Required Electrical Tests for FCC Equipment Authorization

This section should include the test report and data showing compliance with all applicable technical standards. The rule sections which require the test report to be submitted are 2.983(e), and 2.1033(d)(6). Test report is defined as a "complete package" showing data, graphs, test method description, and a list of test equipment.

In addition to FCC approval, the FAA has approved our system for manufacture and installation on aircraft. The FAA has granted our system TSO C147. This TSO requires that we certify that our system is compliant with RTCA DO-197A. RTCA DO-197A describes the minimum operational performance requirements for an active aircraft collision avoidance system (TAS). TSO C147 defines transmitter characteristics and emissions that the FAA requires for installation on aircraft.

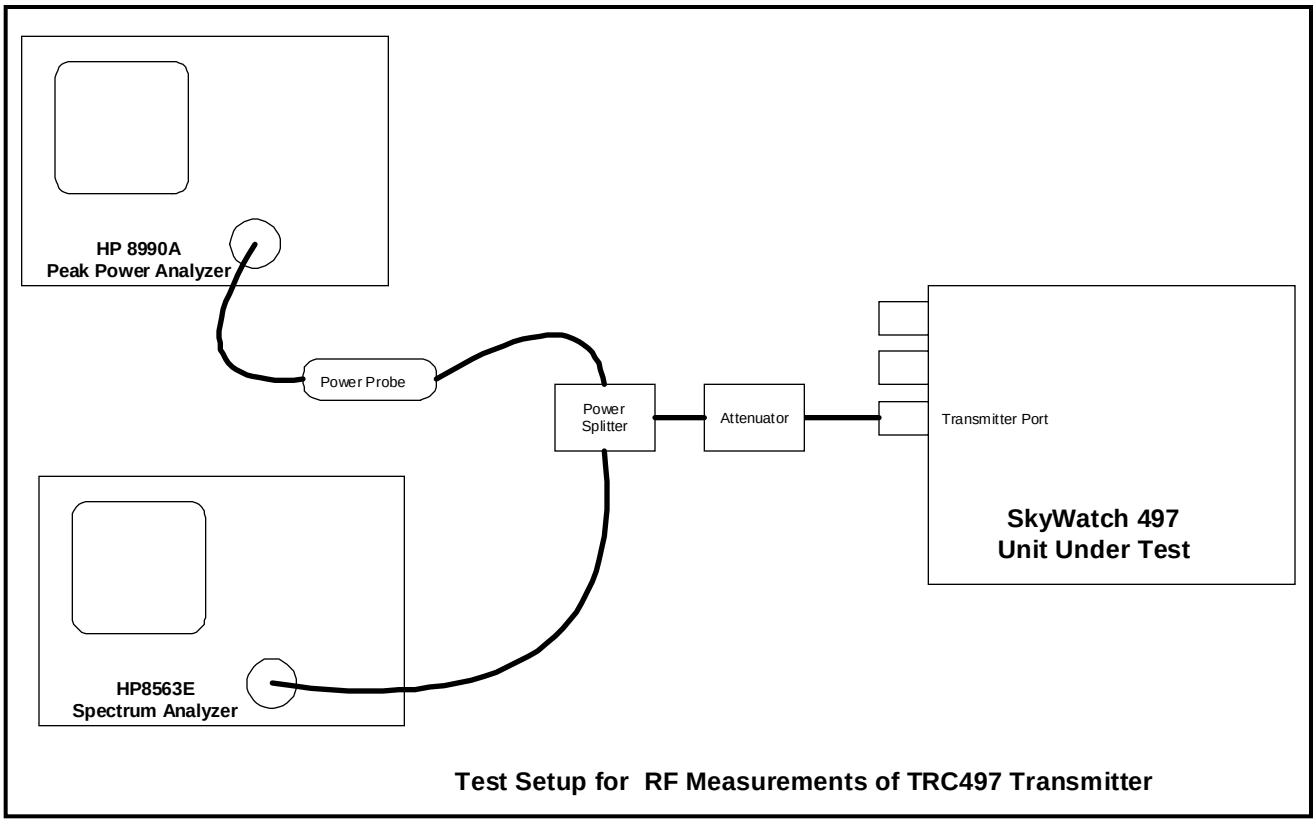
Title 47 part 2 requires that the following measurements be made and submitted to the FCC. The actual requirements are defined in part 87 (Aviation Services).

Table 1 Required Measurements and Tolerances to be made on TRC 497

Required Measurements From part 2	part 87 specifications	FCC requirements
2.1046 – RF Power Output	87.131 note 7 points requirements to DO-197	44 dBm > > 50 dBm peak power
2.1047 – Modulation Characteristics	87.141 – no requirements imposed for our equipment	Pulse width : 800ns ± 75 ns Risetime : < 100 ns Falltime : < 200 ns
2.1049 – Occupied Bandwidth	87.135 implies to refer to DO-197	0.7 MHz offset : -3 dB down 5 MHz offset : -20 dB down 20 MHz offset : -40 dB down 60 MHz offset : -60 dB down
2.1051 – Spurious Emission at Antenna	87.139(a)	Requirement per FCC 10-20 MHz : -25 dB 20 – 50 MHz : -35 dB > 50 MHz : -40 dB
2.1053 – Field Strength of Spurious Radiation	No requirement In part 87	Submit data taken for compliance with FAA regulations.
2.1055 - Frequency stability	87.133 (e)	±200 KHz based upon DO-197A and prior TCAS I systems approved by FCC.

Test Set up and Procedure

Diagram 1 shows the equipment setup used to measure the technical requirements as spelled out in part 87. The equipment used is a Hewlett Packard HP-8990A Peak pulse analyzer and a Hewlett Packard HP-8563E Spectrum Analyzer. A power splitter is used so that both pieces of equipment can be used at the same time. The Peak power analyzer is used to make measurements on the output power and modulation tests. The spectrum analyzer is used to measure frequency and emission requirements.



Figue 1: Test Setup for RF Measurements of TRC497 Transmitter

Test 1: part 2.1046 – RF Out put Power

Connect the equipment per Figure 1. Enable the transmitter and measure the peak power of the transmitter on the HP-8990D. Record the measured power level. The requirement is for the power to be greater than 44dBm and less than 50 dBm.

Test 2: part 2.1047 Modulation Characteristics

Using the peak power analyzer, measure the pulse spacing of the two transmitted pulses. The requirement is 21 us ± 0.1 us. Measure the risetime, falltime and pulse width of the first pulse of transmission. The requirements are as follows:

Risetime: <100 ns
Falltime: <200 ns
Pulsewidth: 800ns ± 75 ns.

Test 3 :part 2.1049 Occupied Bandwidth

Use the spectrum analyzer per figure 1 and measure and record the spectrum of the transmitted pulses. The spectrum requirements of the transmitter is specified in table 2

Table 2 Spectrum Requirements of TRC 497 Transmitter

Spectrum Below Peak at 0.7 MHz Offset	-3 dB
Spectrum Below Peak at -0.7 MHz Offset	-3 dB
Spectrum Below Peak at 5 MHz Offset	-20 dB
Spectrum Below Peak at -5 MHz Offset	-20 dB
Spectrum Below Peak at 20 MHz Offset	-40 dB
Spectrum Below Peak at -20 MHz Offset	-40 dB
Spectrum Below Peak at 60 MHz Offset	-60 dB
Spectrum Below Peak at -60 MHz Offset	-60 dB

Test 4: part 2.1051 Spurious Emissions from Antenna

Using the Test setup from Figure 1, measure the spectrum out of the unit from 9 KHz to 10.3GHz. Record the frequency and emissions present in each of the bands from the table below.

Table 3: Emission Limits from antenna on TRC497

9 Khz – 980 MHz	-40 dB
980 – 1010 MHz	-35 dB
1010 – 1020 MHz	-25 dB
1040 – 1050 MHz	-20 dB
1050 – 1080 MHz	-35 dB
1080 MHz – 10.30 GHz	-45 dB

Test 5: part 2.1053 Field Strength of Spurious Radiation

Attached to this document is a series of measurements made on the TRC497 (called Sky 497 emissions). These tests include radiated and conducted emissions on the TRC497. They were conducted in accordance with DO-160D, which is the FAA document governing emission from equipment to be installed on aircraft.

Test 6: part 2.1055 Frequency Stability

Using the Spectrum analyzer in figure 1, make frequency measurements from -30°C to +50°C and record. Make measurements when the input voltage is at 23.8V input and 32.2V. Record the result in the data sheet. The requirement is 1030MHz ± 200 KHz.

Tests Data

Measurement	**Measured Data**	**Requirement**
Peak Power Output	**46.17 dBm**	50 dBm> >44 dBm
Modulation (pulse characteristics) :		
Pulse width	**794 ns**	800±75 nsec
risetime	**51 ns**	< 100 nsec
Fall time:	**75 ns**	<200 nsec
Pulse spacing	**21.0 us**	21 usec ± 100nsec
Occupied Bandwidth		
Spectrum Below Peak at 0.7 MHz Offset	**-4.3 dB**	-3 dB
Spectrum Below Peak at -0.7 MHz Offset	**-4.8 dB**	-3 dB
Spectrum Below Peak at 5 MHz Offset	**-27 dB**	-20 dB
Spectrum Below Peak at -5 MHz Offset	**-24 dB**	-20 dB
Spectrum Below Peak at 20 MHz Offset	**-50 dB**	-40 dB
Spectrum Below Peak at -20 MHz Offset	**-44.6 dB**	-40 dB
Spectrum Below Peak at 60 MHz Offset	**-69 dB**	-60 dB
Spectrum Below Peak at -60 MHz Offset	**-70 dB**	-60 dB
Spurious Emissions		
9 kHz – 980 MHz	**100 MHz @ -54 dB** **190 MHz @ -55 dB**	-40 dB
980 – 1010 MHz	**1010 MHz @ -48 dB**	-35 dB
1010 – 1020 MHz	**1020 MHz @ -32 dB**	-25 dB
1040 – 1050 MHz	**1040 MHz @ -43dB**	-20 dB
1050 – 1080 MHz	**1050 MHz @ -51 dB**	-35 dB
1080 MHz – 10.30 GHz	**2.060 GHz @ -56 dB**	-45 dB

Measurement	**Measured Data**	**Requirement**
Frequency Stability		
Frequency at – 30° C	**1030.093**	1030 MHz ± 200 KHz
Frequency at – 20° C	**1030.090**	1030 MHz ± 200 KHz
Frequency at – 10° C	**1030.088**	1030 MHz ± 200 KHz
Frequency at 0° C	**1030.085**	1030 MHz ± 200 KHz
Frequency at +10° C	**1030.080**	1030 MHz ± 200 KHz
Frequency at +20° C	**1030.075**	1030 MHz ± 200 KHz
Frequency at +30° C	**1030.053**	1030 MHz ± 200 KHz
Frequency at +40° C	**1030.052**	1030 MHz ± 200 KHz
Frequency at +50° C	**1030.045**	1030 MHz ± 200 KHz
Frequency at 23.8V	**1030.048**	1030 MHz ± 200 KHz
Frequency at 32.2 V	**1030.055**	1030 MHz ± 200 KHz