



# The Next Generation Pan - Tilt

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## Background

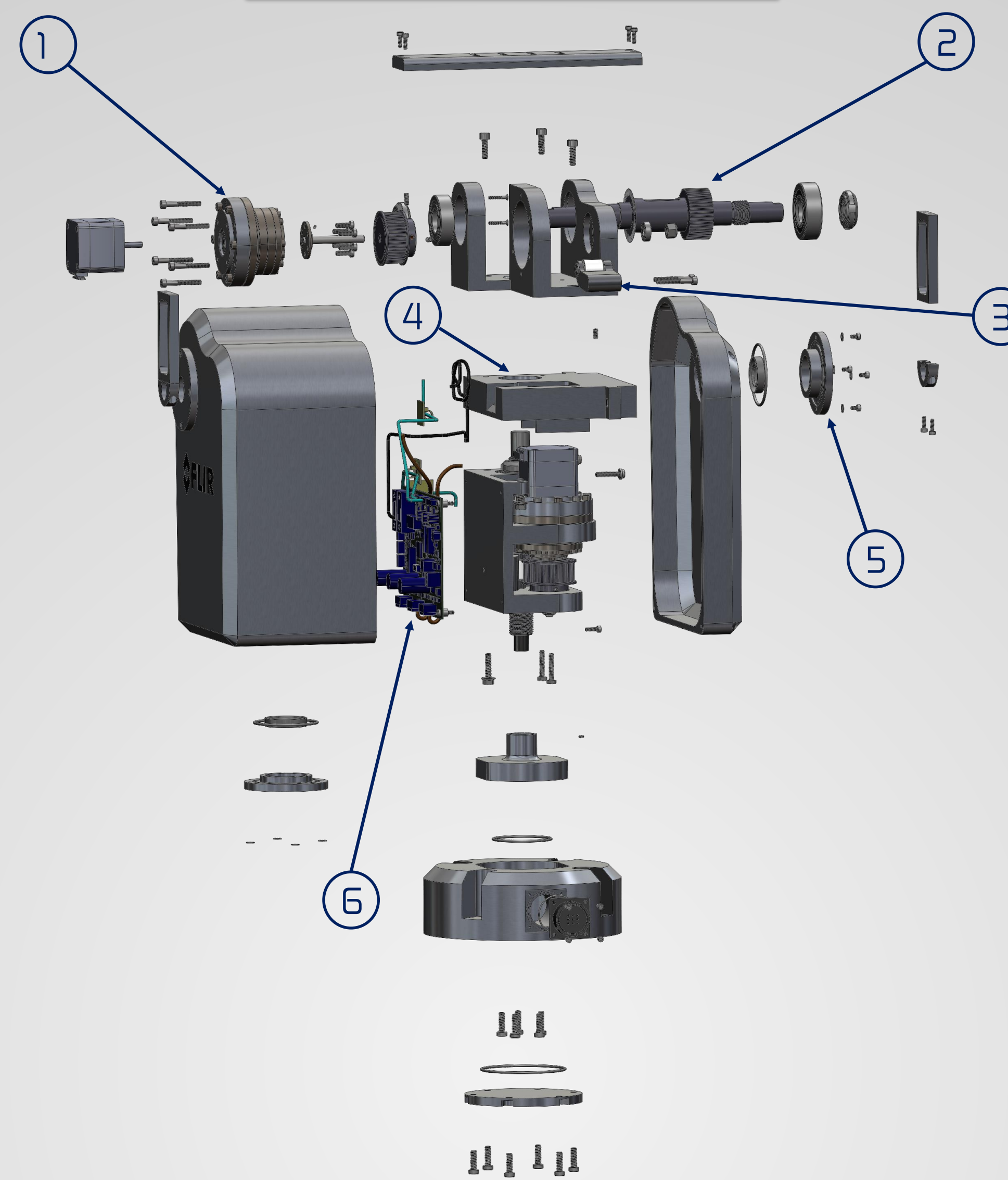
FLIR® ZERO is a high precision, high reliability pan and tilt device for real-time, computer-controlled positioning of virtually any payload. Designed to replace FLIR®'s high end PTU-D48E system, FLIR® ZERO is robust and precise, meeting IP67 waterproof standards and Mil-810f vibration resistance. This pan-tilt has the capability to point a payload with sub 0.01° precision repeatedly for more than six years of continuous use. It is designed for high duty cycles and reliable 24/7 operation in harsh all-weather environments.



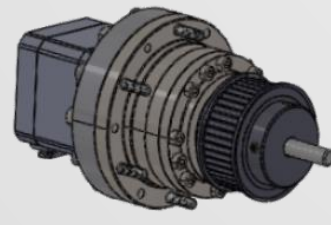

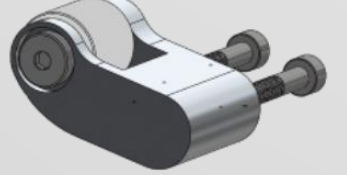
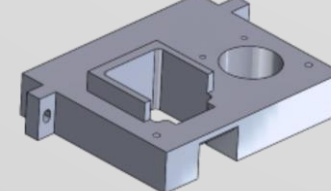
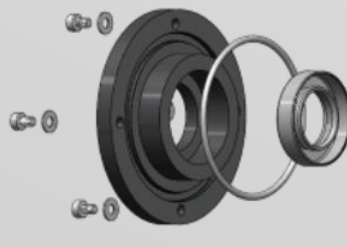
## Overview / Design Specs

Payload (top/side)	10/15 lbs
Pan Field of View	360°
Tilt Field of View (horizontal)	+30° to -90°
Waterproofing	IP67
Shock/ Vibration	Mil-801F
Accuracy	<1°

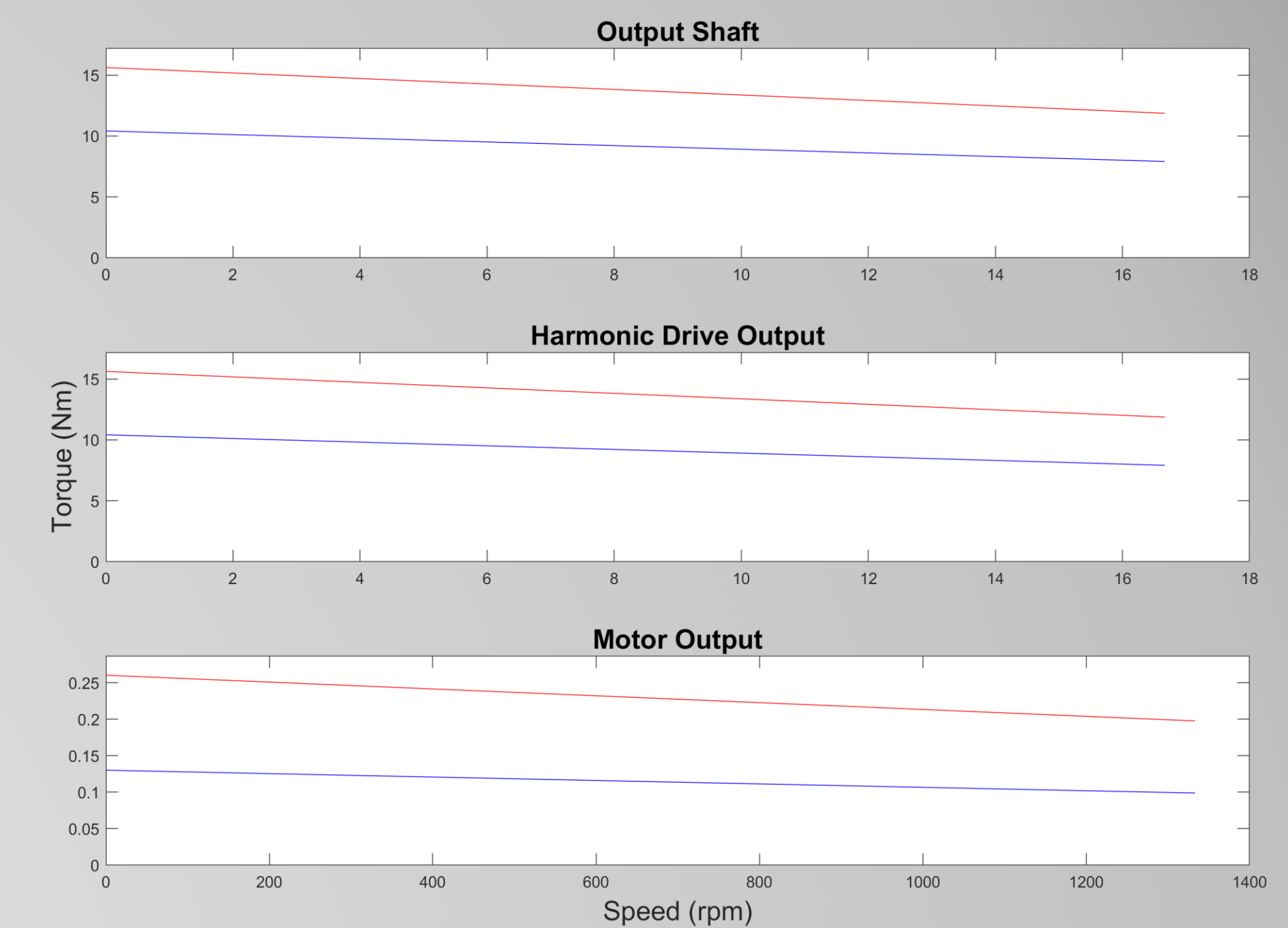
## Exploded View



## Hardware / Key Components

- ①  Strain-wave gear drivetrain with stepper motors provides 0.0072° of pointing precision for 6+ years of continuous motion.
- ②  All drivetrain and frame components thoughtfully designed for a simple assembly process.
- ③  Arc motion idler pulley allows assembler to tension drive belt in a single operation.
- ④  Frame components are shaped to create thermal pathways for heat dissipation in hot weather.
- ⑤  Dynamic rotary seal assemblies maintain near perfect concentricity during assembly, ensuring reliable waterproofing.
- ⑥  Trinamics® driver board provides microstepping functionality for smooth, quiet operation.

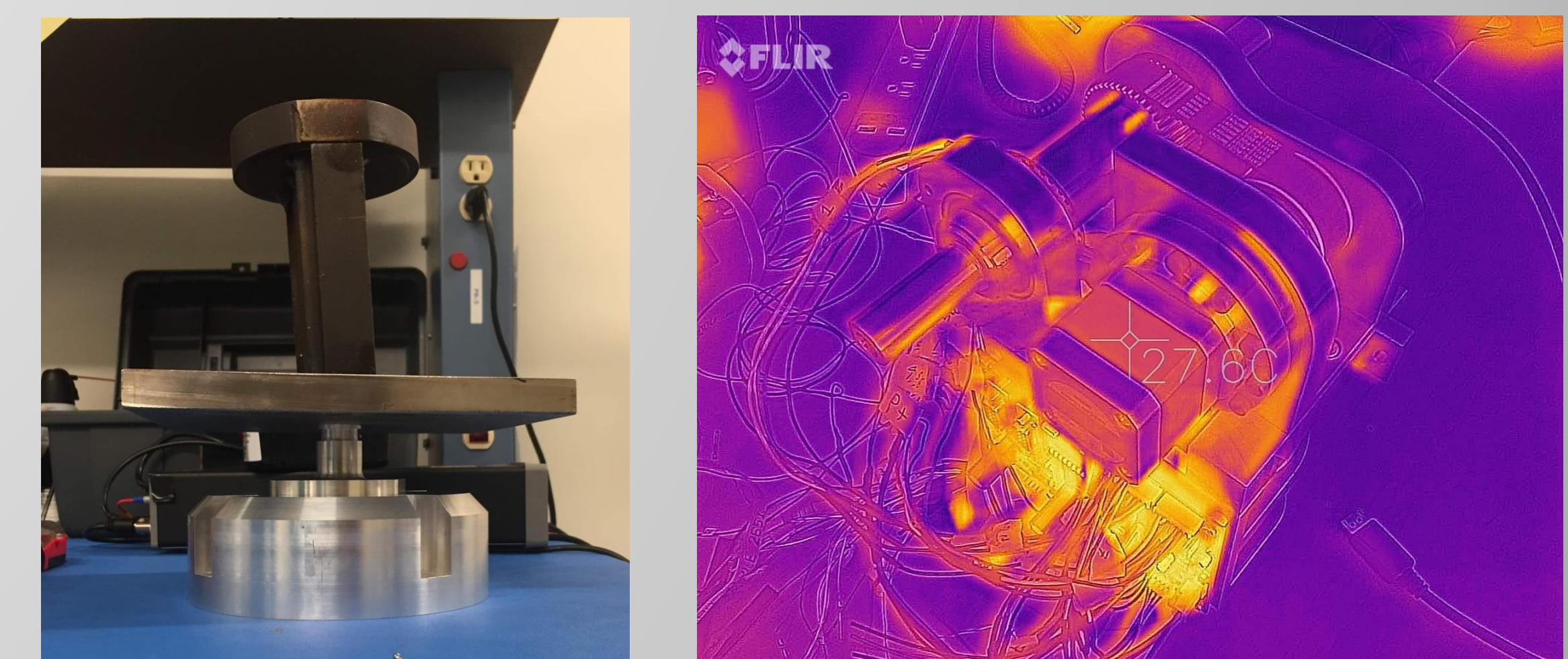
## Drivetrain Selection



Simulated torque speed curves of FLIR® ZERO at the output shaft, Harmonic drive, and the motor. These curves were used to select Harmonic drive, drive belt, and motor based off of critical torque values and their corresponding angular velocities.

Selection:	Peak Torque [Nm]:	Angular Velocity [rpm]:
CSF-14-80-2UH	10.93	16.67
3mm GT3 PowerGrip®	10.93	16.67
PKP244D23	0.19	1320

## Vibration / Thermal



Vibration testing was performed on our base assembly as well as our pan output shaft. These components experience the largest stresses in the system and were tested to verify compliance with the MIL-STD-810f vibration standard. Thermal testing was completed by running the system continuously until equilibrium temperatures were reached. During testing the maximum temperature reached was 36.6°C which is lower than the maximum temperature allowed.

## Acknowledgements:

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