

December 28, 1971

TO: Bill Anders

FROM: George Mansur

You are undoubtedly aware of the Moss Bill which has been introduced into the Congress concerning mandatory use of aviation collision avoidance systems. Because of spectrum allocation considerations, we have had several discussions with the DOD and the FAA concerning CAS plans; for your information, I am attaching our correspondence file.

Our activities may be briefly summarized as follows:

1. McDonnell-Douglas currently has an experimental frequency assignment under which their CAS system is operated. In May, McDonnell-Douglas petitioned the FCC for an operational frequency assignment; this request was forwarded to OTP for action.

2. Because of expected spectral interference between the McDonnell-Douglas CAS system and radar altimeters operating at L-Band, we commissioned a study to determine the quantitative effects. The study demonstrated that there is interference between some altimeters and the McDonnell-Douglas CAS system.

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3. The FAA and DOD have/asked for their views concerning:

a. FAA plans for selection and certification of a national system,

b. DOD plans for modifying or phasing out the radar altimeters.

4. The result is that the FAA has no immediate plans for certification of a national system, nor does the DOD have immediate plans for phasing out their radar altimeters. A joint working group of representatives for the DOD and the FAA has been established to review the collision avoidance situation.

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We are now drafting recommendations to the FCC concerning frequency assignments and related problems. Our tentative conclusion, based on FAA plans, is that a "developmental" frequency assignment should be made so that airlines may gain "operational experience on a voluntary basis", but without protection from altimeter radar interference.

**Attachment**

cc:

DO Records

DO Chron

Dr. Mansur

Mr. Whitehead

Capt Raish

Col Jiggetts

GF Mansur:slr 12/28/71



OFFICE OF THE SECRETARY OF DEFENSE  
WASHINGTON, D. C. 20301

DEC 27 1971

Dear Dr. Mansur:

Your letter of June 15, 1971 to the Acting Assistant to the Secretary of Defense (Telecommunications) referred to an application by McDonnell Douglas for assignment of the 1592.5-1622.5 MHz frequency band for its collision avoidance system, and inquired as to our plans for changing current defense radio altimetry which might interfere with collision avoidance equipment using that frequency band. We have been actively reviewing the collision avoidance situation with the FAA, as you know, and you have been informed about the technical and policy aspects of our investigations, but we want to respond specifically to your inquiry so that action may be completed on the McDonnell-Douglas petition. To assist you further, I am attaching a letter of September 14, 1971 from the Administrator of the FAA to the Secretary of Defense concerning the CAS situation, and my reply on December 7, 1971 to Mr. Shaffer.

With respect to your first question as to whether DOD has plans for phasing out DOD radio altimeter usage from the 1600-1625 MHz band, we do not have any such plans at this time. You will note that the Administrator states that the FAA support of the McDonnell-Douglas petition to FCC for voluntary use "deliberately does not carry with it a recommendation to remove military altimeters from the band by a specific date, nor does it imply that we are ready to develop a national standard for collision avoidance systems."

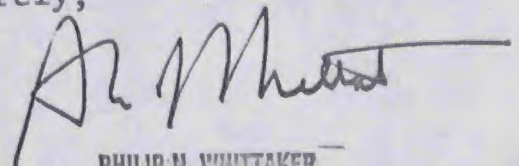
With the FAA not yet ready to adopt the McDonnell Douglas or any other system as a CAS standard, it would be premature for DOD to take action to replace some 4000 radio altimeters in DOD aircraft at public expense. We are not buying any new altimeters to operate in the 1600-1660 MHz frequency band; however, we expect to continue using existing altimeters in that frequency band until they go out of service unless some new development, like CAS, makes an earlier change necessary. We are actively investigating alternate means of alleviating the potential interference by retuning the frequency range of the altimeters, or by restricting their geographical use. If modification or replacement becomes necessary, DOD faces a major expenditure ranging from \$10 million for minimal accommodation to over \$60 million for complete replacement of the current inventory.

Your second question concerns DOD plans for installation of CAS equipment in DOD aircraft. The DOD does not have any plan to install the McDonnell Douglas CAS, or any other CAS, at this time, and DOD doesn't expect to make a decision on CAS installation until a national standard on collision avoidance has been adopted.

We share the concerns of national aviation interests that sound solutions be found to reduce the hazards of mid-air collision. The DOD has cooperated fully with the Federal Aviation Administration in implementing the Air Traffic Control Radar Beacon System (ATCRBS). The level of expenditure is approaching one billion dollars to permit every DOD aircraft and ground station to cooperate fully with this system. The attached letter from the FAA Administrator states that "It should be recognized that the primary responsibility for collision avoidance will rest with the FAA-operated ATC system and that CAS will function as a back up."

In order to resolve the collision avoidance issues addressed in this letter, and the FAA Administrator's letter to the Secretary of Defense, the FAA, NASA and the DOD have formed a technical group under FAA chairmanship. This group will formulate and recommend a national collision avoidance policy leading to the choice of techniques for a future national standard. There are major differences in operational use and cost of alternative systems. Concerted effort by all agencies of government and all aviation interests will be required to delineate a national plan.

Sincerely,



PHILIP N. WHITTAKER  
DOD Representative to the FAA

#### Attachments

Dr. George F. Mansur  
Deputy Director  
Office of Telecommunications Policy  
Executive Office of the President  
Washington, D. C. 20504

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D. C. 20554

June 2, 1971

IN REPLY REFER TO:

6310

Mr. Chester R. Kirkevold  
Executive Secretary  
Interdepartment Radio Advisory Committee  
Office of Telecommunications  
Department of Commerce  
Washington, D.C. 20230

Dear Mr. Kirkevold:

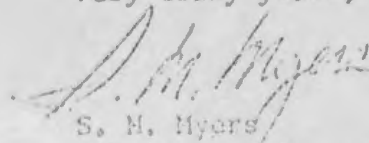
The Commission is in receipt of a petition from the McDonnell Douglas Corporation (copy attached) for amendment of the rules to provide for the regular licensing and type acceptance of Collision Avoidance Systems (CAS) and removal of radio altimeters from the band 1600-1625 MHz. In Docket 18550 the band 1592.5-1622.5 MHz was provisionally allocated for licensing of CAS on a developmental basis.

The Commission would appreciate the Committee's policy and frequency management guidance in this petition with particular attention to the following:

- a. Intention regarding the adoption of CAS for commercial, general and military aviation.
- b. The proposed method and responsibility for operation of CAS ground equipment.
- c. The need and urgency, including a cut off date to remove radio altimeter equipment from the band 1600-1625 MHz.

Final action on the petition will not be initiated until the work of the World Administrative Radio Conference for Space Telecommunications is completed on July 16, 1971.

Very truly yours,



S. M. Myers  
FCC Liaison Representative  
Interdepartment Radio Advisory Committee

Attachment

## Federal Communications Commission

WASHINGTON, D. C. 20554

In the Matter of:

Modification of Part 87 of the  
Commission's Rules to Allow for  
Regular Licensing of Collision  
Avoidance Equipment, and

Establishment of Procedure for  
the Type Acceptance of Airborne  
and Ground Collision Avoidance  
Equipment

PETITION FOR AMENDMENT OF RULES

The McDonnell Douglas Corporation, hereinafter some-  
times referred to as MDC, respectfully petitions that the  
Commission amend its rules to regularize the licensing of  
aeronautical collision avoidance equipment, and to make  
such equipment eligible for type acceptance pursuant to  
Part 2 of the Commission's Rules.

1. MDC has been active in the development of Collision  
Avoidance Systems (CAS) since June of 1960; it is a world  
leader in this effort. Since February, 1970, when the  
Commission concluded its rule making in Docket 18550 and  
provisionally allocated the band 1592.5 to 1622.5 MHz<sup>\*/</sup>  
making it available for the licensing of CAS equipment  
on a developmental basis,<sup>\*\*/</sup> MDC has been completing  
design efforts on its CAS systems for airlines. More  
recently it has invested much time and effort in the

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\*/ FCC Rules and Regulations, Section 2.106, footnote  
U.S. 39A.

\*\*/ FCC Rules, Section 87.183(p), footnote 1.

development of a low cost CAS for use in the general aviation environment. In the past year, cost estimates for the general aviation CAS have been reduced from \$10,000 to \$3,000.

2. Recent tests have also shown that installation of compatible CAS equipment on obstacles and at airports can enhance the usefulness of the system to include avoidance of collisions between aircraft and terrain. The Federal Aviation Administration (FAA) is now simulating system parameters in its controller simulation facility. There has, indeed, been much progress during this year and now the "developmental" nature of the current allocations provides a stumbling block for the early introduction of CAS for the general protection of the flying public.

3. In a letter to the Commission dated 2 September 1970 (but apparently lost until a copy was resubmitted 24 February 1971) the MDC requested guidance regarding the sale and type acceptance of its CAS equipment. This request was made with Subpart I of Part 2 of the Commission's Rules in mind; however, the 24 March 1971 reply from Mr. John T. Robinson of the Commission's staff noted that CAS transmitters in the 1592.5 - 1622 MHz band "may be licensed on a developmental basis only. Type acceptance is not required for, nor applicable to, equipment licensed solely on a developmental basis". This interpretation of the Rules is based

upon footnote 1, Section 87.183(p) 1592.5 - 1622.5 MHz and footnote 1, Section 87.501(h)(3) 1592.5 - 1622.5 MHz.

4. MDC respectfully requests that the Commission amend Section 2.106 of its Rules to remove the "provisional" limitation upon the frequency allocation for CAS and Sections 87.183(p) and 87.501(h)(3) of its Rules by removing the footnote, 1, from the collision avoidance frequency band 1592.5 - 1622.5 MHz. This would permit the licensing of CAS equipment on a regular basis and make such equipment eligible for type acceptance. MDC also requests that the FCC undertake the necessary effort with the Office of Telecommunication Policy (OTP) to establish a definite date for the removal of altimeters, in both government and non-government services, from the CAS band and to modify footnote, 2, to these sections of the Commission's Rules accordingly.

5. In this connection, MDC is aware that footnote 1 to sections 87.183(p) and 87.501(h)(3) relates the provisional nature of the CAS frequency allocation to the forthcoming World Administrative Radio Conference (WARC) scheduled to be held in Geneva, Switzerland during the period June 7 - July 17, 1971. The frequency band provisionally allocated by the Commission for CAS purposes is subject to international consideration and, at least theoretically subject to change, at that Conference. The United States position with regard to WARC provides for the protection



of the CAS interest in these bands. It also allows possible experimentation with satellite facilities compatible with the CAS equipment proposed for terrestrial and airborne stations.

6. MDC believes that its CAS is compatible with the current world allocation of the band it uses and that the Commission could, even taking current international rules into account, remove the "developmental" limitation on presently allocated CAS frequencies. However, even if the Commission desires to await the outcome of the WARC before taking such action it can and should at this time institute any rulemaking proceedings that it may deem necessary to accomplish this purpose and initiate action with OTP respecting the removal of altimeters from the CAS band. Even if these steps were taken immediately, it is unlikely that the time for final action would be reached before the completion of the WARC negotiations. It would be possible, however, to act promptly after the completion of such negotiations.

7. We take this occasion again to note for the Commission our support for the WARC position of the United States respecting the CAS band, and to urge that the United States Delegation be impressed in every way with the importance of this position. CAS manufacturers have invested millions of dollars over an eleven year period in the development of the system meeting Air Transport Association (ATA)

specifications, frequency changes earlier during this period have already caused significant problems, and a frequency change at this time resulting from any action at WARC would cause even greater problems now.

8. We emphasize this latter point. Even a small change in frequencies would cause a minimum of two years delay in the introduction of CAS equipment for airline use. A highly refined exciter provides frequency coherent signals for the computer, the transmitter, the receiver, and the discriminator at a precision of 1 part in  $10^9$ . A shift of frequencies would require a major redesign for all of these hardware components rendering more than \$2 million in MDC's system development costs obsolete. Therefore, the most determined efforts to safeguard the current CAS frequency allocation from any WARC action which would require change in that allocation are warranted.

9. We believe that the following more detailed discussion concerning the requests herein will be helpful.

#### Developmental Period Ending

10. MDC began the development of a Collision Avoidance System on 8 June 1960. On that day two F101 aircraft collided and the company established a task force to resolve this type of problem. The original effort included studies of optical, infra-red, sonic, electronic beaconry, telemetry, and radar. Anything that anyone could suggest to resolve

the collision problem was examined and the more promising possibilities were explored in some depth. Although optical systems and flashing infra-red lights were interesting and inexpensive approaches, they would not do the job in all situations. Over the years, MDC has continually studied mid air collisions on its own <sup>1,2/</sup> and by review of the work of others such as the National Transportation Safety Board <sup>3/</sup> and Air Line Pilots Association International. <sup>4/</sup> Many of these studies include thousands of cases which were computer simulated. These studies concluded that the use of collision avoidance equipment meeting the ATA specification <sup>5/</sup> for either the full airline variety or the general aviation variety could have

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1/ McDonnell Aircraft Corporation, "Appendix I to Collision Warning/Collision Avoidance/Air Navigation/Traffic Control," McDonnell Aircraft Corporation Engineering Note EN-300, 24 April 1961.

2/ McDonnell Aircraft Corporation, "Project EROS Phase I Final Report," Volume I-Summary, McDonnell Report Number 8446, 31 October 1961.

3/ National Transportation Board, "Report of Proceedings of the National Transportation Safety Board into the Midair Collision Problem," Report Number NTSB-AAS-70-2, November 1969.

4/ Ted Linnert, "The Urgent Need for a Low Cost Short Range Collision Prevention Device," Air Line Pilot Association International, November 1969.

5/ Air Transport Association of America, "Airborne Collision Avoidance System," ANTC Report No. 117, Revision 9, 25 August 1971.

prevented mid air collisions which occurred during the last 25 years. MDC developed the Eliminate Range Zero System (EROS)<sup>6/</sup> on which the ATA specification is based. EROS is a CAS that demonstrates the basic principles of time-sharing among large communities of aircraft and ground stations and in the St. Louis area it has been in daily operation since June 1966 on an experimental basis for the sole purpose of preventing collisions.

11. As early as 1967 the ATA, with its CAS specification, carried a policy statement that: 1) supports the development of CAS, 2) sets CAS apart from air traffic control, 3) notes that although non-cooperative CAS systems are considered desirable, a cooperative system is essential for an effective CAS and is supported by the ATA, and 4) opposes incompatible cooperative systems. Based on these premises, the ATA urged industry to carry out the development work that led to a successful airline CAS demonstration at Martin Marietta in Baltimore in 1969 by MDC and two other competitive equipment manufacturers.<sup>7/</sup> MDC has developed production versions (EROS II) of this equipment which will be in the hands of airline companies in the third quarter of 1971, according to current schedules.

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<sup>6/</sup> Stations KVT8 and N10185FLT have been employed for all flight testing activity at St. Louis, Missouri, since April 1963.

<sup>7/</sup> Martin Marietta-Baltimore Division, "Summary Report, Flight Test and Evaluation of Airborne Collision Avoidance System," 20 March 1970.

12. The ATA Specification covers two classes of CAS: Airlines and General Aviation. Until 1970 the major development effort was placed on the airline version. That year the National Transportation Safety Board (NTSB) went on record<sup>3/</sup> with a recommendation, among other things, that the FAA "encourage the expeditious development of a collision avoidance system for installation in air carrier aircraft and larger general aviation aircraft." Elsewhere it says, "The Board believes that the increased speeds of the turbine-powered aircraft will justify the development of a collision avoidance system, even though the system may not protect the large aircraft from the small aircraft in which a CAS is not installed." The NTSB also recommended that the FAA "make funds available for the ground equipment which may be necessary for the support of CAS systems." Today the FAA has budgeted items for this purpose. In this same report, NTSB looked less favorably on the potential of the General Aviation CAS, which it did not believe would be priced below \$8500, meeting the ATA specification. About this same time (March 1970) MDC completed a study for the National Aeronautics and Space Administration Electronic Research Center.<sup>8/</sup> One

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<sup>8/</sup> ERC Contract No.: NAS 12-2182.

conclusion reached was:

"The trend of aircraft midair collisions clearly demonstrates the urgent need for a General Aviation Collision Avoidance System. Distributions of General Aviation aircraft performance characteristics have been developed and were used to determine protection levels afforded by various threat criteria. A General Aviation CAS utilizing range and altitude difference as threat criteria is defined and hardware requirements outlined. Production cost estimates lead to the conclusion that a General Aviation CAS, compatible with the ATA CAS, can be provided at a cost attractive to large numbers of General Aviation owners."

13. Since the time of the final report for this study,<sup>9/</sup> MDC has sponsored a vigorous development program for the low-cost General Aviation CAS (MICRO-CAS), which meets the ATA specification. MICRO-CAS has, indeed, been developed to the point where it has been advertised to General Aviation.<sup>10/</sup> MDC's prototype is well along the way. We believe we have progressed far enough with our work on MICRO-CAS to demonstrate that there can be established within ATA specifications a framework within which the electronics industry can provide a satisfactory General Aviation CAS at a reasonable cost. The target price to General Aviation depends to a large degree

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<sup>9/</sup> McDonnell Douglas Astronautics Company-Eastern Division,  
"System Study for the Application of Time Reference Techniques  
to General Aviation for Collision Avoidance," Report Number  
MDC E0079, Volume 1 and 2, 2 March 1970.

<sup>10/</sup> McDonnell Douglas Astronautics Company-Eastern Division,  
"EROS II, Collision Avoidance, Micro CAS for General Aviation,"  
Report Number MDC E0225, 10 November 1970.

on production. The current FCC restriction on licensing does not foster or encourage the use of CAS frequencies when each applicant must sign a document stating he understands and agrees that his license is subject to cancellation without a hearing.

14. Development of the Airline CAS has proceeded to the point that it is ready for operational use on a regularly licensed and type accepted basis. The current FCC rules prevent this.

#### New Uses for the ATA Collision Avoidance

15. The MDC analysis and design effort that produced the threat evaluation and escape logic maneuver logic for the air-to-air situation has produced two new applications in the field of air safety: 1) for the avoidance of ground obstacles, and 2) for the provision of a minimum altitude protection zone around airports. The airborne CAS, with only minor adaptations, can provide this additional protection. Installation of a CAS compatible time/frequency ground beacon on or near the obstacle or at an airport automatically provides signals to the airborne CAS for threat evaluation and clear escape maneuver commands. As an option, this beacon can also be used for aircraft resynchronization. The

addition of these functions in no way compromises the normal air-to-air CAS protection. The aircraft threat status relative to all CAS-equipped aircraft and relative to ground beacons is evaluated once every three seconds as before.

16. These features have been flight-tested in the St. Louis area. Tests and theory both show that the CAS system can effectively prevent low altitude approaches to airports or warn against natural or man-made obstacles to flight. All McDonnell Douglas supplied CAS (both EROS II for Airlines or Micro CAS for General Aviation) will incorporate these added protection features.

#### Type Acceptance Rules for CAS

17. The Commission does not provide specific rules for type acceptance of Radionavigation Land Stations such as radio beacons, glide slope stations, navigation aids, etc. (However, because of the poor frequency stability of radars such special rules are provided.)<sup>11/</sup>

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<sup>11/</sup> MDC believes that CAS or other systems which do not comply with the ATA Specification<sup>3/</sup> should not continue to be authorized in the CAS band because they could constitute a safety hazard to CAS-equipped aircraft. Rule changes for this purpose may be required, although appropriate implementation of the recently-adopted rules for coordination with the FAA before type acceptance of equipment for use in the aviation services should protect CAS operation to some extent. (Docket No. 18945)



The frequency stability of a CAS transmitter may be 1 part in  $10^7$  to 1 part in  $10^9$ ; therefore, the CAS systems meeting ATA specifications will easily meet the .005 percent specified as requirements for radionavigation stations in section 87.65 of the rules. Thus, it would appear to be appropriate to continue past philosophy by not specifying specific CAS parameters in the FCC rules. However, provision for type acceptance should be made; removal of the "developmental" limitation as requested herein would make CAS equipment eligible under the Commission's rules for type acceptance consideration.

Termination of the Use of the Band 1600-1625 MHz  
for the Use of Radio Altimeters

18. The current rules allow altimeters to operate in the band 1600-1660 MHz. MDC has submitted test results to the Commission<sup>12/</sup> which show unsafe interference between the CAS and commercial radio altimeters. In April 1971, similar tests were arranged by the FAA between MDC collision avoidance

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<sup>12/</sup> Under Docket 18550, MDC filed results of tests of MDC CAS Systems and In-Flight Devices, Inc. Radio Altimeters in March 1970.

equipment and military radio altimeters.<sup>13/</sup> Although the FAA is to prepare the final report on these tests, MDC provided the raw data to FAA, Air Force, and Electromagnetic Compatibility Analysis Center personnel who witnessed the tests. MDC's analysis of the result is that CAS poses no harmful interference to military altimeters, but that such altimeters can and do cause interference to CAS. Thus, continued coexistence of radio altimeters and CAS in the same band cannot be tolerated. The Commission, in conjunction with OTP is, therefore, requested to establish a definite end date for the removal of radio altimeters and modify the rules to reflect this date. In Docket 18550, the FCC has already warned the civil users of the band that short notice for the removal of altimeters may become necessary.

Request for Relief

19. For the foregoing reasons, we respectfully urge that the Commission institute such rulemaking proceedings and coordination with OTP as may be necessary to convert the

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<sup>13/</sup> Letter from R. E. Perkinson to John A. Weber, Ref: CNI-REP-2251, dated 9 April 1971.



FOR INFORMATION

Doc. 14303/1-4.6.2

EXECUTIVE OFFICE OF THE PRESIDENT  
OFFICE OF TELECOMMUNICATIONS POLICY  
WASHINGTON, D.C. 20504

June 15, 1971

Mr. David L. Solomon  
Acting Assistant to the  
Secretary of Defense (Tele-  
communications)  
Washington, D.C. 20301

Dear Mr. Solomon:

Initiatives that began as far back as the mid-1950's have culminated in the development of an airborne collision avoidance system designed to operate on radio frequencies in the 1592.5-1622.5 MHz band. The number of mid-air collisions in recent years has increased interest in proceeding with the regular licensing of collision avoidance systems (CAS) for operational use.

Development of CAS in the 1592.5-1622.5 MHz band was authorized by the Federal Communications Commission (FCC) in early 1970. At the same time plans were made for radio altimeter functions then using the entire 1540-1660 MHz aeronautical radionavigation band to be limited to the 1600-1660 MHz portion of that band only and to be shifted eventually to the 4200-4400 MHz band. The same planning provided that no new altimeters would be authorized in either the 1540-1660 or 1600-1660 MHz bands after July 1, 1971, and those already authorized would be permitted to operate for an unspecified period, recognizing that a termination date for these devices would have to be established at some time. These actions were formalized as regards non-Government interests by an FCC Order released on June 12, 1970. Concurrence on the part of the Executive Branch agencies was obtained through coordination in the Interdepartment Radio Advisory Committee (IRAC) in May 1969.

While development of the CAS seems to have progressed satisfactorily, it became apparent several months ago that use of radio altimeters in the 1600-1660 MHz band might continue longer than originally expected, possibly for several years. Accordingly, in view of the safety of life considerations involved, the IRAC was requested in May 1970 to arrange an on-the-air test of CAS and radio altimeter devices to determine quantitatively the degree or likelihood of interference between the two systems. Initial reports from the aforementioned tests reveal unsafe

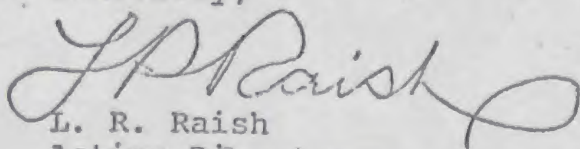
interference between the CAS and radio altimeters. Co-existence of these two systems under operational conditions in the same environment with their present technical characteristics pose what would appear to be unacceptable hazards.

Attached are reports from the Department of the Air Force and the Federal Aviation Administration that substantiate the interference problem. Further analytical data in corroboration of these two reports is understood to be in preparation at the DOD Electromagnetic Compatibility Analysis Center (ECAC) and is expected to be available shortly.

As can be seen, with two safety of life functions involved, critical decisions are needed soon with regard to timing of both the phasing out of the aforementioned altimeters and implementation of the new CAS.

To assist this Office in examining policy implications with regard to the foregoing, information is requested and comments are invited as to plans for phasing out of DOD radio altimeter usage from the 1600-1660 MHz band and for the introduction of the CAS into operational usage aboard military aircraft.

sincerely,



L. R. Raish  
Acting Director  
Frequency Management

Enclosures

cc: Hon. Robert H. Cannon, Jr.  
Asst. Secretary of Transportation  
for Systems Development & Technology

EXECUTIVE OFFICE OF THE PRESIDENT  
OFFICE OF TELECOMMUNICATIONS POLICY  
WASHINGTON, D.C. 20504

June 15, 1971

Honorable Robert H. Cannon, Jr.  
Assistant Secretary of Transportation  
for Systems Development and Technology  
Department of Transportation  
Washington, D.C. 20590

Dear Mr. Cannon:

Initiatives that began as far back as the mid-1950's have culminated in the development of an airborne collision avoidance system designed to operate on radio frequencies in the 1592.5-1622.5 MHz band. The number of mid-air collisions in recent years has increased interest in proceeding with the regular licensing of collision avoidance systems (CAS) for operational use.

Development of CAS in the 1592.5-1622.5 MHz band was authorized by the Federal Communications Commission (FCC) in early 1970. At the same time plans were made for radio altimeter functions then using the entire 1540-1660 MHz aeronautical radionavigation band to be limited to the 1600-1660 MHz portion of that band only and to be shifted eventually to the 4200-4400 MHz band. The same planning provided that no new altimeters would be authorized in either the 1540-1660 or 1600-1660 MHz bands after July 1, 1971, and those already authorized would be permitted to operate for an unspecified period, recognizing that a termination date for these devices would have to be established at some time. These actions were formalized as regards non-Government interests by an FCC Order released on June 12, 1970. Concurrence on the part of the Executive Branch agencies was obtained through coordination in the Interdepartment Radio Advisory Committee (IRAC) in May 1969.

While development of the CAS seems to have progressed satisfactorily, it became apparent several months ago that use of radio altimeters in the 1600-1660 MHz band might continue longer than originally expected, possibly for several years. Accordingly in view of the safety of life considerations involved, the IRAC was requested in May 1970 to arrange an on-the-air test of CAS and radio altimeter devices to determine quantitatively the degree or likelihood of interference between the two systems. Initial reports from the aforementioned tests reveal unsafe

interference between the CAS and radio altimeters. Co-existence of these two systems under operational conditions in the same environment with their present technical characteristics pose what would appear to be unacceptable hazards.

Attached are reports from the Department of the Air Force and the Federal Aviation Administration that substantiate the interference problem. Further analytical data in corroboration of these two reports is understood to be in preparation at the DOD Electromagnetic Compatibility Analysis Center (ESAC) and is expected to be available shortly.

As can be seen, with two safety of life functions involved, critical decisions are needed soon with regard to timing of both the phasing out of the aforementioned altimeters and implementation of the new CAS.

To assist this Office in examining policy implications as regards the foregoing, information is requested and comments are invited as to (a) plans including target dates, if any, for the adoption of CAS for commercial and general aviation use; (b) the proposed method and responsibility for operation of CAS ground equipment; and (c) a target cut-off date for the removal of radio altimeter equipments from the 1600-1625 MHz band.

Sincerely,

LSI-  
L. R. Raish  
Acting Director  
Frequency Management

Enclosures

cc: Mr. D. L. Solomon  
Acting Assistant to the  
Secretary of Defense (Telecommunications)



OFFICE OF THE SECRETARY OF TRANSPORTATION  
WASHINGTON, D.C. 20590

JUL 12 1971

Mr. L. R. Raish  
Acting Director, Frequency Management  
Executive Office of the President  
Office of Telecommunications  
Washington, D. C. 20504

Dear Mr. Raish:

Your letter of June 15, 1971, solicited certain information regarding plans for the introduction of collision avoidance systems for aircraft. The following information is furnished in response to your request:

a) The FAA recognizes the utility of the ATA Collision Avoidance System to certain users of the National Airspace System and therefore intends to sanction the use of this equipment on a voluntary basis by any aircraft operator. The avionics equipment for commercial airlines is presently available, and developmental work is actively being pursued to produce a low cost version for use by general aviation. A military version of the equipment could be developed should DOD feel this was desirable.

It should be recognized that primary responsibility for collision avoidance will continue to rest with the FAA-operated air traffic control system and that the CAS will function as a backup. The first scheduled procurement of CAS equipment by an airline involves Piedmont Airlines with equipment installation due in March 1972.

b) The FAA has agreed to provide ground synchronization facilities for use with CAS equipment of the ATA type. The FAA will assume the responsibility for the accuracy of the signals in space provided by the government owned and operated ground synchronization facilities. These "facilities" may consist of existing FAA ground navigation stations to which a synchronization mechanism has been added or independent dedicated facilities. The FAA also intends to certify ground facilities operated by nonfederal entities on a temporary basis until federal facilities become operative in 1975 because the CAS will be utilized by aircraft under IFR conditions.



c) While there is a need to phase-out the radio altimeters from this band, we, at the present time, do not wish to commit ourselves to a definite date. We are awaiting the outcome of a study and are in the process of preparing detailed recommendations as to the phasing out of all radio altimeters from this band. At this time it is envisioned that there will be different cutoff dates for each type of altimeter.

Our position with respect to this system is, therefore, that we acknowledge the ATA system requirement and need for full licensing of equipment. While the main thrust of the government program revolves around the air traffic control system, we do not believe that users in a position to help themselves should be constrained when an operational system is available. Likewise, these users should be afforded interference protection to ensure proper system operation.

Sincerely,

*M. E. Lindley for*

Robert H. Cannon, Jr.  
Assistant Secretary for  
Systems Development and Technology

FOR INFORMATION

WASHINGTON, D.C. 20590



OFFICE OF  
THE ADMINISTRATOR

6 AUG 1971

Mr. Clay T. Whitehead, Director  
Office of Telecommunications Policy  
Executive Office of the President  
Washington, D. C. 20504

Dear Mr. Whitehead:

As you are aware, the Interdepartment Radio Advisory Committee (IRAC) has requested certain information regarding plans for the introduction of Collision Avoidance Systems (CAS) for aircraft. The following information summarizes the Federal Aviation Administration (FAA) position with respect to CAS implementation:

a. The FAA intends to adopt the Air Transport Association (ATA) CAS for voluntary use under special conditions by commercial airlines, general aviation, and the military services. The avionics equipment for commercial airlines is presently available, and developmental work is actively being pursued in producing a low-cost version for use by general aviation. It is possible that either the general aviation or commercial airline version will be satisfactory for military applications. If not, a military version can be developed to fulfill their unique requirements.

b. The FAA will assume responsibility for the accuracy of the signal-in-space of the CAS ground equipment.

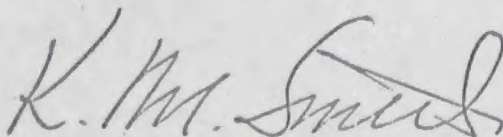
c. While there is a need to remove the radio altimeters from the 1535 to 1660 MHz band, we do not wish, at the present time, to commit ourselves to a definite date. We are awaiting the outcome of a study of this matter and are in the process of preparing detailed recommendations as to the phasing out of all radio altimeters in this band. At this time it is envisioned that there would be different cutoff dates for each type of altimeter.

In consideration of the fact that this equipment might be utilized by aircraft under Instrument Flight Rule (IFR) conditions, the FAA wishes to take all necessary steps to preclude interference to this equipment. In pursuit of this objective, it is felt that delegation of authority from the OTP/Federal Communications Commission (FCC) to FAA to

2

engineer the 1592.5-1622.5 MHz frequency band would facilitate day-to-day operations considerably. Your consideration of this proposal would be appreciated.

Sincerely,

A handwritten signature in cursive script, appearing to read "K. M. Smith". The signature is written in dark ink and is positioned above the typed name.

K. M. Smith  
Deputy Administrator

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590



OFFICE OF  
THE ADMINISTRATOR

14 SEP 1971

Honorable Melvin R. Laird  
Secretary of Defense  
Washington, D. C. 20301

Dear Mr. Secretary:

The petition by the McDonnell Douglas Corporation to the Federal Communications Commission has been one of several recent developments calling attention to collision avoidance systems. This petition is the culmination of considerable Government/industry work over the past few years. A short review of this and other work is provided as requested at a meeting held 26 August 1971 between Mr. John Klotz of your staff (acting as Chairman of the DOD R&E Sub-group on Federal Aviation) and Gen. Gustav E. Lundquist, FAA Associate Administrator for Engineering and Development.

Since the formation of the Collision Prevention Advisory Group (COPAG), which is chaired by FAA and in which DOD has membership, there have been many development efforts to explore various techniques for collision avoidance. It should be recognized that the primary responsibility for collision avoidance will rest with the FAA-operated ATC system and that CAS will function as a backup. Within this context, the basic CAS requirements are to have an independent system which will detect the existence of a threat, evaluate it, and recommend to the pilot the proper maneuver on a timely basis to avoid collision. Serious examination has been made of radar, interrogator/transponder, and other proposed solutions, combined with extensive analysis and simulation of these techniques. Output of these efforts indicated that time/frequency (T/F) technology was the most promising solution. Various schemes have since been suggested but, until recently, we felt none showed sufficient promise to alter our thinking. Recent developments in the state-of-the-art of interrogate/transpond data processing techniques, however, indicate that the saturation problem may be solvable (We refer here specifically to the RCA SECANT system). Joint testing of RCA's correlation technique by the Navy and FAA is scheduled for the near future, but the immediate problem is its comparative

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stage of development versus the McDonnell Douglas system. Our interest in SECANT is motivated by the RCA claim for operation without ground synchronizing stations and in the presence of interfering signals, such as those from radar altimeters which are now operating in the band. For these reasons, the implementation cost of SECANT might represent an economy in initial investment.

At any rate, the FAA was ready to solicit industry for proposals to develop a collision avoidance system based on T/F technology in 1966, when the Air Transport Association offered to collaborate with industry in such a development. In the face of such an offer, the FAA was not in a position to recommend expenditure of public funds, particularly when the development involved was largely related to aircraft equipment. The Air Transport Association then formed a Technical Working Group which included the Department of Defense and the FAA, as well as interested manufacturers. This Technical Working Group produced a specification for a collision avoidance system utilizing the time/frequency technology and three manufacturers have built models of equipment which meet that specification. A flight test program was sponsored by the Air Transport Association and conducted by an independent contractor having no conflict of interest. The flight test program was successful and equipment has been redesigned to accommodate changes surfaced by the flight test program and by subsequent simulation work. The McDonnell Douglas Corporation is now ready to market the equipment they have produced.

There are at least three congressional activities relating to collision avoidance pertinent to this discussion. Senator Moss has introduced a bill in the Senate, Congressman Fascell has introduced a bill in the House of Representatives, and Congressman Brooks has held a hearing early in August 1971. The proposed legislation could result in mandatory use of collision avoidance equipment by all aircraft in the system. The Brooks Subcommittee hearing testimony favored proceeding with all speed on a collision avoidance system, with only two dissents from two separate manufacturers participating in that hearing.

The enclosed letters from the Assistant Secretary for Systems Development and Technology of the Department of Transportation and from the Deputy Administrator, FAA, indicate support for voluntary use of the frequency contained in the McDonnell Douglas petition to FCC. This approval deliberately does not carry with it a recommendation to remove military altimeters from the band by a specific date, nor does it imply that we are ready to develop a national standard for collision avoidance systems. It was given in the

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interest of providing the user of the air traffic control system an opportunity to gain operational experience in using a collision avoidance system and some degree of confidence in protecting the integrity of the system from interference. The FAA is in a position of having a request from a user of the air traffic control system to agree with the use of a device that the user feels will protect lives and property. To deny him the use of such a system would have us appear to oppose safety. In addition to this, one air carrier, Piedmont Airlines, has a bona fide offer from the Air Line Pilots Association to agree to the removal of the third crew member from Piedmont aircraft if they are equipped with collision avoidance equipment. Other airlines feel that with the availability of such a system they become extremely vulnerable in terms of liability if a mid-air collision were to occur, particularly if it were between two of their own aircraft. Many hold the view that they should equip for this legal protection regardless of who else does so. In other words, they believe that a totally-equipped environment is not required to give them the legal protection they seek.

On the basis of the work done by COPAG and done by the ATA Technical Working Group, FAA was convinced that time/frequency technology would be the basis of a collision avoidance system. Commitment was made to the airlines that if such a system were developed, the FAA would provide the ground synchronizing facilities needed to put all aircraft on a common time base. Furthermore, it was recognized that a ground synchronizing system would be required as a means to producing low-cost airborne equipment, enabling many smaller aircraft to equip. As a consequence there is in the FAA R&D program a project for a study of the types, numbers, and locations of ground synchronizing stations and a project for the development of the synchronizing station itself. There is also provision made for undertaking the development of low-cost collision avoidance equipment for use in small aircraft.

Two developmental efforts relating to low-cost airborne equipment are in various stages of completion and can affect FAA low-cost development. The first has an airborne equipment target price of \$1,500 and is an analysis and study being done by the National Aeronautics and Space Administration. We expect the first results of this study by fall 1971. The second is a low-cost unit being developed by the McDonnell Douglas Corporation with a target price of \$2,500 which McDonnell feels can be further reduced by avionics manufacturers. These lower-priced units (expected to be decreased-performance units) will be simulated by the FAA late this fall to determine the effect such units may have on the air traffic control

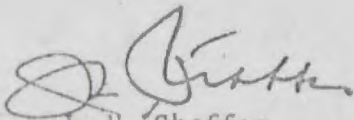
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system. The more sophisticated unit proposed by the airlines is expected to have little effect, but a measure is needed to determine what can be done with less accurate systems.

As can be seen from the work we are pursuing, the question of a U. S. national standard is premature at this time. While there has been good progress toward a collision avoidance system for voluntary airline use, we have far too little experience and too many unanswered questions to be able to predict if or when any collision avoidance system should become a requirement. The approval of the McDonnell Douglas petition can be given, however, without prejudicing the eventual adoption of a national standard or inhibiting additional work toward solution of the problem.

This has been a brief presentation of reasons why the FAA has recommended approval of the McDonnell Douglas petition for voluntary operational use of collision avoidance equipment. It is hoped that it will assist the Department of Defense in understanding the need for such an approval and the view that the FAA has taken of the entire collision avoidance subject. A Department of Defense endorsement of this petition through the DOD Advisory Committee on Federal Aviation, chaired by Mr. Philip Whittaker, would be appreciated.

Sincerely,



J. H. Shaffer  
Administrator

2 Enclosures

## OFFICE OF TELECOMMUNICATIONS POLICY

EXECUTIVE OFFICE OF THE PRESIDENT

WASHINGTON, D.C. 20504

October 13, 1971

## MEMORANDUM FOR

Assistant Director for Legislative Reference  
Office of Management and Budget

Attention: Mr. Lewis Krulwich

SUBJECT: S.2264

This is in response to your request of August 25, 1971, for the views of the Office of Telecommunications Policy on S.2264, a bill to require the installation of collision avoidance and pilot warning indicator systems on commercial, private, military, and other Government aircraft. If enacted this proposed legislation would require the installation of collision avoidance systems on all aircraft having a maximum certificated takeoff weight of 12,500 pounds or more, or used for carrying passengers. Prototype versions of such a collision avoidance system have been developed, and an approximate cost of \$10,000 per installation is indicated. <sup>1/</sup> Smaller aircraft would be required to be equipped with pilot warning systems; a strobe light infrared system could cost about \$1,500. Civil aircraft would be required to meet the requirements of this proposed legislation not later than January 1, 1973; Government aircraft by January 1, 1975.

While we have not yet reached any firm conclusion as to the general desirability of legislation of this sort, we have some reason to believe (a) that the type of collision avoidance systems currently proposed will, because they require both approaching aircraft to be similarly equipped, fail to provide the degree of safety that their proponents advocate; and (b) that the systems will not perform satisfactorily in their intended operational environment due to interference from military radio altimeters

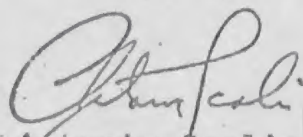
<sup>1/</sup> See 117 Cong. Rec. S10711 (July 12, 1971); 117 Cong. Rec. S15187-88 (September 28, 1971) (remarks of Senator Moss).



operating in the same frequency band.

These problems are currently under joint consideration by the Federal Aviation Administration and the Department of Defense. They are also being examined by this Office, the Federal Communications Commission and other affected Government agencies.

We are of the view that this proposed legislation should not be approved by the Administration until these studies are completed. We therefore recommend that the Senate Committee on Commerce be urged to defer further action on S.2264 until additional information is available as to the practicability of collision avoidance systems and the extent of adjustment in other systems which may be required to eliminate interference.



Antonin Scalia  
General Counsel

OFFICE OF TELECOMMUNICATIONS POLICY  
EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20504

November 11, 1971

Mr. John W. Klotz  
Assistant Director for Combat Support  
Office of the Director,  
Defense Research and Engineering  
Office of the Secretary of Defense  
Washington, D. C. 20301

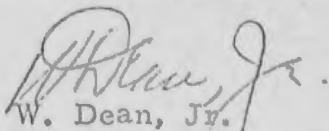
Dear John:

This is with reference to my earlier letters with respect to the problem of CAS systems vs. Altimeters.

On November 9, 1971, representatives of this Office were briefed on the Time-Frequency CAS system by McDonnell-Douglas and ATA personnel. During the course of this briefing, McDonnell-Douglas expressed willingness to conduct the necessary engineering to incorporate a capability into military altimeters whereby these devices could be confined above the band occupied by the CAS (1592.5-1622.5 MHz); the altimeter tuning range being 1600 to 1660 MHz. The question which needs answering is, "What would be involved in converting existing altimeters so as to confine their operations to above 1622.5 MHz and preclude interference to CAS?" I have been in contact with Air Force personnel who are investigating the feasibility of loaning altimeter equipment to McDonnell-Douglas for the foregoing purpose.

In our telephone conversation of October 26, 1971, you advised that a response to our letter of June 15 could be expected momentarily. I hope that this response can be received within the next week.

Sincerely,



W. Dean, Jr.  
Assistant Director  
for Frequency Management

cc: David Solomon  
Col. William Sell

OFFICE OF TELECOMMUNICATIONS POLICY  
EXECUTIVE OFFICE OF THE PRESIDENT  
WASHINGTON, D.C. 20504

DEPUTY DIRECTOR

December 2, 1971

Honorable John H. Shaffer  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20553

Dear Mr. <sup>Joel</sup> Shaffer:

On May 21, 1971, the McDonnell Douglas Corporation petitioned the Federal Communications Commission for amendment of the rules to provide for the regular licensing and type acceptance of Collision Avoidance Systems (CAS), plus removal of radio altimeters from the band 1600-1625 MHz. This was a follow-on action to an FCC Order of June 12, 1970, whereby the frequency band 1592.5-1622.5 MHz was allocated on a primary basis for the licensing of CAS's on a developmental basis.

Tests instigated by this Office established that time-frequency CAS's of the type currently pending before the Commission are susceptible to interference from existing military radio altimeters in the band 1600-1660 MHz. As a consequence, Executive Branch concurrence to the McDonnell Douglas petition has been withheld pending the development of measures necessary to protect the safety of life devices.

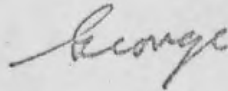
By letter of June 15, 1971, the views of the Department of Transportation were requested on: (a) plans, including target dates if any, for the adoption of CAS for commercial and general aviation use; (b) the proposed method and responsibility for operation of CAS ground equipment; and (c) a target cut-off date for the removal of radio altimeter equipments from the band 1600-1625 MHz. By response of July 12, 1971, DoT advised inter alia that, while there was a need to relocate altimeters, recommendations as to specific dates awaited the outcome of a study then underway.

Increasing interest on the part of the industry, the Congress, and international organizations with respect to Collision Avoidance Systems, dictates that an Executive Branch position must be taken on the altimeter problem.

The views of the Federal Aviation Administration are requested as to: (a) when it is expected that FAA will certify a CAS system upon which standardization will be effected, and (b) the estimated date by which the necessary interference protection criteria for such a system will be established--a prerequisite to removal of altimeters from the band 1600-1625 MHz.

Your cooperation on this matter would be appreciated.

Sincerely,

A handwritten signature in cursive script, appearing to read "George".

George F. Mansur

DEC 7 1971

Dear Mr. Shaffer:

Your letter of September 14, 1971 to the Secretary of Defense summarized a number of recent developments relating to collision avoidance systems.

You conclude that the question of a U.S. national standard for such systems is "premature at this time." We are inclined to agree. The aviation community appears generally to agree that collision avoidance equipment must be installed in essentially all aircraft--commercial, military and general aviation, and that such equipment must be compatible. Until this problem is on its way to solution--and we are not satisfied that a solution has yet been nailed down, it is, as you indicate, premature for you to set a national standard.

As you know, there are a number of competing approaches to the solution of this important problem. In spite of the urgency of the problem, we believe many of these should be evaluated more fully in order to derive the best possible system for the real operating environment. The system we need must be fully compatible and should endure for the rest of this century.

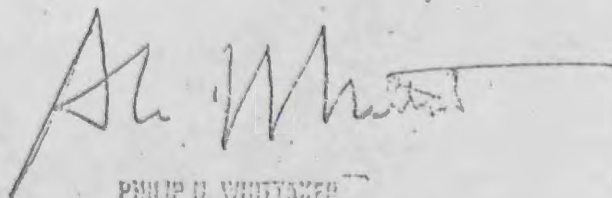
If, as part of this effort, the FAA wishes to conduct further tests of the McDonnell-Douglas system using the radio frequencies now being sought by McDonnell-Douglas, we look upon this as being completely in consonance with the concept mentioned above of continued systems evaluation. Any authorization for such operational testing of the McDonnell-Douglas system should, however, be made in such a way as not to constitute a de facto or implied approval of the establishment of a national standard. Further, as all of the interested parties know, the possibility exists of interference between the McDonnell-Douglas EROS II system and the altimeter equipment which has been installed for some years in over 3,000 military aircraft.

In short, a number of competing candidate collision avoidance systems have been advocated. No one system appears to have clearly solved the compatibility problem across all types of aircraft. The EROS II system presents potential radio

frequency interference problems. Consequently, the Defense Department believes that the Government cannot encourage unrestricted use of EROS II at this time, and that any CAS frequency assignment for operational testing under your auspices should continue to be on a temporary, experimental basis.

As indicated above, we believe the FAA should continue to take the lead in evaluating all candidate systems and developing at the earliest possible date a compatible direction in which the entire aviation community can move. We hope that the Interdepartmental Group on Collision Avoidance and Pilot Warning which we recently established under FAA chairmanship will assist in attaining this objective. In addition, as you know, the military departments are continuing to promote research and development activities in collision avoidance which we hope will be of further assistance in arriving at the best solution to this problem.

Sincerely,



PHILIP H. WHITAKER  
DOD Representative to the FAA

Honorable John H. Shaffer  
Administrator  
Federal Aviation Administration  
Department of Transportation  
Washington, D. C. 20590