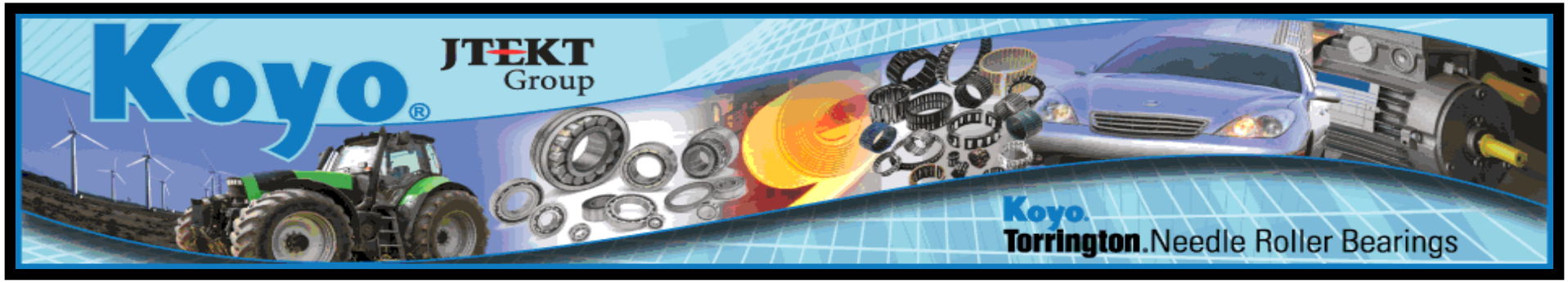


Senior Design Project
Automated High Volume Bearing Bore Gage

Concept Design Review

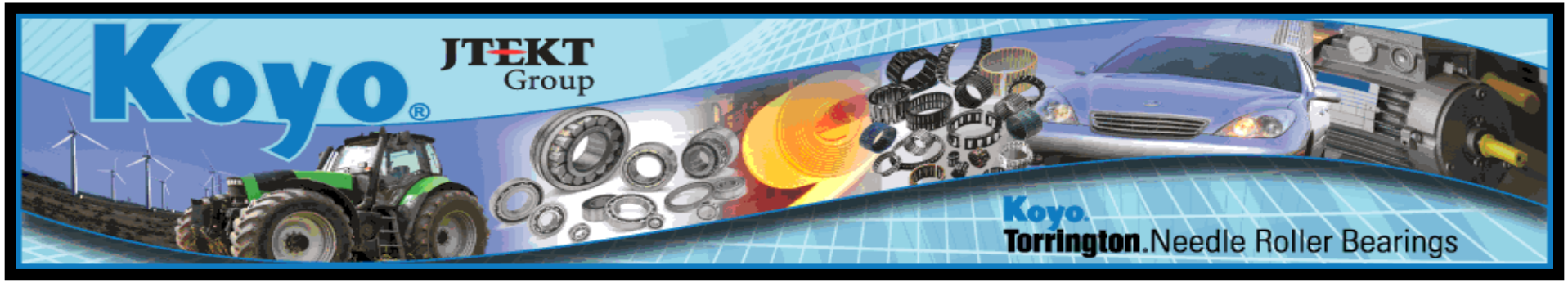
Team 22

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

Team Sponsor
Robert Potts (KOYO Bearings)

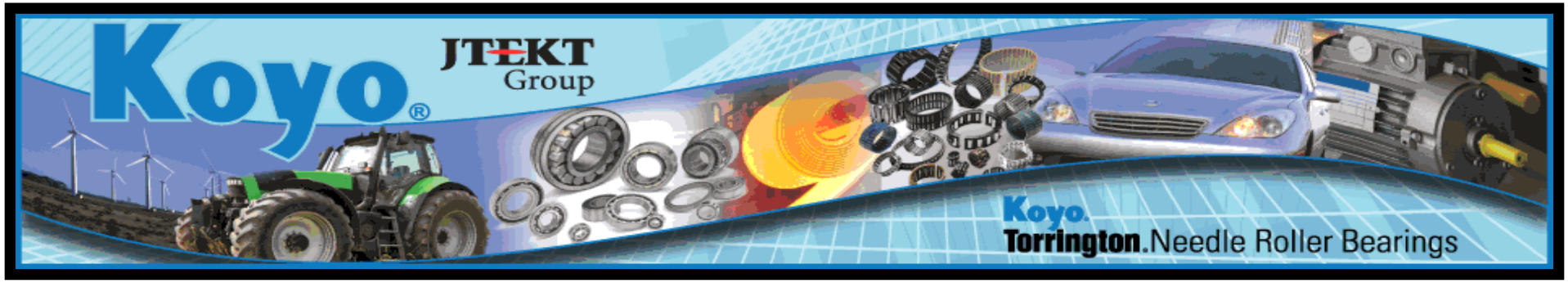
Team Advisor
Dr. Cartes

Instructors
Dr. Shih
Dr. Amin
Dr. Frank



Agenda

Scope of Work
Accomplishments
Functional Analysis
Design Concepts
Chosen Design and Components
Mechanical Housing
GUI
PLC / Test Bed
Signal Conditioners
Conclusion
Future Recommendations



Automated Bearing Bore Gauge

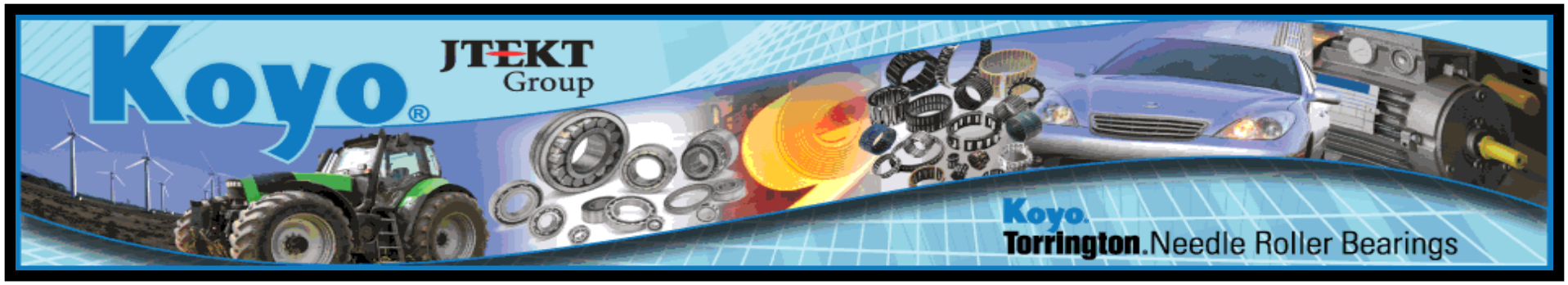
- Measures bore sizes
- Determines pass or fail

Problem Statement

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

Objectives

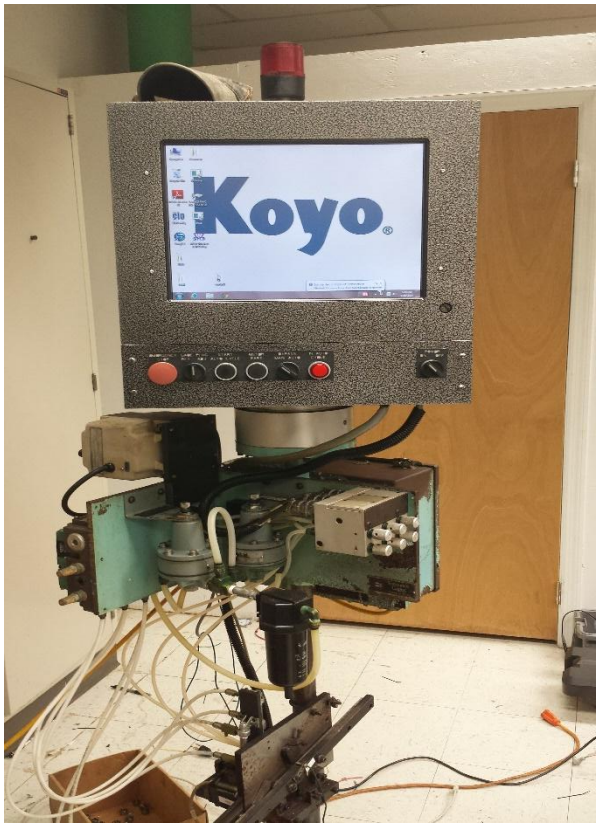
- New GUI (Graphical User Interface)
- Replace electrical components
- Keep existing pneumatic system

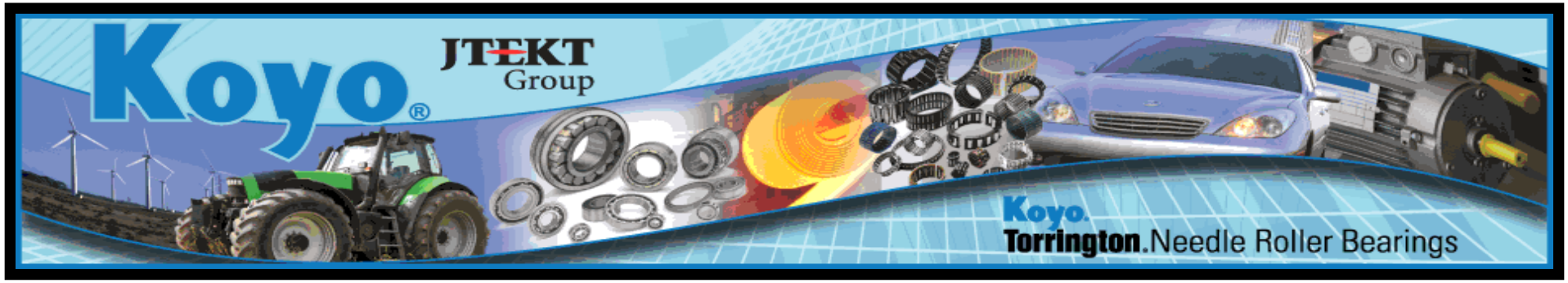


Accomplishments

- Design Conception / Selection
- Housing Reconstruction
- Signal Diagnostics / Rewiring
- PLC Programming
- Graphic User Interface Construction

- Progress toward the objectives
- Not ready for implementation

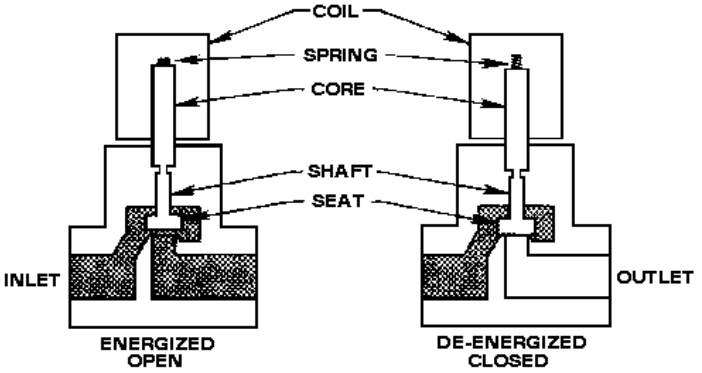


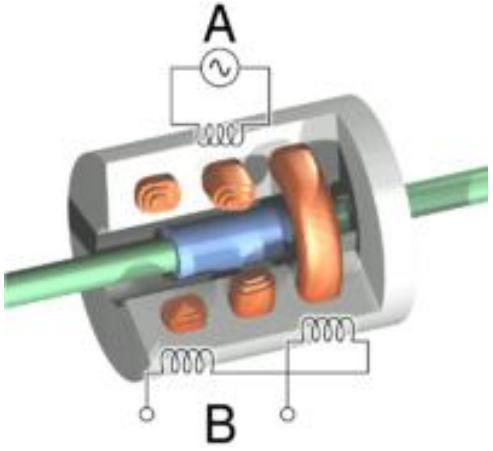


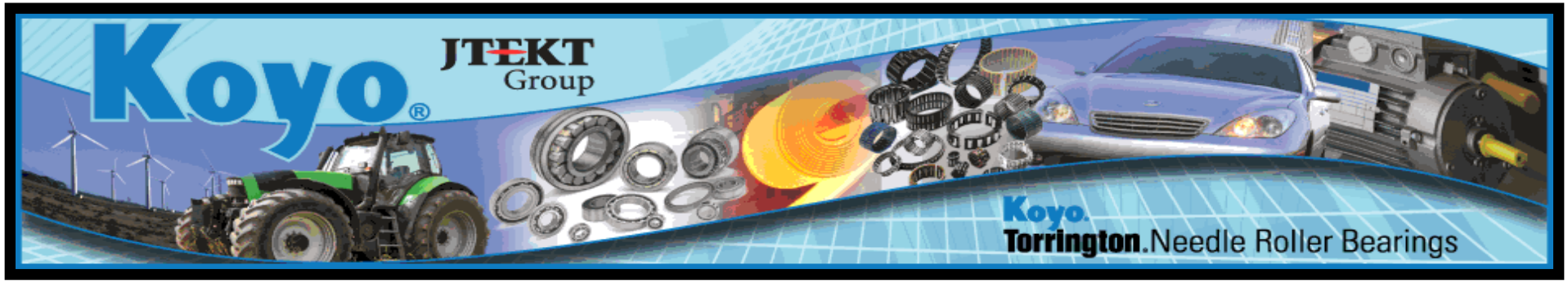
Functional Analysis

Pneumatic System

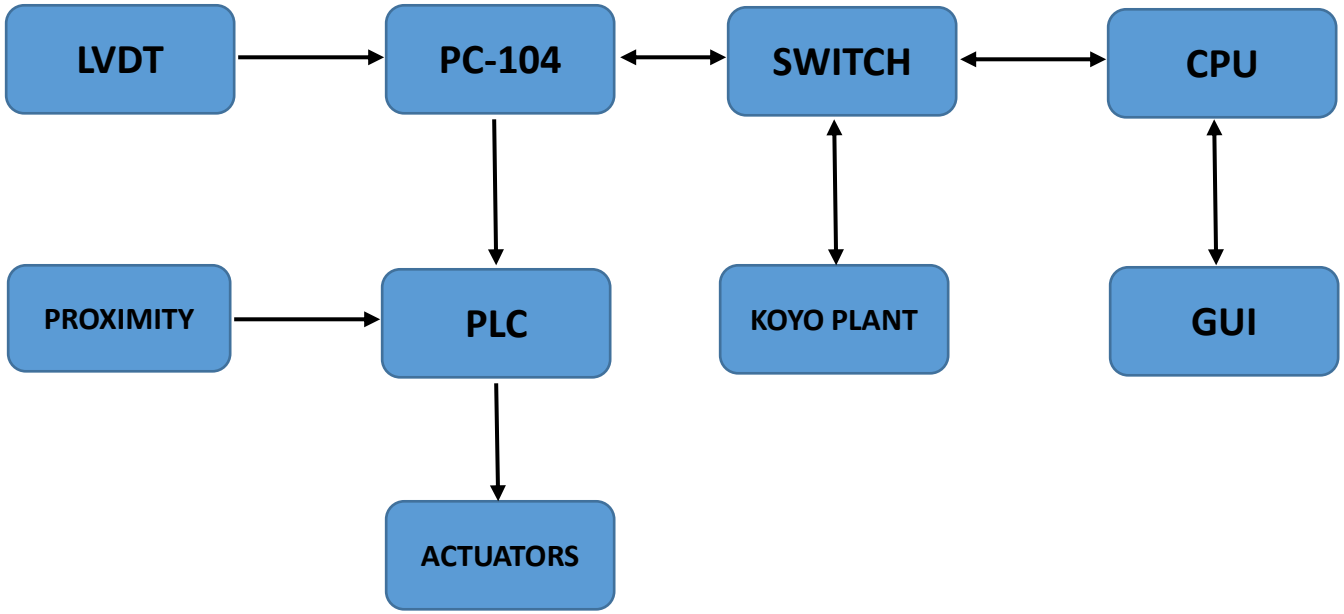
- Solenoids
  - Magnetic core moved through applied voltage
- Cylinders
  - Converts pneumatic pressure to mechanical motion
- LVDT
  - Current induced in central coil
  - Pressure moves magnetic core
  - Induced current in outer coil varies

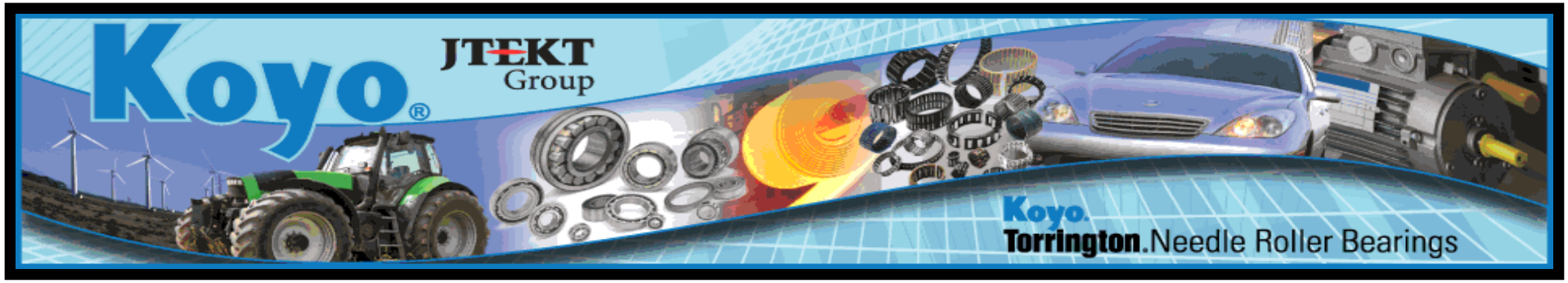






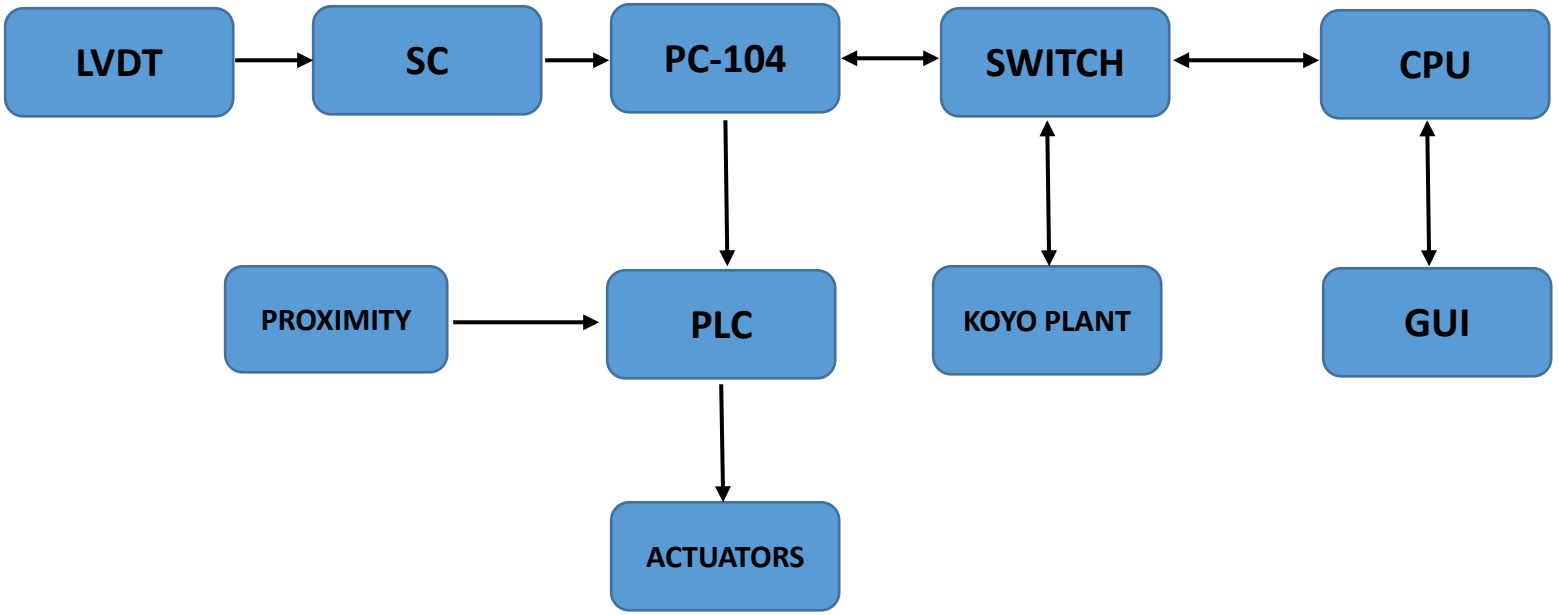
Concept 1: PC-104
Utilizes a PC-104 board

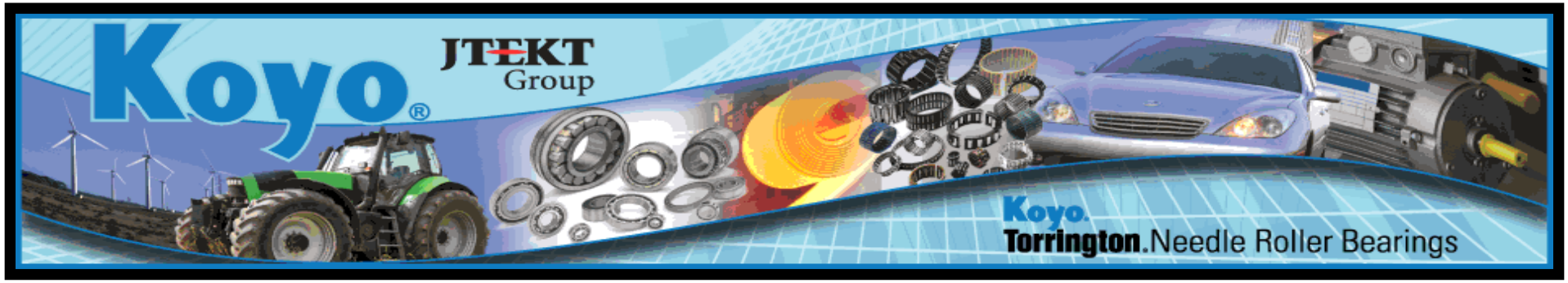




Concept 2: Signal Conditioner and PC-104

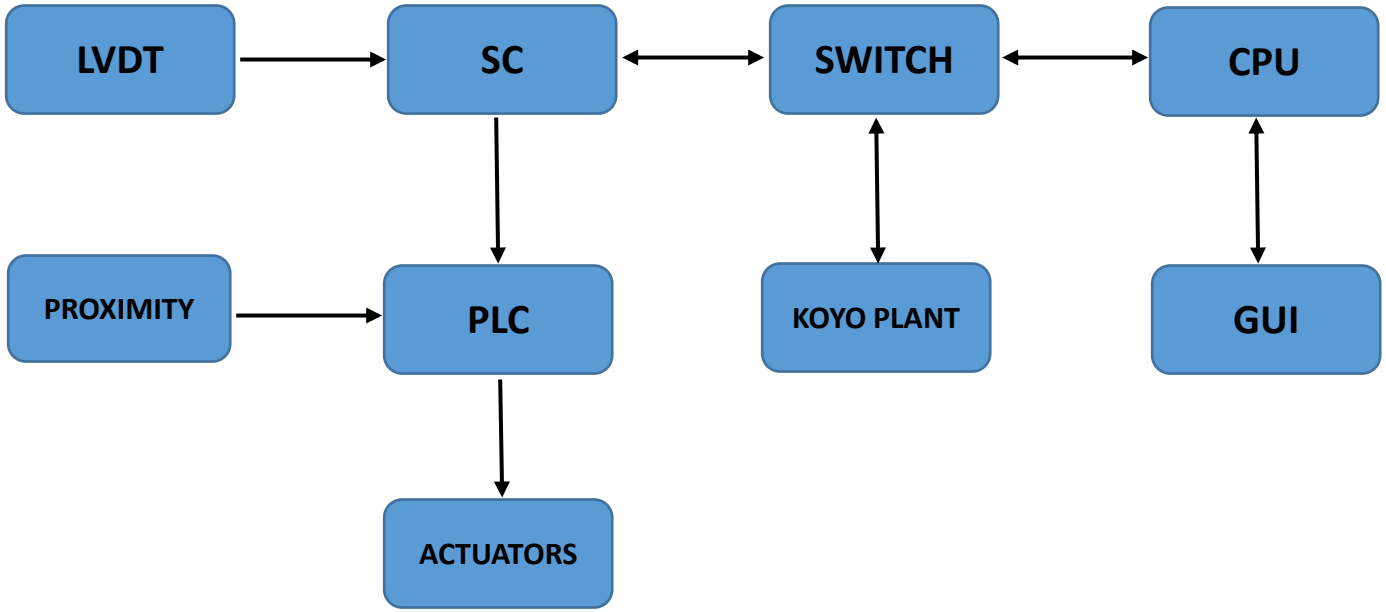
Utilizes a PC-104 board in conjunction with a signal conditioning module (SC)

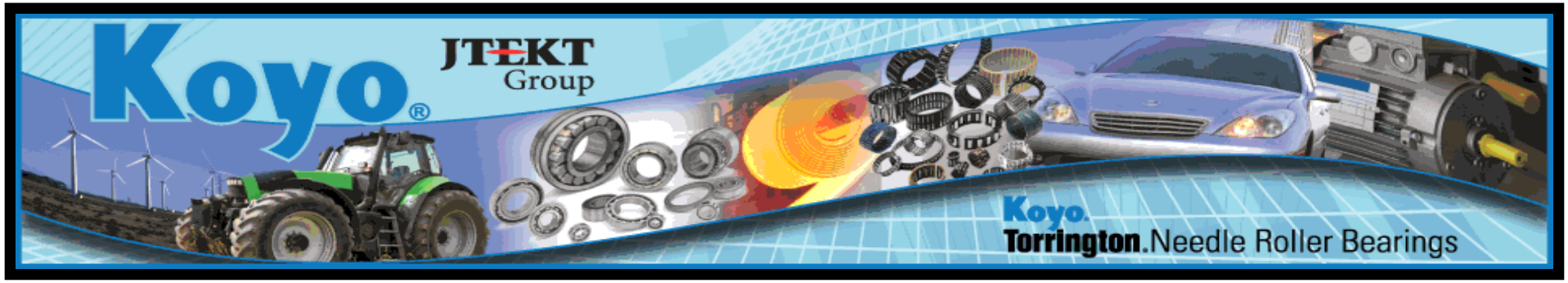




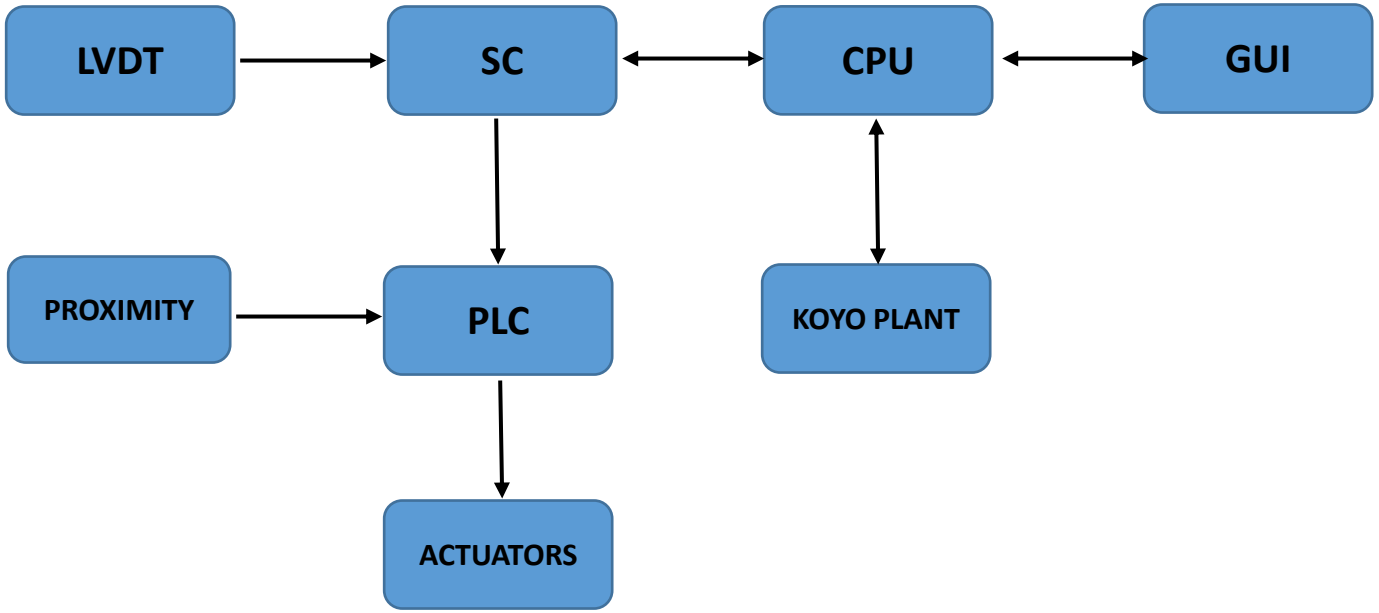
Concept 3: Signal Conditioner to PLC

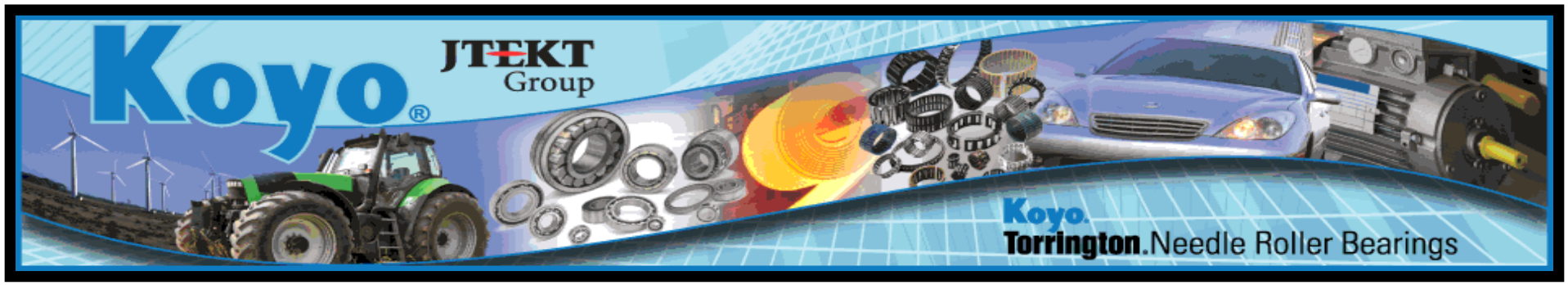
Uses only a signal conditioning module in conjunction with the PLC and CPU.





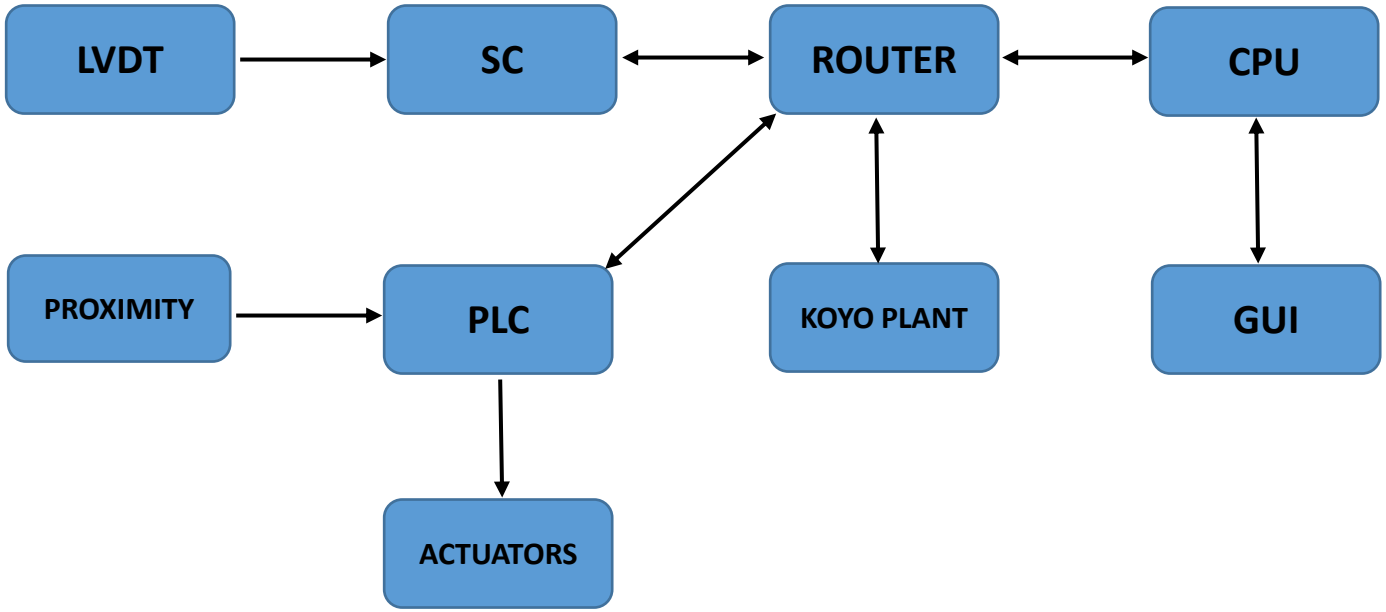
Concept 4: SC and no Switch
CPU communicates with SC and Koyo simultaneously.

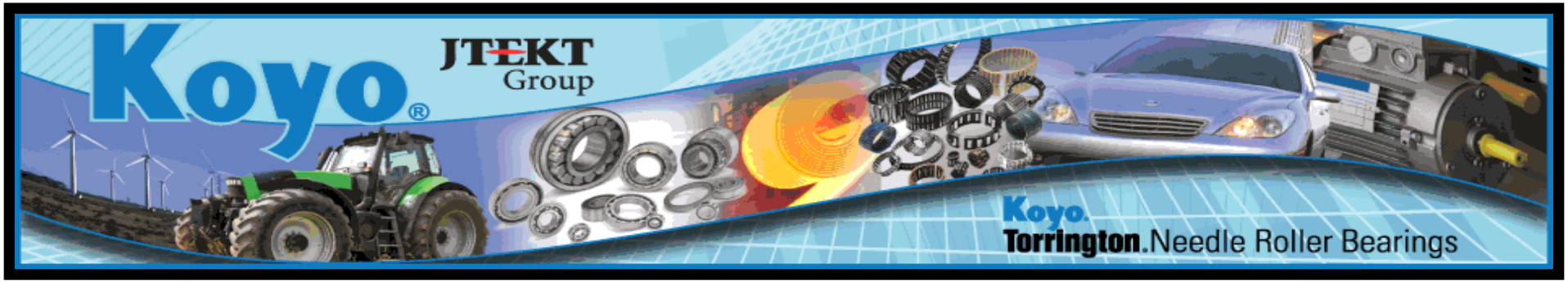




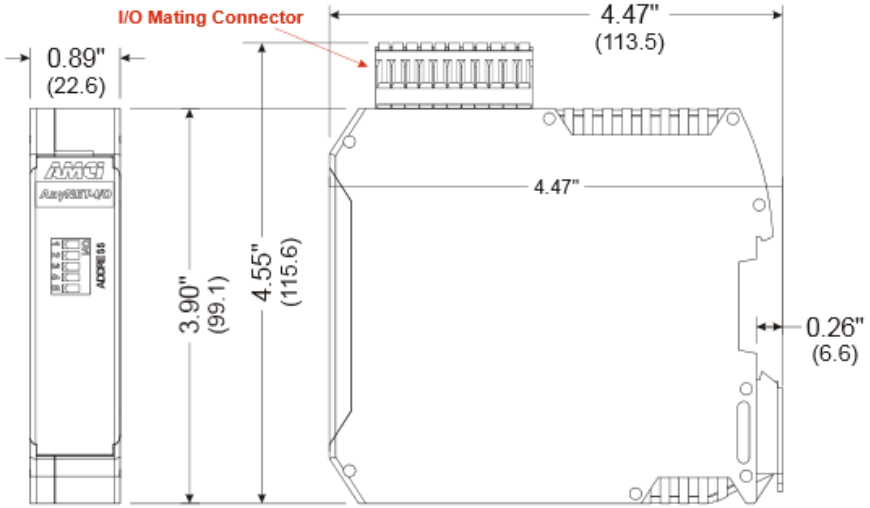
Design Chosen (3)

Uses only a signal conditioning module in conjunction with the PLC and CPU.

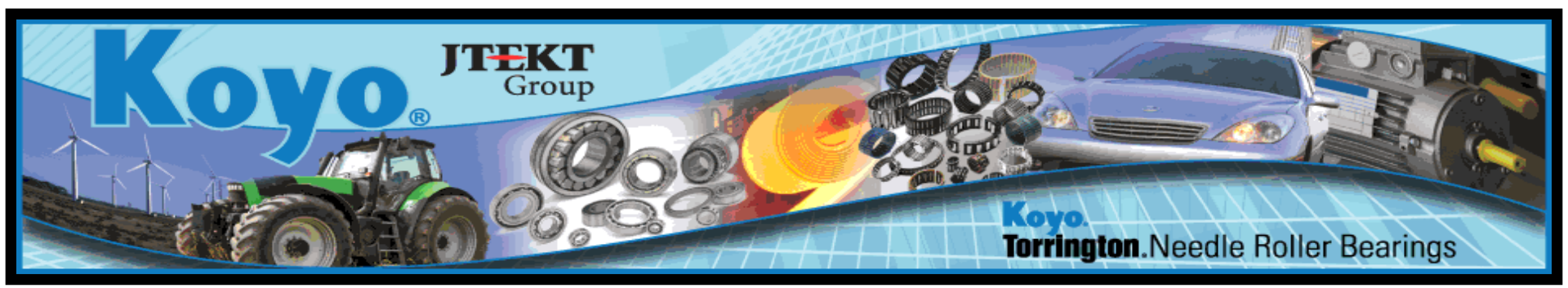




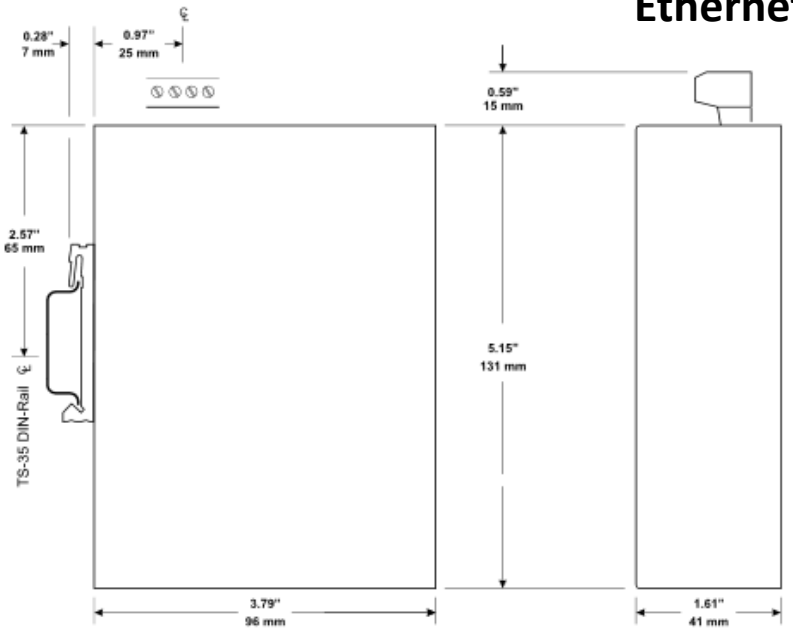
LVDT AC Signal Conditioner (SC)



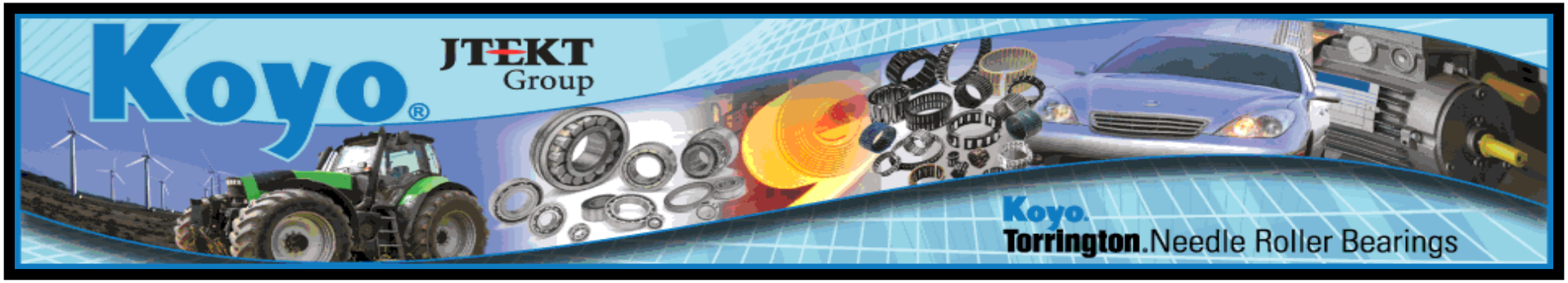
- The LVDT will be excited with 4V at 4 kHz.
- Receive size through a differential voltage.
- Export the data through the Ethernet port to the PLC and CPU.



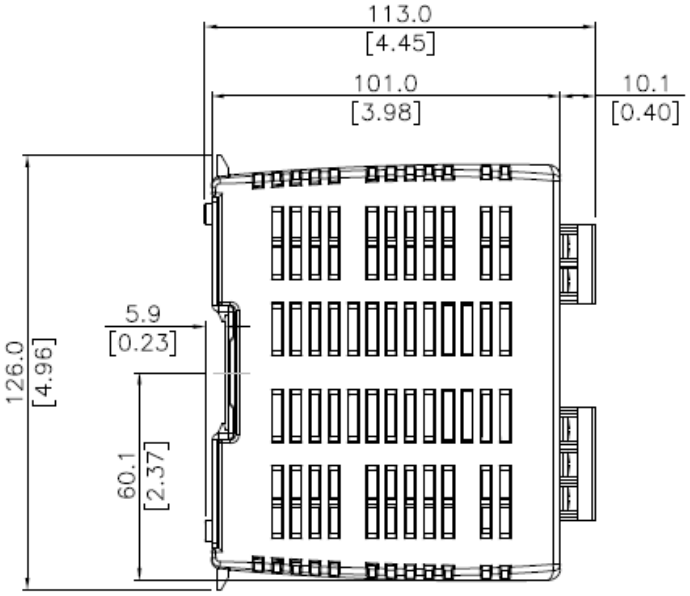
Ethernet Router

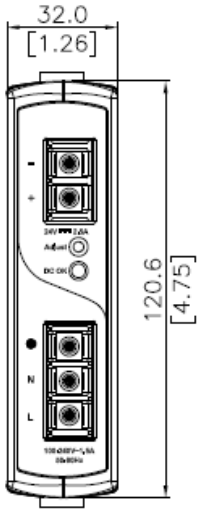


- CTRLink Ethernet Router
- 4 Port 10/100 Mbps LAN Switch.
- 1 Port 10/100 Mbps WAN
- Uses Ethernet to link and network all devices to KOYO Plant

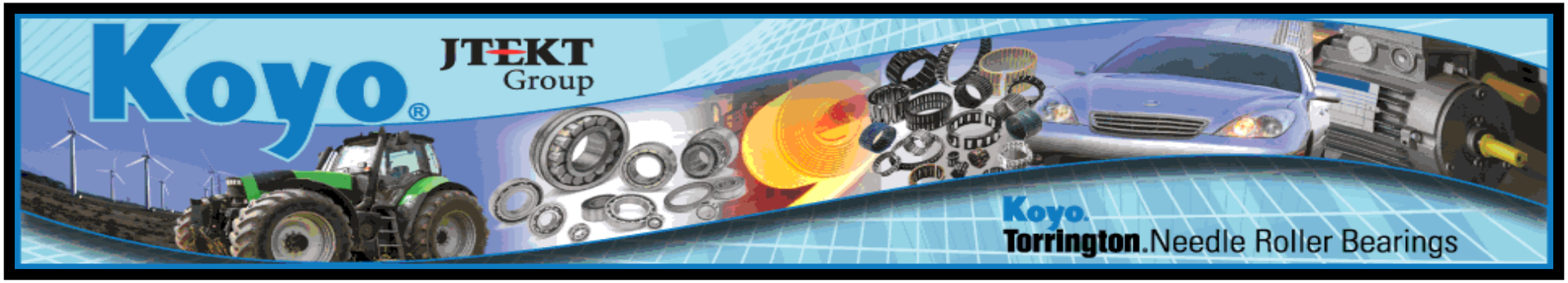


24 VDC Power Supply

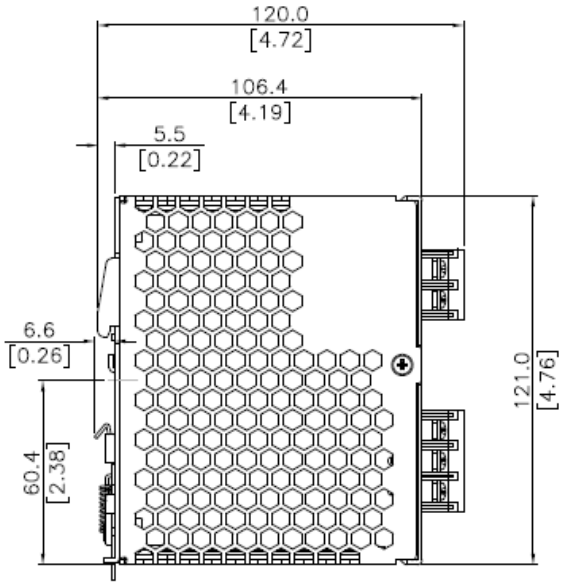


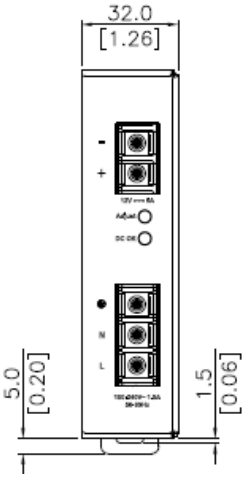


- 24VDC Power Supply used to power the LVDT signal conditioner and the router.

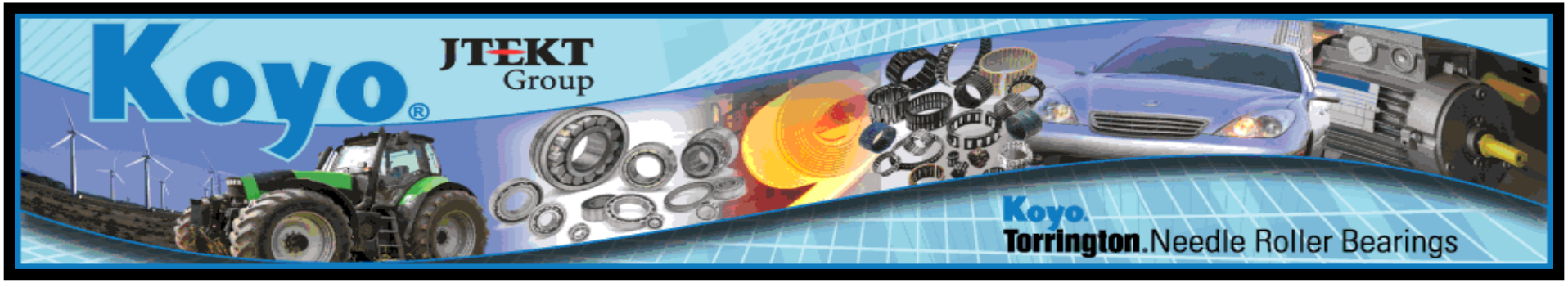


12 VDC Power Supply



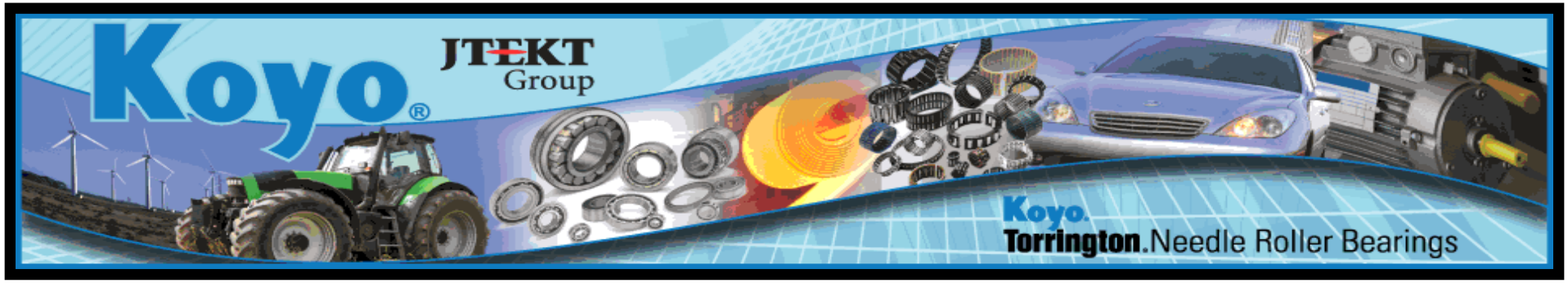


- 12 VDC Power Supply used to power the monitor



CPU – Lenovo ThinkCentre M92p

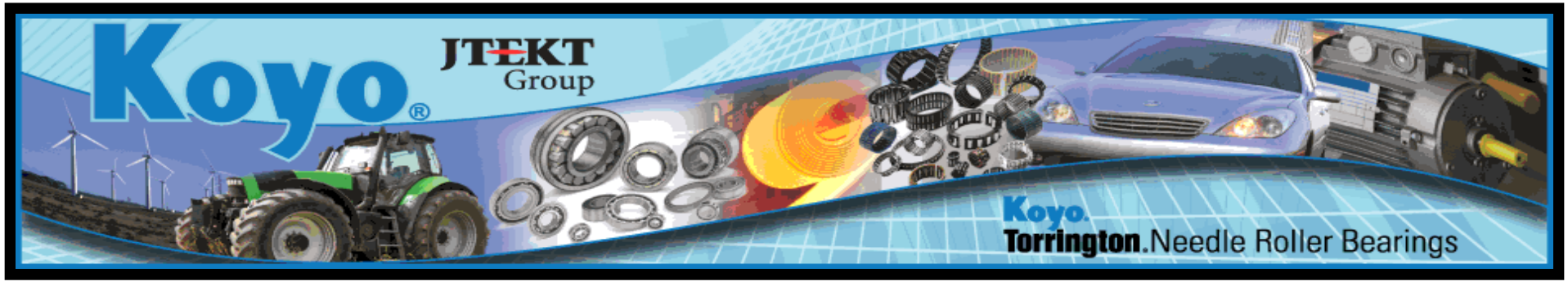
- The CPU will used to collect data from the SC.
- From this data, a histogram will be developed for the plant operator and machine operator convenience.
- CPU will be used to interface between the touch screen monitor and the SC.
- CPU will be used to calibrate the SC for the maximum and minimum bearing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



Touch Screen

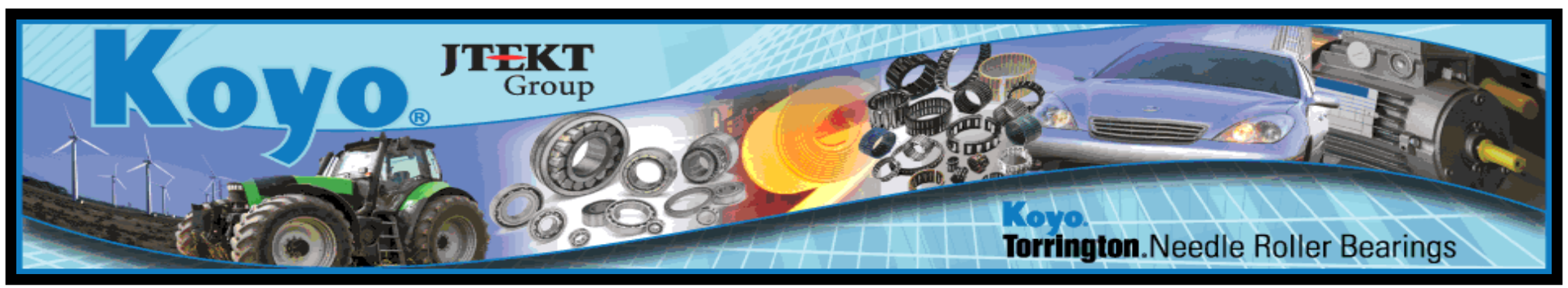
ELO 1537L 15” LCD

- Connects to the CPU via USB and VGI
- Ease of operation through touch screen



PLC and Software

- MicroLogix1200 gives us Ethernet capability
- Rugged industrial standard
- Program software will be RSlogix500
- 14 node, 120 VAC discrete input.
- 10 node, 120 VAC discrete output.



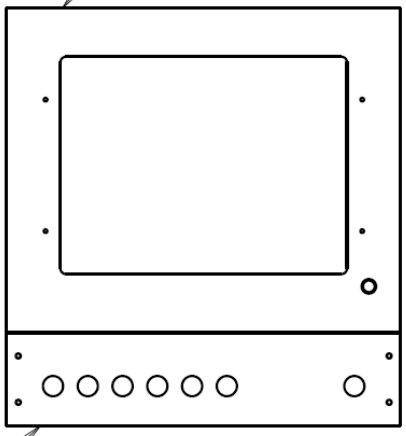
Manufacturing

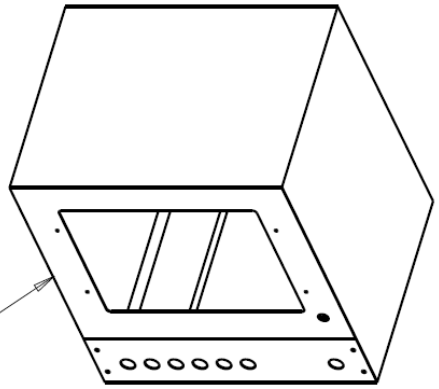
DWG NO F2014-005 Koyo JTEKT

REVISIONS

NUM	DESCRIPTION	DATE	APPROVED

Monitor Panel
Part Number F2014-001





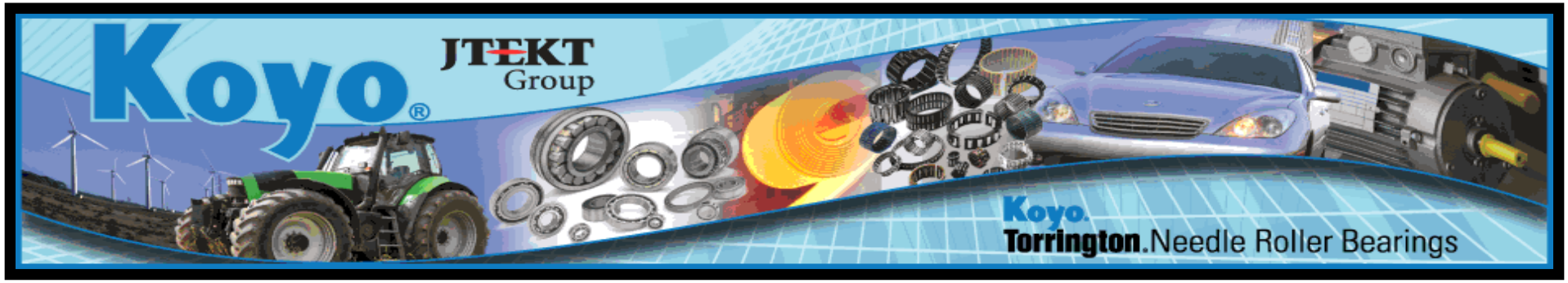
Switch Panel
Part Number F2014-002

Monitor Panel attaches to housing
with tack welds

MATERIAL	PROPRIETARY NOTICE		
	THIS DOCUMENT CONTAINS CONFIDENTIAL AND TRADE SECRET INFORMATION, IS THE PROPERTY OF KOYO BEARINGS NORTH AMERICA LLC, AND IS GIVEN TO THE RECEIVER IN CONFIDENCE. THE RECEIVER BY RECEPTION AND RETENTION OF THE DOCUMENT ACCEPTS THE DOCUMENT IN CONFIDENCE AND AGREES THAT, EXCEPT AS AUTHORIZED IN WRITING BY KOYO BEARINGS NORTH AMERICA LLC, IT WILL (1) NOT USE THE DOCUMENT OR ANY COPY THEREOF OR THE CONFIDENTIAL OR TRADE SECRET INFORMATION THEREIN; (2) NOT COPY THE DOCUMENT; (3) NOT DISCLOSE TO OTHERS EITHER THE DOCUMENT OR THE CONFIDENTIAL OR TRADE SECRET INFORMATION THEREIN; AND (4) UPON COMPLETION OF THE NEED TO RETAIN THE DOCUMENT, OR UPON DEMAND, RETURN THE DOCUMENT, ALL COPIES THEREOF, AND ALL MATERIAL COPIED THEREFROM.	THIRD ANGLE PROJECTION DRAWN MB 2/5 CHECKED MB 2/5 APPROVED KF 2/5 APPROVED	Koyo Bearings North America LLC TITLE: Front Panel SIZE A · DRAWING NUMBER F2014-005 · REV 1 SCALE 0.200 · PAGE 1 OF 1

0 1 (in)
0 5 10 15 20 25 (mm)

ProEngineer VERSION



Manufacturing

DWG NO M2014-003 Koyo JTEKT

REVISIONS

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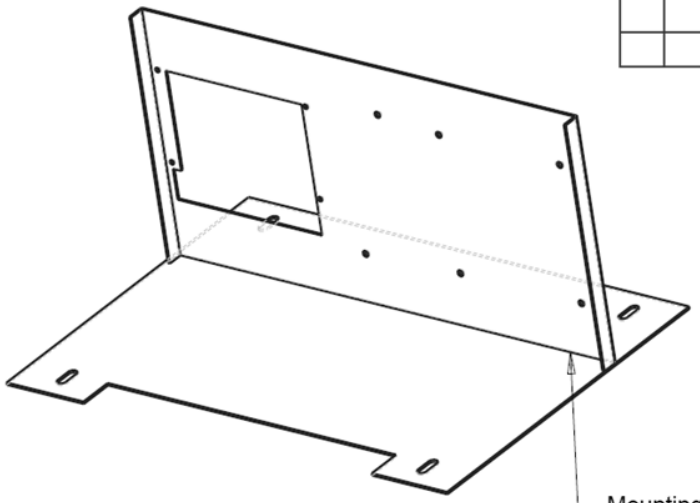

Mounting Plate Top is to be tack welded to the Mounting Plate Bottom

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A36 Carbon Steel 1/16 inch	THIS DOCUMENT CONTAINS CONFIDENTIAL AND TRADE SECRET INFORMATION, IS THE PROPERTY OF KOYO BEARINGS NORTH AMERICA LLC, AND IS GIVEN TO THE RECEIVER IN CONFIDENCE. THE RECEIVER BY RECEPTION AND RETENTION OF THE DOCUMENT ACCEPTS THE DOCUMENT IN CONFIDENCE AND AGREES THAT, EXCEPT AS AUTHORIZED IN WRITING BY KOYO BEARINGS NORTH AMERICA LLC, IT WILL (1) NOT USE THE DOCUMENT OR ANY COPY THEREOF OR THE CONFIDENTIAL OR TRADE SECRET INFORMATION THEREIN; (2) NOT COPY THE DOCUMENT; (3) NOT DISCLOSE TO OTHERS EITHER THE DOCUMENT OR THE CONFIDENTIAL OR TRADE SECRET INFORMATION THEREIN; AND (4) UPON COMPLETION OF THE NEED TO RETAIN THE DOCUMENT, OR UPON DEMAND, RETURN THE DOCUMENT, ALL COPIES THEREOF, AND ALL MATERIAL COPIED THEREFROM.	THIRD ANGLE PROJECTION	Koyo Bearings North America LLC

0 1 (in)
0 5 10 15 20 25 (mm)

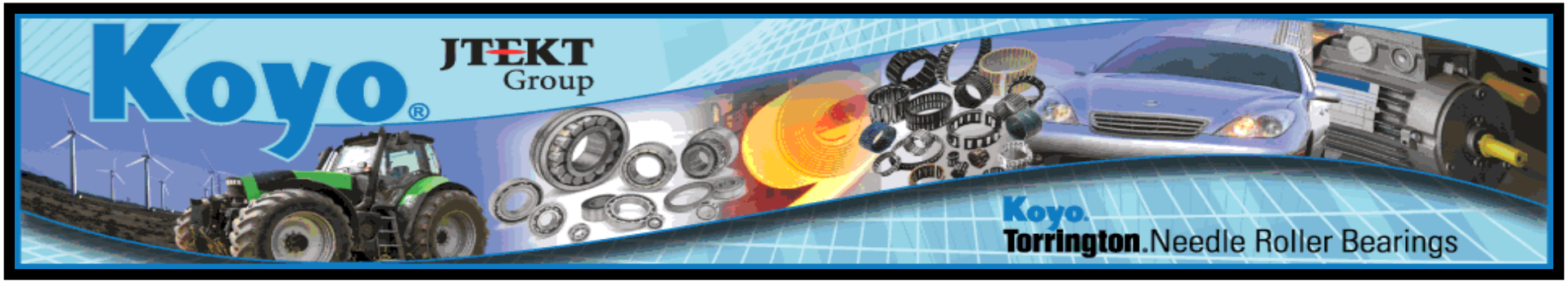
	DRAWN	DATE
	KF	2/3
CHECKED	KF	2/3
APPROVED	MB	2/3
APPROVED		

TITLE: MOUNTING PLATE

SIZE A | DRAWING NUMBER M2014-003 | REV

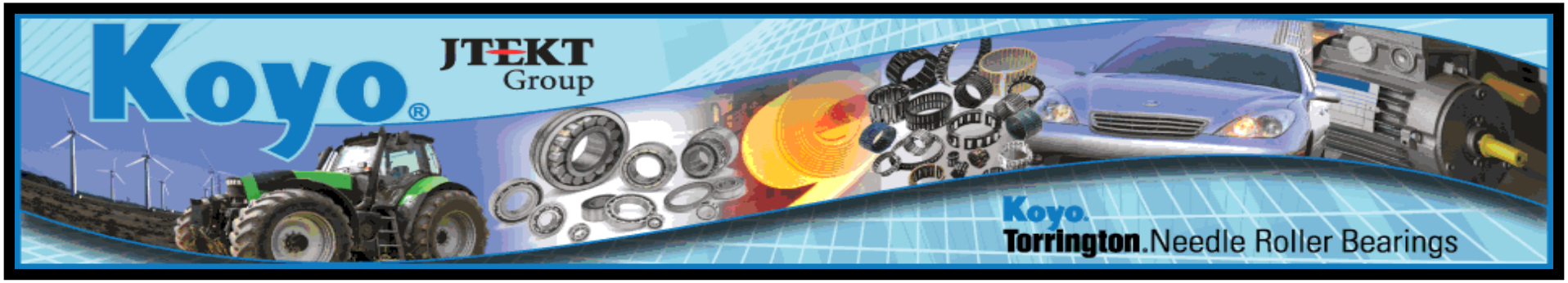
SCALE 0.35 | PAGE 1 OF 1

ProEngineer VERSION

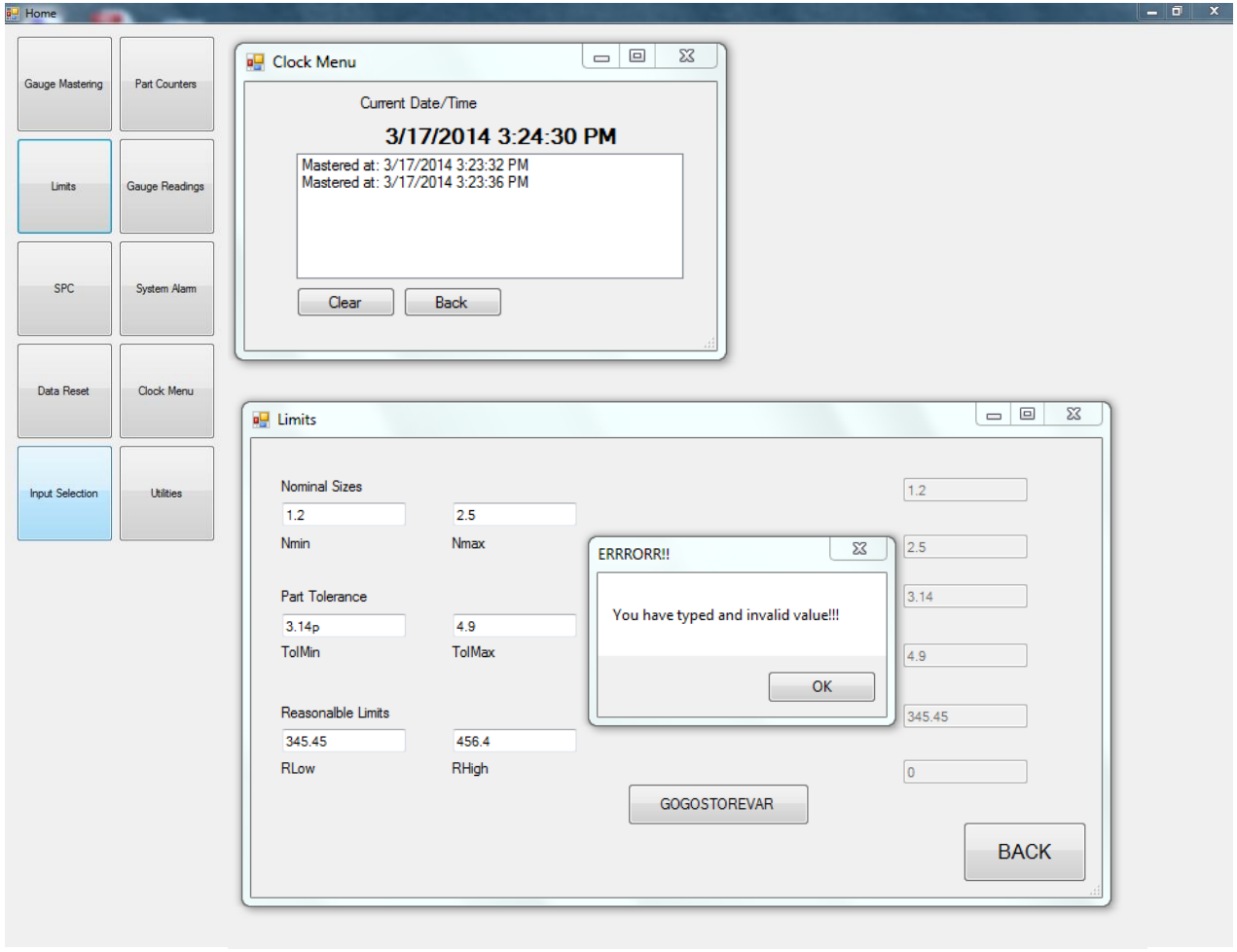


Housing Comparison

TEAM 22



Graphical User Interface

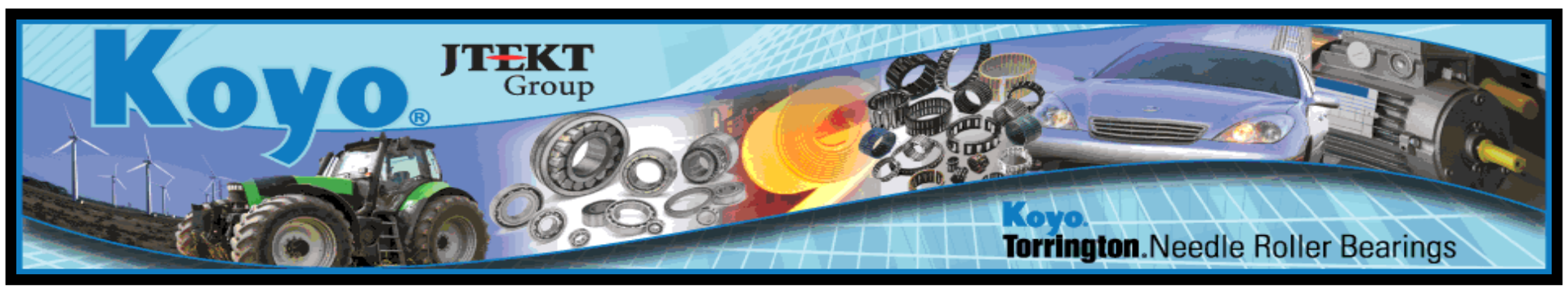


Completed

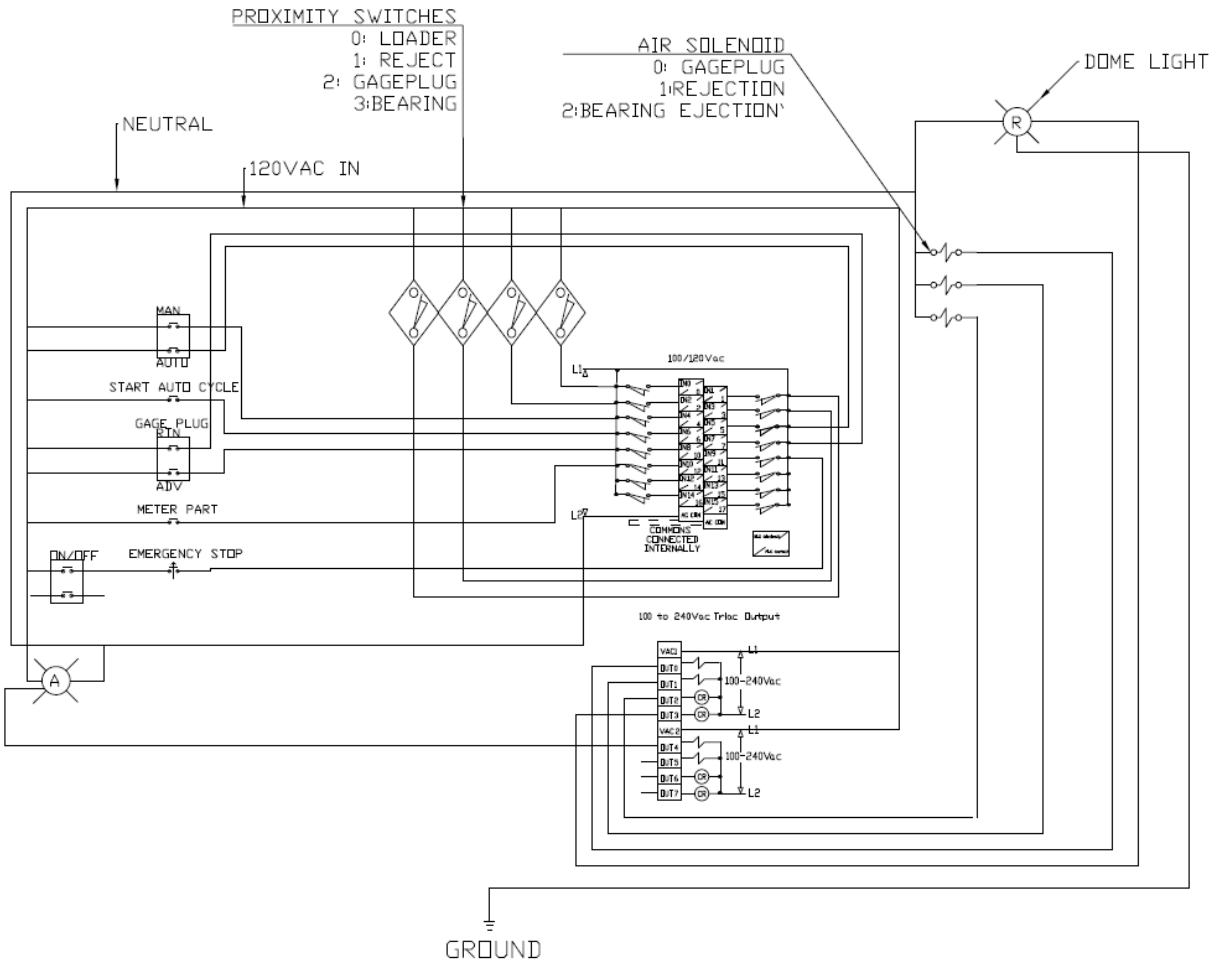
- Design program menu navigation
- 5 of 5 sub-menus
- Signal Conditioner connection through TCP/IP Port 502 through a socket command
- Display data as histogram and bell mouth chart
- Time oriented Data Sorting Algorithm

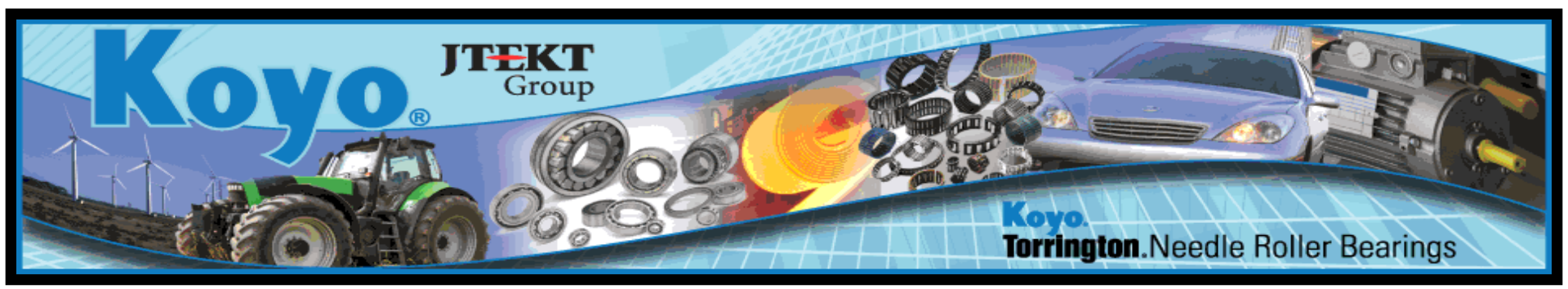
To do:

- Integrate these programs with hardware and each other

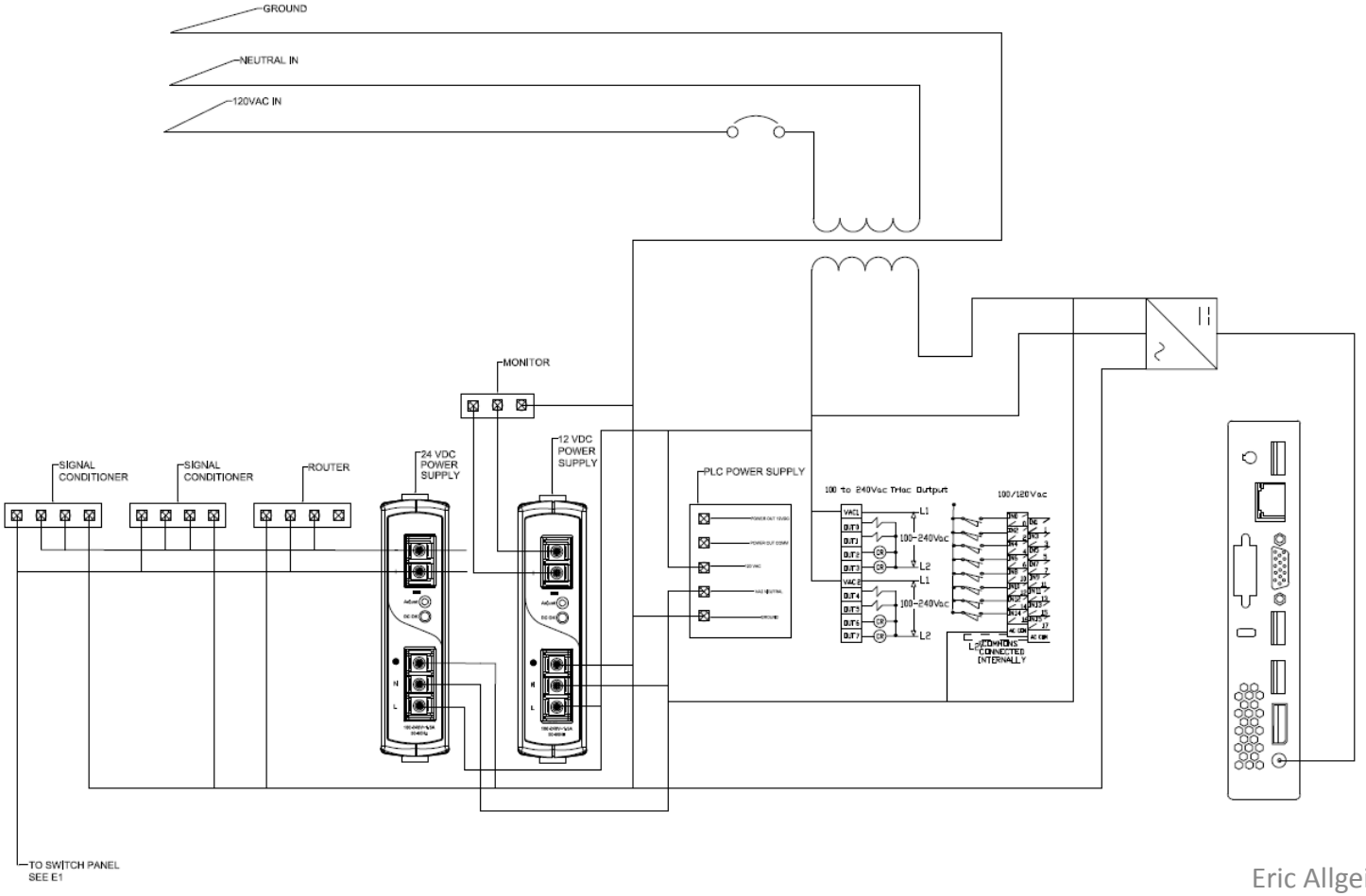


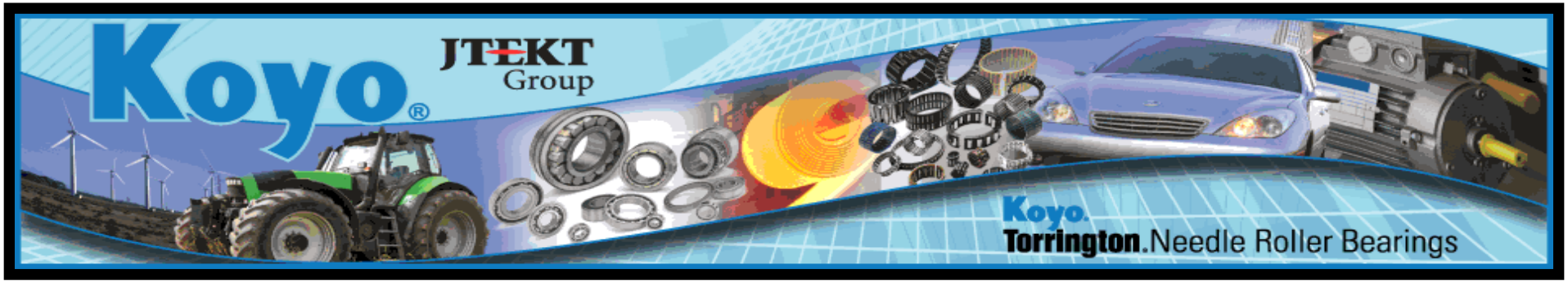
Logic Schematic



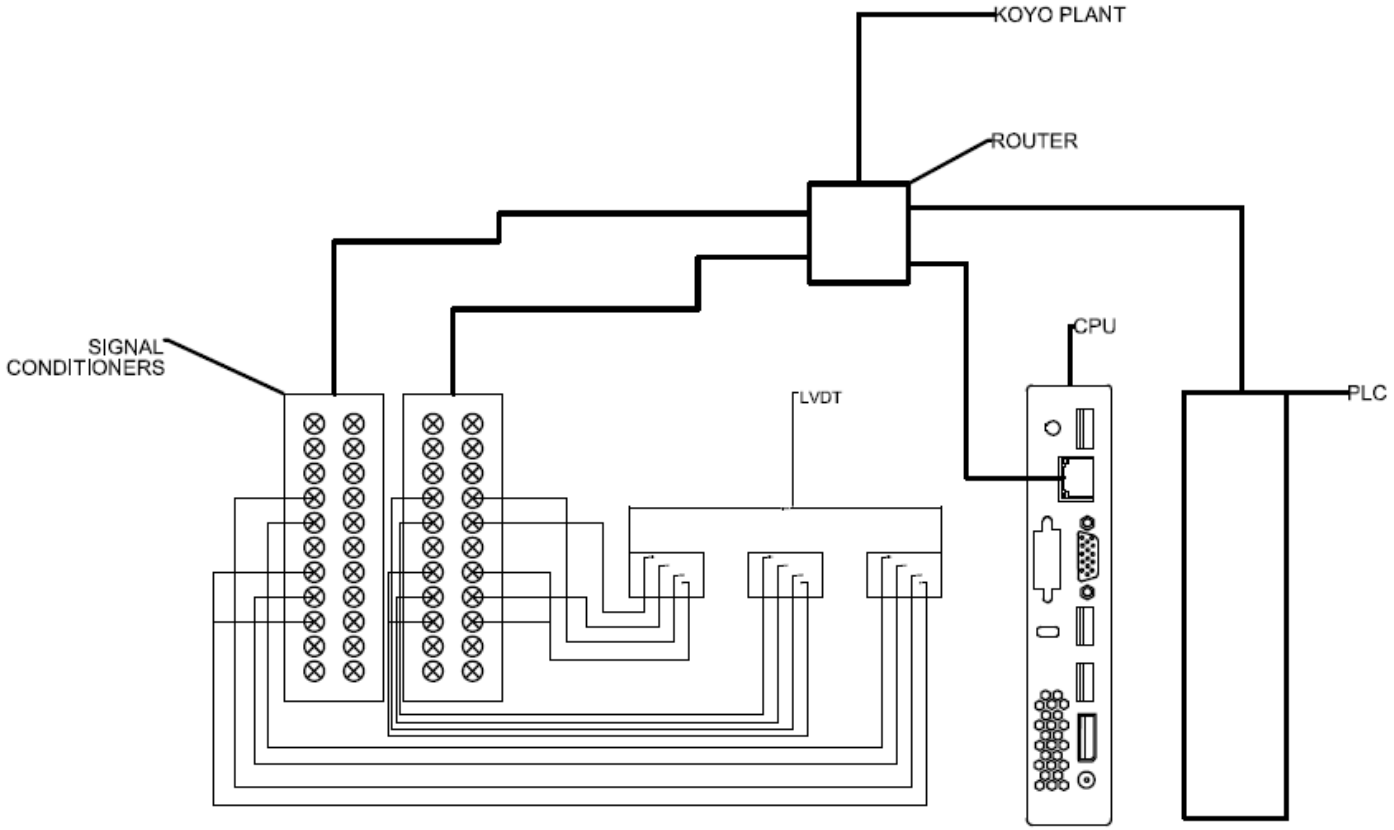


Power Schematic

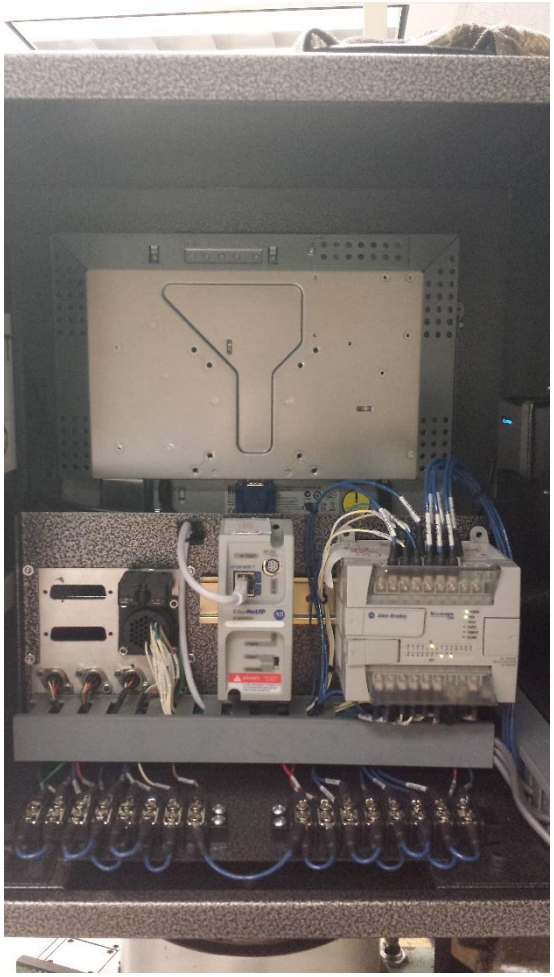


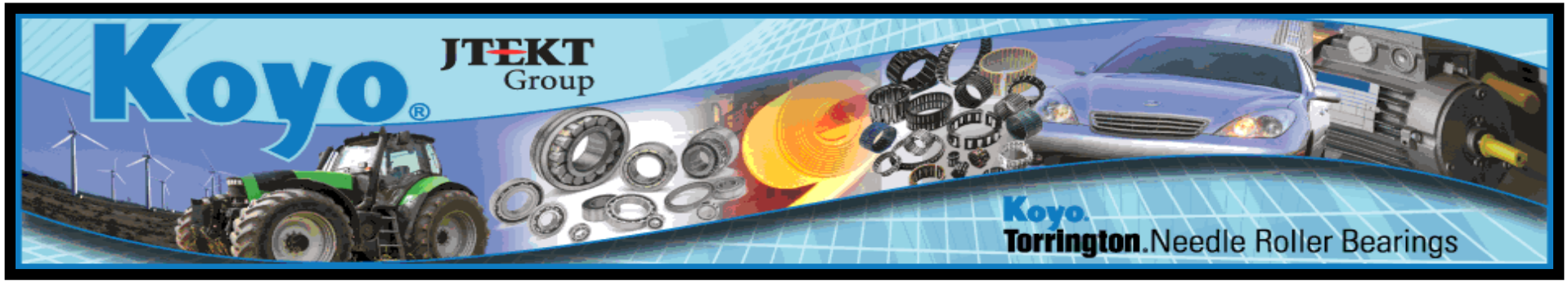


Network Schematic



Wiring

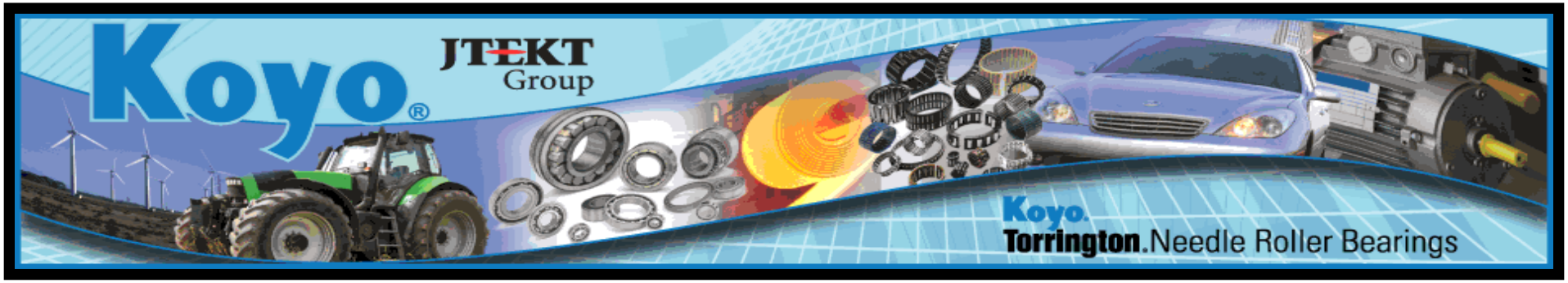




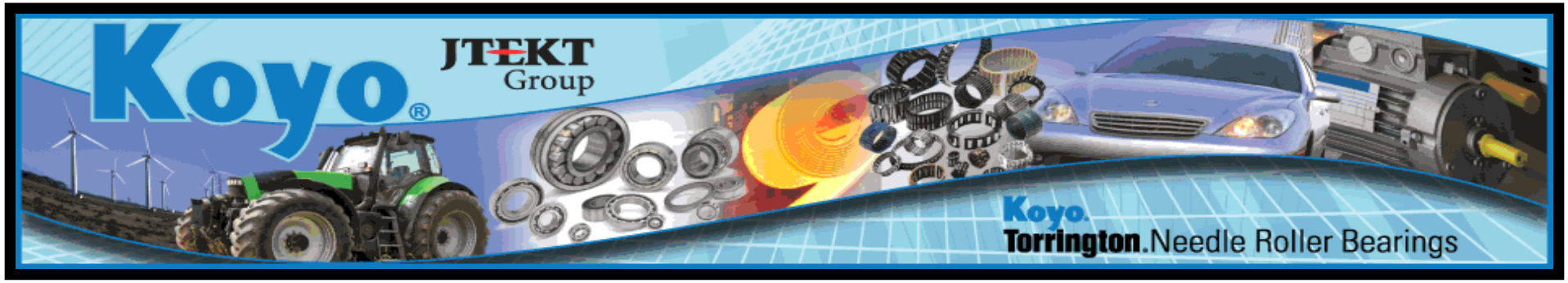
Procurement

Device	Part Number	Unit Price ($)	Quantity	Price ($)
CPU	LENOVO ThinkCentre M92p	*	1	*
PLC	1762-L24AWA	566.20	1	566.20
PLC - Ethernet Module	1761-NET-ENI	950.00	1	950.00
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	6378.10

* Provided by KOYO

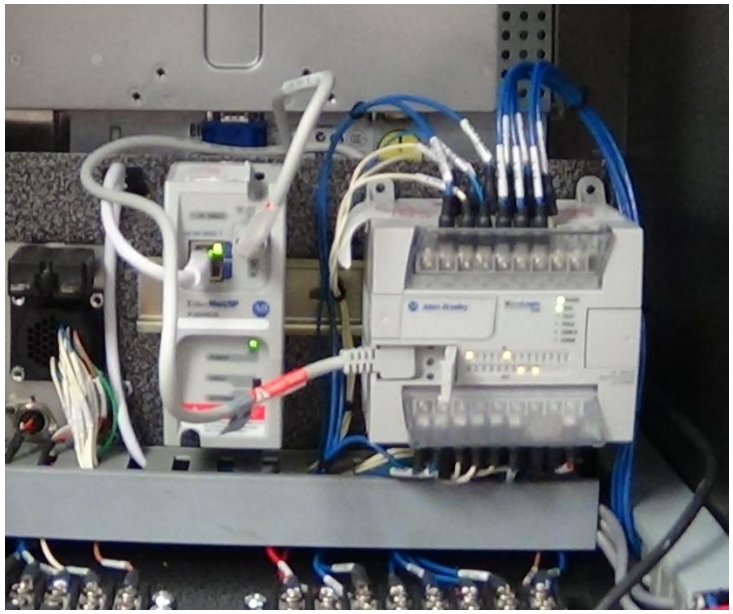


PLC Test-Bed



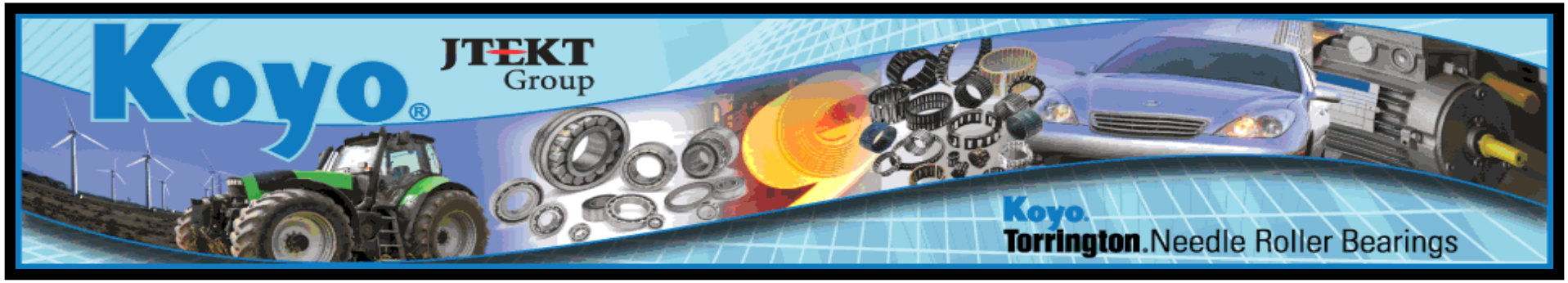
PLC

- Test logic without risking machine
- Found flaws in code
- Program PLC without integrating into another system
- Understand ladder logic implementation without unknown variables



- Able to read input switches and proximity switches
- Able to actuate pneumatics
- Can pass bearings through machine

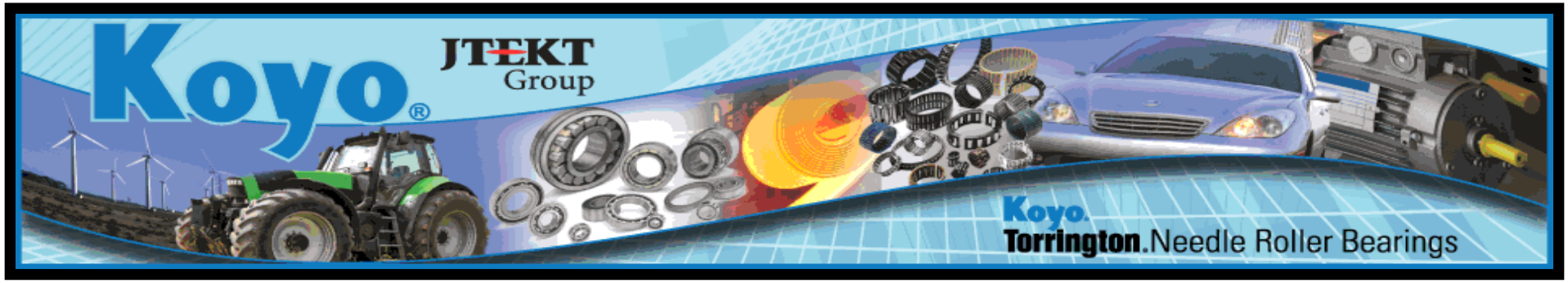

Koyo®
JTEKT
Group
Koyo
Torrington.Needle Roller Bearings
PX1



Conclusion

- New housing has been developed
- Updated the electronic components
  - Touch Screen Monitor (GUI)
  - CPU
  - PLC
  - Signal Conditioners
- PLC can actuate pneumatics
- GUI can receive and store data

- Measurements are not being taken
  - The measuring devices are not LVDTs
  - The original bearing bore gauge used SSPS (Solid State Pressure Sensors)



Future Recommendations

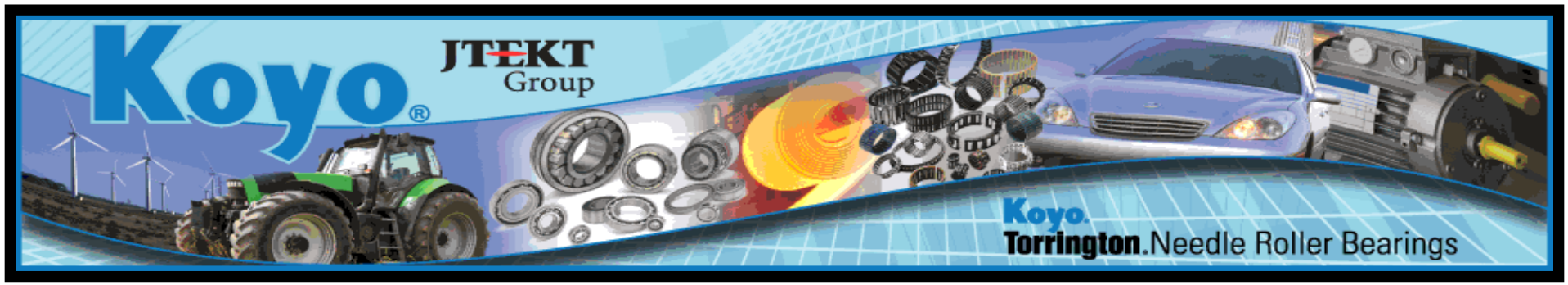
Housing Modifications
- Hinged Front Panel
- Mount PLC higher

PLC
- Incorporate calibration measuring device into code
- Integrate Manual and Automatic Cycle together

GUI
- Compile existing functions into one program
- Format charts and tables

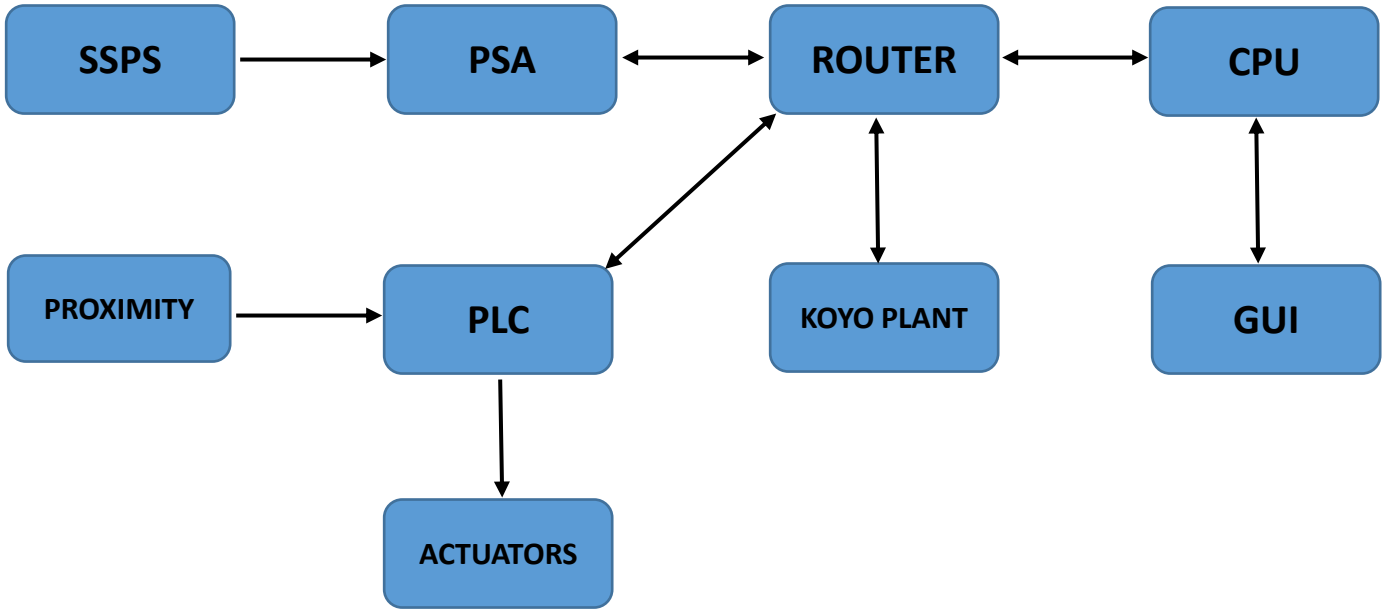
Redesign the measurement taking component
- 2 options
- Make use of solid state pressure sensors with pressure sensor amplifier
- Replace pressure sensors with LVDT

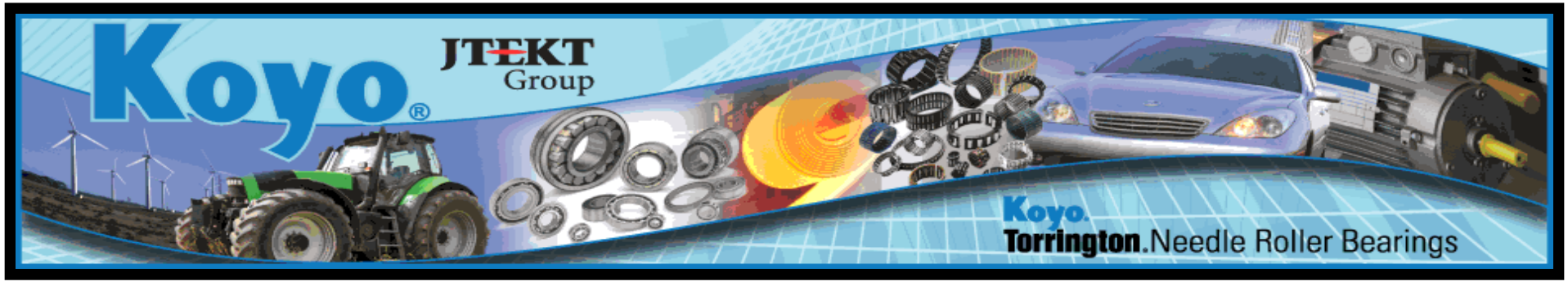
Human Resources
- 1 Mechanical Engineers
- 1 Computer Engineer
- 1 Electrical Engineer
- 1 Computer Science Grad.



Recommended Design

Replace signal conditioners with pressure sensor amplifier.





Questions and Comments

References

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