INSTRUCTIONS

FOR

TYPE 99 TONE DECODER 19D417199G1

OPTION 9526

(For MASTR II Stations)

CONTENTS

SPECIFICATIONS*

DF-5046

Tone Frequencies	517.5-967.5 Hertz
Tone Input:	360 mV to 3.5 Volts RMS
Input Voltage:	13.6 Volts ±20%
Temperature Range:	-40°C to +70°C

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate specification sheet for the complete specification.

DESCRIPTION

General Electric Type 99 Decoders are Solid State sequential tone decoders mounted on a Printed Wire Board that plugs into the auxiliary card slot in the station Control Shelf. The decoder has a four function capability with VERSATONE NETWORKS responding to four different tone codes and will operate with any encoder providing two-tone sequential signaling. These include the General Electric Type 99 and Dial Paging Encoders (100, 400 and 900 call).

OPERATION

Threshold Detector

The threshold detector accepts the tone input from the Volume/Squelch HI of the receiver and feeds it to the tone filter through a limiter stage. Thus the filter receives a constant input level for variations of the level at the Volume/Squelch HI. The filter output is fed back to the threshold detector which provides a DC output on sensing the presence of the proper tone.

Frequency Switchable Selective Amplifier (FSSA)

The FSSA is made up of a thick film resistor network and four high gain operational amplifiers.

Tone Networks

The tone network is a precision resistor network with its associated switching transistors. The network in conjunction with FSSA forms a highly stable, high Q solid state active filter. Four plug-in VERSATONE NETWORKS are used with one FSSA to provide a four tone decoder system.

4 Tone Search

The 4 tone search contains a Free Running Flip Flop which switches every half second from network A1 to A2 until a proper "A" tone is detected. After a proper "A" tone is detected, the Flip Flop switches every half second from tone network B1 to B2 for the duration of the "B" search time or until a proper "B" tone is detected.

4 Function Output

Four form C relay contacts (one for each function) with connection on the Control Shelf Backplane are provided for controlling external circuits and are rated at 2 Amps @ 24 VDC or 1 Amp @ 115 VAC. Two additional form C contacts per function are provided on the decoder board.

Four LED lights are provided on the front panel of the decoder which provide a visual indication of which of the four tone functions are operating.

Relay Strapping

As a result of the flexibility designed into the decoder board, the relays may be strapped for many different methods of operation. Three of the more common methods are described in the following text. Strapping instructions for the three methods are contained in the Relay Strapping Procedure listed in the Table of Contents.

Multiple Lock-Up

The standard board is shipped from the factory strapped for multiple lock-up operation. Selecting the Function 1 Tone Sequence locks up the Function 1 relay. The Function 1 through Function 3 relays may be locked up individually and in any sequence. Selecting the Function 4 Tone Sequency momentarily energizes the Function 4 relay releasing all locked-up relays. The Function 4 relay will be energized for approximately the duration of the second tone (.5 to 3 seconds) once it has been detected.

Exclusive Lock-Up

When strapped for this method of operation, the Function 1 through Function 4 relays may be operated individually and in any sequence. However, the operating of any relay releases any previously-operated relay so that only one relay may be locked up at a time.

Sequential Drop-Out

When strapped for this method of operation, the Function 1 through Function 3 relays may be operated individually and in any sequence. However, the locking path of the lower numbered relays in connected through the normally-closed contacts of the higher numbered relays. Operating a higher numbered relay releases any lower numbered relay that is locked up, so that only one relay may be locked up at a time.

By selecting the proper tone sequence, any relay that has been released may be energized for approximately the duration of the seond tone (.5 to 3 seconds) once it has been detected.

INSTALLATION

The Type 99 Decoder is installed as shown on the Installation Diagram 19D417249. To complete the installation, A DA jumper wire is added to the Backplane as shown.

CIRCUIT ANALYSIS

Tone Decoder (Refer to Figure 1)

The input tone from the Volume/Squelch HI is fed into Pin 7 of the THRESHOLD DETECTOR Integrated Circuit U1404. The tone is then limited and fed into pin 12 of the FREQUENCY SWITCHABLE SELECTIVE AMPLIFIER (FSSA) U1405. The FSSA will only pass a narrow band of frequencies predetermined by the selected VERSATONE NETWORK. The decoder has the following four tone signaling paths: A1-B1, A1-B2, A2-B1 and A2-B2.

Before a tone is received, the 2nd Tone Switch in the Control Integrated Circuit U1406 supplies a logical "1" to pin 14 of the 4 Tone Search Integrated Circuit U1407. Also, the 1st Tone Switch in the Control IC U1406 supplies a logical "0" to pin 10 of the 4 Tone Search IC U1407. This primes the #1 and #3 Resistor OR Gates with a logical "0". The Free Running Flip Flop alternately supplies a logical "0" from A & B of the Flip Flop to the #1 and #3 Resistor OR Gates. When any of the Resistor OR Gates has a logical "0" at both inputs the output will be logical "0". Each of the Tone networks requires a logical "0" at Pin 3 to be selected. So the A1 and A2 tones are alternately sampled until a proper first tone is received. When a proper first tone is received the FSSA U1405 passes the tone to the Amplifier and Threshold Detector IC U1404. After receiving the tone from the FSSA, the Threshold Detector produces a logical "1" which is fed to pin 5 of the 4 TONE SEARCH IC U1407 . This turns on the Flip Flop Lock and stops the Free Running FLIP FLOP. The logical "1" is also fed to the 2nd Tone Search Timer, the 1st Tone Clamp and the "B" input of the Decode Gate of the Control IC U1406. The logical "L" sets the Timer but the 1st Tone Clamp prevents it from starting its 1.5 second run until the first tone ends. The Decode Gate requires a logical "0" on the "A" input and a logical "1" on the "B" input before it will start the Timed Output. When the Decode Gate receives a logical "1" on the "B" input from the first tone, it is still disabled by the logical "1" on the "A" input from the 2nd Tone Switch. At the end of the first tone, the Timer begins the 1.5 second run enabling the 2nd Tone Switch to supply a logical "0" output to pin 14 of the 4 Tone Search IC U1407, and to the 1st Tone Switch, and the "A" input of the Decode Gate in the Control IC U1406. The input from the 2nd Tone Switch enables the 1st Tone Switch to supply a logical "1" output to pin 10 of the 4 Tone Search IC U1407 and to the 2nd Tone Clamp which, in turn, disables the 1st Tone Clamp in the Control IC U1406. During the 1.5 second search time, the logical "1" supplied to pin 14 of U1407 becomes a logical "0" and the logical "0" to pin 10 (of the 4 Tone Search IC U1407) becomes a logical "1". Resistor OR Gates #2 and #4 now feed the 2nd tone networks B1 and B2. The Flip Flop Lock unlatches and starts the Free Running Flip Flop again but now the Free Running Flip Flop supplies alternate logical "0"s to Resistor gates #2 and #4 which operate in the same manner as described for the first tone selection. When a proper second tone is received, the FSSA U1405 passes the tone to the Amplifier and Threshold Detector U1404. The Threshold Detector provides a logical "1" which is fed to pin 5 of the 4 TONE SEARCH Integrated Circuit U1407. This turns on the Flip Flop Lock and stops the Free Running Flip Flop. The logical "1" is also applied to the "B" input of the Decode Gate in the Control IC U1406. If the second tone is within 1.5 seconds of the first tone, the "A" input of the Decode Gate is still at logical "0" due to the 2nd Tone Switch. The logical "0" at "A" and the logical "1" at "B" opens the Decode Gate and starts the timed output. Starting the timed output places a logical "1" at pin 12, the output of the Control Integrated Circuit U1406 for the duration of the second tone.

Function Selector (Refer to Figure 2)

The four available functions (relay closures) correspond to the four available signaling paths of two sequential tones determined by the VERSATONE NETWORKS installed in the decoder; Function 1 corresponds to A1-B1, Function 2 to A1-B2, Function 3 to A2-B1, and Function 4 to A2-B2. The selection of these signaling paths is determined by the logical states on pin 8 and pin 12 of the 4 Tone Search IC U1407 and on pin 5 and pin 12 of the Control IC U1406. The logical states are decoded by the Coincidence Gates which feed the Relay and LED Drivers. The Relay and LED Drivers energize the relays and turn on the Light Emitting diodes (LED).

With a proper decode of Function 1 tones, pin 12 of the Control IC U1406 goes to a logical "1" regardless of the tone sequence as long as it is correct.

The logical state on pin 12 is passed through the buffer stage consisting of Q1401 and Q1402 and is fed to pin 5 of Coincidence Gate "A" (U1402B), pin 13 of Coincidence Gate "B" (U1403A), pin 13 of Coincidence Gate "C" (U1402A), and pin 11 of Coincidence Gate "D" (U1402C). Therefore, the Coincidence Gates are held disabled by the output of pin 12 of the Control IC U1406 until a proper decode is made since

it takes a logical "1" on all three inputs of each coincidence gate to produce a logical "0" on the output. This logical "0" is required to activate the relay and LED drivers which, in turn, energize the relay and turn on the LED.

The tone paths that determine the desired functions are decoded as follows: Pin 5 of U1406 is at logical "0" until the first tone ends, then it goes to logical "1" for the duration of the second tone; or until the 2nd Tone Search Timer times out. The output at Pin 5 is inverted by Q1412 and is fed to pin 2 of U1401A and pin 5 of U1401B. These are the input NAND gates of the Flip Flop (consisting of the cross coupled NAND gate U1401C and U1401A). When the decoder is searching for the first tone, pin 5 of U1406 is at logical "0". Under this condition, the logical state at pin 12 and pin 8 of the 4 Tone Search IC u1407 is inverted and passed to pin 8 and pin 11, respectively, of the Flip Flop U1401C and U1401D.

When the first tone is received, the information as to whether the tone is A1 or A2 is stored in the Flip Flp. The inputs are disabled as soon as the second tone search begins, since pin 5 of the Control IC U1406 goes to logical "1". This disables the input NAND gates to the Flip Flop.

Pin 8 of the Flip Flop U1401C is fed to pin 4 of Coincidence gate "A" (U1402B) and to pin 2 of Coincidence gate "B" (U1403A). Pin 11 of the Flip Flop U1401D is fed to pin 2 of Coincidence gate "C" (U1402A) and to pin 10 of Coincidence gate "D" (U1402C). Thus, while a decode is being made, the Flip Flop U1401C and U1401D loads information concerning the first tone into the Coincidence gates. When the second tone is received, the information as to which tone is decoded (B1 or B2) is inverted and passed directly to the Coincidence gates from pin 12 and pin 8 of the 4 Tone Search IC U1407 through inverters U1403B and U1403C, respectively.

When pin 12 of the Control IC U1406 goes to logical "1", indicating a proper decode, the coincidence gate that has a logical "1" on each of its three inputs will have a logical "0" on its output, and a function will be selected corresponding to the tone function decoded. For example, consider the Function 2 tones (A1-B2). When the A1 tone is received, pin 12 will be at logical "0" and pin 8 will be at logical "1" in the 4 Tone Search IC U1407. The logical "0" on pin 12 is inverted to a logical "1" when it is fed through U1403B and is inverted again to a logical "0" when fed through the enabled NAND gate U1401A. A final inversion occurs at U1401C in the Flip Flop resulting in a high that is placed on pin 2 of Coincidence gate "B" (U1403A).

As soon as the second tone search begins, the information that the first tone was A1 is stored in the Flip Flop, since its input is disabled when pin 5 of the Control IC U1406 goes to logical "1". When the B-2 tone is received, pin 12 will be logical "1" and pin 8 will be logical "0" on the 4 Tone Search IC U1407. The logical "0" on pin 8 is inverted to logical "1" as it is fed through Inverter U1403C and applied to pin 1 of Coincidence gate "B" (U1403A). As soon as the decode is made, pin 12 of the Control IC U1406 goes to logical "1" and is fed through the buffer consisting of Q1401 and Q1402 and is applied to pin 13 of Coincidence gate "B" (U1403A). Coincidence gate "B" now has logical "1" on each of its inputs and will provide a logical "0" at the output, activating the Relay drivers and relay. Thus, by sending the A1-B2 tones, Function 2 relay is selected. Observe that when the A1-B2 tone sequence is sent, only Coincidence gate "B" will have a logical "1" on all three inputs. The other three functions are accomplished in a similar manner.

Relay Drivers

Relay driver transistors Q1403 through Q1410 are controlled by coincidence gates "A" through "D" on the decoder board with the output of gates "A" through "D" connected to the base of transistors Q1403 through Q1406 respectively. Because all of the driver circuits operate in the same manner, only the Function 1 and Function 4 circuits will be described.

Applying the Function 1 Tones to the decoder assembly activates coincidence gate "A", causing its output to go to logical "0". This turns on PNP transistor Q1403, which turns on Q1407, energizing relay K1401. When energized, the relay locks up through its normally-open contacts (K1401-15 and -16). When tone is removed from the decoder, the output of coincidence gate "A" goes to logical "1", turning off driver transistors Q1403 and Q1407. Relay K1401 remains locked up until the Function 4 relay is energized.

Applying the Function 4 Tone to the decoder momentarily activates coincidence gate "D" which turns on driver transistors Q1406 and Q1410. This momentarily energizes relay K1404 (which is not connected to lockup), and opens the normally closed contacts K1404-14 and -15. Opening the contacts removes the logical "0" to relay K1401 (and all locked-up relays), releasing the relay(s).

Lockup-Release Circuit

The lock-up release circuit consists of diodes CR1402, CR1403, CR1405, CR1406, CR1408, CR1409, CR1411 and CR1414, transistor Q1411, and resistor R1426. The circuit is used only when the relay board is strapped for individual relay operation where the operation of any relay releases any previously-

operated relay. Strapping instructions for individual relay operation are contained in the Relay Strapping Procedure (See Table of Contents).

The strapping for this type of operation consists of removing the standard jumpers connecting contact 15 on all of the relays to ground (through K1404-14 and -15), and connecting contact 15 to the collector circuit of Q1411 (at H12 through H52). Q1411 is normally on with its collector at logical "0". This provides the ground return for locking up the relays.

Assume that the Function 1 and Function 2 relays are connected as described, and that the Function 2 relay is locked up. Selecting the Function 1 Tone momentarily turns on relay drivers Q1403 and Q1407. The collector of Q1407 drops to logical "0" energizing relay K1401. This logical "0" is connected through CR1402 and CR1414 to the base of Q1411 turning the transistor off. When turned off, the collector Q1411 is at logical "1", releasing the Function 2 relay K1402.

When tone is removed from the decoder, Q1407 turns off. Q1411 turns on very quickly (before K1401 can drop out), keeping the relay locked up.

MAINTENANCE

To service the Decoder board turn off the power switch on the Base Station Control Shelf and unplug the Decoder board.

TROUBLESHOOTING

To troubleshoot the Decoder board remove the power as described above and unplug the Decoder board. Plug the Decoder board into the extender board (19D417458G1). The extender board extends the connections at the system board jacks to the pin jacks on the Decoder board so that the decoder circuits on the card are beyond other cards mounted on the system board. This allows convenient access to the circuits for troubleshooting with all operating voltages applied.

Logic circuit troubleshooting requires a thorough knowledge of the sequence of operations that occur in the circuit under normal operating conditions. The serviceman should study the circuit analysis and determine the required input and output gating voltages required at each integrated circuit terminal for proper operation.

A clip lead and VTVM may be used to check for proper logic operation. Determine the sequence required by the logic of the circuit and locate a logical "0" input required at a certain gate terminal for the desired result and connect the clip lead from this terminal to ground. Measure the result at the output terminal of the gate with the VTVM to check for proper operation of the gate. Following through the gating sequence, check the output of each gate until an improper result is found or the desired result is obtained.

Several test equipment manufacturers supply special test probes for quick troubleshooting of logic circuits. These probes contain Light Emitting Diodes (LED) which indicate the logical "1" state of a gate by illuminating the LED and indicate a logical "0" by turning the LED off. Other models contain two LED's, with a logical "1" illuminating one color LED and a logical "0" illuminating a different color.

RELAY STRAPPING PROCEDURE

The Decoder board is shipped from the factory with the relays strapped for the MULTIPLE lock-up. The relays may be strapped for different methods of operation, depending on the control function desired. The procedure consists of adding jumpers to the numbered holes on the Decoder board, depending on the method selected. Three of the strapping procedures are as follows:

> **NOTE**
>
> Before adding new jumpers, make sure that all previous jumper connections have been removed (see Table I, II and III).

Multiple Lock-Up

The decoder board is shipped from the factory strapped for this method of operation. The locking path for relays K1401 through K1403 is connected to logical "0" through the normally-closed contacts of relay K1404. Relays K1401 through K1403 may be locked up individually and in any sequence. Selecting the Function 4 Tone momentarily energizes K1404 (approximately four seconds), releasing all locked up relays. The multiple lock-up jumper connections are shown in Table I.

Table I

From	To
H1	H2
H5	H6
H13	H14
H51	H11
H49	H4
H50	H8

Exclusive Lock-Up

When strapped for this method of operation, the locking path for all relays is controlled by the operation of transistor Q1411. Relays K1401 through K1404 may be operated individaully and in any sequence. The operation of any relay releases any previously operated relay so that only one relay may be locked up at a time. The exclusive lock-up connections are shown in Table II.

Table II

From	To
H1	H2
H49	H4
H5	H6
H50	H8
H9	H10
H51	H11
H52	H12
H15	H16

Sequential Drop-Out

When strapped for this method of operation, the locking path of the lower numbered relay is connected through the normally closed contacts of the higher numbered relays. Relays K1401 through K1403 may be operated individually in any sequence. However, operating a higher numbered relay releases any locked-up lower numbered relay so that only one relay may be locked up at a time.

Table III

From	To
H1	H3
H49	H4
H5	H7
H50	H8
H51	H11
H13	H14

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA 24502

Printed in U.S.A.

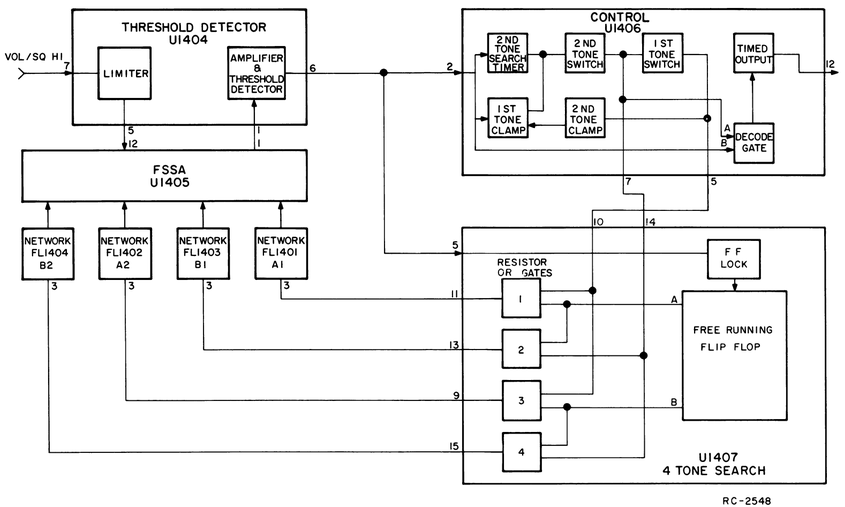


Figure 1 - Tone Decoder

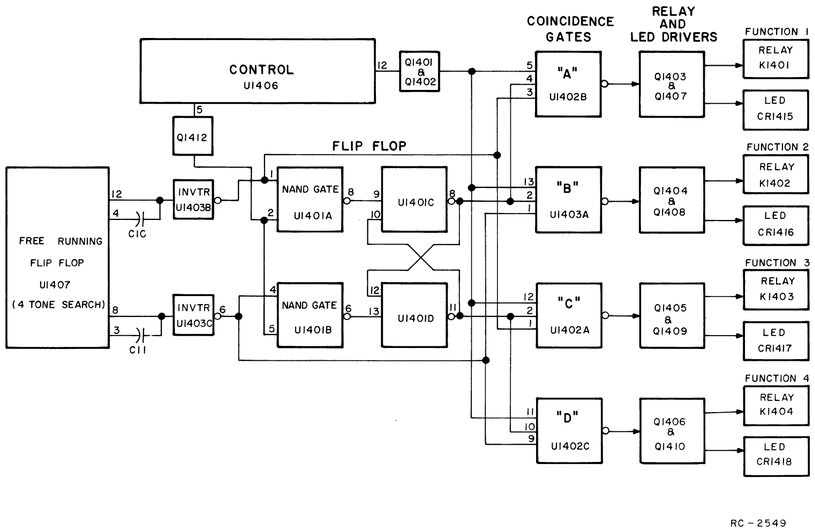
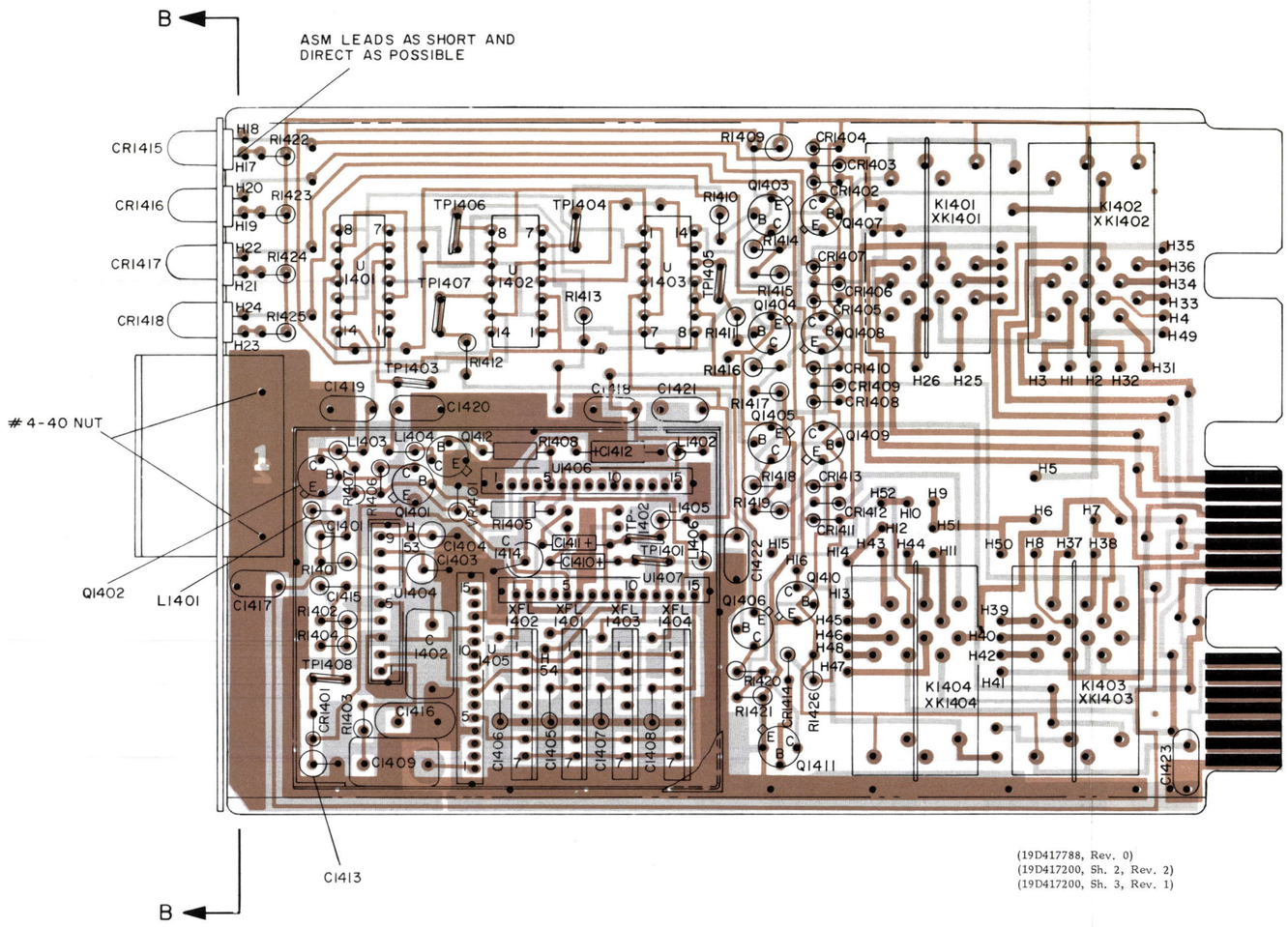
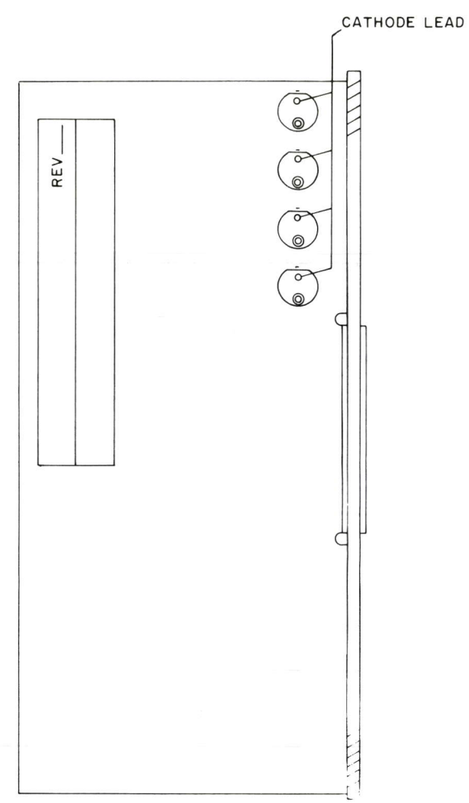
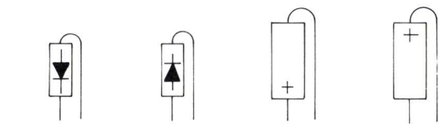


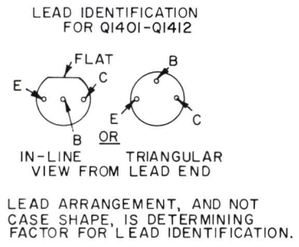
Figure 2 - Function Selector





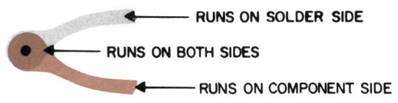
(19D417788, Rev. 0)
(19D417200, Sh. 2, Rev. 2)
(19D417200, Sh. 3, Rev. 1)





NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

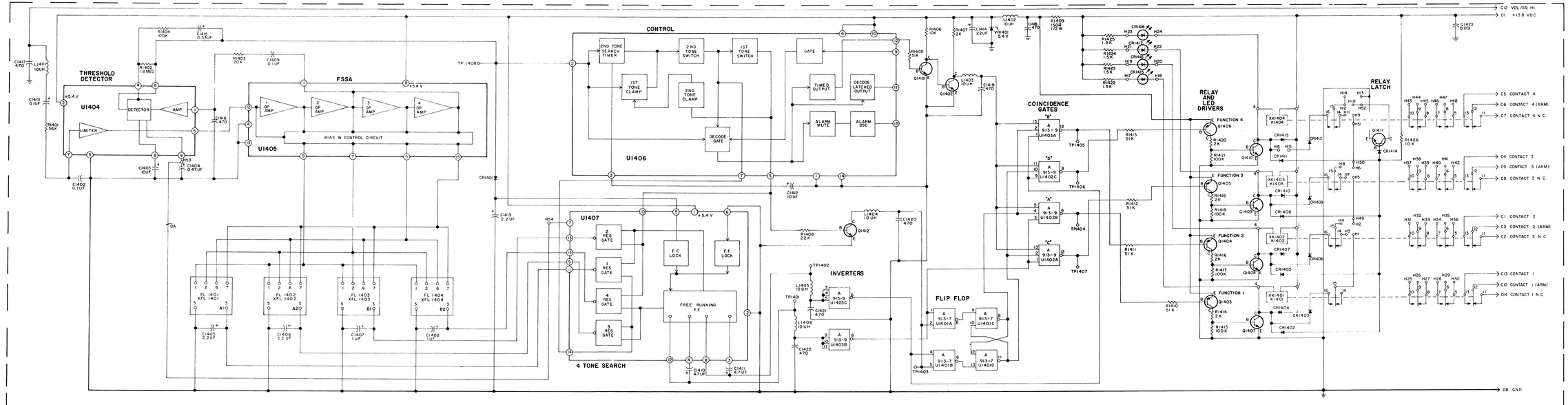
CONNECTION CHART		
FROM	TO	WIRE
H1	H2	DA
H5	H6	DA
H13	H14	DA
H51	H11	DA
H49	H4	DA
H50	H8	DA
H54	H53	DA



OUTLINE DIAGRAM

TYPE 99 DECODER 19D417199G1

8 Issue 1



JUMPER	FROM	TO
MULTIPLE	H1	H2
	H5	H6
	H3	H14
	H51	H11
	H49	H4
	H50	H8
SEQUENTIAL	H1	H3
	H49	H4
	H5	H7
	H50	H8
	H51	H11
	H3	H14
EXCLUSIVE	H1	H2
	H49	H4
	H5	H6
	H50	H8
	H9	H10
	H51	H11
	H52	H12
	H15	H16

IN ORDER TO INSURE RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN IN THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG =1,000,000 OHMS. ALL CAPACITORS ARE IN MICROFARADS UNLESS TO MICROMICROFARADS UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS, UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417199	

(19B622059, Rev. 3)

NOTE:
1. ON U1401, U1402 & U1403 PIN 7 TO GROUND, PIN 14 TO 5.4 V

SCHEMATIC DIAGRAM

TYPE 99 DECODER 19D417199G1

Issue 1

PARTS LIST

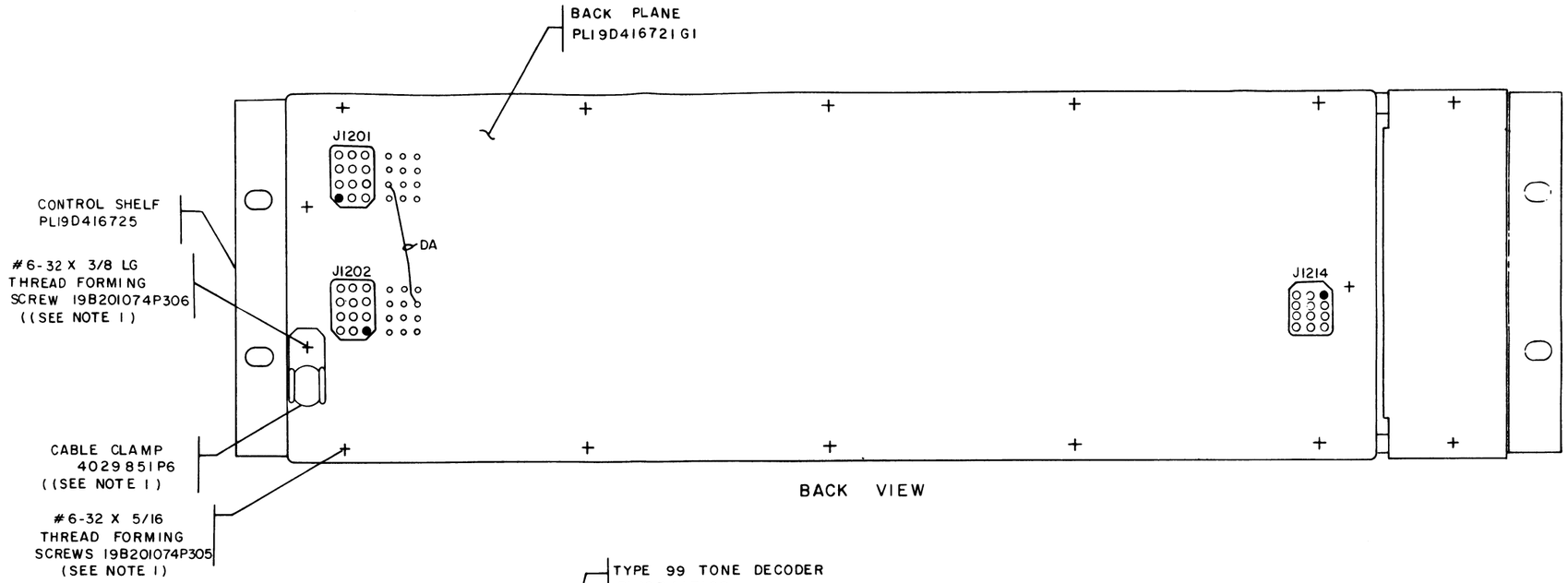
LBI-4659

TYPE 99 TONE DECODER
19D417199G1

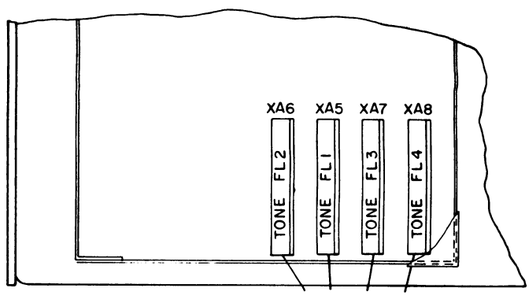
SYMBOL	GE PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1401	5496267P224	Tantalum: 0.1 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1402	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C1403	5491674P40	Tantalum: 10 µf ±20%, 20 VDCW; sim to Sprague Type 162D.
C1404	5496267P228	Tantalum: 0.47 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1405 and C1406	5491674P44	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to
C1407 and C1408	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1409	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C1410 and C1411	5491674P45	Tantalum: 4.7 µf ±10%, 6 VDCW; sim to Sprague Type 162D.
C1412	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1413	5496267P213	Tantalum: 2.2 µf ±10%, 20 VDCW; sim to Sprague Type 150D.
C1414	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1415	5496267P227	Tantalum: 0.33 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1416	489764B1623P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type 2M-15.
C1417 thru C1422	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1423	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		---------- DIODES AND RECTIFIERS ----------
CR1401 thru CR1414	19A115250P1	Silicon.
CR1415 thru CR1418	19A129291P1	Diode, light emitting: red.
		---------- TONE NETWORKS ----------
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
FL1401 thru FL1404	19C320291G3	Hybrid: 517.5 - 997.5 Hz.
	19C320291G3	Hybrid: 288.5 - 1433 Hz.
		---------- RELAYS ----------
K1401 thru K1404	5491595P14	Armature: 1.5 w operating, 530 ohms ±15% coil res, 4 form C contacts; sim to Allied Control T154-C-131.
		---------- INDUCTORS ----------
L1401 thru L1406	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
		---------- TRANSISTORS ----------
Q1401 and Q1402	19A116755P1	Silicon, NPN; sim to Type 2N3947.
Q1403 thru Q1406	19A115779P1	Silicon, PNP; sim to Type 2N3251.
Q1407 thru Q1412	19A116755P1	Silicon, NPN; sim to Type 2N3947.

SYMBOL	GE PART NO.	DESCRIPTION
		---------- RESISTORS ----------
R1401	3B152P563J	Composition: 56,000 ohms ±5%, 1/4 w.
R1402	3B152P185J	Composition: 1.8 megohm ±5%, 1/4 w.
R1403	3B152P203J	Composition: 20,000 ohms ±5%, 1/4 w.
R1404	3B152P104J	Composition: 0.1 megohm ±5%, 1/4 w.
R1405	3B152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R1406	3B152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R1407	3B152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1408	3B152P223J	Composition: 22,000 ohms ±5%, 1/4 w.
R1409	2B77P151J	Composition: 150 ohms ±5%, 1/2 w.
R1410 thru R1413	3B152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R1414	3B152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1415	3B152P104J	Composition: 0.1 megohm ±5%, 1/4 w.
R1416	3B152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1417	3B152P104J	Composition: 0.1 megohm ±5%, 1/4 w.
R1418	3B152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1419	3B152P104J	Composition: 0.1 megohm ±5%, 1/4 w.
R1420	3B152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R1421	3B152P104J	Composition: 0.1 megohm ±5%, 1/4 w.
R1422 thru R1425	3B152P152J	Composition: 1500 ohms ±5%, 1/4 w.
R1426	3B152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
		---------- TEST POINTS ----------
TP1401 thru TP1408	19B211379P1	Spring (Test Point).
		---------- INTEGRATED CIRCUITS ----------
U1401	19A115913P7	Digital, Quad 2-Input Gate; sim to Fairchild DTL 946.
U1402 and U1403	19A115913P9	Digital, Triple 3-Input Gate; sim to Fairchild DTL 962.
U1404	19C330539G1	Threshold Detector.
U1405	19D417092G1	Selector, Amplifier.
U1406	19D417098G1	Control (Type 99).
U1407	19D417132G1	4 Tone Search.
		---------- VOLTAGE REGULATORS ----------
VR1401	403688?P5	Silicon, Zener.
		---------- SOCKETS ----------
XFL1401 thru XFL1404	19C320299G1	Socket: 7 contacts.
XK1401 thru XK1404	5491595P7	Relay: 10 contacts; sim to Allied Control 30054-4.
		---------- MISCELLANEOUS ----------
	5491595P9	Retainer: spring; sim to Allied Control 30040-2. (Used with K1401 thru K1404).

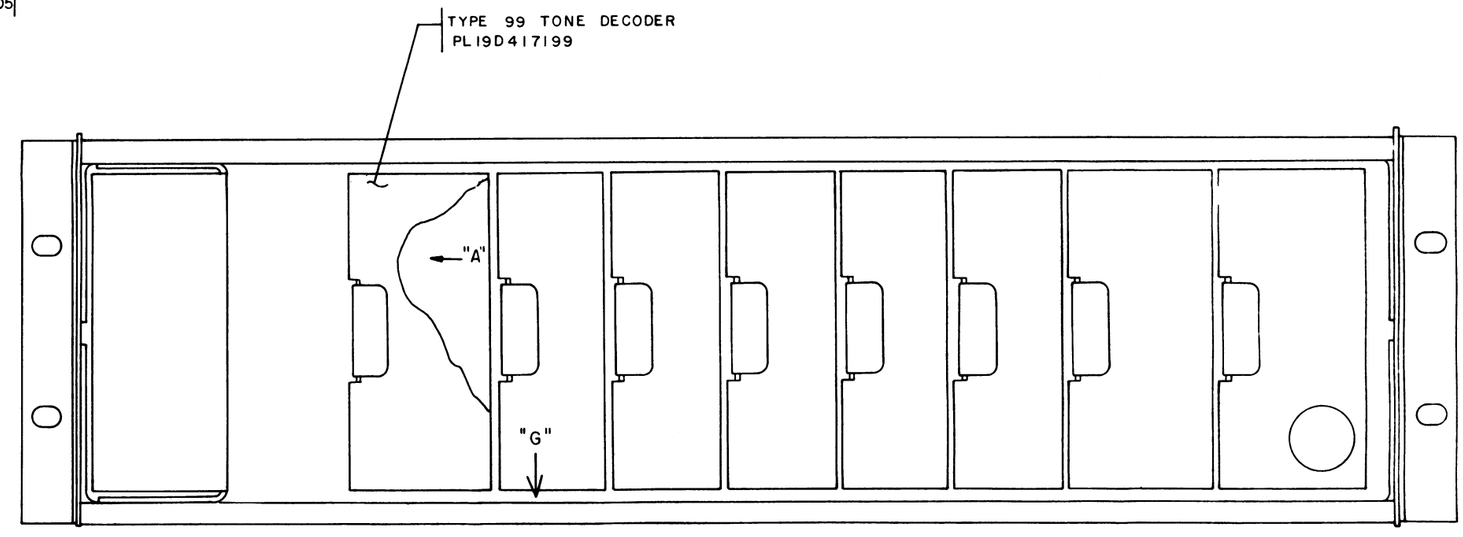
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



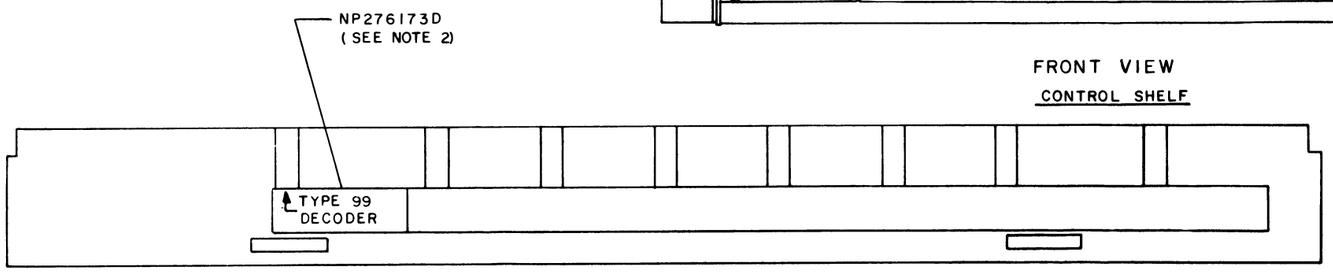
BACK VIEW



VIEW AT A
(ENLARGED)



FRONT VIEW
CONTROL SHELF



VIEW AT "G"

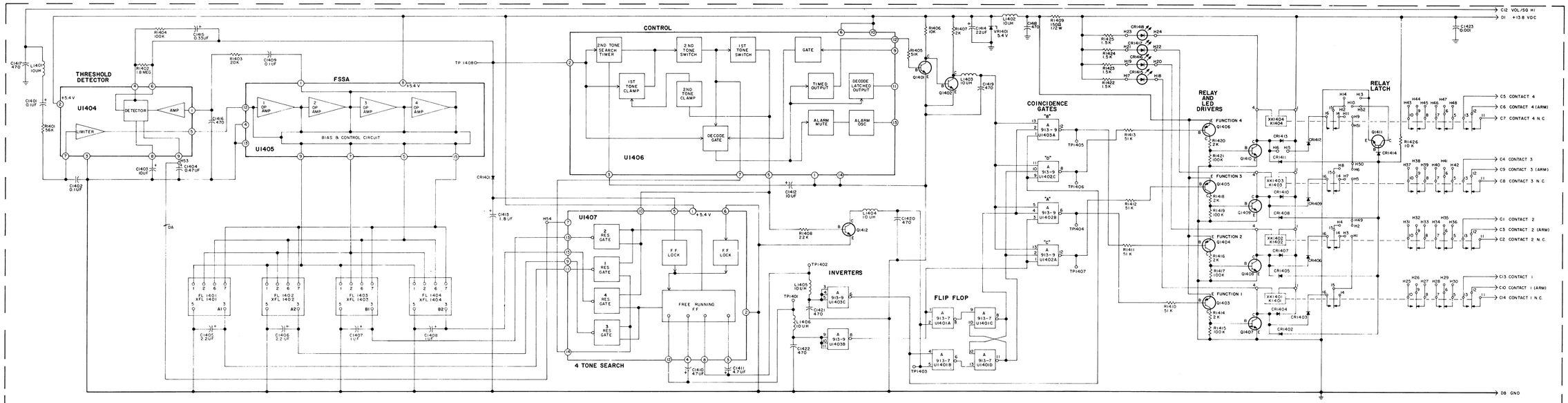
(19D417249, Rev. 1)

NOTES:
1. PART OF HARDWARE KIT PLI9A129385G1.
2. ALIGN ARROW WITH CENTER OF GUIDE WITHIN .060.

MODIFICATION & NSTALLATION DIAGRAM

TYPE 99 DECODER 19D417199G1

Issue 1



JUMPER	FROM	TO
MULTIPLE	H1	H2
	H5	H6
	H3	H4
	H51	H11
	H49	H4
	H50	H8
SEQUENTIAL	H1	H3
	H49	H4
	H5	H7
	H50	H8
	H51	H11
	H13	H14
EXCLUSIVE	H1	H2
	H49	H4
	H5	H6
	H50	H8
	H9	H10
	H51	H11
	H52	H12
	H15	H16

IN ORDER TO MAINTAIN EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=KILOHMS OHMS OR MEG =MEGOHMS OHMS. ALL CAPACITORS ARE IN MICROFARADS UNLESS FOLLOWED BY UF = MICROFARADS, INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
PL19D417199	A

(19B652059, Rev. 4)

NOTE:
1. ON U1401, U1402 & U1403 PIN 7 TO GROUND, PIN 14 TO 5.4 V

SCHEMATIC DIAGRAM

TYPE 99 DECODER 19D417199G1

Issue 2

PARTS LIST

LBI4659A

TYPE 99 TONE DECODER
19D417199G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1401	5496267P224	Tantalum: 0.1 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1402	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C1403	5491674P40	Tantalum: 10 µf ±20%, 20 VDCW; sim to Sprague Type 162D.
C1404	5496267P228	Tantalum: 0.47 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1405 and C1406	5491674P44	Tantalum: 2.2 µf ±20%, 15 VDCW; sim to
C1407	5491674P1	Tantalum: 1.0 µf +40-20%, 10 VDCW; sim to Sprague Type 162D.
C1408		
C1409	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C1410 and C1411	5491674P45	Tantalum: 4.7 µf ±10%, 6 VDCW; sim to Sprague Type 162D.
C1412	5491674P57	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C1413*	19B200240P15	Tantalum: 1.8 µf ±5%, 20 VDCW.
		Earlier than REV A:
	5496267P213	Tantalum: 2.2 µf ±10%, 20 VDCW; sim to Sprague Type 150D.
C1414	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C1415	5496267P227	Tantalum: 0.33 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C1416	4897489162P43	Silver mica: 470 pf ±5%, 300 VDCW; sim to Electro Motive Type DM-15.
C1417 thru C1422	5494681P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C1423	5494681P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1401 thru CR141	19A115250P1	Silicon, fast recovery, 225 ma, 50 PIV.
CR1415 thru CR1418	19A134146P4	Diode, optoelectronic: red; sim to Opcos LSH-6L.
		- - - - - - - - - TONE NETWORKS - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
FL1401 thru FL1404	19C320291G2	Hybrid: 517.5 - 997.5 Hz.
	19C320291G3	Hybrid: 288.5 - 1433 Hz.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K1401 thru K1404	5491595P14	Armature: 520 ohms ±15% coil res, 1.5 w operating, 4 form C contacts; sim to Allied Control T154-E-131.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1401 thru L1406	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4646-4K.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1401 and Q1402	19A116755P1	Silicon, NPN; sim to Type 2N3947.

SYMBOL	G-E PART NO	DESCRIPTION
Q1403 thru Q1406	19A115779P1	Silicon, PNP; sim to Type 2N3251.
Q1407 thru Q1412	19A116755P1	Silicon, NPN; sim to Type 2N3947.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1401	3R152P563J	Composition: 56K ohms ±5%, 1/4 w.
R1402	3R152P185J	Composition: 1.8 megohm ±5%, 1/4 w.
R1403	3R152P203J	Composition: 20K ohms ±5%, 1/4 w.
R1404	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1405	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R1406	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R1407	3R152P203J	Composition: 2K ohms ±5%, 1/4 w.
R1408	3R152P223J	Composition: 22K ohms ±5%, 1/4 w.
R1409	3R77P151J	Composition: 150 ohms ±5%, 1/2 w.
R1410 thru R1413	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R1414	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1415	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1416	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1417	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1418	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1419	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1420	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R1421	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R1422 thru R1425	3R152P153J	Composition: 1.5K ohms ±5%, 1/4 w.
R1426	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP1401 thru TP1408	19B211379P1	Spring (Test Point).
		- - - - - - - - INTEGRATED CIRCUITS - - - - - -
U1401	19A115913P7	Digital, Quad 2-Input Gate; sim to Fairchild DTL 946.
U1402 thru U1403	19A115913P9	Digital, Triple 3-Input Gate; sim to Fairchild DTL 962.
U1404	19C320539G1	Threshold Detector.
U1405	19D417092G1	Selector, Amplifier.
U1406	19D417098G1	Control (Type 99).
U1407	19D417132G1	4 Tone Search.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1401	4036887P5	Zener: 500 mW, 5.4 v. nom.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL1401 thru XFL1404	19C320299G1	Socket: 7 contacts.
XK1401 thru XK1404	5491595P7	Relay: 10 contacts; sim to Allied Control 30054-4.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	5491595P9	Retainer: spring; sim to Allied Control 30240-2. (Used with K1401 thru K1404).
	19B219690G1	Handle assembly.
	19B226302G1	Shield.
	19B226301P1	Shield cover.
	19A130013P1	Insulator. (Used with U1404).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To improve performance. Changed C1413.