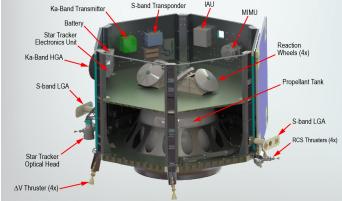


C Internal View of S/C Bus Components



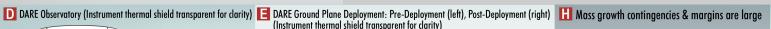
Instrument Thermal Shield (Transparent for clarity) Instrument Antenna (Dual Bicones) Instrument and Spacecraft Radiators

Ground Plane (stowed)

Propulsion Module

Solar Array Panel (2x)

Ground Plane Support (4x)



The DARE spacecraft is simple & high heritage.

Command & Data Handling

Integrated Avionics Unit (IAU)

Moog Broadreach

Single Board Computer

BAE RAD750 SBC

SMOAB

converter. ADCS interfaces

12 GB Flash Memory

Payload Interfaces

Spare Slot

Spare Slot

PAPI-1, PAPI-2, PAPI-3

Power Distribution Boards

Switches and Deployments

McLASI

Power distribution, H-bridges

Valve actuation

Solar Array Interface, Battery Charge Control

Harness

Battery

Battery ABSL

100 A-hr Li-lon

Solar Array

SolAero ZTJ Triple Junction Cells

Electrical Power &

Distribution Subsystem

DARE Instrument

(see Fig E.1.1-2)

RS422, Cmd and Tlm

Attitude Determination

& Control

Star Tracker

Sodern Hydra Optical Head & Electronics Unit

Reaction

Wheels

Mitsubishi

L-A

Sun Sensors

IMU

Honeywell MIMU

(N.H.

Latch Valves

(2)

Thrusters (4)

Propulsion

115N TCM

Service

Valve

Service

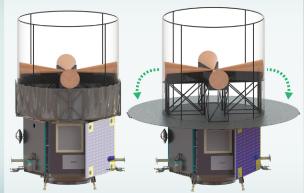
Valve

Flight Heritage Flight Heritage w/Modifications New Design

5N RCS

. LVDS, Science Data

Pavload Power



Telecommunications

BPF

Secondary Structure

Ball

Instrument EMI

Ball

Primary

Structure

Ka-Band

Fransmitter

SpaceMicro

mKaTx-300

BPF

S-band

Transponder

SpaceMicro µSTDN-100

BPF

emperature

Sensors

AD590, PRT

Thermostats Honeywell, 700x

S/A Panel

Propulsion

Module Structure

Launch Vehicle I/F

47" (1194-mm) Standard Clampband

LV

Interface Signals (power, cmd, tlm)

Structures & Mechanisms

DARE Flight System Element	CBE (Kg)	Contig. (%)	MEV (Kg)
Structures and Mechanisms	183.0	16%	212.3
Thermal	10.3	23%	12.8
Power	47.5	6%	50.2
Wiring Harness	15.8	30%	20.5
Attitude Determination and Control	51.4	3%	52.9
Propulsion	53.7	6%	57.1
Telecommunications	11.5	6%	12.2
Command and Data Handling	5.4	3%	5.6
Spacecraft Bus	378.5	12%	423.6
Payload Total	126.4	30%	164.3
Flight System - Dry	504.8	16.4%	587.9
Propellant and Pressurant	355.2	16.4%	413.6
Flight System - Wet	860.0	16.4%	1001.5
Standard Launch Performance	$C3 = -2.78 \text{ km}^2/\text{s}^2$		1590.0*
Margin on launch mass capacity			588.5
Margin on launch mass capacity %			58.8%

* from MIDEX 2016 ELV Summary Info

F/O F.2: DARE SPACECRAFT

G S/C Bus Features Support DARE's Science Objectives HGA Spacecraft Key Characteristics Operational < 2 month transit followed by 2 years of science operations at the moon Lifetime Launch into Earth Phasing Orbit, inject into 50x125 km, <3° inclination Orbit circular science orbit at moon. **Parameters** Compatible with Standard LV defined in PSD 03 - MIDEX 2016 ELV Compatibility Summary info. →**Tx** +X LGAs ADCS 3-axis stabilized, stellar inertial with IMU backup. 0.5" knowledge and Architecture control requirement during science with tracker off for 28 minutes. Redundancy Mainly single string with safe mode and selective redundancy (class C mission). Direct Energy Transfer. 3.9m² active area, body-fixed array. Electrical 100 Ah battery sized for 4.9 hour total lunar eclipse (2/year). Power Thermal Passively cooled with two 72 cm² radiators on top deck. Control S-band omni LGAs to NEN for cmd/tlm during all mission phases. Telecomm Ka-band HGA to NEN for science data downlink at the moon. 6 GB/day Thermal of science and SOH data. Blowdown monoprop system using four 115-N delta-V thrusters and four Propulsion MLI 5-N RCS thrusters for momentum control. 1,260 m/s delta-V budget. Moog-Broad Reach Integrated Avionics Unit with RAD750 processor. Avionics Heaters Minco EMI quiet bus. Faraday cage design with gasketed seams provides FMI

DARE performance margins are substantial in all areas

with EMI gasketing

Controlled Lunar impact

significant shielding over standard MIL-STD-461F emissions.

Heritage aluminum cornerpost, aluminum honeycomb panel design

Requirements and Margins	Requirement	Performance	Margin
Flight System Wet Mass	1590 kg	1001.5 kg	58.7%
Data Storage Capacity (Science + SOH)	6.02 GB	12 GB	99%
Data Downlink	5.5 Mbps	12 Mbps	118%
Power Generation During Science	378W	496W EOL	31%
Pointing Control - downlink (3σ / per axis)	0.1°	0.03°	233%
Pointing Control - science (3σ / per axis)	0.5°	0.289*	73%
ΔV margin (on statistical maneuvers)	28 m/s	110 m/s	290%
1260 m/s -1150 m/s deterministic			
Propellant Load (Tank capability)	410	454	11%
EMI – RE 102 (dB μV/m)	Fig F.2.3-1	Fig F.2.3-1	41% avg

Power margins are adequate for all mission phases

Subsystem	Science Ops (W)	Safe Mode (W)
Command and Data Handling	36.8	36.8
Telecom	13.3	7.2
Thermal Control	36.5	46.6
Attitude Determination & Control	177.5	143.0
Power	21.6	12.6
Misc	2.1	2.1
Total Payload (CBE plus 30% contingency)	90.3	10.5
Total Observatory Loads with Losses	378.0	258.7
BOL Orbital Average Solar Array Capability	550.8	613.4
EOL Orbital Average Solar Array Capability	496.1	552.5
EOL Margin: (Allocation - MEV)/MEV * 100	31%	114%

Structure

End of Life

- Values include contingency ranging from 5% to 30% based on component maturity
- Array capability assumes 20 deg off point, 47min orbital eclipse period, and no sun during one 30min downlink every 4 orbits
- Battery sized at 100 Ah for maximum total lunar eclipse of 4.9 hours (2/year). Avg DOD <10% per orbit.

