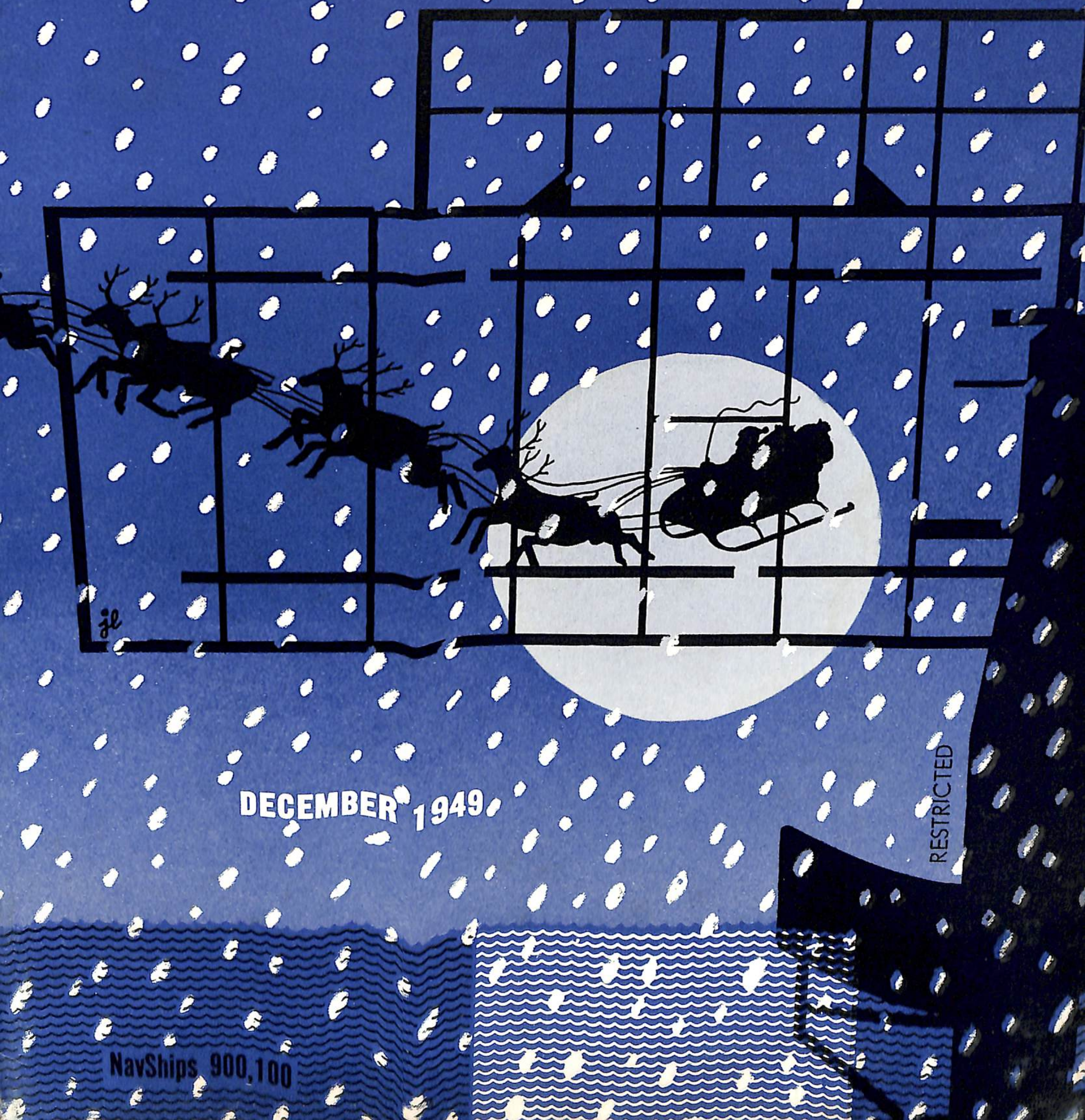
BUSHIPS Electron



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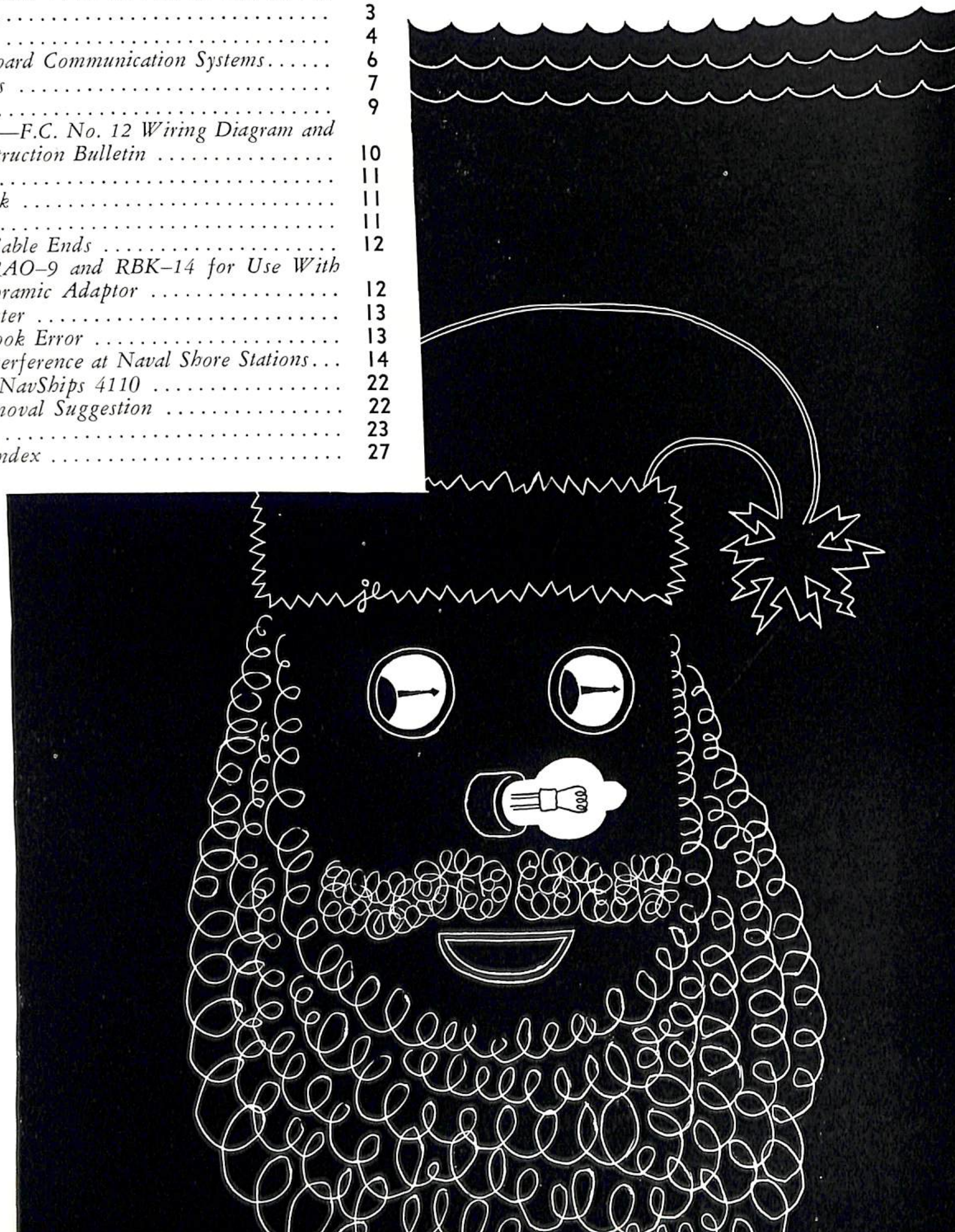
BUSHIPS Electron

A MONTHLY MAGAZINE FOR ELECTRONICS TECHNICIANS

THIS ISSUE



a merry christmas

RESTRICTED

R-223/SPR BLANKING RECEIVER

Since the end of World War II and until only a year or so ago, countermeasures equipment and operation in the fleet had been allowed to deteriorate to a point which was dangerous to fleet security. This was attributable to a shortage of maintenance and operational personnel and concentration on higher priority communication and other electronic equipments. Fortunately this undesirable trend was halted by responsible officials both ashore and afloat resulting in a concentrated effort to improve countermeasures operations and equipment throughout the forces afloat. These improvements covered many phases, one of which was to enhance the techniques of countermeasures intercept by eliminating most, if not all, local electronic interference created by own ship and other ships in the immediate vicinity.

There has long been recognized the need for some means of preventing r-f pulses from own ship's radar equipment from interfering with the functions of the countermeasures search equipment. These local r-f pulses plus the spurious emissions and spurious responses occasioned thereby have created interference to the countermeasures search and intercept equipment which makes the problem of intercepting and analyzing enemy transmissions exceedingly difficult, and in many cases impossible.

To correct this situation and eliminate the major portion of such interference, a receiver was designed for use in conjunction with any radar intercept receiver having the proper video signal output impedance characteristics. This receiver is an untuned, broadband equipment designated R–223/SPR Blanking Receiver (figure 1). Its purpose is to prevent strong r-f pulses, generated in own ship's radar equipments and in equipments of friendly ships in the immediate vicinity from appearing in the displays of associated units such as direction finders and pulse analyzers. The blanking receiver requires two signal inputs: (1) R-f input which can be introduced either by paralleling the antenna input with that of the companion receiver or by use of an antenna separate from that of the companion receiver. (The former method is considered most practical since it involves only one antenna and less manipulation of coaxial cables in the main RADCM control room.) (2) Video signal input from the companion receiver.

The blanking receiver is a compact, easily mounted unit, operating from a 115-volt, 60-cycle, single-phase

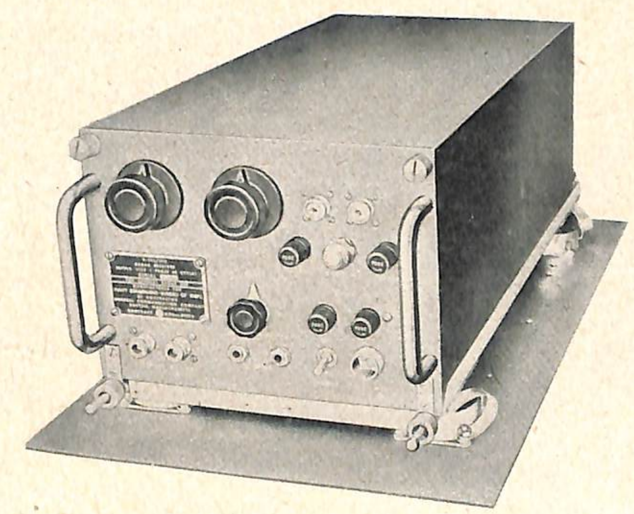


FIGURE 1—Front view of the R–223/SPR Blanking Receiver showing various controls and cable connections.

power source, and requires approximately 115 watts of power. No facilities are provided for tuning the receiver, the frequency coverage of approximately 40 to 3,000 Mc being afforded by the use of a crystal input circuit employing a Type 1N21B crystal. Due to the untuned, broadband characteristics of the receiver, it is a comparatively insensitive system. This feature is desirable (in view of the purpose of the unit). Sensitivity of the unit is variable by means of a front panel control designated BLANKING LEVEL. The setting of this control determines the level of r-f input signal above which blanking pulses are generated. When these pulses are generated, evidences of the strong r-f pulses in the video output of the blanking receiver and consequently in the associated presentation units are obliterated. The receiver furnishes two outputs, a video output for use in associated units of the RADCM system, and an audio output for aural monitoring. Due to the characteristics of the units, each blanking pulse causes a 20-microsecond "hole" in the video output which is not objectionable. However, facilities are provided to prevent this hole from appearing in the audio circuit since it would produce an audible output, which would be misleading to the operator.

The functional block diagram of the R–223/SPR is shown in figure 2. The main portion of the unit is an insensitive receiver consisting of a crystal detector across the antenna input and a four-stage video amplifier. The sensitivity of this channel is controlled by varying the gain of the channel and passing the output through a clipper stage. Thus, if the gain of the channel is made low, no small amplitude signals will pass through the clipper tube that follows the video amplifier and there will be no output from the clipper except for very

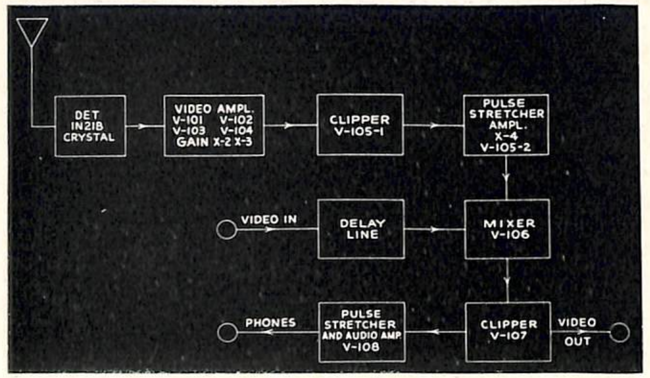


FIGURE 2—Functional block diagram of the R–223/SPR Blanking Receiver.

large amplitude input signals. Conversely, if the gain is increased, smaller signals as well as larger signals will pass through the clipper. Thus the setting of the gain control (BLANKING LEVEL) in conjunction with the bias on the clipper tube affords a means of sifting the stronger signals from the weaker. In this case strong signals are representative of pulses and responses generated by own ship's electronic equipments, which are objectionable and are to be eliminated from associated displays. Each pulse output from the clipper stage is stretched to about 20 microseconds in duration and passed to a mixer tube V–106 (see figure 3).

The video from the companion receiver is connected to a jack on the front of the R–223/SPR. These video signals are passed through a delay line and into the same mixer tube (V–106). The delay line is inserted to insure that unwanted signals will be cancelled out by the 20-microsecond pulse generated in the blanking receiver in time synchronism with the undesired signals. This results in two inputs to the mixer tube: (1) Those large amplitude positive polarity signals which pass through the clipper and are stretched to 20 microseconds in duration; (2) The negative polarity video output of the companion receiver which contains all receiving signals (large and small) but delayed approximately two to three microseconds with respect to the 20-microsecond pulses.

When a large amplitude signal is received (sufficient in amplitude to pass through the blanking receiver) a 20-microsecond blanking pulse will be generated and impressed on the grid of the mixer tubes. Simultaneously this large amplitude signal will pass through the companion receiver, be delayed a few microseconds, and impressed on the grid of the mixer tube. Under these conditions there will appear in the output of the mixer stage a large 20-microsecond negative blanking pulse with a smaller amplitude positive pulse enclosed as illustrated in figure 4. The output of this mixer tube is impressed on a clipper, biased so that only positive signals will pass through and appear in the output. Thus any positive signal enclosed in a large 20-microsecond blanking pulse will not actuate this clipper and there will be no output. This is the principle of eliminating strong pulse interference from the video output which is connected to the associated display units. The holes created by the blanking pulses have been found unobjectionable, but a reduction of the length of the blanking pulses is being considered in order to increase the efficiency of the over-all intercept system.

Since an audio output is furnished for aural monitoring, the holes created by the blanking pulses are undesirable since they will cause a change of current flow through the audio transformer and will therefore be heard in the output. To eliminate these breaks in the audio output, the output from the clipper stage is passed through a diode-connected triode (V–108–1) to a long-time-constant R-C circuit which acts as a pulse stretcher. This circuit in effect allows the desired audio pulses of short duration to pass through the audio system but smooths out the 20-microsecond holes so they will not actuate the audio output stage.

The R–223/SPR has been evaluated by Commander Operational Development Force, U. S. Atlantic Fleet to determine its capabilities and limitations under numerous operational tests. Tests were conducted to determine the effectiveness of the receiver in blanking own ship's radar interference, nearby ships' radar interference, determining maximum and minimum threshold of blanking sensitivity, and the maximum range capabilities when the receiver is operated as a broadband receiving

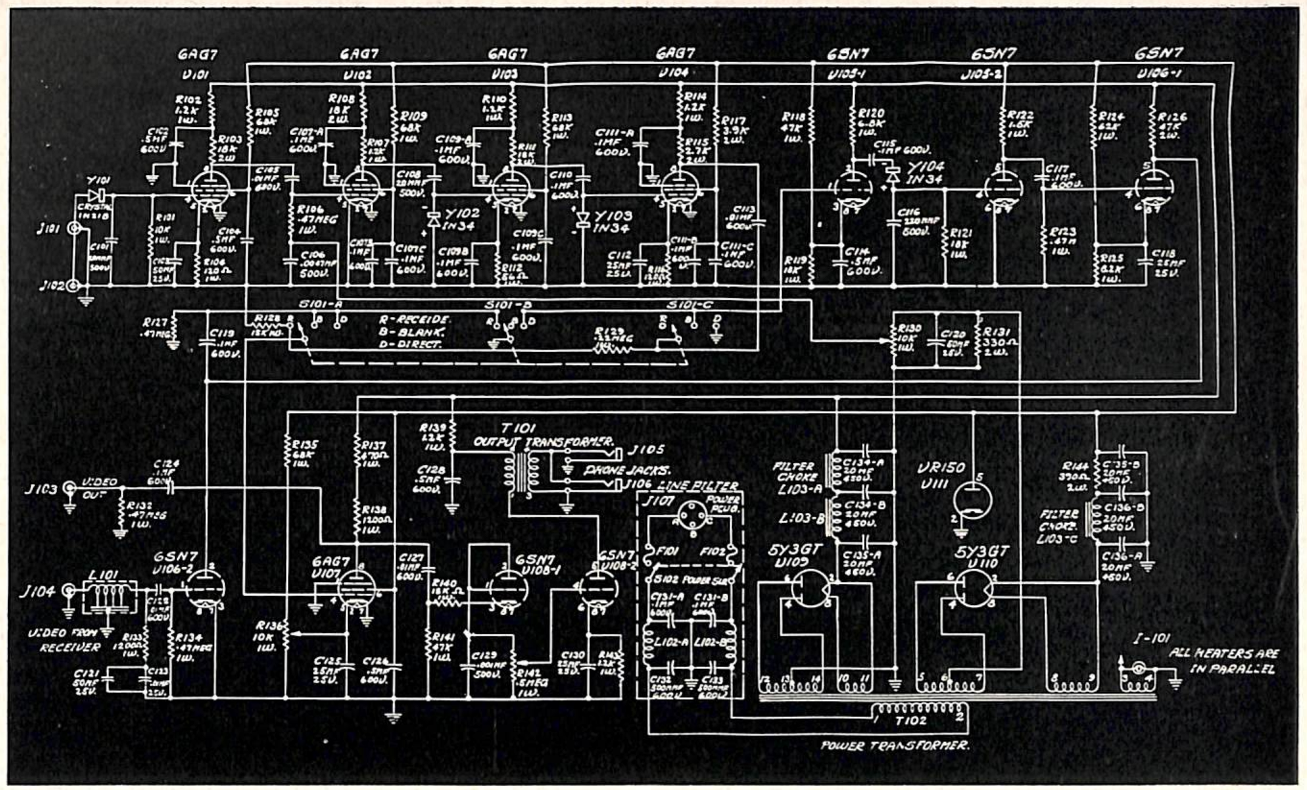


FIGURE 3—Schematic diagram of the R–223/SPR Blanking Receiver.

system. The results obtained from the above mentioned tests were, in general, satisfactory although data obtained indicated a low sensitivity region over a small portion of the frequency band. The evaluation report by ComOpDevFor (from which this article was prepared) also recommended an over-all increase in sensitivity throughout the range, plus minor mechanical alterations to improve operation and appearance. The technical difficulties are being studied by the Naval Research Laboratory and further improvement is expected as a result of their findings.

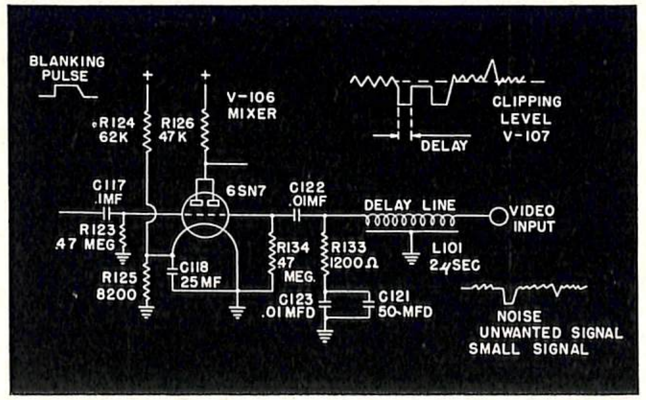


FIGURE 4—Schematic diagram of the video mixer V–106 and representative waveforms illustrating theory of operation.

Type of Approach	Through September	To Date
Practice Landings	12,740	271,982
Landings Under Instrument Conditions	426	10,612

ELECTRONICS ADMINISTRATION

by
LT. CDR. SIDNEY A. SHERWIN, USN
DesLant Staff Electronics Officer

One of the most vital problems facing the Navy is that of maintaining electronic equipment in satisfactory operating condition. We probably have the finest equipment in the world, the product of brilliant scientific and engineering minds, and of production systems unequalled anywhere. Our radios, radars, and sonars are the best to be had at any price. They are almost universally rugged, compact and efficient. They have, however, one fatal weakness—they will not run forever without breaking down. For weeks, yes; for months, sure; for years, maybe; but not forever, and right there arises our problem—and all hands will agree that it is a tough one.

To put it a little more strongly, the problem has become so serious that unless it is attacked systematically and scientifically and continuously by everyone concerned, from the Bureau of Ships down through the greenest striker, the steady improvement of Navy electronic equipment must inevitably come to a faltering halt for lack of maintenance personnel.

The above statement may appear unduly pessimistic; the feeling is common in the field that the present shortage of technicians is a temporary one, the inevitable result of the wartime mushrooming of the electronics field, and that when the mushrooming stops and industry becomes saturated with technicians, the problem will more or less take care of itself. The Navy will then be able to enlist all the expert ET's it can use, and all will be rosy.

There are a few flaws in that line of thinking which are fairly apparent. The most obvious is that the industry is still growing like a weed and that as a result the cream of the technician crop, the men with five, ten, fifteen years experience in the field, are able to earn a good salary outside. (Navy pay by itself has never been a primary inducement to the best men in any field to join the service.) This situation is not likely to change within the foreseeable future; therefore we are dependent on our own training programs to supply our needs. It is not my intention to discuss the long range training program; I merely want to point out that with short enlistments and a small percentage of reenlistments we are faced with the problem of maintaining large quantities of very complex electronic equipment with small numbers of technicians, many of whom are relatively inexperienced.

Another factor which many people have not considered is the increasing complexity of the equipment. It has been estimated that the complexity of electronic gear increases roughly as the square of the number of tubes. Consider then the plight of the commanding officer of a ship carrying an SP radar or—much worse—an SX. Complexity of equipment is increasing in all branches of electronics—contrast the TDZ and RDZ with the TBS—and the numbers and ability of maintenance personnel are about static. This condition cannot continue; something has to give. We are faced with several choices. We could admit our inability to maintain our equipment and make contracts for complete maintenance by civilian engineers. This we are not prepared to do, both because of the tremendous cost involved and because we do not yet feel that it is necessary. Since we plan to continue doing our own maintenance, we are bound to make every effort to improve the quality of our maintenance personnel, *and to use their abilities to the greatest advantage.*

A ship or squadron Electronics Officer has little control over the quality of the personnel he receives on board. He does, however, have considerable control over their shipboard training and over the way their time is used, and those two things are the entire key to his success or failure in his job.

The problem facing a ship's Electronics Officer is one of man-hours—so many men, so many hours, ergo, so many man-hours available in which to keep the equipment functioning. The Electronics Officer knows from his experience with his installation that a certain number of man-hours per day or per month are necessary to keep his installation operating properly. If the number of man-hours available is equal to or greater than the number required, the equipment continues to operate, normal casualties are repaired by ship's force, and the captain is satisfied. If the number available is less than the number required, the installation goes down hill at a rate determined by the size of the gap between the two, and the captain is (or should be) dissatisfied. Obviously, then, the primary function of the Electronics Officer is to make the available man-hours balance the required.

There are various ways of doing this. Let's examine for a minute the available man-hours. They are composed of two factors, men and hours. There are only twenty-four hours in a day, some of which are not available, so we can't do much about the hours. Now what about the men? Well, the ship has only so many ET's, so we can't do anything about that, either. Or can we? Here we run into a matter which while completely settled on paper, is still pretty much up in the air in actuality—the question to what extent operating personnel should be used in maintenance. There are many more operating personnel than technicians. Here is a large source of man-hours which, if properly used, will go a long way toward bridging our gap.

At this point a plaintive cry is heard from Ensign Gridshort, in the rear row. 'That's all very well in theory," says Ensign G., "I know operating personnel are supposed to be able to perform routine adjustments and maintenance, but I'm faced with a practical problem. My operators can't do preventive maintenance—they'd kill themselves or wreck the gear."

An embarrassing admission, Gridshort, but an honest one, and you can take some comfort in the knowledge that you are not alone. However, you *must* use your operators. How you use them is your business, for their capabilities will vary from ship to ship, but use them you must, particularly in preventive maintenance. Routine tuning adjustments and turning the equipment off and on are of course to be expected. In addition, items like testing tubes, inspecting equipments for dirt inside and out, loose cable clamps, loose leads, loose tube clamps, missing knobs, broken meter glasses and many of the thousand other things that constitute a proper preventive maintenance program *should be done by operating personnel.*

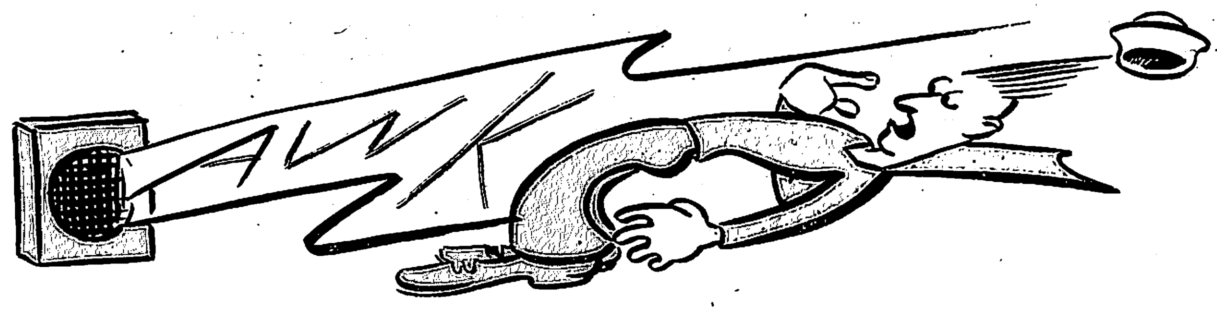
It is quite true that use of operators for inspection and the like will not increase the number of man-hours available for repair work. Its effect is apparent at the other end, in the reduction of the number of repair man-hours required. For there are innumerable cases where the timely discovery of a loose lead in a routine inspection would have saved two days' trouble-shooting for two men—thirty-two man-hours gone forever.

What operating personnel do not know, they must be taught, and this means a training program. Here Ensign Hotbottle, in the front row, emits a howl of anguish. "Doesn't the man know our time is jammed full already?" Yes, the man knows, but the fact remains. You will never get it unjammed until you start using it to the best advantage. That means training for everyone, it means the assignment of each man to duties within his capability, it means a constant spot-check by Electronics Officers to insure that preventive work is actually being carried out, and it means a never-ending supervision of the organization to insure that necessary changes are made in maintenance activity as the ship's personnel changes.

At this point, Gridshort explodes. "Now wait a minute, Sir. I'm working like a dog right now. I'm not just Electronics Officer, you know. I'm Damage Control Officer too, which ought to be a fulltime job, and if I did all you tell me I should, there could never be any time left for me to work on the equipment myself."

And there, Gridshort, you have tapped the well of truth. You have no business working on the gear yourself until the other work is done. In spite of your ten years as a ham, your B.S. in E.E., and your three years' postgraduate work in electronics, yours is an administrative job, *and trouble-shooting for you comes under the heading of recreation.* Until such time as your men can keep the equipment running without your personal assistance, your time must be spent improving your organization, and you should roam the electronic wilds with screwdriver and soldering gun only as a last resort. This may sound extreme, but there are cases where the ship's Electronics Officer is fully qualified technically, works like a dog, knows his equipments backward and forward, does all the work himself because he is the best trouble-shooter on board—and is fighting a losing battle because he can put in only twenty-four man-hours in a day and it takes more than that. There is nothing hypothetical about this—I can name names.

Organization and supervision are the primary concerns of the shipboard Electronics Officer; he must allocate his available man-hours judiciously, knowing that by so doing he will reduce the man-hours required. His sole aim must be to make the two balance, for when they do the problem of electronics maintenance is solved.



EXTRANEOUS NOISE

IN SHIPBOARD COMMUNICATION SYSTEMS

The presence of audio feedback circuits and the pickup of extraneous noise by microphones in shipboard radio communication systems have been known to exist for some time, and the Bureau of Ships is constantly endeavoring to improve these unsatisfactory conditions in the Fleet. It is known, however, that these conditions arise from faulty installation and operation as often as from limitations imposed by installation requirements or by substandard equipment. Standardized installation and operating procedures are publicized through the medium of manuals, periodicals, field change bulletins, etc. Close adherence to these procedures will reduce considerably the difficulties in vessels where communication requirements are constantly changing; where improved units are installed and used along with older equipments; and where equipments designed for other services are utilized.

Observation of the following procedures will alleviate some of the more common faults found in shipboard communication systems:

1—Reduce loudspeaker installations to an absolute minimum.

2—Reduce loudspeaker volume to an absolute minimum. The volume control in the amplifier may be used. Where installation conditions do not permit this, Bureau Drawing RE49F2002 covers a remote volume control that may be utilized. If necessary, relocate loudspeaker as close as possible to the center using the information.

3—Provide proper impedance matching when utilizing Navy type loudspeakers and amplifiers with army or airforce equipments (see CEMB, Page AN/ARC: 16).

The Bureau has set up a project for the preparation of a field change for modifying the Type -23496 and -23500 radiophone units to attenuate the earphone of the handset. For the present, it is desirable to standardize on the Type -51081 handset, used with the -23500 and -23496 radiophone units. Current Bureau drawings are available covering remote receptacles, both watertight and non-watertight and with or without volume control, and receptacles in selector switches. Where remote use of headset and microphone are desired, Type -49016 headsets and Type -51004 microphones are considered standard. A Type -49029 jackbox with one jack removed and replaced with Type -49578 microphone jack is recommended for use where these jacks are not already provided. Type -51094 microphones are not authorized for shipboard use (See ComOpDevFor final report on Project OP/S105/A6-2 of 22 April, 1946).

The requirement for noise-cancelling handsets and microphones is well recognized. The Bureau currently has under procurement a quantity of newly-designed noise-cancelling handsets and microphones which are expected to become available for Fleet evaluation during August, 1949. Upon completion of successful evaluation, procurement of a sufficient quantity of these units to meet Fleet requirements will be undertaken. In addition, newly-designed headsets and chestsets will shortly become available for evaluation. All of the new types of the above accessories will incorporate mechanical and electrical features not now included in present units. Since field changes to existing equipments will be required to accommodate these new units, extensive interim modifications are not justifiable, and the recommendations contained herein are considered adequate for the present.

The communication remote control system in large vessels is becoming increasingly complex. The extreme flexibility of the basic system has resulted in continued demands from the Fleet for expansion, even to the extent of including other related systems such as teletype and facsimile. The Bureau of Ships has already begun simplification of the system in new construction vessels, and hopes to eventually extend such simplification to maintenance vessels.

U-H-F TRANSMISSION LOSSES

Some u-h-f installations have recently been closely inspected in an effort to improve overall performance. The critical factors of antenna location have been generally recognized and many attempts have been made, with varying success, to improve this portion of the installation.

The transmission line leading to or from these antennas has not, in many cases, received the attention it warrants. The recent examination of a cruiser installation indicated a need for relocation of antennas to improve the radiation pattern and replacement of the coaxial transmission lines because of low insulation resistance and excessive r-f losses. This was done during the ship's last yard availability. "Before and after" performance curves of this installation are presented below as a graphic representation of one of the hidden deficiencies that hamper proper performance.

In this case a more uniform coverage is expected as a result of the antenna relocations. A further, though temporary, improvement in performance is expected due to an increase in average power output. The increased performance expected from improved power output can reasonably be considered as a temporary one should the ship's maintenance remain at the average level evidenced on its arrival in the shipyard. As the output of the TDZ transmitters drops back to the previous levels, the average power at the antennas will be even less than before despite the improvement in insulation resistance of the transmission lines. The ratio of transmitter power output to the power at the antenna has been expressed on a percentage basis to represent the overall efficiency of the radio-frequency transmission system. Each check point was adjusted for variations in transmitter output for the particular frequency.

Figure 1 shows a marked decrease in transmission efficiency for the new installation as compared to the one removed. It is not as frequency sensitive as the old one and has a satisfactory insulation resistance. When its performance is matched against the old installation or an expected median, it becomes obvious that the assumptions of the previous paragraph are reasonably well founded and that satisfactory communication will be sustained only if the antenna relocation was a marked improvement, and the ship's force is able to maintain optimum output from the transmitters at all times.

Figure 2 presents a somewhat different picture in that the new installation is a slight improvement at the lower frequencies. It is interesting to note the relatively small difference in efficiency between the old and new transmission line despite a high order difference in insulation resistance. This installation will also be dependent on improved antenna placement as well as maintenance of optimum power output from the transmitters to maintain satisfactory u-h-f communication.

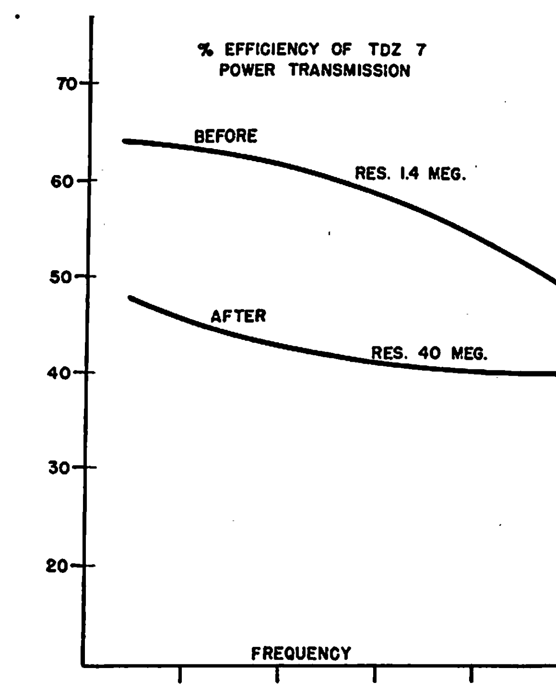


FIGURE 1

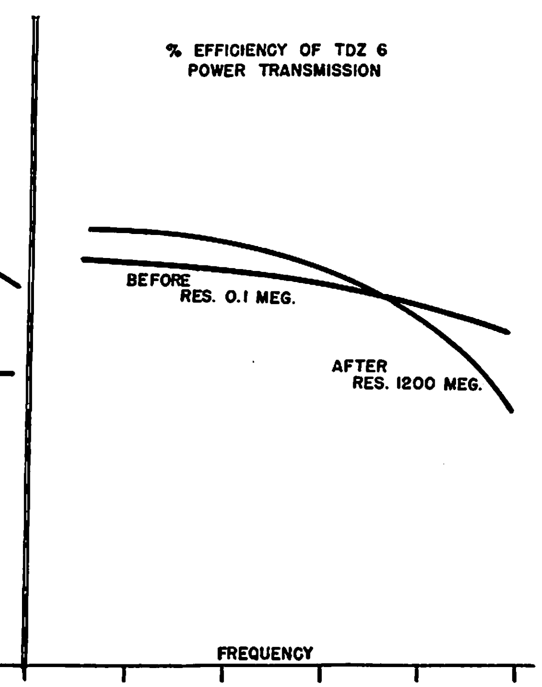


FIGURE 2

The cases illustrated by figures 1 and 2 are among the first of those reported, and the returns to date have not been of such proportion as to permit any comprehensive analysis of the overall conditions existing in the fleet or at the time of installation. These cases do serve, however, to point out the need for the exercise of meticulous care in the makeup of coaxial connectors and the installation of coaxial transmission lines. Important factors to be considered are:

1—Use RG–18/U coaxial cable for the entire run on transmitter installations from the r-f filter to the antenna.

2—Utilize the shortest practicable distances keeping under one hundred feet total line where possible.

3—Avoid kinks and binding clamps which may produce constrictions due to plastic flow in the coaxial cable, and place the cable where it will not be subjected to sustained ambient temperatures in excess of two hundred degrees fahrenheit.

4—Follow the specific instructions for the particular connector being installed.

5—Use a smooth thin uniform film of dielectric compound on gaskets and on the outside of cable jackets where the clamping nut will seize the cable. It should also be used on exposed threads. Dielectric compound can be ordered as Army-Navy specification AN–C–128, Aviation Supply Office Stock Number R52–C–3107–110 or Dow Corning Compound No. 4—Standard Navy Stock Number N16–C–12853–500 from the Electronic Supply Office.

6—Weatherseal exposed connectors with tape and insulating varnish after assembly.

7—Keep the number of connectors used in assembling the line to a minimum.

A convenient test instrument for quantitative analysis of the efficiency of each installation is provided as the R-F Wattmeter ME–11/U. Careful measurements of each installation should be made using the ship's transmitters as a source of power.

NAVSHIPS 383 . . . . . .
LOST, STRAYED OR STOLEN

In order to justify replenishment of spares or modification of an electronic or associated equipment to increase its efficiency, the failure report form NavShips 383 must be filled out and sent to the Bureau of Ships for tabulation and study. It is necessary that these failure reports be submitted for all components of an electronic or associated equipment, which were repaired or replaced for any reason. In the past the mechanical portions of these equipments have been neglected in the reporting of failures.

Recent instances of equipment failures in the mechanical systems of Models JT, WFA, WCA, QHB, QGB, B/T winches and B/T instruments have come to the attention of the Bureau of Ships. No reports covering these failures were received. Some transducer and radar and radio antenna failures also have never been reported. The S&A form used for survey of a lost or defective piece of equipment does not eliminate the necessity for submitting a failure report form NavShips 383.

The beacon failures of Models NAD-6, NAD-10, NAC and NAC-1 are not being reported. It is certain that many of these have been lost or have had component failures of some kind, and equally certain that some repairs were made either by ships or repair activities.

It is requested that vessels, repair activities, tenders, and service forces report all component failures or losses due to component failures of the equipments under their cognizance, with equal attention to the mechanical components.

The person actually making the repair fills out the failure report and should furnish the ship or activity with the information necessary to complete its records. However, the authority (usually the Commanding Officer) responsible for an equipment is also responsible for making arrangements for its repair and seeing that the proper entries are made in the machinery history cards for electronics.

If classified material is included in the failure report, it must be handled accordingly.

Sirs:

After putting a field change in a Model RCH Radio Receiving Equipment (Serial No. 205) on the phone control switch, I plugged it in. All that was connected to the receiver was the power cable and the antenna. *Signals were coming through.* They were tunable and variable. The signals were coming from the output transformer. After checking the transformer I found a resistance of 2500 ohms on the 20,000-ohm impedance secondary. There should have been only 1000 ohms resistance there. I am holding the transformer in case you want it.

Although the short across E–104 had been removed and C–102 had changed value, I don't believe they had anything to do with the reproduction of the CW signals. Also, the receiver only worked on CW and CWOL and not on the voice position.

There were four other witnesses to this occurrence: E. O. White RM3, G. J. Vanpelt RMSN, A. G. Galzinski RMSN, and P. C. Kelley RMSN.

I would like to know what caused this reproduction of the CW signals.

I have read in ELECTRON about arc detecting and reproducing (reference "Singing Palm," ELECTRON Dec. 1948). I wonder if this could have happened?

EDWARD M. GILBERT, ET3
SP120 Tacron 2
NAS, Norfolk, Va.

Bureau Comment: Here is another strange occurrence. ELECTRON *Orbit is thrown open for comments. Who in the field can and will write us and explain this phenomenon? Mr. Gilbert and the Editor await your explanation.*

MODEL SO–10 RADAR

Sirs:

We have a Model SO–10 radar set. Recently we had trouble with the radiation cutting out after the gear had been running for approximately an hour. After a short wait the equipment would radiate again. The trouble was found in the rectifier power unit where relay K–202 was cutting out. I replaced the relay and operation has been satisfactory since.

A few days after this happened, a radarman from the LST–983 came over and said he was having the same trouble. I suggested he replace relay K–202. A short time later he informed me that his radar was in normal operation.

Since I have encountered this trouble twice in a short time, it might be worth printing.

H. B. STEELE, ET2,
USS LST–1153

MODEL QHB–1

Sirs:

A certain amount of trouble was encountered in the Model QHB–1 installation on the *USS Trumpetfish (SS–425)* caused by arcing between Contacts 1 and 6 on Relay K–103, fusing these contacts together, and causing Fuse F–108 in the indicator console to blow when gyro excitation was turned on.

K–103 relay was replaced and a considerable amount of arcing was observed when S–109 was turned on due to close spacing between contacts. A piece of fish paper inserted between the inner relay contacts 1 and 6 eliminated all arcing and the relay then operated satisfactorily.

R. A. GEOFFRION
Electronics Ship Section
Portsmouth Naval Shipyard

TUNING MODELS SU/–1 TRANSMITTER-RECEIVERS

Sirs:

In the article entitled "Tuning Models SU/–1 Transmitter-Receivers" on Page 25 of the June 1949 BUSHIPS ELECTRON, it seems to me that the second sentence in the second paragraph reading, "If the meter does have an output position . . ." should read "If the meter does *not* have an output position . . ."

R. V. BUGGY,
Electronics Engineer,
Code 129A,
Philadelphia Naval Shipyard

Bureau Comment: The Bureau of Ships and ELECTRON magazine wish to thank Mr. Buggy for calling this typographical error to our attention.

ERRORS IN WFAa IB, WFA–F.C. NO. 12 WIRING DIAGRAM AND WFA–F.C. NO. 16 INSTRUCTION BULLETIN

WFAa Instruction Book NavShips 900,448(A) Errors

Figure 7–119 on Pages 7–125/126 applies to the Local Range Recorder CBM–55166A instead of the Remote Range Recorder CBM–55166.

Figure 7–120 on Pages 7–127/128 applies to the Remote Range Recorder CBM–55166 instead of the Local Range Recorder CBM–55166A.

The shop wiring diagrams for the range recorders, Figures 7–147 and 7–148, do not include WFA Field Changes No. 12 and No. 16.

The shop wiring diagram of the Training Power Unit CBM–20452, Figure 7–157, does not include the feedback resistors R–1919, R–1920, R–1921 and R–1922, and capacitors C–1912 and C–1913. These components are added when WFA Field Change No. 14 is made and are shown on schematic diagram Figure 7–128.

The shop wiring diagrams of the Receiver-Amplifier CBM–46262 shown in Figures 7–134 and 7–135 do not contain WFA Field Change No. 16 shown in the schematic diagram of Figure 7–117. Corrected shop wiring diagrams are being prepared by the contractor for distribution and insertion in WFAa instruction books.

WFA Field Change No. 12 Connection Wiring Diagram

The connection wiring diagram, Figure B–4, shown on Page 17 of the instruction bulletin for WFA Field Change No. 12 is incomplete and misleading. The correct connection wiring diagram accompanies this article. This diagram will be provided by the contractor as an addendum to the instruction bulletin.

WFA Field Change No. 16 Instruction Bulletin

No instructions for connecting the lead from T–107 to the junction of R–129 and R–130 are given in the step-by-step procedure for the modification of Receiver-Amplifier CBM–46262. The connection can be made by connecting the blue wire from Terminal #3 of T–107 to the bottom of R–130 (See Figure 20 and 25).

Figure 20 shows Terminal 18 tied to the lower end of R–164, whereas it should be tied to the junction of R–156 and R–164 as shown in Figure 7–117 of the WFAa Instruction Book.

The instruction in Figure 18 which states—"Remove from 182 and 272B on old terminal panel and connect to 181A and 182A on new panel"—should be corrected to read—"Remove from Terminals 272B and 182 on old terminal panel and connect to 272B and 182 on new terminal panel."

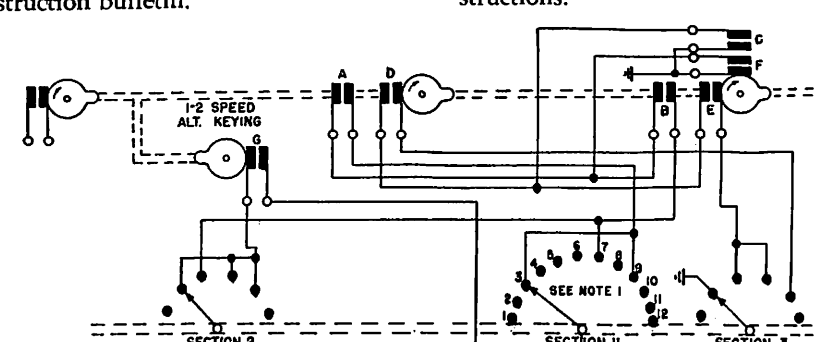
In Figure 15, Terminal A8 in each ranging receiver should be designated Terminal 23.

Figure 12 applies to the shop wiring for the remote amplitude modulation instead of the local amplitude modulation control; likewise Figure 13 applies to the local instead of the remote control.

The driver barrier strip after modification, Figure 3, does not indicate that Terminal 3 is connected to R–406. This connection should be made as shown in Figure 7–127 of the WFAa Instruction Book.

Leads 109A, 201 and 255, supplied for the modification of the transfer relay and BDI amplifier, are too short and have to be replaced with longer leads.

An addendum will be provided by the contractor describing pen-and-ink corrections to the bulletin of instructions.



NOTE: OTHER SECTIONS OF SWITCH S-904 REMAIN THE SAME AND ARE NOT SHOWN.

REFER TO WFA-a INSTRUCTION BOOK NAVSHIPS 900,448(A) FOR SCHEMATIC WIRING OF LOCAL RANGE RECORDER (FIG.7-119) AND SCHEMATIC WIRING OF REMOTE RANGE RECORDER (FIG.7-120)

KEYING SELECTOR SWITCH S-904

NOTE 1
POSITION 3 OF SECTION 11 CORRESPONDS TO POSITION #2 (STANDBY AND MANUAL) OF KEYING SELECTOR SWITCH S-904 (FIG.B-1)
POSITION #7 OF SECTION #11 CORRESPONDS TO POSITION #4 (PULSE 1500 YD.) OF S-904
POSITION #8 OF SECTION #11 CORRESPONDS TO POSITION #5 (3750 YD.) OF S-904

RCM INFORMATION

Analysis of operational reports received by the Bureau of Ships indicates an increasing number of failures in radar countermeasures installations, with the causes for such failures being poor installation and maintenance practices.

The latest reports on installations aboard destroyers indicate increasingly poor reception. Inspection of the RCM compartments to determine the causes leading to this condition showed the equipment to be in good condition and the fault to be outside of the compartment.

Inspection of the cabling and antennas showed the following conditions:

1—The yardarm supporting the antennas was next to the stack.

2—Indications of personnel working on the stack using the yardarm for a stepping platform were noted.

3—The coaxial cable mounted on top of the yardarm was badly damaged due to having been stepped on, and needed to be replaced.

4—The coaxial connectors were in poor condition due to stack gases and salt spray.

5—The antennas needed cleaning, repairing or replacing.

A substantial part of the cause of this damage can be eliminated in future installations and replacements by running the coaxial cable underneath the yardarm as far as is practical so that it will be protected from such abuse. Also, the connectors and antennas should be more frequently and more thoroughly inspected where subjected to stack gases.

Maintenance reports on the Model AN/SPR–2 indicate an increasing number of oscillator cavity failures. These cavities are in short supply and should, therefore, be handled with the greatest care and repaired if at all possible. The TN56/SPR–2 tuning units have sliding finger shorting rings for tuning which cause wear on the cavity and noise during tuning if excessive wear has occurred. The majority of units have a plate cap soldered to the plate rod. Failure reports indicate that the plate cap becomes loose due to the melting of the solder by the heat of the oscillator tube. Upon cooling, a cold solder joint is formed. Under such conditions the cavity becomes noisy. This point should be thoroughly inspected when the cavity is being repaired. A few of the latest AN/SPR–2 equipments have a collar around the plate cap over the plate rod. No failures have been reported for this type of unit.

The TN56B/SPR–2 tuning units have reactance plunger cavities with no sliding fingers. The TN57/-SPR–2 tuning units shown in the preliminary instruction books for the AN/SPR–2 equipments were not procured. The present applicable instruction book for the AN/SPR–2 is NavShips 900,654.

RELAY STUCK—ELECTRIC SHOCK

The danger of electric shock must be borne in mind at all times when working with electrical and electronic equipment. Placing too great a reliance on automatic safety devices leads to carelessness and casualties. Interlocks and other safety equipment are not intended to do away with the need for caution. Frequent checks of these devices should be made to assure their proper operation and in no case should they be depended upon exclusively.

A recent fatal accident at a Naval Communication Station was caused by a material failure in conjunction with a dependence being placed on interlocks to remove high voltages. This material casualty, occuring in a Model TEC transmitter, was the failure of the 3-kv plate contactor K-1122 to open, due to stuck or welded contacts, when a door interlock circuit was opened. This potential hazard is brought to the attention of all operating and maintenance personnel together with a repeated warning against the practice of relying upon interlock circuits to remove hazardous voltages from equipments.

All personnel having experience with similar failures of safety equipment or casualties resultant from operation or repair of any type of electronic equipment are requested to forward details of the experience and suggestions for avoiding similar failures to the Chief of the Bureau of Ships (Code 993C) Washington 25, D. C.

USE OF THE ECHO BOX

The Bureau of Ships has recently received a letter from the Senior Member, Subboard of Inspection and Survey, which is quoted in part for the information of electronics personnel. "The results of inspections made to date indicate a general lack of knowledge of the use of the echo box and the use of ring time as a gauge of radar performance. It is believed that the Naval service would be greatly benefited if ELECTRON contained an article on the theory and use of the echo box, the use and significance of ring time, and methods for correcting troubles that ring time measurements disclose."

There have been published in ELECTRON, from time to time, several descriptive articles on the theory, use and application of the echo box for maintenance purposes. These articles, as a whole, present a very complete picture of the echo box, its functions, capabilities and limitations. In view of this fact it is strongly recommended that Electronics Officers require all technicians to read and thoroughly understand the information presented therein. The following issues of ELECTRON contain informative material on this subject: August 1945, October 1945, March 1946 and November 1946.

WATER-SEALING ELECTRONIC CABLE ENDS

Correspondence recently received in the Bureau of Ships indicates that some installation activities are end sealing electronic cables. One Naval shipyard expressed concern over the difficulty of following the end sealing methods shown on BuShips Drawing 9–S–5357–L for water-sealing electronic cables terminating in electronic equipment. This drawing requires the use of crimp type lugs which cannot be soldered because of the method of end sealing employed. Since the use of crimp type lugs without soldering is not authorized in the ship's electronic systems wiring, the Bureau of Ships was requested to waive the requirement for end sealing the individual leads of multi-conductor cables.

The Bureau invites attention to the fact that there is no general requirement for end sealing electronic cables terminating at electronic equipment. Section S62–2–f of the General Specifications for Machinery contains no such requirement. Also drawing 9–S–5357–L is not applicable to electronic cables since it is impossible to solder the crimp type lugs as employed in the end sealing method shown on this plan.

In submarines and special surface ship installations where end sealing of electronic cables is deemed necessary, the method of end sealing to be employed will be determined by the Bureau after a study of the particular conditions involved. Pertinent information on cable end sealing in such cases will be given installation activities concerned along with promulgating instructions.

MODIFICATION OF MODELS RAO–9 AND RBK–14 FOR USE WITH MODEL REM DUAL PANORAMIC ADAPTOR

The Model REM Dual Panoramic Adaptors are now being made available to the fleet for special installations on vessels as designated by the Bureau of Ships to replace the Model RBW–2M and Model RCX–1 panoramic adaptor equipments used in communication countermeasures installations.

To use the Model REM to the fullest extent requires that the Model RAO–9 and RBK–14 receivers supply local oscillator voltage to the Model REM so as to produce marker pips on the panoramic presentation. The Model RBK–14 receivers have been so modified by the manufacturer and are supplied with an oscillator output connection (see figure 1). The Model RBK–14 circuit was modified as shown in figure 2. The instruction book circuit diagram and the circuit diagram on the inside of the cover of the receiver do not show that this change has been made. They should be corrected accordingly.

The Model RAO–9 was not modified by the manufacturer to supply the local oscillator voltage for use with the Model REM. The Bureau of Ships is now preparing a field change bulletin to cover the modification of the Model RAO–9 for oscillator output.

Pending availability of the above field change, the Model REM should be connected into the countermeasures system as shown in the Model REM instruction book, NavShips 91003(A) minus the cable between the Model RAO–9 oscillator output and the Model REM–RAO–9 oscillator input. The system will operate satisfactorily but minus the advantage of the marker pips.

FIGURE 1

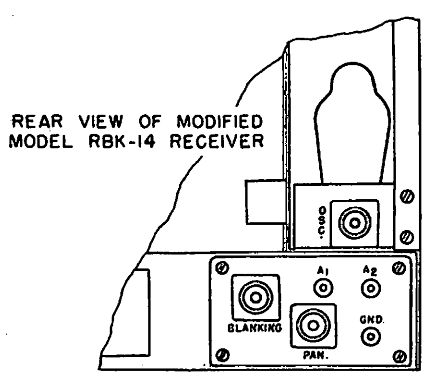
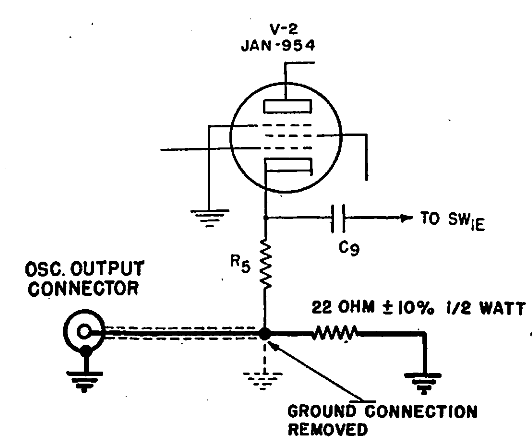


FIGURE 2



NOTE: MODIFIED CIRCUIT IN HEAVY LINES

MODEL 929 PHOTO-CELL TESTER

Would you test a photo-electric cell by putting it in a circuit and then exposing it to light from a window or take it out doors for a reading? If you get a poor reading on a cloudy day, would you say the cell was worn out and throw it away? William F. Yeagley of the Electronics Office of the Boston Naval Shipyard decided such a testing method had too many variables in it so he has come up with a beneficial suggestion for determining the sensitivity and output of photo-electric cells of the type used in the Model AN/GMQ–2 Ceilometer.

The beneficial suggestion involves the device shown in figure 1. This device consists essentially of a light source rich in ultra-violet light to which the photo-cells are most sensitive, a measuring circuit into which photo-cells can be plugged, and an enclosure for excluding all unwanted light. The light source is an ultra-violet "black light" fluorescent tube with the necessary circuit components of ballast and starter switch. The measuring equipment consists of a 22½-volt dry battery, a microammeter of 0–50 μa range and a 1-megohm load resistor.

The box which holds all the units serves also to exclude all extraneous light and thus gives a constant quantity of illumination. The schematic diagram of the tester is shown in figure 2.

In operation, a photo-cell to be tested is inserted in the socket mounted on the hinged cover of the box, the cover is closed, and the tester turned on. After several cells known to be good are tested, an average reading is obtained which can be used to compare the sensitivities of questionable photo-cells.

The advantages of this tester over the previous method are obvious, the greatest advantage being a constant source of illumination. The "black-light" should be kept dusted off and periodically checked against a new fluorescent tube to see if it is aging or burning out.

FIGURE 1

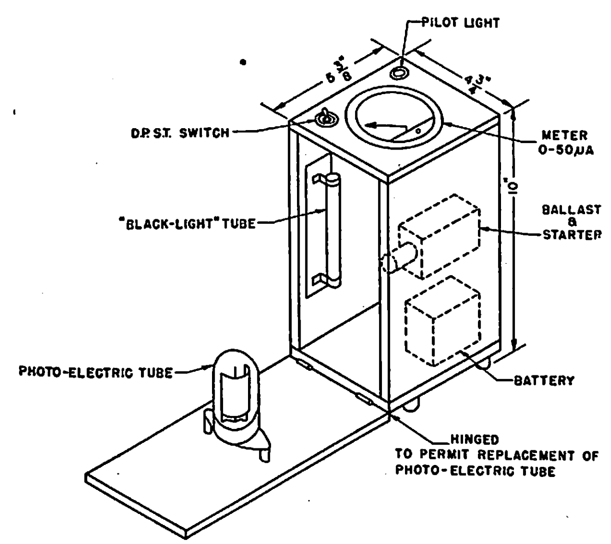
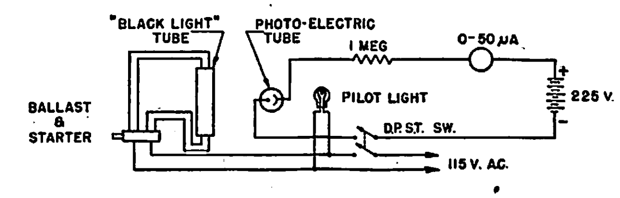


FIGURE 2



MODEL SS–A INSTRUCTION BOOK ERROR

An error exists in Figure 7–9 of the instruction book for the Model SS–a Radar Equipment (synchro system a-c distribution schematic). In this drawing there is a box labeled "Electronic Control Amplifier, Unit 23," and in the lower right hand corner of the box is a Switch S1.2 which selects RELATIVE or TRUE bearing information for the input to the O.S.C. 1CT in the O.S.C. gear assembly. The connections to this switch as shown in Figure 7–9 do not agree with the internal connections of Unit 23, as depicted on the schematic for this unit. The correct arrangement is shown in Figure 1.

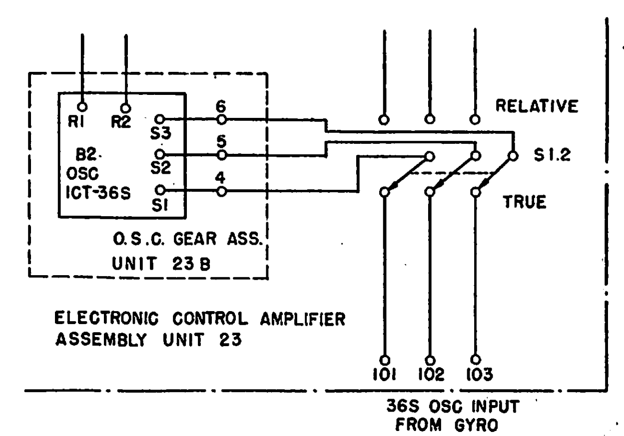


FIGURE 1

MEASUREMENT OF RADIO INTERFERENCE AT NAVAL SHORE STATIONS

by
WILLIAM A. RITZ
Electronics Shore Division, Bureau of Ships

The objective of this article does not encompass the design or construction details of radio interference measuring instruments, but aims at acquainting operating personnel with the basic concepts and requirements of these instruments and with the terminology involved in their use. This discussion will be followed by articles outlining the detailed procedures and techniques involved in the usage of certain radio interference measuring instruments in the conduct of radio interference surveys at Naval shore communication stations and Naval air stations.

General Considerations of the Problem

As the development of modern military communications and electronic control systems proceeds, the need for the adoption of standard techniques, instruments and terminology for use in connection with the measurement of radio interference becomes greater. During World War II, the measurement and interpretation of the results of such measurements were accomplished in a haphazard manner using improvised equipment and techniques. Since that era the ultimate aim of the engineers engaged in this specialized work has been the procurement and use of standard radio interference measuring instruments, the adoption of standard procedures and measuring techniques, and the universal interpretation of results that are independent of the locality where the measurement was made or the nature of the interference measured.

Much progress has been made in recent years in the direction of standardization using the best of the instruments and techniques available, but much more remains to be accomplished before the results of the many measurements made by all the various persons interested in radio interference reduction can be correlated.

The great problem confronting equipment engineers in their efforts to present a true picture of a given interference condition, has been a general lack of a sound theoretical basis on which to proceed. This lack stems from the highly complex nature of the electrical disturbances which constitute radio interference. These electrical disturbances vary so greatly and so rapidly in phase, amplitude, frequency distribution, and rate of repetition that they are exceedingly difficult to measure. It is therefore a difficult task to select from the many measurements that might be made the ones that are the most significant for the desired purpose. It is comparatively easy to obtain numerical values of radio interference but the difficult part lies in understanding just what the measurements mean. This can be particularly confusing especially when analyzing the results of multiple radio interference surveys at Naval shore communication stations and Naval air stations, unless the measurements are obtained in a standard manner, using identical measuring instruments and techniques.

Radio interference cannot be specified in terms of any single parameter. Measurements may be made of the r.m.s., average, or peak value, or of the fractional time during which the electrical disturbance exceeds some previously assigned value. For practical purposes the measurement of any of the above quantities alone will serve no useful purpose, as it is not the absolute value of any of these parameters which is required, but rather the minimum value of the signal field which will give a specified degree of intelligibility in the presence of interference. Since the radio interference field may vary in nature and intensity very rapidly, the value of this minimum signal field will also be indefinite if measured over only a short time period.

Perhaps the most practical and useful method of expressing radio interference is in terms of the signal-to-noise ratio which will give certain degrees of intelligibility with a special type of transmisson, as for example teletype or facsimile. Each type of intelligence signal such as speech, teletype, facsimile, television and position data has a characteristic form of amplitude versus time and frequency spectrum and each type displays particular traits of vulnerability to detrimental phenomena such as radio interference and crosstalk. Each type of intelligence signal is made to operate over one of the standard nominal bandwidths. All these facts must be given consideration at the time radio interference measurements are made. Numerous references are given in radio literature regarding the signal-to-noise ratio which is desirable in a particular radio service. The values given are necessarily rather indefinite, since the criterion of satisfactory reception is not usually defined and the precise type of radio interference and signal is not always stated. However the fact remains that the prime factor at the receiver antenna input is the signal-to-noise ratio and not merely the existing radio interference levels alone.

Requirements for Interference Measuring Instruments

Despite the inaccuracy inherent in most radio interference measuring instruments currently available, the indications will have meaning and be useful provided standard instruments are agreed upon and provided they are used in a standard way. The most useful information we can obtain with the best of the currently available radio interference measuring instruments is as follows:

1—An indication of the amplitude of the radio interference voltage effective at the input of the disturbed radio system or electronic control device, at the frequency under consideration.

2—An indication of the audio output of the disturbed apparatus due to the radio interference voltage present at the input. (If the gain of the apparatus is known, the amplitude of the radio interference voltage present at the input can be determined from the measurement made.)

3—An indication of the amplitude of the radio interference field strength in proximity to a source.

4—An indication of the conducted radio interference impressed by a source of radio interference on the power wiring.

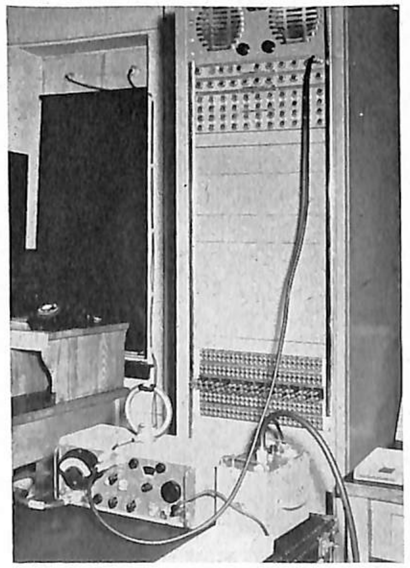
The instruments that have been developed for making the types of measurements listed above may be divided into two general types, i. e., audio-frequency and radio-frequency measuring instruments.

The audio-frequency type is used for the measurement of the "effect" of radio interference. It is connected across the output of a radio receiver, and as such it is essentially an output meter. The types currently in use include quasi-peak reading meters and average reading meters. These meters may be calibrated in volts, milliwatts, or decibels. Meters of this type may be used for the measurement of the r-f disturbances which cause radio interference, if they are used in conjunction with a calibrated receiver.

The radio-frequency type, which is the type more widely used, is complete within itself. This meter usually consists of a specially designed high-sensitivity radio receiver used to locate and measure radio interference and also to make field strength measurements. This meter is basically a selective two-terminal voltmeter with sufficient sensitivity to measure radio interference of the intensity of radiated and conducted radio-frequency signals. It measures the radio-frequency amplitude of radio interference in much the same manner as a conventional field strength meter, but with certain differences to satisfy the special requirements of radio interference measurements.

In determining the choice of a radio interference measuring instrument, it becomes necessary to decide

THREE USES FOR THE MODEL AN/URM-6


Measuring radio interference in the 14 to 250 kc. range with a directly-connected Model AN/URM-6.


Model AN/URM-6 connected to make a 24-hour period recording of radio interference intensities.


Using the Model AN/URM-6 to measure power line interference. Note the two different size loop antennas, and the rod antenna.

which of the instruments available gives an indication which most closely indicates the effect of noise on the ear. It is known that the response of the ear to single sound impulses is less than the peak value but greater than the average value of the radio interference and that the masking effect of recurrent impulses is proportional to the repetition rate. A peak reading instrument would, therefore, most closely approximate the effect of radio interference on the ear.

Many difficulties arise in the use of conventional peak reading instruments. In the face of the variations of the electrical disturbances constituting radio interference, it becomes impossible to get the indicator to "hold still" long enough to obtain a reading. Also, the noise levels indicated by any type of meter represent the actual noise, averaged in a specific way, peculiar to the meter employed. The meter usually will record voltages at frequencies which are not transferred by most headsets or speakers into acoustic pressure. The energy which is distributed outside the frequency range to which the headset or speaker responds, is ineffective in masking desired outputs, and is of no special interest.

Another important item which must be considered, especially in a test instrument designed to measure the r-f field of a source of radio interference, or the radio-frequency voltages effective at the input of a receiver, is the effect of the bandwidth of the measuring device, or of the receiver, on the readings obtained. For random type interference (similar to thermal interference), the peak, effective, and average values read are directly proportional to the square root of the bandwidth. For impulse type interference (similar to ignition interference or atmospherics) the peak value is directly proportional to the bandwidth; the effective value is directly proportional to the square root of the bandwidth; and the average value is independent of bandwidth.

In developing radio interference measuring instruments that will as closely as possible record the effect of radio interference on the ear, the following features must be given consideration:

1—Weighting circuits must be included in the measuring instrument in order to make the indicator "hold still" long enough to take readings. These weighting circuits must incorporate time constants that impart a rapid response slow recovery characteristic to the meter. With proper weighting circuits, "quasi-peak" values closely approximating the average of peak values of the radio interference and the effect of the radio interference on the ear, are recorded by the meter. The meter indicator is steadied down so that it is possible to take readings.

2—In order that the meter will not "average-in" voltages at frequencies to which the headset or speaker will not respond, a filter with the identical cut-off characteristics of the speaker or headset, must be incorporated in the meter if it is to be used to measure radio interference in receiver outputs.

3—The bandwidth of a radio interference measuring instrument must be known and given consideration in evaluating the results obtained. When radio interference is measured at the receiver output by means of a meter designed for this purpose, the bandwidth of the receiver as well as its gain must be considered if it is desired to convert the radio interference output into r-f voltage effective at the receiver input.

THREE USES FOR THE MODEL AN/PRM-1

Model AN/PRM-1 directly connected to the antenna input of a control tower radio receiver.

Model AN/PRM-1 connected to make a 24-hour period recording of radio interference intensities.

Using the Model AN/PRM-1 to measure radiated radio interference intensities, with a loop and rod antenna. Note the Ferris Model 32A on the right being used for comparative readings.

Quasi-peak meters indicate more nearly the "nuisance value" of radio interference than other types of instruments. However, milliwattmeters and output voltmeters may be used to measure radio interference if their limitations as radio interference measuring instruments are understood by the user. These instruments are easier to use and adjust but they do not present a true picture of the radio interference condition. This is due to the fact that they indicate average values, while it is the peak value of the radio interference that affects the ear the most.

However, the readings obtained with such instruments are useful in that they will indicate relative values. Measurements made with an instrument of this type may be compared with like measurements made with an instrument of the same type. Also, for "steady" or relatively "steady" radio interference measurements, an average value indication possesses considerable accuracy. For impulse type radio interference an average value indication contains large errors.

Any attempt to compare measurements made with quasi-peak reading meters with those made by average reading meters will be almost meaningless. These two types of meters have entirely different averaging characteristics when used to measure radio interference. Quasi-peak and average reading meters may be calibrated against a pure sine wave and the readings of the two meters compared, but there may be no correlation between the two when measuring radio interference.

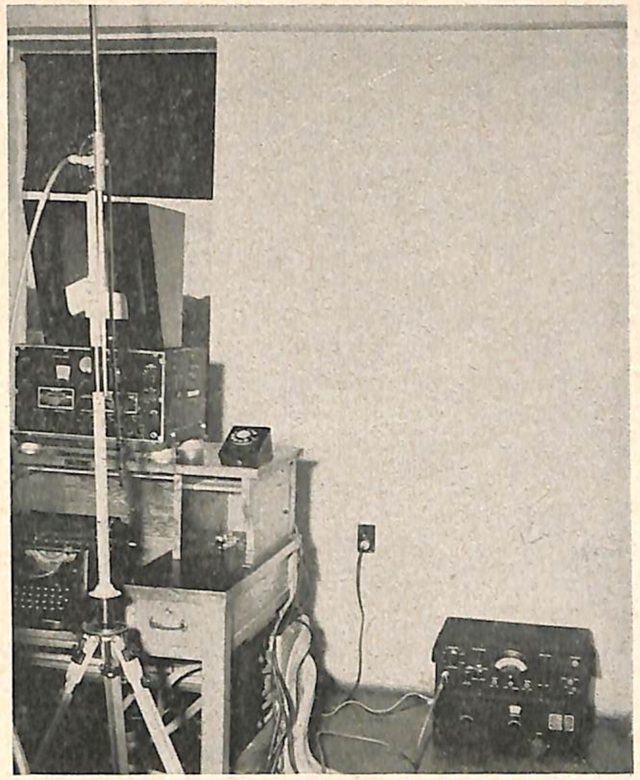
The measuring instruments presently in use by Naval activities are designed for the measurement of field intensities and radio interference intensities, covering the radio-frequency spectrum from 14 kilocycles to 400 megacycles.

Before commencing a detailed discussion of the methods of operational radio interference and field intensity measurements involving each of the three measuring instruments used in conducting radio interference surveys at Naval shore communication stations and Naval air stations, it is advisable to establish a basis for a common terminology, standardizing the definitions used in expressing values and conditions of radio interference on which measurements are made.

Standard Terminology

There have been many definitions given to the same characteristics and observed phenomena in radio interference measurements. The following terms will be used throughout this series of articles. Definitions associated with these terms are as follows:

Radio Interference—Any electrical or non-electronic disturbance in the radio-frequency spectrum affecting the reception of desired signals or producing malfunctioning of electronic or electrical equipments. Also, any signals transmitted by electronic or electrical equipment other than those for which the equipment is specifically designed.



The Navy Type TS/587-U Radio Interference Measuring Equipment, used to measure radio interference and field intensities from 15 to 400 Mc.

Noise—Thermal and shot noise etc., inherent in a receiver.

Peak Value of Radio Interference—The maximum instantaneous value during a given interval of time.

Quasi-Peak Value of Radio Interference—Quasi-peak measurement is one in which a fraction of the peak of the i-f amplifier output voltage is determined, the size of the fraction being directly proportional to the ratio of discharge time constant to the charge time constant of the weighted detector circuit.

Radio Field Intensity—The electric or magnetic field intensity at a given location resulting from the passage of radio waves. It is commonly expressed in terms of the electric field intensity (microvolts-per-meter) but may be expressed in terms of electromagnetic field intensity. In the case of a sinusoidal wave, the root-mean-square value is commonly stated. Unless otherwise stated, it is taken in the direction of maximum field intensity. It is commonly expressed in microvolts-per-meter effective height of the antenna.

Radio Interference Intensity—Radio interference intensity is a measure of the field intensity at a point (as at a radio receiving station) of electromagnetic waves of an interfering character. For interference of random nature, the measured radio interference intensity is proportional to the square root of the effective bandwidth of the measuring equipment. For interference of impulsive nature, the peak value of interference field intensity is proportional to the effective bandwidth, the effective (r.m.s.) value is proportional to the square root of the effective bandwidth and the average value is independent of the effective bandwidth. Thus, a complete specification of radio interference intensity may or may not be possible, depending on the character and proportion of the components of the interference.

Suppression—The abatement of radio interference to an acceptable level by remedial measures applied to the source of the interference.

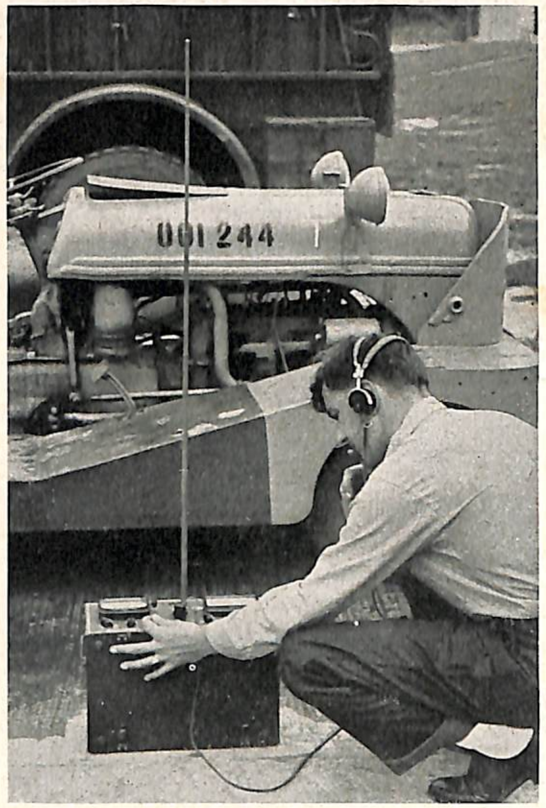
Crosstalk—Crosstalk is a disturbing signal introduced into a particular channel or circuit. The source of the interfering signal is intelligence being transmitted in another circuit or channel. The interfering crosstalk signal resulting in the disturbed circuit is not necessarily of the same wave form as the original signal causing the disturbance. The relationship existing between the crosstalk signal in the disturbing and disturbed circuits is a function of the coupling or other transfer characteristics. Crosstalk between telegraph circuits or channels is a common occurrence.

Power Frequency Hum—Power frequency hum is a complex signal, consisting of the fundamental power frequency and related harmonics, which can be induced in a wire line by coupling with nearby power transmission lines, or can be originated in a circuit because of faults in equipment or wire conductors.

Cross Modulation—With the advent of more and more transmitters in proximity to one another, many new radiations appear at various frequencies not possessing simple relationships to the assigned frequencies of the transmitters producing them. These emissions are often due to the interaction of one transmitter's radiation falling upon another transmitter and producing cross modulation products.

Transmitter Interference—Interference created by radio transmitters is usually created by harmonic radiation or spurious side bands. The radiation of harmonics by high powered transmitters is a serious source of radio interference. For example, one tenth of one percent second harmonic in a 50-kw transmitter corresponds to a signal power of 50 watts, which is capable of producing an interfering signal over a considerable area.

Spurious side bands normally are caused by distortion of the modulation envelope and create radio interference in adjacent channels, normally assigned to other transmitter stations. The chief cause of such adjacent channel interference is overmodulation on the negative peaks. This distorts the modulation envelope, causing it to be prolific in harmonics.



Using the Model OF-2 to measure the radiated ignition interference of an aircraft tow tractor.

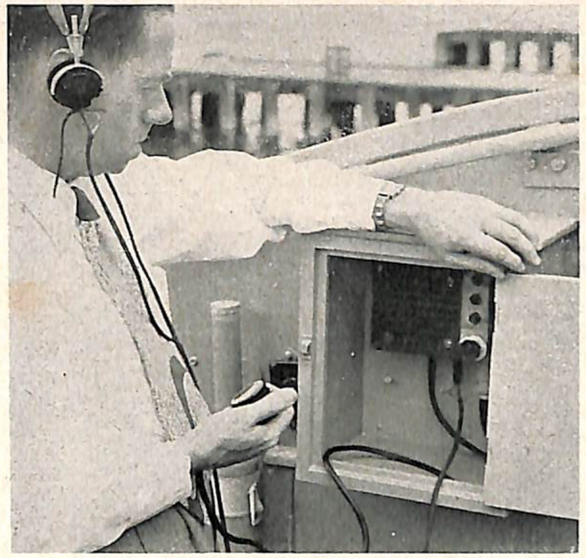
Classification of Radio Waves (according to frequency):

Very low frequency (VLF)	10–30 kc
Low frequency (LF)	30–300 kc
Medium frequency (MF)	300–3000 kc
High frequency (HF)	3–30 Mc
Very high frequency (VHF)	30–300 Mc
Ultra high frequency (UHF)	300–3000 Mc
Super high frequency (SHF)	3000–30,000 Mc
Extremely high frequency (EHF)	30,000–300,000 Mc

Signal-to-Noise Ratio—At a specified point in a transmission system, it is the ratio, expressed in decibels, of the effective voltage at the nominal signal level of the desired signal to that of the radio interference. This signal-to-noise ratio for proper reception varies over wide limits, depending on the type of communication, bandwidth, type of modulation, directivity of receiving antenna, and character of noise.

Receiver and Antenna Noise—This type of radio interference is caused by thermal agitation in resistance components of the antenna and receiver circuits and by electronic current flow in the tubes.

Effective Bandwidth—The effective bandwidth of a measuring equipment used in radio interference intensity measurements is the width of a band of frequencies responding to the interference, weighted according to the selectivity of the receiver. The value of



Aural checks are an important part of every radio interference survey. Here a crash communication frequency used between control towers and crash boats is being checked.

effective bandwidth is obtained by determining the integrated area under a curve plotted on linear graph paper, whose ordinates are equal to the square of the ratio:

$$\frac{\text{input voltage at resonance}}{\text{input voltage off resonance}}$$

to give the same output, and whose abscissas correspond to the frequency so that by dividing this area by the area corresponding to a rectangle one kilocycle wide and of a height equal to the ratio at resonance, the effective bandwidth is thus expressed in kilocycles.

Antenna Effective Height—The effective height of an antenna is the height of its center of radiation above the effective ground level. The height h is obtained from the following equation:

$$h = \frac{ed}{1.25\, f\, I}$$

where h = effective height in meters
e = measured field intensity in microvolts-per-meter
d = distance in kilometers from the antenna to the point where e is measured
f = frequency in kilocycles
I = Antenna current at the point where the antenna is energized

Atmospheric Interference—Radio interference caused by natural electrical discharges in the atmosphere (also called static). This is an erratic and unpredictable combination of random and impulse radio interference. Its short-time and long-time intensity vary over a wide range and it has no definite ratio of peak to average power. It has no definite correlation with the bandwidth of the transmission system. This type of radio interference is believed to originate at the center of local electrical and magnetic disturbances, such as thunder storms, and is propagated through space as any electromagnetic field, inducing voltages on either horizontal or vertical conductors.

Conducted Interference—The term conducted interference shall mean radio interference that is propagated along the circuit conductors.

Conducted Radio Interference Measurement—Refers to a measurement made with a radio interference meter by direct connection to the apparatus terminals or the circuit under investigation. Measurements may also be made between terminals or circuit conductors and ground or the frame of the apparatus. A connection through a capacitor of suitable value, which is a conductive element for radio-frequency currents is considered a direct connection.

Radio Interference Classes:

1—Random (sometimes referred to as continuous interference). Interference of a continuous nature not resolvable into discrete disturbances. Fluctuation noise produced in an electrical circuit is an example of random interference and is caused when a quantity of elementary elements are superimposed with random relationship. Thermal noise in a circuit and shot noise in a tube are examples of this type interference. In both cases the elementary events occur with such rapidity and irregularity that the wave trains set up in a receiver completely overlap and bear no relation to one another, hence the term continuous interference.

2—Impulse Interference. Interference consisting of well-separated impulses distinguished individually, with the spacing and form of the impulses either regular, random or intermediate. In the intermediate type of impulsive interference, the degree of impulse regularity determines whether the interference may be termed quasi-systematic or quasi-random, and thereby whether the frequency distribution is more nearly that furnishing a line or a continuous spectrum.

3—Recurrent Wave Interference. Interference consisting of a sharply tunable signal of a single frequency such as is produced by harmonic radiation from transmitters, local receiver oscillators, etc.

4—Complex Radio Interference. This type interference consists of a combination of two or more types of interference such as random, impulsive and recurrent wave interference.

Introduction to Measurements

Due to the limitations of space, it is not possible at this point to enter into a detailed discussion of the electromagnetic theories which form the basis for all field intensity measurements. The following facts, however, are considered important to a proper understanding of

Eltron radio noise locator being used to check interference intensity from fluorescent lighting fixture. The suitability of this type of portable instrument is being evaluated.

the operation of radio interference measuring instruments in connection with their field usage.

The intensity of the electric field produced by a radio transmitter, at any point in the space surrounding it, is measured by the difference of potential in microvolts which would be produced in a vertical receiving antenna one meter high and perpendicular to an ideal grounded plane, provided that the presence of this antenna does not change appreciably the intensity of the field at the point where the antenna is erected. The electrostatic unit of field intensity, therefore, is one microvolt-per-meter.

Any electromagnetic wave is composed of an electric field and a magnetic field perpendicular to each other and to the direction of propagation. A magnetic field in motion produces an electric field. The value of the field intensity in microvolts-per-meter is expressed in terms of the effective height of the antenna and the corrected indicated microvolts, and should be accompanied by figures as to the frequency of the received signal and other pertinent facts.

The measurement of radio frequencies requires a general knowledge of wave propagation. This is necessary in order to intelligently select a measuring site and also as a guide to help measuring personnel to evaluate the peculiarities of signal reception while making measurements.

There are two major paths over which transmitted signals propagate. One is the path adjacent to the earth and that portion of the transmitted energy which travels along this route is known as the "ground wave." The other path is towards the sky and that portion of transmitted energy which propagates along this path is known as the "sky wave." The ionosphere is an ionized region starting approximately 30 miles above the earth and extending out to the limits of the earth's atmosphere at about 300 miles, a region which reflects or refracts radio waves, often sufficiently well to return a usable signal to the earth at great distances from the radio transmitter.

At the very low frequencies, under usual conditions, little energy is reflected back to the earth. As the frequency is increased, a greater portion of the sky wave energy is reflected back to the earth.

The ground wave energy at very low frequencies propagating just above the surface of the earth suffers little dissipation with distance as compared with ground wave energy at high frequencies.

When measuring field intensities in the low-, medium- and high-frequency ranges, there are two major factors to consider. The most important of these factors is the distance of the measuring site from the transmitting antenna. There is an area where the ground wave from the transmitting area is too weak to be detected and the sky wave is not present due to the angle of radiation from the transmitting antenna and the angle of reflection of the transmitted signal from the ionosphere. This area, at a distance from the transmitting station depending upon the transmitting frequency, is called

Detecting radiated interference from an auxiliary power supply aboard a 63-foot crash boat with the Eltron radio noise locator.

the "skip distance." The extent of this area is dependent to a great extent upon the conditions of the ionosphere at the time of measurement. Therefore, the distance of the recording site from the transmitting antenna and the exact time of measurement are very important.

The next factor of importance to correct measuring practice is the area of fading. This condition is common in the lower portion of the medium frequencies and in the upper portion of the low-frequency spectrum. This is an area where the ground wave and the sky wave begin to equal each other in intensity. This again is a problem of wave propagation and the extent of the area in which this phenomenon occurs is greatly dependent upon conditions existing at the time in the ionosphere. In this area large variations in field intensities may be observed in a short period of time. This large varation in field intensity, most commonly referred to as fading, is due to the phase relationship of the sky wave to the ground wave at the receiving site. There are two functions affecting this phase relationship. One is the difference in the distances traveled by the two types of wave fronts and the other is the shift in the phase of the sky wave as reflected back from the ionosphere.

An example of the varying conditions due to ionospheric changes is known as night and dawn effect. This effect is due primarily to changes in the ionosphere. At or shortly after sunset and just before dawn considerable changes take place in the ionosphere. It is

Detecting power line radiated interference with the Eltron radio noise locator.

Using the Eltron radio noise locator to detect radio interference created by the turbo-jet motor of a Link Trainer.

due to these ionospheric disturbances that large variations in field intensities occur at certain frequencies. The higher these frequencies the greater the effect of these disturbances.

The prime requirement for suitable field intensity measuring equipment is a high order of sensitivity combined with complete stability of operation in order that the results obtained may be accurate. This high sensitivity necessitates that a reasonable degree of selectivity be provided so that measurements of weak signals may be made without serious interference from local transmitters. These requirements have been met by the use of superheterodyne circuits, especially where it is desired to measure the field intensity of very-high-frequency signals. The use of the superheterodyne circuit permits the inclusion of an intermediate-frequency amplifier having very high gain with complete stability. The procedure for making measurements requires the adjustment of sensitivity of the measuring equipment in known steps, over a wide range. Utilizing the superheterodyne circuit, this is readily accomplished in the intermediate circuits where the accuracy of the adjustment is independent of the frequency of the received signal. These desirable characteristics with the addition of attenuation in the input circuits to prevent overloading have been included in the equipments available for use in conducting radio interference surveys at Naval shore communication stations and Naval air stations with a high degree of accuracy.

INCREASED DISTRIBUTION OF NAVSHIPS 4110

The June 1949 ELECTRON announced an increased distribution of the Ship Electronics Installation Record NavShips 4110. Recent requests received by the Bureau of Ships have caused further changes to be made in the distribution of NavShips 4110 for both the Active and Reserve Fleet ships. The new distribution is as follows:

ACTIVE FLEET

Copies	*Activity*
3	Ship (one for Operational Commander)
8	Type Commander (6 for overhaul yard to be forwarded with ship's work list)
1	Home Yard
1	Each Service Force Commander
2	Atlantic Fleet Ships: 1—CinCLantFlt; 1—Com Second Task Fleet. Pacific Fleet Ships: 1—Com First Task Fleet; 1—Held for future disposition
3	Bureau of Ships (one copy for ComOpDevFor ships)
18	TOTAL

RESERVE FLEET

Copies	*Activity*
2	Ship (forwarded to Group Commander)
2	Group Commander (one for overhaul yard)
1	Each Service Force Commander
1	Type Commander
1	Home Yard
2	Bureau of Ships
9	TOTAL

TELETYPEWRITER MOTOR REMOVAL SUGGESTION

A. J. Spezia of the electronics shop at Mare Island Naval Shipyard has made the beneficial suggestion that a male and female line-cord plug be inserted in the Model M-14 teletypewriter motor leads where they pass behind the typebar comb. The connector is shown inserted in the motor leads in figure 1. In figure 2 the location of the plug is shown when the motor is in operating position.

In order to remove this motor without the plug installed, it is necessary to disassemble part of the gear mechanism, unbolt the terminal block, and cut some of the protective "serving" to other wires. All this involves work in tight quarters and thus the possibility of damage to nearby wire insulation.

After the plug is inserted in the leads, the problem of motor removal is a matter of simply disconnecting the plug "with a twist of the wrist." Thus a time consuming operation is reduced to a matter of a minute or so. The advantage of this suggestion is that the shutdown period for a piece of equipment suffering motor failure is reduced many fold.

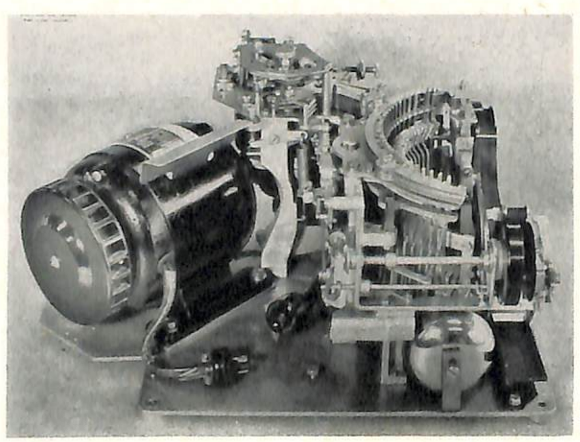


FIGURE 1—Model M-14 teletypewriter showing line-cord plug before being inserted in motor leads.

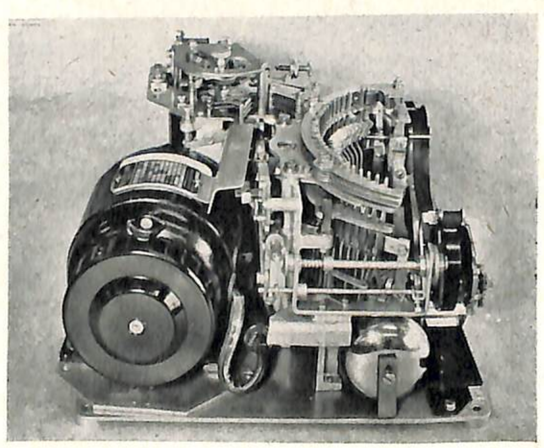
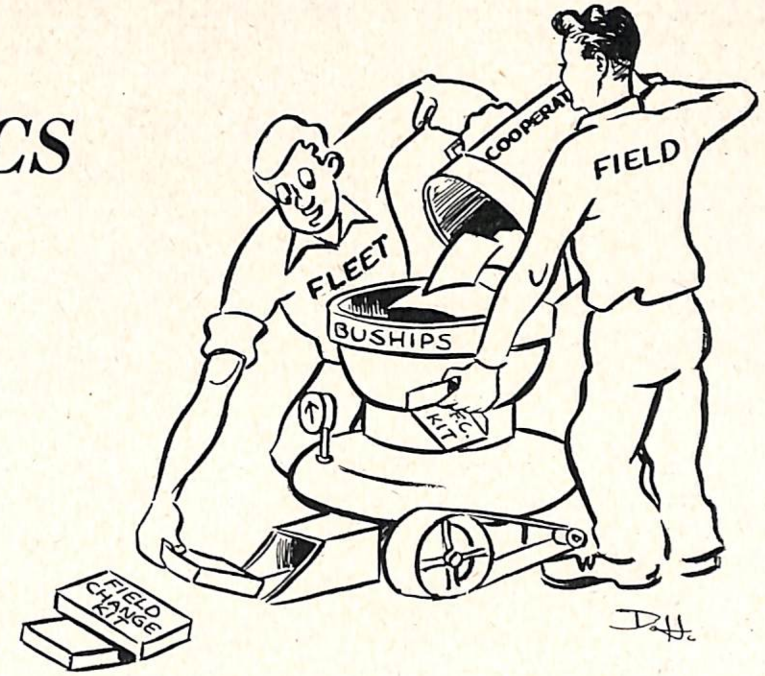


FIGURE 2—Model M-14 teletypewriter showing location of line-cord plug when motor is swung into place.

ELECTRONICS FIELD CHANGES



DEFINITION: A field change is a Bureau authorized mechanical, electronic or electrical change, modification or alteration made to any portion of an electronic equipment subsequent to delivery to the Navy.

Special attention should be given to the foregoing definition in order to fully grasp and understand the complete meaning and intent of the term "field change." Particular stress should be placed on the fact that the term applies only to changes made *after the equipment has been accepted by and delivered to the Navy.* Changes or modifications made to equipments by the manufacturer prior to delivery to the Navy are known as "factory changes." Factory changes may or may not be identical to field changes, from a material standpoint; but in view of the fact that the accomplishment of such changes do not concern the fleet or field in any manner, they are not termed field changes and therefore, are not under the scope of this article or Specification 16F8 (Ships).

There are two types of field changes, classified as follows:

Type I—This nomenclature identifies a field change which requires a kit of parts or material, a step-by-step instruction bulletin covering the change and a set of corrections for the applicable equipment instruction book and/or manual.

Type II—This nomenclature identifies a field change which does not require any parts or material to be furnished, but consists of a step-by-step instruction bulletin covering the change and a set of corrections for the applicable equipment instruction book and/or manual.

Complete control of all field changes is under the cognizance of the maintenance section concerned with the applicable equipment. This control encompasses the basic procedural specifications (16F8), the initiation of changes, the final approval or disapproval, the assignment of identifying serial numbers, the content of accompanying bulletins and correction sheets and the general authorizations for field accomplishment. In exercising control of field changes, the cognizant maintenance section collaborates with equipment design sections, laboratories, manufacturers, fleet and field activities, logistics sections and publications sections in order to coordinate the various phases involved.

Bureau of Ships Specification 16F8 (Ships) dated 15 June 1949 outlines definite and standard procedures and requirements to be followed by both commercial and Naval activities when preparing field changes applicable to Navy electronic equipments. Other applicable specifications or publications are as follows:

16B16 (RE)	Instruction Books
JANP–109	Manual of Standard Descriptions
JANP–658	Packaging and Packing
NAVEXOS P–29	Security Measures

Specifications covering the details of a specific change to the equipment, where required, are prepared for each individual change either by the Bureau or by a field activity, and accompany the procurement requisition. All parts and material required to accomplish the change must conform to the standard specifications applicable to such items.

A field change is initiated by the applicable equipment maintenance section of the Electronics Divisions as a result, usually, of one or more of the following:

1—Analysis of routine equipment failure reports indicating a necessity for corrective action.

2—Special reports requested from the field or by personal investigations made by maintenance engineers.
3—Recommendations from fleet and field activities.
4—A directed or desired change in operational characteristics.

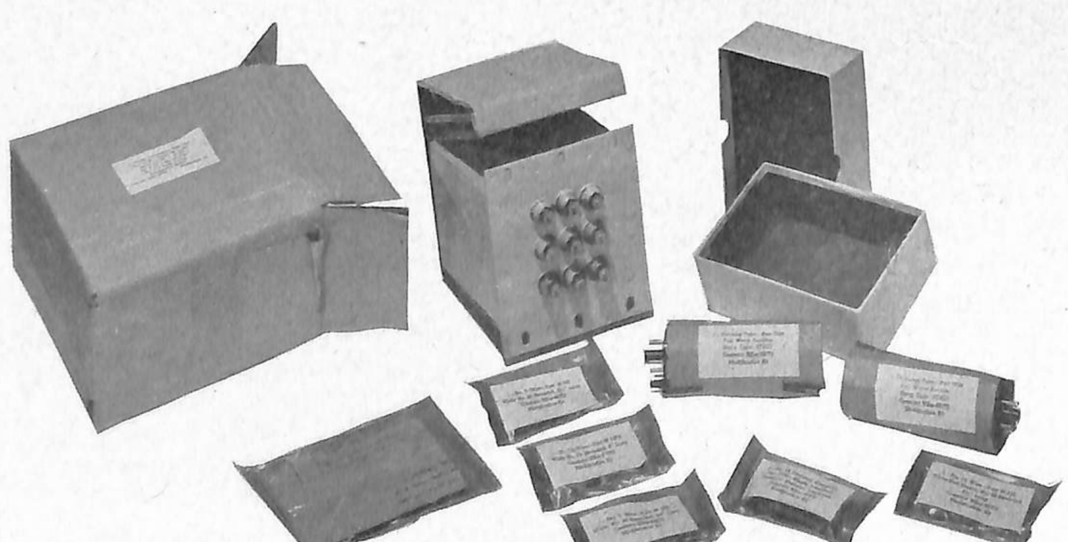
After an apparent necessity for a change has been established and recognized by the maintenance section concerned, a field change is initiated. This initiation, however, does not indicate that the change has been given final approval or will be processed to completion. The initiation merely indicates that the desirability of the change has been recognized and that the technical, practical and economic phases will be thoroughly investigated and, probably, a trial change made to one equipment. The investigation may be made by the cognizant maintenance engineers, by a Naval shipyard or laboratory or by a commercial manufacturer. The nature of the change and the type of the equipment involved usually determines the activity and the method of investigation to be followed. If the complete investigation and the trial installation prove that the proposed field change is beneficial, practicable and economical, the change is then officially approved and procurement action begun.

At this stage it is necessary to determine whether the field change will be Type I or Type II; i.e., if a kit of parts or material will be supplied or if the required parts or material are already available or readily obtainable at all locations where the changes will be accomplished, so that only instructions and correction sheets are required to be furnished. To determine this, the list of parts required for the field change is checked with the master inventory of common stock items. If all field change items are found to exist as "parts common" in the regular stock bins of the fleet and field, the field change is classified as Type II and a kit of parts will not be procured. If, on the other hand, one or more of the parts involved falls under the classification of "parts peculiar" and is not to be found in common stock bins, the change will be termed Type I and a kit of parts will be procured and furnished along with the instruction bulletins and correction sheets. The step-by-step instruction bulletins and the instruction book correction sheet or sheets are prepared in all cases, regardless of whether the change is classified as Type I or Type II.

A field change may or may not be applicable to the entire quantity of a single model series or type of equipment, due to varying operational requirements, the installation locations or the associated equipments with which they operate. Therefore, the quantity of field change kits to be procured must be carefully determined by the maintenance engineer after consulting installation records and making a survey of the circumstances under which all of the pertinent equipments are operated.

If the field change kit is to be procured from a Naval shipyard or on open bids from a commercial manufacturer, it is necessary that specifications covering the technical details of the specific change be prepared. These specifications must contain all the requirements and data concerning the change and the material to be included in the kit. If, however, the kits and/or instruction material is to be furnished by the same activity, either Naval or commercial, that made the complete investigation of the change in the early stages, it may be unnecessary to prepare fully detailed specifications for procurement purposes. Frequently, equipment manufacturers, through their own initiative, furnish field change kits gratis in order to correct deficiencies or modernize equipments of their own design and manufacture. In these cases, however, the changes must first be approved by the cognizant maintenance section and processed in the same manner as all other field changes; i.e., in accordance with Specification 16F8.

FIELD CHANGE TYPE I

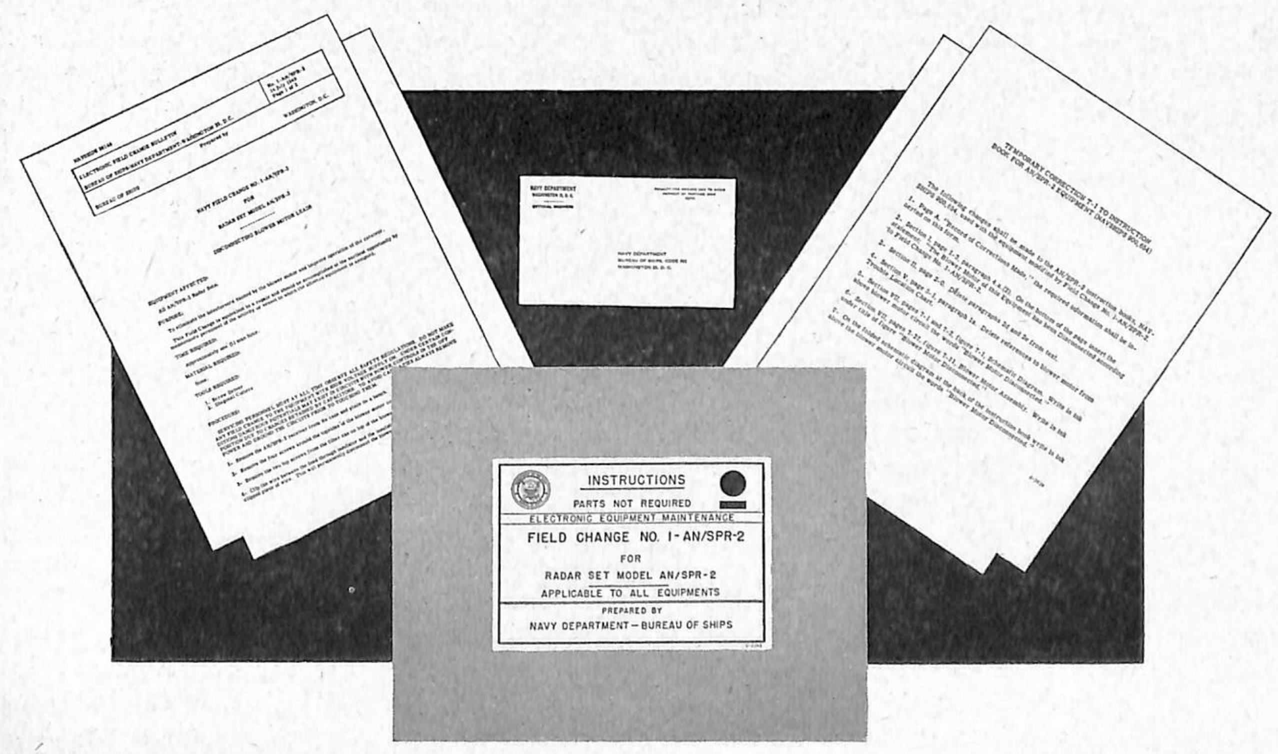


Field changes that are furnished gratis by an equipment manufacturer are not processed through the usual Bureau procurement activities. They are handled by correspondence directly between the cognizant maintenance section and the manufacturer, after proper coordination with the equipment design section. All other changes are obtained in one of two ways: procured directly under contract from a commercial manufacturer, or obtained under project order from a Naval shipyard or supply activity. In either of the latter two cases, the initial procurement processing steps within the Bureau of Ships are identical. Type II changes, which require only instruction bulletins and revision sheets, are frequently prepared within the Bureau and the usual procurement steps are eliminated. In such cases, the required bulletins and revision sheets are placed in an appropriately labeled envelope and, thereafter, the envelope "kits" are handled in the same manner as Type I changes involving kits.

After all the necessary data has been obtained from the various investigations, tests, trials, etc., and the individual specifications have been prepared, the cognizant maintenance section initiates a request for the procurement of the field change. This request is processed through the various sections of the Bureau and finally results in a contract with a commercial manufacturer or a project order on a Naval shipyard. Subsequent to the award of the contract or order, it is frequently necessary for the maintenance engineer and contractor to collaborate in order to work out various details and to interpret the intent of the specifications. This is usually accomplished via official correspondence, but occasionally necessitates conferences, either at the Bureau of Ships or at the manufacturer's plant.

The preparation of some field change kits necessitates the manufacture of special assemblies and parts, while others involve only the assembly of standard parts, wire, etc. The elapsed time between the award of contract or order and the delivery of the kits varies, usually between one and twelve months, depending upon the complexity of the kit material and the amount of special manufacture required. Concurrently with the manufacture of the parts and/or assembly of the kits, the contractor prepares the manuscript copy of the step-by-step instruction bulletin and the revision sheets for the equipment instruction book. The bulletins are required to be prepared in accordance with Specification 16F8(Ships), which specifies the format and content. The instruction book revision pages and drawings which accompany field changes must be in accordance with requirements of the Instruction Book Specification 16B16(RE) in order to correspond with the books in which they are to be inserted. Once the manuscript copies of both the bulletin and the revision pages have

FIELD CHANGE TYPE II



been prepared by the contractor or sub-contractor, they are forwarded to the Bureau of Ships for checking and approval. The cognizant maintenance engineer reviews both manuscripts for technical content and accuracy and the format and printing quality is reviewed by the Publications Section. If they are satisfactory from all angles, an approval letter is prepared and forwarded to the contractor, via the cognizant Naval Inspector.

The approval of the bulletin and revision sheets constitutes the final approval stage, and at this point a serial number is assigned to the field change for convenient identification. The changes for each type or model of equipment are assigned consecutive numbers, suffixed with the *complete* model letters or type number of the applicable equipment. Examples: #5—DAS–3, #1—SO–2, #4—AN/ARC–3, #3—49545. Previously, one consecutive series of numbers were assigned to all changes applicable to the same model series of equipments, such as the Model RAK series. This scheme, however, resulted in considerable confusion and has been abandoned. A separate series of numbers for each separate model or type of equipment is now used for all categories of electronic equipment. With the present scheme, it is extremely important that the *complete field change number* be listed in all correspondence, records and publications. It is obvious that the serial number without the equipment identification would be useless, and may lead to considerable confusion and many costly errors.

A NavShips number is assigned to the instruction bulletin to facilitate stocking and handling of the reserve quantities at the various supply activities. This number serves to identify these bulletins, when handled separately from kits, in lieu of the field change number. The reserve quantity stowed at supply centers is not intended primarily for general issue, but is placed there for possible future use in connection with reactivation of equipments and ships. Two copies of the bulletin and two copies of the instruction book revision sheets are included with each field change kit and should fulfill all the requirements of the ship and shore installation personnel. Additional copies of either the bulletins or revision sheets should not be necessary under normal circumstances. In special cases where additional copies are necessary, they should be requested in the regular manner, via the nearest Electronics Officer who is furnished a very small quantity for such purposes, or if not available, copies can be obtained from the District Printing and Publication Offices.

When the field change kits have been completed and are ready for shipment, the contractor advises the Bureau of this fact and requests shipping instructions. The shipping instructions are issued in the majority of cases to effect distribution to Naval shipyards and supply centers. In a few special instances, the kits are shipped direct to the ships or activities having the applicable equipments. If the field change is to be accomplished by ship's force or station personnel, the ship or station should requisition the kit from the appropriate supply activity. Kits for changes which are to be installed by shipyards should not be requisitioned by ships or stations. Shipboard equipment changes which affect weight and/or moment factors must be authorized by Shipalt prior to accomplishment.

There is a Field Change Report Card, NavShips 2369, included with both Type I and II field changes which must be filled in and mailed to the Bureau immediately upon completion of a change. The value of the field change record maintained by the Bureau depends entirely upon the receipt of these cards and it is extremely important that the proper information be entered in the six blank spaces provided thereon. Failure to mail the card results in incomplete records and causes unnecessary follow-up correspondence between the Bureau and the ship or station concerned. The follow up on delinquent completions and/or reports is unnecessary when the proper attention is given to the accomplishment and reporting of all authorized changes.

A record of each field change is also maintained by ships and stations concerned with the equipments. This record is of paramount importance to the operating and maintenance personnel and it is essential that it be complete and up-to-date at all times. The form Record of Field Changes, NavShips 537, is furnished for this purpose. This record, for all intents and purposes, becomes a part of the equipment. Should the equipment be transferred to another location, this record must be also transferred.

In order to expedite the field change program and provide the field with all pertinent information concerning these changes, the Bureau has initiated the Field Change Index. The Index is a tabulation of field change data which should be known to all ships and stations to permit these activities to intelligently requisition, plan for and accomplish the changes applicable to their electronic equipment. The Index will also provide a list for check-off purposes when it is desired to ascertain if all applicable changes have been made. The Index will be published at a later date as a permanent feature in the three maintenance bulletins, Communication Equipment Maintenance Bulletin, Radar Maintenance Bulletin, and Sonar Bulletin. The Index will be divided into three sections according to the three general categories of equipment and each section will be published in its respective bulletin. These tabulations will be revised and supplemented on a quarterly basis.

As the index is prepared, however, it is being printed in parts in ELECTRON magazine. Part I appeared last month; Part II follows this article. As the data is prepared, it will appear in future issues of the magazine.

ELECTRONICS FIELD CHANGE INDEX

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Number Contract
NEW FIELD CHANGES:									
AN/SPR–2 Radar Receiver									
1	Disconnecting Blower Motor Leads	14 July '49	All	SF	1	None	None	NavShips 98144	None
TBK–14 Radio Transmitting Equipment									
1	Meter M–107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	Dec. '45	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O–5/FR Exciter Unit	Dec. '45	All using O–5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBK–15 Radio Transmitting Equipment									
1	Meter M–107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	Dec. '45	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O–5/FR Exciter Unit	Dec. '45	All using O–5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBK–16 Radio Transmitting Equipment									
1	Meter M–107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	Dec. '45	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
3	Modification of the O-5/FR Exciter Unit	Dec. '45	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBK-17 Radio Transmitting Equipment									
1	Meter M-107 Erroneously Labeled	Dec. '45	All under contract NXss28616	SF	1	Stock	None	CEMB	None
2	Paralleled High Speed Keying	Dec. '45	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Dec. '45	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBL Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-1 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-2 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-3 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-4 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-5 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-6 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch	Dec. '45	All	SF	½	Stock	None	CEMB	None
2	Wiring Correction to Audio Output Jack J-101		Not applicable						

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
TBL-7 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch	Dec. '45	All	SF	½	Stock	None	CEMB	None
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-8 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101	Dec. '45	All on contract NXss-33180	SF	1	Stock	None	CEMB	None
TBL-9 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101	Dec. '45	All on contract NXss-33180	SF	1	Stock	None	CEMB	None
TBL-10 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-11 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-12 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-13 Radio Transmitting Equipment									
1	Modification of Labeling of Bond Change Switch		Not applicable						
2	Wiring Correction to Audio Output Jack J-101		Not applicable						
TBM Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-1 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-2 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-3 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-4 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-5 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-6 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-7 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-8 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-9 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-10 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46	All	SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-11 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units	Jan. '46		SF	3	Kit			
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None
TBM-12 Radio Transmitting Equipment									
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	Jan. '46	All using parallel and high speed keying	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	Jan. '46	All using O-5/FR Exciter Units	SF	2	Stock	None	CEMB	None

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
TBS Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-1 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-2 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2.	Stock	None	CEMB	None
TBS-3 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-4 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-5 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-6 Radio Transmitting Equipment									
1	Providing Standby Circuit	Jan. '46	All	SF	2	Stock	None	CEMB	None
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-7 Radio Transmitting Equipment									
1	Providing Standby Circuit		Not applicable						
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TBS-8 Radio Transmitting Equipment									
1	Providing Standby Circuit		Not applicable						
2	Installation of Transmission Line Filter CHW-53155	Jan. '46	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	Jan. '46	All	SF	2	Stock	None	CEMB	None
TCK Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	½		Kit	IB & CEMB	None
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-1 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	½		Kit	IB & CEMB	None
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-2 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	½		Kit	IB & CEMB	None
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-3 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	½		Kit	IB & CEMB	None
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-4 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	Not applicable						
2	Replacement of TCK-4 Filament Transformers		All shipped prior to 24 June 1944	SF	½		Kit	IB & CEMB	
TCK-5 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	½		Kit	IB & CEMB	None

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-6 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	Not applicable						
2	Replacement of TCK-4 Filament Transformers		All shipped prior to 24 June 1944	SF	2		Kit	IB & CEMB	
TCK-7 Radio Transmitting Equipment									
1	TCK Replacement Brush Kits	Jan. '46	All	SF	2		Kit	IB & CEMB	None
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCS Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Stock			N5ar-799
TCS-1 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-2 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Stock			N5ar-799
TCS-3 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-4 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-5 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-6 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-7 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-8 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286

Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-9 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-10 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-11 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit	Jan. '46	All	SF	1				
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-12 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators	Jan. '46	2632 thru 2766 3497 thru 3511 3912 thru 4311 5504 thru 5703 6554 thru 6853	YF	3	Stock	None	CEMB	None
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	3	Stock		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	2	Kit			N5ar-799
TCS-13 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit		Not applicable						

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Field Change Number	Field Change Title	Date of Field Change	Serial Numbers of Equipment Affected	Modifying Activity	Man-Hours Req'd	Source of Material	Stock Number of Kit	Instruction Bulletin	Contract Number
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799
TCS-14 Radio Transmitting-Receiving Equipment									
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	Jan. '46	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	Jan. '46	All	SF	1	Stock	None	CEMB	None
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	Jan. '46	All	YF	2	Kit		NavShips 900,005—IB & CEMB	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	Jan. '46	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	Jan. '46	All	SF	3	Kit			N5ar-799

YOU would squawk if St. Nick failed you on Christmas, and you also would squawk if your electronic equipment failed. Now we can't advise you where to file the St. Nick squawks, but you CAN solve your equipment failure problems by filing THOSE squawks on NAVSHIPS 383 FORMS

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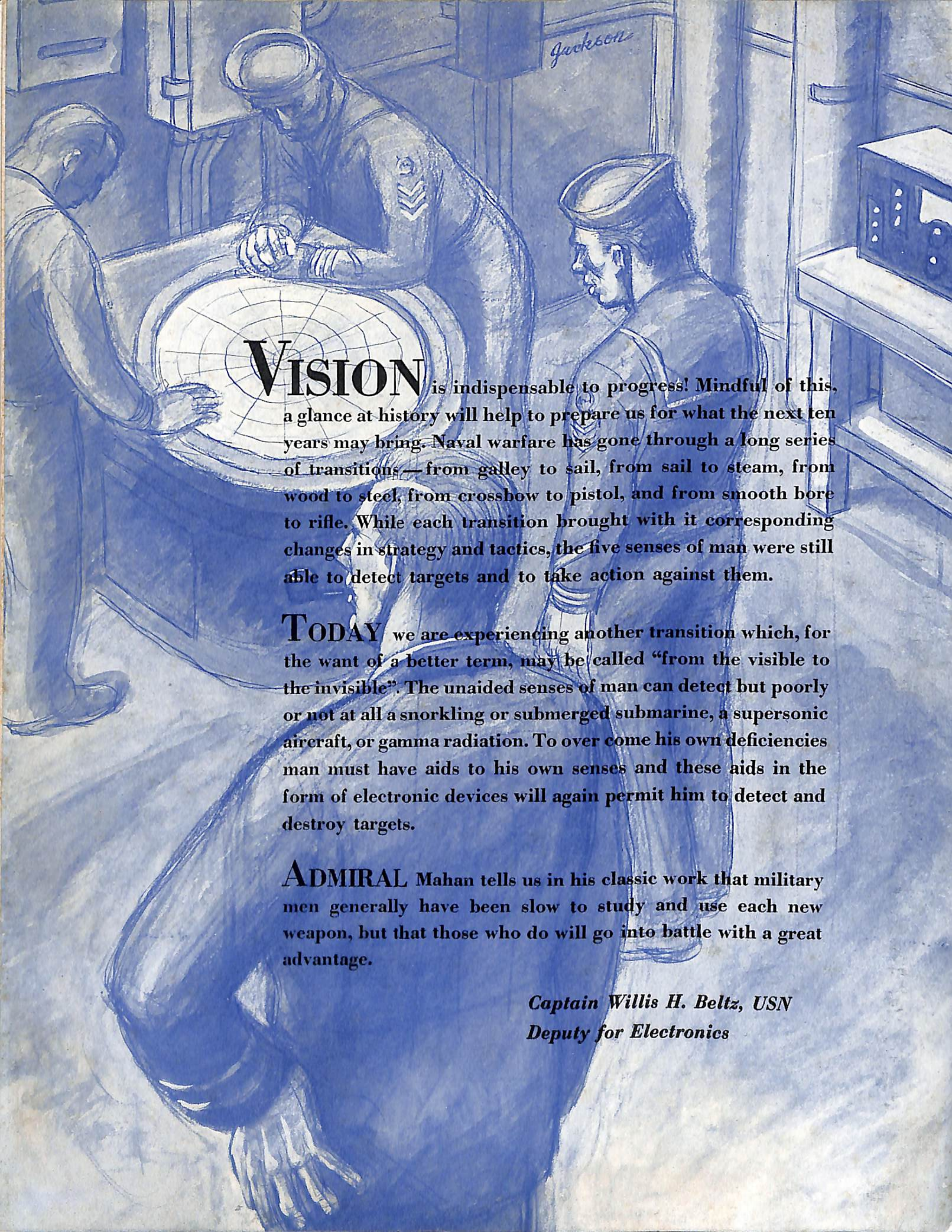

VISION is indispensable to progress! Mindful of this, a glance at history will help to prepare us for what the next ten years may bring. Naval warfare has gone through a long series of transitions—from galley to sail, from sail to steam, from wood to steel, from crossbow to pistol, and from smooth bore to rifle. While each transition brought with it corresponding changes in strategy and tactics, the five senses of man were still able to detect targets and to take action against them.

TODAY we are experiencing another transition which, for the want of a better term, may be called "from the visible to the invisible". The unaided senses of man can detect but poorly or not at all a snorkling or submerged submarine, a supersonic aircraft, or gamma radiation. To over come his own deficiencies man must have aids to his own senses and these aids in the form of electronic devices will again permit him to detect and destroy targets.

ADMIRAL Mahan tells us in his classic work that military men generally have been slow to study and use each new weapon, but that those who do will go into battle with a great advantage.

Captain Willis H. Beltz, USN
Deputy for Electronics