



# Advisory Circular

## AC91-5

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### Operation of portable electronic devices (PED) during flight under IFR

Initial Issue

01 July 2002

#### **GENERAL**

Civil Aviation Authority Advisory Circulars (AC) contain information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

#### **PURPOSE**

This Advisory Circular provides methods, acceptable to the Director, for showing compliance with the operation of portable electronic device requirements of Part 91 and explanatory material to assist in showing compliance.

#### **RELATED CAR**

This AC relates specifically to Civil Aviation Rule 91.7 Portable electronic devices.

#### **CHANGE NOTICE**

There was no previous issue of this AC, consequently no change is in effect.

# INTRODUCTION

1. The problems associated with the use of portable electronic devices by passengers has been a growing concern for the airline industry for a number of years. Portable electronic devices (PED) are not designed to the same stringent standards as aircraft avionics systems. As a result, a number of devices transmit electronic signals, either intentionally or unintentionally. These transmitted signals can affect aircraft navigation, communication and flight control systems. Incidents reported overseas have included minor deviations in navigation instruments, difficulties in communication, disconnection of auto-pilot and auto-throttle systems, through to un-commanded inputs to the auto-pilot resulting in a sometimes rapid, unintentional climb and/or turn of the aircraft.
2. There is evidence to show that certain types of devices generate Electro-Magnetic Interference (EMI). Devices most likely to cause interference are intentional transmitters like cellular telephones and CB radios. These devices often transmit on a frequency that is similar to aircraft communication systems. There are other digital devices that are unintentional transmitters. These devices will radiate signals due to the use of a high-frequency clock oscillator; such devices include laptop computers, hand-held electronic games, video cameras and tape recorders. Other items like compact disc and CD-ROM devices generate interference due to the voltage pulses that result as the laser sensors read information from the disc. Due to the way the laser sensor operates, the pulses are of an extremely short duration with the resultant effect that the switched power is of a short duration and can be in the order of watt or so for a brief instant. This is sufficient energy to affect aircraft systems.
3. The exact way that portable electronic devices and the resulting EMI is able to affect aircraft systems has not been determined. There is sufficient evidence to confirm that they do, and this has resulted in extensive investigation to determine a solution. RTCA Special Committee 177 (a committee established in the United States to investigate the use of portable electronic devices on-board aircraft) has carried out research since the 1960s on the interference created by portable electronic devices. To date, the committee has not been able to conclusively determine the way that portable electronic devices affect aircraft systems. Two possible methods are the coupling of the PED-EMI through either the aircraft wiring (which is routed under the floor and through the roof and sides of the aircraft cabin), or out through the cabin windows and received by the aircraft antennas. Until a quantified explanation for the interference is provided, the development of a solution is difficult. It is also highly probable that such a solution will only be able to be embodied on new-build aircraft.
4. The Authority is required to provide the public with protection from the hazards associated with the use of portable electronic devices on-board aircraft. Until a technical solution is achieved, this is being achieved through the use of regulatory restrictions. Hopefully, the regulations can be replaced by tighter aircraft and equipment technical standards in the future, allowing the use of portable electronic devices through all phases of flight. The current Civil Aviation Rules prohibit the use of portable electronic devices during the most critical phases of flight under IFR and the pilot-in-command may prohibit their use at other times.
5. The Authority has placed passenger and aircraft safety ahead of the need to use items like laptops, CD players and electronic games by introducing rules to cover what is a potentially a hazardous situation. As more information is made available on the cause and solutions to interference by portable electronic devices the rules will be amended as required.

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## 1. Rule objective

**1.1** Civil Aviation Authorities of many States have received a number of reports on incidents resulting from interference on aircraft systems by PEDs. These reports indicate that PEDs may affect communication, navigation, auto-pilot, auto-throttle and air-conditioning systems. Some of the effects have resulted in large, and sometimes rapid, deviations of the aircraft from the intended flight path and there is no doubt that the indiscriminate use of PEDs could affect the safety of air navigation.

**1.2** The objective of the 91.7 requirements is to limit any possible interference to portions of IFR flight when systems are operating which will alert the flight crew to a possible PED-induced deviation which may result in the aircraft deviating from the intended flight path.

**1.3** The rule—

- (1) restricts the use of PEDs during an instrument approach or departure or during any other critical phase of flight; and
- (2) lists PEDs that may be used at any time; and
- (3) allows the use of other PEDs when the operator of the aircraft has determined that an individual PED will not interfere with the navigation or communication aircraft systems; and
- (4) prohibits the use of any PED that has the capability of intentional transmitting electromagnetic energy—  
during flights under IFR

## 2. Abbreviations

**EMI** is electromagnetic interference:

**PED** is a portable electronic device:

**RTCA** is the Radio Technical Committee for Aeronautics:

## 3. Recommended procedures for the use of PEDs

If you allow the use of PEDs onboard your aircraft, you must establish procedures to control and limit their use during flight under IFR. The procedures should establish at least the following—

- (1) the method(s) to inform passengers, as required under 91.211(a)(7) of—
  - (i) the restriction on the operation of any PED during an instrument approach or departure procedure; and
  - (ii) permissible times, conditions, and limitations when specific PEDs may be used; and
- (2) the procedures for inter-operation between flight crew, and for the co-ordination between the flight crew and flight attendants for monitoring of possible PED interference; and
- (3) the procedures to terminate the operation of a PED suspected of causing interference with an aircraft system; and
- (4) the procedure(s) for reporting instances of suspected and confirmed interference by a PED as required under Part 12; and
- (5) the procedures for determining the suitability of PEDs to be operated on-board the aircraft in accordance with 91.7(d) (refer Section 3).

## **4. Recommended procedure for determining the suitability of PEDs for use on aircraft**

**4.1** RTCA Document No. RTCA/DO-233, Appendix A, details an acceptable EMI test procedure for PEDs used on-board aircraft. The procedure is reproduced at Appendix A to this Advisory Circular.

**4.2** PED emissions must be within the limits specified in RTCA Document No RTC/DO-160C, Section 21, Emission of Radio Frequency Energy. The relevant extracts from Section 21 have been reproduced at Appendix B. The three categories identified in Figures 21-6 and 21-7 are:

- (1) Category Z – Equipment intended primarily for operation in systems where interference-free operation is required.
- (2) Category A – Equipment intended primarily for operation in systems where interference-free operation is desirable.
- (3) Category B – Equipment intended primarily for operation in systems where interference should be controlled to a tolerable level.

**4.3** You should ensure that PEDs used on your aircraft have been found acceptable in accordance with Appendix A, or equivalent, procedure and meet the specifications of Appendix B. The test may be carried out by an organisation acceptable to you. Each PED should be approved by part or model number and serial number.

## **APPENDIX A – EMI test procedure for PEDs to be used on aircraft (RTCA Document No. RTCA/DO-233, Appendix A)**

### **1.0 Purpose**

The purpose of this specification is to measure the electromagnetic energy being radiated by a portable electronic device (PED).

### **1.1 Test Rationale**

This test method differs slightly from that specified in Section 21.4 of DO-160C due to the nature and size of portable electronic devices (PEDs) and because they are not designed for permanent installation on aircraft. For these reasons, the table-top ground plane specified in Section 21 of DO-160C has been replaced with a non-conducting table. In addition, the height of the table has been reduced to 80 cm because the height is more representative of the height at which PEDs are used on aircraft (lap or seat-back table) and also because this height already is called up in IEC, CISPR and FCC test-set configurations for information-technology equipment and digital devices.

Since PEDs are self-powered devices, methods for conducted-emissions testing have not been included in this document. However, it is anticipated that data-communications services will be available in the near future and, consequently, such lines and applicable simulators/terminators are to be included in the radiated-test set-up.

### **1.2 Requirements**

#### **1.2.1 General**

General requirements related to test methods, test facilities, and equipment are as stated below. Any exceptions or deviations from these general test requirements shall be documented in the test report.

#### **1.2.2 Measurement Tolerances**

Unless otherwise stated for a particular measurement, the tolerances shall be as follows:

- A. Distance  $\pm 5\%$
- B. Frequency  $\pm 2\%$
- C. Amplitude, Measurement Receiver:  $\pm 2\text{ dB}$
- D. Amplitude, Measurement System (includes measurement receivers, transducers, cables, etc):  
 $\pm 3\text{ dB}$

### **1.3 Bandwidth And Scan Time**

All testing will be performed using the bandwidth and scan times listed below.

#### **1.3.1 Measuring-Equipment Bandwidths**

Measuring-equipment bandwidths must be chosen so that ambient levels are 6dB below emission limits. (These limits to be chosen based on the findings of the RTCA SC-177 In-Aircraft Test Group.)

Table 1-1 is a list of suggested bandwidths.

**Table 1-1. Bandwidth And Measurement Time**

Frequency Range	6 dB Bandwidth	Dwell Time	Minimum Measurement Time
10 kHz - 250 kHz	1 kHz	0.015 sec	0.015 sec/kHz
250 kHz - 30 MHz	10 kHz	0.015 sec	1.50 sec/MHz
30 MHz - 1 GHz	100 kHz	0.015 sec	0.15 sec/MHz
Above 1 GHz	1 MHz	0.015 sec	15.00 sec/GHz

#### **1.4 Emission Identification**

All emissions, regardless of characteristics, shall be measured with the measurement receiver bandwidths specified above in Table 1-1. A peak detector shall be used and only narrow band emissions need to be recorded.

#### **1.5 Frequency Scanning**

For emission measurements, the entire frequency range for each applicable test shall be scanned. Minimum measurement time for analog-measurement receivers during emission testing shall be as specified in Table 1-1. Synthesised-measurement receivers shall step in one-half bandwidth increments or less and the measurement dwell-time shall be as specified in Table 1-1.

#### **1.6 Emission-Data Presentation**

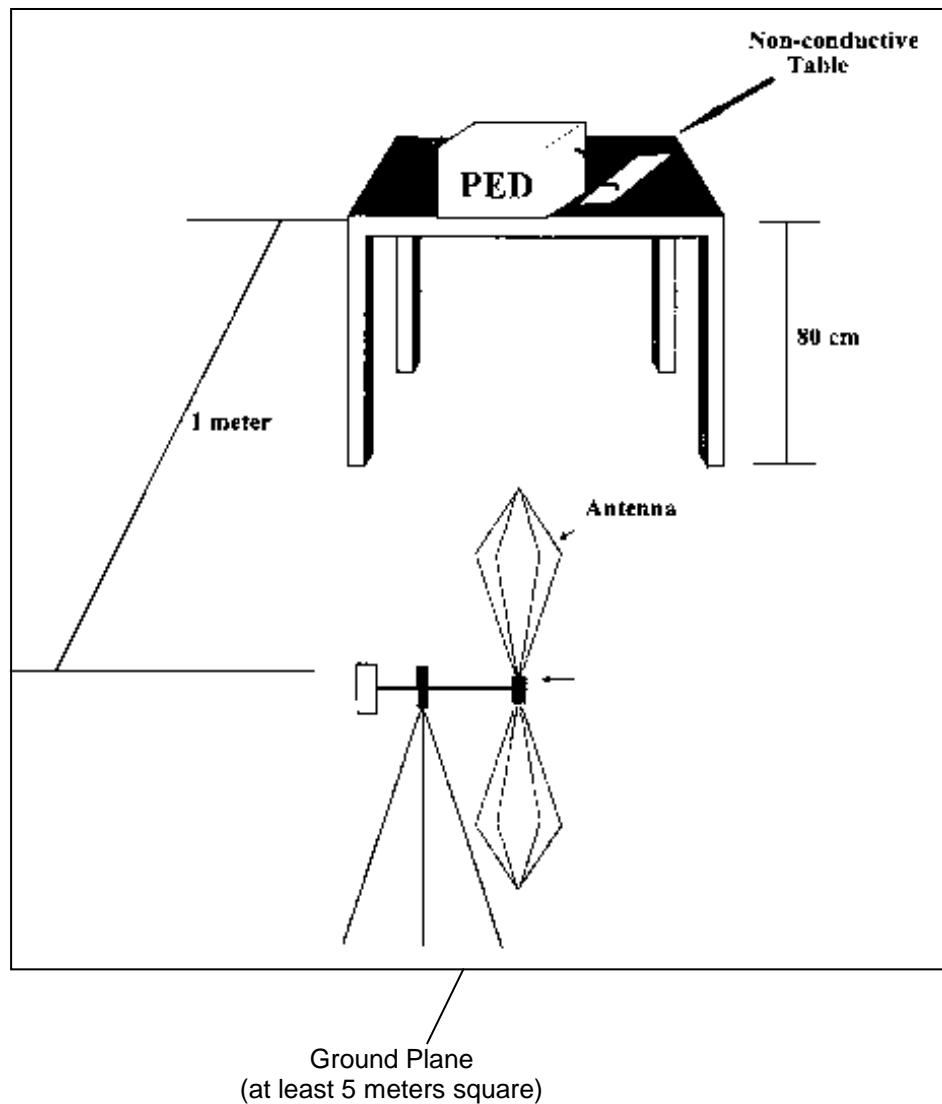
Amplitude versus frequency profiles of emission data shall be automatically and continuously plotted. The applicable limit shall be displayed on the plot. Manually gathered data is acceptable. The plotted data for emission measurement shall provide a minimum frequency resolution of 1.0% or twice the measurement-receiver bandwidth, whichever is less stringent, and minimum-amplitude resolution of 1.0 dB. The above resolution requirements shall be maintained in the reported results of the test report.

#### **1.7 PED Operating Conditions**

The PED shall be operated in the mode most representative of its uses as a carry-on item aboard aircraft. This mode shall be documented. This does not necessarily imply that all external ports must be active or connected, since PEDs often are designed to interface with a variety of peripheral devices that are not designed for use on aircraft. However, the PED shall not be operated in a standby mode.

The PED shall be powered by its own internal source to simulate actual user operation. AC power adapters shall not be included in the test set up since there are no connections which can be made to the aircraft at this time.

Typical PED accessories (for example, headphones, mouse, supplementary battery packs) shall be connected during testing. The cables of such accessories shall be positioned so that they are on a line parallel with the face of the PED and 1.0 meter from the test antenna.



**Figure A-1**

### **1.8 Purpose Of Test**

The purpose of this test is to measure the electric-field energy being generated by a PED.

### **1.9 Test Configuration**

The equipment will be set up as shown in Figure A-1. Equipment shall be set up on a non-conducting table and operated in accordance with the normal operating procedure that is called out in the unit's user manual. The PED shall be oriented to produce the worst-case emissions. Any connections to the aircraft shall be simulated. The EMI receiver/analyser shall be tuned over the frequency range from 10 kHz to 6 GHz with the bandwidths as contained in paragraph 1.5 of this document.

*A shielded enclosure most likely will be required to meet ambient test requirements across the test-frequency range. However, an open-field test site or other site with reference ground plane is not excluded.*

If a shielded enclosure is used, the PED, as well as all measurements antennas, must be positioned at least 1.0 m from any wall. (This does not include the spacing from the reference ground plane.)

The antenna shall be positioned such that its phase centre is 1.0m in front of the face of the PED under test. The axis of a directional antenna shall be at the same height as the centre of the PED under test.



**1.10 Test Method**

Narrowband radiated emissions only shall be measured across the frequency range from 10 kHz to 6 GHz, as described above.

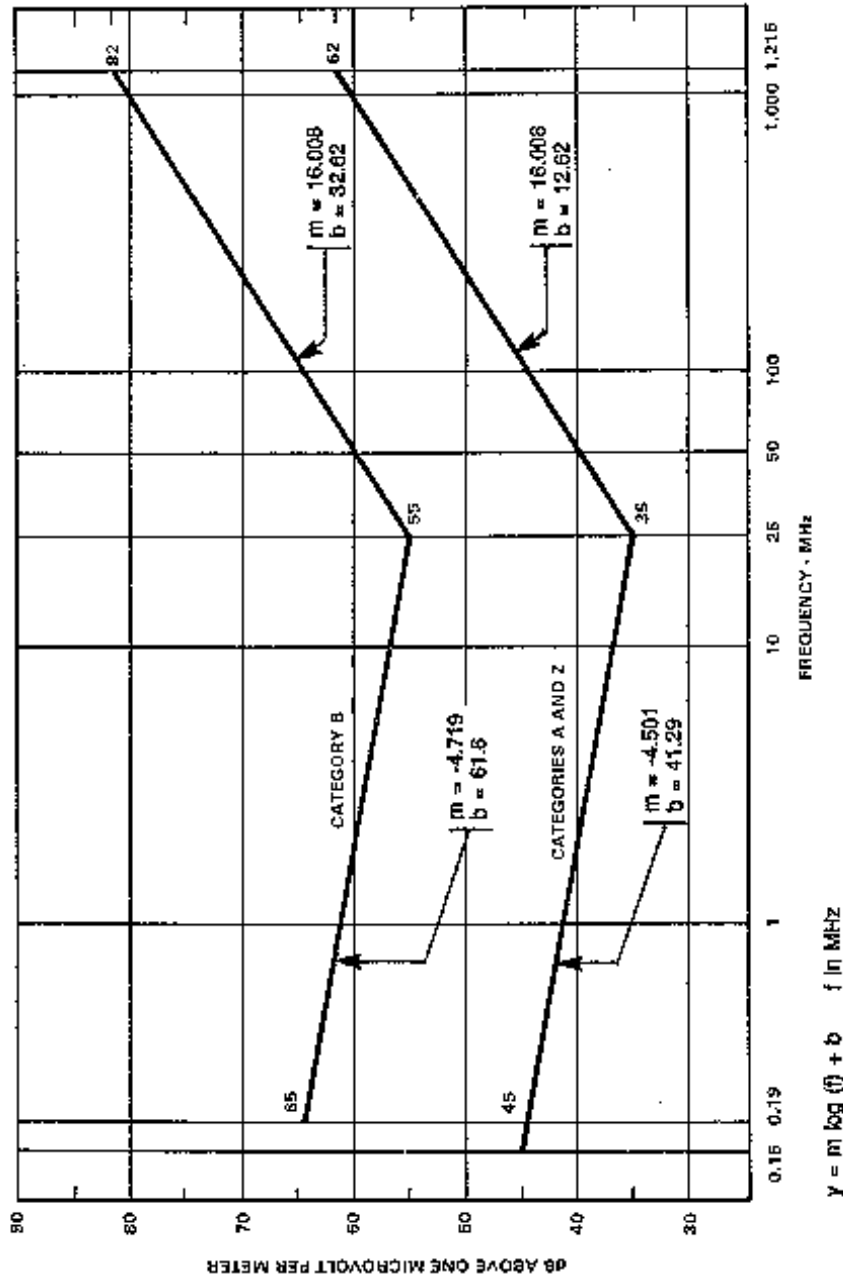
All measurements shall be made using a peak detector.

From 10 kHz to 30 MHz a non-directional vertical rod antenna should be used. The rod antenna is positioned such that its centre corresponds to the height of the centre of the PED.

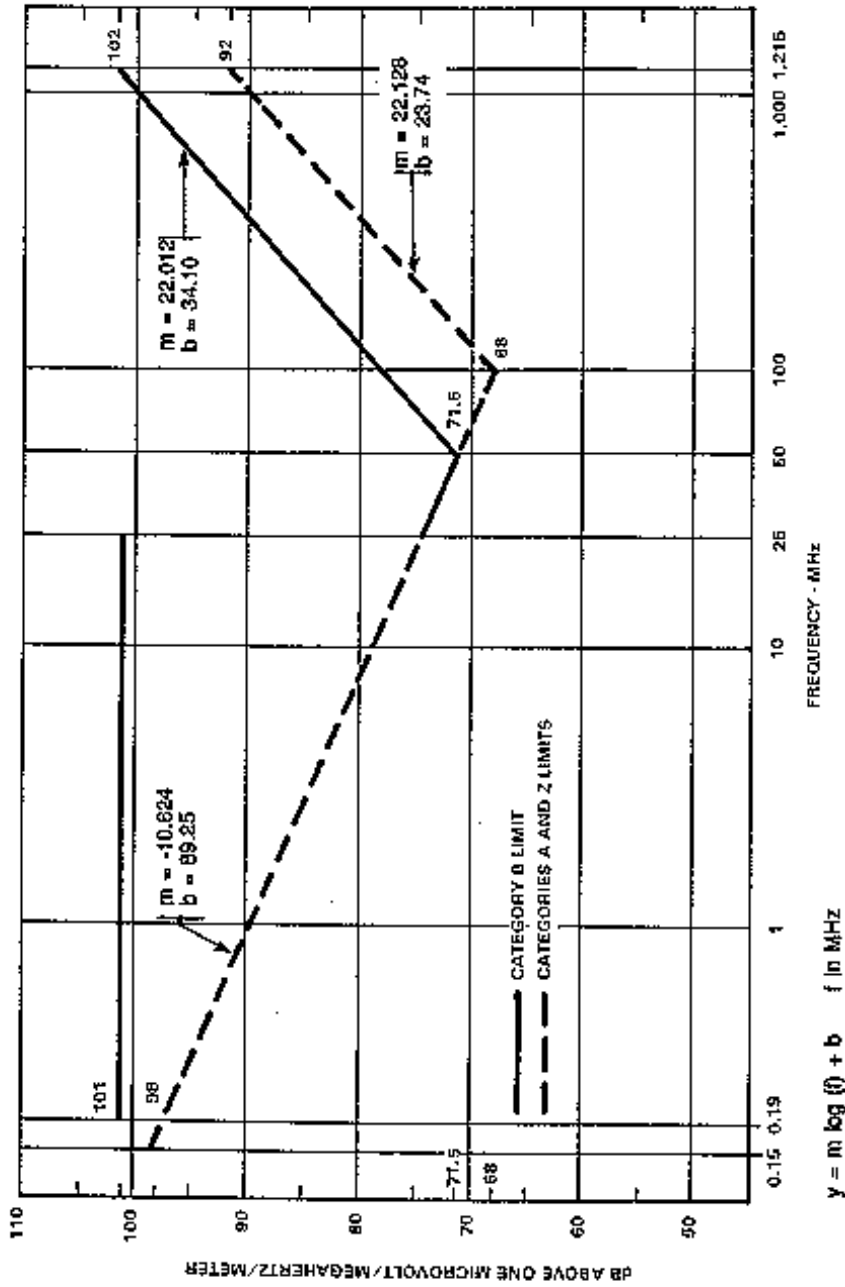
From 30 MHz to 6 GHz, directional antennas are used. Measurements shall be made using both horizontal and vertical polarisations and the higher of the two values shall be recorded.

If sweep-frequency measuring equipment is used, care must be taken to ensure that the sweep rate is slow enough to record the highest value of PED emissions at each frequency being measured.

**APPENDIX B - Emission of Radio Frequency Energy : Maximum Levels  
(Extract from RTCA DO-160C, Section 21)**



**FIGURE 21-6 MAXIMUM LEVEL OF RADIATED CW INTERFERENCE FROM ANY ONE EQUIPMENT**



**FIGURE 21-7**  
**MAXIMUM LEVEL OF RADIATED BROADBAND AND PULSED CW FROM ANY ONE EQUIPMENT**