

L4 CARRIER OVERALL SYSTEM

TESTS

MAINTENANCE CONSIDERATIONS

CONTENTS	PAGE
1. GENERAL	1
2. TEST EQUIPMENT	1
3. TEST FACILITIES	2
4. TROUBLE CLEARING	5

1. GENERAL

1.01 *L4* is a general term for both the long-haul L4 and for the L4S (short L4) carrier systems. L4 carrier equipment is of two main types according to location:

(a) *Line repeater equipment* is mounted in pressurized apparatus cases in unattended underground repeater stations at 2-mile intervals along the coaxial cable. This equipment is designed for minimum on-site maintenance. Defective units are returned to a maintenance center for repair.

(b) *Main station equipment* is mounted in bays in buildings at up to 150-mile intervals along the coaxial cable. Each main station contains receiving and transmitting repeaters, line switching equipment, and line repeater power supply equipment.

1.02 This section is reissued to add references to the L4S system, to expand the explanations, and to show later equipment arrangements.

1.03 The L4 carrier system utilizes a wide frequency band and contains numerous unattended repeaters. Adjustable equalizers are provided in equalizing repeater stations and in main stations so that gain deviations across the L4 frequency band may be held within required limits.

1.04 L4 lines may include only *stepped* equalizers which are adjusted from a control center in a main station or may include stepped equalizers at the main stations and *manual* equalizers at the equalizing repeater stations. For L4S lines, only *manual* equalizers are provided in the main stations.

1.05 The L4 remote control system, where provided, permits centralized measurements of gain deviations and in-service adjustments of stepped equalizers at remote locations. The remote control system also permits turning on the monitoring oscillators, in groups, so that the received signals may be used for locating troubles. A monitoring oscillator is associated with each L4 repeater. For an L4S system, monitoring oscillators are controlled by means of pushbuttons in the main stations.

2. TEST EQUIPMENT

2.01 The following test equipment is suitable for the precision measurements required in maintaining L4 carrier equipment.

Wandel-Goltermann Sending and Receiving Console AT444

Wandel-Goltermann Selective Level Meter AT463

Hewlett-Packard Frequency Counter 5326A or 5327C

Selective Level Meter AT463 is a portable transmission measuring set which can be used at L4 line repeater locations. This unit operates from ac or from internal rechargeable batteries.

2.02 Specialized test equipment for L4 carrier includes:

J68898A Pilot Measuring Test Set

J68899A Main Station Repeater Test Set

J68906A Equalizing Repeater Test and Maintenance Stand

J68906B L4 Line Repeater Test Set

J68906C L4S Repeater Test and Maintenance Stand

L4 Pilot Hit Detector

(a) **Pilot measuring test set** J68898A is a portable unit used at line repeater locations to measure repeater gain at 11.648 MHz, to check for the presence of direct current on a coaxial line, and to act as a line current bypass when replacing defective repeaters.

(b) **Main station repeater test set** J68899A is used for bench tests at main stations to measure the gain, regulation, noise, modulation products, and frequencies of various line and main station repeater units.

(c) **Equalizing repeater test and maintenance stand** J68906A is used at main stations to test equalizing repeater units such as the A equalizer and associated control circuits, which cannot be tested in a main station repeater test set.

(d) **L4 line repeater test set** J68906B is used at main stations to test L4 repeaters and associated units. This test set will perform all the tests possible on the J68899A and J68906A units.

(e) **L4S repeater test and maintenance stand** J68906C is used at main stations to test L4S repeaters and associated units. This test stand is similar to the J68906B except that there is no provision for testing the equalizing repeater and associated units.

(f) An **L4 pilot hit detector** is used to locate hits affecting the 11.648-MHz line pilot. Hits are rapid changes in signal level and are indicated when a number of fast switches occur in L4 lines. The hit detector responds to hits as short as 50 microseconds; some hits may not cause line switches. A hit detector can be installed at a line repeater station and operated

locally or can be operated remotely from a main station.

3. TEST FACILITIES

3.01 Transmission path jacks are provided in the main station bays.

(a) For **long-haul L4** systems, transmission equipment is provided in three types of bays: a line receiving bay that serves one receive line, a line transmitting bay that serves two transmit lines, and a control connecting bay that serves all lines in a route; ie, the cable extending in one direction from a main station.

(b) For **L4S** systems, transmission equipment is provided in two types of bays: a line bay that serves one receive and one transmit line, and a control connecting bay that serves all the lines in a route.

3.02 The locations of components, connectors, and controls are described as viewed from the front of a bay, unless otherwise specified, to simplify test procedure explanations. This must be kept in mind when working at the rear of a bay.

Pilot Indicators

3.03 A pilot indicator panel J68877EA (Fig. 1) is provided in later L4 line receiving bays and in L4S line bays to indicate the relative levels of the received line pilot signals: 512 kHz and 11.648 MHz. Earlier L4 line receiving bays include jack and meter panel ED-50711 (Fig. 2) which is manufacture discontinued.

Test Jacks

3.04 A jack field is provided for each line as shown in Fig. 2 through 5. Patch plugs are required in certain jacks to connect command carrier, monitoring oscillator, pilot, and switching signals as well as added, branched, dropped, and through signals.

Order Wires

3.05 Paper-insulated pairs in the L4 cable are used for four 4-wire order wires which provide voice communication among main station, line repeater, and cable trouble locations. Other

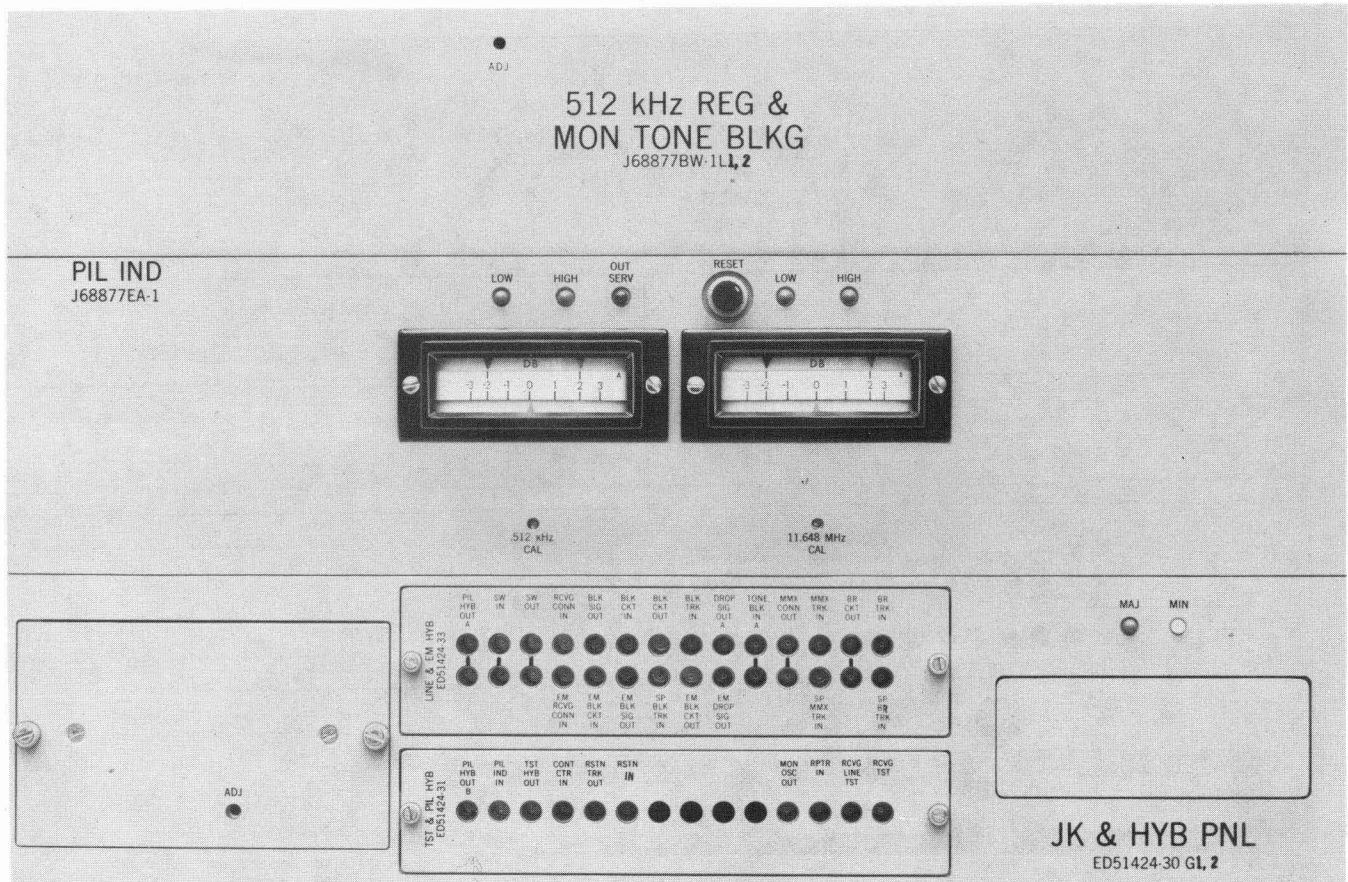


Fig. 1—Line Receiving Bay Panels

paper-insulated pairs are used for four 4-wire circuits for the E1 status reporting and control system and for restoration order wires, alarms, and controls. Voice-frequency repeaters for these circuits are provided at equalizing repeater stations and at main stations. These voice-frequency repeaters are powered by 130 volts dc simplex on the paper-insulated pairs. The 130-volt rectifiers are located at adjacent main stations.

3.06 The four order wires are designated cableman order circuit (COC), local order circuit (LOC), L4 order circuit (L4OC), and express order circuit (XOC). The COC and LOC appear at main stations and line repeater stations. The L4OC and XOC appear at main stations only.

Remote Control System (not provided for L4S)

3.07 Remote control system equipment, when provided, is located at main stations and

equalizing repeater locations. A **control center** (Fig. 6) is located at certain main stations; however, in an L4 system including a remote control system, at least every other main station will have a control center.

3.08 The remote control system permits two main actions at a control center:

- (a) Measuring gain deviations and adjusting equalizers to compensate for these gain deviations.
- (b) Locating troubles in the L4 repeaters through use of the monitoring oscillator signals.

In addition, external test equipment may be used at the control center jacks.



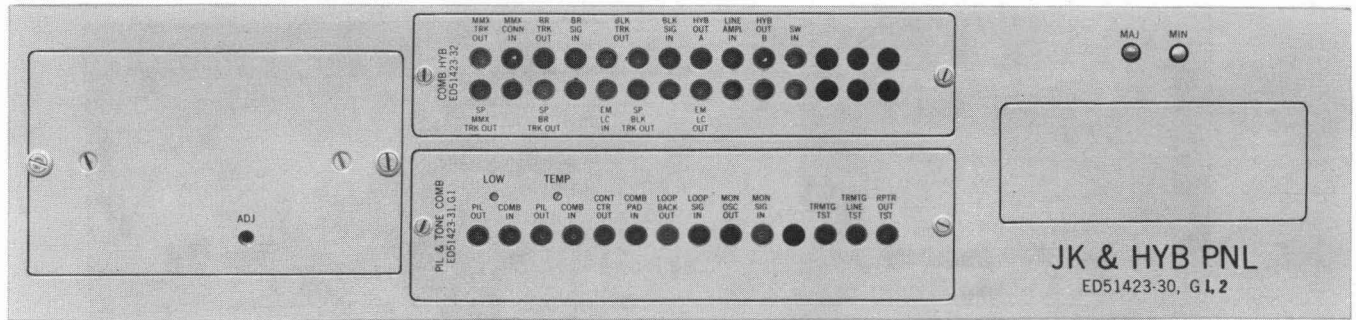


Fig. 4—Transmitting Jack and Hybrid Panel ED51423

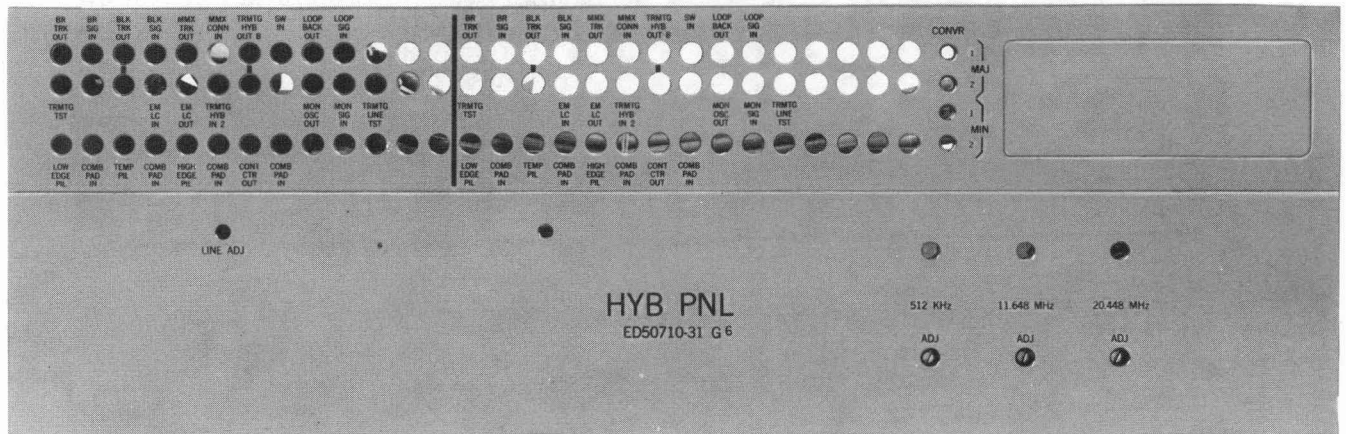


Fig. 5—Transmitting Jack and Hybrid Panel ED50710

E1 Status Reporting and Control System

3.09 The E1 system includes equipment at a **master** main station and at one or more **slave** main stations. The master station is attended and the slave stations are unattended or partially attended. Each slave station monitors the equipment and conditions at that station. Upon command from the master, the slave gives a **go** or **no-go** report for each of up to 4096 conditions being monitoring.

3.10 The master interrogates the slaves, receives and displays alarm and status information, and sends commands to operate switches at a slave station. The interrogation and resulting display may be automatic and may recur periodically, or interrogation may be manual to check on any alarms reported by a slave. Alarms may be reported for such conditions as ac power failure, open door,

high temperature, etc. The status of spare mastergroup circuits at a slave station may be reported, such as whether particular spare mastergroups are on standby or have switched into service. Commands may be sent from a master to a slave to operate coaxial line switches, switch spare mastergroups into service, start emergency generators, etc.

4. TROUBLE CLEARING

4.01 Trouble **isolating** in the L4 system begins at the main stations because of the following considerations:

- (a) Main stations are the only attended locations.
- (b) Office alarms are provided in main stations to indicate trouble conditions.

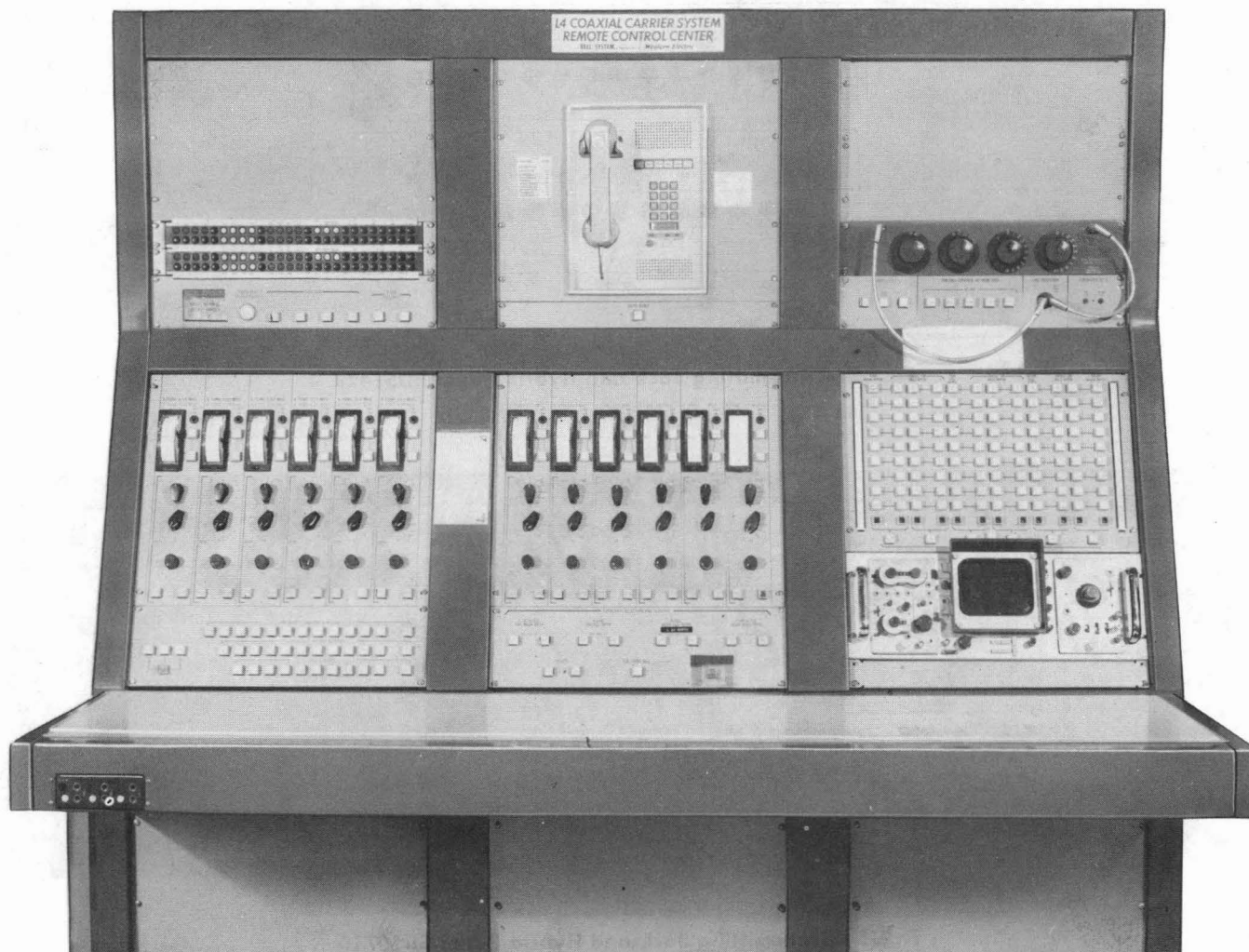


Fig. 6—Control Center

- (c) Transmission measuring equipment, control centers, and E1 system displays are located in the main stations.
- (d) Each line receiving bay includes the meters which continuously monitor the received line pilot signal levels.
- (e) Automatic line switching occurs at main stations under control of the line pilot signals.
- (f) Voltmeters and ammeters on dc power supplies in the main stations indicate the L4 line voltage and current conditions.

4.02 Trouble is isolated to a specific line repeater, if possible. In some cases, a particular unit can be determined to be defective by tests made from the main station.

4.03 Trouble *clearing* at line repeater locations involves locating and replacing defective units with units known to be good. After a unit is replaced, the main station attendant checks that the trouble is cleared. The defective unit is returned to the main station, checked insofar as possible, and returned to a maintenance center for repair.

4.04 Charging current limiter ED-52355 is used when installing fuses in the dc-dc converters

J87334A in the L4 line bays. Converter J87334A draws a heavy input current when power is first applied. This heavy surge current can damage the contact lugs of the fuseholder for the input power fuse. Use the following procedure to avoid damage to the fuseholder.

1. Insert charging current limiter ED-52355 in the fuseholder normally occupied by the 0.25-ampere fuse (fuseholder S2, S4, S12, or S10 for converters 1 through 4, respectively).
2. Install a 7.5-ampere AGC fuse in the assigned fuseholder (fuseholder S1, S3, S11, or S9 for converters 1 through 4, respectively).

3. Remove the charging current limiter.

4. Install a 0.25-ampere fuse in this fuseholder.

Note: The limiter has a high negative temperature coefficient and the limiter resistance will drop to a low value after carrying the converter input current for more than a few seconds. This low resistance will have a minimum effect on converter performance. The limiter should be allowed to cool for at least one minute before use with another converter.