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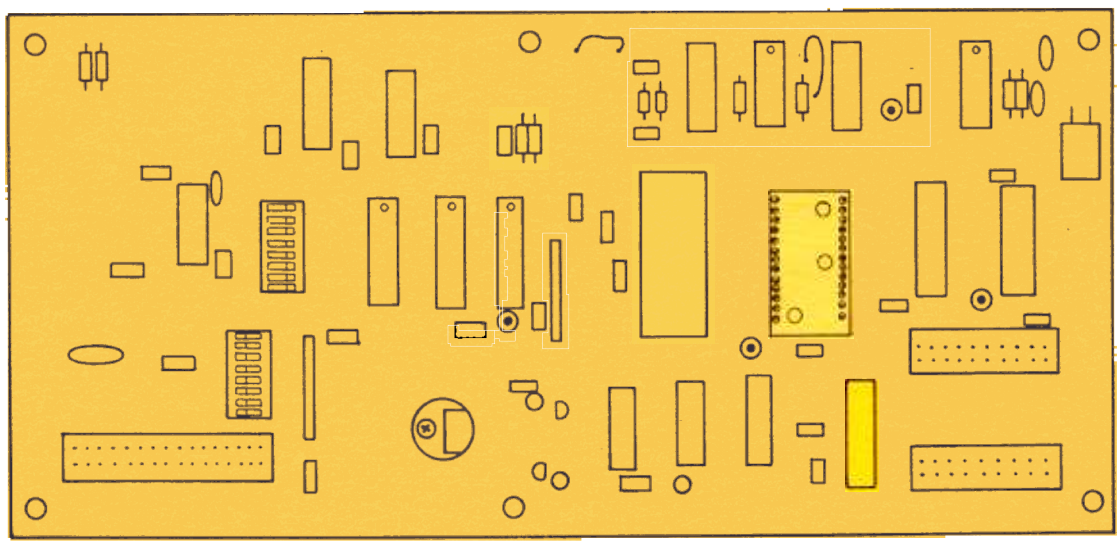
RF COMMUNICATIONS

SUPPLEMENT NUMBER: SU-10073-0017A
TO
PUBLICATION NUMBER: 10073-0020A
JULY 1983

REMOTE CONTROL ASSEMBLY

(A17 ASSEMBLY)



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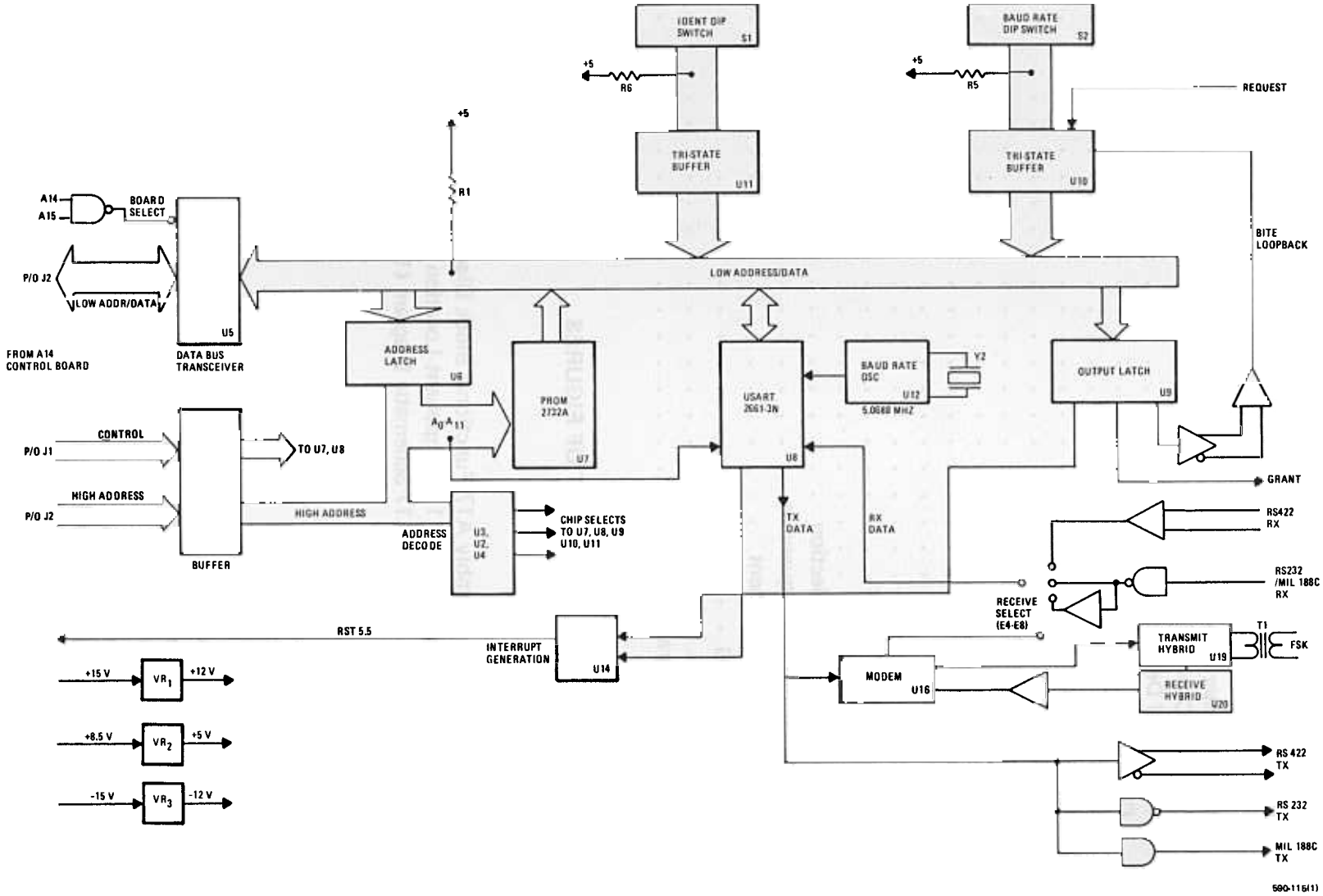


Remote Control Assembly A17 Functional Block Diagram

1. GENERAL DESCRIPTION

Remote Control Assembly (LCU) A17 provides facilities necessary to permit control of the RF-590 Receiver from a remote site. Connected to the microprocessor controlling the RF-590, this assembly contains interface buffering to Control Board A14, additional program memory, and circuits for parallel I/O, serial I/O controls, and modem. It functions as a local control unit (LCU) for the receiver providing RS-232C, MIL-STD-188C, RS-422, and FSK interface options to a distant remote control unit (RCU). The software programming using one 4K byte EPROM interfaces the A17 control and communication functions to the main control software on the A14 assembly. Electrical connection to the receiver from A17 is through ribbon cables to the control board and to interface connectors J8 and J9 on the RF-590 rear panel.

2. INTERFACE CONNECTIONS

LCU Assembly A17 interface connections are summarized in table 1

Table 1. LCU Assembly A17 Interface Summary

Connector	Function	To	From
A17J1-1	+8.5V	—	A14J15-1
-2	+8.5V	—	A14J15-2
-3	Reset Out	—	A15J15-3
-4	HOLD	A14J15-4	—
-5	Line Audio	—	A14J15-5
-6	$\overline{\text{HLDA}}$	—	A14J15-6
-7	Line Audio Gnd	—	A14J15-7
-8	CPU Clk. Out	—	A14J15-8
-9	+15V	—	A14J15-9
-10	Gnd	—	A14J15-10
-11	Ready	A14J15-11	—
-12	-15V	—	A14J15-12
-13	RST 5.5	A14J15-13	—
-14	IO/$\overline{\text{M}}$	—	A14J15-14
-15	INTR	A14J15-15	—
-16	S1	—	A14J15-16
-17	$\overline{\text{WR}}$	—	A14J15-17
-18	$\overline{\text{RD}}$	—	A14J15-18
19	$\overline{\text{INTA}}$	—	A14J15-19
-20	ALE	—	A14J15-20

Table 1. LCU Assembly A17 Interface Summary (Cont.)

Connector	Function	To	From
A17J2-1	N/C	–	–
-2	N/C	–	–
-3	AD0	Bidirec	A14J15-23
-4	N/C	–	–
-5	AD1	Bidirec	A14J15-25
-6	A15	–	A14J15-26
-7	AD2	Bidirec	A14J15-27
-8	A14	–	A14J15-28
-9	AD3	Bidirec	A14J15-29
-10	A13	–	A14J15-30
-11	AD4	Bidirec	A14J15-31
-12	A12	–	A14J15-32
-13	AD5	Bidirec	A14J15-33
-14	A11	–	A14J15-34
-15	AD6	Bidirec	A14J15-35
-16	A10	–	A14J15-36
-17	AD7	Bidirec	A14J15-37
-18	A9	–	A14J15-38
-19	Gnd	–	A14J15-39
-20	A8	–	A14J15-40
A17J3-1	Bus Available	–	J9-21
-2	RS-422 IN –	–	J9-20
-3	Bus Request	J9-3	–
-4	N/C	–	–
-5	RS-422 OUT +	J9-4	–
6	N/C	–	–
-7	RS-422 IN +	–	J9-6
-8	RS-422 OUT –	J9-37	–
-9	Gnd	J9-19	–
-10	Shield (Gnd)	J8-1	–
-11	N/C	–	–
-12	RS-232 TX	J8-2	–
-13	ID3	–	J8-15
-14	RS-232 RX	–	J8-3
-15	ID2	–	J8-16
-16	RSK Data OUT –	J8-4	–
-17	ID5	–	J8-17
-18	FSK Data IN +	–	J8-5
-19	ID6	–	J8-18
-20	ID0	–	J8-6

Table 1 LCU Assembly A17 Interface Summary (Cont.)

Connector	Function	To	From
A17J3-21	Gnd	J8-19	—
-22	RS-232 Sig. Gnd	J8-7	—
-23	N/C	—	—
-24	ID1	—	J8-8
-25	N/C	—	—
-26	ID4	—	J8-9
-27	BR3	—	J8-22
-28	BR1	—	J8-10
-29	BR0	—	J8-23
-30	BR2	—	J8-11

3. FUNCTIONAL DESCRIPTION

3.1 Control and Data Transfer

When installed in the RF-590, the A17 assembly appears as an electrical extension of the address/data bus of the microprocessor on the A14 assembly. This bus is buffered by tri-state bidirectional buffer U5 and high-order address and control inputs buffered by U1. Selection of IC devices on the LCU for data transfer to/from the CPU is done using three-to-eight decoder U3 with high-order address bits. Interface signals $\overline{RD}$, $\overline{WR}$, and S1 from the A14 assembly determine the direction of data flow after addresses have been loaded into latch U6 by ALE, the address latch enable.

The information stored in the EPROM is part of the system software and is not customer alterable.

3.2 Serial Data Transmission/Reception

Upon power up reset, the controlling CPU (A14U1) detects the presence of the LCU option, and initializes all IC devices on A17. Using the software in the LCU EPROM, the CPU conditions the USART U8 to receive incoming signals according to user-selected options. When response to a distant RCU is required by this RF-590 LCU, the transmit interface is enabled, and appropriate parallel data sent via address/data bus AD0-AD7 from the CPU is converted to serial data by USART U8. Completed reception/transmission of message characters by U8 is signaled to the CPU by interrupt line RST 5.5, generated by U8 and U14. The BRCLK input to the USART is from the 5.0688 MHz crystal oscillator circuit using Y2.

3.3 Serial Interfaces

The A17 assembly provides all standard data communication interfaces (each is individually jumper selectable). For RS-232C/MIL-STD-188C interfaces, 1488 drivers in U15 and 1489A receiver U21 are used. The RS-422 interface utilizes tri-state drivers of U13 and receiver in U18.

Parallel Data I/O

Parallel data I/O is accomplished by input buffers U10 and U11 reading user-selected options from DIP switches S1 and S2. Outputs from latch U9 select operating modes of modem U16 and the interface control functions. Data transfer to/from these parallel I/O elements, as well as USART U8, is managed by chip selects from U3 combined with appropriate $\overline{RD}$ and $\overline{WR}$ signals in U4.

3.5 Modem I/O

The TXD signal from USART U8 (2661) is presented in serial data format to the TXD input of universal low speed (0-600 bps) modem U16 (MC14412) for conversion to frequency shift keying (FSK) signals. The 1.0 MHz Y1 crystal is required to utilize the U16 on chip oscillator. The TXCND signal (transmit carrier), a digitally synthesized sine wave derived from the 1.0 MHz oscillator reference is applied to the filter input of transmit filter/line hybrid U19 (1262). With the MODE input from parallel data control U9 (74LS374) set to "1" and the TYPE input from switch S1 set to "1", the US standard originate frequencies are used. A MARK "1" is 1270 Hz while a SPACE "0" is 1070 Hz. The RX RATE input to U16 selects a receive data rate of 0-600 bits per second (bps).

Transmit filter/line hybrid U19 lowpass filters the oscillator output to attenuate those modulation components which would interfere with the adjacent channel. The CHAN SELECT signal input of U19 (1262), via part of dual op amp U22 allows the filter to pass the originate frequencies 1170 Hz ± 100 Hz when the CHAN SELECT signal is -12V and the answer frequencies 2125 Hz ± 100 Hz when the CHAN SELECT signal is +12V. U19 (1262) also contains an active line hybrid which couples the modem to the line. T1 provides a 600 ohm balanced audio output. LEVEL ADJ potentiometer R20 allows the operator to adjust the hybrid output level. The XMT FSK output signal is applied to the distant RCU via rear panel connector J8.

The RCV RSK input signal from the distant RCU via connector J8 is passed through U19 (1262) to receive filter U20 (1267) as the RCV FSK signal. Receive filter U20 (1267) attenuates signals outside the channel passband and also band limits noise energy from the line. The CHAN SELECT signal input to U20 (1267) allows the filter to pass the originate frequencies 1170 Hz ± 100 Hz when the CHAN SELECT signal is -12V and the answer frequencies 2125 Hz +100 Hz when the CHAN SELECT signal is +12V. U20 (1267) also contains a soft limiter amplifier which limits the RXCND signal to supply the demodulator in U16 (MC14412) with a square wave FSK signal. The RXCND signal is demodulated and routed to serial I/O (USART) U8 as the RXD signal via jumper A17E8 to A17E4.

BITE (Self-Test)

When installed, the A17 LCU hardware is tested along with all other RF-590 functions during execution of the build-in-test (BITE) feature of the receiver. These tests are performed if the receiver is in Local or Remote operation. Specifically, three LCU tests are made: a test of USART U8 function, a checksum test to ensure correct EPROM function, and a test of parallel I/O and RS-422 receivers. The corresponding BITE fault codes are:

- Fault 01 – EPROM (U7) fault
- Fault 02 – Communications (USART U8) fault
- Fault 03 – Interface (U9, U10, U17, U18) fault

Dc Distribution

The A17 assembly receives three supply voltages from A14, each of which is converted by local regulators to provide voltages needed by the LCU circuits. The +8.5 volt input is regulated by VR2 to yield the +5V logic supply. The +15V and -15V inputs are converted by regulators VR1 and VR3 respectively to provide +12V and -12V levels for the modem and serial interface.

4. MAINTENANCE

4.1 Setup

Identification Number

For use in a remote control system consisting of many RF-590 or other compatible units, each LCU must be setup to have an individual unique identification number. This number, an eight-bit Binary code is set up on DIP switch S1 and allows 255 individual unit codes (1 to 255) according to table 2.

Table 2. Identification Number Setup

Switch	Binary Weight
S1-1	128 (highest order bit)
S1-2	64
S1-3	32
S1-4	16
S1-5	8
S1-6	4
S1-7	2
S1-8	1 (lowest order bit)

0 = switch closed
1 = switch open

For example, leaving only S1-4 and S1-7 open and all other S1 switches closed, forms the binary idenfification number 00010010 which is 16 + 2 = 18 (in decimal format).

4.1.2 Baud Rate Selection

The RF-590 LCU allows any of sixteen popular baud rates to be used in communication through the USART U8. The baud rate is selectable by setting switches on DIP switch S2 according to table 3.

Table 3. Baud Rate Setup

S2-1	S2-3	S2-4	S2-7	Baud Rate
C	C	C	C	50
C	O	C	C	75
C	C	C	O	110
C	O	C	O	134.5
C	C	O	C	150
C	O	O	C	300
C	C	O	O	600
C	O	O	O	1200
O	C	C	C	1800
O	O	C	C	2000
O	C	C	O	2400
O	O	C	O	3600
O	C	O	C	4800
O	O	O	C	7200
O	C	O	O	9600
O	O	O	O	19200

O = switch open
C = switch closed

4.1.3 Signaling Interface Selection

As mentioned before, the RF-590 LCU allows any one of four common signaling interfaces to be used. Typically, the desired interface will be set at the factory. If another interface is needed, configure jumpers as shown in table 4.

Table 4. Jumper Selection of Interface

Selected Interface	Jumper Configuration
RS-232C Interface	
RS-232C Tx	E27-E11 Jumpered E14-E16 Jumpered E15-E16 Open

Table 4. Jumper Selection of Interface (Cont.)

Selected Interface	Jumper Configuration
RS-232C Rx	E6-E4 Jumpered E5-E4 Open E7-E4 Open E8-E4 Open
MIL-188C Interface	
MIL-188C Tx	E27-E11 Jumpered E15-E16 Jumpered E14-E16 Open
MIL-188C Rx	E7-E4 Jumpered E6-E4 Open E7-E4 Open E8-E4 Open
RS-422 Interface	
RS-422 Rx and Tx	E5-E4 Jumpered E6-E4 Open E7-E4 Open E8-E4 Open
Modem (Refer to paragraph 4.1.4)	
Modem Tx	E27-E12 Jumpered
Modem Rx	E8-E4 Jumpered E5-E4 Open E6-E4 Open E7-E4 Open

For normal operation, leave jumpers E1-E2 open.

4.1.4 Modem Signalling Frequencies

The FSK modem may be operated using the US Answer or US Originate frequencies from the RF-590 remote control option. Typically, the RF-590 remote option is configured for US Originate operation and the distant controller then must be set for US Answer frequencies. Frequency pair selection is accomplished by the setup listed in table 5. Setup for FSK modem is listed in table 4.

Table 5. US Answer and US Originate Frequencies

RF-590 Option	Jumper Configuration
US Answer	E21-E22 Jumpered E26-E22 Open E26-E24 Jumpered E24-E21 Open
US Originate	E21-E22 Open E26-E22 Jumpered E26-E24 Open E24-E21 Jumpered

4.2 Hybrid Level Adjustment

The following adjustment is for the FSK modem output level, andhas been completed at the factory prior to shipment. In the event a board needs repair or realignment, the following procedure has been included.

Connect an HP-3400A Analog Voltmeter, or equivalent, between pins 16 and 18 of connector J8 on the RF-590 rear panel.

b. Connect an ac power cord on the RF-590 rear panel.

Jumper A17E1 to A17E2.

d. Set the voltmeter RANGE control to the 1 volt, 0 dBm position.

e. Turn on the RF-590 power using Power ON/OFF VOLUME control switch/potentiometer located on the front panel.

f. Adjust hybrid level adjustment A17R20 for a meter reading of 1 volt, 0 dBm.

g. Turn off power and disconnect test equipment. Remove E1-E2 jumper.

4.3 Troubleshooting

There are six test points located on LCU Assembly A17. Table 6 used together with the schematic diagram and component location drawing should help in locating most A17 problems.

Table 6. Test Point Indications

Test Point	Indicates
TP1	A17 address/data buffer enable A17U5
TP2	Chip enable for LCU EPROM A17U7
TP3	LCU activity signal from A17U9
TP4	RST 5.5 interrupt from A17U14
TP5	Modem Transmit carrier (MARK = 1270 Hz, SPACE = 1070 Hz)*
TP6	Modem Receive Carrier (MARK = 2225 Hz, SPACE = 2025 Hz)*

* Modem configured as U.S. Standard Originate.

Data transfer to or from the microprocessor on Control Board A14 takes place when a logic LOW is seen at TP1. A simultaneous LOW at TP2 indicates the exchange is that of program steps from the EPROM containing software to manage the A17 assembly. When installed in a properly functioning receiver, logic HIGH pulses should be seen once per millisecond at TP3, even if the RF-590 is not in remote operation (with or without an attached, controlling unit). When a controlling unit is operating, its communication with the RF-590 will result in intermittent active high pulses on the interrupt line (TP4), again regardless of the local or remote operation of the receiver.

Absence of activity on points TP1-TP3 indicate a failure in the connection of A17 assembly to Control Board Assembly A14. If the Remote board is not properly installed, an operator pressing the REMOTE button on the RF-590 front panel will get no response. If activity is seen on TP1-TP3 and the receiver can be placed into remote operation (but no activity is seen at TP4), the fault lies in the setup of the A17 board (baud rate or interface jumpering) or in the controller or link between controller and RF-590.

If activity is seen on all four test points during operation with a controller, but the RF-590 cannot be remotely commanded, check that the LCU identification number is properly selected. Also check that this LCU is the one being commanded from the controller. As an aid to checking desired baud rate and identification number setups, apply power to the receiver after the corresponding DIP switches S1 and S2 have been set on A17. With the receiver selected to remote receive operation, depress and hold in the front panel ENTER button. Within ten seconds, the lefthand display of the RF-590 will show the identification number and baud rate selected on A17S1 and A17S2 in a format such as REMOTE # 04 2400 BPS. This is for LCU identification number 4 and a communication rate of 2400 bits per second (baud). Users should change the baud rate switches only when the RF-590 is off so that the A17 PWB will correctly be set up when power is again applied.

5. PARTS LIST

Table 7 is a comprehensive parts list of all replaceable components in Remote Control Assembly A17. When ordering parts from the factory, include a full description of the part. Use figure 1, Remote Control Assembly A17 Component Location Diagram to identify parts.

6. SCHEMATIC DIAGRAM

Figure 2 is the Remote Control Assembly A17 schematic diagram.

Table 7. Remote Control Assembly A17 Parts List (PL 10073-6200)

Ref. Desig.	Part No.	Description
	10073-6200	Remote Control Assembly
C1, C2	CK05BX103M	Capacitor, .01 uF
C3	C26-0050-109	Capacitor, 1 uF
C4	CK05BX103M	Capacitor, .01 uF
C5, C6	C26-0050-109	Capacitor, 1 uF
C7-C23	CK05BX103M	Capacitor, .01 uF
C24	CM04FD201J03	Capacitor, 200 pF, 500 V
C25-C27	CK05BX103M	Capacitor, .01 uF
C28	C11-0006-225	Capacitor, 2.2 uF, 50 V
C29	CK05BX103M	Capacitor, .01 uF
C30	CM05FD511J03	Capacitor, 510 pF, 500 V
C31	C22-0005-001	Capacitor, 2.7 uF, 50 V
C32, C33	CM04ED330J03	Capacitor, 33 pF
CR1, CR2	1N5234B	Diode, Zener, 6.2 V
E1, E2	J45-0041-001	Wire Wrap Post
E4-E8	J45-0041-001	Wire Wrap Post
E11, E12	J45-0041-001	Wire Wrap Post
E13-E22	J45-0041-001	Wire Wrap Post
E24, E26	J45-0041-001	Wire Wrap Post
E27	J45-0041-001	Wire Wrap Post
J1, J2	J45-0013-020	Connector, Jack, 20 pin
J3	J45-0013-030	Connector, Jack, 30 pin
R1	R50-0010-103	Resistor, SIP, 10 K
R2, R4	R65-0003-103	Resistor, Carbon Film, 10 K, 1/4 W, 5%
R5	R50-0010-103	Resistor, Network, 10 K
R6	R50-0010-103	Resistor, Network, 10 K
R7	R65-0003-362	Resistor, Carbon Film, 3.6 K
R8	R65-0003-103	Resistor, Carbon Film, 10 K
R9	R65-0003-203	Resistor, Carbon Film, 20 K
R11, R12	R65-0003-473	Resistor
R14	R65-0003-103	Resistor, Carbon Film, 10 K, 1/4 W, 5%
R16, R17	R65-0003-361	Resistor, Carbon Film, 360 ohms, 1/4 W, 5%

Table 7. Remote Control Assembly A17 Parts List (PL 10073-6200) (Cont.)

Ref. Desig.	Part No.	Description
R18, R19	R65-0003-102	Resistor, Carbon Film, 1 K, 1/4 W, 5%
R20	R30-0002-204	Resistor, Variable, 200 K
R21, R22	R65-0003-471	Resistor, Carbon Film, 470 ohms, 1/4 W, 5%
S1, S2	S50-0001-008	Switch, DIP, 8 position
T1	T30-0001-004	Transformer
TP1	J-0071	Test Point, Brown
TP2	J-0066	Test Point, Red
TP3	J-0069	Test Point, Orange
TP4	J-0070	Test Point, Yellow
TP5	J-0068	Test Point, Yellow
TP6	J-0072	Test Point, Green
U1	I16-0002-000	Integrated Circuit, Octal Buffer
U2	I01-0042-000	Integrated Circuit, Quad AND Gate
U3	I37-0001-000	Integrated Circuit, Three-to-Eight Decoder
U4	I01-0045-000	Integrated Circuit, Quad OR Gate
U5	I58-0006-000	Integrated Circuit, Bus Transceiver
U6	I05-0000-373	Integrated Circuit, 8 Bit Latch
*U7	See Note	Integrated Circuit, 4KX8 EPROM
U8	I59-0005-000	Integrated Circuit, USART
U9	I50-0027-000	Integrated Circuit, 8 Bit Latch
U10	I16-0002-000	Integrated Circuit, Octal Buffer
U11	I16-0002-000	Integrated Circuit, Octal Buffer
U12	I01-0008-000	Integrated Circuit, Hex Inverter
U13	I16-0008-000	Integrated Circuit
U14	I01-0048-000	Integrated Circuit, Quad NAND Gate
U15	I16-0001-000	Integrated Circuit, RS-232 Driver
U17	I16-0008-000	Integrated Circuit, RS-422 Driver
U18	I17-0003-000	Integrated Circuit, RS-422 Receiver
U21	I17-0001-000	Integrated Circuit, RS-232 Receiver
XU7	J77-0008-005	Socket, 24 pin
VR1	I12-0006-012	Regulator, +12 V
VR2	IC-0441	Regulator, +5 V
VR3	I12-0010-012	Regulator, -12 V
Y1	Y15-0002-000	Crystal, 11000 MHz
Y2	Y15-0003-000	Crystal, 5.0688 MHz

*When ordering this PROM, refer to the number on the sticker over the PROM

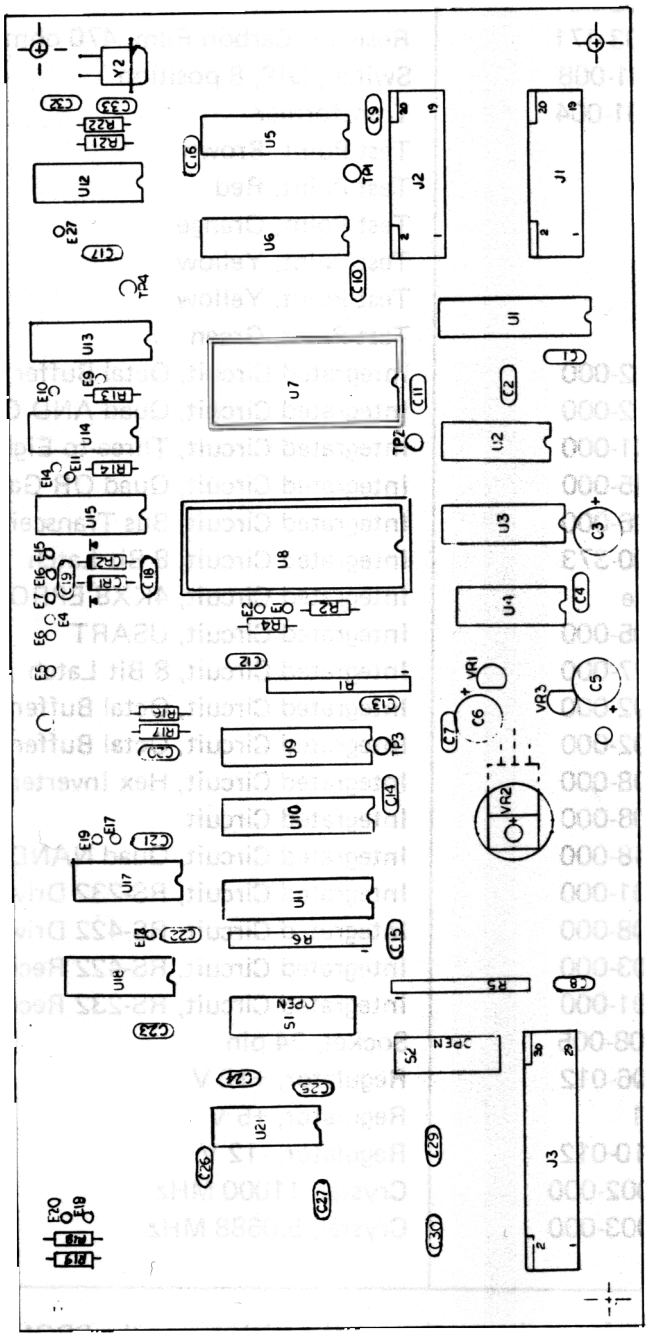


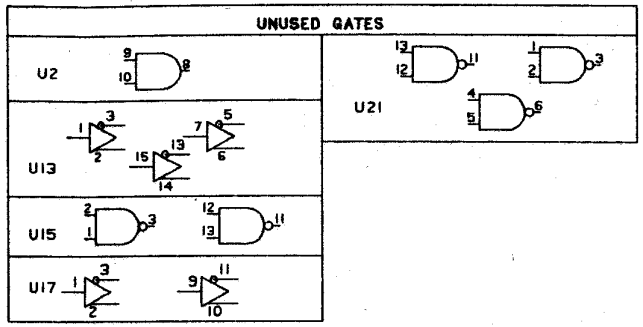
Figure 1. Remote Control Assembly A17 Component Location Diagram (10073-6200)

NOTE: UNLESS OTHERWISE SPECIFIED:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR A COMPLETE DESIGNATION, PREFIX WITH UNIT NO. AND/OR ASSEMBLY NO. DESIGNATION.
2. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. VENDOR PART NO. CALLOUTS ARE FOR REFERENCE ONLY. COMPONENTS ARE SUPPLIED PER PART NO. IN PARTS LIST.

U2	74LS08
U4	74LS32
U12	74LS04
U13	26LS31
U14	74LS00
U15	MC1488
U17	26LS31
U18	26LS33
U21	MC1489
U22	MC4558

UNUSED GATES



JUMPER SELECTION OF INTERFACE

SELECTED INTERFACE	JUMPER CONFIGURATION	
RS-232-C INTERFACE		
RS-232-C Tx	E27 TO E11	JUMPERED
	E14 TO E16	JUMPERED
	E16 TO E16	OPEN
RS-232-C Rx	E6 TO E4	JUMPERED
	E5 TO E4	OPEN
	E7 TO E4	OPEN
	E8 TO E4	OPEN
MIL-STD-188C INTERFACE		
MIL-STD-188C Tx	E15 TO E16	JUMPERED
	E14 TO E16	OPEN
	E27 TO E11	JUMPERED
MIL-STD-188C Rx	E7 TO E4	JUMPERED
	E5 TO E4	OPEN
	E6 TO E4	OPEN
	E8 TO E4	OPEN

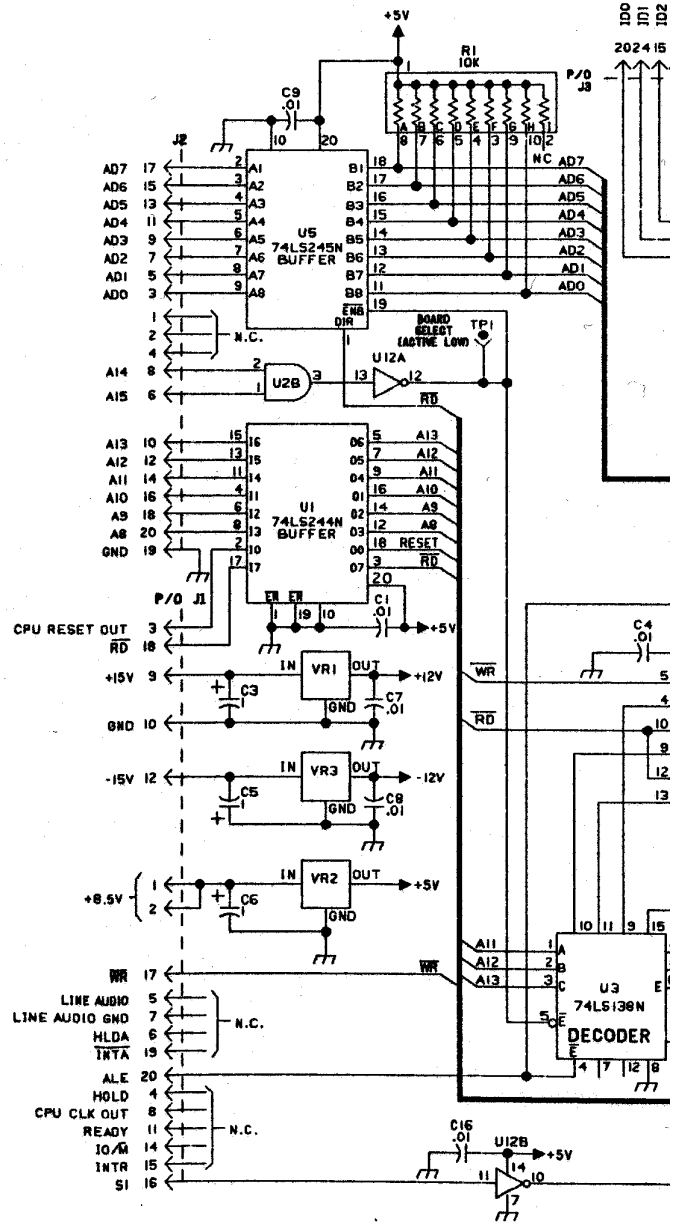
JUMPER SELECTION OF INTERFACE

SELECTED INTERFACE	JUMPER CONFIGURATION	
RS-422 INTERFACE		
RS-422 Tx		
RS-422 Rx	E5 TO E4	JUMPERED
	E6 TO E4	OPEN
	E7 TO E4	OPEN
	E8 TO E4	OPEN
FSK MODEM		
MODEM Tx	E27 TO E12	JUMPERED
MODEM Rx	E8 TO E4	JUMPERED
	E5 TO E4	OPEN
	E6 TO E4	OPEN
	E7 TO E4	OPEN

NOTE:
FOR NORMAL OPERATION
E1 TO E2 LEFT OPEN.
CONNECT E1 TO E2 FOR
MODEM OUTPUT ADJUSTMENT.

JUMPER SELECTION OF INTERFACE

MODEM HYBRID	JUMPER CONFIGURATION	
U.S. ANSWER		
TRANSMIT HYBRID	E21 TO E22	JUMPERED
RECEVE HYBRID	E26 TO E24	JUMPERED
U.S. ORGINATE		
TRANSMIT HYBRID	E26 TO E22	JUMPERED
RECEVE HYBRID	E21 TO E24	JUMPERED



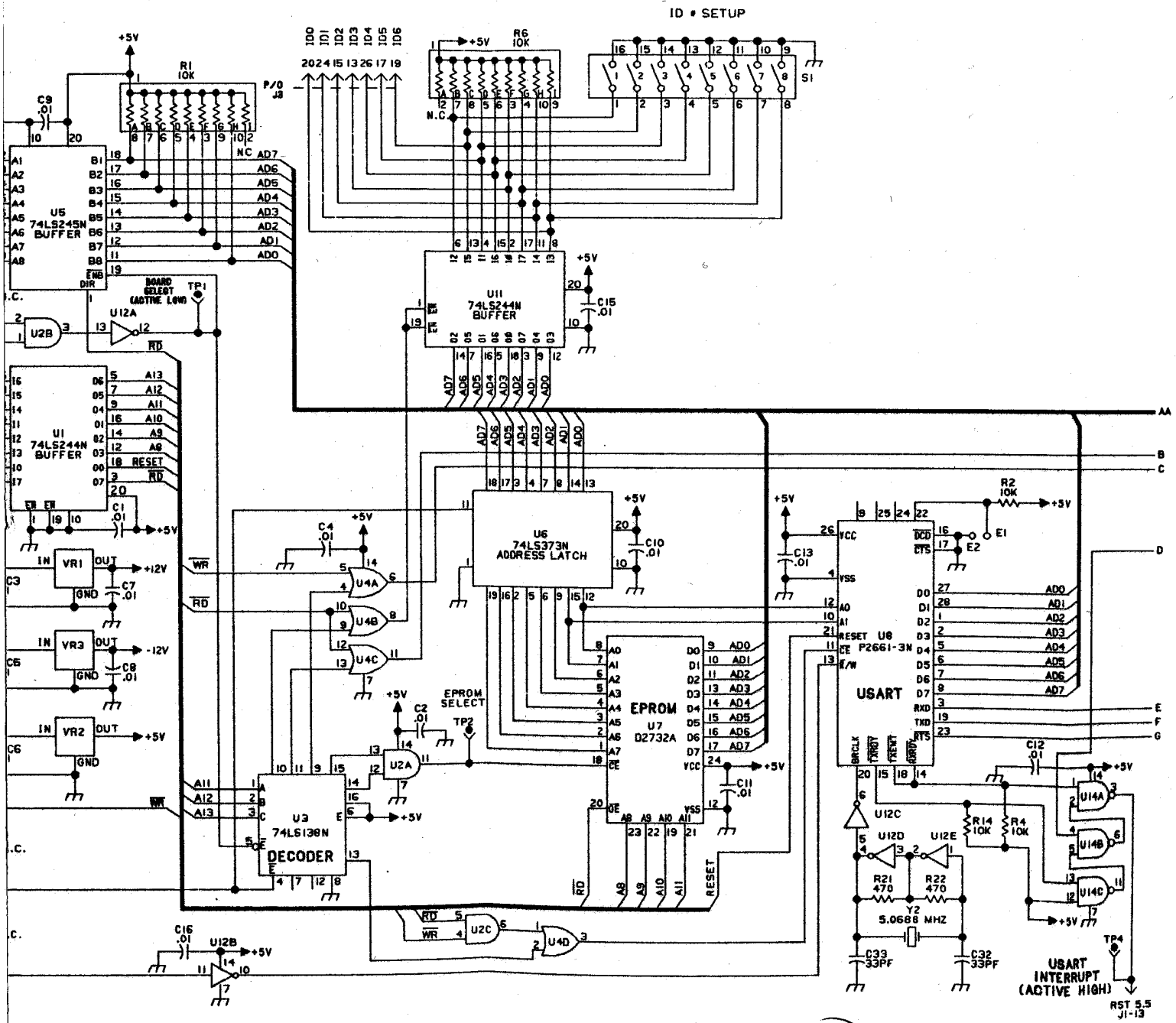


Figure 2. Remote Control Assembly A17 Schematic Diagram (10073-6201) (Sheet 1 of 2)

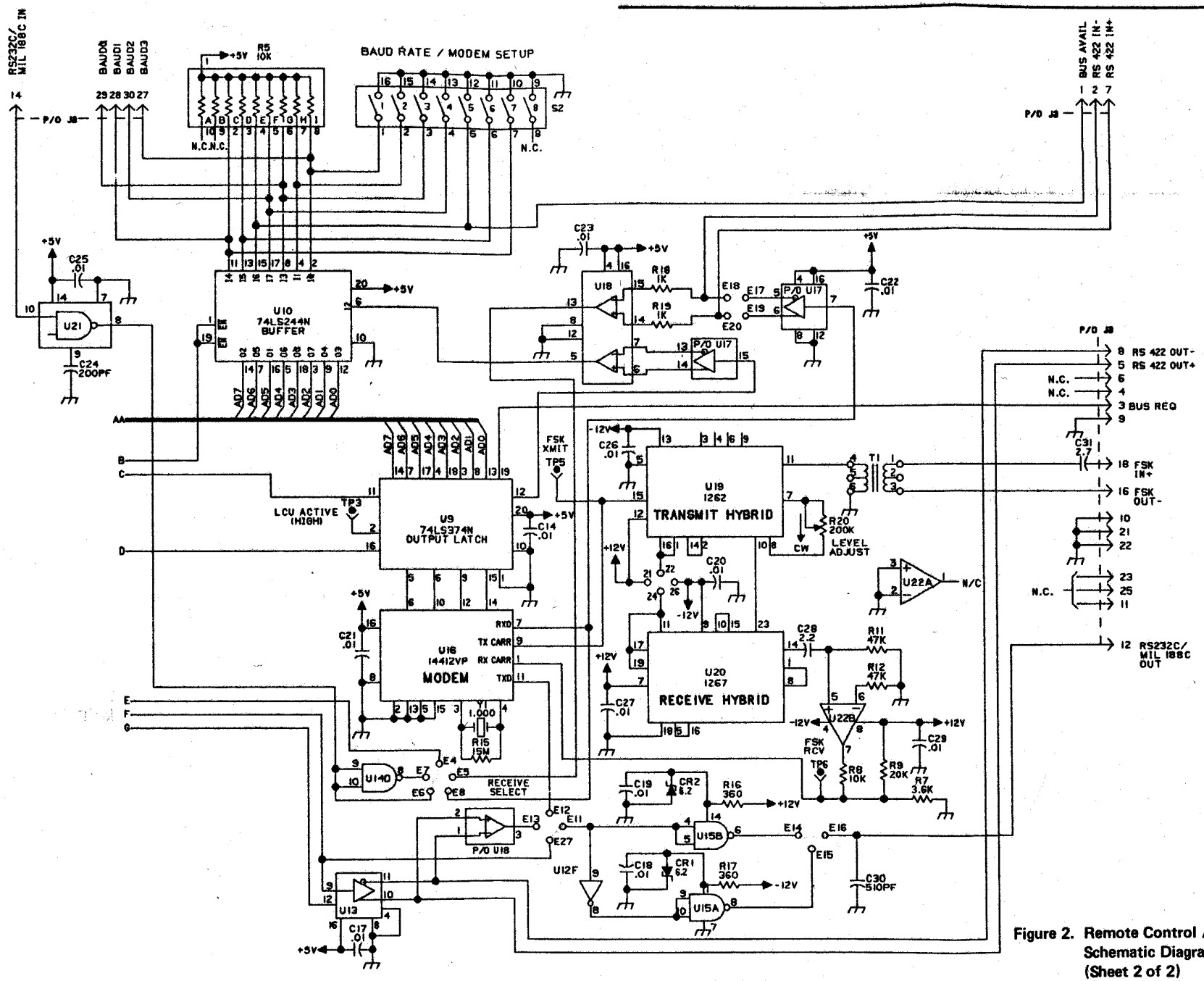


Figure 2. Remote Control Assembly A17 Schematic Diagram (10073-6201) (Sheet 2 of 2)