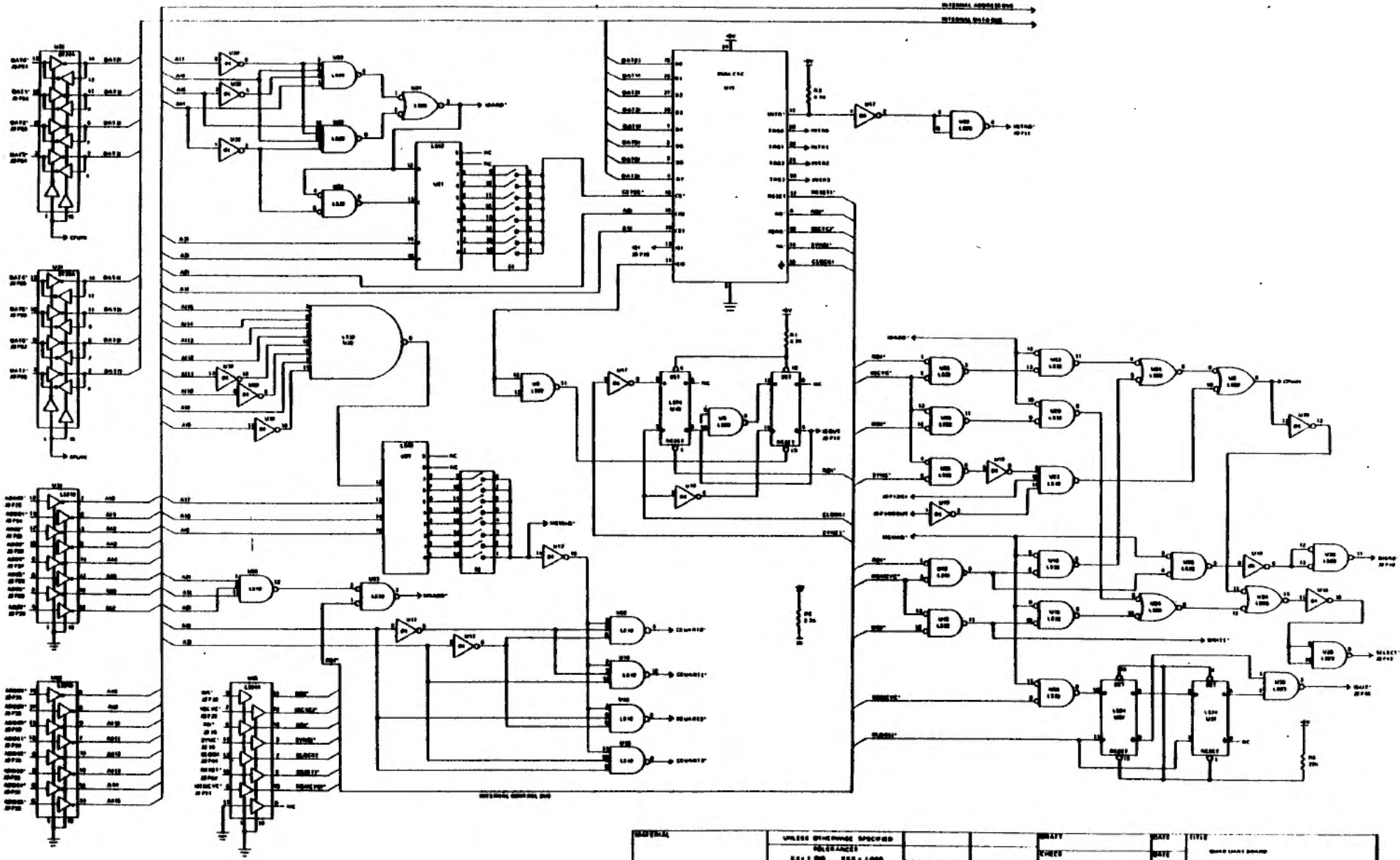
QUAD UART BOARD

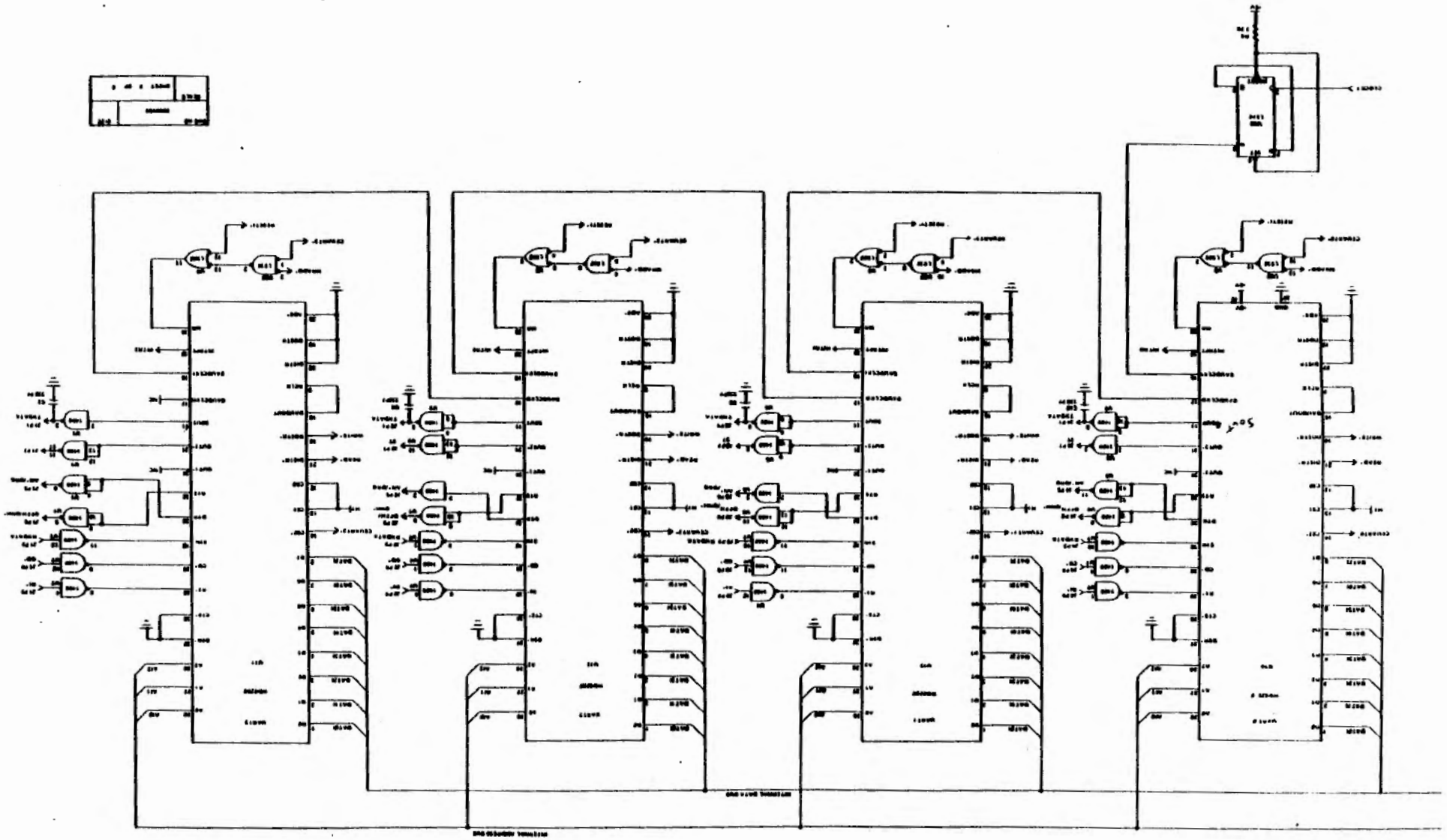
The Quad UART Boards, when used with the Dual Modem Boards, allow the TRS-80 Communications Multiplexer to function with either 8 or 16 channels of asynchronous communication, depending upon the number of boards used. Each UART board handles four separate channels.

The heart of the Quad UART board consists of four WD-8250 Universal Asynchronous Receiver Transmitters (UART's). These UARTS's (U11, U12, U13, and U14) are 40-pin DIP packages. There is one Z-80 CTC chip per board (U15) which handles the interrupt controlling for the UART chips.

MAPPING

UART address locations are memory mapped starting at F200 Hex and incremented by 08 Hex for each channel (CH 0 = F200H, CH 1 = F208H, CH 2 = F210H, etc.) The base address of each board is determined by the setting of two 8-position DIP switches, S1 and S2. For example, the first UART board, containing channels 0 to 3, would be set at base address F200H with the position 1 setting for both S1 and S2 closed or ON, and all other positions open or OFF. The next UART board, containing channels 4 through 7, would have a base address of F220H with position 2 of the switches closed (ON) and other positions open (OFF). Switches S1 and S2 must be set identically on


tandy



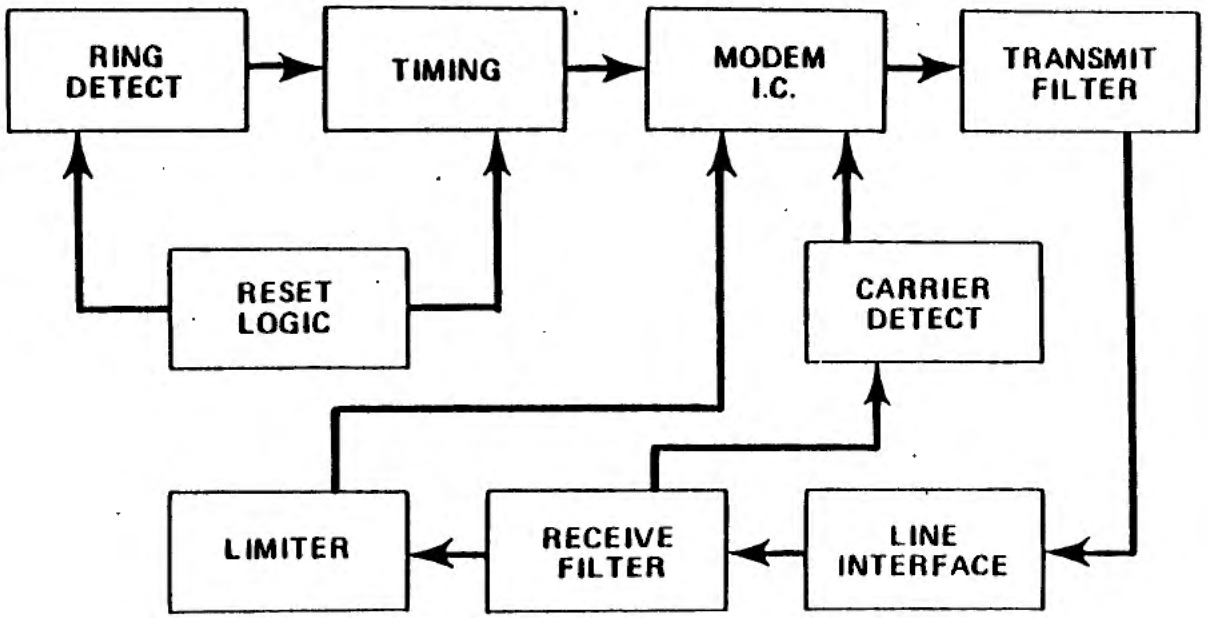
THEORY OF DUAL MODEM BOARD FOR COMMUNICATIONS MULTIPLEXER

The Dual Modem Board contains two frequency shift keying (FSK) modems operating at 300 baud each. In this Multiplexer, the modems are hard-wired to be auto-answer only. The two modems are totally independent in operation and share only the power supply and bus control signals. The modems are designed on the same PC Board with parts for the left modem corresponding with the parts for the right modem. Component designators are 1xx for the left modem and 2xx for the right modem.

Each modem consists of the following "block" circuitry:

1. Ring Detect
2. Telephone Line Interface
3. Receive Filter
4. Carrier Detection
5. CMOS Modem Circuitry
6. Transmit Filter
7. Reset Logic
8. Power

The Block Diagram (Figure 1) shows the configuration of these


RING DETECT
TIMING
MODEM I.C.
TRANSMIT FILTER
RESET LOGIC
CARRIER DETECT
LIMITER
RECEIVE FILTER
LINE INTERFACE

"blocks" in the modem. The theory which follows explains the function of each of these sections. This theory holds true for either modem on the circuit board. Please note that component designators referenced in the discussion and on the schematic are "common" designators. To make the discussion and/or schematic pertain to one particular modem, add the appropriate numbers (1 or 2) in front of the designator number. For example: U15 would be U115 on the left modem and U215 on the right modem; C3 would be C103 on the left and C203 on the right.

Theory of Operation

Ring Detect

The ring detect circuitry consists of level comparator, Q1, optoisolator, U1, and CMOS counter, U2. The ringing signal provided by the phone company is a 20 to 30 Hz sine wave, approximately 60 volts peak-to-peak. This signal is AC coupled and current limited by R1 and C1 and is full-wave rectified by CR1 through CR4. The voltage is then presented at the top of the voltage divider made up of R3 and R4. Transistor Q1 is used as a voltage comparator and switch. When the voltage at the base of the transistor exceeds 3.0 volts (0.6 volts for the VBE <voltage base to emitter> junction plus 2.4 volts for the zener diode, CR5) the transistor turns on, pulling current through R9 and turning on the LED in the optoisolator.

- - - - IMPORTANT - - - -

When probing the phone line input circuitry with an oscilliscope, the 'scope must be floated by an isolation transformer or damage to the circuit will result.

When the LED inside U1 turns on, the coupled transistor also turns on, pulling down pin 10 of U2; therefore, when the phone line is a ringing condition, there will be pulses of 40 to 60 Hz at pin 10. These pulses cause the counter to count up towards 255. A jumper option is provided to tap which counter stage caused the ring interrupt. SHORT is one ring; LONG is six rings.

Before the counter can count, pin 11 (RESET) must be low. Once the terminal count has been reached (designated by the rising edge at pin 11 of U3), flip-flop U3 is set. This causes two things to happen. First, pin 13 of U3 (RELAY) is set to +5 volts which turns on the seize relay, K1. The phone line is then seized and considered "busy."

The second thing caused by the setting of U3 is the generation of the UART ring interrupt. This is accomplished by one half of the dual timer, U7. C6 and R42 cause a negative-going "glitch" which triggers both timers simultaneously. (The timers are used as one-shots; the UART timer is about 100 useconds and the other, transmit mute, is about 2 seconds.) The glitch fires the one-shot

which produces the 100 usecond positive pulse. This negative pulse is converted to RS-232 levels (RS-232ized) by driver U8.

Line Interface

The line interface matches the telephone line impedance to the receive and transmit filters. This is accomplished by transformer T1 and impedance network R17 and C3. High voltage spikes are shunted by ZN1. R15 and R20 load the secondary to provide proper balance.

Receive Filter

The receive filter amplifies the carrier tones from the Videotex (or similiar terminal) while rejecting all other noise and signals. Half of U5 is used as an amplifier with a gain of 13. C10 provides some high frequency roll-off to eliminate clock noise and other high frequencies. The amplified signal then passes through three bandpass filters (U9 and one half of U13). The signal level at the output of the filter is 2 to 4 volts peak-to-peak. The output goes to two sections, the limiter and the carrier detect.

The limiter takes the sine waves from the filter and generates 50% duty cycle square waves. C40 removes any DC offset. The sine wave is compared to zero, which generates the square waves. The 311 chip (U14) has an open-collector output which is used in the carrier

detect section as a mute. The square waves, RX IN, are sent to the modem IC.

Carrier Detect

The carrier detect is made up of the other half of U13 and two sections of the quad comparator U12 (LM339). Flip-flop U3 and OR gate U15 are also used. There are two parts of the carrier detect: the actual detection and the delay.

The delay keeps spikes which occur in the carrier detection process from interrupting the UART. U13 is a precision half-wave rectifier with a gain of 4. C33 is used to smooth the pulses generated by U13. The resulting DC level is compared to the reference set by voltage divider R61 and R62. When the DC level (corresponding to a carrier level out of the filter) exceeds the reference, the comparator output goes low. This turns off Q6 which is used to mute possible garbage output from the limiter.

The flip-flop and OR gate assist the delay to keep false carrier detects from reaching the UART. The 2 second timer, which is triggered when the phone line is seized, outputs a positive pulse which mutes the modem transmitter and set flip-flop U3. This places a low at the input of the OR gate after the 2 second delay (because we invert the timer output and the flip-flop is rising edge triggered). The output of the '339 must go low to allow the OR gate

output to go low (signifying a valid carrier). It does this by discharging C43 through R56 when the other '339 section has a low output.

5. CMOS Modem IC

The modem functions (modulation and demodulation) are performed by a single CMOS IC, the MC14412. A flip-flop, U17, is used to divide the 4 MHz clock on the Model II bus. Data from the remote Videotex or equivalent terminal is limited by U14 and sent to the modem IC (U4) via RX IN. The modem IC transmits the proper logic levels at pin 7. These levels are RS-232ized by U8 and sent to the UART.

The other half of the modem IC receives data from the store-and-forward computer (via the UART) and does the opposite of before; i.e., it receives a logic level and transmits a "sine" tone of the proper frequency. The tone produced is a stair-step approximation of a sine wave, containing some harmonics. The tone also rides on a DC level of about 0.4 volts. To eliminate this DC, C9 is used to AC couple the input of the transmit filter. The transmit level (-10dB into 600 ohms) is set by R6.

Transmit Filter

The transmit filter removes the nasty harmonics of the modem tone so

the phone company won't get mad. A single stage bandpass filter is used. Also note that we can change the center frequency of the filter by Q5, R31, and the status of the TEST/NOR* line. This is because the modem IC changes the transmit tones in the test mode.

Reset Logic

The reset logic consists mainly of U15. The RESET signal (not to be confused with SYSRES*) keeps the flip-flops and the 4040 counter (U2) reset. In this state the modem will not answer an incoming call. This condition occurs if:

a) the modem is in the test mode
b) MODEM DISABLE is used
c) a reset signal from the CPU is received.

Power Supply

Power for the modem board is +12V, -12V, and +5V. These are available as regulated voltages on the bus. Pi filters are used to keep noise at a minimum.

TABLE OF CONNECTIONS

J1-1	Transmit Data In
J1-2	Not Connected
J1-3	Received Data Out
J1-4	Not Connected
J1-5	Modem Disable
J1-6	Test/Normal*
J1-7	Make Busy
J1-8	Carrier Detect*
J1-9	Read*
J2-1	Phone Line Tip
J2-2	Phone Line Ring

NOTES

1) Outputs referenced to input of EIA drivers.

2) Inputs referenced at outputs of EIA receivers.

3) J1 lines are MODEM CONTROL/STATUS

4) J2 lines are the telephone connections

DUAL MODEM BOARD PARTS LIST

SYMBOL	DESCRIPTION	MAN. PART#	R.S. PART#
	Capacitors		
C101,201	1uF, 250V, metal poly.	8355106	
C102,202	2.2uF, 50V, elect, radial	8325224	
C103,203	0.047uF, 250V, metal poly.	8352476	
C104,204	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C105,205	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C106,206	0.001uF, 50V, cer. disc	8302104	ACC102QJCP
C107,207			
C108,208	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C109,209	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C110,210	68pF, 100V, cer. disc	8300685	
C111,211	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C112,212	0,1uF, 50V, mono., axial	8374104	ACC104QJCA
C113,213	0.0047uF, 100V, plyprop.	8392475	
C114,214	0.0047uF, 100V, plyprop.	8392475	
C115,215	0.0047uF, 100V, plyprop.	8392475	
C116,216	0.0047uF, 100V, plyprop.	8392475	
C117,217	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C118,218	0.01uF, 50V, mono. cer.	8383104	
C119,219	6.8uF, 16V, elect., axial	8395661	
C120,220	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C121,221	0.01uF, 50V, mono. cer.	8383104	
C122,222	0.01uF, 50V, mono. cer.	8383104	

C123,223	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C124,224	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C125,225	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C126,226	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C127,227	0.0047uF, 100V, plyprop.	8392475	
C128,228	0.0047uF, 100V, plyprop.	8392475	
C129,229	330pF, 50V, cer. disc	8301334	
C130,230	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C131,231	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C132,232	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C133,233	3.3uF, 50V, elect., radial	8325334	
C134,234	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C135,235	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C136,236	0.0047uF, plyprop.	8392475	
C137,237	0.0047uF, plyprop.	8392475	
C138,238	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C139,239	0,1uF, 50V, mono., axial	8374104	ACC104QJCA
C140,240	1uF, 100V,N-P elect,radial	8395114	
C141,241	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C142,242	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C143,243	6.8uF, 16V, elect., axial	8395661	
C144,244	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C145,245	0.1uF, 50V, mono., axial	8374104	ACC104QJCA
C146,246	3.3uF, 16V, tantalum	8335331	
C150,250	3.3uF, 16V, tantalum	8335331	
C151,251	100uF, 16V, elect., axial	8317101	

C152,252	3.3uF, 16V, tantalum	8335331	
C153,253	3.3uF, 16V, tantalum	8335331	
C154,254	100uF, 16V, elect., axial	8317101	
C155,255	3.3uF, 16V, tantalum	8335331	
C156,256	100uF, 16V, elect., axial	8317101	
C157,257	100uF, 16V, elect., axial	8373101	
C158,258	3.3uF, 16V, tantalum	8335331	
C159,259	100uF, 16V, elect., axial	8317101	
C160,260	3.3uF, 16V, tantlaum	8335331	
	Connectors		
J101,201	9-pin, right angle	8519114	
J102,202	2-pin, right angle	8519113	
	Diodes		
CR101,201	1N4002	8150002	ADX1148
CR104,204	1N4002	8150002	ADX1148
CR105,205	1N5221, 2.4V, zener	8150021	
CR106,206	1N4148	8150148	ADX1152
CR109,209	1N4148	8150148	ADX1152
ZN101,201	22V, transient supressor	8190022	
	Inductor		
L101,201	470uh	8419001	
L102,202	470uh	8419001	
L103,203	470uh	8419001	
	Integrated Circuits		
U101,201	4N29, opto-coupler	8170001	

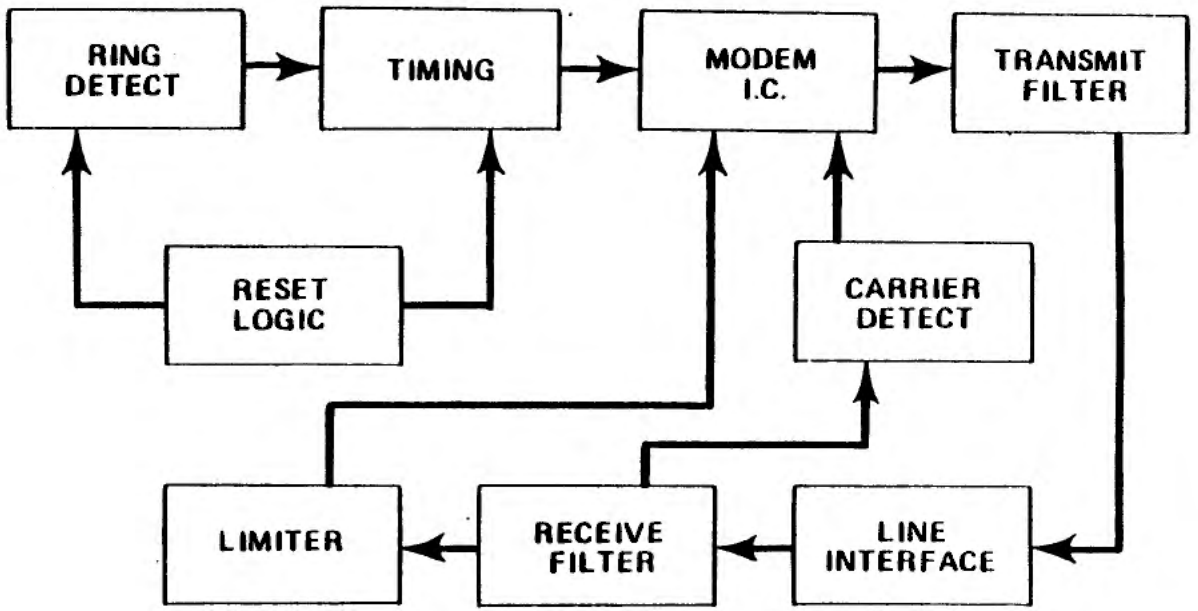
U102,202			
U103,203	MC4013, dual D flip-flop	8030413	
U104,204	MC14412AFP,CMOS modem chip	8030412	
U105,205	MC4558,dual wideband opamp	8050558	
U106,206	MC1489, quad line receiver	9050189	
U107,207	MC3456, dual timer	8030456	
U108,208	MC1488, quad line driver	9050188	
U109,209	MC4558,dual wideband opamp	8050558	
U110,210			
U111,211	MC4069, hex inverter	8030069	
U112,212	LM339, quad comparator	8050339	AMX4200
U113,213	MC4558,dual wideband opamp	8050558	
U114,214	MLM311P1, comparator	8050311	
U115,215	MC4075, triple 3-in OR	8030075	
U116,216			
U117,217	74LS74, dual D flip-flop	8020074	AMX3558
	Relay		
K101,201	9-volt	8429103	
K102,202	9-volt	8429103	
	Resistors		
R101,201	6.8K, 1W, 5%	8247268	
R102,202	10K, 1/4W, 5%	8207310	AN0281EEC
R103,203	3.3K, 1/4W, 5%	8207233	AN0230EEC
R014,204	560 ohm, 1/4W, 5%	8207156	AN0176EEC
R105,205	68 ohm, 1/4W, 5%	8207062	
R106,206	10K, trimmer pot	8279310	
R107,207	68 ohm, 1/4W, 5%	8207062	

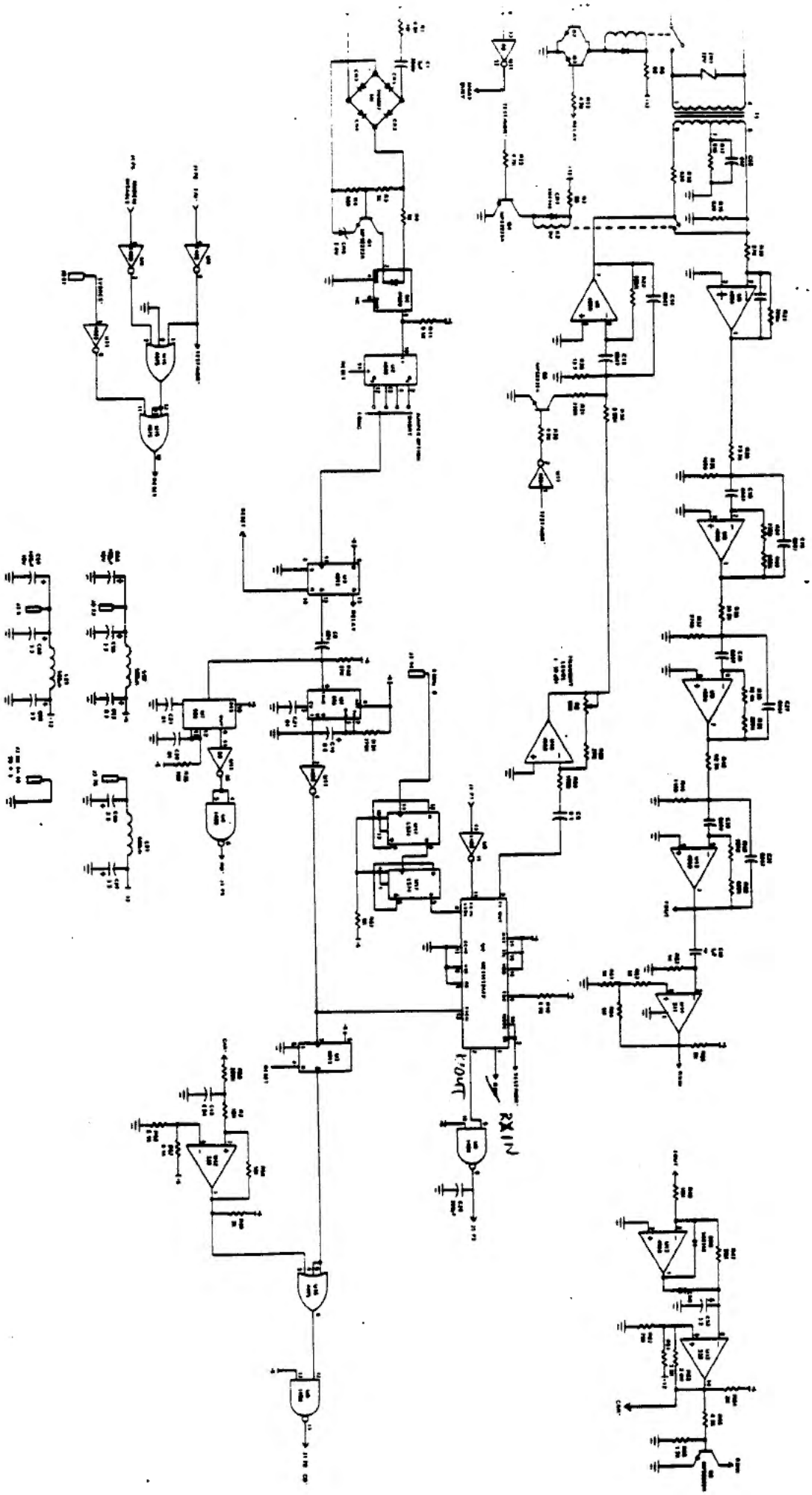
R108,208	4.7K, 1/4W, 5%	8207247	AN0247EEC
R109,209	1K, 1/4W, 5%	8207210	AN0196EEC
R110,210	1M, 1/4W, 5%	8207510	
R111,211	9.1K, 1/4W, 5%	8207291	
R112,212			
R113,213	4.7K, 1/4W, 5%	8207247	AN0247EEC
R114,214			
R115,215	620 ohm, 1/4W, 5%	8207162	
R116,216	620 ohm, 1/4W, 5%	8207162	
R117,217	910 ohm, 1/4W, 5%	8207191	AN0192EEC
R118,218			
R119,219	4.7K, 1/4W, 5%	8207247	AN0247EEC
R120,220	27K, 1/4W, 5%	8207327	
R121,221	360K, 1/4W, 5%	8207436	
R122,222	165K, 1/4W, 5%	8200417	
R123,223	4.7K, 1/4W, 5%	8207247	AN0247EEC
R124,224			
R125,225	1650 ohm, 1/4W, 1%	8200216	
R126,226	590K, 1/4W, 1%	8200459	
R127,227	118K, 1/4W, 1%	8200412	
R128,228	73.2K, 1/4W, 1%	8200373	
R129,229	4.7K, 1/4W, 5%	8207247	AN0247EEC
R130,230			
R131,231	2260 ohm, 1/4W, 1%	8200222	
R132,232	13.7K, 1/4W, 1%	8200314	
R133,233	8060 ohm, 1/4W, 1%	8200280	
R134,234	270K, 1/4W, 5%	8207427	

R135,235	10K, 1/4W, 5%	8207310	AN0281EEC
R136,236	33.2K, 1/4W, 1%	8200333	
R137,237	2740 ohm, 1/4W, 1%	8200227	
R138,238	287K, 1/4W, 1%	8200428	
R139,239	32.4K, 1/4W, 1%	8200332	
R140,240	52.3K, 1/4W, 1%	8200352	
R141,241	1180 ohm, 1/4W, 1%	8200212	
R142,242	27K, 1/4W, 5%	8207327	
R143,243			
R146,246			
R147,247	39K, 1/4W, 5%	8207339	AN0330EEC
R148,248	10K, 1/4W, 5%	8207310	AN0281EEC
R149,249	107K, 1/4W, 1%	8200411	
R150,250	422K, 1/4W, 1%	8200422	
R151,251	1K, 1/4W, 5%	8207210	AN0196EEC
R152,252	1K, 1/4W, 5%	8207210	AN0196EEC
R153,253	1K, 1/4W, 5%	8207210	An0196EEC
R154,254	1M, 1/4W, 5%	8207510	
R155,255	2K, 1/4W, 5%	8207220	
R156,256	220K, 1/4W, 5%	8207422	
R157,257	9.1K, 1/4W, 5%	8207291	
R158,258	5.1K, 1/4W, 5%	8207251	AN0252EEC
R159,259	1M, 1/4W, 5%	8207510	
R160,260	2K, 1/4W, 5%	8207220	
R161,261	3.3K, 1/4W, 5%	8207233	AN0230EEC
R162,262	750 ohm, 1/4W, 5%	8207175	AN0185EEC

R163,263	2.4M, 1/4W, 5%	8207524	
R164,264	2K, 1/4W, 5%	8207220	
R165,265	4.7K, 1/4W, 5%	8207247	AN0247EEC
R166,266	1.2K, 1/4W, 5%	8207212	AN0199EEC
R167,267	1K, 1/4W, 5%	8207210	AN0196EEC
	Transformer		
T101,201	Hybrid, 600:600	8790024	
	Transistor		
Q101,201	MPS2222A, NPN	8110222	AMX4263
Q106,206	MPS2222A, NPN	8110222	AMX4263

DESCRIPTION	QUANTITY	MAN. PART#	R.S. PART#
	Miscellaneous		
Jumper Plug	2	8519021	AJ6769
Socket, 8-pin	8	8509011	
Socket, 14-pin	21	8509008	AJ6759
Socket, 16-pin	4	8509003	AJ6581
Staking Pins	16	8529014	AHB9682


RING DETECT
TIMING
MODEM I.C.
TRANSMIT FILTER
RESET LOGIC
CARRIER DETECT
LIMITER
RECEIVE FILTER
LINE INTERFACE


RXIN