

FCC test report for the ADR-7050 Radio

This report contains the test setups and data required by the FCC for equipment authorization in accordance with Title 47 parts 2, and 87.

Prior to this FCC approval application, the FAA has already approved our system for manufacture and installation on aircraft. The FAA has granted our system TSO C169. This TSO requires that we certify that our system is compliant with RTCA DO-186A. RTCA DO-186A is a specification for airborne radio communications equipment. TSO C169 is a certification from the FAA that the unit has complied with the specification (in addition to software and environmental specifications).

Title 47 part 2 requires that the measurements in this report be made and submitted to the FCC. Some of the specific requirements are defined in part 87 (Aviation Services) or in DO-186A , which is the governing equipment specification imposed by the FAA for system certification.

All data taken for this report was conducted in Columbus Ohio by Brent Locher, between June 6 and June 9, 2006

Manufacturer of Equip: L-3 Communications Avionics Systems Inc.

Model Number: ADR-7050

FCC ID: PMYADR7050

Emission Type: 6K00A3E

Freq Range: 117.975-137.00 MHz Adjustable in 25 KHz Steps

Output Power: Less than 55 W

Test Set up and Procedure for testing the ADR-7050 radio

Diagram 1 shows the equipment setup used to measure the technical requirements as spelled out in part 2 and 87. The equipment used is a Standard 100 MHz Oscilloscope an Audio Frequency generator and a Hewlett Packard HP-8563E Spectrum Analyzer. The spectrum analyzer is used to measure frequency and emission requirements.

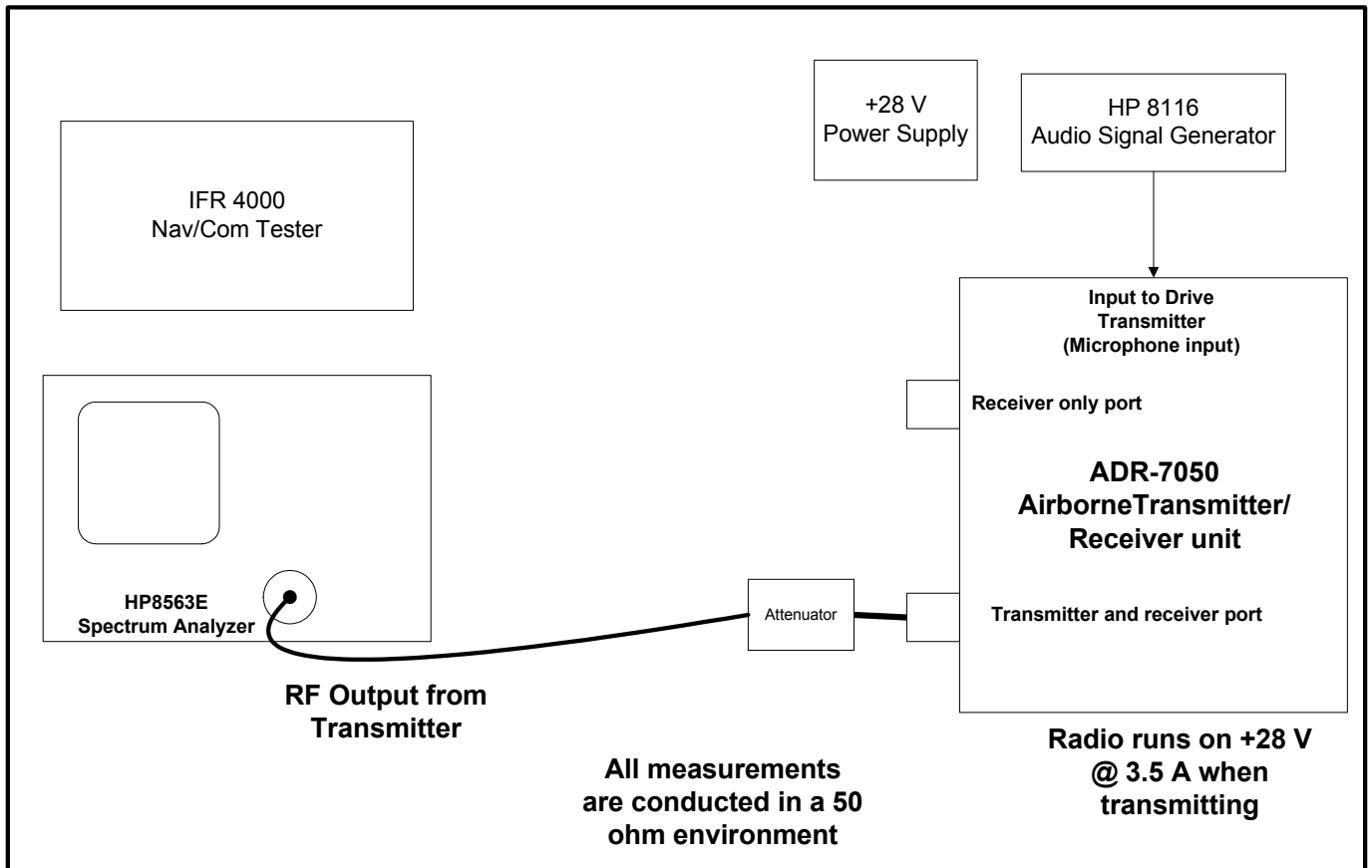


Figure 1: Test Setup for FCC Measurements on ADR-7050 Transmitter/Receiver

LIST OF TEST EQUIPMENT

Item	Description
HP 8563	Spectrum Analyzer
IFR-4000	Nav/Com Test Set
HP 8116	Function Generator
Narda 766-20	20 dB Attenuator
Thermotron S-1.2	Temperature Chamber
HP6024A	Power Supply

Test 1: part 2.1046 – RF Output Power

Connect the equipment per Figure 1. Enable the transmitter in the CW mode and measure the power of the transmitter on the IFR-4000 test set. Record the measured power level. The requirement is for the power to be greater than 16W and less than 55W.

Peak Power Output		
Measurement	Measured Data	Requirement
Power output at 118.00 MHz	17 W	16W < < 55 Watts
Power output at 136.975 MHz	17 W	16W < < 55 Watts

Rationale and Notes:

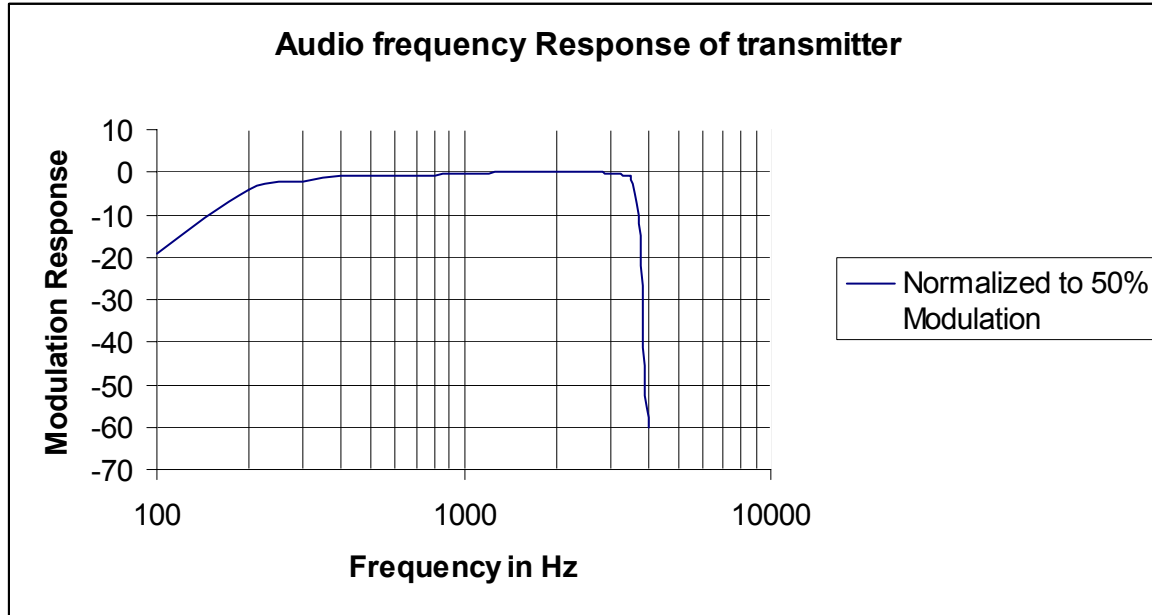
Part 2.1046 requires a power measurement with a declaration as to the load impedance.

Part 87.131 states a power limit of 55W when using A3E.

The governing FAA specification (DO- 186A) requires a minimum output power of 16 W.

Test 2: part 2.1047 Modulation Characteristics

Use the Audio generator to drive the transmitter to 50 % modulation at 1 KHz. Sweep the audio generator and record the audio frequency response of the transmitter. Do this for the 6K00 mode of operation.



Use the Audio generator to drive the transmitter to achieve a maximum modulation level. Adjust the audio input frequency to the frequencies listed below and use the spectrum analyzer to verify that the modulation amount does not exceed 100%. Record the amount of modulation out of the transmitter at the indicated audio frequencies.

Audio Frequency.	Max Modulation Level when overdriving input by 16 dB (Requirement is less than 100%)
100Hz	30%
350 Hz	80%
1000Hz	76%
2500 Hz	73%
3500 Hz	70%
5000Hz	0.6%

Rationale and Notes:

Part 2.1047 requires a power a curve showing the frequency response of the Transmit modulated signal. Curves are attached for both BW designators

Part 87.141 states that the modulation level shall not exceed 100 %.

Test 3: part 2.1049 Occupied Bandwidth

Set the transmitter to 120.00 MHz. Modulate the transmitter with an audio signal to produce a 50% modulation at 2500Hz audio frequency (each sideband will be -12 dB down). After the 50% modulation is achieved, increase the audio input level by 16 dB (increase audio drive X 6.3). Sweep the audio frequency generator out in frequency until the transmitter is modulating at 20%. The outer frequency where 20% modulation is achieved is one half the occupied bandwidth

Occupied Bandwidth		
Necessary BW Designator	Measured Data	Requirement
6K00	7.56 KHz	6.0 KHz < < 25 KHz

Rationale and Notes:

Part 2.1049 requires a measurement that indicates the occupied BW of the modulated signal

Part 87.137 indicates that 6K00A3E is an acceptable type of modulation. It also authorizes 25 KHz of BW for the 6K00 emission.

Test 4: part 2.1051 Spurious Emissions from Antenna

While Transmitting:

With the transmitter set to 137.00 MHz key the transmitter such that a non modulated (CW) tone is transmitted. Measure the spectrum from the unit from 9 KHz to 1.4 GHz. Note the highest harmonic and its level in the data sheet. The requirement is that no harmonic shall be greater than -13 dBm.

While Receiving:

With the unit in receive mode, look at each receive port on the spectrum analyzer. Determine the frequency and power level of the highest emission from each port. The requirement is no greater than -57 dBm

Spurious Emissions		
Measurement	Measured Frequency and level of highest emission	Requirement
9 kHz – 1400 MHz – during non transmission TX/RCV Port	-80 dBm @235 MHz	-57 dBm
9 kHz – 1400 MHz – during non transmission/ RCV only port	-79 dBm @235 MHz	-57 dBm
Harmonics from 200 MHz – 1.215 GHz	-35 dBm @ 274 MHz (2nd Harmonic) -61 dBm @ 411 MHz (3rd Harmonic) All other harmonics less than -70 dBm	-13 dBm

Rationale and Notes:

Part 2.1051

requires a measurement to determine the spurious emissions from the antenna port of the device.

87.139 (d)

Except for telemetry in the 1435-1535 MHz band, when the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth for aircraft stations above 30 MHz and all ground stations the attenuation must be at least $43 + 10 \log_{10} P_Y$ dB.

[This equals $43\text{dB} + 10 \log (16 \text{ watts}) = 55 \text{ dB}$

For our system: Our output power is roughly $44 \text{ dBm} - 55 \text{ dB} = -13 \text{ dBm}$]

Rationale and Notes continued:

We also have a built in receivers in our unit:

part 15.111a states:

In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of Sec. 15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in Sec. 15.33 shall not exceed 2.0 nanowatts.

Measurements were made to 1.4 GHz, which is a little above ten times the maximum operating frequency of the unit. 2.1057 indicates that this is the upper limit of where the unit needs to be characterized.

Test 5: part 2.1053 Field Strength of Spurious Radiation

A separate attachment with test data has been sent to the FCC to fulfill this requirement. This attachment includes the radiated and conducted emission tests that the FAA required for its certification process.

Rationale and Notes:

There are no specific requirements for testing this in part 87.

The FAA specifies this radio through DO-186A and requires radiated and conducted emission tests to be conducted and submitted to the FAA as part of its certification process. Details of the emission requirements are found in DO-160E

The data which was used to fulfill the FAA certification requirement (although not part of part 87 requirements) has been submitted to the FCC to fulfill this requirement.

Test 6: part 2.1055 Frequency Stability

Set the transmitter to 127.5 MHz. Key the transmitter to achieve an unmodulated (CW) signal. Take frequency measurements on the unit with temperatures ranging from -30°C to +50°C. Record the results. Take measurements when the input voltage is at 23.8V input and 32.2V. Record the result. The requirement is that the frequency of the transmission is 127.5 MHz $\pm$ 630Hz.

Frequency Stability		
Measurement	Measured Data	Requirement
Frequency at - 30° C	127.50021 (+ 1.67 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at - 20° C	127.50004 (+ 0.37 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at - 10° C	127.50004 (+ 0.37 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at 0° C	127.49998 (-0.15 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at +10° C	127.49998 (-0.15 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at +20° C	127.50005 (+ 0.39 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at +30° C	127.50000 (+ 0.00 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at +40° C	127.49988 (- 0.95 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at +50° C	127.49980 (- 1.59 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at 23.8V (Temp at 25° C)	127.49993 (-0.55 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)
Frequency at 32.2 V (Temp at 25° C)	127.49993 (-0.55 ppm)	127.5 MHz $\pm$ 630 Hz (5 ppm)

Rationale and Notes

87.133 (e) states a tolerance of 20 ppm, however, the FAA relies on another document (DO-186A) that governs the specification of this radio, and this document states that the required tolerance is 5ppm.

Test 7: part 2.1057 Frequency spectrum to be investigated

No additional testing required because the highest harmonic level is more than 20 dB below the FCC specification.

Rationale and Notes

2.1057 (c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported