(2) 29 April 1952 ~~SECRET~~

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MEMORANDUM

From: J.H. Trexler, NRL representative to Comm. Unit 32-G in April 1952

To: Officer in Charge Comm. Unit 32-G
Subj: Video Receiver, Installation Report on

1. This is a Naval Research Laboratory engineering report summarizing certain problems associated with the Comm. Unit 32-G installation of the NRL Video Receiver R-467(XB-1)/ALR. This receiver, which was developed by Code 3945 NRL as a wide band intercept device, was sent to Comm. Unit 32-G for evaluation as an "S" and "X" band alternate for the AN/APR-9 receiver in the AN/APA-69 direction finding system, installed in the P4M-1Q aircraft No. 124372. This method of operating the APA-69 is intended as an intercept assurance device and was tried previously on an AD aircraft at N.A.T.C. Patuxent with good results. The present installation in the P4M is to evaluate the system's usefulness in ferret patrol work. A complete account of the installation trials of the receiver may be found in the Naval Research Laboratory registered notebook No. 78441, this report being merely a summary and description of the installation made 29 April 1952.

2. In preliminary trials prior to 7 April no operational value was derived from the Video Receiver due to an unexplained low sensitivity combined with exceptionally high power frequency "hum" picked up by the set. The Comm. Unit installation and maintenance groups were placed at a decided disadvantage not having been supplied with sufficient detailed information concerning the problems of installation or with quantitative performance tests. About all that could be reported was that on the maintenance bench the receiver worked well receiving local GCA signals but in the aircraft it did not work at all.

3. The NRL representative started an installation checkout 7 April finding first that the antenna in use was open circuited for the crystal's d.c. ground return current which accounted for the low sensitivity. This short was an installation requirement not made clear to the Comm. Unit. After changing to a grounded system the measured sensitivity was approximately 50 dbm at "S" band and 40 dbm at "X" band, these figures are in line with the values obtained at NRL. The method of measurement and acceptable values are given in a paper prepared by Code 3945, NRL. A copy of this paper is attached to this report as Appendix I. At all times during the installation check out the sensitivity was measured with crystals supplied by Code 3945. These calibrated crystals will be left with the Comm. Unit's maintenance group for future reference.

4. The sensitivity problem having been cleared up the next problem was the high "hum" level incurred when operating on the aircraft's power supply. Many cabling and wiring arrangements were tried but none gave adequate suppression of the interference, however analysis of the results of these trials indicated that the power frequency

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(400 cycles) currents flowing on the input coaxial cabling system were coupling to the input causing the interference that overrode the comparatively weak crystal signal input. All tests seemed to indicate that high audio or video frequency currents cannot be allowed to flow over the coaxial crystal holder. Since in the system arrangement prescribed by NRL the crystal holder is between the antenna selector switch and the Video Receiver it is impossible to reduce the currents on the holder to an acceptable value due to the heavy "ground" currents that are flowing throughout the aircraft. Extra grounding straps and shielding did not sufficiently bypass these ground currents. To complicate the situation it was found that in many cases some of the interference seemed to be induced in the coaxial sheath by magnetic coupling from nearby cables carrying heavy current. In the APA-69 nose installation this type of coupling was exceptionally bad.

5. The only possible cure for the trouble seemed to be the removal of the crystal holder from the high current circuits and their associated high fields. The simplest method of accomplishing this isolation was to make the crystal holder an internal component of the receiver. Consequently a new input was provided on the the receiver's front panel which is for r.f. instead of video, the original input remaining intact in case some future application requires its use. This new r.f. input is very carefully bonded to the heavy panel of the receiver. A UG-23 B/U female cable connector was made into a feed-thru by sweating a large panel flange to its barrel. This flange was bonded to the front panel by scraping the paint off and bolting the flange and panel together with heavy steel bolts. It will be noted that in this type of feed-thru the braid of the RG-9A/U cable is not continuous thru the panel but effectively terminates at the panels front face. Also note that in this arrangement thereare a minimum of connectors and associated poor ground bonds.

6. In most installations the isolating of the crystal inside the receiver is sufficient protection against "hum" but if the "ground" currents flowing in the input cabling system are excessive, as in the nose position, it is necessary to resort to more drastic measures. A grounded quarter wave stub (r.f.) placed directly behind the feed-thru will often give sufficient protection but it was found after many trials that it was also necessary to open-circuit the antenna in the APA-69 nose installation. This is a major modification and should not be attempted without laboratory and shop facilities. The AS-436 antenna in aircraft No. 124372 was changed over at Comm. Unit 32-G by the NRL representative but it should be replaced by one from NRL as soon as possible. Spot checkes show that it is down in gain by 2 to 4 db. The three-fold modification of (1) placing the crystal inside the receiver, (2) "grounding" the input cable's center conductor at the receiver input, and (3) opeing the antenna circuit will, in all cases checked so far, give adequate protection against the "hum".

7. The crystal holder which has a type "N" male connector at its r.f. end is screwed to the quarter wave stub on the inside of the receiver and a short cable (RG-71/U) with a UG-260/U connector on one end and a special right-angle connector on the other is used between

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the crystal holde[illegible] the video input of the receiver sub-chassis. To change from "S" band to "X" band it is only necessary to change the crystal in the coaxial holder (IN32 for "S" band and IN23B for "X" band) and change from an "S" to and "X" band stub. (The "X" band stub is being sent back to NRL, until another one is received the "S" band one should be used in its place. This will cause poor results near 6000 and 12,000 mc.) The Video Receiver incorporating these changes is the R-467(XB-1)/ALR Mod. 4x Ser.#5 brought to Comm. Unit 32-G April 5. The circuit of this receiver is shown in Fig. 6 of this report. The receiver was put in service 29 April 1952 after the installation modifications were worked out on the older Ser.#4 receiver. Ser.#4 will be returenéd to NRL 2 May for modification evaluation by Code 3945. Figs. 1 thru 5 show the various configurations of equipment using the Video Receiver that have been given test flights at Comm. Unit 32-G. Fig. 3 shows the "S" band installation using the APA-69 with the Ser. #4 Video Receiver. This is the installation that gave the first acceptable results in actual operation, the flight of 16 thru 21 April. Fig. 5 shows the installation of 29 April which is an "X" Band setup.

8. The final problem is one of reducing noise coming from the rotating joint in the AS-434, "S" band, antenna assembly used in the AN/APA69. This type of noise is not a problem when the shorting stub is placed in the receiver. This stub provides a path to ground for the crystal current keeping it off the rotating joint and also provides a low impedance path to ground for static charges set up by the joint rotation.