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ROUTE SHEET

PRNC-NRL-10-863d (Rev. 6-54)

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CODE	DATE	INITIALS	*PURPOSE	REMARKS
5435	4-27	RBB		
5430	4/27	[illegible]		
5400	4/28	LTB		APR 2 7 1959 Prepared in accordance with instructions from Code 5402
1900	5-4-59	[illegible]	8	[illegible]
1570	4/28	[illegible]		
1525	4/28	[illegible]		Classified by: Dir NRL Review on: 19 Apr 1969
1522	4/28	[illegible]		
1523	4-30	[illegible]		
5000	5/11/59	[illegible]	1	[illegible]
4010	5/5	[illegible]	✓	MAY 5 1959
5168	5/8	[illegible]	8	
1523	[illegible]			

INSTRUCTIONS

Prepare 2 copies of this route sheet and forward ALL copies together with necessary correspondence and other documents.

*PURPOSES

1. FOR INFORMATION
2. FOR APPROVAL
3. PREPARE REPLY
4. PREPARE ENDORSEMENT
5. FOR NECESSARY ACTION
6. FOR SIGNATURE
7. RETAIN ENCLOSURES
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NAVY-DEPT PRNC, WASH., D.C.

FROM: Dir, US NRL to INMAT, Fort Wayne, Indiana

DATE OF MATERIAL:

BRANCH, SECT., SYMBOL: 5430-91:RBO:bws

ORIG. IDENT. SYMBOL (Mail Room): NRL Prob No. RO6-29

SER: 0571

DIVISIONS DO NOT FILL IN

DATE MAILED: 29 APR 1959

FILE NO.: RO6-29

SUBJECT: Contract Nonr 2788(00)X - ITT Laboratories for Omnidirectional Microwave Transistorized Crystal-Video Radio Receiving System; Report of Test of Prototype

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~~[illegible]~~ [redacted]

5120-91:REC:bws
NRL Prob No. R06-29
SER: 0571

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29 APR 1959

From: Director, U. S. Naval Research Laboratory, Washington 25, D.C.
To: Inspector of Naval Material, Fort Wayne, Indiana

Subj: Contract Nonr 2733(00)X - ITT Laboratories for Omnidirectional Micro-wave Transistorized Crystal-Video Radio Receiving System; Report of Test of Prototype

Encl: (1) Proposed Rejection Response for Omnidirectional Microwave Transistorized Crystal-Video Radio Receiving System
(2) Drawing No. D-3081, showing suggested container for crystal biasing components

1. The Prototype of the Omnidirectional Microwave Transistorized Crystal-Video Radio Receiving System personally delivered to the Laboratory by Mr. Mast of ITT Laboratories on 1 April 1959 for test and approval under terms of the subject contract prior to release of production has been subjected to the required evaluation. The results of this evaluation indicate that the prototype fails to meet the governing specification requirements in several particulars and therefore the Production equipments patterned thereafter would be unsuitable for the purpose intended. The specific requirements that the Prototype fails to meet were transmitted to the Contractor by telephone on 22 April 1959 and are enumerated below, together with a report on the actual data obtained. The numbers used refer to the pertinent paragraph numbers of the specifications.

a. 3-1(a) Sensitivity: The minimum sensitivity was found to be at least 4.6 db below the minimum specified by this paragraph as amended by the Addendum to the specifications (1×10^{-9} watts/cm^2), or 3×10^{-9} watts/cm^2. The measurements were made in increments of 10° rotation of the sphere and over the specified frequency range, so that it is possible that the figure might be even worse. The minimum sensitivity was found to exist at 3.25 kmc. It is believed that this dereliction resulted primarily from the dissimilar performance of the six Filter-Crystal units which were not only found to vary markedly in their individual frequency responses in their acceptance band but from filter to filter. In an attempt to make this test as realistic as possible and eliminate the effects of variations in crystal sensitivity, crystals were matched in the filters at 3.0 kmc to better than 1.5 db for the assembly. The Filter-Crystal characteristics will be covered later in this report.

Classified by: Dir NRC
Review on: ~~29 Apr 1989~~ 949471
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NRL Prob No. RC6-29
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b. 3-1(d) Overload Recovery: Two different amplifier units were submitted by the contractor for evaluation. They differed primarily in their Overload Recovery versus Overshoot characteristics. The first amplifier supplied (#1) had a recovery time meeting the specifications but a rather high overshoot while the other (#2) had little overshoot but an excessively long recovery time. Inasmuch as Overshoot is not covered by the specifications and is not of importance in the operation of the System as long as it is close to the initial pulse, the amplifier (#1) with the high overshoot and fast recovery is desired and meets the specification requirements.

c. 3-1(f) Acceptance Bands: As stated above, the six filters varied markedly in their characteristics. Several of them showed a variation in frequency response characteristics in their Acceptance band as much as a total of 7 db. Furthermore the frequencies of low and high loss are not uniform for the various filters. This has a deleterious effect on both the sensitivity of the System as well as the Discriminationality and is highly undesirable.

d. 3-1(g) Rejection Bands: The requirement for the rejection of all frequencies below and above the Acceptance band by at least 60 db is not met. At the lower frequencies there are spots at which the rejection is no greater than 37 db while at the higher frequencies the attenuation at certain spots is no greater than 17 db. This was particularly apparent just below the third harmonic rejection band. It is the opinion of the Laboratory that it may be necessary to compromise the rejection characteristics of the filters in order not to adversely affect their Acceptance characteristics. In this connection the Rejection characteristics of the filters were measured with their inputs excited directly rather than through the antenna and their connecting cables. These would unquestionably assist in adding additional attenuation but hardly in excess of 10 db maximum.

e. 3-1 Environmental Conditions: All units of the Prototype equipment successfully withstood all temperature and vibration tests in accordance with the specification requirements with but one exception. One of the six Filter-Crystal Units (#5) when tested at the completion of the vibration tests showed intermittently erratic action, the Acceptance loss varying as much as 25 db. Upon removing the crystal and shaking the filter a number of small metallic particles dropped out of the crystal mount. It was impossible to determine the nature of the fault that might have developed within this unit, but it will be returned to the contractor together with the other five units for

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examination and as a guide in future design and fabrication of these units. Parenthetically it might be mentioned that one of the six crystals showed a degradation in sensitivity of approximately 1.6 db as a result of the vibration test, but this is not considered serious nor anything that the contractor could have prevented; crystals being a sub-contracted item and not within the contractor's control.

3. With the realization that the subject contract involves some element of research and a large element of development, the Laboratory has made a careful reappraisal of the realistic requirements for the System involved in an effort to determine where any easement in the specification requirements might be made without jeopardizing its usefulness for the purpose intended. This appraisal indicates the following facts:

(a) No further reduction in the Sensitivity of the over-all System is acceptable. The original specification figure of 2.5×10^{-10} watts/cm^2 was and still is the figure that should be achieved in order to permit the System to fully accomplish its mission. At the reasonable request of the contractor this was later reduced by specification Amendment by six decibels, resulting in a sensitivity figure that is considered to be on the ragged edge of usefulness. Tests of the Prototype indicate that the minimum Sensitivity is nearly five decibels below this figure. This means that the Sensitivity would be 11 db below that originally and still believed to be necessary, a prohibitive reduction. It would appear necessary, therefore, to examine the design of the over-all System to determine where compromises may be made without a reduction in Sensitivity below 1×10^{-9} watts/cm^2.

(b) From a consideration of the evaluation data on the Prototype, it would appear that the basic dereliction in the performance of the System revolves primarily around the characteristics of the Filter-Crystal units; either in their design or adjustment. The variation in the Acceptance attenuation versus frequency of some seven decibels for some of the individual filters is believed to be the prime cause of the failure of the over-all system to meet the Amended Specification requirements. If these variations could be held to, or below, the specified 2 db it is possible that the required Sensitivity of 1×10^{-9} watts/cm^2 might be met.

(c) While there is no confirmation of the fact, it is believed possible that the contractor in the design and adjustment of these filters may have put too much emphasis on attempting to comply with the specified rejection figure of 50 db. While the attainment of such a figure would be desirable, the rejection

characteristics are obviously of much less importance than the Acceptance characteristics. To express it in a homely fashion, the rejection of undesired signals at the expense of the rejection of the desired signals is a poor trade. Therefore it is believed that the one source of possible and acceptable easement of the over-all specification requirements in order to achieve the required Sensitivity might be in the Rejection requirements for the Filters.

4. Accordingly the six Prototype Filter-Crystal units are being returned to the contractor for examination and further design and/or adjustment. In working on this filter problem it is suggested that every emphasis be put on obtaining the flattest Acceptance characteristics possible and the best possible match in this characteristic among the filters of a set (using a common crystal) with the Rejection characteristics being subordinated to a secondary consideration. This is not to say that the Rejection characteristics should be completely ignored; otherwise there would be no necessity for filters at all, but rather it is intended to denote the region of maximum emphasis.

5. In giving consideration to the very minimum rejection versus frequency that it is believed could be tolerated, the Laboratory has evolved the characteristics shown by enclosure (1), copies of which are forwarded herewith. This is intended to serve as a guide to the contractor in effecting any compromise between the Acceptance and Rejection characteristics of the Filters that might be found necessary in order to permit the Sensitivity requirements to be met. However, this should not be interpreted as a promiscuous waiver of the specified filter rejection characteristics but is indicative of the very minimum that could be considered as a desperate (last) necessity.

6. While the Amplifiers and Antenna units meet all the specific requirements of the specifications governing them individually, their ultimate performance is immutably tied to the performance of the SYSTEM as a whole. It is therefore impossible to definitely approve these units until a Prototype employing them can be demonstrated as being satisfactory and in accordance with the over-all System performance requirements, particularly with respect to Sensitivity. However, the design and performance of the Amplifiers appear sufficiently firm as to give them tentative approval for production, at the contractor's risk.

7. With respect to the antennas, a different situation exists. The performance requirements of the specifications in which the antennas play a dominant role were predicated on the assumption that they would be mounted on a smooth

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sphere or at least that such deviations from this condition that might result from the necessity of mounting other objects on the surface of the sphere would have negligible effects. The details of these objects were not known at the time the contract was let. Subsequently the details of these objects have been crystallized and tests with the antennas on a sphere carrying mock-ups of all objects that will additionally be mounted on its surface have indicated that the original assumption was too optimistic and that these objects, in their present forms affect the antenna patterns so severely as to render the omni-directional characteristics of the antenna system unusable. An intensive investigation is being prosecuted both with respect to possible revision of the offending objects and the possibility of overcoming the difficulty by the use of antennas of different design. The contractor will be kept advised of the progress in these particulars.

8. In the interim, release of production on the antennas should be held in abeyance.

9. Again referring to the Amplifier Units, it has been suggested that the use of six input leads (believed to have had its origin in a developmental design when the use of six pre-amplifiers was visualized and later found to be disadvantageous) is undesirable, inasmuch it introduces five additional points of possible failure under vibration. Lead entrance points have been found to be particularly vulnerable in this connection. The use of a single input lead to the Amplifier would be an improvement and would similarly simplify the wiring of the System. The Laboratory is favorably inclined to such a design change. However, such a change will necessitate the contractor furnishing an additional unit with each System, these units containing the crystal bias dropping resistors and by-passes and being provided with the required number of Microdot connectors for receiving the leads from the six Filter-Crystal units and the lead from the Amplifier. Should the contractor be amenable to making this change and supplying the additional units, the Laboratory would desire such units to be provided encapsulated within a container whose overall dimensions do not exceed those of the suggested housing shown in enclosure (2), with identically located mounting holes, in order to permit this unit and six filter-crystal units to be mounted around their mounting canister. In this connection the contractor is advised that the Laboratory, in anticipation of this change, is doing the necessary design work to permit the mounting of seven units instead of six. Any alternative design for that outlined in enclosure (2) will be considered on receipt of a detailed sketch. Early confirmation of the action the contractor will take in these premises would be appreciated.

10. In connection with the possible divorcement of the crystal biasing circuits and components from the Amplifier proper, it is requested that the contractor re-evaluate the method by which bias current is supplied to the crystals. It has been noted that on occasions while attempting to match crystals in the system, crystals appear to mysteriously change their characteristics as if they had been subjected to a heavy overload. An examination of the biasing circuit employed indicates the possibility that the closing of the 12-volt power circuit to the amplifier or the replacement of a crystal might result in a charging surge through the 20-mfd by-pass capacitor and the crystal of sufficiently high value to damage the crystal. Because of the fact that all the biasing circuitry is encapsulated in the amplifier it is impossible to completely analyze the conditions that might exist in this particular. Oscilloscope investigation of the voltages existing across the crystals when power is applied to the amplifier indicated a surge in excess of five volts for a duration of approximately a millisecond. Whether this is sufficient to damage a crystal is a moot question and is only brought to the attention of the contractor for his consideration in any divorced design of the biasing circuitry. Whether or not any charging (or discharging) surges that might be impressed across the crystals could damage them, it would appear that such voltages should be held to an absolute minimum.

11. As stated in paragraph 4 above, the Laboratory is returning the six Prototype Filter-Crystal units direct to ITT Laboratories, to the attention of Mr. Mast. It is anticipated that either they, or six new units must be returned to the Laboratory as a second submission of a Prototype. Accordingly the Laboratory is retaining the antennas and amplifiers of the first Prototype for the conduct of additional tests prior to approval and complete release of production.

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By direction

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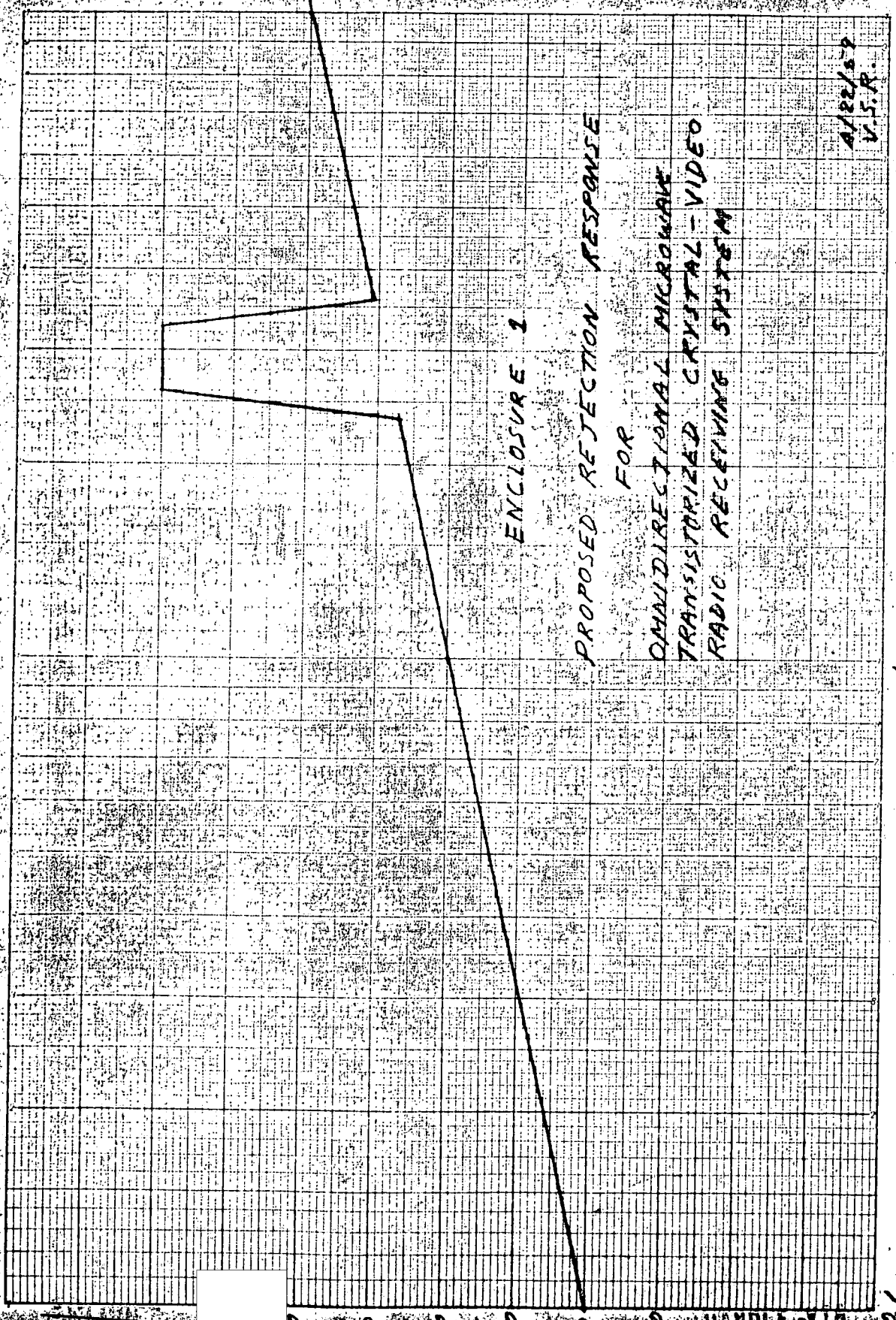

ENCLOSURE 1

PROPOSED REJECTION RESPONSE FOR OMNIDIRECTIONAL MICROWAVE TRANSISTORIZED CRYSTAL-VIDEO RADIO RECEIVING SYSTEM

HANDLE VIA ENCLOSURE TO NRL LTR C05430-91: dated [illegible]