Senior Design Project
Automated High Volume Bearing Bore Gage

Concept Design Review

Team 22

Seth Norman - *Project Manager (EE Lead)*   **Matthew Boler** – *ME Lead*
Eric Allgeier - *Webmaster*   **Christopher Proffett** - *Sponsor Liaison*
Kevin Flemming - *Treasurer*

Team Sponsor   **Instructors**
Robert Potts (KOYO Bearings)   Dr. Shih   Dr. Amin
        Dr. Franks

Team Advisor
Dr. Cartes
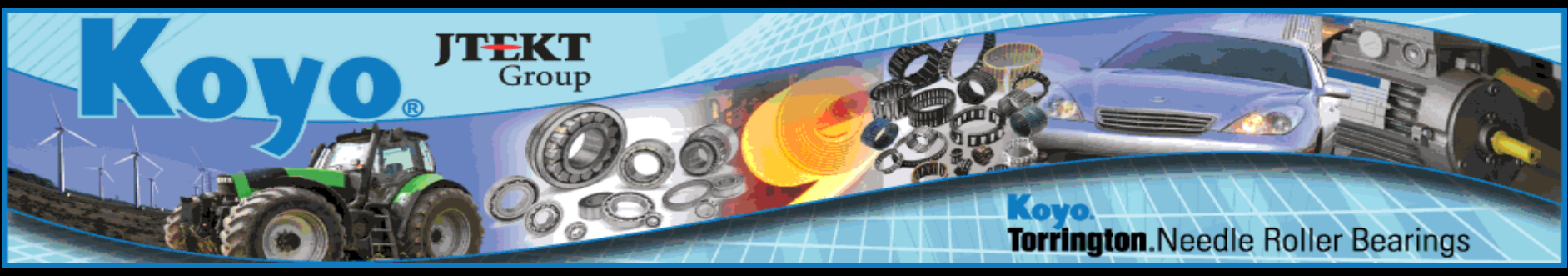
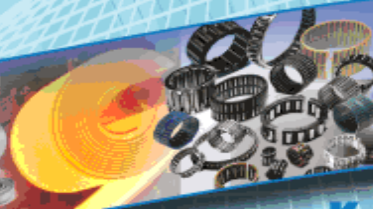**Agenda**

Project Objectives
Fall Schedule
Design Selection
Component Details/CAD Drawings
Hardware/Software
Manufacturing
Safety
Bill of Materials
Spring Schedule
Conclusion

Automated Bearing Bore Gage

- Measures bore sizes
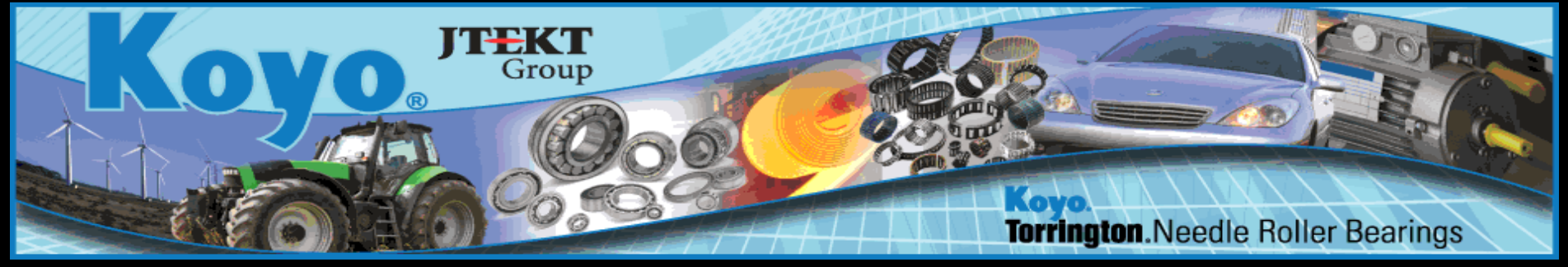- Determines pass or fail

Problem Statement

- Update the automated bearing bore gage
- Maintain measuring quality and sampling rate
- Allow for networking with Koyo

Objectives

- New GUI
- Replace electrical components
- Keep existing pneumatic system and PLC

Fall Schedule

August

1. Organize Team

2. Contact Sponsor

September

3. Initial Research

4. Diagnostic Testing

October

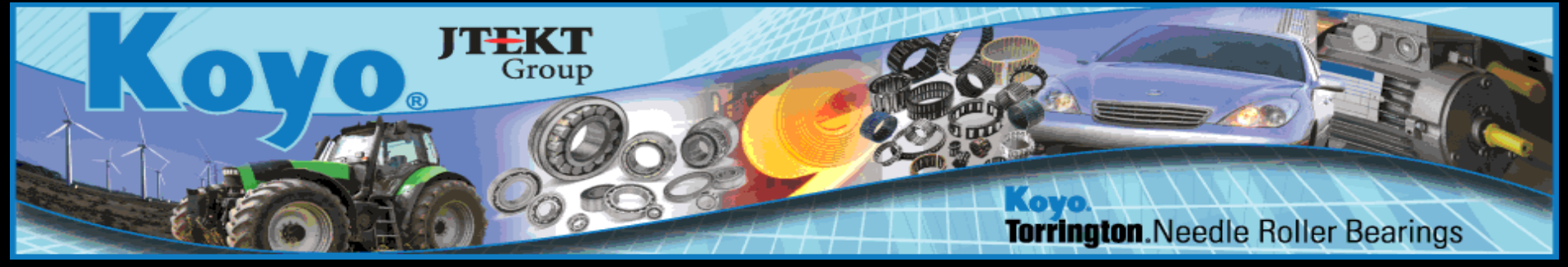5. Design Concepts

6. Component Research

November

7. Design/Component Selection

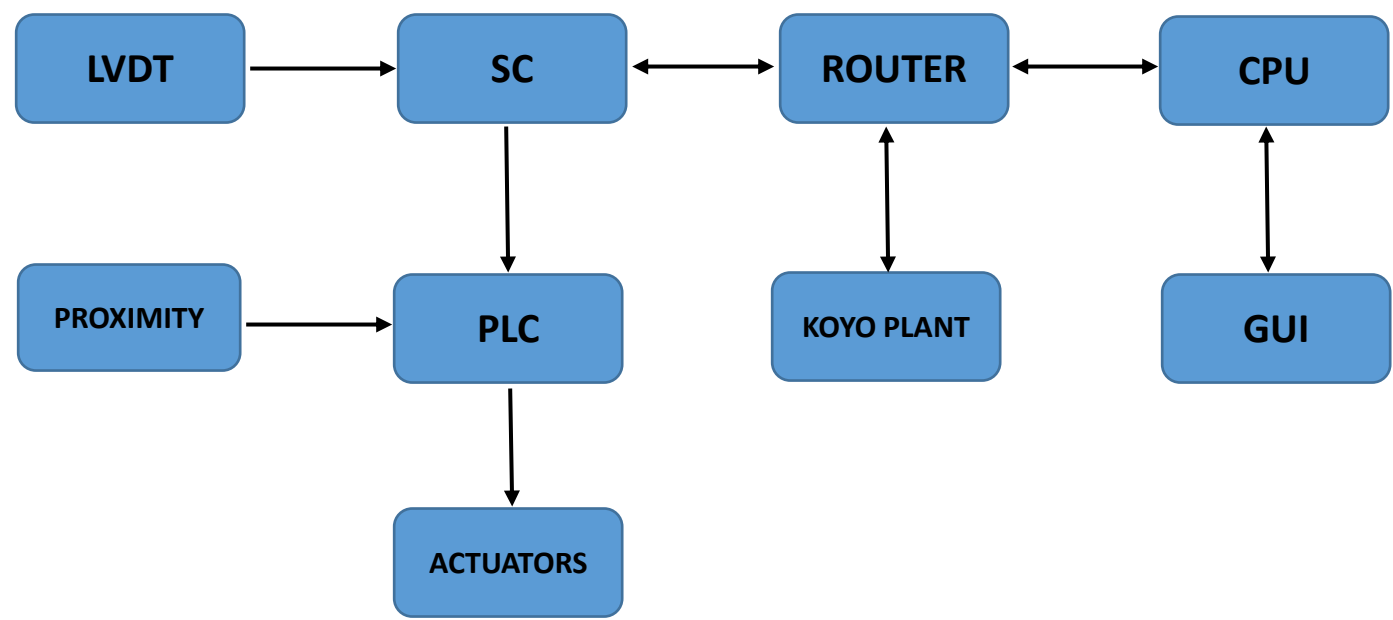8. Generate Bill of Materials

December

9. Submit design proposal to Koyo Bearings

10. Order all parts needed for the design

11. Create project objectives for Spring Semester

Design Concept

Uses only a signal conditioning module in conjunction with the PLC and CPU.
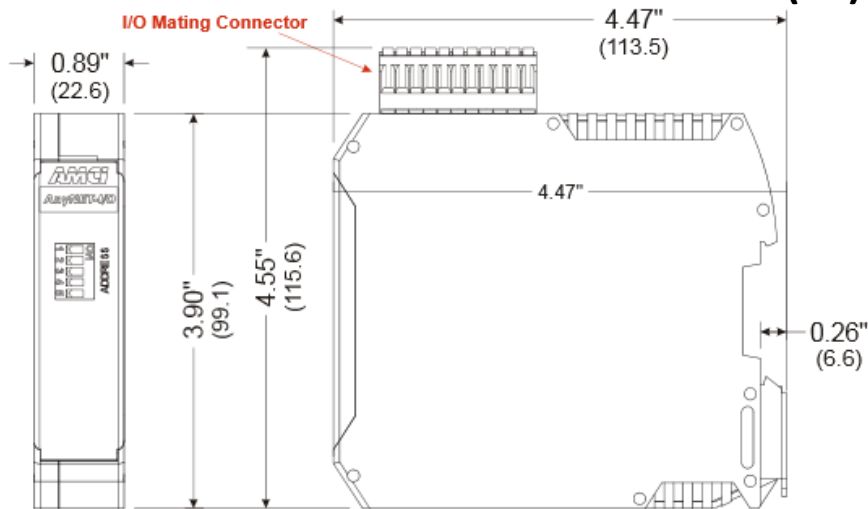
```
LVDT ──────▶ SC ◀──────▶ ROUTER ◀──────▶ CPU
              │            │               │
              ▼            ▼               ▼
PROXIMITY ──▶ PLC       KOYO PLANT        GUI
              │
              ▼
           ACTUATORS
```

LVDT AC Signal Conditioner (SC)

- The LVDT will be excited with 4V at 4 kHz.
- Receive size through a differential voltage.
- Export the data through the Ethernet port to the PLC and CPU.
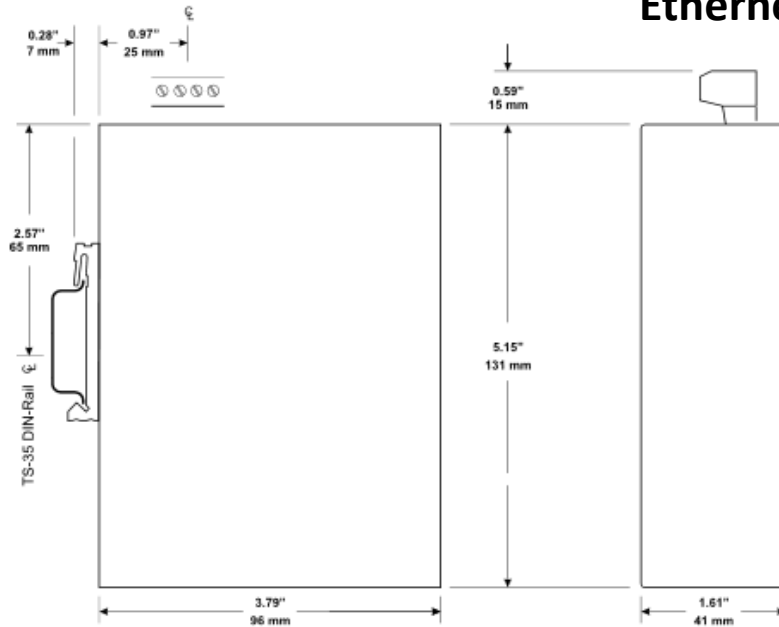
Ethernet Router

- CTRLink Ethernet Router
- 4 Port 10/100 Mbps LAN Switch.
- 1 Port 10/100 Mbps WAN
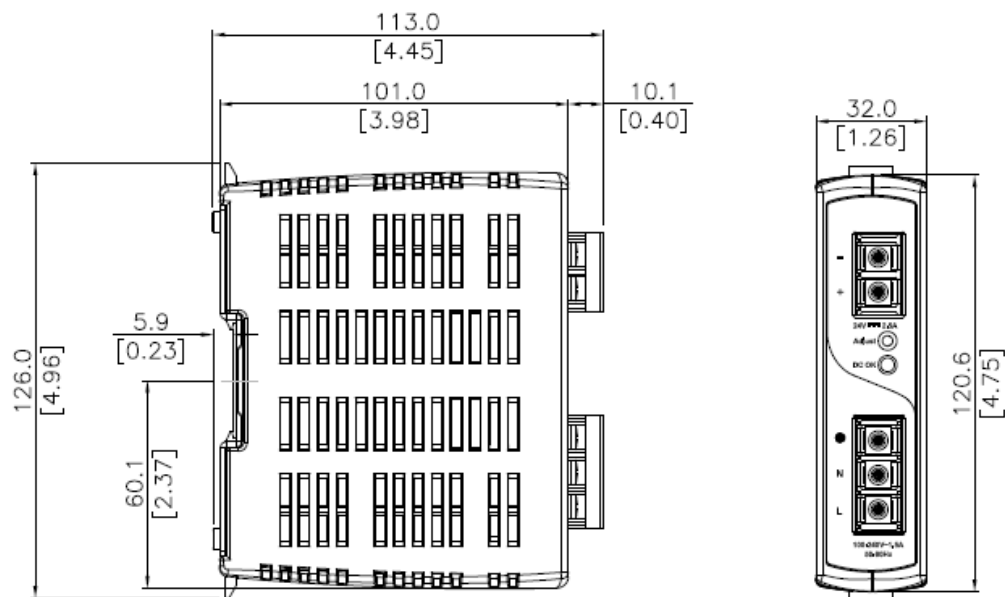- Uses Ethernet to link and network all devices to KOYO Plant

24 VDC Power Supply

- 24VDC Power Supply used to power the LVDT signal conditioner and the router.
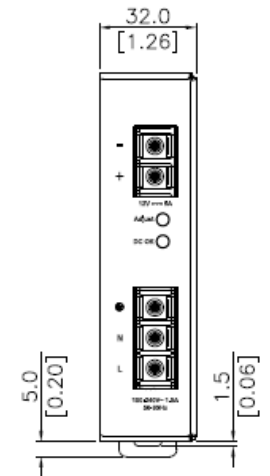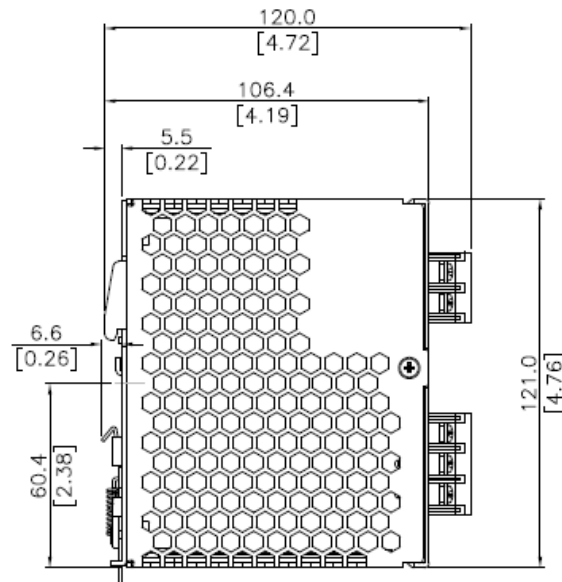
12 VDC Power Supply

- 12 VDC Power Supply used to power the monitor

## CPU – Lenovo ThinkCentre M92p

- The CPU will used to collect data from the SC.
- From this data, a histogram will be developed for the plant operator and machine operator convenience.
- CPU will be used to interface between the touch screen monitor and the SC.
- CPU will be used to calibrate the SC for the maximum and minimum bearing size.
- Windows 8 operating system for ease of touch screen
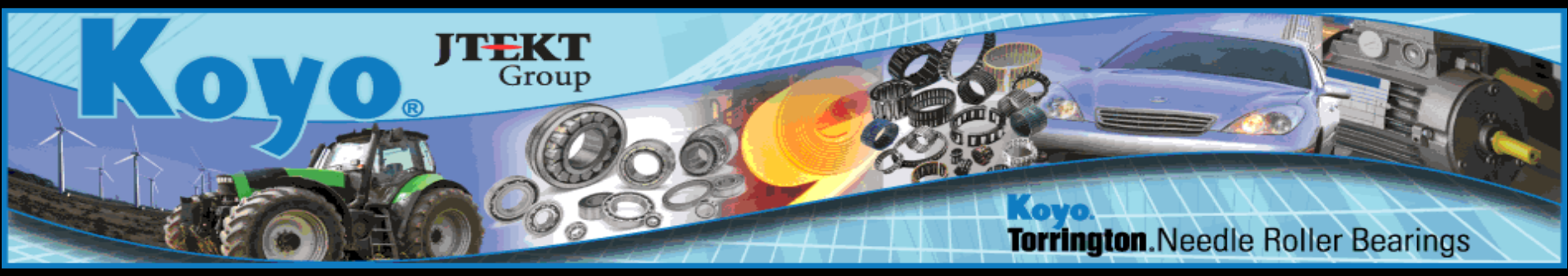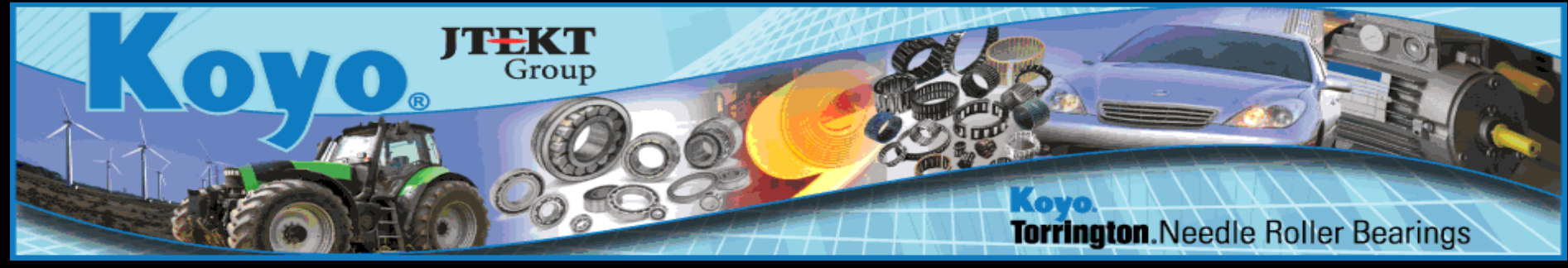
PLC and Software

- SLC 500 gives us Ethernet capability .

- Rugged industrial standard

- Program software will be RSlogix500

- 16 node, 120 VAC discrete input.

- 8 node, 120 VAC discrete output.
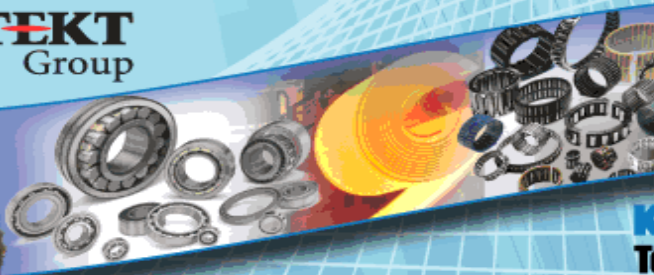

Allen-Bradley SLC 500

Touch Screen

ELO 1537L 15" LCD
- Connects to the CPU via USB and VGI
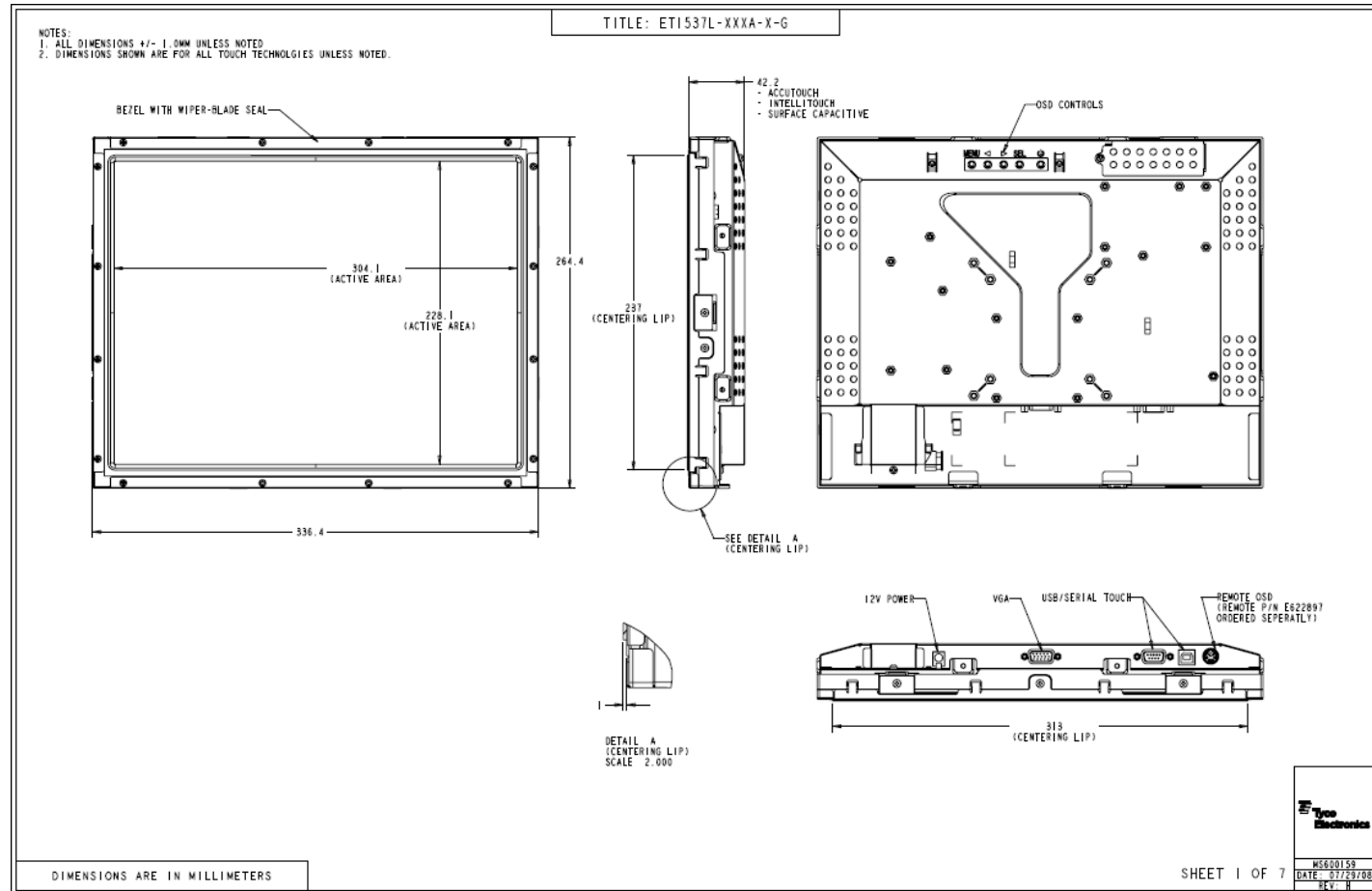- Ease of operation through touch screen

Touch Screen

Housing Cabinet

Components

Monitor

PLC
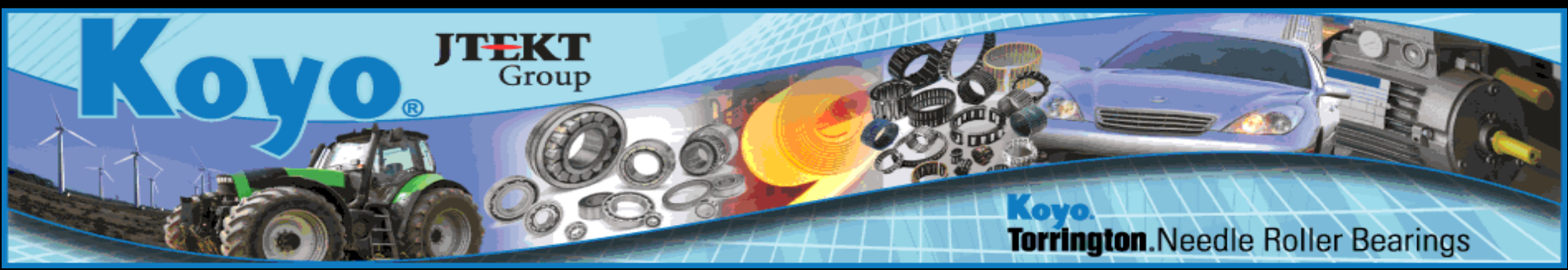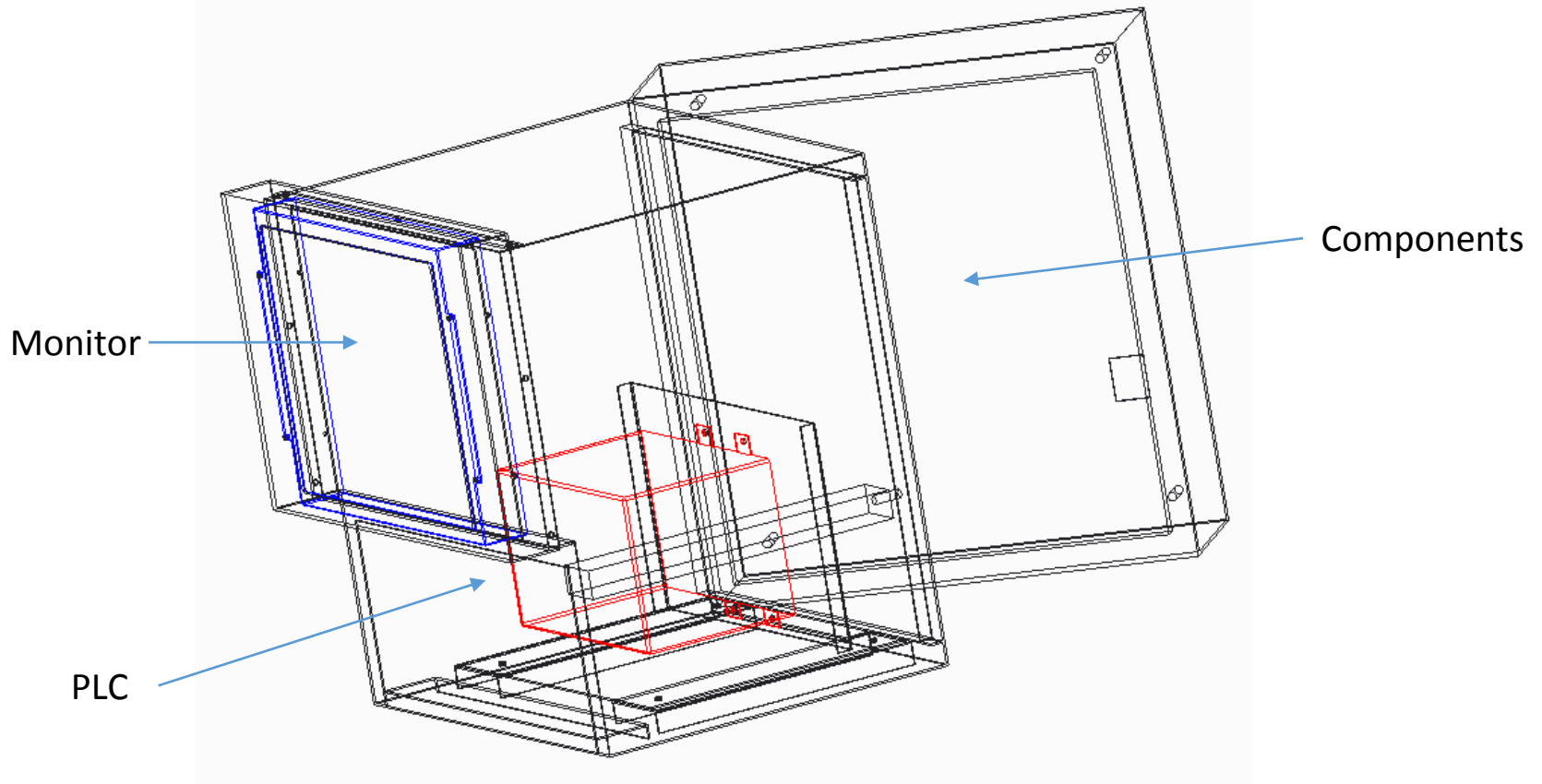
Component Layout
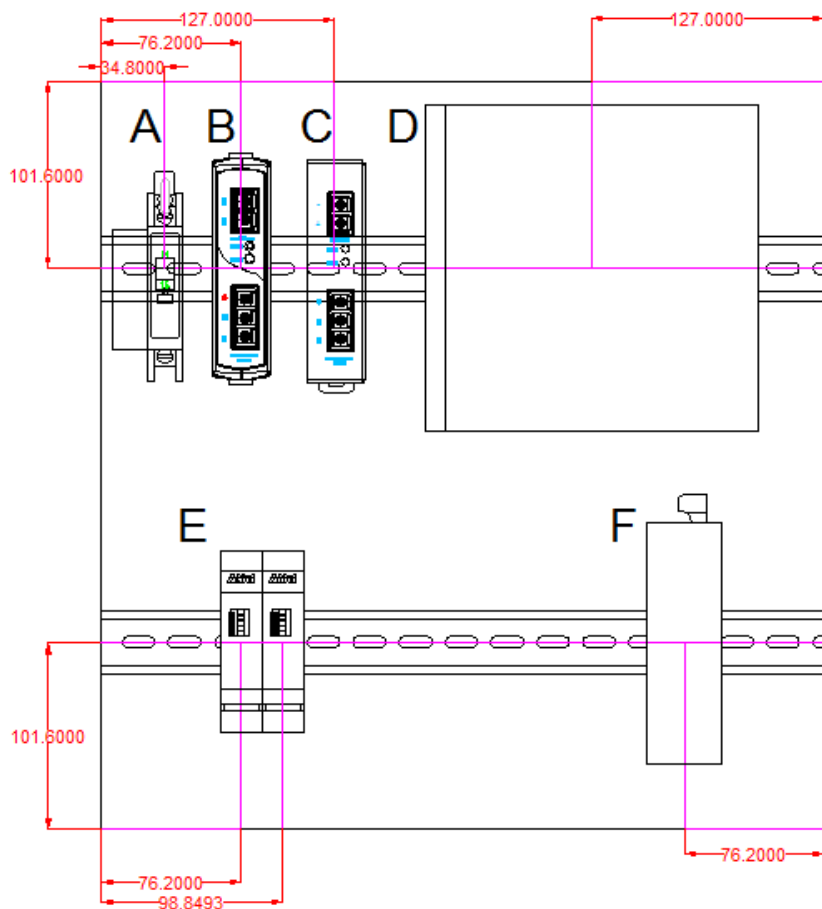
	Part
A	Square D, 10 A single pole breaker
B	12VDC 60W Power Supply
C	24VDC 60W Power Supply
D	ThinkCentre M92p, CPU
E	ANR2 LVDT Signal Conditioner
F	10/100 Ethernet Router

Electrical Schematic

Electrical Schematic

Eric Allgeier 17

Electrical Schematic

Eric Allgeier 18
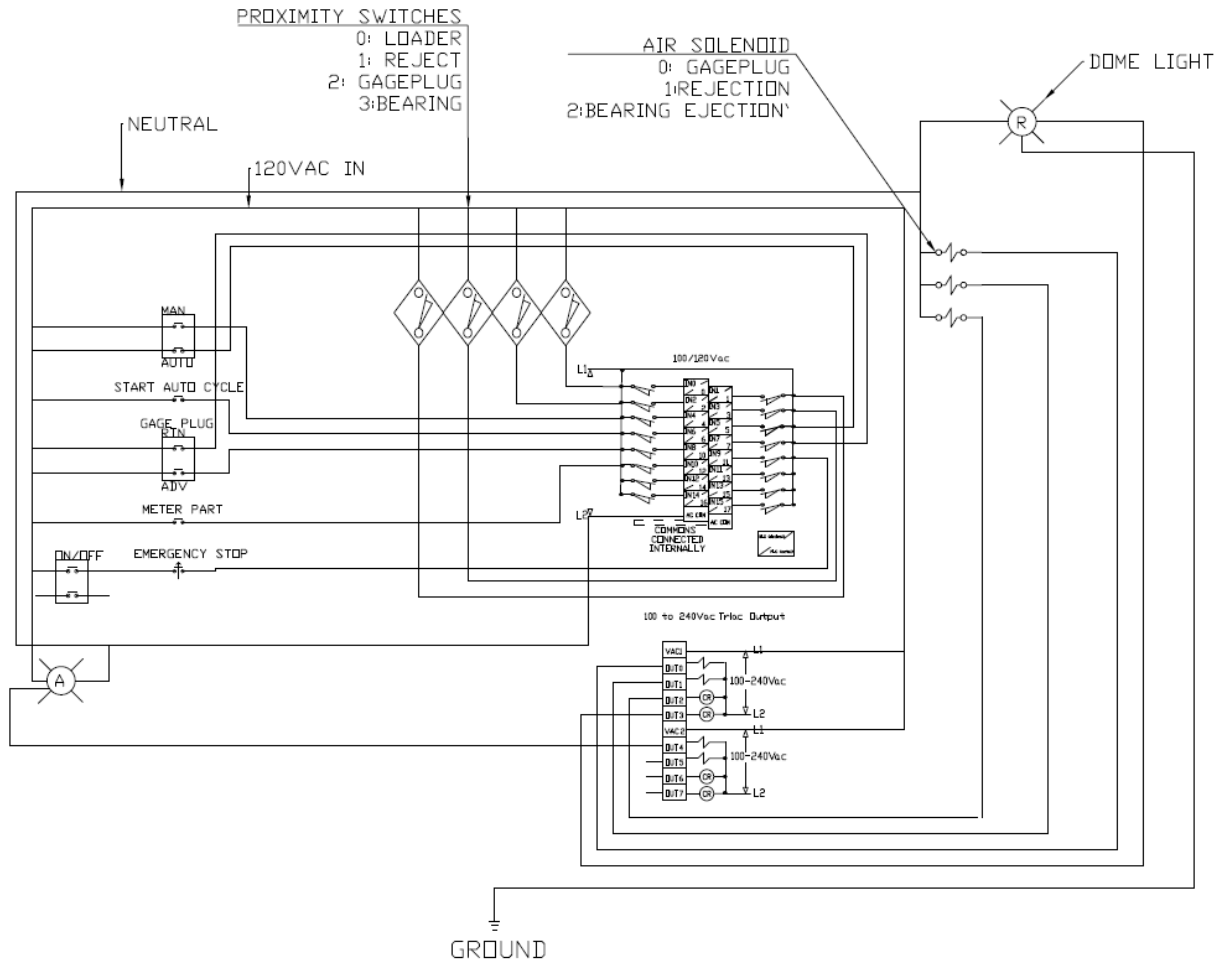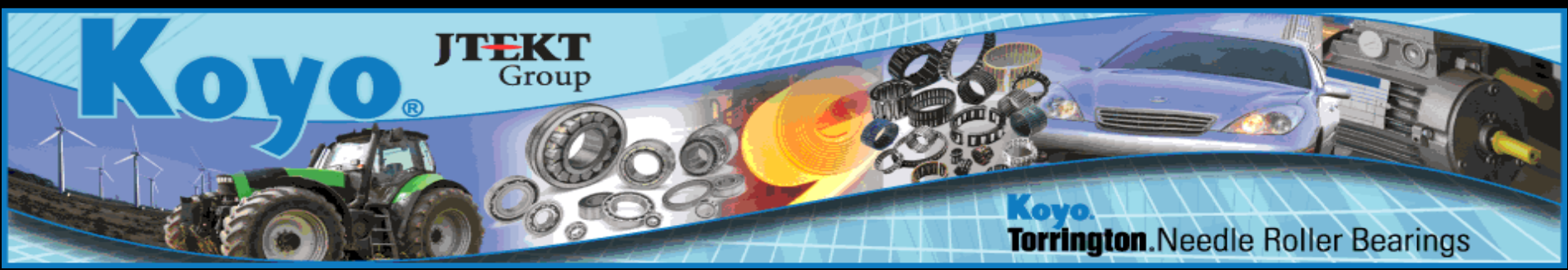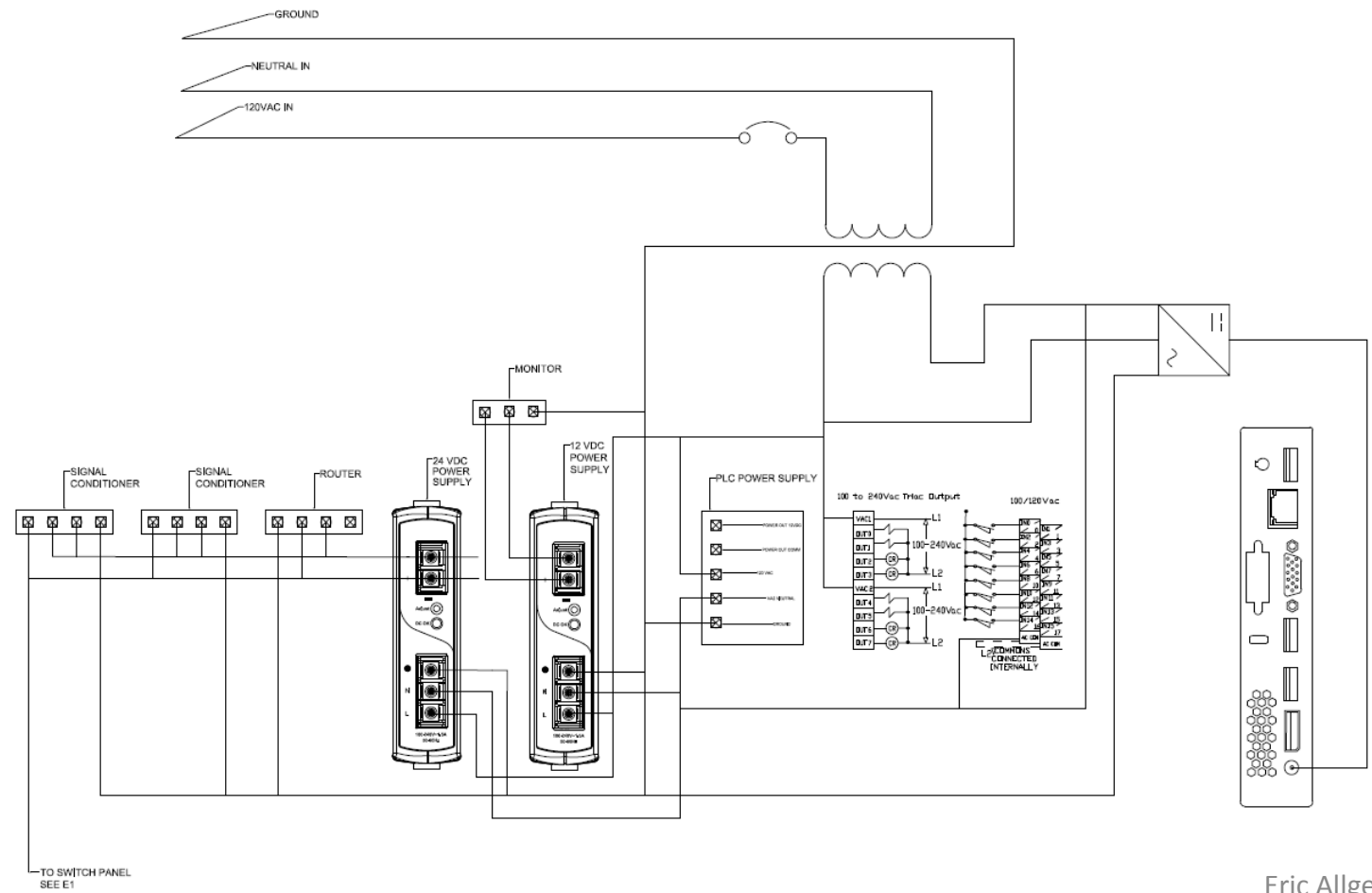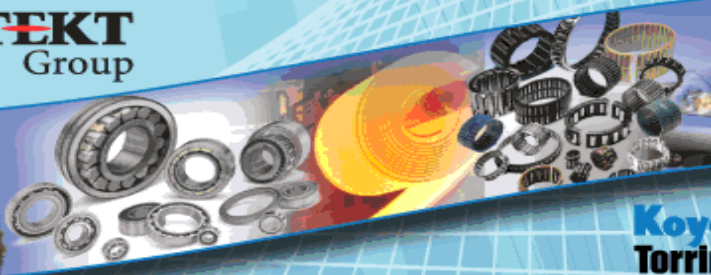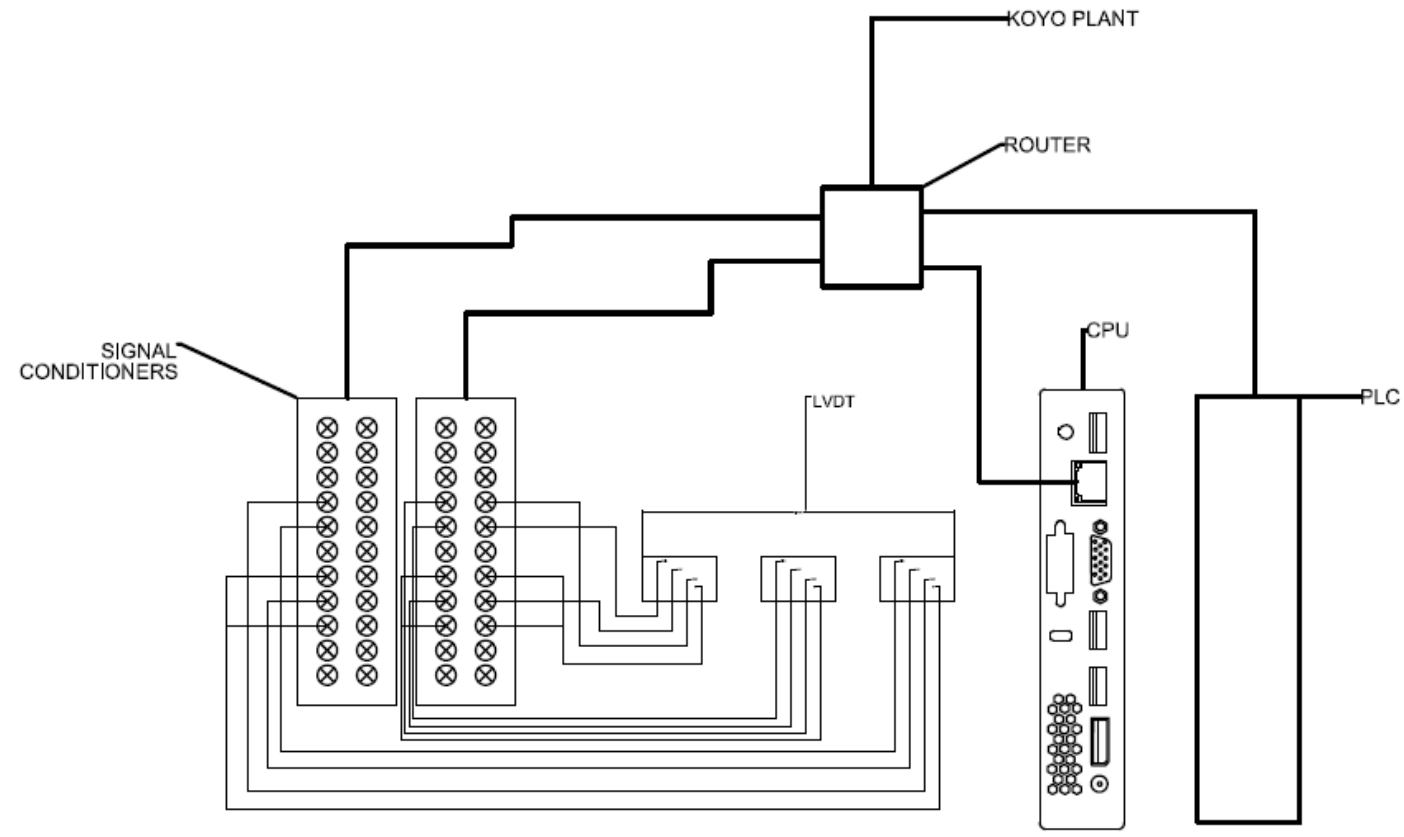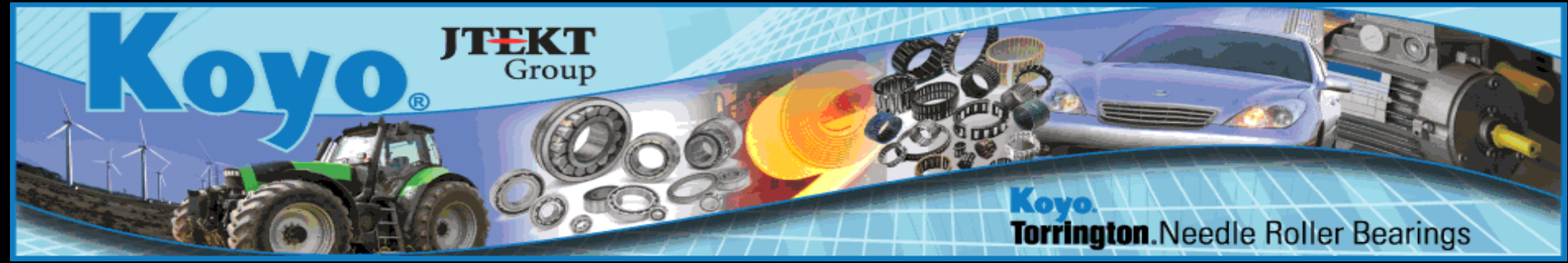
Hardware / Software

Materials

- 16 gage wire

- 3/16-24 machine screws

- Wire terminal crimps

- Heat shrink

- Printable wire labels

- Wire Ties

- Din rail (35mm)

- Din rail mounted two screw

  terminals

Programming Software

- RSLogix 500 for the PLC ladder logic

  programming

- Quincy (Open Source) for GUI development

Manufacturing Recommendations

- Setup test bed for new components
- Code equipment
- Remove old wiring and subsystems
- Insert new mounting devices
- Insert electrical components
- Run and land wires
- Final testing
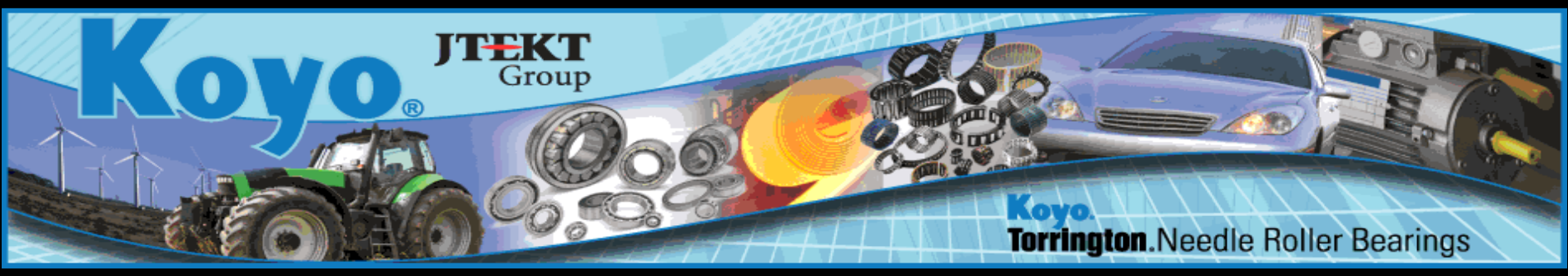
Safety

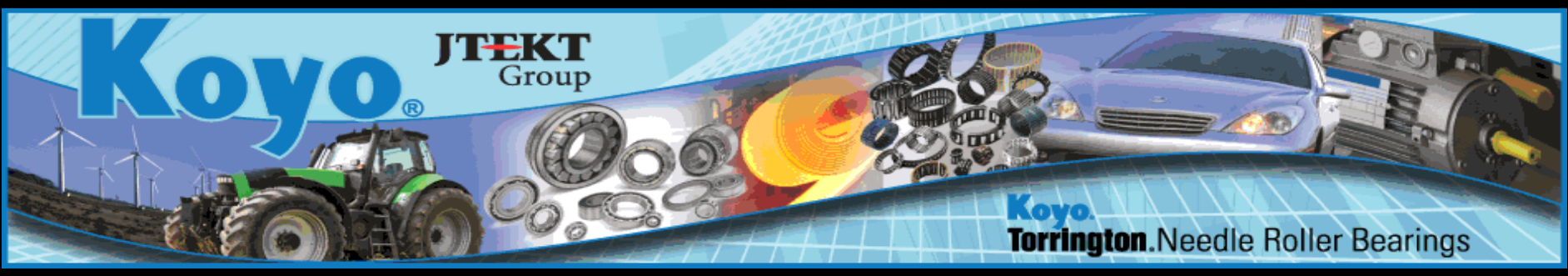- All work to be done on this machine will follow a strict LOTO (Lock out tag out) on all sources of potential energy.

- All potential electrical hazards are contained in the two housing on the machine.

- Both housing have locking mechanisms to keep untrained personnel away from any unnecessary hazards.

Bill of Materials

| Device	Part Number	Unit Price ($)	Quantity	Price ($)
CPU	LENOVO ThinkCentre M92p	*	1	*
PLC - Chassis	1746-A4	*	1	*
PLC – CPU/Ethernet Module	1746	*	1	*
PLC – Input Module AC	1746-IA16	*	1	*
PLC – Output Module DC	1746-OA16	*	1	*
PLC - Software	RSLogix 500	2050.00	1	2050.00
Signal Conditioner	ANR2	895.00	2	1790.00
Power Supply 24V	PSB24-060-P	28.00	1	28.00
Power Supply 12V	PSB12-060	37.25	1	37.25
Router	CTR-Link EIPR-E	299.00	1	299.00
Monitor	ELO 1537L	527.00	1	527.00
Circuit Breakers	QUO110	30.65	1	30.65
Misc. (DIN Rail...)	TBD	TBD	TBD	~100.00
Total			11	$4861.90

* Provided by KOYO
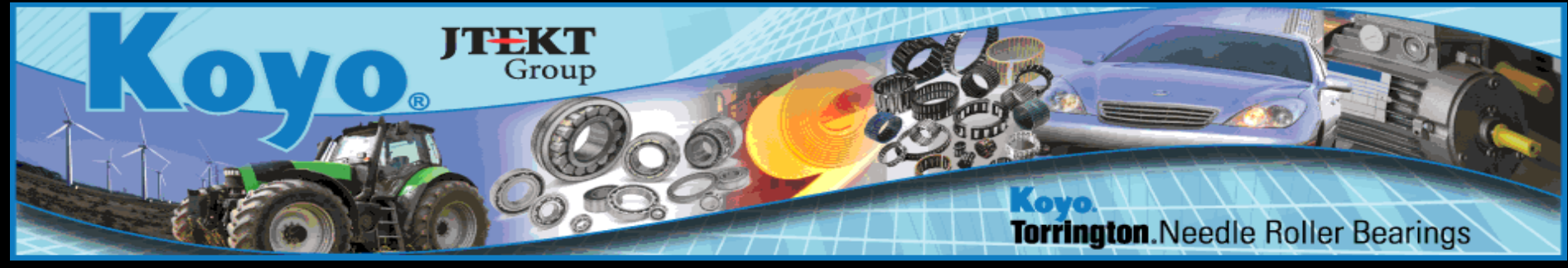
Spring Schedule

January

1. Remove old electrical components from the machine
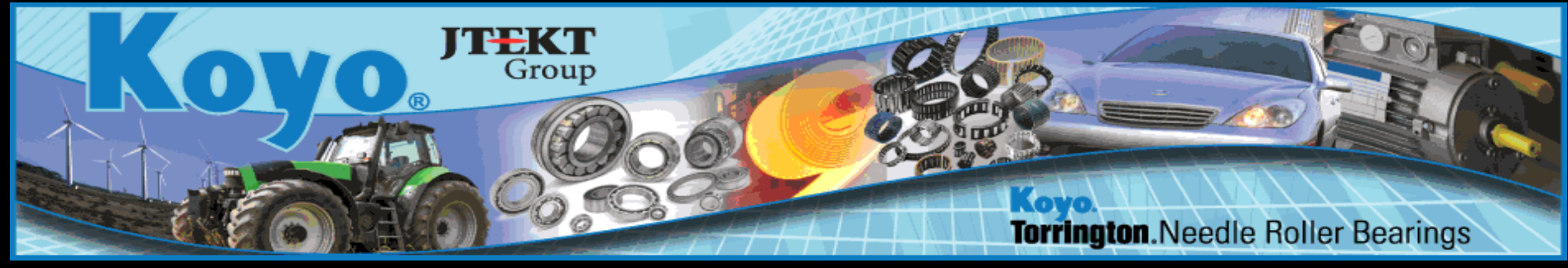
2. Install new components

February / March

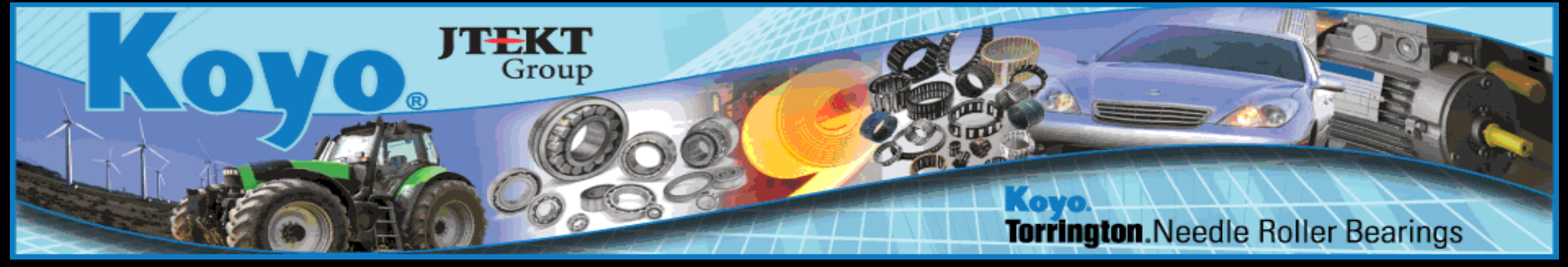3. Program and test all components.

April

4. Debug

Conclusion

- Mechanical aspects meet Koyo Bearing's standards

- Update the electronic components of an Automated Bearing Bore Gage

- Getting final approval of bill of materials from Koyo to order parts

- Assembling the parts and setting up the internal network

Questions and Comments

References
http://eng.fsu.edu/me/senior_design/2014/team22/