AC NO: 00-35A

DATE: 9/28/73

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: EMERGENCY LOCATOR TRANSMITTERS - OPERATIONAL AND MAINTENANCE PRACTICES

1. PURPOSE. This advisory circular provides guidelines relative to the licensing, installation, maintenance, and testing of Emergency Locator Transmitters (ELT).

2. CANCELLATION. AC 00-35, dated October 27, 1972, is cancelled.

3. BACKGROUND. In 1970, Congress enacted Public Law 91-596 amending Section 601 of the Federal Aviation Act of 1958 to require the installation of "emergency locator beacons" on U.S. registered civil airplanes. Federal Aviation Regulations were amended to implement this legislation.

4. LICENSING REQUIREMENTS. The Federal Communications Commission has initiated rule making that will change the requirements pertaining to ELTs. An FCC license is required for an aircraft station that has an ELT installed, but no application filing fee is required. An operator permit is not required for the operation of an aircraft station ELT while it is being used for survival purposes, or for maintenance/
* operational testing. However, the ELT cannot have a voice capability. When a radio transmitter with A9 emission also has an A3 (voice) emission capability, it is not an ELT and cannot be legally advertised or sold as an ELT. The FCC has not type accepted such a device as an ELT. Therefore, such a transmitter does not comply with the provision of TSO-C91 which requires FCC type acceptance. However, the ELT portion of a survival craft station (erroneously referred to as an ELT with voice capability but approved under TSO-C91) satisfies the FAA requirements and their installations may continue to be approved by the FAA. *

Emergency locator transmitters used in connection with design, manufacture, demonstration or training should not operate on 121.5 megahertz or 243.0 megahertz. These units should use off-set crystals. The frequencies of 121.6, 121.65, 121.7, 121.75, 121.8, 121.85, and 121.9 megahertz may be used for these purposes provided that the user obtains the proper FCC operator and station license; coordination is established with the appropriate FAA Regional Frequency Management Office prior to activating each test period; and no harmful interference is caused to voice communications on these frequencies.

Initiated by: AFS-350

5. INSTALLATION. The installation requirements for ELTs are contained in Federal Aviation Regulations Part 37.200, "Emergency Locator Transmitters - TSO-C91", and Part 91.52. However, additional consideration should be given to the following:

   a. Maintain adequate clearance from control cables, pulleys, bell cranks, wiring, etc.

   b. When installed, the ELT should be visually and physically accessible to allow for easy monitoring of the battery change date and for arming of the unit.

   c. Location of the ELT antenna as far as practicable from the other antennas on the airplane to prevent interaction between the avionics systems.

   d. Performance of an operational test on the ELT after the installation is completed, in accordance with paragraph 7 of this advisory circular. The test should also include operation of the airplane avionic systems with the ELT armed. This will check for inadvertent activation of the ELT by the proximity of strong RF signals, such as from the VHF transmitter.

   e. Use of standard installation practices as outlined in AC 43.13-1, "Acceptable Methods, Techniques and Practices, Aircraft Inspection and Repair," and AC 43.13-2 "Acceptable Methods, Techniques, and Practices, Aircraft Alterations."

6. ELT BATTERY USEFUL LIFE. The useful life of the battery, is the length of time which the battery may be stored without losing its ability to continuously operate the ELT, for 48 hours.

   a. Fifty percent of the useful battery life is the time at which replacement is required. Additionally, the battery must be replaced when the transmitter has been in use for more than one cumulative hour. In the case of rechargeable batteries, the fifty percent limitation is the period of time at which the regulation requires recharging the battery. Since the ELT manufacturer is required by Section 91.52 and 37.200 of the FARs, to determine the useful life and consequently fifty percent of the useful life, use replacement batteries that are identified in the data which is furnished with each ELT.

   b. The fifty percent useful life criterion for replacement or recharging of batteries is a very practical means of assuring adequate ELT power and battery life. It provides a safety margin by taking into consideration reasonable exposures to adverse conditions such as temperature extremes and typical decay, or discharge, of battery capacity when the ELT is in the ready to use condition.

7. FACTORS WHICH AFFECT ELT BATTERY PERFORMANCE. Shelf life storage, ELT environment, and the type of battery (rechargeable or non-rechargeable) are factors to be considered regarding ELT performance.

   a. Batteries in storage should be kept in a clean, dry, and cool storage area. These normal environmental conditions keep the battery self-discharge rate to a minimum, and will assure the predetermined useful lifetime period. Batteries stored improperly in areas such as, near hot air ducts, radiators, or in direct sunlight may have a shortened useful life.

   b. High ambient temperatures that the batteries in the ELT may be exposed to for prolonged periods of time, such as in an aircraft parked on the ramp, can cause a premature deterioration of the battery before the replacement or recharging date is reached. Batteries in the ELT that are subjected to extremes of low temperature, such as aircraft in far northern hemisphere areas, cause the capacity and load voltage to decrease and results in reduced power output from the ELT. Anything that a pilot can do in time of emergency to obtain a battery temperature of approximately 70°F will result in improved performance and longer operation of the ELT.

   c. Rechargeable batteries are affected by the same environmental and storage conditions as the non-rechargeable type. The prime consideration regarding rechargeable batteries is that the ELT manufacturers' manuals be followed regarding recharging methods and testing procedures.

   d. Water activated batteries have practically an unlimited shelf life since their condition in a dry-state is not time-related. Therefore, they are exempted from the shelf-life requirements of rechargeable and non-rechargeable batteries. However, unlike other batteries, water activated batteries should be replaced after activation irrespective of time use.

   e. Replacement batteries identified by the ELT manufacturer, should be used. This will ensure proper ELT operation as the ELT manufacturer has been charged with the responsibility of selecting a battery type which is compatible with the transmitter design. Over-the-counter batteries of the type that are generally sold for flashlights, portable radios, etc., are not recommended for use as replacement batteries in an ELT since their condition and useful life is generally unknown. They may not meet the power supply requirements of the ELT; thereby being inconsistent with Technical Standard Order C91 and not in accordance with FAR 91.52. Battery replacement may be made by certificated pilots under the preventive maintenance provisions of FAR 43, Appendix A, paragraph (c), (24).

f. When the battery replacement is made a new date for replacement must be marked on the outside of the transmitter. This period of time is fifty percent of the useful life as established by the ELT manufacturer, and is computed from the date of battery manufacture.

For example, if the fifty percent useful life of your batteries is one year, and these batteries are dated the 15th of June 1971, the replacement date that you mark on the transmitter would be June 15, 1972. Water activated batteries are exempt from this marking requirement. In the case of rechargeable batteries this would be the new date for recharging.

g. Aircraft owners should obtain, from the vender, a copy of the operating instructions, equipment limitations, installation procedures, and data sheets that are required to be furnished with each ELT manufactured under the TSO. This data will familiarize them with the battery requirements and provide servicing data when repairs are required.

8. TESTING OF EMERGENCY LOCATOR TRANSMITTERS. Generally, tests will be performed following maintenance or repair of ELTs, other than battery replacement, to determine their operational capability. Repair agencies are encouraged to follow the manufacturer's recommended test procedures, particularly with regard to shielding, to minimize the possibility of radiation of emergency signals. Testing of the ELT, if improperly done, could trigger false alerts and create frequency jamming, and may interfere with the reception of a bonafide emergency transmission. Federal Communications Commission regulations require that this testing be performed in a screened or shielded test room, or in a test enclosure that will hold the self-contained ELT unit with the antenna fully extended.

Repair stations should contact the nearest FAA tower or flight service station and establish the necessary coordination for conducting the tests.

If interference is caused during the testing, the repair station should coordinate each test and limit transmissions in accordance with local FAA requirements. However, if no interference is caused, further coordination is not necessary.

Operational testing of installed ELTs may be performed provided the following criteria are observed:

a. Tests should not be longer than three audio sweeps (one audio sweep may be defined as amplitude modulating the carrier with an audio frequency sweeping downward over a range of not less than 700 Hz, within the range 1600 to 300 Hz, and a sweep repetition rate between 2 and 4 Hz).

b. If the antenna is removable, a dummy load should be substituted for the test.

c. Tests should be conducted only in the first five minutes of any hour.

d. If the operational tests must be made at a time not included within the first five minutes after the hour, the tests should be coordinated with the nearest FAA tower or flight service station.

e. To assist in the detection of inadvertent ELT activation which may occur because of aerobatics, after a hard landing, or during maintenance on the aircraft, we recommend the following:

(1) After the termination of a flight the pilot should make a practice of tuning his VHF communications receiver to 121.5 MHz and listening for ELT audio sweeps.

(2) Anytime maintenance is performed in the vicinity of the ELT the mechanic should tune the VHF communications receiver to 121.5 MHz and listen for ELT audio sweeps.

(3) If the ELT audio sweeps are heard and it is determined they are coming from the aircraft, the ELT must be turned off immediately. The ELT may require maintenance before the "G" activation unit is returned to the "ARMED" position.

9. BENCH TEST PROCEDURES.

a. Direct power measurement tests should be performed in a shielded room with the antenna removed from the ELT. The procedure for this measurement and modulation tests are specifically outlined in the manufacturers' maintenance manuals.

b. The comparison method. One of the simplest and most reliable techniques is to compare the ELT to be measured with a "standard" ELT whose power output has already been determined. Because the ELTs transmit on the international emergency frequencies of 121.5 MHz and 243.0 MHz all testing must be accomplished in a shielded enclosure. Two types of test enclosures that may be used are: (1) a rectangular metallic enclosure with inside dimensions of 2x2x4 feet, and (2) a metallic circular cylinder with inside dimensions two feet in diameter and four feet long. Either type of enclosure is adequate for test purposes.

(1) The test equipment consists of the test enclosure, and the detection circuitry. Figure 2 shows the relative positions of the major components of the measurement set-up and the critical dimensions.

(2) The transmitter is a self-contained ELT unit, including antenna, and should be completely inside the test enclosure. If the antenna length is variable, all tests should be made with the antenna in the fully extended position with the axis of the antenna in the same direction as the longest dimension of the test enclosure. The tip of the antenna should be at least one foot away from any wall of the test enclosure. If necessary, dielectric clamps should be utilized to insure that both the standard ELT, and the ELT under test are in the same position inside the test enclosure.

(3) The test enclosure consists of the metallic box discussed previously and includes any dielectric clamps necessary to insure repeatability in positioning the ELTs. Care should be exercised to insure there is no excess leakage outside the test enclosure when the ELTs are under test. A suitable opening (which can be closed during testing) should be constructed on one side of the test enclosure for introducing and removing the ELTs.

(4) The detection circuit consists of a receiving probe, a low-pass filter, an rf to DC conversion circuit, and a DC millivoltmeter. The receiving probe is a 4-inch monopole made of No. 12 copper wire, one end of which is attached to the center conductor of a length of coaxial cable. The probe is positioned 4 inches from one side of the test enclosure, midway between the adjacent two sides and parallel to the antenna of the ELT. The probe is positioned so that its tip is even with the tip of the ELT antenna. By use of coaxial connectors (such as type N), the probe can be mounted in a fixed or rigid position in the test enclosure.

The low-pass filter is used to filter out all undesirable signals above 121.5 MHz, especially the 243.0 MHz signals, which should be attenuated 40 decibels or more. The low-pass filter is attached directly to the panel connectors on the test enclosure.

The rf to DC conversion circuit is connected on the output side of the low-pass filter. Details of this circuit are shown in Figure 1. This circuit need not be shielded.

The DC millivoltmeter should be chosen to operate in a range which will give at least half-scale deflection in response to the peak voltage output produced by the standard ELT under operating test conditions. The input impedance of the millivoltmeter should be 10^6 ohms or greater, and have a range from approximately 10 to 10,000 millivolts. The millivoltmeter should be stable to within 3 percent during the length of time required to complete a test as outlined below.

(5) Measurement Procedure. Allow proper equipment warm-up, place the standard ELT in the test enclosure in an operating condition (See Figure 2), and record the reading on the millivoltmeter. Remove the standard ELT from the test enclosure and replace it with the ELT to be tested. Record the peak output indicated on the millivoltmeter and then repeat the above procedure to establish the repeatability of the measurement system.

(6) Precautions. The positioning of the ELTs within the test enclosure is critical; therefore, extreme care must be exercised during these steps. The relative positions of all components in the test set-up must remain fixed throughout the test for reliable results.

(7) Analysis of results. This method utilizes the comparison technique which has the advantage of making the results readily available. By calibrating the millivoltmeter in decibels the output of an ELT under test can be directly compared to the known output of a standard ELT.

(8) The output of the millivoltmeter can be converted to decibels by the expression:

$$\text{decibels} = 20 \log_{10} \frac{V_0}{V_1}$$

Where V_0 = the peak voltmeter reading from the standard ELT, and
V_1 = the peak voltmeter reading from the ELT under test.

The face of the voltmeter can also be marked in decibels for direct decibel readings.

Because a diode is used in the detection circuit, and this device may not be linear, it is advisable to calibrate the diode in decibels using a signal generator to achieve maximum accuracy. For small changes in output the calibration may not be necessary.

(9) The aforementioned comparison test is a measurement technique for accurately determining the effective radiated power from an ELT at 121.5 MHz. By modifying the filter circuitry the technique can be used to measure the effective radiated power at 243.0 MHz.

C. R. Melugin Jr.

C. R. MELUGIN, JR.
Acting Director, Flight Standards Service

FIGURE 1. DETECTION CIRCUIT DIAGRAM FOR MEASUREMENT TECHNIQUE

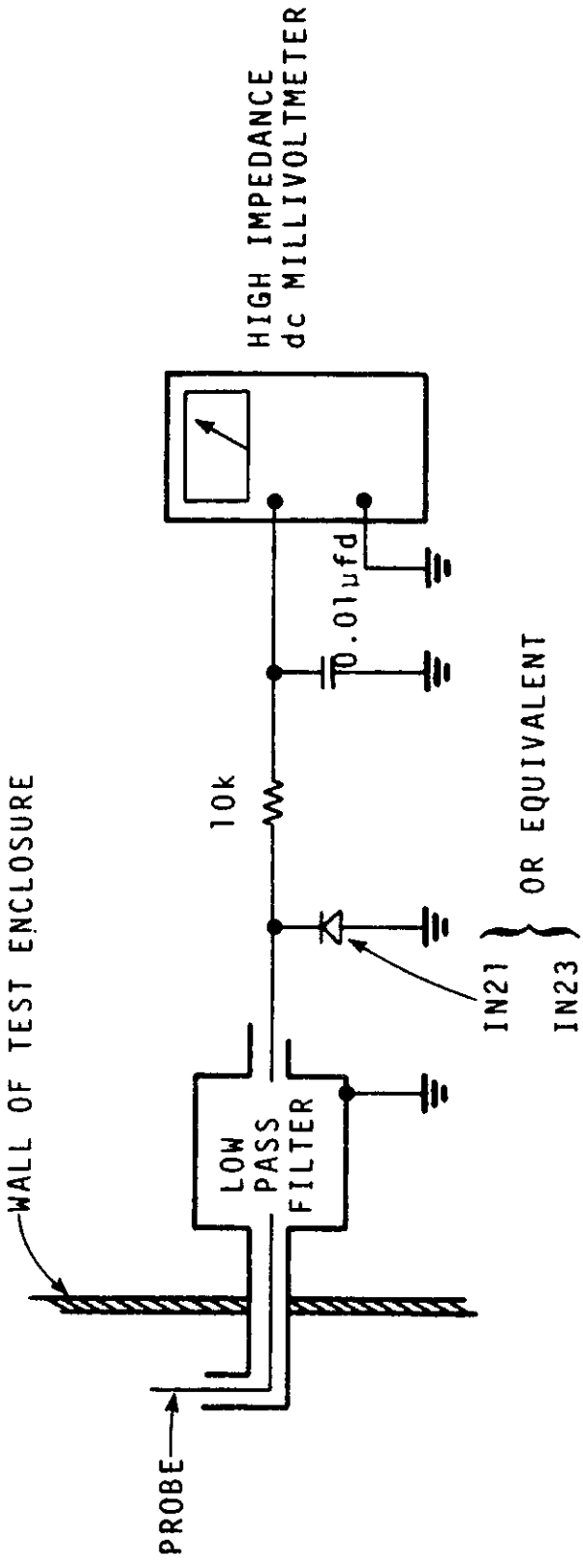

Figure 1. Detection circuit diagram for measurement technique.

FIGURE 2. DIAGRAM OF MEASUREMENT SETUP

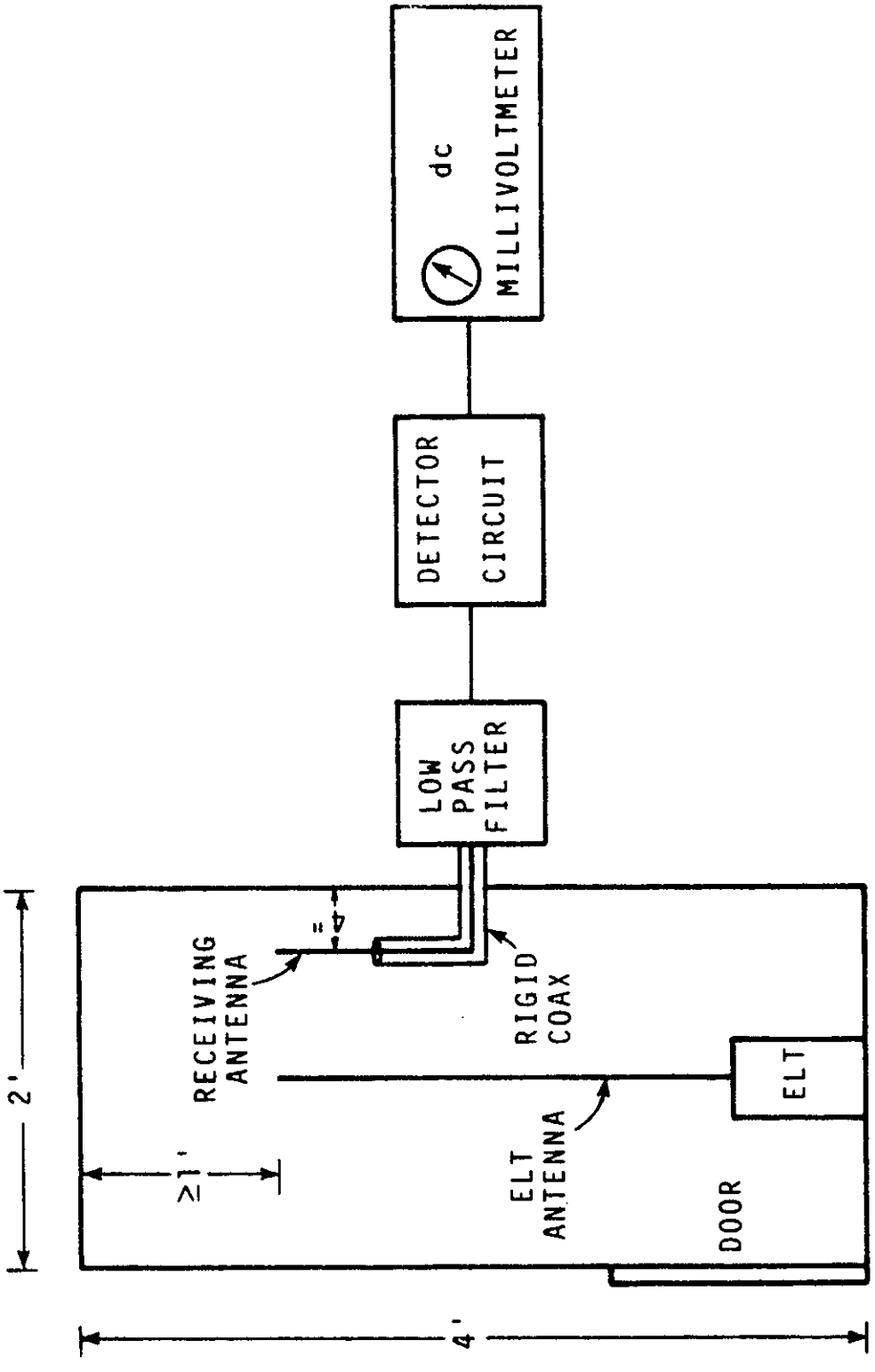

Figure 2. Diagram of measurement setup.

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For example, if the fifty percent useful life of your batteries is one year, and these batteries are dated the 15th of June 1971, the replacement date that you mark on the transmitter would be June 15, 1972. Water activated batteries are exempt from this marking requirement. In the case of rechargeable batteries this would be the new date for recharging.

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The low-pass filter is used to filter out all undesirable signals above 121.5 MHz, especially the 243.0 MHz signals, which should be attenuated 40 decibels or more. The low-pass filter is attached directly to the panel connectors on the test enclosure.

The rf to DC conversion circuit is connected on the output side of the low-pass filter. Details of this circuit are shown in Figure 1. This circuit need not be shielded.

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(5) Measurement Procedure. Allow proper equipment warm-up, place the standard ELT in the test enclosure in an operating condition (See Figure 2), and record the reading on the millivoltmeter. Remove the standard ELT from the test enclosure and replace it with the ELT to be tested. Record the peak output indicated on the millivoltmeter and then repeat the above procedure to establish the repeatability of the measurement system.

(6) Precautions. The positioning of the ELTs within the test enclosure is critical; therefore, extreme care must be exercised during these steps. The relative positions of all components in the test set-up must remain fixed throughout the test for reliable results.

(7) Analysis of results. This method utilizes the comparison technique which has the advantage of making the results readily available. By calibrating the millivoltmeter in decibels the output of an ELT under test can be directly compared to the known output of a standard ELT.

(8) The output of the millivoltmeter can be converted to decibels by the expression:

$$\text{decibels} = 20 \log_{10} \frac{V_0}{V_1}$$

Where V_0 = the peak voltmeter reading from the standard ELT, and
V_1 = the peak voltmeter reading from the ELT under test.

The face of the voltmeter can also be marked in decibels for direct decibel readings.

Because a diode is used in the detection circuit, and this device may not be linear, it is advisable to calibrate the diode in decibels using a signal generator to achieve maximum accuracy. For small changes in output the calibration may not be necessary.

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Acting Director, Flight Standards Service

FIGURE 1. DETECTION CIRCUIT DIAGRAM FOR MEASUREMENT TECHNIQUE

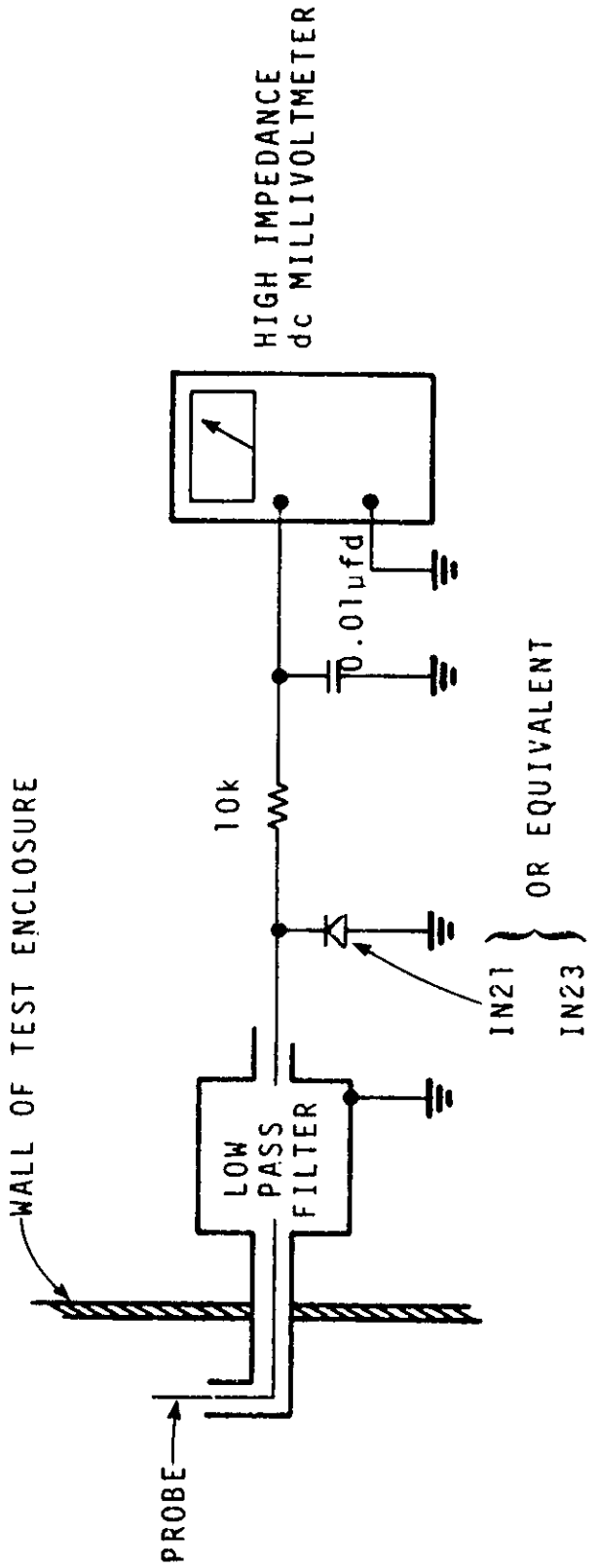

Figure 1. Detection circuit diagram for measurement technique.

FIGURE 2. DIAGRAM OF MEASUREMENT SETUP

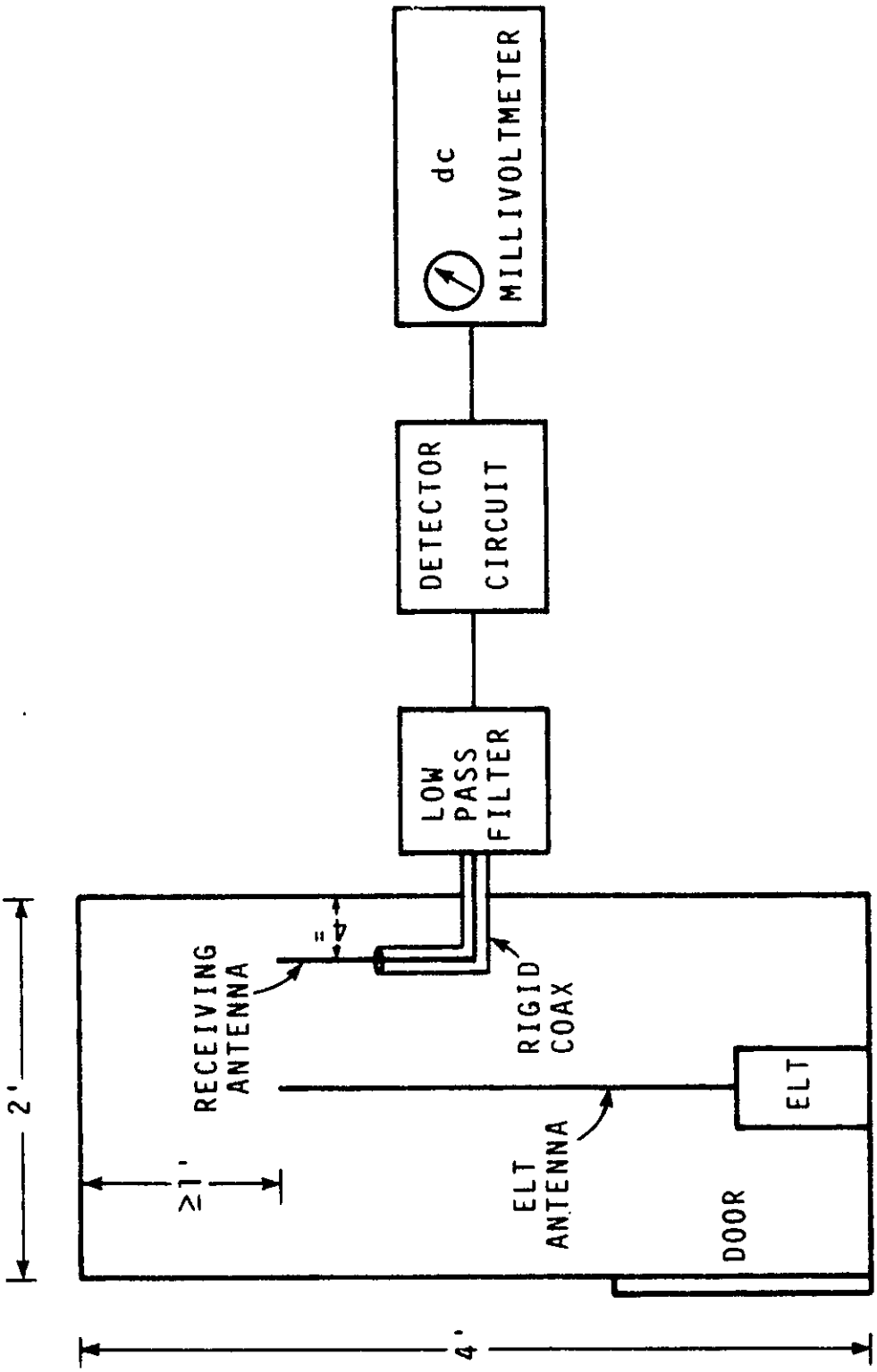

Figure 2. Diagram of measurement setup.

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