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SECURITY INFORMATION—RESTRICTED

T. O. No. 16-350A229-1

HANDBOOK
OPERATION AND SERVICE INSTRUCTIONS

RADIO TRANSMITTER

T-216/GR

(A PART OF TRANSMITTER GROUP OA-229/GR.)

(COLLINS)

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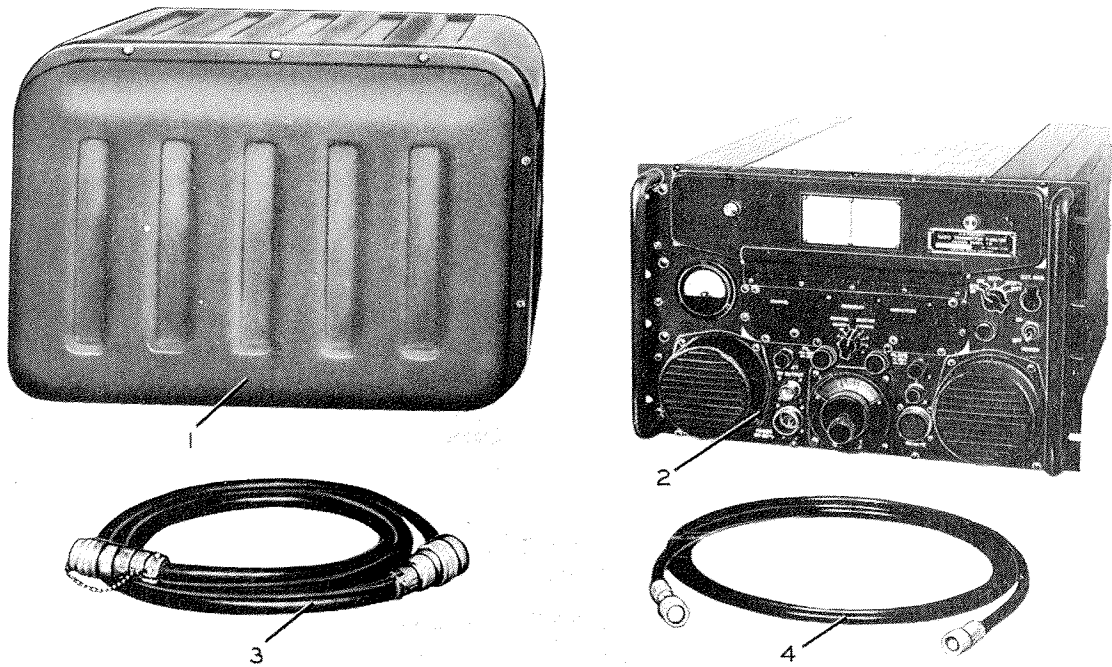
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1. Case CY-894/GR
2. Radio Transmitter T-216/GR
3. Power Cable Assembly CX-1174/U
4. RF Cable Assembly CG-553/U

Figure 1-1. Transmitter Group OA-229/GR

SECTION I
DESCRIPTION

1-1. OVERALL IDENTIFICATION.

1-2. Transmitter Group OA-229/GR, as pictured in figure 1-1, consists of one each of the following items.

- a. Radio Transmitter T-216/GR
- b. RF Cable Assembly CG-553/U (6 feet)
- c. Power Cable Assembly CX-1174/U (10 feet)
- d. Case CY-894/GR

1-3. PURPOSE OF EQUIPMENT.

1-4. Transmitter Group OA-229/GR has been developed to serve a dual purpose: (1) as a target transmitter in conjunction with Radio Direction Finder AN/CRD-6, and (2) as a crystal-controlled signal generator for laboratory use. Its capacity as a target transmitter in AN/CRD-6 installations is discussed in the Handbook of Operation and Service Instructions for that equipment. As a laboratory signal generator, Radio Transmitter T-216/GR, which is the primary

component in Transmitter Group OA-229/GR, provides any one of 1750 crystal-controlled frequencies between 225 and 399.9 megacycles. These frequencies are spaced at 100-kilocycle intervals. Output level is accurately calibrated from one microvolt to one-half volt. Output may be amplitude-modulated externally or internally. Internal modulation is at either 400 or 1000 cycles per second.

1-5. The equipment is designed to be air transportable. It may be operated while it is in the associated submersion and shock-proof case, in a rack mounted position, or installed upon the test bench.

1-6. COMPONENTS REQUIRED TO FORM COMPLETE EQUIPMENT.

1-7. Components supplied to the operating activity as part of the equipment are listed in paragraph 1-2. A power source of 115 or 230 volts at 50 to 60 cycles per second is required at the operating site. No additional components or auxiliary equipment items are required.

SECTION II

TEST EQUIPMENT AND SPECIAL SERVICE TOOLS

2-1. GENERAL.

2-2. Since Radio Transmitter T-216/GR is a highly complex unit of laboratory test equipment, it is suggested that no testing or alignment be attempted by

personnel at the operating level. For a complete list of test equipment and special service tools refer to Handbook of Maintenance Instructions for Transmitter Group OA-229/GR including Radio Transmitter T-216/GR.

SECTION III

PREPARATION FOR USE

3-1. CHOICE OF OPERATING SITE.

3-2. When Transmitter Group OA-229/GR is used in conjunction with a Radio Direction Finder AN/CRD-6 installation, the operating site will be dictated by the site of that installation. When the equipment is employed as an r-f signal generator, either in a laboratory or radio repair shop, Radio Transmitter T-216/GR and its associated cables should be removed

from the transit case, and either rack mounted in a standard 19-inch rack or placed upon a sturdy table or test bench. Its position at the test bench should be within easy reach of the operator to provide access to the operating controls.

3-3. UNCRATING.

3-4. When wooden crating is used, use a nail puller

to remove nails. Never allow a bar, hammer or other instrument to slip inside the crate accidentally since one of the controls or meters may become damaged. If the equipment is shipped in a transit case, remove the hex screws from the periphery of the cover. The cover may then be removed.

3-5. INSTALLATION.

3-6. Connections to be established between components, including intercomponent cabling and identification of cables in AN/CRD-6 installations, are discussed in the Handbook of Operation and Service Instructions for Radio Direction Finder AN/CRD-6. If Radio Transmitter T-216/GR is to be used as a laboratory signal generator, the only necessary cables for the installation are the included power input cable and the r-f output cable.

3-7. TUNING AND ALIGNMENT.

3-8. Radio Transmitter T-216/GR has no external tuning or alignment controls other than those needed for frequency selection, attenuation, modulation selection, and attenuator trimming. All frequency generating, filtering, and amplifying circuits are pre-tuned and should not be altered by operating personnel.



Before connecting Radio Transmitter T-216/GR to a power source, make certain that the 115V-230V switch on the Power Supply Rectifier unit is set to correspond to the supply voltage used, and that the PLATE and FILAMENT fuses are of the correct value for that voltage.

3-9. TEST OF EQUIPMENT FUNCTIONING.

3-10. GENERAL. To check for proper functioning of Radio Transmitter T-216/GR in its capacity of signal generator, connect the r-f output cable to the antenna of a receiver that covers the correct frequency range, and which is known to be operating properly. With the Function Selector switch on Radio Transmitter T-216/GR in STD. BY, turn the POWER switch ON. When both the receiver and Radio Transmitter T-216/GR are warmed up and operating, set the Transmitter controls as follows:

<u>Control</u>	<u>Setting</u>
POWER	ON
CHANNEL SELECTOR	MANUAL
FUNCTION SELECTOR	1000 ~
ATTENUATOR	1000 μv
FREQUENCY SELECTOR	225.0 mc
MOD. SET.	30%
TRIMMER	White Line

Under these conditions the cabinet blower should function, as evidenced by air passing through the filter on the equipment's front panel, and the pilot light should be glowing. With the receiver tuned to

225.0 mc a 1000 cycle note should be heard at the receiver output.

3-11. FREQUENCY GENERATING SYSTEM AND MANUAL OPERATION OF FREQUENCY SELECTOR UNIT. A check of each crystal in the frequency generating system, as well as manual operation of the Frequency Selector Unit, may be made by setting the manual channel to each of the following frequencies in turn as the receiver is simultaneously tuned to that same frequency.

<u>Frequency</u>	<u>Crystals Employed</u>		
225.0	Y-401	Y-416	Y-201
236.1	Y-402	Y-417	Y-202
247.2	Y-403	Y-418	Y-203
258.3	Y-404	Y-419	Y-204
269.4	Y-405	Y-420	Y-205
270.5	Y-406	Y-411	Y-206
281.6	Y-407	Y-412	Y-207
292.7	Y-408	Y-413	Y-208
303.8	Y-409	Y-414	Y-209
314.9	Y-410	Y-415	Y-210
325.0	Y-401	Y-416	Y-211
335.0	Y-401	Y-416	Y-212
345.0	Y-401	Y-416	Y-213
355.0	Y-401	Y-416	Y-214
365.0	Y-401	Y-416	Y-215
375.0	Y-401	Y-416	Y-216
385.0	Y-401	Y-416	Y-217
395.0	Y-401	Y-416	Y-218

At each frequency a 1000-cycle tone should be heard at the receiver output.

3-12. FREQUENCY SELECTOR UNIT. To check the functioning of the Frequency Selector Unit, proceed as follows:

- a. Set the Transmitter controls as indicated in paragraph 3-10.
- b. Connect the r-f output cable to the antenna terminal of a receiver that covers the frequency range, and which is known to be functioning properly.
- c. Position the knurled disks on the preset panel (figure 4-1) so that each channel is set to a different frequency. The first 10 frequencies listed in paragraph 3-11 are ideal for this purpose.
- d. Rotate the CHANNEL SELECTOR switch to each of the channels 1 through 10 in succession; simultaneously tune the receiver to the corresponding channel frequency. A 1000-cycle tone should be heard at the receiver output for each channel.

3-13. FUNCTION SELECTOR SWITCH. With the equipment operating as in paragraph 3-12, the FUNCTION SELECTOR switch may be checked by rotating it to various positions and noting the effect upon the receiver output.

- a. Connect an audio oscillator through a standard two-contact audio connector to the EXT. MOD. jack.
- b. Rotate the FUNCTION SELECTOR switch to EXT., and note the receiver output tone. It should vary in

frequency as the frequency of the oscillator is changed.

c. Rotate the FUNCTION SELECTOR switch to 400 cycles. A 400-cycle tone should be heard in the receiver output.

d. Rotate the FUNCTION SELECTOR switch to the CW position. No audio note should be detected in the receiver output, but AVC should be present in the receiver, and the usual "r-f hiss" should be noted.

e. Rotate the FUNCTION SELECTOR switch to STD.

BY. The "r-f hiss" and AVC should disappear from the receiver, but the POWER pilot light should continue to glow, and the cabinet blower should continue to operate.

3-14. ATTENUATOR. For a qualitative check of the attenuator operation, note the AVC voltage for the receiver as the ATTENUATOR control is rotated from one extreme to the other. After the AVC threshold has been reached the AVC should increase as the signal generator output increases. For a more accurate check of absolute magnitude of output voltage refer to the Handbook of Maintenance Instructions for Radio Transmitter T-216/GR.

SECTION IV

OPERATION

WARNING

Do not attempt to operate this equipment with the dust cover removed because of shock hazard. As the dust cover is an electrical shield, it also acts to reduce undesirable radiation.

4-1. PURPOSE AND LOCATION OF OPERATING CONTROLS.

4-2. Figure 4-1 illustrates the panel position of all operating controls. The purpose of these controls is given in the following table.

<u>Control</u>	<u>Purpose</u>
POWER	Turns equipment on and off
Function Selector	Selects STD, BY-CW - 400~ - 1000~ - EXT modulation
Preset Panel	Sets frequency of 10 preset channels.
CHANNEL Selector	Selects one of 10 preset channel frequencies, Manual channel or remote operation.
Fiducial Ring	Calibrates attenuator on CW
Attenuator	Controls r-f output amplitude
ZERO SET	Sets meter zero on STD, BY
MOD. SET	Adjusts percent modulation
TRIMMER	Peaks Attenuator tank

4-3. OPERATING PROCEDURE.

4-4. The primary function of Radio Transmitter

T-216/GR, when used as a signal generator, is to supply a calibrated source of signal - either modulated or unmodulated - for use in the r-f alignment of receivers operating in this frequency range. The exact procedure to be followed in such cases depends to a great extent upon the individual receiver being aligned. The procedure outlined in the following steps will make available at the RF OUTPUT jack a signal of known frequency, amplitude and modulation characteristics.

a. Operate the POWER switch to the ON position and allow Radio Transmitter T-216/GR to warm up for at least 15 minutes.

b. Set each of the 10 channels on the preset panel by positioning the three knurled disks associated with each numbered channel to indicate a desired frequency.

c. Position the CHANNEL SELECTOR to indicate the number of the preset channel that corresponds to the desired frequency.

NOTE

If it is necessary to operate at a frequency other than those ordinarily set up on the preset panel, operate the CHANNEL SELECTOR switch to MANUAL, and position the three knurled disks associated with the MANUAL channel on the preset panel to the desired frequency. This does not disturb the setting of the ten preset channels.

d. Operate the emission selector switch to STD, BY.

e. Rotate the ZERO SET control slightly until the pointer on the % MODULATION meter corresponds exactly to the red line marked ZERO SET.

f. Operate the Function Selector switch to CW.

g. Adjust TRIMMER for maximum indication on the meter.

h. Adjust the fiducial ring on the output level control until the pointer on the % MODULATION meter corresponds to the PWR SET red line. (Steps g and h must be performed at each channel frequency if extremely accurate quantitative measurements are to be made.)

i. Adjust the attenuator control so that the desired output level is indicated by the proper red line on output level indicator dial.

E_2 indicates output level across a 52-ohm resistive load. This output level may be read either in db or in microvolts directly from the output level indicator dial.

j. Operate the Function Selector switch to the desired modulation frequency.

k. Adjust the MOD. SET control for the desired amount of modulation as indicated on the % MODULATION meter.

NOTE

The red line designated E_1 indicates open circuit output level while the red line designated

l. To turn the equipment off operate the POWER switch to the OFF position.

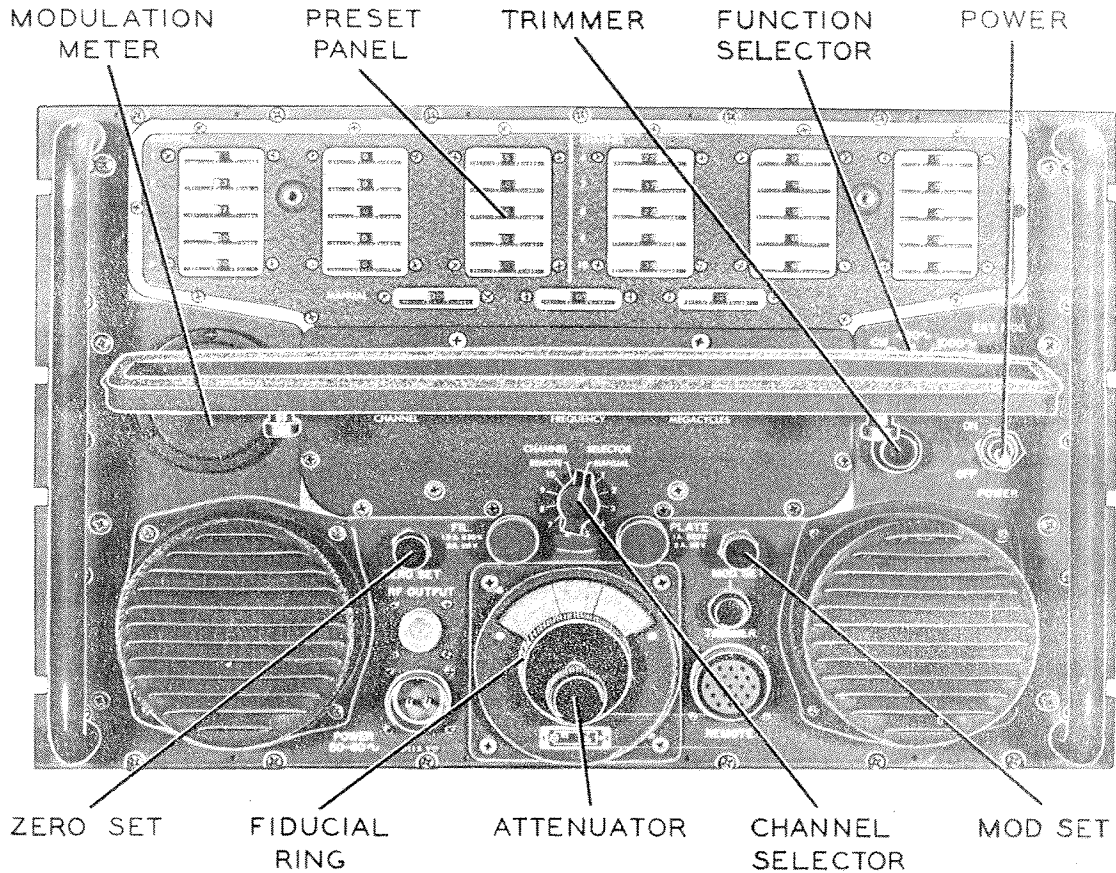


Figure 4-1. Radio Transmitter T-216/GR, Operating Controls.

SECTION V
INSPECTION AND PREVENTIVE MAINTENANCE

5-1. GENERAL.

5-2. Since Radio Transmitter T-216/GR is a highly complex set of test equipment used to align and test the operation of vital communications equipment, it is of utmost importance that it operate properly at all times. The operator must constantly remain on guard against erratic or abnormal functioning of the equipment, and report such abnormal operation to maintenance personnel responsible for the equipment.

5-3. PERIODIC INSPECTION.

5-4. Under normal operating conditions the exterior portions of this equipment should be dusted daily with a clean soft cloth to remove surface dirt. Power input and r-f output connections should be checked to make certain they are properly terminated and secured. The controls should be operated to make sure there is no tendency to seize or bind.

5-5. At least once each week the air filters should be inspected to make sure they have not become filled with dust and lint. If these filters become dirty or obstructed in any way, excessive heat generated within the unit due to lack of circulating air will result in damage to the equipment.

5-6. PREVENTIVE MAINTENANCE.

5-7. CLEANING. The greatest enemies to uninterrupted service in equipment of this type are corrosion and dirt. Corrosion itself is accelerated by the presence of dust and moisture on the component parts of the assembly. It is impossible to keep moisture out of the equipment in certain localities but foreign particles and dust should be removed by means of a soft brush and a dry, oil-free jet of air. Remove the dust as often as a perceptible quantity accumulates in any part of the equipment. To prevent wear, it is very important that rotating equipment, such as tap switches, be kept free of dust. Remove the air filters and clean them by means of oil (SAE #30 or #40) directed at both sides of the filter. Allow to drain well and replace.

5-8. One of the predominant sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden air may cause equipment failure for no apparent reason. In general, it will be found that contacts such as tap switches, tube prongs, and cable connectors are most affected by corrosion. When it is necessary to operate the equipment in localities subject to such corrosive atmosphere, inspect wiping contacts, cable connectors and so forth frequently in order to keep the equipment in good condition.

5-9. TROUBLE SHOOTING.

5-10. GENERAL. Prior to removing the equipment from the dust cover to attempt any trouble shooting, check the position of all controls to ascertain whether they have been accidentally moved from the normal operating position, and check all fuses to determine if a power circuit has been affected by the trouble. Faulty fuses should be replaced only after the circuit in question has been carefully examined to make certain no permanent fault exists.

5-11. DUST COVER REMOVAL. To remove the dust cover from the equipment, remove the 13 Phillips head screws recessed into the edges of the front panel, place the equipment upon the test bench in such a manner that the front panel is downward, and the weight of the unit is resting on the two handles. The dust cover may now be removed by lifting directly upward and sliding the cover free of the main frame assembly.

5-12. INTERLOCK SWITCH. The cabinet interlock switch will open when the unit is removed from the dust cover. To lock the switch on, pull the plunger on the switch out until it locks.

5-13. VACUUM TUBES. Most erratic and abnormal operation in equipment of this nature is attributable to faulty vacuum tubes. In event the equipment is working poorly and signal tracing is not feasible, use a tube tester to locate the faulty tubes. Replace defective tubes and determine whether performance has improved. After making the tube emission check, examine prongs of the good tubes to make certain they are free from corrosion and are not bent or broken. Replace each good tube in the same socket from which it was removed. Replace all tubes correctly and fully into their sockets, and be sure that good electrical contact exists between the prong of the tube and the socket. Before discarding a tube make certain that it is at fault and that the trouble is not due to a loose or broken connection within the equipment. A complete set of tested tubes of the same type specified should be kept on hand at all times. If faulty operation of the equipment is observed and tube failure is suspected, check each by replacing it with a tube known to be in good condition. Defective tubes that cause an overload in power circuits can usually be located by inspection. It will be found that excessive heating or sputtering within the vacuum tubes is a good indication of a fault in the tube. A marked improvement in the performance of the equipment is usually noticeable after defective tubes have been replaced.

5-14. TUBE REPLACEMENT PRECAUTIONS. When replacing vacuum tubes, remember:

- a. Before removing any tube from the equipment, be sure to disconnect the primary power from the equipment.
- b. Remove all tubes by pulling straight up on them.
- c. If the prongs on the miniature tubes become bent, straighten them with one of the special pin straighten-

ers obtainable for this purpose.

- d. Always replace a tube with another of the correct type.

5-15. LUBRICATION. All moving parts of this unit are lubricated upon assembly and require no further lubrication until the period of general overhaul when it is reassembled.

SECTION VI

PREPARATION FOR RESHIPMENT

6-1. GENERAL.

6-2. Preparation for reshipment consists of disconnecting the associated cables, and packing the complete equipment either in Case CY-894/GR or in a wooden packing crate.

6-3. PACKING IN CASE CY-894/GR.

6-4. To pack the equipment in Case CY-894/GR, proceed as follows:

- a. Lower Radio Transmitter T-216/GR into Case CY-894/GR, and secure it to the shock-mounted frame.

- b. Place R. F. Cable Assembly CG-553/U and Power Cable Assembly CX-1174/U inside the case cover.

- c. Attach retainer plate to the case cover, using wing nuts on the stud bolts.

- d. Inspect the rubber gasket within the recessed edge of the case to see that it remains undamaged and clean.

- e. Place the cover on the case, and tighten the cover fastening screws by means of the wrench clipped to the side of the case.

- f. With this same wrench, check the pressure-equalizing valve for tightness.

6-5. PACKING IN WOODEN CRATE.

6-6. To facilitate reshipment, retain the original packing materials. These materials have been designed to most effectively protect the equipment and their use will greatly speed reshipment. First, wrap and tape the cables in some fluffy, protective material; then place them along with Radio Transmitter T-216/GR, in a strong cardboard carton. To prevent damage to controls, block the components so that they cannot shift within the carton.



Place the blocking material so that it always makes contact with strong structural parts of the unit. Block the unit away from all sides of the panel with strips that are thick enough to give clearance to panel controls.

6-7. After sealing the carton with strong tape, place it in a wooden crate, constructed of 3/4-inch lumber or plywood equivalent. Float the carton in two or three inches of excelsior. Mark the crate with appropriate identifications and handling instructions.