Atromos

MARS COMPANION MISSION, MID SIZED POLAR LANDER INVESTIGATION

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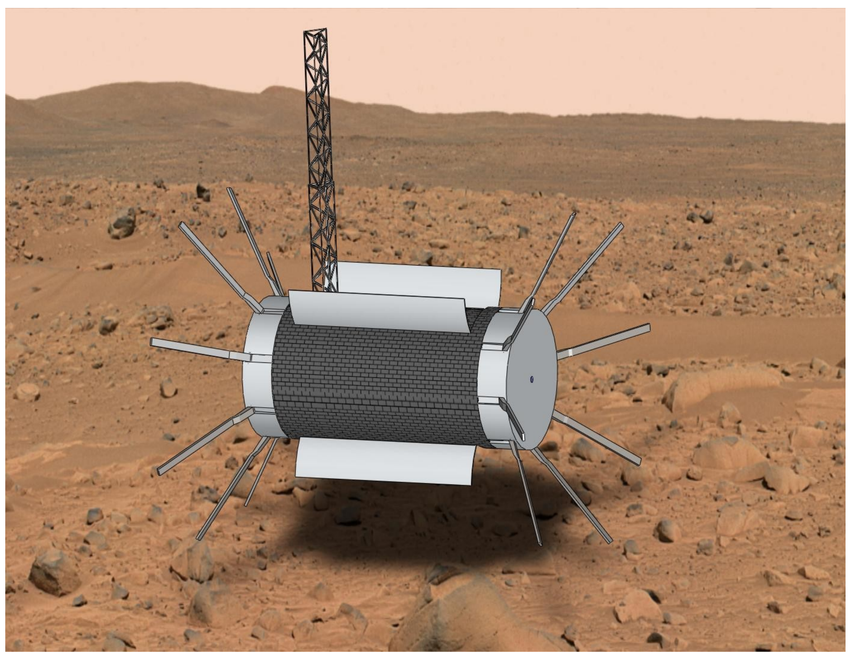
Objectives:
To conduct life detection experimentation on the polar caps of Mars and to gather weather data for atmospheric characterization.

Mission Requirements:
-Entire system fits in cylinder with 18in Diameter and 36in length.
-System can communicate remotely to perform science and send back data
-Incorporate several scientific instruments that can aid in life detection
-Include meteorological instruments for atmospheric data readings
-Entire system can withstand impact of landing
-Entire system can withstand heat loads of entry / decent
-Instrumentation system can withstand the low temperatures encountered at the Polar regions
-Incorporate a drill to penetrate 1 meter into Martian surface.
-Incorporate a 1 – 2 meter mast for instrumentation placement



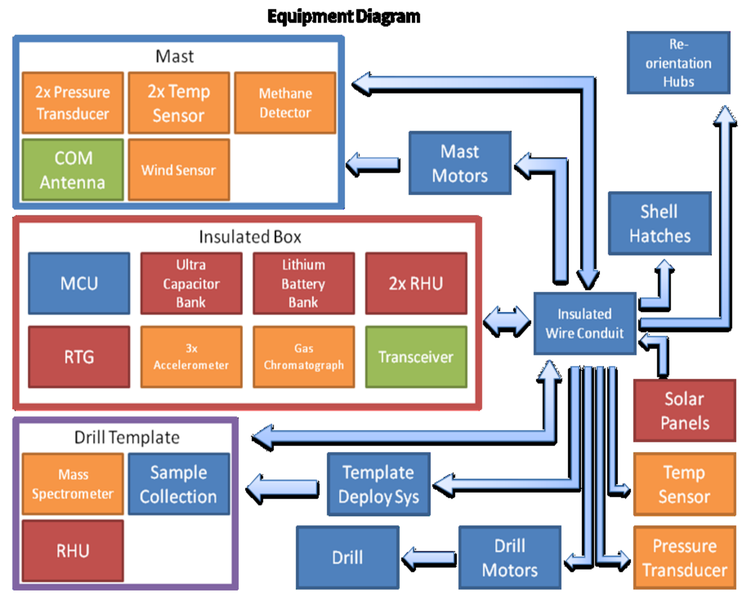
Scientific Instrumentation
-Pressure Transducers x3
-Temperature Sensors x3
-Wind Sensor
-Methane Detector
-Gas Chromatograph*
-Mass Spectrometer*
*pending technology miniaturization

Key Equipment
-RTG Power and Heat Source x4
-Solar Panel Exterior Wrap
-Ultra Capacitor Energy Storage
-Piezoelectric Ultrasonic Drill
-"Mechanical Airbag" Landing System

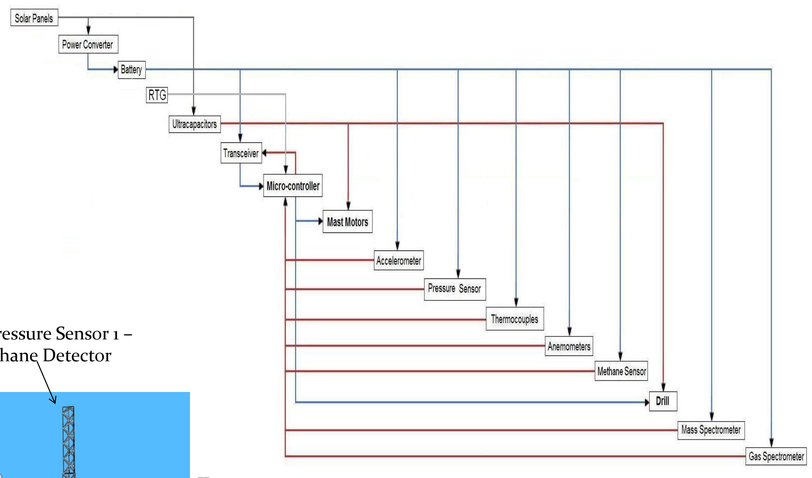
Environmental Details:
Location: Polar region of Mars
Temperature: -140C to 40C
Pressure: 1-9 millibar
Atmosphere: 95% C02, 2.5% N02, .13% O2
Solar Flux: ~300 W/m^2

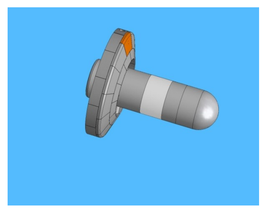
Structural Requirements:
-Must fit within a 18inch diameter, 36inch long tube.
-Must withstand a 30m/s impact with ground.
-Must incorporate a instrument mast of at least 1 meter
-Must incorporate a drill to dig at least 1 meter deep
-Must carry equipment used in life detection

Equipment Diagram

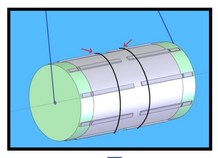


System N2 Diagram

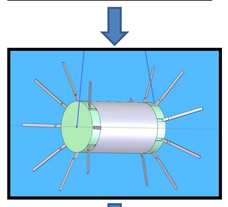




Entry to Martian Atmosphere via SCRAMP



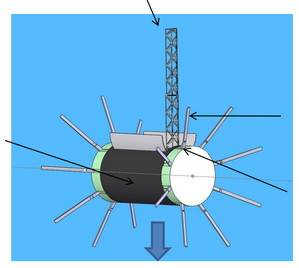
Station ejection from SCRAMP, decent via parachute



Landing via "Mechanical Airbag"

Reorientation of Probe and deployment of Mast and Drill

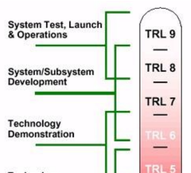
Temp Sensor 1 – Pressure Sensor 1 – Wind Senor – Methane Detector



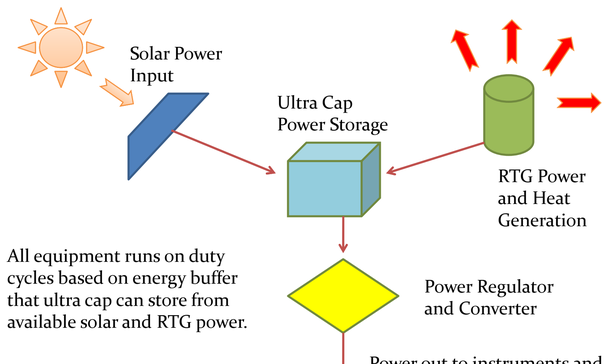
Drill Deployment

TRL Levels

	TRL
Mass Spectrometer	6
Gas Analyzer Package	7
Drill	5
Methane detector	5
Pressure Transducers	9
Temperature Sensors	9
Anemometer	8
Wind Direction Sensor	8
Accelerometer	9
Micro-Controller	8
Transceiver	5



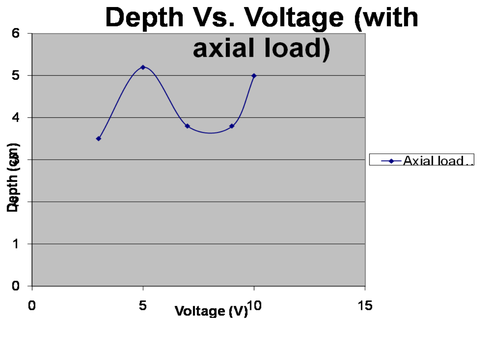
Power Management Overview



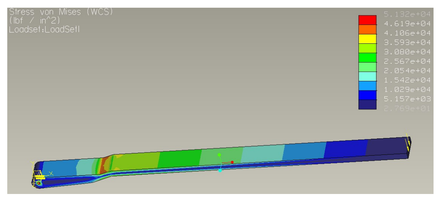
All equipment runs on duty cycles based on energy buffer that ultra cap can store from available solar and RTG power.

Ultrasonic Piezoelectric Drill
-Coring device
-Driven by sonic and ultrasonic vibrations
-Piezoelectric stack provides vibrations

-Phase 1 Drill testing was successful but limited by power supply. Further testing at higher power levels will be done for future validation.

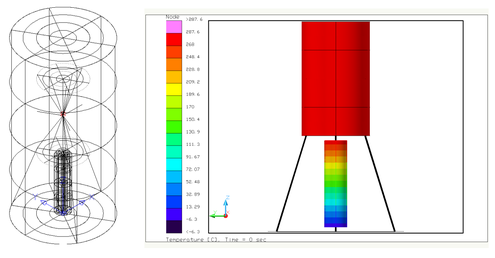


Landing Spoke FEA Analysis



AL 2014			
Angle of Force	*Max. VM Stress (PSI)*	*Max. Displacement Mag. (inches)*	*Safety Factor = yield strength of metal / max_stress_vm*
Normal to the surface	5.214764e+04	1.724243e+00	60 KSI / 52.1 KSI = 1.15
Steel			
Angle of Force	*Max. VM Stress (PSI)*	*Max. Displacement Mag. (inches)*	*Safety Factor = yield strength of metal / max_stress_vm*
Normal to the surface	5.132058e+04	6.299356e-01	40 KSI / 51.3 KSI = 0.78

RHU Thermal Analysis



Placement	Temperature (°C)	Placement	Temperature (°C)
Huddled 2	5.6718	**Equilateral 3; d=10cm**	5.4735
Huddled 1	5.6644	**Centroid 2**	5.2722
Equilateral 3; d=5cm	5.5569	**Equidistant**	5.2667
Equilateral 1	5.5565	**Centroid 1**	4.5379
Equilateral 2	5.5419	**Equal area**	4.4173
Equilateral 3; d=8cm	5.5172