# RTG Waste Heat System for the Cassini Propulsion Module

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## ABSTRACT

The Cassini mission is being developed by the Jet propulsion Laboratory for NASA for a 1997 launch. The spacecraft (Figure 1) will deliver a probe (supplied by ESA) to Saturn's moon Titan and continue on a 4-year orbital tour of the planet. The interplanetary trajectory for the mission uses gravity assists from Venus, Earth and Jupiter (Figure 2) to get the spacecraft to Saturn. Because this trajectory is long (more than 7 years) and has a wide range of solar environments (0.6 AU after Venus encounter to 10 AU at Saturn) , the design requires an effective thermal control system that is reliable and minimizes the use of limited spacecraft electrical power. A new approach to the Propulsion Module Subsystem (PMS) thermal. design was implemented.

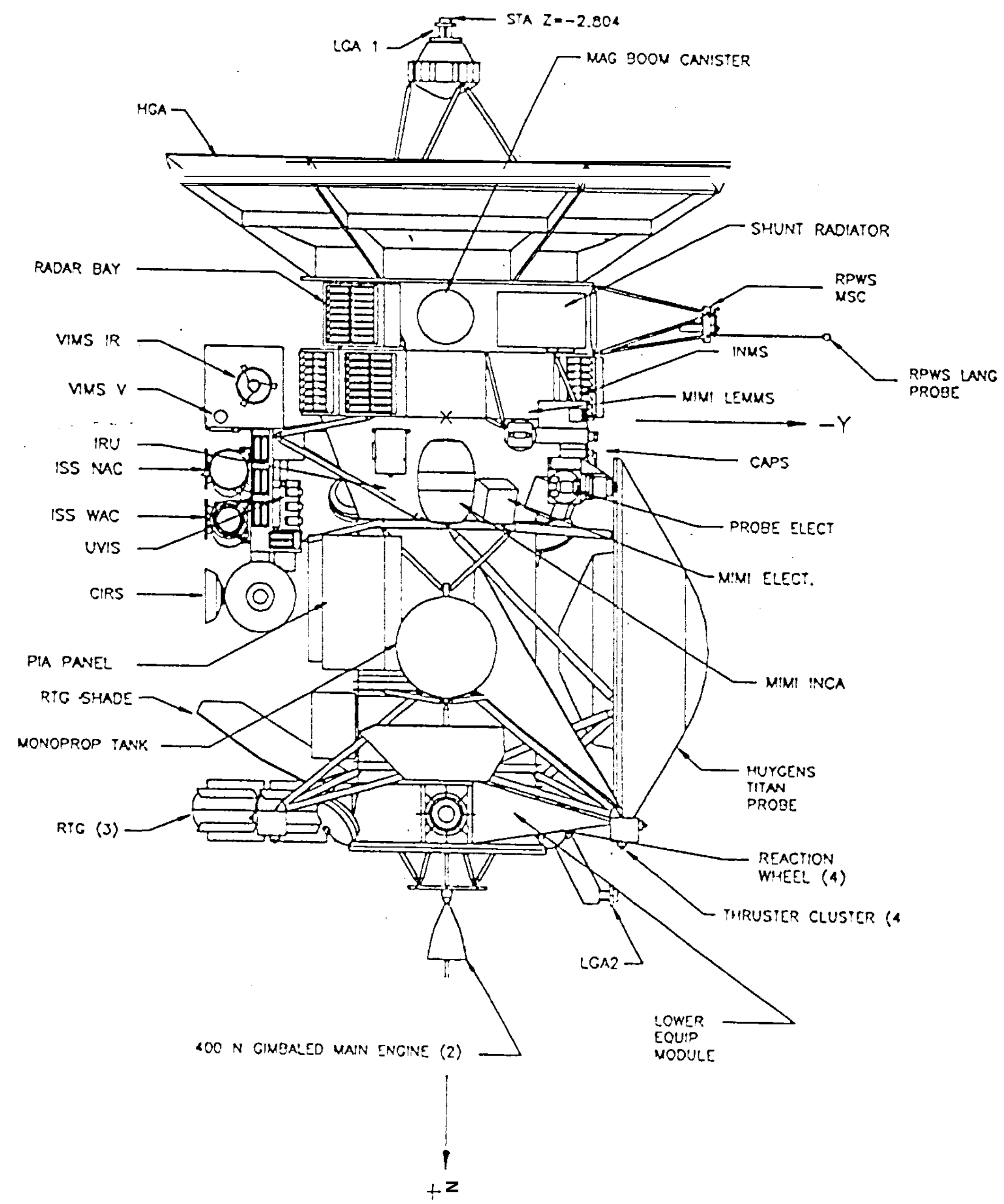
Cassini is three-axis stabilized and consists of the following major elements: two science platforms, a bus, a PMS, and three Radio-isotope Thermoelectric Generators (RTGs) for electrical power. The overall approach is to thermally couple most of the spacecraft subsystems to the thermally stable and massive PMS in order to make the spacecraft thermal design less susceptible to transient thermal drivers (e. g. off-Sun **excursions**, spacecraft faults and planned extreme power modes).

The PMS thermal design approach is to blanket the entire central core structure by the use of multi-layer insulation (in order to minimize heat leaks to space) and to create a "cavity" for energy distribution by spacing the blanket away from the structure, tankage, etc. (Figure 3) . The design obviates the need for electrical heater power by relying on waste heat from the RTGs and Bus electronics for controlling the PMS temperatures.

The waste heat concept uses the excess radiative and conductive heat available from the three RTG end domes and directs it to the PMS and its blanket cavity (Figure 4). A thermal test was conducted to measure the radiative and conductive heat inputs and to evaluate design adjustment techniques for the flight configuration (setup is shown in Figure 5) .

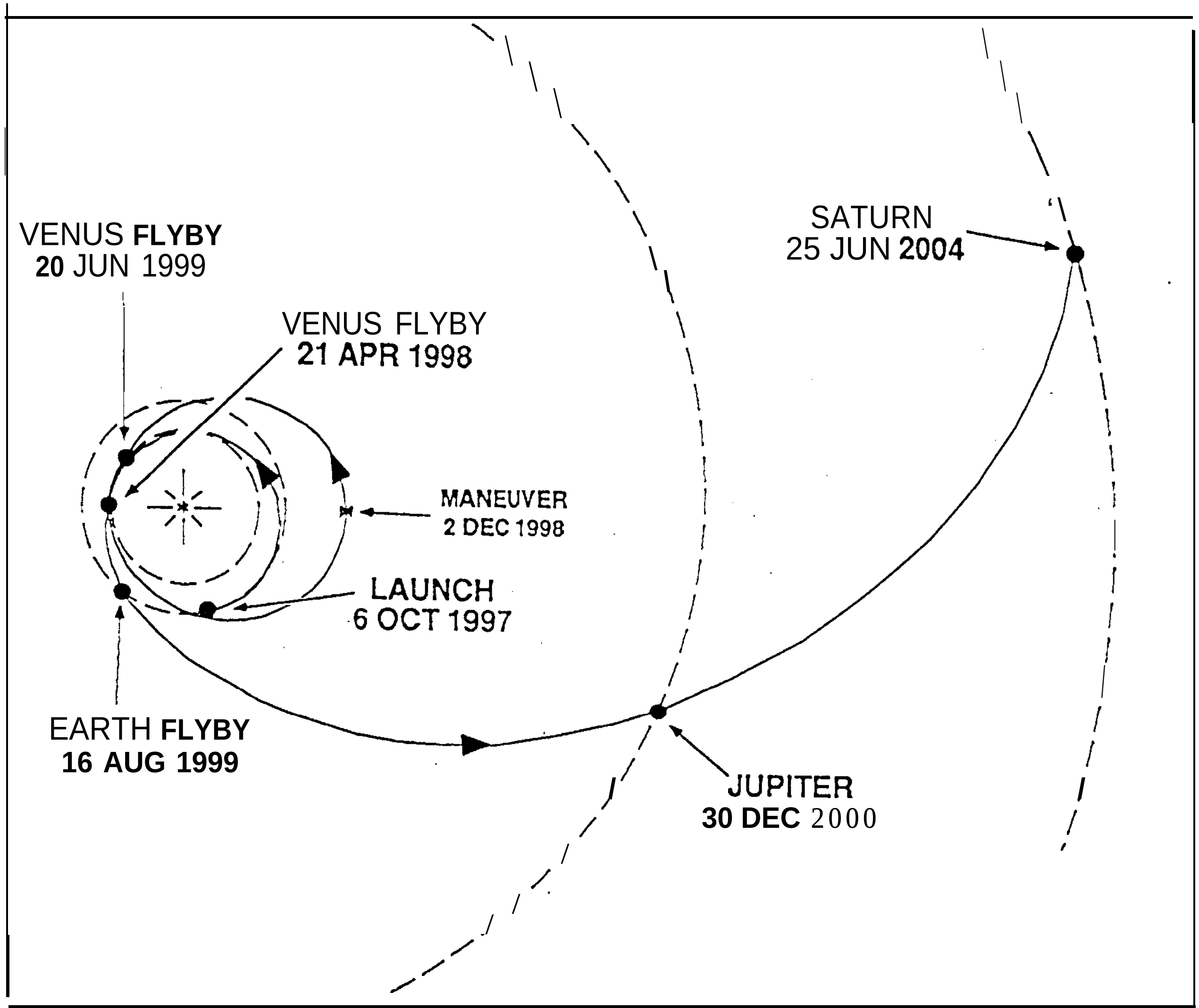
This paper describes the thermal. design for the PMS, presents the results from the RTG waste heat thermal test, summarizes the design adjustment techniques and their relative effectiveness, and shows the resulting predicted PMS flight temperatures relative to the requirements.

# F GURE 1 - CASS ᴺI SPAC≤CRAFT



# FIGURE 2

## CASSINI OCT 1997 VVEJGA
INTERPLANETARY TRAJECTORY

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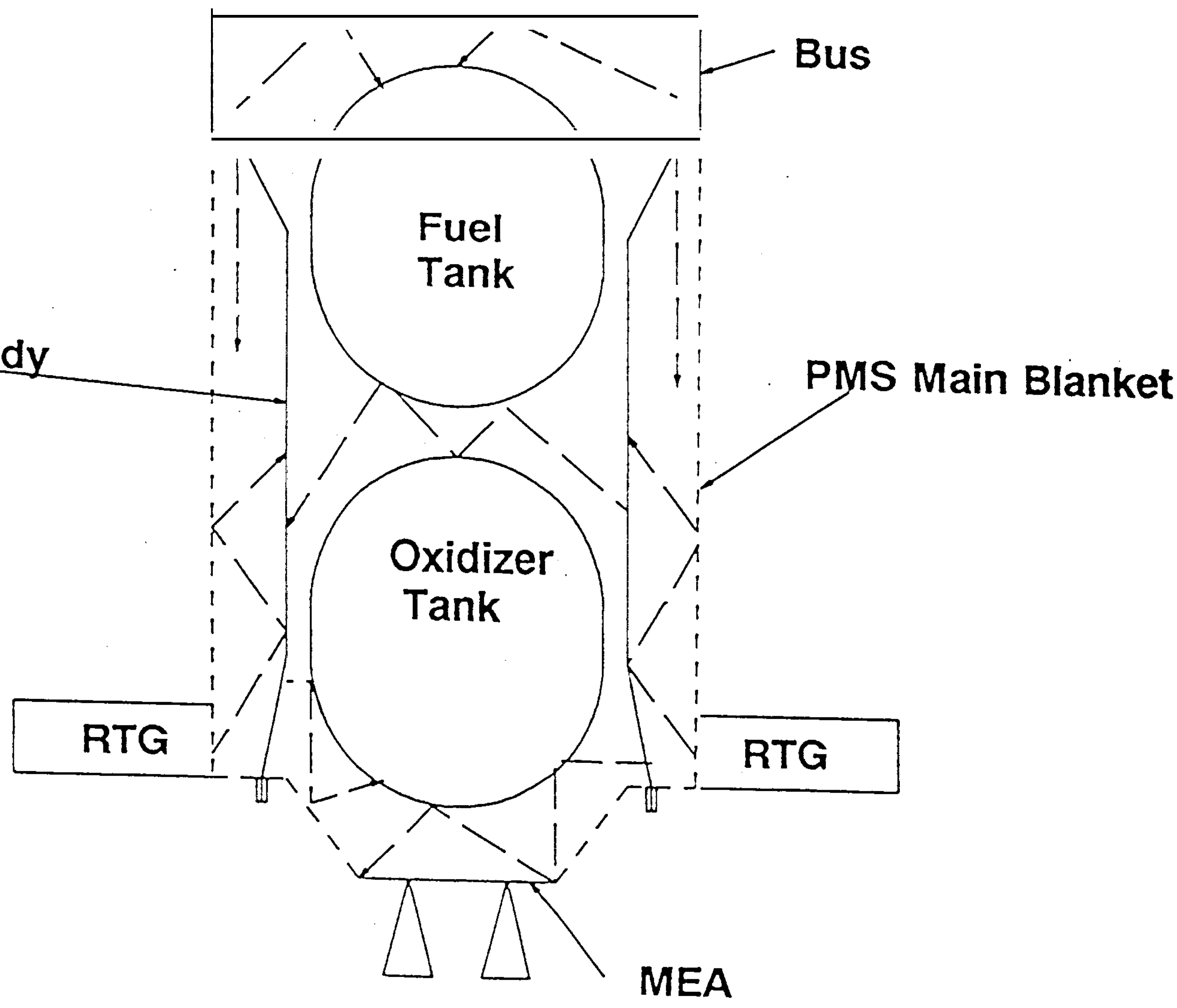
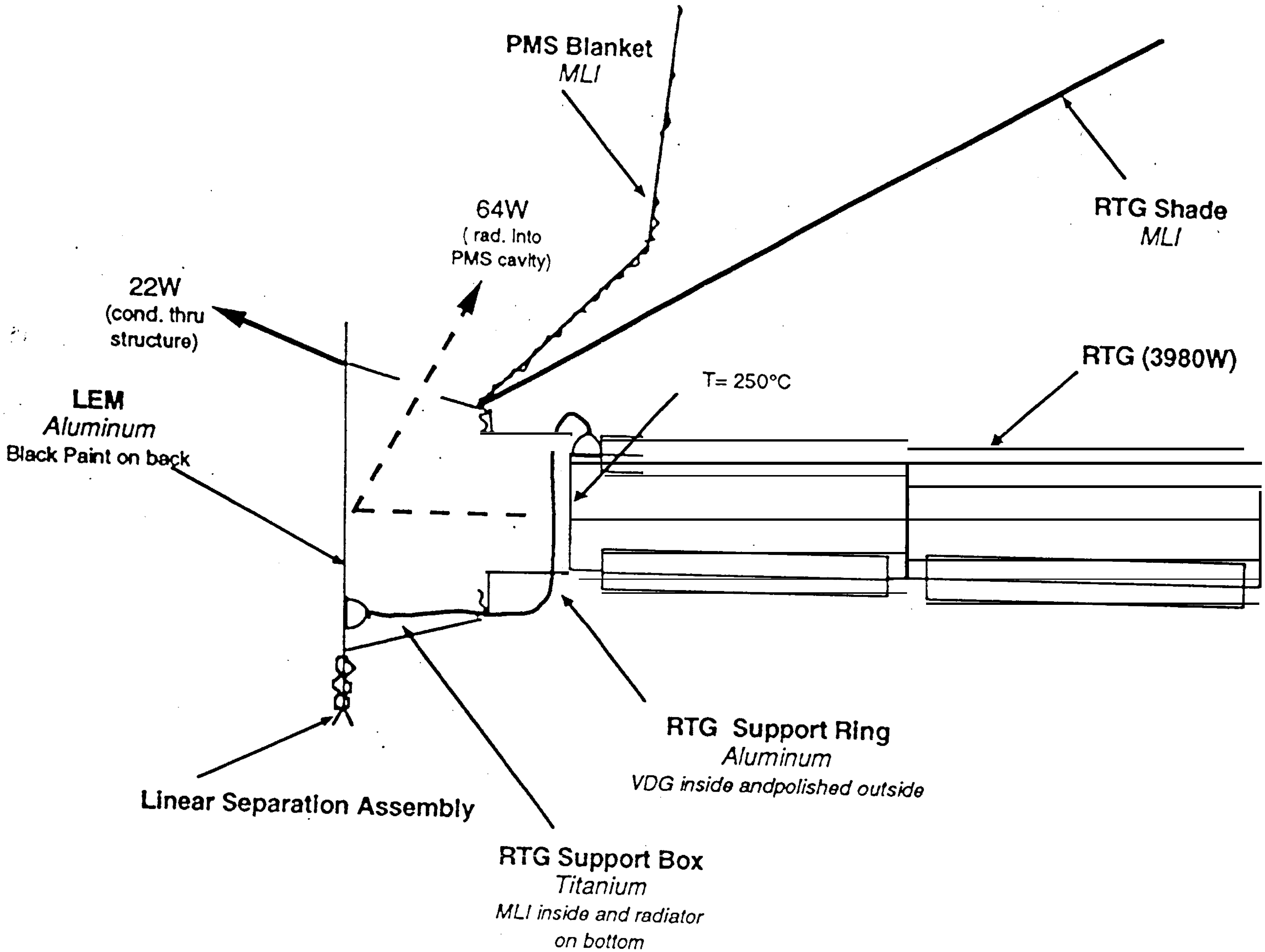
# FIGURE 3

PMS Heat Distribution Concept



# FIGURE 4 - RTG WASTE HEAT CONCEPT



# FIGURE 5- RTG WASTE HEAT THERMAL TEST SETUP