

**MJ AND MK MOBILE RADIO TELEPHONE SYSTEMS
SMALL SYSTEM EQUIPMENT UNITS
EQUIPMENT DESIGN REQUIREMENTS
RADIO SYSTEMS**

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1. GENERAL	

SCOPE

1.01 This section and the references listed in 4. EQUIPMENT describe the general equipment design requirements to be used in the engineering and installation of the small MJ and MK mobile

radio telephone systems. The description covers the most recent configuration of each system.

1.02 This specification is reissued to rate J41645A, List 25 and 26 Mfr Disc. and remove Notes 4 and 5 and add Note E; to rate J41645B, List 22 and 23 Mfr Disc. and remove Notes 3 and 4; to add J41645C; to rate KS-19609, Lists 3, 5, 7, and 9 through 11 Mfr Disc.; and to change the series number AA290.023 to the new 9-digit section number 806-158-150.

1.03 Issue 4 and Issue 4, Addendum 1 of this section did not receive official distribution.

CAPACITY

1.04 The small MJ and MK mobile radio telephone systems will serve a maximum of 90 customers per system over a maximum of two radio channels.

DESCRIPTION

A. Equipment Arrangement

General

1.05 The small MJ (150-MHz band) and MK (450-MHz band) mobile radio telephone systems are fully automatic, 2-way dial telephone systems using narrowband frequency modulated (FM) transmission on a maximum of two 2-way channels between the mobile subscriber and the central office. Each system operates from a step-by-step, crossbar, or ESS central office (modified for ground start on the central office lines that tie to the control terminal) and uses one mobile subscriber line assignment per mobile unit. Replacing the existing manual push-to-talk mobile telephone system, the MJ and MK systems furnish multichannel access and automatic full-duplex operation of both mobile and base station radio equipment, allowing the subscriber to talk and listen simultaneously. The MJ system is fully compatible with existing manual toll systems.

1.06 The MJ and MK mobile radio telephone systems can be operated over wire-line or carrier-type facilities between the base station control terminal and base station radio equipment. When carrier-type facilities are used, remote signaling circuits must be provided. These circuits convert dc commands and responses between the control

terminal and base station radio equipment to carrier operation.

1.07 The small MJ and MK mobile radio telephone systems furnish service that is comparable to present land subscriber service. Both mobile-to-land and land-to-mobile calls can be dialed directly without operator assistance when the mobile station is operating in its home area. Equipment options allow either one or two channels for use in any one area, depending upon the number of channels necessary to provide good quality service and the number of channels available locally.

1.08 A larger terminal, J41644, is available that will provide a large MJ or MK mobile radio telephone system with as many as eight channels and 480 customers. While the small system is similar in its transmission and radio aspects, it can handle a maximum of only 90 customers on two channels.

1.09 MJ and MK systems consist of base station control terminal equipment, base station radio equipment, and mobile station equipment. The small system base station control terminal consists of a maximum of two 11-foot 6-inch bays (Fig. 1). Base station radio equipment consists of base station transmitters (Fig. 2 or 3) and one to eight receivers (Fig. 4). The mobile station consists of a radio unit (Fig. 5 and 8), a supervisory unit (Fig. 6), and a control unit (Fig. 7 and 8).

1.10 The base station control terminal consists of both logic and transmission circuits mounted on one or two channel bays, depending on the number of channels or customers. The logic circuits associate a radio channel with the proper line circuit or switchboard trunk, identify the channel periodically, alarm trouble conditions, facilitate testing, and provide supervision. The transmission circuits provide 2-wire to 4-wire operation, assure proper audio levels, control the transmitters and receivers, and generate and detect the supervisory tones. Transmission facilities connect the individual channels to the base station radio equipment. This equipment, which may or may not be remotely located, consists of high- or low-power (FM) transmitters and fixed tuned receivers for each channel. In order to assure adequate coverage of the assigned area, a number of receivers per channel (maximum of eight) may be placed throughout the coverage area. Receiver selection circuits in the terminal will automatically switch to the receiver providing the

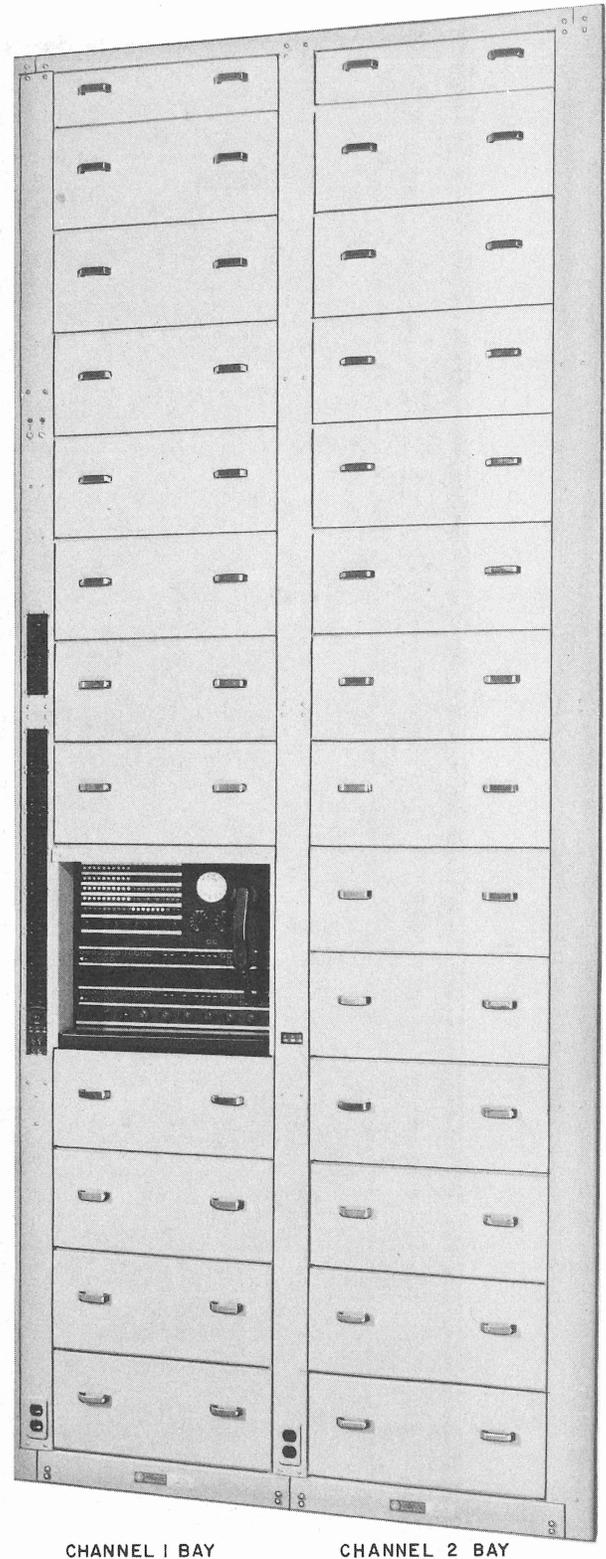


Fig. 1—Typical Base Station Control Terminal

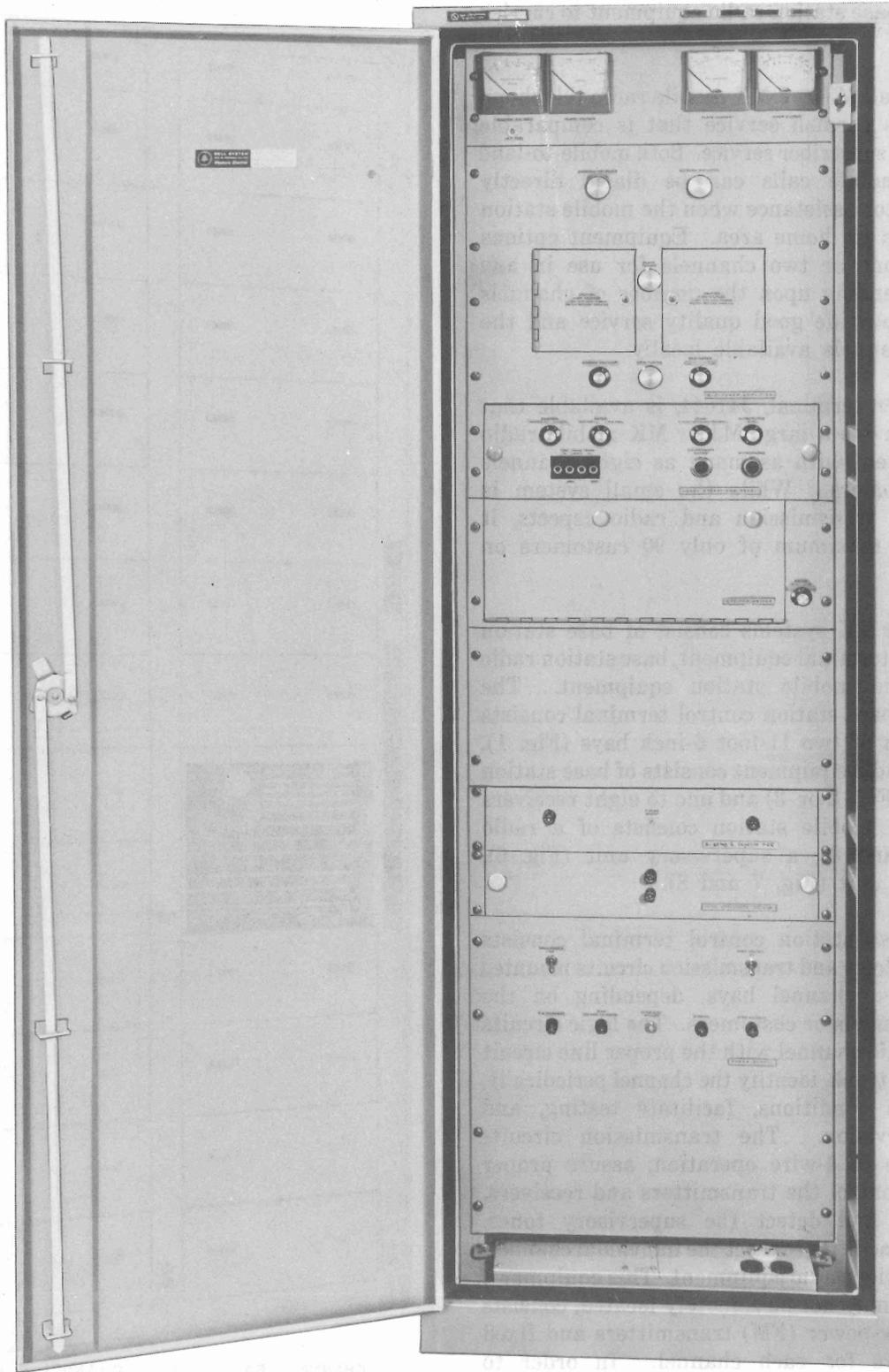


Fig. 2—Typical Base Station Transmitter—MJ 250-Watt Transmitter Unit KS-19618, L21 Shown

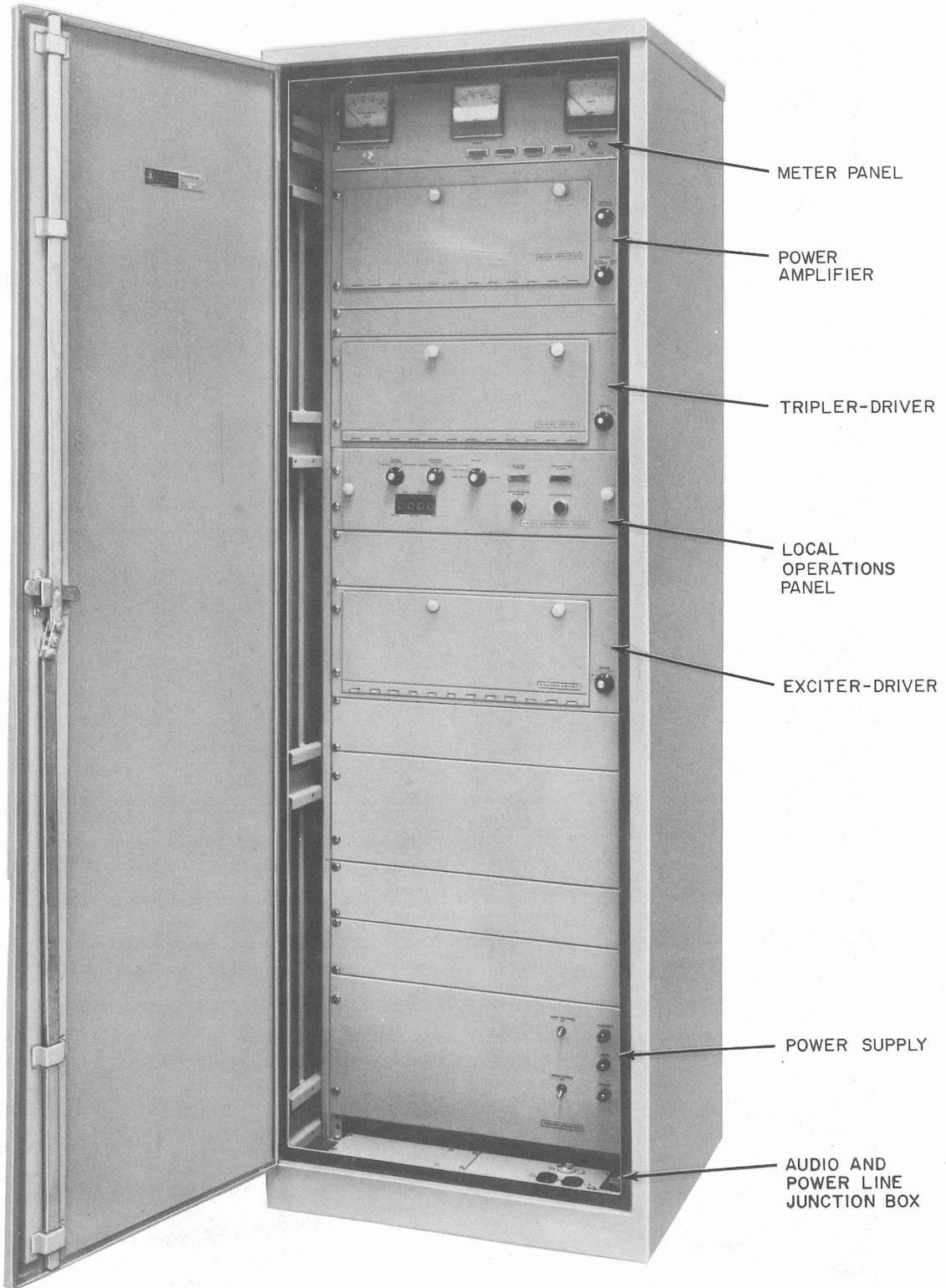


Fig. 3—Typical Base Station Transmitter—MK 5- to 120-Watt Transmitter Unit KS-20285, L1 Shown

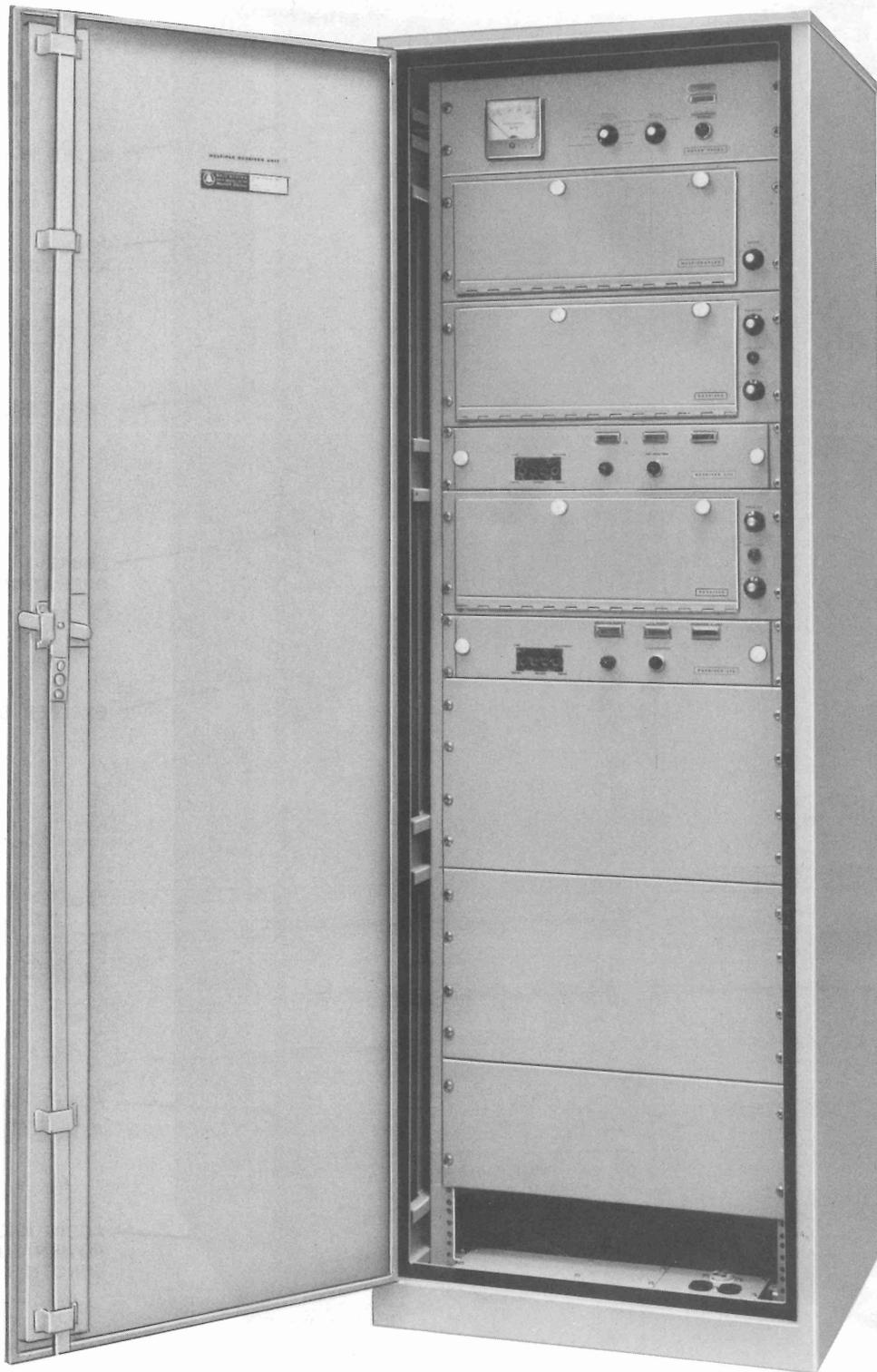
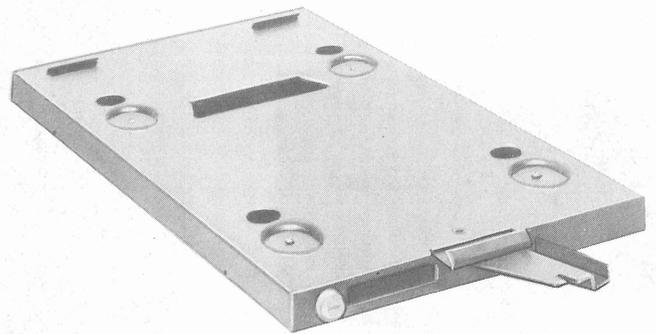


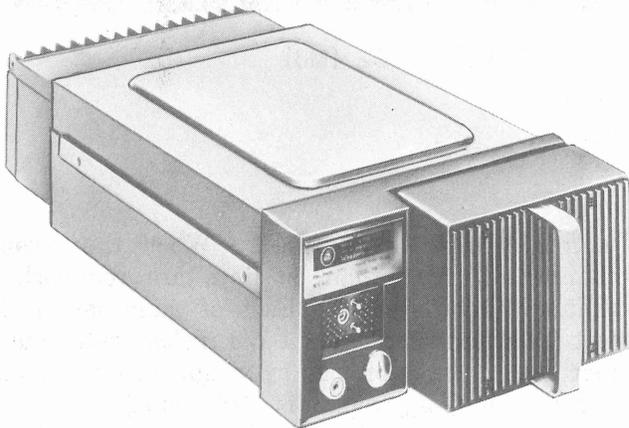
Fig. 4—Typical Base Station Receivers—MK Receiver Package KS-20285, L52 Shown



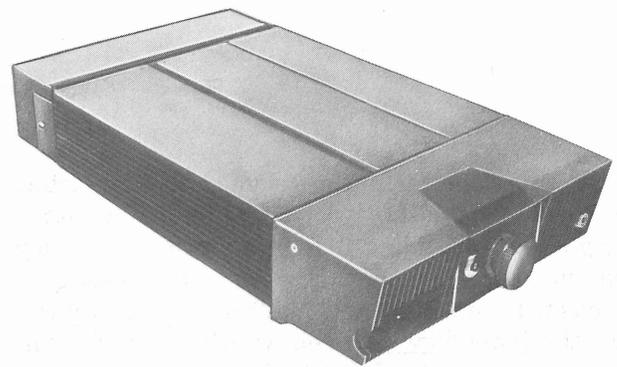
C. KS-20282 (MK)



D. MOUNTING PLATE FOR KS-20282 (MK)



A. KS-19609 (MJ)



B. KS-19852 (MJ)

Fig. 5—Mobile Station Radio Unit

best signal-to-noise ratio. The mobile station supervisory unit performs the necessary logic and control functions for the mobile station in the customer's vehicle to allow the subscriber simply to dial the desired number. The supervisory unit is mounted within the mobile radio unit.

1.11 A multichannel access feature, an integral part of the MJ and MK systems, permits the mobile station to automatically seek out and lock on an idle channel during on-hook conditions. This is accomplished by the mobile station supervisory and radio units that search for the channel that is marked by the single frequency idle tone. The next call in either direction will then be completed over this channel, with system logic functioning to

drive all on-hook mobile stations from the channel. All mobile stations not involved in the call will then search for the next idle channel, if any, marked by the base station control terminal. In this way, a mobile station may send or receive calls on any channel in its home area, since it must be equipped for all home area channels.

1.12 Three modes of operation are available to the MJ mobile station: home, roam, and manual. The home mode permits the mobile station to search for the marked-idle channel in the group of channels assigned to the mobile station home area as preset by strapping options in the control unit. (The supervisory unit is programmed for automatic operation and contains strapping appropriate

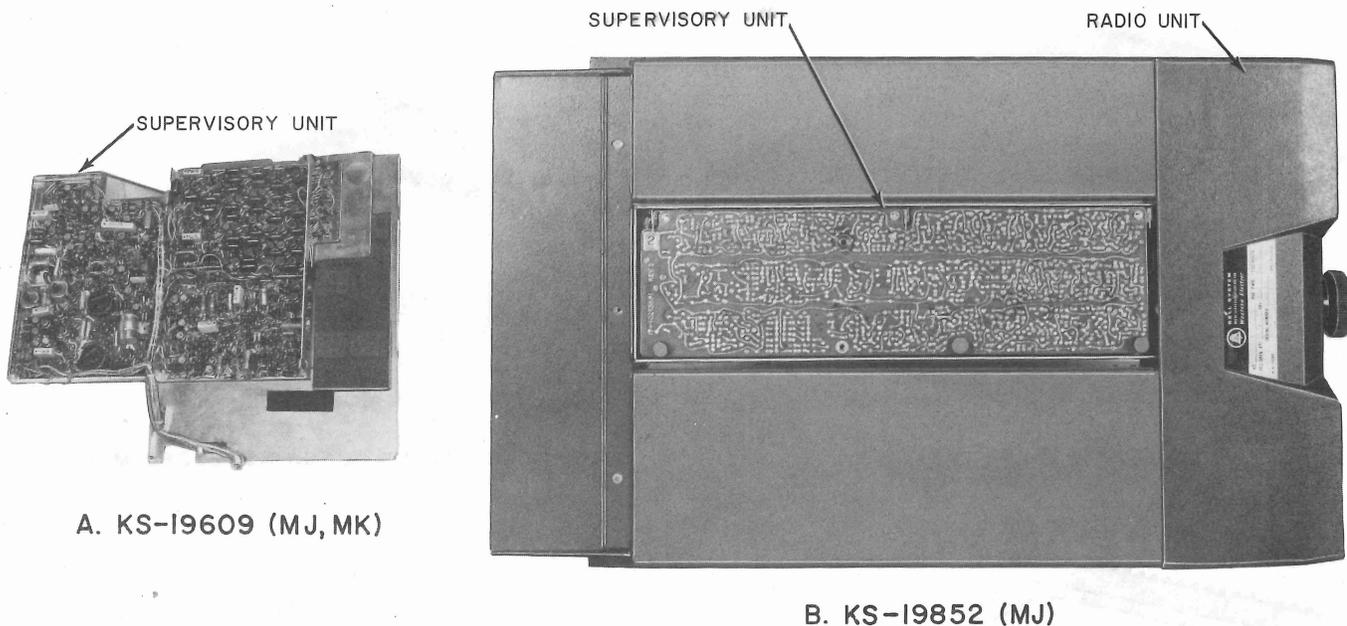


Fig. 6—Mobile Station Supervisory Unit

to the subscriber number assigned to the mobile station.) Should the mobile station roam into a foreign area providing MJ type service, the roam mode may be selected; this permits the subscriber to select, by means of pushbuttons on the control unit, the individual channels which the radio unit will scan in search of the marked-idle channel and assures that the set will scan only the selected channels. The third mode, manual, enables the MJ mobile station to be compatible with existing manual areas.

1.13 The MK system has two modes of operation, home and roam, which are functionally identical to the MJ system in the case of an optional control head. In the case of an other control head, there is one exception: the MK mobile control unit is not equipped with pushbuttons for channel selection for the roam mode of operation. Channel selection for the roam mode is accomplished by strapping options which are wired into the subscriber's radio unit at the time of installation.

1.14 Expansion provision in the small MJ and MK systems is such that the terminal can initially be equipped for a minimum of 1 channel and 10 lines and can grow to a maximum of 2 channels and 90 lines. The initial installation in this case would be a single channel 1 bay that

permits growth to 30 lines. When the second channel or more than 30 lines are required, a channel 2 bay is added. Each of these bays is 11 feet 6 inches high, 2 feet 1-1/8 inches wide, and 1 foot deep. The floor loading weight is 750 pounds, and the shipping weight is 1000 pounds.

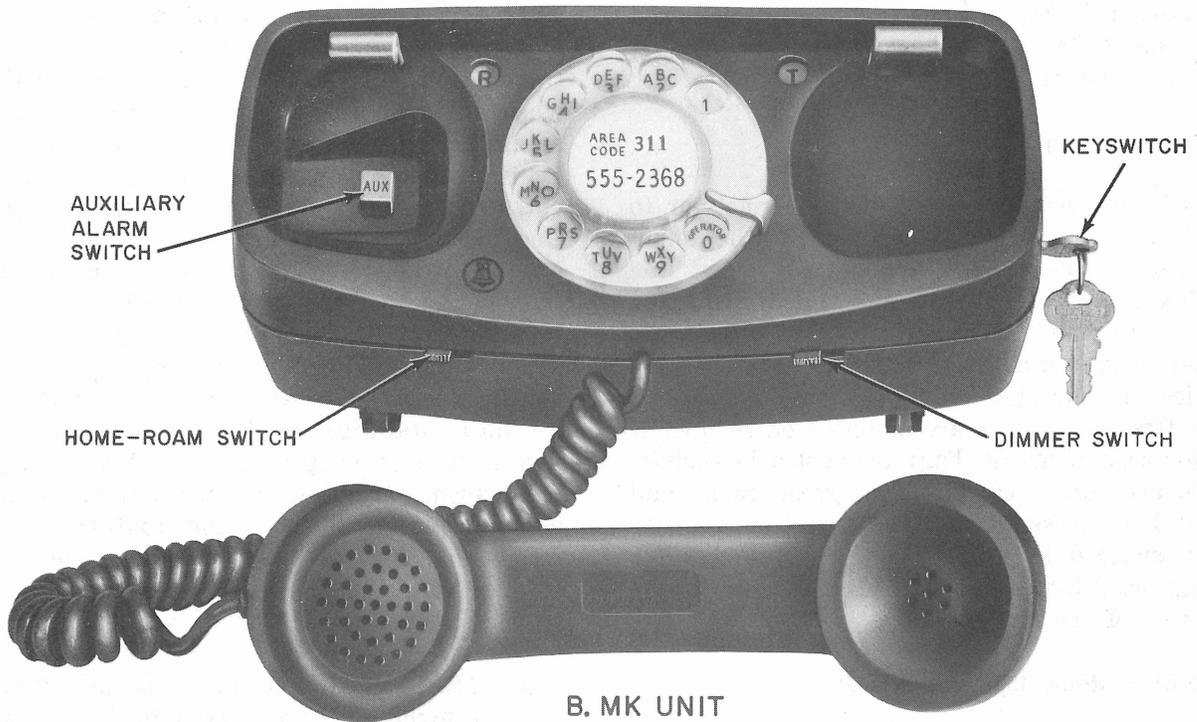
Base Station Control Terminal Equipment

Channel 1 Bay (J41645A)

1.15 The individual circuits contained in the channel 1 bay (Fig. 9) are the line, link access, link, register-sender, translator, base station identifier, test panel, stile, and transmission signaling and test access (TSTA) circuits. The TSTA circuits are divided into printed circuit cards that slide into connectors mounted on the channel shelf, and the circuits are identical with those of the large control terminal. The stile strip holds the fuses for the individual circuits; the test panel provides lamps and keys for test and display. The other circuits consist of relays and associated components mounted on removable bars (Fig. 10). These bars are cabled according to shelves (in groups of six bars) and the shelves are tied together by local frame cable. All interbay cabling connected by the installer can be wired from the front of the bay. The shelves are cabled for a maximum installation. When



A. MJ UNIT



B. MK UNIT

Fig. 7—Mobile Station Control Units

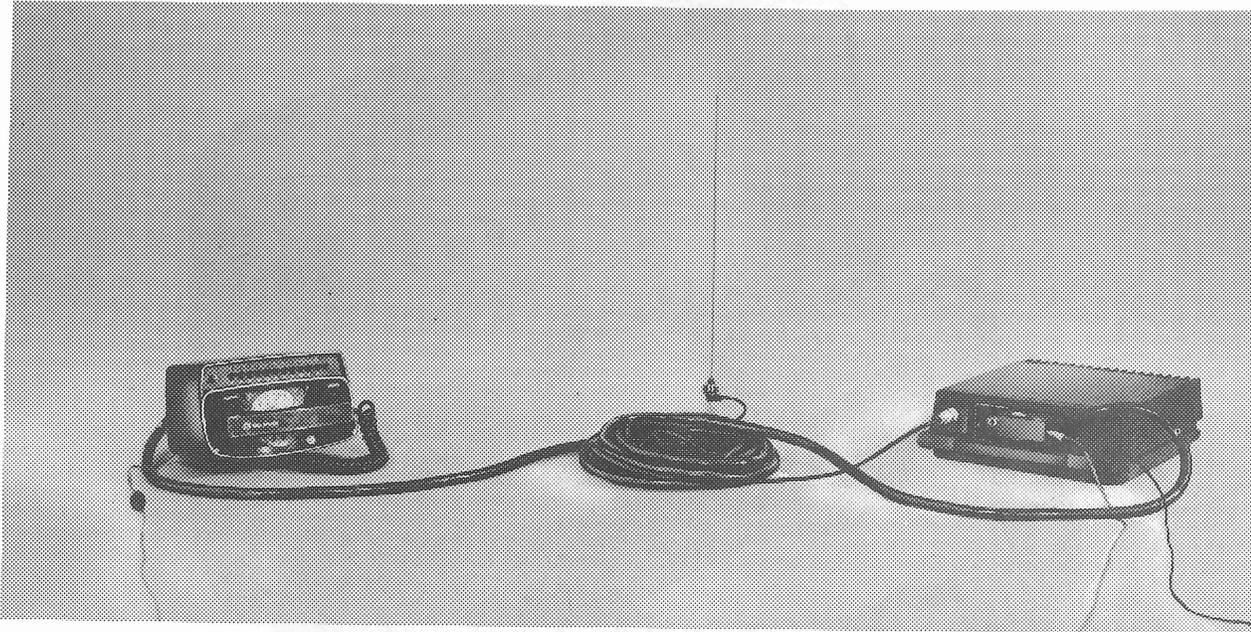


Fig. 8—KS-21466 Mobile Radio Station Equipment

adding circuits to existing shelves, the relays are connected directly to the cables by soldered connections. The entire bay (except for the test panel) is enclosed in removable metal covers.

Channel 2 Bay (J41645B)

1.16 If the system grows to two channels or to more than 30 lines, the channel 2 bay must be added. Included here are the additional line and link access circuits for the added customers and the link and TSTA circuits for the second channel. No common control equipment or test facilities are equipped on the channel 2 bay. As on the first bay, relays are mounted on removable bars for ease of access, bars are cabled in shelves, shelves are connected via local frame cable, and all installer access is from the front. The entire bay is enclosed in removable covers. Power for the channel 2 bay is supplied via the fuses of the stile strip of the channel 1 bay.

Base Station Radio Equipment (MJ)

1.17 The base station radio equipment normally consists of one base station transmitter and from one to eight base station receivers for each channel. The receivers (Fig. 4) are spotted throughout the area to assure the best reception

from the mobile station. The number of transmitters and receivers used is determined by the characteristics of the area covered. In large areas, a 250-watt transmitter, supplemented by one 50-watt transmitter when necessary, is used on each channel. In small areas, a 50-watt transmitter is used. A 50-watt transmitter-receiver unit (Fig. 11) is available with both transmitter and receiver in the same cabinet. Generally there should be no need for more than one receiver per channel when a 50-watt transmitter-receiver unit is used. When two transmitters are used on the channel, frequency synchronization or phase correction between transmitters is not provided other than that provided by high stability oscillators installed in the transmitters on an optional basis. A multifrequency test transmitter unit (Fig. 12) is optional equipment used to permit line up and routine testing of receivers. The test transmitter can replace one of the main transmitters during an emergency. Table A lists sizes and weights of the equipment.

1.18 The transmission facilities connecting the control and audio circuits from the base station control terminal to the transmitters and receivers are wire-line or carrier-type facilities. When carrier-type facilities are used, remote signaling circuit J41646 must also be used. Manual control of the transmitters can be exercised from the

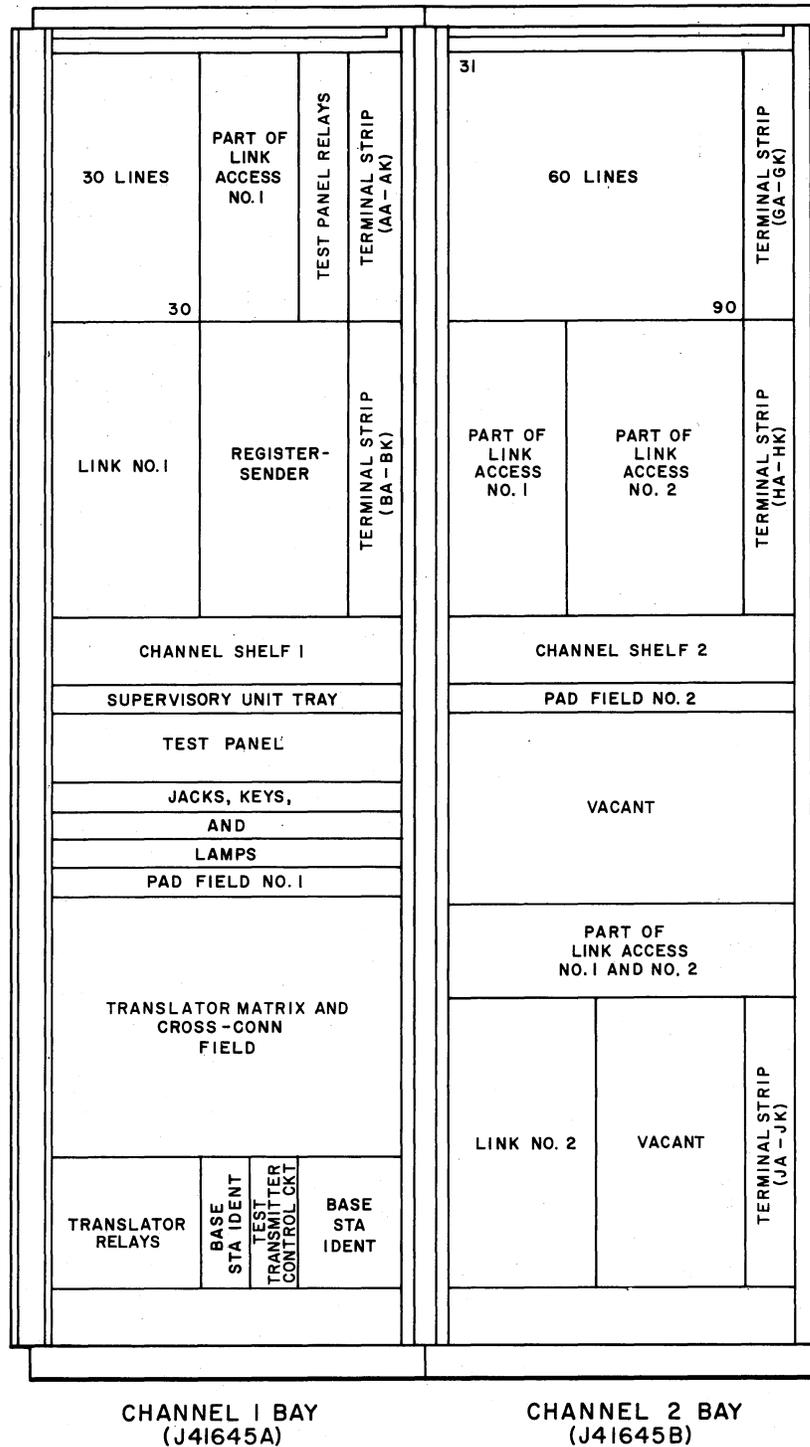


Fig. 9—Small Base Station Control Terminal Equipment on 11-Foot 6-Inch Bays for a System of 90 Subscriber Lines and 2 Channels

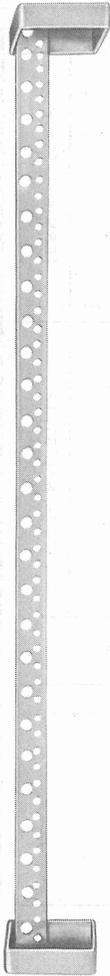


Fig. 10—Typical Relay Bar for Small System Control Terminal

channel jack and key field located on the channel 1 bay or locally at each transmitter site. Keys on the channel 1 bay can be used to remove the transmitter from service and to operate the transmitter at full power. Controls on the local operations panel at each transmitter site can be used to remove the unit from service. These controls are able to override all automatic or manual remote control from the base station equipment control terminal.

250-Watt Transmitter Unit

1.19 Four 250-watt transmitters are available, each of which is enclosed in an indoor cabinet and consists of six individual panels, a directional coupler, and a junction box located on a mounting

rack inside the cabinet. The basic 250-watt transmitter unit is KS-19618, L1. List 21 contains a list 10 high stability oscillator panel. List 4 contains an isolator and a different harmonic filter to provide improved intermodulation conversion loss. List 5 contains all the above. A KS-19618, L41 conversion kit is available to convert the L1 and L21 units to L4 and L5 units in the field. The panels and junction boxes common to all transmitters are identified as follows: the audio and power line filter junction box, the power supply panel, the F-zero (carrier power of 0.5 watt without audio modulation) and screen regulator panel, the exciter-driver panel, the rf power amplifier panel, the meter panel, and the local operations panel.

50-Watt Transmitter Unit

1.20 The 50-watt transmitter unit can be enclosed in either an indoor or an outdoor cabinet and can also be equipped with a high stability oscillator. The indoor unit without the high stability oscillator is KS-19618, L2 and the indoor unit with the high stability oscillator is KS-19618, L22. The outdoor unit without the high stability oscillator is KS-19618, L3 and the outdoor unit with the high stability oscillator is KS-19618, L23. In addition, a KS-19618, L40 provides ac line regulation for the 50-watt transmitter.

Test Transmitter Unit

1.21 The test transmitter unit KS-19618, L16 (Fig. 12) is equipped with an indoor cabinet. The test transmitter unit is controlled remotely at the base station control terminal from the test transmitter control circuit located on the channel 1 bay or locally at the local operations panel in the transmitter unit.

Receiver Package

1.22 The receiver package consists of a maximum of eight receivers, one receiver per channel, housed in either an indoor cabinet or an outdoor cabinet. From one to eight cabinets can be located throughout the coverage area to assure the best reception from the mobile station. Each cabinet operates from a single antenna that serves all receivers equipped in the package. The particular receiver used for reception on a channel is determined by a receiver selector circuit located in the base station control terminal. Receiver selection is determined by a dc signal with a magnitude that

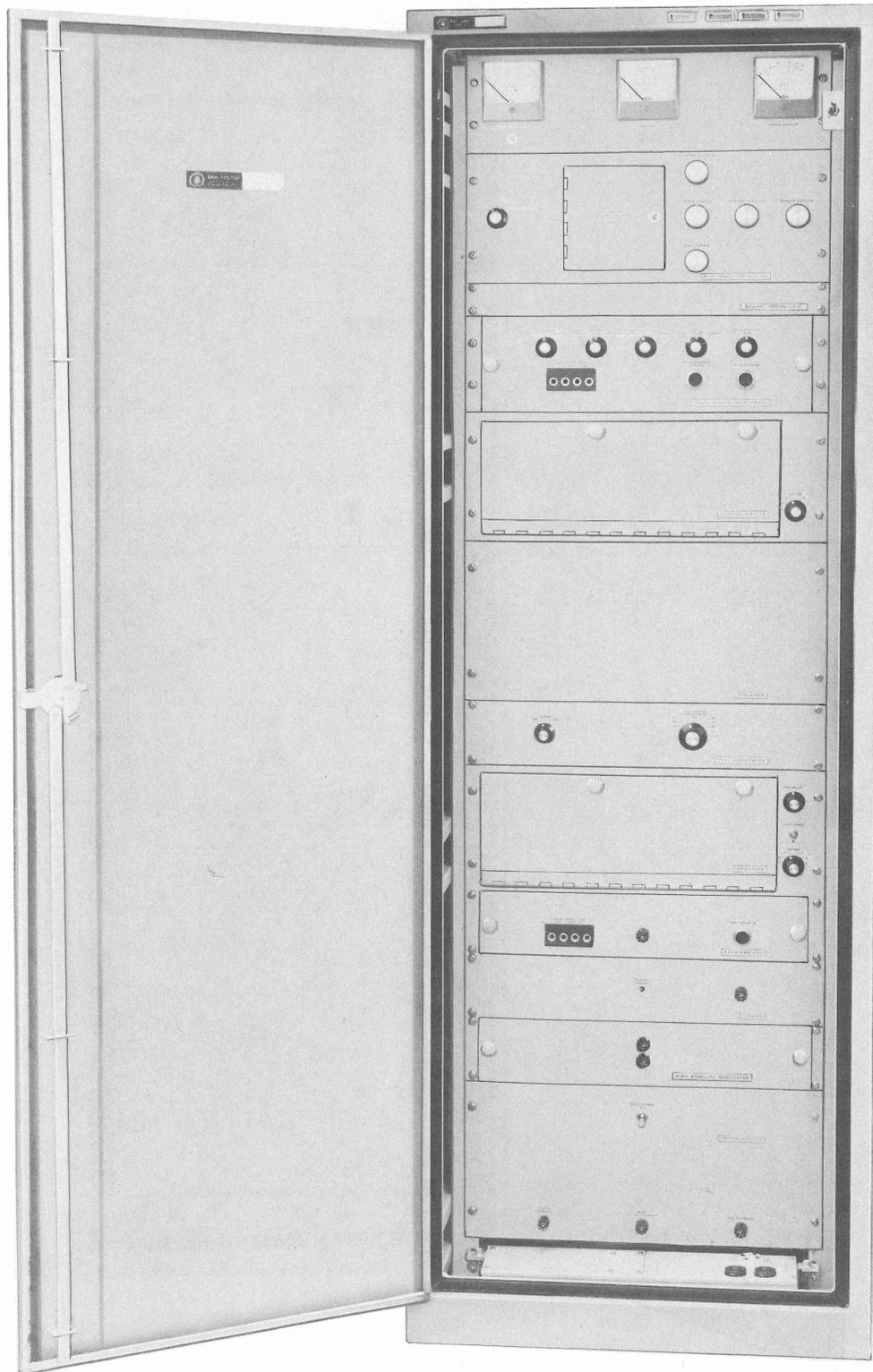


Fig. 11—Typical Base Station Transmitter-Receiver—MJ 50-Watt Transmitter-Receiver Unit KS-19618, L24 Shown

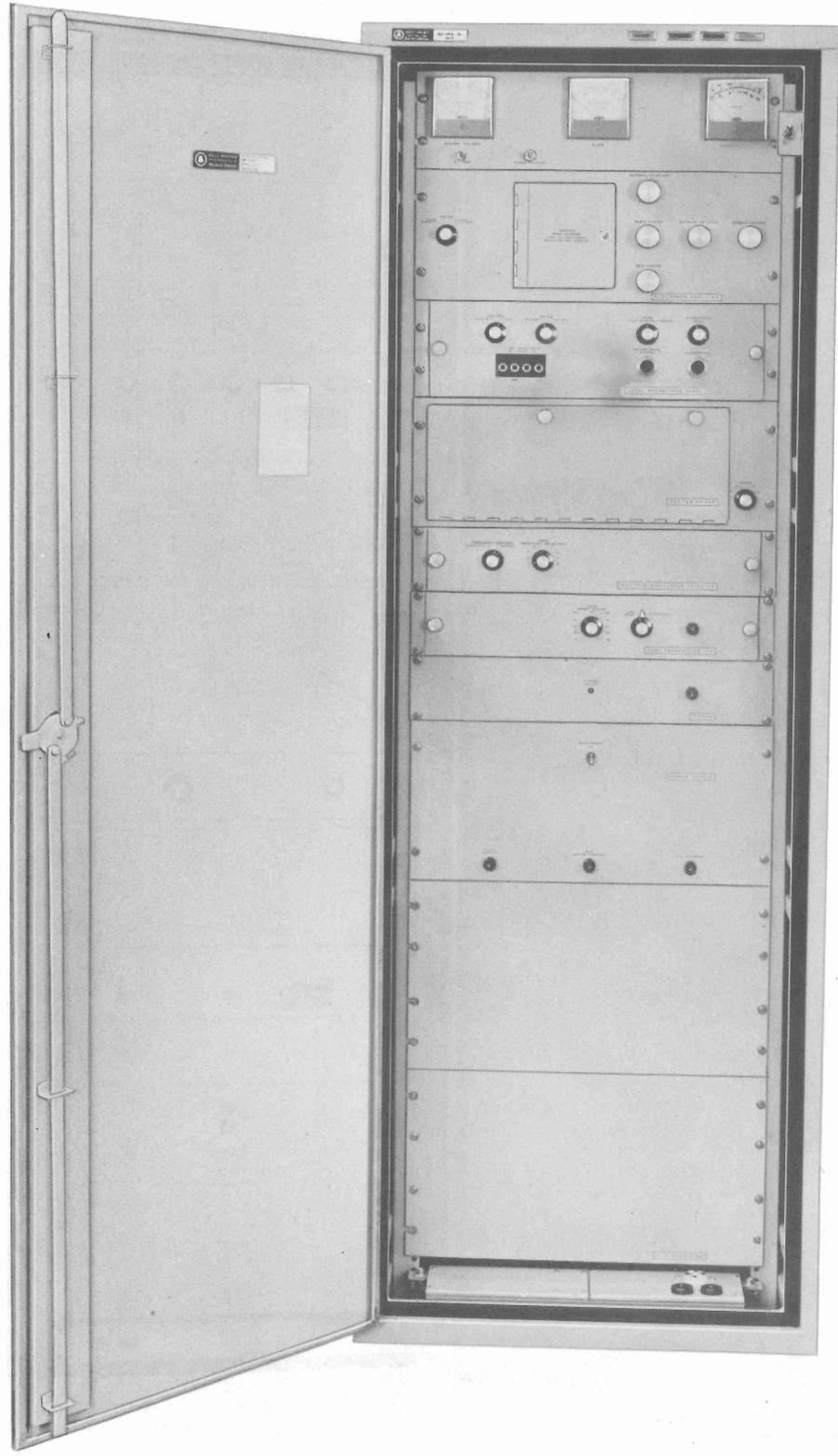


Fig. 12—MJ Test Transmitter Unit KS-19618, L16

TABLE A
MJ BASE STATION RADIO EQUIPMENT

UNIT	CABINET				SHIPPING WEIGHT (LBS)
	HEIGHT (IN.)	WIDTH (IN.)	DEPTH (IN.)	WEIGHT (LBS)	
250-Watt Transmitter Unit KS-19618, L1 or L21	70	23-3/4	21-1/2	485	650
50-Watt Transmitter Unit KS-19618, L2, L3, L22, or L23	70	23-3/4	21-1/2	370	520
50-Watt Transmitter-Receiver Unit KS-19618, L8, L9, L24, or L25	70	23-3/4	21-1/2	420	570
Test Transmitter Unit KS-19618, L16	70	23-3/4	21-1/2	420	570
Receiver Package KS-19618, L124 or L134 (4 receivers)	70	23-3/4	21-1/2	150	300
Receiver Package KS-19618, L125 or L135 (5 receivers)	70	23-3/4	21-1/2	200	350
Receiver Package KS-19618, L126 thru L128 or L136 thru L138 (6 thru 8 receivers)	70	23-3/4	21-1/2	200 + 30 additional for each receiver over 5	350 + 30 additional for each receiver over 5

increases monotonically with the receiver signal-to-noise ratio. Receiver packages KS-19618, L121 through L128 have the indoor cabinet, and receiver packages KS-19618, L131 through L138 have the outdoor cabinet. In an 8-receiver package, four receivers are accessible from the front door and the remaining four from the rear door.

50-Watt Transmitter-Receiver Unit

1.23 The 50-watt transmitter-receiver unit KS-19618, L8 (without high stability oscillator) and the 50-watt transmitter-receiver unit KS-19618, L24 (with high stability oscillator) (Fig. 11) are mounted in an indoor cabinet. The 50-watt transmitter-receiver unit KS-19618, L9 (without high stability oscillator) and the 50-watt transmitter-receiver unit KS-19618, L25 (with high stability oscillator) are mounted in an outdoor cabinet. A diplexer, a test converter, a receiver, and a receiver line terminating unit may be connected into the 50-watt transmitter

unit to form a 50-watt transmitter-receiver unit. The KS-19618, L40 provides ac line regulation for the 50-watt transmitter-receiver.

Base Station Radio Equipment (MK)

1.24 The base station radio equipment consists of one base station transmitter and from one to eight base station receivers for each channel. The receivers (Fig. 4) are spotted throughout the area to assure the best reception from the mobile station. A combination 5- to 100-watt transmitter-receiver unit is available with both transmitter and receiver in the same cabinet. The transmitter-receiver combination is used for systems where one transmitter and one receiver for each channel are sufficient. Table B lists sizes and weights of the equipment.

1.25 The transmission facilities connecting the control and audio circuits from the base

TABLE B

MK BASE STATION RADIO EQUIPMENT

UNIT	CABINET				SHIPPING WEIGHT (LBS)
	HEIGHT (IN.)	WIDTH (IN.)	DEPTH (IN.)	WEIGHT (LBS)	
5- to 120-Watt Transmitter Unit KS-20285, L1	70	23-3/4	21-1/2	420	570
5- to 100-Watt Transmitter-Receiver Unit KS-20285, L2 or L3	70	23-3/4	21-1/2	420	570
Receiver Package KS-20285, L51 (1 receiver)	70	23-3/4	21-1/2	180	280
Receiver Package KS-20285, L52 (2 receivers)	70	23-3/4	21-1/2	210	310
Receiver Package KS-20285, L53 (3 receivers)	70	23-3/4	21-1/2	240	340
Receiver Package KS-20285, L54 (4 receivers)	70	23-3/4	21-1/2	270	370
Receiver Package KS-20285, L55 (5 receivers)	70	23-3/4	21-1/2	300	400
Receiver Package KS-20285, L56 (6 receivers)	70	23-3/4	21-1/2	330	430
Receiver Package KS-20285, L57 (7 receivers)	70	23-3/4	21-1/2	360	460
Receiver Package KS-20285, L58 (8 receivers)	70	23-3/4	21-1/2	390	490

station control terminal to the transmitter and receiver consist of the same wire-line or carrier-type facilities as in the MJ system (see 1.18).

5- to 120-Watt Transmitter Unit

1.26 The 5- to 120-watt transmitter unit KS-20285, L1 (Fig. 3) is enclosed in a cabinet designed for indoor use; however, a rain shield is available to convert the cabinet for outdoor use. The 5- to 120-watt transmitter cabinet consists of a meter panel, a power amplifier, a tripler-driver, a local operations panel, a harmonic filter panel, a main

power supply, an audio line filter and junction panel, and an exciter-driver. A diplexer unit (list 120) is available for installation where a common antenna is desired for use with a base transmitter and a base receiver package. The unit mounts in the transmitter cabinet. In addition, two isolator unit add-to kits are available for use where additional intermodulation protection is required between adjacent transmitters. The first isolator add-to kit (list 103) is used in transmitter cabinets where the minimum space loss between the respective antennas is less than 65 dB. The second isolator add-to kit (list 104) is used in conjunction with

the first isolator add-to kit (list 103) where the space loss between the respective antennas is between 15 and 40 dB.

Receiver Package

1.27 The receiver package consists of a maximum of eight receivers, one receiver per channel, housed in a cabinet that is designed for indoor or outdoor use. From one to eight cabinets, depending on the number required for reception from the mobile station, are located at various places in the area covered. Each cabinet operates from a single antenna serving all receivers equipped in the package. The particular receiver used for reception on a channel is determined by a receiver selector circuit (located in the base station control terminal) that automatically selects the receiver with the best signal-to-noise ratio.

1.28 Eight receiver packages are available; they consist of from one to eight receivers as shown in Table B. Fig. 4 shows typical 2-receiver base station receiver equipment.

5- to 100-Watt Transmitter-Receiver

1.29 The transmitter-receiver unit KS-20285, L2 is enclosed in a cabinet designed for indoor use. However, a rain shield is available to adapt the cabinet for outdoor use. The transmitter-receiver cabinet consists of a meter panel, power amplifier, exciter-driver, tripler-driver, local operations panel, harmonic filter panel, test converter, main power supply, audio line filter and junction panel, receiving line terminating unit, receiver, and diplexer. A transmitter-receiver unit KS-20285, L3 that does not include a diplexer for common antenna use but is otherwise the same as list 2 is available.

Mobile Station Equipment (MJ and MK)

1.30 The mobile station equipment (Fig. 13) for both the MJ and MK systems consists of the following three main units: the radio unit, the supervisory unit, and the control unit. The radio unit containing the supervisory unit is mounted in the trunk of the mobile vehicle. The control unit is in a location accessible to the subscriber.

Radio Units (MJ)

1.31 These are two Motorola radio units. Mostly solid-state radio unit KS-19609, L3 is a

multifrequency unit capable of operating on any of 11 crystal-controlled frequencies. The transmitter has a nominal rf power output of 20 watts. Provision is made for varying the channel complement of both the transmitter and receiver with plug-in channel elements to include only the number of channels desired. Dummy channel elements KS-19609, L10 are used for unequipped channels. The transmitter and receiver in the radio unit, in addition to the supervisory unit described in 1.35, are housed in a heavy gauge steel case measuring 11 inches wide, 22-1/2 inches long, and 5 inches high (Fig. 5). Except for the filtering components, the power supply is contained in a separate housing mounted on the front panel of the radio unit. The total combined weight is approximately 42 pounds.

1.32 The all solid-state radio unit KS-21466, L2 is a multifrequency unit capable of operating on any of 11 channels. All channel frequencies are derived by a frequency synthesizer from a single crystal-controlled reference oscillator. The transmitter has a nominal rf output of 20 watts. The list 2 unit also includes the supervisory logic and control functions. The list 2 unit measures 4 inches high, 10.75 inches wide, and 13.9 inches long, and weighs approximately 25 pounds. KS-21466, L1 mobile radio includes this list 2 radio unit and the list 3 control unit of 1.37, as well as cable assembly, antenna, and, pro rata, instruction manual and tuning tool set.

1.33 General Electric radio unit KS-19852, L4 is a multifrequency unit capable of operating on any of 11 crystal-controlled frequencies. The transmitter has a nominal rf power output of 20 watts. Provision is made for varying the channel complement of both the transmitter and receiver with plug-in oscillators mounted on the channel hunting circuit board. The radio unit consists of a system frame on which are mounted a transmitter, receiver, power supply, and front casting that contains miscellaneous circuit components. The supervisory unit described in 1.36 and the channel hunting circuit board of the radio unit are mounted in the center portion of the unit. The fully assembled unit measures 14 inches wide, 23 inches long, and 4 inches high (Fig. 5). The weight is approximately 45 pounds.

Radio Unit (MK)

1.34 Motorola radio unit KS-20282, L1 is a multifrequency unit capable of operating on

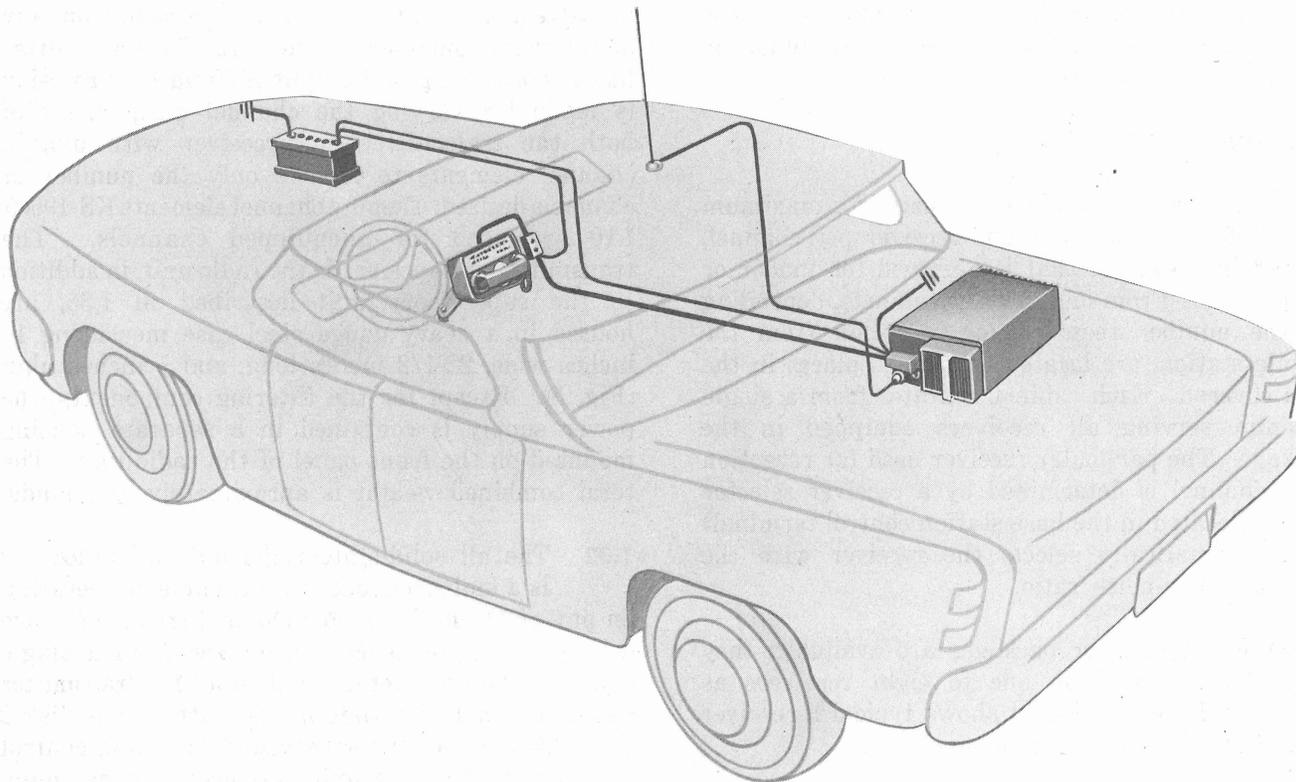


Fig. 13—Typical Mobile Station Installation—MJ Shown

any of 12 crystal-controlled frequencies. The transmitter has a nominal rf power output of 16 watts. Provision is made for varying the channel complement of both transmitter and receiver with plug-in channel elements to include only the number of channels desired. Dummy channel elements KS-20282, L8 are used for unequipped channels. The transmitter and receiver, as well as the supervisory unit, are housed in a heavy gauge steel case measuring 12 inches wide, 23 inches long, and 6 inches high (Fig. 5). The unit weighs approximately 45 pounds. A KS-20282, L4 mounting base is available on which the radio unit can be locked in place. This mounting base allows for easy removal of radio units from subscriber vehicles for replacement or repair.

Supervisory Units (MJ)

1.35 Supervisory unit KS-19609, L2 (Fig. 6), for radio unit KS-19609, L3 is a completely transistorized plug-in unit that contains three interconnected printed circuit boards. The radio

unit completely encloses the supervisory unit, eliminating the need for additional storage space in the vehicle. The 7-digit telephone number assigned to the mobile station is programmed by means of a strapping arrangement in the supervisory unit. The KS-21466, L2 radio unit includes its supervisory unit.

1.36 Supervisory unit KS-19852, L2 (Fig. 6) for radio unit KS-19852, L4 is a completely transistorized plug-in unit that contains five interconnected printed circuit boards. The radio unit completely encloses the supervisory unit, eliminating the need for additional storage space in the vehicle. The five printed circuit boards of the supervisory unit and the channel hunting circuit board of the radio unit are mounted in a wrap-around chassis with the top and bottom boards mounted on hinges for access to both sides and to the boards on the center level. The 7-digit telephone number assigned to the mobile station is programmed by means of a strapping arrangement in the supervisory unit.

Supervisory Unit (MK)

1.37 The supervisory unit KS-19609, L2 for the MK mobile station is identical to the one used in the KS-19609, L3 radio unit of the MJ mobile station described in 1.35.

Control Units (MJ)

1.38 Control unit KS-19626, L1 (Fig. 7) used with radio units KS-19609, L3 and KS-19852, L4 includes an on-off keyswitch, transmit and busy lamps, channel and mode selection pushbuttons, a dial, a handset, and a ringer. In addition, an auxiliary pushbutton is provided as an optional feature for enabling an external alarm (horn or lights). The control unit weighs approximately 5-3/4 pounds and can be mounted on the transmission tunnel or dashboard of the vehicle by means of a mounting bracket and hardware which are furnished. A KS-19626, L2 auxiliary mounting bracket is available for installations that require additional mounting rigidity. Control unit KS-21466, L3 used with radio unit KS-21466, L2 provides the same features and includes mounting hardware.

Control Units (MK)

1.39 Control unit KS-20283, L1 includes an on-off keyswitch, receive level volume control, transmit (T) and roam (R) lamps, mode selection slide switch (home and roam), dial, handset, and ringer (Fig. 7). An auxiliary pushbutton switch is provided to enable an external alarm (horn or lights). The control unit weighs approximately 5 pounds and can be mounted on the transmission tunnel or dashboard of the vehicle by means of a mounting bracket and hardware which are furnished. A KS-20283, L2 auxiliary mounting bracket is available for installations that require additional mounting rigidity. Control unit KS-21466, L4, intended for use with radio unit KS-20282, L14 provides the same features plus customer programmable roam channel selection.

B. Equipment Features

General

1.40 The base station control terminal uses general purpose (4000-type) relays (Fig. 14). These relays are designed to be easily disassembled, if required. The coil, the spring pile-up, and the residual clip can each be replaced independently if

a relay fails. All relay connections in the terminal, whether the relays are installed initially or added later, are soldered. Most other connections are wire wrapped. The circuits are supplied with fuses equivalent to Western Electric type 35 fuses mounted on the stile strip. The basic circuits of the terminal are provided factory installed on the 11-foot 6-inch mounting frame. These circuits are automatically supplied with the channel 1 bay regardless of the MJ or MK mobile system size. Other circuits must be ordered in addition to the mounting frame. These circuits can be either factory installed, if part of the initial order, or added to the terminal as the number of subscribers and channels in the system increases. All mounting shelves contain cabling to accommodate all circuits whether ordered with the frame or separately. The relays are assembled into bars that are cabled according to shelves (typically six bars and two terminal strips).

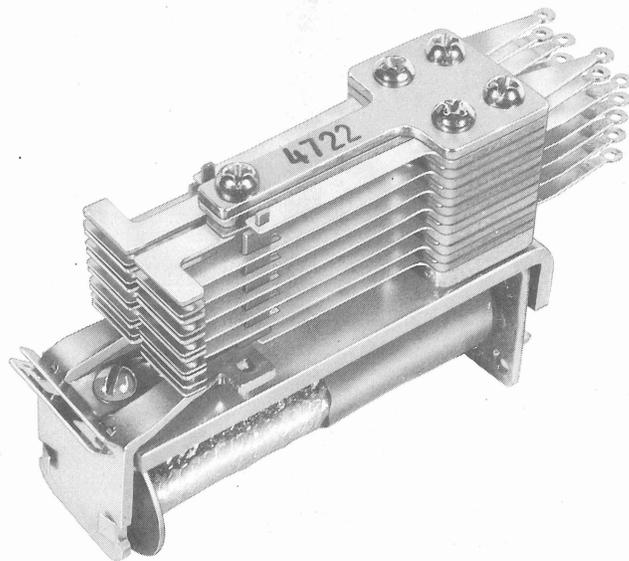


Fig. 14—General Purpose Relay

Switching and Common Control Circuits

Line Circuit

1.41 Each line circuit is composed of two relays mounted on a relay bar plus associated components that are pigtailed to the relay springs. Ten line circuits are assembled on one relay bar, and line circuits are ordered in groups of ten (Fig. 15). One line circuit is required per mobile

subscriber, and one wire pair is provided per subscriber and cross-connected at a distributing frame as is the loop of any land subscriber. Thirty line circuits can be equipped on the channel 1 bay and 60 more on the channel 2 bay.



Fig. 15—Ten Line Circuits

1.42 The line circuit functions to detect that a land-to-mobile call has been placed to the mobile subscriber associated with the line circuit (via the ringing return ground on the tip side of the line) and to operate the link access circuit accordingly. If all the channels are busy, the line circuit returns busy tone. If the mobile is not functioning or if the call is not answered, the line circuit places the call in a lockout condition to prevent the channel from being busied out while the land subscriber listens to ringback. On a mobile-to-land call, the line circuit does not function.

Link Access Circuit

1.43 The link access circuit (Fig. 16 through 18) is composed of three main categories of equipment. The line chain (LC) relays, provided only once per system, assure that simultaneous demands can be handled; five 18-line group (ELG) relays are provided per channel and they make up one level of a contact tree; six 5-line group (FL) relays are provided for each ten line circuits for each channel furnished and they make up the second level of the contact tree. The link access circuit is also bar mounted. Like the line circuits, circuits for 30 customers are located on the channel 1 bay (Fig. 16); circuits for the next 60 customers are located on the channel 2 bay (Fig. 17). All link access equipment for a second channel is located on the channel 2 bay (Fig. 18).

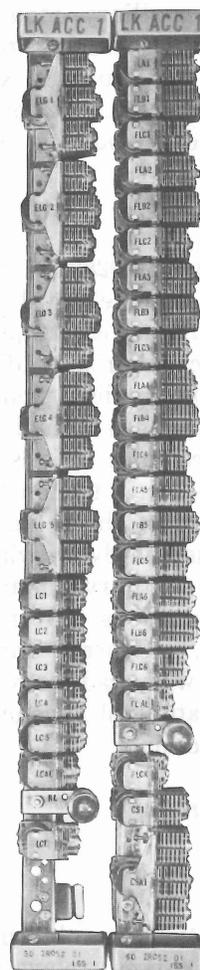


Fig. 16—Link Access Circuit (Channel 1, First 30 Lines)

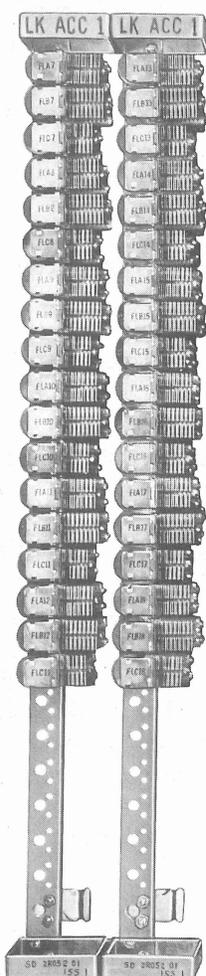


Fig. 17—Link Access Circuit (Channel 2, Last 60 Lines)

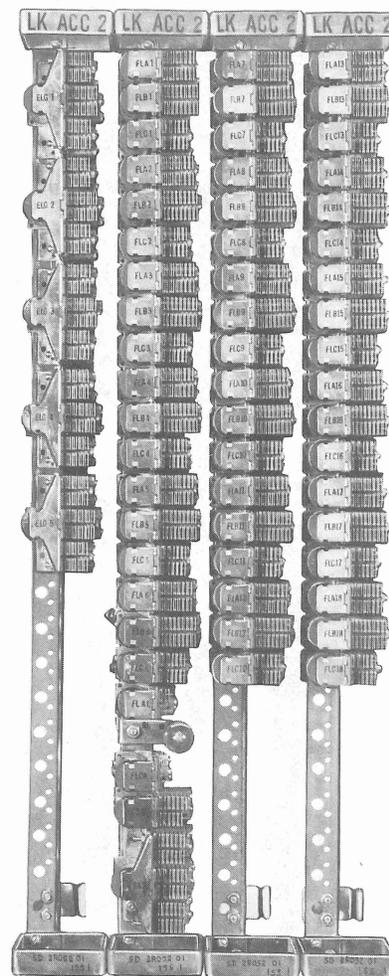


Fig. 18—Link Access Circuit (Channel 2)

1.44 On a land-to-mobile call, the link access circuit accepts the demand from a line circuit, determines which channel is to be used (if two are equipped), and operates one ELG relay and one set of FL relays. This connects the called subscriber tip and ring connection to the link and furnishes the translator with the identity of the called subscriber. On a mobile-to-land call, the ELG and FL relays are operated by the translator to associate the link with the tip and ring of the calling mobile. On both types of calls, once the link access circuit is operated, control of it is switched to the link for holding and supervision.

Link Circuit

1.45 One link circuit (Fig. 19) is provided for each channel and is composed of three relay bars. One link is mounted in each channel bay.

1.46 The link circuit provides the interface between the transmission and radio equipment and the switching equipment. All calls are routed via the link. Briefly, the link circuit performs the following functions:

- (a) Provides a talking path between the line circuit and the TSTA circuit.

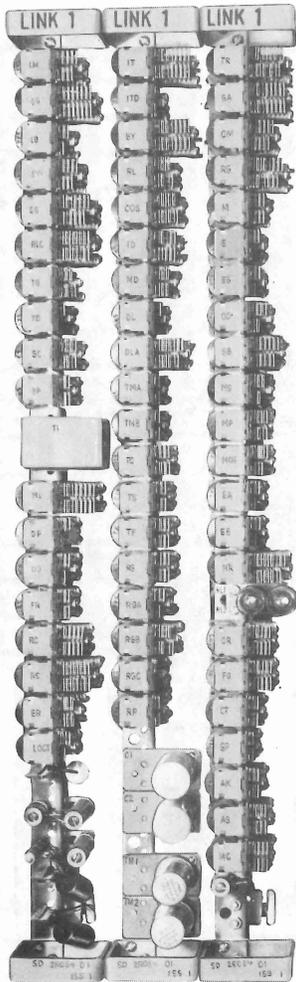


Fig. 19—Link Circuit

- (b) Provides supervision.
- (c) Repeats all pulsing between the TSTA circuit and the register-sender circuit and between the TSTA circuit and the loop.
- (d) Provides timing for the application of tones as required by the mobiles.
- (e) Generates a ringing signal as required by the mobiles.
- (f) Provides for signaling to manual mobiles (MJ only).
- (g) Seizes and accepts signals from the register-sender circuit.
- (h) Interfaces with the switchboard trunk circuit and with the technical operator position.
- (i) Routes calls to the operator as required.
- (j) Places an associated line circuit in lockout as required.
- (k) Controls the transmitter on the associated channel.
- (l) Indicates the state of the link to the test panel.
- (m) Times out on the absence of speech or carrier.

1.47 To eliminate the manual mode of operation, the link circuits used in the control terminal for an MJ system blocking manual access or for an MK system are wired differently from link circuits in MJ systems providing manual service. A KS-19664, L32 MK modification kit is available for field conversion of each link circuit from providing manual service to blocking manual access.

Register-Sender Circuit

1.48 The register-sender circuit (Fig. 20) is composed of three relay bars mounted on the channel 1 bay. Only one circuit is needed for each system. Cross-connections in the register-sender provide optional methods of handling roamers and mobile-to-mobile calls and allow the local number plan area (NPA) code to be prefixed to the mobile number for sender outpulsing. Functionally, the circuit has two modes of operation (registering and sending), and these can be described independently.

1.49 ***Sending (Land-to-Mobile Call):*** The link, on a land-to-mobile call, seizes the sender and commands it to outpulse. The translator furnishes the sender with the number to be outpulsed. The sender proceeds to outpulse the local NPA code plus the required 4-digit number into the transmission equipment via the link.

1.50 ***Registering (Mobile-to-Land Call):*** The link repeats the automatic number identification (ANI) pulses to the register where they are separated into digits and stored on a 2-out-of-5 basis. The register operates the translator; that either operates the link access circuit or gives a roamer indication (ie, an indication that the mobile

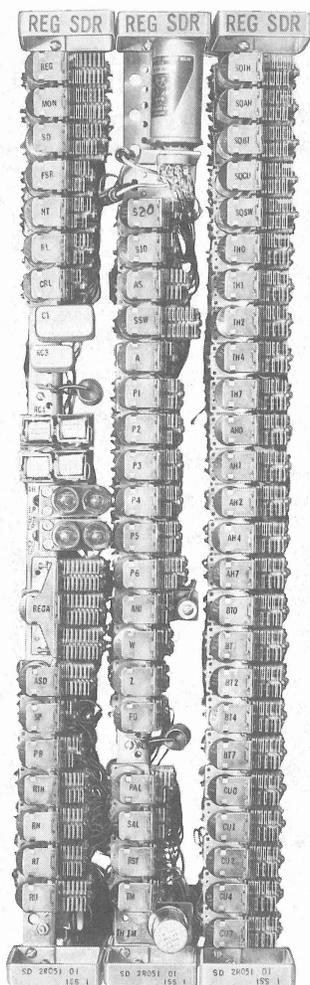


Fig. 20—Register-Sender Circuit

is not locally assigned). The register also monitors the dialing from a mobile to intercept mobile-to-mobile calls (1-channel systems only) or toll calls, which require an operator (roamers only). In addition, the register performs a parity check to detect errors resulting from fading during the ANI pulsing.

Translator Circuit

1.51 The translator (Fig. 21 and 22), mounted on the channel 1 bay, is composed of:

- (a) Relays mounted on short relay bars near the bottom of the bay (Fig. 21).
- (b) A cross-connected field located beneath the test panel.

- (c) Matrix boxes also located beneath the test panel (Fig. 22).

Programming the mobile numbers into the equipment is done via the matrix boxes; inserting the NPA code and office code information is done via the cross-connected field. The basic translator is equipped for 30-line capacity but can be expanded to 60 or 90 lines as needed.

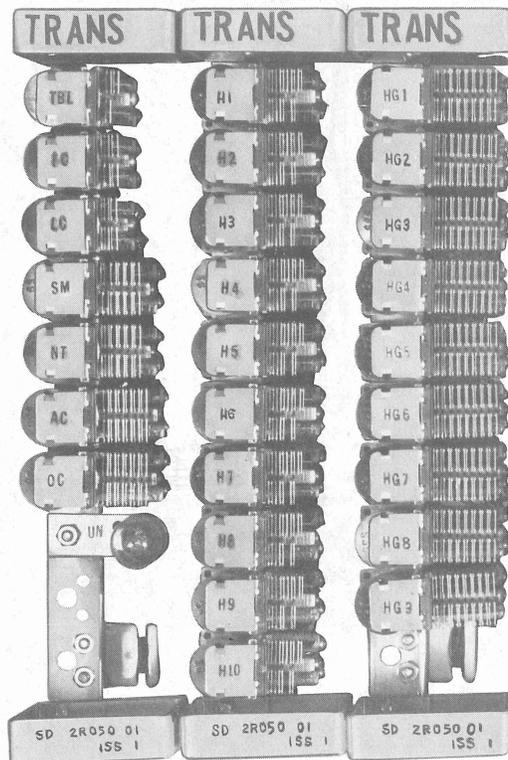


Fig. 21—Translator Circuit (Translator Relays)

1.52 The translator circuit relates equipment location with assigned directory number. When a mobile is given service, its number is programmed into the translator matrix horizontal corresponding to the assigned line circuit. In addition, area code and office code information is stored here. On land-to-mobile calls, the translator provides the sender with the number to be outpulsed. On mobile-to-land calls, the translator either operates the link access circuit to associate the channel with the required line circuit or indicates to the register whether a roaming mobile should be given the roamer line circuit or the switchboard.

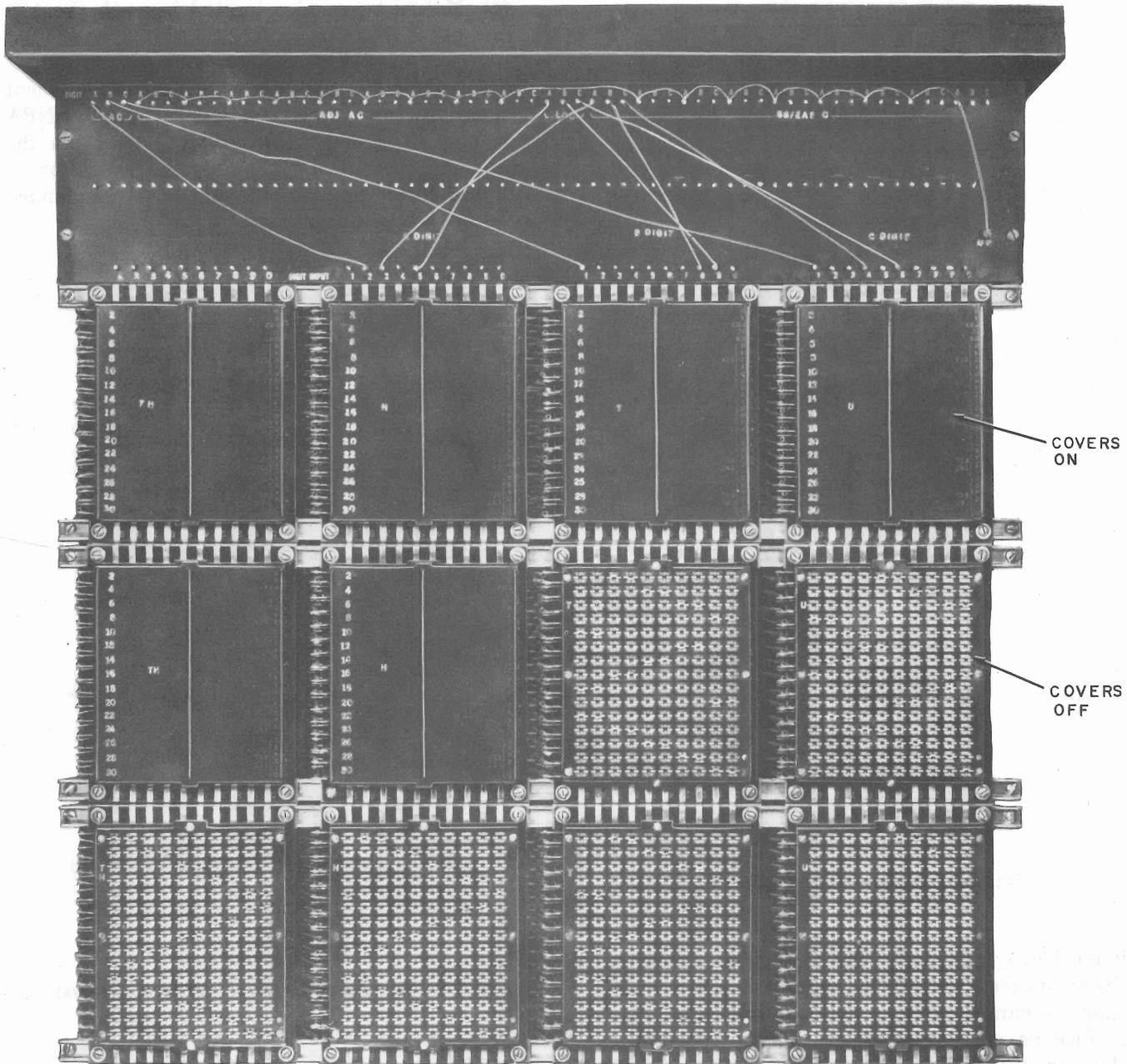


Fig. 22—Translator Circuit (Translator Matrix and Cross-Connect Field)

Test Panel Circuit

1.53 The test panel circuit (Fig. 23 and 24), mounted in the channel 1 bay, is composed of:

- (a) Relays mounted on one relay bar (Fig. 23).
- (b) Test panel containing lamps for display, keys for control of the tests, and a handset and dial (Fig. 24).
- (c) A supervisory interface circuit (Fig. 24) that simulates the base and the mobile radio equipment to permit end-to-end system test calls without involving radio transmission.

The latter circuit is a printed circuit board that plugs into the bay above the test panel and interfaces with a standard mobile supervisory unit.

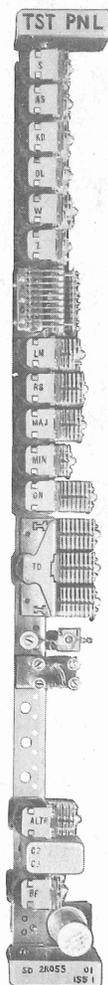


Fig. 23—Test Panel Relays

1.54 The test panel circuit provides for:

- (a) Checking the performance of the register-sender circuit, the translator circuit, and portions of the link circuit.
- (b) Monitoring the status of actual calls through the control terminal.
- (c) Performing system tests and simulating all types of calls.

- (d) Transferring functions of the mobile service operator to the control of qualified personnel at the terminal.
- (e) Checking the performance of a mobile supervisory unit.
- (f) Displaying, transmitting, and releasing alarms.

Base Station Identifier Circuit

1.55 This circuit (Fig. 25) is also mounted in the channel 1 bay on short relay bars adjacent to the translator. The circuit consists of several relays, a motor driven code wheel that is notched to indicate the call letters of the terminal in international Morse code, and a timer to initiate the identification. The base station identifier is basically equipped for one channel, but equipment can be added to accommodate a second channel.

1.56 The base station identifier circuit sends identification required by the Federal Communications Commission over each channel provided in the system. Identification is outpulsed on each channel once every 30 minutes, provided that the channel is not busy. In the event that a channel is seized prior to identification, the identification takes place after the call between subscribers is completed. Identification of the base station on each channel is accomplished with a single frequency, 1800-Hz tone generated by the tone generator. A motor driven cam, rotated at a rate of 1 revolution approximately every 7 to 8 seconds and notched to a prescribed code, sends coded ground pulses in Morse code to the link circuit. The link circuit gates the tone generator on and off according to the code. A second motor driven shift, which contains one cam for each channel, rotates once every 30 minutes and determines when identification will be attempted on each particular channel. The base station identifier control contains alarm circuits that indicate power and identification failures.

Transmission Equipment

TSTA Circuit

1.57 The TSTA circuit is composed of:

- (a) Printed circuit boards that are mounted on a channel shelf.

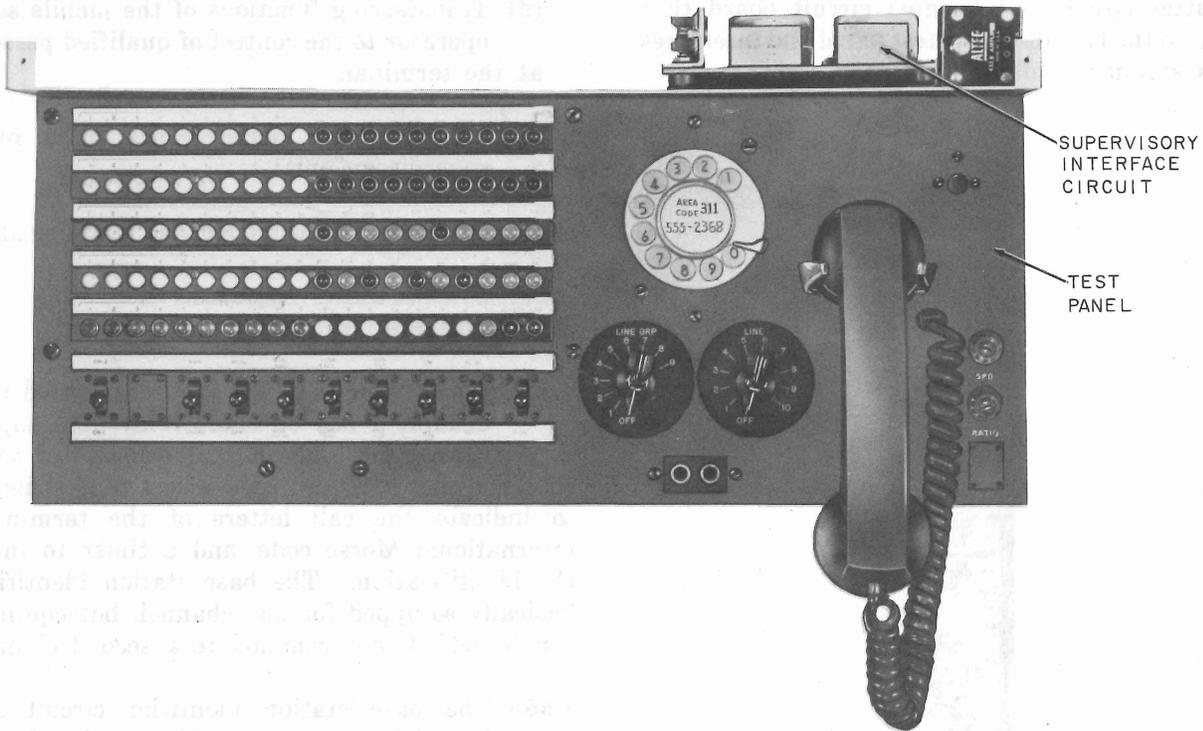


Fig. 24—Test Panel With Supervisory Interface Circuit

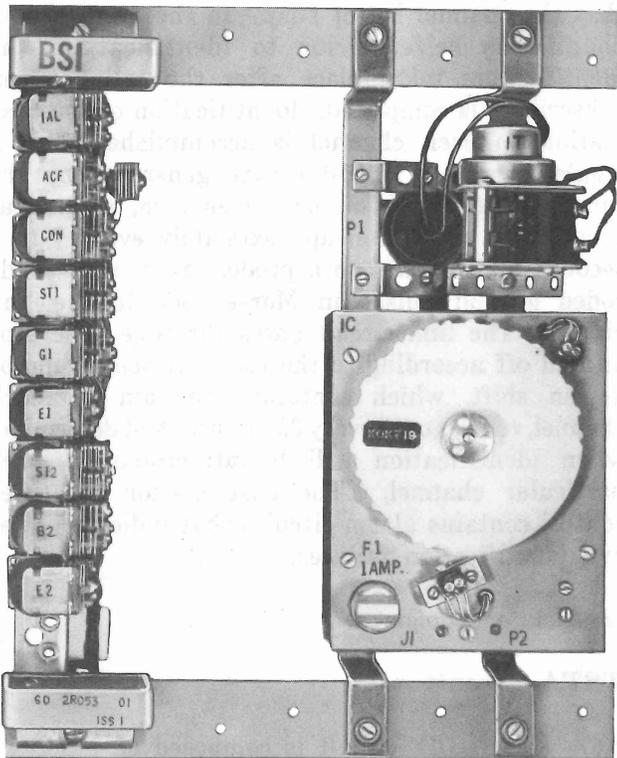


Fig. 25—Typical Base Station Identifier Control Circuit

(b) Keys and jacks for testing; they are mounted on a jack mounting strip below the test panel. One circuit is needed for each channel.

1.58 The TSTA circuit provides for:

- (a) Coupling the link circuit to the radio equipment.
- (b) Maintaining the proper transmission levels to the 2- and 4-wire loops.
- (c) Selecting and indicating the receiver with the best quality signal.
- (d) Controlling signaling tones.
- (e) Permitting access, by means of jacks, to various points within the transmission circuitry.
- (f) Placing the channel out of service.
- (g) Controlling the transmitter, receivers, and converter.

1.59 The TSTA channel shelf-mounted equipment (Fig. 26) consists of a hybrid circuit, tone

generator circuit, voice operated gain adjusting device (VOGAD), receive and transmit line terminating units, receiver selector circuit, bandpass filter, sound operated noise attenuating device (SONAD), and tone detector circuit. The equipment is furnished as a group with the exception of a transmit line terminating unit and additional receive line terminating units. The line terminating units are ordered as required.

1.60 Tone Generator: The tone generator consists of four oscillator circuits mounted on one printed circuit card. An 1800-Hz seize tone and a 2000-Hz idle tone are used for the automatic mode of land-to-mobile signaling; 600-Hz and 1500-Hz tones are used in the manual mode of land-to-mobile signaling. Potentiometers are furnished for controlling output levels. If an oscillator fails, an alarm is indicated.

1.61 VOGAD: The VOGAD is contained on two printed circuit cards. The VOGAD is a gain adjusting device that provides a constant average ac output level for wide variations of input speech signal level. Provision is included for minimizing the compression of speech signals and effectively preventing noise from affecting the gain increase circuit of the VOGAD. The circuits making up the VOGAD are on a main amplifier card and a control circuit card. A plug-in pad is

used at the output of the VOGAD for adjustment of the level in the transmit loop. All controls and test points are accessible at the front of the main amplifier and control circuit cards.

1.62 Transmit Line Terminating Unit:

The transmit line terminating unit is mounted on one printed circuit card. One transmit line terminating unit is required for each transmitter used in the base station. The transmit line terminating unit matches the 600-ohm transmit leg to the cable pair and connects the dc transmitter control signals to the line. Provision for receiving an rf on-the-air signal from the transmitter is included. The transmit line terminating unit includes provision for line building-out resistors for a 3500-ohm loop and for protection against lightning or power surges on the line. On an optional basis, a transmit line terminating unit (two printed circuit cards) can be provided for controlling two MJ transmitters on a single channel.

1.63 Receive Line Terminating Unit:

The receive line terminating unit is mounted on one printed circuit card. One receive line terminating unit is required for each receiver used in the base station. The receive line terminating unit matches one remote receiver cable pair to the 600-ohm channel shelf unit, provides amplification, indicates whether the receiver is in use, and gives an alarm

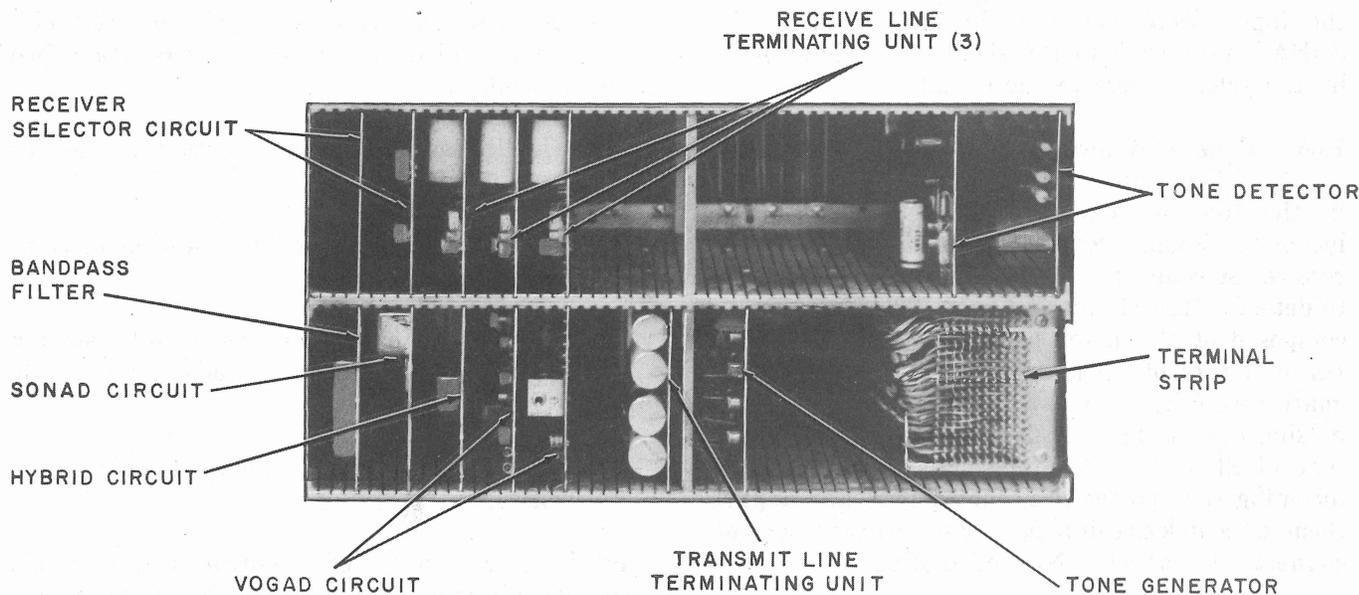


Fig. 26—Channel Shelf

when the receiver fails. It also includes line protection and a dc current-to-voltage converter for the receiver selector unit. A dc current that is proportional to the signal-to-noise ratio of the receiver is received by the receive line terminating unit over the receiver connecting facilities. A means for manually rejecting a receiver is also included.

1.64 Receiver Selector Circuit: The receiver selector circuit consists of a threshold control and a regulated power supply, each mounted on a printed circuit card. The threshold control enables adjustment of the signal level (signal-to-noise ratio based upon a dc signal from the receive line terminating unit) at which receiver selection is accomplished and the signal level below which no receiver will remain selected. The receiver selector circuit continuously compares and selects the best receiver at any given moment. This selection also takes place during conversation. When one receiver per channel is used, the receiver selector functions only to establish the accept and reject thresholds. The card containing the regulated power supply also contains a relay to freeze the selection process during mobile identification and dialing.

1.65 SONAD: The SONAD circuit is contained on one printed circuit card. The SONAD circuit suppresses noise during silent intervals of transmission from the mobile station to the central office subscriber by inserting 20 dB of loss when the input drops below a threshold value. The SONAD has a variable threshold that is determined by the selected receiver dc signal.

1.66 Tone Detector: The tone detector consists of two printed circuit cards. Four circuits in the tone detector are tuned to detect four incoming signals from the mobile station via the receiver selector circuit. The four circuits function to detect a 1633-Hz connect tone, a disconnect tone composed of alternate pulses of 1336 Hz and 2150 Hz at a rate of approximately 20 pps, a 2150-Hz guard tone (also used as acknowledgment), and dial pulsing consisting of 1633-Hz pulses with a guard tone of 2150 Hz. The tone detector changes the incoming tone pulses to ground pulses and applies them to the link circuit to be used for acknowledgment, connect, disconnect, ANI, and dialing.

1.67 TSTA Keys and Jacks: Keys are provided which permit the testing of the radio receivers and transmitters and the removal

of the channel from service. Jacks permit access to the input and output of each channel shelf card for testing or for patching into the test panel circuit.

Test Transmitter Control Circuit (MJ Only)

1.68 If equipped, this circuit is mounted in the channel 1 bay. It is composed of a printed circuit card (the power supply and coupling transformers), relays for pulsing, keys for control, and pilot lamps.

1.69 The circuit provides either remote control of the test transmitter for test purposes or allows the test transmitter to substitute as a regular base station transmitter in an emergency mode of operation. The emergency mode is used when a base station transmitter fails in operation. Patch cords are used to make the necessary circuit changes. When the test mode of operation is used, it is possible to vary the transmitter output power over approximately a 90-dB range (0.1 microwatt to 50 watts), to key the transmitter on and to select the channel to be tested.

Mobile Simulator (MK Only)

1.70 A mobile simulator panel for use in the MK system can be constructed as required. This panel provides the following:

- (a) Routine performance checks on the MK control terminal and associated central office equipment.
- (b) Qualitative checks on base station transmitter output power.
- (c) Qualitative checks on base station receiver sensitivity.
- (d) Simulation of customer's mobile station equipment as an aid in analyzing a mobile trouble complaint.
- (e) Test fixture to facilitate overall performance checks.

The simulator consists of a control panel (Fig. 27) used in conjunction with a KS-20282, L1 MK mobile radio unit. The radio unit is used as a combined test transmitter and mobile simulator. The control panel is not furnished as a part of the control

terminal equipment but must be constructed locally by the operating company. The control panel should be mounted in a space as close to the control terminal equipment as possible. A standard MJ control head is mounted on the control panel. Equipment and schematic drawing numbers for the MK simulator are listed in 2. SUPPLEMENTARY INFORMATION.

Base Station Radio Equipment (MJ)

1.71 The MJ transmitters and receivers are linked to the base station control terminal and are controlled as described in 1.18. Receiver selection for each channel is described in 1.22.

250-Watt Transmitter Unit (MJ)

1.72 One base station 250-watt transmitter unit (Fig. 2) operating in the 150-MHz band is normally used for each channel provided in the system. Power output of the transmitter, measured at the transmission line leading to the antenna, is 250 watts.

1.73 The exciter-driver operating into the 250-watt rf power amplifier supplies the required channel frequency. An audio and power line filter and a power supply are provided in the cabinet. Also in the cabinet are the meter panel and the local operations panel, which contain the meters, controls, and circuits required to control and monitor transmitter operation. Low power operation of the transmitter and regulation of the power amplifier screen voltage are accomplished by the F-zero and screen regulator panel in the large MJ system. The F-zero mode, that furnishes low power operation, is a holdover from the large system and is not required in the small system. The panel also furnishes 24 volts dc for operation of all relays in the cabinet. In remote standby operation, only the POWER lamp is lit. In local standby operation, both the LOCAL and POWER lamps are lit. A directional coupler circuit is furnished to permit direct reading of both power output and voltage standing-wave ratio.

1.74 The exciter-driver contains a temperature compensating, crystal-controlled oscillator (in the form of a channel element) and the necessary amplifier and multiplier stages required to drive the rf power amplifier. A modulator circuit contained in the exciter-driver modulates the channel carrier with audio signals received from the local operations panel. An optional high stability oscillator panel

can be used to provide the transmitter with an output frequency signal of excellent long term stability. The high degree of accuracy and stability is achieved by the use of a precision quartz crystal that is maintained with a temperature stability of a few hundredths of a degree centigrade by a precision oven. The output of the high stability oscillator replaces the output of the temperature compensating, crystal-controlled oscillator in the exciter-driver. The output is amplified and multiplied by the exciter-driver, resulting in the transmitter carrier frequency, and is then applied to the rf power amplifier.

1.75 Three meters on the meter panel are used to monitor power amplifier output power, plate current, and plate voltage. A fourth meter is used to measure the power amplifier control grid voltage and five different circuit values of the exciter-driver. The indication on this meter is determined by the METER switch on the local operations panel in conjunction with switches located on the chassis containing the circuits monitored with the meter.

1.76 In addition to the METER switch, the local operations panel contains a CONTROL switch that is used to place the transmitter in either the local mode or the remote mode of operation (1.50). The LOCAL switch on the local operations panel is used when the CONTROL switch is set to LOCAL. The STANDBY position of the CONTROL switch leaves the transmitter in an unkeyed, standby condition; the TRANSMIT position keys the transmitter for full power operation and lights the TRANSMIT lamp. A MICROPHONE jack and a MICROPHONE LEVEL control for local modulation of the carrier, a MAINTENANCE PHONE jack for communications between base station radio sites, and jacks for local monitoring of the audio circuit are furnished on the local operations panel. In addition, the local operations panel chassis contains the transmit line terminating circuit and an rf on-the-air circuit. The transmit line terminating circuit is used for an interface between the incoming wire-line or carrier facilities and the base station 250-watt transmitter. The rf on-the-air circuit is used to return an indication to the control terminal transmission equipment that radio transmission is in progress.

50-Watt Transmitter Unit (MJ)

1.77 The 50-watt transmitter unit operates in the 150-MHz band and consists of a local

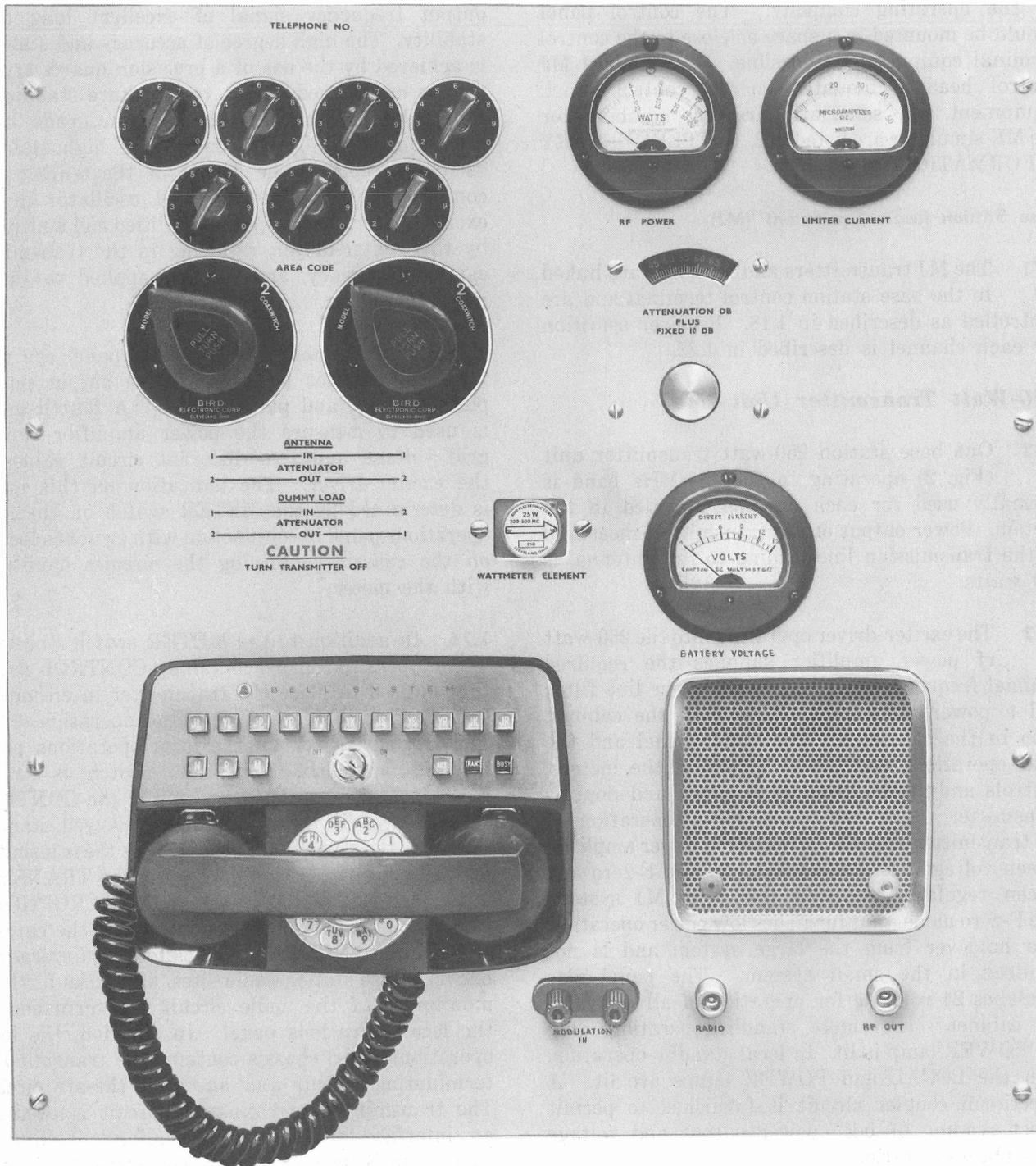


Fig. 27—MK Mobile Simulator

operations panel, exciter-driver panel, F-zero panel (a holdover from the large system), power supply panel, rf power amplifier panel, meter panel, screen regulator panel, optional high stability oscillator panel, and an audio and power line filter junction box.

1.78 The transmitter panels perform the same function as the 250-watt transmitter described in 1.72 through 1.76. Like the 250-watt transmitter, the 50-watt transmitter has a directional coupler circuit. A 5- to 50-watt option is available which allows for regulation of the output power. The option allows the transmitter output power to be varied by controlling the regulated screen grid voltage applied to the power amplifier. The **METER** switch on the local operations panel has an additional position to monitor receiver circuits when a receiver is equipped in the cabinet to form the 50-watt transmitter-receiver unit (1.90).

1.79 Two meters on the meter panel are used to monitor power amplifier output power and plate current or plate voltage. A third meter can be switched to metering points in the power amplifier, exciter-driver, or receiver. The indication on this meter is determined by the **METER** switch on the local operations panel in conjunction with switches located on the chassis containing the circuits monitored with the meter. The **R.F. TEST** jack, furnished on the meter panel, is used for measuring frequency and deviation. The level at the test jack is fixed. An adjustable attenuator (Dumont type 21-1CBA) can be connected to provide lower levels as required. (See Section 104-201-000.)

1.80 The meter panel installed in the outdoor cabinet contains four indicating lamps in addition to the jack and three meters. The **POWER** lamp indicates that voltage is applied to all parts of the cabinet. Local operation of the transmitter is indicated by the **LOCAL** lamp. Transmitter keying is indicated by the **TRANSMIT** lamp. The **F-ZERO** lamp is a holdover from the large system. The indoor transmitter lamps are on the cabinet.

Test Transmitter Unit (MJ Only)

1.81 Like the 50-watt transmitter cabinet (1.77), the test transmitter cabinet contains an exciter-driver panel, rf power amplifier panel, power supply panel, audio and power-line filter junction box, meter panel, local operations panel,

directional coupler, and a F-zero panel. The F-zero panel is a holdover from the large system. The directional coupler circuit is furnished to permit direct reading of both power output and voltage standing-wave ratio. In addition, an ac regulator panel, test transmitter line terminating unit panel, and a multiple oscillator selector panel are used. The 50-watt test transmitter unit (Fig. 12) used for tests and line up of the remote receivers, can be pretuned to operate on any one of eight different frequencies. Power output can be varied from 0.1 microwatt to 50 watts. Both frequency selection and power adjustment can be accomplished either locally at the test transmitter cabinet or remotely at the base station transmission equipment.

1.82 The multiple oscillator selector panel is used for selecting, either locally or remotely, the channel element corresponding to the frequency of the channel on which the test transmitter is to be operated. Local, remote, and emergency modes of operation for the test transmitter are described in 1.154 through 1.161. The **LOCAL FREQUENCY SELECTION** switch is supplied on the multiple oscillator selector panel for use in the local mode of operation to select the desired channel frequency. A **FREQUENCY CONTROL** switch is supplied either to select normal operation (by local or remote control) or emergency operation of the test transmitter. Emergency operation can be used when a channel base station transmitter fails, provided the test transmitter is retuned.

1.83 The test transmitter line terminating unit is used to terminate wire-line or carrier facilities from the base station transmission equipment to make remote control possible. The **LOCAL POWER ADJUST SWITCH** on the line terminating unit is used for local control of the transmitter output power. A **TEST TRANS/EMERGENCY** switch is furnished on the line terminating unit to allow normal operation (remote or local) or emergency operation of the test transmitter. Realignment is required to switch from test transmitter to emergency operation.

1.84 In addition to the wire-line or carrier facilities terminated at the test transmitter line terminating unit for remote control, the test transmitter unit also has the wire-line or carrier facilities terminated at the transmitter line terminating circuit. The transmitter line terminating circuit is contained on the local operations panel chassis as in the 250-watt and 50-watt transmitter units. The

local operations panel is the same as that described for the 250-watt transmitter (1.76). The ac regulator panel contained in the test transmitter unit supplies a regulated input line voltage to all circuits in the cabinet. The meter panel contains three meters for measurement of power amplifier plate current and voltage, power amplifier control grid voltage, exciter-driver circuit values, and power output of the power amplifier. Four lamps to indicate power on, low power operation (a holdover from the large system), transmitter keying, and local operation are located on the cabinet.

Receiver Package (MJ)

1.85 A typical receiver installation is shown in Fig. 4. Depending upon the number of receivers installed in the receiver package, each base station receiver package can receive as many as eight frequencies simultaneously in the 150-MHz band. One receiver is used for each channel. Maximum for the small system is two channels. A multicoupler permits from two to four receivers to be connected to one antenna. When five through eight receivers are needed, one antenna can be used if two multicouplers and an rf power splitter are used. In addition to the receivers, the multicouplers, and the rf power splitter, the cabinet contains a receiver meter panel and an audio and power line junction box. One receiver line terminating unit is also equipped for each receiver.

1.86 The meter panel consists of a meter, meter polarity switch, 5-position receiver selector switch, and a handset jack. Measurements required for alignment and maintenance of the selected receiver can be made using this meter panel. The RECEIVER SELECTOR switch is used to select the receiver to be tested. The METER switch on the receiver is then used to select the desired test point to be monitored. The METER POLARITY switch is furnished to measure the discriminator output. The MAINTENANCE PHONE jack is furnished for intercommunication between the base station radio sites. One meter panel is required for up to four receivers. For more than four receivers, two meter panels are required.

1.87 The multicoupler consists of an impedance-matching device and crystal filters corresponding to the number of receivers in the system. Each filter is tuned to the frequency of its associated receiver.

1.88 The receiver contains, in addition to the METER switch, an audio LINE LEVEL control and a SQUELCH control, all located on the front panel. The channel frequency on which the receiver will operate is determined by the frequency of the channel element contained in each receiver. This frequency is multiplied and mixed with the incoming frequency to produce the constant first intermediate frequency of 8 MHz.

1.89 The receiver line terminating unit matches impedance between wire-line or carrier facilities and the receiver output circuit. It also furnishes a dc voltage proportional to the signal-to-noise ratio of the receiver. This dc voltage and audio signals are sent over the wire-line or carrier facilities to the base station transmission equipment by the line terminating unit. Each line terminating unit consists of a power supply, a signal-to-noise ratio voltage circuit, and a line matching transformer. Taps on the transformer permit matching of the line impedance. The RCVR LISTEN jack on the front panel allows monitoring of the audio signals received at the receiver. Break jacks, RCVR OUT and LINE OUT, are also provided to permit isolation of the line and the receiver.

50-Watt Transmitter-Receiver Unit (MJ)

1.90 The 50-watt transmitter-receiver cabinet (Fig. 11) houses a receiver tuned 5.26 MHz above the operating frequency of the 50-watt transmitter that operates in the 150-MHz band. Duplex operation is used in the unit, making simultaneous operation of the transmitter and receiver possible with a single antenna. The transmitter portion of the unit is the same as the 50-watt transmitter (including available options) described in 1.77 through 1.80. The 50-watt transmitter-receiver unit is formed by physically connecting a diplexer, test converter, receiver, and a receiver line terminating unit to connectors that are reserved in the 50-watt transmitter cabinet for this purpose. The receiver and the receiver line terminating unit are identical to those housed in the receiver package cabinet described in 1.85 through 1.89. The audio and power line filter junction box and the meter panel contained in the 50-watt transmitter cabinet are used with the receiver when the unit is converted to a 50-watt transmitter-receiver unit as previously described.

1.91 When a test transmitter is not provided in the mobile system, the test converter is

used to test the receiver housed in the 50-watt transmitter-receiver unit. It contains an oscillator and mixer circuit used to convert the transmitter output frequency to the receiver frequency. This frequency is channeled to the receiver input for test purposes. The test converter can be turned on remotely by the base station transmission equipment (1.193) or locally by a switch on the test converter panel.

1.92 The diplexer allows simultaneous use of a common antenna by both the transmitter and receiver with the transmitter frequency 5.26 MHz below the receiver frequency. Each diplexer is factory tuned according to the frequencies specified by the customer. A diplexer factory tuned on a common carrier transmitting frequency within the 152.51- to 152.81-MHz range can be operated on any transmitting frequency in this range without retuning.

Base Station Radio Equipment (MK)

1.93 The MK transmitters and receivers are linked to the base station control terminal and controlled as described in 1.18. Receiver selection for each channel is described in 1.27.

5- to 120-Watt Transmitter Unit (MK)

1.94 One base station transmitter unit (Fig. 3) operating in the 450-MHz band is normally used for each channel provided in the system. Power output of the transmitter, measured at the transmission line leading to the antenna, is 100 watts.

1.95 The 5- to 120-watt transmitter uses an exciter-driver, tripler-driver, and power amplifier stage to process a carrier signal. A temperature compensating, crystal-controlled oscillator (channel element) in the exciter-driver stage furnishes the fundamental transmitter frequency. The output signal (150 to 170 MHz) from the exciter-driver is coupled to the tripler-driver where it is tripled in frequency, and its output operating into the 100-watt rf power amplifier supplies the required channel frequency. A power and audio line filter, exciter-driver power supply, and main power supply are used in the cabinet to enable transmitter operation. The cabinet also contains a meter panel and a local operations panel on which are mounted the meters, controls, and circuits needed to control and monitor transmitter operation. In the large MK system,

low power operation of the transmitter is accomplished by the F-zero circuit that regulates the screen voltages to the tripler-driver and power amplifier. Low power operation (F-zero mode) is a holdover from the large system and is not required in the small system. In remote standby operation, only the POWER lamp is lit; in local operation, both the POWER and LOCAL lamps are lit. A directional coupler is furnished to permit direct reading of both power output and voltage standing-wave ratio.

1.96 A meter panel equipped with three meters is provided for checking and aligning the base station transmitter. The POWER OUTPUT meter indicates the rf output (in watts) of the station. Depending upon the position of the METER switch on the local operations panel, the EXCITER-TRIPLER-DRIVER-PA-GRID meter indicates (1) exciter or tripler-driver voltages and currents and (2) voltages on the control grid of the power amplifier. Switches on the exciter-driver and tripler-driver chassis, used in conjunction with the METER switch, determine circuit points to be monitored by the meter. The PLATE meter and an associated switch on the power amplifier chassis are used to measure the plate voltage or current of the power amplifier tube.

1.97 The local operations panel contains a CONTROL switch and a LOCAL switch in addition to the METER switch. The transmitter is placed in either the local or remote mode of operation (1.163) by the CONTROL switch. The LOCAL switch is used when the CONTROL switch is set to the LOCAL position. The LOCAL switch has three positions: STANDBY, TRANSMIT, and F-ZERO. The STANDBY position places the transmitter in an unkeyed, ready condition. Placing the LOCAL switch in the TRANSMIT position lights the TRANSMIT lamp, and the transmitter can be operated at its full rated rf output power. A MICROPHONE jack and MIC LEVEL control for local modulation of the carrier, a MAINTENANCE PHONE jack for communication between base station radio sites, and jacks for local monitoring of the audio circuit are furnished on the local operations panel. The panel also contains a line matching circuit and an rf on-the-air circuit. The line matching circuit is used for an interface between the incoming wire-line or carrier facilities and the base station 5- to 120-watt transmitter. The rf on-the-air circuit is used to return an indication to the control terminal transmission equipment that radio transmission is in progress.

Receiver Package (MK)

1.98 A base station receiver package of maximum capacity is capable of receiving eight frequencies simultaneously in the 450-MHz band. One receiver, in conjunction with an associated line terminating unit, is used for each channel. Maximum for the small system is two channels. Depending upon system requirements, the base station can be installed as a 1-receiver station or any complement thereof to a maximum of eight receivers. Fig. 4 shows a 2-receiver package. A multicoupler permits from two through four receivers to be connected to a single antenna. When receivers five through eight are required in a cabinet, all eight receivers can be connected to the same antenna provided two multicouplers and an rf power splitter are used. In addition to the receivers, the multicouplers, and the rf power splitter, the cabinet contains a meter panel and an audio and power line junction box.

1.99 The meter panel consists of a meter, meter polarity switch, 9-position function selector switch, multicoupler power indicator light, and a handset jack. Measurements required for alignment and maintenance of the selected receiver or line terminating unit (LTU) may be made using this meter panel. The METER FUNCTION switch is used to select the receiver, LTU, or multicoupler to be tested. The METER switch on the receiver or multicoupler is then used to select the test point to be monitored. The METER POLARITY switch is provided for measuring the discriminator output. The multicoupler power light is provided as an indication of multicoupler power and fuse condition. The handset MAINTENANCE PHONE jack is provided for intercommunication between the various base station radio sites. One meter panel is needed for up to four receivers. For more than four receivers, two meter panels are required.

1.100 The multicoupler consists of an impedance matching device and four crystal filters. Each of the four filters is tuned to the frequency of its associated receiver. One multicoupler can accommodate from two through four receivers. For more than four receivers, two multicouplers are needed.

1.101 The receiver contains, in addition to the METER switch, an audio LINE LEVEL control and a SQUELCH control located on the front panel. The channel frequency on which the

receiver operates is determined by the channel element contained in each receiver. This frequency is multiplied and mixed with the incoming frequency to produce the constant first intermediate frequency of 11 MHz.

1.102 The receiver line terminating unit matches the impedance between wire-line or carrier facilities and the receiver output circuit. It also furnishes a dc voltage proportional to the signal-to-noise ratio of the receiver. The dc voltage and audio signal are sent over the wire-line or carrier facilities to the base station transmission equipment by the line terminating unit. Each line terminating unit consists of a power supply, a signal-to-noise ratio voltage circuit, and a line matching transformer. Taps on the transformer permit matching of the line impedance. A handset LINE MONITOR connector located on the front panel allows the received audio signals to be monitored. A set of multiple jacks (EQUIPMENT BREAK, EQUIPMENT BRIDGE; and LINE BREAK, LINE BRIDGE) is also located on the front panel of the line terminating unit. These jacks permit monitoring of the audio signal on the line facility and isolation of the line facility from the receiver.

5- to 100-Watt Transmitter-Receiver Unit (MK)

1.103 The 5- to 100-watt transmitter-receiver cabinet houses a receiver tuned 5 MHz above the operating frequency of the 5- to 120-watt transmitter that operates in the 450-MHz band. Full-duplex operation is used in the transmitter-receiver unit, making simultaneous operation of the transmitter and receiver possible with a single antenna. The transmitter used in the cabinet is the same as the 5- to 120-watt transmitter described in 1.94 through 1.97. The 5- to 100-watt transmitter-receiver unit is formed by physically connecting a diplexer, test converter, receiver, and receiver line terminating unit to connectors provided in the 5- to 120-watt transmitter cabinet for this purpose. The receiver and receiver line terminating unit are identical to those in the receiver package described in 1.98 through 1.102. The audio and power line filter junction box and the meter panel in the 5- to 120-watt cabinet are used with the receiver when the unit is converted to a 5- to 100-watt transmitter-receiver unit.

1.104 The test converter, in conjunction with the power sampler, is used to check overall

performance of the base station. It consists of an oscillator, mixer (part of the power sampler), relay module, and control for adjusting the output level. This unit converts the transmitter output frequency to the receiver frequency and then connects the signal to the receiver input for test purposes. The unit can be turned on remotely by the base station transmission equipment or locally by a switch on the test converter panel.

1.105 The diplexer allows simultaneous use of a common antenna by both the transmitter and receiver, provided the transmitter frequency is 5 MHz below the receiver frequency. Each diplexer is factory tuned to the frequencies specified by the customer. A diplexer, factory tuned on a common-carrier frequency within the 454.375- to 454.650-MHz range, can be operated on any frequency in this range without retuning.

Mobile Station Equipment (MJ)

Radio Units (MJ)

1.106 The transmitter of the Motorola KS-19609 or KS-21466 or the General Electric KS-19852 radio is a nominal 20-watt, crystal-controlled unit capable of operating on any of 11 common carrier mobile frequency assignments in the 150-MHz band. The receiver is a completely transistorized, crystal-controlled, superheterodyne type. It accepts frequency-modulated signals on any of the 11 common carrier base station frequency assignments in the assigned band.

1.107 *Radio Unit (KS-19609):* This radio unit (Fig. 5) is completely housed in a heavy gauge steel case with a removable top for access to the components mounted on the radio chassis. The transmitter, receiver, power supply, diplexer, and channel hunting logic together form a drawer unit that slides into the case. The power supply with some of the filtering components is contained in a separate housing that mounts on the front panel. Metering connections are made through receptacles on the front panel. Two metering receptacles are located under a protective nameplate cover and are used to connect a portable test set necessary to align and check the transmitter and receiver. The antenna is connected to a UHF-type coaxial connector on the radio unit front panel. The case is not vented to prevent dust and dirt from entering the radio unit.

1.108 The radio unit contains supervisory unit KS-19609, L2 and transistorized oscillator plug-in modules, one module for each channel on which the radio unit operates. The oscillator module generates the radio frequency required for the transmitter and receiver to operate on a given channel. The oscillator module corresponding to the desired channel of operation is selected by a switching circuit in the radio unit. The radio unit is interconnected with the control unit by a multiple conductor cable.

1.109 *Radio Unit KS-21466, L2:* This updated radio unit (Fig. 8) differs from its KS-19609 predecessor by being all solid state (including the transmitter) and by deriving all channel frequencies from a single crystal controlled oscillator by means of a frequency synthesizer.

1.110 *Radio Unit KS-19852:* The radio unit (Fig. 5) consists of a transmitter, receiver, power supply, channel hunting circuit board (located in the supervisory unit housing), and a diplexer. Supervisory unit KS-19852, L2 described below, fits into the center housing. Individual covers for each subassembly can be lifted off to service the radio unit or any individual subassembly can be completely removed. The front casting is designed to fit on the end of the assembly and provides mounting for the power and control cable jack and for the antenna jack. When this casting is removed from the assembly and disconnected from the radio unit, the 10-volt regulator and the keying relay are exposed. The transmitter contains a safety interlock switch that is opened when the cover is removed and a centralized metering jack that is provided for use with a test set. The test set meters the transmitter multiplier, amplifier, and power amplifier stages as well as filament and regulated supply voltages. The metering jack also provides access to receiver audio, microphone, and push-to-talk leads. The receiver also contains a centralized metering jack (for use with the test set) that facilitates alignment and servicing. The test set meters the receiver multiplier and limiter stages as well as the discriminator, audio, regulated 10 volts, and filtered 12 volts.

1.111 The channel hunting circuit board contains oscillator plug-in modules, one module for each channel. The oscillator module generates the radio frequency required for the transmitter and receiver to operate on a given channel. The oscillator module corresponding to the desired

channel of operation is selected by a switching circuit on the circuit board. The diplexer allows the transmitter and receiver to be operated simultaneously, using a single antenna. A multiple conductor cable is used to interconnect the radio unit (containing the supervisory unit) and the control unit.

Supervisory Units (MJ)

1.112 Supervisory units KS-19609, L2 and KS-19852,

L2 and the supervisory unit included in radio unit KS-21466, L2 contain the tone detectors, oscillators, timers, and logic circuits required for operation of the radio unit and the control unit on an automatic or a manual basis. The unit causes the mobile set to hunt over each equipped channel for the marked-idle channel and, when the idle channel is detected, locks the mobile station to that channel. When a call is incoming from the base station to the mobile station, the supervisory unit evaluates the incoming mobile station code number information. If the code number is not the one assigned to the mobile station, the supervisory unit initiates a search for the new marked-idle channel. If the code number is the one assigned to the mobile station, the supervisory unit keys the transmitter in the radio unit and injects an acknowledgment tone generated by the unit into the transmitter input circuit. The supervisory unit turns on the ringer in the control unit to alert the subscriber of an incoming call when ringing signals are received from the radio unit. An answer signal is generated and sent to the transmitter when the mobile subscriber goes off-hook to answer the call. A disconnect signal is sent to the transmitter upon termination of the call. When a call is outgoing to the base station, the supervisory unit sends the mobile station code number information for ANI to the mobile transmitter when the base station commands it to do so. After dial tone is received by the mobile subscriber, the supervisory unit converts the dial pulses from the control unit into tone signals and feeds them to the transmitter. It also controls handset muting to maintain privacy and provide talk-off protection during signaling. The unit also maintains supervision over calls placed in the manual mode of operation.

1.113 Supervisory Unit KS-19609, L2:

This supervisory unit (Fig. 6) is a completely transistorized, logic, tone generating, and pulse decoding unit. The supervisory unit consists mainly of two tone generators with their associated timer

circuits, two tone detectors, a pulse and digit counter, and logic circuits required to control the mobile station. The tone generators and the timer circuitry, under control of logic circuits, and the pulse and digit counter produce all the mobile station-to-base station signaling tones (1.112). The tone detectors respond to base station-to-mobile station signaling and produce outputs that cause the mobile station to search for and lock onto a marked-idle channel to indicate when ANI is to begin, and to drive the pulse counter during base station outpulsing. The digit counter contains a 7-digit code corresponding to the area code and the last four digits of that particular mobile station. Coding is accomplished by the strapping of digit counter terminals on the printed circuit board. It is possible to program the digit counter with any one of ten million 7-digit code numbers. Thus, any 7-digit code can be programmed in the mobile station. The pulse and digit counter determines when a particular mobile station has been signaled and furnishes the information needed to generate ANI.

1.114 Supervisory Unit KS-19852, L2:

This supervisory unit (Fig. 6) is a completely transistorized logic, tone generating, and pulse decoding unit. The supervisory unit consists of two tone receiver boards, a decoder board, a tone oscillator board, and a logic board. Each of the two tone receiver boards functions as a tone detector to convert incoming tones to positive and negative shifts in voltage for the decoder board. One tone receiver is for 600- and 1500-Hz tones used in manual operation. The other is for 1800- and 2000-Hz tones used for automatic operation. The decoder contains a 7-digit code corresponding to the area code and the last four digits of that particular mobile station. Coding is accomplished by strapping on the printed circuit board. Use of the strapping permits any 7-digit code to be programmed in the mobile station. The decoder accepts incoming voltage shifts that represent the mobile station code, counts the transitions, stores them until the bit train is complete, and stores the digits when correct. When the code number is correct, the decoder triggers the logic board. If the call is not for the mobile station or if the number is otherwise incorrect, the call will be dropped. The logic board provides supervision and switching of the circuits as needed during a call. In the processing of a call, either incoming or outgoing, the mobile station must respond to the operating conditions selected by the operator

and to the signals transmitted from the control terminal. For each condition of operation, the requirements differ in some degree and the logic board provides the necessary controls. The tone oscillator board provides the three tone frequencies needed in the operation of the mobile station for signaling.

Control Unit (MJ)

1.115 Control unit KS-19626 (Fig. 7) or KS-21466, L3 (Fig. 8) mounts on the transmission tunnel or on the dashboard. A multiconductor cable is used for interconnections with the radio unit. The control unit contains a rotary dial, mode selector switch consisting of three mode pushbuttons, channel selector switch consisting of 11 channel pushbuttons, AUX pushbutton, TRANS lamp, BUSY lamp, and an on-off keyswitch. The dial is lit by a lamp contained within the unit.

1.116 The H (home), R (roam), and M (manual) mode pushbuttons on the mode selector switch are interlocked with positive blockout so that when one pushbutton is pressed, the previously pressed pushbutton releases. When the H pushbutton is pressed, the channel selector switch is changed to nonlocking, spring return operation so that each channel pushbutton on the channel selector switch immediately releases after being pressed. When the R pushbutton is pressed, the channel selector switch is changed to all-pushbutton-latch operation. Each channel pushbutton pressed latches until either the H or M pushbutton is pressed. When the M pushbutton is pressed, the channel selector switch changes to single pushbutton latch operation. One channel pushbutton latches at a time. The pushbutton is released by pressing another channel pushbutton or one of the mode pushbuttons.

1.117 The AUX pushbutton is used to supplement the control unit ringer with an external alarm for signaling the subscriber. The TRANS lamp indicates when the transmitter in the radio unit is keyed. The BUSY lamp indicates that the system is busy.

Mobile Station Equipment (MK)

Radio Unit (MK)

1.118 The transmitter of the KS-20282 radio is a nominal 16-watt, crystal-controlled, transistorized unit capable of operating on any of

12 common-carrier mobile frequency assignments in the 450-MHz band. The receiver is also completely transistorized and is of the crystal-controlled, double conversion, superheterodyne type. It accepts frequency-modulated signals on any of 12 common carrier base station frequency assignments in the assigned band.

1.119 Radio Unit KS-20282, L1: This radio unit (Fig. 5) is completely housed in a heavy gauge steel case with a removable top for access to the components mounted on the radio chassis. The case is mounted either directly on the trunk floor of the vehicle or on a mounting base with a key operated lock. The base provides for easy removal of the radio for repair or replacement. The radio unit operates directly from the vehicle's 12-volt (positive or negative ground) power supply, eliminating the need for a separate power supply. The transmitter, receiver, diplexer, and channel hunting logic together form a drawer unit that slides into the case. Metering connections are made through receptacles on the front panel. Two metering receptacles are located under a protective nameplate cover and are used to connect a portable test set necessary to align and check the transmitter and receiver. The antenna is connected to a UHF-type connector on the radio unit front panel. The case is not vented to prevent dust and dirt from entering the radio unit.

Supervisory (MK)

1.120 The supervisory unit in the MK mobile station equipment is the KS-19609, L2 supervisory unit, which is also used in the MJ mobile station equipment and is described in 1.112 and 1.113.

Control Unit (MK)

1.121 Control unit KS-20283 (Fig. 7) or KS-21466, L4 (Fig. 8) mounts on the transmission tunnel or dashboard of the vehicle and provides the necessary control, indicators, and audio facilities required to operate the mobile station. The control unit includes an on-off keyswitch, receive level volume control, transmit (T) and roam (R) lamps, home/roam mode selection slide switch, lamp-intensity switch (bright or dim), illuminated dial, handset, ringer, and an AUX alarm pushbutton.

1.122 The home/roam mode selection slide switch and the dimmer slide switch are located

on the underside of the control unit KS-20283 (Fig. 7). To select the home mode of operation, the mode selection switch is operated to the right; and to select the roam mode of operation, the switch is operated to the left. The dimmer switch provides for two light intensities (bright or dim) of the roam (R) and transmit (T) lamps. The AUX pushbutton is used to supplement the control unit ringer with an external alarm for signaling the subscriber. Illumination of the T lamp indicates that the transmitter in the radio unit is keyed. Illumination of the R lamp indicates that the roam mode of operation is selected. Control unit KS-21466, L4 provides similar features plus customer programmable channel selection. The radio unit KS-20282 it is used with must be list 14. A list 3 radio unit may be modified in the field to list 14 by use of a Motorola kit.

C. Functional Characteristics

Base Station Control Terminal Equipment

Land-to-Mobile Call

1.123 To reach an MJ or MK mobile station, the calling land subscriber dials the number of the mobile in the same manner used to reach another land subscriber. The calling land customer is then switched through to a single party subscriber loop as in a normal call. However, this loop terminates in the control terminal at the line circuit assigned to the called mobile station instead of at a land subscriber station (Fig. 28). Ringing normally applied through the tip and ring leads by the central office to the land subscriber station is now applied to the control terminal. The central office grounds the tip lead and applies ringing voltage and ring trip battery to the ring lead. The tip ground serves as a demand for a channel. If a channel is available, the demand is placed on the link circuit via the link access circuit. If all channels are busy, the control terminal trips ringing and an all-trunks-busy tone is returned to the calling land subscriber.

1.124 The link circuit reacts to the demand by (1) permitting the link access circuit to switch and hold, (2) setting itself into a land-to-mobile state, (3) removing idle tone (the marked-idle indication) and applying seize tone to hold all mobiles on the channel, and (4) seizing the sender (ie, sender mode of the register-sender circuit). A translate mark is sent back through the link access

circuit to the translator to mark a matrix horizontal. Shorting disks in the matrix supply this mark to one of the ten leads in each of four digit groups to indicate the 4-digit number to be outpulsed.

1.125 The sender outpulses (pulses of idle tone) the local NPA code plus the indicated 4-digit number. As mobiles miscode, they drop off and search for a new marked-idle channel, leaving only one mobile to acknowledge at the end of the seven digits.

1.126 If the called mobile station does not acknowledge in 3 seconds, the link circuit places the line circuit in a lockout condition with the calling land customer listening to audible ring. The channel is then immediately free to serve other demands for service.

1.127 If the called mobile station acknowledges, the link circuit applies ringing in the form of alternate pulses of idle and seize tone. The ringing cycle is 2 seconds on and 4 seconds off. The link circuit times for approximately 120 seconds, placing the line circuit in lockout if the called mobile station does not answer in this time.

1.128 If the called mobile station answers, central office ringing is tripped, MJ or MK ringing is terminated, and the conversation can take place. At the end of the call, the mobile sends a disconnect pulse and the channel is released. If the land customer is slow in hanging up, the link circuit places the line circuit in lockout (1.126 and 1.127) and the channel is then free to be used again.

Switchboard-to-Mobile Call

1.129 When a call is to a roaming mobile, the calling land customer must contact the mobile service operator (Fig. 28).

1.130 For a call to an MJ or MK roamer, the operator plugs into the A jack. The link circuit detects this seizure, removes idle tone and applies seize tone as before, and gives a start dial indication. The operator dials the roaming MJ or MK mobile station NPA code plus its unique 4-digit code (deleting the 3-digit central office code). The operator then judges how long to wait for acknowledgment and answer. If the link circuit detects the acknowledgment signal from the mobile station, it applies ringing as described in 1.127. Upon answer, ringing is terminated and answer

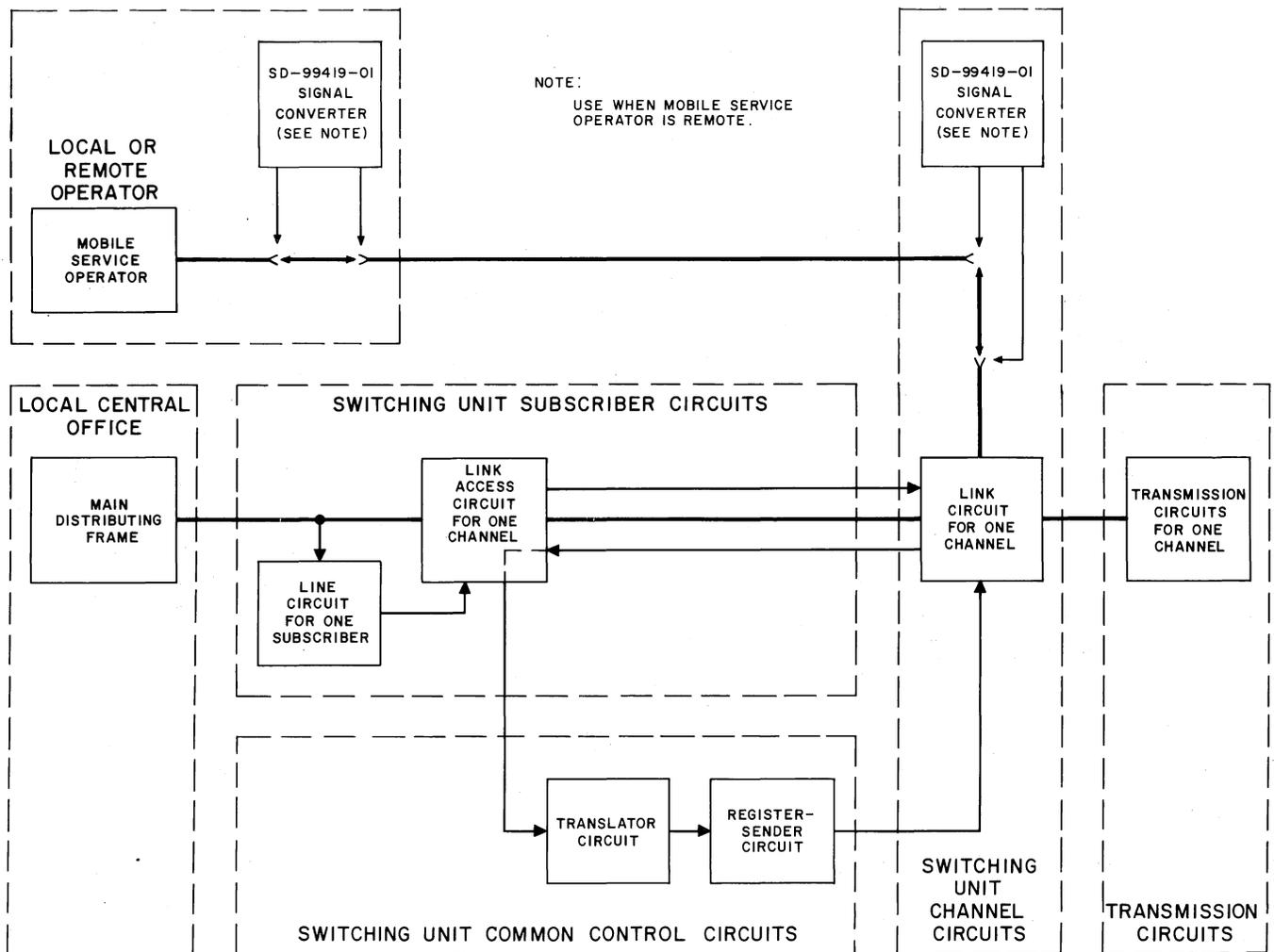


Fig. 28—Control of Land-to-Mobile Call for Small MJ and MK Systems, Block Diagram

supervision is given to the operator. Upon disconnect, the operator is alerted by a supervisory lamp and the connection can be removed.

1.131 For a call to a manual mobile (MJ systems only), the operator plugs into the B jack. The link circuit detects the seizure, drops idle tone, applies a 600-Hz tone, makes a transition from a 600-Hz tone to a 1500-Hz tone, and then gives a start dial signal to the operator. The operator then dials the 5-digit manual mobile number. The link circuit converts the dial pulses to 600-Hz and 1500-Hz tone transitions. The called mobile station is programmed to respond to the incoming pulses. Its control unit ringer is allowed to ring for 4 seconds, after which another transition cuts off the ringer. The tones are then terminated. The

operator must monitor to supervise the call, since there will be no disconnect tones.

Mobile-to-Land Call

1.132 To place a call, the MJ or MK subscriber lifts the handset. If the set is locked to the idle channel, the mobile transmitter is energized, modulated by guard tone, and followed by a burst of connect tone. The link circuit responds to the carrier plus guard tone by busying the channel. It responds to the connect tone by dropping the idle tone mark, setting itself into the mobile-to-land mode, applying seize tone, seizing the register (ie, register mode of the register-sender circuit), and then dropping the seize tone.

1.133 The disappearance of seize tone commands the mobile to transmit its automatic number identification (ANI). The register (Fig. 29) stores the first three digits of ANI and then asks the translator whether these three digits are assigned to the local NPA, an adjacent NPA having permission to dial local calls, or a foreign NPA (eg, another state or operating company). The register stores the result of this translation and proceeds to use the same storage tanks to store the next four digits. Again it asks the translator whether the number is assigned locally or not. If the number is assigned locally, the translator operates the link access circuit to connect the local mobile to its line circuit. Otherwise, either it is given the roamer line circuit or the call is routed to the mobile service operator.

1.134 If the mobile subscriber is given a line circuit, he or she hears central office dial

tone and proceeds to dial for a connection. However, further registration and translation is required for two reasons: toll diverting and revertive (mobile-to-mobile) call processing.

1.135 The first three digits of the dialed number are registered and translated in the same manner as were the three digits of the NPA code. The translator indicates to the register that the number is the local central office code, another office in the local calling area, or a long distance call. If a long distance call is indicated, and if the calling mobile station is a roamer, the call is routed to the operator. If the local central office code is indicated, a revertive call is still possible. If another office in the local calling area is indicated, the register is released. If a long distance call is indicated for a local customer, the register is also released.

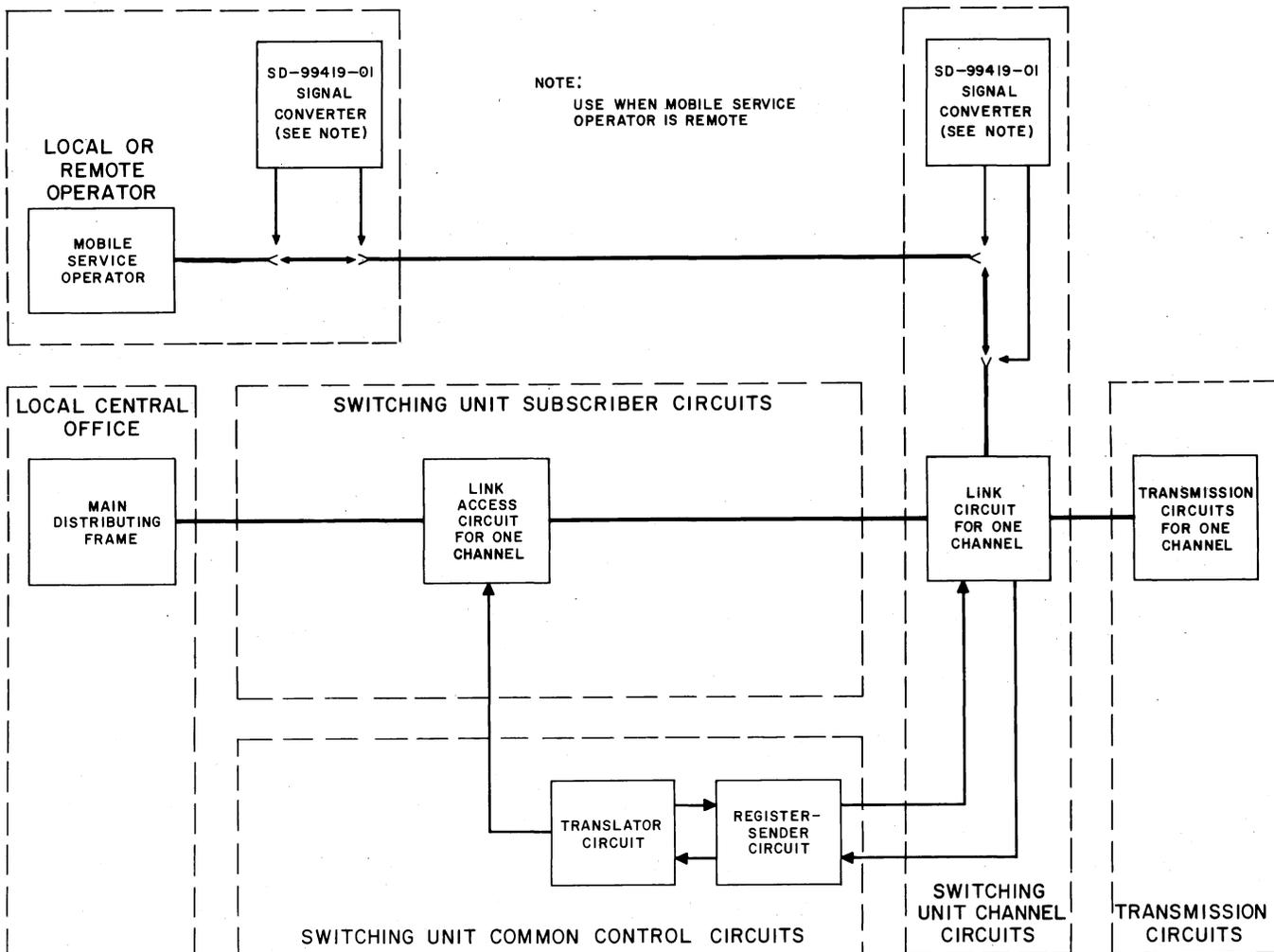


Fig. 29—Control of Mobile-to-Land Call for Small MJ and MK Systems, Block Diagram

1.136 If the local central office code is indicated above, the last four digits are now translated. If the number is not locally programmed, the register is released. If the number is locally assigned to a mobile, the revertive call goes to the operator and the connection to the central office is dropped. Note, however, that in a 2-channel system there is no monitoring for revertive call purposes; a mobile-to-mobile call uses both channels.

1.137 In all cases, the required dialing and supervisory functions are repeated to the central office by the link circuit. Disconnect is as in the land-to-mobile case.

1.138 If an operator is needed, an answer lamp is lit at the switchboard. Disconnect supervision is supplied to the switchboard by the link circuit.

Manual Mobile-to-Land Call (MJ Only)

1.139 Carrier without guard tone is the manual indication. The channel is busied (Fig. 29), and an answer lamp is lighted at the switchboard. The mobile station must use push-to-talk operation, and the operator must supervise all functions.

Base Station Control Terminal Transmission Equipment

1.140 Each MJ or MK channel contains a complete set of transistorized transmission equipment that is located on its channel equipment shelf and reserved for its exclusive use (Fig. 30). The transmission equipment enables the base station transmitter to be modulated with speech and supervisory signals and applies incoming speech and supervisory signals to the link circuit talking path as required. The hybrid network, which is part of the transmission equipment, divides the remainder of the transmission equipment into two groups. One group forms the transmit speech path between the link circuit and the base station transmitter, and the other group forms the receive speech path between a base station receiver and the link circuit. Equipment forming the transmit speech path consists of a VOGAD circuit, pad, and transmit line terminating unit (one for each transmitter), in addition to the hybrid network. Equipment composing the receive speech path, in addition to the hybrid speech network, consists of a receive line terminating unit (one for each receiver), receiver selector, bandpass filter, and a

SONAD circuit. A tone generator is used to apply tones for signaling to the transmit speech path and a tone detector is used to detect tones received on the received speech path.

Transmit Speech Path

1.141 The talking path in the base station control terminal is extended to the base station transmitter over the transmit speech path in the base station control terminal transmission equipment (Fig. 30). The transmit speech path is used to modulate the base station transmitter not only with speech from the land customer but also with supervisory tones from the tone generator.

1.142 The tip and ring leads from the link talking path are extended to the hybrid network that applies the speech signals to the VOGAD circuit in the transmit speech path. The VOGAD is a circuit that adjusts itself automatically to furnish a constant level of speech output over a wide range of input levels. The constant output of the VOGAD circuit is adjusted to the level required for adequate modulation of the base station transmitter. The transmit line terminating unit contains circuits that match the impedance between the transmission equipment and the wire-line or carrier facilities that connect to the base station transmitter. The base station transmitter may be remotely located (a number of miles) from the base station control terminal. The transmit line terminating unit also contains a circuit used in conjunction with the link circuit for the performance of MJ or MK transmitter switching functions.

Receive Speech Path

1.143 The receive speech path applies speech signals incoming from a base station receiver to the tip and ring leads in the control terminal switching unit talking path (Fig. 30). Like the transmit speech path, the receive speech path accommodates supervisory tones and speech signals. The tone detector detects and converts the incoming tones to dc pulses and applies them to the link circuit for supervising switching functions.

1.144 An incoming signal (speech or supervisory tone) is received by a group of radio receivers assigned to the channel and transmitted to the base station transmission circuits. The signal is applied, through a pad and an impedance-matching receive line terminating unit, to the receiver selector.

The receiver selector selects the receiver having the highest signal-to-noise ratio and applies the signal from that receiver to a bandpass filter. From the bandpass filter, the signal is applied to the tone detector and to the SONAD. Supervisory tones are converted to ground pulses by the tone detector and applied to the link circuit; the audio signal is also applied through the SONAD circuit to the hybrid network that couples the speech signal to the control terminal talking path. A resistance pad is provided at the SONAD output to facilitate changing the level at that point.

Tone Signaling

1.145 The tone generator applies one of four supervisory tones through the transmit line terminating unit to the transmit speech path. Two of the tones, 600 and 1500 Hz, are used for selective signaling in the manual mode of operation (MJ system only). The 1800- and 2000-Hz tones are used for the seize tone and the idle tone in the home and roam modes of automatic operation, respectively. Under the direct control of the link circuit, the tone generator modulates the transmitter with idle tone or with a combination of idle tone and seize tone. The idle tone causes all operating mobile stations not involved in a call to lock to the idle channel. The combination of idle tone and seize tone performs the functions of selective signaling and repetitive ringing.

Tone Detection

1.146 Supervisory tones are transmitted by the mobile station to the base station for establishing an incoming or outgoing call. The tones are received by a tone detector circuit via the bandpass filter and receiver selector circuits. These tones are used by the mobile station for acknowledgment, ANI, disconnect, connect, and dialing. The tone detector operates a circuit associated with the incoming tone and applies a ground pulse representing the incoming tone to the link circuit that receives it as input information used for establishing the call.

Transmitter Switching

1.147 The base station transmitter is normally controlled by the link circuit and the transmit line terminating unit, but the control may be transferred to the channel jack and key field by operation of the CHAN O/SVC key. The power

at which the transmitter can be operated is determined by operation of the TX FP key. The link also provides an indication that the transmitter is energized.

Receiver Selection

1.148 The current generator associated with each channel receiver uses a dc input from the receiver to apply a generated current over the transmission facilities to the receive line terminating unit. This generated current, which is based on the signal-to-noise ratio at the associated receiver, is converted to a voltage by the receive line terminating unit and applied to the receiver selector. The receiver, one of a maximum of eight, with the highest signal-to-noise ratio, is chosen by the receiver selector and its audio output is applied to the receive speech path.

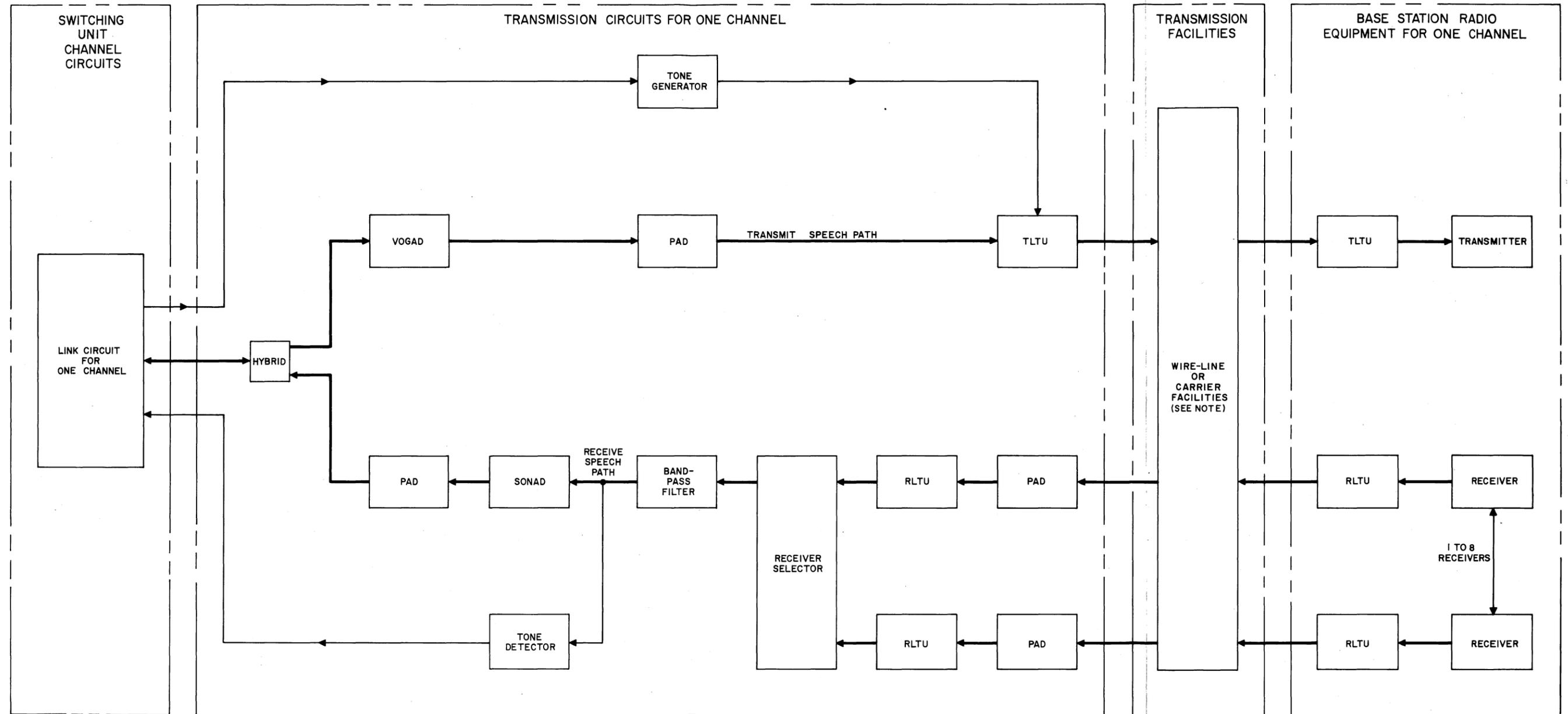
1.149 Two threshold adjustments on the receiver selector determine the minimum signal-to-noise ratio at which a receiver will be connected to the speech path and the signal-to-noise ratio at which a receiver will be disconnected after it is once connected. A signal from the link circuit to the receiver freezes receiver selection during the ANI procedure and during mobile dialing.

1.150 An output from the SONAD circuit is used to indicate to the link circuit that speech is being received from the mobile station. This signal is used by the link circuit to route a call to the mobile service operator when speech from the mobile station is absent for longer than approximately 120 seconds.

Base Station Radio Equipment (MJ and MK)

Transmitter Control (MJ)

1.151 The CONTROL switch on the local operations panel is used to assign transmitter control to a local operator at the transmitter site or to a remote operator at the base station transmission equipment (Fig. 31). A negative 24 volts operates the F-zero relay (a holdover from the large system) when the LOCAL switch is set to F-ZERO and the CONTROL switch is set to LOCAL. The F-zero relay applies a lower than normal plate and screen grid voltage to the output stage of the 250-watt transmitter to achieve a power output of 0.5 watt. To the output stage of the 50-watt transmitter, it



NOTE:
USE REMOTE SIGNALING UNIT SD-2R059-01
WITH CARRIER FACILITIES.

Fig. 30—Base Station Control Terminal Transmission Circuits, Block Diagram

applies a lower than normal screen grid voltage to achieve a power output of 0.5 watt.

1.152 The negative 24 volts is applied through the CONTROL switch and the LOCAL switch to operate the keying relay in the power supply when the CONTROL switch is set to LOCAL and the LOCAL switch is set to TRANSMIT. The keying relay keys the transmitter by applying line voltage to the primary of the power supply high voltage transformer and to the exciter-driver chassis in the case of the 250-watt transmitter. In the case of the 50-watt transmitter, the line voltage is applied only to the power supply. When the LOCAL switch is set to STANDBY, neither the F-zero relay nor the keying relay is operated and the transmitter remains in a standby condition.

1.153 When the CONTROL switch is set to REMOTE, the negative 24 volts is applied through the polar-type remote relay to operate the F-zero relay (large system only) or the keying relay. The particular relay operated depends upon the polarity of a remote control signal incoming on the wire-line or carrier facilities from the base station transmission equipment. The remote control signal operates the remote relay in one direction or the other. The keying relay keys the transmitter as described previously. In addition, the keying relay causes the rf on-the-air circuit to return an rf on-the-air signal over the wire-line or carrier facilities to the base station transmission equipment to give a visual indication that the transmitter is keyed. When no remote control signal is received from the base station transmission equipment, the polar-type remote relay in the local operations panel is not operated and the transmitter remains in a standby condition.

Test Transmitter Control (MJ Only)

1.154 The frequency and rf power output of the test transmitter, in test operation, can be controlled locally by controls and switches in the test transmitter cabinet or remotely from the base station transmission equipment (1.68 and 1.69). The dc signals transmitted over the transmission facilities between the base station control terminal transmission equipment and the test transmitter cabinet are used for remote control. The test transmitter can also be used as an emergency substitute for a regular transmitter.

1.155 To use the test transmitter as an emergency substitute, the TEST TRANS/EMERGENCY switch on the line terminating unit and the FREQUENCY CONTROL switch on the multiple oscillator selector panel are set to EMERGENCY (Fig. 32). This causes the line terminating unit and the multiple oscillator selector chassis to be disconnected from the other circuits in the cabinet. In this condition, the test transmitter operation is identical to that of an ordinary transmitter as described in 1.151. A channel element having the proper frequency must be plugged into the exciter-driver chassis and the transmitter realigned as required to operate on a given channel in the emergency mode of operation.

1.156 To use the transmitter for test purposes, the TEST TRANS/EMERGENCY switch and the FREQUENCY CONTROL switch are set to TEST TRANS and NORMAL, respectively. The rf power output of the test transmitter is controlled locally by setting the CONTROL switch on the local operations panel to LOCAL. With the CONTROL switch in this position, a power output control voltage from the LOCAL POWER ADJUST switch on the line terminating unit is applied through the TEST TRANS/EMERGENCY switch, where it is applied to the screen grid of the tripler and driver stages on the exciter-driver chassis.

1.157 To control the rf power of the test transmitter remotely, the CONTROL switch is set to REMOTE. When the CONTROL switch is set to REMOTE, a power output control voltage from the wire-line or carrier facilities incoming from the base station transmission equipment is applied through the TEST TRANS/EMERGENCY switch, where it is applied to the screen grid of the tripler and driver stages on the exciter-driver chassis.

1.158 The LOCAL FREQUENCY SELECTION switch on the multiple oscillator selector panel can be used by a local operator to set the test transmitter to a desired channel frequency. When the CONTROL switch is set to LOCAL, the local/remote relay on the multiple oscillator selector chassis is operated, causing ground to be applied through the LOCAL FREQUENCY SELECTION switch on the multiple oscillator selector panel to a channel element. The local operator selects the channel element corresponding to the desired channel frequency by setting the LOCAL FREQUENCY SELECTION switch. The channel element output is amplified and applied to the modulator circuit

in the exciter-driver. The exciter-driver multiplies and amplifies the channel element frequency to obtain the desired channel frequency.

1.159 The channel frequency select stepping relay on the multiple oscillator selector chassis can be controlled by a remote operator to set the test transmitter to a desired channel frequency. When the CONTROL switch is set to REMOTE, the local/remote relay is released, causing ground potential to be applied through the stepping relay to a selected channel element.

1.160 The frequency select stepping relay is controlled by incoming pulses from the base station transmission equipment. The incoming pulses are applied to the step relay in the line terminating unit. The relay operates once for each pulse and causes the frequency select stepping relay to step once for each operation. When the current in the step relay and the reset relay in the line terminating unit is reversed in polarity, the reset relay and the step relay operate. The reset relay resets the frequency select stepping relay. This is used to provide a starting reference in case a pulse is missed.

1.161 In a test operation, the power amplifier control grid bias voltage can be adjusted. An adjustable voltage is applied from the bias adjust potentiometer on the line terminating unit through the TEST TRANS/EMERGENCY switch to the power amplifier control grid. In emergency operation, a constant bias is applied to the power amplifier.

Transmitter Control (MK)

1.162 The CONTROL switch on the local operations panel determines the mode of operation of the base station transmitter. It can be set to control the transmitter locally at the transmitter site or remotely at the base station transmission equipment (Fig. 33).

1.163 A positive 24 volts dc operates the F-zero relay (a holdover from the large system) when the LOCAL switch is set to F-ZERO and the CONTROL switch is set to LOCAL. The F-zero relay applies a lower than normal screen voltage to the tripler-driver and power amplifier which causes the transmitter, when keyed, to produce an rf output of 0.5 watt. With the CONTROL switch set to LOCAL and the LOCAL switch set to

TRANSMIT, the positive 24 volts dc is coupled through the CONTROL and LOCAL switches to the transmitter switching circuit. The transmitter switching circuit is then activated to supply 24 volts dc to the exciter-driver and energize the main power supply, which supplies all the voltages needed to operate the transmitter at its full rated rf output power. When the LOCAL switch is set to STANDBY, neither the F-zero relay nor the transmitter switching circuit is energized, and the transmitter remains in a standby condition.

1.164 The transmitter equipment is operated remotely with the CONTROL switch set to REMOTE. A dc control current received over the wire-line or carrier facilities from the base station transmission equipment operates the polar-type remote relay. The remote relay operates in one direction or the other, depending on the polarity of the incoming control current. A positive 24 volts dc is then coupled through the CONTROL switch and the closed contacts of the remote relay to operate the transmitter switching circuit or the F-zero relay. The transmitter switching circuit and F-zero relay cause the transmitter to operate on low power or high power as previously described. When the transmitter is keyed, dc inputs to the rf on-the-air circuit from the directional coupler and remote relay cause this circuit to return an indication to the control terminal that the transmitter has been keyed. When no control current is received from the base station transmission equipment, the remote relay is not operated and the transmitter remains in a standby condition.

Receiver Supervision and Selection (MJ and MK)

1.165 All receivers assigned to a particular channel are installed in different receiver cabinets, and the cabinets are spotted throughout the coverage area to assure good reception from the mobile station. The receiver with the highest signal-to-noise ratio on a given channel is selected by the base station transmission equipment. Receiver selection is made on the basis of a dc signal that is produced by the line terminating unit in the receiver cabinet. This signal is sent to the base station transmission equipment over the wire-line or carrier facilities. The receiver audio output is sent to the base station transmission equipment over the same wire-line or carrier facilities from the line terminating unit in the receiver cabinet.

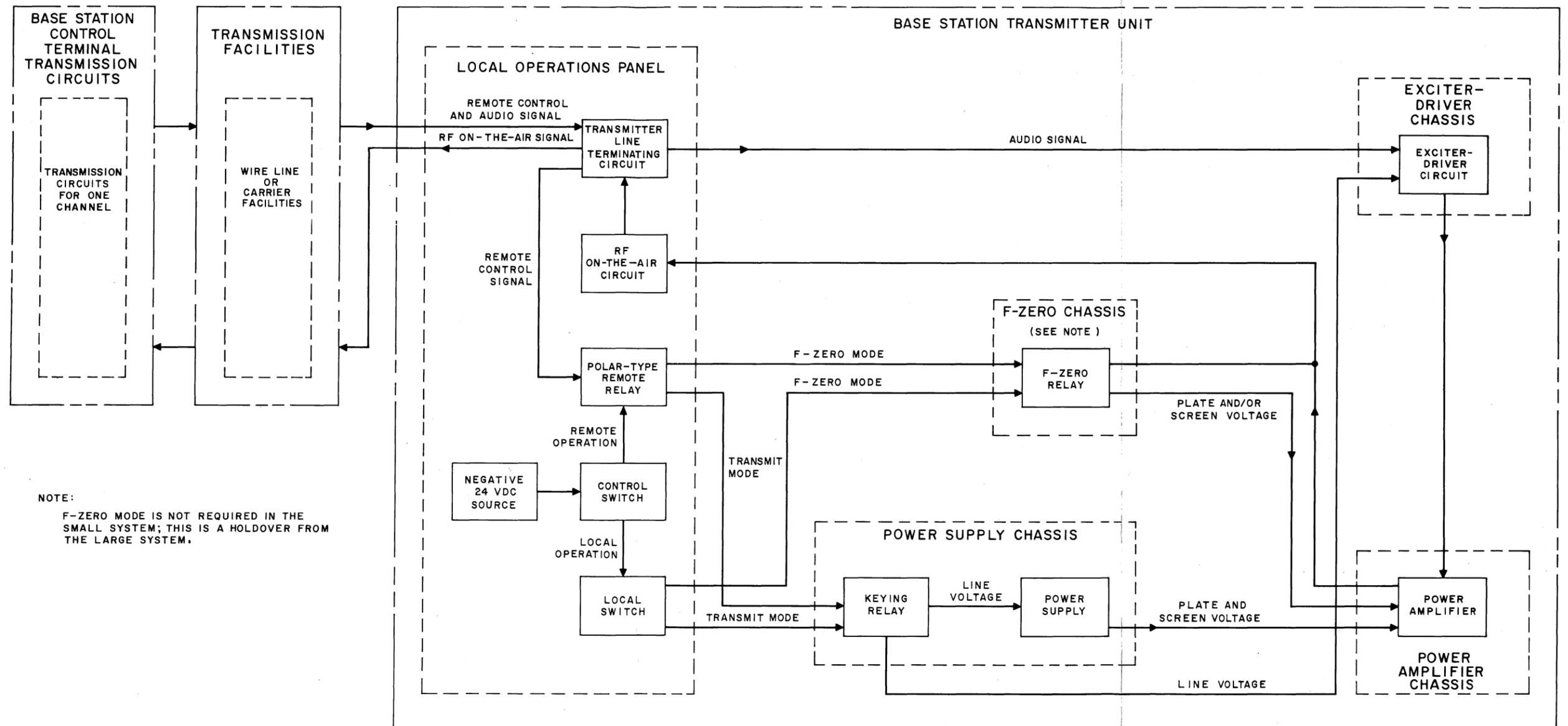


Fig. 31—MJ Transmitter Control, Block Diagram

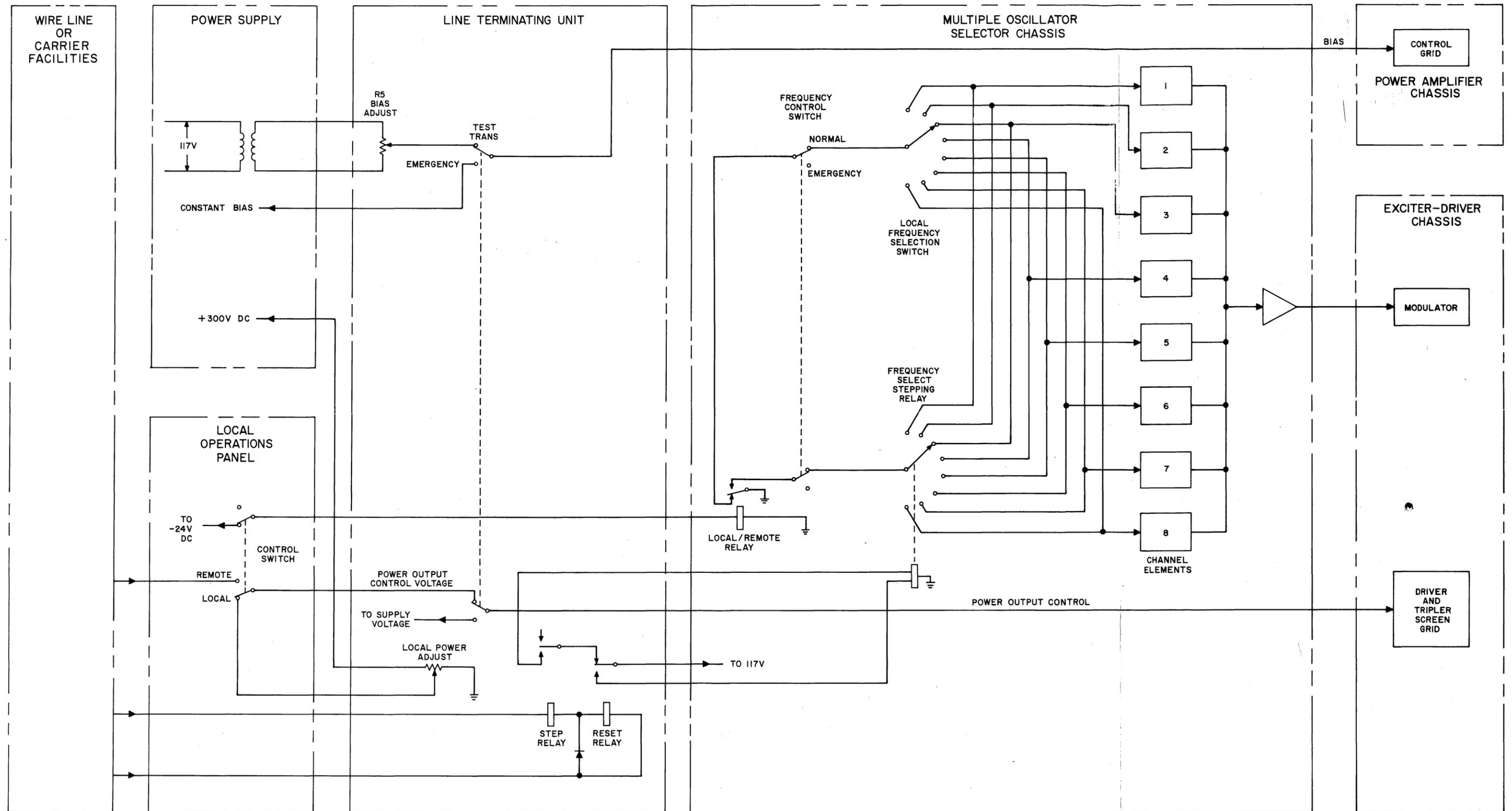


Fig. 32—MJ Test Transmitter Control, Simplified Schematic Diagram

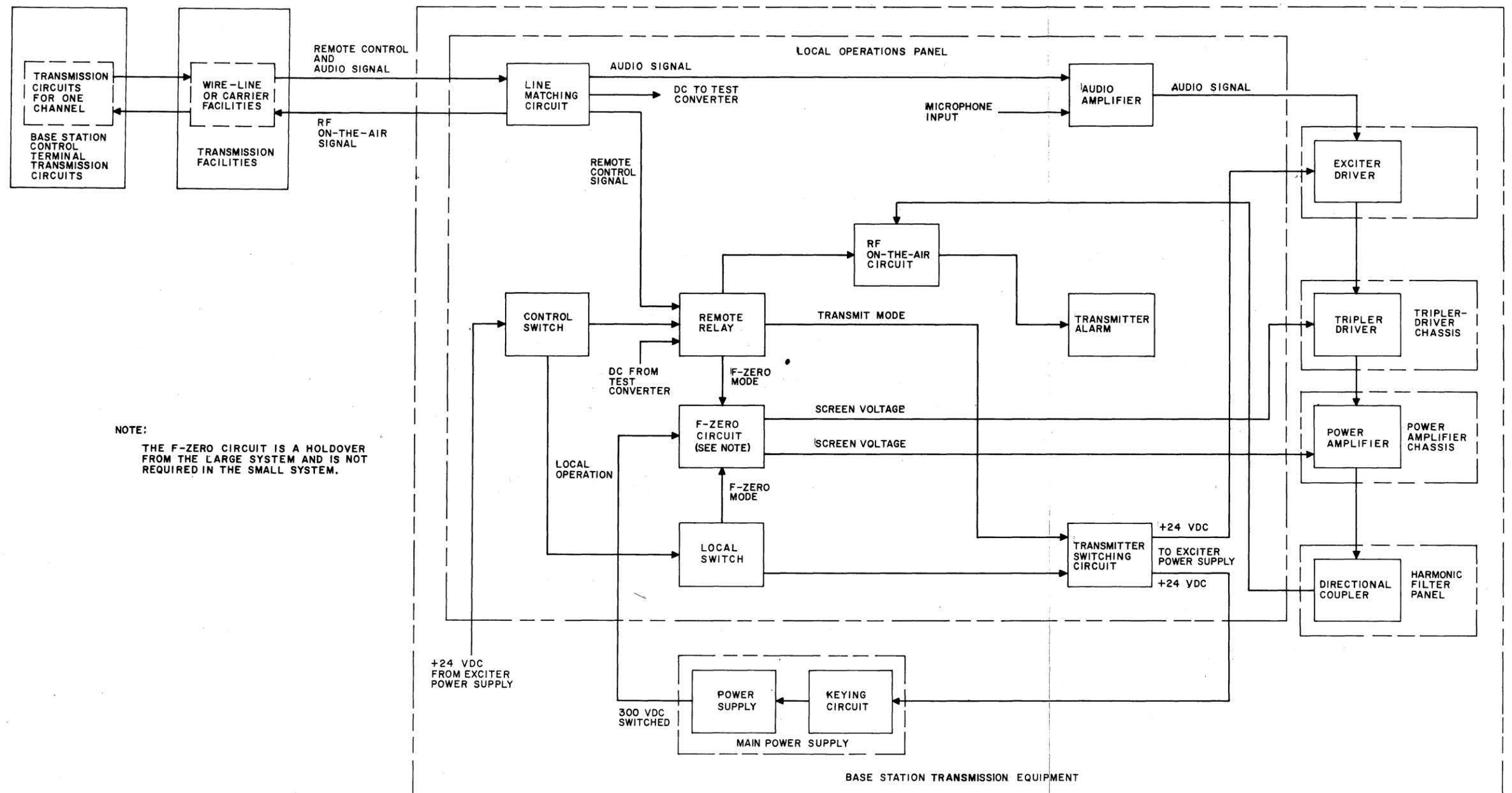


Fig. 33—MK Transmitter Control, Block Diagram

Mobile Station Equipment (MJ)

1.166 When the control unit is set for home or roam operation, the supervisory unit performs the necessary logic and control functions for automatic operation of the mobile station. The supervisory unit controls the radio unit, which cycles through a predetermined set of channels. The channels to be scanned are established in home operation by strapping contained in the control unit, and in roam operation by the subscriber, who sets the channel selector pushbuttons on the control unit. Upon command from the supervisory unit, the channels selected are scanned at the rate of four channels per second until the supervisory unit detects the idle channel tone. The supervisory unit then sends a stop-search signal to the radio unit, causing the radio unit to lock on the marked-idle channel. A 120-ms recognition delay is incorporated in the supervisory unit to avoid false detection of idle tone. Brief fades of the idle tone will not cause the channel to be abandoned. Search will be initiated if idle tone is absent for more than a nominal 175 ms.

Mobile-to-Land Sequence (Home Operation)

1.167 Before a mobile subscriber can initiate a call, the mobile equipment must be homed-in on the marked-idle channel when the subscriber lifts his handset. Upon going off-hook, the supervisory unit initiates the connect sequence, causing the mobile transmitter to be turned on (Fig. 34). There are two phases of the connect sequence: first, a 350-ms connect delay; and second, the transmittal of connect tone for 50 ms. The tone oscillators in the supervisory unit send a guard tone (F_g) of 2150 Hz during the connect delay and connect tone (F_c) of 1633 Hz during the connect interval.

1.168 Upon receipt of the connect tone, the base station control terminal removes the idle tone, previously defined, from the channel and replaces it 300 ms later with a seize tone of 1800 Hz. Idle tone is placed on the next available channel. Detection of idle tone dropout causes all on-hook mobiles to be blocked from originating calls and initiates channel hunting for the new marked-idle channel. The mobile attempting to connect must detect the dropout of idle tone during its connect interval (50 ms) for a valid seizure. If idle tone dropout is detected too soon (during the connect delay interval), the call attempt is blocked

and the sequence shorted, after which the busy lamp on the control unit is energized. Thus, two mobiles can make a valid seizure only if there is an overlap of their connect intervals. Should idle tone still be present after the connect interval, the call attempt is again blocked.

1.169 Detection of seize tone by the calling mobile primes the supervisory unit for ANI. The removal of seize tone causes the supervisory unit to outpulse the mobile ANI code with 25-ms pulses of connect tone at 20 pps. To enable ANI error detection, the supervisory unit transmits odd-even parity information along with the ANI code. The odd-even parity information in the form of guard tone is transmitted after every cumulatively totaled even ANI pulse. Guard tone is not transmitted after every cumulatively totaled odd pulse. The base station control terminal verifies the first three digits as the home NPA code and translates the last four digits to the mobile subscriber line location. After the selected line is connected to the seized channel, dial tone is returned from the central office and passed to the mobile control unit handset over the established radio channel. Upon receipt of dial tone, the mobile subscriber can dial the call. Dial pulsing consists of a dial-off-normal tone interrupted by pulses of connect tone. The base station control terminal converts each pulse into the conventional dc dial pulsing for the central office. On completion of the call and return of the mobile hookswitch to on-hook, the tone oscillators in the supervisory unit transmit a 3/4-second signal composed of alternate 25-ms pulses of disconnect tone (F_d) of 1336 Hz and guard tone at 20 pps to furnish disconnect supervision to the control terminal. At the end of the disconnect burst, the supervisory unit turns off the transmitter and initiates search for the idle channel.

Mobile-to-Land Sequence (Roam Operation)

1.170 The mobile-to-land sequence for a roaming mobile is identical to that for a mobile operating in the home mode of operation to the point of receipt of ANI by the local base station control terminal. When the identification of a mobile originating a call is not possible, equipment options make it possible for the call to be handled in a number of different ways. (See 1.50.)

Land-to-Mobile Sequence (Home Operation)

1.171 On a call to a mobile station, the base station control terminal seizes the marked-idle channel by shifting from idle tone (F_i) to seize tone (F_s). The dropout of idle tone and detection of seize tone by the idle/seize tone detector holds all mobiles on the channel and blocks them from originating a call in preparation for receiving outward signaling. The signaling consists of mark-space keying between idle and seize tone at the rate of 10 pps. As each mobile detects a digit mismatch, it abandons the channel and initiates search for the marked-idle channel. On completion of selective signaling, all mobiles except the desired one will have abandoned the seized channel to seek the new marked-idle channel.

1.172 Upon correct selector match after the last digit, the supervisory unit in the called mobile causes the transmitter to be energized and a 3/4-second acknowledgment signal to be transmitted. The acknowledgment signal consists of guard tone. If the base station control terminal does not receive this signal within 3 seconds after signaling, seize tone is removed and the call abandoned. If coding acknowledgment is received, the base station control terminal sends repetitive ringing at the standard cycle of 2 seconds on and 4 seconds off. If the mobile station does not answer in approximately 120 seconds, the base station control terminal abandons the call.

1.173 The mobile, upon going off-hook, causes the supervisory unit to energize the transmitter and send a 400-ms burst of answer signal. The answer signal consists of connect tone. Upon receipt of the answer signal, the control terminal stops the ringing and establishes a talking path between the calling party and the mobile via the radio channel. Disconnect supervision is provided upon return of the mobile to on-hook, which is indicated by a 3/4-second burst of disconnect tone alternating with guard tone at 20 pps.

Land-to-Mobile Sequence (Roam Operation)

1.174 To signal a roaming mobile, the mobile operator dials or keys the mobile station 4-digit code number prefixed by its 3-digit NPA code. Upon acknowledgment, all supervision is the same as for a home mobile station.

Mobile Station Equipment (MK)

1.175 When the mobile station control unit is set for home or roam operation, the supervisory unit performs the necessary functions for automatic operation of the mobile station. The supervisory unit controls the radio unit that cycles through a programmed set of channels. The channels to be scanned are programmed in home and roam modes of operation by straps on the channel strapping board contained in the radio unit when using the KS-20283 control unit. When using the KS-21466, L4 control unit, the home channels are strapped in the radio unit but the roam channels are programmed by the customer. Upon command from the supervisory unit, the programmed complement of channels is scanned at the rate of four channels per second until the supervisory unit detects the idle channel tone. The supervisory unit then sends a stop-search signal to the radio unit, causing the radio unit to lock on the marked-idle channel. A 120-ms recognition delay is incorporated in the supervisory unit to avoid false detection of idle tone. Brief fades of the idle tone will not cause the channel to be abandoned. Search will be initiated if idle tone is absent for more than a nominal 175 ms.

Mobile-to-Land Sequence (Home Operation)

1.176 Before a mobile subscriber can initiate a call, the mobile equipment must be homed in on the marked-idle channel when the subscriber lifts his handset. Upon going off-hook, the supervisory unit initiates the connect sequence, causing the mobile transmitter to be energized (Fig. 35). There are two phases of the connect sequence: a 350-ms connect delay and the transmittal of connect tone for 50 ms. The tone oscillators in the supervisory unit send a guard tone (F_g) of 2150 Hz during the connect delay and connect tone (F_c) of 1633 Hz during the connect interval.

1.177 Upon receipt of the connect tone, the base station control terminal removes the idle tone, previously defined, from the channel and replaces it 300 ms later with a seize tone of 1800 Hz. Idle tone is placed on the next available channel. Detection of idle tone dropout causes all on-hook mobiles to be blocked from originating calls and initiates channel hunting for the new marked-idle channel. The mobile attempting to connect must detect the dropout of idle tone during its connect interval (50 ms) for a valid seizure. If

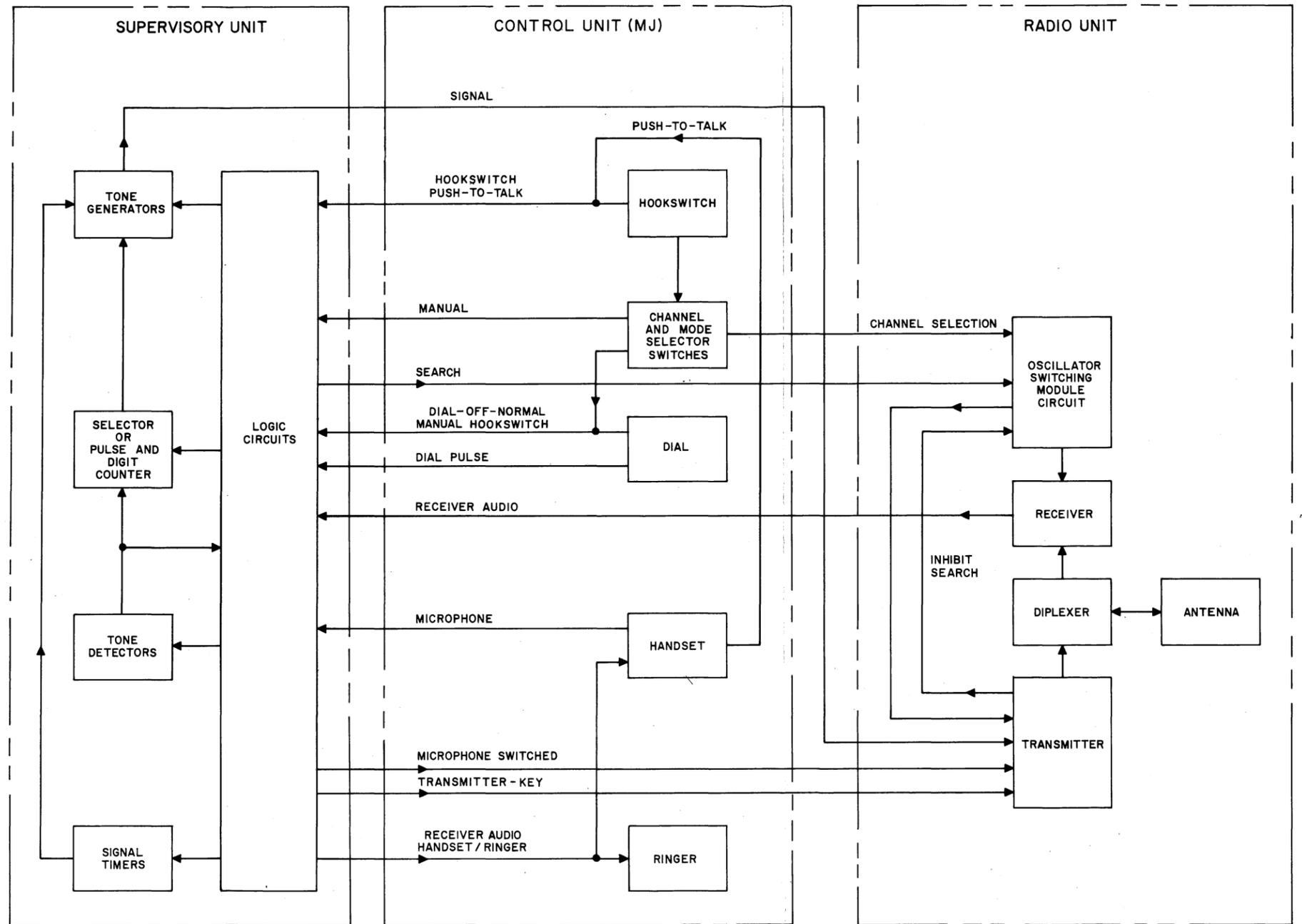


Fig. 34—MJ Mobile Station Equipment, Block Diagram

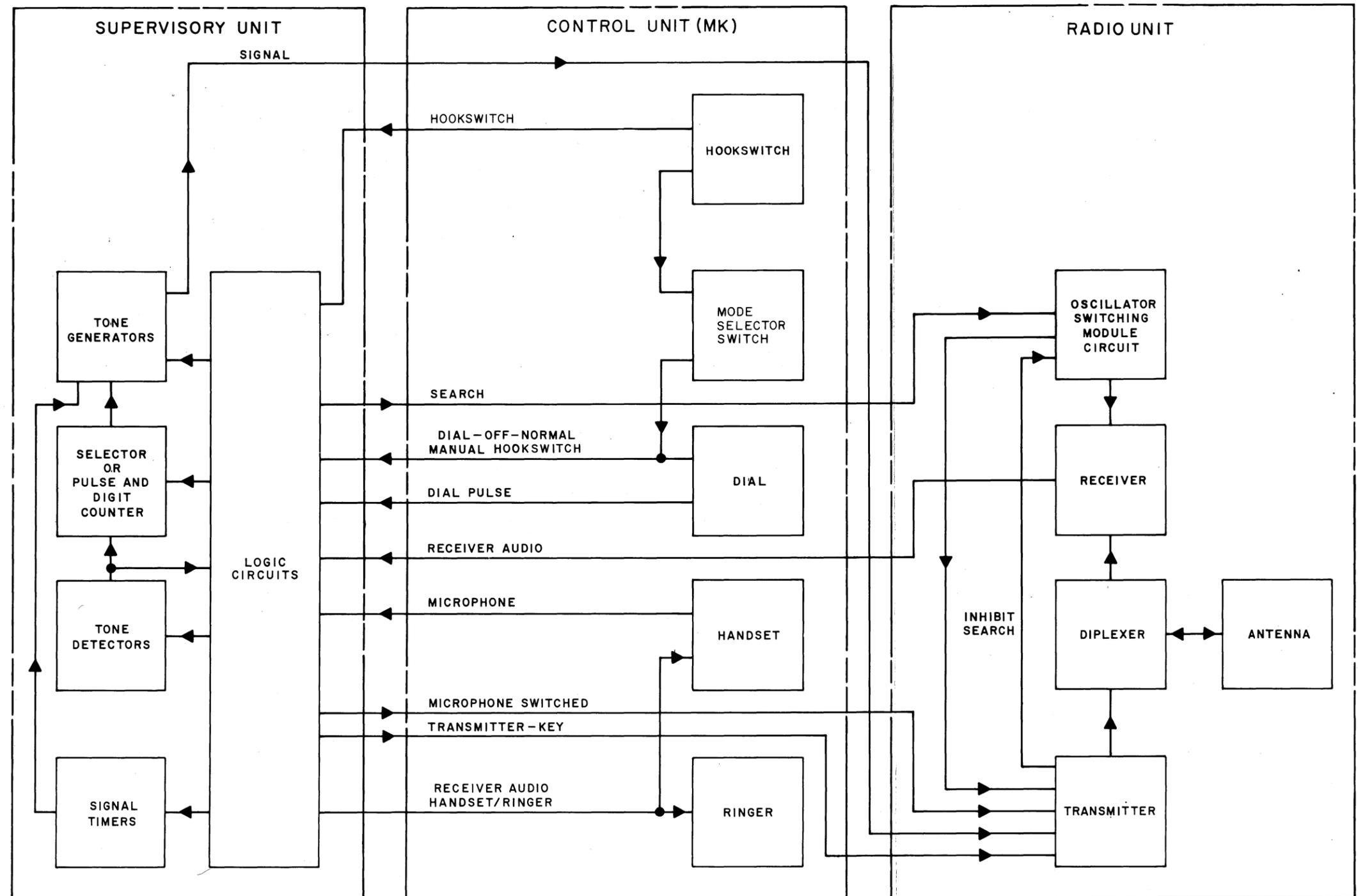


Fig. 35—MK Mobile Station Equipment, Block Diagram

idle tone dropout is detected too soon (during the connect delay interval), the call attempt is blocked, the sequence is shorted, and the transmit lamp (T) on the control unit does not light. Thus, two mobiles can make a valid seizure only if there is an overlap of their connect intervals. Should idle tone still be present after the connect interval, the call attempt is again blocked.

1.178 Detection of seize tone by the calling mobile primes the supervisory unit for ANI. The removal of seize tone causes the supervisory unit to output the mobile ANI code with 25-ms pulses of connect tone at 20 pps. To enable ANI error detection, the supervisory unit transmits odd-even parity information along with the ANI code. The odd-even parity information in the form of guard tone is transmitted after every cumulatively totaled even ANI pulse. Guard tone is not transmitted after every cumulatively totaled odd pulse. The base station control terminal verifies the first three digits as the home NPA code and translates the last four digits to the mobile subscriber line location. After the selected line is connected to the seized channel, dial tone is returned from the central office and passed to the mobile control unit handset over the established radio channel. Upon receipt of dial tone, the mobile subscriber can dial the call. Dial pulsing consists of a dial-off-normal tone interrupted by pulses of connect tone. The base station control terminal converts each pulse into the conventional dc dial pulsing for the central office. On completion of the call and return of the mobile hookswitch to on-hook, the tone oscillators in the supervisory unit transmit a 3/4-second signal composed of alternate 25-ms pulses of disconnect tone (F_d) of 1336 Hz and guard tone at 20 pps to furnish disconnect supervision to the control terminal. At the end of the disconnect burst, the supervisory unit turns off the transmitter and initiates search for the idle channel.

Mobile-to-Land Sequence (Roam Operation)

1.179 The mobile-to-land sequence for a roaming mobile is identical to that for a mobile operating in the home mode, to the point of receipt of ANI by the local base station control terminal. When the identification of a mobile originating a call is not possible, equipment options make it possible for the call to be handled in a number of different ways. (See 1.50.)

Land-to-Mobile Sequence (Home Operation)

1.180 On a call to mobile station, the base station control terminal seizes the marked-idle channel by shifting from idle tone (F_i) to seize tone (F_s). The dropout of idle tone and detection of seize tone by the idle/seize tone detector holds all mobiles on the channel and blocks them from originating a call in preparation for receiving outward signaling. The signaling consists of mark space keying between idle and seize tone at the rate of 10 pps. As each mobile detects a digit mismatch, it abandons the channel and initiates search for the marked-idle channel. On completion of selective signaling, all mobiles except the desired one will have abandoned the seized channel to seek the new marked-idle channel.

1.181 Upon correct selector match after the last digit, the supervisory unit in the called mobile causes the transmitter to be energized and a 3/4-second acknowledgment signal (guard tone) to be transmitted. If the base station control terminal does not receive this signal within 3 seconds after signaling, seize tone is removed and the call abandoned. If coding acknowledgment is received, the base station control terminal sends repetitive ringing at the standard cycle of 2 seconds on and 4 seconds off. If the mobile station does not answer within approximately 120 seconds, the base station control terminal abandons the call.

1.182 The mobile, upon going off-hook, causes the supervisory unit to energize the transmitter and send a 400-ms burst of answer signal. The answer signal consists of connect tone. Upon receipt of the answer signal, the control terminal stops the ringing and establishes a talking path between the calling party and the mobile via the radio channel. Disconnect supervision, which is indicated by a 3/4-second burst of disconnect tone alternating with guard tone at 20 pps, is provided upon return of the mobile to on-hook.

Land-to-Mobile Sequence (Roam Operation)

1.183 To signal a roaming mobile, the mobile operator dials or keys the mobile station 4-digit code number prefixed by its 3-digit NPA code. Upon acknowledgment, all supervision is the same as for a home mobile station.

D. System Test Features (MJ and MK)

1.184 Test features for the small MJ and MK systems are provided by the test panel and the transmission signaling and test access (TSTA) circuit (Fig. 36).

Monitoring Normal Operation

1.185 With the test panel energized, both the quality of transmission and the state of the switching circuits can be monitored. Lamps indicate the type of call in progress, the state of the register-sender, etc. A monitoring amplifier and handset, supplied as part of the test panel, can be bridged across the loop for transmission checking.

Technical Operator Position

1.186 Operation of the OPR key transfers the functions of the switchboard to the test panel circuit. This permits all the functions of the mobile service operator to be performed at the technical operator position. A handset, hook-switch, dial, and control keys are provided for this purpose.

TSTA Jack Field

1.187 Jacks are provided at appropriate points in the TSTA circuits for checking or bypassing circuits as necessary. In addition, access to the register-sender circuit is provided for pulse checking and pulse insertion. Connection to the milliwatt

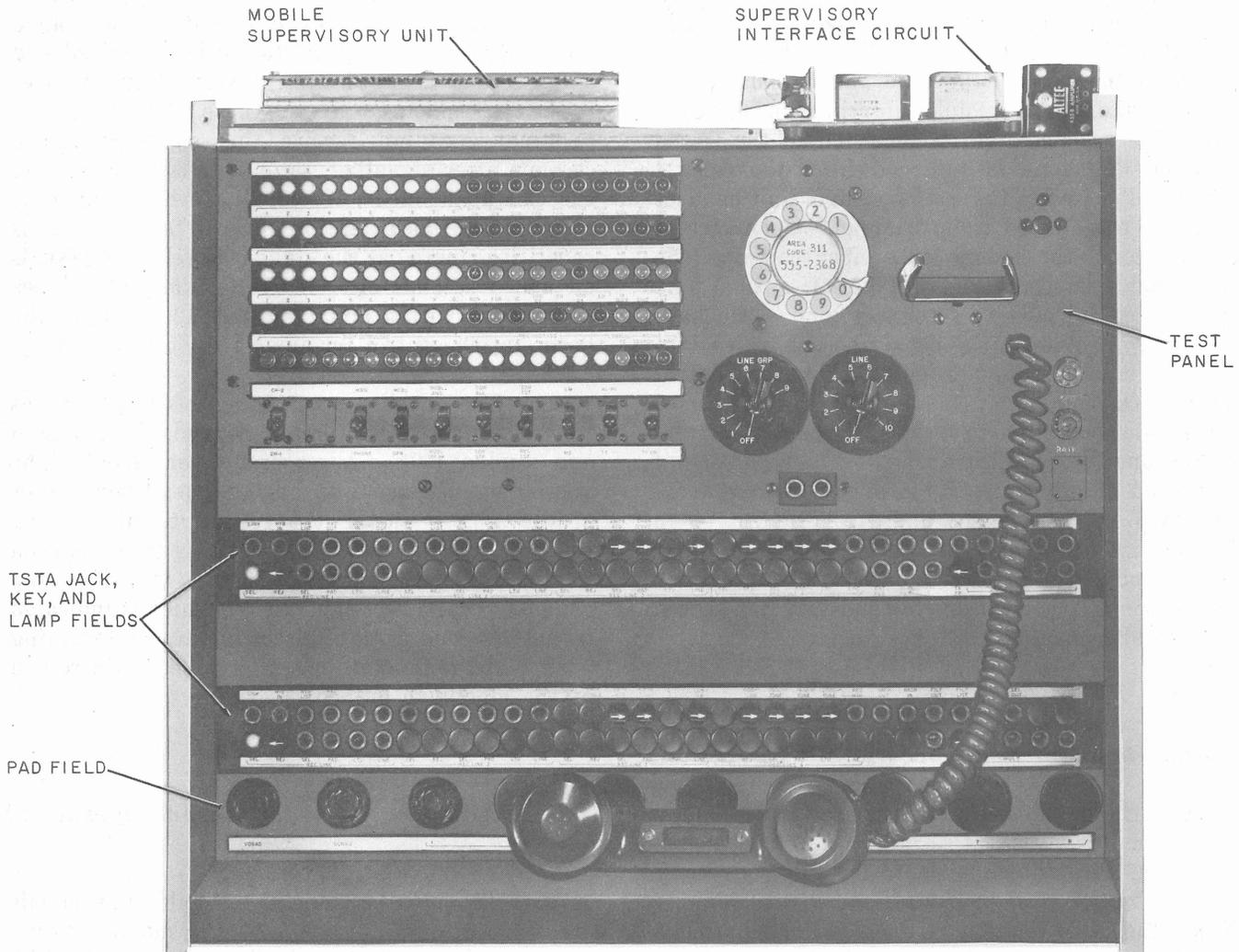


Fig. 36—Test Facilities (Typical 2-Channel)

reference generator and to the supervisory interface circuit (1.192) can be done here. (See 1.193).

Common Control Circuit Tests

Translator Program Verification Test

1.188 The translator test (TT) key, when operated, provides an indicator lamp display to check that a mobile number assignment has been programmed correctly into the translator.

Sender Test

1.189 With switches set to select a specific mobile line, operation of the SDR TST key seizes the sender and the number of the selected line is outpulsed. Proper operation of the sender can be checked by observing indicator lamps.

Register-Translator Test

1.190 Operation of the REG TST key seizes the register. The dial on the test panel can be used to dial seven digits for simulation of ANI pulsing and mobile dialing. A comparison between the numbers dialed and a lamp display permits the operation of the register and the translator to be checked.

Land-to-Mobile Test

1.191 This test checks the ability of the link circuit to process a land-to-mobile call.

System Tests

1.192 The test panel is provided with a supervisory interface circuit that can simulate the functions of the base station radio transmitter and receiver and of the mobile transmitter-receiver. When it is patched into the LTU and TLTU jacks of the TSTA circuit and when a mobile supervisory circuit is plugged into it, all possible types of calls can be simulated (mobile-to-land, land-to-mobile, switchboard-to-roamer, manual roamer-to-switchboard, etc). The test panel handset and dial can be associated with either a local test line or the mobile supervisory unit. The operations of transmit, busy, ring, and search can be checked for the mobile supervisory unit via indicator lamps.

Radio Tests

1.193 As in the large MJ or MK system, keys in the TSTA jack and key field permit testing of the base receivers via either a test converter or a test transmitter. Also, the channel can be taken out of service by means of a CHAN O/SVC key. Lamp displays indicate transmitter failures, receiver failures, and tone failures if they occur. Receivers may also be rejected, as required, for testing in multiple-receivers-per-channel installations.

Mobile Simulator (MK Only)

1.194 The major components of the MK mobile simulator are shown in Fig. 37. The simulator operates on assigned MK mobile frequencies either to test base receiver and base transmitter operation or to simulate a customer's mobile unit as an aid in analyzing mobile trouble complaints. As indicated in Fig. 38, the transmitter is connected directly to an antenna when the coaxial switches are in position 2. In this position, power output to the antenna is approximately 16 watts. When the coaxial switches are in position 1, a fixed (10-dB) attenuator and a variable (6- through 120-dB) attenuator are inserted in the line, allowing the power output of the transmitter to the antenna to be varied. Calls to any desired mobile or land telephone number can be simulated by using the control panel. Therefore, all signaling and logic functions of the system can be tested. A standard MJ control head is mounted on the control panel.

Mobile Station Supervisory Unit Test Set (MJ and MK)

1.195 Three supervisory unit test sets are available. They are self-contained portable instruments designed to permit off-the-air functional testing of the supervisory unit. The Motorola model T1257A test set measures 11 inches high, 6-1/2 inches deep, and 11 inches wide and is used to test supervisory unit KS-19609, L2. The Motorola model S1336A test set, which is the same size, is required to test the supervisory unit of radio unit KS-21466, L2 and is also used to test supervisory unit KS-19609, L2. The General Electric model 4EX5A10 test set measures 9 inches high, 6 inches deep, and 13-1/4 inches wide and is used to test supervisory unit KS-19852, L2. Optional cables and connectors are available with the 4EX5A10 test set for use with supervisory unit KS-19609, L2. Each test set supplies power to the supervisory unit and generates

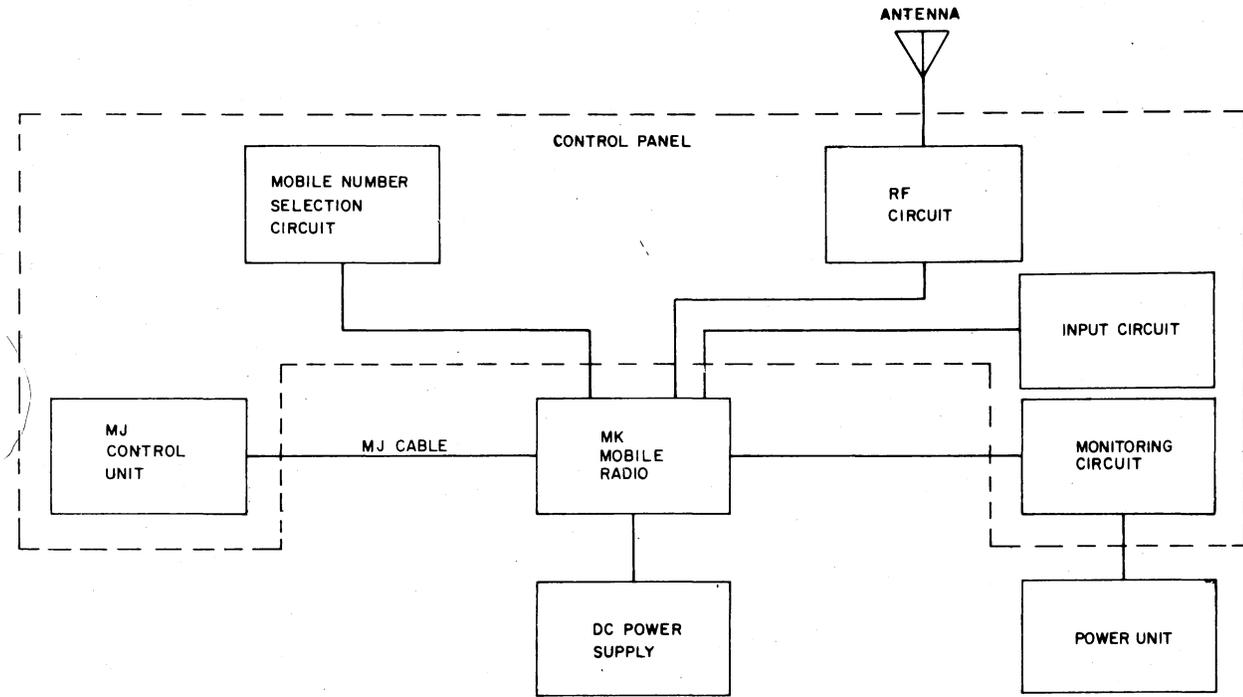


Fig. 37—MK Mobile Simulator, Block Diagram

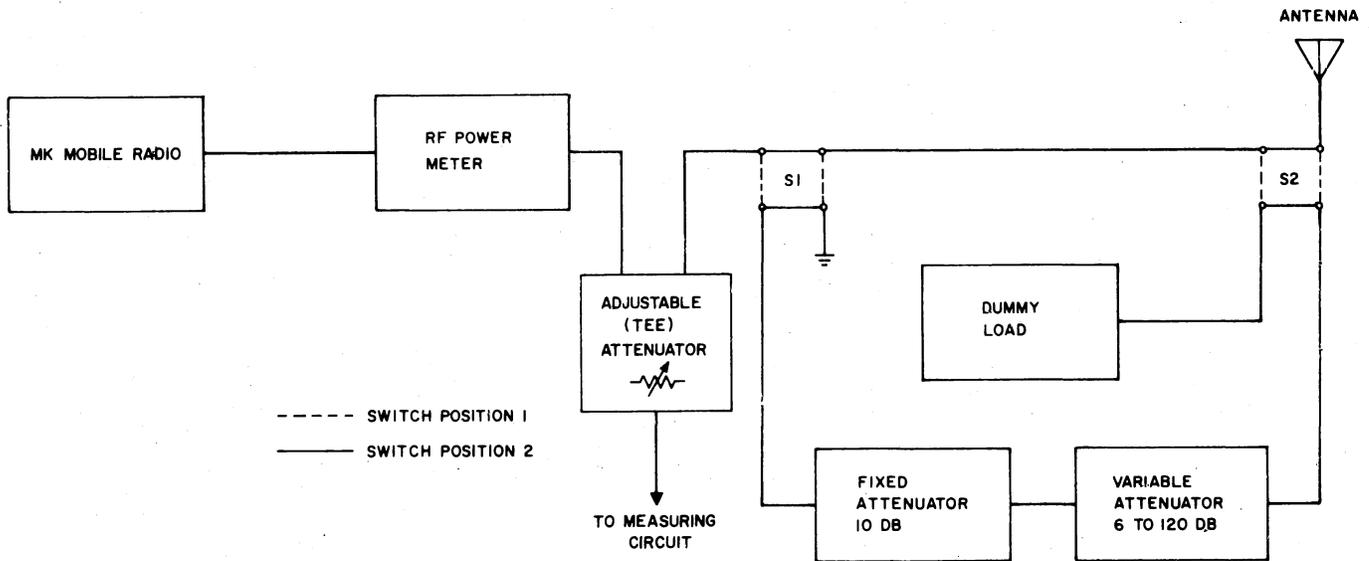


Fig. 38—MK Mobile Simulator RF Circuit, Block Diagram

the base station signaling sequences needed to simulate both an incoming and an outgoing call. Visual indicators on the T1257A test set show the state of the logic outputs of the supervisory unit and provide a visual readout of the ANI code outputted from the supervisory unit. A speaker furnishes audible monitoring of signals used for testing. The S1336A test set supplies signaling tones that radio unit KS-21466, L2 normally supplies to its supervisory unit. Available with this test set as an option is an 11-channel, crystal-controlled signal generator so that tests may be easily made using the rf path to the receiver without need of an external signal generator. Crystals must be ordered separately for each channel required.

Mobile Station Radio Unit Test Set (MJ)

1.196 The Motorola model S1056A portable test set, together with adapter TEN6055A, furnishes the metering necessary to align and check MJ radio unit KS-19609. It also provides intermediate frequencies for alignment of receiver IF stages. Crystals must be ordered separately. Crystal frequencies used are 5.26 MHz for the first IF stage and 455 kHz for the second IF stage. The test set measures 12-1/2 inches high, 6-1/2 inches deep, and 12 inches wide and weighs 11 pounds. An internal 6-volt dc source, consisting of four 1-1/2 volt D batteries, supplies operating voltage for the test set. The test set makes possible the metering of circuits in transmitters and receivers, and it contains a direct indicating multiscale meter, transistorized ac voltmeter, transistorized oscillator, and a zero-center scale meter. Test set model S1057A can be used in place of model S1056A to check radio unit KS-19609. It is the same as test set model S1056A except that it contains a peaking generator that is a crystal-controlled signal source. The generator is used for tuning the rf stages in the receivers.

1.197 The General Electric model 4EX3A10 portable test set is used for aligning and troubleshooting MJ radio unit KS-19852. A test cable connects the test set to the transmitter or receiver being serviced to furnish centralized metering of various circuits. The transmitter can be keyed with a switch on the test set. Dimensions of the test set are 3-1/2 inches high, 5 inches deep, and 13 inches wide. It includes a 3-1/2 inch panel meter, a 20,000 ohm-per-volt voltmeter, jacks for connecting an audio oscillator for modulating the transmitter,

and jacks for measuring the audio output from the receiver.

Mobile Station Radio Unit Test Set (MK)

1.198 The Motorola model S1056A portable test set, together with adapter TEN6055A, furnishes the metering necessary to align and check MK radio unit KS-20282, L1. It also provides intermediate frequencies for alignment of receiver IF stages. Crystals must be ordered separately. Crystal frequencies used are 5.26 MHz for the first IF stage and 455 kHz for the second IF stage. The test set measures 12-1/2 inches high, 6-1/2 inches deep, and 12 inches wide and weighs 11 pounds. An internal 6-volt dc source consisting of four 1-1/2 volt D batteries supplies operating voltage for the test set. The test set makes possible the metering of circuits in transmitters and receivers, and it contains a direct indicating multiscale meter, transistorized ac voltmeter, transistorized oscillator, and a zero center scale. Test set model S1057A can be used in place of model S1056A to check radio unit KS-20282, L1. It is the same as test set model S1056A except that it contains a peaking generator that is a crystal-controlled signal source. The generator is used for tuning the rf stages in the receivers.

E. Power Requirements

1.199 Power requirements for the MJ and MK base station radio equipment are listed in Tables C and D, respectively. Power requirements for the MJ and MK mobile station equipment are listed in the installation requirements for each type of mobile station. Power requirements for the base station control terminal equipment are contained in SD-2R023-02.

1.200 Control terminal equipment for the small MJ and MK mobile radio telephone systems is listed numerically by J numbers.

2. SUPPLEMENTARY INFORMATION

2.01 Supplementary information for the small MJ and MK mobile radio telephone systems is contained in the following Bell System Practices:

405-000-000—Numerical Index—MJ, MK, and ML
Mobile Radio Telephone
806-000-000—Numerical Index—Radio Systems and
Television Systems

TABLE C

**POWER REQUIREMENTS FOR THE MJ BASE
STATION RADIO EQUIPMENT**

BASE STATION RADIO EQUIPMENT	MAXIMUM DC POWER REQUIREMENTS (48 Vdc)	MAXIMUM AC POWER REQUIREMENTS (117 Vac)
250-Watt Transmitter Unit KS-19618, L1 or L21	None	10 A
50-Watt Transmitter Unit KS-19618, L2, L3, L22, or L23	None	3 A
Test Transmitter Unit KS-19618, L16	None	3A
Receiver Package KS-19618, L121 thru L128 or L131 thru L138	None	0.25 A for each receiver
50-Watt Transmitter-Receiver Unit KS-19618, L8, L9, L24, or L25	None	3.25 A

TABLE D

**POWER REQUIREMENTS FOR THE MK BASE
STATION RADIO EQUIPMENT**

BASE STATION RADIO EQUIPMENT	MAXIMUM DC POWER REQUIREMENTS (48 Vdc)	MAXIMUM AC POWER REQUIREMENTS (117 Vac)
5- to 120-Watt Transmitter Unit KS-20285, L1	None	7.8 A
5- to 100-Watt Transmitter-Receiver Unit KS-20285, L2	None	7.8 A
5- to 100-Watt Transmitter-Receiver Unit KS-20285, L3	None	7.8 A
Receiver Package KS-20285, L51 thru L58	None	0.25 A for each receiver

800-600-000—Checking List—General Equipment Requirements
 406-220-100—KS-21131 Air-Ground Telephone Control Terminal—General Description
 806-158-180—MJ and MK Mobile Radio Telephone Systems—Performance Requirements—Small System Control Terminal
 J41646—806-158-151—Remote Signaling Circuit—MJ Mobile Radio Telephone Systems
 Floor Plan Data—Section 1, Sheet 103
 Current Drain Data—SD-2R023-02

3. DRAWINGS

WE J drawings should be ordered by referring to the prefix and base number and requesting the current (—) number.

Small MJ and MK Mobile Radio Telephone Control Terminal

Keysheet

SD-2R023-01—Small MJ and MK Mobile Radio Telephone System

Circuits

SD-2R000-01—Transmission Signaling and Test Access Circuit
 SD-2R017-02—Stile Circuit
 SD-2R049-01—Line Circuit
 SD-2R050-01—Translator Circuit
 SD-2R051-01—Register-Sender Circuit
 SD-2R052-01—Link Access Circuit
 SD-2R053-01—Base Station Identifier Circuit
 SD-2R054-01—Link Circuit
 SD-2R055-01—Test Panel Circuit
 SD-2R109-01—Air-Ground Telephone Control Terminal
 KS-21131—Interconnection Information
 SD-2R112-01—ESS Tone and All Channels Busy Interface Circuit
 ED-2R102-01—MK Mobile Simulator Circuit

Equipment

ED-2R024-01—MK Mobile Simulator Equipment
 ED-2R027-01—ESS Tone and All Channels Busy Interface Circuit
 J41645A-()—Channel 1 Bay (KS-19663, L1)
 J41645B-()—Channel 2 Bay (KS-19663, L2)
 J41645C-()—Air Ground Bay (KS-19663, L6)
 J99236G-()—Auxiliary Line Circuit—Relay Rack-Mounted Equipment

KS-19457—Circuit Units—Mobile Radio Telephone Control Terminal

MJ Base Station and Mobile Radio Equipment

Keysheet

SD-2R023-01—MJ and MK Mobile Radio Telephone System

Circuits

SD-2R018-01—KS-19609 Mobile Radio Circuit
 SD-2R020-01—KS-19626 Control Unit Circuit
 SD-2R022-01—Mobile Interconnection Cable Circuit
 SD-2R024-01—Base Station 250-Watt Transmitter—Application Schematic
 SD-2R025-01—Base Station Test Transmitter—Application Schematic
 SD-2R026-01—Base Station Receiver—Application Schematic
 SD-2R027-01—Base Station 50-Watt Transmitter-Receiver—Application Schematic
 SD-2R028-01—KS-19609 Supervisory Unit Circuit
 SD-2R029-01—Exciter-Driver Circuit (250W) (50W)
 SD-2R030-01—Exciter Power Supply Circuit (250W) (50W) (Test Transmitter)
 SD-2R031-01—Lead Filter Circuit (250W) (50W) (Test Transmitter)
 SD-2R032-01—Harmonic Filter Circuit (250W)
 SD-2R033-01—RF Power Amplifier Circuit (250W)
 SD-2R034-01—Local Operations Panel Circuit (250W) (Test Transmitter)
 SD-2R035-01—F-Zero Panel Circuit (50W) (Test Transmitter)
 SD-2R036-01—High-Voltage Power Supply Circuit (250W)
 SD-2R037-01—Test Converter Circuit (50W Transmitter-Receiver)
 SD-2R038-01—Receiver Circuit (Receiver)
 SD-2R039-01—Receiver Power Supply Circuit (Receiver)
 SD-2R040-01—Receiver Line Terminating Unit Circuit (Receiver)
 SD-2R041-01—Multiple Oscillator Selector Circuit (Test Transmitter)
 SD-2R042-01—Test Transmitter Line Terminating Unit Circuit (Test Transmitter)
 SD-2R044-01—RF Power Amplifier Circuit (50W) (Test Transmitter)
 SD-2R045-01—High-Voltage Power Supply Circuit (50W) (Test Transmitter)
 SD-2R046-01—Local Operations Panel Circuit (50W)
 SD-2R047-01—Harmonic Filter Circuit (50W) (Test

Transmitter)

SD-2R048-01—Exciter-Driver Circuit (Test Transmitter)

SD-2R056-01—Screen Regulator Circuit (50W) (50W Transmitter-Receiver)

SD-2R057-01—KS-19852 Mobile Radio Circuit

SD-2R058-01—F-Zero and Screen Regulator Panel Circuit (250W)

SD-2R059-01—Remote Signaling Circuit

SD-2R060-01—Test Transmitter Control Circuit

SD-2R061-01—High-Stability Oscillator Circuit (50W) (250W)

SD-2R062-01—KS-19852 Supervisory Unit Circuit

SD-2R064-01—Directional Coupler Circuit (50W) (Test Transmitter)

SD-2R065-01—Directional Coupler Circuit (250W)

Equipment

KS-19609—MJ Mobile Radio—Equipment

KS-19618—MJ-Base Radio—Equipment

KS-19626—MJ Control Unit

KS-19852—MJ Mobile Radio—Equipment

KS-21466—MJ Mobile Radio—Station Equipment

MK Base Station and Mobile Station Radio Equipment

Keysheet

SD-2R023-01—MJ and MK Mobile Radio Telephone System

Circuits

SD-2R078-01—Control Unit Circuit

SD-2R079-01—Mobile Interconnection Cable Circuit

SD-2R080-01—Mobile Radio Circuit

SD-2R081-01—Multiple Receiver Circuit

SD-2R082-01—Transmitter Circuit

SD-2R083-01—5- to 120-Watt Base Station Transmitter

Equipment

KS-19664—Circuit Units—Mobile Radio

KS-21131—Air-Ground Telephone Control Terminal

KS-20282 MK Mobile Radio—Equipment

KS-20283—MK Mobile Radio—Control Unit

KS-20285—Radio MK Base Equipment

KS-21466, L4—MK Mobile Radio—Control Unit

4. EQUIPMENT

4.01 The following information contains a complete list of all equipment contained in the small MJ and MK mobile radio telephone systems. The

equipment is listed according to J or KS number so that an equipment engineer can order any size small MJ or MK mobile radio telephone system. The system is ordered by specifying J numbers to Western Electric Company or KS numbers to the supplier. The double coding of the terminal units is made necessary by Western Electric Company record practices.

4.02 Two sets of drawings are furnished with each basic bay that is ordered. The drawings contain all the wiring information needed to install a fully equipped bay. These drawings should be retained for the purpose of adding new equipment and for troubleshooting.

CONTROL TERMINAL (See Fig. 9)

J41645A—AT&T Co Std—Channel 1 Bay (KS-19663, L1) (See Note A)

List 1—Framework, assembly, wiring, and equipment for one KS-19663, L1 channel 1 bay equipped with all necessary common circuits plus one channel and arranged and wired for 10, 20, or 30 line circuits. One required for each system. (See Note B.) (For two channels and/or lines 31 through 90, the J41645B channel 2 bay is also required.) Specify station call letters for the code wheel associated with the base station identifier circuit. If call letters are not known at time of the order, the code wheel may be ordered later as "Code Wheel (part of KS-19664, L10) Station Call Letters___."

List 2—KS-19664, L6 link access equipment for SD-2R052-01, Fig. 3. One required in addition to list 1 for each additional ten lines (11 through 20 or 21 through 30) equipped. (Maximum two.) (See Note C.)

List 3—KS-19664, L1 line circuit per SD-2R049-01, ten Fig. 1 and option Z or none. One needed in addition to list 1 for each ten lines (1 through 10, 11 through 20, or 21 through 30) equipped. (Minimum one, maximum three.) (See Note C.)

List 4—KS-19664, L3 translator equipment per SD-2R050-01, Fig. 2 or 3 and option Y or X. One needed in addition to list 1 for each group of 30 lines or fewer (31 through 60 or 61 through 90) equipped in the system, not including the first 30.

- (Maximum two.) (See Note C.)
- List 5**—KS-19664, L11 base station identifier equipment per SD-2R053-01, Fig. 2. One needed in addition to list 1 if a second channel is equipped. (Maximum one.) (See Note C.)
- List 6**—KS-19457, L36 transmit line terminating unit (plug-in board) per SD-2R000-01, CPS4, Fig. 8 and option T. One needed in addition to list 1 or for field additions when the system uses a single transmitter for each channel; mounts in KS-19457, L33. (Maximum one.)
- List 7**—KS-19457, L48 circuit A and circuit B transmit line terminating unit (two plug-in boards) per SD-2R000-01, CPS4A and CPS4B, Fig. 9. One needed in addition to list 1 or for field additions when the system uses two transmitters for each channel; mounts in KS-19457, L33. (Maximum one.)
- List 8**—KS-19664, L14 test jack per SD-2R000-01, Fig. 15. One needed in addition to list 1 for each channel when the system uses two transmitters for each channel; mounts on KS-19664, L12. (Maximum two.) (See Note C.)
- List 9**—KS-19457, L38 receive line terminating unit (plug-in board) per SD-2R000-01, CPS5, Fig. 5. One needed in addition to list 1 or for field additions per additional receiver (2 through 8) equipped on channel 1; mounts in KS-19457, L33. (Maximum seven.)
- List 10**—KS-19664, L13 test jack per SD-2R000-01, Fig. 14. One needed in addition to list 1 for each receive line terminating unit (2 through 8) that is equipped on each channel in the system. Equipment for channels 2 through 4 mounted on KS-19664, L12 or L18; equipment for channels 5 through 8 mounted on KS-19664, L15. (Maximum 14.) (See Note C.)
- List 11**—KS-19664, L18 test jack assembly per SD-2R000-01, Fig. 11. One needed in addition to list 1 if channel 2 is equipped in the system. (Maximum one.) (See Note C.)
- List 12**—KS-19457, L46 pad per SD-2R000-01, Fig. 13. One needed in addition to list 1 or for field additions for each additional receive line terminating unit (2 through 8) that is equipped on channel 1; mounted in pad field. (Maximum seven.)
- List 13**—KS-19664, L15 test jack strip. One required in addition to lists 1 and 10 (list 14 and 21 for field addition) if the number of receivers on any one channel exceeds four or if a test transmitter control circuit is equipped. Provides a jack mounting strip for receivers 5 through 8 and for the test transmitter control jacks, keys, and lamps. (Maximum one.)
- List 14**—KS-19664, L17 test transmitter control circuit per SD-2R060-01, Fig. 1, 2, and 3. One needed in addition to list 1 and list 13 when the test transmitter is equipped. (Maximum one.) (See Note C.)
- List 15**—KS-19609, L2 mobile supervisory unit per SD-2R028-01, Fig. 1, 2, 3, and 4. One needed in addition to list 1 or for field additions to simulate a mobile station if a self-contained system test of the terminal is needed. Unit plugs into the test panel circuit tray assembly. (Maximum one.)
- List 16**—KS-19664, L22 line circuit per SD-2R049-01, ten Fig. 1 and option Z or none; and KS-19664, L23 link access per SD-2R052-01, Fig. 3. One needed for each additional ten lines (11 through 20 or 21 through 30) added to an existing system. (Maximum two.) (See Note D.)
- List 17**—KS-19664, L20 test jack assembly per SD-2R000-01, Fig. 11; and KS-19664, L26 base station identifier equipment per SD-2R053-01, Fig. 2. One needed if a second channel is added to an existing system. (Maximum one.) (See Note D.)
- List 18**—KS-19664, L24 translator equipment per SD-2R050-01, Fig. 2 or 3 and option Y or X. One needed for each group of 30 lines or fewer (31 through 60 or 61 through 90) added to an existing system. (Maximum two.) (See Note D.)
- List 19**—KS-19664, L25 test jack circuit per SD-2R000-01, Fig. 14. One needed for each receive line terminating unit (2 through 8) that is added to each channel in an existing system. (Maximum 14.) Equipment for channels 2 through 4 mounted on KS-19664, L12, L18, or L20; equipment for channels 5 through 8 mounted on KS-19664, L15. (See Note D.)
- List 20**—KS-19664, L27 test jack circuit per SD-2R000-01, Fig. 15. One needed when a second transmitter for each channel

is added to an existing system. (Maximum two.) Mounts on KS-19664, L12, L18, or L20. (See Note D.)

List 21—KS-19664, L31 test transmitter control circuit per SD-2R060-01, Fig. 1, 2, and 3. One needed in addition to list 13 when a test transmitter is added to an existing system. (Maximum one.) (See Note D.)

List 22—KS-19663, L3 wiring drawings as needed if there is a need for additional copies of wiring information for bay J41645A.

List 23—MK modification kit per KS-19664, L32 (SD-2R054-01). One needed for channel 1 when bay is for an MK system or for an MJ system blocking manual access. (Maximum one.) (See Note C.)

List 24—MK modification kit per KS-19664, L32 (SD-2R054-01). One needed for channel 1 when bay is for an MK system or for an MJ system blocking manual access. (Maximum one.) (See Note D.)

Notes

A. A minimum system of one channel, ten lines, one transmitter, and one receiver calls for one each of lists 1, 3, and 6. A maximum one-bay system of 1 channel, 30 lines, 2 transmitters, a test transmitter, 8 receivers and a mobile supervisory unit calls for 1 each of lists 1, 7, 8, 13, 14, and 15; 2 of list 2; 3 of list 3; and 7 each of lists 9, 10, and 12. If the latter system expands to two channels, in addition to the equipment on the channel 2 bay, the following must be added to the channel 1 bay: one each of list 17 and 20 and seven of list 19.

B. Furnished with list 1 is one each of the following (except as noted):

(a) Register-sender circuit per SD-2R051-01, Fig. 1 and options Z or Y; X or W; S or R; and V, T, or Q (KS-19664, L4).

(b) Test panel circuit per SD-2R055-01, Fig. 1, 2, 3, and 4 (KS-19664, L9).

(c) Channel shelf per SD-2R000-01, Fig. 1 (KS-19457, L33). The channel shelf does not include a transmit line terminating unit; two types are available and are described in lists 6 and 7. Also, additional receive line terminating

units may be ordered as described in list 9. The component plug-in units of this channel shelf are as follows (one each):

(1) Hybrid per CPS1 (KS-19457, L34)

(2) VOGAD, circuit A, per CPS2A (KS-19457, L35)

(3) VOGAD, circuit B, per CPS2B (KS-19457, L35)

(4) Tone generator per CPS3 (KS-19457, L37)

(5) Receive line terminating unit per CPS5 (KS-19457, L38)

(6) Receiver selector, circuit A, per CPS6A (KS-19457, L39)

(7) Receiver selector, circuit B, per CPS6B (KS-19457, L39)

(8) SONAD per CP59 (KS-19457, L40)

(9) Tone detector, circuit A, per CPS8A (KS-19457, L41)

(10) Tone detector, circuit B, per CPS8B (KS-19457, L41)

(11) Bandpass filter per CPS7 (KS-19457, L42)

(d) Translator circuit per SD-2R050-01, Fig. 1 and option Z (KS-19664, L2)

(e) Base station identifier circuit per SD-2R053-01, Fig. 1, 3, and 4 and option Z (KS-19664, L10)

(f) Link circuit per SD-2R054-01, Fig. 1 and option E and options Z or Y, X or W, V or none, and T or S and J or both G and ZG (KS-19664, L8)

(g) Link access circuit per SD-2R052-01, Fig. 1 and 2, and options Z and X or W (KS-19664, L5)

(h) Test jack assembly per SD-2R000-01, Fig. 11 and 16 and option Q (KS-19664, L12.)

- (i) Pads per SD-2R000-01, Fig. 12 (KS-19457, L46); three supplied.
 - (j) Also included are two sets of wiring drawings (list 22); end covers KS-19663, L5, and all cabling and wiring, fuses, touch-up paint, relay adjusting tools, covers, and miscellaneous hardware.
- C. These circuits are wired in the bay by the supplier; order only in conjunction with list 1.
- D. These circuits are prepared for field installation; order only when adding to existing bays.
- E. When a control terminal is used with No. 1 or No. 2 ESS, it is necessary to provide one circuit per SD-2R112-01 [ED-2R027-() ESS tone and all channels busy interface circuit] mounted in or convenient to the control terminal.

**J41645B—AT&TCo Std—Channel 2 Bay
(KS-19663, L2) (See Note A)**

- List 1**—Framework, assembly, pad field, link access and line circuit cables, and all necessary terminal blocks for one channel 2 bay equipped to accept the second channel and/or the line and link access equipment for lines 31 through 90.
- List 2**—KS-19664, L7 link and link access circuit per SD-2R054-01, Fig. 1 and option E and options Q or W, option V or none, option T or S, option R and J or both G and ZG; and link access equipment per SD-2R052-01, Fig. 1, and two Fig. 4, and options Y and W. One needed in addition to list 1 if channel 2 is equipped. (Maximum one.) (See Note B.) Includes the frame cable and the link circuit cable.
- List 3**—KS-19457, L33 channel shelf per SD-2R000-01, Fig. 1. One required in addition to list 1 if channel 2 is equipped. (Maximum one.) The component plug-in units of this channel shelf are listed in Note B of J41645A. (See Note B of J41645B.)
- List 4**—Reserved.
- List 5**—KS-19664, L6 link access equipment per SD-2R052-01, Fig. 3. One needed in addition to list 1 for each additional ten lines (41 through 50, 51 through 60, 71 through 80, or 81 through 90), plus one required in addition to list 2 for each additional ten lines (11 through 20, 21 through 30, 41 through 50, 51 through 60, 71 through 80, or 81 through 90) if channel 2 is equipped. (Maximum ten.) (See Note B.)
- List 6**—KS-19664, L1 line circuit per SD-2R049-01, ten Fig. 1 and option Z or none. One needed for each ten lines (31 through 40, 41 through 50, 51 through 60, 61 through 70, 71 through 80, or 81 through 90) equipped after the first 30. (Maximum six.) (See Note B.)
- List 7**—KS-19457, L46 pads per SD-2R000-01, Fig. 12 and 13. Three needed in addition to list 1 or for field additions if channel 2 is equipped; and, in addition, one is needed for each receive line terminating unit (2 through 8) that is equipped on channel 2; mounted in pad field. (Maximum ten.) (See list 10 below.)
- List 8**—KS-19457, L36 transmit line terminating unit (plug-in board) per SD-2R000-01, CPS4, Fig. 8 and option T. One required in addition to list 1 and list 3 or for field additions if channel 2 is equipped and uses a single transmitter; mounts in KS-19457, L33.
- List 9**—KS-19457, L48 circuit A and circuit B transmit line terminating unit (two plug-in boards) per SD-2R000-01, CPS4A and CPS4B, Fig. 9. One needed in addition to list 1 and list 3 or for field additions if channel 2 is equipped and uses two transmitters; mounts in KS-19457, L33.
- List 10**—KS-19457, L38 receive line terminating unit (plug-in board) per SD-2R000-01, CPS5, Fig. 5. One needed in addition to list 1 and list 3 or for field additions for each additional receiver (2 through 8) equipped on channel 2; mounts in KS-19457, L33. (Maximum seven.)
- List 11**—KS-19664, L28 link access equipment per SD-2R052-01, Fig. 3. One needed in addition to list 1 for each additional ten lines (31 through 40 or 61 through 70) for each channel. (Maximum four.) (See Note B.) Includes a relay mounting bar.
- List 12**—Reserved.
- List 13**—KS-19664, L22 line circuit per SD-2R049-01, ten Fig. 1 and option Z or none. One needed per ten lines (31 through 40, 41 through 50, 51 through 60, 61 through 70, 71 through 80, or 81 through 90) added to an existing system, after the first 30. (Maximum six.) (See Note C.)

- List 14**—KS-19664, L29 link access equipment per SD-2R052-01, Fig. 3. One needed for each additional ten lines (31 through 40 or 61 through 70) for each channel, added to an existing system. (Maximum four.) (See Note C.) Includes a relay mounting bar.
- List 15**—KS-19664, L23 link access equipment per SD-2R052-01, Fig. 3. One needed for each additional ten lines (41 through 50, 51 through 60, 71 through 80, or 81 through 90), plus one needed for each additional ten lines (11 through 20, 21 through 30, 41 through 50, 51 through 60, 71 through 80, or 81 through 90) if channel 2 is equipped. (Maximum ten.) (See Note C.)
- List 16**—KS-19664, L30 link and link access circuit per SD-2R054-01, Fig. 1 and option E and options Q or W; V or none; options T or S; and R; and per SD-2R052-01 Fig. 1, two Fig. 4, and options Y and W. One needed if channel 2 is to be equipped in an existing system. (Maximum one.) (See Note C.) Includes the frame cable and the link circuit cable.
- List 17**—KS-19457, L68 channel shelf per SD-2R000-01, Fig. 1. One needed if channel 2 is added to an existing system. (Maximum one.) (See Note C.) See J41645A, Note A, for components of channel shelf.
- List 18**—KS-19663, L5 end covers. One needed if channel 2 bay is physically separated from the channel 1 bay.
- List 19**—KS-19663, L4 wiring drawings, as needed for additional copies of wiring information for bay J41645B.
- List 20**—MK modification kit per KS-19664, L32 (SD-2R054-01). One needed for channel 2 when bay is for an MK system or for an MJ system blocking manual access. (Maximum one.) (See Note B.)
- List 21**—MK modification kit per KS-19664, L32 (SD-2R054-01). One needed for channel 2 when bay is for an MK system or for an MJ system blocking manual access. (Maximum one.) (See Note C.)

Notes

- A. The expansion of a single-channel, 20-line, single transmitter and receiver system to a 2-channel, 40-line, single transmitter and

receiver (for each channel) system requires one each of lists 1, 2, 3, and 8; two of lists 5, 6, and 11; and three of list 7 on J41645B. In addition, one each of lists 16, 17, and 18 on J41645A is needed to add for the channel 1 bay. A maximum initial installation consisting of 2 channels, 90 lines, 2 transmitters and 8 receivers for each channel, a test transmitter, and a mobile supervisory unit requires the following:

- (a) On J41645A—one each of lists 1, 5, 7, 11, 13, 14, and 15; 2 of lists 2, 4, and 8; 3 of list 3; 7 of lists 9 and 12; 14 of list 10.
 - (b) One J41645B—one each of lists 1, 2, 3, and 9; four of list 11; six of list 6; seven of list 10; and ten of lists 5 and 7.
- B. These circuits are wired in the bay by the supplier; order only in conjunction with list 1.
- C. These circuits are prepared for field installation; order only when adding to existing bays.

J41645C—AT&T Co Std—Air Ground Bay (KS-19663, L6) (See Note A)

List 1—Framework, assembly, wiring, and equipment for one KS-19663, L6 air-ground bay equipped with all necessary circuits for the signaling channel with channel digit sender and one talking channel. One needed for each system. Specify station call letters for code wheel associated with base station identifier circuit. If call letters are not known at the time of the order, the code wheel may be ordered later as "Code Wheel (Part of KS-19664, L10) Station Call Letters___." Furnished with list 1 is one each of the following (except as noted):

- (a) KS-19664, L4—Register-sender circuit per SD-2R051-01, Fig. 1 and options Z or Y; X or W; S or R; and V, T, or Q.
- (b) KS-19664, L37—Test panel circuit per SD-2R05501, Fig. 1, 2, 3, 4 and option Z.
- (c) KS-19457, L81—Channel shelf per SD-2R000-01, Fig. 1 except as noted (Fig. 18). See Note B.

- (d) KS-19664, L2—Translator circuit per SD-2R050-01, Fig. 1 and option Z.
- (e) KS-19664, L10—Base station identifier circuit per SD-2R053-01, Fig. 1, 3, and 4 option Z.
- (f) KS-19664, L35—Link circuit per SD-2R054-01, Fig. 1 and options F, W, and ZD.
- (g) KS-19664, L5—Link access circuit per SD-2R052-01, Fig. 1 and 2 and options Z and X or W.
- (h) KS-19664, L36—Test jack assembly per SD-2R000-01, Fig. 11, 15, 16, and 19 and option Q.
- (i) KS-19457, L46—Pads per SD-2R000-01, Fig. 12.
- (j) Also included are two sets of wiring drawings KS-19663, L7; end covers KS-19663, L5; and all cabling and wiring, fuses, touch-up paint, relay adjusting tools, covers, and miscellaneous hardware.

List 2—Modification kit per KS-19663, L8 (SD-2R000-01, SD-2R054,01, SD-2R055-01). One needed to modify KS-19663, L1 bay, channel 1 to KS-19663, L6 air-ground bay without channel digit sender. See list 3 and Note C.

List 3—Modification kit per KS-19457, L83 (SD-2R000-01, option ZP Fig. 18). One needed in addition to list 2 to add channel digit sender. See Note C.

Notes

- A. KS-21131 (Section 406-220-100, SD-2R109-01) air-ground control terminal will be required for two or more talking channels and should be considered initially.
- B. The component plug-in units of the channel shelf are as follows (one each except as noted).
 - (a) Hybrid per CPS1 (KS-19457, L34)
 - (b) VOGAD, circuit A per CPS2A (KS-19457, L35)
 - (c) VOGAD, circuit B per CPS2B (KS-19457, L35)

- (d) Tone generator per CPS3 (KS-19457, L37)
- (e) Receive line terminating unit per CPS5 (KS-19457, L38)
- (f) Receiver selector, circuit A per CPS6A (KS-19457, L39)
- (g) Receiver selector, circuit B per CPS6B (KS-19457, L39)
- (h) SONAD per CPS9 (KS-19457, L40)
- (i) Tone detector, circuit A per CPS8A (KS-19457, L41)
- (j) Tone detector, circuit B per CPS8B (KS-19457, L41)
- (k) Bandpass filter per CPS7 (KS-19457, L42)
- (l) Two transmit line terminating units per CPS4, Fig. 18 and option T (KS-19457, L36)
- (m) Channel digit sender per CPS10, option ZP, Fig. 18 (KS-19457, L83).

C. These circuits are prepared for field installation; order only when adding to an existing bay.

KS-19664, L16—AT&TCo Std—Spare Parts Package

Spare Parts

- (a) One each of the following ITT-type complete relays:

CODE	ADJUSTED PER
AA4007 (S10)	SD-2R054-01
AA4019 (S38)	SD-2R052-01
AA4020 (S79)	SD-2R054-01
AA4037 (S46)	SD-2R050-01
AA4138 (S8)	SD-2R052-01
AA217 (T41)	SD-2R054-01
AA4300 (S8)	SD-2R050-01

CODE	ADJUSTED PER
AA5327 (S9)	SD-2R052-01
AE4001 (S50)	SD-2R054-01
AE4009 (S12)	SD-2R054-01
AE4019 (T48)	SD-2R051-01
AE4072 (T11)	SD-2R051-01
AE4078 (S64)	SD-2R049-01
AE4156 (P2)	SD-2R051-01
AE4167 (S34)	SD-2R054-01
AE4251 (T3)	SD-2R051-01
AE4497 (S80)	SD-2R051-01
AE4727 (S6)	SD-2R052-01
AE4805 (S78)	SD-2R051-01
AE6011 (S36)	SD-2R052-01
AE6965 (S35)	SD-2R050-01
AF5015 (S67)	SD-2R050-01
AH4651 (T9)	SD-2R051-01
AH6007 (T21)	SD-2R054-01
AK4022 (S82)	SD-2R051-01

(b) One each of the following ITT-type relay coils: T52, T14, and P6.

(c) One each of the following ITT-type contact pile-ups: 4561, 4083, 4287, and 5654.

(d) One each of the following ITT-type thermal relays: 82222-2, 82222-3, and 82222-8.

(e) One type HG2A-1015 and one type HGP-1012 Clare complete mercury relays.

(f) One type 80329-44 and one type 80329-3 ITT multicontact relays.

(g) One 300- μ F 60V Aerovox AEP capacitor.

(h) One 60- μ F 60V Sprague DEA 3-section capacitor.

(i) One KS-19457, L26 channel shelf equipped with one KS-19457, L36 transmit line terminating unit (for single transmitter). KS-19457, L26 differs from KS-19457, L33 in that shelf wiring is not included.

(j) Two type 1S(X)1-T microswitches, each equipped with a JX-20 actuator.

(k) Two Sylvania 48D lamps, each equipped with a lamp cap.

(l) One type 80975-1 ITT complete duo quintet relay.

(m) Three type 1N4004 diodes.

List 19—Spare parts in list 19 contain the same apparatus as those in list 16 except that the channel shelf is equipped with KS-19457, L48, circuit A and circuit B transmit line terminating unit cards (for two transmitters) rather than KS-19457, L36.

BASE STATION RADIO EQUIPMENT (MJ) (See Notes A, B, C and Table E)

KS-19618—AT&T Co Std—250-Watt Transmitter Unit

List 1—250-watt transmitter. Indoor cabinet; includes list 14 channel element. (See Note A.)

List 4—250-watt base station transmitter. Same as list 1 except with an isolator (improved intermodulation conversion loss).

List 5—250-watt base station transmitter. Same as list 21 except with an isolator (improved intermodulation conversion loss).

List 10—High-stability oscillator. Stability ± 0.0001 percent. For 2-transmitter-per-channel use. Includes all necessary equipment for converting from list 1 to list 21. (See Note A.)

List 14—Single-frequency transmitter channel element. For single-transmitter-per-channel use. (See Note A.)

List 21—250-watt transmitter. Indoor cabinet; includes list 10 oscillator. (See Note A.)

TABLE E

MJ BASE STATION CIRCUIT DRAWINGS

CIRCUIT DRAWING	EQUIPMENT CODE KS-19618 LIST NUMBERS							
	1 & 4	2 & 3	5 & 21	8 & 9	16	22 & 23	24 & 25	121-128 & 131-138
SD-2R024-01 SD-2R025-01 SD-2R026-01 SD-2R027-01	X		X		X		X	X
SD-2R029-01 SD-2R030-01 SD-2R031-01 SD-2R032-01	X	X	X	X	X	X	X	
SD-2R033-01 SD-2R034-01 SD-2R035-01 SD-2R036-01	X	X	X	X	X	X	X	
SD-2R037-01 SD-2R038-01 SD-2R039-01 SD-2R040-01				X			X	X
SD-2R041-01 SD-2R042-01 SD-2R044-01 SD-2R045-01		X		X	X	X	X	
SD-2R046-01 SD-2R047-01 SD-2R048-01 SD-2R056-01		X		X	X	X	X	
SD-2R058-01 SD-2R061-01 SD-2R064-01 SD-2R065-01	X	X	X	X	X	X	X	

List 41—Field conversion kit to convert list 1 to list 4 and list 21 to list 5.

KS-19618—AT&TCo Std—50-Watt Transmitter Unit

List 2—50-watt transmitter. Indoor cabinet; includes list 14 channel element. (See Note A.)

List 3—50-watt transmitter. Same as list 2 except outdoor cabinet. (See Note A.)

List 10—See listing under 250-watt transmitter unit.

List 14—See listing under 250-watt transmitter unit.

List 22—50-watt transmitter. Indoor cabinet; includes list 10 oscillator. (See Note A.)

List 23—50-watt transmitter. Same as list 22 except outdoor cabinet. (See Note A.)

List 40—5- to 50-watt option. Needed in addition to list 2, 3, 22, or 23 when 5- to 50-watt operation is required. (Replaces the screen regulator.)

KS-19618—AT&TCo Std—Test Transmitter Unit

List 14—See listing under 250-watt transmitter unit.

List 16—Test transmitter. Indoor cabinet; variable output from 0.1 microwatt to 50 watts. Order list 14 and/or list 18 channel elements separately. (See Note B.)

List 18—2-frequency transmitter channel element. Test transmitter condition only. (As many as four may be used for a maximum of eight channels.) (See Note B.)

KS-19618—A&TCo Std—50-Watt Transmitter-Receiver Unit

List 8—50-watt transmitter-receiver. Indoor cabinet; includes list 14 channel element for transmitter and list 15 channel element and list 27 crystal filter for receiver. (See Note A.)

List 9—50-watt transmitter-receiver. Same as list 8 except outdoor cabinet. (See Note A.)

List 10—See listing under 250-watt transmitter unit.

List 14—See listing under 250-watt transmitter unit.

List 15—Single-frequency channel element. Receiver use only. When changing frequency in an existing receiver also order list 27 crystal filter for the corresponding frequency. (See Note A.)

List 24—50-watt transmitter-receiver. Indoor cabinet; includes list 10 oscillator for transmitter and list 15 channel element and list 27 crystal filter for receiver. (See Note A.)

List 25—50-watt transmitter-receiver package. Same as list 24 except outdoor cabinet. (See Note A.)

List 27—Receiver crystal filter. For receivers of transmitter-receiver packages only. (See Note A.)

List 40—See listing under 50-watt transmitter unit.

KS-19618—AT&TCo Std—Receiver Package

List 12*—Receiver package. Indoor cabinet; includes list 15 channel element and list 26 crystal filter. (See Note C.)

List 13*—Receiver package. Same as list 12* except outdoor cabinet. (See Note C.)

List 15—Single-frequency receiver channel element. Receiver use only. When changing frequency in an existing receiver also order list 26 crystal filter for the corresponding frequency. (See Note A.)

List 19—Add-to-receiver kit. Needed for expanding a receiver package to an additional receiver. Includes list 28 receiver and power supply and list 29 line terminating unit. When expanding to a fifth receiver order list 20 in place of list 19. (See Note A.)

List 20—Add-to receiver and cabinet expansion kit. Needed for expansion to fifth receiver only. Includes list 19 add-to receiver kit and cabinet expansion kit. Receiver package can accommodate as many as eight receivers after addition of this kit.

List 26—Receiver crystal filter. For receivers of receiver packages only. (See Note A.)

List 28—Receiver and power supply. Part of list 19 add-to receiver kit. Includes list 26 crystal filter and connecting coaxial cable.

List 29—Line terminating unit. Part of list 19 add-to receiver kit.

*Replace asterisk with number (1 through 8) which indicates the number of receivers and associated units required in cabinet.

Notes

A. Specify one of the following channels:

Channel 1 (JL) 157.77 MHz (receive),
152.51 MHz (transmit)

Channel 2 (YL) 157.80 MHz (receive),
152.54 MHz (transmit)

Channel 3 (JP) 157.83 MHz (receive),
152.57 MHz (transmit)

Channel 4 (YP) 157.86 MHz (receive),
152.60 MHz (transmit)

Channel 5 (YJ) 157.89 MHz (receive),
152.63 MHz (transmit)

Channel 6 (YK) 157.92 MHz (receive),
152.66 MHz (transmit)

Channel 7 (JS) 157.95 MHz (receive),
152.69 MHz (transmit)

Channel 8 (YS) 157.98 MHz (receive),
152.72 MHz (transmit)

Channel 9 (YR) 158.01 MHz (receive),
152.75 MHz (transmit)

Channel 10 (JK) 158.04 MHz (receive)
152.78 MHz (transmit)

Channel 11 (JR) 158.07 MHz (receive),
152.81 MHz (transmit).

B. Channel elements for the test transmitter are ordered separately. The test transmitter is capable of being changed for emergency use as a 50-watt transmitter. If an even number of channels is to be tested, half that number of 2-frequency channel elements KS-19618, L18 should be ordered with the base station receiver frequencies specified. If an odd number of

channels is to be tested, a single frequency channel element KS-19618, L14 should be ordered for one of the channels and KS-19618, L18 should be ordered for each remaining pair of channels. In addition, single frequency channel elements KS-19618, L14 may be ordered for emergency use on all base transmit frequencies which the test transmitter may be called upon to replace. For example, if any MJ mobile radio telephone system is equipped for the three channels YS, YR, and JK, the following channel elements may be ordered:

(a) For test transmitter use:

(1) One KS-19618, L18 (channel YS, 152.72 MHz and channel YR, 152.75 MHz)

(2) One KS-19618, L14 (channel JK, 158.04 MHz).

(b) For emergency transmitter use three KS-19618, L14 (channel YS, 152.72 MHz; channel YR, 152.75 MHz; and channel JK, 152.78 MHz).

C. Specify the number of receivers and associated circuits (1 through 8) and list the channels required. Available channels are shown in Note A. For example, if a 5-receiver indoor package with channels JL, YL, JP, YS, and YR is needed, an order may be placed for KS-19618, L125 to be equipped with channels 1 through 3 and 8 and 9 (for channels JL, YL, JP, YS, and YR).

RCVR QTY	INDOOR CABINET	OUTDOOR CABINET
1	KS-19618,L121	KS-19618,L131
2	KS-19618,L122	KS-19618,L132
3	KS-19618,L123	KS-19618,L133
4	KS-19618,L124	KS-19618,L134
5	KS-19618,L125	KS-19618,L135
6	KS-19618,L126	KS-19618,L136
7	KS-19618,L127	KS-19618,L137
8	KS-19618,L128	KS-19618,L138

BASE STATION RADIO EQUIPMENT (MK) (See Notes A and B and Table F)**KS-20285—AT&TCo Std—Transmitter Unit**

List 1—5- to 120-watt transmitter. Indoor cabinet; includes a list 111 crystal set, list 116 manual, and tuning tools. (See Note A.)

List 102—Diplexer for use where a common antenna is desired for a base transmitter and a base receiver package. Intended for installation in the transmitter cabinet.

List 103—Isolator (first add-to kit). Mounts on the harmonic filter panel in transmitter cabinet. For use where the minimum separation loss to adjacent transmitters (antenna-to-antenna) is less than 65 dB.

List 104—Isolator (second add-to kit). Mounts below the harmonic filter panel. Used in conjunction with list 103 isolator where separation loss to adjacent transmitters (antenna-to-antenna) is between 15 and 40 dB.

List 105—Rain shield. Used to convert transmitter cabinet for outdoor use.

List 111—Crystal set. For use in exciter-driver chassis of transmitter. Consists of a channel element and crystal filter. (See Note A.)

List 116—Instruction manual (transmitter). Contains information to install, operate, and maintain the KS-20285 transmitter.

KS-20285—AT&TCo Std — Transmitter-Receiver Unit

List 2—5- to 100-watt transmitter-receiver. Indoor cabinet; includes list 112 crystal set, diplexer (similar to list 102), list 111 crystal set, list 117 manual, and tuning tools. (See Note A.)

List 3—5- to 100-watt transmitter-receiver. Same as the list 2 except the diplexer is omitted. (See Note A.)

List 105—Rain shield. Used to convert transmitter-receiver cabinet for outdoor use.

List 111—Crystal set. For use in the exciter-driver chassis of the transmitter-receiver. Consists of a channel element and crystal filter. (See Note A.)

List 112—Crystal set. For use in the receiver chassis of the transmitter-receiver cabinets. It is the high IF filter and the second oscillator crystal. (See Note A.)

List 117—Instruction manual (transmitter-receiver). Contains information to install, operate, and maintain the KS-20285 transmitter-receiver.

KS-20285—AT&TCo Std—Receiver Package

List 5*—Receiver package. Cabinet is for indoor or outdoor installation. Includes list 112 crystal set or sets, list 115 dummy crystal set or sets, list 118 manual, and tuning tools. (See Note B.)

List 112—Crystal set for use in multicoupler, receiver chassis in transmitter-receiver cabinets, and receiver in receiver package. It is the high IF filter and second oscillator crystal. (See Note A.)

List 115—Dummy crystal. Consists of two plug-mounted units for use in the inactive channels in multicouplers.

List 118—Instruction manual (receiver). Contains information to install, operate, and maintain the KS-20285 receiver.

List 121—Receiver cabinet expansion kit. Provides for complete field installation of the **fifth** receiver in a receiver package. Receiver package can accommodate as many as eight receivers after addition of this kit. (See Note A.)

List 122—Receiver add-to kit. Provides for complete field installation of one receiver

TABLE F

MK BASE STATION CIRCUIT DRAWINGS

EQUIPMENT CODE	CIRCUIT DRAWING
KS-20285, L1	SD-2R083-01
KS-20285, L2	SD-2R082-01
KS-20285, L3	SD-2R082-01
KS-20285, L51 thru L58	SD-2R081-01

Note: A KS-20285, L105 rain shield is available to adapt the transmitter and transmitter-receiver cabinets for outdoor installation.

in a receiver package (except receiver No. 5; see list 121). (See Note A.)

1 through 5 (for channels QC, QJ, QD, QA, and QE).

*Replace asterisk with number (1 through 8) which indicates the number of receivers and associated units required in the cabinet.

MOBILE STATION EQUIPMENT (MJ) (See Note A)

Notes

A. Specify one of the following channels:

Channel 1 (QC) 459.375 MHz (receive), 454.375 MHz (transmit)

Channel 2 (QJ) 459.400 MHz (receive), 454.400 MHz (transmit)

Channel 3 (QD) 459.425 MHz (receive), 454.425 MHz (transmit)

Channel 4 (QA) 459.450 MHz (receive), 454.450 MHz (transmit)

Channel 5 (QE) 459.475 MHz (receive), 454.475 MHz (transmit)

Channel 6 (QP) 459.500 MHz (receive), 454.500 MHz (transmit)

Channel 7 (QK) 459.525 MHz (receive), 454.525 MHz (transmit)

Channel 8 (QB) 459.550 MHz (receive), 454.550 MHz (transmit)

Channel 9 (QO) 459.575 MHz (receive), 454.575 MHz (transmit)

Channel 10 (QR) 459.600 MHz (receive), 454.600 MHz (transmit)

Channel 11 (QY) 459.625 MHz (receive), 454.625 MHz (transmit)

Channel 12 (QF) 459.650 MHz (receive), 454.650 MHz (transmit).

B. Specify the number of receivers and associated circuits (1 through 8) and list the channels required per Note A. For example, if a 5-receiver package with channels QC, QJ, QD, QA, and QE is needed, an order can be placed for KS-20285, L55 to be equipped with channels

KS-19609—AT&TCo Std—Motorola

List 2—Supervisory unit. Mounts within the list 3 radio unit.

KS-19852—AT&TCo Std—General Electric

List 2—Supervisory unit. Mounts within the list 4 radio unit.

List 4—Radio unit. Tuning tools are supplied at a rate of one set per five radios or fraction thereof. (See Note A.)

List 5—20-foot channel assembly for negative ground installations. Includes connector housing cover.

List 7—Oscillator channel hunting circuit. Provides the oscillators and also the channel hunting circuit for the list 4 radio unit.

List 9—20-foot cable assembly for positive ground installations. Includes connector housing cover.

List 11—Channel element. KS-19852 mobile only. Specify channel. (See Note A.)

Note: Minimum KS-19852 mobile radio order for initial system: one each of KS-19852, L2, L4, L7, and L5 or L9 (whichever is needed) plus a number of list 11 as needed (maximum 11). Specify channels.

For further information on KS-19852, see circuit drawings SD-2R022-01, SD-2R057-01, and SD-2R062-01.

KS-19626—AT&TCo Std—Control Unit ITT

List 1-(*)—Control unit. (See Fig. 7.)

List 2—Auxiliary mounting bracket for use in conjunction with the mounting bracket furnished with list 1 if additional rigidity is required.

List 3-(*)—Replacement housing kit. Front and rear assembly for list 1 control units. [Handset used is WE G5KR-(*)].

*Replace asterisk with number indicating color of unit desired as follows:

3—Black

51—Moss Green

58—White
 60—Light Beige
 61—Light Gray

For further information on KS-19626, see circuit drawing SD-2R020-01.

KS-21466—AT&TCo Std—Motorola

- List 1**—(*)—Mobile station. Complete; includes list 2 radio unit, list 3 control unit, tuning tool set, list 101 instruction manual, VHF roof top antenna, and cable assembly.
- List 2**—Radio unit. Includes supervisory unit and frequency synthesizer for all channel frequencies.
- List 3**—(*)—Control unit. Includes mounting hardware.

*Replace asterisk with number indicating color of control unit desired. Black is 3 and beige is 60.

Note

A. Specify channels as follows:

- Channel 1 (JL) 155.77 MHz (transmit),
 152.51 MHz (receive)
- Channel 2 (YL) 157.80 MHz (transmit)
 152.54 MHz (receive)
- Channel 3 (YP) 157.83 MHz (transmit),
 152.57 MHz (receive)
- Channel 4 (YP) 157.86 MHz (transmit),
 152.60 MHz (receive)
- Channel 5 (YJ) 157.89 MHz (transmit),
 152.63 MHz (receive)
- Channel 6 (YK) 157.92 MHz (transmit)
 152.66 MHz (receive)
- Channel 7 (JS) 157.95 MHz (transmit),
 152.69 MHz (receive)
- Channel 8 (YS) 157.98 MHz (transmit),
 152.72 MHz (receive)
- Channel 9 (YR) 158.01 MHz (transmit),
 152.75 MHz (receive)

Channel 10 (JK) 158.04 MHz (transmit),
 152.78 MHz (receive)

Channel 11 (JR) 158.07 MHz (transmit),
 152.81 MHz (receive)

MOBILE STATION EQUIPMENT (MK) (See Notes A and B)

KS-20282—AT&TCo Std—Radio Unit Motorola

- List 1**—Radio. Consists of a list 3 radio unit, a KS-19609, L2 supervisory unit, list 7 channel elements, list 13 channel strapping board, and, if needed, list 8 dummy channel elements. In addition, a set of list 9 tuning tools and a list 11 manual will be furnished at the rate of one set per five radios or fraction thereof. Specify channels. (See Notes A and B.)
- List 3**—Radio unit. Consists of main transmit and receive facilities and all 12 dummy channel elements. This unit has been made available primarily for field replacement use. Includes list 13 channel strapping board.
- List 4**—Mounting base. Consists of a base plate with key operated locking facilities on which the list 1 radio can be mounted. For use when easy removal of set is desired.
- List 5**—Negative ground cable for use between the radio, control unit, and vehicle power supply. The cable is 20 feet long and equipped with an appropriate connector for each terminating point. Includes a list 12 cover.
- List 6**—Positive ground cable. Same as list 5 cable except that it is arranged for positive ground use.
- List 7**—Channel element. This is the frequency determining element that is used to activate channels in the list 3 radio unit. (See Note 2.)
- List 8**—Dummy channel element used to replace the list 7 element for the inactive channels in the list 3 radio unit.
- List 11**—Instruction manual (mobile). Contains information to install, operate, and maintain KS-20282 radios.
- List 12**—Cover. Connector cover for connector on the control unit end of lists 5 and 6 cables.
- List 13**—Channel strapping board used to provide

channel selection at the time of installation.

List 14—Radio unit. Same as list 3 except for use with KS-21466, L4 control unit. (List 3 may be modified to list 14 by use of Motorola modification kit.)

For further information on KS-20282, see circuit drawings SD-2R079-01 and SD-2R080-01.

**KS-20283—AT&TCo Std—Control Unit
Motorola**

List 1-(*)—Control unit. (See Fig. 7.)

List 2—Auxiliary mounting bracket used in conjunction with the regularly furnished bracket where additional rigidity is required.

List 3-(*)—Replacement housing kit. Front and rear housing for list 1 control unit. [Handset used is WE G3AR-(*).]

*Replace asterisk with number indicating color of unit desired as follows:

- 3—Black
- 51—Moss Green
- 58—White
- 60—Light Beige
- 61—Light Gray

For further information on KS-20283, see circuit drawing SD-2R078-01.

**KS-21466—AT&TCo Std—Control Unit
Motorola**

List 4-(*)—Control Unit. Intended for use with KS-20285, L14 radio. Customer programmable roam channel selection.

*Replace asterisk with number indicating color desired. Black is 3 and beige is 60.

Notes

A. The KS-20282, L1 radio is furnished with the proper number of list 7 channel elements and list 8 dummy channel elements to satisfy the customer's particular order. For example, if the radio is to be equipped with N channels, 12 minus N dummy channel elements (list 8) will be supplied with the N channel elements (list 7).

B. Channels available are as follows:

Channel 1 (QC) 459.375 MHz (transmit), 454.375 MHz (receive)

Channel 2 (QJ) 459.400 MHz (transmit), 454.400 MHz (receive)

Channel 3 (QD) 459.425 MHz (transmit), 454.425 MHz (receive)

Channel 4 (QA) 459.450 MHz (transmit), 454.450 MHz (receive)

Channel 5 (QE) 459.475 MHz (transmit), 454.475 MHz (receive)

Channel 6 (QP) 459.500 MHz (transmit), 454.500 MHz (receive)

Channel 7 (QK) 459.525 MHz (transmit), 454.525 MHz (receive)

Channel 8 (QB) 459.550 MHz (transmit), 454.550 MHz (receive)

Channel 9 (QO) 459.575 MHz (transmit), 454.575 MHz (receive)

Channel 10 (QR) 459.600 MHz (transmit), 454.600 MHz (receive)

Channel 11 (QY) 459.625 MHz (transmit), 454.625 MHz (receive)

Channel 12 (QF) 459.650 MHz (transmit), 454.650 MHz (receive)

SPECIAL TEST EQUIPMENT (MJ and MK)

4.03 The following special test equipment is required for line up and maintenance of the MJ and MK mobile station equipment. The list does not include test equipment needed for overall system line up and maintenance.

(a) Motorola model T1257A (for KS-19609, L2) or S1336A (for KS-21466 or KS-19609, L2) supervisory unit test set

(b) Motorola model S1056A test set for mobile radio unit

- (c) Motorola model TEN 6055A test set adapter for use with S1056A
- (d) Motorola model TEK-31 audio tone generator, 400 Hz, 1000 Hz, adjustable level
- (e) General Electric model 4EX5A10 test set for supervisory unit
- (f) General Electric model 4EX3A10 test set for radio unit
- (g) Motorola part No. 40-84066A7B channel selector test set adapter.

The above equipment has been replaced as indicated. Where A&M Only items appear, the issue numbers shown are those of the issue in which the rating was first applied.

5. GENERAL NOTES AND INDEXES

List of A & M Only and Mfr Disc. Equipment

EQUIPMENT	RATING	DETAILS	
		LAST SHOWN IN ISSUE	REPLACING EQUIPMENT
J41645A,L25	Mfr Disc.	3	—
L26	Mfr Disc.	3	—
J41645B,L22	Mfr Disc.	3	—
L23	Mfr Disc.	3	—
KS-19609,L3	Mfr Disc.	3	KS-21466
L5	Mfr Disc.	3	KS-21466
L7	Mfr Disc.	3	KS-21466
L9	Mfr Disc.	3	KS-21466
L10	Mfr Disc.	3	KS-21466
L11	Mfr Disc.	3	KS-21466
KS-19618,L30	Mfr Disc.	3	—

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