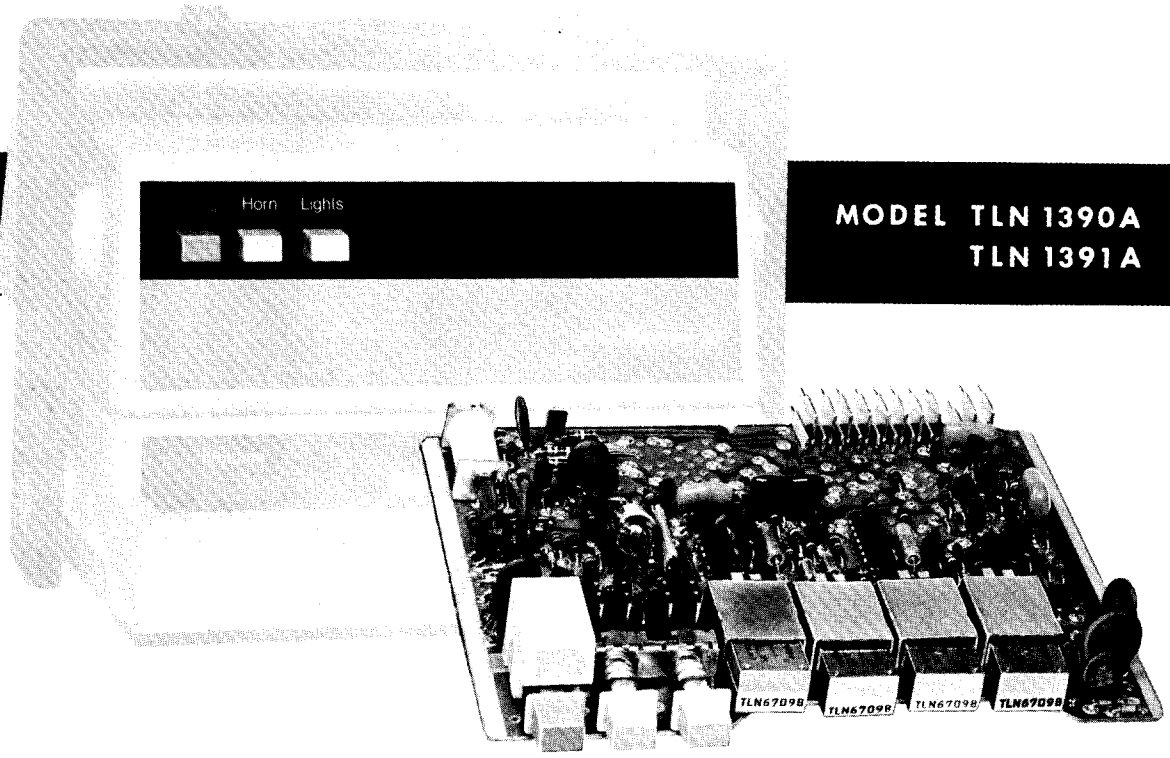
MICOR® | Systems 90

"QUIK-CALL II"
MOBILE PAGING DECODER



MODEL TLN 1390A
TLN 1391A

MOTOROLA INC. *Communications Division*
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THIS MANUAL HAS BEEN **DISCONTINUED**

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MODEL TABLE

MODEL	DESCRIPTION	APPLICATION
TLN1390A	4-REED MOBILE PAGING DECODER	INDIVIDUAL AND GROUP CALL
TLN1391A	2-REED MOBILE PAGING DECODER	INDIVIDUAL CALL

1. TECHNICAL CHARACTERISTICS

TONE FREQUENCIES	288.5 to 1433.4 Hz
TONE STABILITY	±0.2% from -30°C to +85°C ambient (+25°C reference)
SENSITIVITY	Less than 6 dB quieting
MUTING	Greater than 50 dB below 10 watts of audio
TONE CODING	Two pulses of one tone each (automatic encoder timing)
PULSE LENGTHS	1st pulse: 1.25 ±0.25 seconds 2nd pulse: 3.0 ±0.5 seconds Interval between pulses: 0.24 to 0.33 second
INPUT IMPEDANCE	Greater than 25 kilohms
NOMINAL INPUT VOLTAGE	±13.6 Volts dc
CURRENT DRAIN	Standby: 190 mA Decoding: Call light & alert tone 300 mA; Horn Relay add 150 mA; Lights Relay add 150 mA
HORN AND LIGHT RELAY CONTACT RATINGS	30 amperes @13.6 V

2. DESCRIPTION

The "Quik-Call II" Mobile Paging Decoder equips Motorola "Micor" FM Two-Way Mobile Radio for use in a mobile paging system. The decoder is fully solid-state and uses two integrated circuits (three in 4-reed models) in addition to transistorized circuits. Circuits are built on a circuit board card which slides into a Motorola "Systems 90" accessory housing. Switches and indicators of the operator's panel are an integral part of the board, as is the connector at the rear of the unit. All necessary related items are included such as the microphone hang-up switch box, interconnecting cable with connector, and the horn and lights relays. The housing is ordered separately, since numerous combinations of housings and accessories are possible.

3. MOBILE PAGING SYSTEM

a. Typical System

A mobile paging system allows a dispatcher to call any mobile unit of an FM two-way radio network without disturbing the other mobile units. The mobile radio units do not respond unless they are called by the dispatcher.

The equipment comprising such a system includes:

--A base station, through which the dispatcher transmits calls and messages to mobile radio units.

--A paging encoder which is used by the dispatcher to generate the coding tones.

--A mobile radio set for each vehicle of the system.

--A mobile paging decoder in each mobile unit.

Each mobile paging decoder is assigned a specific code and will not allow the mobile radio set to respond unless the correct code is received. The encoder which is used by the dispatcher is able to send any of the codes used in the system. The dispatcher selects the code for the desired mobile radio unit and transmits the coded tones. The selected mobile radio unit alerts the operator by the lighting of a CALL lamp and the sounding of an alert tone from the radio's speaker. The mobile operator then disables the decoder and monitors the channel for messages from the dispatcher (tone only operation). The decoder can be connected for automatic channel monitoring after the alert tone ends until the decoder is

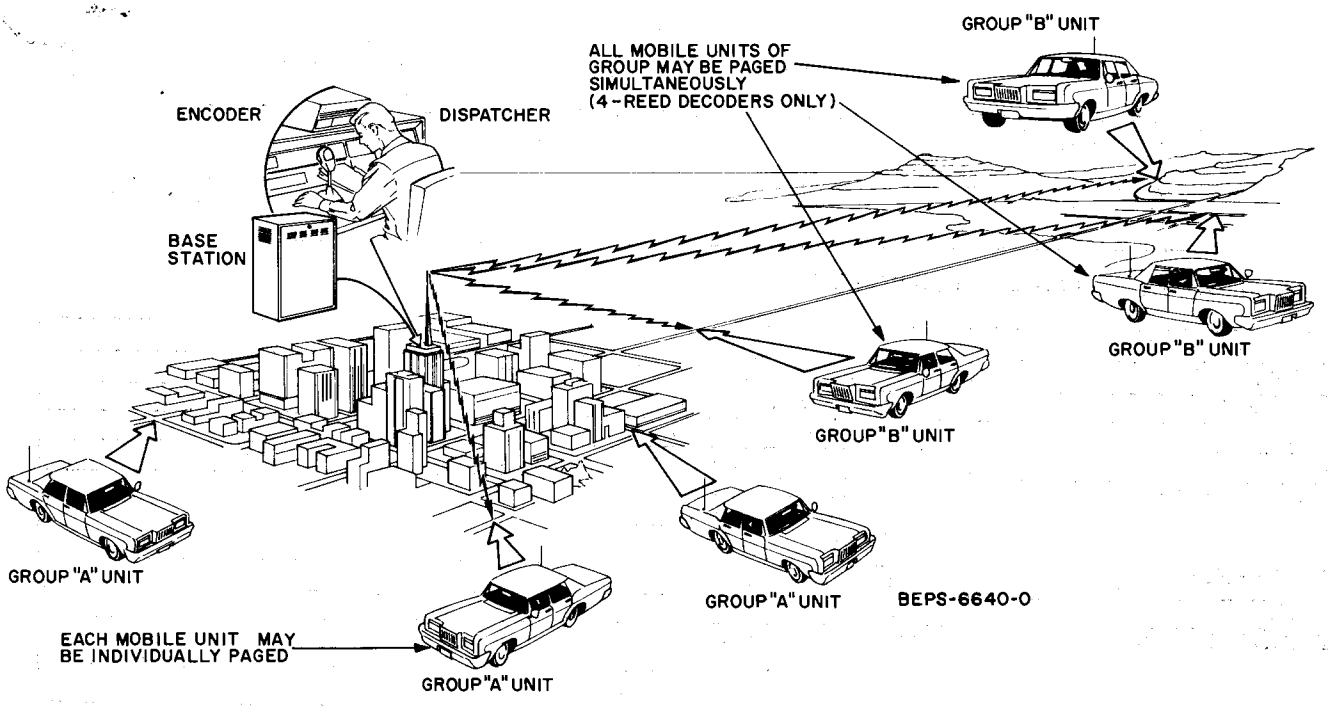


Figure 1.
Typical Mobile Paging System

reset (tone and voice operation). The CALL light remains lit until reset by the operator. Thereby, the mobile operator is notified of any call that was received while he was away from the vehicle.

When the vehicle is unattended, the decoder output can be used to turn on the vehicle lights or sound the horn as a method of announcing an incoming call. Switches on the decoder allow the horn and lights alerting methods to be deactivated when the operator is present.

Two types of decoders are available; 2-reed and 4-reed models. Both types allow selective calling of an individual mobile radio unit as just described. However, the 4-reed model additionally permits a group of mobile units to be called simultaneously. The 4-reed decoders respond to either of two codes. One code is the individual call code which is different for each vehicle, and the second code is the group call code which is identical in a group of vehicles. The group call coding can be set up to call all the mobile units in the system, or several groups may be established.

b. Coding Technique

The coding scheme used in a mobile paging system is a two tone sequential type as shown in Figure 2. The decoder will respond only if the tones are the correct frequencies and only if they occur in the proper sequence. The scheme allows paging systems of from 2 to 3540 units. The scheme is secure from false operation since two conditions must be met to activate the decoder.

Audio frequencies in the 288- to 1450-Hz range are used. The frequencies are very precise and the decoding devices are equally precise so that they do not operate except at the assigned code. Motorola "Vibrasponder" resonant reeds are used as the frequency sensitive elements in the decoder. These electromechanical devices will vibrate and produce an output only when the input signal is at the frequency for which the reed is designed. Reeds are available in 60 different paging tones and 36 different "Quik-Call" tones as listed in Tables 1 and 2. Code frequencies are assigned by Motorola systems analysists at the factory and any add-on order should refer to the initial order for correct assignment.

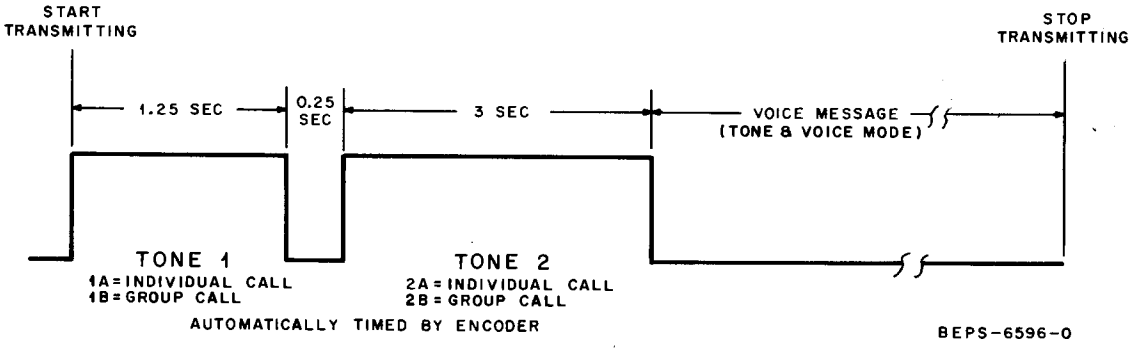


Figure 2.
Coding Scheme

Table 1. Radio Paging Codes

TONE NUMBER (2nd & 3rd digits)	Reed Group 1		Reed Group 2		Reed Group 4		Reed Group 5		Reed Group 3		Reed Group 6	
	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)
1	111	349.0	121	600.9	141	339.6	151	584.8	138	288.5	191	1153.4
2	112	368.5	122	634.5	142	358.6	152	617.4	108	296.5	192	1185.2
3	113	389.0	123	669.9	143	378.6	153	651.9	139	304.7	193	1217.8
4	114	410.8	124	707.3	144	399.8	154	688.3	109	313.0	194	1251.4
5	115	433.7	125	746.8	145	422.1	155	726.8	160	953.7	195	1285.8
6	116	457.9	126	788.5	146	445.7	156	767.4	130	979.9	196	1321.2
7	117	483.5	127	832.5	147	470.5	157	810.2	161	1006.9	197	1357.6
8	118	510.5	128	879.0	148	496.8	158	855.5	131	1034.7	198	1395.0
9	119	539.0	129	928.1	149	524.6	159	903.2	162	1063.2	199	1433.4
0	110	330.5	120	569.1	140	321.7	150	553.9	189	1092.4	190	1122.5

Table 2. "Quik-Call" Codes

Z Series		B Series		A Series	
Code	Freq. (Hz)	Code	Freq. (Hz)	Code	Freq. (Hz)
CZ	346.7	CB	371.5	CA	358.9
DZ	384.6	DB	412.1	DA	398.1
EZ	426.6	EB	457.1	EA	441.6
FZ	473.2	FB	507.0	FA	489.8
GZ	524.8	GB	562.3	GA	543.3
HZ	582.1	HB	623.7	HA	602.6
JZ	645.7	JB	691.8	JA	668.3
KZ	716.1	KB	767.4	KA	741.3
LZ	794.3	LB	851.1	LA	822.2
MZ	881.0	MB	944.1	MA	912.0
NZ	977.2	NB	1047.1	NA	1011.6
PZ	1084.0	PB	1161.4	PA	1122.1

On decoders using the paging codes, a three-digit number is stamped on each reed to identify the code frequency for that unit. Each number identifies the reed group and reed frequency (Table 1).

On decoders that may use the "Quik-Call" frequencies, the number stamped on the reed consists of two letters (example LZ). The letters correspond to the reed codes as identified in Table 2. For the example given, the reed (LZ) operates at 794.3 Hz.

Reed placement is very important; reversing the order of the reeds reverses the coding sequence of the decoder. For individual call codes, the frequency of the reed in socket 1A must correspond to the first tone and the frequency of the reed in socket 2A must correspond to the second tone. For group call operation (4-reed models), the frequency of the reed in socket 1B must correspond to the frequency of the first group call tone, and 2B must correspond to the second group call tone. The reed sockets are labeled for easy identification.

4. INSTALLATION

The decoder comes either as a factory equipped option, completely prewired, or as a field installed add-on to an existing "Micor" radio set. The decoder circuit card is installed in the accessory housing, either alone or in combination with other radio accessories. The installation instructions provided here are for the decoder used as the only accessory. For instructions pertaining to multiple installations, refer to the Installation Instructions supplied with the housing assembly.

a. Field Installed Option (Refer to Figure 3)

(1) Remove the escutcheon backing and apply carefully to the housing assembly front panel. Use care to align the holes in the escutcheon with the holes in the panel.

(2) Place the card into the two rails as shown in Figure 3D and slide the circuit card completely into the housing assembly.

(3) Determine which of the knockout panels in the rear housing cover must be removed to allow access to the 22-pin assembly on the board. (Refer to Figure 3C.) Remove the panel by pushing it out toward the rear of the cover.

(4) Refer to Figure 3D. Install the rear housing cover by inserting the tabs on the top of the cover into the holes in the top of the housing assembly and swinging the cover down against the bottom and securing it with the two captive screws.

(5) Disconnect the black connector (P1101) from the control head.

(6) Use the contact removal tool to remove the following wires, with pins attached, from P1101.

- Yellow wire from position 1.
- Black-violet wire from position 9.
- Black-brown wire from position 16.
- Black-green wire from position 20.
- Shield from position 21.

NOTE

Steps (7) and (8) are not necessary when the wires extend at least five inches beyond the sleeving on the multiconductor cable.

(7) Remove the "S" clamp from the end of the multiconductor cable and move the strain relief back about five inches from the ends of the wires.

(8) Cut and remove the cable sleeving so that approximately five inches of the wires are exposed. Be careful not to cut the insulation of the wires. Hook the strain relief "S" hook to the bracket on the option housing.

(9) Insert the pins and wires which were removed from P1101 into the green connector (P1) as follows:

- Yellow wire into position 18.
- Black-violet wire into position 13.
- Black-brown wire into position 15.
- Black-green wire into position 21.
- Shield into position 20.

(10) Insert the pins and wires connected from P1 into P1101 as follows:

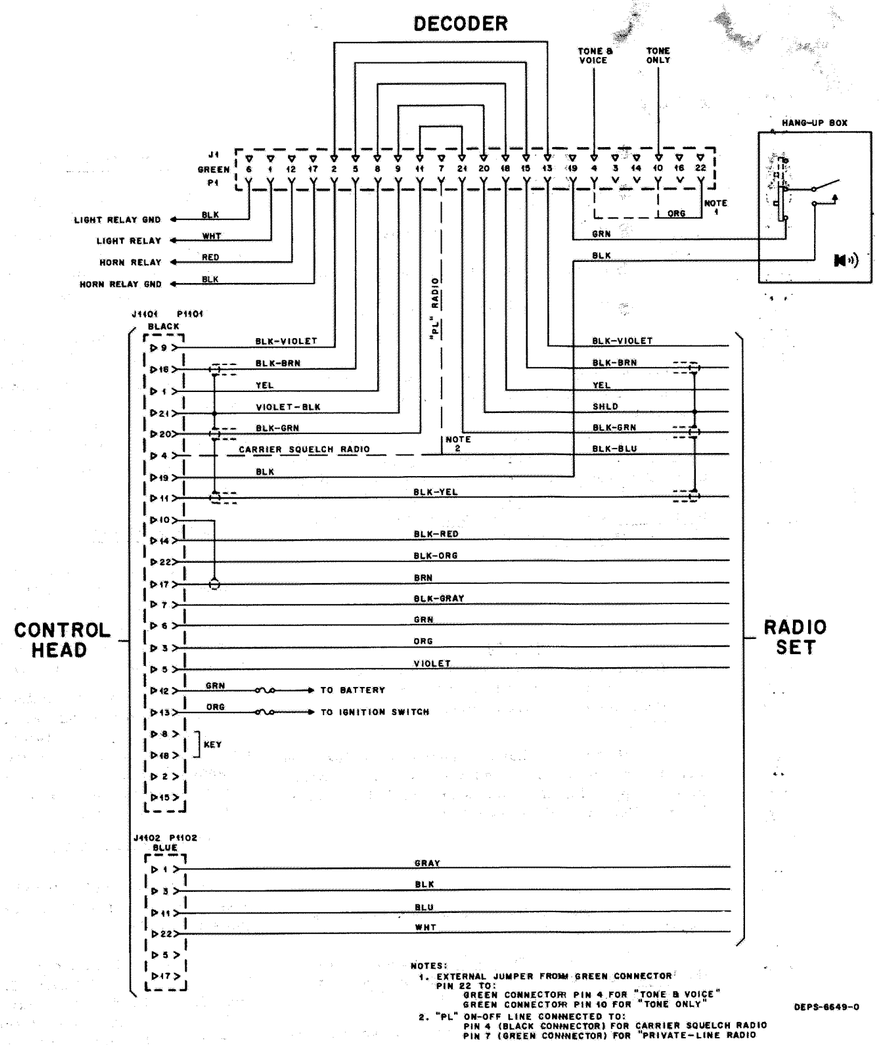


Figure 3A. Connection Diagram

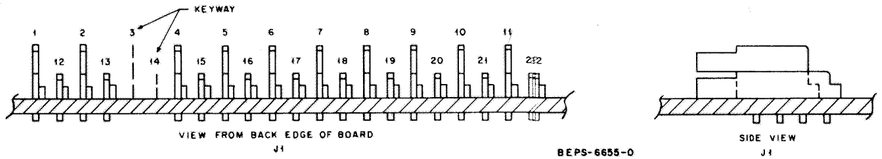


Figure 3B. Pin Location Detail

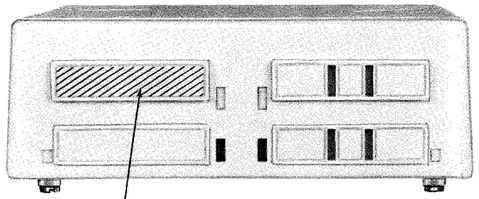


Figure 3C.
Rear Panel Removal

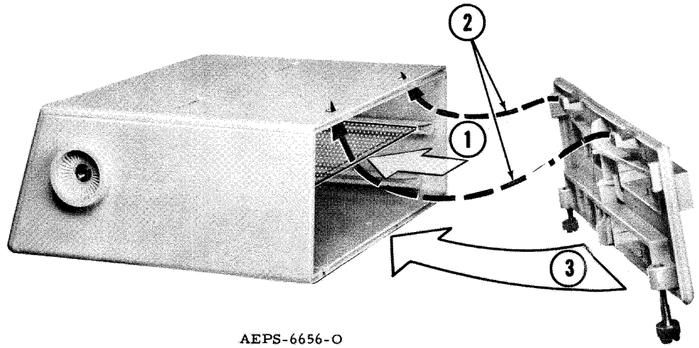


Figure 3D.
Rear Cover Installation Detail

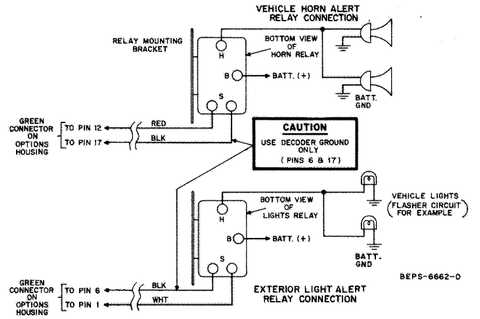
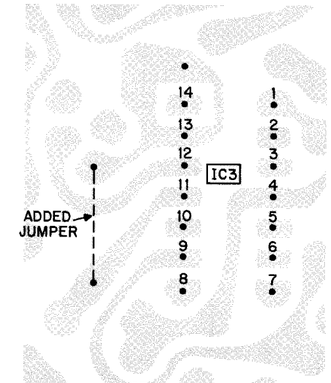


Figure 3E.
Lights and Horn Relay Installation Diagram



FOR 2-TONE SIMULTANEOUS CODING JUMPER BETWEEN IC3 PIN 13 AND PIN 11

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Figure 3F.
Jumper Detail

Figure 3.
Installation Detail
Motorola No. PEPS-6664-A
5/7/71-NPC

- Yellow wire into position 1.
- Black-violet wire into position 9.
- Black-brown wire into position 16.
- Black-green wire into position 20.
- Violet-black wire into position 21.

(11) Reconnect P1101 to the control head and connect P1 to the 22-pin receptacle (J1) on the rear of the circuit card.

(12) If a microphone hang-up box was installed with the radio, ("Private-Line" equipped radios) move the green wire from the black connector pin 15 to pin 19 of the green connector, and move the black-blue wire from the black connector, pin 4 to pin 7 of the green connector.

NOTE

If the previously installed radio is a carrier squelch model, do not remove the black-blue wire from pin 4 of the black connector.

If no microphone hang-up box was installed with the radio, (carrier squelch radios) the hang-up box supplied with the decoder circuit board must be installed and wired as follows:

(a) Install the hang-up box within easy reach of the operator.

(b) Insert the black wire into pin 19 of the black connector (P1101) and the green wire into pin 19 of the green connector.

(13) Attach the horn and light relays in a secure position in the engine compartment, (such as the firewall, etc.) and connect them as illustrated in Figure 3E.

b. Factory Wired Option

When the decoder option is purchased as part of a radio system, the wiring changes will have been completed. The individual system components are shipped with all interconnecting cables attached to permit a thorough system check out before unpacking. To install the radio system proceed as follows:

(1) Install the radio and cabling as directed in the radio installation instructions.

(2) Install the trunnion bracket and housing assembly as instructed.

(3) Connect the black (and blue, if used) connector(s) to the control head.

(4) Connect the green connector (P1) to decoder jack (J1).

c. Jumper Options

(1) As shipped from the factory, the jumper between pins 22 and 4 of the green connector provide "Tone and Voice" operation. "Tone Only" operation can be obtained by removing the wire from pin 4 and reconnecting it so that pin 22 is connected to pin 10 of the green connector.

(2) If the system includes both mobile paging and selective signaling coding, a 4-reed decoder can be wired to permit two simultaneous tone decoding for group call operation by adding a jumper as shown in Figure 3F. This form of tone coding is not as reliable as the normal sequential coding and is not recommended.

d. Installation Options

(1) When mobile decoders are used in "Private Line" systems there are various muting options available.

(a) If the decoder is left wired as shipped from the factory, "Private-Line" muting will be in "parallel" with decoder muting. Both the proper "PL" code and the correct selective tones must be received to unmute the receiver. When the microphone is removed from the hang-up box, or the "monitor-operate" switch is placed in the monitor position, all muting is disabled.

(b) If the decoder is to be used only for horn and/or lights activation and all vehicles are to hear all transmissions with the proper "PL" code, continuous unmuting of the decoders without affecting horn and lights or "PL" operation can be achieved by removing the ORG jumper from P1 (the green decoder connector housing). The decoder alert tone will only be heard if the base station transmits the signalling tones and "PL" tone simultaneously.

(c) If individual calling is desired from base-to-mobile without disturbing the other mobiles in the system, while retaining "Private-Line" operation for general mobile-to-mobile and mobile-to-base communications, the decoder muting may be wired as an "OR" function, i.e., it will respond to either signalling tones or the proper "PL" tone. Proceed as follows:

1. Remove and discard the BLK-GRN jumper from P1 (green) pin 11, to P1101 (black) pin 20.

2. Move the BLK-GRN wire from the "Micor" radio cable from P1 (green) pin 21, to P1101 (black) pin 20.

3. Move the BLK-BLU "PL Select" wire from the "Micor" radio cable from P1 (green) pin 7 to P1 (green) pin 21 or 11.

4. Remove resistor R62 (47k ohms). In this configuration, individual base to mobile signalling without disturbing other mobiles is accomplished by the base station disabling its transmit "PL" tone while signalling and communicating with the paged vehicle. The decoder pulsating alert tone will not be operational in this configuration, however, a portion of the second paging tone (about one second) will be heard when the receiver unmutes.

(2) Two separate hang-up boxes, one controlling "Private-Line" on/off and the other controlling mobile decoder muting and horn and lights operation, can be installed as follows:

(a) Move hang-up Box BLK wire from black connector P1101-19 to blue connector P1102-19.

(b) Move "Private-Line" on/off (BLK-BLU wire) from the green connector (P1-7) to black connector P1101-4.

(c) Install the hang-up box for controlling the "Private-Line" on/off function in the normal manner, GRN to P1101-15 and BLK to P1101-19.

(3) To allow one hang-up box to unmute both "Private-Line" and mobile decoder when off-hook, but have a separate "Private-Line" on/off control when on-hook, connect as shown for carrier squelch. Then modify the second unused hang-up box as follows:

(a) Cut out the short BLK jumper from the slide switch to the spring clip.

(b) Move BLK wire of the 2-conductor cable on the slide switch.

(c) Connect GRN wire of the 2-conductor cable to the green decoder connector (P1-7) and the BLK wire to black connector P1101-15.

(4) To allow one hang-up box to unmute both "Private-Line" and a mobile decoder when off-hook, but have separate decoder disable when on-hook, connect as follows:

(a) Connect a standard hang-up box, GRN wire to P1101-15 and BLK wire to P1101-19.

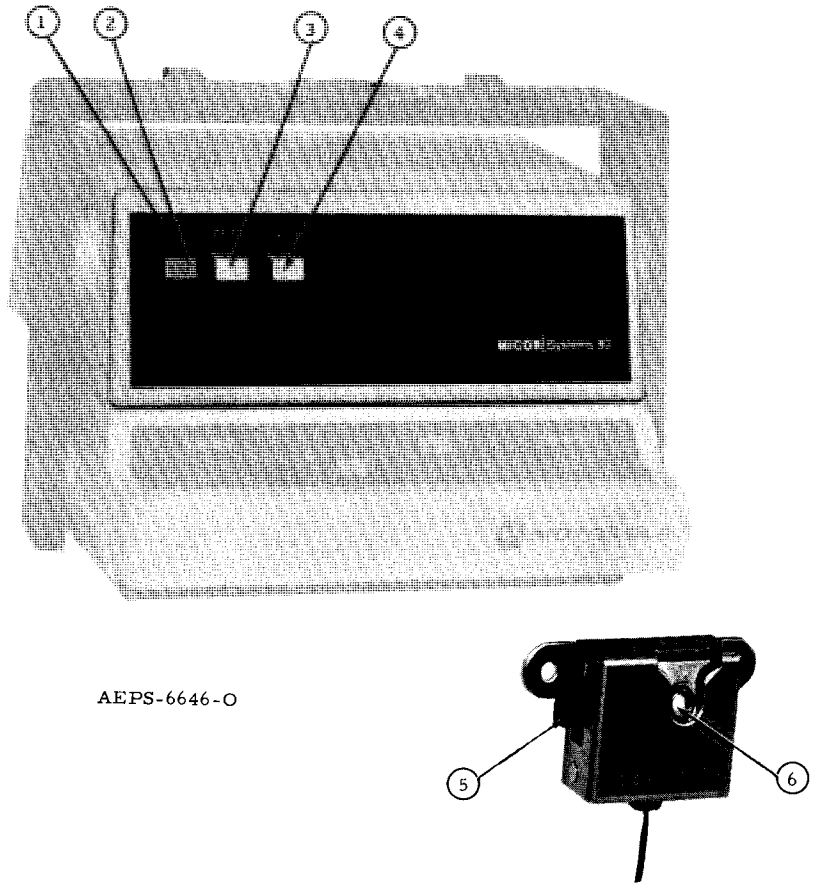

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Figure 4.
Controls and Indicators

(b) Modify the second hang-up box as in paragraph (3) and connect GRN to green decoder connector P1-19 and BLK P1101-4.

(c) Connect "Private-Line" on/off wire (BLK-BLU) to blue connector P1102-7.

The control head must also be slightly modified as follows:

(a) Remove top cover by loosening two Phillips captive screws from bottom.

(b) Locate the plating on the front of the board which runs from P1101-4 and -15 to P1102-7. Cut this plating in a convenient location and solder in a diode (part no. 48C83654H01) with cathode (band) towards P1101-4 and -15.

(c) Replace top cover.

5. OPERATING PROCEDURE

a. Controls and Indicators (Refer to Figure 4)

(1) CALL Light - Lights when correctly tone-coded message is received. An alert tone is also heard at this time. The lamp remains on until reset. The CALL light will always respond to a correctly coded transmission regardless of the setting of other controls.

(2) Call Reset Switch - Momentary action pushbutton switch, resets the CALL light and remutes the receiver when operated.

(3) HORN switch - Alternate action pushbutton switch. This switch enables or disables the vehicle horn as an external alerting feature of a received call.

(4) LIGHTS Switch - Alternate action push-button switch. This switch enables or disables the vehicle lights as an external alerting feature of a received call.

(5) Monitor-Operate Switch - Slide switch on the side of the microphone hang-up box. When this

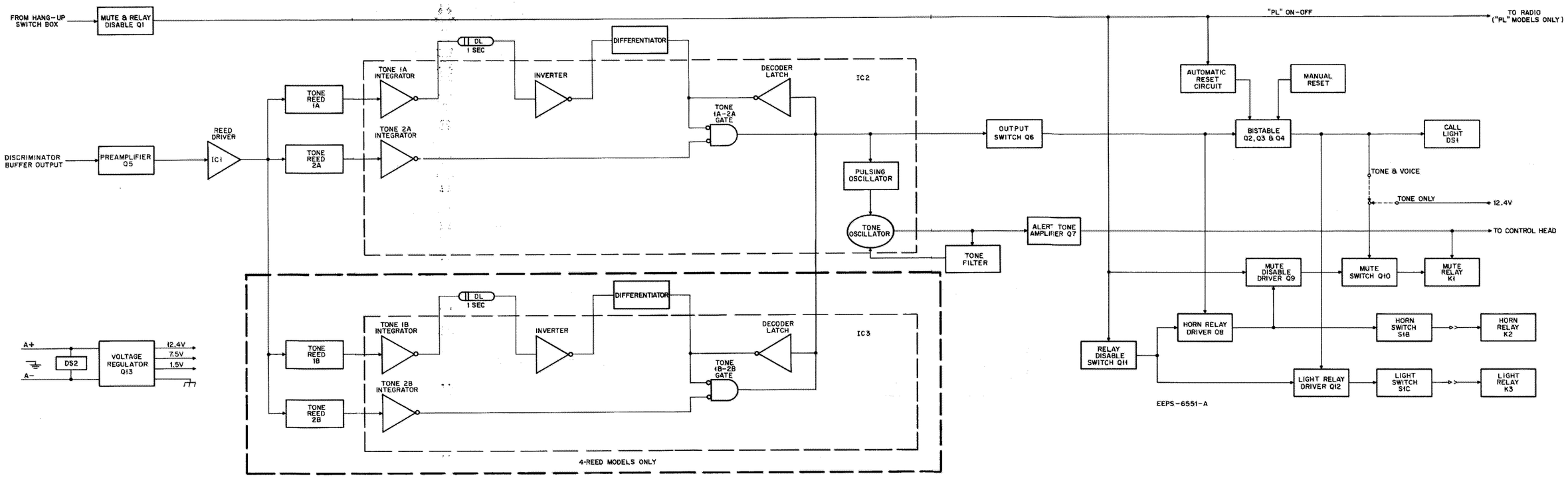


Figure 5.
Functional Block Diagram

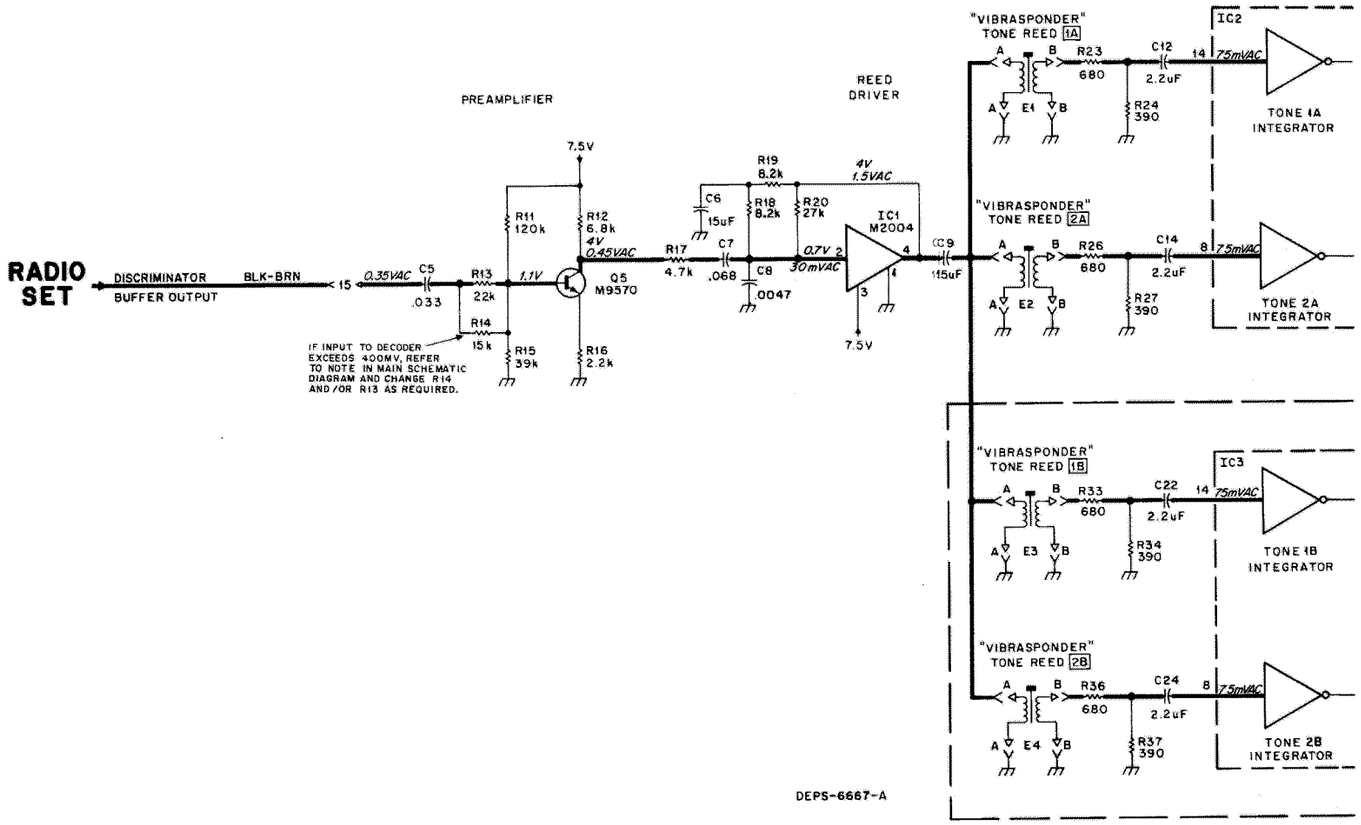


Figure 6.
Audio Input Circuit

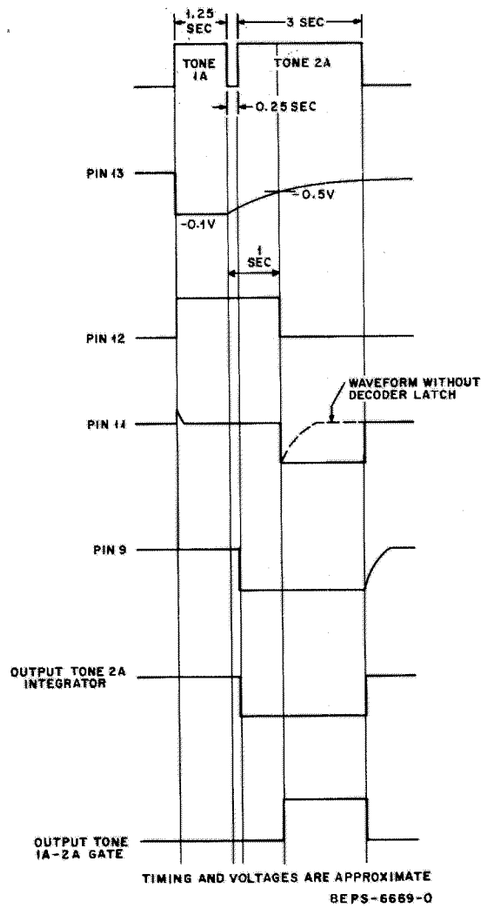


Figure 7.
IC2 Timing Relationship

switch is in the monitor position (nearest the) the receiver is unmuted and all on frequency calls (regardless of tone coding) are heard. Permits monitoring while the microphone is "on-hook".

⑥ Hang-Up Box - Automatic monitoring of the channel and automatic reset when the microphone is lifted "off-hook". Also restores receiver muting when microphone is placed "on-hook" after the alert tone is heard.

Placing of the hang-up box "monitor-operate" switch in the monitor position, or having the microphone off-hook, also disables the horn & lights relays.

b. Receiving a Call

Depending upon the placement of the optional jumper, the decoder functions in one of the following two ways:

(1) Tone Only

Upon reception of a properly coded call, the CALL lamp lights and a brief series of tone pulses are heard at the speaker. The vehicle operator should then remove the microphone from the hang-up box and call into the station originating the tone call. When the microphone is removed from the hang-up box, the CALL light is turned off. If the operator is absent from the vehicle at the time of the original call, the CALL light remains on to indicate a received call. If either the LIGHTS or HORN functions have been enabled and a call is received, the vehicle lights (flashers for instance) will remain on until reset, while the horn will only sound for a few seconds. Either function is automatically reset with the CALL light or may be reset by again pressing the LIGHTS or HORN pushbutton, which disables the function.

(2) Tone and Voice

The reception of a call is the same as described for "Tone Only" except that the receiver will remain unmuted and an audio message may be heard until the decoder is reset.

c. Transmitting

Lift the microphone off-hook or place the monitor-operate switch in the monitor position ( ) and monitor to make sure it is clear before transmitting. Otherwise, use normal transmitting procedures.

6. FUNCTIONAL OPERATION

a. Audio Input Circuit (Refer to Figure 6)

The decoder is activated by the paging code coupled from the discriminator buffer output in the radio set. The paging code consists of a tone approximately one second in duration followed by a 1/4-second delay and then a second tone whose duration is approximately three seconds. These tones are coupled through C5 to the parallel network consisting of R13 and R14. If the amplitude of the tones exceeds 400 mV at 60% system deviation, the resistance of the decoder input circuit (R13 and R14) should be adjusted in accordance with NOTE 1 in the main schematic diagram to provide the proper drive to the base of Q5. The output of Q5 is coupled to reed driver IC1 which is a 1/4 watt audio amplifier stage. Distortion at the output of the reed driver is reduced by the feedback network consisting of R18, R19, R20, and C6. The output of the reed driver is capacitively coupled to "Vibrasponder" tone reeds 1A and 2A (also 1B and 2B in a four-reed model).

These reeds are highly frequency selective so that only tones of the proper frequency are allowed to pass. The 390-ohm and 680-ohm resistors at the outputs of the reeds form voltage divider networks so that an acceptable signal level of approximately one-third of the signal output from a reed is coupled to tone integrators 1A and 2A.

b. Decoder Logic

Tone 1A causes pin 13 of IC2 to go low (see Figures 7 and 8). At the end of the tone, the voltage at pin 13 again starts to rise toward its supply voltage of 1.5 volts. The rate of rise is determined by the charging rate of C10 through R21. Tone 2A causes pin 9 of IC2 to go low. At this same time the output of the tone 2A integrator will go low and keep one input to the tone 1A-2A gate (AND gate) low for approximately three seconds.

After about 3/4 second into the tone 2A pulse, C10 will have charged sufficiently high to turn the next stage on. At this time pin 12 goes low and the RC network of C11 and R22 produce a sharp negative pulse. Tone 2A and the sharp negative pulse will turn on the AND gate to provide a positive output. This output is fed back and inverted through the decoder latch to hold pin 11 low. This arrangement of circuitry will therefore provide for two simultaneous low inputs to the AND gate until tone 2A disappears.

The positive output from the AND gate is coupled to an astable pulsing oscillator. The charge-discharge function of external capacitor C15 turns the tone oscillator on and off. The tone oscillator and twin tee filter determine the frequency of the alert tone. Pin 3 is the tone oscillator feedback and pin 2 is the output which is coupled to the alert tone amplifier Q7. This pulsating alert tone is a series of pulses at a rate determined by C15. The output is taken from the collector of Q7 and, after attenuation by R62, is coupled to the audio amplifier in the radio set.

IC3, which is used on four-reed models only, is identical to IC2 but the pulsing or tone oscillators are not used. However, its pin 10 output is

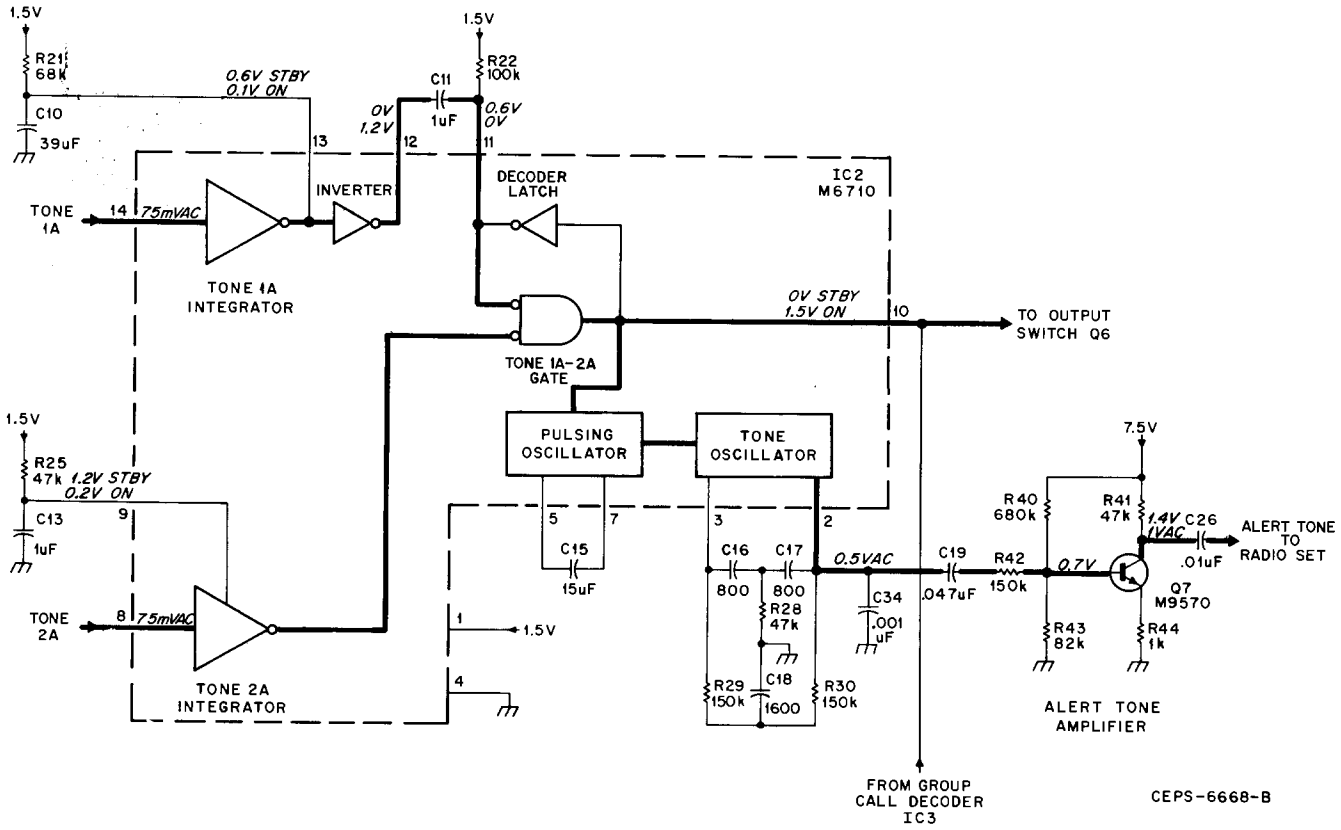


Figure 8.
Decoder Logic Circuit

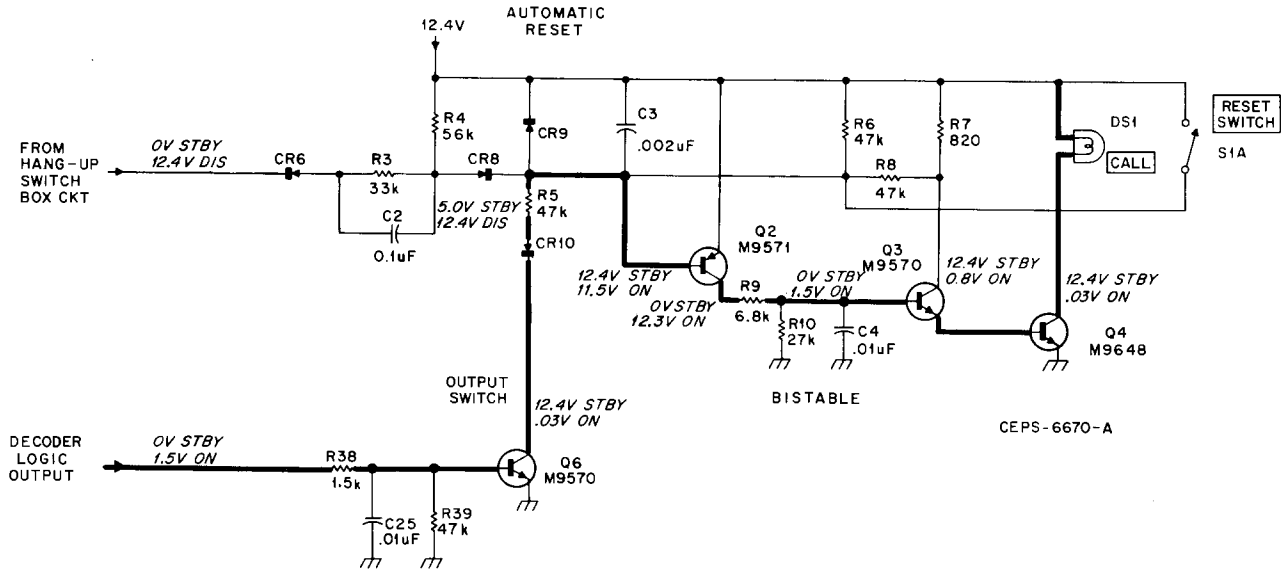


Figure 9.
CALL Light Switching Circuit

coupled to pin 10 on IC2 and, in this manner, the pulsating alert tone will be generated.

Falsing protection against tone reversal is inherent in the IC circuit. If tone 2A should come in first, the output of the tone 2A integrator will remain low for only approximately three seconds. When tone 1A comes in, the inherent delay designed into the circuit (previously described) will not produce a low at pin 11 until after the low from tone 2A has disappeared. Therefore, the AND gate will not operate. If tones 1A and 2A happen to come in simultaneously, falsing protection is provided by the fact that although the outputs of tone 2A integrator and pin 13 are low; pin 11 is high. Therefore the inputs to the AND gate are dissimilar and it will not operate.

c. CALL Light Switching (Refer to Figure 9)

The high output from the AND gate is coupled to the base of output switch Q6 and causes it to conduct. When it conducts, it effectively places a ground at its collector. This effective grounding of R5 through CR10 causes the base voltage of Q2 to drop and Q2 turns on. The conduction of Q2 biases Q3 and Q4 into conduction. The conduction of Q3 effectively grounds R8 which latches Q2 on. The conduction of Q4 effectively grounds one side of CALL lamp DS1 and places 12.4 volts across the lamps. The lamps will go on and remain on until reset. One method used to extinguish the lamp is to depress reset switch S1A. This action places 0 volt across the base-emitter junction of Q2 and stops its conduction. With Q2 cut off, Q3 and Q4 will be biased into cut-off. This removes the effective ground from DS1 and the lamp will go out.

d. Receiver Unmuting (Refer to Figure 10)

The incoming call also unmutes the receiver so the alert tone may be heard (tone only operation). For tone and voice operation, the receiver remains unmuted until the decoder is reset.

When a call is received, Q8 remains on as long as the second tone is present and the collector of Q6 is low. The high collector voltage of Q8 is coupled through R51 to the base of Q9 and causes this stage to conduct. The collector of Q9 drops to near zero volts and cuts off Q10. With tone only operation (pin 22 connected to pin 10) reed switch K1 remains de-energized as long as Q10 is cut off. Consequently, the radio set will remain unmuted only until the second tone has disappeared and the collector of Q6 goes high (Q8 cuts off).

For tone and voice operation, pin 22 is connected to the CALL light circuit (collector of Q4). With a tone coming through, the collector of Q4 remains low until reset. This low is connected through pins 4 and 22 to the base of Q10 and holds this stage cut off. Therefore, K1 remains de-energized and the radio set stays unmuted until the decoder is reset. The condution time of Q8, which only continued until the disappearance of the tone signal, has no effect on the cut-off time of Q10 in the tone and voice mode of operation.

e. Lights and Horn Relay Circuits (Refer to Figure 11)

The incoming call will activate the horn relay for the duration of the alert tone if the HORN switch is on. It will activate the lights relay until the decoder is reset if the LIGHTS switch is on.

When the proper code is detected and output switch Q6 is switched on, its collector is effectively grounded. This causes conduction from ground to 12.4 volts through voltage divider CR11, R49, R48 and Q11 (which is switched on during stand-by and "on" modes). A bias is developed for horn relay driver Q8 to turn on that stage. With Q8 switched on, 12.2 volts is applied to the coil of horn relay K2 (if the HORN switch is closed). When the paging tones end and output switch Q6 turns off, Q8 also switches off and horn relay K2 de-energizes.

When the incoming code activates the CALL light, a switched ground from that circuit is applied through a voltage divider (CR14, R57, R56, Q11) to the base of lights relay driver Q12 which turns it on. Q12 provides a switched 12.2 volts to the coil of lights relay K3 (if the LIGHTS switch is closed). Since the CALL light circuit remains activated until reset, the lights relay circuit also remains activated for that period.

If the microphone is lifted off-hook before the end of the alert tone, the horn and lights relay operation is stopped immediately. During standby (on-hook) operation, relay disable switch Q11 is on which allows the 12.4 volts to be available to Q8 and Q12. The disable (off-hook) condition removes the bias from Q11 and it switches off. The source of operating potential for Q8 and Q12 is removed and relays K2 and K3 are de-energized. Therefore, the horn and lights alerting devices are deactivated.

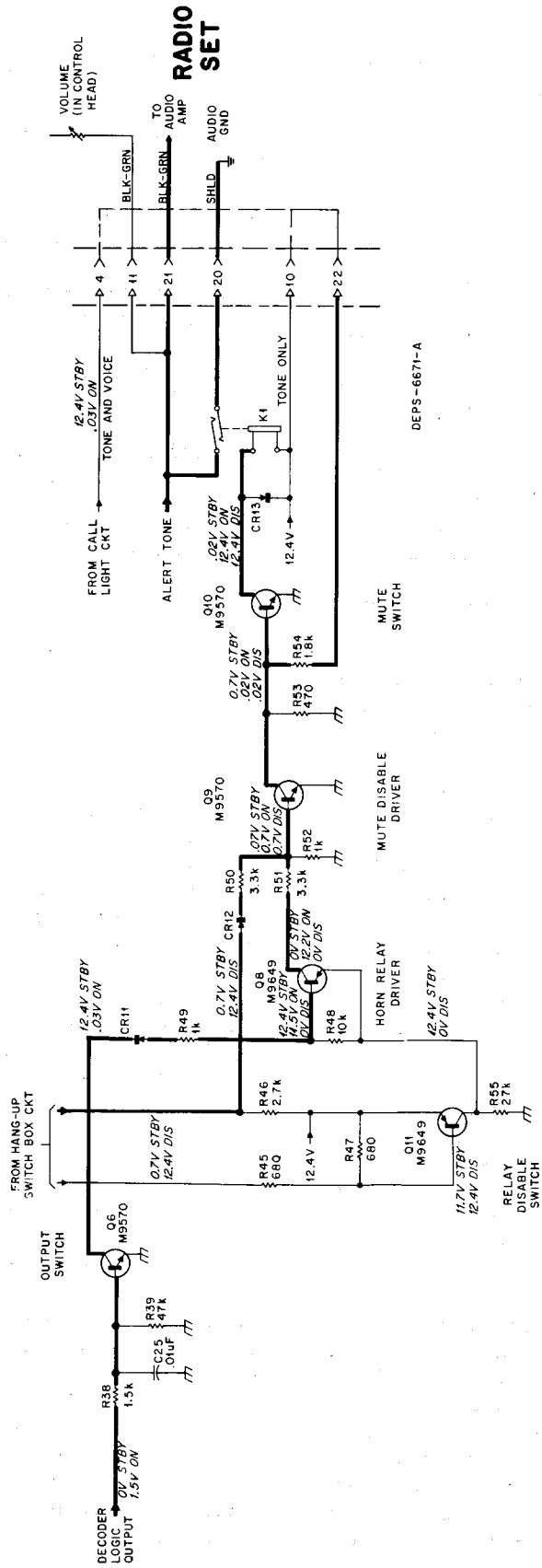


Figure 10.
Receiver Unmuting

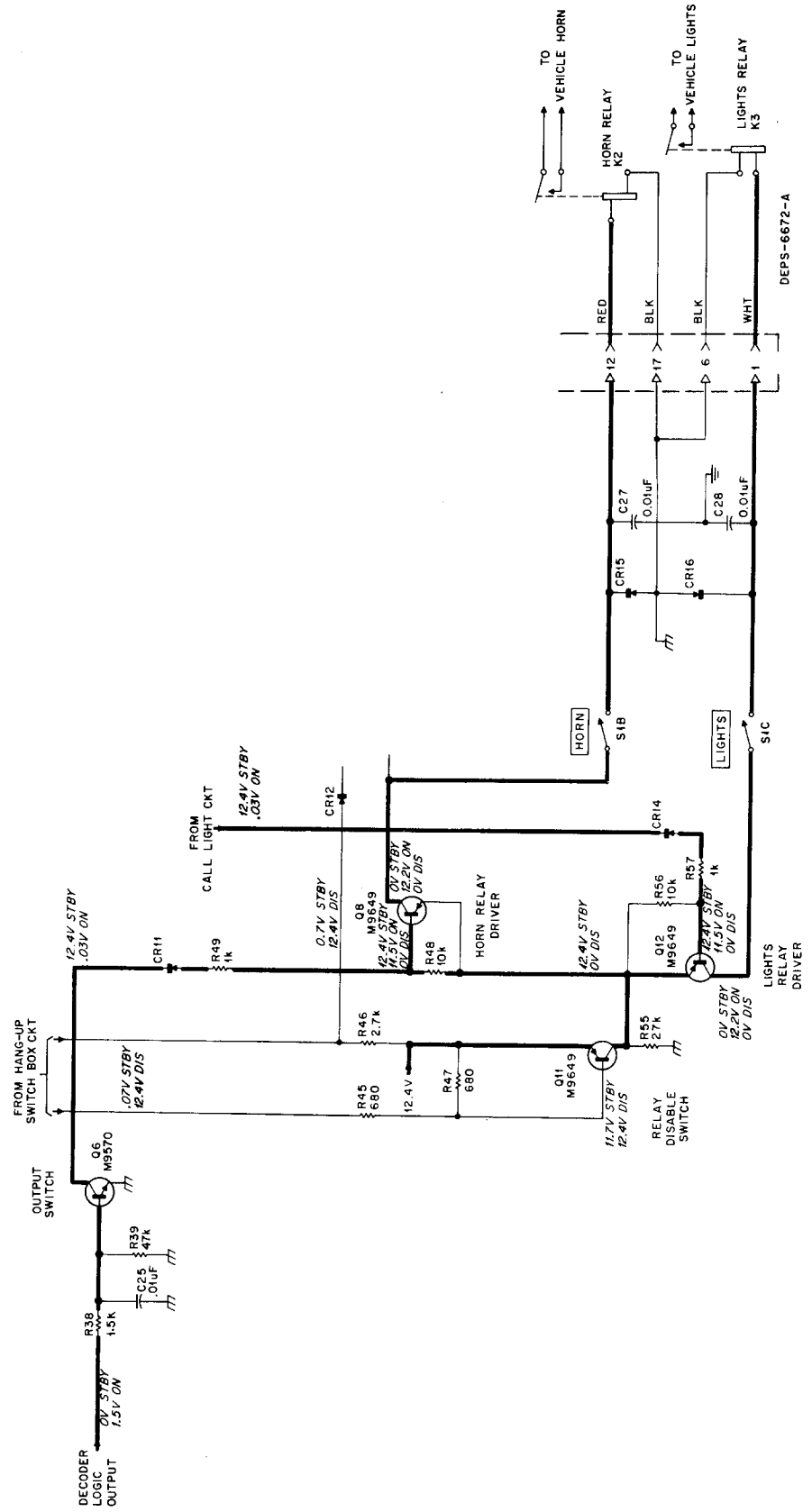


Figure 11.
Lights and Horn Relay Circuits

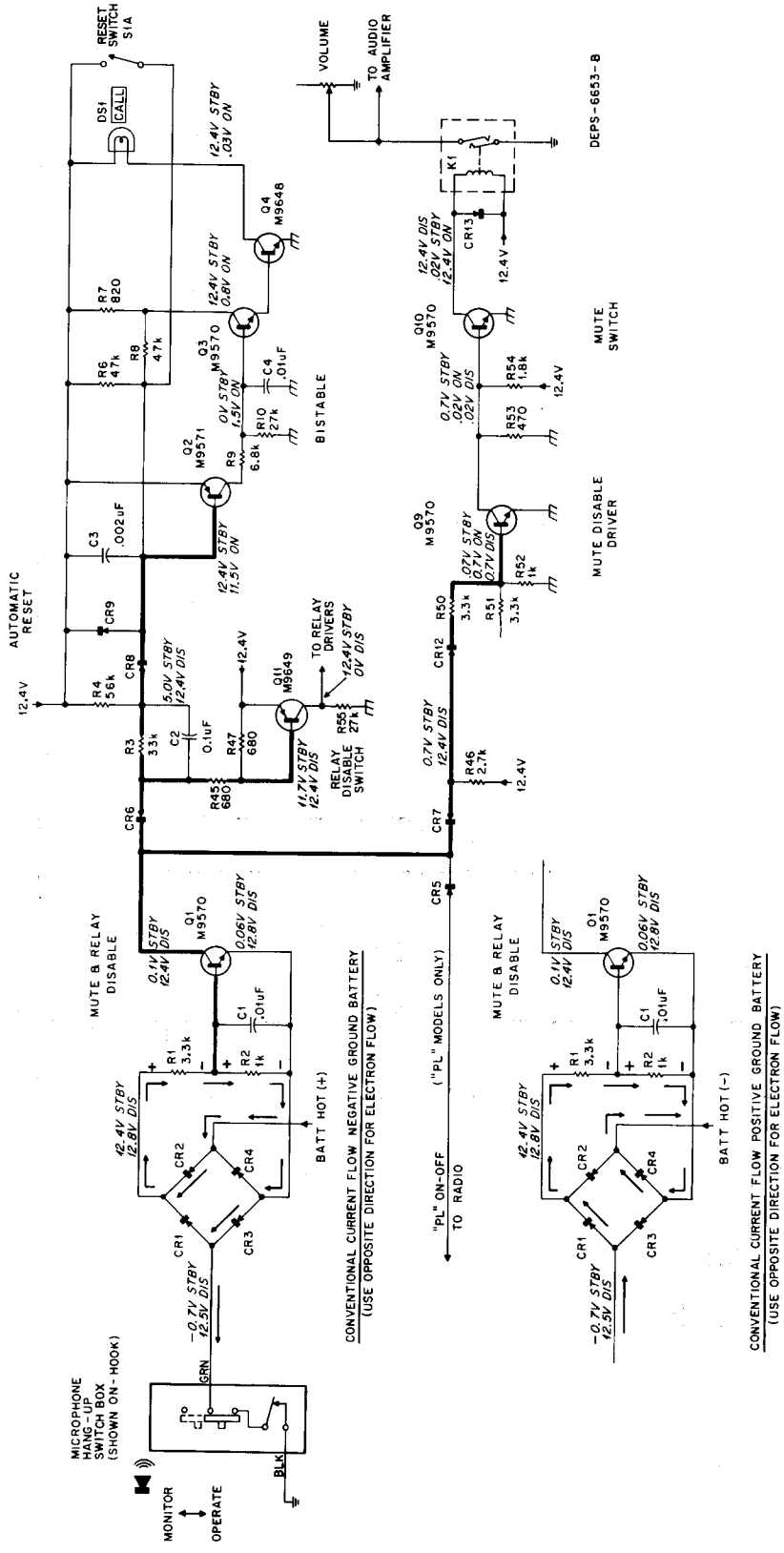


Figure 12.
Channel Monitoring and Automatic Reset

f. Channel Monitoring and Automatic Reset (Refer to Figure 12)

When the microphone is lifted off-hook or the monitor-operate switch is placed in the monitor ( ) position, the receiver is unmuted to allow monitoring of the channel (disable mode). If a call has been previously received, the decoder will also reset; that is, the CALL light goes off and the lights relay is de-energized. When the microphone is returned on-hook and the monitor-operate switch is returned to the operate position (both conditions must be met), the receiver is again muted and the decoder is ready to receive the next call. This is the standby mode. The following circuits provide this operation.

Vehicle ground is connected to the microphone hang-up switch box. If the microphone is on-hook and the monitor-operate switch is in the operate position, the decoder is in the standby mode. Ground is routed to the diode bridge in this mode. The ground completes a circuit path from battery ground through the diode bridge and bias network resistors R1 and R2, turning on mute & relay disable switch Q1. The diode bridge allows the same circuit operation from either a negative ground or positive ground electrical system. With Q1 on, its collector voltage is at decoder ground. This voltage enables the voltage divider composed of CR6, R3 and R4, which reverse biases diode CR8 and allows capacitor C2 to be charged to 5 volts. The low collector voltage of Q1 also forward biases diode CR7, which holds the anode voltage of CR12 low (reverse bias).

When the microphone is lifted off-hook or the monitor-operate switch is placed in the monitor position, the ground path to the diode bridge is interrupted and the entire circuit floats at battery hot potential. Since no current flows through the bias voltage network R1 and R2, the forward bias for Q1 is lost and Q1 turns off. Its collector voltage rises to 12.4 volts which disables the voltage dividers of which CR6 and CR7 were included. Capacitor C2 discharges its 5-volt charge in addition to the rise to 12.4 volts at the collector of Q1. This voltage forward biases CR8, which reverses the state of bistable Q2/Q3 and turns off the CALL light. This action of course, also turns off the lights relay if it was previously on. This eliminates the need to push the CALL button to reset the decoder if a reply is to be made.

When the conduction of diode CR7 is cut off by the lifting of the microphone from the hang-up switch box, diode CR12 becomes forward biased. This, in turn, activates mute disable driver Q9 which allows the mute reed switch K1 to be de-energized. Its contacts open to unmute the receiver. When the microphone is returned on-hook, the receiver is again muted.

The switched ground output from Q1 is also routed to the radio set on "Private-Line" models so that channel monitoring not only disables the mobile paging decoder, but also disables the "Private-Line" decoder in the radio set as well.

g. Power Input and Voltage Regulator Circuit (Refer to Figure 13)

The decoder will operate from a negative ground or positive ground electrical system with no change of connections. Decoder ground is isolated from vehicle ground (and radio set ground) and no attempt should be made to make both grounds common. Vehicle ground is approximately -0.7 volt with respect to decoder ground in a negative ground system and +13.1 volts in a positive ground system.

Vehicle battery voltage is applied across a diode bridge circuit which permits operation from either negative or positive ground electrical systems. The lamp across the input power terminals gives low level illumination for the HORN and LIGHTS switches identification. This gives a low glare-free illumination that is visible only in dim or dark lighting conditions. The input power to the decoder is turned on and off whenever the radio is turned on and off.

The diode bridge provides a +12.4-volt output in respect to decoder ground. The 12.4-volt unregulated output is used for the stages requiring higher power such as the relay drivers and switching transistors. Zener diode CR21 establishes a regulated reference voltage at the base of voltage regulator transistor Q13. Transistor Q13 provides a regulated 7.5-volt output which is used by the audio amplifier stages, including the reed driver integrated circuit IC1. A voltage divider network (R361, CR22, and CR23) develop a regulated 1.5-volt output, using the regulated 7.5-volt output as a source of power. The 1.5-volt output is used by the decoder integrated circuits IC2 and IC3.

7. MAINTENANCE

Maintenance of the mobile paging decoder falls into two areas; testing and troubleshooting. Testing is performed either in-system or on the service bench.

a. In-System Testing

Performing a checkout of the circuit card while it is still connected into the radio system

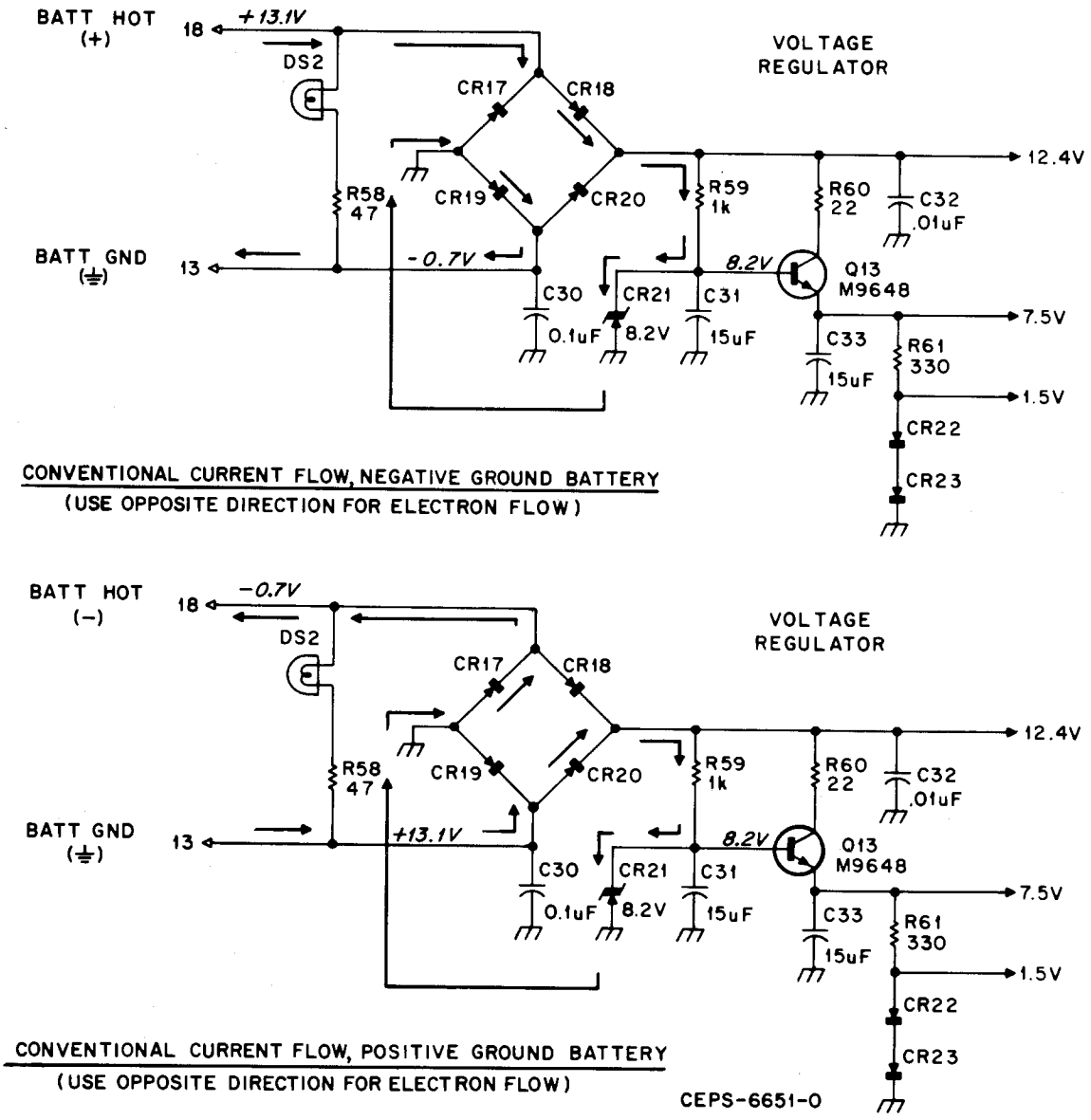


Figure 13.
Power Input and Voltage Regulator Circuit

necessitates removing the circuit card from the "Systems 90" housing. This is accomplished as follows:

(1) Disconnect the green connector from the circuit card.

(2) Loosen the two captive screws securing the rear housing cover and remove the cover.

(3) Slide the circuit card out of the housing assembly and place it atop the housing with the solder side up.

(4) Reconnect the green connector to the circuit card.

CAUTION

Do not allow the circuit card to come into contact with any metallic object which may cause damage from an accidental short circuit.

(5) Apply power to the system and proceed to take the voltage measurements necessary to isolate the source of the problem.

b. Bench Testing

Bench testing allows the radio system to stay "in-service" by substituting an operational circuit card for a defective one, while the malfunction is corrected on the service bench. The following equipment is required for a thorough circuit check-out.

- DC power supply.
- Motorola TEK-34C Tone Generator with the required "Vibrasender" resonant reeds.
- Service bench VTVM.
- General purpose Oscilloscope.
- Two short jumper wires terminated in alligator clips.

To perform the bench check proceed as follows:

(1) Remove the green connector from the rear of the circuit card.

(2) Loosen the captive screws securing the rear housing cover and remove the cover.

(3) Remove the circuit card from the housing.

(4) Set up the circuit card as shown in Figure 14, connecting jumper JU1 between pins 19 and 13 and JU2 between pins 22 and 4.

NOTE

JU1 is used to simulate the condition caused by placing the microphone "on-hook". JU2 is used to determine tone only or tone and voice modes and is connected for tone and voice.

(5) Set the tone generator output level for 0.35 V ac.

(6) Depress the CALL button to reset the decoder.

(7) Connect the ohmmeter between pins 20 and 21.

(8) Depress the TONE 1 switch on the generator, release and quickly depress the TONE 2 switch.

NOTE

No more than 1/2 second should elapse between the release and acutation of the next switch.

(9) Observe the following indications.

- The ohmmeter indicates open.
- Pulsating 1500 Hz ±100 Hz sine wave displayed on the oscilloscope.
- CALL light is illuminated.

(10) Depress the CALL button and observe the following:

- CALL light goes "off".
- Ohmmeter indication returns to zero (short).

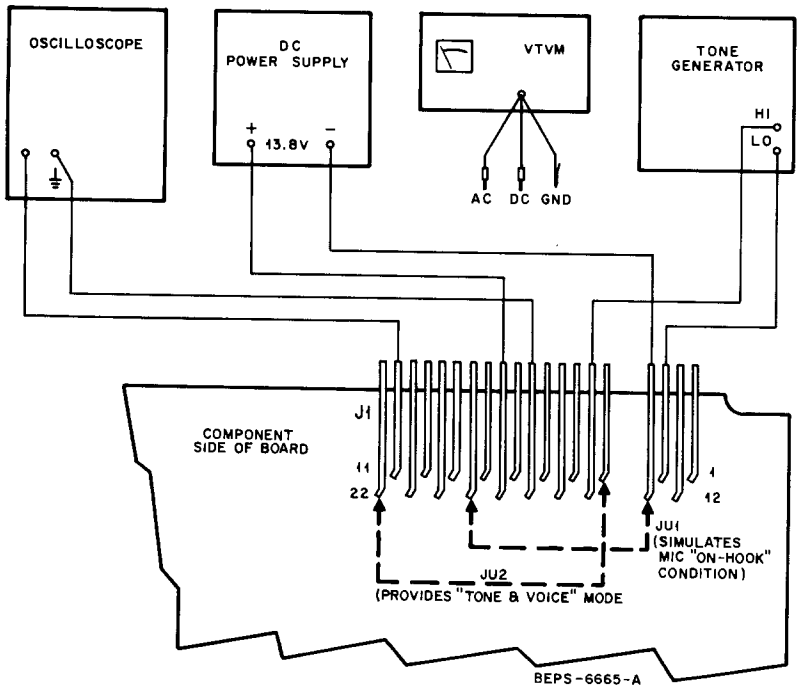
(11) Again operate the tone generator to send the proper code and observe the same indications as in step (9).

(12) Remove JU1 (simulating microphone "off-hook") and verify the CALL light goes "off".

(13) Reconnect JU1 between pins 19 and 13 and note that the ohmmeter indicates zero.

(14) Connect the dc voltmeter between pins 12 (+) and 17 (-).

(15) Depress the HORN and LIGHTS switches, and note the voltmeter indicates 0 volt.



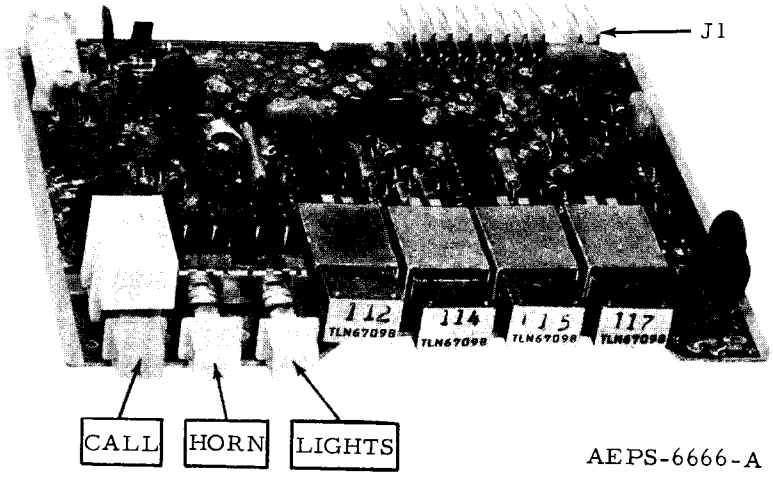


Figure 14.
Bench Test Set-Up

(16) Operate the tone generator to send the proper code and verify voltmeter indicates 12.2 volts for approximately 2.5 seconds.

(17) Move the voltmeter to measure between pins 1(+) and 6(-). This point should also give a 12.2-volt indication.

(18) Depress the CALL switch and note voltmeter indication drops to zero.

(19) To check four-reed models, perform steps (5) through (7) and then depress the TONE 3 switch, release and depress the TONE 4 switch. Observe the indications listed in step (9).

(20) Reverse the power supply connections and repeat steps (5) through (10) to test positive ground operation.

c. Troubleshooting

A troubleshooting chart is provided as an aid in isolating the cause of any malfunction attributed to the decoder circuits. This chart presents a logical sequence of steps which result in isolating a faulty component or circuit. Refer to this chart when attacking any problem caused by this unit.

d. Repair

Any component on the circuit card can be replaced by following accepted repair procedures. Refer to the "Micor" radio instruction manual for information pertaining to ordering replacement parts. Upon completion of repairs, the circuit card is reinstalled as follows:

(1) Disconnect the green connector from the circuit card.

(2) Slide the card completely into the housing.

(3) Install the rear housing cover and secure with two captive screws.

(4) Reconnect the green connector to the circuit card.

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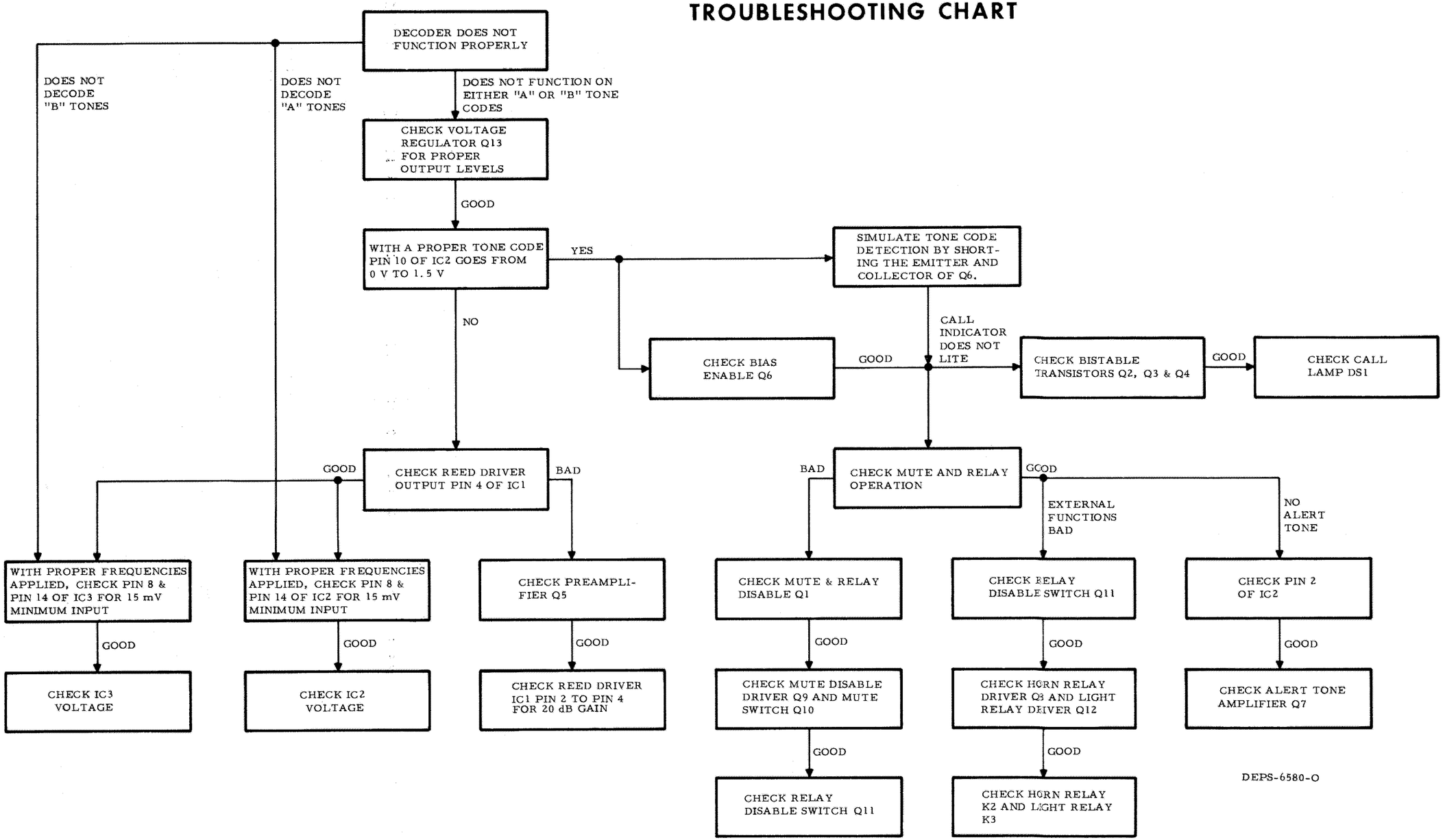
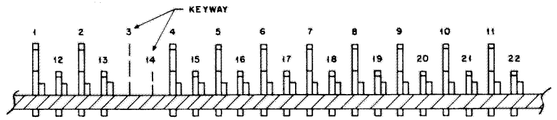
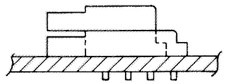
MOBILE PAGING DECODER TROUBLESHOOTING CHART



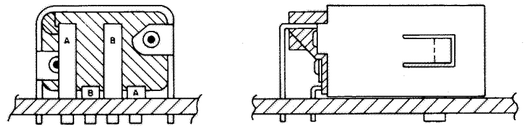
DEPS-6580-O



VIEW FROM BACK EDGE OF BOARD
J1



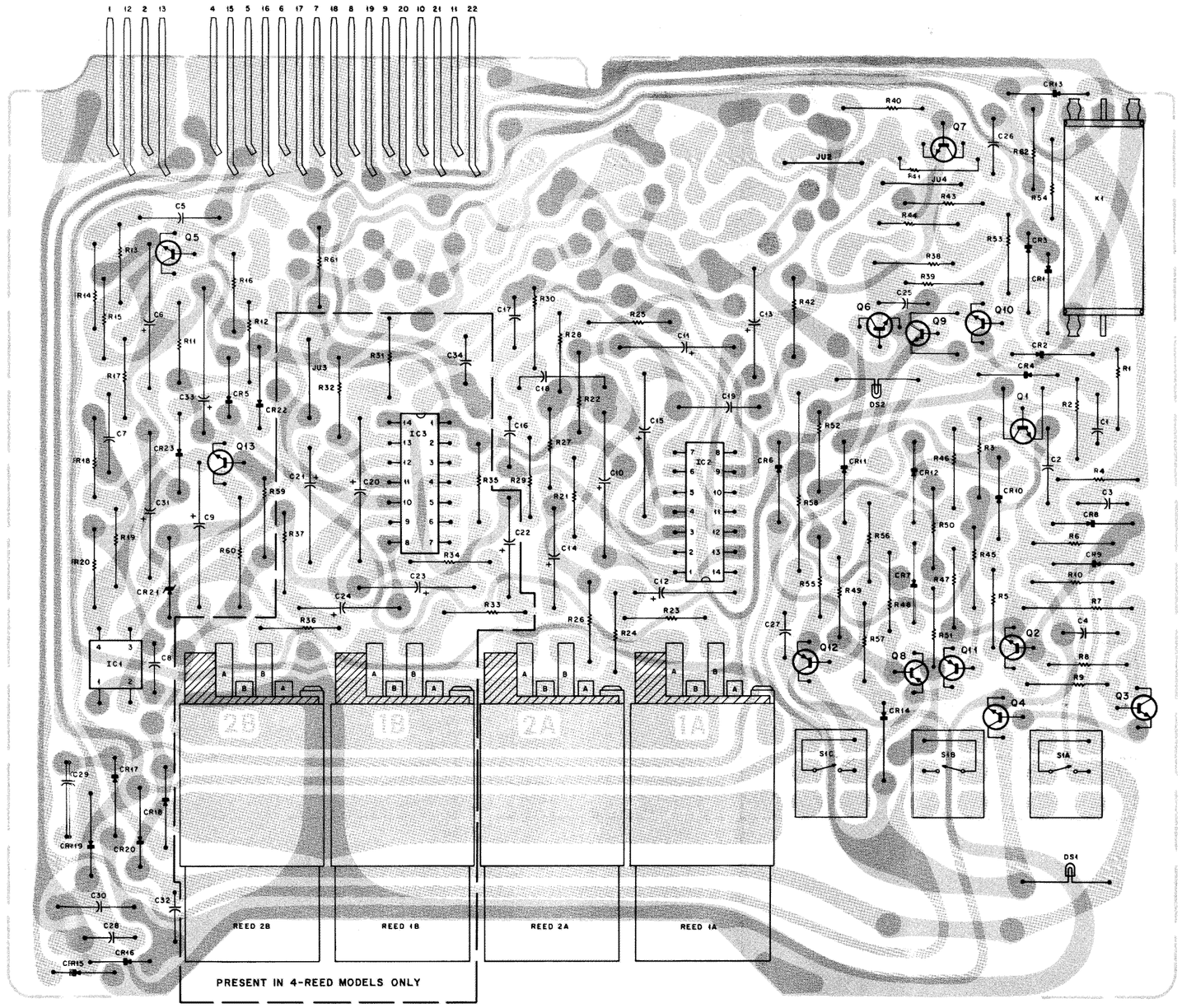
SIDE VIEW
J1



BACK VIEW

SIDE VIEW

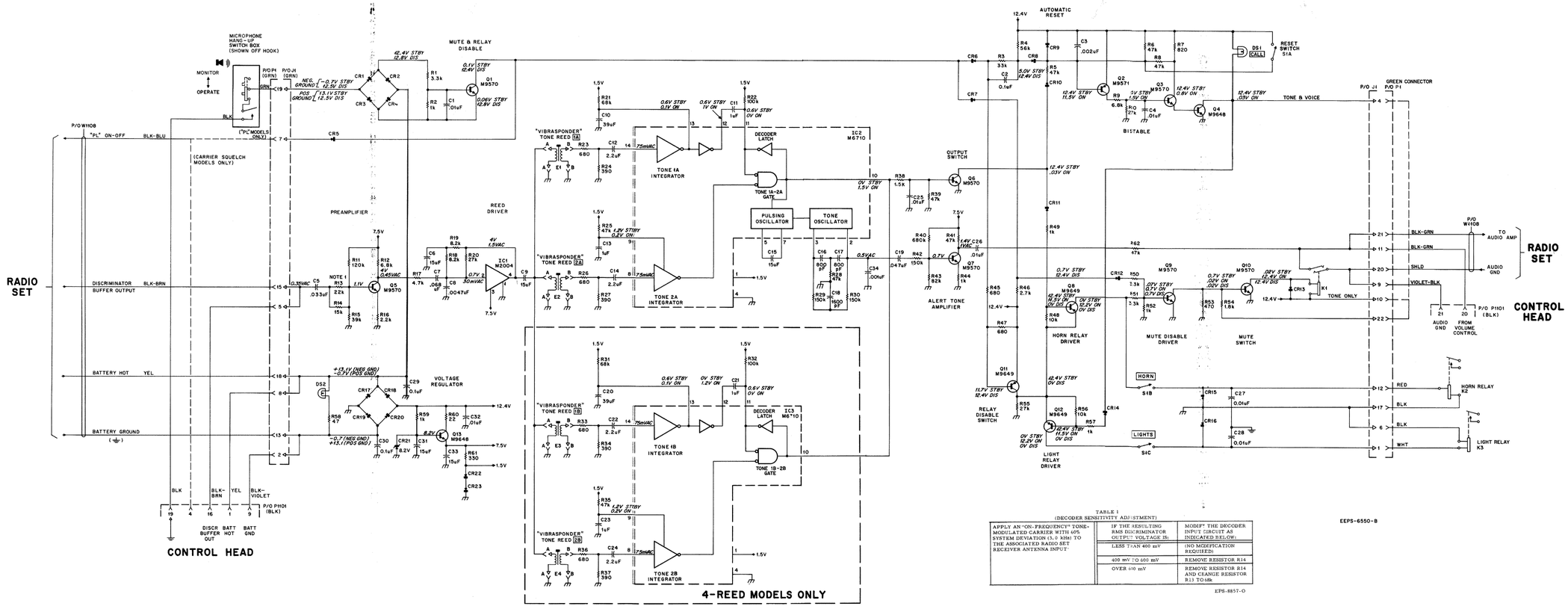
P1 REED SOCKET DETAIL



Circuit Board Detail
Motorola No. PEPS-6589-A
5/7/71-NPC

COMPONENT SIDE
SOLDER SIDE

OL-EEPS-6588-A



NOTES:

1. REFER TO TABLE 1 CONCERNING DECODER SENSITIVITY ADJUSTMENT.
2. WHERE MORE THAN ONE DC VOLTAGE READING APPEARS: STBY = STANDBY, MICROPHONE ON-HOOK AND MONITOR-OPERATE SWITCH IN OPERATE POSITION, DECODER HAS BEEN RESET.
   ON = PROPER TONE CODE RECEIVED
   DIS = DISABLED, MICROPHONE OFF-HOOK OR MONITOR-OPERATE SWITCH IN MONITOR POSITION.
3. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (11 MEGOHM) DC VOLTMETER. ALL MEASUREMENTS WITH RESPECT TO DECODER GROUND.
4. AC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. ALL RMS MEASUREMENTS MADE WITH RESPECT TO DECODER GROUND.
5. = BATTERY GROUND
   = DECODER GROUND

EPS-6584-A

TABLE 1
(DECODER SENSITIVITY ADJUSTMENT)

APPLY AN "ON-FREQUENCY" TONE-MODULATED CARRIER WITH 60% SYSTEM DEVIATION (3.0 kHz) TO THE ASSOCIATED RADIO SET RECEIVER ANTENNA INPUT	IF THE RESULTING RMS DISCRIMINATOR OUTPUT VOLTAGE IS:	MODIFY THE DECODER INPUT CIRCUIT AS INDICATED BELOW:
	LESS THAN 400 mV	(NO MODIFICATION REQUIRED)
	400 mV TO 600 mV	REMOVE RESISTOR R14
	OVER 600 mV	REMOVE RESISTOR R14 AND CHANGE RESISTOR R13 TO 68k

EPS-8857-O

EEPS-6550-B

MODEL AND SUFFIX TABLE

MODEL	SUFFIX	DESCRIPTION
TLN1190A		MOBILE PAGING DECODER (4-REED)
TLN1191A		MOBILE PAGING DECODER (2-REED)

ITEM	SUFFIX	DESCRIPTION				
TLN4522A		DECODER BOARD (4-REED)	X			
TLN4523A		DECODER BOARD (2-REED)		X		
TKN6503A		CABLE ASSEMBLY	X	X		
TLN4533A		FIREWALL RELAYS	X	X		
TLN4510A		HDW & ESCUTCHEON	X	X		
*TLN4346A		MIC, HANG-UP SWITCH BOX	X	X		
*TLN6709B		"VIBRASPONDER" REED	4	2		

EPS-6652-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Mobile Paging Decoder
Schematic Diagram
Motorola No. 63P81102E28-C
7/20/73-NPC

REVISIONS

63P81102E28-C

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN1390A TLN1391A	DS1	FROM 65C84326C01 TO 65C84047E01	PARTS LIST	NONE

PARTS LIST

TLN1390A Mobile Paging Decoder (4-Reed)
TLN1391A Mobile Paging Decoder (2-Reed) PL-1180-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 15 V; unl. stated
C1	21D82428B59	.01 +80-20%; 200 V
C2	21C82372C01	0.1 +80-20%; 25 V
C3	21D82428B25	.002 ±20%; 500 V
C4	21D82428B59	.01 +80-20%; 200 V
C5	8D8Z905G08	.033; 50 V
C6	23D83214C27	15 ±20%; 25 V
C7	8D82905G04	.068; 50 V
C8	21D82428B09	.0047; 100 V
C9	23D83214C27	15 ±20%; 25 V
C10	23D83214C29	39; 10 V
C11	23D83214C28	1 ±20%
C12	23D84762H04	2.2
C13	23D83214C28	1 ±20%
C14	23D84762H04	2.2
C15	23D83214C27	15 ±20%; 25 V
C16	21C82633E15	800 pF ±5%; 100 V
C17	21C82633E15	800 pF ±5%; 100 V
C18	21E82537B37	1600 pF ±5%; 100 V
C19	8D8Z905G03	.047; 50 V
C20	23D83214C29	39; 10 V (4-reed models only)
C21	23D83214C28	1 ±20% (4-reed models only)
C22	23D84762H04	2.2 (4-reed models only)
C23	23D83214C28	1 ±20% (4-reed models only)
C24	23D84762H04	2.2 (4-reed models only)
C25	21D82428B59	.01 +80-20%; 200 V
C26	21D82428B59	.01 +80-20%; 200 V
C27	21D82428B59	.01 +80-20%; 200 V
C28	21D82428B59	.01 +80-20%; 200 V
C29	21C82372C01	0.1 +80-20%; 25 V
C30	21C82372C01	0.1 +80-20%; 25 V
C31	23D83214C27	15 ±20%; 25 V
C32	21D82428B59	.01 +80-20%; 200 V
C33	23D83214C27	15 ±20%; 25 V
C34	21D82187B20	.001
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48C83654H01	silicon
CR2	48C83654H01	silicon
CR3	48C83654H01	silicon
CR4	48C83654H01	silicon
CR5	48C83654H01	silicon
CR6	48C83654H01	silicon
CR7	48C83654H01	silicon
CR8	48C83654H01	silicon
CR9	48C83654H01	silicon
CR10	48C83654H01	silicon
CR11	48C83654H01	silicon
CR12	48C83654H01	silicon
CR13	48C83654H01	silicon
CR14	48C83654H01	silicon
CR15	48C83654H01	silicon
CR16	48C83654H01	silicon
CR17	48D82466H13	silicon
CR18	48D82466H13	silicon
CR19	48D82466H13	silicon
CR20	48D82466H13	silicon
CR21	48D82256C16	silicon; Zener type; 8.2 V
CR22	48C83654H01	silicon
CR23	48C83654H01	silicon
		LAMP,
DS1	65C84047E01	Lamp Assy. (encapsulated)
DS2	65B83554G01	incandescent: min. wedge base; 12 V; 0.19 A; type No. 161
		"VIBRASPONDER" RESONANT REED: (SEE NOTE)
E1	TLN6709B	"plug-in" unit
E2	TLN6709B	"plug-in" unit
E3	TLN6709B	"plug-in"unit (4-reed models only)
E4	TLN6709B	"plug-in"unit (4-reed models only)
		INTEGRATED CIRCUIT:
IC1	51R84320A04	type M2004
IC2	51R84267A10	type M6710
IC3	51R84267A10	type M6710 (4-reed models only)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J1		CONNECTOR, receptacle: c/o contact terminals mounted on edge of circuit board, as follows: 28C84269C01 TERMINAL, contact: narrow mounting tab (lower row) 28C84269C02 TERMINAL, contact: wide mounting tab (upper row)
K1	80D84082A01	RELAY, magnetic reed: 8.0 to 16.5 V; 1 form "A"; coil res 820 ohms ±10%
K2	59K813674	RELAY, armature: 12 V; 1 form "A"; coil res 85 ohms ±10%
K3	59K813674	12 V; 1 form "A"; coil res 85 ohms ±10%
P1		CONNECTOR, plug: incl. 14C84556B03 BODY, 9C84151B01 TERMINAL, contact
Q1	48R869570	TRANSISTOR: (SEE NOTE) N-P-N; type M9570
Q2	48R869571	P-N-P; type M9571
Q3	48R869570	N-P-N; type M9570
Q4	48R869648	N-P-N; type M9648
Q5	48R869570	N-P-N; type M9570
Q6	48R869570	N-P-N; type M9570
Q7	48R869570	N-P-N; type M9570
Q8	48R869649	P-N-P; type M9649
Q9	48R869570	N-P-N; type M9570
Q10	48R869570	N-P-N; type M9570
Q11	48R869649	P-N-P; type M9649
Q12	48R869649	P-N-P; type M9649
Q13	48R869648	N-P-N; type M9648
		RESISTOR, fixed: ±5%; 1/4 W; unl. stated
R1	6S129981	3.3k
R2	6S129805	1k
R3	6S129526	33k
R4	6S128684	56k
R5	6S131527	47k
R6	6S131527	47k
R7	6S129818	820; 1/2 W
R8	6S131527	47k
R9	6S129237	6.8k
R10	6S129886	27k
R11	6S131446	120k
R12	6S129237	6.8k
R13	6S129299	68k
R14	6S129668	10k
R15	6S129777	39k
R16	6S129804	2.2k
R17	6S129669	4.7k
R18	6S129983	8.2k
R19	6S129983	8.2k
R20	6S129886	27k
R21	6S129299	68k
R22	6S124A97	100k
R23	6S129984	680
R24	6S124A39	390
R25	6S131527	47k
R26	6S129984	680
R27	6S124A39	390
R28	6S131527	47k
R29	6S128683	150k
R30	6S128683	150k
R31	6S129299	68k (4-reed models only
R32	6S124A97	100k (4-reed models only)
R33	6S129984	680 (4-reed models only)
R34	6S124A39	390 (4-reed models only)
R35	6S131527	47k (4-reed models only)
R36	6S129984	680 (4-reed models only)
R37	6S124A39	390 (4-reed models only)
R38	6S124A27	120
R39	6S129668	10k
R40	6S131857	680k
R41	6S131527	47k
R42	6S128683	150k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R43	6S124A95	82k
R44	6S129805	1k
R45	6S129984	680
R46	6S129707	2.7k
R47	6S129984	680
R48	6S129668	10k
R49	6S129805	1k
R50	6S129981	3.3k
R51	6S129981	3.3k
R52	6S129805	1k
R53	6S129709	470
R54	6S129820	1.8k
R55	6S129886	27k
R56	6S129668	10k
R57	6S129805	1k
R58	17C82350A02	47 ±10%; 1.5 W
R59	6S129805	1k
R60	6S124A09	22; 1/2 W
R61	6S129806	330
R62	6S131527	47k
		SWITCH ASSEMBLY, push:
S1	40D84324C04	3 independent sections; incl.
S1A		spdt; momentary action
S1B		spdt; alternate action
S1C		spdt; alternate action (pushbuttons are listed under NON-REFERENCED ITEMS)
		SOCKET,
XDS2	9C84285C01	Bulb Socket
XE1 thru 4	42B84116B02	"Vibrasponder" Resonant Reed: 4-contact
NON-REFERENCED ITEMS		
	13D84319C01	ESCUTCHEON
	38C84321C01	PUSHBUTTON (shadow pearl)
	38C84321C02	PUSHBUTTON (orange)
	14C84360C01	INSULATOR, Switch (3 req'd)
	14C84006D01	SPACER, (DS1/S1A)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

Replacement "Vibrasponder" Resonant Reeds must specify the reed code and frequency. Do not add reed frequencies to your system without consulting your Motorola Area Systems Engineer for assignment of tones that will provide the most satisfactory operation.

END OF DOCUMENT