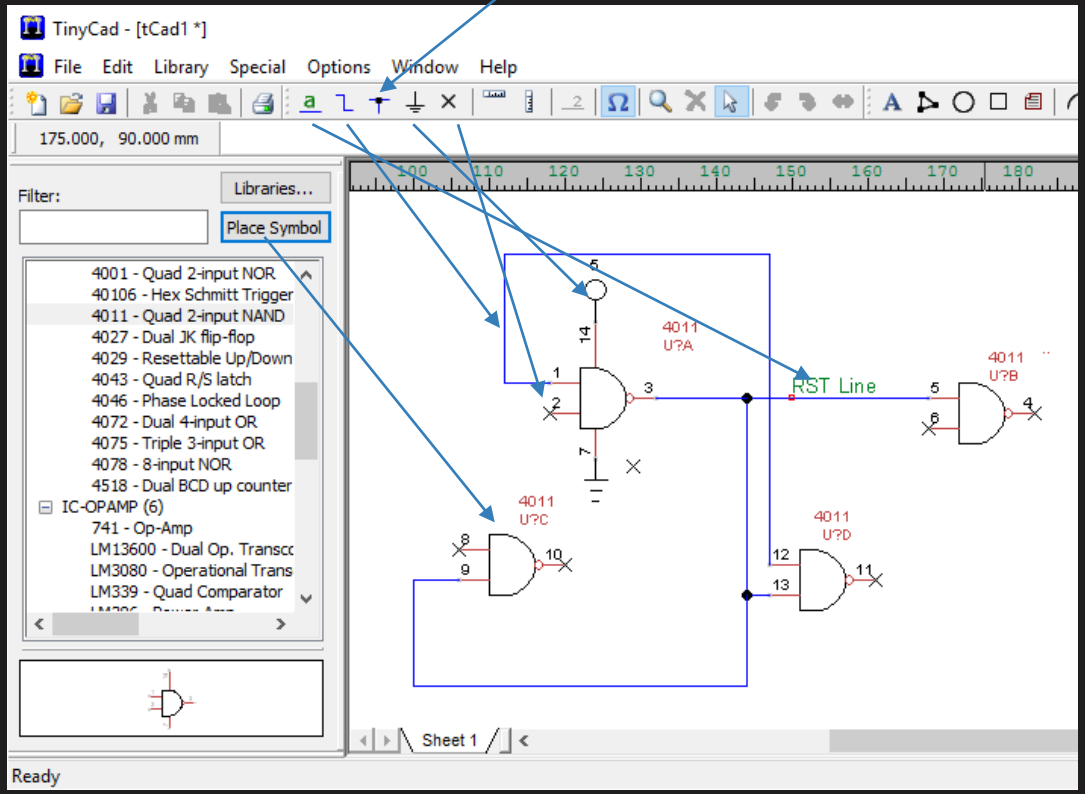


Select a symbol from Library

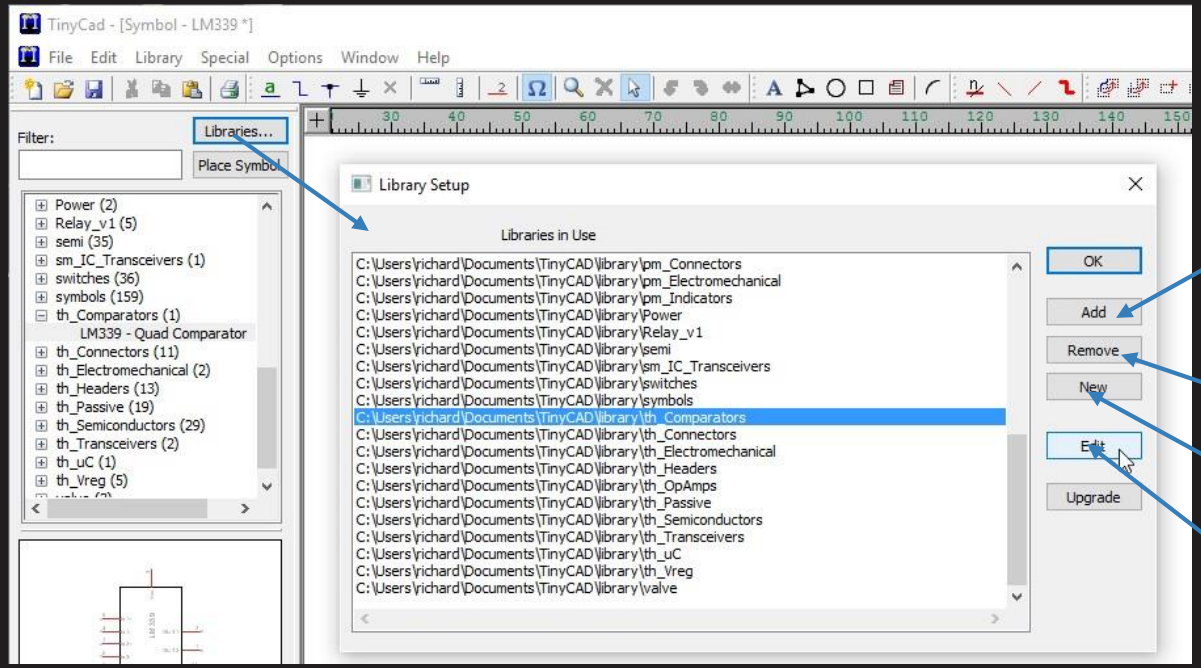
Left Click on drawing to place the symbol

Schematic – Wiring Tools

Not used – built in when you end on a wire



Schematic - Working with Symbols



Add a Library from Library Directory

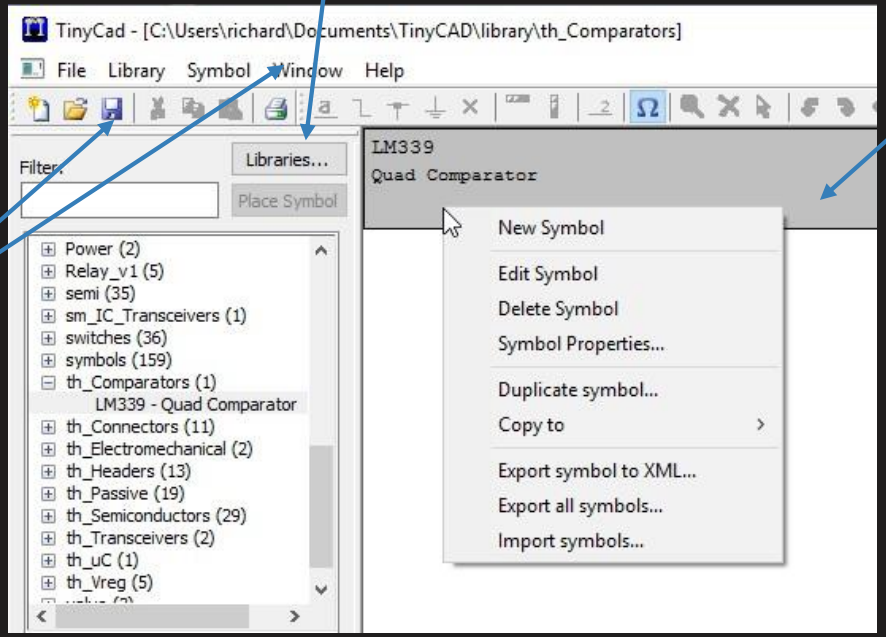
Remove a Library from List

Create a new Library

Edit a Library

Schematic - Library Symbol Edit Options

Select Library and then “Edit” option from Libraries option



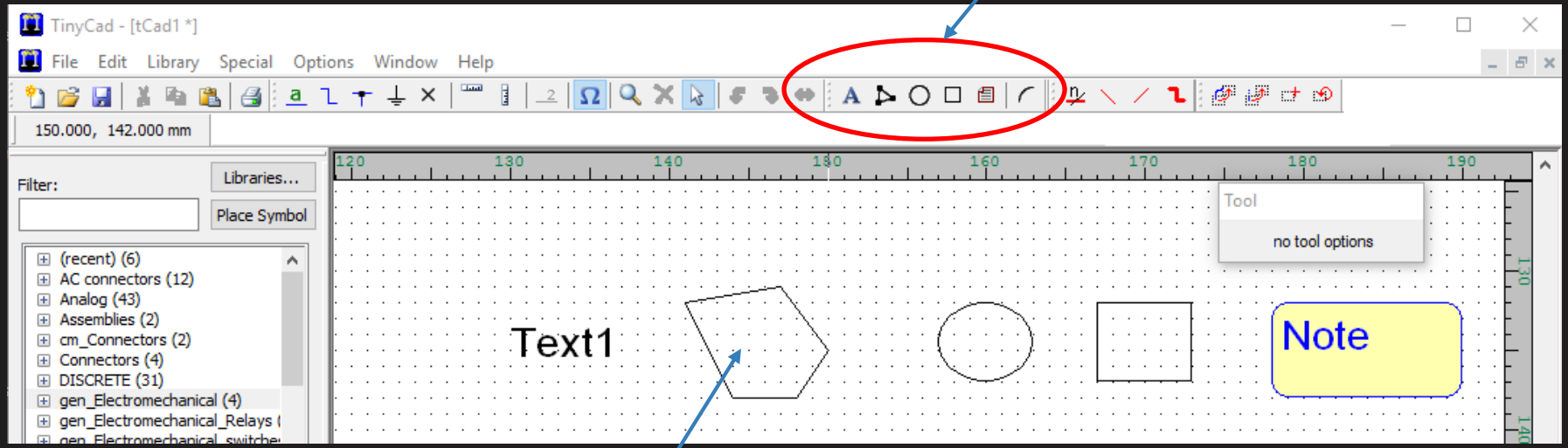
Right Click on symbol for options

To exit:

- Save work or select drawing from “Window”

Schematic – Shape Drawing Tools

Select Tool and size on drawing



To exit polygon tool – right click and then select end polygon

To exit a tool: “ESC” or click on drawing surface

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