Deployable Helical Antenna

LOCKHEED MARTIN

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Background & Impact

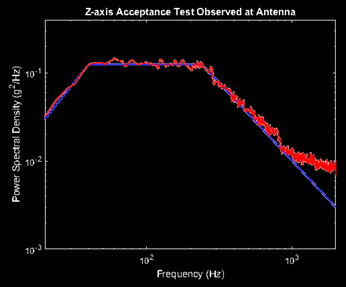
- Industry shift from large satellites to a fleet of smaller satellites necessitates deployable instrumentation
- Maintains antenna performance while drastically reducing launch volume
- Robust data transmission through helical antennas

Design Requirements

✓ : Deploy to 4x stowed height, < 4kg, < 20cm x 40cm
✓ : Fully deploy within 90 seconds
✓ : ±50% Scalability
✓ : Capable of 50 deployments without damage/fatigue
✓ : Less than 1000 g's of self-induced shock
✓ : Survive random launch vibrations of Atlas V rocket
✓ : L-band antenna functionality

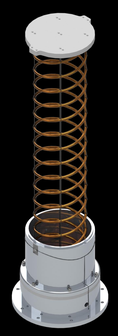
Testing

VIBRATION



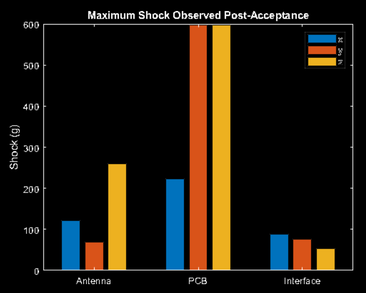
- Survived Atlas V
- Design Change: Improve electrical harnessing

DEPLOYMENT



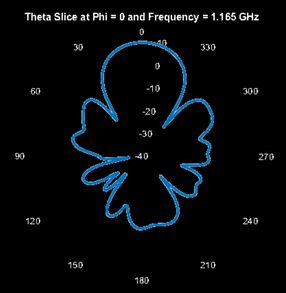
- Antenna deploys buckled due to spring, compression system, & lid
- Deploys 98% of full height
- Design Change: Improve rotary damper system

MECHANICAL SHOCK



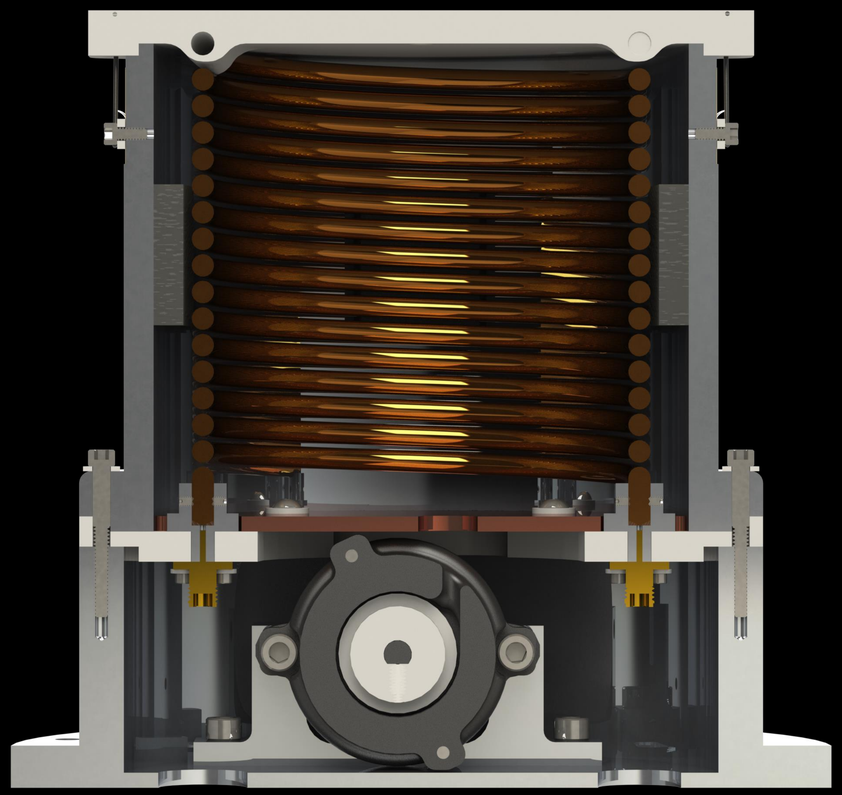
- 600 g's maximum
- 100 g's of shock at mounting interface

ANTENNA

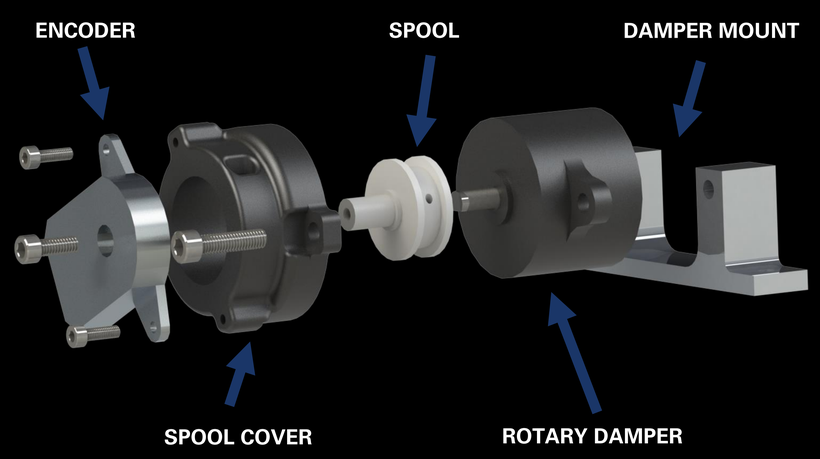


- 9dB of gain
- Analog antenna met expected performance

Design Overview

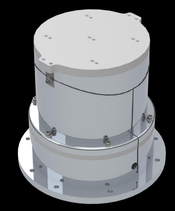


ROTARY DAMPER SYSTEM



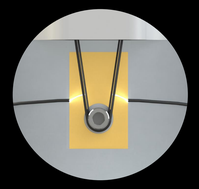
- Designed to control spring deployment and reduce shock
- Custom spool, spool cover, and damper mount
- Encoder counts spool rotations to verify full deployment

STOWED CANISTERS



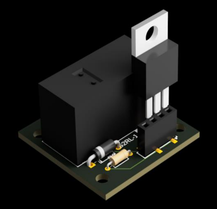
- Houses all internal components
- Designed with interlocking features to withstand launch vibrations

RELEASE MECHANISM



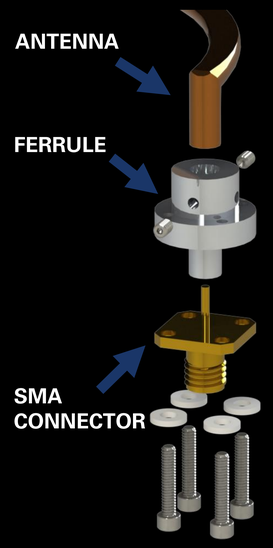
- Electronics send current through highly resistive wire to burn through restraint lines initiating deployment

PCB



- Customized electronics initiate and monitor antenna deployment
- Electrical redundancy to ensure deployment

ANTENNA ATTACHMENT



- Electrical insulation for antenna feed and performance
- Ferrule doubles as a structure to disperse the load of the spring and to transfer the signal from SMA connector to antenna
- Poor quality of outsourced spring manufacturing and material mismatch do not allow for proper RF transmission

ANTENNA OPTIMIZATION

- Spring and antenna designed for passive deployment
- Matches capabilities of rigid antenna predecessors
- Both a mechanical spring and functioning antenna

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