

N F P A

# **Fluid Power**

## **VEHICLE**

# **Challenge**



NFPA  
Education and  
Technology  
Foundation

Ohio University  
Final Presentation  
April 2024

**OHIO**  
UNIVERSITY  
Russ College of  
Engineering and  
Technology

# Team Members



Michael Kennedy  
Team Advisor

# Team Members



Austin Ireton  
Senior



Madeline Hofmann  
Senior



Dylan Kirkbride  
Senior



Andrew Eckman  
Sophomore

# Vehicle Design

Gear system is 7:1

Ability to charge accumulator by hand pump, pedaling, and regen

3 switch electronic system that actuates solenoids in the manifold which defines what circuit is operating

# Changes From Last Year

- Added 10:1 gear box to rear gear system
- Total ratio changed from 5.7:1 to 7:1
- Redesigned hydraulic circuit to include a hydraulic manifold
- Frame has more permanent mounting capability
- Added hand pump to manifold to charge the accumulator
- Simplified electrical system
- Added ability to operate without electrical power

# New Components Used

## Manifold Block

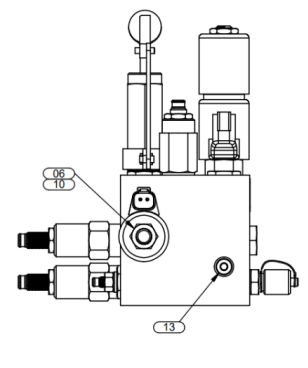
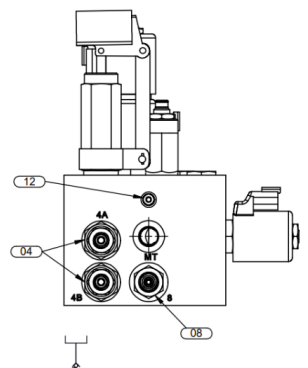
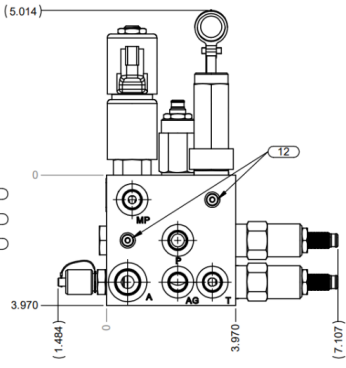
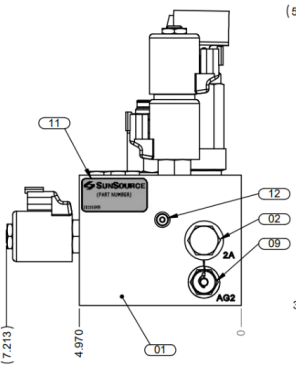
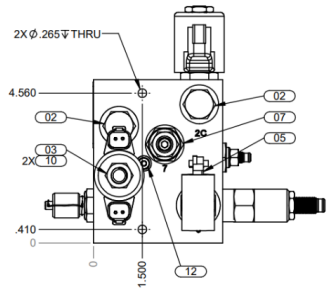


## Gear Box (10:1)



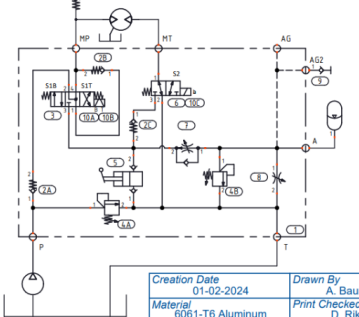
ITEM ID	PORT TYPE	PORT SIZE
A	SAE O-RING	#6 SAE
AG, AG2, MP, MT, P, T	SAE O-RING	#6 SAE

- NOTES:
- 3000 PSI MAXIMUM PRESSURE
  - TEAM TO PROCURE ALL COMPONENTS SEPARATELY AND INSTALL THEM INTO THE MANIFOLD BODY AT THEIR FACILITY
  - TEAM TO SET THE RELIEF VALVES AT THEIR FACILITY
  - COIL S1B IS THE BOTTOM COIL AND S1T IS THE TOP COIL
  - ALL COMPONENTS DRAWN OUTSIDE OF THE MANIFOLD ENCLOSURE LINE ARE NOT INCLUDED AND ARE FOR REFERENCE ONLY



Bill of Materials

Item	Qty	ID	Description	Manufacturer	Wrench	Torque (AN)	Units
01	1	FV-14212-M1	Manifold Body				
02	3	CV08-NP-0.3-B-00	Check Valve, 5 PSI Spring	Comatrol	7/8"	25	ft lbs
03	1	SV9-10N-F-0-0-00	Solenoid Valve, 3 position 4 way, Motor Spool	Eaton	1"	25 - 30	ft lbs
04	2	RV1-10-S-0-36	Relief Valve, Direct Acting Poppet Type, 8 GPM Max, 1800 - 3600 PSI Adjustment Range	Eaton	1"	35 - 40	ft lbs
05	1	241871-S	Hand Pump Push style 661 ci	Doering	1-1/4"	50	ft lbs
06	1	SV1-10-3-0-00	Solenoid Valve, 2-Position 3-Way	Eaton	1"	35 - 40	ft lbs
07	1	FAR1-10-S-0	Pressure Compensated Flow control	Eaton	1"	35 - 40	ft lbs
08	1	NV1-8-S-0	Needle Valve, Non-Compensated	Eaton	7/8"	25 - 30	ft lbs
09	1	D1620-01-06SAE	SAE -6 ORB Test Point	Dynamic Test	5/8"	225	in lbs
10	3	300AA00101A	12VDC Deutsch Coil J Series	Eaton		4 - 6	ft lbs
11	1	Label-0011-1x2A-FV	SunSource Label	SunSource			
12	6	22S-S02	SAE 2 Plug	Epcos	1/8"	54	in lbs
13	1	22S-S04	SAE 4 Plug	Epcos	3/16"	107	in lbs



SOLENOID OPERATION			
FUNCTION	S1B	S1T	S2
DIRECT DRIVE	-	-	-
ACCUM CHARGE	ON	-	-
REGEN BRACE	-	ON	ON
ACCUM DUMP	-	ON	-



Creation Date	01-02-2024	Drawn By	A. Bauman	Customer Name	Ohio University
Material	6061-T6 Aluminum	Print Checked By	D. Rikala	Title	NFPA-PPVC Manifold
Protective Finish	None	Sheet Name		Part Number	FV-14212-V1
Dimensions are in inches.		Sheet of	1	Proprietary and Confidential	

REV.	ECO#	DATE	BY
A		01-02-2024	AUSTIN BAUMAN

Revision History

Site C

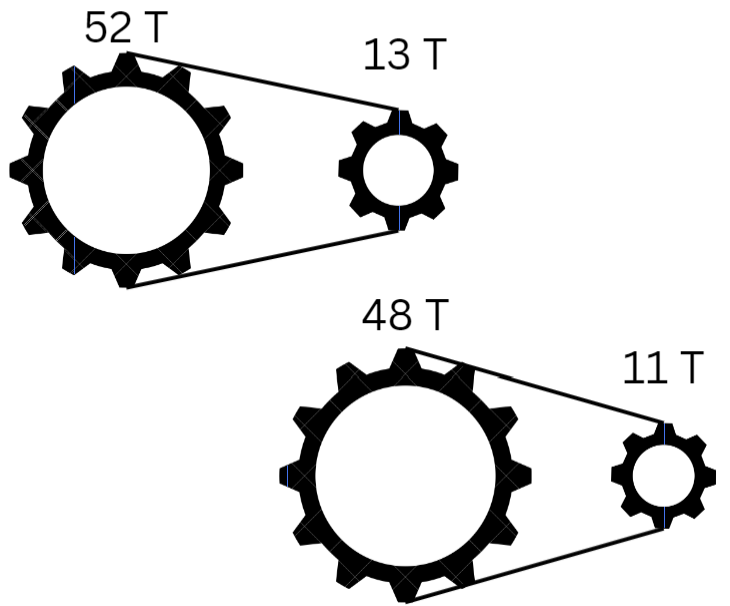
Third Angle Projection

Rev A

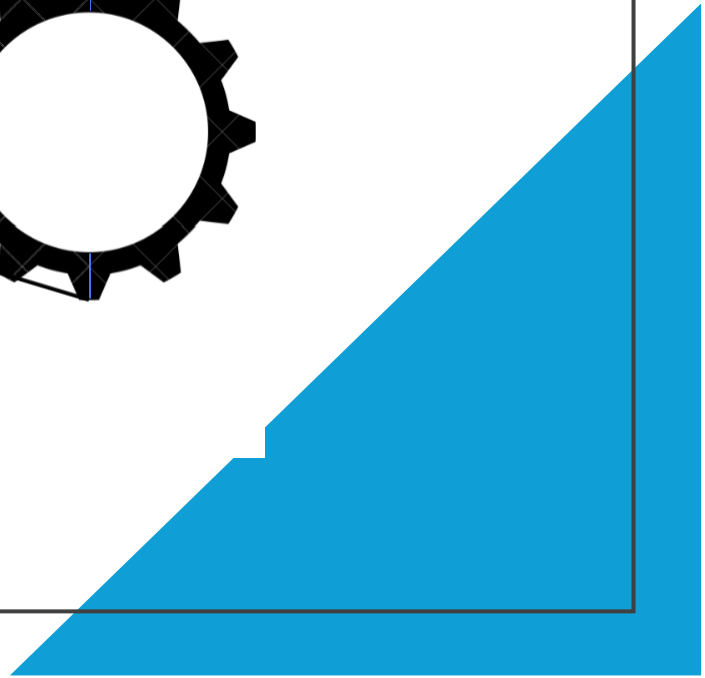
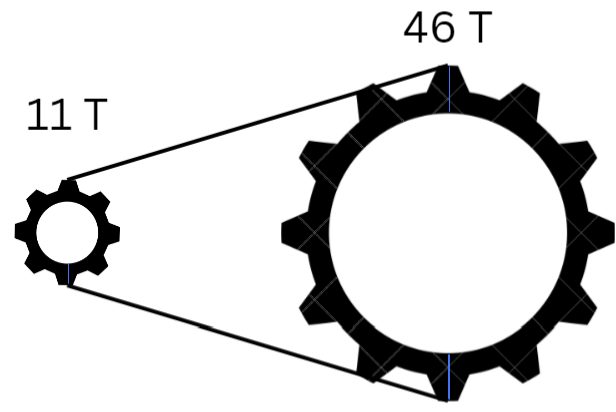
# The Manifold

# Gears

Front Gear System

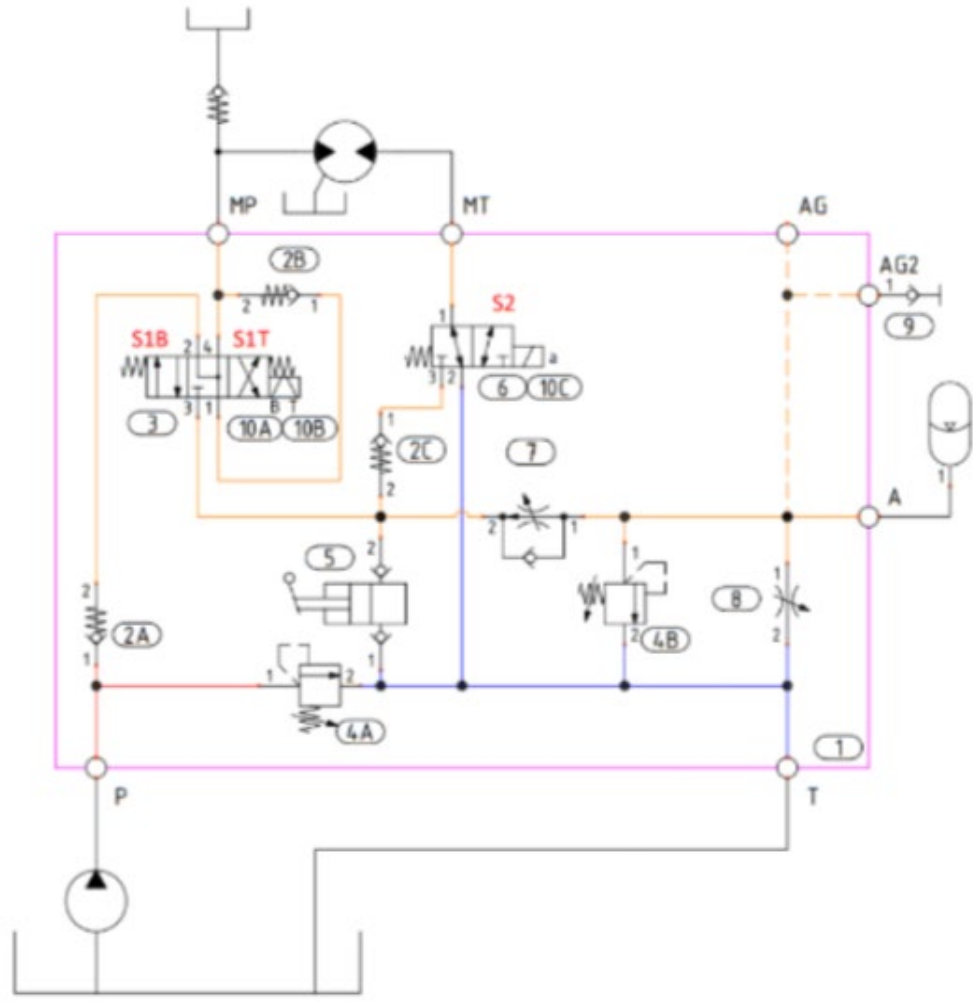


Rear Gear System





# Hydraulic Circuit



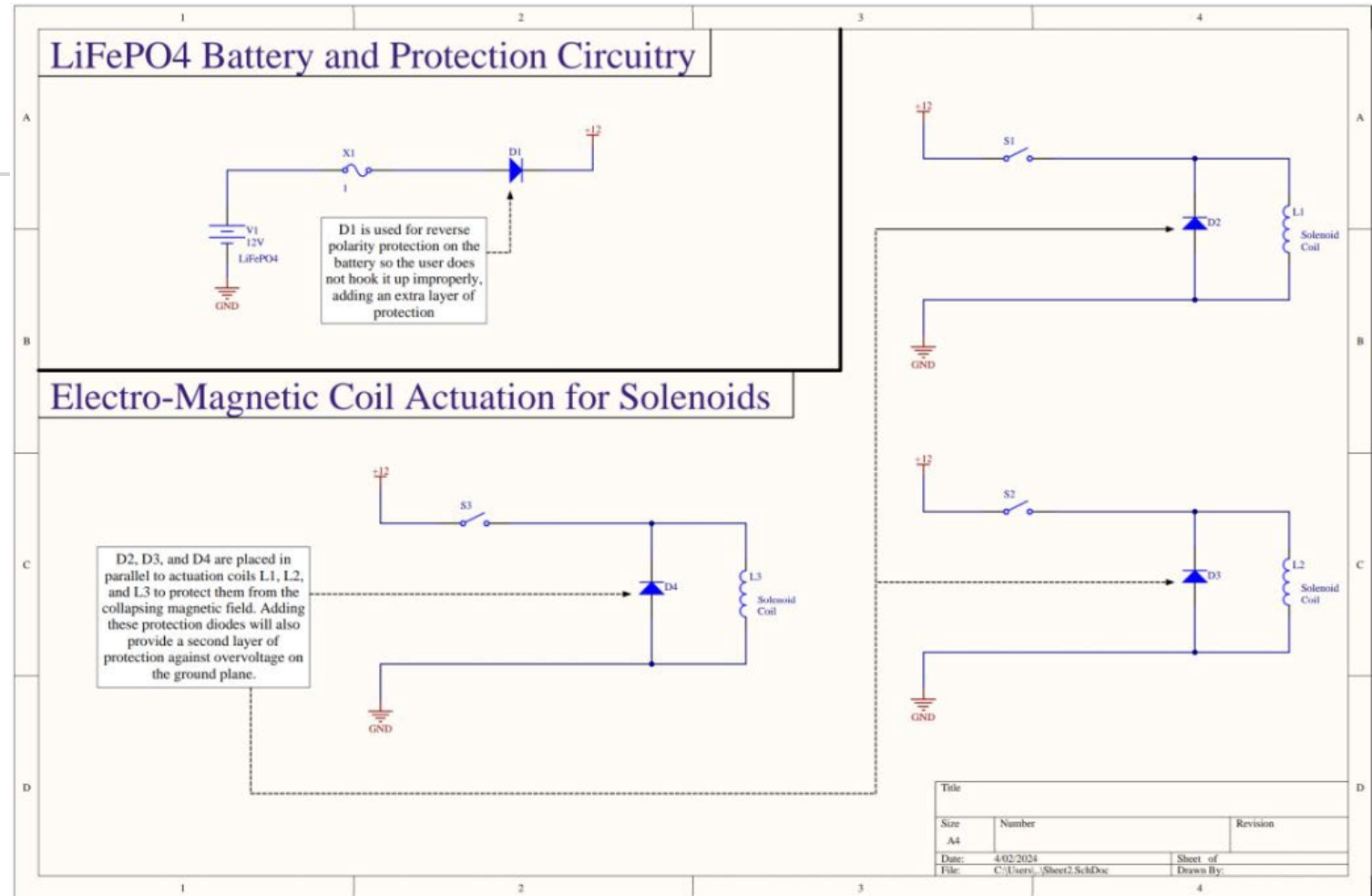
SOLENOID OPERATION			
FUNCTION	S1B	S1T	S2
DIRECT DRIVE	-	-	-
ACCUM CHARGE	ON	-	-
REGEN BRAKE	-	-	ON
ACCUM DUMP	-	ON	-

Item	Qty	Model Code	Description	Manufacturer
1	1	FV-14212-M1	Manifold body	Source FP
2	3	CV08-NP-0.3-B-00	Check 1 to 2	Danfoss ICS
3	1	SV9-10N-F-0-0-00	Solenoid 3 pos. 4 way	Legacy-Eaton
4	2	RV1-10-S-0-36	Relief Direct Acting	Legacy-Eaton
5	1	241871-S	Pump Lever Operated 1 to 2 Push to pump .601 CID	Doering
6	1	SV1-10-3-0-00	Solenoid 2 pos. 3 way	Legacy-Eaton
7	1	FAR1-10-S-0	Flow Control Compensated, Screw Adjust	Legacy-Eaton
8	1	NV1-8-S-0	Needle Valve, Knob Adj	Legacy-Eaton
9	1	D1620-01-04SAE	Test Point Fitting, M16 x 2	Dynamic
10	3	300AA00101A	Coil 12VDC, Deutsch	Legacy-Eaton

# Hydraulic Circuit

# Electrical Work

- Andrew Clabaugh helped to design a safe electrical circuit and ran the wiring to the solenoids
- System has less power draw than the former design
- Added reverse polarity protection as a safety feature



# Manufacturing Process

- Machined clamps and sprockets
- Water jet sprockets
- Machined keyed shafts



# Obstacles

- The bike frame was difficult to build on/around
- Length of manufacturing process with a small team
- Designing frame mounts for gear train



# Lessons Learned

- Gear box created complication and unnecessary resistance
- Importance of being proficient on CNC machines, water jet, and manual mills

# Questions?