LBI30784
(DF5048)

INSTRUCTION MANUAL

SPEEDCALL MODEL 4099 MOBILE DECODER

(GENERAL ELECTRIC PART NO. 19B209698P1)

May 1978

CAUTION

When Decoder PC boards are exposed, handle with special care to prevent damage to CMOS Integrated Circuits through discharge of static electricity with or without power applied. This condition usually exists in dry atmospheres and especially around nylon or wool carpets and clothing

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Model 4099 Mobile Decoder

SPECIFICATIONS

ELECTRICAL

INPUT

Format:	Standard 2-of-7 Touch-Tone
Receive Audio	
Signal Level:	20mV to 10Vrms (2 tones measured with an average-reading rms-calibrated meter)
Noise Threshold:	12.0dB SINAD will provide 95% or greater probability of decoding a correct address
CTCSS Rejection:	20.0dB @ 100 Hz; 10.0dB @ 260 Hz
Input Impedance:	30K Ohms nominal, DC blocked
Frequency Acceptance:	±1.5% of nominal tone frequencies
Tone Level Differential (Twist):	12.0dB if lesser tone is over 35mV rms
Data Rate:	0.4 to 12 digits per second (dps) (with 75 ms tone duration minimum; at rates below 2 dps, duty cycle should not exceed 50%)
Interdigit Interval:	2.5 seconds nominal
Code Capacity:	Up to 8 digits, field-programmable
Monitor Hookswitch:	When connected to A+ or open circuit, the decoder operates normally. When connected to A-, the receiver mute output cuts off, the Channel Guard Disable output is connected to A-, and the decoder is reset

OUTPUT

Receiver Mute:	Open-collector transistor, referenced to negative supply voltage; transistor is normally conducting and is cut-off upon receipt of a call until manually reset. Voltage rated at equal to or less than supply voltage. Current rated at 100mA maximum
Channel Guard Disable:	Open-collector transistor, referenced to negative supply voltage; transistor is normally cut-off and conducts upon receipt of a call until manually reset. Voltage is rated at equal to or less than supply voltage. Current is rated at 100mA maximum
Horn (Optional):	Open-collector transistor, referenced to negative supply voltage; transistor conducts for 2.5 seconds nominal upon receipt of a call. Voltage rated at equal to or less than supply voltage. Current rated at 500mA maximum

SPECIFICATIONS (Continued)

OUTPUT (Continued)

LITE (Optional)	Open-collector transistor, referenced to negative supply voltage; transistor conducts after receipt of a call until manually reset. Voltage rated at equal to or less than supply voltage. Current rated at 500mA maximum

POWER REQUIREMENTS

Voltage:	13.8VDC ±20%
Current	
Operate:	175mA @ 13.8VDC during the momentary output time with the CALL lamp ON and the receiver audio unmuted
	135mA @ 13.8VDC during the continuous output time with the CALL lamp ON and the receiver audio unmuted
Standby:	35mA @ 13.8VDC

ENVIRONMENTAL

Temperature	
Operating:	-30°C to +85°C
Storage:	-65°C to +105°C
Humidity:	0 to 95%, non-condensing

MODEL 4099 MOBILE DECODER

DESCRIPTION

SPEEDCALL Model 4099 is a dual-tone multi-frequency (DTMF) Decoder designed for selective calling applications using standard Touch-Tone format. The 4099 Decoder is an Option Module for installation in GENERAL ELECTRIC C-800/900 series Control Units for use in vehicles with 12 volt electrical systems. The 4099 may be used simultaneously with or without Channel Guard options.

Address codes are field-programmable with jumper wires by the user, and may consist of any number of digits up to eight. The 4099 will respond only to its programmed address code, and will reject all other signals. Upon receipt of its address code, the 4099 will alert the operator to the incoming call by illuminating the CALL lamp, energizing a sounder for approximately 2.5 seconds, and unmuting the receiver audio, if the muting feature is in use.

Pushbutton controls are provided for RESET and MONITOR functions. Optional pushbuttons are available for control of the external HORN and LITE functions. Depressing the momentary-action RESET pushbutton will return the unit to its pre-set condition following the receipt of a call. The alternate-action MONITOR pushbutton mutes the receiver audio until a call is received, or permits the operator to selectively monitor the radio channel.

The CALL lamp and pushbuttons protrude through openings in the front panel of the Control Unit. The MONITOR and optional pushbuttons are backlighted with Light Emitting Diodes. The LED's normally glow at reduced intensity until the pushbutton is depressed, then increase to full intensity. The RESET pushbutton does not increase in intensity when depressed.

Group-Call and All-Call circuitry in the 4099 allows it to respond to a five-second tone duration of the first or subsequent digits of its programmed address code, as well as to its full address code. In order to differentiate between individual calls and all-or-group calls, the momentary output and sounder are energized steadily for approximately 2.5 seconds upon receipt of an individual call, and interuppted at approximately a 3 pulses-per-second (pps) rate upon receipt of an all-or-group call.

Command Reset circuitry is also included. The 4099 can be programmed to allow the calling station to extinguish the CALL light, de-energize the sounder, and re-mute the receiver audio. When so programmed, sending the Touch-Tone asterisk (*) as a suffix to the address code will reset the 4099 to cancel the call.

PROGRAMMING INSTRUCTIONS

Each Model 4099 must be programmed to respond only to its address code and to reject all other signals. Programming is accomplished by making cross-connections with jumper wires in the programming pin field on the PC board. Each jumper is color-coded to correspond to the EIA Color Code. Thus, brown will be the first digit, red the second digit, etc. Following the EIA Color Code will reduce the probability of errors while programming the unit, and will make it easier to check the address code at any later time.

All decoders operating in a system should contain the same number of digits in the address codes to avoide false responses. As an example, if a decoder is programmed for 123 and another is programmed for 10253, the first unit will most likely respond to the address code of the second decoder due to the appearance of its digits in the longer code. This will be avoided by programming the same number of digits in all decoders within a system.

Figure 1 illustrates the 4099 PC board on which the address code is programmed. The register pins (R1 - R9) represent the position of each digit in the code. A multiple pin (M1 - M9) is located adjacent and connected by PC trace to the register pin to permit duplication of numbers in the address code. The digit pins (D1 - D#) correspond to the numeric value of each digit in the code. Addresses may be programmed for as many digits as required by the system operation, up to a maximum of 8, and re-programmed as system requirements change.

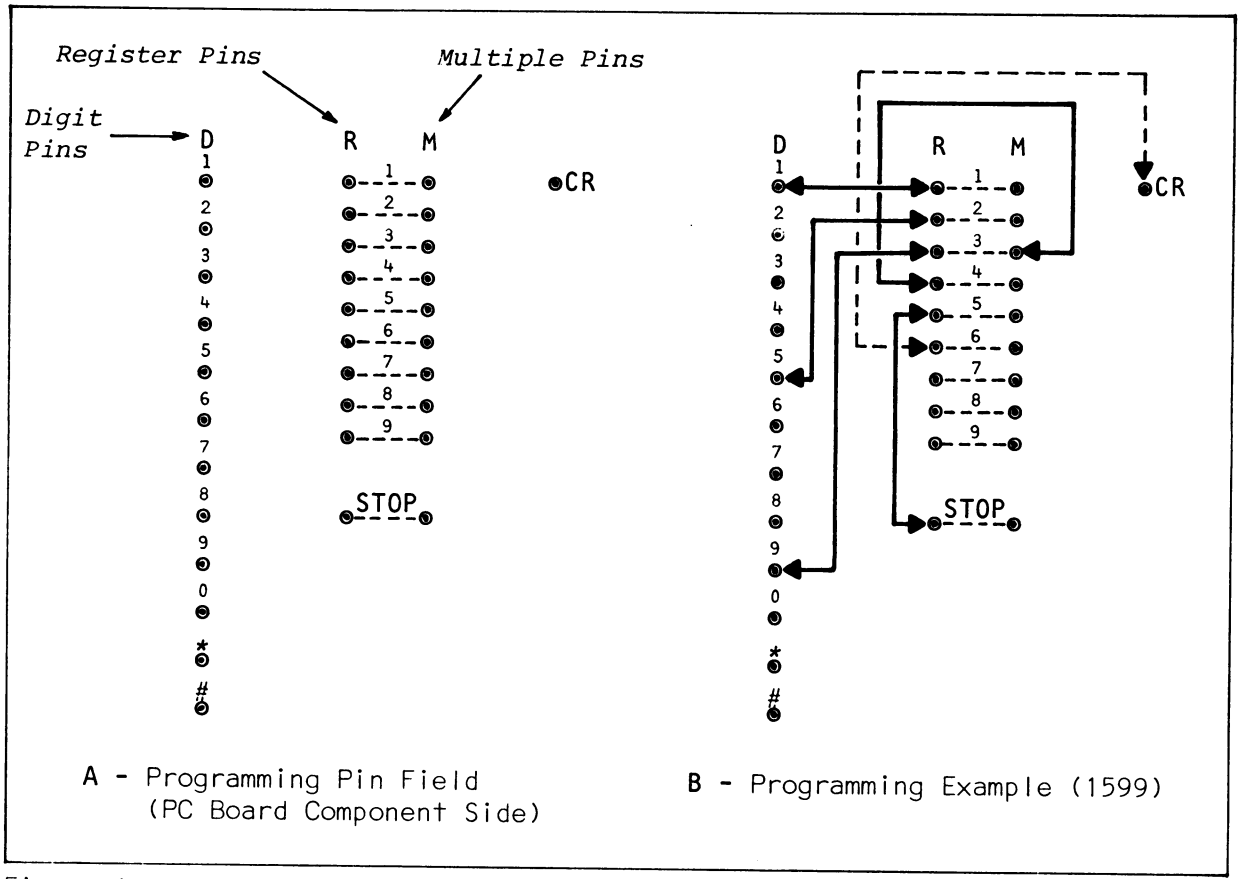


Figure 1 - Model 4099 Decoder Programming Pin Field and Example

To program the address code 1599 in the Model 4099, as illustrated in Figure 1, proceed as follows:

1. Connect a brown jumper from R1 to D1 to program the digit **1**
2. Connect a red jumper from R2 to D5 to program the digit **5**
3. Connect an orange jumper from R3 to D9 to program the digit **9**
4. Connect a yellow jumper from R4 to M3. This forma a series circuit through R3 and the orange jumper to D9 to duplicate the digit **9**
5. Connect a green jumper from R5 to the STOP pin. This connection will always be from the next available register pin following the last digit of the address code to the STOP pin. This allows the 4099 to recognize the last digit of the address and to operate its outputs as well as reset the digit counter to the zero count

The jumper shown in dotted lines in Figure 1 between R6 and the CR pin is explained in the next paragraph entitled "COMMAND RESET".

COMMAND RESET (CR)

If the Command Reset feature is to be used, connect the next available register pin following the STOP function to the pin marked "CR" (refer to the Component Assembly Drawing in Figure 5 for location of the CR pin). As shown in Figure 1, R6 would be connected to the CR pin with a blue jumper. When programmed in this manner, receipt of the address code 1599 will light the CALL lamp, energize the internal sounder, and unmute the receiver audio. The subsequent receipt of the address code with an asterisk suffix (1599*) will extinguish the CALL lamp, de-energize the sounder, and re-mute the receiver audio.

ADJUSTMENTS AND STRAPPING

ADJUSTMENTS

The Model 4099 Decoder requires no pre-installation adjustments. However, when used in FM or PM radio systems, the associated receiver and transmitter must be properly netted on frequency with the system. Unnetted systems produce distortion which may cause erratic operation of the decoder.

Touch-Tone encoders used to address the 4099 Decoder in FM or PM systems should be adjusted for a maximum peak deviation output level of no more than 2/3 of full system deviation. If this level is exceeded, the distortion caused by clipping in the audio stages of the transmitter may result in erratic operation of the decoder.

STRAPPING REQUIREMENTS

When Touch-Tone and Channel Guard decoders are both present in a system, two types of operation can be provided:

- Touch-Tone **AND** Channel Guard
- Touch-Tone **OR** Channel Guard

Operation with Touch-Tone **AND** Channel Guard

In the **AND** configuration, or when Touch-Tone is used without Channel Guard, and when the microphone/handset is on-hook, both Touch-Tone and Channel Guard must be properly received to unmute the receiver audio and allow it to function in normal noise squelch operation. Should a valid Touch-Tone address be received at the same time as an incorrect Channel Guard tone, the CALL lamp will illuminate and the sounder will be energized, but the receiver audio will not unmute. In this case, reset the 4099 Decoder using the RESET switch.

When used in the **AND** configuration, or when used with Touch-Tone only,

- connect a jumper between pads E6 and E7 on the 4099 PC board, and
- connect a jumper between pads E9 and E10 on the 4099 PC board, and
- if present, remove the jumper from between pads E8 and E9

NOTE: All 4099 Decoders will be shipped from the factory in the **AND** configuration and should not require any additional strapping unless they are to be operated in the Touch-Tone **OR** Channel Guard configuration.

Operation with Touch-Tone **OR** Channel Guard

When operating in the **OR** configuration, a correctly received Touch-Tone address or Channel Guard tone will operate the receiver audio muting and permit it to function in the normal noise squelch operation.

When used in the **OR** configuration

- connect a jumper between pads E8 and E9 on the 4099 PC board, and
- remove the jumper from between pads E6 and E7, and
- remove the jumper from between pads E9 and E10

When operating in any of the above configurations, a jumper may be installed between pads E2 and E3 to allow the MONITOR switch, when depressed, to apply ground to P906A-4 for special applications by the user.

INSTALLATION

These instructions outline the requirements to install the 4099 Decoder, and the optional switches for the External Alarm (G.E. Option 9409), and/or the SPEEDCALL general purpose relay option.

CONTROL MODULE

Refer to the Control Unit maintenance manual for removal and replacement procedures for the control module, and for location of jumper "L".

- remove the front panel of the Control Unit
- Remove the control module from the lower deck
- Remove or cut jumper "L" on the control module
- Do not reinstall the control module at this time

OPTION SWITCH/RELAY INSTALLATION

If any of the optional switches and/or relay are to be installed, they should be completed before installing the 4099 PC board into the Control Unit.

- Refer to Figure 5 on page 14 (4099 Installation Instructions) and Figure 6 on page 15 (4099 Component Layout)
- Install and solder the switch(es) in the position designated in the 4099 Component Layout Drawing in Figure 6. The shoulder of the switch terminal must be tight against the surface of the PC board (.010" maximum gap after soldering)
- Install and solder the LED as shown in Figure 5
- Insert the red wire into the auxiliary switch jack J760-1 and the black wire into J760-2. The wires are terminated on the 4099 PC board at J1-2 (red) and J1-1 or J1-3 (black)
- Remove the second option module, if present and necessary, to gain access to install J760
- Install J760 by pressing the connector into the rear cover from inside the Control Unit. Install the cable clip around the cable and fasten to the backplane board using the existing #6-32 screw
- Install the 4099 Decoder PC board in the appropriate option deck (component side UP) and plug the short cable into J1 at the -1, -2 and -3 pins on the Decoder PC board

SWITCH AND CALL LIGHT INSTALLATION

The 4099 Decoder is installed in the option deck of the GENERAL ELECTRIC C-800. It may be installed in either the upper or center option deck of the C-900 Control Unit. Edge contact fingers on the 4099 PC board mate with J906 on the vertical backplane board in the Control Unit. The PC board must be inserted with the component side up for the edge fingers to mate correctly. All electrical connections are made through the edge contacts except the optional switches and relay.

To install the RESET, MONITOR, and optional switches, and CALL light

- Remove the first three snap-out inserts on the left side of the front panel of the Control Unit. The first two holes will accomodate the RESET and MONITOR switches
- Replace the third insert with the CALL lamp assembly containing the CALL lamp lens. This assembly is supplied with the 4099
- If any optional switches are to be used, they will occupy the spaces immediately to the right of the RESET and MONITOR switches. This will necessitate moving the CALL lamp insert a corresponding number of holes so that it is always installed after the switches
- Firmly seat the 4099 PC board into the selected option deck
- Insert the CALL lamp bulb, attached to the 4099 PC board by wires, into the lamp assembly lens from the rear
- Reinstall the control module
- Replace the front cover of the Control Unit
- Plug the external alarm cable plug into J760 on the rear of the Control Unit

EXTERNAL RELAY KIT

Refer to the External Relay outline in Figure 5 to locate and identify the connecting points.

- Fasten the relay in the desired location, using self-tapping screws
- Crimp terminal 19B209260P12 to the red or black wire. Connect the terminal to the relay lug #4 using 8-32 x 5/16 screw
- Cut the red fused lead so the fuse assembly is close to the voltage source. Attach the solderless terminal with the 0.197" hole to the end of the lead going into the relay. Using #8-32 x 5/16 LG hardware, attach the terminal to lug #3 of the relay. Attach the other end of the fused lead to the voltage source with appropriate hardware

OPERATING INSTRUCTIONS

CALL LAMP

The CALL lamp is normally off, and will illuminate continuously after receipt of a valid Touch-Tone address. Momentarily pressing the RESET switch will extinguish the CALL lamp in preparation for the next call.

MONITOR SWITCH

With the MONITOR switch in its normal position (i.e., not depressed), the receiver audio will be muted, and will open upon receipt of a valid Touch-Tone address. The audio circuit will remain in normal noise squelch operation until the RESET switch is momentarily pressed, or the handset/microphone is returned to an on-hook condition.

Depressing the MONITOR push-push switch will by-pass the receiver mute circuit, causing the receiver audio to continuously operate in a normal noise squelch mode. Removal of the handset/microphone from the hook will also by-pass the mute circuit to allow the operator to monitor the channel before transmitting.

HORN AND LITE SWITCHES (OPTIONAL)

The external alarms are selected by the push-push HORN and LITE switches to alert the operator to incoming calls.

When a valid Touch-Tone address is received and the horn alarm is selected, the horn will sound for approximately 2.5 seconds. If the LITE alarm is selected, the light alarm will remain on continuously until the unit is reset. Both alarms, if installed, may be selected simultaneously.

CIRCUIT ANALYSIS

TOUCH-TONE FORMAT

The Model 4099 uses standard Touch-Tone format, originally developed by AT&T Co. for telephone dialing. Each digit is identified by a unique combination of two tones; one corresponding to the horizontal row, and the other to the vertical column of encoder pushbutton positions as illustrated in Figure 2. The frequencies are grouped about the geometric center of the 300 to 3000 Hz voice band used in telephone and radio systems. The two tones are generated simultaneously and remain on as long as a digit is being sent. Row tones are all in a lower frequency group than the column tones. The frequencies are non-harmonic to give high immunity to false identification from beat frequencies and distortion-produced overtones.

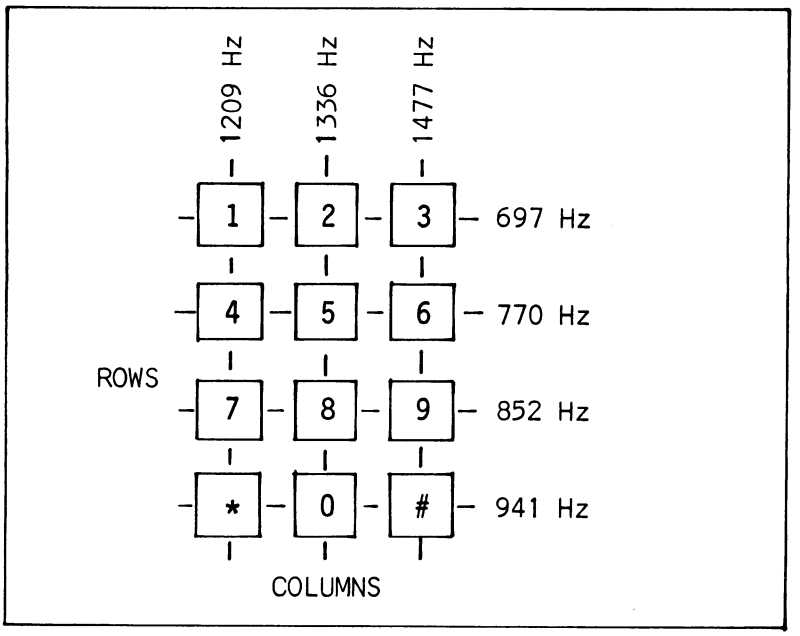


Figure 2 - Touch-Tone Keypad and Frequency Format

GENERAL CIRCUIT DESCRIPTION

Refer to the Model 4099 Block Diagram in Figure 3. Initially, the Decoder is in the standby condition with the first stage of the shift counter applying a voltage to the coding matrix via the program field to set the detectors for the column and row frequencies of the first digit of the programmed address.

An incoming Touch-Tone pair will be applied through the column and row filters to the column and row limiters. After limiting, the column and row tones are applied to the inputs of the tone detectors.

If the proper first digit is received, the column and row detectors will detect correct tones simultaneously. Outputs from both detectors will cause the AND gate to trigger the clock generator and reset the interdigit timer. The clock generator's output will cause the shift counter to advance one position, and apply a voltage to the coding matrix to set the detectors for the column and row frequencies of the second digit of the programmed address. Similarly, as each successive correct digit of the programmed address is received, the shift counter advances one position and sets the detectors for the next address digit.

After the final digit of the address is received, the shift counter energizes the output circuits. One output is continuous and stays on until it is manually reset; while the other is momentary and stays on for a period determined by the interdigit timer (approximately 2.5 seconds). When the timer cycle is completed, the momentary output is shut off, and the shift counter is reset so that the Decoder is returned to the standby condition to await a new call. The timer will also reset the shift register if less than the full number of digits is received before its time-out.

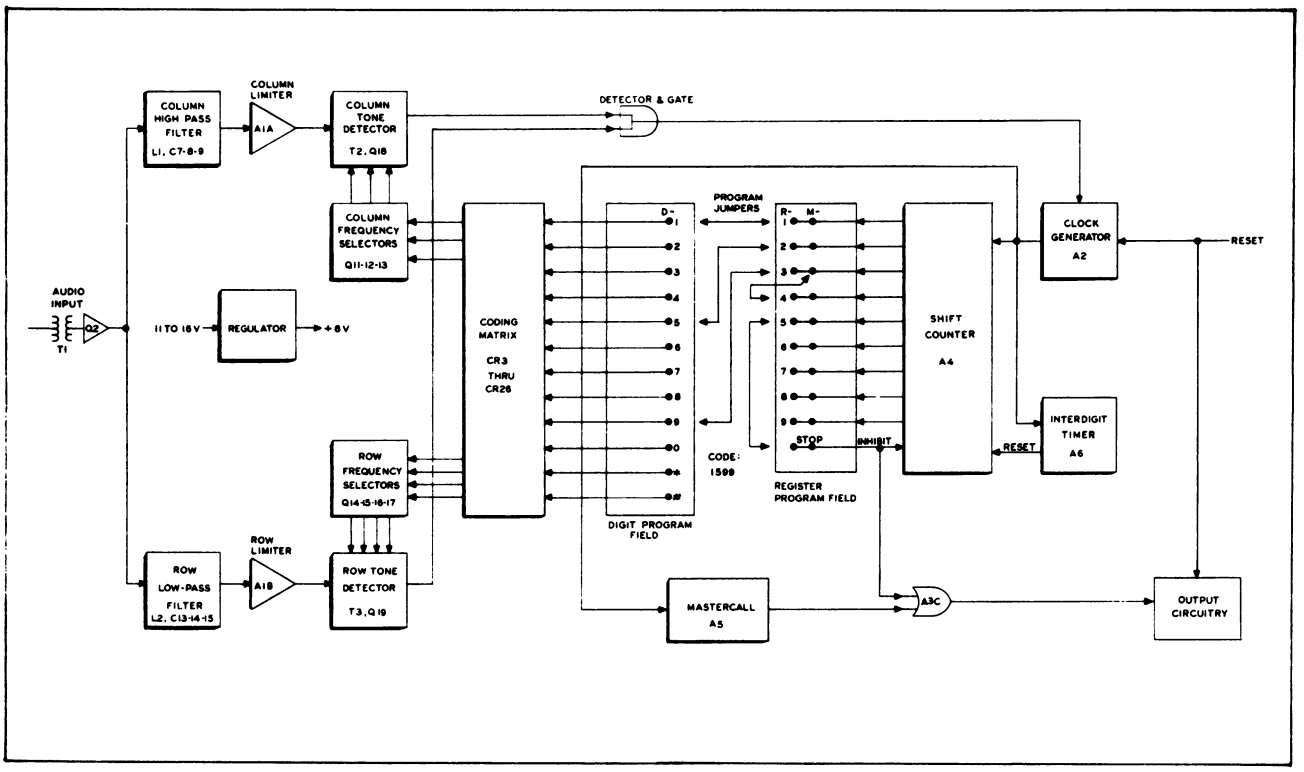


Figure 4 - Model 4099 Decoder Block Diagram

DETAILED THEORY OF OPERATION

Refer to the Model 4099 Circuit Schematic in Figure 7

Initial Condition:

Upon power turn-on, capacitor C27 has no charge. Therefore, pins 2 & 6 of A6 are low and pin 3 is high. This applies a reset to pin 15 of A4 so that A4 goes to zero count, with pin 3 high. This output is coupled through CR30 and the R-1 programming lead to the appropriate Digit (D) pin. Thus, one pair of transistors (Q11 through Q17) are turned on to program the tanks.

Incoming Address:

The audio signal from the receiver or other source is connected to P906C-3 and P906C-6 of the Decoder. DC isolation is provided by C4 and T1 so that the audio may be obtained from any convenient point in the receiver, independent of the DC level. T1 also prevents noise caused by stray currents in ground loops. The resonant frequency of C5 and the secondary of T1 is at the approximate center of the DTMF band of tone frequencies. Emitter-follower stage Q2 determines the source impedance for the high-and low-pass filters.

First Digit:

The column tones pass through the high-pass filter consisting of L1, C7, and C9, and are coupled to the column limiter, A1A. The series-resonant circuit of L1 and C8 provides a low impedance path to battery negative at the row tone frequncies and prevents them from being coupled into the column channel. The row tones are coupled to the row tone limiter, A1B through the low-pass filter consisting of L2, C13, and C15. The parallel-resonant circuit of L2 and C14 rejects column tones.

Amplifier A1A is connected as an operational amplifier. Its basic gain is determined by the ratio of feedback resistor R8 to R7. C10 provides a low impedance feedback path at high frequencies to roll off the high frequency response of the stage.

At very low signal levels, Q3 and Q4 have no effect on the circuit. However, when the input level at P906C-3 and P906C-6 exceeds approximately 50mVrms, the peak voltage of the signal output from the operational amplifier will overcom the forward conduction levels of the junctions of Q3 and Q4, causing them to conduct. When these junctions conduct, they provide a low impedance feedback path for A1A so the gain of the stage is reduced. Under these conditions, the output of the column limiter is a clipped sine wave.

The column limiter output is applied to the column tank driver, Q7 and Q8. This circuit applies a constant-current square wave to the tank circuit which consists of C18 and the primary of T2. If this current square wave is at the resonant frequency of the tank circuit, the voltage coupled to the secondary of T2 and rectified by CR28 will cause enough current to flow in R31 to balance the current in R32, cutting off Q18. Only the corrent column tone will provide enough output to cut off Q18.

The column and row circuits are identical in operation. When the correct first digit is received, the column tone cuts off Q18 and the row tone cuts off Q19. C23 can then discharge through R35. A2 is used as a Schmitt-Trigger and, when C23 discharges to 1/2 of the voltage at pin 8 of A2, pin 3 of A2 goes high and pin 4 of A3 goes low. The voltage at pin 3 of A2 is coupled through CR39 and R37 to charge C26, causing pin 3 of A6 to go low and remove the reset from pin 15 of A4.

At the termination of the digit, Q18 and Q19 again conduct, recharging C23. When the voltage at pins 2 & 6 of A2 reaches 2/3 of the voltage at pin 8 of A2, pin 3 of A2 goes low and pin 4 of A3 goes high. This positive-going transition applied to pin 14 of A4 causes A4 to advance one count so that pin 3 goes low and pin 2 goes high, and the R-2 lead programs the Decoder for the second digit of the address.

Subsequent Digits:

The sequence will be repeated as each digit of the address is received and terminated. If there are N number of digits in the address, the shift counter will advance to N+1 stage when the last digit is terminated. The register lead of that stage will be connected to the STOP pin. Thus, when the complete address has been received, the STOP pin goes high. This voltage is applied through R48 to pin 13 of A3 so pin 11 goes low. This sets the A7C/A7D flip-flop so that pin 10 is high and

pin 11 is low. Emitter-follower Q23 supplies base current to Q24 to run on the CALL light and apply A- to the LITE switch, if used. Since pin 11 of A7 is low, pin 10 of A8 is forced high, and pin 10 of A3 goes low, and pin 4 of A8 goes high. Thus, if the unit is connected for Model 4099 only, or Model 4099 AND Channel Guard (E6 connected to E7), Q25 no longer applies A- to P906D-13 to mute the receiver. If the unit is connected for Model 4099 OR Channel Guard (E8 connected to E9), Q26 conducts to apply A- to P906B-7 to disable the Channel Guard decoder and open the receiver.

The CALL light will remain illuminated and the receiver unmuted until the 4099 is reset by means of the RESET pushbutton or the microphone hookswitch.

The low voltage at pin 11 of A3 also causes Q21 to conduct and supply base current to Q22. Q22 energizes the internal sounder, DS1, and applies A- to the HORN switch, if used. Q22 will continue to conduct until A6 resets A4 to the initial conditions, as explained below.

Timing Circuit:

Upon power turn-on, or in the standby condition awaiting the first digit of the address, C26 is discharged and pin 3 of A6 is high, applying a reset to A4. Receipt of the first digit charges C26 so that pin 3 of A6 goes low and A4 can then advance as digits are received.

When the first digit is terminated, C26 starts to discharge through R38. If the second digit is not received within approximately 2.5 seconds, the charge on C26 drops to 1/3 of the voltage at pin 8 of A6 and pin 3 goes high and A4 resets to the standby condition.

If the second digit is received within the 2.5 second interdigit timer period, C26 is re-charged, resetting the timer. Each succeeding digit resets the timer in the same manner. After the last digit of the address is received, the timer determines the period that Q22 conducts.

Group and All-Call Circuit (MASTERCALL):

In the standby condition, pin 7 of A2 applies an open-collector negative clamp to R39 and R40, holding pins 2 & 6 of A5 low, causing pin 3 of A5 to be high. Upon receiving any correct digit, pins 2 & 6 of A2 will go low, causing pin 3 of A2 to go high. When pin 3 of A2 goes high, pin 7 of A2 releases its clamp on R39 and R40, allowing C25 to start charging. After approximately five seconds, C25 will have charged enough to cause pin 3 of A5 to go low. With pins 1 & 2 of A3 low, pin 3 of A3 will go high, allowing the A7A/A7B multi-vibrator to function and causing an interrupted output at pin 11 of A3.

Microphone Hookswitch and Monitor Circuits:

First, assume that the unit is strapped for 4099 only, or 4099 AND Channel Guard operation with E6 connected to E7, and E9 connected to E10. In the normal condition, Q25 applies A- to P906D-13 to disable the receiver audio output and Q26 is not conducting. Depressing the MONITOR switch applies A- to pin 2 of A8 so pin 3 goes high. This causes Q26 to conduct and disable the Channel Guard decoder, if used. The output at pin 3 of A8 is also applied to pin 9 of A3, causing pin 10 of A3 to go low so that Q25 cuts off to remove the muting from the receiver. When the microphone is removed from the hookswitch, the hookswitch applies A- to P906A-4 and this is coupled through R50 to pin 1 of A8 to cause pin 3 of A8 to go high.

When the unit is strapped for the 4099 OR Channel Guard with E8 connected to E9, depressing the MONITOR switch or removing the microphone from the hookswitch causes pin 3 of A8 to go high in the same manner. Thus, pin 10 of A3 goes low and pin 4 of A8 goes high, so Q26 conducts to disable the Channel Guard decoder.

Command Reset:

If the Command Reset is used, the register lead immediately following the one connected to the STOP pin is connected to the CR pin. When the address of the decoder is received, A4 applies a positive voltage to the STOP pin to energize the output circuitry, as previously described. This voltage at the STOP pin also causes emitter-follower Q20 to apply a positive voltage to the D* pin. Thus, if the Touch-Tone asterisk (*) is received before A6 times out and resets A4, A4 will count one more position and apply a positive voltage to the CR pin. Pin 11 of A8 goes low and this is coupled through CR40 and R50 to pin 13 of A7 to reset the A7C/A7D flip-flop to cancel the previous call.

MAINTENANCE

The SPEEDCALL Model 4099 Decoder is designed for stable, trouble-free operation over long periods of time. Most of the parts used in the 4099 are standard, and are available at local distributor stores. The following guidelines are provided to troubleshoot the unit if it should not operate properly:

1. Check that radios used in the system are properly netted and that the Decoder is properly interfaced.

2. Check all programming leads to ensure that the unit is programmed to receive the correct address.

3. Check the input power source that it is within specifications. Measure the +8V (7.5 to 9.0V).

4. Substitute a known operational decoder in place of the suspected faulty decoder. If the substitute unit also fails to operate, the problem is most likely elsewhere in the system.

5. If the decoder proves faulty, the following steps to isolate the problem are recommended:

   a. Check the output circuit of the decoder. Connect a jumper from +8V to the Digit STOP pin. The CALL lamp and buzzer should energize continuously. When the jumper is removed, the momentary circuit will time out, stopping the buzzer, but the CALL lamp should remain ON until reset. If the light also goes out, check A3C, A7C/A7D and the associated circuitry.

   b. Check the programming jumpers for proper placement and damaged wires. Normally, the decoder will be tested using the address code assigned to the vehicle, or the same code which the unit is failing to decode. The address code 1590 is recommended for bench testing as it will utilize all row and column frequencies.

   c. Insert the first digit of the address with a Touch-Tone encoder (20mV minimum) while measuring for 130mV rms minimum at TP1 (column input) and TP2 (row input). If both of these points are low, the problem is most likely in the audio input circuit. If either of these points is good while the other is low, check the corresponding filter and limiter circuit.

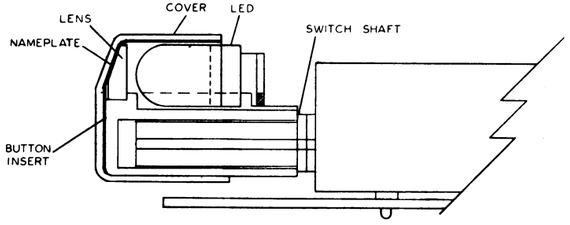
   d. Again, while inserting the first digit, check TP3 and TP4 (400mV rms minimum). If either of these points is low, check the corresponding digit pin in the coding matrix, and also check the collector of the coding transistors (for TP3 check Q11 -Q13; for TP4 check Q14 - Q17). The collectors of the two transistors associated with the first digit should pull down to 1VDC.

   e. Measure pin 14 of A4. With no signal input, the voltage should be 7.5 to 9V. With the signal input from the encoder, the level should drop to 0V.

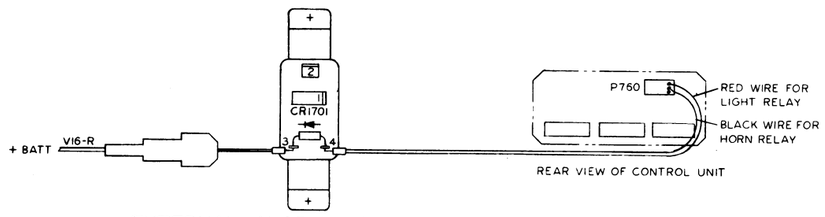
   f. Measure the output of the A4 Decade Counter. Measure the output at the first register pin. Without the signal applied (and with A4 reset), the level at R-1 should be approximately 5V. Enter the first digit of the address. Upon termination of this digit, R-1 should drop to 0V. Within 2.5 seconds after inserting the signal, measure the level at R-2. It should be high to indicate that A4 counted to the second position. Insert the second digit while measuring R-2. The reading should be the same as R-1. Again, move to R-3 whithin 2.5 seconds to ensure that A4 has counted.

   g. If A4 does not count to the next register pin, let it reset and check pin 15 for high. Pin 15 should go low when the signal is applied. If it does not, check the A6 circuit. If pin 15 does go low and A4 is not counting, A4 is probably defective.

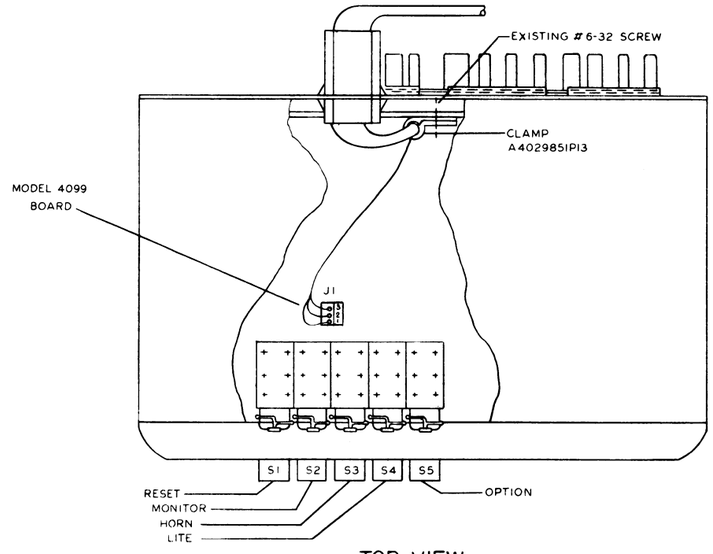
NOTE: Prior to checking the register pins at the output of A4, ensure that the programmed address code does not contain any duplicate numbers. If it does, remove the programming leads and re-program the unit for 1590.



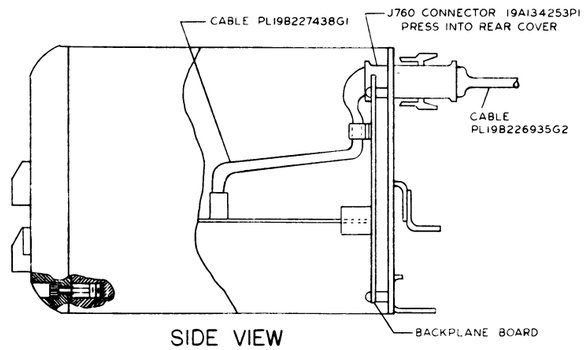
SWITCH ASSEMBLY - SIDE VIEW



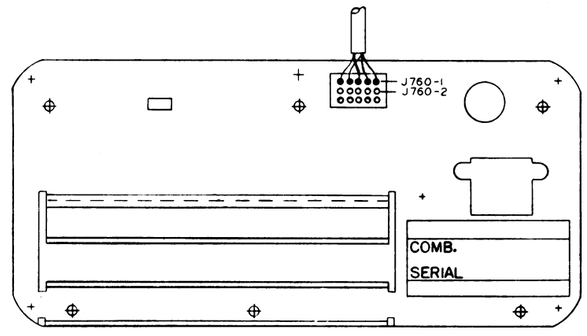
EXTERNAL ALARM RELAY (OPTIONAL)



TOP VIEW

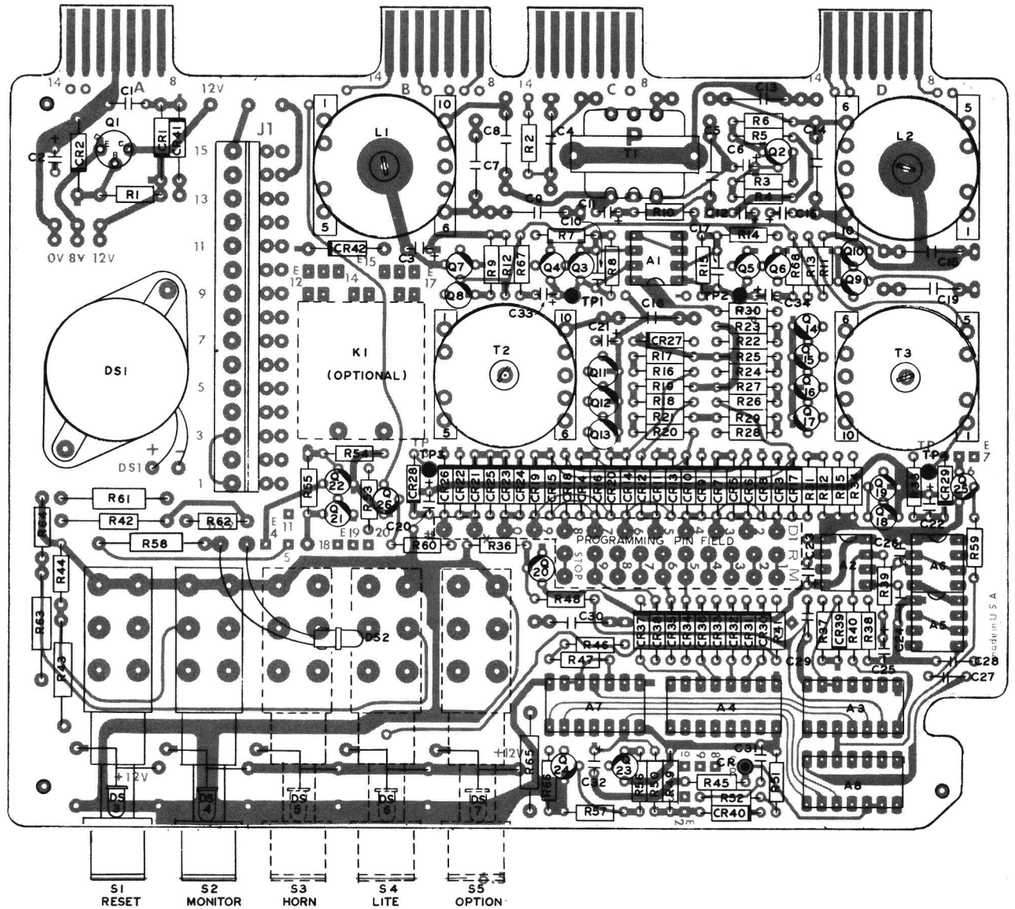


SIDE VIEW

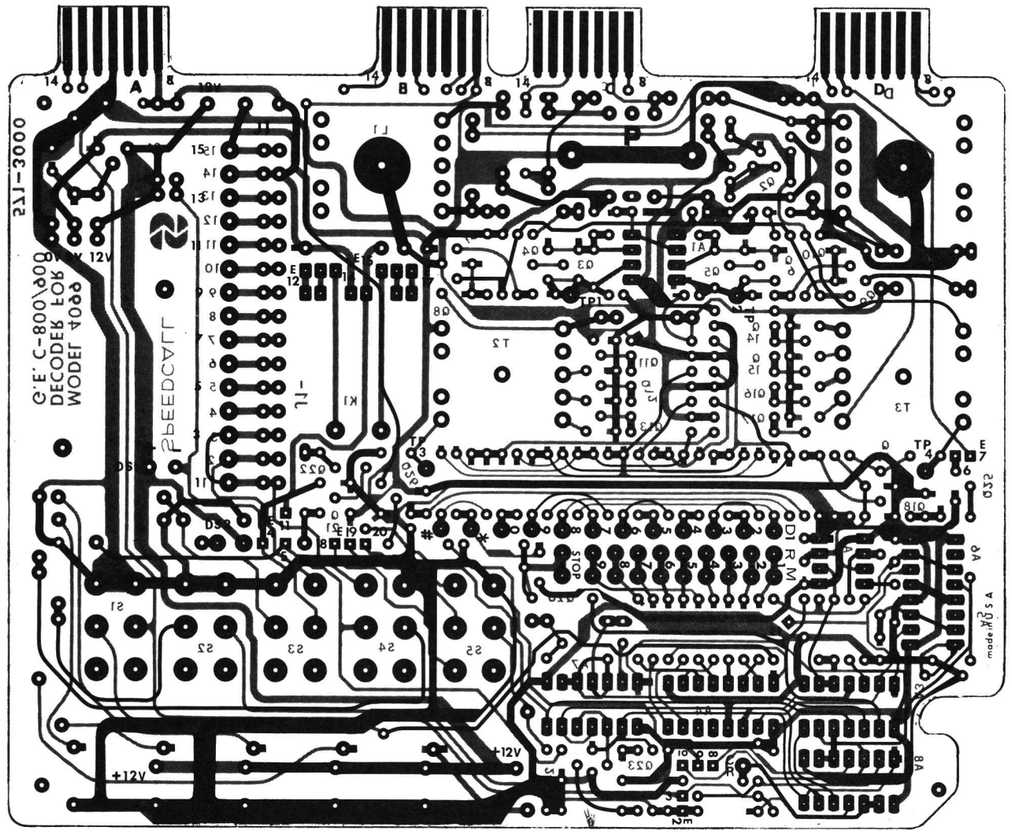


REAR VIEW

Figure 5 - Model 4099 Mobile Decoder



Components shown mounted in place over traces on component side



Component and circuit side traces with component traces dominating

PADS WITH TABS INDICATE:
1. DIODE CATHODES
2. TRANSISTOR EMITTER PIN
3. + SIDE OF POLARIZED CAPACITORS
4. I.C. PIN NO.1

TRANSISTOR PIN LOCATION

DIAGRAM — TOP VIEW (ALL TYPES)

PHYSICAL — BOTTOM VIEW (2N3391 / 2N5355)

BOTTOM VIEW (2N4401)

Figure 6 - Model 4099 Mobile Decoder

PC COMPONENT LAYOUT AND TRACE PATTERNS

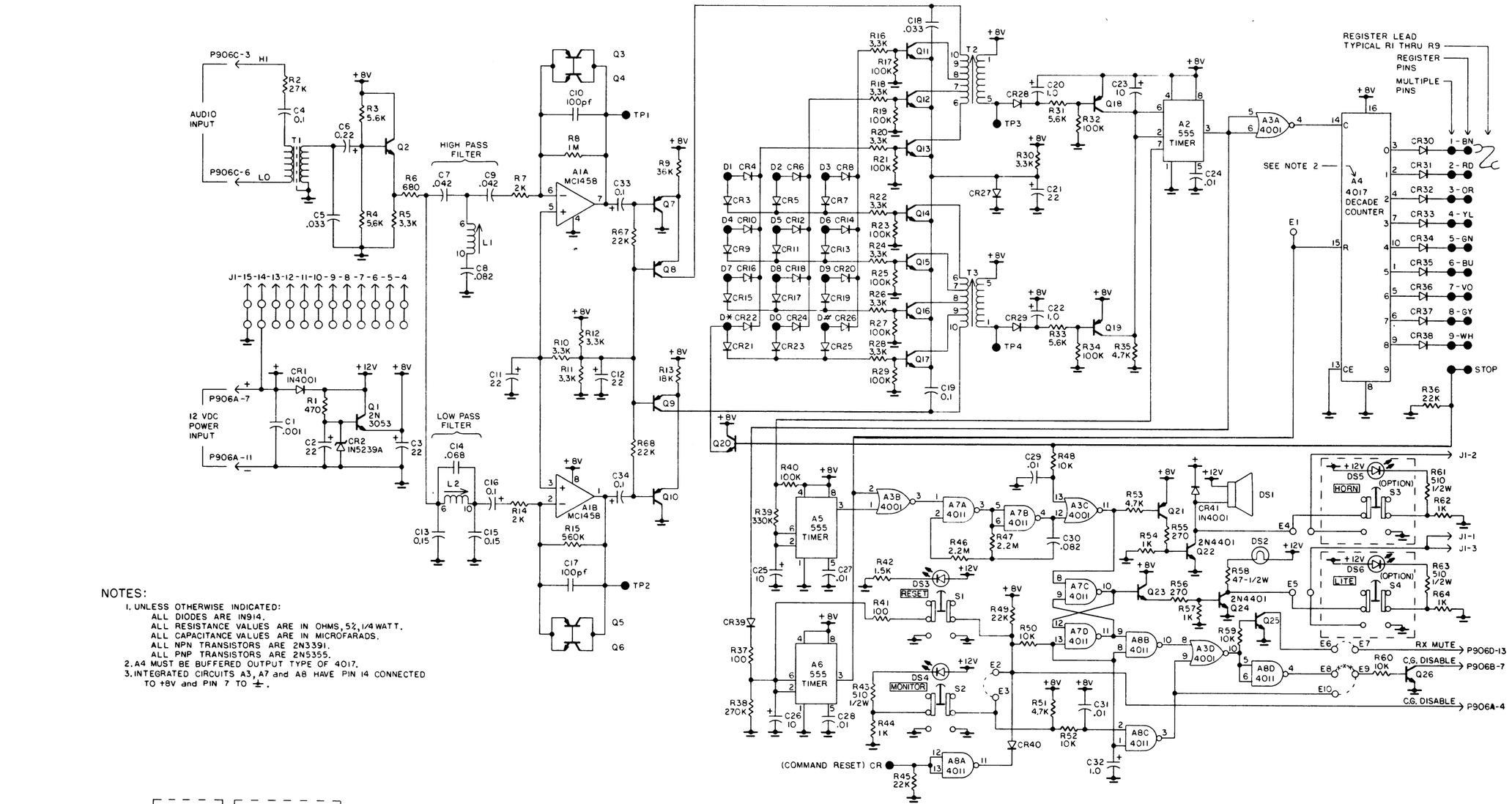


Figure 7 - Model 4099 Mobile Decoder

CIRCUIT SCHEMATIC

Model 4099 Mobile Decoder

REPLACEABLE PARTS LIST

GENERAL

Symbol	*Description*	*Part No.*
	Model 4099 PC Assembly	571-3000
	Connector, 15-pin Polarizing Wafer, Molex #09-60-1151	036-0010
DS1	Buzzer, 12V, Tone Alert Mdl T-12	095-0005
DS2	Lamp, 12V Mura	103-0001
DS3-4	LED, Yellow	156-0008
L1	Inductor Coil, High-Pass Filter	521-6400
L2	Inductor Coil, Low-Pass Filter	521-6500
S1	Switch, Momentary, 2PDT, Single Station (G.E. P/N 19B209563P3)	
S2	Switch, Push-Push, 2PDT, Single Station (G.E. P/N 19B209563P2)	
T1	Transformer, Audio Input, 10K:2K, PC Mount	024-0004
T2-3	Tone Coil	557-6400
	OPTIONAL COMPONENTS	
K1	Relay, 12V, 2-Form C, Potter & Brumfield #R50-E2-Y2-12DC	042-0024
S3-4	Switch for HORN and LITE (G.E. Option #9409)	
DS5-7	LED, Yellow	156-0008

INTEGRATED CIRCUITS

Symbol	*Description and Manufacturer's Type*	*Part No.*
A1	8-Pin DIP, Dual Operational Amplifier, MC1458	163-0001
A2	8-Pin DIP, Linear Timer, NE555V	161-0001
A3	14-Pin DIP, Quad 2-Input NOR Gate, CD4001AE	160-0064
A4	16-Pin DIP, Decade Counter, SCL 4017 (Do not use RCA)	160-0045
A5-6	8-Pin DIP, Linear Timer, NE555V	161-0001
A7-8	14-Pin DIP, Quad 2-Input NAND Gate, CD4011AE	160-0022

CAPACITORS

Symbol	*Value*	*V*	*%*	*Type*	*Part No.*	*Symbol*	*Value*	*V*	*%*	*Type*	*Part No.*
C1	0.001uF	1KV	20	Disc Cer	051-0004	C17	100pF	100	5	Dip Mica	054-0029
C2-3	22uF	15		Rad Tant	053-0008	C18	0.033uF	50	5	Polycarb	057-0010
C4	0.1uF	100	10	Mylar	052-0019	C19	0.1uF	50	5	Polycarb	057-0008
C5	0.033uF	100	10	Mylar	052-0011	C20	1.0uF	35		Rad Tant	053-0005
C6	0.22uF	35		Rad Tant	053-0003	C21	22uF	15		Rad Tant	053-0008
C7	0.042uF	50	5	Mylar	052-0014	C22	1.0uF	35		Rad Tant	053-0005
C8	0.082uF	50	5	Mylar	052-0016	C23	10uF	15		Rad Tant	053-0007
C9	0.042uF	50	5	Mylar	052-0014	C24	0.01uF	500	10	Disc Cer	051-0006
C10	100pF	100	5	Dip Mica	054-0029	C25-26	10uF	15		Rad Tant	053-0007
C11-12	22uF	15		Rad Tant	053-0008	C27-29	0.01uF	500	10	Disc Cer	051-0006
C13	0.15uF	50	5	Mylar	052-0026	C30	0.082uF	50	5	Mylar	052-0016
C14	0.068uF	50	5	Mylar	052-0015	C31	0.01uF	500	10	Disc Cer	051-0006
C15	0.15uF	50	5	Mylar	052-0026	C32	1.0uF	35		Rad Tant	053-0005
C16	0.1uF	35		Rad Tant	053-0001	C33-34	0.1uF	35		Rad Tant	053-0001

DIODES

Symbol	*Mfg's Type*	*Part No.*	*Symbol*	*Mfg's Type*	*Part No.*
CR1	1N4001	153-0006	CR3-40	1N914	153-0004
CR2	1N5239A Zener	154-0008	CR41-42	1N4001	153-0006

RESISTORS, Deposited Carbon, 5%, ¼ Watt, except * = ½ Watt

Symbol	*Value*	*Part No.*	*Symbol*	*Value*	*Part No.*	*Symbol*	*Value*	*Part No.*
R1	470Ω	140-4700	R25	100K	140-1003	R46-47	2.2 Meg	140-2204
R2	27K	140-2702	R26	3.3K	140-3301	R48	10K	140-1002
R3-4	5.6K	140-5601	R27	100K	140-1003	R49	22K	140-2202
R5	3.3K	140-3301	R28	3.3K	140-3301	R50	10K	140-1002
R6	680Ω	140-6800	R29	100K	140-1003	R51	4.7K	140-4701
R7	2K	140-2001	R30	3.3K	140-3301	R52	10K	140-1002
R8	1 Meg	140-1004	R31	5.6K	140-5601	R53	4.7K	140-4701
R9	36K	140-3602	R32	100K	140-1003	R54	1K	140-1001
R10-12	3.3K	140-3301	R33	5.6K	140-5601	R55-56	270Ω	140-2700
R13	18K	140-1802	R34	100K	140-1003	R57	1K	140-1001
R14	2K	140-2001	R35	4.7K	140-4701	R58 *	47Ω	141-0470
R15	560K	140-5603	R36	22K	140-2202	R59	10K	140-1002
R16	3.3K	140-3301	R37	100Ω	140-1000	R60	10K	140-1002
R17	100K	140-1003	R38	270K	140-2703	R61 *	510Ω	141-5100
R18	3.3K	140-3301	R39	330K	140-3303	R62	1K	140-1001
R19	100K	140-1003	R40	100K	140-1003	R63 *	510Ω	141-5100
R20	3.3K	140-3301	R41	100Ω	140-1000	R64	1K	140-1001
R21	100K	140-1003	R42	1.5K	140-1501	R65 *	510Ω	141-5100
R22	3.3K	140-3301	R43 *	510Ω	141-5100	R66	1K	140-1001
R23	100K	140-1003	R44	1K	140-1001	R67-68	22K	140-2202
R24	3.3K	140-3301	R45	22K	140-2202			

TRANSISTORS

Symbol	*Type*	*Part No.*	*Symbol*	*Type*	*Part No.*	*Symbol*	*Type*	*Part No.*
Q1	2N3053	178-0004	Q5	2N5355	176-0002	Q18-19	2N5355	176-0002
Q2	2N3391	178-0001	Q6	2N3391	178-0001	Q20	2N3391	178-0001
Q3	2N5355	176-0002	Q7-10	2N5355	176-0002	Q21	2N5355	176-0002
Q4	2N3391	178-0001	Q11-17	2N3391	178-0001	Q22-26	2N3391	178-0001