

TL MICROWAVE RADIO
GENERAL INFORMATION
GENERAL MAINTENANCE

1. GENERAL

1.01 This section and associated sections describe methods for making tests and adjustments on the TL radio system.

1.02 The tests outlined here are those which will be performed at the radio sites and control points. It is assumed that the test equipment required for routine maintenance will be available for testing at one or more stations.

1.03 If after routine tests it has been necessary to replace a complete unit or subassembly, the defective unit should be returned to the Western Electric Company for repair and alignment.

1.04 Sections in the TL microwave series covering the various tests and adjustments are completely listed in Section 409-000-000.

1.05 The test procedures outlined in these sections are based upon the premise that maintenance personnel are familiar with operation of the test equipment. Only such information as is necessary for the proper performance of the particular test is included in these sections. Further information should be obtained from Sections 104-440-300 and 104-440-500 which cover operation and maintenance of the test set.

1.06 A radio station transmitter log should be maintained in accordance with appropriate Federal Communications Commission (FCC) regulations. A log form similar to that shown in Fig. 1 might be used. A separate sheet would be filled out for each transmitter with the original copy maintained at each radio station for the period specified by the FCC. A front sheet similar to Fig. 2 should be added to the station log listing the names, addresses, class of license, license number, and expiration date for each employee who may perform work on radio equipment at that station. The front sheet should

also carry a notation as to where the licenses are posted for those employees listed. In addition, entries should be made on the routine test forms each time routine tests are performed. A sample routine test form is contained in Section 409-302-330. Where adjustments are required, entries before and after adjustments, the reasons for adjustments, and an explanation of the adjustment procedures are recommended.

1.07 A radio station having obstruction lighting with associated automatic alarm system should maintain a log at the alarm center similar to that shown in Fig. 3. A notation should be made in the transmitter log front sheet that such a log is kept and where it is located.

1.08 Any individual, upon arriving at and just before leaving an unattended microwave station or site, should report to the control point. By so doing, the control point may direct the maintenance personnel to perform other than routine work, correlate any alarms with the presence of the maintenance man at the site, and take advantage of any times when maintenance personnel are simultaneously at adjacent stations to make adjustments not normally feasible.

2. SPECIAL PRECAUTIONS CONCERNING KLYSTRONS

2.01 Although the klystron is a fairly rugged tube, it is relatively expensive and can be easily damaged if care is not exercised when working on the RE equipment.

2.02 Special precautions covering the handling and replacement of klystrons may be found in Sections 409-304-504 and 409-306-506.

3. SAFETY PRECAUTIONS

3.01 The electronic equipment of the TL radio system operates with some voltages higher than those normally encountered in the tele-

phone plant. The applicable safety precautions described in Section 010-110-001 should be followed.

Warning 1: *Any work performed on energized equipment should be done with one hand, while standing on an insulated surface, keeping the other hand away from the equipment or any other apparatus that will conduct electricity.*

Warning 2: *Do not peer into an open waveguide or the end of an antenna feed when the equipment is energized, as an eye injury may result.*

4. GENERAL TEST CONSIDERATIONS

4.01 It is essential that there be no extraneous frequencies radiating in the station area which might leak into units and cause irregularities in the test results, or result in degradation of transmission. Extreme care should be taken to ensure that all sources of RF energy are properly terminated or otherwise shielded. All waveguide flanges must be tight and waveguide adequately supported and grounded.

4.02 The figures illustrating test arrangements show the physical appearance of the unit under test and the test set. These figures enable the maintenance personnel to familiarize themselves with the test setup.

4.03 Experience with other microwave systems has emphasized the importance of continuity of power supply as a factor influencing stability of transmission characteristics. The removal of power supply and its reapplication after a period long enough to permit cooling of the klystrons and, therefore the vapor phase boiler, will necessitate a warmup period to attain stabilization of transmission characteristics before final adjustments are made.

4.04 Special attention should be paid to the instructions relating to removal and restoration of service contained in Fig. 4.

5. TROUBLE INVESTIGATION

5.01 When trouble occurs in a unit, it is important to localize the fault as soon as possible. The maintenance philosophy on TL

radio is based as far as possible on replacing complete units or subassemblies to correct trouble conditions. In this way, on-site maintenance time can be kept low and out-of-service time reduced to a minimum.

5.02 The associated sections have been arranged to provide maximum assistance in locating and correcting trouble in the TL radio system. The use of these sections as guides is essential to the continued efficient operation of the system.

6. TEST EQUIPMENT

6.01 The performance of the TL radio system is determined by the proper functioning of a number of radio bays in tandem. Each is tested independently and as an integral part of the system. The proper adjustment of each bay is dependent upon the proper functioning of the test equipment. It is essential that at least the same maintenance standards be applied to the test equipment as are applied to the radio bays.

6.02 The following apparatus is required for routine performance checks on a TL radio system:

2 — J99262AA Portable TL Test Sets

1 — KS-14510, List 1 Volt-ohm-milliammeter (VOM)

1 — KS-19178, List 1 Voltmeter with list 2 case and list 3 and list 4 test leads or Weston Model 931, type S87665 Voltmeter

7. SPECIAL TOOLS

7.01 The following is a list of special tools and equipment required for performing routine maintenance on the TL radio system. They are all contained in the spare parts transit case, which is carried by maintenance personnel to each site.

KS-6854 Screwdriver For klystron and and control panel adjustments

No. 2358 UG Quick-wedge Screwdriver (or equivalent) For removing crystal covers on 1A modulator

SPWR-6 Waveguide Wrench, Omega Laboratories, Inc. Rowley, Mass.	1/4-inch swivel head socket wrench, 6 inches long	P-30C127 Graduated Syringe, 5 milliliter Macalaster Bicknell Company, Cambridge, Mass.	For filling klystron boiler and measuring fluid
SPWR-10 Waveguide Wrench, Omega Laboratories, Inc. Rowley, Mass.	1/4-inch swivel head socket wrench, 10 inches long	Polyethylene Bottle 250 milliliter Macalaster Bicknell Company, Cambridge, Mass.	For transporting fluoro-chemical for klystron boilers
No. 29 Williams Wrench (or equivalent)	11/16- and 25/32-inch double, flat, open end, hexagon wrench for coupling between bladder and condenser assembly	P-13D070 Heat Sink	1-3/8 inch by 1-3/8 inch by 3-inch copper block for cooling down boiler prior to filling or removing
No. 731 Williams Wrench (or equivalent)	3/4- and 13/16-inch double, flat, open end, hexagon wrench for coupling between bladder and condenser assembly	No. 642 Eagle Fuse Puller, Eagle Electric Manufacturing Co., Inc., Long Island City, N.Y.	For removing Bussman 30-ampere cartridge fuses
No. 3408 Spintite Socket Wrench (or equivalent)	1/4-inch socket wrench for removing boiler screws	7.02 The following items will be kept either at the sites or on the truck.	
No. 3414 Spintite Socket Wrench (or equivalent)	7/16-inch socket wrench for removing klystron screws	KS-5499, List 1401 Syringe	For filling battery cells
388A Tool	1/4- and 3/16-inch open-end wrench for No. 6 and No. 8 waveguide screws	No. 126 Bickman Rubber Jug (or equivalent)	For transporting battery fluid
602C Tool	Tool for removing 227-type amplifiers on order-wire panel	Gloves — Heat Resistant	For removing hot boilers and klystrons
319B Tool	Tool for removing No. 2 type lamp caps	8. RELAY MAINTENANCE EQUIPMENT	
553A Tool	Tool for removing No. 2 type lamps	8.01 The tools, material, and test apparatus for the maintenance and adjustment of wire-spring relays, and the cleaning and reconditioning of relay contacts, are listed in the appropriate sections as follows:	
KS-16598, List 1 Tool	For removing crystals from 1A modulator	Section 040-502-701	Relays — AF, AG, and AJ Types
KS-16887, List 1 Wedge	Tool for blocking AK-type relays	Section 040-504-701	Relays — Type AK

SECTION 409-302-500

Section 040-267-701 Relays — 280 Type

Section 069-306-801 Relay Contacts Cleaning Relay Parts and Cleaning and Reconditioning Similar Contacts on other Apparatus Except Keys and Jacks

8.02 The method of operation of the relay test apparatus is listed in the appropriate sections as follows:

Section 100-101-101 35-type Test Set

Section 100-130-101 Test Set for Timing Test — J24753A

RADIO STATION TRANSMITTER LOG			
LICENSEE _____			
SYSTEM _____		STATION LOCATION _____	CALL SIGN _____
TRANSMITTING FREQUENCY _____ MC			
DATE	TIME	REMARKS	OPERATOR SIGN

Fig. 1 - Radio Station - Transmitter Log

Diversity System

(Steps 1 through 4 cover Manual Switch Operation; 5 and 6, Removal and Restoral of Transmitter; 7 and 8, Removal and Restoral of Receiver)

<u>STEP</u>	<u>FUNCTION</u>	<u>ACTION</u>	<u>NOTES</u>
1	Coordinate with Alarm Center	Obtain permission to perform manual switch at receiving station of section under test. a. If Note 1 applies, go to Step 3. b. If Note 2 applies, go to Step 2.	1. If no diversity alarm from station under test, proceed to Step 3. 2. If diversity alarm from station under test, find which pair involved (Step 2). a. If one of pair under test, locate and clear trouble before switching; b. If one of another pair terminating at same station, manual switch permissible on pair under test.
2	Find source of diversity alarm	Measure dc due to pilot in each J99262L Diversity Switch Panel in station under test, until source located: 1. Remove dust cover. 2. With KS-14510 Meter measure dc on PIL MON LEV jacks for each channel in turn (See Note 2). a. Tone present if -5 to -10V. b. Tone absent if -3V or less. 3. Close hinged panel and restore dust cover.	1. Diversity alarm conditions: a. Tone present on both, no alarm; b. Tone absent on both, no diversity alarm (but major alarm due to total absence of pilot); c. Tone present on one, absent on other, diversity alarm. 2. PIL MON LEV jacks for regular channel accessible on left side of panel behind dust cover; those for diversity channel accessible behind hinged panel on right.
3	Find active channel	With KS-14510 Meter (on 3-volt dc scale) measure from K4 jack to ground, Diversity Switch Panel under test. a. If no voltage, Regular channel active; b. If between -2 and -3V, Diversity channel active.	
4	Manuel switch	Operate the MAN switch from AUTO to the MAN position desired, Regular or Diversity.	The <u>idle</u> channel may now be removed from service for maintenance. a. Do Steps 5 and 6 to remove and restore transmitter from service. b. Do Steps 7 and 8 to remove and restore receiver from service.
5	Remove transmitter from service. <u>CAUTION:</u> Steps 1 through 4 must be done first.	1. Remove patch to Transmitter Baseband IN jack. 2. Terminate open patch at once (See Note).	Open output of diversity split-pad must be terminated to minimize effects of change of level on working line. A terminating jack for this purpose provided with TL Test Set.
6	Restore transmitter to service	When maintenance done: 1. Remove terminating jack applied in Step 5. 2. Restore transmitter input patch to IN jack of Transmitter BB'Ampl. 3. At receiving location verify that service is now being received on the idle channel. See Note. 4. Restore the MAN switch to the AUTO position if no further maintenance required, or to other MAN position if the other channel is to be maintained.	Determine from the alarm center that a diversity alarm is not being received from the receiving location.
7	Remove receiver from service. <u>CAUTION:</u> Steps 1 through 4 must be done first.	No special action required	
8	Restore receiver to service	1. Verify that service is now being received on idle channel. See Note. 2. Restore the MAN switch to the AUTO position if no further maintenance required, or to other MAN position if the other channel is to be maintained.	Determine from the alarm center that a diversity alarm is not being received from the receiving location.

Non-Diversity System

1. Secure permission from Alarm and Control Center.
2. Perform needed maintenance.
3. Restore service.
4. Verify service restoral with Alarm and Control Center.

Determine from the alarm center that no alarms are present.

Fig. 4 – Procedures for Removing and Restoring Service