

interface
TECHNOLOGY

MODEL RS-660
TIMING SIMULATOR/WORD GENERATOR
USER'S MANUAL

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July 1, 1980

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804



MODEL RS-660

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PERSONAL SAFETY

The equipment described in this manual contains voltages hazardous to human life and safety and which are capable of inflicting personal injury.

For all procedures involving component insertion or withdrawal, the equipment must be powered off to prevent component damage. It is also recommended for such procedures that the primary power cord be disconnected from the equipment's rear panel connector to prevent accidental contact with primary power circuits. While physical measures have been built into the equipment to prevent accidental contact with high voltages during maintenance and troubleshooting procedures, the user should still exercise caution. Careless probing inside the equipment may result in the exposure of high voltage terminals.

Before operating the unit, ensure that the primary power outlet includes a functional protective ground (earth) circuit. Do not defeat the unit's internal protective ground circuit to chassis by using a two conductor adapter plug or other such device.

I N T E R F A C E T E C H N O L O G Y

MODEL RS-660

MANUAL REV. N/C

DATE 12/17/81

ERRATA NO. 660-1

PAGE 1 OF 1

ERRATA

Drawing 1001 1163, Rev. N/C, Page 1 of 4. Page 2 of 4

Change IC C6 from 74LS163 to 74S163

I N T E R F A C E T E C H N O L O G Y

MODEL RS-660

DATE November 18, 1983

MANUAL REV. November, 1981

ERRATA NO. 660-2

PAGE 2 OF 2

ERRATA

Page 4-18, TABLE 4-2

ADDED: Note: When executing the remote command "Load Word Generator Data" via the RS-232C interface, it may be necessary to insert delays between data words to insure against the lost of data. The delay requirement is dependant upon the interface baud rate and the RS-660 channel configuration as tabulated below:

<u>INTERFACE</u>	<u>RS-660 CHANNEL CONFIGURATION</u>					
<u>Baud Rate</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>8</u>	<u>16</u>
110	Ø	Ø	Ø	Ø	Ø	Ø
150	Ø	Ø	Ø	Ø	Ø	Ø
300	19 MS	Ø	Ø	Ø	Ø	Ø
600	53 MS	11 MS	Ø	Ø	Ø	Ø
1200	72 MS	29 MS	3 MS	Ø	Ø	Ø
2400	80 MS	38 MS	12 MS	Ø	Ø	Ø
4800	85 MS	42 MS	17 MS	Ø	Ø	Ø
9600	87 MS	45 MS	19 MS	Ø	Ø	Ø

The form for this command then should be: Wc, aaaa, dddd, delay dddd, delay dddd,, delay dddd,

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I. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model RS-660 Word Generator/Timing Simulator is a 16 channel, general purpose, digital signal generator. The unit is capable of operating at frequencies up to 20 MHz (50 nsec bit time) and incorporates the following key features:

Versatile operating modes; WORD GENERATOR or TIMING SIMULATOR.

Simplified front panel operation.

C R T display for added operating convenience.

Fully controllable cursor.

Selectable data formats; hexadecimal or binary.

Single step, repetitious or continuous operation.

First bit and programmable sync outputs.

Free running and gated output clocks.

External clock and trigger inputs.

External oscillator input for synchronous system operation.

Plug-in stored program card.

Remote control interfaces.

Combined line voltage selector and safety AC power connector.

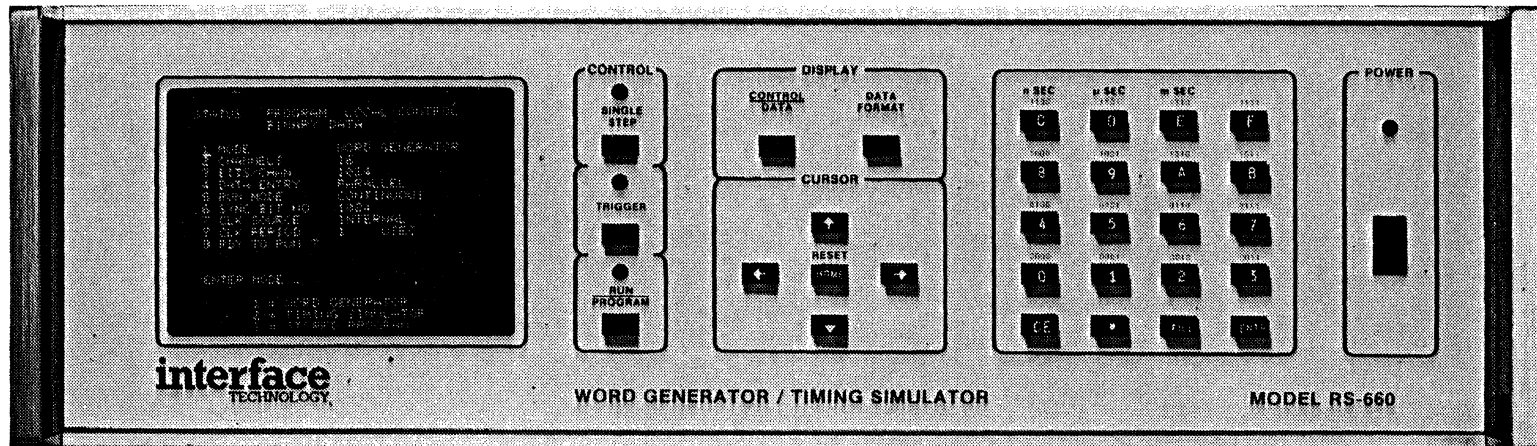
Figure 1-1 is a front view of the Model RS-660 and illustrates the front panel operating controls.

Figure 1-2 illustrates the unit's rear panel features, including the optional interface connectors.

1.2 OPTIONS

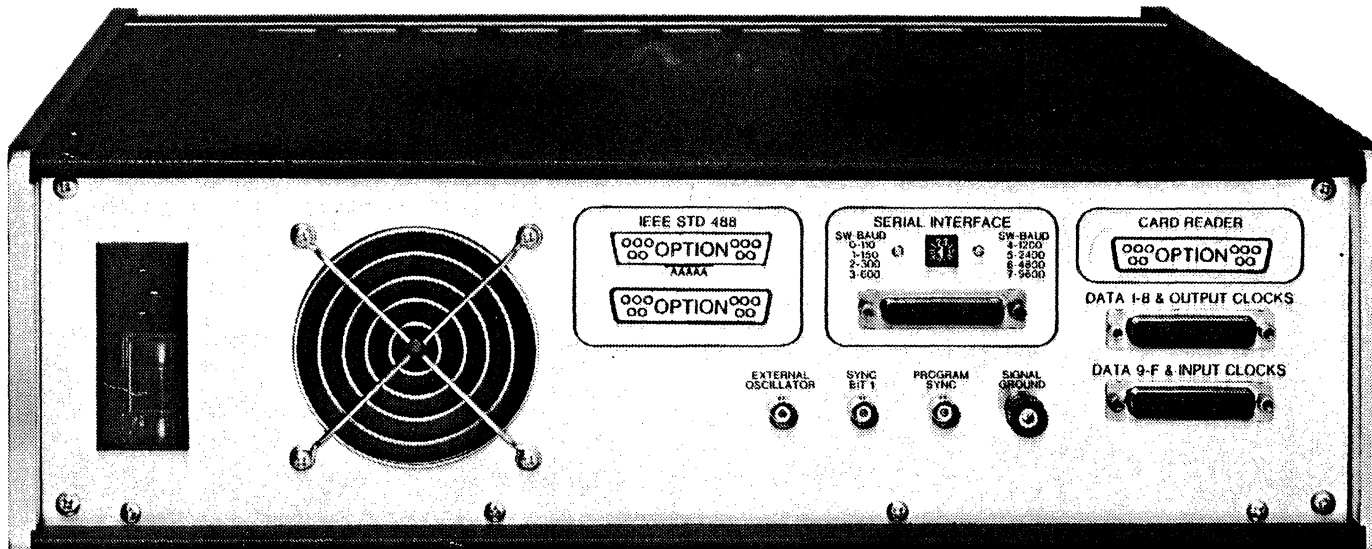
1.2.1 Memory Option, 4K (Option 660-001)

This option provides the user with up to 65,536 programmable output bits in the Word Generator mode or 32,768 output bits in the Timing Simulator mode.



MODEL RS-660 TIMING SIMULATOR/WORD GENERATOR

FIGURE 1-1



MODEL RS-660 REAR PANEL

FIGURE 1-2

1.2.2 IEEE Std 488-1978 Control Interface (Option 660-002)

The optional IEEE Std 488-1978 control interface is a plug-in card which provides for remote control of the Model RS-660. The interface is capable of loading and reading the memory and control parameters, starting and stopping the unit and reading its status. Reference section 4.2.

1.2.3 RS-232C/TTY Control Interface (Option 660-003)

The RS-232C/TTY control interface is also an optional, plug-in card which provides for remote control of the Model RS-660, with the same capabilities as the IEEE Std 488-1978 control interface. Reference section 4.3.

1.2.4 Card Reader Interface (Options 660-004 & 660-005)

Option 660-004 includes both a mark-sense card reader and the required interface. This enables the user to load frequently used programs into the Model RS-660 from mark-sense cards.

Option 660-005 comprises only the Model RS-660 card reader interface and may be used as a parallel eight bit interface for loading the instrument. Reference section 4.1.

1.2.5 Stored Program Card (Option 660-006)

The optional, plug-in stored program card enables the Model RS-660 to execute programs which have previously been stored in EPROMs. The card is capable of accommodating up to eight EPROMs which are not supplied and must be programmed externally.

Any of the following, 5 volt EPROM types may be used:

- | | |
|-----------------------|------|
| i) Intel 2758 | 1Kx8 |
| ii) Intel 2716 | 2Kx8 |
| iii) Intel 2732 | 4Kx8 |
| iv) Texas Instr. 2516 | 2Kx8 |

With Intel 2732 EPROMs installed, the card provides a maximum storage capacity of 26Kx8. Reference section 3.5 for a description of the stored program mode.

1.2.6 Rack-mount Adapter (Option 660-007)

This option allows the Model RS-660 to be mounted in a standard, 19 inch rack.

1.2.7 Additional Documentation Set (Option 660-008)

Additional copies of the instruction manual for the Model RS-660 may be ordered under option number 660-008.

1.2.8 Additional I/O Connector Set (Option 660-009)

An additional set of I/O mating connectors is available under option number 660-009.

1.2.9 Interface Pod (Option 660-010)

This option comprises an interface pod, which is configurable as either TTL or CMOS compatible. Reference section V.

1.3 APPLICATION OF THE RS-660

The Model RS-660 may be operated in either of two distinct modes - Word Generator or Timing Simulator. The most convenient mode depends upon the specific application and must be selected prior to loading the instrument. While operating in the Word Generator mode each and every data word is output for the same length of time; i.e., the period of the clock source. This mode is therefore best suited to applications where data transitions occur at regular intervals. In the Timing Simulator mode each word of data may be output for a unique period of time. This enables the instrument to generate waveforms, containing pulses, of extremely short duration in the midst of long time intervals.

The Model RS-660 may be directed to either output a programmed data pattern from 1 to 4096 times upon receipt of a trigger, or to repeat the pattern continuously. This function is applicable to both Word Generator and Timing Simulator modes.

Data may be loaded using either binary or hexadecimal. When dealing with waveforms it is usually more convenient to use binary, whereas data transfers are sometimes more conveniently dealt with using hexadecimal.

1.3.1 Application of the Word Generator Mode

Assuming that the desired output waveform has been examined and the Word Generator mode of operation has been selected as being the most appropriate, the next step entails selecting the number of data channels to be used and determining the period of the clock source. The clock period may be defined as the shortest time interval between any data level transitions on any channel. Having defined the clock period, the desired output waveform should be divided into time intervals, each being equal to one clock period. The number of bits per channel may now be defined and is equal to the number of time intervals required to generate one cycle of the desired waveforms. At this point the data memory may be loaded. In order to accomplish this the logic levels on all channels during the first time interval or word should be converted into 'ones' and 'zeros' and loaded into the data memory at word number one. This process should then be repeated for all subsequent words. If so desired, the device may be clocked by an external clock source. This provides for synchronous system operation or operation at frequencies not obtainable using the device's internal clock source.

1.3.2 Application of the Timing Simulator Mode

Having selected the Timing Simulator mode, the desired output waveform should be divided into a series of time intervals. A level transition on any channel constitutes the end of the previous time interval and the beginning of a new one. Once the desired number of channels have been selected the data/time memory may be loaded. For each word, both the logic levels on each channel and the relevant time interval must be programmed. The number of the last word may be determined by counting the number of words required to generate one complete cycle of the waveforms.

1.4 SPECIFICATIONS

Memory Capacity: 1024x23 std. (4Kx23 optional)

MODE	NUMBER OF CHANNELS	NUMBER OF BITS PER CHANNEL	
		1K	4K
TIMING SIMULATOR	1 through 8	1024	4096
WORD GENERATOR	1	16384	65536
	2	8192	32768
	4	4096	16384
	8	2048	8192
	16	1024	4096

Period Resolution and Range:

RESOLUTION	RANGE
50 ns	50 ns
0.1 us	0.1 us - 99.9 us
1 us	1 us - 999 us
0.01 ms	0.01 ms - 9.99 ms
0.1 ms	0.1 ms - 99.9 ms
1 ms	1 ms - 999 ms

Operating Frequency: (WORD GENERATOR MODE)

INTERNAL CLOCK = 1.001 HZ - 20MHZ (See Note)
 EXTERNAL CLOCK = 0 HZ - 20MHZ (See Note)

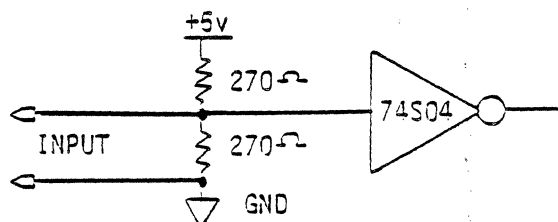
NOTE: If the number of BITS PER CHANNEL (B) and the number of CHANNELS (C) satisfy the following equation, the clock frequency is limited to 10MHZ internal, 12MHZ external.

$$\frac{C}{16} (B-1) = n \quad \text{where } n=0,1,2,\dots$$

Reference Section 3.2.8

Input Signals: EXTERNAL TRIGGER, EXTERNAL CLOCK, EXTERNAL OSCILLATOR

Reference Appendix A for pin designations of rear panel connectors J7 and J3.



Typical Configuration of all Inputs

All inputs have TTL compatible logic levels; Hi=+2.0Vdc min, +5.5Vdc max.
 Lo=-0.5Vdc min, +0.8Vdc max.

1.4 SPECIFICATIONS (continued)

INPUT	RESIDENT LEVEL	ACTIVE EDGE	MAX. FREQ.	MIN. PULSE WIDTH
EXTERNAL OSCILLATOR	NONE	(+VE)	20MHz	25nS (SEE NOTE)
EXTERNAL CLOCK	HIGH	(+VE)	20MHz	25nS (LOW LEVEL)
EXTERNAL TRIGGER	HIGH	(-VE)	N/A	20nS (LOW LEVEL)

NOTE: For operation with an external oscillator, the incoming waveform should have a 50% duty cycle.

Output Signals: FREE-RUNNING OUTPUT CLOCK (FOCLK+), GATED OUTPUT CLOCK (GOCLK+), PROGRAM SYNC (PSYNC-), SYNC BIT 1 (SYNC1-) and DATA OUTPUTS 0-F.

Reference Appendix A for pin designation of rear panel connectors J7 and J8.

TTL compatible drivers, low ("0") = $\pm 0.4V$ max at +48mA dc, high ("1") = +2.4V min at -13mA dc or +2Vdc min at -42mA dc; rise and fall times = 10 nanoseconds maximum into terminated 75 ohm load and 10 feet of coax cable.

Skew:

Data Channel to Data Channel = 8 nanoseconds maximum

Gated Output Clock to Data Channel = 20 nanoseconds maximum

Gated Output Clock to Sync Output = 20 nanoseconds maximum

Free Running Output Clock to Gated Output Clock = 25 nanoseconds maximum

External Input Clock to Gated Output Clock = 30 nanoseconds maximum

Word Generator, Non-continuous Mode; External Trigger to Gated Output Clock = 50 ns max + (2 x CLOCK PERIOD)

Timing Simulator, Non-continuous Mode; External Trigger to Gated Output Clock = 150 nsec max + FIRST WORD PERIOD

Power:

200 watts; 120Vac $\pm 10\%$, 50/60 Hz; 100/220/240Vac, 50/60 Hz optional

Dimensions:

Height = 134 mm (5.25 in.)

Width = 432 mm (17 in.)

Depth = 430 mm (16.8 in.) including 46 mm (1.8 in.) for handles

Weight = 13.6 kg. (30 lbs.)

II. INSTALLATION AND MAINTENANCE

2.1 INSTALLATION

2.1.1 Unpacking and Inspection

The Model RS-660 is packed in a molded, plastic foam form, within a cardboard carton. The molded form holds the unit securely in the carton and absorbs any reasonable external shock, normally encountered in transit. Carefully remove the unit from the carton and inspect the exterior of the instrument for any signs of damage.

The shipping container and packing material should be retained, in case reshipment is required.

Included in the shipping container with the instrument are the instruction manual, power cord and external option accessories.

2.1.2 Mechanical Installation

The Model RS-660 is equipped with a collapsible tilt bail, which may be used to elevate the front of the instrument for convenient bench use.

The instrument may be mounted in a standard 19 inch rack with the optional rack-mount kit (option 660-007). To install, remove the small, decorative side panels located near the front of the instrument. Attach each of the rack-mount flanges, using the two screws supplied.

2.1.3 Electrical Installation

Prior to connecting power to the Model RS-660, confirm that the primary power source is compatible with the unit's source requirements. The Model RS-660 is fitted with a combined AC connector, fuse holder and voltage selector, on the rear panel. This enables the unit to be operated from the following power sources:

- a) 100 Vac., 50/60 HZ., 2 amp fuse
- b) 120 Vac., 50/60 HZ., 2 amp fuse
- c) 220 Vac., 50/60 HZ., 1 amp fuse
- d) 240 Vac., 50/60 HZ., 1 amp fuse

In order to select a different operating voltage, the following procedure should be adopted:

- i) remove AC power cord.
- ii) slide connector window over to cover AC receptacle.
- iii) remove fuse by lifting fuse release lever.
- iv) remove printed circuit board selector.
- v) reorientate and install selector board, such that desired voltage will be visible upon reassembly.
- vi) return fuse release lever to original position and install fuse of correct rating.
- vii) slide window over, to cover fuse and check that desired operating voltage is now visible.

viii) make certain that power switch is in the OFF (lower half of switch depressed) position and install power cord.

An AC line cord, having a three-pin plug, is supplied with the instrument. When the cord is plugged into the Model RS-660's rear panel receptacle, the round pin of the plug is connected to the instrument's chassis. This pin must be connected to a good quality earth ground, when the plug is installed in the user's primary power receptacle.

NOTE: Chassis ground and logic ground are internally connected.

2.2 FUNCTIONAL VERIFICATION

The purpose of this section is to provide calibration or metrology lab personnel with a means of verifying the correct operation of the Model RS-660. The procedure should be undertaken upon initial receipt of the unit and at the periodic maintenance interval.

It is not to be implied that this procedure will provide a 100% test of the unit. Rather, it verifies the basic performance of the Model RS-660 and will detect most of the potential problems.

The procedure is divided into six tests, each of which must be performed with the aid of an oscilloscope.

Verification Setup

Connect instrument to a compatible source of AC power and place front panel POWER switch to the ON position (upper half of switch depressed). The POWER LED should be illuminated immediately. After an initial power-up delay of approximately 10 seconds, a display resembling that shown in figure 2.1 should be visible on the CRT.

Figure 2.1
POWER-UP DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1 MODE:                               WORD GENERATOR
2 CHANNELS:                            16
3 BITS/CHANNEL:                        XXXX
4 DATA ENTRY:                         PARALLEL
5 RUN MODE:                             CONTINUOUS
6 SYNC BIT NO:                         XXXX
7 CLK SOURCE:                          INTERNAL
8 CLK PERIOD:                          1 USEC
9 RDY TO RUN?

ENTER MODE _____

1 = WORD GENERATOR
2 = TIMING SIMULATOR
3 = STORED PROGRAM:
```

Note XXXX = 1024 or 4096 depending on memory capacity.

Note that application of power to the device causes the internal microprocessor to verify the correct operation of the instrument's memory. Memory failure will result in the CRT displaying the message, 'RAM FAILURE', together with diagnostic information and a procedure menu. The information supplied is comprised of the following:

- 1) the section of memory, RAM1(MD0- MD7-), RAM2(MD8/T7- MDF/T0-) or RAM3(MT8- MLAST-) where the failure occurred.
- 2) the hexadecimal address of the memory location that failed.
- 3) the hexadecimal data retrieved from this location.
- 4) the hexadecimal data that should have been retrieved.
- 5) the error count; i.e., the number of failures thus far.

Assuming that a memory failure has occurred, the operator may direct the device to perform any of the following functions by activating the appropriate key (1,2,3 or 4):

- 1) Continue test; i.e., test for further errors.
- 2) Bypass RAM test; i.e., enter normal operating mode.
- 3) Loop on RAM read/write; i.e., alternately write the values: '55 and 'AA' into memory location '0000.
- 4) Loop on address pattern; i.e., continually increment memory address.

CAUTION:

It is possible for certain, extraordinary device malfunctions to interfere with the normal operation of the CRT unit. If any of the following symptoms occur, the unit should immediately be powered down, as prolonged operation, under these conditions, may result in damage to the CRT unit:

- i) Loss of horizontal or vertical synchronization, indicated by display roll or tearing.
- ii) Loss of horizontal or vertical deflection, indicated by display being reduced to a bright line or spot.
- iii) Incorrect horizontal drive frequency, indicated by duplicated or partial display and accompanied by audible transformer whine.

TEST #1 WORD GENERATOR 16 CHANNEL

Procedure:

- i) Having obtained a display that resembles that shown in figure 2.1 following application of power to the instrument, activate the keys marked "3" and ENTR respectively. Successively activate the following keys and observe that the resultant display is depicted by figure 2.2:

"9", "9", "0" and ENTR

Figure 2.2
STORED PROGRAM NO. 990 CONTROL DISPLAY

STATUS: PROGRAM; LOCAL CONTROL BINARY DATA	
1 MODE:	PGM 990 WRD GEN
2 CHANNELS:	16
3 BITS/CHAN:	16
4 DATA ENTRY:	PARALLEL
5 RUN MODE:	CONTINUOUS
6 SYNC BIT NO:	1
7 CLOCK SOURCE:	INTERNAL
8 CLOCK PERIOD:	0100 NSEC
9 RDY TO RUN?	
ENTER NO. OF CHANNELS _ _	
1,2,4,8,16	

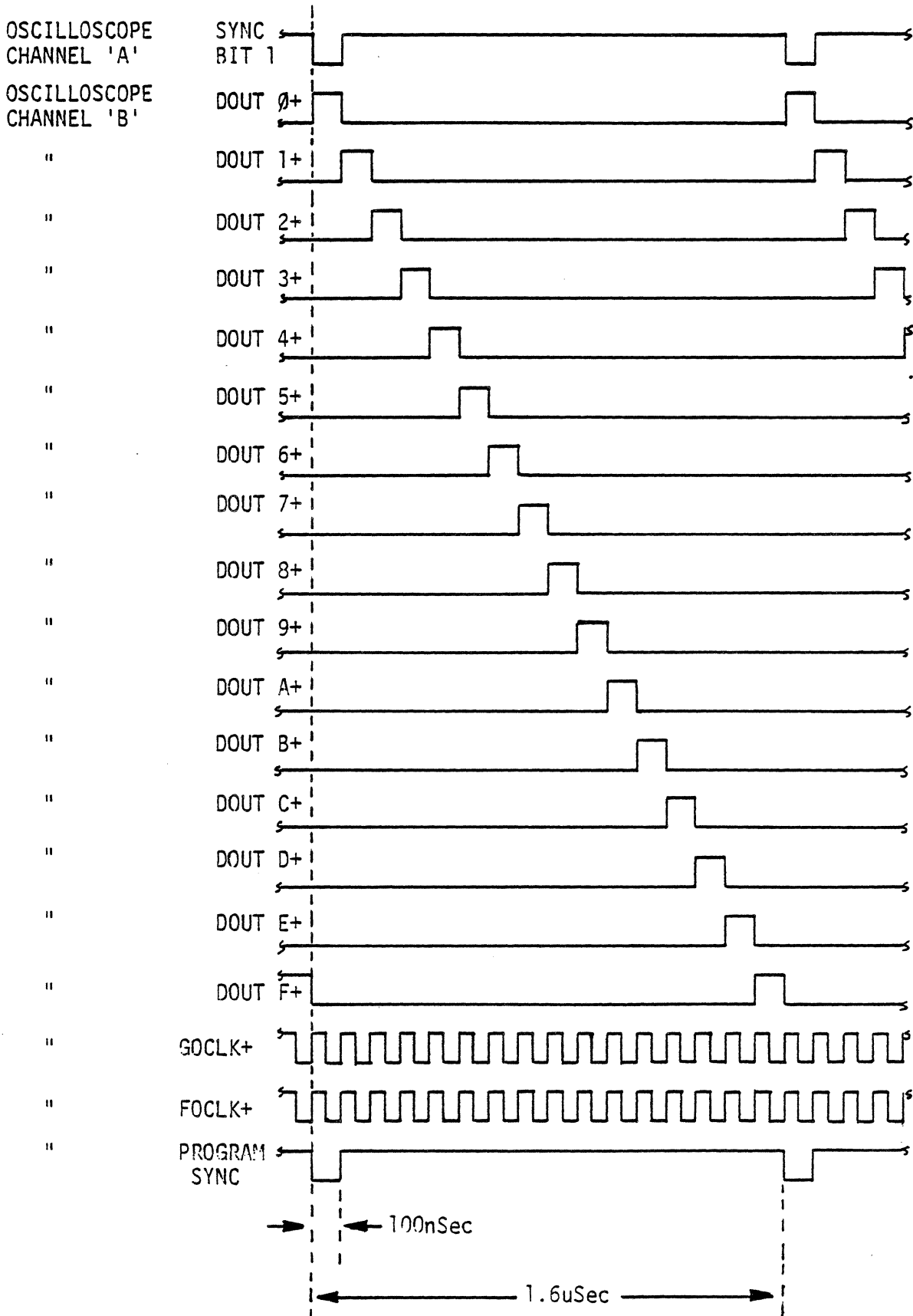
- ii) Activate the key marked CONTROL/DATA and verify that the display is as shown in figure 2.3.

Figure 2.3
STORED PROGRAM NO. 990 DATA DISPLAY

WORD	CHANNEL			
	0123	4567	89AB	CDEF
1S	1000	0000	0000	0000
2	0100	0000	0000	0000
3	0010	0000	0000	0000
4	0001	0000	0000	0000
5	0000	1000	0000	0000
6	0000	0100	0000	0000
7	0000	0010	0000	0000
8	0000	0001	0000	0000
9	0000	0000	1000	0000
10	0000	0000	0100	0000
11	0000	0000	0010	0000
12	0000	0000	0001	0000
13	0000	0000	0000	1000
14	0000	0000	0000	0100
15	0000	0000	0000	0010
16L	0000	0000	0000	0001

- iii) Again activate the CONTROL/DATA key, followed by the RUN/PROGRAM key.
- iv) Connect channel A of an oscilloscope to the SYNC BIT 1 BNC connector, on the rear panel of the Model RS-660. Set the oscilloscope timebase to 200nsec/DIV. and trigger on the negative edge of channel A.
- v) Using channel B of the oscilloscope, verify that the PROGRAM SYNC(BNC), gated output clock (GOCLK+), free running output clock (FOCLK+) and data output channels (DOUT0+ through DOUTF+) bear the same relationships, to the SYNC BIT 1 (BNC) output, as depicted by figure 2.4. Reference appendix A for connector pin numbers.

Figure 2.4
 STORED PROGRAM NO. 990 OUTPUT WAVEFORMS



TEST #2 WORD GENERATOR 8 CHANNEL

Procedure:

- i) Obtain the CONTROL display, by activating the CONTROL/DATA key, home the CURSOR by activating the HOME key.
- ii) Activate the "3" and ENTR keys to enter the STORED PROGRAM MODE.
- iii) Call STORED PROGRAM number 991.
- iv) Verify that the CONTROL and DATA displays resemble those depicted in figures 2.5 and 2.6.

Figure 2.5
STORED PROGRAM NO: 991 CONTROL DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1  MODE:                PGM 991 WRD GEN
2  CHANNELS:            8
3  BITS/CHANNEL:       9
4  DATA ENTRY:        PARALLEL
5  RUN MODE:           CONTINUOUS
6  SYNC BIT NO:        2
7  CLOCK SOURCE:       INTERNAL
8  CLOCK PERIOD:       0002 USEC
9  RDY TO RUN?

ENTER NO. OF CHANNELS _ _
                        1,2,4,8,16
```

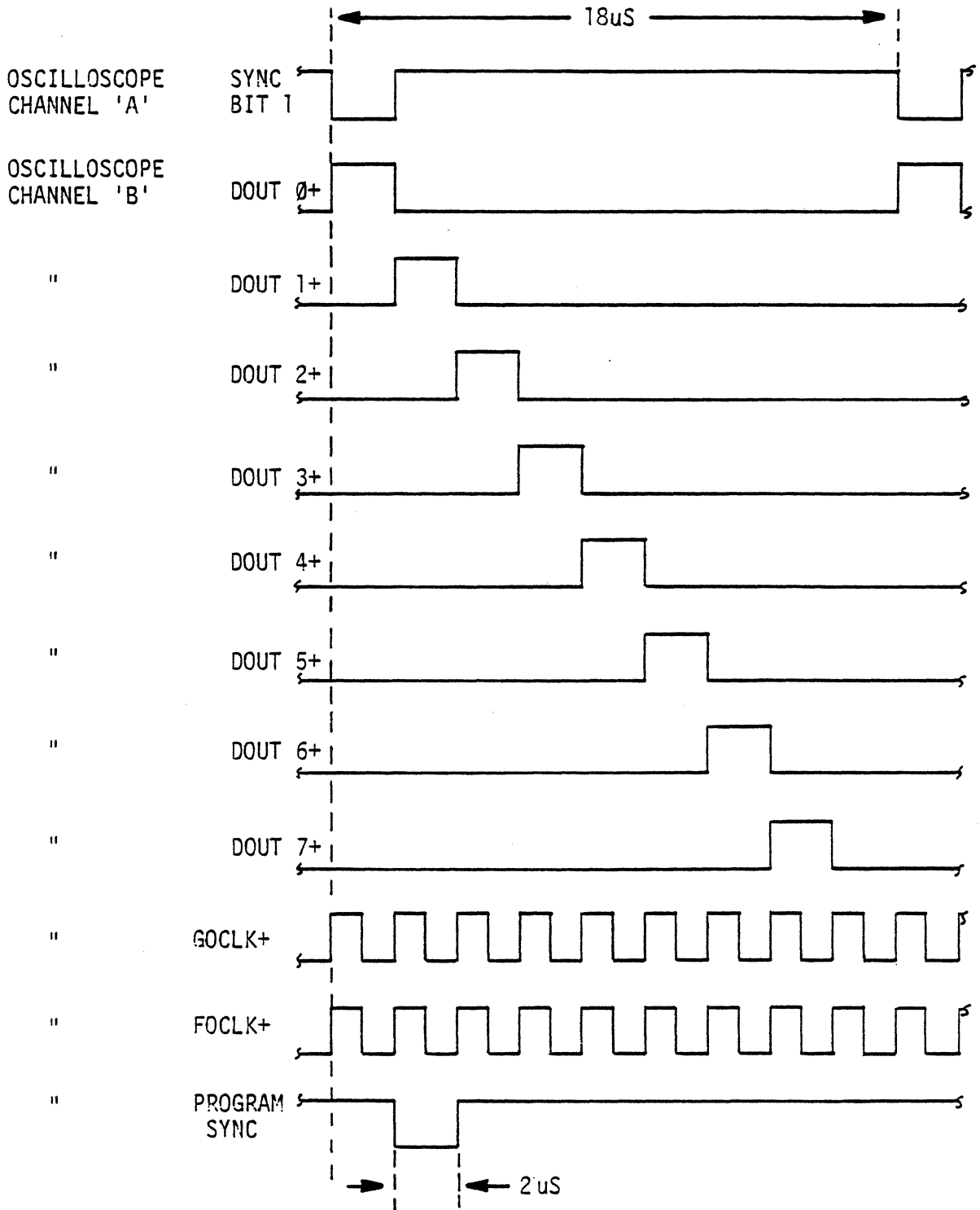
Figure 2.6
 STORED PROGRAM NO. 991 DATA DISPLAY

WORD	CHANNEL		WORD	CHANNEL	
	0123	4567		0123	4567
1	1000	0000	17	XXXX	XXXX
2S	0100	0000	18		
3	0010	0000	19		
4	0001	0000	20		
5	0000	1000	21		
6	0000	0100	22		
7	0000	0010	23		
8	0000	0001	24		
9L	0000	0000	25		
10	XXXX	XXXX	26		
11			27		
12			28		
13			29		
14			30		
15			31		
16			XXXX		

NOTE: X=DON'T CARE

- v) Set the unit to RUN and verify that the PROGRAM SYNC (BNC), gated output clock (GOCLK+), free running output clock (FOCLK+) and data output channels (DOUT0 through DOUT7+) bear the same relationships, to the SYNC BIT 1 (BNC), as depicted by figure 2.7. Reference appendix A for connector pin numbers.

Figure 2.7
STORED PROGRAM NO. 991 OUTPUT WAVEFORMS



TEST #3 WORD GENERATOR 4 CHANNEL

Procedure:

- i) Call STORED PROGRAM number 992 and verify that the CONTROL and DATA displays resemble those depicted in figures 2.8 and 2.9.

Figure 2.8
STORED PROGRAM NO.992 CONTROL DISPLAY

STATUS: PROGRAM; LOCAL CONTROL BINARY DATA	
1	MODE: PGM 992 WRD GEN
2	CHANNELS: 4
3	BITS/CHANNEL: 6
4	DATA ENTRY: PARALLEL
5	RUN MODE: CONTINUOUS
6	SYNC BIT NO: 3
7	CLOCK SOURCE: INTERNAL
8	CLOCK PERIOD: 0500 USEC
9	RDY TO RUN?
ENTER NO. OF CHANNELS __	
1,2,4,8,16	

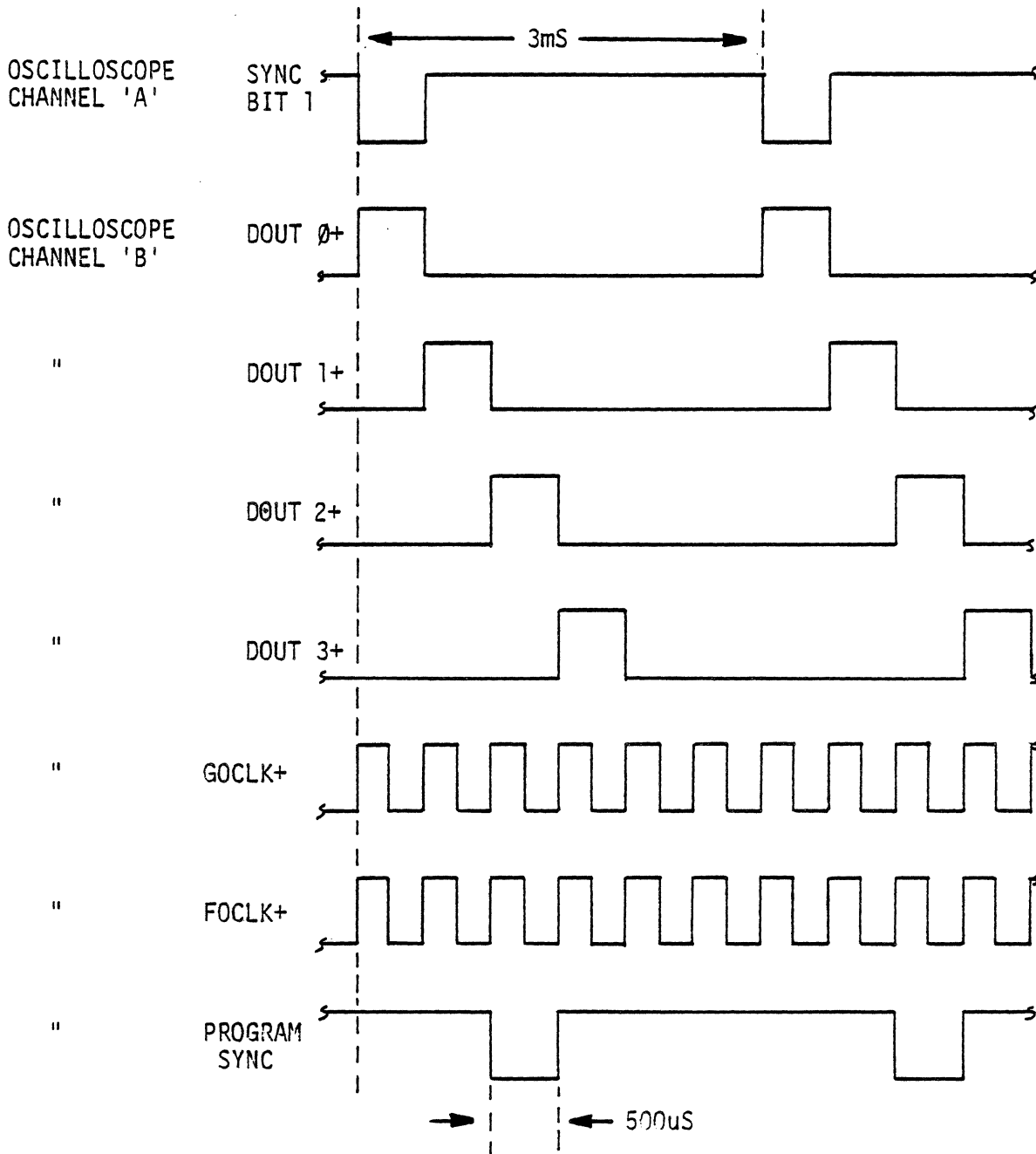
Figure 2.9
 STORED PROGRAM NO. 992 DATA DISPLAY

WORD	CHANNEL	WORD	CHANNEL
	0123		0123
1	1000	17	XXXX
2	0100	18	
3S	0010	19	
4	0001	20	
5	0000	21	
6L	0000	22	
7	XXXX	23	
8		24	
9		25	
10		26	
11		27	
12		28	
13		29	
14		30	
15		31	
16	XXXX	32	XXXX

NOTE: X=DON'T CARE

- ii) Verify that setting the unit to RUN, yields the waveforms shown in figure 2.10.

Figure 2.10
STORED PROGRAM NO. 992 OUTPUT WAVEFORMS



TEST #4 WORD GENERATOR 2 CHANNEL

Procedure:

- i) Call STORED PROGRAM number 993 and verify that the CONTROL and DATA displays resemble those depicted by figures 2.11 and 2.12.

Figure 2.11
STORED PROGRAM NO. 993 CONTROL DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1  MODE:                PGM 993 WRD GEN
2  CHANNELS:            2
3  BITS/CHANNEL:       12
4  DATA ENTRY:        SERIAL
5  RUN MODE:            CONTINUOUS
6  SYNC BIT NO:        5
7  CLOCK SOURCE:        INTERNAL
8  CLOCK PERIOD:        0001 MSEC
9  RDY TO RUN?

ENTER NO. OF CHANNELS  _ _
                        1,2,4,8,16
```

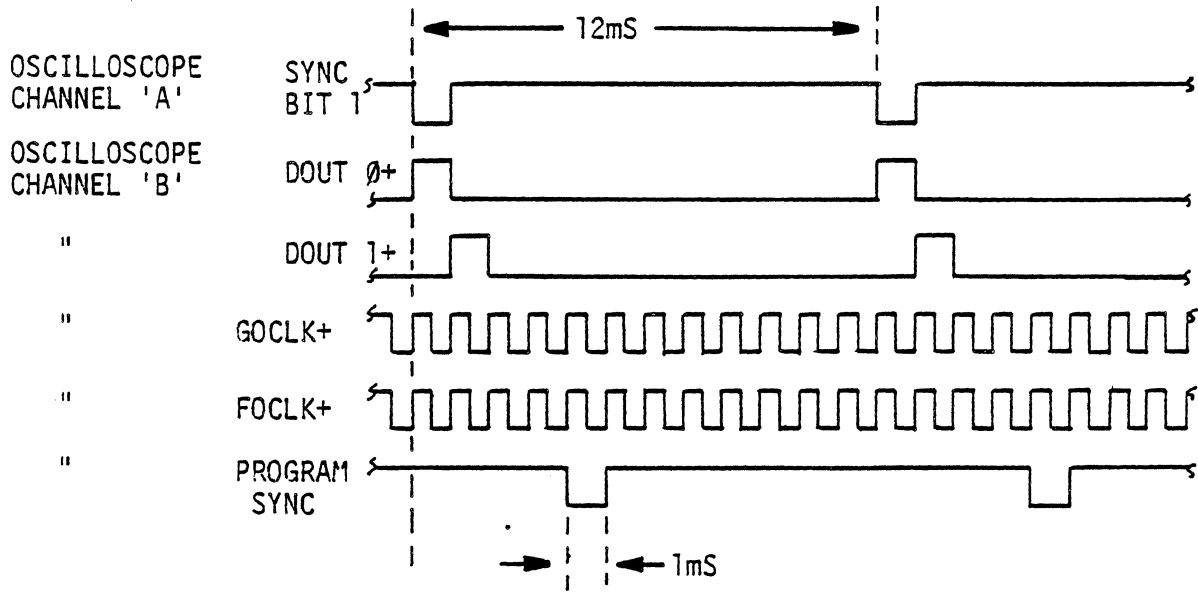
Figure 2.12
STORED PROGRAM NO. 993 DATA DISPLAY

```
CURSOR BIT 1

1 - - - - BIT - - - - 16
CHAN
0  1000  0000  0000  XXXX
1  0100  0000  0000  XXXX
   S
17 - - - - BIT - - - - 32
CHAN
0  XXXX  XXXX  XXXX  XXXX
1  XXXX  XXXX  XXXX  XXXX
```

NOTE: X = DON'T CARE

Figure 2.13
STORED PROGRAM NO. 993 OUTPUT WAVEFORMS



TEST #5 WORD GENERATOR SINGLE CHANNEL

Procedure:

- i) Call STORED PROGRAM number 994 and verify that the CONTROL and DATA displays resemble those depicted by figures 2.14 and 2.15.

Figure 2.14
STORED PROGRAM NO. 994 CONTROL DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1  MODE:                PGM 994 WRD GEN
2  CHANNELS:           1
3  BITS/CHANNEL:       25
4  DATA ENTRY:        SERIAL
5  RUN MODE:           CONTINUOUS
6  SYNC BIT NO:        9
7  CLOCK SOURCE:       INTERNAL
8  CLOCK PERIOD:       0010 USEC
9  RDY TO RUN?

ENTER NO. OF CHANNELS  __
                        1,2,4,8,16
```

Figure 2.15
STORED PROGRAM NO. 994 DATA DISPLAY

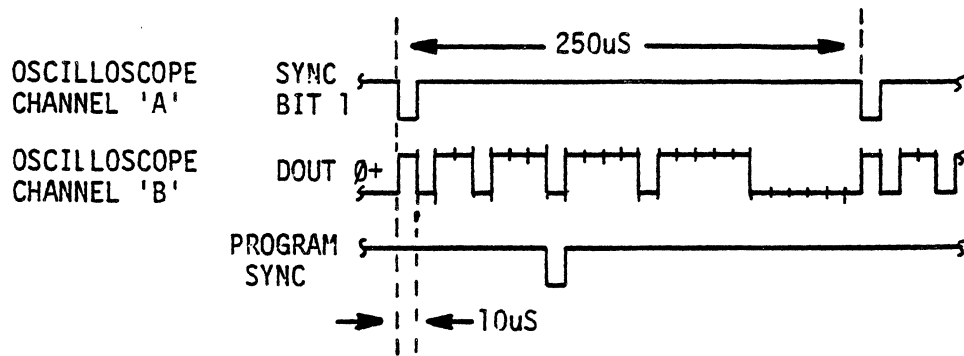
```
CURSOR BIT 1

      1 - - - - BIT - - - - -16
CHAN  0  1011  0111  0111  1011
          S

      17 - - - -BIT - - - - -32
CHAN  0  1110  0000  0XXX  XXXX
          L
```

NOTE: X = DON'T CARE

Figure 2.16
STORED PROGRAM NO. 994 OUTPUT WAVEFORMS



TEST #6 TIMING SIMULATOR 8 CHANNEL

Procedure:

- i) Call STORED PROGRAM number 995 and verify that the CONTROL and DATA displays resemble those depicted by figures 2.17 and 2.18.

Figure 2.17
STORED PROGRAM NO. 995 CONTROL DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1  MODE:                PGM 995 TIM SIM
2  CHANNELS:            8
3  LAST WORD:           8
4  DATA ENTRY:        PARALLEL
5  RUN MODE:            CONTINUOUS
6  SYNC WORD:           1
7  RDY TO RUN?

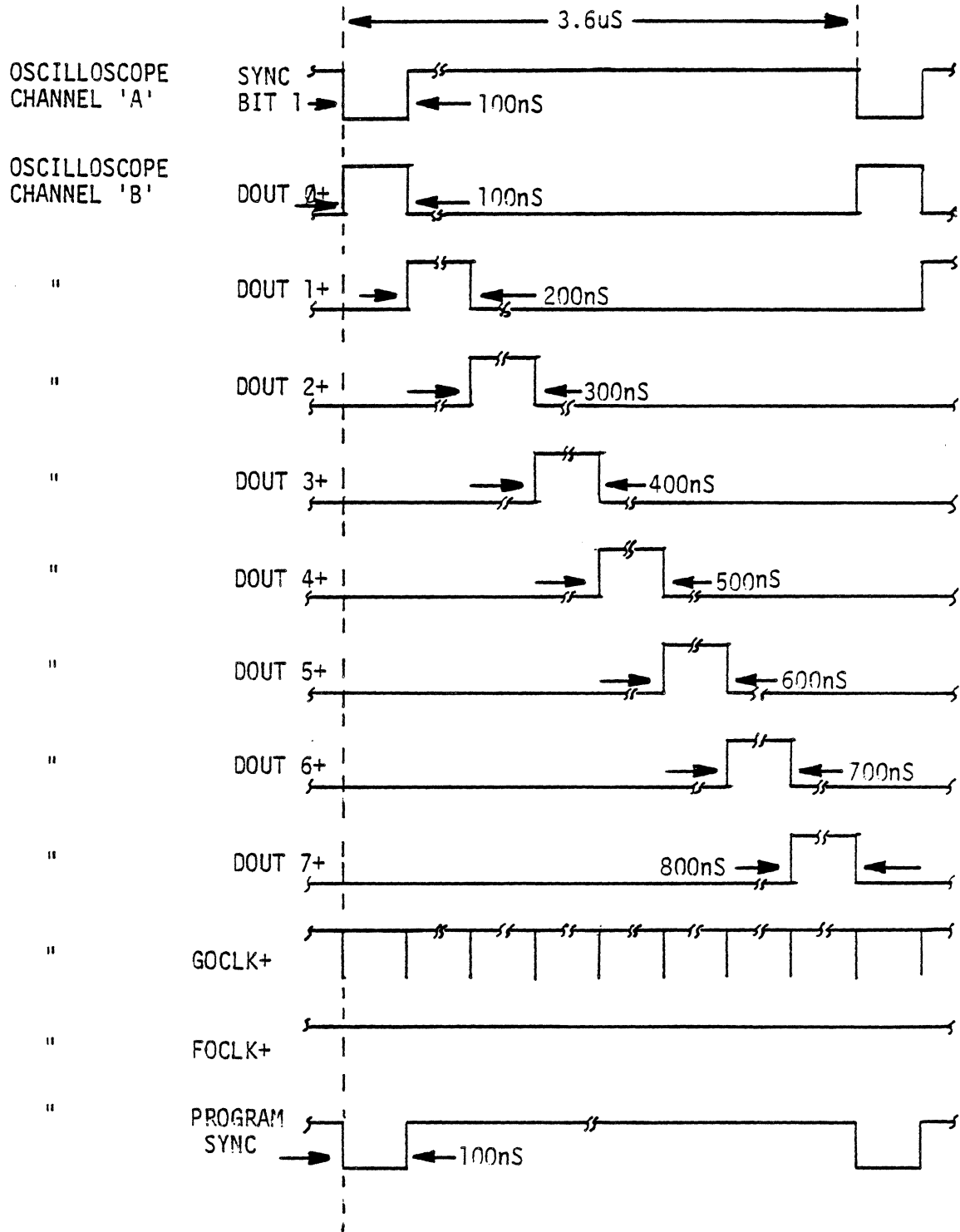
ENTER NO. OF CHANNELS __
                        1 THRU 8
```

Figure 2.18
STORED PROGRAM NO. 995 DATA DISPLAY

		CHANNEL		PERIOD
WORD		0123 - 4567		
1	S	1000	0000	.1 US
2		0100	0000	.2 US
3		0010	0000	.3 US
4		0001	0000	.4 US
5		0000	1000	.5 US
6		0000	0100	.6 US
7		0000	0010	.7 US
8	L	0000	0001	.8 US

ENTER BINARY DATA.

Figure 2.19
 STORED PROGRAM NO. 995 OUTPUT WAVEFORMS



2.3 CALIBRATION

Being a digital instrument, the Model RS-660 requires limited calibration in the conventional sense. It is recommended that the power supply voltage be checked/adjusted every six months as follows:

- a) With power applied to the unit, remove the top cover.

CAUTION

Hazardous voltages are contained within this device. Therefore, extreme caution should be exercised, while the top cover is not in position.

Care should also be taken, not to short-circuit any of the power supplies; although such action should not damage the supplies, the erasable programmable read only memories (EPROM's) may well be damaged or altered.

- b) Connect a DVM across the electrolytic capacitor (C21) at the rear of the lower logic assembly. Observe the polarity markings on the capacitor. Reference drawing number 10011163.
- c) The voltage at this point should be +5.00 +/- 0.05Vdc.
- d) In order to adjust this voltage, locate the +5v (VCC) voltage adjustment potentiometer on the power supply. This pot will be found as being the rearmost, of the three pots on the rear PC board of the power supply. Reference drawing number 10011157. Carefully insert an insulated shaft, screwdriver and rotate slowly until the DVM registers the correct voltage.
- e) Disconnect the DVM and connect it to the center and rear terminals, on the front power supply PC board; the center terminal is ground (common) and the rear terminal is -5v(VBB), (observe polarity).
- f) The voltage at this point should be set to -5 +/- 0.05Vdc and may be adjusted by means of the rearmost potentiometer on the front power supply PC board.
- g) Disconnect the DVM and connect it to the front and center terminals on the front power supply PC board; the center terminal is ground (common) and the front terminal is +12V (VDD), (observe polarity).
- h) The voltage at this point should be set to +12 +/- 0.05 Vdc and may be adjusted by means of the frontmost potentiometer on the front power supply PC board.

It is also recommended that the Functional Verification Procedure, section 2.2, be performed after calibration.

2.4 MAINTENANCE

Maintenance documentation for the RS-660 consists of the logic diagrams located in Appendix D and the service manual for the CRT (separately provided).

The RS-660 contains voltages hazardous to personnel, especially in the area of the CRT. Maintenance procedures therefore should only be conducted by qualified personnel.

In order to perform fault corrective maintenance, the user must be familiar with the RS-660 logic diagrams. Basically, the lower logic panel assembly includes the high speed word generator and timing simulator logic. The lower panel logic shares use of the memory card assembly with the remainder of the RS-660 assemblies. The remaining assemblies (front panel keyboard, CRT, CPU card) are simply the means of interfacing the operator with the word generator/timing simulator.

During power-up initialization, the CPU performs a memory test (Reference Section 2.2). If the CRT then results in the display shown in Figure 2.1, it may be assumed the CRT, CPU, and memory are functional. Until the RS-660 is set into the run mode, the lower logic panel assembly may be essentially disregarded as a source of problems. If the unit is capable of being programmed as indicated by the expected CRT displays, and yet generates incorrect output patterns when set to the run mode, the lower logic panel may be assumed to be the source of the problems.

III. LOCAL CONTROL OPERATION

This section describes the operation of the Model RS-660 under local control, using the front panel controls and indicators.

Initiation of communications between the Model RS-660 and a remote, controlling device causes the unit to go into remote control operation. (Note the status will only indicate REMOTE CONTROL when the remote communication requests a CRT display update; reference section 4.2.2) Depressing the HOME/RESET key returns control of the unit to the front panel and the Model RS-660 will remain in this mode until the remote controlling device again initiates communications.

3.1 CONTROLS AND INDICATORS

Figure 3.1 illustrates the front panel controls and indicators of the Model RS-660.

3.1.1 POWER Switch and LED

Activation of the POWER switch causes the Model RS-660 to execute its initialization routine which results in the POWER LED being illuminated and the CRT presenting the following display:

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

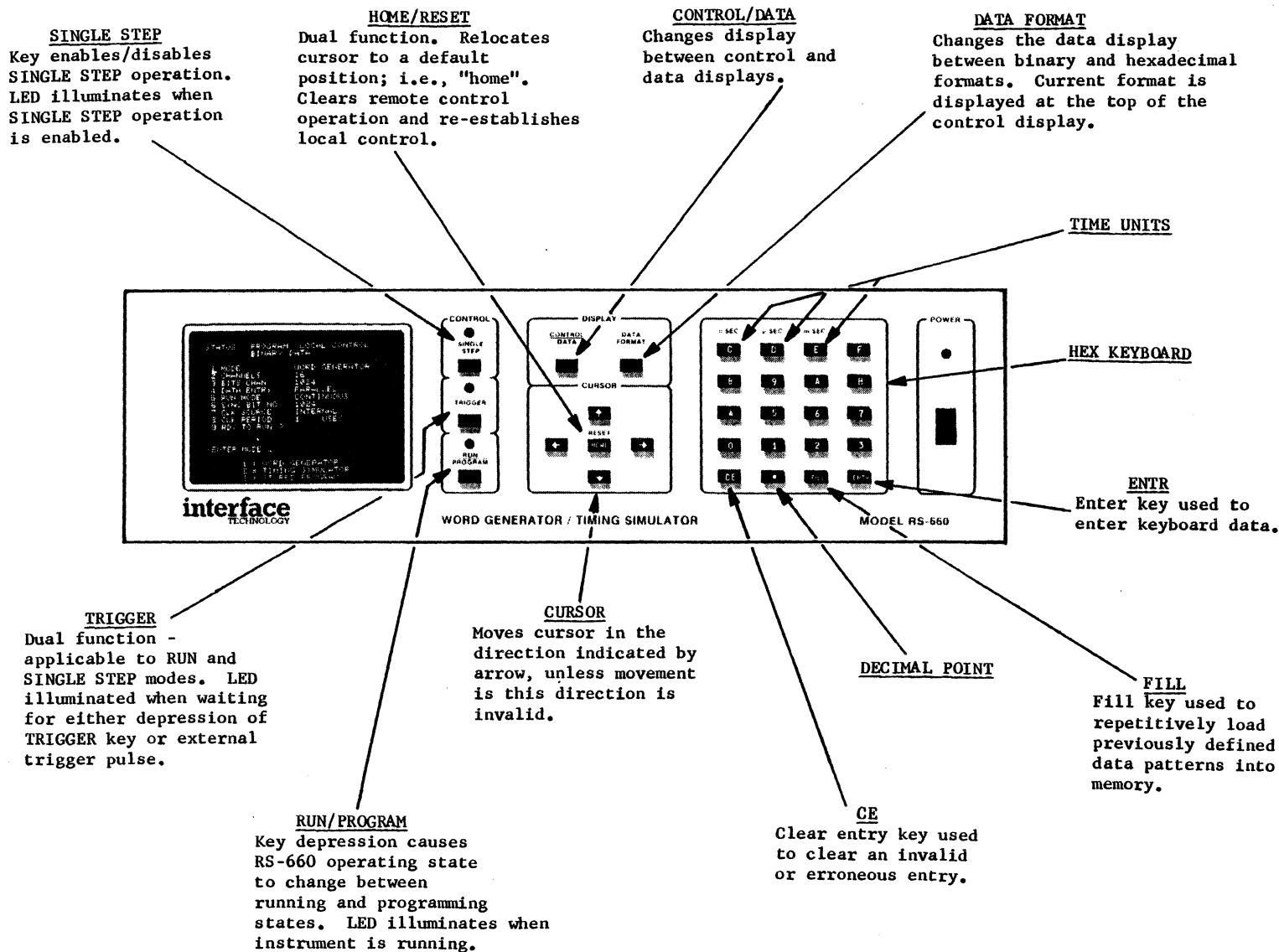
1 MODE:          WORD GENERATOR
2 CHANNELS:      16
3 BITS/CHANNEL:  XXXX
4 DATA ENTRY:   PARALLEL
5 RUN MODE:      CONTINUOUS
6 SYNC BIT NO:   XXXX
7 CLK SOURCE:    INTERNAL
8 CLK PERIOD:    1 USEC
9 RDY TO RUN?

ENTER MODE _____

1 = WORD GENERATOR
2 = TIMING SIMULATOR
3 = STORED PROGRAM:
```

Note XXXX = 1024 or 4096 depending on memory capacity.

FIGURE 3-1
FRONT PANEL CONTROLS AND INDICATORS



3.1.2 Control Keys and Indicators

Three CONTROL keys are provided on the Model RS-660: SINGLE STEP, TRIGGER, and RUN/PROGRAM.

3.1.2.1 RUN/PROGRAM Key and LED

The RUN LED indicates whether the Model RS-660 is in the run (LED illuminated) or program (LED extinguished) mode. Its status may be changed by the activation of the RUN/PROGRAM key. Note that, when the unit is in the run mode, the following operations are illegal and are ignored:

- i) single step
- ii) attempts to display data if the CONTROL format is presently being displayed
- iii) cursor manipulation when displaying data
- iv) data modifications or format changes
- v) attempts to modify items "1" through "4" in the CONTROL display

3.1.2.2 SINGLE STEP Key and LED

The SINGLE STEP LED illuminates when the device is in the single step mode. Its status may be reversed by the activation of the SINGLE STEP key.

3.1.2.3 TRIGGER Key and LED

The TRIGGER LED, when illuminated, indicates that the device requires a trigger. This situation will arise when one of the two following conditions exists:

- i) The device is in the run, noncontinuous mode (RUN LED is illuminated and RUN MODE=XXXX REPETITIONS) and is waiting to generate the specified number of cycles. Activation of the TRIGGER key, or a high to low transition at the rear panel TRIGGER INPUT (EXTRIG-), will initiate the execution of the specified number of repetitions and extinguish the TRIGGER LED until the completion of the last cycle. Note that the TRIGGER LED is extinguished for a minimum of 100 ms and is therefore not an exact indication of program time.
- ii) The device is in the single step mode (SINGLE STEP LED also illuminated), in which case, each activation of the TRIGGER key will cause the unit to output the next word of data.

3.1.3 DISPLAY Keys

Two DISPLAY keys are provided on the Model RS-660: CONTROL/DATA and DATA FORMAT.

3.1.3.1 CONTROL/DATA Key

This key is used to alternate the CRT display between the CONTROL and DATA formats. Note that, when the unit is in the run mode (RUN LED illuminated), any attempts to change the display from CONTROL TO DATA will be ignored by the device.

3.1.3.2 DATA FORMAT Key

Activation of the DATA FORMAT key will alternate the DATA display between the hexadecimal and binary formats. Format changes are ignored when the unit is in the run mode (RUN LED illuminated). The current DATA FORMAT mode is presented at the top of the CONTROL display.

3.1.3.3 CURSOR Control and HOME/RESET Keys

Five cursor control keys are provided on the Model RS-660. The four direction keys move the cursor, one position per momentary activation or continuously for a prolonged activation, in the direction indicated by the arrows. The HOME/RESET key has two functions which are described below:

- i) The HOME function is used to relocate the cursor to any output word in the DATA display or to certain parameters in the CONTROL display. In order to position the cursor to the first output word in the DATA display, depress the HOME/RESET key and then the ENTR key. The DATA cursor may be relocated by activating the HOME/RESET key, entering the desired output word number via the keyboard, and activating the ENTR key. Note that when the unit is in the RUN mode all cursor manipulation in the DATA display and all attempts to position the cursor to parameters 1 through 4 in the CONTROL display are ignored.
- ii) The RESET function is used to regain local control of the device when it is under remote control. This function may be invoked whenever the device is in the remote control mode by activating the HOME/RESET key.

Note that local and remote control each share the same priority and the Model RS-660 will therefore remain in the most recently requested mode.

3.1.4 Keyboard

The keyboard on the Model RS-660 includes 3 function keys (CE, FILL and ENTR) and 17 data keys of which three (C/nSEC, D/uSEC and E/mSEC) perform dual functions. Hexadecimal data is loaded using keys "0" through "F" whereas decimal data requires the use of keys "0" through "9" including the decimal point key if necessary. Binary data is loaded using keys "0" and "1" and units of time are loaded via the C/nSEC, D/uSEC and E/mSEC keys.

3.1.4.1 CE Key

This key is used to clear an invalid or erroneous entry and must be activated whenever the CRT is displaying INVALID.

3.1.4.2 FILL Key

The function of the FILL key is to enable the user to repeatedly load a previously defined data pattern into a specified memory area.

3.1.4.3 ENTR Key

Activation of the ENTR key signifies the completion of a particular keyboard entry and causes the cursor to be advanced to the next valid position. Note that data entries, in the DATA display, do not require activation of the ENTR key.

3.2 WORD GENERATOR MODE

This section describes the WORD GENERATOR mode of operation. When the RS-660 is operating in the WORD GENERATOR mode, the periods of succeeding output data words (or bits) are equal and determined by the period of the clock source (parameter no. 7).

3.2.1 Mode Selection

In order to select the WORD GENERATOR mode, the cursor must first be positioned to parameter no. 1. This may be accomplished either by using the two vertical cursor keys or the HOME key. At this time the entry menu in the lower portion of the display will read as follows:

ENTER MODE _____

- 1 = WORD GENERATOR
- 2 = TIMING SIMULATOR
- 3 = STORED PROGRAM

Depression of the "1" key followed by the ENTR key will result in the cursor being advanced to parameter no. "2". The parameter no. "1" display will be the following:

1 MODE: WORD GENERATOR

3.2.2 Channel Selection - WORD GENERATOR Mode

The number of output channels is defined by parameter no. "2" in the control display. In order to modify the number of channels, the cursor must first be positioned to this parameter, resulting in the following entry menu:

ENTER NO. OF CHANNELS _ _
1,2,4,8,16.

Having entered the desired number of channels, activation of the ENTR key will update the parameter and advance the cursor.

Note that selecting 16 channels restricts the minimum clock period to 100 ns.

Following selection of the WORD GENERATOR mode and the number of channels, the user's output pattern may be loaded into the data memory (reference Section 3.2.8). The remaining control parameters do not impact the data configuration.

3.2.3 Bits/Channel - WORD GENERATOR Mode

Positioning the cursor to parameter no. "3" allows the number of bits per channel to be defined and results in the following entry:

ENTER # OF BITS PER CHAN - - - - -
1 THRU XXXXX

Note that the maximum number of bits per channel (XXXXX) varies in accordance with the selected number of channels and is defined in section 1.3. In the DATA display the last word/bit is indicated by the letter "L" adjacent to the specified word or bit number.

3.2.4 Data Entry - WORD GENERATOR Mode

Parameter no. "4" specifies the method of data entry as either serial or parallel. Data entry is determined by the number of channels selected and is not a variable.

3.2.5 Run Mode - WORD GENERATOR Mode

The run mode may be either continuous or may repeat the pattern generation from 1 through 4096 times. Accessing parameter no. "5" will result in the following entry:

```
ENTER RUN MODE -----  
  
ENTER C FOR CONTINUOUS PATTERN  
OR  
ENTER 1 THRU 4096 for NO. OF  
PATTERN REPEATS PER TRIGGER
```

3.2.6 Sync Bit Number - WORD GENERATOR Mode

Selection of parameter no. "6" allows the user to define the sync bit number. The entry menu is as follows:

```
ENTER SYNC BIT NO. -----  
1 THRU XXXXX
```

Note that, in the event of the sync bit number being greater than the number of bits per channel, an asterisk will appear immediately following the sync bit number. In the DATA display, the sync word/bit is indicated by the letter "S" adjacent to the selected word or bit number.

3.2.7 Clock Source - WORD GENERATOR Mode

Parameter no. "7" enables selection of the CLOCK SOURCE and may be specified as either the internal RS-660 clock generator or a user's external clock. The clock source entry menu is shown below:

```
ENTER CLOCK SOURCE -  
  
1 = INTERNAL  
2 = EXTERNAL
```

3.2.8 Clock Period - WORD GENERATOR Mode

If the clock source has been defined as INTERNAL, parameter no. "8" may be accessed by the cursor to enter the desired period of the internal clock. The following entry menu will be displayed:

```
ENTER CLOCK PERIOD----SEC  
MS .001 - 999  
US .1 - 999  
NS 50, 100, 200, ---900
```

Note that if the number of bits per channel (B) and the number of channels (C) have been defined, such that the following equation is valid, the minimum clock period is limited to 100 ns:

$$\frac{C}{T_6} (B-1) = n$$

where n = 0,1,2.....

If an external clock source has been selected, parameter no. "8" specifies the minimum period of the external clock.

3.2.9 Data Memory - WORD GENERATOR Mode

Once the WORD GENERATOR mode and the number of channels have been defined via the CONTROL display, the data memory may be loaded. Data may be entered in either binary or hexadecimal formats. The current entry format is indicated under status at the top of the CONTROL display. Transitions between binary and hex data formats are accomplished by activating the DATA FORMAT key.

In order to enter data, the data display must be accessed by activating the CONTROL/DATA key (assuming that the device is not already displaying data). Data may now be entered via the keyboard. Note that when entering data, it is not necessary to activate the ENTR key after each data key.

3.2.10 Run Mode Operation - WORD GENERATOR Mode

Once the parameters have been specified and the data loaded, the device may be directed to RUN by activating the RUN/PROGRAM key. This will result in the following:

- a) RUN LED is illuminated.
- b) Data generator is started.
- c) Cursor is initialized to parameter no. "5", if displaying CONTROL.
- d) Status display changes from PROGRAM to RUNNING.
- e) Cursor manipulation in the DATA display is inhibited.
- f) Attempts to position cursor to parameters "1" through "4" in the CONTROL display are inhibited.
- g) Transitions from CONTROL display to DATA display are inhibited.
- h) DATA FORMAT key activations are ignored.

In order to exit from the RUN mode, the RUN/PROGRAM key should again be activated. Note that if parameter no. "5" (run mode) has not been defined as continuous and the device is directed to run, the TRIGGER LED will be illuminated, indicating that a trigger is required. The trigger may be supplied, either by activating the TRIGGER key or by a high to low transition at the unit's rear panel EXTERNAL TRIGGER input. Either of these actions will extinguish the TRIGGER LED and cause the device to output the required data pattern for the specified number of times. The TRIGGER LED will remain extinguished for at least 100 ms and as long as the data pattern is still being generated.

3.2.11 Single Step Mode Operation - WORD GENERATOR Mode

The Model RS-660 may be operated in the single step mode by activating the SINGLE STEP key instead of the RUN/PROGRAM key. This action will result in the following:

- a) Data display is immediately invoked.
- b) SINGLE STEP and TRIGGER LEDs are illuminated.
- c) Cursor is initialized to WORD/BIT NO. 1.
- d) DATA FORMAT, CONTROL/DATA, CURSOR direction and FILL keys are all ignored.
- e) Data format is forced to binary data format.

Under these conditions, each activation of the TRIGGER key will cause the device to output the next data word bit, as indicated by the cursor advancement on the data display.

The HOME key performs a slew function in the SINGLE STEP mode. Activating the HOME key will result in the display of the word HOME and a scratch pad area. A decimal value, representing the desired word/bit number, may be entered via the keyboard followed by depression of the ENTR key. The device will output all words/bits from the one previously designated by the CURSOR to the one entered via the keyboard.

Note that if the desired word number is less than the number of the word previously designated by the cursor, the generator will wrap around via the last word.

The SINGLE STEP mode may be exited by activating either the SINGLE STEP key again or the RUN/PROGRAM key. In the latter case, the device will immediately enter the RUN mode.

3.3 TIMING SIMULATOR MODE

In the TIMING SIMULATOR mode, the periods of a channel's succeeding bits are independently programmable.

3.3.1 Mode Selection

In order to select the TIMING SIMULATOR mode of operation, the following procedure should be followed:

- a) Select CONTROL DISPLAY.
- b) Position cursor to parameter no. "1".
- c) Enter "2" via the keyboard in accordance with the entry menu.
- d) Depress the ENTR key.

3.3.2 Channel Selection - TIMING SIMULATOR Mode

The TIMING SIMULATOR mode provides for eight output channels. Parameter no. "2" permits enabling from 1 to 8 of the available channels. To

establish the channels, the operator must enter the desired number in accordance with the entry menu and depress the ENTR key.

Note that in the TIMING SIMULATOR mode, the selected number of channels has no effect on the maximum last word value as occurs in the WORD GENERATOR mode.

3.3.3 Last Word - TIMING SIMULATOR Mode

The number of the last word is selected using control parameter no. "3". The operator must enter the desired last word number in accordance with the entry menu and depress the ENTR key. The last word is identified on the DATA display by the letter "L".

3.3.4 Data Entry - TIMING SIMULATOR Mode

In the TIMING SIMULATOR mode, data entry (parameter no. "4") must be in parallel and is not a variable.

3.3.5 Run Mode - TIMING SIMULATOR Mode

The run mode may be either continuous or may repeat the pattern generation from 1 through 4096 times. Selection is made in accordance with the entry menu associated with control parameter no. "5".

3.3.6 Sync Word - TIMING SIMULATOR Mode

Parameter no. "6" enables selection of the sync word number. The selected word number is to be entered in accordance with the entry menu of parameter no. "6". The letter "S" is positioned adjacent to the sync word number on the DATA display.

3.3.7 Data/Time Memory - TIMING SIMULATOR Mode

Once the TIMING SIMULATOR mode and the number of channels have been selected via the CONTROL display, the data memory may be loaded. The DATA FORMAT may be either binary or hexadecimal. The currently selected DATA FORMAT status is displayed at the top of the CONTROL display. Transitions between binary and hexadecimal are accomplished by activating the DATA FORMAT key.

In order to enter the data and time, the DATA display must first be accessed by activating the CONTROL/DATA key (assuming that the device is not already displaying DATA). Data and time values may be entered via the keyboard with the aid of the CURSOR. Note that time values

are in decimal and require the use of the ENTR key, whereas data entries do not. Note also that selecting a 50 nsec period for any word will cause the device to automatically insert a second 50 nsec word. These two words are indicated as A and B. If the SYNC word happens to be a 50 ns word, the SYNC pulse will occur coincidentally with the A word.

3.3.8 Run Mode Operation - TIMING SIMULATOR Mode

The run mode for TIMING SIMULATOR operates in exactly the same fashion as the run mode for WORD GENERATOR (ref. Section 3.2.10). Note that the device may not be operated in single step while in the TIMING SIMULATOR mode.

3.4 FILL FUNCTION

Except while operating in the run or single step modes, the fill function may be invoked by activating the FILL key. In order to perform this operation, the desired data pattern should first have been entered. Activating the FILL key will result in the RS-660 requesting, by means of the CRT display, the following information:

- 1) PATTERN START WORD/BIT.
- 2) PATTERN END WORD/BIT.
- 3) NO. OF PATTERN REPEATS.
- 4) START FILL AT WORD/BIT.
- 5) RDY TO EXECUTE? PUSH ENTR.

Once all of these parameters have been entered, activating the ENTR key initiates the execution of the fill and results in the following:

- 1) The device will first verify that enough memory exists to perform the fill as directed.
- 2) Assuming that this condition is satisfied, the fill function will be executed.
- 3) The Model RS-660 will exit from the fill mode upon completion.

Note that while the function is being executed, the CRT will display the message "FILLING" and all front panel controls are locked out. The fill mode may be aborted at any stage prior to activating the ENTR key, for the last time, by activating the CONTROL/DATA key.

Example:

Assuming that it is required to repetitively load the following, hexadecimal data pattern, into words 4,5&6; 7,8&9 and 10,11&12:

WORD	CHANNEL
	Ø--F
1	0123
2	4567
3	89AB

The fill function should first be invoked, by activating the FILL key. The following values should then be entered:

1	PATTERN START WORD/BIT:	1
2	PATTERN END WORD/BIT:	3
3	NO. OF PATTERN REPEATS:	3
4	START FILL AT WORD/BIT:	4
5	RDY TO EXECUTE? PUSH ENTR	

The data table would then appear as follows:

WORD	CHANNEL
	Ø--F
1	Ø123
2	4567
3	89AB
4	Ø123
5	4567
6	89AB
7	Ø123
8	4567
9	89AB
10	Ø123
11	4567
12	89AB

3.5 STORED PROGRAM MODE

The stored program mode enables the user to call and execute "programs" (control parameters and the data/time tables) which have been previously stored in EPROMs (erasable programmable read only memories).

Using 4K x 8 EPROMs the stored program card provides the user with a maximum of 24K x 8 of storage.

3.5.1 Operation

The stored program mode may be accessed as follows:

- 1) access the CONTROL display and position the cursor to parameter "1". The following entry menu will be displayed:

```
ENTER MODE ___  
  1 = WORD GENERATOR  
  2 = TIMING SIMULATOR  
  3 = STORED PROGRAM
```

- 2) enter "3" via the keyboard; the menu will now request the number of the desired stored program:

```
ENTR STRD PGM NO. ---
```

- 3) entering a valid number will result in the RS-660 memories being loaded with the specified program.

The Model RS-660 may now be operated in either the run or single step modes. Note that valid stored program numbers lie in the range from 000 through 999; however, the numbers 990 through 999 are reserved for Interface Technology verification programs. These stored programs may be called whether or not the stored program card is installed.

Note also that, once a stored program has been called, both the control parameters and the data may be modified by the user. However, the device will no longer remain in the stored program mode.

3.5.2 Programming

The Model RS-660 plug-in stored program card may be ordered as option number 660-006 and is supplied without EPROMs. This card is to be installed in card slot J3 as indicated on the Model RS-660 top assembly drawing 10011157 contained in Appendix D.

CAUTION

Removal or installation of the stored program card should not be done while power is applied to the Model RS-660. Personnel safety considerations recommend that the primary power cord be disconnected from the unit's rear panel, while installing or removing the card.

The card is capable of containing 8 24 pin EPROMS as illustrated on the card's assembly and logic diagram drawing 10011130-002 contained in Appendix D. The EPROMs are assigned component designations of U1 - U8 and any of the following 5 volt EPROM types may be used for all EPROMS (450 nsec access maximum):

- a) Intel 2758, (1Kx8)
- b) Intel 2716, (2Kx8)
- c) Intel 2732, (4Kx8)
- d) Texas Instr. 2516, (2Kx8)

Component platform U9 must be prepared in accordance with the notes on drawing 10011130 in order to accommodate the EPROM type being used. The EPROMs are assigned the hexadecimal address space from '2000 to '7FFF relative to the Model RS-660's microprocessor. The following represents the resultant address assignments for each of the EPROMs:

EPROM ADDRESS ASSIGNMENTS

EPROM LOCATION	EPROM TYPE		
	2758	2716/2516	2732
U5	'2000	'2000	'2000
U6	'2400	'2800	'3000
U7	'2800	'3000	'4000
U8	'2C00	'3800	'5000
U1	'3000	'4000	'6000
U2	'3400	'4800	'7000
U3	'3800	'5000	-----
U4	'3C00	'5800	-----

The EPROMs must be programmed externally to the Model RS-660 and must contain both an EPROM directory of all stored programs and the control parameters and data for each stored program.

The directory is assumed to start at location '2000; i.e., the EPROM containing the directory must be installed in location U5. Each stored program requires 4 bytes in the directory. The first two bytes specify the program number, while the second two bytes specify the location in the EPROMs where the actual stored program starts. The programs need not

be listed in any particular sequence in the directory. The end of the directory must be identified by the delimiter "FF" which happens to be the unprogrammed state of the EPROMs. It is recommended that the user leave spare locations at the end of his directory, in order that other programs may be added at a later date.

Each stored program consists of the following:

- i) Two bytes which specify the last EPROM location used by the particular stored program.
- ii) Twelve control bytes which contain all the information required to define the parameters in the CONTROL display.
- iii) As many bytes of data/time as the program requires, starting with data word/bit number 1 in the 15th byte of the stored program EPROM contents.

The formats of the EPROM contents are summarized in tables 3-1 and 3-2.

TABLE 3.1
STORED PROGRAM EPROM DATA FORMAT

	EPROM ADDRESS	EPROM DATA	COMMENTS
Directory Start	'2000	0n	MSD of program number nnn. 000 ≤ nnn ≤ 989 (BCD).
	'2001	nn	LSDs " " " "
	'2002	aa	MSB of first EPROM address where program number nnn resides (HEX)
	'2003	aa	LSB " " " " " " " "
	'2004	0m	} directory data for program number mmm
	'2005	mm	
	'2006	bb	
	'2007	bb	
Directory			
	'x-4	0p	} directory data for program number ppp
	'x-3	pp	
	'x-2	cc	
	'x-1	cc	} designates end of directory
Directory End	'x	'FF	
Program nnn Start	'aaaa	AA	MSB of last EPROM address where program nnn resides (HEX)
	+1	AA	LSB " " " " " " " "
Control	+2	PC	mode control(P) and number of channels(C) (ref. table 3.2)
	+3	0N	MSD of number of words/bits per channel (BCD)
	+4	NN	LSDs " " " " " " " "
	+5	NN	LSDs " " " " " " " "
	+6	0S	MSD of sync word/bit number (BCD)
	+7	SS	LSDs " " " " " " " "
	+8	SS	LSDs " " " " " " " "
	+9	RR	MSDs of number of pattern repetitions (BCD)
	+10	RR	LSDs " " " " " " " "
	+11	0M	Clock period multiplier (ref. table 3.3)
	+12	TT	MSDs of clock period digits (ref. table 3.3)
Control	+13	TT	LSDs " " " " " " " "

} irrelevant in
continuous mode
irrelevant in
TIMING SIMULATOR
or External Clock
WORD GENERATOR
MODES

TABLE 3.1 (continued)
 STORED PROGRAM EPROM DATA FORMAT

	<u>EPROM ADDRESS</u>	<u>EPROM DATA</u>	<u>COMMENTS</u>
Data ↓ Program end	'aaaa+14	DD	Reference table 3.4 for Word Generator 16 channel " " " " " " 8 " " " " " " " 4 " " " " " " " 2 " " " " " " " 1 " Reference table 3.5 for Timing Simulator
	+15	DD	
	'AAAA	DD	

TABLE 3.2
 STORED PROGRAM EPROM DATA FORMAT
 MODE CONTROL AND NUMBER OF CHANNELS

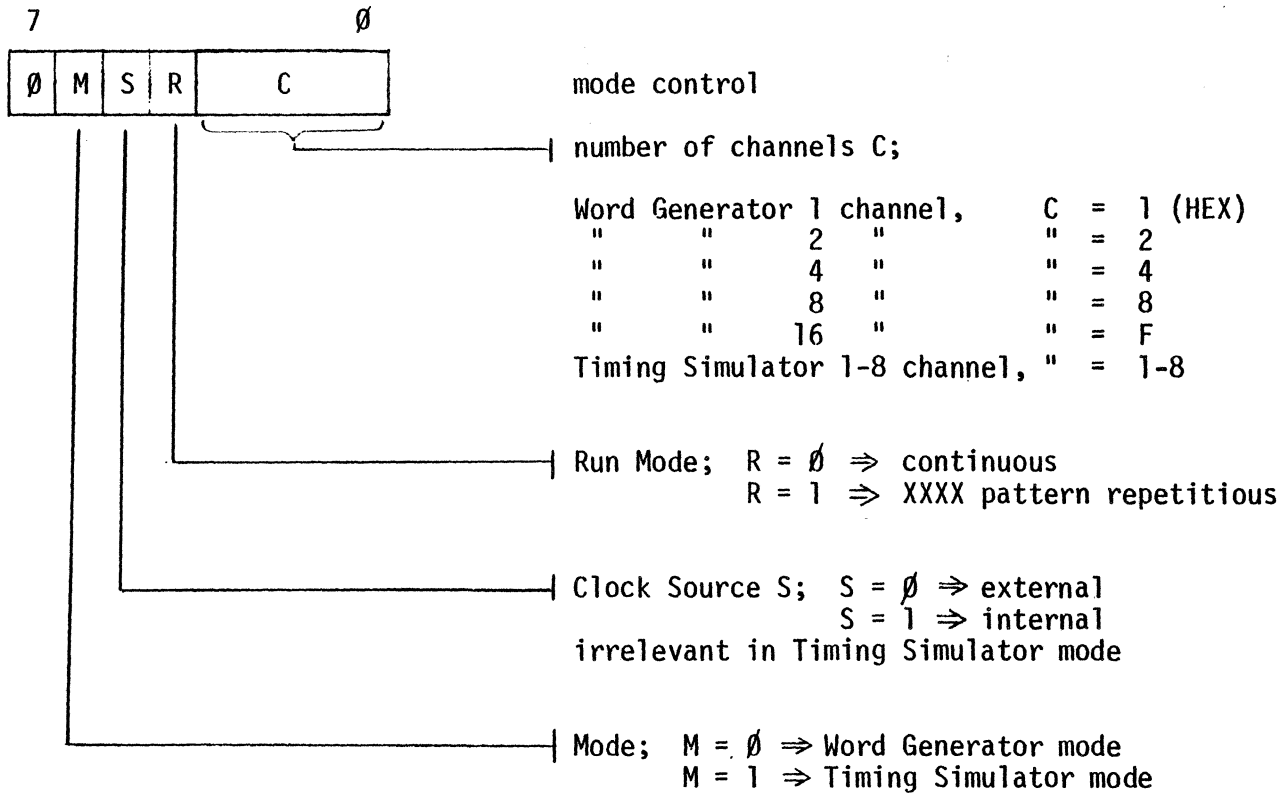


TABLE 3.3
 STORED PROGRAM EPROM DATA FORMAT
 CLOCK PERIOD MULTIPLIER AND DIGITS

7	0
0	M

clock period multiplier; $M = C_{(HEX)} \Rightarrow nSec$

$M = D_{(HEX)} \Rightarrow uSec$

$M = E_{(HEX)} \Rightarrow mSec$

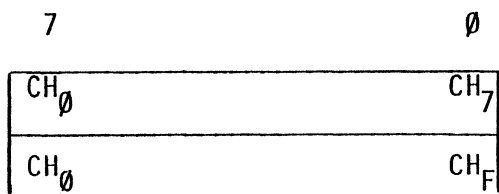
7	0
T	T
T	T

MSDs of clock period (BCD) 3 digits +
 LSDs of clock period (BCD) decimal point.

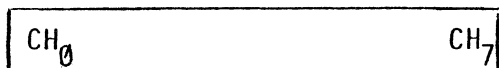
NOTE 1: $T = F_{(HEX)} \Rightarrow$ decimal point.

NOTE 2: clock period is irrelevant in Timing Simulator
 and external clock Word Generator modes.

TABLE 3.4
 STORED PROGRAM DATA FORMATS
 WORD GENERATOR DATA



16 channel; each data word requires 2 bytes

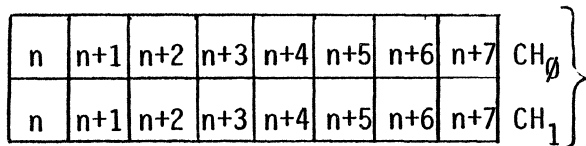


8 channel; each data word requires 1 byte

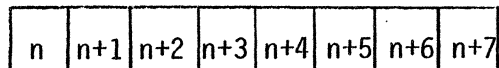


4 channel; 2 data words per byte

word n word n+1



2 channel; 8 data words per 2 byte



1 channel; 8 data bits per byte

TABLE 3.5
 STORED PROGRAM DATA FORMAT
 TIMING SIMULATOR DATA AND TIME

period $\neq 50$ nSec

7	0
CH ₀	CH ₇
T	T
T	T
∅	M

data word n

period digits for data word n (BCD)
 3 digits + decimal point.
 T = F(HEX) \Rightarrow decimal point.

period multiplier for data word n
 M = C(HEX) \Rightarrow nSec, M = D(HEX) \Rightarrow uSec, m = E(HEX) \Rightarrow mSec

3-21

50 nSec
word pair

CH ₀	CH ₇
CH ₀	CH ₇
5(HEX)	∅
∅	C(HEX)

data word nA
 data word nB

designates 50 nSec word pair

IV REMOTE CONTROL OPERATION

This section describes the operation of the Model RS-660 while under remote control from one of the following optional interfaces:

- a) Card Reader
- b) IEEE Std 488-1978
- c) RS-232C/TTY

These interfaces provide various degrees of control of the Model RS-660. The card reader simply enables the operator to load the data/time memory and define all parameters. The IEEE Std 488-1978 and RS-232C/TTY interfaces permit the loading and reading of the memory, definition of the parameters, starting and stopping the unit, and reading the status of the Model RS-660.

4.1 CARD READER

The card reader option (no. 660-004) consists of an optical card reader into which pencil marked cards may be inserted to load the Model RS-660. This provides a hard copy medium for loading frequently used programs.

4.1.1 Card Programming

The card reader cards must be marked with binary data, a mark representing a binary "1" and no mark representing a binary "0". The most reliable method of programming a set of cards is to first load the Model RS-660 manually, run the program, verifying correct operation, and then translate the parameters and data/time directly from the device to cards. Note that a soft lead (#2) pencil should be used to mark the cards and that any erasures must be performed completely. Cards may be categorized as follows:

- a) control cards: used to load CONTROL parameters
- b) Word Generator data cards: 16,8,4,2 and 1 channel
- c) Timing Simulator data and time cards

Figure 4.1 depicts the blank cards, showing valid areas. The formats for the three different types of cards are defined by figures 4.2 through 4.8.

The number of the first word or bit on any data or data/time card is directly related to the card number (specified by card row numbers 2 & 3) and may be calculated, if required, using the following table or formula:

DATA WORD/BIT ORGANIZATION FOR CARD PROGRAMMING

DATA CARD NUMBER	DATA CARD FIRST WORD/BIT NUMBER					TIMING SIMULATOR
	W.G. 16 CHANNEL	W.G. 8 CHANNEL	W.G. 4 CHANNEL	W.G. 2 CHANNEL	W.G. 1 CHANNEL	
1	1	1	1	1	1	1
2	17	33	65	129	257	9
3	33	65	129	257	513	17
4	49	97	193	385	769	25
5	65	129	257	513	1025	33
63	993	1985	3969	7937	15873	497
64	1009	2017	4033	8065	16129	505
65	-	-	-	-	-	513
127	-	-	-	-	-	1009
128	-	-	-	-	-	1017

NOTE: The number of the first word/bit (b_F) on any data card may be calculated using the following formula:

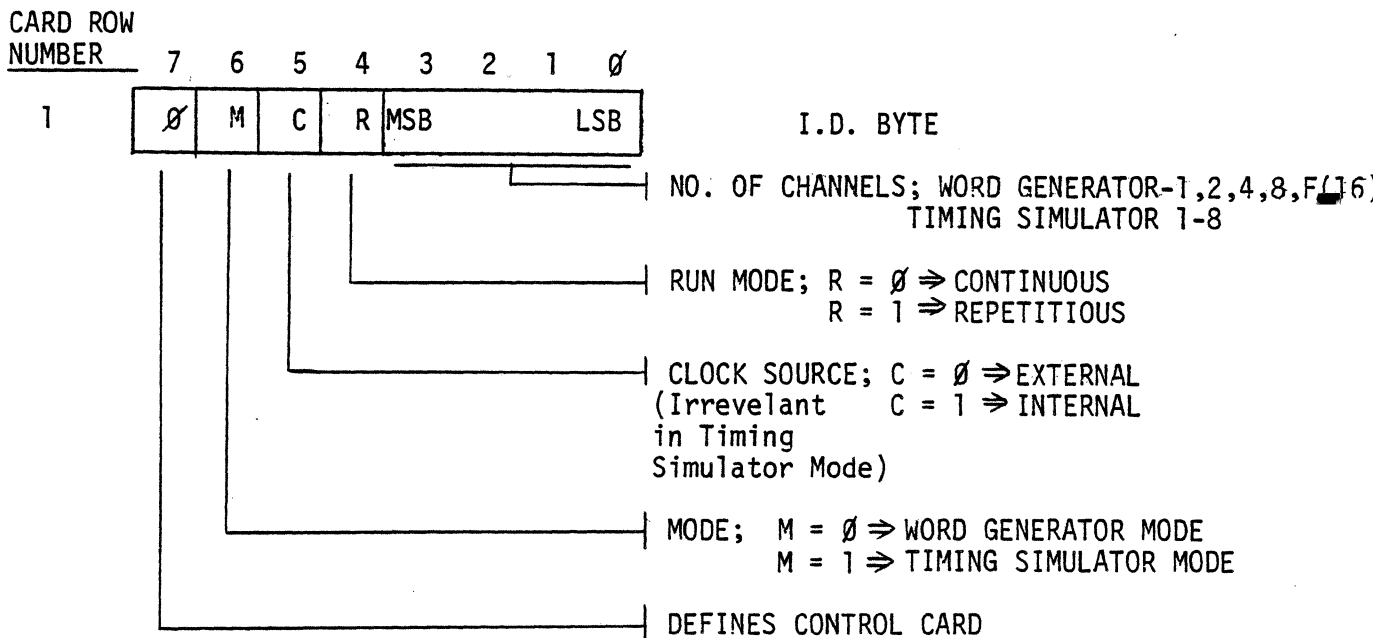
$$b_F = 1 + \left[\frac{256}{C} (N_C - 1) \right]$$

where b_F = number of first word/bit on card
 c = number of channels (substitute 32 for TIMING SIMULATOR)
 N_C = data card number

This enables the user to load the cards into the card reader in any order but necessitates that the data, on all cards, commences from and ends at the specified boundaries.

No extraneous marks should be present below the top 7/8 inch of the card, on either the front or the rear.

Figure 4.2
CARD READER CONTROL CARD FORMAT



2	∅	∅	∅	∅	MSD	} WORDS/BITS PER CHANNEL (BCD)
3						
4					LSD	
5	∅	∅	∅	∅	MSD	
6						} SYNC WORD/BIT (BCD)
7					LSD	
8					MSD	} NUMBER OF REPETITIONS (BCD) (Irrevelant in Continuous Mode)
9					LSD	
10	∅	∅	∅	∅		} CLOCK PERIOD MULTIPLIER; C _(HEX) ⇒ nSec D _(HEX) ⇒ uSec; E _(HEX) ⇒ mSec
11					MSD	
12						} CLOCK PERIOD DIGITS (BCD) 1111 ⇒ DECIMAL POINT
					LSD	

NOTE: Rows 10, 11 and 12 are not used in TIMING SIMULATOR or EXTERNAL CLOCK, WORD GENERATOR Modes.

Figure 4.3
16 CHANNEL WORD GENERATOR DATA CARD FORMAT

CARD ROW
NUMBER

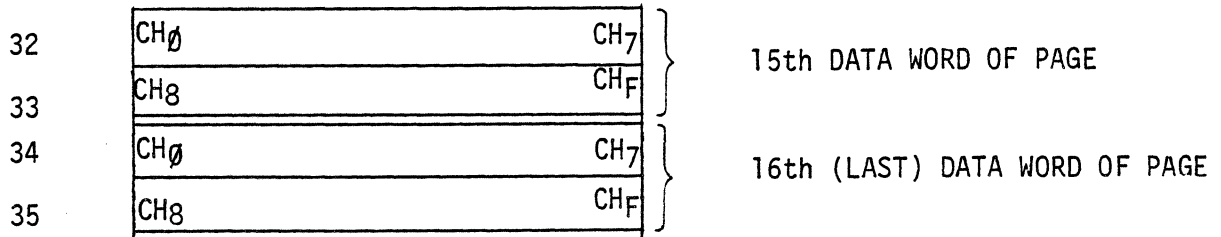
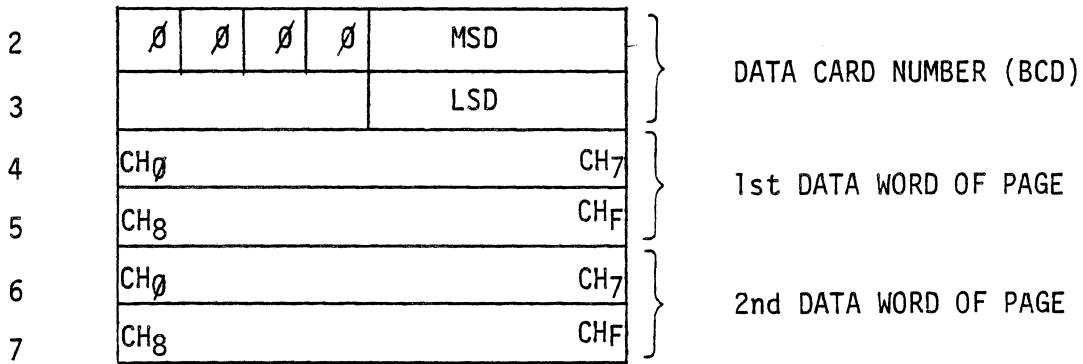
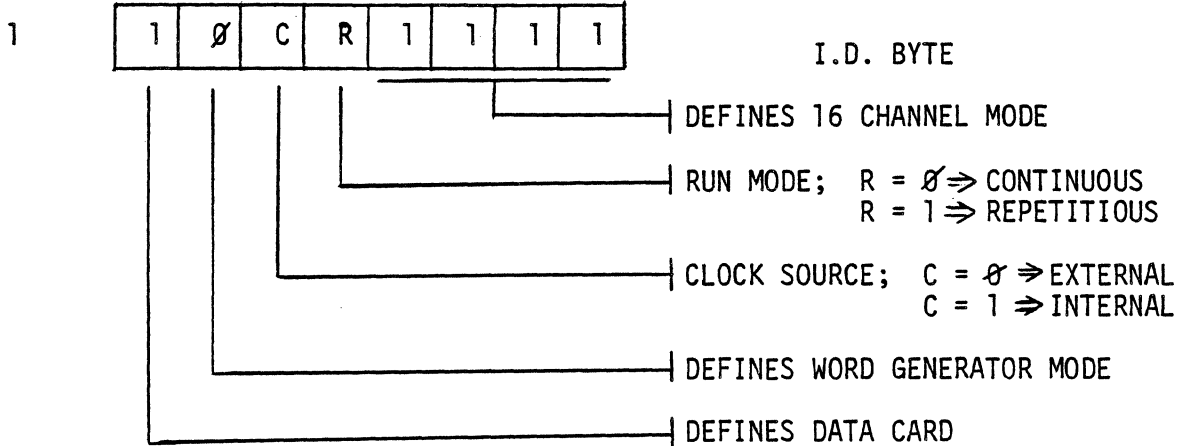
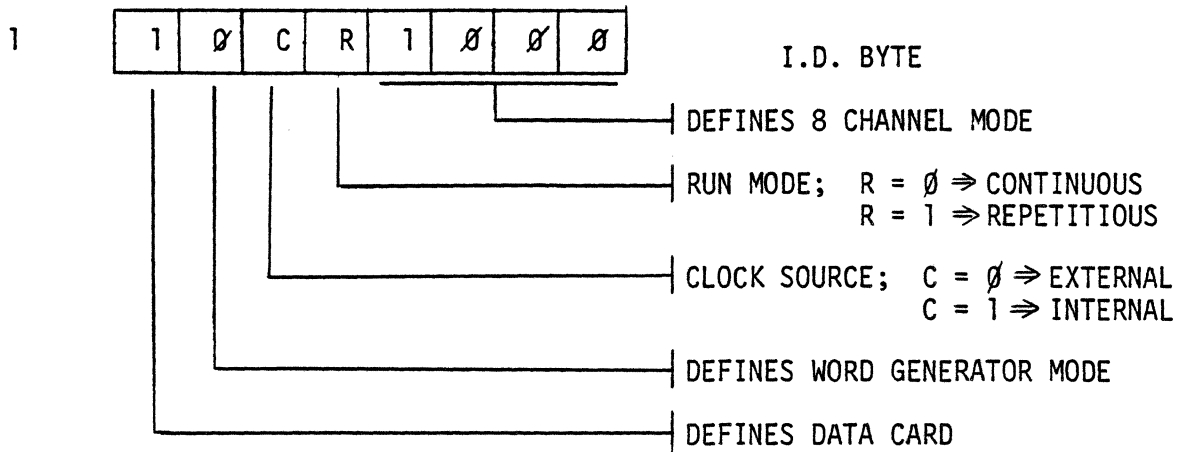


Figure 4.4
8 CHANNEL WORD GENERATOR DATA CARD FORMAT

CARD ROW
NUMBER



2	Ø	Ø	Ø	Ø	MSD	}	DATA CARD NUMBER (BCD)
3					LSD		
4	CHØ				CH7		1st DATA WORD OF PAGE
5	CHØ				CH7		2nd DATA WORD OF PAGE
34	CHØ				CH7		31st DATA WORD OF PAGE
35	CHØ				CH7		32nd DATA WORD OF PAGE

Figure 4.5
4 CHANNEL WORD GENERATOR DATA CARD FORMAT

CARD ROW
NUMBER

1

1	∅	C	R	∅	1	∅	∅
---	---	---	---	---	---	---	---

I.D. BYTE

DEFINES 4 CHANNEL MODE

RUN MODE; R = ∅ ⇒ CONTINUOUS
R = 1 ⇒ REPETITIOUS

CLOCK SOURCE; C = ∅ ⇒ EXTERNAL
C = 1 ⇒ INTERNAL

DEFINES WORD GENERATOR MODE

DEFINES DATA CARD

2

∅	∅	∅	∅	MSD
---	---	---	---	-----

DATA CARD NUMBER (BCD)

3

				LSD
--	--	--	--	-----

4

CH _∅ WORD #1	CH ₃	CH _∅ WORD #2	CH ₃
-------------------------	-----------------	-------------------------	-----------------

1st and 2nd DATA WORD OF PAGE

5

CH _∅ WORD #2	CH ₃	CH _∅ WORD #3	CH ₃
-------------------------	-----------------	-------------------------	-----------------

3rd and 4th DATA WORD OF PAGE

34

CH _∅ WORD#61	CH ₃	CH _∅ WORD#62	CH ₃
-------------------------	-----------------	-------------------------	-----------------

61st and 62nd DATA WORD OF PAGE

35

CH _∅ WORD#63	CH ₃	CH _∅ WORD#64	CH ₃
-------------------------	-----------------	-------------------------	-----------------

63rd and 64th DATA WORD OF PAGE

FIGURE 4.6
2 CHANNEL WORD GENERATOR DATA CARD FORMAT

CARD ROW
NUMBER

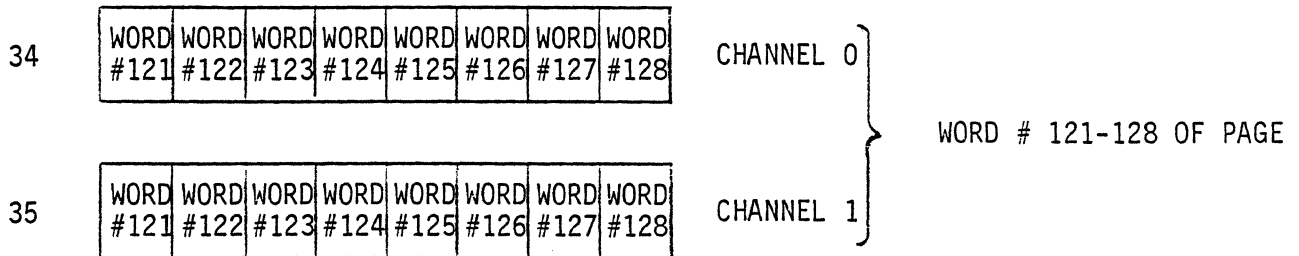
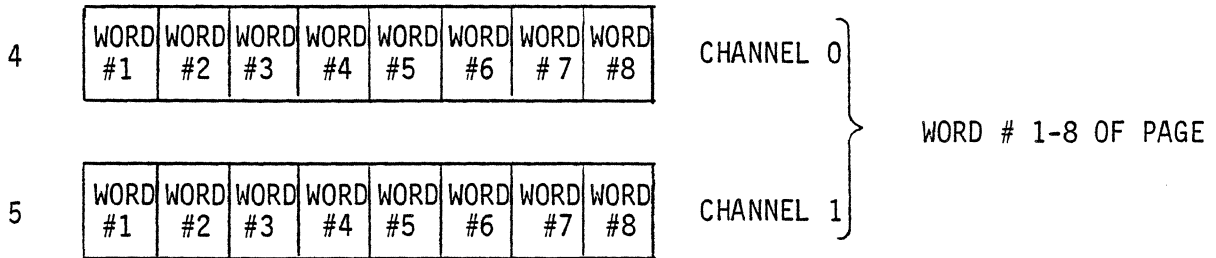
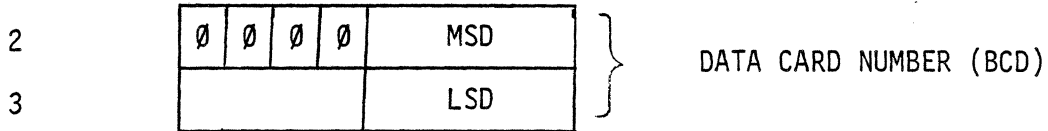
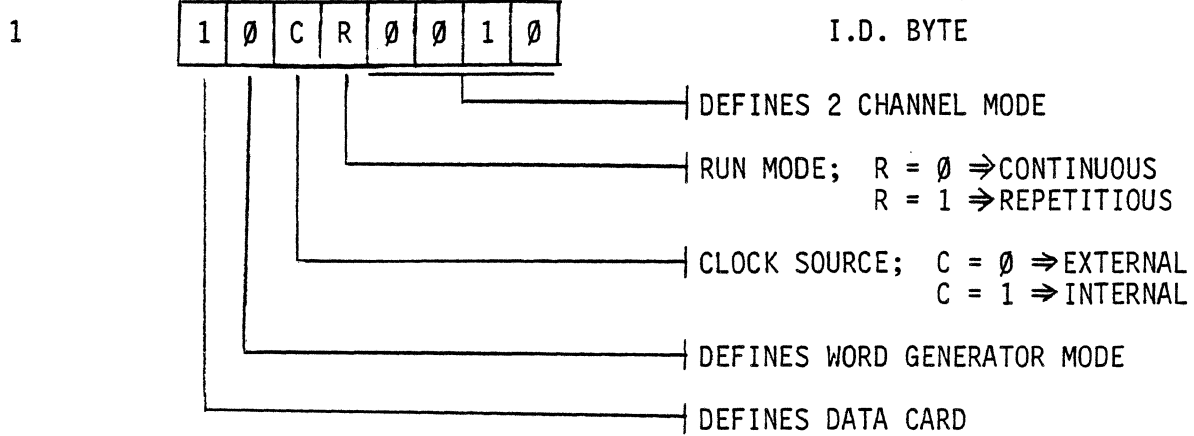


Figure 4.7
SINGLE CHANNEL WORD GENERATOR DATA CARD FORMAT

CARD ROW
NUMBER

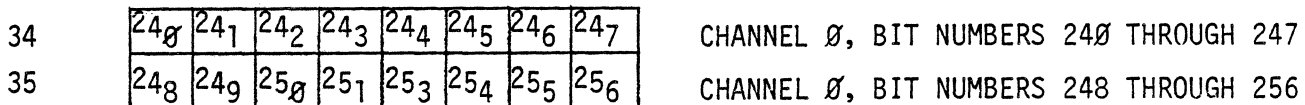
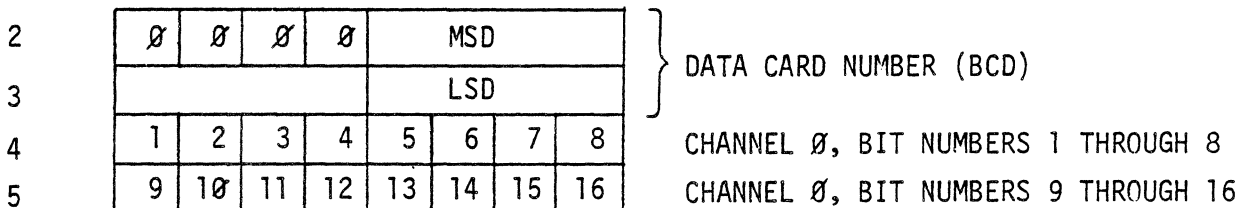
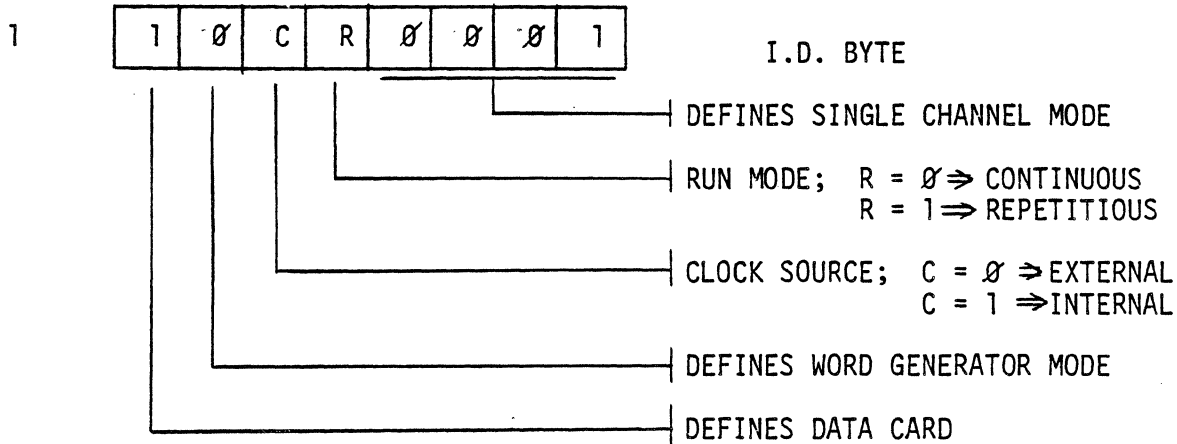
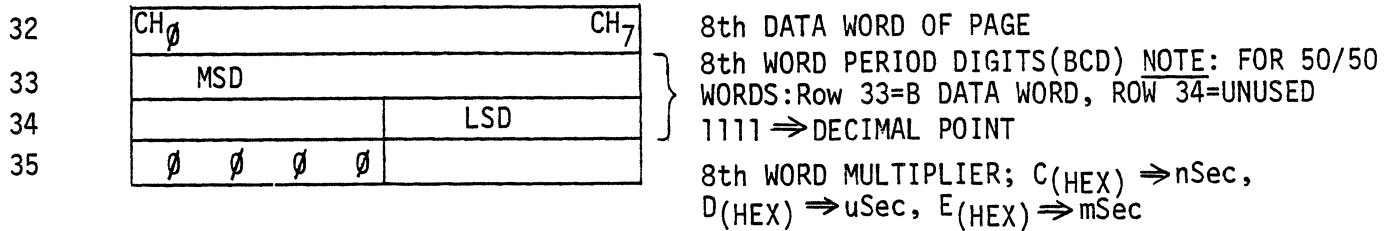
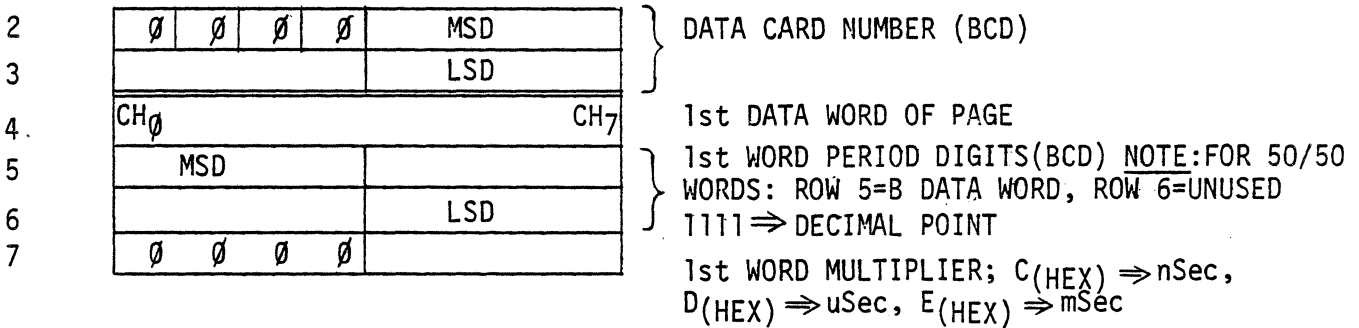
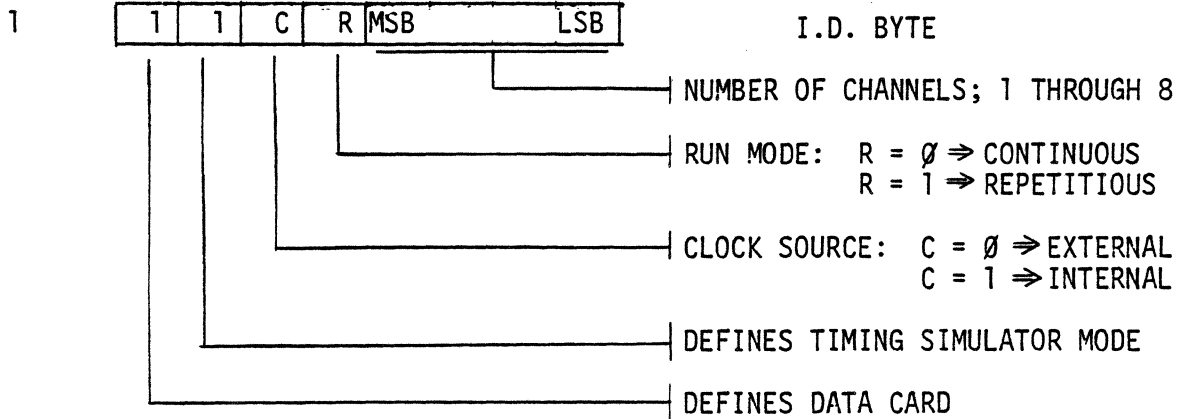


Figure 4.8
TIMING SIMULATOR DATA/TIME CARD FORMAT

CARD ROW
NUMBER



4.1.2 Operation

The card reader connects to the Model RS-660's designated rear panel connector. The cards must be inserted, one at a time, into the card reader with the marked side down and should be released as soon as the drive engages the card. Do not force or assist the card. While the Model RS-660 is reading a card, all front panel controls are locked out. REMOTE CONTROL is not displayed on the CRT, as this is only a temporary condition. Note that the Model RS-660's CRT display will be modified, according to the most recently loaded card.

Once all of the cards have been loaded the device may be operated under local control (reference section 3).

4.2 IEEE STD 488-1978 CONTROLLER INTERFACE

The Model RS-660's IEEE controller interface is available as option number 660-002 and may be either factory or field installed.

4.2.1 Preparation For Use

Prior to attempting communication with the user's system controller, the desired device address must be selected by setting five dipswitches located on the rear panel of the RS-660 directly above the IEEE 488 connector. Depressing a switch to the "ON" position sets the corresponding address bit to a logical one. The address switches may be changed while power is applied to the unit; however, the front panel RESET switch must be depressed to complete the address reselection.

The Model RS-660's IEEE controller incorporates the following functions of IEEE Std 488-1978:

- SH1 : includes the source handshake function
- AH1 : includes the acceptor handshake function
- T6 : incorporates the non-extended talker function including serial poll
- L4 : includes the non-extended listener function
- SR0 : does not generate service request (SRQ)
- RL0 : does not incorporate remote selection functions using interface messages; instead uses device dependent data for selection of remote control; receipt of any data byte sets the RS-660 in remote; local control is achieved either upon receipt of an ASCII "L" data byte or upon depression of the front panel RESET key.
- PP0 : does not include parallel poll capability
- DC1 : incorporates device clear function (DCL,SDC)
- DT1 : incorporates device trigger function (GET)
- C0 : includes no controller capability

The interface option uses open-collector drivers on all signals.

4.2.2 Operation

All data communication with the Model RS-660 controller interfaces is accomplished using a limited set of ASCII characters. Control is accomplished using the characters K,L,N,P,Q,R,S,T,U,V,W,X,Y and Z. Hexadecimal data use the ASCII characters 0,1...9, A,...F. The ASCII comma is used as an instruction delimiter. All other ASCII characters are ignored. This enables the user to imbed a carriage return/line feed in his transmitted data for local page formatting.

When operating under remote control, the CRT display data does not reflect prior user remote programming until the RS-660 receives an ASCII "Q".

Table 4-1 provides a summary of the protocol for the RS-660 controller interfaces and is applicable to both the IEEE STD-488 and RS-232-C interfaces. Table 4-2 provides a detailed description of the controller interfaces' protocol.

TABLE 4-1
 PROTOCOL SUMMARY FOR CONTROLLER INTERFACES

<u>FUNCTION</u>	<u>INPUT/OUTPUT</u>		<u>FORMAT</u>
Update CRT	I	Q	
Return to Local Control	I	L	
Reset	I	R	
Read Unit Status	I	U	
	O		d CR/LF
Load Parameters	I		Pnw, c, bbbbb, 1111, sssss, i, ttttm,
Read Parameters	I	Y	
	O		w, c, bbbbb, 1111, sssss, i, ttttm, CR/LF
Load Word Gen. Data	I		Wc, aaaa, dddd, dddd,, dddd,
Read Word Gen. Data	I		Zaaaaa, nnnn,
	O		dddd, dddd,, dddd, CR/LF
Load Timing Sim. Data	I		Xaaaa, ddttttm,, ddttttm,
Read Timing Sim. Data	I		Vaaaa, nnnn,
	O		ddttttm, ddttttm,, ddttttm, CR/LF
Execute Fill	I		Naaaaa, bbbbb, ccccc, nnnnn,
Read Stored Program Menu	I	M	
	O		nnn, nnn, . . ., nnn, CR/LF
Load Stored Program	I	Knnn,	
Start/Stop	I	S	
Trigger	I	T	

Notes:

1. All characters are ASCII.

TABLE 4-2
DETAILED PROTOCOL DESCRIPTION
FOR CONTROLLER INTERFACES

UPDATE CRT

Control: Q

Updates the CRT to display current programming parameters.

RETURN TO LOCAL CONTROL

Control: L

Causes the unit to return to local control. Also resets machine and stops.

RESET

Control: R

Causes the following:

1. Stops the generator if running.
2. Resets Word Generator/Timing Simulator Memory to word/bit number 1.

READ UNIT STATUS

Control: U

Response: d CR/LF

- U = Read unit status control character
- 2 = Remote, programming mode (stopped)
- 3 = Remote, running
- 4 = Remote, running, waiting for trigger

LOAD PARAMETERS

Control/Data:

P0w, c, bbbbb, 1111, sssss, i, ttttm,
P1w,
P2c,
P3 bbbbb,
P4 1111,
P5 sssss,
P6 i,
P7 ttttm,

w: Mode

1 = Word Generator

2 = Timing Simulator

c: Number of output channels

Word Generator - 1, 2, 4, 8, F (F used to specify 16 channels)

Timing Simulator - 1, 2, 4, 8

TABLE 4-2
(CONTINUED)

LOAD PARAMETERS (Continued)

bbbb: Number of bits/words per channel (decimal).
llll: Number of pattern repeats, 1 - 4096; 0000 = continuous(decimal).
ssss: Sync word/bit (decimal).

i : Clock Source
1 = Internal
2 = External

tttm: Period and multiplier (Word Generator only)

Multiplier Coding

C = Nanoseconds; reference restrictions of paragraph 3.2.8.
D = Microseconds
E = Milliseconds

Comma: Used as instruction delimiter.

READ PARAMETERS

Control: Y

Response: w, c, bbbb, llll, ssss, i, tttm, CR/LF

Y: Read parameters control character.

Response data format same as "Load Parameter" format.

LOAD WORD GENERATOR DATA

Control/Data: Wc, aaaa, dddd, dddd,, dddd,

W: Load word generator control character.

c: Number of output channels - 1,2,4,8,F (F used to specify channels).

aaaa: First word or bit number to be loaded.

dddd: Data (hex); reference Table 4-3.

Comma: Used as parameter delimiter.

READ WORD GENERATOR DATA

Control: Zaaaa, nnnn,

Response Data: dddd, dddd,, dddd, CR/LF

Z: Read word generator control character.

aaaa: First word or bit number to be read.

nnnn: Number of 16 bit words (four ASCII digits) to be read; reference
Table 4-3.

dddd: Data (hex); reference Table 4-3.

Comma: Used as instruction delimiter.

TABLE 4-2
(CONTINUED)

LOAD TIMING SIMULATOR DATA

Control/Data: Xaaaa, ddtttm,, ddtttm,

- X: Load Timing Simulator control character.
- aaaa: Number of first time interval to be loaded.
- ddtttm: Data (hex); reference Table 4-4.
- Comma: Used as instruction delimiter.

READ TIMING SIMULATOR DATA

Control: Vaaaa, nnnn,

Response Data: ddtttm, ddtttm,, ddtttm, CR/LF

- V: Read Timing Simulator control character.
- aaaa: Number of first time interval to be read.
- nnnn: Number of intervals to be read (50/50 nsec intervals count as one).
- ddtttm: Data (hex); reference Table 4-4.
- Comma: Used as instruction delimiter.

EXECUTE FILL

Control: Naaaaa, bbbbbb, ccccc, nnnnn,

- N: Execute fill control character.
- aaaaa: First word/bit of data to be repeated (decimal).
- bbbbbb: Last word/bit of data to be repeated (decimal).
- ccccc: Number of times pattern must be repeated (decimal).
- nnnnn: Number (decimal) of first word/bit where pattern is to be repeated.
- Comma: Used as instruction delimiter.

READ STORED PROGRAM MENU

Control: M

Response: nnn, nnn, . . . , nnn, CR/LF

Outputs the program number (decimal) of all programs in the stored program EPROM card.

LOAD STORED PROGRAM

Control: Knnn,

- K: Load stored program control character.
- nnn: Stored program number (decimal - nnn \neq 0)
- Comma: Used as instruction delimiter.

This function transfers the desired stored program from the stored program EPROM card to the RS-660 generator.

TABLE 4-2
(CONTINUED)

START/STOP

Control: S

Causes the unit to change state between programming and running.

TRIGGER

Control: T

Applicable only for single cycle mode. A trigger causes the generator to repeat the basic data block according to the number of repetitions specified.

TABLE 4-3
WORD GENERATOR DATA CONFIGURATION

Number of Channels

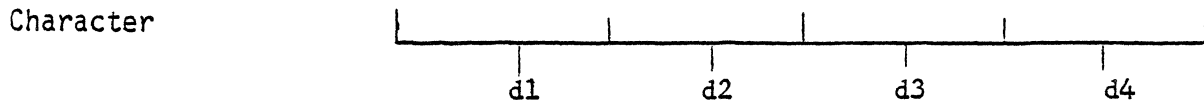
16	Channel No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	Bit No.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

8	Channel No.	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
	Bit No.	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2

4	Channel No.	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
	Bit No.	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4

2	Channel No.	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Bit No.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8

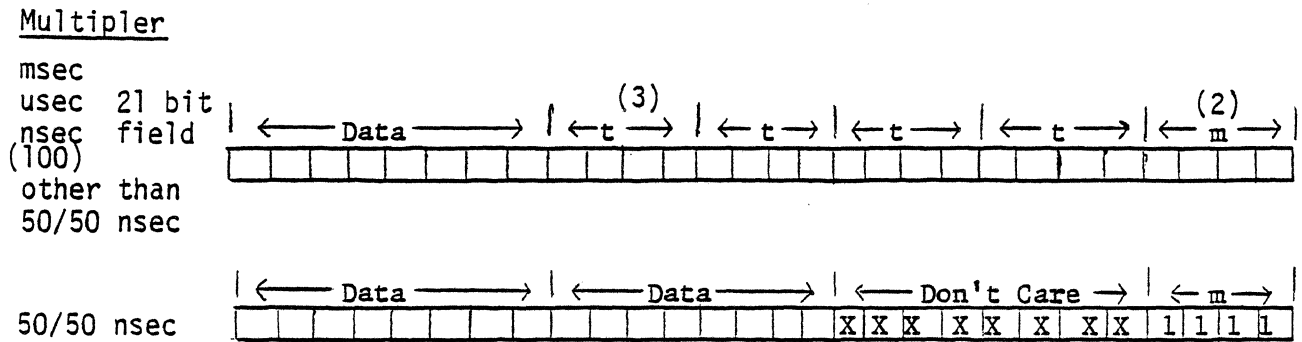
1	Channel No.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



Notes:

- 1) All Word Generator data are formatted in hex for transfer over the interface; i.e., $0 \leq d \leq F$.

TABLE 4-4
TIMING SIMULATOR DATA CONFIGURATION



Notes:

- 1) All Timing Simulator data (d) is formatted in hex' i.e., $0 \leq d \leq F$. Channel 0 is the left-most bit, channel 7 is the right-most.
- 2) Multiplier codes (ASCII).
 - C - nsec
 - D - usec
 - E - msec
 - F - 50/50
- 3) "tttt" consists of a maximum 3 BCD numbers and an optional decimal point. Reference period resolution and range of SPECIFICATIONS, section 1.4.

4.2.3 Operating Example

Table 4-5 provides an example of remote programming the RS-660. The example program performs the following:

- a) Resets the unit.
- b) Transmits parameter table to unit.
- c) Transmits word generator data to unit.
- d) Places unit in run mode.
- e) Reads the unit status.
- f) Triggers the device a number of times.
- g) Places the unit in programming mode.
- h) Returns the unit to local control.

Once all of the data is loaded into the RS-660, the test program is started. The source of the trigger inputs may be manual or automatic. Note that the same control character is used to start and/or stop the unit.

Data that is underlined is transmitted from the RS-660.

TABLE 4-5
CONTROLLER INTERFACE
PROGRAMMING EXAMPLE

DATA	COMMENTS
R	: Resets the RS-660
P01,	: Sets up to load all parameters, word gen. mode.
8,	: Defines 8 output channels.
1234,	: Defines 1,234 bits per channel.
1567,	: Defines 1,567 pattern repeats.
890,	: Defines sync address of 890.
1,	: Internal clock source.
12.5D,	: Defines clock period 12.5 us.
Q,	: Updates display.
W8,1,	: Sets up to load word gen. data starting at word 1.
4815,	: Word 1 and 2
551F,	: Word 3 and 4
FEF7,	: Word 5 and 6
FFFF,	: Word 7 and 8
.	
.	
.	
4111,	: Word 1,233 and 1,234.
S	: Places unit in run mode.
U	: Reads unit status.
* <u>4</u>	: Remote control, waiting for trigger.
T	: Triggers unit.
U	: Reads unit status.
* <u>4</u>	: Remote control, waiting for trigger.
T	: Triggers unit.
U	: Reads unit status.
* <u>4</u>	: Remote control, waiting for trigger.
S	: Places unit in programming mode.
L	: Returns unit to local control.

*Continue reading status until "4" appears before re-triggering

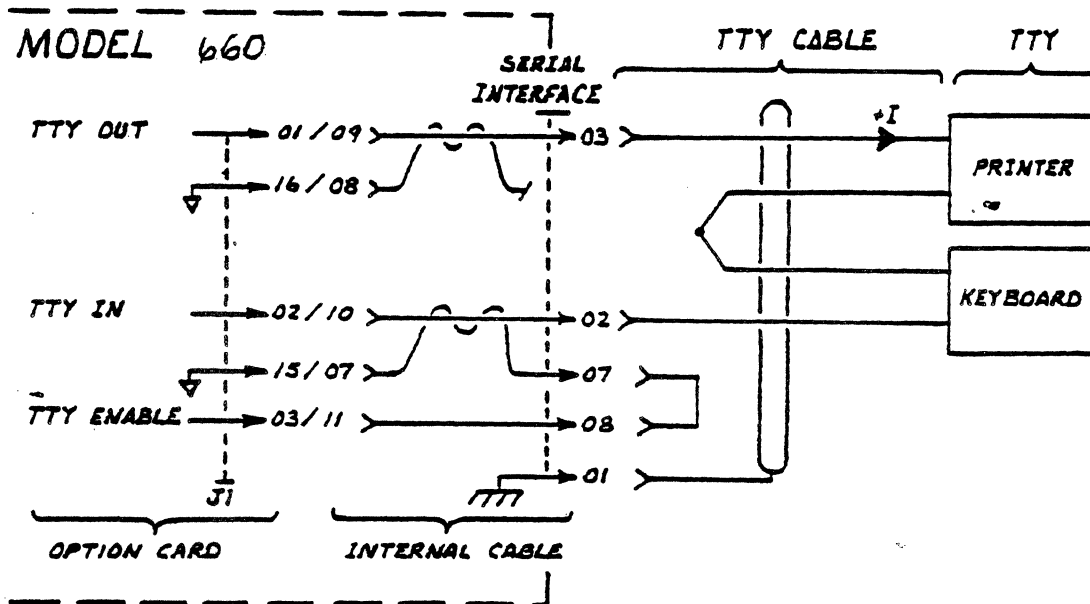
4.3 RS-232C/TTY CONTROLLER INTERFACE

The Model RS-660's RS-232-C controller interface is available as option number 660-003 and is a factory installed option.

4.3.1 Preparation For Use

The Model RS-660's rear panel connector, designated as SERIAL INTERFACE, is configured to connect to the cable of an RS-232-C terminal. Alternately, the RS-660 may be used as an RS-232C terminal by connecting the supplied terminal cable to the SERIAL INTERFACE connector and connecting the other end to the user's calculator or computer. The supplied cable is end interchangeable.

A teletype (TTY) may also be connected to the SERIAL INTERFACE connector. The following diagram illustrates the TTY cable construction:



Note that the internal RS-660 cable which plugs into the option card must be rotated 180° for TTY operation, such that pin 09 of the cable plugs into pin 01 of card socket J1.

Prior to attempting communication, the transmission baud rate must be selected by setting the rotary switch located on the RS-660's rear panel. The correspondence between baud rate and the switch positions is as follows:

<u>SWITCH POSITION</u>	<u>BAUD RATE</u>	<u>NO. OF BITS STOP BITS</u>
0	110	2
1	150	1
2	300	1
3	600	1
4	1200	1
5	2400	1
6	4800	1
7	9600	1
8 and 9	Invalid	-

The baud rate may be changed while power is applied. Following reselection of the baud rate while power is applied, depress the front panel RESET key to re-initialize the interface.

The RS-232-C interface option is a data channel implementation only.

The serial data format consists of the following:

- a) One start bit
- b) Seven data bits (LSB first)
- c) One parity bit, transmitted false, received "DON'T CARE"
- d) One stop bit (other than 110 baud), two stop bits at 110 baud

The Model RS-660's RS-232-C interface does not ECHO transmit the received characters and therefore would normally be connected to a half-duplex terminal. The interface option does not delay when switching between the transmit and receive modes.

The selectable baud rates listed above represent only the valid character transmission rates and not the execution rates of the various RS-660 commands. Except for three functions, the commands of the RS-660 are executed within 3 msec. This implies that the maximum rate is 2400 baud if null pads are not inserted between commands. The update CRT function ("Q") requires 75 msec to execute. The load stored program ("K") and execute fill ("N") functions require variable execution times, dependent on the length of their required task. The user is able to sense the busy state by simply requesting status ("U") and waiting for a response. The RS-660 will not respond with a status until it has completed the last task.

4.3.2 Operation

Refer to sections 4.2.2 and 4.2.3 for a description of the controller interface operation and an operating example.

V. INTERFACE POD

This section describes the features and operation of the Model RS-660 optional interface pod.

5.1 GENERAL DESCRIPTION

The interface pod (option 660-010) has been developed to extend the versatility and flexibility of the RS-660 Timing Simulator/Word Generator. The pod may be used, in conjunction with the RS-660, to generate digital signal sequences that are either TTL or CMOS compatible. The Model RS-660 outputs are terminated, at the pod, to reduce transmission line effects. The CMOS compatible outputs are open-collector drivers with 470 pull-up resistors. The pod further accepts either TTL or CMOS trigger and/or clock inputs, converts them as necessary, and transmits them to the RS-660. The purpose of the interface pod is to save time and money in applications which would otherwise require the engineer to develop costly, special purpose converters.

5.2 OPERATIONAL DESCRIPTION

The interface pod is connected to the RS-660 by plugging the cable connectors P1 and P2 into receptacles J7 (DATA 0-7 & OUTPUT CLOCKS) and J8 (DATA 8-F & INPUT CLOCKS) respectively, on the rear panel of the RS-660. Additionally, the user selects either TTL or CMOS compatible inputs and outputs by means of four jumper plugs, P1 through P4 located inside the pod. Reference drawing number 10011310.

In order to configure the inputs and outputs as CMOS compatible, these jumper plugs should be installed such that pin 1 on each plug mates with pin 1 on its socket. Installing the plugs, such that pin 1 on each plug mates with pin 8 on its socket, will result in the inputs and outputs being configured as TTL compatible.

The pod is connected to the user's circuit via hook type probes. These provide the sixteen data outputs, two clock outputs, external clock and trigger inputs and four returns. Reference appendix C for signal/pin listing and probe color coding.

Note that when the pod is configured as CMOS compatible, the user's logic supply (VDD and GND) must be supplied to the two banana jacks on the rear panel of the pod.

If desired, the probe connector may be disconnected and connection made to the user's system via an alternative cable and connector. A list of compatible connector types is provided in section 5.3.

5.3 SPECIFICATIONS

INPUT SIGNALS (TRIG IN, EXT CLK):

Loading:	1 TTL Load	1 CMOS Load
Max. Input Frequency:	20 MHz	10 MHz
Input Signal Levels:		
Low (0)	-.5v to +0.4v	+ 2v max @ VDD=10v
High (1)	+2.4v to +5.25v	+ 8v min @ VDD=10v
VDD:	N/A	+15v absolute max

OUTPUT SIGNALS (DATA OUT, CLK OUT):

Loading:	2 TTL Load	2 CMOS Load
Max. Output Frequency (c load = 20 pf)	20 MHz	10 MHz
Rise Time (10%-90%)	10 nsec	45 nsec
Propogation delay:		
Low to High	12 nsec	30 nsec
High to Low	12 nsec	25 nsec
Interchannel Skew: (in addition to RS-660 output)	1 nsec max.	15 nsec max.

GENERAL

Operating Temperature:

Dimensions:

Pod: 1½"H x 5"W x 5¼"D
Cable to RS-660: 48"
Cable to users: 6"

Weight: 21 lbs.

Alternative Mating Connectors:

AMP P/N 86673-7

ITT/Cannon P/N 121-7326-120

APPENDICIES

APPENDIX A

INPUT/OUTPUT SIGNAL LISTING

Rear Panel Connector (J7, DATA 0-7 & OUTPUT CLOCKS)

<u>SIGNAL</u>	<u>MNEMONIC</u>	<u>SIGNAL PIN NO.</u>	<u>RETURN PIN NO.</u>
DATA OUTPUT CHANNEL 0	DOUT0+	01	14
" " " 1	DOUT1+	02	15
" " " 2	DOUT2+	03	16
" " " 3	DOUT3+	04	17
" " " 4	DOUT4+	05	18
" " " 5	DOUT5+	06	19
" " " 6	DOUT6+	07	20
" " " 7	DOUT7+	08	21
GATED OUTPUT CLOCK	GOCLK+	09	22
FREE RUNNING OUTPUT CLOCK	FOCKL+	10	23
VCC (+5Vdc)	VCC	11	24

Rear Panel Connector (J8, DATA 8-F & INPUT CLOCKS)

<u>SIGNAL</u>	<u>MNEMONIC</u>	<u>SIGNAL PIN NO.</u>	<u>RETURN PIN NO.</u>
DATA OUTPUT CHANNEL 8	DOUT8+	01	14
" " " 9	DOUT9+	02	15
" " " A	DOUTA+	03	16
" " " B	DOUTB+	04	17
" " " C	DOUTC+	05	18
" " " D	DOUTD+	06	19
" " " E	DOUTE+	07	20
" " " F	DOUTF+	08	21
EXTERNAL INPUT CLOCK	EXCLK+	09	22
EXTERNAL TRIGGER INPUT	EXTRIG-	10	23
VCC (+5Vdc)	VCC	11	24

APPENDIX B

CARD READER INTERFACE SIGNAL LISTING

Rear Panel Connector (J6, CARD READER)

<u>SIGNAL</u>	<u>MNEMONIC</u>	<u>SIGNAL PIN NO.</u>
DATA 0	CRD0+	01
DATA 1	CRD1+	02
DATA 2	CRD2+	03
DATA 3	CRD3+	04
DATA 4	CRD4+	05
DATA 5	CRD5+	06
DATA 6	CRD6+	07
DATA 7	CRD7+	08
DATA STROBE	STOMI-	14
CARD PRESENT	CPOMD-	16
+5 VOLT SUPPLY	VCC	20
SIGNAL GROUND	GND	22

APPENDIX C

INTERFACE POD I/O SIGNAL LISTING

Pod Connector (J3, USER I/O)

SIGNAL	MNEMONIC	SIGNAL		RETURN	
		PIN NUMBER	PROBE BODY	PIN NUMBER	PROBE BODY
DATA OUTPUT CHAN. 0	CDOUT 0+	01	BLACK	02	-
" " " 1	CDOUT 1+	03	"	04	-
" " " 2	CDOUT 2+	05	"	06	BLACK
" " " 3	CDOUT 3+	07	"	08	-
" " " 4	CDOUT 4+	09	"	10	-
" " " 5	CDOUT 5+	11	"	12	-
" " " 6	CDOUT 6+	13	"	14	-
" " " 7	CDOUT 7+	15	"	16	BLACK
" " " 8	CDOUT 8+	17	"	18	-
" " " 9	CDOUT 9+	19	BROWN	20	-
" " " A	CDOUT A+	21	"	22	-
" " " B	CDOUT B+	23	"	24	-
" " " C	CDOUT C+	25	"	26	BLACK
" " " D	CDOUT D+	27	"	28	-
" " " E	CDOUT E+	29	"	30	-
" " " F	CDOUT F+	31	"	32	-
GATED OUTPUT CLOCK	CGOCLK+	33	"	34	-
FREE RUNNING OUTPUT CLOCK	CFOCLK+	35	"	36	BLACK
EXTERNAL INPUT CLOCK	CEXCLK+	37	"	38	-
EXTERNAL INPUT TRIGGER	CEXTRIG-	39	RED	40	-

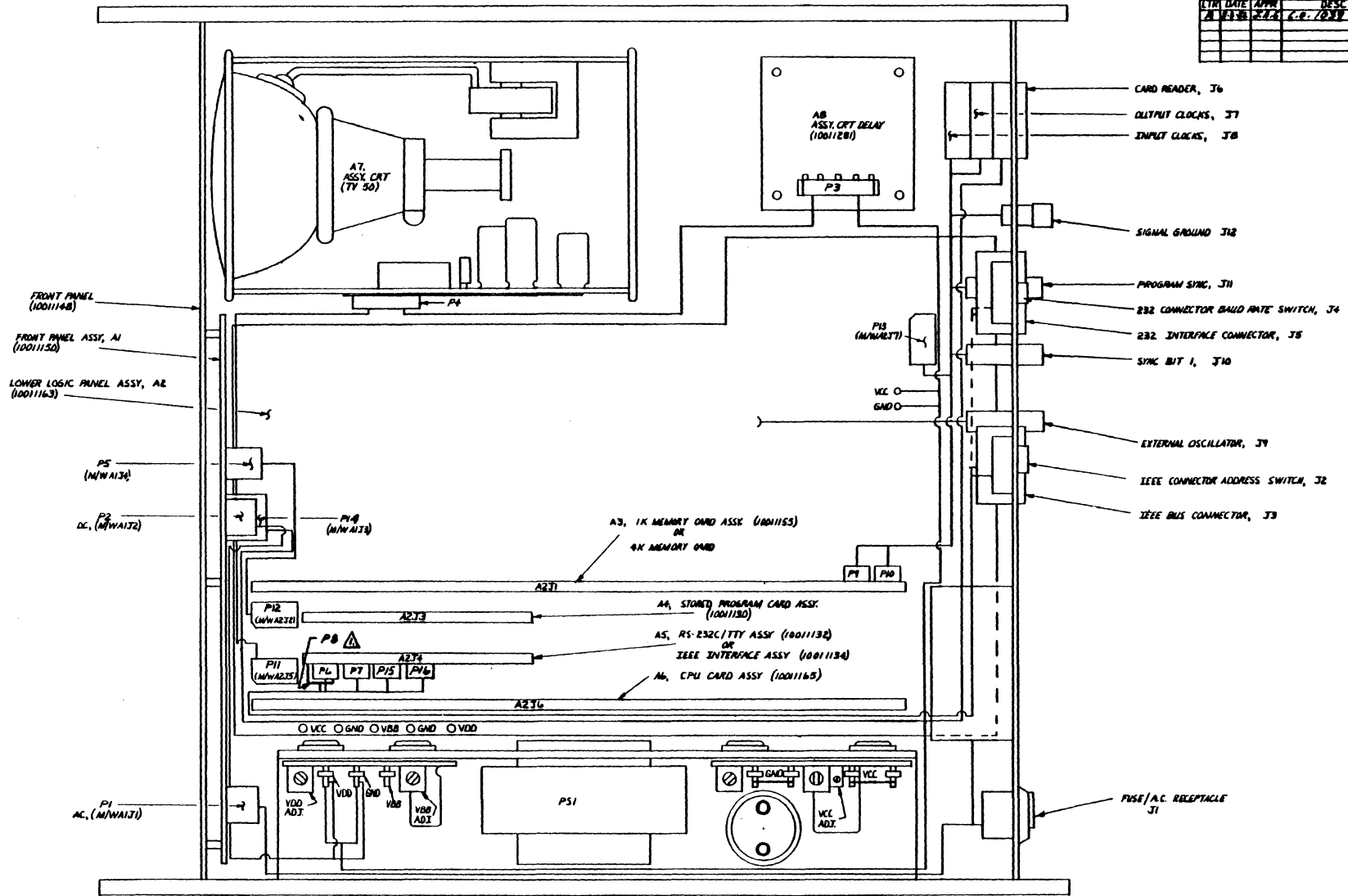
APPENDIX D
LOGIC DIAGRAMS

Top Assembly	10011157
Front Panel Assembly	10011150
Lower Logic Panel Assembly	10011163
CPU Card Assembly	10011165
1K Memory Card Assembly	10011155
IEEE Interface Card Assembly	10011134
Serial Interface Card Assembly	10011132
Stored Program Card Assembly	10011130
CRT Delay Assembly	10011281
Interface Pod Assembly	10011310

POWER SUPPLY DRAWINGS/SCHEMATICS

<u>Drawing Number</u>	<u>Title</u>
3012-S01	Power Supply Schematic, Rev. A
2975-S01	Schematic, Power Supply Assembly, Rev. A
2975-S02	Schematic, Regulator, Rev. N/C

REVISIONS		DATE	BY
A	REVISED	2-2-79	C.R. OBY

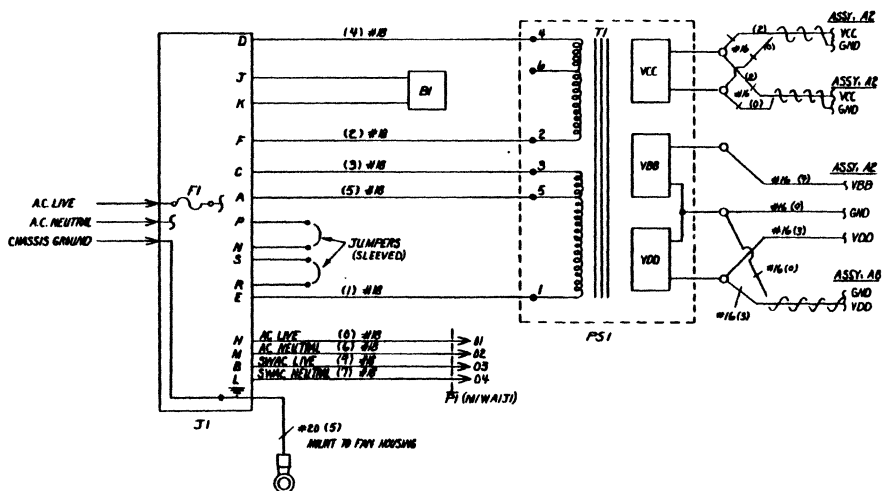


⚠ FOR IEEE INTERFACE ON RS-660 S/N-001 THRU S/N-050, CONNECT P8 TO ASJ3 SUCH THAT PIN 1 OF P8 MATES WITH PIN 10 OF ASJ3. FOR IEEE INTERFACE ON RS-660 S/N-051 AND UPWARD, CONNECT P8 TO ASJ3 WITH CORRESPONDING PIN NUMBERS.

NOTES: UNLESS OTHERWISE SPECIFIED

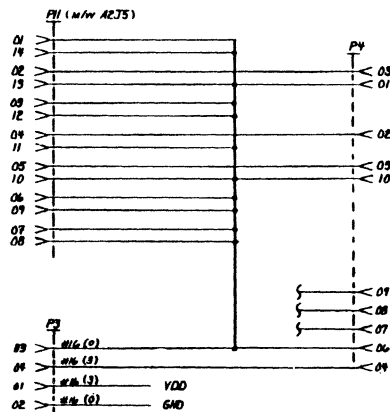
interface		
MODEL: NTS	APPROVED BY: <i>SHK</i>	DESIGNED BY: EK
DATE: 6-15-79		
RS-660 TDP ASSEMBLY		
SHT 1 OF 2	55613	1001137

AC WIRING



CRT HARNESS

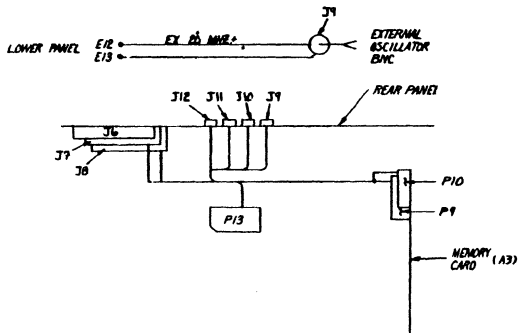
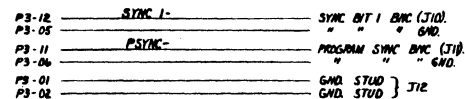
NOTE: P# NUMBERING APPLIES TO CONNECTOR ONLY. NUMBERING ON CRT UNIT IS REVERSED.



RS-660 I/O CABLE

NOTE: CONNECTORS J9 AND J8 MUST BE ASSEMBLED TO REAR PANEL PRIOR TO CABLE ASSEMBLY.

J7	J8		
P9-11 DOUT 0+	01	P9-10 DOUT B+	01
P9-06 DOUT 1+	02	P9-07 DOUT 1+	14
P10-11 DOUT 1+	02	P10-10 DOUT 2+	02
P10-06 DOUT 2+	03	P10-07 DOUT 2+	05
P10-12 DOUT 2+	03	P10-15 DOUT A+	03
P10-05 DOUT 3+	04	P10-04 DOUT 3+	16
P9-12 DOUT 3+	04	P9-15 DOUT B+	04
P9-05 DOUT 4+	05	P9-04 DOUT 4+	17
P9-14 DOUT 4+	05	P9-16 DOUT C+	05
P9-03 DOUT 5+	06	P9-01 DOUT 5+	18
P10-14 DOUT 5+	06	P10-16 DOUT D+	06
P10-03 DOUT 6+	07	P10-01 DOUT 6+	19
P10-15 DOUT 6+	07	P10-08 DOUT 7+	07
P10-02 DOUT 7+	08	P10-02 DOUT 7+	20
P9-15 DOUT 7+	08	P9-09 DOUT 8+	08
P9-02 DOUT 8+	09	P9-02 DOUT 8+	21
P13-13 BACKL+	09	P13-08 EXCLK+	09
P13-04 EXCLK+	10	P13-08 EXCLK+	22
P13-14 EXCLK+	10	P13-10 EXTRIG-	10
P13-03 VCC	11	P13-09 EXTRIG-	23
P13-16 GND	11	P13-15 VCC	11
GND STUD	24	P13-15 GND	24
		GND STUD	24



A.C. POWER WIRING AND CABLE HARNESSES

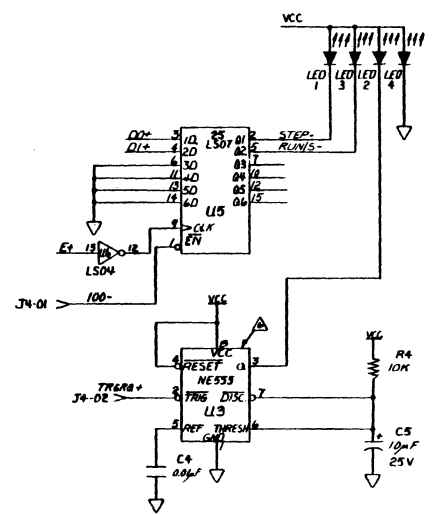
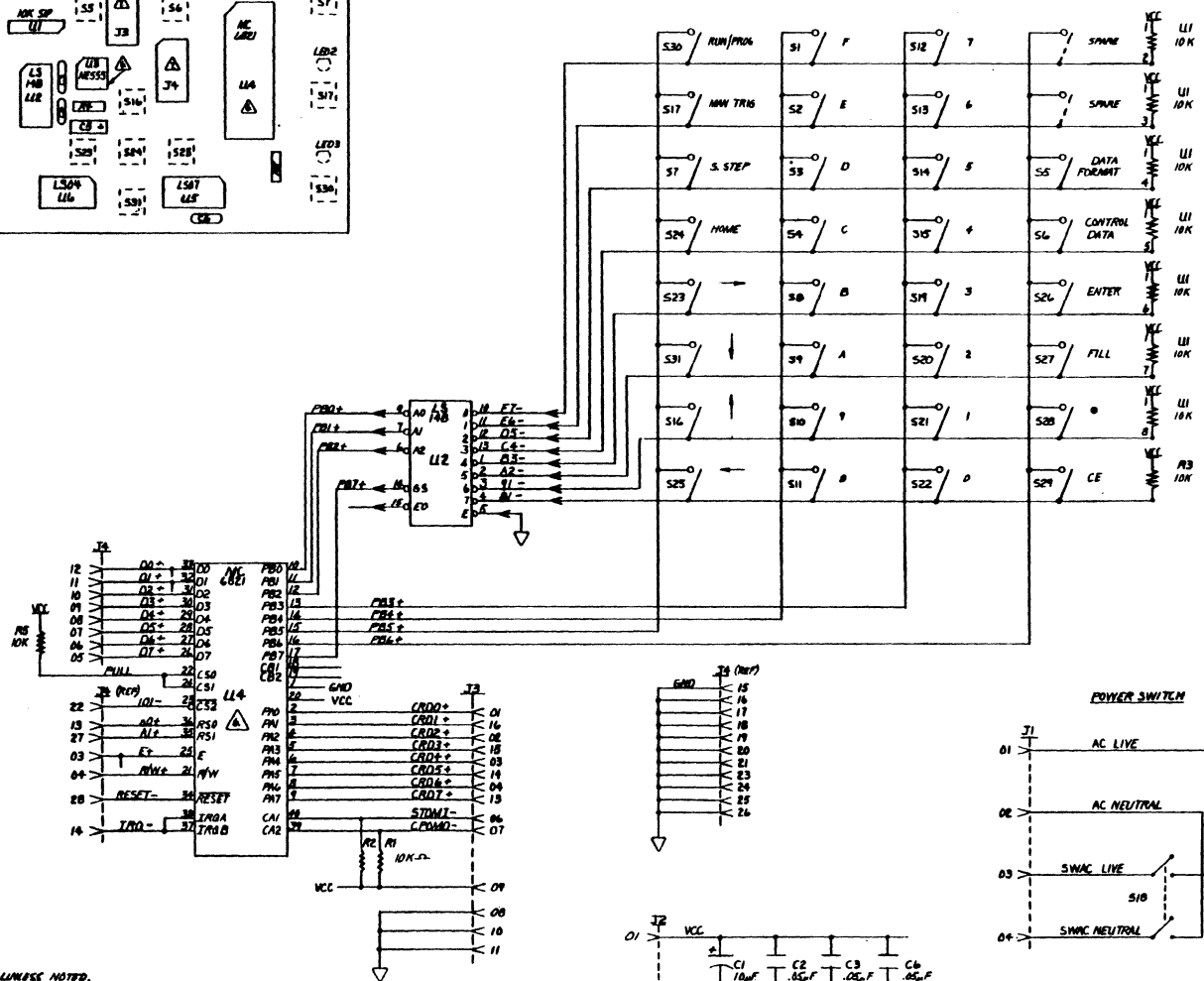
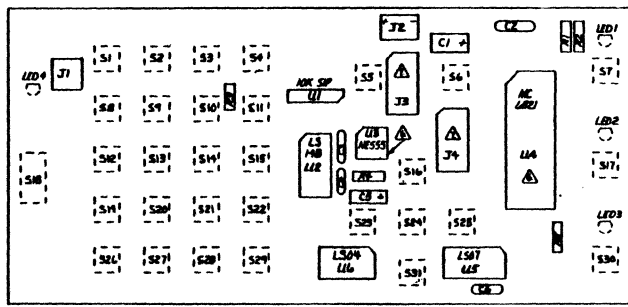
Interface
TECHNOLOGY

SCALE: NTS APPROVED BY: DATE: 7-23-79 DRAWN BY: RK

RS-660 TOP ASSEMBLY

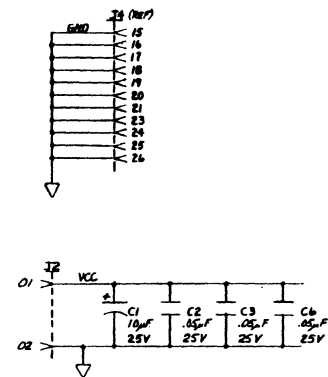
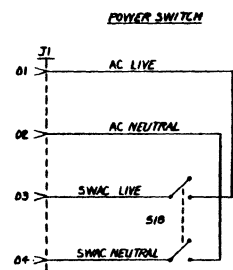
SHT 2 OF 2 55613 1001/157

REVISIONS				
LT	DATE	APPR	DESC	
A	1/15/79	W	ADDN XC TRM K's	



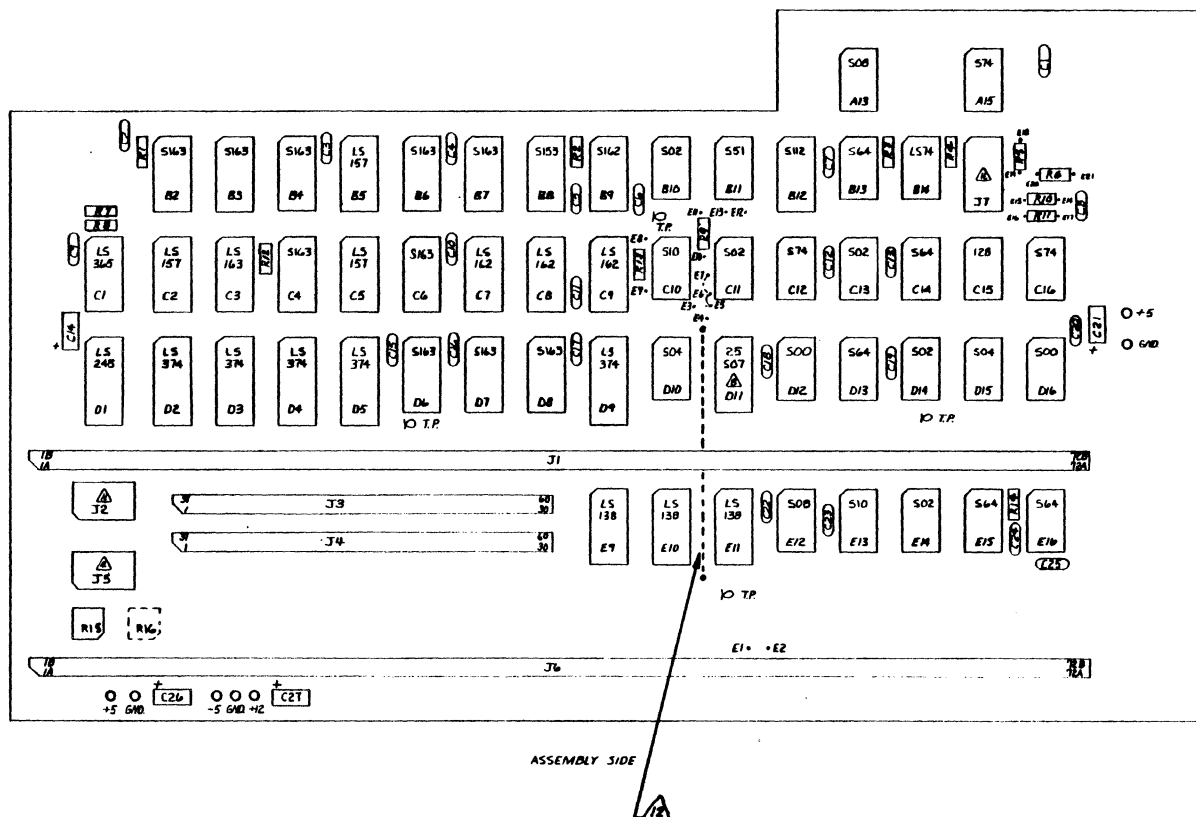
▲ H-P DESIGNATES HIGH PROFILE SOCKET.
 ▲ ALL INTEGRATED CIRCUITS ARE SHOWN UNLESS NOTED.
 S REFER TO 100/109 FOR PCB.
 A RESISTORS R1 THRU R5 10K-Ω 1/4W CARBON COMPOSITION
 3 CAPACITOR C4 IS A .01μF AT 25V CERAMIC DISC.
 B CAPACITORS C2, C3, C6 ARE .05μF AT 25V CERAMIC DISC.
 L CAPACITORS C1 & C5 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED



interface TECHNOLOGY		
DESIGN: NTS	APPROVED BY: <i>Bob Kruger</i>	DRAWN BY: R.J.M.
DATE: 1-15-79		REVISION:
ASSY/LBD RS660 FRONT PANEL		
SHT. 1 OF 1	55613	WORKING NUMBER 1001150

REVISIONS			
LT#	DATE	APPR	DESC
A	4-28-79	EC	C.O. 1007
B	5-20-79	J.L.P.	C.O. 1157
C	6-13-79	J.L.P.	C.O. 1296

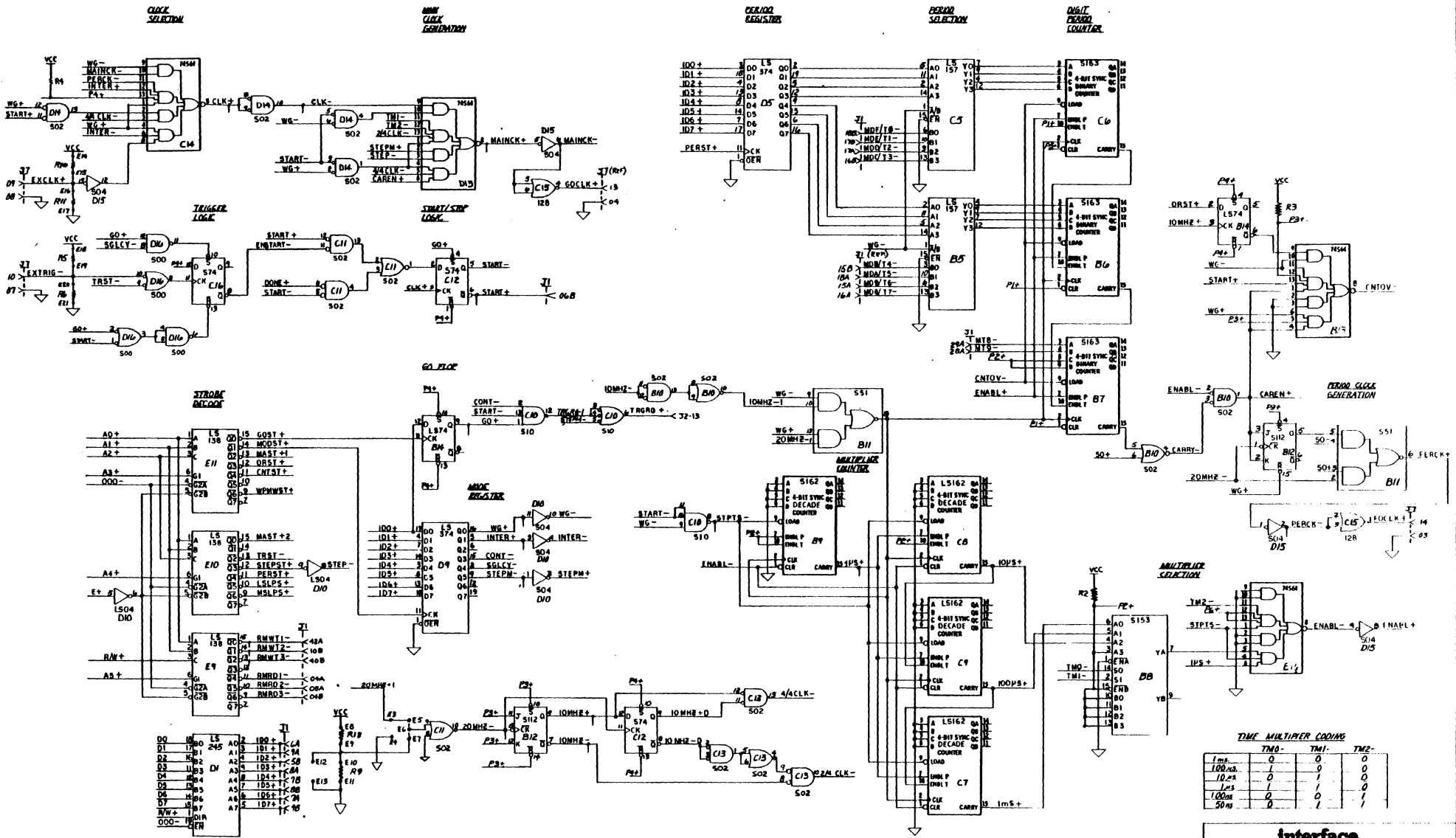


▲ ADD A GROUND JUMPER ON BACKSIDE OF BOARD FROM GROUND PLANE IN ROW C TO GROUND PLANE IN ROW E.

- ▲ HIGH PROFILE SOCKETS DESIGNATED H.P.
- 10. FOR EXTERNAL OSCILLATOR OPERATION, DISCONNECT JUMPER E5 TO E6 AND MAKE JUMPER CONNECTION E6 TO E7.
- 9. COMPONENTS SHOWN BY BROKEN LINES ARE OPTIONAL.
- ▲ INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED
- 7. REFER TO 1001162 FOR PCB
- 6. RESISTOR R16 IS A 100K POT.
- 5. RESISTOR R15 IS A 500Ω POT.
- 4. RESISTORS R5, R6, R9-R11, R13 ARE 270Ω 1/4 W ORDN COMP.
- 3. RESISTORS R1-R4, R7, R8, R12, R14 ARE 1KΩ 1/4 W CARBON COMP.
- 2. CAPACITORS C1-C13, C15-C20, C22-C25, ARE .05μF AT 25V CERAMIC DISC.
- 1. CAPACITORS C14, C16, C26, C27 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED

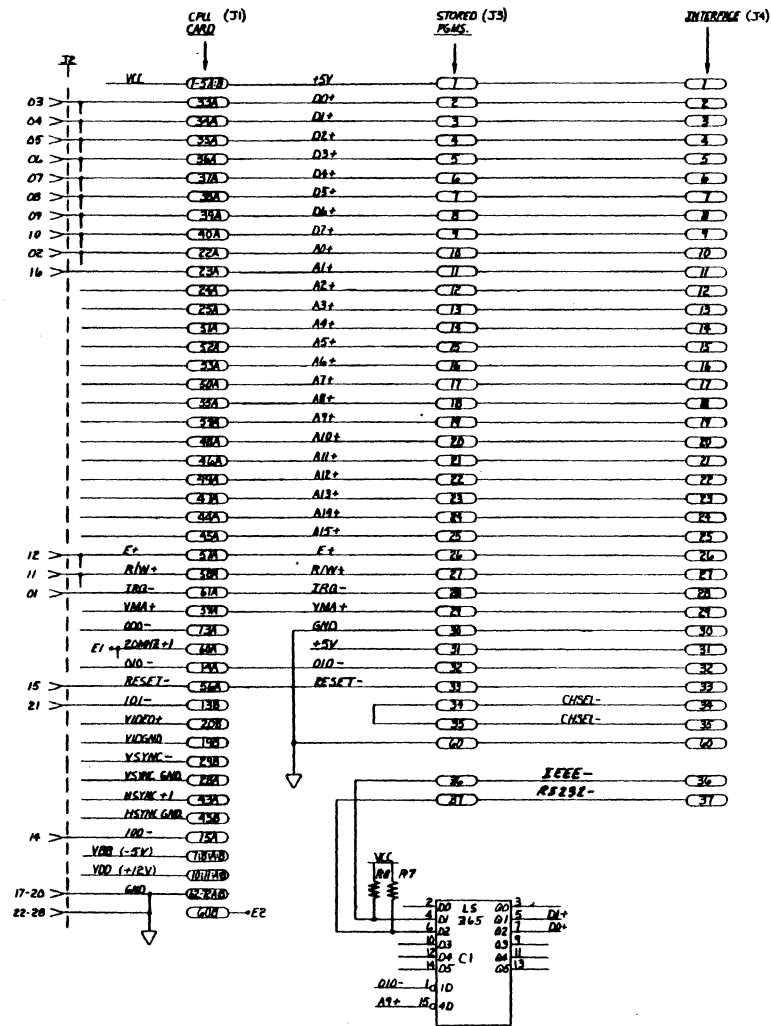
interface TECHNOLOGY		
SCALE: NTS	APPROVED BY: <i>SHK</i>	DESIGNED BY: RE
DATE: 6-13-79		METHOD:
ASSY 1 LDO LOWER LOGIC PWR. RS-640		
SHT. 1 OF 4	55613	1001163

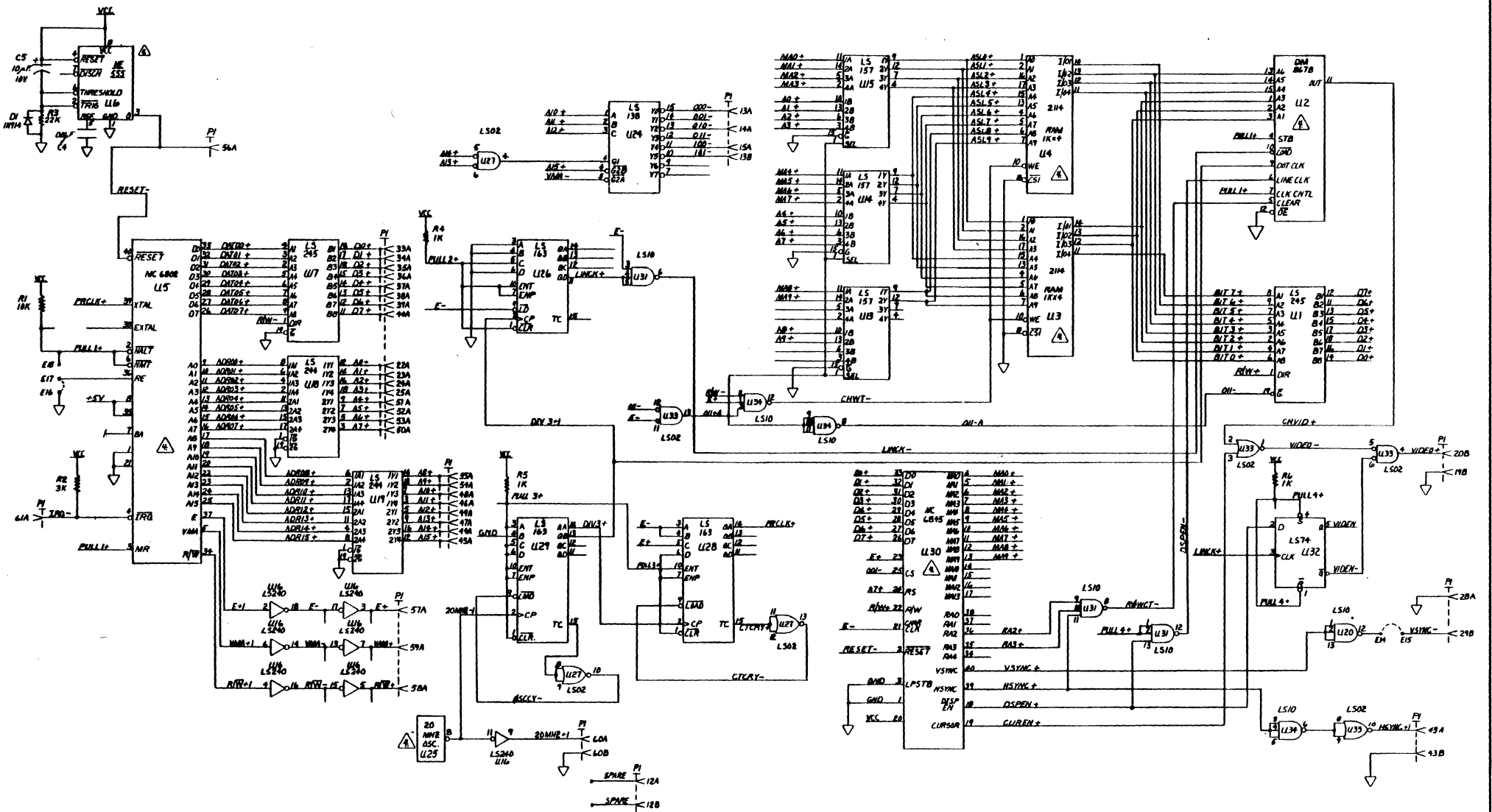


TIME MULTIPLIER CODING

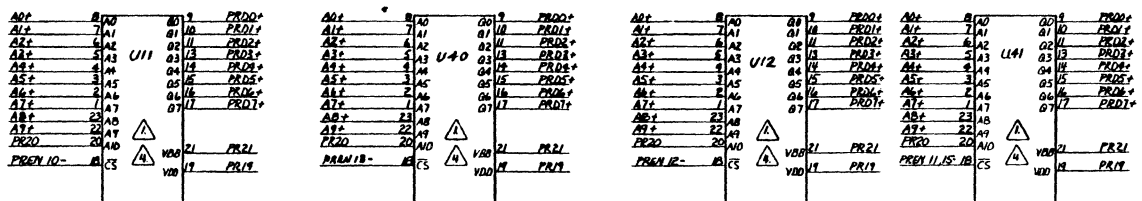
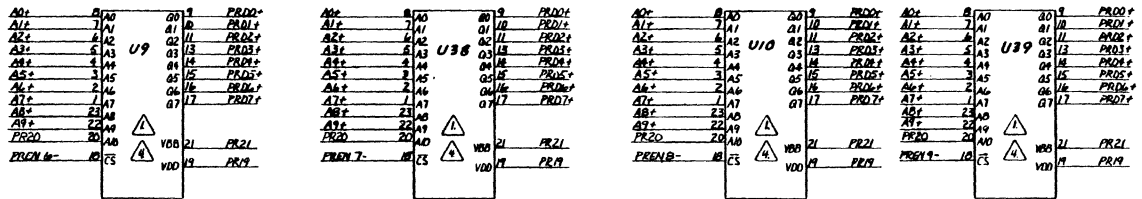
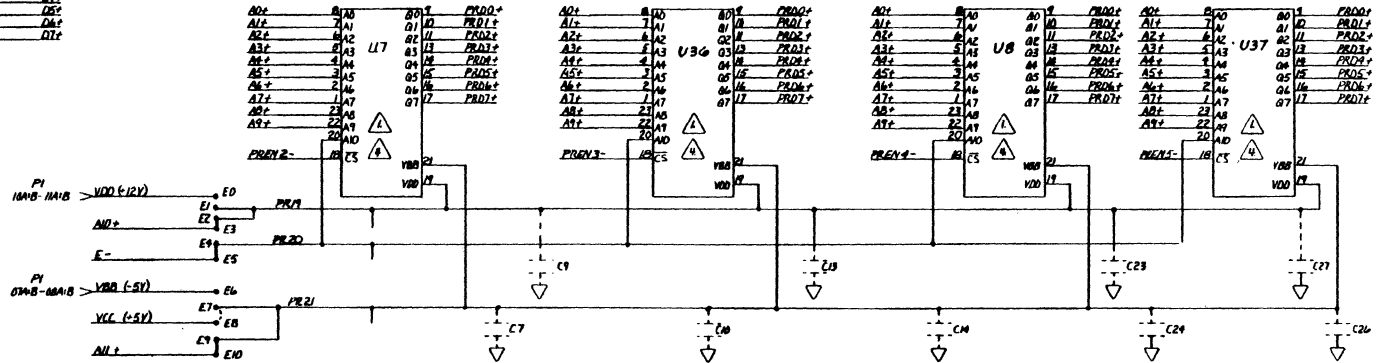
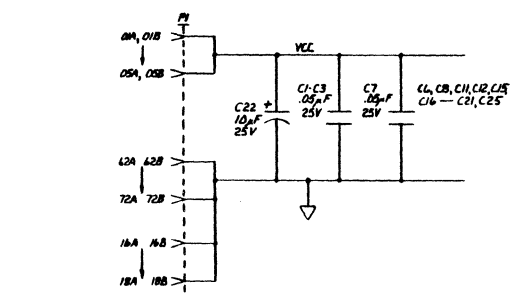
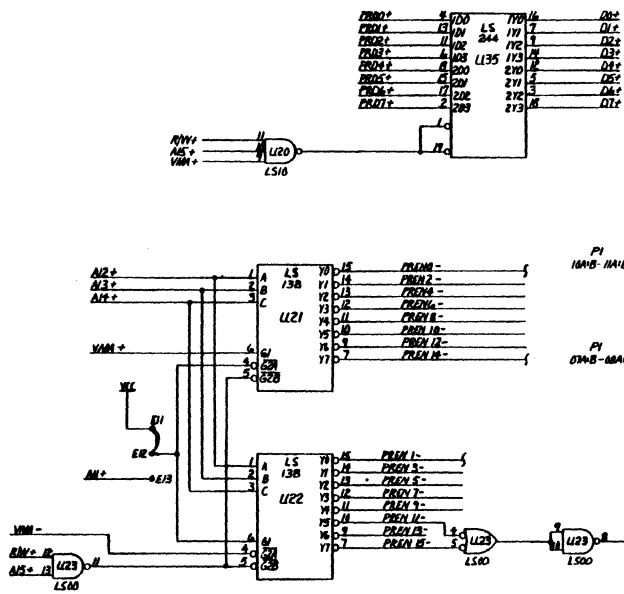
	TM0	TM1	TM2
1ms	0	0	0
100μs	0	0	0
10μs	0	1	0
1μs	1	1	0
100ns	0	1	1
50ns	0	1	1

REVISIONS			
LYR	DATE	APPR	DESB.
C			SEE SHEET 1

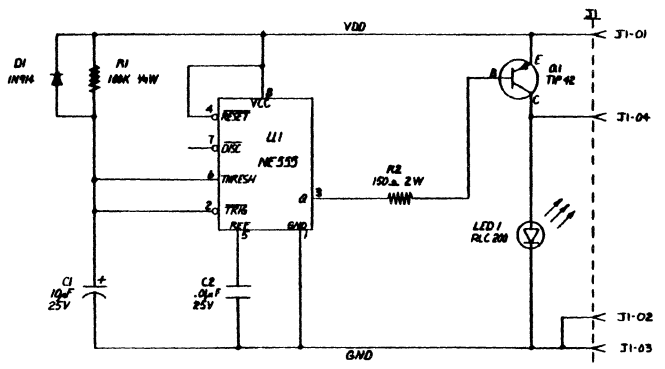
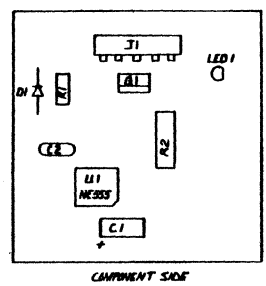




interface		
DESIGN: N.T.S.	APPROVED BY:	DRAWN BY: R.J.H.
DATE: 1-12-79		REVISION:
ASSY/LBO RS-640 CPU CARD		
SHT 2 OF 3	55613	1001165



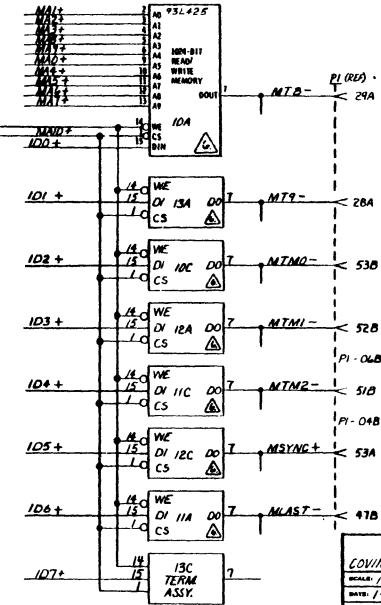
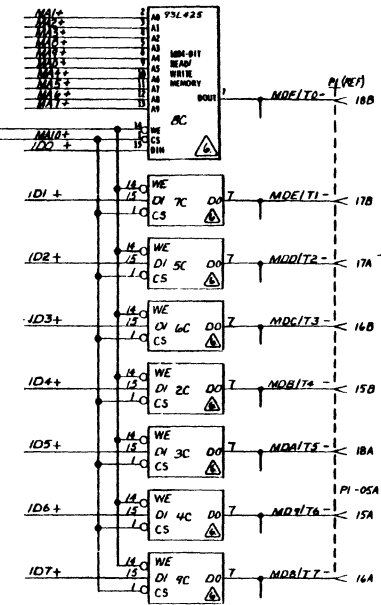
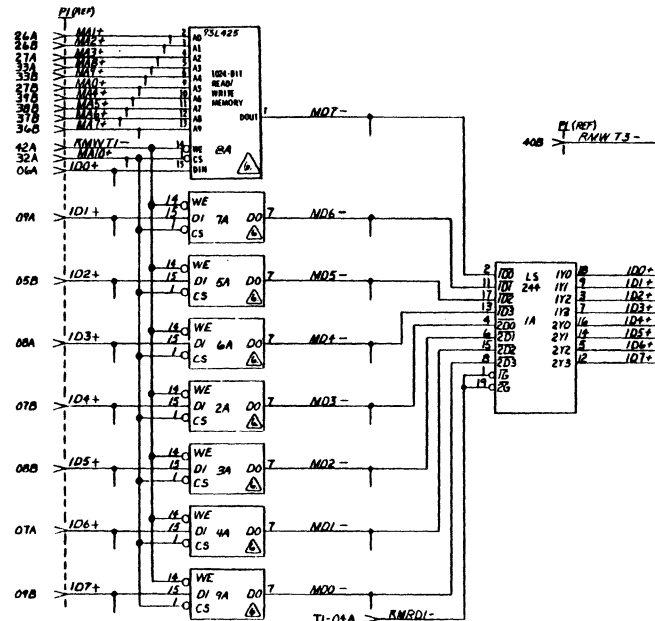
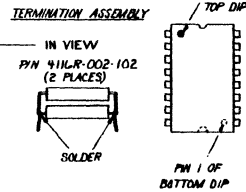
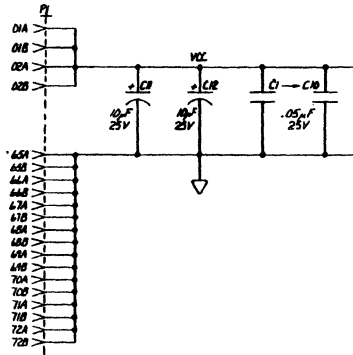
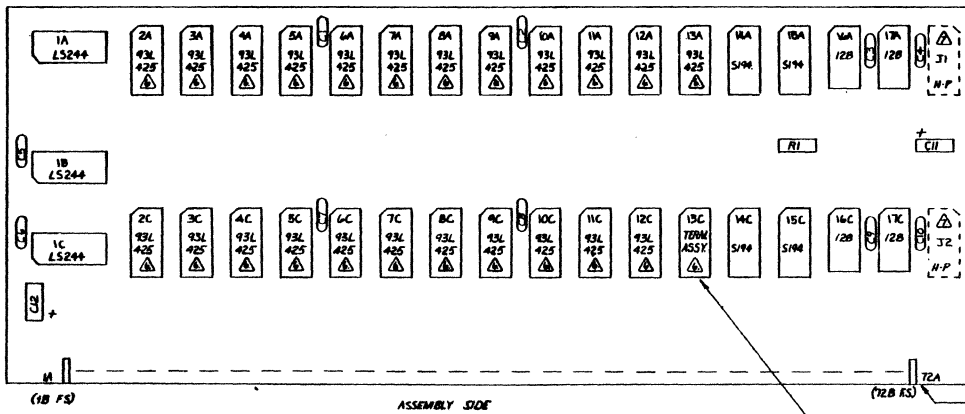
REVISIONS		
LTN DATE	APPV	DESC



- 5. REF 1001280 FOR PCB.
- 4. RESISTOR RE IS A 150Ω 2W CARBON COMP.
- 3. RESISTOR R1 IS A 100KΩ 1/4W CARBON COMP.
- 2. C2 IS A .01µF AT 25V CERAMIC DISC CAPACITOR.
- 1. C1 IS A 10µF AT 25V ELECTROLYTIC CAPACITOR.

NOTES: UNLESS OTHERWISE SPECIFIED.

interface TECHNOLOGY		
DESIGN: NTS	APPROVED BY: <i>SKK</i>	DESIGNED BY: RK
DATE: 6-1-79		REVISED:
ASSY L80 RS-660 CRT DELAY CIRCUIT AB		
SHT 1 OF 1	55413	10011281



REVISIONS			
LYR	DATE	APPN	DESC

MAD10-	2	100	L5	110	10	100+
MAD11-	11	101	244	111	9	101+
MAD12-	17	102		112	7	102+
MAD13-	13	103		113	7	103+
MAD14-	4	200		210	16	104+
MAD15-	6	200		210	18	105+
MAD16-	5	203		212	5	106+
MAD17-	8	203		213	12	107+

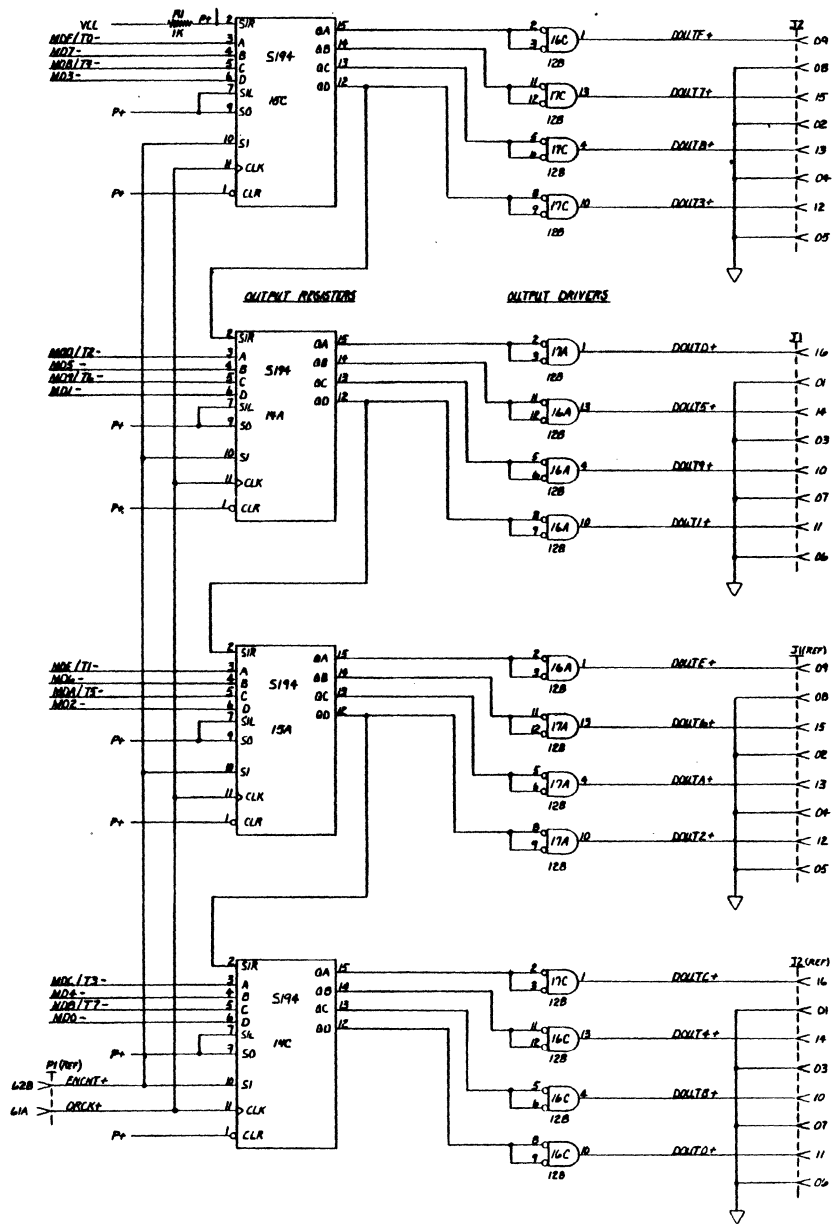
MAD18-	2	100	L5	110	10	100+
MAD19-	11	101	244	111	9	101+
MAD20-	17	102		112	7	102+
MAD21-	13	103		113	7	103+
MAD22-	4	200		210	16	104+
MAD23+	6	200		210	18	105+
MAD24-	5	203		212	5	106+
MAD25-	8	203		213	12	107+

- △ H-P DESIGNATES HIGH PROFILE SOCKETS.
 ⊠ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
 2. RESISTOR RI IS A 1KΩ 1/4W CARBON COMP.
 3. CAPACITORS C1 THRU C3 ARE .05μF AT 25V CERAMIC DISC.
 4. CAPACITORS C4 & C2 ARE 10μF AT 25V ELECTROLYTIC.
 5. REF. 100H154 FOR PCB.
 6. 93L425 INSTALLED IN 23 PLACES. ADDRESS LINES MAD+ THRU MAD- ARE CONNECTED TO A0 THRU A9 OF ALL 23 CHIPS.

NOTES:

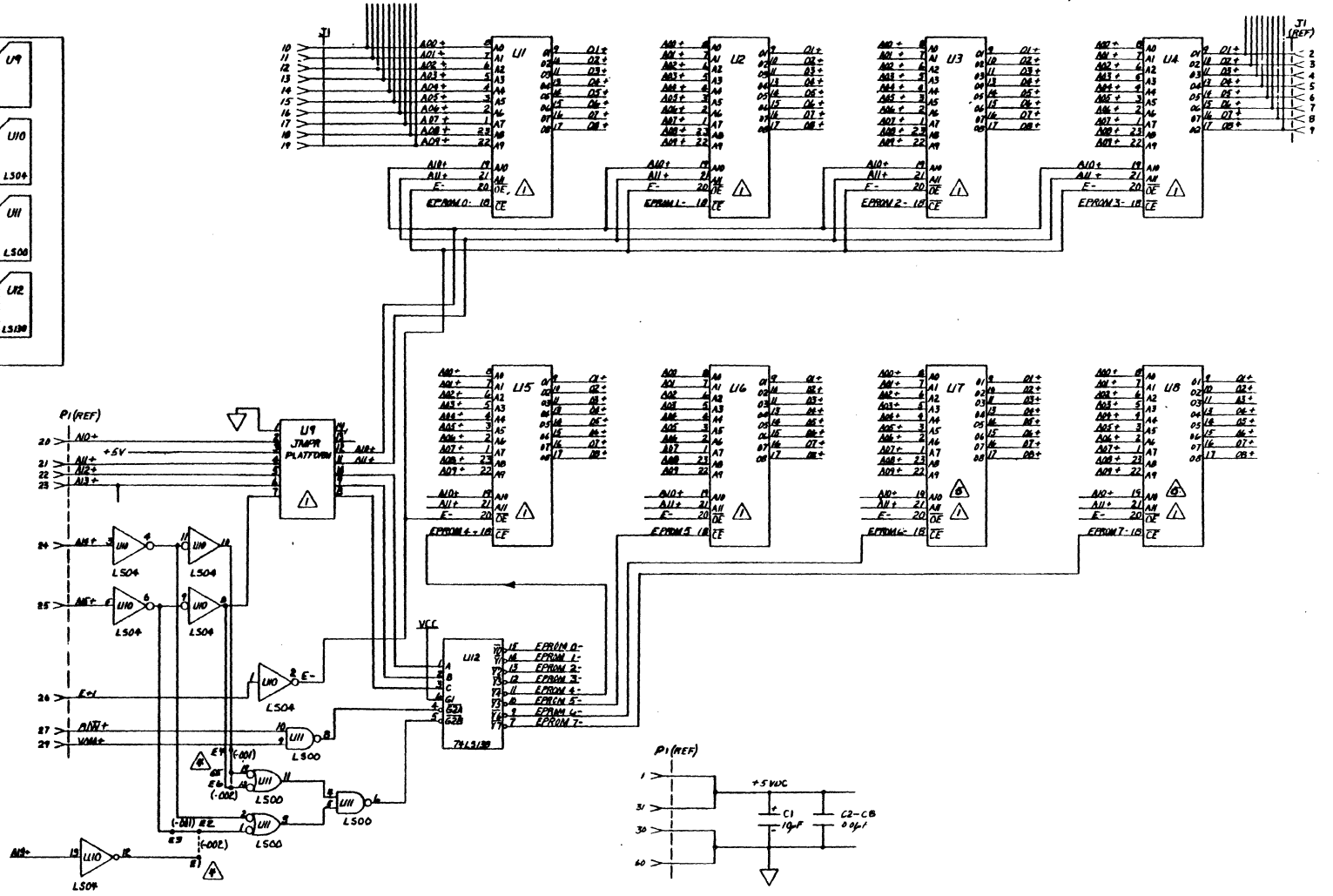
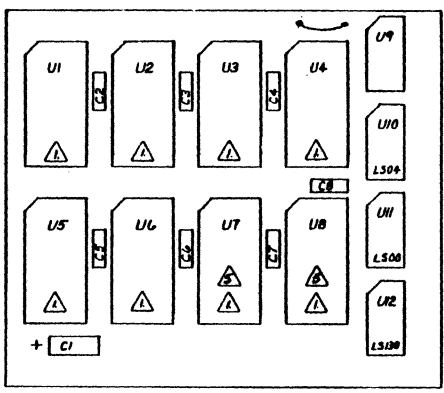
interface
 TECHNOLOGY
 600 VLS
 DATE: 1-6-79
 ASSY/LBO, RS-660 1K MEMORY CARD
 SHEET 1 OF 2

APPROVED BY: *BHK*
 DRAWN BY: A.P.P.
 REVISIONS:
 DRAWING NUMBER: 1-71155



interface TECHNOLOGY		
SCALE: NTS	APPROVED BY:	DRAWN BY: EK
DATE: 1-6-79		REVISION:
ASSY LBD RS-660 1K MEMORY CARD		
SHT 2 OF 2	55613	1001155

REV/SIGNS			
TYPE	DATE	BY	DESC
A	07-79	AME	ADD -002
B	11-80	PK	PER C.D. 0003



6. REF. 1001189 FOR PCB.

- ▲ OMIT FOR -002
- ---○--- -002 (MS-L60)
- ⊕ ---○--- -001 (MODEL 408)

3 CAPACITORS C2-C8 ARE 0.01 μF CERAMIC
 2. CAPACITOR C1 IS 10 μF 25 V.

TO U9
 PIN NO.

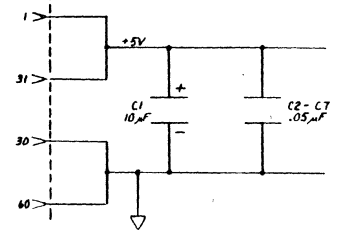
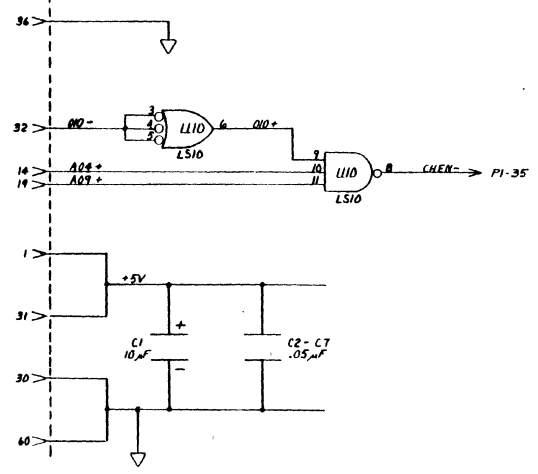
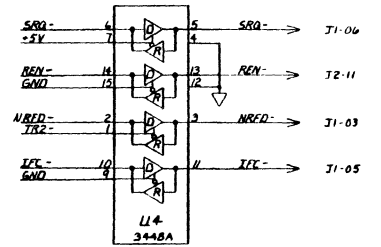
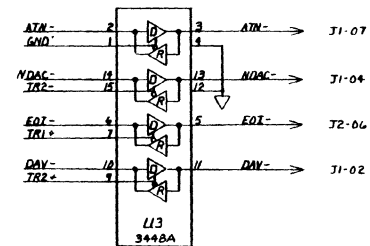
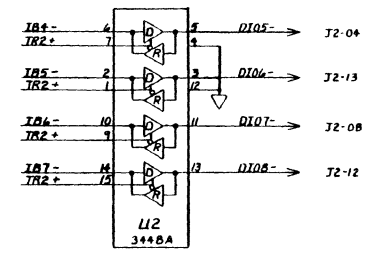
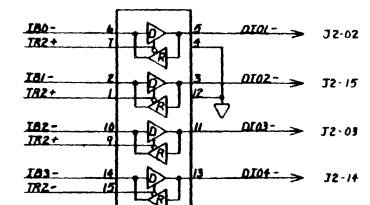
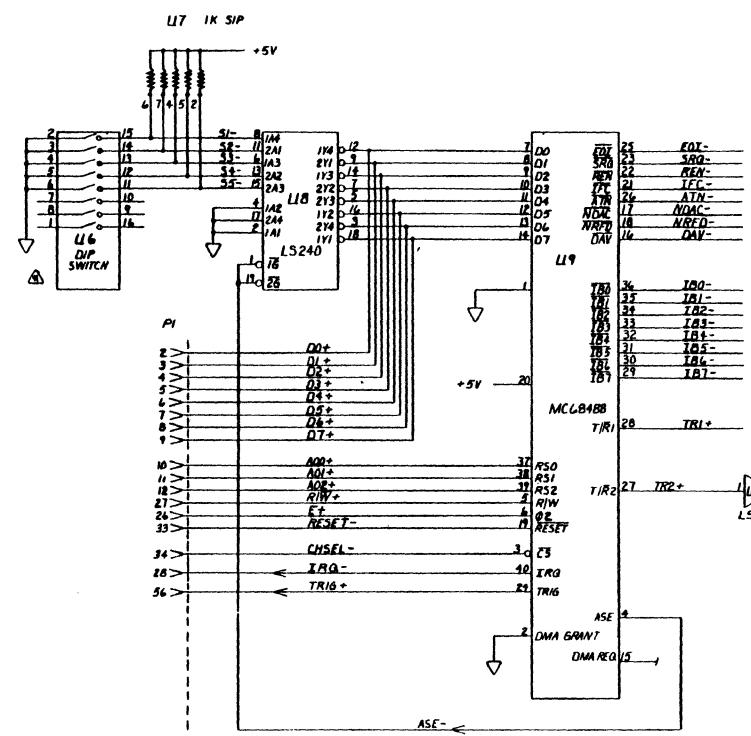
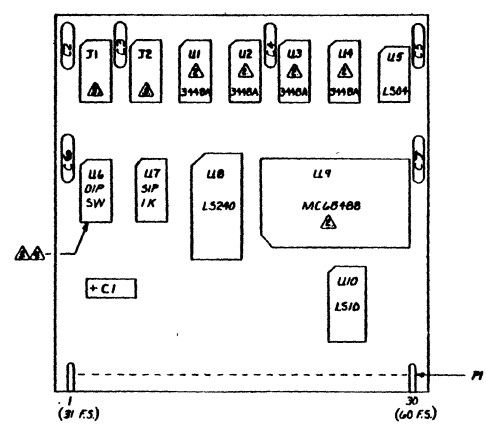
EPROM TYPE	FROM U9 PIN NO.	12	11	10	9	8
2758		1	3	2	4	5
2716		2	3	4	5	6
2732		2	4	5	6	7
2516		2	3	4	5	6

▲ U1-U8 MAY USE INTEL 2758, 2716, 2732 OR TI 2516
 INSTALL FOLLOWING JUMPERS ON U9.

NOTES:

interface TECHNOLOGIST			
DESIGNED BY: N.T.S.	APPROVED BY: ENL	DATE: 2-7-79	DESIGNED BY: A.J.K.
DATE: 1-8-79			
ASSY/LBD, STORED PGM CARD			
SHT 1 OF 1	556/13	1001133	

REVISIONS			
LT#	DATE	APPR	DESC
A	8/27/77	BJE	GENERAL

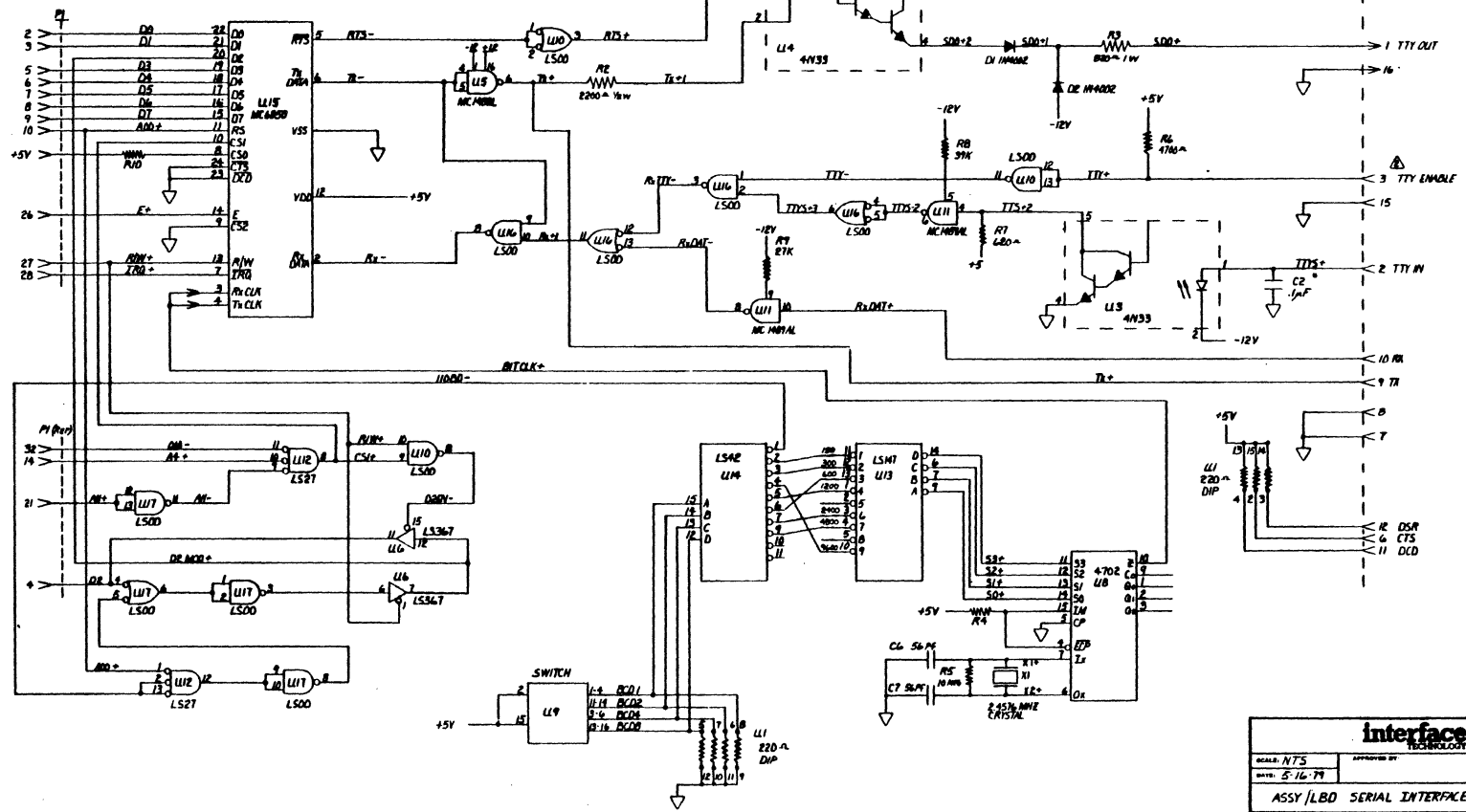
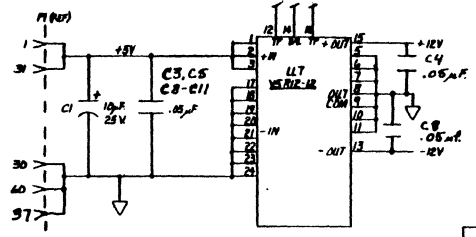
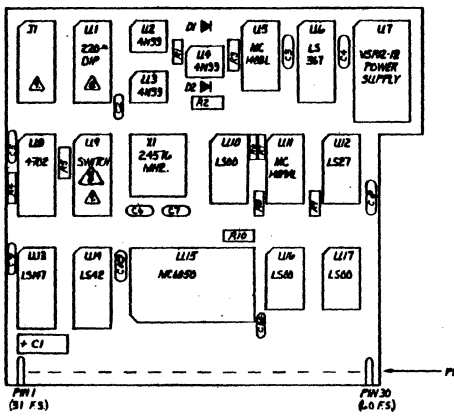


⚠ FOR MODEL 488, INSTALL 5 POSITION DIPSWITCH WITH SWITCH NO. 1 IN SOCKET PIN 2. FOR RS-660, INSTALL CABLE TO REAR PANEL.
 ⚠ N.P. DENOTES HIGH PROFILE SOCKET.
 ⚠ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED. I REFER TO 1001139 FOR PCB.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY		
DESIGN: NTS	APPROVED BY: <i>[Signature]</i>	DRAWN BY: RK
DATE: 8-9-77	REVISED:	REVISED:
ASSY/LBO IEEE INTERFACE CARD		
SHT. 1 OF 1	55613	REVISED NUMBER 1001134

REVISIONS			
REV	DATE	APP'D	DESC
A	05-13-79	R/R	GENRAL



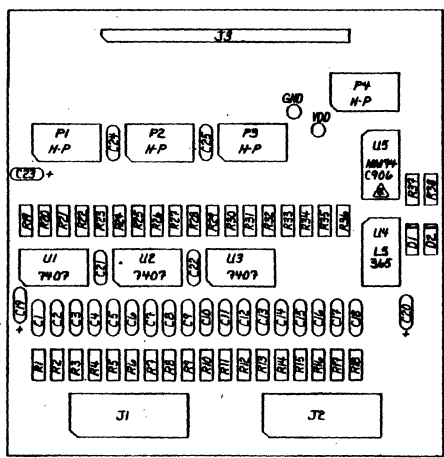
- ▲ #P DENOTES HIGH PROFILE SOCKET.
- ▲ FOR MOD. LOCATE 10 POSITION ROTARY SWITCH IN PIN 1 OF U1. FOR RS-660 INSTALL CABLE IN U1.
- 1. ALL INTERCONNECTED CIRCUITS ARE SYNTHIN UNLESS NOTED.
- 2. REF. IND1131 FOR PCB.
- 3. ALL RESISTORS ARE 1KΩ 1/4W CARBON COMP. UNLESS NOTED.
- 4. ALL CAPACITORS ARE 0.05µF 25V CERAMIC UNLESS NOTED.
- 5. C1 IS A 10µF 25V WVC ELECTROLYTIC CAPACITOR.
- 6. GROUND ON EXTERNAL CABLE TO ENABLE TTY.
- 7. REVERSE CABLE PULLS IN J1 TO OPERATE WITH TTY 20 mA NEUTRAL HALF-DUPLEX.

NOTES: UNLESS OTHERWISE SPECIFIED

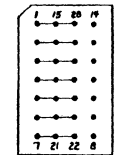
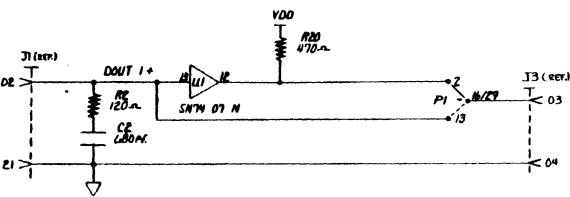
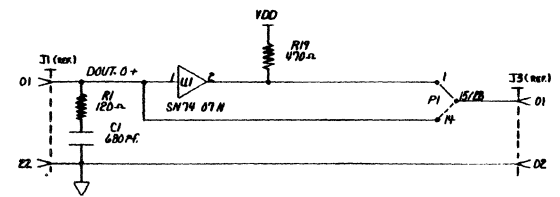
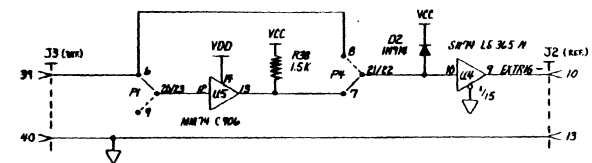
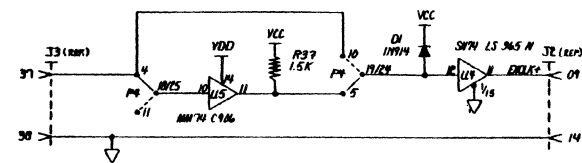
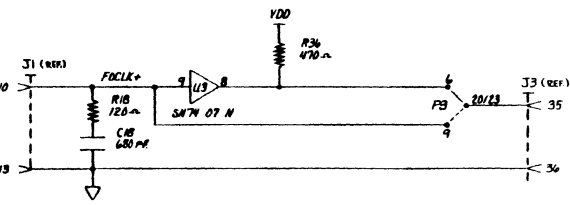
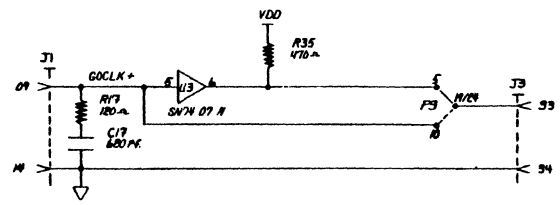
interface
TECHNOLOGY

SCALE: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 5-16-79	DESIGNED BY:	REVISION:
ASSY/LBD SERIAL INTERFACE CARD		
SHT 1 OF 1	ESS/LIS	ISSUANCE NUMBER 1801132

REVISIONS			
LTN	DATE	APPN	DESC



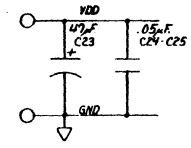
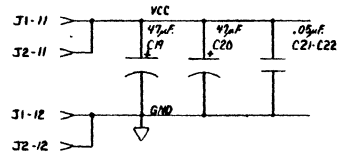
ASSEMBLY SIDE



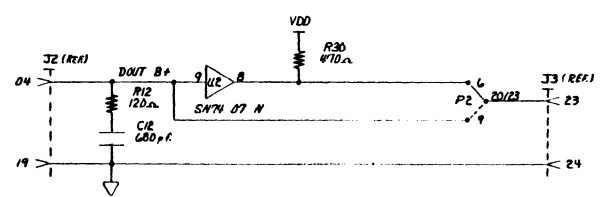
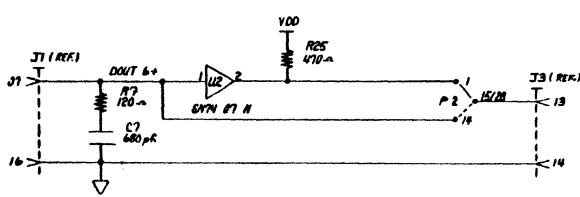
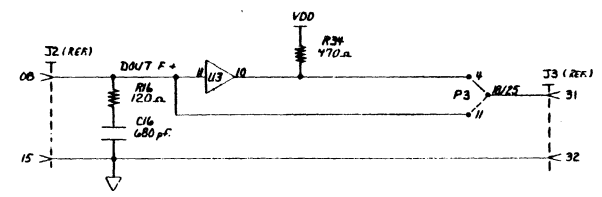
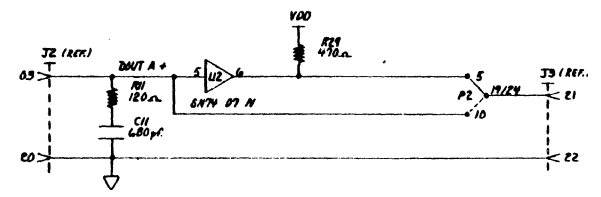
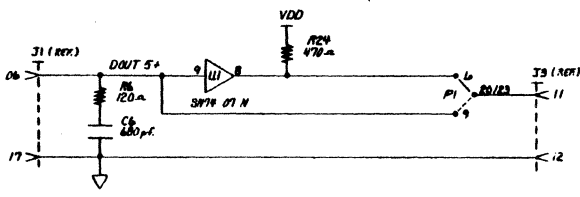
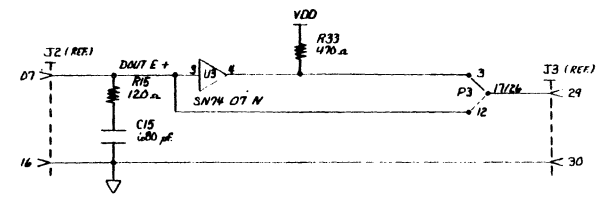
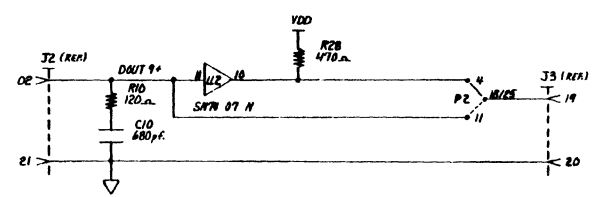
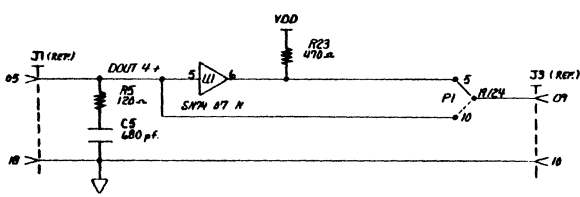
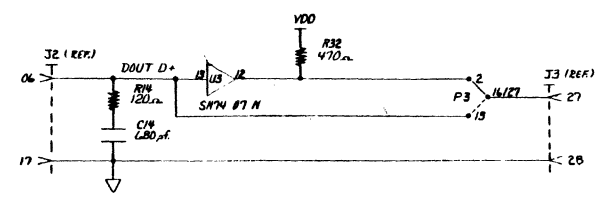
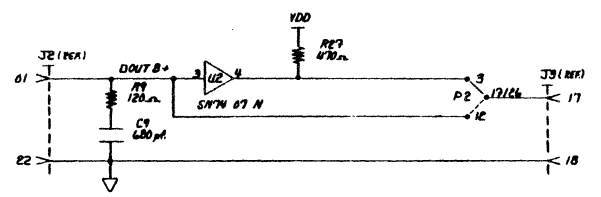
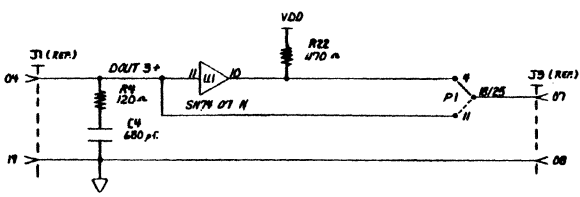
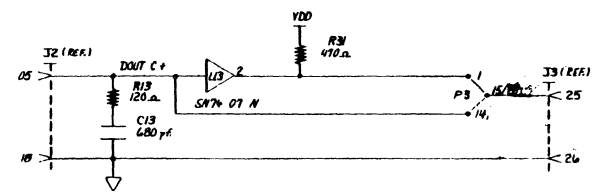
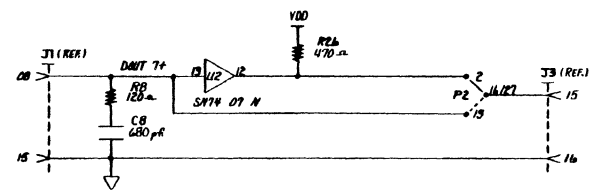
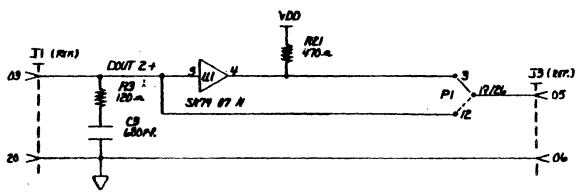
TYPICAL: P1 - P4

- 10. P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN1 DENOTES CMOS.
- 11. P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN8 DENOTES TTL.
- 1. REF. 10011509 FOR PCB.
- 2. ALL INTEGRATED CIRCUITS ARE SN74XK UNLESS NOTED.
- 3. D1 AND D2 ARE 1N4148 DIODES.
- 4. R37 AND R38 ARE 1.5K 1/4W CARBON COMP. RESISTORS.
- 5. R17 - R36 ARE 470Ω 1/4W CARBON COMP. RESISTORS.
- 6. R1 - R16 ARE 120Ω 1/4W CARBON COMP. RESISTORS.
- 7. C1, C22, C24 AND C25 ARE .05μF AT 25 WVDC CERAMIC DISC CAPACITORS.
- 8. C1 - C10 ARE 680pF AT 25 WVDC CERAMIC DISC CAPACITORS.
- 9. C19, C20 AND C23 ARE 47μF AT 25 WVDC TANTALUM CAPACITORS.

NOTES: UNLESS OTHERWISE SPECIFIED

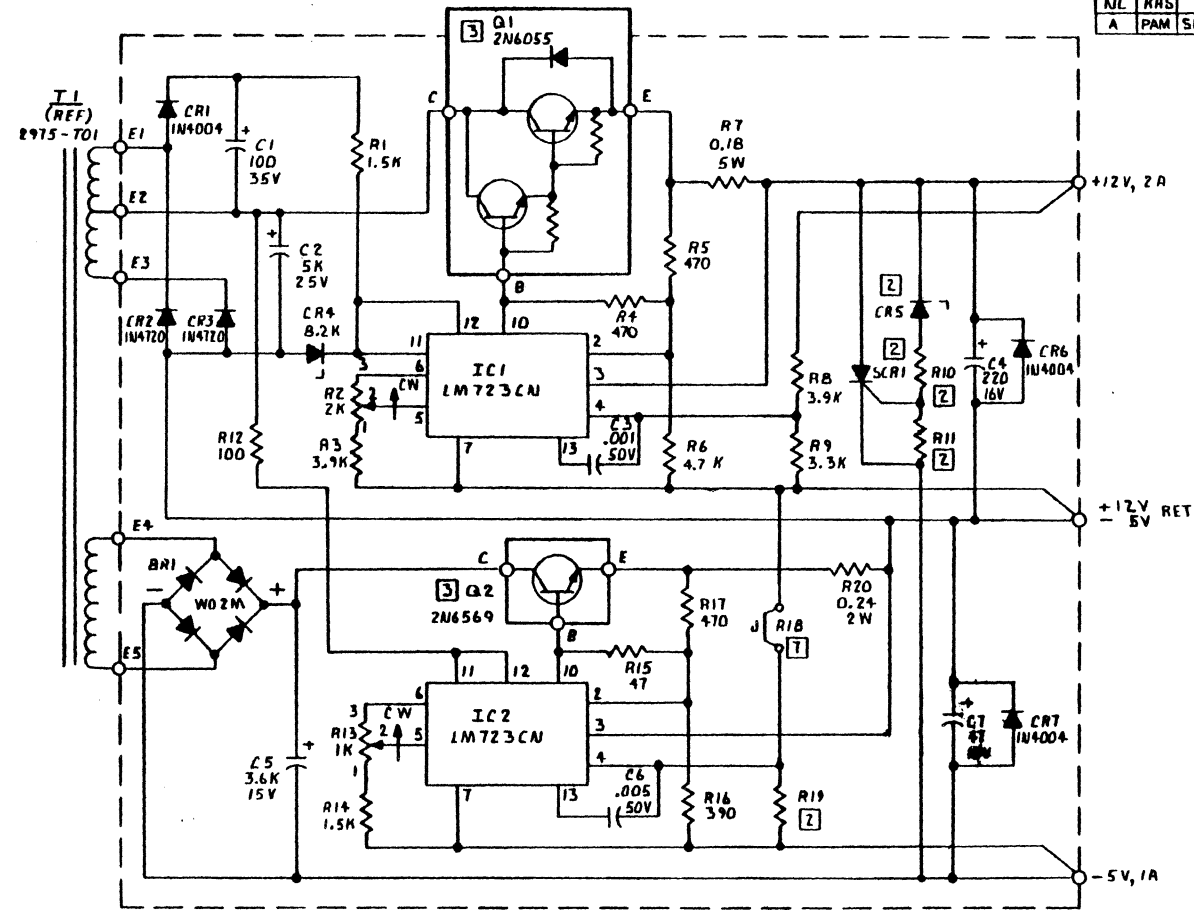


interface TECHNOLOGY		
DESIGN: NTS	APPROVED BY: <i>SKK</i>	DRAWN BY: RK
DATE: 8-7-79		
CLA / LBD, POD		
SHT. 1 OF 2	55613	DESIGN/DATE 10011310



interface TECHNOLOGY		
DESIGN: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 8-9-79		REVISED:
CCA/LBD, POD		
SHT. 2	556/3	ISSUING NUMBER 1001 1310

REVISIONS			APPR	DATE
REV.	BY	DESCRIPTION		
NC	KRS	INITIAL RELEASE	AP	5/2/79
A	PAM	SEE GUSECN 136	2/27/77	1/2/79



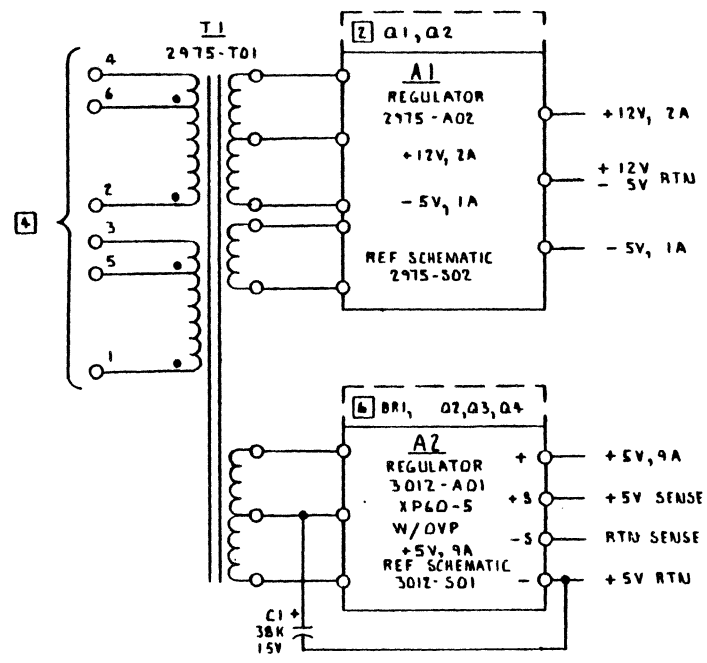
- [1] ADD JUMPER IN R18 POSITION.
 - 6. ALL CAPACITANCE VALUES IN MICROFARADS.
 - 5. ALL RESISTANCE VALUES IN OHMS $\pm 5\%$, $1/2W$.
 - 4. REF DOCUMENTS: ASSY 2975-AD1, 2975-AD2, SCHEM 2975-S01, P.C. BOARD 2940-DO1.
 - [3] COMPONENTS MOUNTED ON CHASSIS (REF ONLY): Q1, Q2.
 - [2] UNUSED REF DESIGNATIONS: CR5, R10, R11, R18, R19, SCR1.
 - 1. LAST USED REF DESIGNATIONS: BR1, C7, CR7, E5, IC2, Q2, R20, SCR1.
- NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQ'D	DESCRIPTION	PART NO.	MATERIAL	MANUFACTURER	ITEM NO.
LIST OF MATERIAL					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		SIGNATURES		DATES	
TOLERANCES		DWN. KAS		5/2/79	
FRAC. DEC. ANGLES		CHK.			
$\pm 1/32$.XX $\pm .02$.X.XX $\pm .010$		DSGN.		5-15-79	
MATERIAL:		APPR. A. P. [Signature]		15 MAR 79	
FINISH:		PROPRIETARY NOTICE		(INTERFACE TECH)	
		ALL PATENT OR OTHER PROPRIETARY RIGHTS PERTAINING TO THE ITEMS SOLD HEREUNDER SHALL REMAIN THE SOLE PROPERTY OF XENTEK INCORPORATED EXCEPT THAT THE PURCHASER SHALL HAVE THE RIGHT TO USE SUCH ITEMS FOR THEIR INTENDED PURPOSE.		CODE IDENT	
		DO NOT SCALE DWG.		SCALE: NONE	
		SIZE		DWG. NO.	
		53279 C		2975-S02	
		WEIGHT: ---		REV. NC	
		SHEET 1 OF 1			

NC 2975-S02

AC INPUT SCHEDULE			
INPUT (±10% AT 60HZ)	JUMPER TERMINALS	APPLY AC LINE	NEUT WIRE
100 VAC	1 TO 2, 5 TO 6	6	1
115 VAC	1 TO 2, 3 TO 4	4	1
200 VAC	2 TO 5	6	1
230 VAC	2 TO 3	4	1

REVISIONS			
REV.	BY	DESCRIPTION	APPR. DATE
MC	KAS	INITIAL RELEASE	APR 82
A	KAS	SEE ECN CUS-095	APR 82



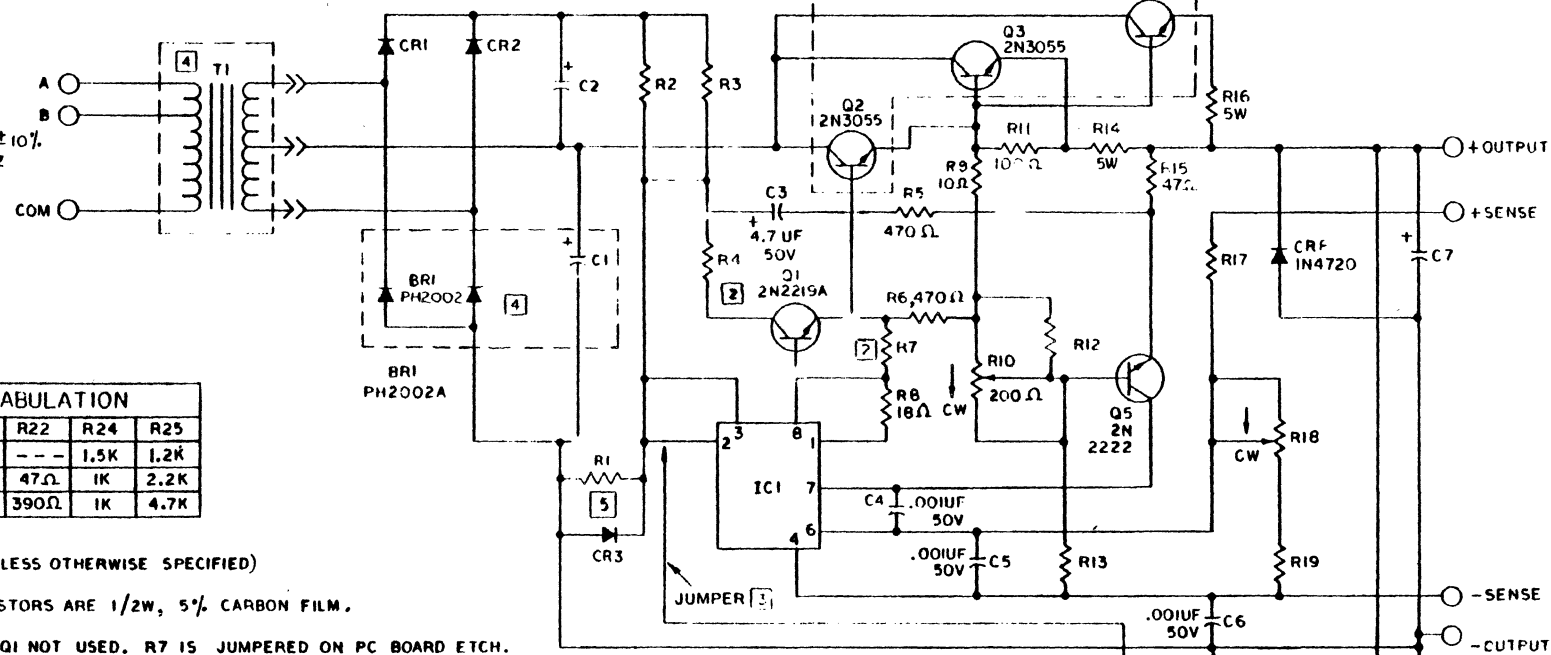
- 1. COMPONENTS MOUNTED ON CHASSIS AND WIRED PER SCHEMATIC 3012-S01.
- 2. ALL CAPACITANCE VALUE IN MICROFARADS.
- 3. SEE TABLE FOR INPUT VOLTAGE JUMPERING.
- 4. REF DOCUMENTS: ASSY 2975-A01, 2975-A02, 3012-A01, SCHEM 2975-S02, 3012-S01.
- 5. COMPONENTS MOUNTED ON CHASSIS AND WIRED PER SCHEMATIC 2975-S02.
- 6. LAST USED REF DESIGNATIONS: A1, A2, T1.

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQ'D	DESCRIPTION	PART NO.	MATERIAL	MANUFACTURER	ITEM NO.
LIST OF MATERIAL					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		SIGNATURES		DATES	
TOLERANCES		DWN. KAS		5/1/79	
FRAC. DEC. ANGLES		CHK.			
±1/32 .XX ±.00 ±1/2°		DGN.		TITLE	
		ENGR. <i>[Signature]</i>		5-15-79	
		APPR. <i>[Signature]</i>		15 MAY 79	
MATERIAL:		PROPRIETARY NOTICE			
FINISH:		ALL PATENT OR OTHER PROPRIETARY RIGHTS PERTAINING TO THE ITEMS SOLD HEREUNDER SHALL REMAIN THE SOLE PROPERTY OF XENTEK INCORPORATED EXCEPT THAT THE PURCHASER SHALL HAVE THE RIGHT TO USE SUCH ITEMS FOR THEIR INTENDED PURPOSE.			
		DO NOT SCALE DWG.		CODE IDENT	REV
				53279 C	A
				DWG. NO.	
				2975-S01	
				SCALE: NONE	WEIGHT: —
				SHEET 1 OF 1	

2975-S01

115VAC, ±10%
47-63HZ



OVP TABULATION

MODEL	R21	R22	R24	R25
3,5,9	470Ω	---	1.5K	1.2K
12	1.2K	47Ω	1K	2.2K
24,28	1.5K	390Ω	1K	4.7K

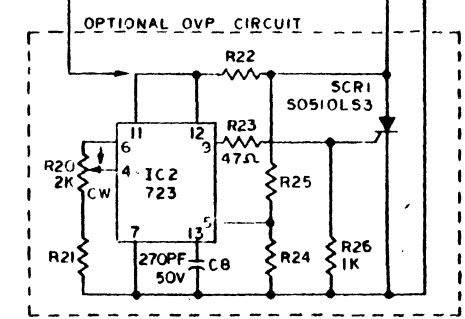
NOTES: (UNLESS OTHERWISE SPECIFIED)

- 1. ALL RESISTORS ARE 1/2W, 5% CARBON FILM.
- 2 R4 AND Q1 NOT USED. R7 IS JUMPED ON PC BOARD ETC.
- 3 JUMPER USED ON -3,-5,-9 MODELS WITH OVP.
- 4 [] INDICATES CHASSIS MOUNTED COMPONENTS.
- 5 CR3 USED ON -24,-28 ONLY.

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF XENTEK INC.

TABULATION

MODEL	INPUT TAP A	INPUT TAP B	IC1	C1	C2	C7	CR1,2	IC3	R2,3	R12	R13	R14,16	R17	R18	R19
XP60-3	2-3V, 12A	4V, 12A	LM300	56K UF 15V	100UF 16V	2.2K UF 10V	IN4001	-	100Ω	270Ω	220Ω	.1Ω	220Ω	2K	100Ω
XP60-5	5V, 12A	6V, 10A	LM305	56K UF 15V	100UF 16V	2.2K UF 10V	IN4001	3.3K	470Ω	100Ω	270Ω	.1Ω	5.6K	2K	1.8K
XP60-9	7V, 9A 8V, 8.6A	9V, 8.2A 10V, 7.8A	LM305	29K UF 25V	100UF 25V	1K UF 25V	IN4001	4.7K	1K	470Ω	1K	.1Ω	10K	2K	1.5K
XP60-12	11V, 6.8A 12V, 6.5A 13V, 6.1A	14V, 6.4A 15V, 6.0A 16V, 5.6A	LM305	22K UF 35V	100UF 35V	1K UF 25V	IN4002	12K	3.9K	470Ω	1.5K	.22Ω	18K	2K	1.8K
XP60-24	17±18V, 5.2A 19±20V, 5A	21±22V, 5.2A 23±24V, 5A	LM305A	13K UF 50V	47UF 63V	470UF 35V	IN4002	IN 4751A	8.2K	-	3.9K	.22Ω	15K	1K	1K
XP60-28	25±26V, 3.2A 27±28V, 2.6A	29±30V, 2.4A 31±32V, 1.8A	LM305A	13K UF 50V	47UF 63V	470UF 35V	IN4002	IN 4753A	10K	390Ω	5.6K	.22Ω	27K	1K	1.3K



XENTEK INC.
SAN MARCOS CALIF.

SCALE: --- APPROVED BY: *LH/AF* DRAWN BY: *GAJ*

DATE: 8-3-74 REVISED:

POWER SUPPLY SCHEMATIC REV. **A**

MODEL XP60 SERIES DRAWING NUMBER: 3012 - 501

APPENDIX F: REPRESENTATIVE LIST

DOMESTIC

CALIFORNIA, NEVADA

Ward/Davis Associates
2615 Manhattan Beach Blvd.
Redondo Beach, CA 90278
213-973-7772

2333 Camino Del Rio South, Suite 150
San Diego, CA 92108
714-298-8912

3329 Kifer Road
Santa Clara, CA 95051
408-245-3700

METRO NEW YORK, NORTHERN NEW JERSEY

SET Marketing, Inc.
287 Northern Blvd., Suite 104
Great Neck, NY 11021
516-466-0550 TWX: 510-223-0833

UPSTATE NEW YORK

Naco Electronics Corporation
P.O. Box 276
N. Syracuse, NY 13212
315-699-2651 TWX: 710-541-0439

2631 Edgewood Road
Utica, NY 13501
315-732-1801

6780 Pittsford-Palmyra Road
Fairport, NY 14450
716-223-4490

NEW ENGLAND

Pat Jenks Associates
2315 Whitney Avenue
Hamden, CT 06518
203-281-0810 TWX: 710-465-2096
607 North Avenue, Door #16
Wakefield, MA 01880
617-246-1590 TWX: 710-348-6559

ROCKY MOUNTAINS

BFA Corporation of Arizona
12015 East 46th Avenue
Campus Six, Suite 160
Denver, CO 80239
303-371-2422 TWX: 910-932-0315

3705 Westerfield, N.E.
Albuquerque, NM 87111
505-292-1212 TWX: 910-989-1157

P.O. Box 1237
Las Cruces, NM 88001
505-523-0601 TWX: 910-983-0543

4426 N. Saddlebag Trail
Scottsdale, AZ 85251
602-994-5400 TWX: 910-950-1193

140 W. 2100 South, Suite 130
Salt Lake City, UT 84115
801-466-6522 TWX: 910-925-5666

SOUTH CENTRAL

Data Marketing Associates
3330 Bering Drive
Houston, TX 77057
713-780-2511 TWX: 910-881-2569

14235 Proton Road
Dallas, TX 75240
214-661-0300 TWX: 910-860-5483

2401 N.W. 39th Expressway, Suite 103
Oklahoma City, OK 73112
405-528-6071

8622 Crownhill, Suite 105
San Antonio, TX 78009
512-828-0937 TWX: 910-871-1033

300 E. Huntland Drive
Austin, TX 78752
512-451-5174

MIDWEST

Ramsey Associates
1901 Congressional Drive
St. Louis, MO 63141
314-569-1406

6900 W. 80th Street
Overland Park, KS 66204
913-649-6996

Sector Engineering Sales
6200 Rolling Hills Road
Hamel, MN 55340
612-478-6675

8705 Port Washington Road
Milwaukee, WI 53217
414-352-8280

770 N. Church Road
Elmhurst, IL 60126
312-530-7850

8463 Castlewood Drive
Indianapolis, IN 46250
317-842-1120

MID ATLANTIC

Creative Marketing Associates
6845 Elm Street, Suite 107
McLean, VA 22101
703-893-6612 TWX: 710-833-0310

Eastern Instrumentation of Philadelphia
Street Road & Bristol Pike
Neshaminy Plaza, Bldg. 2, Suite 114
Cornwells Heights, PA 19020
215-245-6660 TWX: 510-667-1581

OHIO VALLEY

EQS Systems
P.O. Box 445
8517 Herrick Drive
Chesterland, OH 44026
216-729-2222

6520 Milhoff
Dayton, OH 45424
513-434-8993

6145 Hillsboro Rd.
Davisburg, MI 48019
313-961-3042

NORTHWEST

Pacific Northwest Electronics
14264 S.E. Eastgate Way
Bellevue, WA 98007
206-641-6444

2035 S.W. 58th
Portland, OR 97221
503-292-3505

SOUTHEAST

Saber Associates, Inc.
2501 N.W. 17th Lane
Pompano Beach, FL 33064
305-973-3804 or 800-327-8998 (Outside Florida)
TWX: 510-956-9477

FOREIGN

CANADA

Interfax Systems, Inc.
P.O. Box 880
Richmond, Ontario K0A 2Z0
tel: 613-838-3187

2800 Sabourin
Montreal, Quebec H4S 1M2
tel: 514-336-0430
telex: 05-825820

2651 Aquitaine, Unit 42
Mississauga, Ontario L5N 1V5
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DENMARK

Tagø Olsen A/S
Postbus 225
Ballerup BYVEJ 222
Dk-2750 Ballerup, Denmark
tel: (02) 65 81 11
telex: 35293

FRANCE

MB Electronique
Rue Fourny, Zac de Buc
B.P. No 31
78530 Buc, France
tel: 956-31-30
telex: 695414

BENELUX

Airparts International, BV
Postbus 255
2400 AG Alphen A/D Rijn, Holland
tel: (01720) 29300
telex: 39564

Huart-Hamoiriaan, 1-7B
1030 Brussels, Belgium
tel: (02) 241-81-30
telex: 25146

JAPAN

Tokyo Electronics Trading Co., Ltd.
307, 4-Chome, Higashifushimi
Hoya-shi, Tokyo 188, Japan
tel: (0424) 66-0103
telex: 2822617

UK (ENGLAND, WALES, SCOTLAND, IRELAND)

Wavetek Electronics Ltd.
109 Crockhamwell Road
Woodley, Reading
Berks RG5, 3JP, England
tel: (0734) 694944
telex: 849301

WEST GERMANY (W. BERLIN)

Kontron Elektronik GmbH
Breslauer Strasse 2
8057 Eching B.
Munchen, W. Germany
tel: (089) 31901-1 (central operator)
telex: 522122

AUSTRIA

Kontron GmbH & Co. KG
Industriestrasse B13
A-2345 Brunn am Gebirge, Austria
tel: 022 36/866 31 0
telex: 79337

SWEDEN

Aktiv Elektronik AB
Box 365
S-162 03 Vallingby, Sweden
tel: 08/739 00 45
telex: 08 854-11-436

SWITZERLAND, SPAIN

Instrumatic AG
Weingartenstrasse 9
CH-8803 Ruschlikon
Zurich, Switzerland
tel: 01/724-14-10
telex: 56 605

20, rue de Montchoisy
CH-1207 Geneva
Geneva, Switzerland
tel: 022 36-08-30
telex: 28 667

Avenida Generalisimo 20
Apartado 151
E-Malaga, Spain
tel: 21-31-99
telex: 77-131

Angel Guirnera 11
E-San Cugat del Valles
Barcelona, Spain
tel: 674-50-48