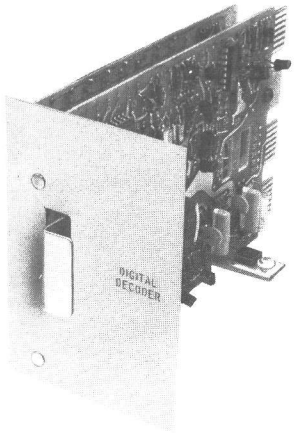
MOBILE RADIO

MASTR PROGRESS LINE

REPEATER CONTROL DIGITAL DECODER MODELS 19D416914G2,G3 (OPTIONS 7765 & 7766)



Maintenance Manual LBI-4683

DF-5036

REPEATER CONTROL DIGITAL DECODER

SPECIFICATIONS *

Model Number	Tone Input	MASTR Professional Option Number
19D416914G1	590 Hz	Not available
19D416914G2	1500 Hz	7765
19D416914G3	2805 Hz	7766

Pulsing Speed	8 to 16 PPS (10 PPS Nominal)
Input Impedance	50K ohms
Audio Sensitivity	
590 & 1500 Hz	.120 to 6.0 volts at 10 dB SINAD
2805 Hz	.120 to 6.0 volts at 14 dB SINAD
Input Power	12.6 volts at 175 milliamperes (add 20 milliamperes for relay)
Temperature Range	-30°C to +60°C

hese specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

General Electric Digital Decoder Models 19D416914G1, G2 & G3 transistorized, single-tone decoders for controlling the operation of MASTR repeater stations. The decoder assembly plugs into the BASE STATION CONTROL SHELF.

The decoder responds to a tone that is interrupted by a telephone-type dial to form a series of pulses corresponding to the digit dialed. The standard decoder is connected for Repeater Control. In this type of operation, dialing the "Repeater On" code enables the repeater (all timers operative). The repeater remains enabled until the "Repeater Off" code is dialed

If desired, the decoder may be connected for Timer Control operation. In this type of operation dialing the "Repeater On" code enables the repeater. However, when the Drop-Out Delay Timer or 3-Minute Limit timer on the repeater control board cuts off the transmitter, it automatically disables the repeater. The "Repeater On" code must be dialed each time the repeater is enabled. Dialing the "Repeater Off" code overrides the Drop-Out Delay Timer and disables the repeater.

A relay may be added to the decoder assembly whenever additional external control functions are desired.

PRELIMINARY ADJUSTMENTS

The decoder is normally shipped from the factory set to operate on the following codes:

- Repeater On: 5-9-5-5
- Repeater Off: 5-9-5-6

Before placing the decoder into operation, new code assignments and new code settings are normally required. Complete instructions for setting three- and four-digit codes, as well as a one-digit repeater drop-out code are contained in the Code Setting Procedure. Instructions are also provided for connecting the decoder for Timer Control Operation (see Table of Contents).

CIRCUIT ANALYSIS

(Refer to Figure 1)

The basic decoder consists of a tone receiver pulse routing board and a counter board.

The decoder is fully transistorized, using both discrete components and Integrated Circuit Modules (IC's) for increased reliability. Typical schematic and logic diagrams of the IC's used in the decoder are listed in the Table of Contents.

References to symbol numbers mentioned in the following test may be found on the applicable Schematic Diagram, Outline Diagram and Parts List (see Table of Contents).

TONE RECEIVER & PULSE ROUTING BOARD

TONE RECEIVER

Two different tone receiver and pulse routing boards are available for use in the decoder, depending on the system frequency.

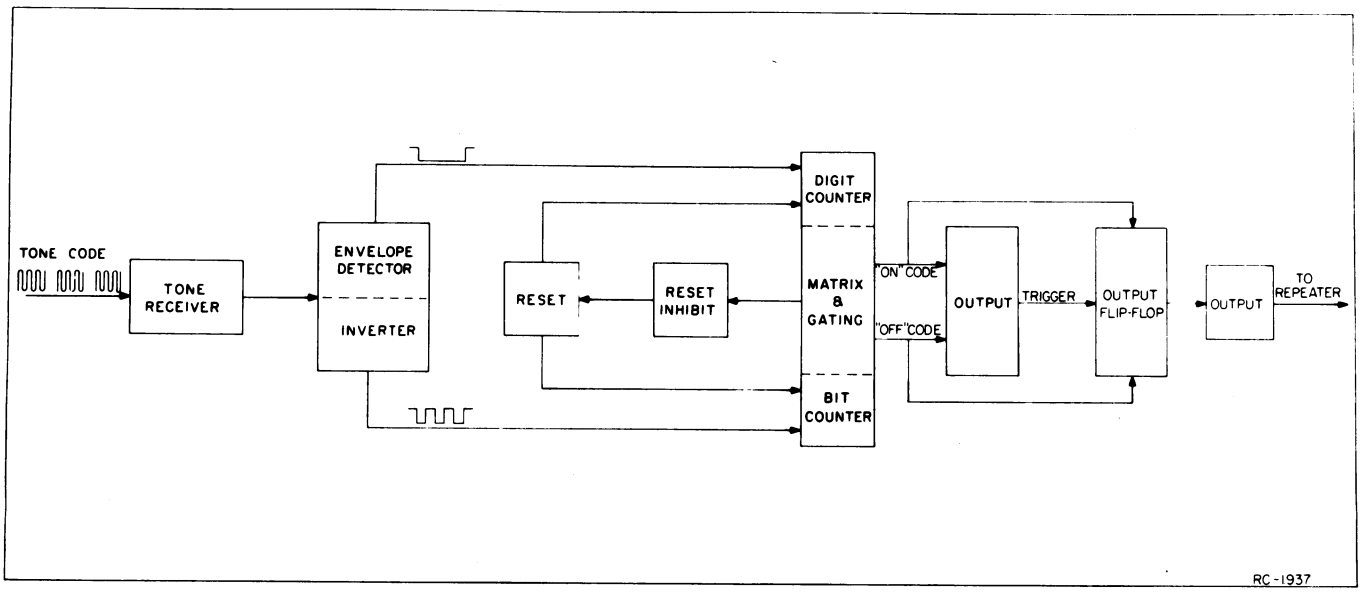


Figure 1 - Decoder Block Diagram

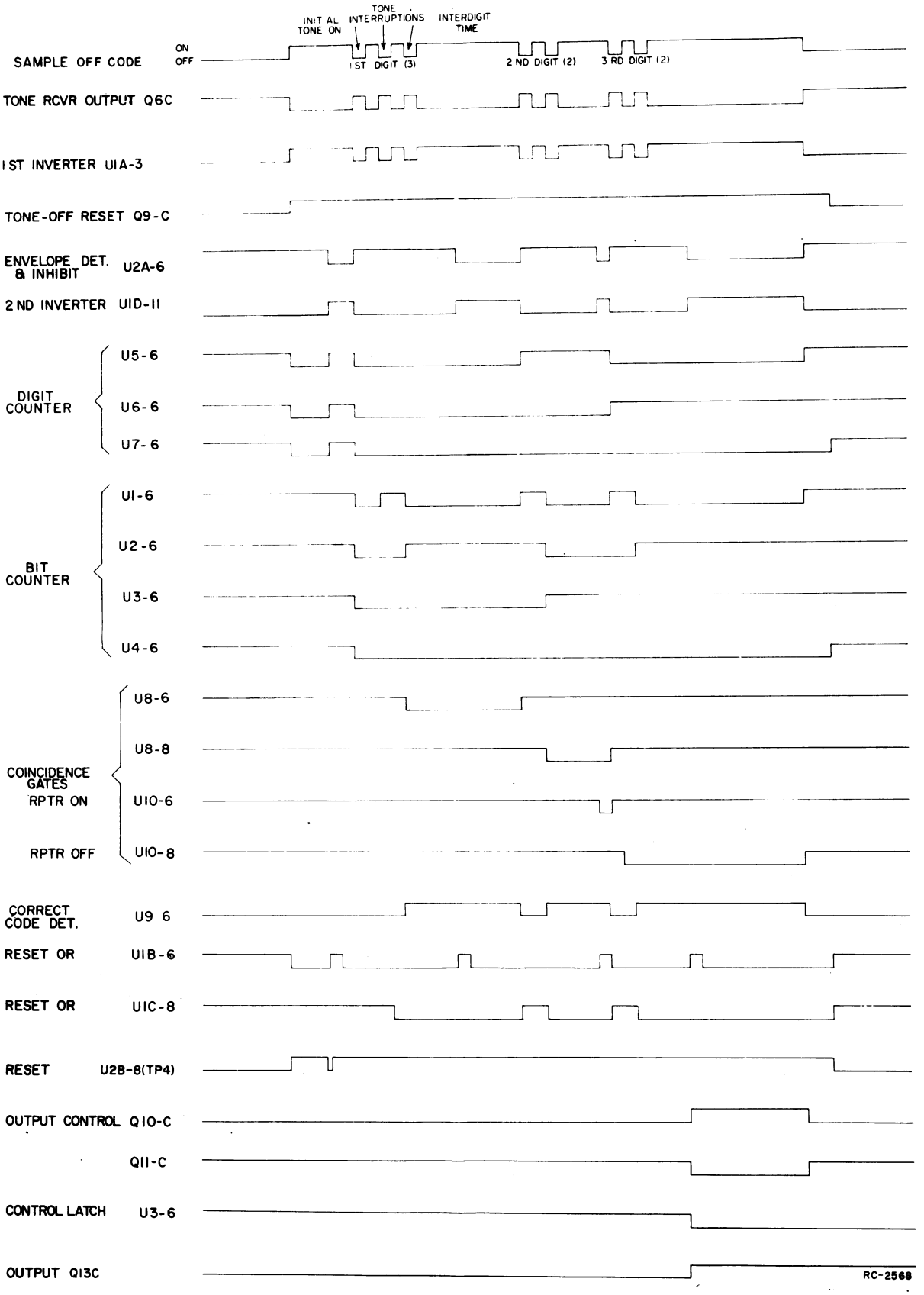


Figure 2 - Decoder Timing Waveforms

The operating frequency of each board is as follows:

- A1 - 590 Hz (not available)
- A2 - 1500 Hz
- A3 - 2805 Hz

Each tone receiver consists of an amplifier-limiter, a tuned circuit, a detector and regulator, and an output switch.

6-VOLT REGULATOR

Operating voltage for the decoder is supplied by the 6-volt regulator. +13 volts from the station power supply is applied to the zener diode-emitter follower regulator (VR1 and Q1). The +6-volt, 250-milliamp output is taken from the emitter of Q1.

A coded tone from the mobile or station receiver is coupled through DC blocking capacitor C2 to amplifier-limiters Q2 and Q3. A negative feedback path from the collector of Q2 to diode limiters CR4 and CR5 limits the signal applied to the base of Q3. Diodes CR2 and CR3 provide large-signal protection for Q2. The output of Q3 is applied to a tuned circuit consisting of C9/C10, C11/C12/C13 and L1/L2.

When an incorrect tone (or no tone) is applied to the tuned circuit, diode CR6 is forward biased by current through L1/L2. With CR6 conducting, detector Q4 is turned off. This allows diode CR7 to conduct, keeping output switch Q6 turned off.

Applying the correct tone to the tuned circuit increases the impedance of L1/L2, removing the bias on CR6. The diode now conducts only on the positive half-cycles of tone, and is cut off (reverse biased) on the negative half cycles. When a negative half cycle turns CR6 off, Q4 turns on. Turning on Q4 turns off CR7, which forward biases CR8 and CR9 and turns on output switch Q6. When a positive half cycle turns CR6 on (and Q4 off), C24 starts discharging through R18 and R19, keeping CR7 off and Q6 on. The output of Q6 is a positive pulse for each interruption in the tone code. Q5 acts as a regulator, keeping the emitter voltage of Q4 constant over the temperature range.

PULSE ROUTING

The pulse routing section contains the inverters, envelope detector, tone-off reset, reset, and output stages. Multiple-input Integrated Circuits, (IC's) are used for the inverters, envelope detectors control latch flip-flop and reset circuits. Discrete transistors are used for the tone-off reset and output stages, and in the envelope detector.

Figure 2 contains a complete set of decoder timing waveforms. It is recommended that these waveforms be used in conjunction with the circuit analysis for a better understanding of the decoder circuitry.

1ST INVERTER

The output of the tone receiver board is connected to input terminal 1 of the 1st inverter (U1A).

When no tone is applied to the decoder, the output of the tone receiver board is high (positive) and the output of the inverter is low (zero). When tone is first applied the inverter output goes positive. The positive-going pulses (one for each interruption in the tone) from the tone receiver are changed to negative-going pulses by the inverter. These negative-going pulses are applied to the trigger of the first flip-flop in the bit counter.

The inverter output is also applied to the input of the envelope detector and the tone-off reset circuits.

ENVELOPE DETECTOR

With no tone applied, the zero inverter output is applied to terminal 1 of the envelope detector OR gate, resulting in a positive output.

When tone is first applied to the decoder, the inverter output goes positive. This positive potential is applied to terminal 1 of the OR gate, and also turns on Q7 so that its collector drops to zero. This keeps the OR gate output positive for as long as Q7 conducts. Q7 conducts until C18 is fully charged, and then turns off. This causes the OR gate output to drop to zero.

The first negative-going pulse in the pulse train from the inverter switches the OR gate output to positive, and also causes C1 to rapidly discharge through CR10 and CR12. The trailing edge of the first pulse (now positive-going) turns on Q7, keeping the OR gate output positive. This cycle is repeated until the end of the digit pulse train and results in a positive pulse envelope for the digit pulses. The pulse envelope is inverted by U1D(TP2) and the negative-going pulse triggers the first flip-flop in the digit counter.

TONE-OFF RESET

When tone is first applied, the positive inverter output of the first inverter turns on Q8, and also charges C19 through CR11. Turning on Q8 turns off normally-on transistor Q9 so that its collector goes positive.

The negative-going digit pulses applied to the tone-off reset circuit causes C19 to discharge through R25 and the base-emitter junction of Q8, which keeps Q8 on. The output of Q9 remains positive until tone is

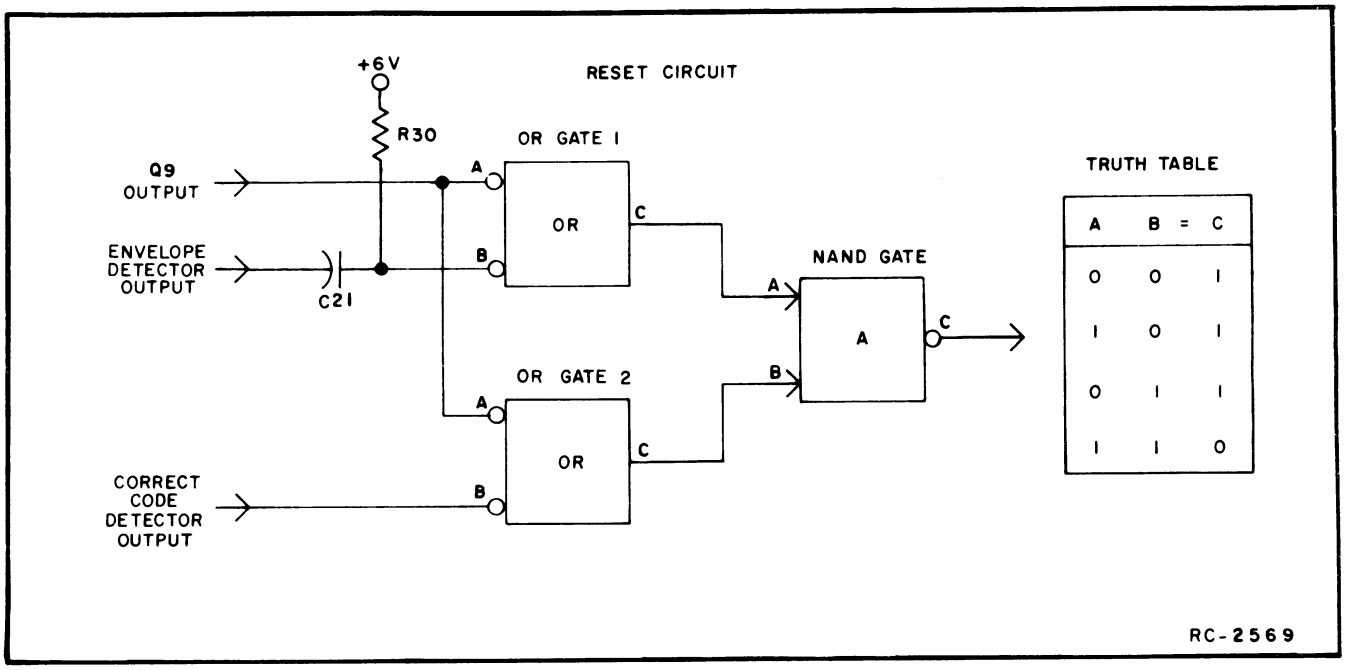


Figure 3 - Reset Circuit

removed from the decoder and C19 discharges. The output of Q9 is applied to the reset circuit.

RESET

The reset circuit consists of two NAND gates utilized as negative OR gates (U1B,C) driving a NAND gate (U2B). A simplified reset circuit and the truth table for all of the gates is shown in Figure 3. When both OR gate outputs are positive, the NAND gate output goes negative, resetting the counter flip-flops.

With no tone applied to the decoder, input A to each OR gate is at zero, holding the NAND gate in the reset condition.

When tone is applied, the positive output of Q9 keeps terminal A of both OR gates positive. Terminal B of the first OR gate is kept positive through R30, and the output of OR gate is "0". In the second OR gate, terminal A is positive and terminal B is held at "0" by the correct code detector so that the second OR gate output is positive. The zero and positive inputs to the NAND gate keep its output high, preventing the counters from resetting.

At the end of the first digit, a negative pulse from the envelope detector is coupled through C21 to terminal 4 of the OR gate, causing its output to go positive momentarily. At the same time, if a correct code has been applied to the counters, the output of correct code detector (OR gate) goes positive and is applied to terminal B of the second OR gate. Now, the output of the first reset OR gate is positive, and the second OR gate is zero, keeping the NAND gate output positive (no reset).

If an incorrect code is dialed, the correct code detector output remains at zero and both OR gate outputs go positive at the end of the incorrect digit. This switches the NAND gate output to zero, resetting the counters.

OUTPUT

The decoder output can be connected for either Repeater Control or Timer Control applications. In Repeater Control applications, dialing a "Repeater on" code enables the repeater function, and dialing a "Repeater Off" code disables the repeater function. The decoder is normally shipped from the factory connected for Repeater Control.

In Timer Control applications, dialing a "Repeater On" code enables the repeater function. The repeater function is disabled when the Drop Out Delay Timer operates. The repeater can also be disabled by dialing the "Repeater Off" code.

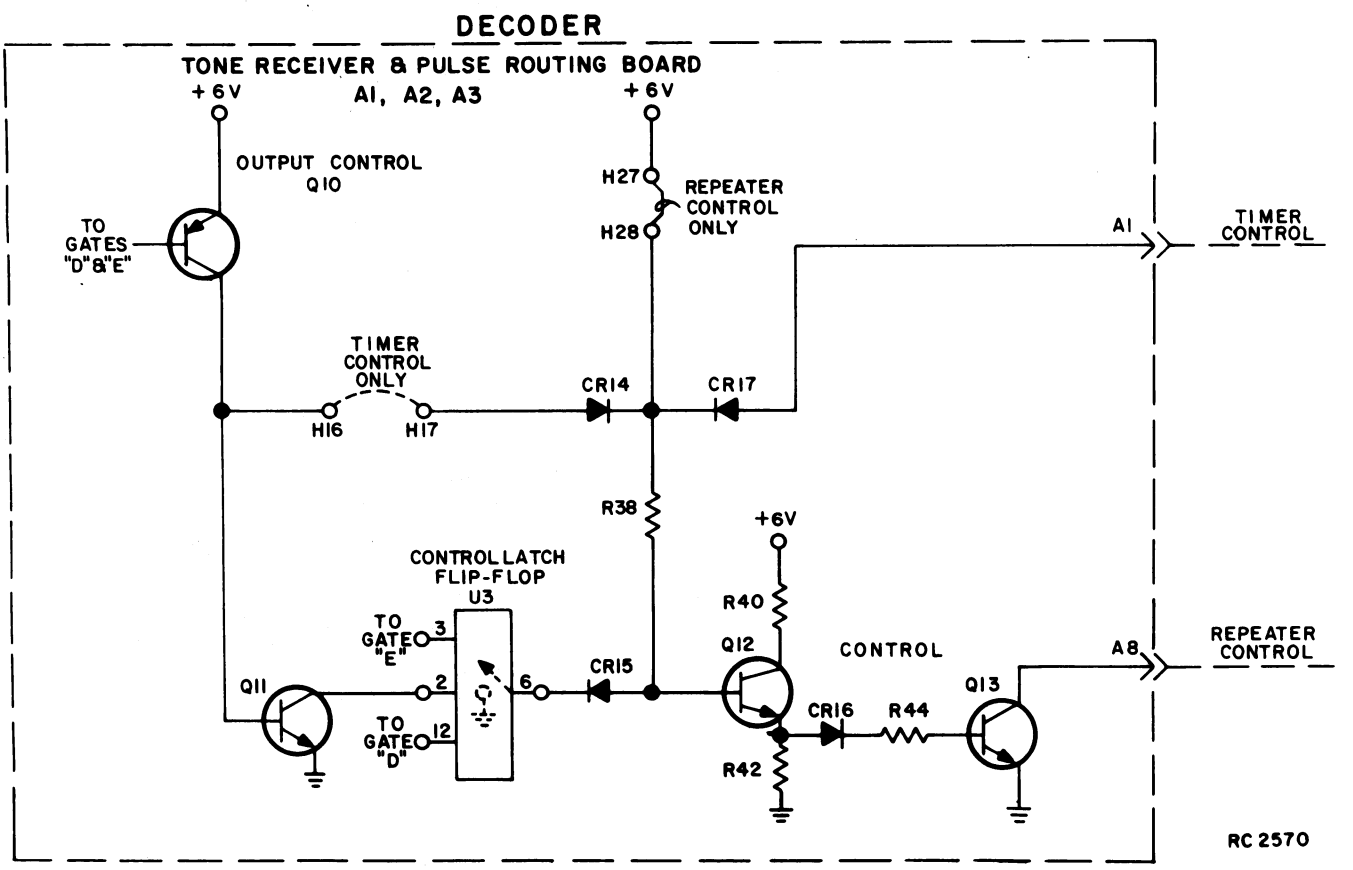


Figure 4 - Output Control Circuits

Repeater Control

When no code is applied to the decoder, the positive output of coincidence gates "D" and "E" on the counter board is connected through R32 and R34 to the base of out output transistor Q10, keeping the transistor turned off. Dialing the "Repeater On" code switches the output of coincidence gate "D" to ground potential. This causes current to flow in emitter-base junction of Q10, turning it on (see Figure 4). The ground from gate "D" is also applied to terminal 12 of the Control-latch flip-flop. When Q10 is turned on, the positive voltage on its collector causes current to flow in the base-emitter junction of Q11, turning it on. When terminal 3 of the flip-flop at a positive potential and terminal 12 at ground, turning on Q11 grounds terminal 2, triggering the flip-flop. Triggering the flip-flop causes terminal 6 to go positive, back biasing diode CR15. Back biasing CR15 removes the shunt on the base current of Q12, permitting current to flow in the base-emitter junction of the transistor, turning it on. This forward biases CR16 turning on Q13. When turned on, Q13 completes a current path on the repeater control board, enabling the repeater function.

Dialing the "Repeater Off" code switches the output of coincidence gate "E" to ground, turning on Q10. The ground is also applied to terminal 3 of the control latch flip-flop. When turned on, the positive voltage on the collector of Q10 causes current to flow in the emitter junction of Q11, turning it on. With terminal 3 of the flip-flop at ground potential and terminal 12 at a positive potential, turning on Q11 triggers the flip-flop, causing output terminal 6 to drop to ground potential. This forward biases CR15 and shunts the base current to Q12, turning it off. Turning off Q12 and Q13 removes the current path to Q3 on the repeater control board, disabling the repeater function. The repeater remains disabled until the "Repeater On" code is dialed.

Timer Control

In Timer Control applications, the output of Q10 is connected to the base circuit of Q12 by a jumper from H16 to H17. The 6-volt supply jumper from H27 to H28 is removed.

When no code is applied to the decoder, the positive output of coincidence gates

"D" and "E" on the counter board is connected through R32 and R34 to the base of output control transistor Q10 keeping the transistor turned off. Dialing the "Repleater On" code switches the output of coincidence gate "D" to ground potential. This causes current to flow in emitter-base junction of Q10, turning it on (see Figure 4). The ground from gate "D" is also applied to terminal 12 of the control-latch flip-flop. When Q10 is turned on, the positive voltage on its collector causes current to flow in the base-emitter junction of Q11, turning it on. With terminal 3 of the flip-flop at a positive potential and terminal 12 at ground, turning on Q11 grounds terminal 2, triggering and flip-flop. Triggering the flip-flop causes terminal 6 to go positive, back biasing diode CR15. Back biasing CR15 removes the shunt on the base current of Q12, permitting current to flow in the base-emitter junction of the transistor, turning on Q12 and Q13. When turned on, Q12 and Q13 complete a current path to the repeater control board, enabling the repeater to function.

The positive voltage from the Repeater Control Board of the timer output lead keeps Q12 and Q13 on. When either timer times out, the voltage is removed from the base of Q12, turning Q13 off. This disables the repeater function until the "Repeater On" code is dialed again.

In the case of interference keying (noise unsquelching the receiver), dialing the "Repeater Off" code overrides the timer control voltage, disabling the repeater.

Dialing the "Repeater Off" code switches the output of coincidence gate "E" to ground, turning on Q10. The ground is also applied to terminal 3 of the control latch flip-flop. When turned on, the positive voltage on the collector of Q10 causes current to flow in the emitter junction of Q11, turning it on. With terminal 3 of the flip-flop at ground potential and terminal 12 at a positive potential, turning on Q11 triggers the flip-flop, causing output terminal 6 to drop to ground potential. This forward biases CR15 and shunts the base current at Q12, turning it off. Turning off Q12 removes the current path to the repeater control board disabling the repeater function. The repeater remains disabled until the "Repeater On' code is dialed.

EXTERNAL CONTROL RELAY

A relay (5491595P12) spike suppressor diode (4037822P1) may be mounted on the decoder Tone Receiver and Pulse Routing Board whenever external control functions are required. The relay provides two form-C contacts for the desired switching functions, and may be dialed on (energized) and dialed off (de-energized).

Mounting locations and connections for the relay and circuitry are shown on the decoder Outline and Schematic Diagram (see Table of Contents).

COUNTER BOARD

The counter board consists of 10 IC's in the counters and gating circuits. The digit counter consists of three master-slave flip-flops (U5, U6 and U7) whose outputs are connected to the coincidence gate through a discrete diode matrix. The bit counter consists of four master-slave flip-flops (U1, U2, U3 and U4) whose outputs are connected to the coincidence gate inputs by screws located in the various holes in the counter board. The screws are positioned in holes 1 through 8 on lines A through G according to the code setting information as listed in Table of Contents.

The decoder Schematic Diagram is shown strapped (by dotted lines in the matrix) for a "Repeater On" code of 5-9-5-5 and a "Repeater Off" code of 5-9-5-6. The Truth Table on the Schematic Diagram shows all possible states of the flip-flop outputs (at terminal 6) while counting.

Assume that the "Repeater On" code (5-9-5-5) is dialed at the encoder. When the first digit is received at the decoder, one pulse is applied to the digit counter and five pulses are applied to the bit counter.

The pulse applied to the digit counter switches all of the flip-flops from the reset condition (all "1"s at terminal 6) to a "0" at terminal 6 and "1" at terminal 9. This back biases diodes CR1, CR2 and CR3, removing the ground on terminal 3 of NAND coincidence gate "A".

The five pulses applied to the bit counter sequentially switches the flip-flop outputs at terminal 6 from the reset condition (all "1"s at terminal 6) to a "0" - "0" - "1" - "0" as shown on line 5 of the Truth Table. Now all of the inputs to coincidence gate "A" are positive, and its output goes to ground. The ground activates the correct code detector OR gate, and its output goes positive. The positive output (reset inhibit) is applied to the reset circuit to prevent the counters from reseting.

When the second digit (9) is applied to the decoder, another pulse is applied to the digit counter and nine pulses are applied to the bit counter.

The pulse applied to the digit counter switches the flip-flops to a "1" - "0" - "1" at terminal 6. This back biases CR4, CR5 and CR6, removing the ground on terminal 11 of coincidence gate "B".

The nine pulses applied to the bit counter switches the flip-flop outputs at terminal 6 to a "1" - "0" - "1" - "1" as shown on line 14 of the Truth Table. Now all of the inputs to coincidence gate "B" are positive, and its output goes to ground. This activates the correct code detector and its output goes positive. The positive reset inhibit is applied to the reset circuit to prevent the counters from resetting

Applying the third digit (5) to the decoder applies one more pulse to the digit counter and 5 more pulses to the bit counter.

The pulse applied to the digit counter switches the flip-flops to "0" - "1" - "0" at terminal 6. This back biases CR7, CR8 and CR9, removing the ground on terminal 11 of coincidence gate "C".

The five pulses applied to the bit counter switches the flip-flop to "0" - "1" - "0" - "0" at terminal 6 as shown on line 3 of the Truth Table. Note that after the counter counts 16 bits, it recycles (i.e., starts counting over again from the first line on the Truth Table). Now all of the inputs to coincidence gate "C" are positive. The output of the coincidence gate goes to ground, activating the correct code detector.

The fourth digit applies one more pulse to the digit counter and five more pulses to the bit counter. The pulse applied to the digit counter switches the flip-flops to "1" - "1" - "0" at terminal 6. This back biases diodes CR10, CR11 and CR12, removing the ground on terminal 3 of coincidence gate "D".

The five pulses applied to the bit counter switch the bit counter outputs at terminal 6 to "1" - "1" - "0" as shown on line eight of the Truth Table. Now all of the inputs to coincidence gate "D" are positive, causing its output at terminal 6 to drop to ground potential to activate the correct code detector. The ground is also applied to the base of output control transistor and to terminal 12 of the control latch flip-flop. This activates the output stages and enables the repeater.

After the code is completed, the counters reset so that the decoder is ready for another code.

Dialing the "Repeater Off" code activates coincidence gates "A", "B", "C" and "E" in that order. This activates the output stages and disables the repeater function.

MAINTENANCE

DISASSEMBLY

To service the Decoder board turn off the power switch on the Base Station Control Shelf and unplug the Decoder board. The counter board is located on the right side of the Decoder for ease of code strapping. The Tone Receiver and Pulse Routing Board is on the left side.

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.

Procedures for troubleshooting the decoder include DC readings and waveforms for the tone receiver, pulse routing and counter boards. Refer to the Troubleshooting Procedure as listed in the Table of Contents.

TIMER CONTROL MODIFICATION

For timer control operation, modify the tone receiver and pulse routing board as follows:

1. Remove the decoder to gain access to the pulse routing board as directed in the Disassembly Procedure.
2. Remove the jumper between H27 and H28 (refer to the Outline Diagram for location of Holes).
3. Connect a jumper between H16 and H17.

ADJUSTMENT

Coil L1/L2 on the tone receiver and pulse routing board is the only adjustment on the decoder. This coil is set at the factory and will normally require no further adjustment unless it is necessary to replace L1/L2, C9/C10 or C11/C12/C13. If any of these components are replaced, adjust L1/L2 as follows:

1. Connect a VTVM across C9/C10 or C11/C12/C13.
2. Apply a continuous tone to the decoder at the proper operating frequency (590 Hz, 1500 Hz or 2805 Hz).
3. Tune L1/L2 for maximum meter reading.

CODE SETTING

3-DIGIT INDIVIDUAL CALL CODES

For three-digit operation, modify the counter board and set the codes according to the following procedure:

1. Move the White-Black-Brown wire from H9 to H17 (see Figure 5).
2. Move diode CR10 to the dotted position (see Figure 5).
3. Connect a jumper from H11 to H12 (see Figure 5).
4. The codes used as examples are:

   Repeater On - 5-9-5
   Repeater Off -5-9-6

5. Write complete three-digit codes in the box below:

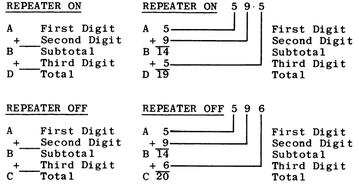
EXAMPLE:

Function	Number
Repeater On	
Repeater Off	

Function	Number
Repeater On	5-9-5
Repeater Off	5-9-6

6. Place the first digit of the code beside the letter A in the column of letters below. Next add second digit to the first and put this sum beside B. Add the third digit to figure placed at B and place this sum at C (Repeater Off) or D (Repeater On). NOTE: Zero on the telephone dial actually provides 10 pulses. When a zero is used in a code number, it must be added as a 10.

EXAMPLE:



7. Write each letter beside its corresponding subtotal in the following columns.
8. Read the screw positions for each subtotal and move the four screws for each letter to their proper positions on the Counter Board.

LETTERS	SUBTOTALS	SCREW POSITIONS
	1	2 4 6 8
	2	1 4 6 8
	3	2 3 6 8
	4	1 3 6 8
A	(5)	(2 4 5 8)
	6	1 4 5 8
	7	2 3 5 8
	8	1 3 5 8
	9	2 4 6 7
	10	1 4 6 7
	11	2 3 6 7
	12	1 3 6 7
	13	2 4 5 7
B	(14)	(1 4 5 7)
	15	2 3 5 7
	16	1 3 5 7
	17	2 4 6 8
Repeater On--D	(18)	(1 4 6 8)
Repeater Off-C	(19)	(2 3 6 8)
	20	1 3 6 8
	21	2 4 5 8
	22	1 4 5 8
	23	2 3 5 8
	24	1 3 5 8
	25	2 4 6 7
	26	1 4 6 7
	27	2 3 6 7
	28	1 3 6 7
	29	2 4 5 7
	30	1 4 5 7
	31	2 3 5 7
	32	1 3 5 7

4-DIGIT INDIVIDUAL CALL CODES

The decoder is normally shipped from the factory set for the codes used in the examples below. Set the new codes assembly to the following procedure. The codes used are:

REPEATER ON - 5-9-5-5
REPEATER OFF - 5-9-5-6

1. Write the complete four-digit code in the box below:

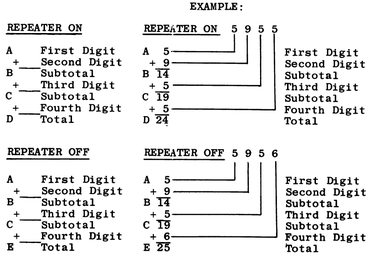
EXAMPLE:

Function	Number
Repeater On	
Repeater Off	

Function	Number
Repeater On	5955
Repeater Off	5956

2. Place the first digit of the code beside the letters below. Next, add the second digit to the first and put this sum beside B. Add the third digit to figure placed at B and place this sum at C. NOTE: Zero on the telephone dial actually provides 10 pulses. When a zero is used in a code number, it must be added as a 10.

EXAMPLE:

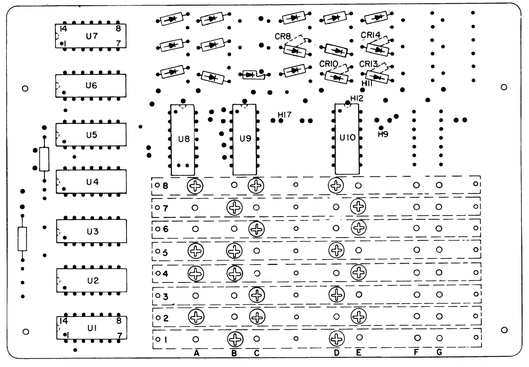


3. Write each letter beside its corresponding subtotal in the columns at right.
4. Read the screw positions for each subtotal and move the four screws for each letter to their proper positions on the counter board (see Figure 5).

LETTERS	SUBTOTALS	SCREW POSITIONS
	1	2 4 6 8
	2	1 4 6 8
	3	2 3 6 8
	4	1 3 6 8
A	(5)	(2 4 5 8)
	6	1 4 5 8
	7	2 3 5 8
	8	1 3 5 8
	9	2 4 6 7
	10	1 4 6 7
	11	2 3 6 7
	12	1 3 6 7
	13	2 4 5 7
B	(14)	(1 4 5 7)
	15	2 3 5 7
	16	1 3 5 7
	17	2 4 6 8
	18	1 4 6 8
C	(19)	(2 3 6 8)
	20	1 3 6 8
	21	2 4 5 8
	22	1 4 5 8
	23	2 3 5 8
D	(24)	(1 3 5 8)
E	(25)	(2 4 6 7)
	26	1 4 6 7
	27	2 3 6 7
	28	1 3 6 7
	29	2 4 5 7
	30	1 4 5 7
	31	2 3 5 7
	32	1 3 5 7
	33	2 4 6 8
	34	1 4 6 8
	35	2 3 6 8
	36	1 3 6 8
	37	2 4 5 8
	38	1 4 5 8
	39	2 3 5 8
	40	1 3 5 8

NOTE

The letters A through G used in the Code Setting Procedure correspond to a line of screw positions on The Counter Board. The numerals 1 through 8 represent the position of each screw in the selected screw line.



RC-1956A

Figure 5 - Counter Board

CODE SETTING PROCEDURE

REPEATER CONTROL DIGITAL DECODER
MODELS 19D416914G1, G2 & G3

CODE SETTING

1-DIGIT DROP-OUT

The counter board may be modified for one-digit drop-out, so that dialing a single number disable the repeater. It is recommended that a higher number be used to minimize falsing (i.e., 7, 8, 9 or 0).

NOTE

The number used for the one-digit drop-out code cannot be used in any other code.

With a 4-Digit Code:

1. If the decoder is strapped for a four-digit "Repeater On" code, move CR13 and CR14 to the dotted position as shown in Figure 5.
2. Write an "E" beside the number selected in the column below. The number used in the example is a 0 (must be counted as a 10).
3. Read the screw positions for the selected number, and move the four screws to their proper position in line E.

CODE NUMBER	SCREW POSITIONS
1	2 4 6 8
2	1 4 6 8
3	2 3 6 8
4	1 3 6 8
5	2 4 5 8
6	1 4 5 8
7	2 3 5 8
8	1 3 5 8
9	2 4 6 7

EXAMPLE: E--(10)----------(1 4 6 7)

With a 3-Digit Code:

1. If the decoder is strapped for a three-digit "Repeater On" code, move CR8 to the dotted position as shown in Figure 5.
2. Write a "C" beside the number selected in the column below. The number used in the example is a 0 (must be counted as a 10).
3. Read the screw positions for the selected number, and move the four screws to their proper position in line C.

CODE NUMBER	SCREW POSITIONS
1	2 4 6 8
2	1 4 6 8
3	2 3 6 8
4	1 3 6 8
5	2 4 5 8
6	1 4 5 8
7	2 3 5 8
8	1 3 5 8
9	2 4 6 7

EXAMPLE: C--(10)----------(1 4 6 7

NOTE

The letters A through G used in the Code Setting Procedure correspond to a line of screw positions on The Counter Board. The numerals 1 through 8 represent the position of each screw in the selected screw line.

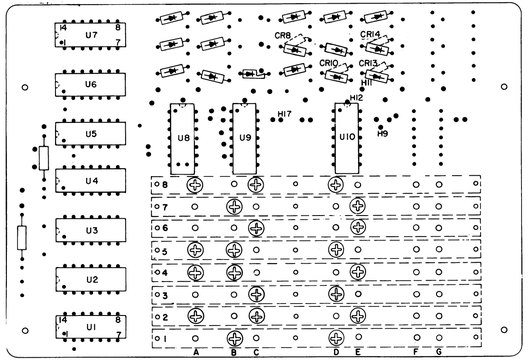
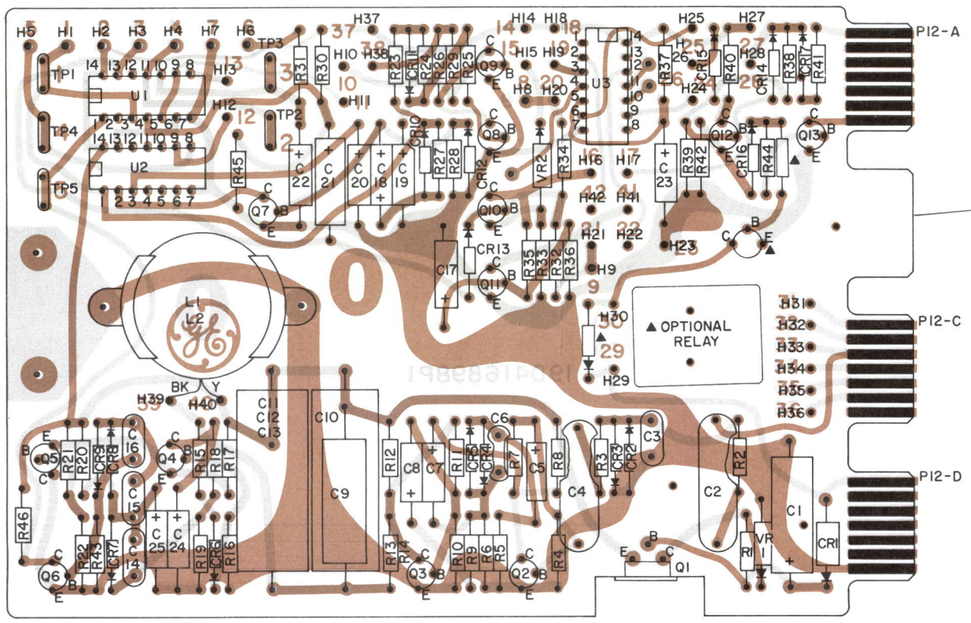


Figure 5 - Counter Board

CODE SETTING PROCEDURE

REPEATER CONTROL DIGITAL DECODER
MODELS 19D416914G1, G2 & G3

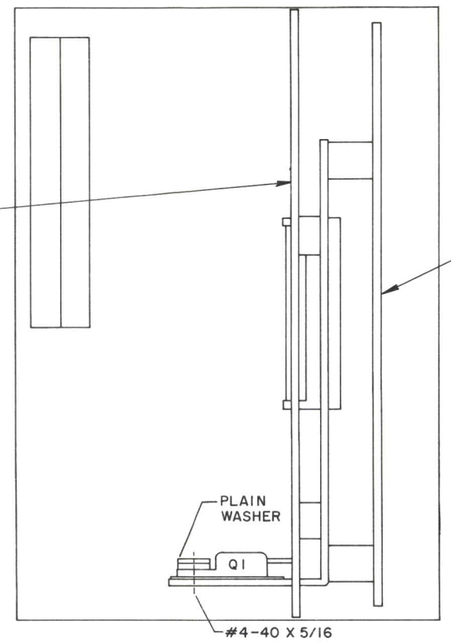
TONE RECEIVER & PULSE ROUTING BOARD
A1, A2 & A3



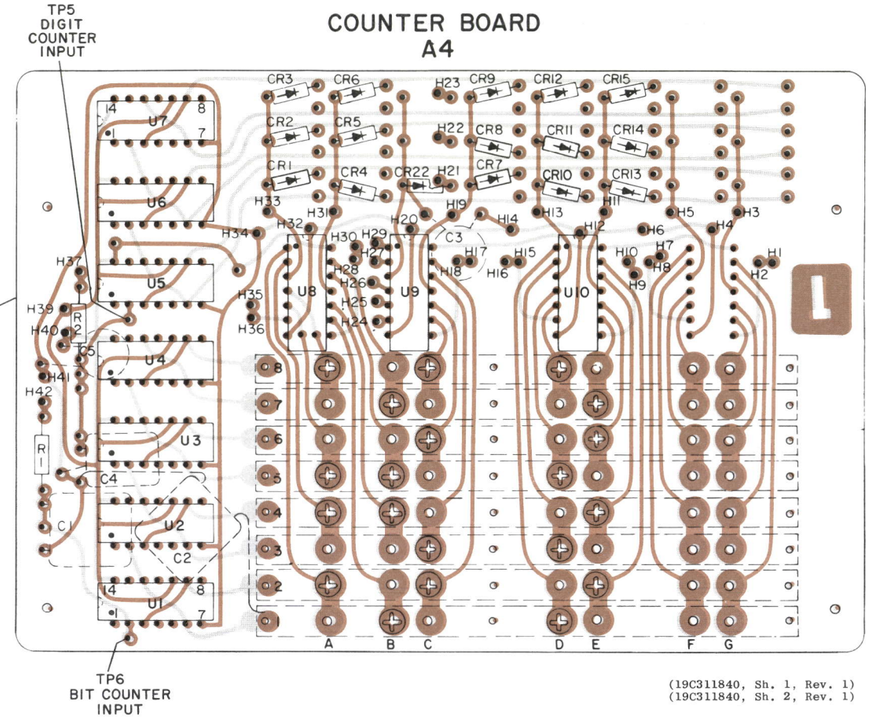
(19D416898, Sh. 2, Rev. 0)
(19D416898, Sh. 3, Rev. 0)

▲CUSTOMER SUPPLIED OPTIONAL RELAY AND ASSOCIATED CKTS.

REAR VIEW



COUNTER BOARD
A4

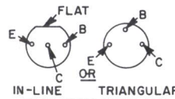


(19C311840, Sh. 1, Rev. 1)
(19C311840, Sh. 2, Rev. 1)

8 9 10 11 12 13 14
7 6 5 4 3 2 1
SOLDER SIDE

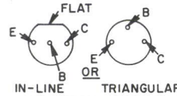
TYP. NUMBERING OF CONT. FINGERS

LEAD IDENTIFICATION
FOR Q3-Q6, Q8-Q11 & Q13



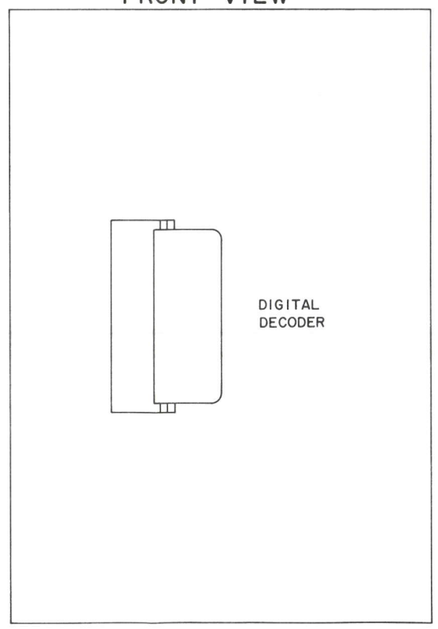
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION
FOR Q2, Q7 & Q12

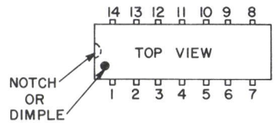


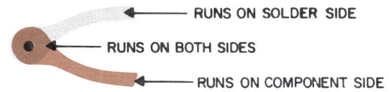
(19D417876, Rev. 0)

FRONT VIEW



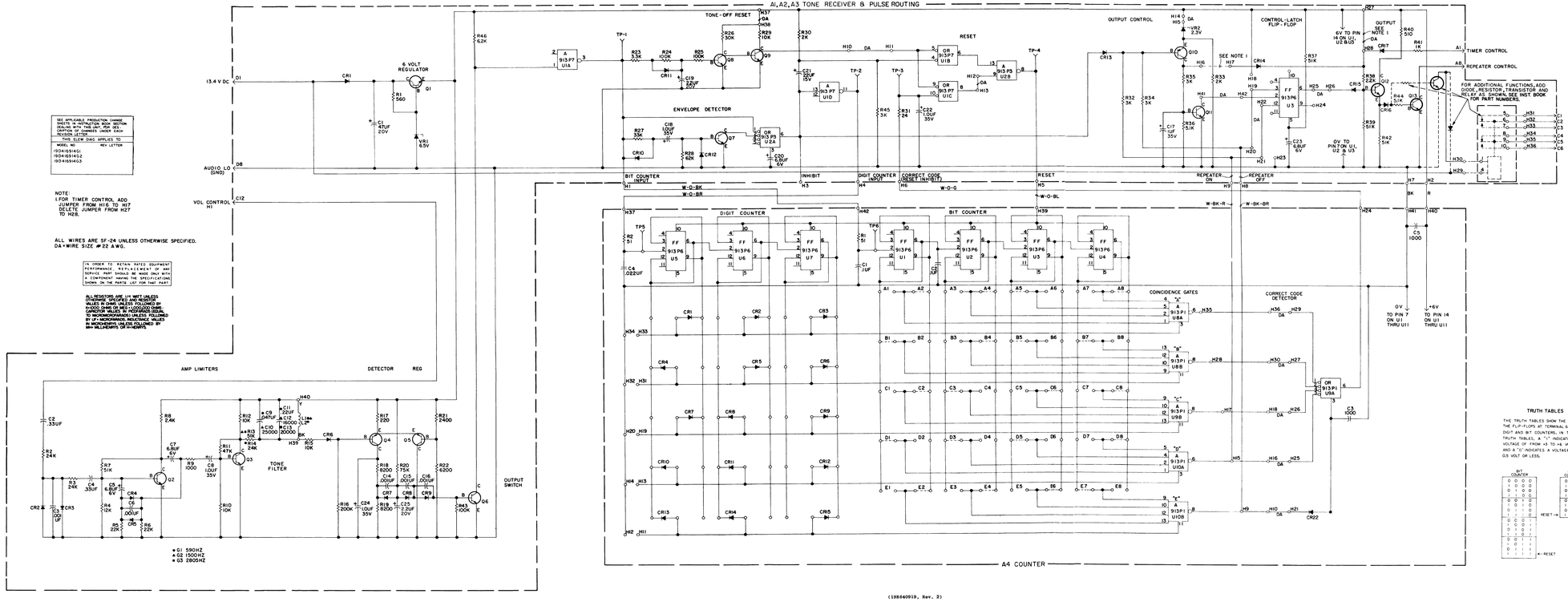
INTEGRATED CIRCUIT
LEAD IDENTIFICATION





OUTLINE DIAGRAM

REPEATER CONTROL DIGITAL DECODER
MODELS 4EJ18D10-12



(19R640919, Rev. 2)

SCHEMATIC DIAGRAM

REPEATER CONTROL DIGITAL DECODER
MODELS 4EJ18D10-12

Issue 1

PARTS LIST

LBI-4684

REPEATER CONTROL DIGITAL DECODER
19D419914G1-G3
(G1 not available)

SYMBOL	GE PART NO.	DESCRIPTION
A1 thru A3		TONE RECEIVER AND PULSE ROUTING 19D419903G1-G3
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496267P15	Tantalum: 47 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C2	19B209243P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C3	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C4	19B209243P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C5	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C6	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C7	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C8	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C9	19C300075P 47001G	Polyester: 47,000 pf ±2%, 100 VDCW; sim to GE Type 61F.
C10	5496249P25000G	Polystyrene: 25,000 pf ±2-1/2%, 125 VDCW.
C11	19C300075P 22003G	Polyester: 220,000 pf ±2%, 100 VDCW; sim to GE Type 61F.
C12	5496249P16000G	Polystyrene: 16,000 pf ±2-1/2%, 125 VDCW.
C13	5496249P20000G	Polystyrene: 20,000 pf ±2-1/2%, 125 VDCW.
C14 thru C16	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C17 and C18	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C19	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C20	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C21	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C22	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C23	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C24	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C25	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	402782ZP1	Silicon.
CR2 thru CR17	19A115250P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B205354G2	Coil.
L2	19B205354G3	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q2	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q3	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q4 and Q5	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q6	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q7	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q8 and Q9	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q10	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q11	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q12	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q13	19A115889P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P561J	Composition: 560 ohms ±5%, 1/4 w.
R2 and R3	3R152P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R4	3R152P133J	Composition: 13,000 ohms ±5%, 1/4 w.
R5 and R6	3R152P223J	Composition: 22,000 ohms ±5%, 1/4 w.
R7	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R8	3R152P242J	Composition: 2400 ohms ±5%, 1/4 w.
R9	3R152P103J	Composition: 1000 ohms ±5%, 1/4 w.
R10	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R11	3R152P473J	Composition: 47,000 ohms ±5%, 1/4 w.
R12	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R13	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R14	3R152P243J	Composition: 24,000 ohms ±5%, 1/4 w.
R15	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R16	3R152P204J	Composition: 0.20 megohm ±5%, 1/4 w.
R17	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R18 and R19	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
R20	3R152P753J	Composition: 75,000 ohms ±5%, 1/4 w.
R21	3R152P242J	Composition: 2400 ohms ±5%, 1/4 w.
R22	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
R23	3R152P332J	Composition: 3300 ohms ±5%, 1/4 w.
R24 and R25	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R26	3R152P303J	Composition: 30,000 ohms ±5%, 1/4 w.
R27	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R28	3R152P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R29	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R30	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R31	3R152P240J	Composition: 24 ohms ±5%, 1/4 w.
R32	3R152P302J	Composition: 3000 ohms ±5%, 1/4 w.
R33	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R34 and R35	3R152P302J	Composition: 3000 ohms ±5%, 1/4 w.
R36	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R37	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R38	3R152P202J	Composition: 2000 ohms ±5%, 1/4 w.
R39	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R40	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R41	3R152P102J	Composition: 1000 ohms ±5%, 1/4 w.
R42	3R152P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R43	3R152P104J	Composition: 0.10 megohm ±5%, 1/4 w.
R44	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
R45	3R152P302J	Composition: 3000 ohms ±5%, 1/4 w.
R46	3R152P622J	Composition: 6200 ohms ±5%, 1/4 w.
		- - - - - - - - TEST POINTS - - - - - - - - -
TP1 thru TP5	19B211379P1	Spring (Test Point).
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A115913P7	Digital, Quad 2-Input Gate; sim to Fairchild DTL 946.
U2	19A115913P3	Digital, Dual Buffer; sim to Fairchild DTL 932.
U3	19A115913P6	Digital, Clocked Flip-Flop; sim to Fairchild DTL 945.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1	403688TP6	Silicon, Zener.
VR2	403688TP1	Silicon, Zener.
A4		COUNTER BOARD 19D413100G3
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C3	5494481P11	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
C4	19A116080P103	Polyester: 0.022 µf ±10%, 50 VDCW.
C5	5494481P11	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Dimcap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR15	19A115250P1	Silicon.
CR22	19A115250P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R152P510J	Composition: 51 ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - -
TP5 and TP6	8503P304C13	Cotter pin.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1 thru U7	19A115913P6	Digital, Clocked Flip-Flop; sim to Fairchild DTL 945.
U8 and U10	19A115913P1	Digital, Dual 4-Input Gate; sim to Fairchild DTL 930.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116118P1	Silicon, NPN.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A116022P1	Insulator, bushing. (Used with Q1).
	19A116023P1	Insulator, plate. (Used with Q1).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

TROUBLESHOOTING PROCEDURE

QUIPMENT REQUIRED

- DC-triggered oscilloscope
- AC and DC VTVM
- A tone generator of the proper frequency and a telephone-type dial, or a TGS-735 or TGS-740 encoder on the proper frequency
- A 12-volt, DC power supply

PRELIMINARY INSTRUCTIONS

1. All waveforms shown are with the proper tone applied and the digit 5 dialed. Note: the digit 6 was dialed for the incorrect code reset waveform shown in Figure 6.
2. The oscilloscope setting for all waveforms is 5 volts/division vertical and 100 milliseconds/division horizontal except where noted.
3. Before starting the procedure, check for +6 volts DC at the emitter of regulator transistor Q1 (see Fig. 6). Then check for +6 volts on the Counter Board (see Fig. 7).

SYMPTOM	PROCEDURE
	PULSE ROUTING AND COUNTER BOARD
Decoder responds to a wrong code	1. Check the screw placement on the counter board (refer to the Code Setting Procedures as listed in the Table of Contents). 2. Check to see that no screws are missing (one screw in each pad). 3. Check to see that all screws are firmly seated. 4. Check diode CR13 (see Fig. 6).
Decoder doesn't respond to correct codes	1. Check the screw placement on the counter board (refer to the Code Setting Procedure as listed in the Table of Contents). At no time should two screws be located in any one screw pad (see Figure 7). 2. Dial a "5" and check the waveforms at TP1 and TP2 (see Fig. 6). If the proper waveforms are not present, refer to Tone Receiver Checks. If proper waveforms are present, continue with Step 3. 3. Dial a correct first digit and keep the tone on after dialing. All of the screw heads in row A should measure approximately +6 volts DC, which indicates that the first digit was counted correctly. Dial a correct second digit and keep the tone on after dialing. All of the screw heads in Row B should be at +6 volts, indicating the second digit was counted correctly. Dial a correct third digit and keep the tone on after dialing. All of the screw heads in row C should measure +6 volts, indicating that the third digit was counted correctly. Dial a correct fourth digit (Repeater on Code), and keep the tone on after dialing. All of the screw heads in row D should measure +6 volts, indicating that the fourth digit was counted correctly. If all of the digits are counted correctly, check the output of Q10 at H16 (see Fig. 6) and check the output circuit (Q12, etc.). If the screw heads do not go to +6 volts during the digit checks, continue with Step 4.

SYMPTOM	PROCEDURE
Decoder doesn't respond to correct codes (cont'd)	4. Connect the reset disable jumper to battery negative to prevent re-setting while dialing (see Fig. 6). Dial the correct first digit again, keeping the tone on after dialing. Check the screw heads in row A again for +6 volts. If all of the screw heads are at +6 volts, check for a positive voltage at the cathode of CR1, CR2 and CR3. If the screw heads or cathodes are not positive, check the flip-flops as instructed in Step 5. If the screw heads and cathodes are positive (indicating a correct count), dial the second, third and fourth correct digits to check the screw heads in rows B, C, and D, and the cathode of diodes CR4 through CR12. If all codes are counted correctly and the cathode of the diodes are positive, this indicates a fault in the reset circuit. Check the correct code, incorrect code reset and reset inhibit waveforms shown in Figure 6, and refer to the circuit analysis section for detailed operation and Truth Table for the reset circuitry. 5. With the reset disable jumper connected, dial a "5" and check the input waveforms at TP5 and TP6 (see Fig. 7). If the waveforms are not correct, check the Tone Receiver or the envelope detector circuitry. If the waveforms are correct, check to see if the flip-flops are switching (one output terminal at +6 volts ("1") and the other at zero ("0"). Refer to the circuit analysis of the Counter Board and the Truth Table on the Schematic Diagram (see Table of Contents). 6. If the flip-flops are not switching properly (both output terminals at zero volts or both at +6 volts), remove all of the screws in the bit counter flip-flop or unsolder all of the diodes in the output of the digit counter and re-check the flip-flop output. If the flip-flop does not switch correctly, replace the IC module. NOTE To remove an IC module, clip off all of the leads as close as possible to the body of the module. Then unsolder and remove one lead at a time, being careful not to pull the printed wiring away from the board.
No tone output	1. While applying 100 millivolts of on-frequency tone, dial a "5" and check the waveform at C7 (see Fig. 6). If the proper waveform is not present, check the Tone Receiver input circuitry. 2. With tone applied, dial a "5" and check the waveform at C24 (see Fig. 6). If the proper waveform is present, check CR7, CR8, CR9 and Q6. If the waveform is not correct, check for a sine wave across L1/L2. 3. If the sine wave is present across L1/L2, connect a jumper across L1/L2 and check for a near zero reading at the positive end of C24. If the reading is not near zero, check CR6, Q4 and Q5.
No tone output at high input levels, but operates normally at low input levels	Check C5, C7, CR4, CR5, R5 and R6 in the limiter circuitry.

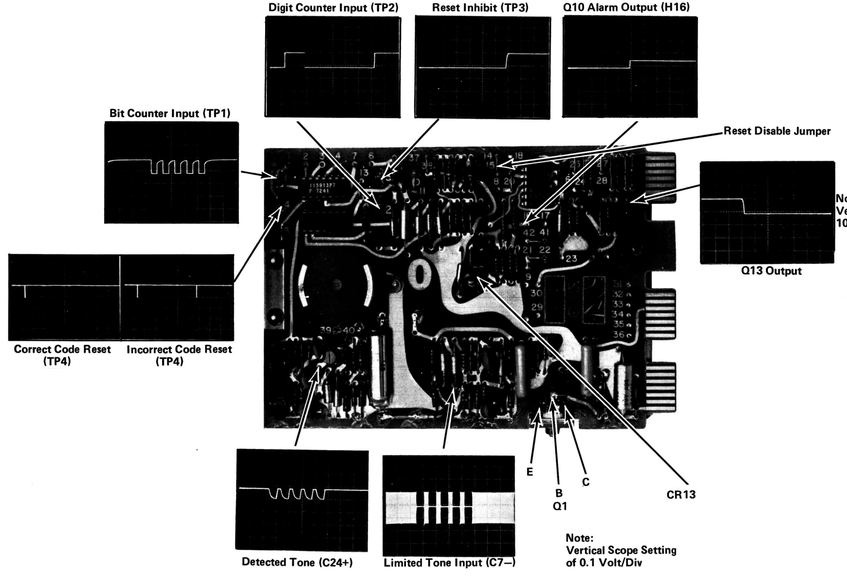


Figure 6 - Tone Receiver & Pulse Routing Board

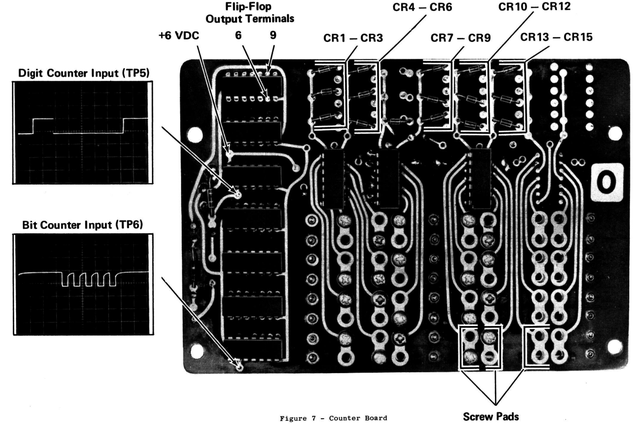


Figure 7 - Counter Board

THESE INSTRUCTIONS COVER THE MODIFICATION OF THE CONTROL SHELF & REPEATER CONTROL BOARD FOR REPEATER CONTROL DIGITAL DECODER

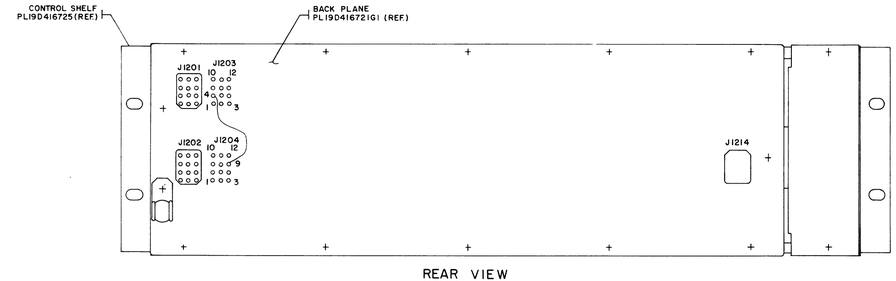
A. INSTRUCTION FOR MODIFICATION OF REPEATER CONTROL BOARD 19D416675.

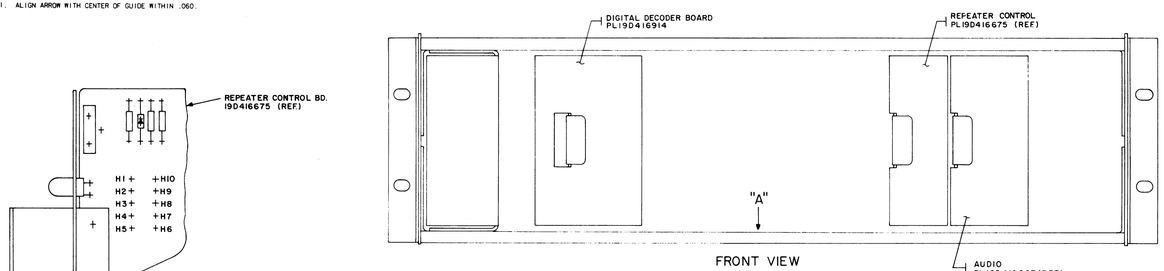
1. REMOVE REPEATER BOARD FROM SHELF.
2. REMOVE JUMPER BETWEEN HOLE 7 AND HOLE 8.
3. REPLACE REPEATER CONTROL BOARD IN SHELF.

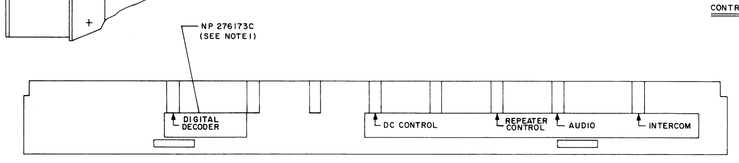
B. INSTRUCTION FOR MODIFICATION OF CONTROL SHELF 19D416725.

1. AFFIX NAMEPLATE NP-276173C TO SHELF AS SHOWN.
2. INSTALL #22 AWG BUS WIRE BETWEEN J1203-4 & J1204-9. INSULATE WITH SLEEVING TO PREVENT SHORTS.
3. INSTALL DIGITAL DECODER BOARD IN SHELF.
4. TEST PER 19A129641.

NOTES:
1. ALIGN ARROW WITH CENTER OF GUIDE WITHIN .060.







(19D416927, Rev. 1)

ORDERING SERVICE PARTS

Each component appearing on the schematic daigram is identified by a symbol number, to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

DF-5036

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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