

# Advisory Circular

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## USE OF PORTABLE ELECTRONIC DEVICES ONBOARD AIRCRAFT

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### GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 3C of the Air Navigation Act (Cap. 6) (ANA), to demonstrate compliance with a statutory requirement. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

### PURPOSE

This AC provides guidance to demonstrate compliance with, and information related to, requirements relating to the use of portable electronic devices on board an aircraft.

### APPLICABILITY

This AC is applicable to the AOC holder operating in accordance with ANR-121.

### RELATED REGULATIONS

This AC relates specifically to Regulation 10, 11, 12 and 13 of ANR-121.

### RELATED ADVISORY CIRCULARS

- AC 121-2-7 Management of Lithium Batteries in the Aircraft Passenger Cabin
- AC DGR-2 Guidance for Carriage of Lithium Batteries by Air

### CANCELLATION

This AC supersedes AC AOC-7.

### EFFECTIVE DATE

This AC is effective from 1 October 2018.

**OTHER REFERENCES**

- PED ARC Report
- FAA Notice – N8900.240
- FAA InFO 13010 and InFO 13010Sup
- ICAO Technical Instructions for the Transport of Dangerous Goods by Air (ICAO TI)
- RTCA DO-307
- RTCA DO-160
- RTCA DOC 294C
- EUROCAE ED-130
- EASA Safety Information Bulletin – EASA SIB No. 2013-21
- UK-CAA Information Notice –Number: IN-2014/022

## **1 BACKGROUND**

1.1 PEDs could potentially cause electromagnetic (EM) interference to installed aircraft systems, including communications and navigation equipment, thus could pose a safety risk to aircraft operation. PEDs can be classified into two main categories: unintentionally transmitting PEDs and intentionally transmitting PEDs (T-PEDs).

### **(a) Unintentionally Transmitting PEDs**

- (i) Unintentionally transmitting PEDs do not intentionally transmit Radio Frequency (RF) signals. However, by virtue of their electrical operation, spurious RF radiation will be unintentionally emitted and these could cause EM interference in the operational band of aircraft radio receivers by distorting low level desired signals or create erroneous signals received by them.
- (ii) These PEDs may include but not limited to, computing equipment, cameras, radio receivers, electronic games and toys and medical portable electronic devices (such as automated external defibrillators (AEDs) and portable oxygen concentrators).

Note: Due to the proliferation of wireless technologies in consumer products, PEDs that were conventionally not wireless enabled were increasingly embedded with such capabilities. For the purpose of this AC, unintentionally transmitting PEDs refers to PEDs with no embedded wireless function, or with their wireless function positively deactivated.

### **(b) Intentionally Transmitting PEDs (T-PEDs)**

- (i) Intentionally transmitting PEDs transmit RF signals to accomplish their intended functions. For such PEDs, the primary concern is that the radiated RF energy could induce direct EM interference into aircraft equipment, wiring and components, and compromise safe operation of flight.
- (ii) T-PEDs may include but not limited to cellphones, satellite phones, wireless enabled devices (such as laptops and tablets), remote control equipment and two-way radios.

## **2 USE OF PEDS FOR DIFFERENT FLIGHT PHASES.**

2.1 The permitted use of PEDs onboard an aircraft during the different phases of flight is depicted in Table 1.

Table 1: Permitted use of PEDs on board an aircraft during the different phases of flight

Types of PEDs	Use of PEDs			
	Critical Phases of Flight	Non-Critical Phase of Flight	Critical Phases of Flight	Non-Critical Phase of Flight
	From taxi-out to 10,000ft	Above 10,000ft	From 10,000ft to landing	After aircraft has exited runway



<b>Unintentionally T-PEDs</b>				
<b>T-PEDs with its transmitting functions disabled (i.e. "airplane" mode)</b>	Permitted if granted an approval by CAAS <sup>1</sup>	Permitted	Permitted if granted an approval by CAAS <sup>1</sup>	Permitted
<b>T-PEDs with its transmitting functions in active mode</b>	Permitted if granted an approval by CAAS <sup>2</sup>			Permitted
<b>Voice communications using T-PEDs</b>	Prohibited			Permitted
<b>Unintentionally transmitting, with low level of emission</b>	Permitted <sup>3</sup>			
<b>Medical PEDs approved for use in an aircraft</b>	Permitted <sup>4</sup>			

**Footnote:**

- <sup>1</sup> The procedures to control the use of PED on board the aircraft must be approved. Particularly for low visibility operations, PEDs should be switched off unless aircraft systems have been shown to be tolerant of "front door" interference effects as per RTCA DO-307 or EUROCAE ED-130 and an approval has been granted. See paragraph 2.2.
- <sup>2</sup> See paragraph 2.3 & 2.4 for details.
- <sup>3</sup> This refers to PEDs with low power consumption, such as heart pacemakers, hearing aids and digital watches.
- <sup>4</sup> See paragraph 2.5.

**2.2 Unintentionally Transmitting PEDs and intentionally transmitting PEDs with transmitting function switched off.**

- (a) Spurious emission from PEDs as received by the aircraft antenna could potentially lead to misleading information and compromise the operation of navigation instruments such as the localizer and glide slope systems, used during low visibility operations. Hence, the use of such PEDs when the aircraft is flying at or less than 10,000ft in altitude is only permitted if an approval has been granted by the CAAS. To obtain the CAAS approval, the AOC holder must

submit a safety risk assessment and implement operational procedures to control the use of these PEDs. Guidance on the safety risk assessment and procedures are detailed in paragraph 3.

- (b) The procedures should ensure the PEDs used are either unintentionally transmitting or have their transmitting functions switched off. Unless otherwise stated in the approval granted by the CAAS, the procedures should prohibit the use of PEDs during low visibility operations.
- (c) For an approval that permits the use of PEDs during low visibility operations, the AOC holder will have to demonstrate that the aircraft systems are tolerant of “front door” interference effects in accordance with:
  - (i) RTCA DO-307 “Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance”; or
  - (ii) EUROCAE ED-130 “Guidance for the Use of Portable Electronic Devices (PEDS) On Board Aircraft”.

Note: “Front door” interference refers to coupling mechanism that occurs in the operational band of the avionics receivers. The spurious emissions from PEDs can potentially distort low level desired signals or create erroneous signals received by the aircraft radio receiver antennas.

### 2.3 Intentionally Transmitting PEDs (T-PEDs) with transmission functions in the active mode

- (a) Intentional RF emissions from T-PEDs have the potential to interfere with aircraft electrical and electronic systems by means of coupling to cables or directly into the aircraft system equipment. Unless approved by the CAAS, the use of T-PEDs with transmissions in the active mode is prohibited on board an aircraft. The AOC holder shall implement operational procedures to require passengers to switch off the T-PED, or disable its transmitting functions (i.e. put to “flight” or “airplane” mode), from the start of the flight when all passengers have boarded and all doors have been closed until the aircraft has exited the runway.
- (b) The use of T-PEDs with transmission functions in active mode may be permitted under the scenarios identified in Table 2. To obtain the approval from CAAS, the AOC holder must submit a safety risk assessment and implement operational procedures to control the use of these PEDs. Guidance on the safety risk assessment and procedures are detailed in paragraph 11.

Table 2 – Various scenarios where the use of T-PED may be permitted

No	Scenarios	T-PEDs with transmitting functions active
1	Aircraft certified as T-PED tolerant from factory	All phases of flight, if granted an approval
2	Aircraft had successfully passed “front door” and “back door” coupling tests	All phases of flight, if granted an approval
3	Aircraft had successfully passed “front door” coupling test only	Permitted only when aircraft has exited the runway after landing.
4	Aircraft had successfully passed “back door” coupling test only	All phases of flight, except for low visibility, if granted an approval
5	No EMI assessment performed	Permitted only when aircraft has exited the runway after landing.

Note:

- (1) *T-PEDs with their transmitting function (i.e. “airplane” or “flight” mode) and wireless capability (i.e. Wi-Fi function) positively deactivated will be considered as unintentionally transmitting PEDs.*
  - (2) *“Back door” interference refers to interference from intentional RF emissions from T-PEDs with aircraft electrical and electronic systems by the emitted signal coupling to cables or directly into the aircraft system equipment.*
- (c) To demonstrate that the aircraft systems are tolerant against “front door” interference, the AOC holder will need to conduct “front door” coupling test in accordance with the following and submit the corresponding data:
- (i) RTCA DO-307 “Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance”; or
  - (ii) EUROCAE ED-130 “Guidance for the Use of Portable Electronic Devices (PEDS) On Board Aircraft”.
- (d) To demonstrate that the aircraft systems are tolerant against “back door” interference, the AOC holder will need to conduct “back door” coupling test in accordance with the following and submit the corresponding data:
- (i) RTCA DO-307 “Aircraft Design and Certification for Portable Electronic Device (PED) Tolerance”; or
  - (ii) EUROCAE ED-130 “Guidance for the Use of Portable Electronic Devices (PEDS) On Board Aircraft”; or
  - (iii) RTCA DO-294C “Guidance on allowing transmitting portable, electronic devices (T-PEDs) on aircraft”
- (e) For aircraft that had been certified as T-PED tolerant from factory, the AOC holder will need to submit relevant documents stating that the “front door” and “back door” coupling tests have been satisfactory.

#### 2.4 Aircraft equipped with on board wireless systems

- (a) Some aircraft may be equipped with on board wireless system that allows the passengers T-PEDs to connect to the internet or on board in-flight entertainment system. AOC holders intending to equip their aircraft with such

systems must obtain an approval from the CAAS for the installation. The installation approval granted by the CAAS for the onboard wireless system normally involves safety assessment, functional tests, EM compatibility tests and EM interference tests. It is recommended that an appropriate CAAS DOA holder or equivalent be engaged to apply for the certification approval for the installation of onboard wireless system.

(b) The technical demonstration to determine the acceptable use of T-PEDs should be performed in accordance with the applicable processes set forth as below:

(i) Aircraft with Demonstrated PED Tolerance

- (1) The applicant should provide data that shows the aircraft has demonstrated PED tolerance using RTCA DO-307, RTCA DO-294C or EUROCAE ED-130.
- (2) The applicant should use laboratory EMC tests in accordance with RTCA DO-160, to qualify the on board wireless system equipment.
- (3) Standard Aircraft EMC Ground or Flight Tests should be performed with the on board wireless system equipment transmitting to and receiving from T-PEDs. The T-PEDs should be operated in all areas of the aircraft that passengers or crewmembers can occupy, and the number of T-PEDs selected should cause the system to operate at high capacity.

(ii) Aircraft without Demonstrated PED Tolerance

- (1) Standard aircraft EMC ground tests or flight tests should be performed. Appropriate pass/fail criteria for these aircraft EMC tests should be defined by the applicant in the respective test plan.
- (2) In addition to the aircraft EMC ground or flight tests, the applicant should perform aircraft RF susceptibility demonstrations. Aircraft RF susceptibility demonstrations should expose the aircraft electrical and electronic systems to RF fields that represent the fields from the T-PEDs that communicate with the on board wireless system. These demonstrations must show acceptable performance for all aircraft systems that perform functions that are required by regulation or that have major, hazardous and/or catastrophic failure conditions. The RF susceptibility tests should be performed using a transmitter and antenna operating at the maximum effective isotropic radiated power (EIRP) authorized by IDA where the aircraft is intended for use. The following standards provide acceptable guidance on performing the RF susceptibility demonstrations.

- RTCA DO-294C "Guidance on Allowing Transmitting Portable Electronic Devices (T-PEDs) on Aircraft"

- EUROCAE ED-130 “Guidance for the Use of Portable Electronic Devices (PEDS) On Board Aircraft”
- (3) The EIRP should be increased by a multiple equipment factor for systems where the EIRP seen at the aircraft systems increases when multiple T-PEDs can transmit simultaneously. The multiple equipment factor should be determined assuming that the number of T-PEDs is equal to the number of passenger and crew member seats in the aircraft, unless a different number is justified by the applicant.
  - (4) A transmitter emulator and antenna may be used to generate the RF fields. The emulator should operate using modulations similar to the authorized modulations for the T-PEDs intended for communication with the on board wireless system. The T-PEDs or emulator antenna should be positioned to expose electrical and electronic equipment in all locations of the aircraft that passengers or crew members can occupy.
- (c) This assessment must confirm that there is no interference to aircraft equipment as a result of both “back door” interference effects caused by intentional transmission as well as “front door” interference effects caused by spurious transmission from the T-PEDs.
  - (d) There may be aircraft equipped with on board wireless systems that are installed in the factory. These systems will also need to meet the requirements as stated in paragraphs 2.4(b) and (c). To obtain an approval by CAAS to permit the use of T-PEDs in conjunction with these systems, the AOC holder must submit a safety risk assessment and implement operational procedures to control the use of these PEDs. Guidance on the safety risk assessment and procedures are detailed in paragraph 3.

## 2.5 Medical PEDs

- (a) Medical portable electronic devices refer to PEDs such as automated external defibrillators (AEDs), portable oxygen concentrators and airborne patient medical telemonitoring equipment.
- (b) The use of medical PEDs may be permitted for all phases of flight, including low visibility operations, if they are designed and tested in accordance with RTCA DO-160, current edition.
- (c) Laboratory RF emission test should be performed using procedures detailed in RTCA DO-160 “Environment Conditions and Test Procedures for Airborne Equipment”. Section 21, Category ‘M’ of the RTCA document should be used to test and establish the RF emission limits. The RF emissions should be measured in all modes of operation.
- (d) Medical PEDs that have been tested and found to be within the RF emission limits may be used on board the aircraft without further testing by the AOC holder.



### 3 OPERATIONAL POLICY AND PROCEDURES.

- 3.1 The safety risk assessment should address the changes and possible hazards, and identify the mitigating measures regarding the implementing expanded usage of PED. The operational policy and procedures for crew training and cabin safety management should be correspondingly updated in the operations manuals, checklists, training programmes, associated documents and relevant safety materials such as safety briefing cards whose revision must be submitted for the approval or acceptance by the CAAS prior to use.
- 3.2 Updates, to the abovementioned operations documents, relating to the expanded use of PED should include:
- (a) normal, non-normal and emergency procedures for all crew;
  - (b) cabin management procedures to include, but not limited to the following:
    - (i) providing passengers information of the permissible times, conditions and limitations when various PEDs may be used. This may be through:
      - (1) pre-flight safety briefings and in any other ad hoc safety briefings; and
      - (2) supplementary information on expanded use of PED policy prior to flight and in flight.
    - (ii) ensuring passengers remained seated with their seat belt fastened during taxi, take-off and landing.
    - (iii) ensuring passengers are aware that voice communication using PEDs is only permitted after the aircraft has landed and exited the runway.
    - (iv) ensuring the proper stowing and securing of PED items, including the identification of phases of flight during which PEDs are to be stowed and the determination of suitable stowage locations taking into account and the following general concerns should be addressed:
      - (1) Device size and weight - large PEDs such as full-size laptops must be safely stowed so as to prevent them from becoming projectiles in an emergency. Small PEDs may be used as long as they are secured during take-off and landing,
      - (2) PED cords and accessories must not impede emergency egress.
    - (v) Locating and terminating the operation of any PED suspected of causing interference to aircraft systems.
    - (vi) Coordination between flight crew and cabin crew on how to recognize and deal with suspected interference from PEDs.

- 3.3 The AOC holder should demonstrate that all crew are adequately briefed and trained on the policy, procedures and crew responsibilities in regard to permitting the expanded use of PEDs. The training should include, but is not limited to cabin management of PEDs and the provision of a list of PEDs that can/cannot be used on board, permissible times of use, when voice communication is permitted, etc.
- 3.4 The AOC holder will need to report to CAAS any events or anomalies associated with the use of PED. Reportable items include but are not limited to suspected or confirmed electromagnetic interference, and malfunctions in PED unit that results in smoke emitted or fire. The report should include such as the time of event, effect on aircraft, aircraft location and the phase of flight that the event occurred, the suspected PED Make, Model, location, actions taken, and effect of action taken.

#### **4 BATTERY SAFETY.**

##### **4.1 Passenger PEDs**

- (a) Batteries installed in PEDs pose a fire hazard and safety concerns include the possibility of explosion caused by failures of the batteries.
- (b) The AOC holder should refer to the ICAO TI for the carriage requirements of PEDs installed with batteries.
- (c) The AOC holder should also refer to the following ACs for guidance on managing and handling PEDs with such batteries.
- AC 121-2-7 Management of Lithium Batteries in the Aircraft Passenger Cabin
  - AC DGR-2 Guidance for Carriage of Lithium Batteries by Air

##### **4.2 PED provided by the AOC holder**

- (a) The AOC holder may provide PEDs to passenger for use as entertainment devices. The batteries contained in these devices pose a fire hazard and the potential large amount of PEDs that the AOC holder may carry on board for this purpose would result in an increased risk of a battery fire.
- (b) To mitigate the risk of a battery fire, the following procedures should be adhered to:
- (i) PEDs installed with lithium metal or lithium ion batteries
- (1) The PEDs should be safely stored in a manner to prevent consecutive thermal runaway. In proposing the storage of AOC holder provided PEDs for CAAS approval, the AOC holder should consider the conditions in which the PEDs will be stored and the size of the compartment. For example, PEDs should be separated and not stacked together, without any insulation between them.
- (2) The location selected to stow the AOC holder-provided PEDs must be certificated to hold the weight of the PEDs along with other contents intended to be stored at that location, (where applicable).

- (3) The containers, drawers and peripherals used to store multiple PEDs must be able to contain fire that is generated from PEDs.
  - (4) If the AOC holder-provided PEDs are protected with a sleeve or cover, the materials used for the fabrication of the sleeve or cover must be demonstrated to meet the flammability requirements (commonly known as 14 CFR 25.853 – Compartment interiors or CS 25.853 – Compartment Interiors).
  - (5) The lithium metal or lithium ion batteries installed in the PEDs must be of the type that meet the requirements of each test of the UN Manual of Test and Criteria, Part III, subsection 38.3 and manufactured under a quality management programme as described in the ICAO TI.
  - (6) The capacity of the main and spare lithium metal or lithium ion batteries of the PEDs must be within the watt-hour limitations permitted for passengers and crew as specified in the ICAO TI.
  - (7) Spare lithium metal or lithium ion batteries not installed in PEDs must be protected from external short circuit and stored in the cabin only.
- (ii) PEDs installed with other non-spillable batteries
- (1) PEDs containing batteries that meet the requirements of special provision A67 stipulated in ICAO TI may be permitted provided the battery must not have a voltage greater than 12 volts and a Watt-hour (Wh) rating of not greater than 100Wh.
  - (2) Spare batteries must be protected from external short circuit and stored in the cabin only.

**5 CONTACT PERSON AND INFORMATION.**

5.1 Should you have any queries relating to the above, please contact CAAS at [CAAS\\_AFO\\_Infocenter@caas.gov.sg](mailto:CAAS_AFO_Infocenter@caas.gov.sg).