

Low Level Continuous Wave Lightning Test

07/19/2012

Submitted by

Joel D. Thorsheim
The Boeing Company
Frequency Management Services MC: 2T-22
P.O. Box 3707
Seattle, WA 98124-2207
206-544-6066 Office
866-248-1493 Toll Free

This STA is required to conduct testing necessary to validate the lightning protection design on the 787-9 airframe. The test data will be scaled and transformed to obtain estimates of the peak voltage and current transients that can be expected on the aircraft systems as specified by the following:

1. FAA issue paper SE-2, "Lightning Protection Requirements."
2. JAA document JAR25X899, Electrical Grounding and Protection Against Lightning and Static Electricity."
3. FAA issue paper SE-1, Protection from High Intensity Radiated Fields (HRIF)."
4. JAA HIRF Certification Review Item D-5 – Stage 2, Special Condition Protection from External High Intensity Radiated Fields."

The purpose of this experimental operation is to allow for testing in support of the FAA required aircraft Lightning Testing and Certification.

The tests to be conducted are low level, swept continuous wave tests on production aircraft/components. This type testing is conducted as a **closed loop, non-intentional radiator**. The aircraft and ground plane form a closed loop transmission line, however parasitic emissions may occur. The emission type is CW. At best, the test set up is a very inefficient antenna, particularly at the higher frequencies, above 10 MHz. Although we do not have any measured data on the actual emission level,

In order to further minimize the possibility of interference, the test will be conducted inside of an aircraft hangar, with all doors closed. In addition, this is a swept frequency test, using a single sweep and a limited dwell time, which should allow the test to be conducted without any interference.

Low Level Continuous Wave Lightning Test

Test Description

This test requires the aircraft to be located on a ground plane constructed of chicken wire. A vector network analyzer, an HP 3577B or equivalent, will be used to inject low level swept CW currents, from DC to 50 MHz into the aircraft at a point that represent a typical lightning attachment location. Another connection from the aircraft will be made to the ground plane, which will represent a typical lightning exit location. The ground plane returns the current back to the network analyzer. It will sometimes be necessary to amplify the injected current using a laboratory grade 25 or 50 Watt linear amplifier. (See Figure 1 for a typical test setup). Again, **the test configuration is set-up as a non-intentional radiator, and Boeing has conducted this type testing on numerous past occasions with no issues noted.** The test is repeated with a variety of injection and exit configurations to represent various lightning attachment configurations. Testing, using widely spaced discrete frequencies would miss critical resonant frequencies.

The desired frequency range for this test is DC to 50 MHz. The sweep time will be approximately 10 seconds, with a dwell time at any single frequency that will not exceed 50 mS. A typical data acquisition will require 1 to 8 sweeps. The RF drive current will be turned off between data acquisitions. The down time between data acquisitions can be anywhere from minutes to hours depending on the complexity of the test configuration changes. The 787-9 as well as other aircraft types which have similar shapes, sizes, weights and composition may also be tested using this procedure. However the test procedure, RF parameters and test locations will not change. As summary of the frequency, power and emission data are follows:

Frequency Band: 0.001 KHZ to 50.0 MHZ

Sweep Time Through Band: 10 Seconds

Max Dwell Time per Frequency: 50 milliseconds

Max ERP to Closed Loop Configuration: 50 Watts (see note 1)

(Note 1: 50 watts is the maximum input power into the closed loop test configuration. It is anticipated that the actual parasitic (unintentional emission) will be well below 1 watt. In addition, the test will be conducted inside of a metal construction aircraft hangar.)

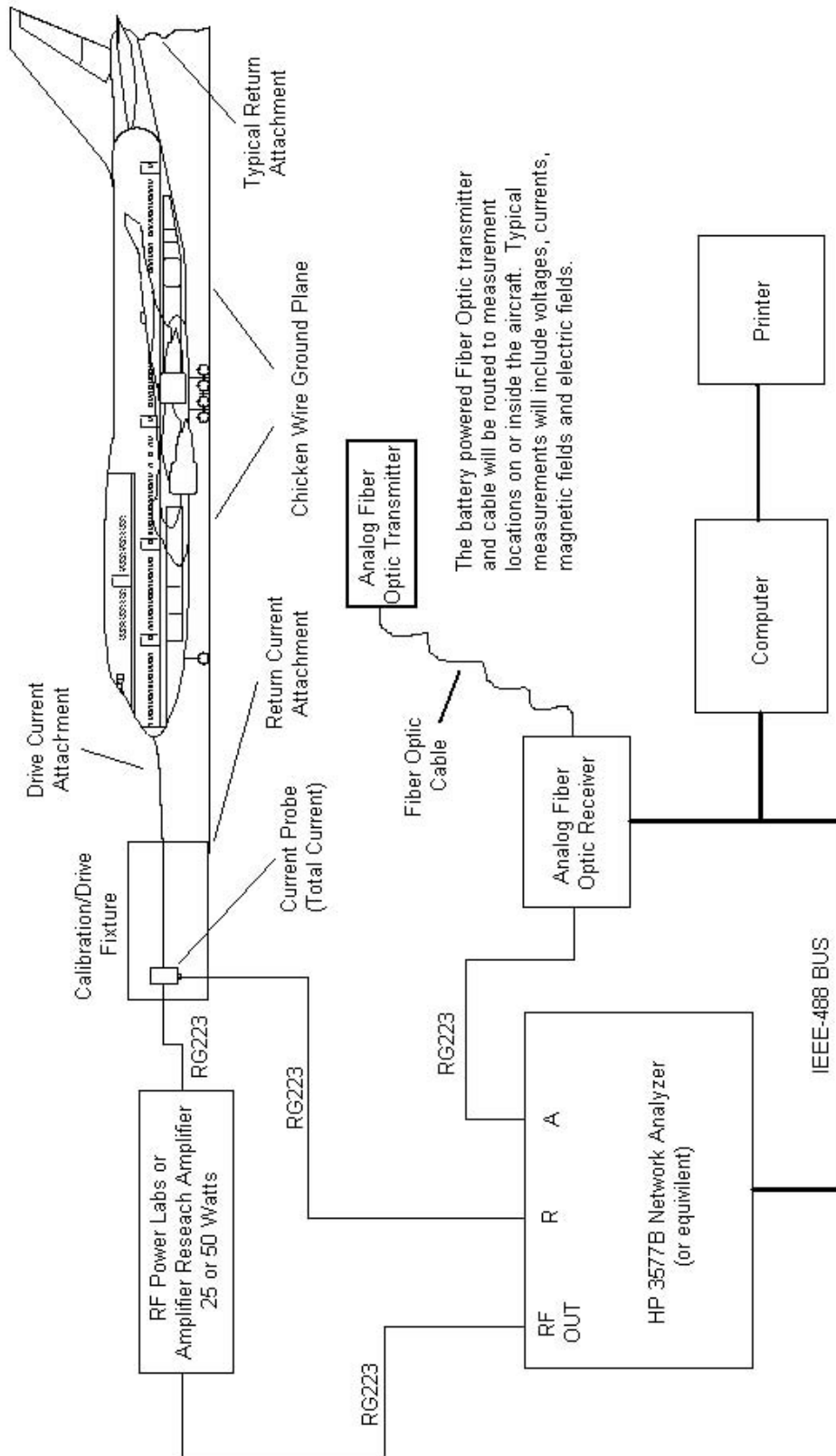
Location of Operation:

Moses Lake, WAA
47-12-03N; 119-17-57W, NAD83

Stop Buzzer:

The "Stop Buzzer" is John Erdelyan, telephone 425.314.7165.

Figure 1



Low Level CW Direct Drive Test Setup for a Typical Full Scale Aircraft Test