



BEPICOLOMBO MTM PCDU

Application

For the ESA BepiColombo mission Terma was contracted to develop and manufacture a 100V bus Power Conditioning & Distribution Unit (PCDU) with a power capability of > 12 kW, to support the Mercury Transfer Module (MTM) ion propulsion system and other functions during its seven years cruise phase to Mercury. During the cruise phase the PCPU supports the Mercury Planetary Orbiter (MPO) satellite with power as well as its own solar panel is sized for Mercury sun distance only.

Power Conditioning & Distribution Function

The MTM electrical power system topology is a battery bus; however, the battery is sized only to support heaters and other low power units necessary to operate during a few planetary eclipses. It is therefore most of the cruise phase operated as a sun-regulated bus, continuously regulating the main bus to battery end of charge voltage level of 100V.

To meet the mission demand of high reliability the PCPU design comprises full redundancy, all operating in hot redundancy to obtain full autonomy and no sensitivity to any single failure that might occur during the mission. The PCPU is built in a modular format consisting of 23 modules. Each module forms to the extent possible an autonomous function itself that shares only a few transparent interfaces distributed along all modules via a backplane module.

Solar Array Regulation

As the solar array illumination depends on the spacecraft distance to the sun, the solar array electrical performance and characteristics varies significantly from leaving earth and until arriving at Mercury. Due to this the optimum power system solution is a Maximum Power Point Tracking (MPPT) solar array regulation concept.

To obtain a segregated system the solar array is sub-divided into 30 sections. The PCPU therefor interfaces the solar array with 30 individual MPPT regulators, all controlled by one common fail tolerant main bus regulation function. Each MPPT regulator can transfer >480 watt to the main bus with an efficiency up to 98%. 10 modules each accommodates individual MPPT regulators for three solar array sections.

Power Link

The PCPU comprises among other distribution functions a mission specific Power Link for the Mercury Planetary Orbiter. The power link function is designed to simulate a solar array characteristic such that the MPO PCPU can operate safe with its built-in MPPT function. Three modules provide six isolated converters that operates in hot redundancy.

Secondary Bus

The PCPU generates a secondary regulated power bus of 28 volt, derived from the 100V bus. The secondary bus topology is formed as a mini-PCPU function with full hot redundant bus generation and regulation and comprises its own power distribution protected function based on latching current limiters for 28V equipment.



Unit Key Specification

Primary Power bus 100V sun regulated
Load capability 12 kW

Sunlight power capability 14 kW
Solar array sections 30
30 individual MPPTs 480 watt
Solar array voltage 42V – 115V

100V LCL outputs 4 x 10A

Heater switch outputs 72

Secondary power bus 28V regulated
Load capability 700 watt
Distribution 28 LCLs

Power Link Distribution 60-67V, 2050W

Pyro Activation 2 x 8 lines, 5A

Thermal Knives Activation 2 x 14 lines, 20V

Command and monitoring MIL-STD-1553 bus

Idle consumption < 50 watt

Modules 23
Format 282 x 150 x 24 [mm]

Volume 556 x 317 x 158 [mm]

Unit mass 28.1 kg

Build of High-Power Modules

#

Array Power Regulator (3 x MPPT) APR 10

Battery Disconnection Device BDD 1

Equipment Power Distribution EPD 1

Heater Power Distribution HPD 3

Secondary Bus Distribution SBD 2

Power Link Distribution PLD 3

Actuator Firing Drive AFD 2

Command & Monitoring (2 x CM I/F) CM 1

Flight Heritage

Launch date 20 October 2018

Units launched 1

Reported errors 0

Obtained flight heritage 3 unit-years