

Role of Power Distribution System Tests in Final Assembly of a Military Derivative Airplane

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ABSTRACT

Boeing has contracts for military application of twin engine airplanes generically identified in this paper as the MX airplane. Unlike previous derivatives, the MX airplanes are produced with a streamlined manufacturing process to improve cost and schedule performance. The final assembly of each MX airplane includes a series of integration tests, called factory functional tests (FFT), which are modified from those of typical commercial versions and verify correctness of equipment installation and basic functionalities.

Two airplanes have been through the production line resulting in a number of FFT lessons learned. Addressed are the power distribution lessons learned: 1) the expanded coverage of the basic automated power-on generation system test, 2) the need for a manual wire continuity test, 3) salient features of the power distribution tests, and 4) keys to make first pass power distribution test smooth and successful. These points are discussed in generic terms to stay within non-proprietary confines and where not prohibited by US export laws and regulations, including those of International Traffic in Arms Regulations (ITAR) and the US Export Administration Regulations (EAR).

INTRODUCTION

Throughout this paper the names and nomenclature used are different from those actually used in the MX project. Qualitative and quantitative information is also omitted as

necessary to protect proprietary nature of certain technical details.

The MX electrical power generation system is comprised of two major sub-systems, referred to in this paper as:

- Power Generation System (PGS),
- Power Distribution System (PDS)

A brief description of each system is provided as background to discuss power distribution tests.

POWER SYSTEM DESCRIPTION

The following power system description does not provide proprietary data of any manufacturer's airplane model but may be characterized as a realistic, practical or advanced text book level description. The MX power generation system (PGS) architecture is a hybrid design that utilizes major aspects of relatively common commercial airliners power system combined with new design to address the needs of the MX missions. The airplane replaces the two 90 kVA 400 Hz constant frequency generators (CFG) with larger units; expands the power distribution system to accommodate the mission systems application needs; and provides a greater degree of automated control to reduce crew workload. The system also retains much of the FAA certified system architecture from one of the relatively common two-engine airliners.

Figure 1 illustrates the architecture of the PGS.

The acronyms BPCU and GCU in Figure 1 refer to equipment commonly used in commercial airliner power systems: Bus Power Control Unit and Generator Control Unit, respectively. Similar in nature are the other acronyms: GCB

(Generator Control Bus), LMB (Left Main Bus), BTB (Bus Tie Breaker), SCU (Start Converter Unit) and AGCU (APU Generator Control Unit).

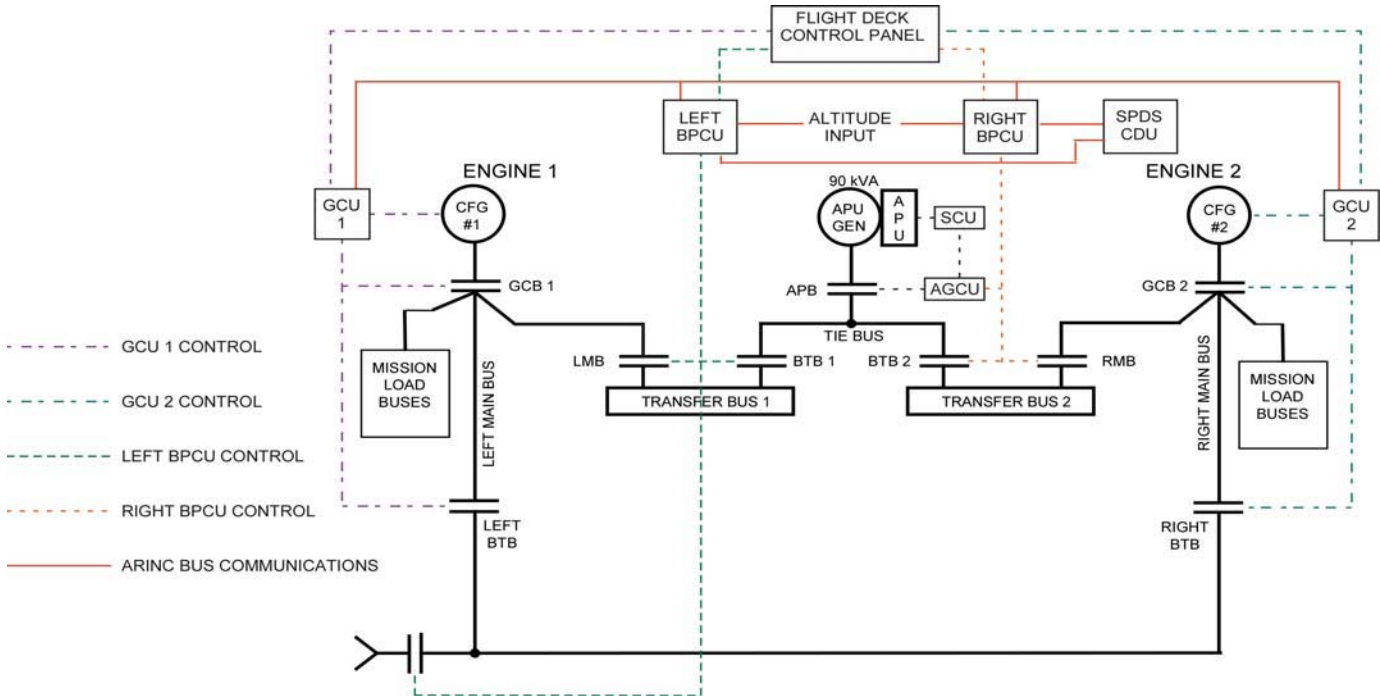


Figure 1: Power Generation System Architecture Illustration

POWER GENERATION - MX airplane replaces the two-engine driven 90 kVA AC generators commonly installed for such commercial airliners with significantly higher capacity generators. The power system also utilizes a 90 kVA Auxiliary Power Unit (APU) driven generator which is unmodified from what has been certified by the US Federal Aviation Authority (FAA) for such airliners.

The combination of the two enhanced generators and the 90 kVA Auxiliary Power Unit (APU) driven generator in this airplane re-presents a state of the art in CFG design, for its size and application.

As with commercial variants, the AC power system also includes the ability to accept input power from a 90 kVA external ground power source.

As commonly practiced in commercial airliners, the 28Vdc power is provided by three separate systems. The DC & Standby system is unmodified from similar commercial airliners and consists of three 75A Transformer Rectifier Units (TRUs) and 48 Amp-hour Nickel

Cadmium batteries. The 28Vdc power is used for the mission systems and is provided by additional higher-rated TRUs, connected in a parallel manner to provide redundancy should a failure take a TRU out of service. The dual mission DC systems are also isolated from each other as in an otherwise similar commercial airplane's configuration.

Power Distribution- Each MX airplane is equipped with an extensive power distribution system. The basic power distribution system from its commercial airliner counterpart is retained to supply standard aircraft systems equipment buses. These buses support the typical complement of flight essential equipment that is found on similarly sized FAA certified commercial airliner. In addition to these buses, additional buses are connected to each generator to supply power to the extensive mission equipment system.

The mission systems power distribution is a key part of this airplane PDS. The PDS has a microprocessor controlled array of solid state power controllers (SSPC). These controllers are commonly used in many other