



DuPont™ Pyralux® Flexible Laminates

Pyralux® AP and LF Products in Space Applications for Pioneer

Reliable Products for Demanding Space Exploration

In the late 60s and early 70s, NASA began its manned and space exploration programs. These early missions culminated with the Apollo Program successfully landing men on the moon. Other missions such as the Viking Program brought us pictures from the Martian surface, our nearest neighbor in the solar system. NASA's Pioneer Space Vehicle was launched from Earth, went through our solar system and is now on its way into deep space.

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Since 1994, Pioneer has looked to DuPont to provide Pyralux® AP All-Polyimide Copper Clad Laminates and Pyralux® LF Adhesive Coverlays as the ideal products for every one of these demanding, ultra high-reliability, flexible and rigid-flex circuit applications. Pyralux® AP based circuits are built into the Cassini-Huygens probe that began its flight to Saturn over a decade ago, highlighting possibly the longest in-service space application to date. And in the Mars MER03 Rovers, Spirit and Opportunity, Pioneer Circuits provided seventy different part numbers for each that interconnect all their major electronics subsystems, like steering, motors, antennas, and the large main towers. Pyralux® AP and LF based flexible circuits are also present in each rover's electronic wheels, six panoramic cameras, the cameras' telescoping masts and robotic arms. The camera circuits create the images of Mars that we all see, as they send messages and images back home just like "E.T." "The trouble-free performance of Pyralux® AP and LF materials in the two Rovers, which have now exceeded the mission goals by over a year, have validated Pioneer's confidence," says Vicki Pulczynski, DuPont Marketing Manager.

During the last few months Pioneer has been working directly with JPL on a new and exciting Mars Rover Mission (Mars Science Laboratory or MSL). This Rover will be twice the size of the MER03s Spirit and Opportunity (a little bit smaller than a VW Bug). It will be a six-wheeled vehicle equipped with a manipulation arm, a camera on a mast (utilizing rigid flex circuitry designed and built by Pioneer) and multiple instruments for analyzing the Martian surface. One of these instruments includes a laser to vaporize thin layers of the rock surfaces to analyze for elemental composition of the underlying materials. The Mars Science Laboratory, or MSL, will roam up to 24

miles on the Martian surface. The scheduled launch date is set for the fall of 2009, for arrival on Mars in 2010. Don Schatzel, JPL's Group Supervisor for Advanced Electronic Packaging, says that Pioneer had more rigid flex and flexible parts on Mars than any other vendor.

This partnership with NASA on space programs is ongoing and future programs such as the Herschel Space Observatory, the Dawn MRO Mars Phoenix Lander Program, and the James Web Telescope and Grace Programs, are in the process of being built for launch in the near future. These space vehicles will allow us to figuratively touch those distant stars we see in the sky every night. Many of these same space vehicles that are on distant planets or venturing out into space will be in existence for literally thousands of years. Pioneer's circuit boards and flex cable assemblies may outlast the oldest man made monuments built on the earth.

In the first quarter of 2006, NASA and JPL presented Pioneer with a panorama award of achievement for its involvement in the NASA Programs. This two-part panorama depicts a view of the Lander from the Rover's perspective. The larger panorama at the top of the presentation plaque is of the crater the Lander found itself in after it touched down on the Martian surface. Both of these unique pictures are part of the JPL archives and have not been published for the general public. Pioneer is proud to give the commitment to NASA and JPL for continued support of their space programs.

Pioneer Circuits, Inc. (Pioneer/PCI) has been fortunate to have been part of NASA's Space Exploration Programs since the early 1990s. These missions included the Space Shuttle Program, International Space Station, Clementine Lunar Exploration Project, Hubble Telescope, Mars Path Finder, Cassini Huygens Mission to Saturn, Near Earth Asteroid Rendezvous JPL Program, Mars Global Surveyor, Star Dust Program, and the Mars Exploration Rover (MER03) Mission with Spirit and Opportunity.

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