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Auto Answer Circuit Design for an Anderson Jacobson AD 342 Modem

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AUTO-ANSWER CIRCUIT DESIGN

FOR AN ANDERSON JACOBSON AD 342 MODEM

by

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FOREWORD

Environmental measurements are required to determine the quality of ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory-Cincinnati conducts research to:

- o Develop and evaluate techniques to measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid wastes.

- o Investigate methods for the concentration, recovery, and identification of viruses, bacteria, and other microbiological organisms in water; and to determine the responses or aquatic organisms to water quality.

- o Develop and operate a computerized system for instrument automation; leading to improved data collection, analysis, and quality control.

This report was developed by the Advanced Instrumentation Section of the Environmental Monitoring and Support Laboratory, in the interest of distribution of information to aid the advancement of laboratory techniques through computerization.

Dwight G. Ballinger, Director
Environmental Monitoring & Support Laboratory
Cincinnati

ABSTRACT

This report describes a circuit that connects a Western Electric Model 1001F Data Accessing Arrangement to an Anderson Jacobson Model AD 342 Modem. It automatically answers the telephone and holds a data connection as long as a received carrier is present. It self-resets upon loss of carrier, allowing further incoming calls to be answered. It also disconnects and resets if no carrier is received within ten seconds after answering. In addition, the circuit allows for easy origination of calls to other systems.

This report is a result of work done in conjunction with the laboratory automation project, sponsored by the Environmental Monitoring and Support Laboratory of the Environmental Protection Agency. This work was accomplished over the period September, 1976 to June, 1977.

CONTENTS

SECTION 1

INTRODUCTION

Manual telephone operation for data communication does not allow unattended, dial-up, computer use. Not only is it necessary for someone to answer the telephone and place it on an acoustical coupler, but it is also necessary to hang up upon session completion to allow further incoming calls.

The circuitry discussed in this report was designed to eliminate the need for human intervention in computer data communication by telephone. It was also designed to allow easy origination of calls, so as to make full use of a Modem.

In addition to the circuitry, necessary equipment consists of a Western Electric Data Accessing Arrangement and a Modem capable of answer mode operation.

SECTION 2

DESIGN OBJECTIVES

The desired circuit functions were:

1. To answer a telephone equipped with a Western Electric Data Accessing Arrangement (DAA), and connect a data path from the DAA to a Modem.

2. To break the connection and reset the circuitry upon loss of incoming carrier.

3. To break the connection and reset the circuitry if no carrier is received within a given period after answering.

4. To provide an easy means to originate calls to other systems.

SECTION 3

THEORY

Circuit operation can be divided into four areas, input, output, reset, and control. The input circuitry provides conversion of the necessary control signals from Electronic Industries Association (EIA) levels to (TTL) levels. The output circuitry provides the TTL-to-EIA conversion, and also drives front panel Light Emitting Diode (LED) indicators. The reset circuitry resets all sequential logic either on power-up or manually by push-button. The control circuitry provides the necessary logic for the circuit to accomplish the desired goals. A detailed block diagram is shown in Figure 1. Figure 2 is a schematic diagram of the logic circuitry, and Figures 3 and 4 show the power filtering and regulation and Integrated Circuit (IC) pin connections.

Input circuitry is shown as blocks 1 through 4 on the block diagram. These four blocks use two 9617, triple EIA receivers. These convert EIA RS-232C logic levels. The RS-232C standard is such that +4 to +15 volts defines a true logic level and -4 to -15 volts defines a false level. The 9617 IC is also fail safe, that is, voltages between -4 and +4 (such as those for an open or grounded line) are considered false. Also note that the output is in negative logic. Two of the signals attached to these receivers come from the DAA and two from the Modem. The signals from the DAA are:

1) SH, Switch Hook, that indicates the phone handset has been picked up and,
2) RI, Ring Indicator, that indicates the phone is ringing.

The signals from the Modem are:

1) CD, Carrier Detect, that indicates a carrier is being received, and
2) DTR, Data Terminal Ready, that indicates the Modem power is one.

It is appropriate at this time to mention the two connections between the DAA and the Modem that do not connect to the circuit. These are R, Receive, and T, Transmit, sometimes called Ring and Tip by telephone companies.

Output circuitry is represented by blocks 5 through 8. Blocks 5 and 6 consist of 9616, triple TTL to EIA drivers. These convert TTL to the RS-232C levels needed by the DAA. These IC's also have negative logic inputs. Two signals go to the DAA. These are:

1) OH, Off Hook, that signals the DAA to complete a DC circuit to the phone company office in the same manner as when a phone is taken off the hook, and

2) DA, Data Available, that connects the audio signal from the phone lines to the R and T terminals on the DAA.

Blocks 7 and 8 of the output circuitry consist of two sections of a 7404 hex inverter. These are used with a dropping resistor to drive front panel LED indicators. These indicators show the DTR and CD signals from the Modem. The signals are a quick indication of Modem status. DTR is a power-on indicator, and CD shows when a connection is established to a user or system.

The reset circuitry provides power-up and manual reset functions. Block 14 produces a manual reset and consists of a pushbuttom with a pull-up resistor, R5. Block 14 produces a power-up reset, and consists of an RC network, made up of one-third of a 7410 triple 3-input NAND gate and one section of the hex inverter. Note the use of negative logic here and throughout the control circuitry.

The control circuitry uses the TTL-level RI, SH, and CD signals and through sequential and parellel logic produces an output signal (Pin6 IC6) that causes both OH and DA. This signal should be present under these conditions:

1) When the telephone receiver is lifted to originate a call (SH).

2) When a carrier is present, indicating a completed connection (CD).

3) When the telephone rings, to answer it (RI).

4) For a reasonable amount of time after the telephone rings, to allow the person originating the call to respond with a carrier.

5) For a short time after the telephone is hung up in originating a call, to hold the line until the Modem responds to the carrier.

The fourth conditions is met by stretching the third condition by ten seconds. This takes place in block 11, and is accomplished by using half of a 74122 dual monostable multivibrator. This is then logically OR'ed with the first two conditions by block 12, another section of the 7410. Block 13 is a circuit whose output is true whenever its input is true, and stays true for approximately two seconds after its input goes false. This satisfies the last condition and also allows for short dropouts in the carrier. The other half of the 74122 provides the two-second dropout delay, and half of a 7474 dual D flip-flop and one section of the hex inverter are used for logic and to remove the glitch that occurs when the two-second dropout delay is initiated.

SECTION 4

CONSTRUCTION

Construction may be wire-wrap, point-to-point, or printer circuit techniques. Parts placement is not critical, but a placement that follows the logic flow is an aid to troubleshooting. Figure 8 shows a suggested outline. A printed circuit is desirable but wire wrapping is less time consuming when making single units.

SECTION 5

OPERATION

For the circuit to be used in the answer mode, the Modem must be capable of answer operation and this mode must be selected. When the number associated with the circuit is called, the circuit answers, (usually on the first ring) and connects the Modem to the line, signified by an audible tone. Within 10 seconds after the tone, the person originating the call must respond with a carrier of their own. This is usually done by placing the telephone receiver in a Modem coupler or by switching a terminal with a built-in Modem to Data. Approximately one second after the answer Modem receives the carrier, a data connection is established. Once established, the session may proceed for as long as necessary. If there is a loss of carrier for more than two seconds, the connection will be lost and must be reestablished by the above procedure. All that is necessary to reset the circuitry at the end of a session is to break the carrier, usually by hanging up the telephone.

To originate a call, the Modem must be in the originate mode. When a call is made to another system, the other system responds with a carrier. When this occurs, the telephone is hung up and, in approximately one second, the carrier detect light should light. This indicates a connection is established and may proceed for as long as necessary. Again, if the carrier is lost for more than two seconds, the circuit will reset and the procedure will have to be repeated to reestablish a connection. On most systems, a LOGOFF or similar command is given to indicate the end of a terminal session and the carrier is dropped shortly after receiving a LOGOFF command. If this is the case, the circuit will self-reset after two seconds. If this is not the case, it will be necessary to break the connection manually. This may be done either by pressing the reset button or by picking up the telephone as if to make another call. The carrier detect light will extinguish when the connection has been broken.

SECTION 6

TROUBLESHOOTING

Should any trouble with the circuitry arise, troubleshooting is fairly easy. Probably the handiest tool for service is a logic probe. Caution should be used for EIA-level signals because most probes will allow only a positive input less than 7 volts and the high positive and negative voltages present could easily damage the probe. As most signals are present long enough to allow a reading, a Volt Ohm Meter (VOM) can be used for the EIA measurements.

The synchrograms, Figures 5 through 7, can be used for determining what logic levels should be present on most external and some important internal points. The first item to check is the Modem power and circuit power.

APPENDIX A

PARTS LIST

C1	500 MF.	(Part of Single Shot RC Network)
C2	1 MF.	(Part of R4C2 Power Up Reset)
C3	100 MF.	(Part of Single Shot RC Network)
C4	1 MF.	(Power Supply Bypass)
C5	1 MF.	(Power Supply Bypass)
C6	1 MF.	(Power Supply Bypass)
D1	12 Volt 1 Watt Zener	(Power Supply Regulation)
D2	12 Volt 1 Watt Zener	(Power Supply Regulation)
IC1	9617	(Fairchild EIA to TTL Converter)
IC2	9617	(Fairchild EIA to TTL Converter)
IC3	74122	(Dual Monostable Multivibrator)
IC4	7410	(Triple 3 input NAND Gate)
IC5	7404	(Hex Inverter)
IC6	7474	(Dual D Type Flip Flop)
IC7	9616	(Fairchild TTL to EIA Converter)
R1	39K Ohms	(Part of Single Shot RC Network)
R2	470 Ohms	(Current Limiter for LED)
R3	470 Ohms	(Current Limiter for LED)
R4	120K Ohms	(Part of R4C2 Power Up Reset)
R5	2.2K Ohms	(Pull up Resistor)
R6	39K Ohms	(Part of Single Shot RC Network)

R7	47 Ohms	(Current Limiter for Zener)
R8	47 Ohms	(Current Limiter for Zener)

APPENDIX B

FIGURES

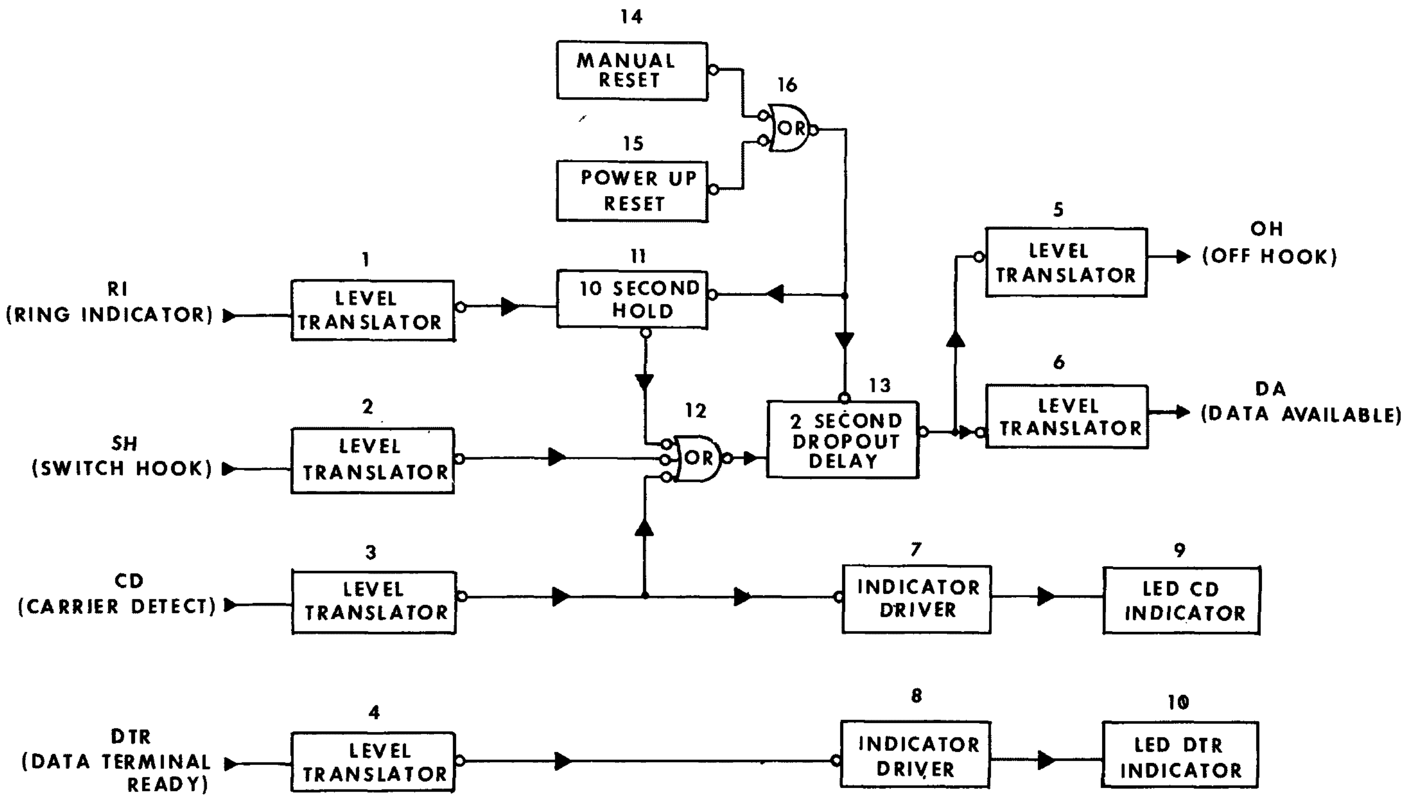

Figure 1. Circuit Block Diagram.

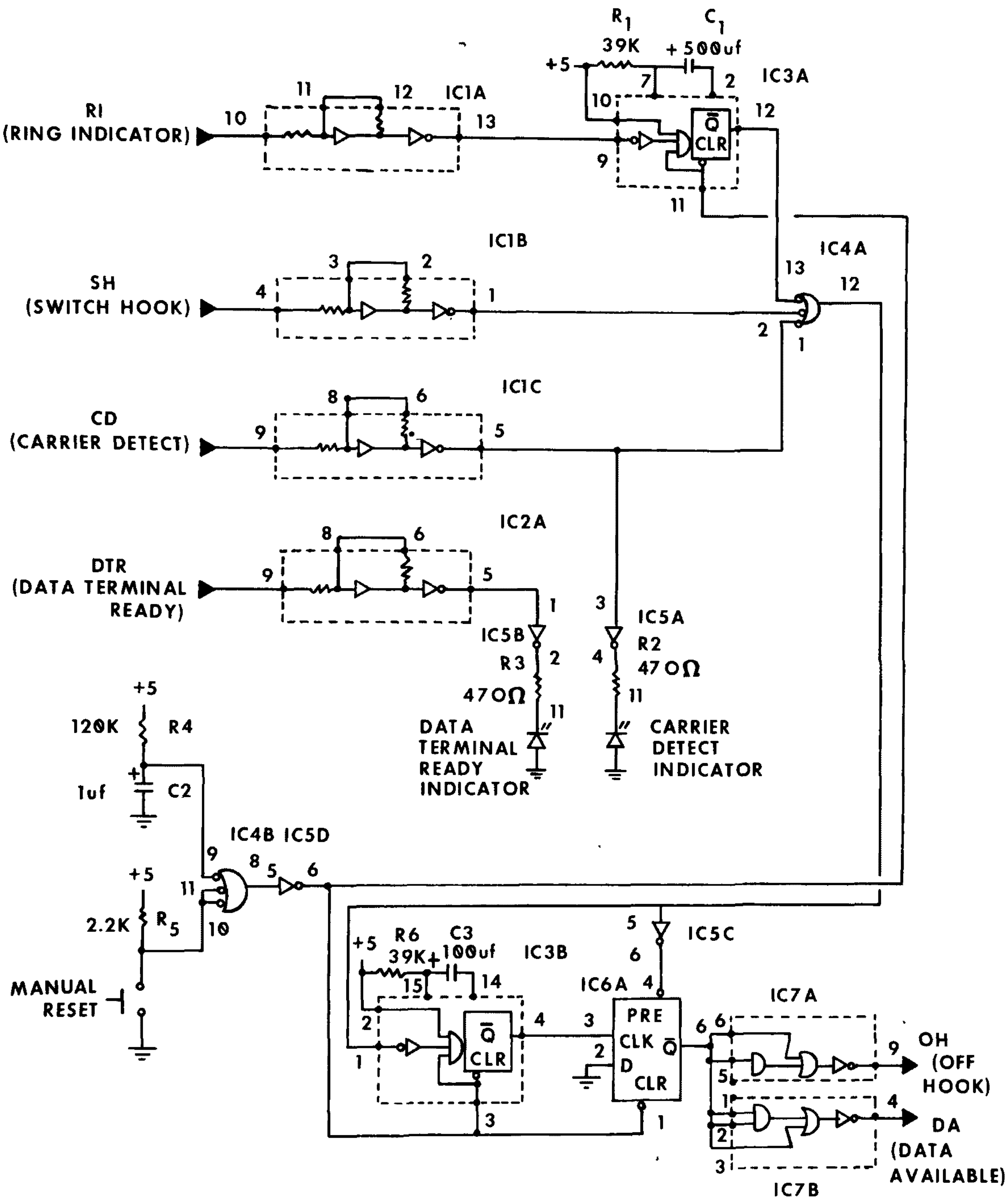

Figure 2. Circuit Schematic Diagram.

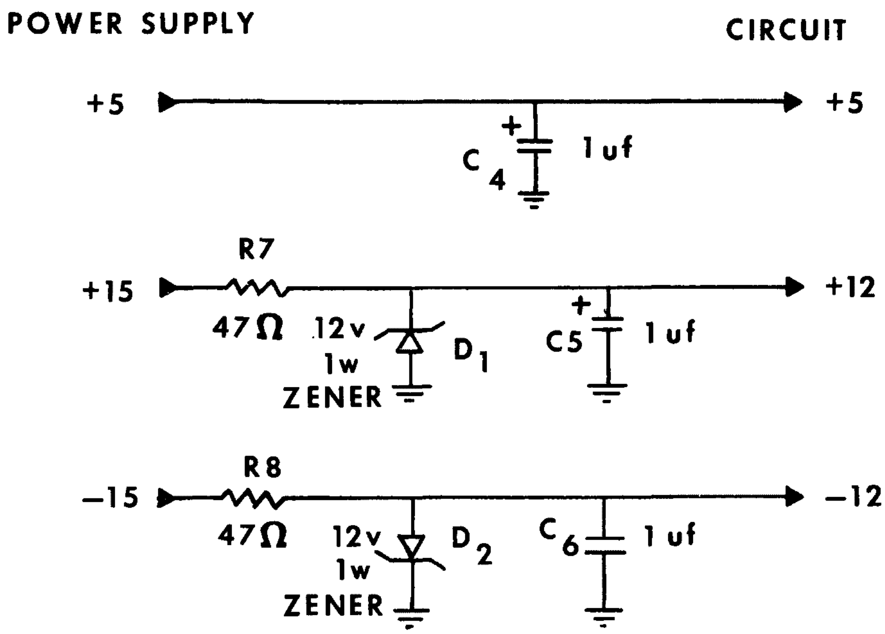

Figure 3. Power Supply Regulation Circuitry.

I.C.	VOLTAGE			
	GND	+5	+12	−12
	PIN NO.			
1	7	14	—	—
2	7	14	—	—
3	8	16	—	—
4	7	14	—	—
5	7	14	—	—
6	7	14	—	—
7	7	—	14	8

Figure 4. I.C. Power Connection Table.

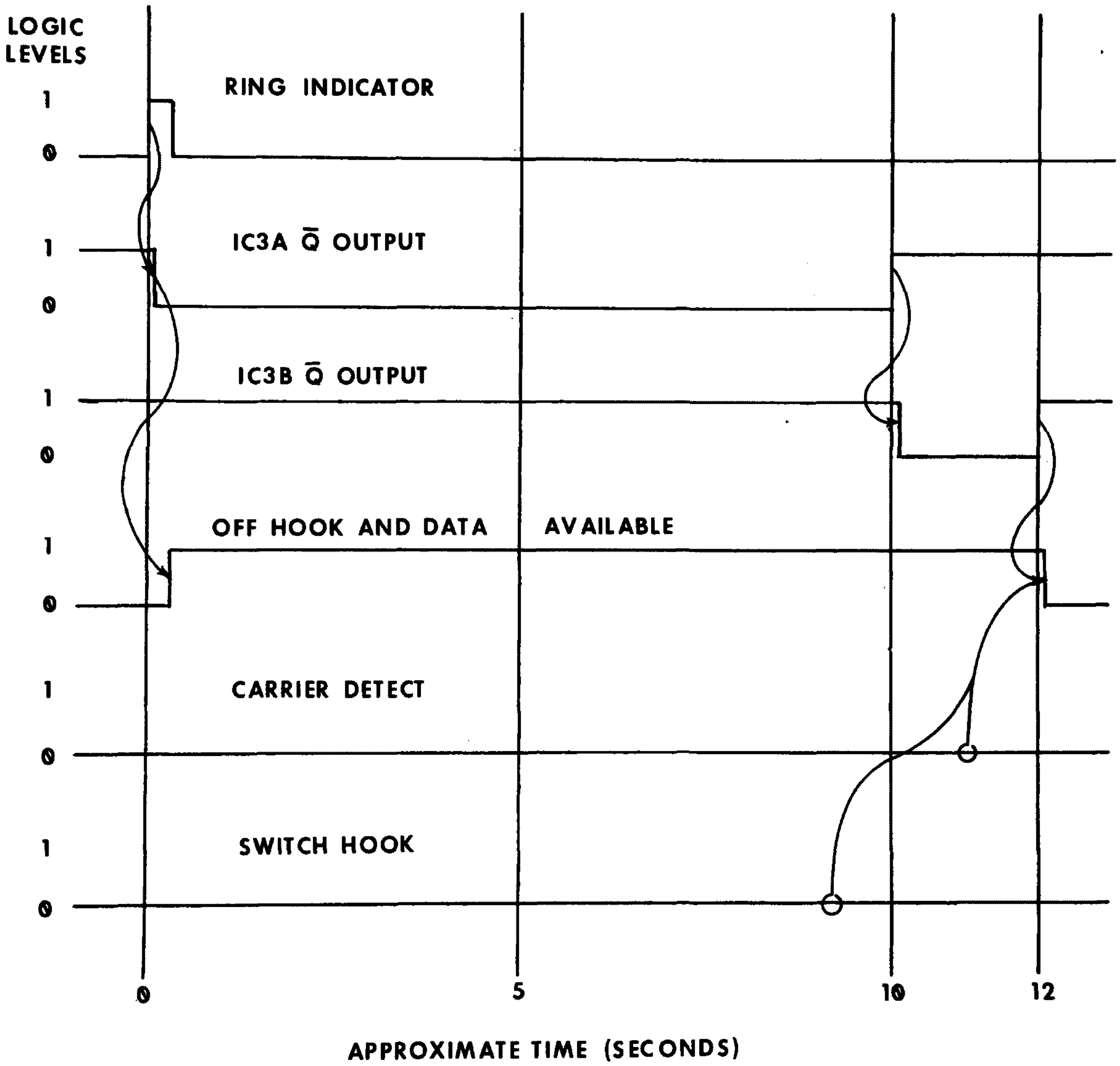

Figure 5. Answer Mode Synchrogram - Carrier Not Received.

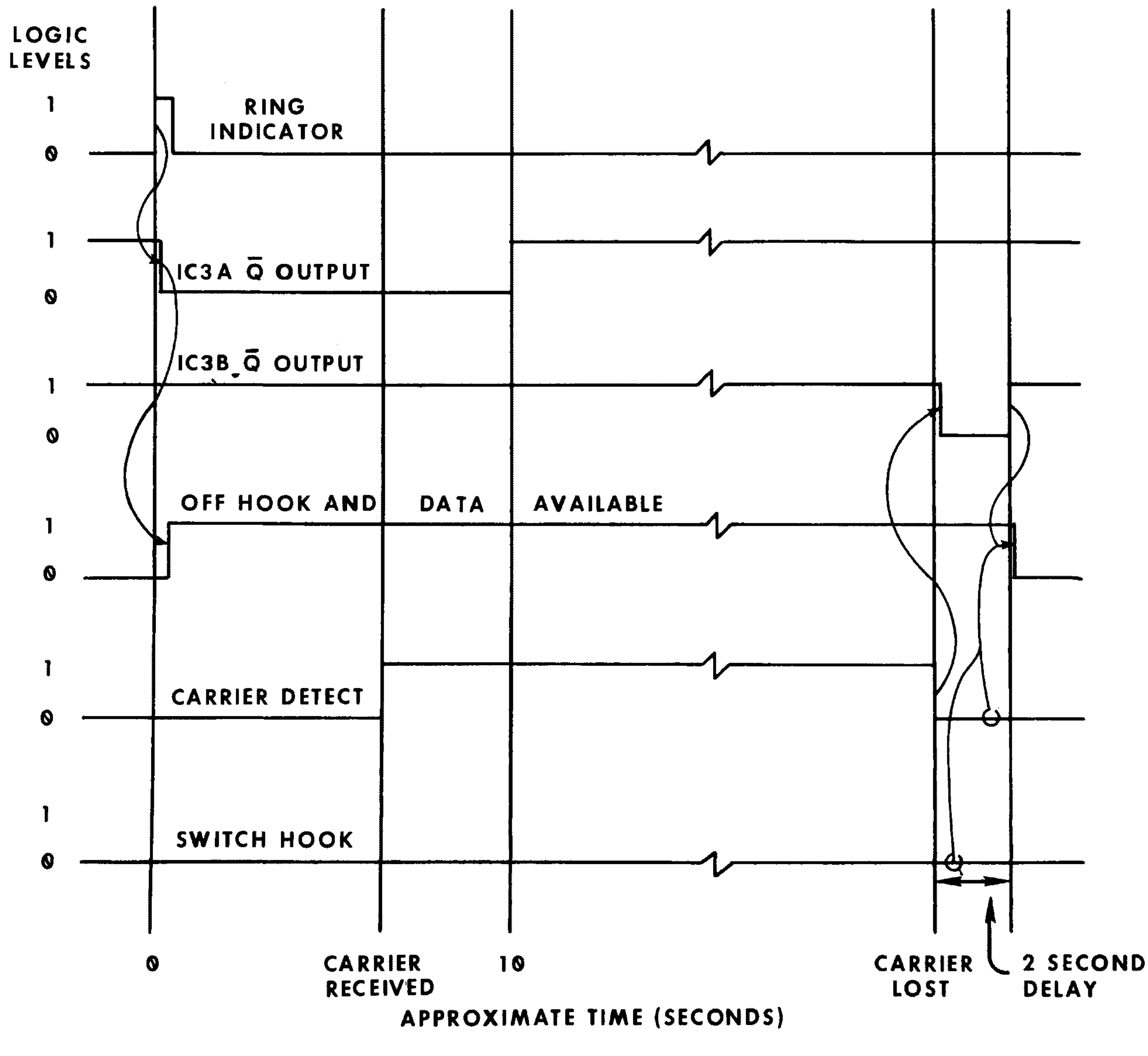

Figure 6. Answer Mode Synchrogram - Normal Operation.

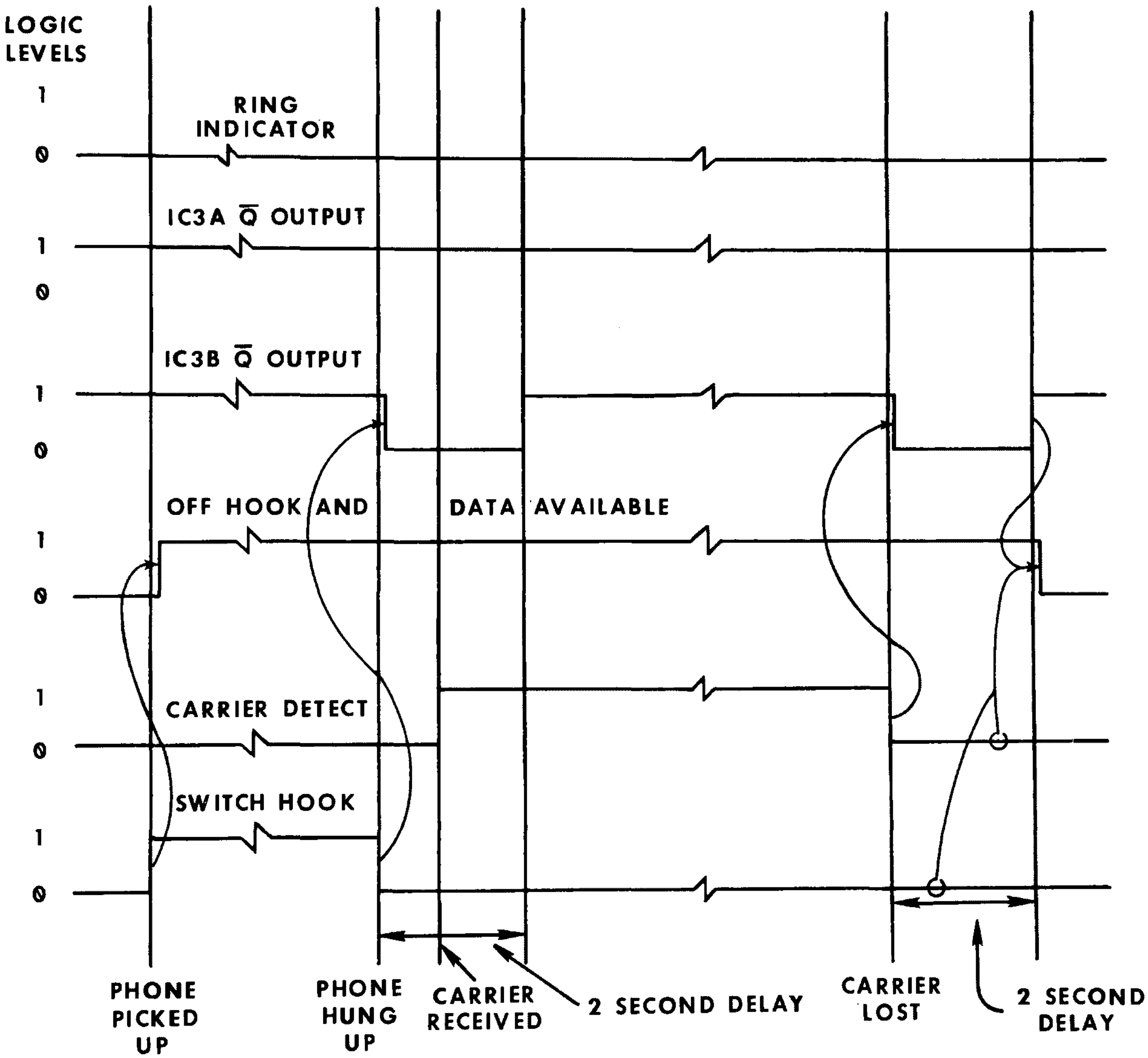

Figure 7. Originate Synchrogram.

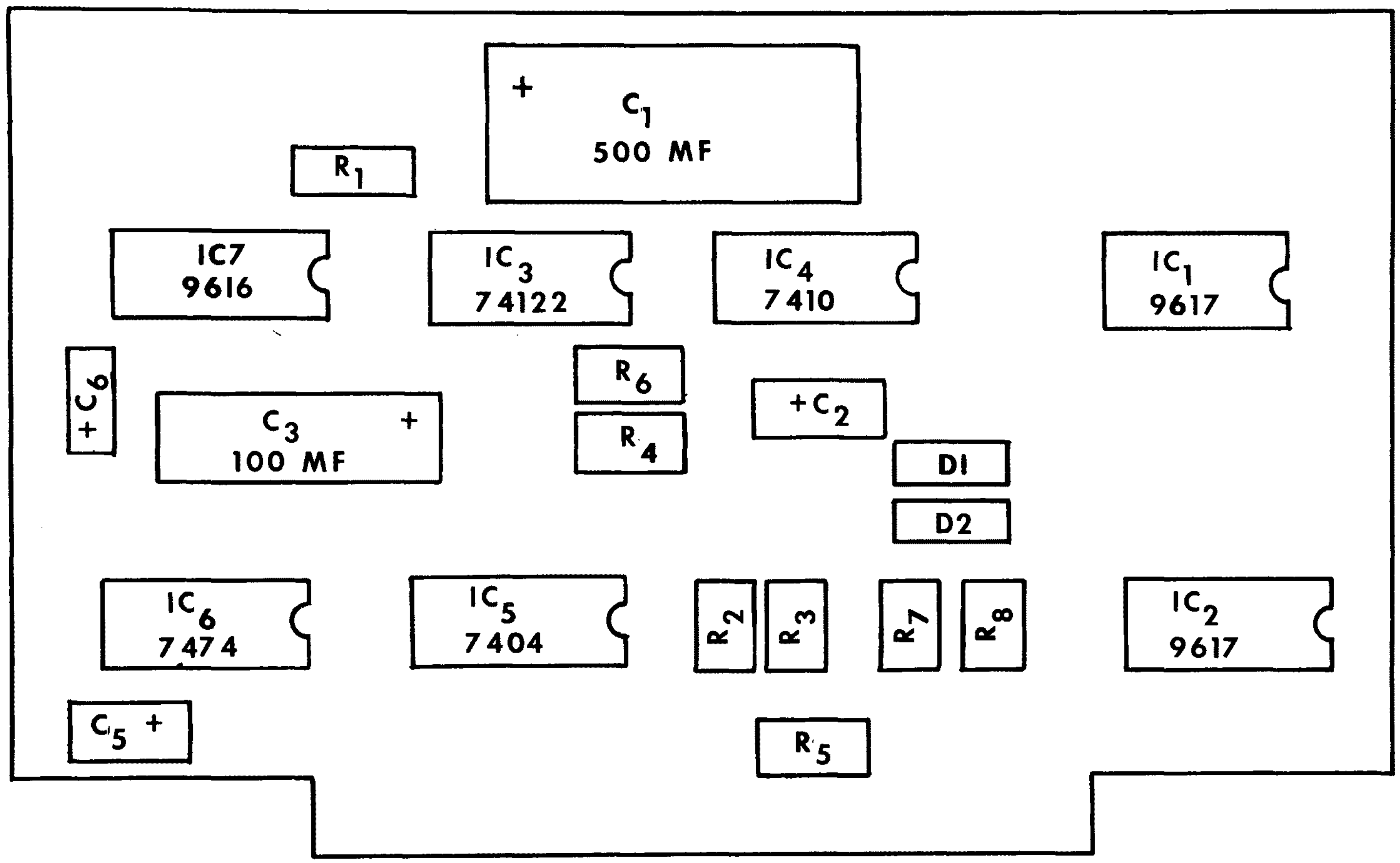

Figure 8. Parts Layout.

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(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

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