OPERATION AND MAINTENANCE
TERMINAL STATION
1 X N FREQUENCY DIVERSITY
MAINTENANCE INTRODUCTION

CONTENTS PAGE

This section contains a description of the maintenance concept, the maintenance procedures, and the admonishments that must be observed during repair activities.

To clear alarmed conditions at this terminal station, go to the " Station Alarm Trouble Isolation" tab and follow instructions.

MAINTENANCE PHILOSOPHY

The DR 6/11-135 Digital Radio System with frequency diversity protection switching is designed to operate on a demand maintenance basis. No routine maintenance is necessary except for the annual tests required by the FCC (Federal Communications Commission). However, additional performance evaluation tests are recommended. These procedures are outlined under the " Annual FCC Tests" tab.

Demand maintenance is made possible by the automatic protection switching, self-checking, and alarm-reporting capabilities designed into the system. Whenever failures or other service-threatening troubles develop, alarms generated by the self-checking and alarm-reporting circuits alert maintenance personnel of the need for repair activity. If necessary, service is also protected by automatic protection switching, which transfers the affected payload signal to a parallel protection channel at the terminal end stations.

Operation on the demand maintenance basis requires efficient procedures to quickly localize and repair the source of the problem. If each equipment site in a system is manned continuously, the built-in self-checking local office and equipment alarm features of the system are usually sufficient to guide maintenance work. In multiple hop systems, however, some failures may generate multiple station alarms requiring communication between the

maintenance personnel at several stations to isolate the true source of the problem.

For operation on an unattended basis, which is the normal situation, the system is designed to be used with an external centralized alarm-reporting or telemetry system, such as the AT&T TASC (Telecommunications Alarm Surveillance and Contol) system. In this arrangement, information from the centralized alarm center is used to quickly isolate the station most likely to be the source of the problem and to dispatch maintenance personnel to that site.

The maintenance procedures may be used with either alarm-reporting arrangement described in the previous paragraphs. However, when centralized alarm reporting is used, information from the alarm center is often useful in station trouble isolation, repair, and verification of repair procedures. Therefore, the procedures in this section are designed to take advantage of this information when it is available.

The station maintenance procedures are designed to take full advantage of the self-checking and alarm-reporting features built into the system. Monitoring circuits in key units continuously check the operating status of transmission equipment at each station. Additional monitors also evaluate the transmission performance on a per-hop and system basis. The alarm-reporting circuits at each station process the status information (called scan points) from the monitoring circuits, activate appropriate indicators on the local equipment, and after additional combining, generate the control signals. The control signals activate the local office alarm system, which identifies the alarmed equipment location in that station.

When a centralized alarm-reporting system is used, the alarm-reporting circuits (available in several output formats) do additional processing of the alarm and status information. This generates the appropriate data signal format for interfacing the specific central alarm-reporting system used. The alarm and status information for each assigned scan point is transmitted to the central alarm center either via an independent transmission facility interfacing directly at each station or via interface equipment at the terminal station(s) only. In the latter case, which is more common, digital circuits available on the optional DR 6/11-135 integral service channel are normally used to carry the alarm and status information from each station to the terminal interface point. The general procedures to be used for either type of system are provided in the following paragraphs.

CENTRALIZED ALARM-REPORTING NOT USED

When centralized alarm-reporting is not used, maintenance personnel simply respond to the local office alarms at their specific station. For multiple hop systems where initial analysis indicates that the trouble may not be at their station, communication with maintenance personnel at other sites is necessary to isolate the actual trouble location. Once the trouble is located, the maintenance personnel use local alarm indications and, if necessary, tests to isolate the source of the failure. The alarm-causing failure is then cleared by replacement of the failed plug-in or functional unit. Once the cause of the failure has been repaired and locally verified, communication between the manned stations is used to verify system status.

CENTRALIZED ALARM-REPORTING USED

Since most systems have centralized alarm-reporting, the DR 6/11-135 maintenance manuals are designed for this arrangement. The following information outlines general procedures which take place upon receipt of an alarm at the alarm center.

With centralized alarm-reporting, only alarm-type scan points that require a response are automatically relayed to and displayed at the alarm surveillance center. Analysis of these alarm-type scan points will normally isolate the failure to a specific station within the

switching section. The switching section can also be scanned for status-type scan points. Analysis of the status-type scan points can help verify the validity of the alarm and should help isolate most equipment failures to a terminal bay, regenerator bay, radio transmitter, or radio receiver in a specific hop.

After analysis, the alarm surveillance center notifies the appropriate maintenance center of the location and nature of the failure. The maintenance center supervisor sends maintenance personnel to the suspected station. Once at the location, the maintenance personnel use local alarm indications and, if necessary, tests to isolate the source of the failure. The alarm-causing failure is then cleared by replacement of the failed plug-in or functional unit. Once the cause of the failure has been repaired and locally verified, maintenance personnel contact the alarm surveillance center to verify that repair is complete.

Repairs of the system should be analyzed on a switching system basis. Since a single failure can generate alarms at different locations, all trouble-clearing should begin and be supervised by the alarm surveillance center. Otherwise, repair attempts at the wrong station may result. The alarm surveillance center instructions are provided in the Maintenance Center Operation document. This guide instructs alarm center personnel to:

- Analyze scan points and locate trouble
- Initiate dispatch
- Protect service prior to repair
- Verify station and switching section repair
- Restore system to operating condition.

The remainder of this section contains general information on how to use this maintenance manual and the procedures to be followed in isolating and repairing alarmed troubles at a terminal station.

STATION REPAIR MAINTENANCE

All repair at a terminal station begins with the " Station Alarm Trouble Isolation" tab. The flowchart references local indications to direct the technician to the appropriate alarm-clearing procedures.

The alarm-clearing procedures consist of detailed alarm-clearing flowcharts. The flowcharts reference local indications and any necessary tests and adjustments to determine the plug-in or functional unit that failed. Once the failed plug-in or functional unit has been located, repair is accomplished by replacement of the faulty unit with a spare. After repairs have been made, follow up with repair verification.

The " Repair Verification" tab contains information necessary to ensure that there are no alarms and that the repaired equipment meets system requirements. Once this is accomplished, the technician is directed to notify the alarm center or other manned stations for station and switching section repair verification. When repair is verified, station maintenance is complete.

TEST EQUIPMENT

The test equipment required for trouble-clearing depends on the nature of the problem. When a test is required, the alarm-clearing flowchart references a specific procedure in one of the tabs of the " Tests and Adjustments" section. Each procedure lists the required test equipment and accessories to complete that particular procedure. For a complete list of the recommended test equipment, refer to the " Test Equipment and Accessories" tab in the " Test and Adjustments" section.

ADMONISHMENTS

Admonishments are provided to assure safety of personnel, to avoid service interruptions, and to avoid equipment damage. The admonishments used in this document are defined below.

- DANGER — Used when there is a possibility of personal injury.
- CAUTION — Used when there is a possibility of service interruption.
- WARNING — Used when there is a possibility of equipment damage.

The following general admonishments should be observed whenever maintenance is performed on this equipment.

DANGER: Never look directly into an open waveguide port. When a signal is present eye damage may occur due to RF radiation.

Caution: Ensure that service is protected prior to repair. Service on any regular channel MUST be manually switched to a protection channel to prevent service interruptions during testing. Even if automatically switched, the switch should be reinforced with a manual switch before testing. If the protection channel is to be tested, it MUST be manually locked out to prevent a regular channel from switching to it during testing.

Caution: Exercise caution when working around in-service equipment to prevent interruption to the service on operating channels.

Warning: To prevent ESD (electrostatic discharge) from damaging a plug-in unit, ensure that all ESD precautions are followed during removal, replacement, handling, and storage of circuit packs.

Warning: Damage to a backplane connector or circuit pack may occur during replacement unless the plug-in unit replacement procedures are followed.

Warning: A torque wrench of the proper rating must be used to tighten all radio SMA connectors to prevent connector damage and to ensure proper connection.

Warning: All test apparatus must be supported to prevent connector damage due to strain on the connectors.

SERVICE PROTECTION PRIOR TO REPAIR

The action taken to protect service depends on the condition of the equipment and the type of repair. Most repair activity will cause interruption to a transmission path. Therefore, every effort should be made to transfer service to a path that will not be interrupted. Refer to the " Service Protection" tab to determine the action required to protect service.

HOW TO USE FLOWCHARTS

The alarm-clearing flowcharts use four basic symbols, as shown in Fig. 1. All flowcharts are entered at the START reference. It is assumed that the alarmed condition covered by the specific flowchart exists either locally or at the remote alarm center. The technician should address the first decision block and continue following the appropriate " YES" or " NO" paths to isolate and clear the trouble. Once the specific trouble is cleared, the technician should continue following the flowchart instructions to ensure that all alarms associated with the station are cleared.

The flowcharts in this manual are broken down into the three levels shown in Fig. 2. Level 1 covers the station and references local alarm indicators on a centralized alarm panel to determine if the trouble is in the radio receiver, radio transmitter, or terminal bay. All station alarm-clearing begins with the " Station Alarm Trouble Isolation" tab.

Level 2 covers the specific bay and references local alarm indicators on the associated equipment to direct the technician to the appropriate alarm-clearing flowchart.

Level 3 covers bay equipment and references local alarm and status indicators and any necessary tests and adjustments that isolate the trouble to a failed unit.

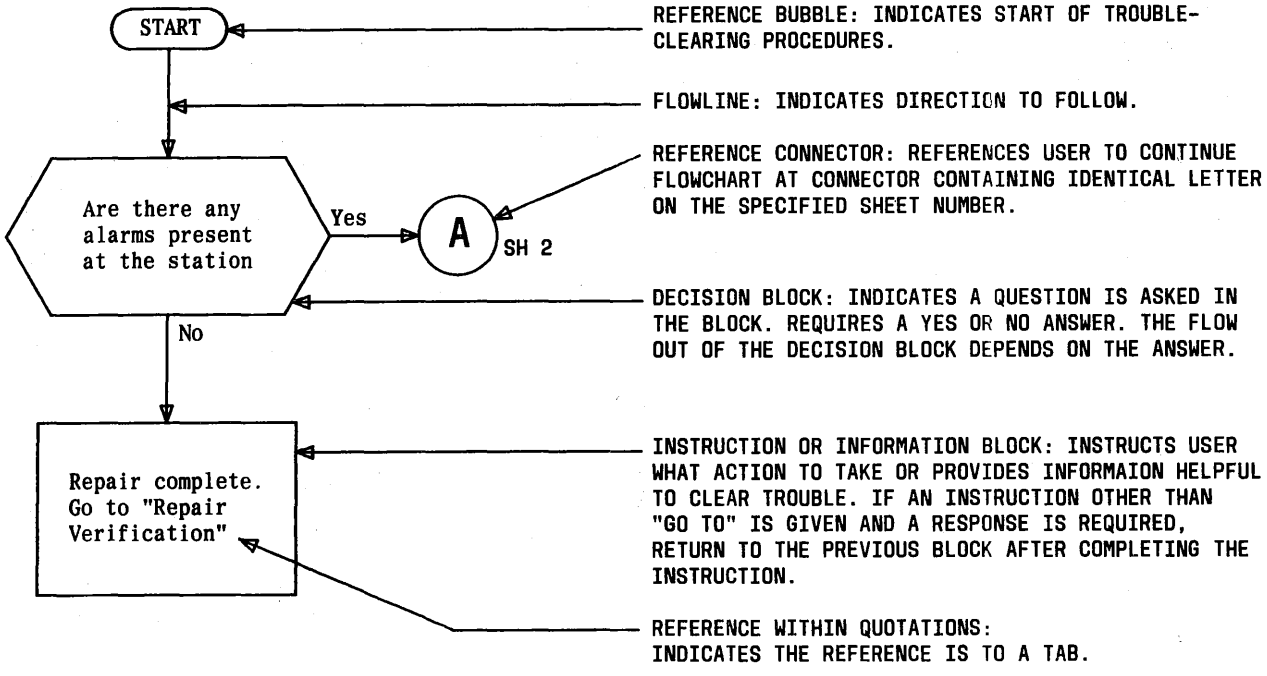

Fig. 1—Flowchart Symbol Explanation

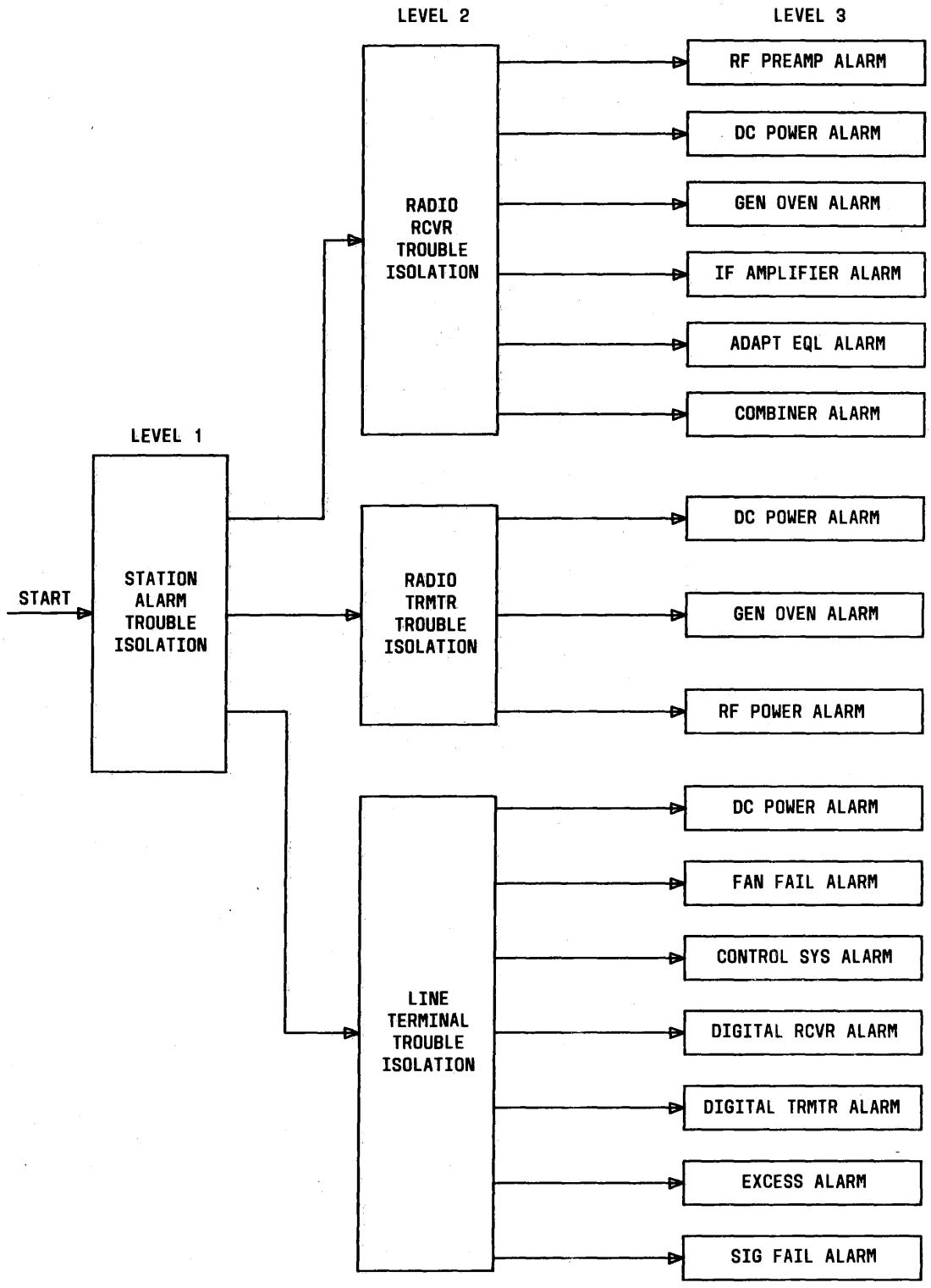

Fig. 2—Terminal Station Flowchart Hierarchy