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MODEL RS-660

TIMING SIMULATOR/WORD GENERATOR

INSTRUCTION MANUAL

interface
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MODEL RS-660

TIMING SIMULATOR/WORD GENERATOR

INSTRUCTION MANUAL

August, 1979

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WARRANTY

Interface Technology warrants each instrument manufactured to be free of defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Interface Technology will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to Interface Technology freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Instruments repaired beyond the effective date of warranty or when abnormal useage has occurred will be charged at applicable rates. Interface Technology will submit an estimate for such charges commencing repair if so requested.
For any questions concerning this warranty or shipping call Interface Technology or our sales representative in your area.

PERSONNEL SAFETY

The equipment described in this manual contains voltages hazardous to human life and safety and which is 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. 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.

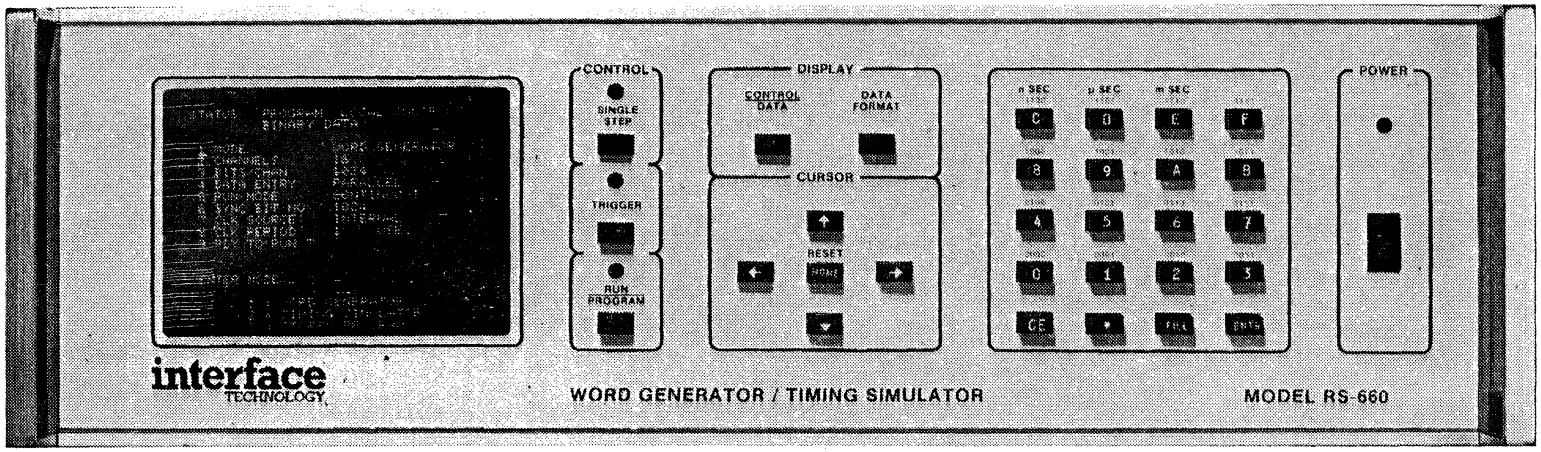
Figure 1-1 is a front view of the Model RS-660 and illustrates the front panel operating controls.

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

1.2 OPTIONS

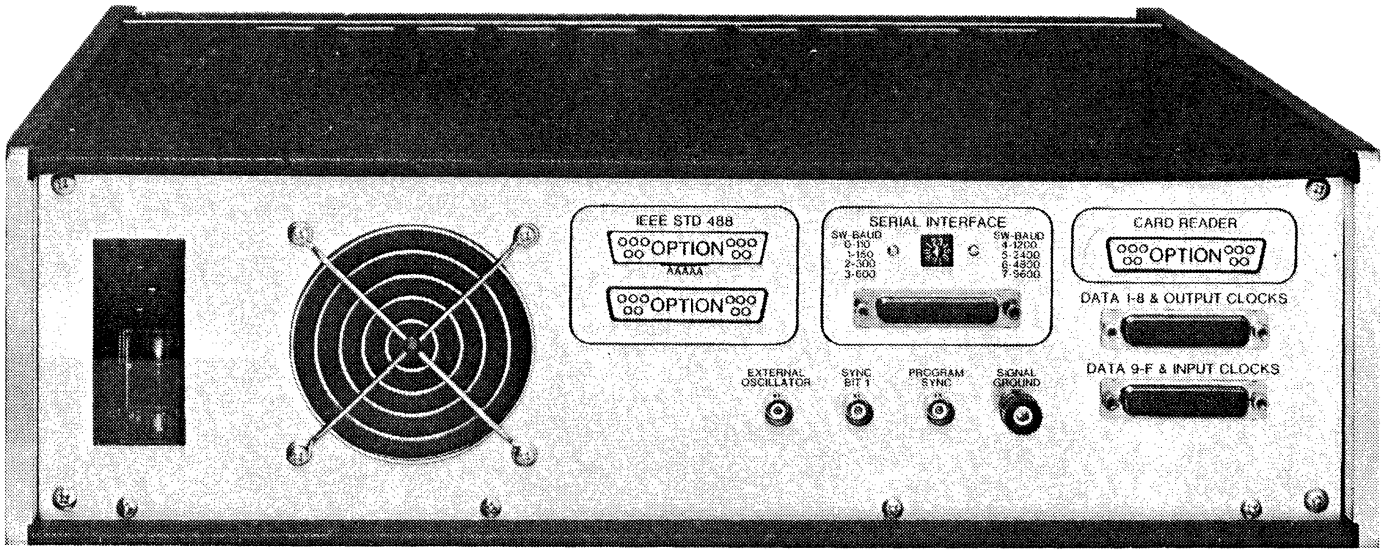
1.2.1 Memory Option, 4K (Option 660-001)

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 six 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 determing 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)

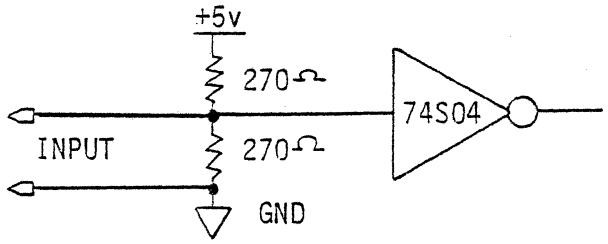
NOTE: If the number of BITS PER CHANNEL (B) and the number of CHANNELS (C) satisfy the following equation, the clock frequency is limited to 10MHZ internal, 12MHZ external.

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

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 J8.



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.

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") = +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 suppled 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.

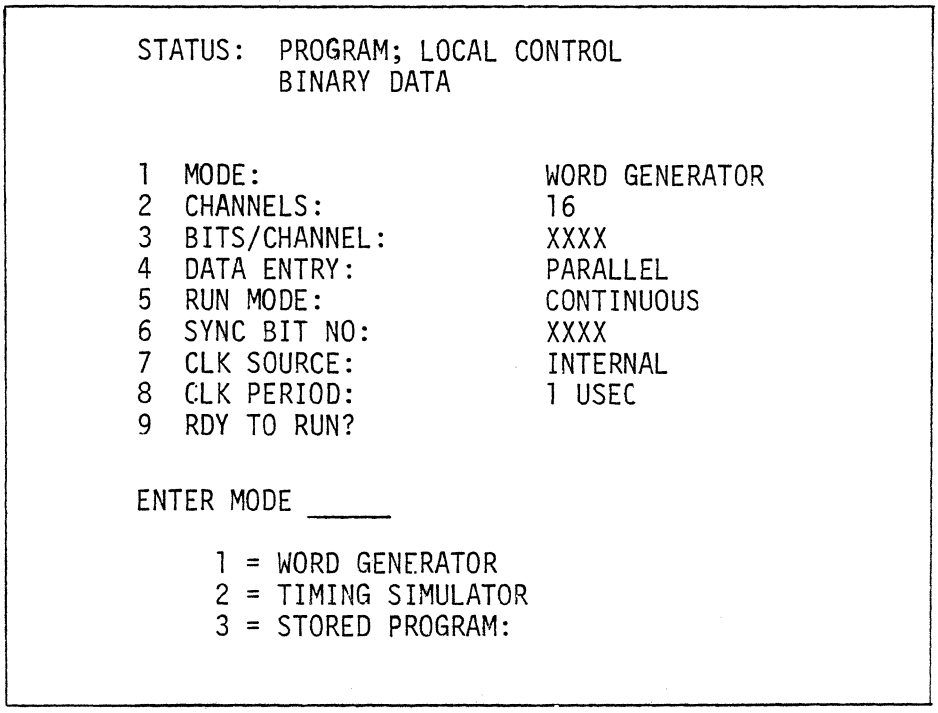
It is not to be implied that this procedure will provide a 100% test of the unit. Rather, it verifies the basic performance of the Model RS-660 and will detect most of the potential problems.

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



Note XXXX = 1024 or 4096 depending on memory capacity.

Note that application of power to the device causes the internal microporcessor 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(MDØ- MD7-), RAM2(MD8/T7- MDF/TO-) 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

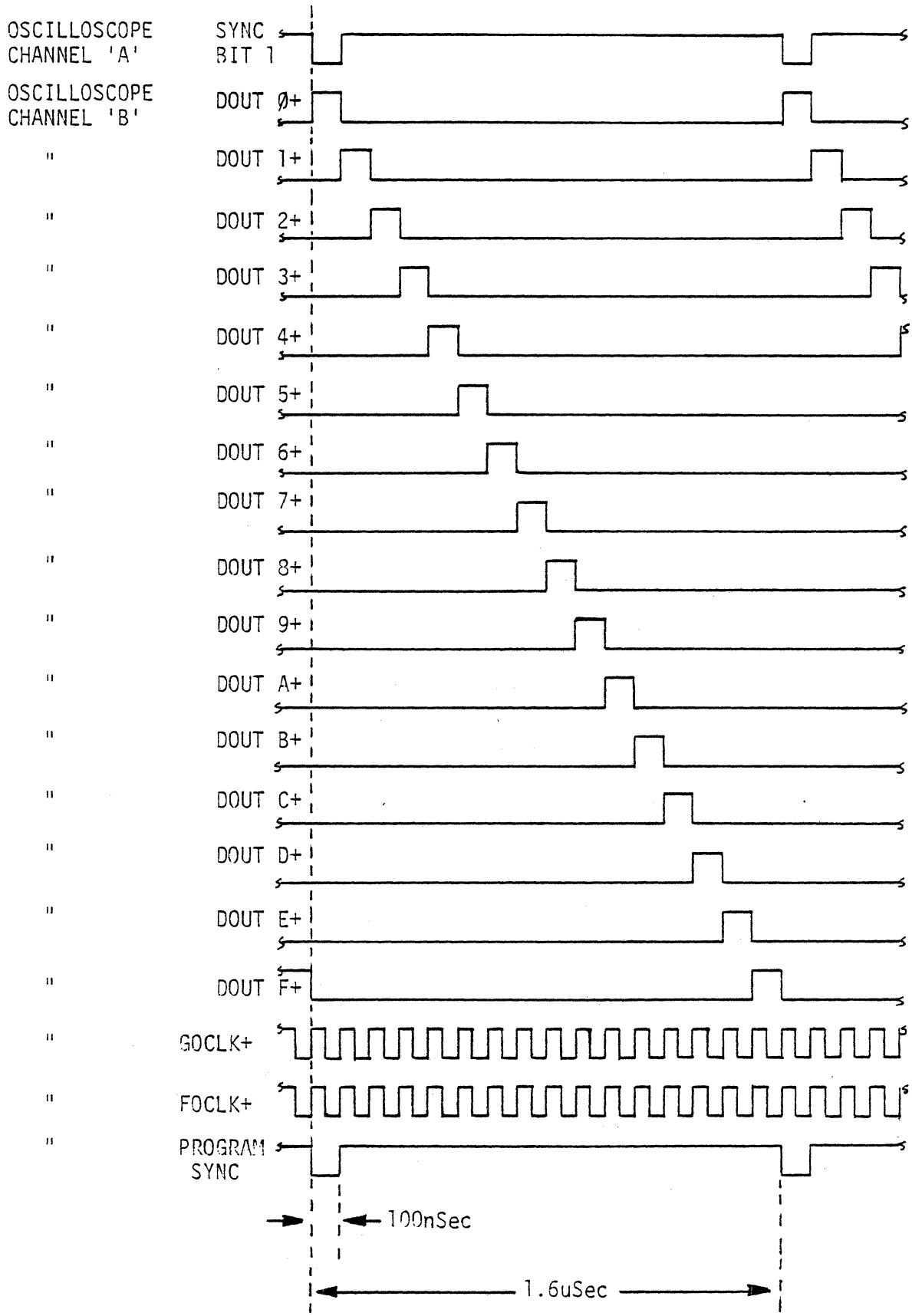
WORD	CHANNEL			
	0123	4567	89AB	CDEF
1S	1000	0000	0000	0000
2	0100	0000	0000	0000
3	0010	0000	0000	0000
4	0001	0000	0000	0000
5	0000	1000	0000	0000
6	0000	0100	0000	0000
7	0000	0010	0000	0000
8	0000	0001	0000	0000
9	0000	0000	1000	0000
10	0000	0000	0100	0000
11	0000	0000	0010	0000
12	0000	0000	0001	0000
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 (DOUTØ+ 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
```

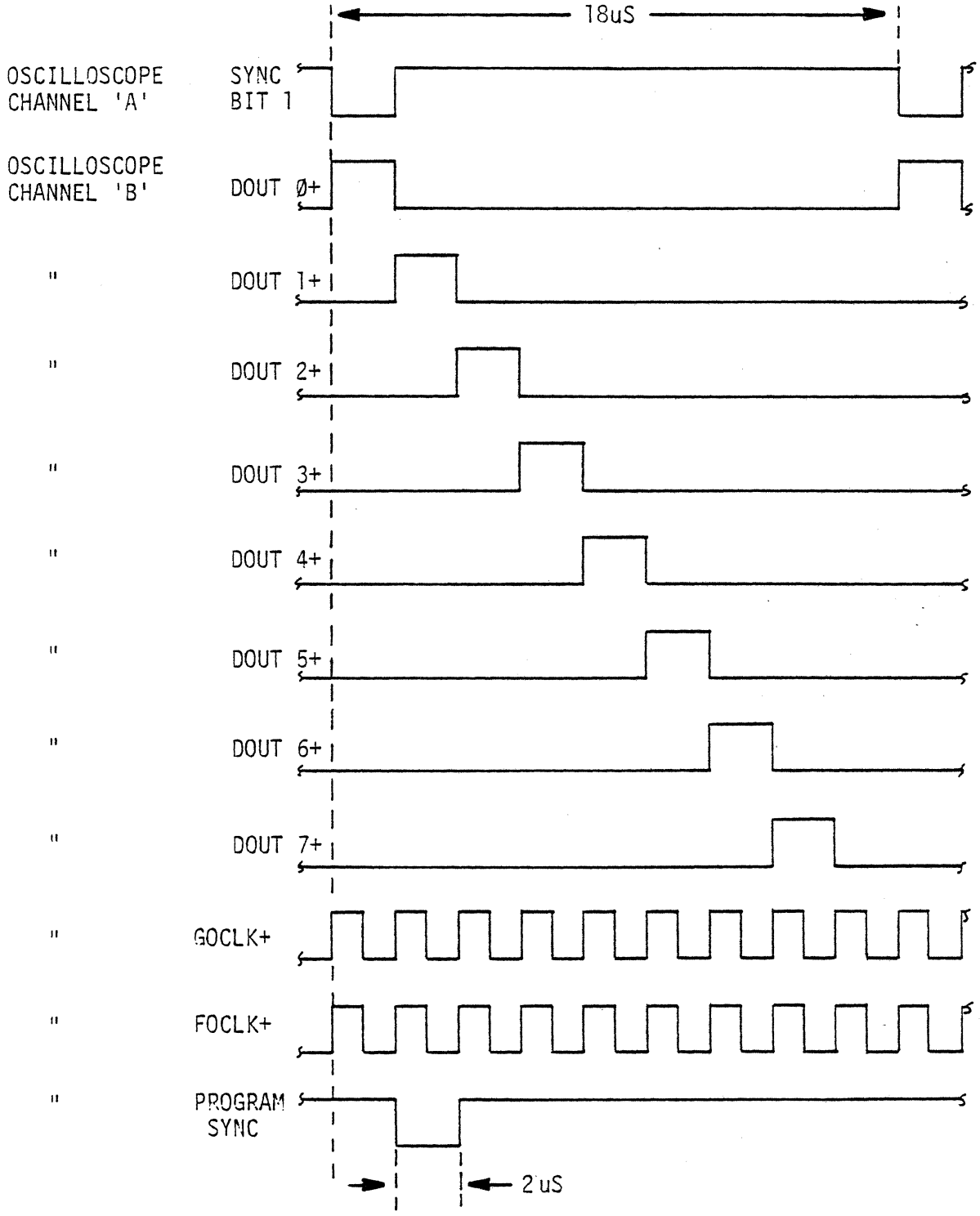
Figure 2.6
STORED PROGRAM NO. 991 DATA DISPLAY

WORD	CHANNEL 0123	CHANNEL 4567	WORD	CHANNEL 0123	CHANNEL 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	XXXX	32	XXXX	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 (DOUTØ 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.

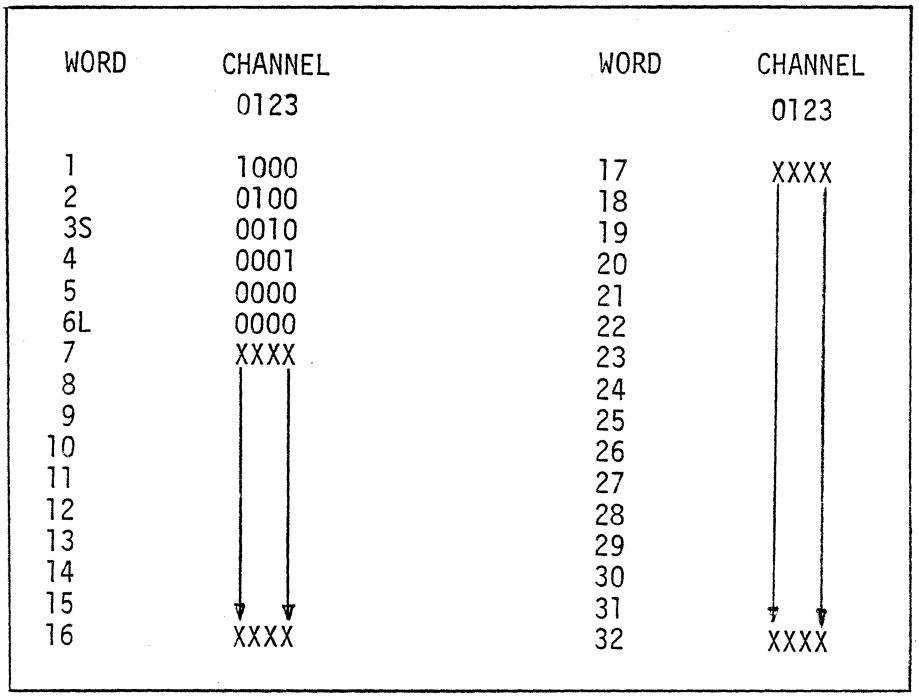
Figure 2.8
STORED PROGRAM NO. 992 CONTROL DISPLAY

```
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
```

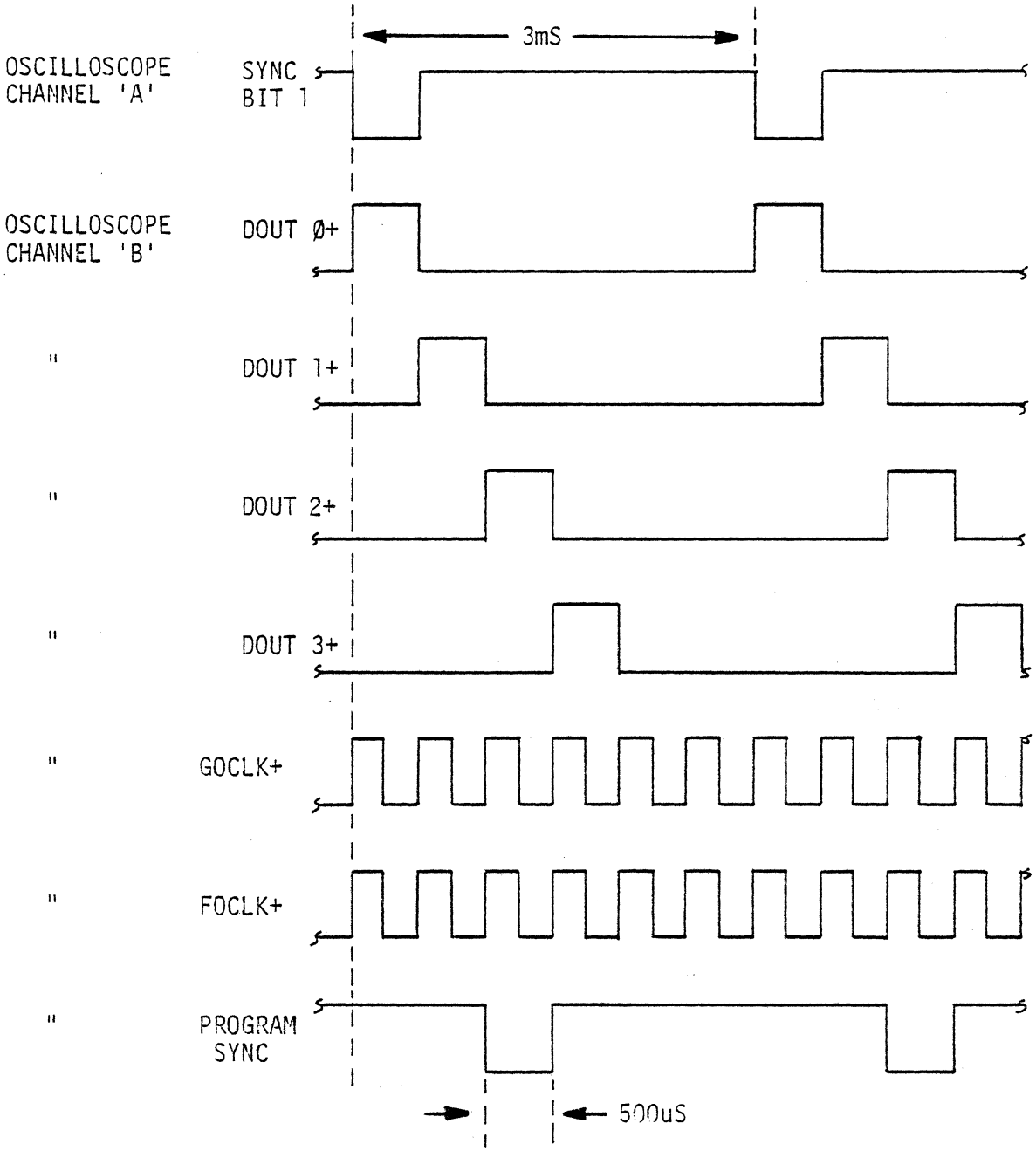
Figure 2.9
STORED PROGRAM NO. 992 DATA DISPLAY



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:              PARALLEL
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
```

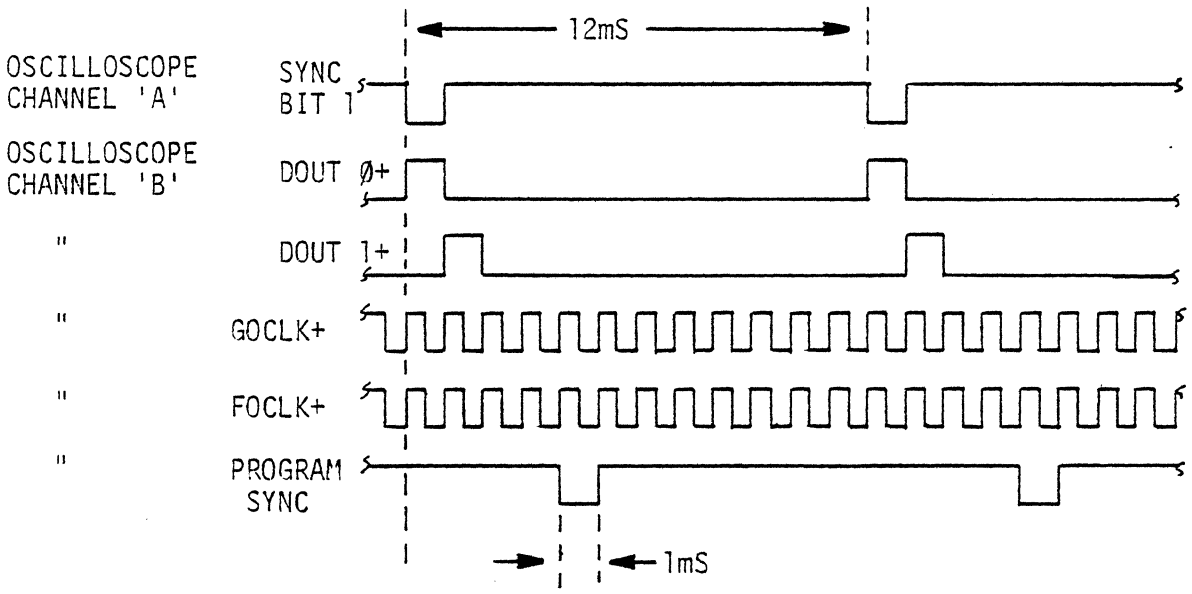
Figure 2.12
STORED PROGRAM NO. 993 DATA DISPLAY

```
CURSOR BIT 1

       1 - - - - BIT - - - - -16
CHAN                        L
  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:              PARALLEL
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

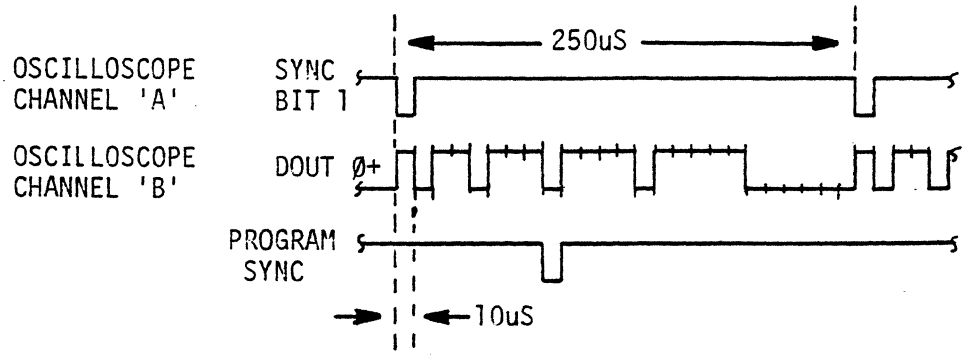
```
CURSOR BIT 1

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

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

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
```

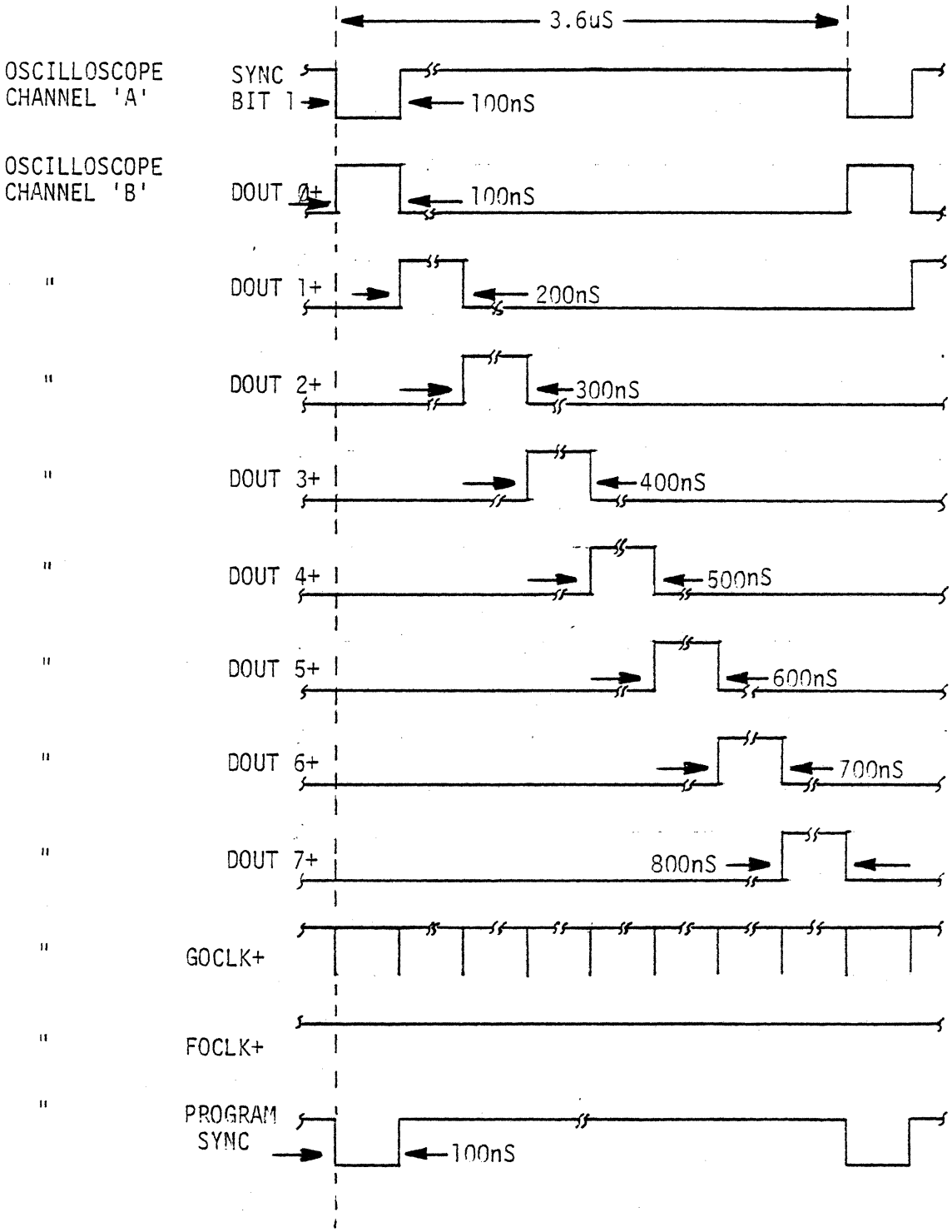
Figure 2.18
STORED PROGRAM NO. 995 DATA DISPLAY

```
                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

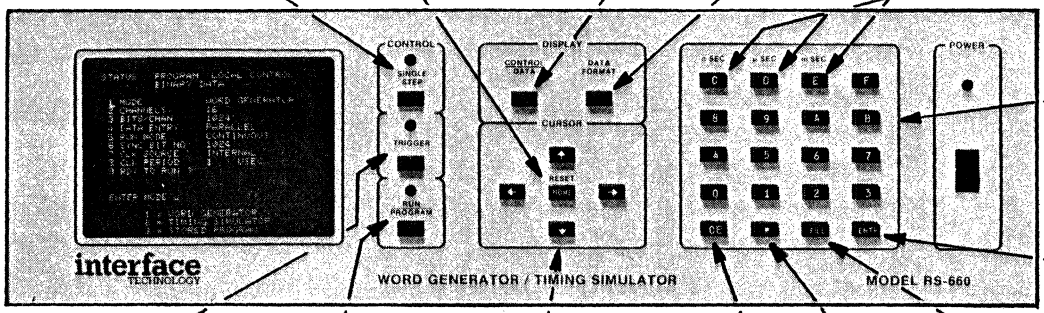

1  MODE:              WORD GENERATOR
2  CHANNELS:          16
3  BITS/CHANNEL:      XXXX
4  DATA ENTRY:        PARALLEL
5  RUN MODE:          CONTINUOUS
6  SYNC BIT NO:       XXXX
7  CLK SOURCE:        INTERNAL
8  CLK PERIOD:        1 USEC
9  RDY TO RUN?

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



SINGLE STEP
Key enables/disables SINGLE STEP operation. LED illuminates when SINGLE STEP operation is enabled.

HOME/RESET
Dual function. Relocates cursor to a default position; i.e., "home". Clears remote control operation and re-establishes local control.

CONTROL/DATA
Changes display between control and data displays.

DATA FORMAT
Changes the data display between binary and hexadecimal formats. Current format is displayed at the top of the control display.

TIME UNITS

HEX KEYBOARD

ENTR
Enter key used to enter keyboard data.

TRIGGER
Dual function - applicable to RUN and SINGLE STEP modes. LED illuminated when waiting for either depression of TRIGGER key or external trigger pulse.

RUN/PROGRAM
Key depression causes RS-660 operating state to change between running and programming states. LED illuminates when instrument is running.

CURSOR
Moves cursor in the direction indicated by arrow, unless movement is this direction is invalid.

CE
Clear entry key used to clear an invalid or erroneous entry.

DECIMAL POINT

FILL
Fill key used to repetitively load previously defined data patterns into memory.

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:

$$\frac{C}{16}(B-1) = n$$

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

If an external clock source has been selected, parameter no. "8" specifies the minumum 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 suppled, 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 coincidently 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 is 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 eight 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	'2ØØØ	Øn	MSD of program number nnn. ØØØ≤nnn≤989 (BCD).
	'2ØØ1	nn	LSDs " " " " .
	'2ØØ2	aa	MSB of first EPROM address where program number nnn resides(HEX)
	'2ØØ3	aa	LSB " " " " " " " " "
	'2ØØ4	Øm	directory data for program number mmm
	'2ØØ5	mm	
	'2ØØ6	bb	
Directory	'2ØØ7	bb	
	'x-4	Øp	directory data for program number ppp
	'x-3	pp	
	'x-2	cc	
	'x-1	cc	
Directory End	'x	'FF	designates end of directory
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	ØN	MSD of number of words/bits per channel (BCD)
	+4	NN	" " " " " " "
	+5	NN	LSDs " " " " " " " "
	+6	ØS	MSD of sync word/bit number (BCD)
	+7	SS	" " " " " "
	+8	SS	LSDs " " " " " "
	+9	RR	MSDs of number of pattern repetitions (BCD) } irrelevant in
	+10	RR	LSDs " " " " " " } continuous mode
	+11	ØM	Clock period multiplier (ref. table 3.3) } irrelevant in
	+12	TT	MSDs of clock period digits (ref. table 3.3) } TIMING SIMULATOR
Control	+13	TT	LSDs " " " " } or External Clock WORD GENERATOR MODES

TABLE 3.1 (continued)
STORED PROGRAM EPROM DATA FORMAT

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

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

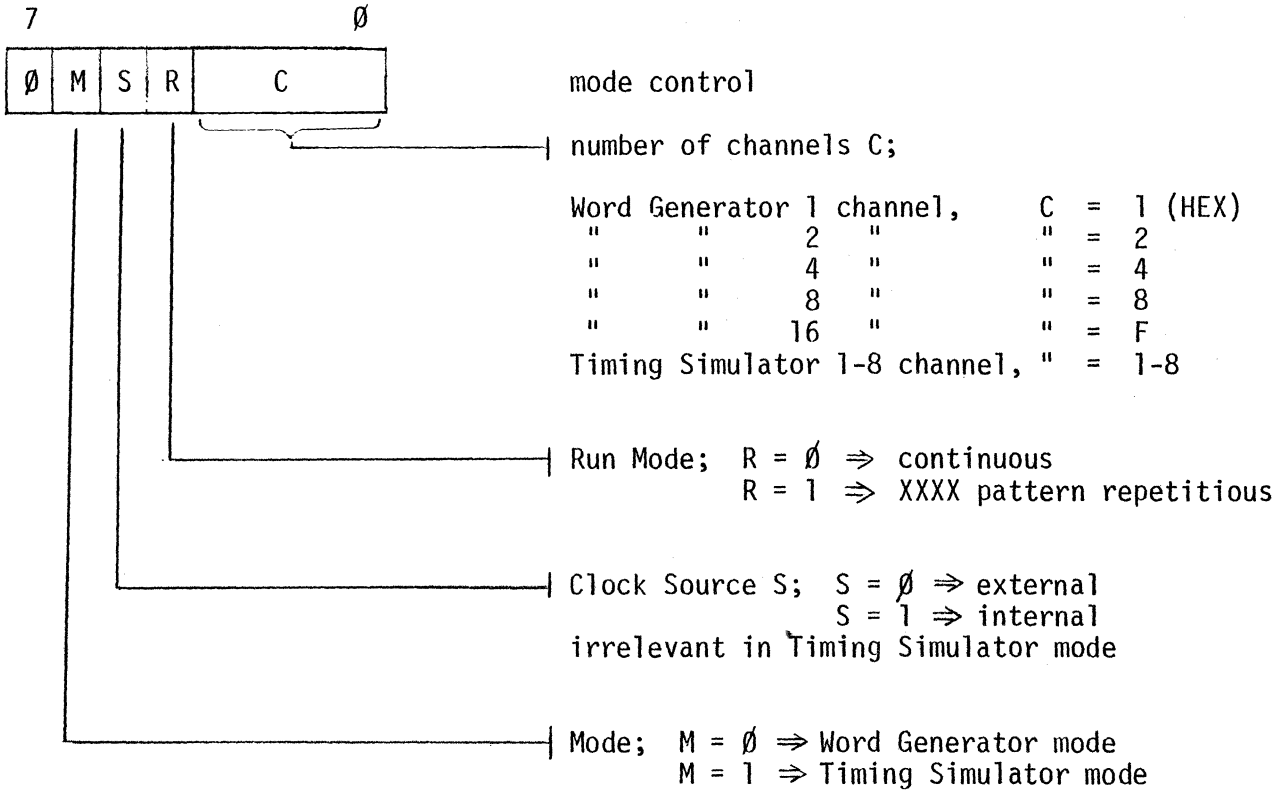
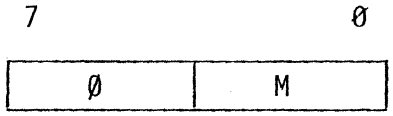


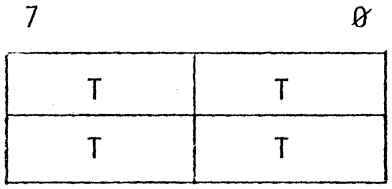
TABLE 3.3
STORED PROGRAM EPROM DATA FORMAT
CLOCK PERIOD MULTIPLIER AND DIGITS



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

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

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

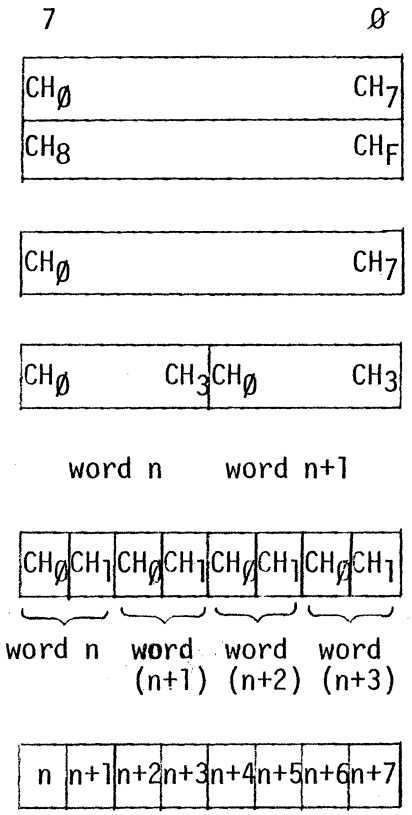


MSDs of clock period (BCD) 3 digits +
LSDs of clock period (BCD) decimal point.

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.

2 channel; 4 data words per byte

1 channel; 8 data bits per byte

TABLE 3.5
STORED PROGRAM DATA FORMAT
TIMING SIMULATOR DATA AND TIME

period≠5ØnSec

7	0
$CH_Ø$	CH_7
T	T
T	T
Ø	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

5ØnSec word pair

$CH_Ø$	CH_7
$CH_Ø$	CH_7
$5_{(HEX)}$	Ø
Ø	$C_{(HEX)}$

data word nA
data word nB

designates 5Ø 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.

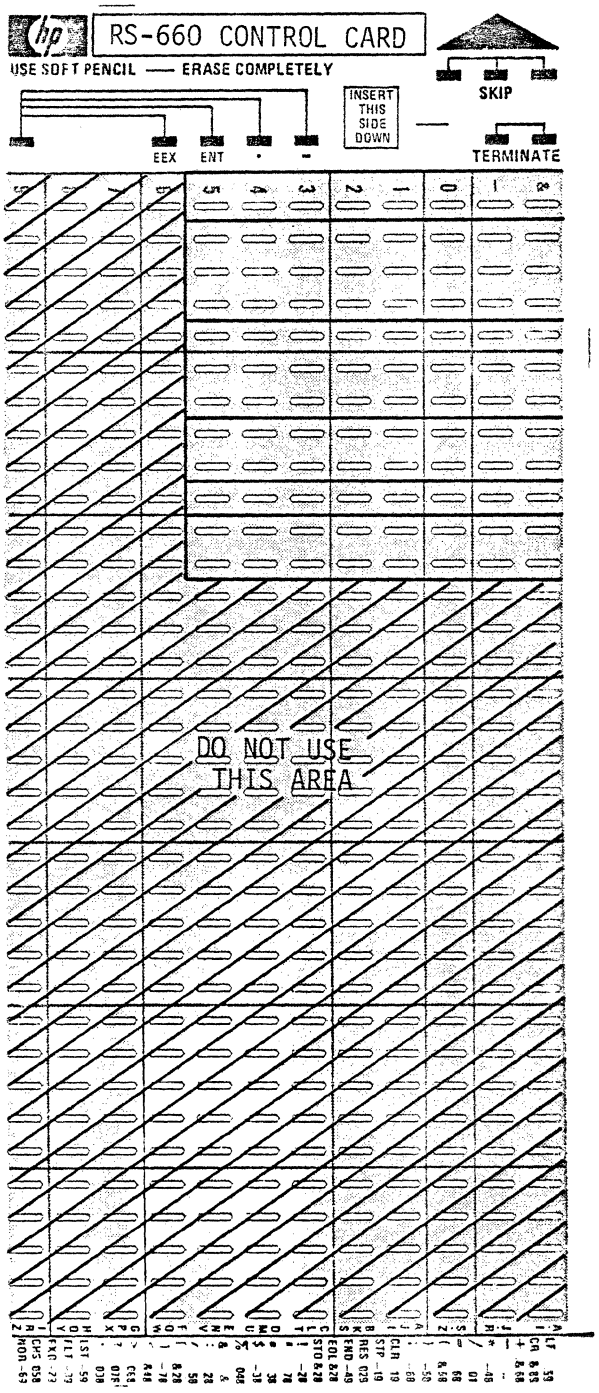
4.1.1 Card Programming

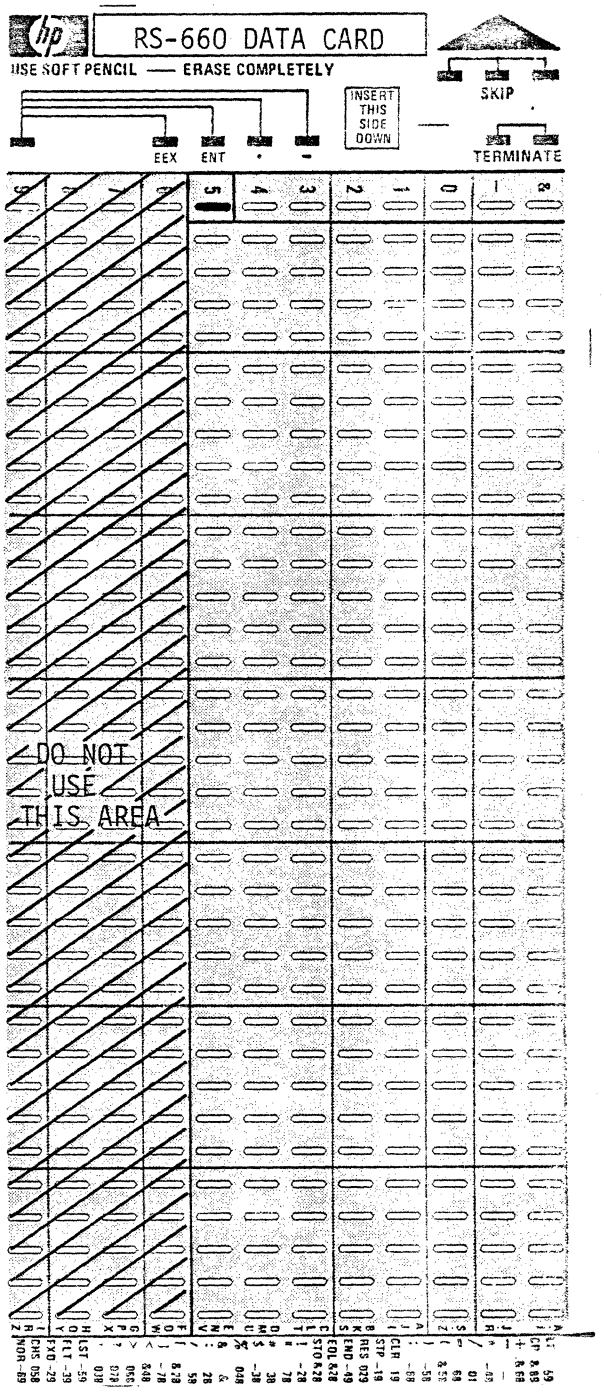
The card reader cards must be marked with binary data, a mark representing a binary "1" and no mark representing a binary "0". The most reliable method of programming a set of cards is to first load the Model RS-660 manually, run the program, verifying correct operation, and then translate the parameters 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.

Figure 4.1
CARD READER CARD FORMATS





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					
	W.G. 16 CHANNEL	W.G. 8 CHANNEL	W.G. 4 CHANNEL	W.G. 2 CHANNEL	W.G. 1 CHANNEL	TIMING SIMULATOR
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:

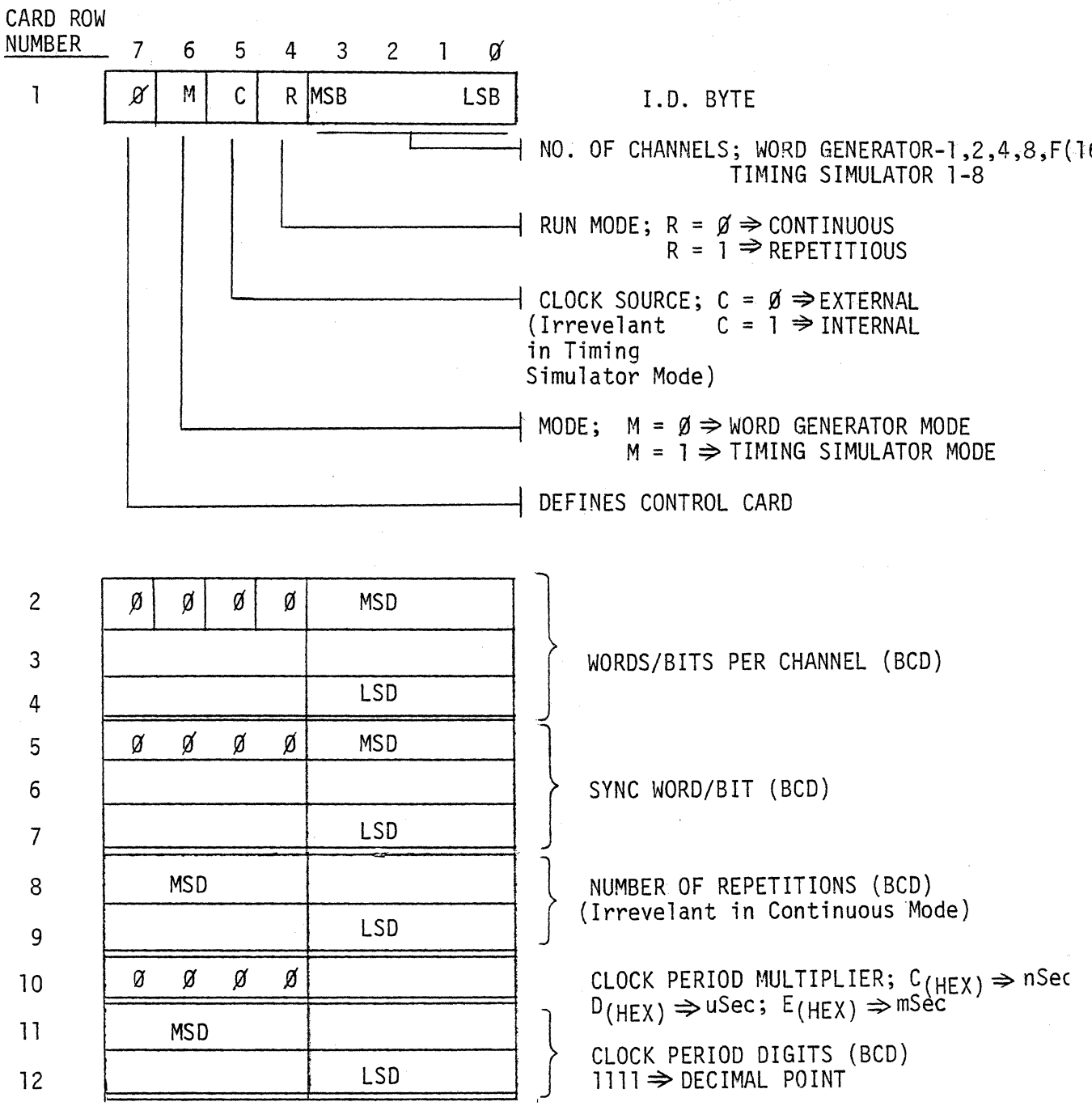
$$b_F = 1 + \left[\frac{256}{C} (Nc-1)\right]$$

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



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

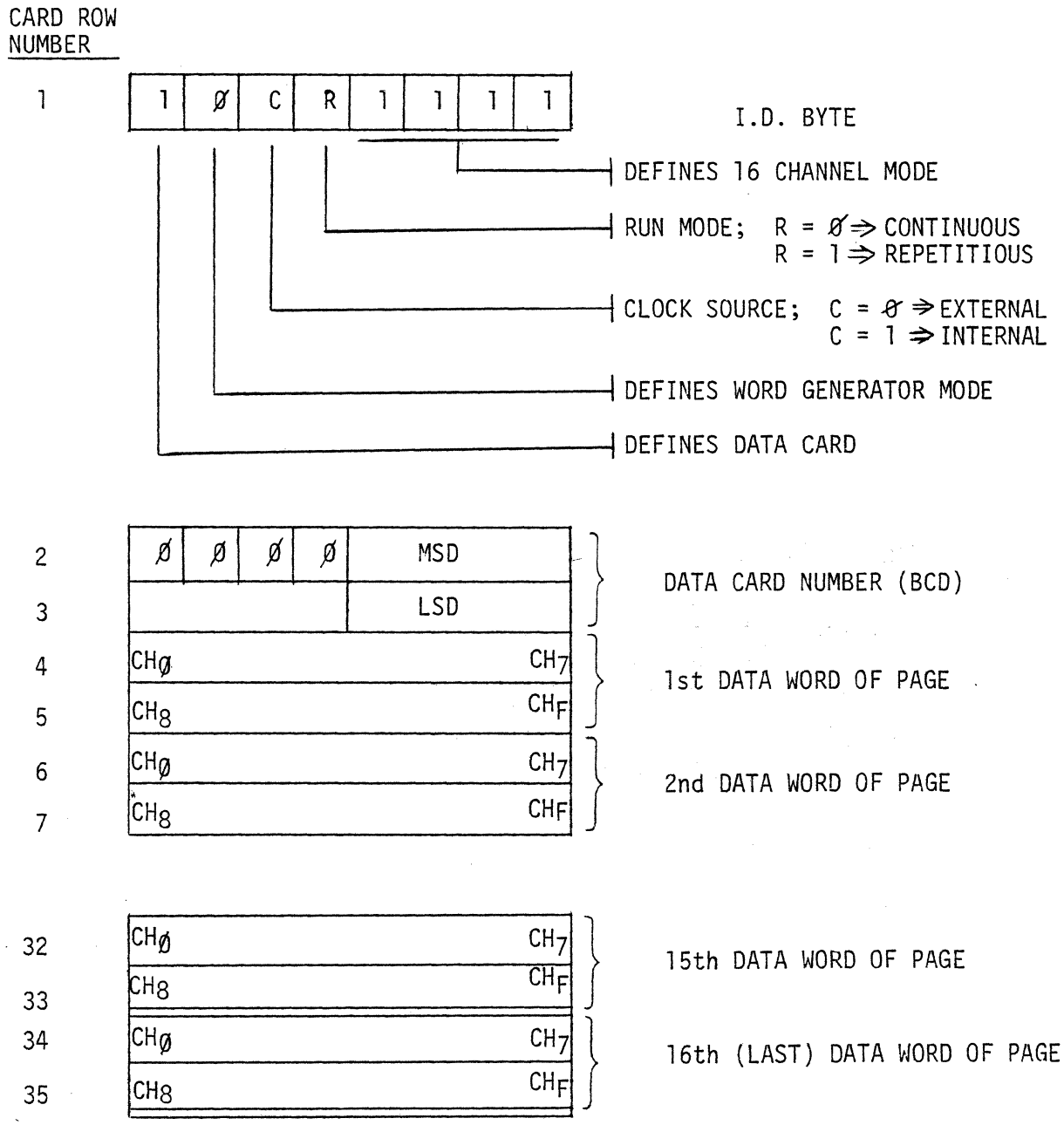


Figure 4.4
8 CHANNEL WORD GENERATOR DATA CARD FORMAT

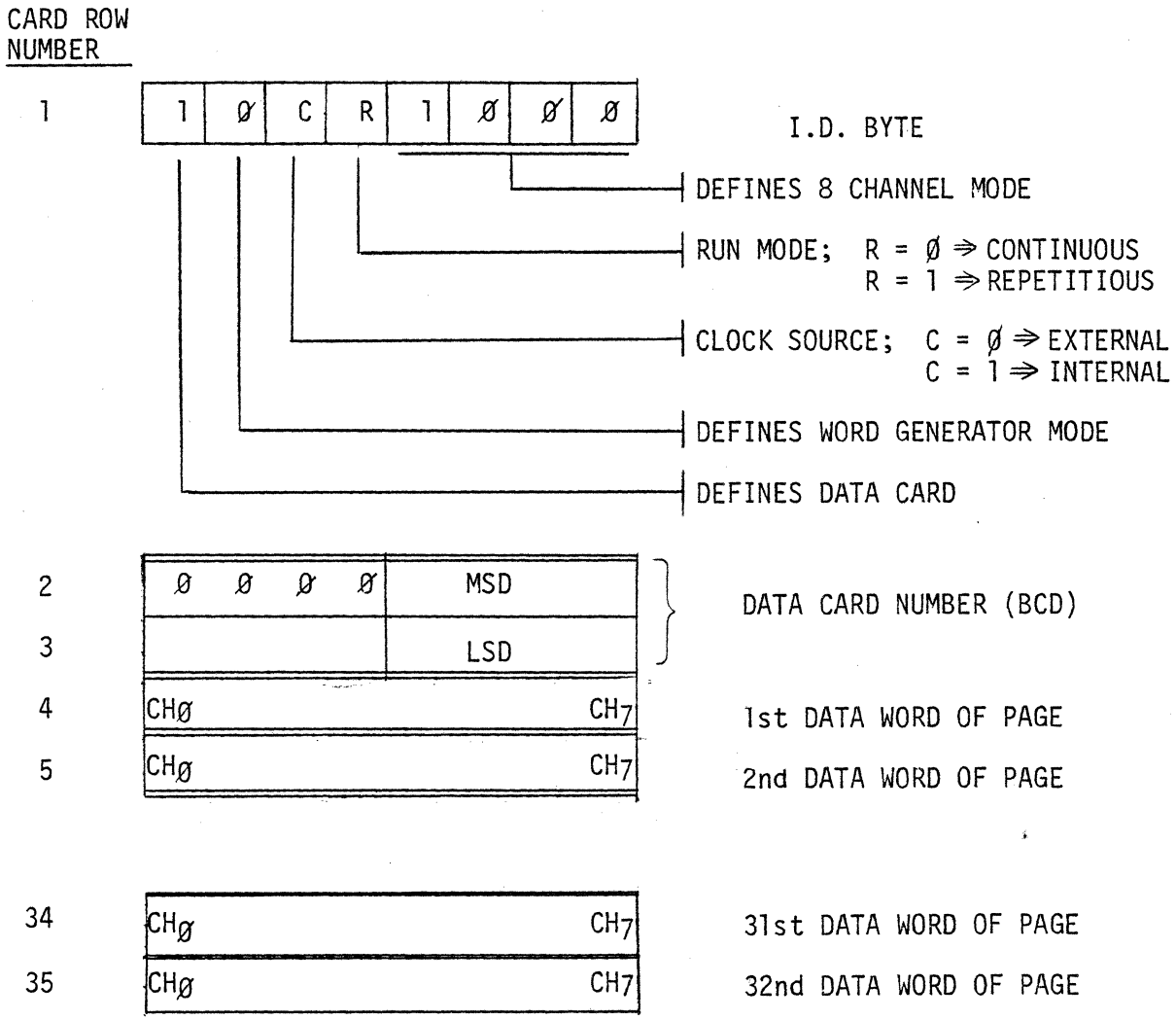


Figure 4.5
4 CHANNEL WORD GENERATOR DATA CARD FORMAT

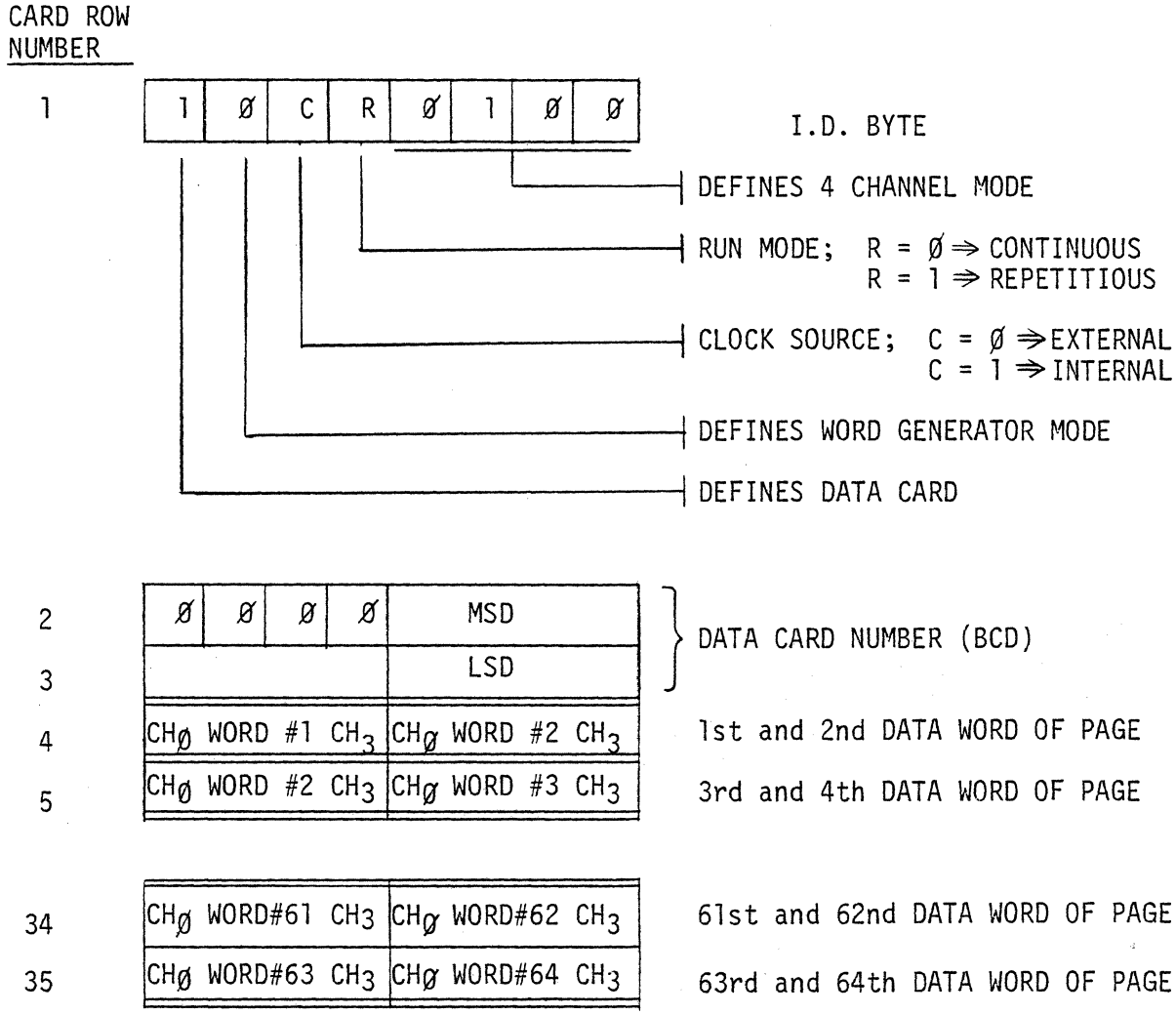


Figure 4.6
2 CHANNEL WORD GENERATOR DATA CARD FORMAT

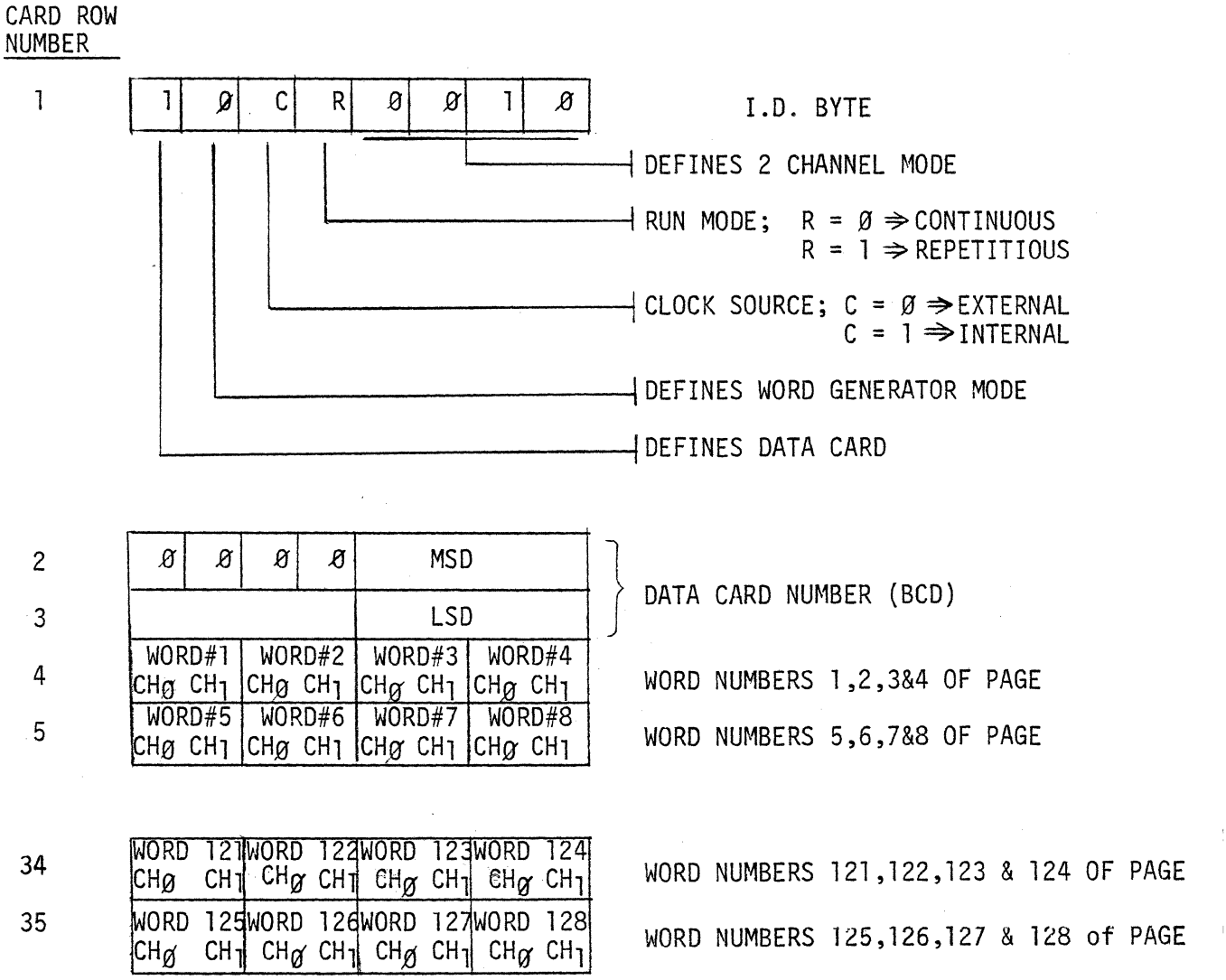


Figure 4.7
SINGLE CHANNEL WORD GENERATOR DATA CARD FORMAT

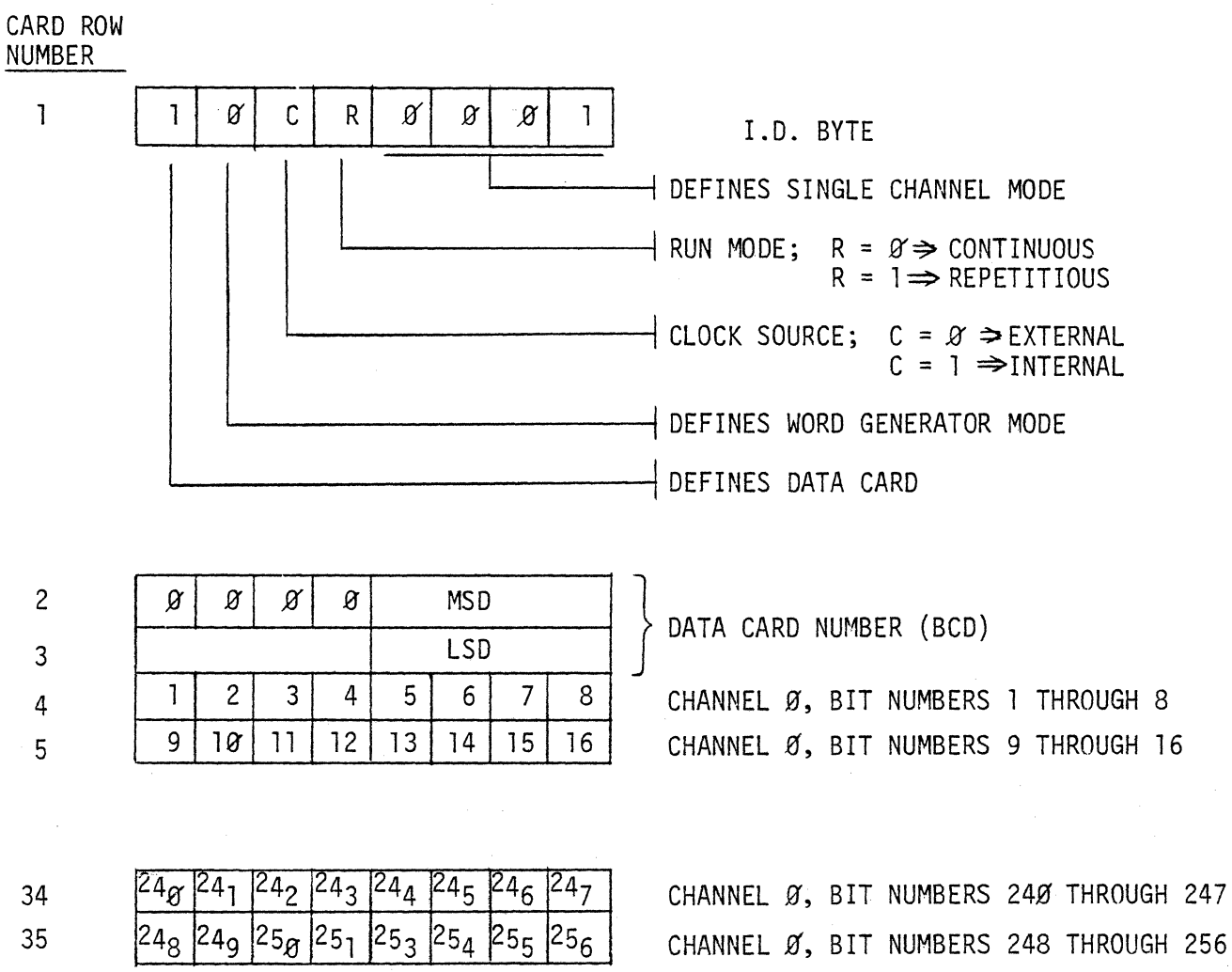
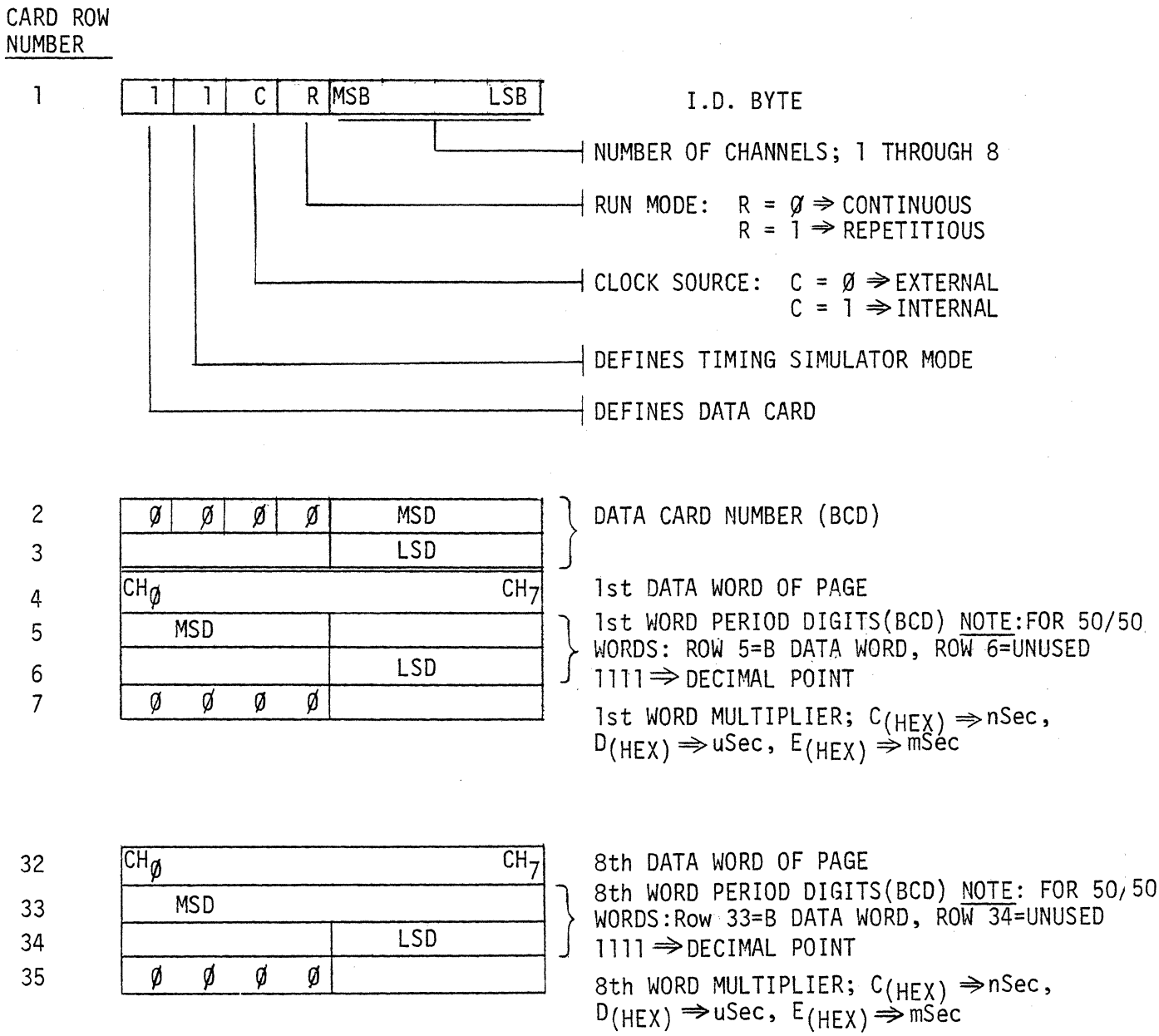


Figure 4.8
TIMING SIMULATOR DATA/TIME CARD FORMAT



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

SRØ : does not generate service request (SRQ)

RLØ : 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.

PPØ : does not include parallel poll capability

DC1 : incorporates device clear function (DCL,SDC)

DT1 : incorporates device trigger function (GET)

CØ : 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

FUNCTION	INPUT/OUTPUT	FORMAT
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, llll, sssss, i, ttttm,
Read Parameters	I	Y
	O	w, c, bbbbb, llll, 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:

POw, c, bbbbb, llll, sssss, i, ttttm,
P1w,
P2c,
P3 bbbbb,
P4 llll,
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)

bbbbb: Number of bits/words per channel (decimal).

llll: Number of pattern repeats, 1 - 4096; 0000 = continuous(decimal).

sssss: Sync word/bit (decimal).

i : Clock Source
1 = Internal
2 = External

ttttm: 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, bbbbb, llll, sssss, i, ttttm, 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: Zaaaa, ddttttm, ..., ddttttm,

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

READ TIMING SIMULATOR DATA

Control: Vaaaa, nnnn,

Response Data: ddttttm, ddttttm, ..., ddttttm, 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).
ddttttm: Data (hex); reference Table 4-4.
Comma: Used as instruction delimiter.

EXECUTE FILL

Control: Naaaaa, bbbbb, ccccc, nnnnn,

N: Execute fill control character.
aaaaa: First word/bit of data to be repeated (decimal).
bbbbb: 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

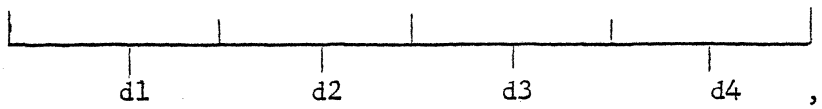
Control: T

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

Character



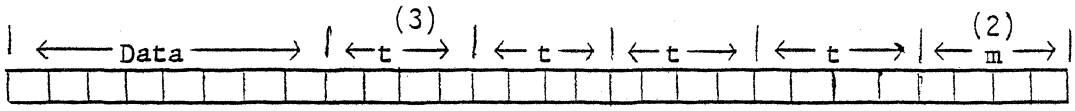
Notes:

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

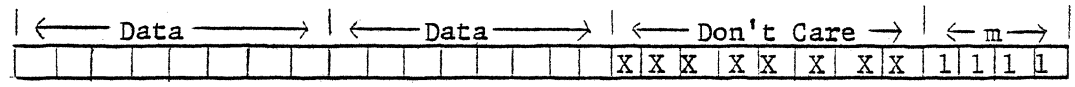
TABLE 4-4
TIMING SIMULATOR DATA CONFIGURATION

Multipler

msec
usec 21 bit
nsec field
(100)
other than
50/50 nsec



50/50 nsec



Notes:

1) All Timing Simulator data (d) is formated 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.
W81,	: 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.
4	: Remote control, waiting for trigger.
T	: Triggers unit.
U	: Reads unit status.
4	: Remote control, waiting for trigger.
T	: Triggers unit.
U	: Reads unit status.
4	: Remote control, waiting for trigger.
S	: Places unit in programming mode.
L	: Returns unit to local control.

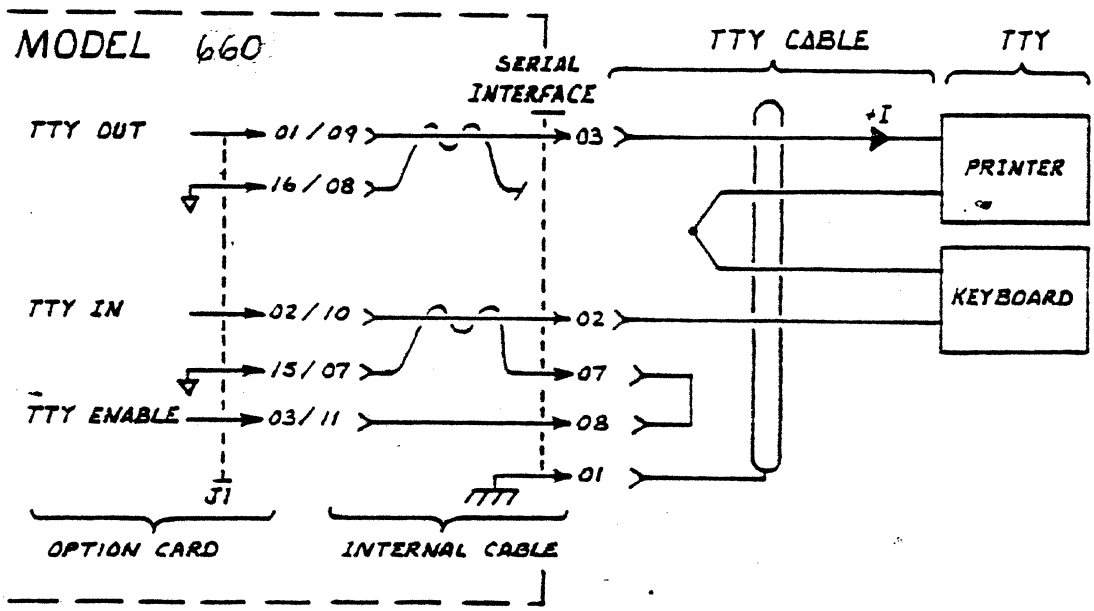
4.3 RS-232C/TTY CONTROLLER INTERFACE

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 transmisssion 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:

SWITCH POSITION	BAUD RATE	NO. OF BITS STOP BITS
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 Ø-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 5¼D
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)

SIGNAL	MNEMONIC	SIGNAL PIN NO.	RETURN PIN NO.
DATA OUTPUT CHANNEL Ø	DOUTØ+	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)

SIGNAL	MNEMONIC	SIGNAL PIN NO.	RETURN PIN NO.
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)

SIGNAL	MNEMONIC	SIGNAL PIN NO.
DATA Ø	CRDØ+	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)

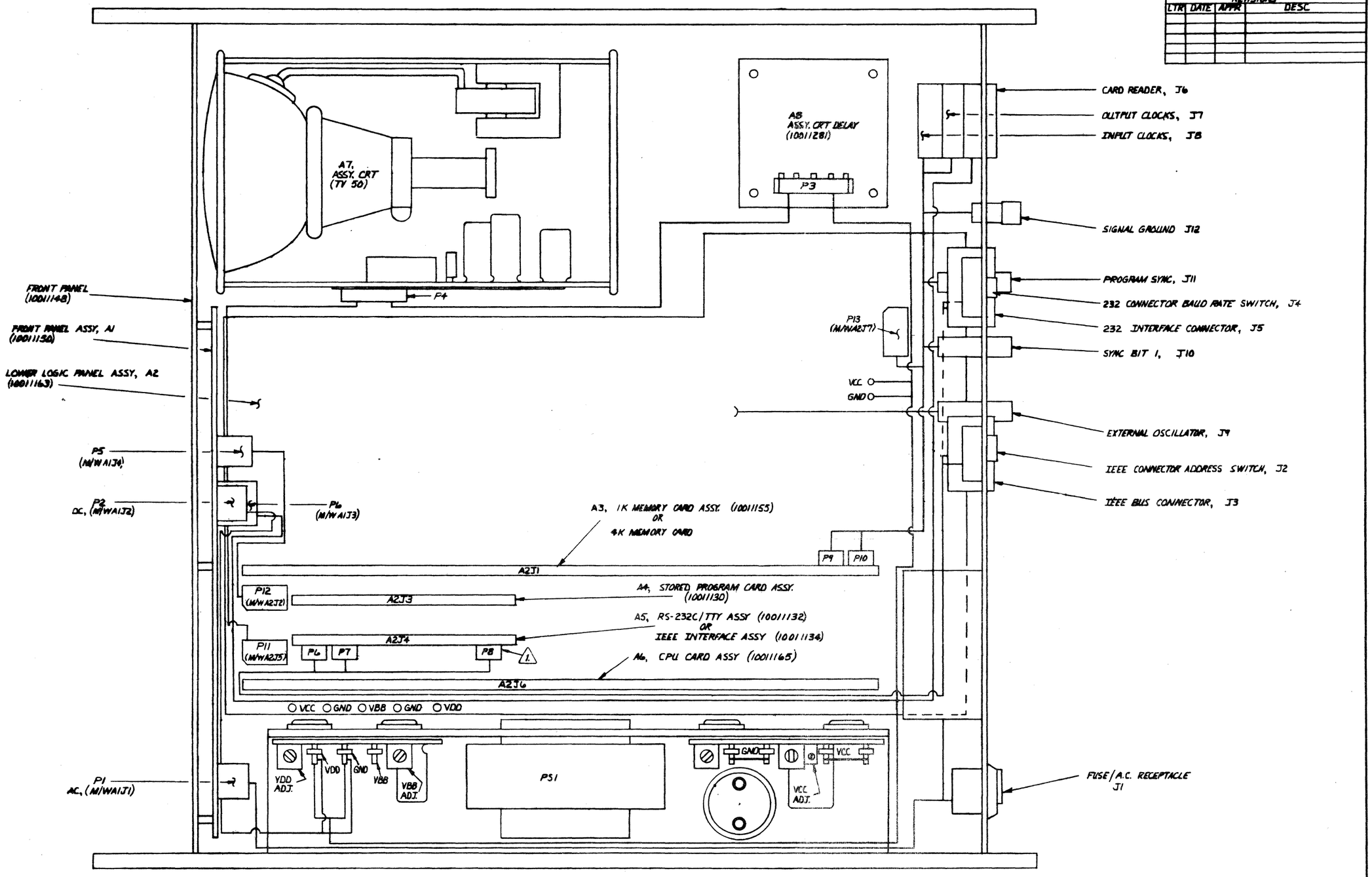
SIGNAL	MNEMONIC	SIGNAL PIN NUMBER	SIGNAL PROBE COLOR BODY	SIGNAL PROBE COLOR TIP	RETURN PIN NUMBER	RETURN PROBE COLOR BODY	RETURN PROBE COLOR TIP
DATA OUTPUT CHAN. Ø	CDOUT Ø+	Ø1	BLACK	BROWN	Ø2	-	-
" " " 1	CDOUT 1+	Ø3	"	RED	Ø4	-	-
" " " 2	CDOUT 2+	Ø5	"	ORANGE	Ø6	BLACK	BLACK
" " " 3	CDOUT 3+	Ø7	"	YELLOW	Ø8	-	-
" " " 4	CDOUT 4+	Ø9	"	GREEN	1Ø	-	-
" " " 5	CDOUT 5+	11	"	BLUE	12	-	-
" " " 6	CDOUT 6+	13	"	VIOLET	14	-	-
" " " 7	CDOUT 7+	15	"	GREY	16	BLACK	BLACK
" " " 8	CDOUT 8+	17	"	WHITE	18	-	-
" " " 9	CDOUT 9+	19	BROWN	BLACK	2Ø	-	-
" " " A	CDOUT A+	21	"	BROWN	22	-	-
" " " B	CDOUT B+	23	"	RED	24	-	-
" " " C	CDOUT C+	25	"	ORANGE	26	BLACK	BLACK
" " " D	CDOUT D+	27	"	YELLOW	28	-	-
" " " E	CDOUT E+	29	"	GREEN	3Ø	-	-
" " " F	CDOUT F+	31	"	BLUE	32	-	-
GATED OUTPUT CLOCK	CGOCLK+	33	"	VIOLET	34	-	-
FREE RUNNING OUTPUT CLOCK	CFOCLK+	35	"	GREY	36	BLACK	BLACK
EXTERNAL INPUT CLOCK	CEXCLK+	37	"	WHITE	38	-	-
EXTERNAL INPUT TRIGGER	CEXTRIG-	39	RED	BLACK	4Ø	-	-

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

REVISIONS			
LTR	DATE	APPR	DESC



⚠ FOR IEEE INTERFACE ON RS-660 S/N-001 THRU S/N-050, CONNECT P8 TO A5J3 SUCH THAT PIN 1 OF P8 MATES WITH PIN 10 OF A5J3. FOR IEEE INTERFACE ON RS-660 S/N-051 AND UPWARD, CONNECT P8 TO A5J3 WITH CORRESPONDING PIN NUMBERS.

NOTES: UNLESS OTHERWISE SPECIFIED

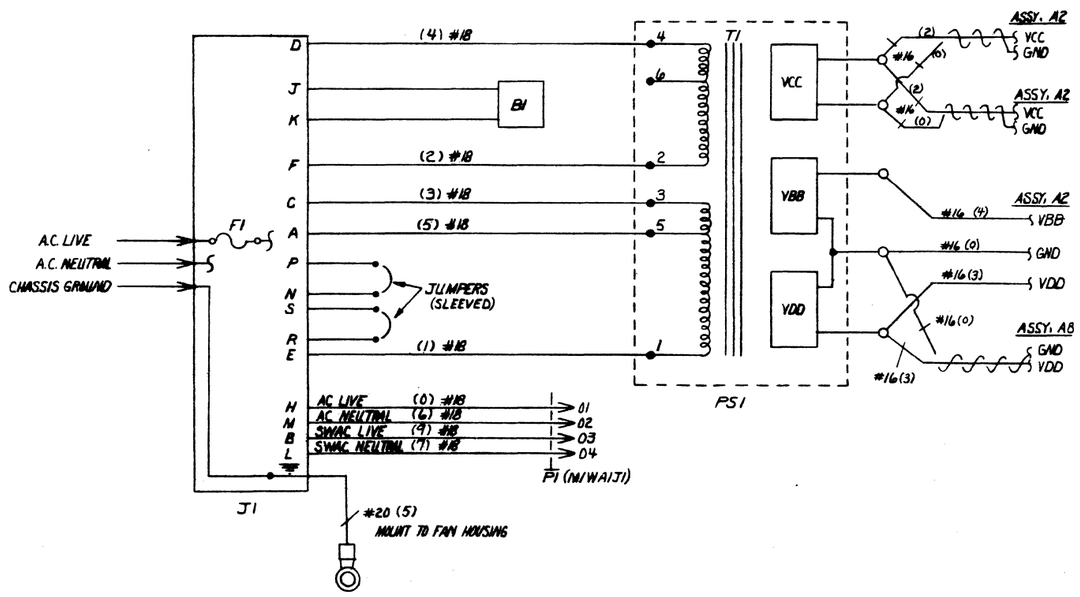
interface TECHNOLOGY

SCALE: NTS	APPROVED BY: BRK	DRAWN BY RK
DATE: 6-15-79		REVISED

RS-660 TOP ASSEMBLY

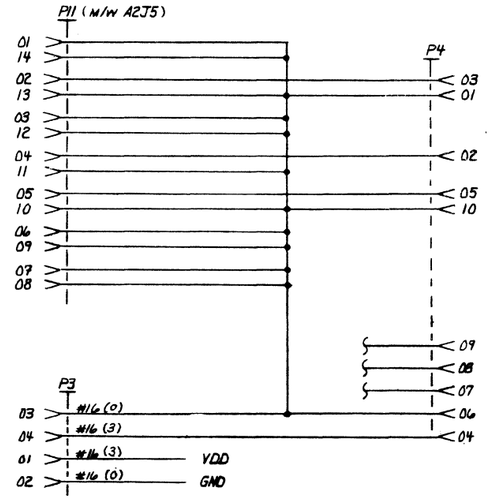
SHT 1 OF 2	55613	DRAWING NUMBER 10011157

A.C. WIRING



CRT HARNESS

NOTE: P4 NUMBERING APPLIES TO CONNECTOR ONLY; NUMBERING ON CRT UNIT IS REVERSED.

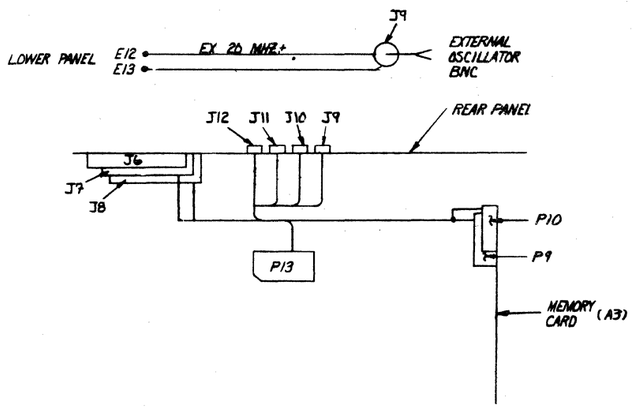


RS-660 I/O CABLE

NOTE: CONNECTORS J7 AND J8 MUST BE ASSEMBLED TO REAR PANEL PRIOR TO CABLE ASSEMBLY.

J7			J8		
P9-11	DOUT 0+	01	P9-10	DOUT 8+	01
P9-06		14	P9-07		14
P10-11	DOUT 1+	02	P10-10	DOUT 9+	02
P10-06		15	P10-07		15
P10 12	DOUT 2+	03	P10-13	DOUT A+	03
P10-05		16	P10-04		16
P9-12	DOUT 3+	04	P9-13	DOUT B+	04
P9-05		17	P9-04		17
P9-14	DOUT 4+	05	P9-16	DOUT C+	05
P9-03		18	P9-01		18
P10 14	DOUT 5+	06	P10-16	DOUT D+	06
P10-03		19	P10-01		19
P10-15	DOUT 6+	07	P10-09	DOUT E+	07
P10-02		20	P10-08		20
P9-15	DOUT 7+	08	P9-09	DOUT F+	08
P9-02		21	P9-08		21
P13-13	GOCLK+	09	P13-09	EXCLK+	09
P13-04		22	P13-08		22
P13-14	FOCLK+	10	P13-10	EXTRIG-	10
P13-03		23	P13-09		23
P13-16	VCC	11	P13-15	VCC	11
GND. STUD	GND	24	GND. STUD	GND	24

P3-12	SYNC 1-	SYNC BIT 1 BNC (J10).
P3-05		" " " GND.
P3-11	PSYNC-	PROGRAM SYNC BNC (J11).
P3-06		" " " GND.
P3-01		GND. STUD } J12
P3-02		GND. STUD } J12



A.C. POWER WIRING AND CABLE HARNESSES

interface TECHNOLOGY

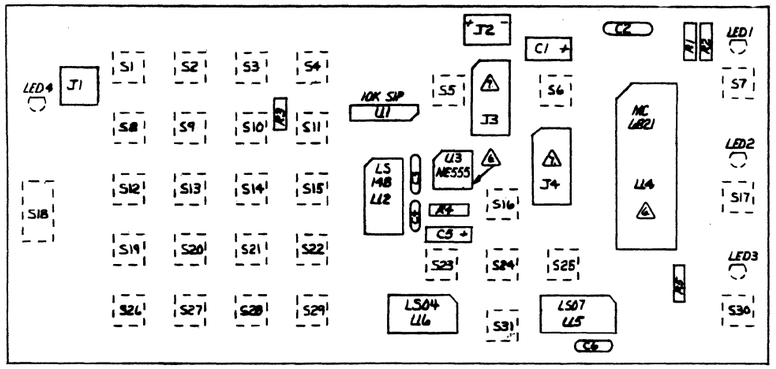
SCALE: NTS	APPROVED BY:	DRAWN BY RK
DATE: 7-23-79		REVISED

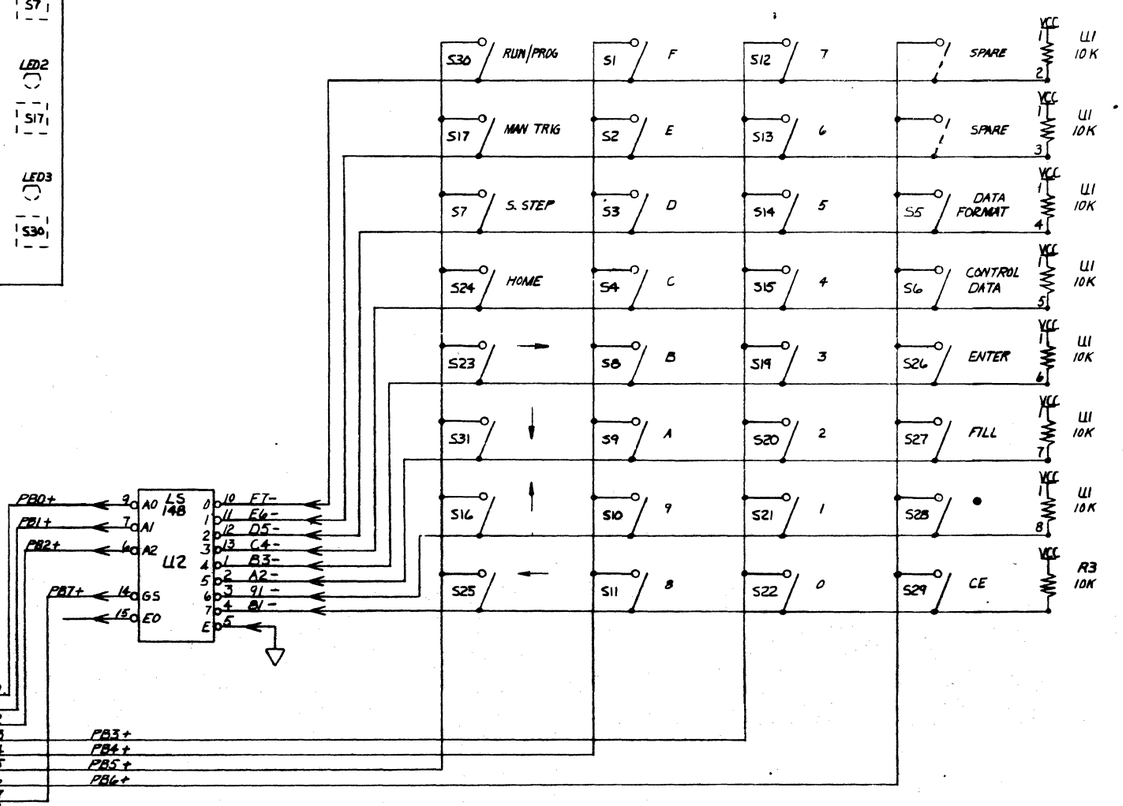
RS-660 TOP ASSEMBLY

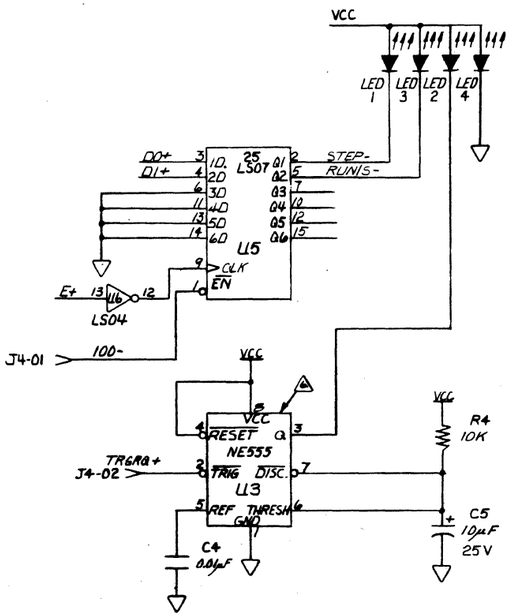
SHT 2 OF 2	55613	DRAWING NUMBER 1001 1157

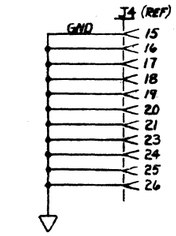
PRINTED ON NO. 10020-10 CLEARPRINT PAPER-DWT

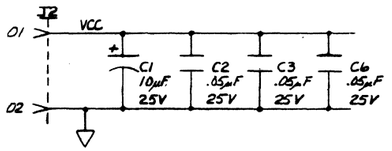
REVISIONS			
LTR	DATE	APPR	DESC
A	1-11-79	[illegible]	ADDED IC FOR E+

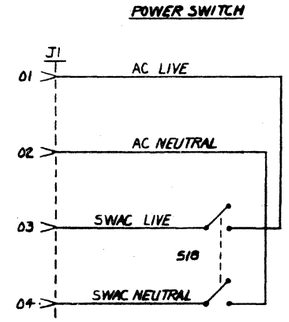










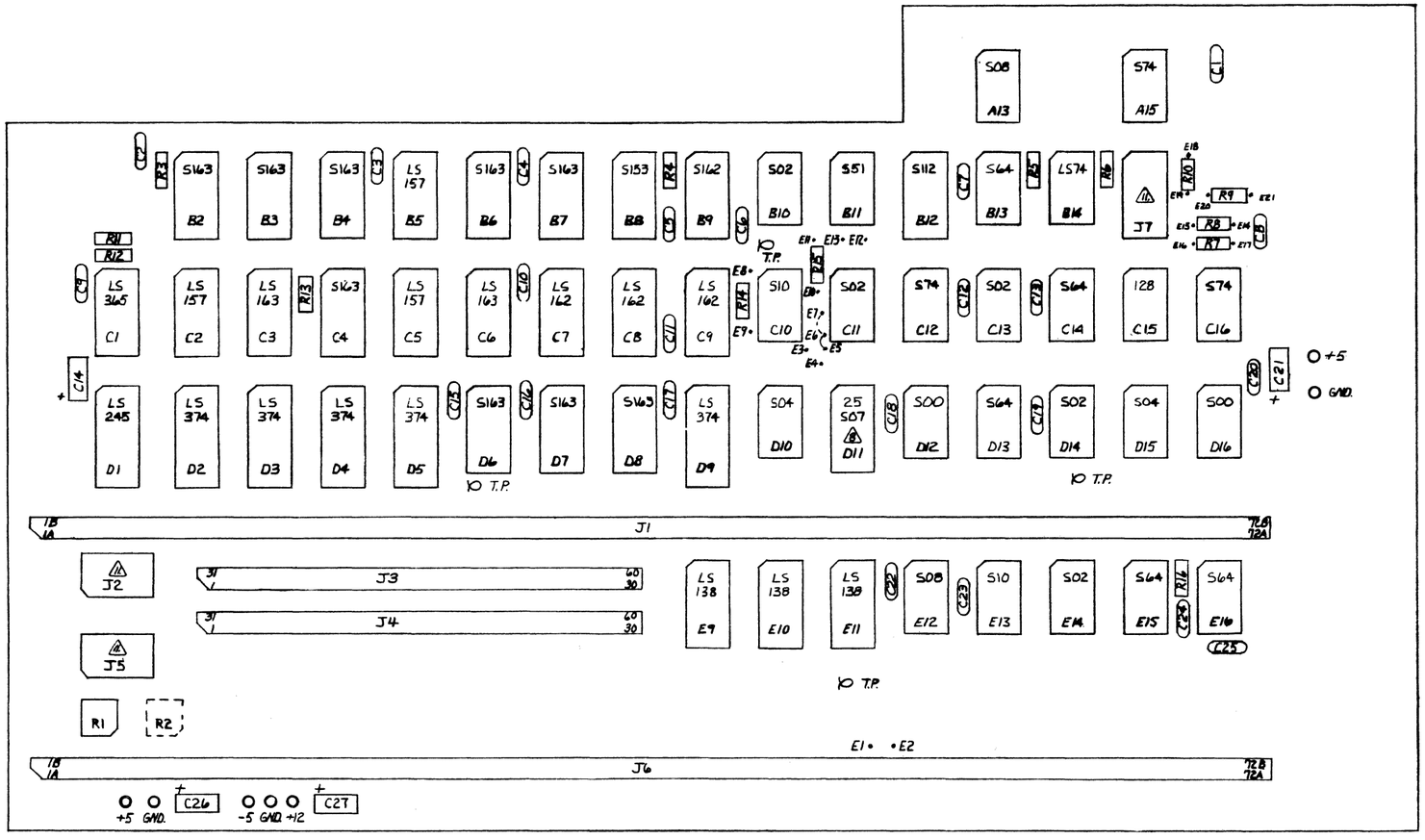


⚠ H-P DESIGNATES HIGH PROFILE SOCKET.
△ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
5. REFER TO 10011149 FOR PCB
4. RESISTORS R1 THRU R5 10K-Ω 1/4W CARBON COMPOSITION
3. CAPACITOR C4 IS A .01μF AT 25V CERAMIC DISC.
2. CAPACITORS C2, C3, C6 ARE .05μF AT 25V CERAMIC DISC.
1. CAPACITORS C1 & C5 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY			
SCALE: NTS	APPROVED BY: Ed Kruger	DRAWN BY R.J.K.	
DATE: 1-15-79		REVISED	
ASSY/LBD RS660 FRONT PANEL			
SHT. 1 OF 1	55613	DRAWING NUMBER 10011150	

REVISIONS			
LTR	DATE	APPR	DESC



ASSEMBLY SIDE

⚠ 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 10011162 FOR PCB.
6. RESISTOR R2 IS A 100KΩ POT.
5. RESISTOR R1 IS A 500Ω POT.
4. RESISTORS R7- R10, R14 & R15 ARE 270Ω ½ W CARBON COMP.
3. RESISTORS R3-R6, R11-R13 & R16 ARE 1KΩ ¼W CARBON COMP.
2. CAPACITORS C1-C13, C15-C20, C22-C25, ARE .05μF AT 25V CERAMIC DISC.
1. CAPACITORS C14, C21, C26, & C27 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY		
SCALE: NTS	APPROVED BY: Bill Kruger	DRAWN BY RK
DATE: 6-13-79		REVISED
ASSY/ LBD LOWER LOGIC PWB. RS-660		

CLOCK SELECTION

MAIN CLOCK GENERATION

PERIOD REGISTER

PERIOD SELECTION

DIGIT PERIOD COUNTER

TRIGGER LOGIC

START/STOP LOGIC

GO FLOP

STROBE DECODE

MODE REGISTER

MULTIPLIER COUNTER

MULTIPLIER SELECTION

PERIOD CLOCK GENERATION

TIME MULTIPLIER CODING

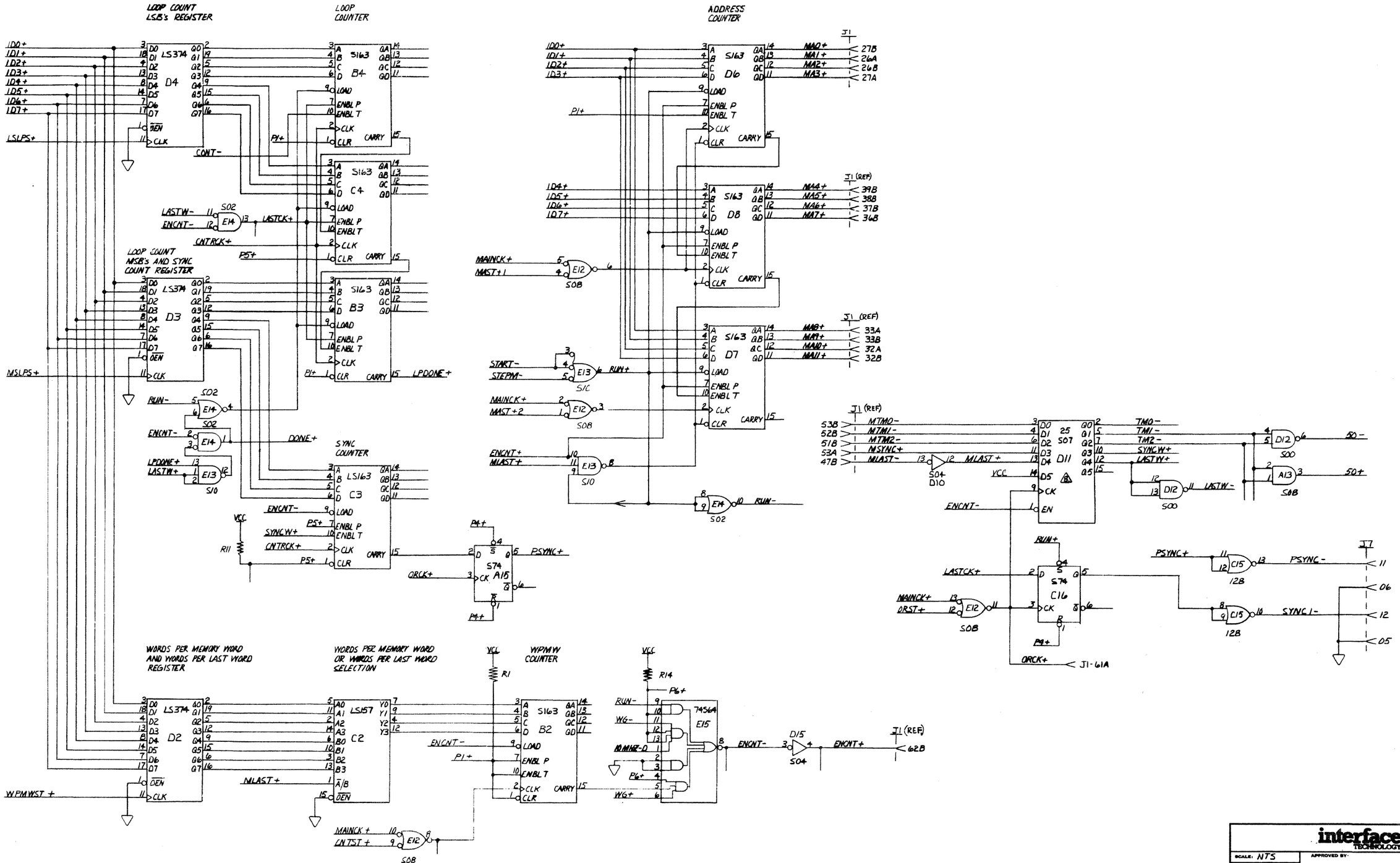
	TM0-	TM1-	TM2-
1 ms.	0	0	0
100 µs.	1	0	0
10 µs.	0	1	0
1 µs.	1	1	0
100 ns	0	0	1
50 ns	0	1	1

interface TECHNOLOGY

SCALE: NTS
DATE: 6-7-79
APPROVED BY:
DRAWN BY: RK
REVISED:

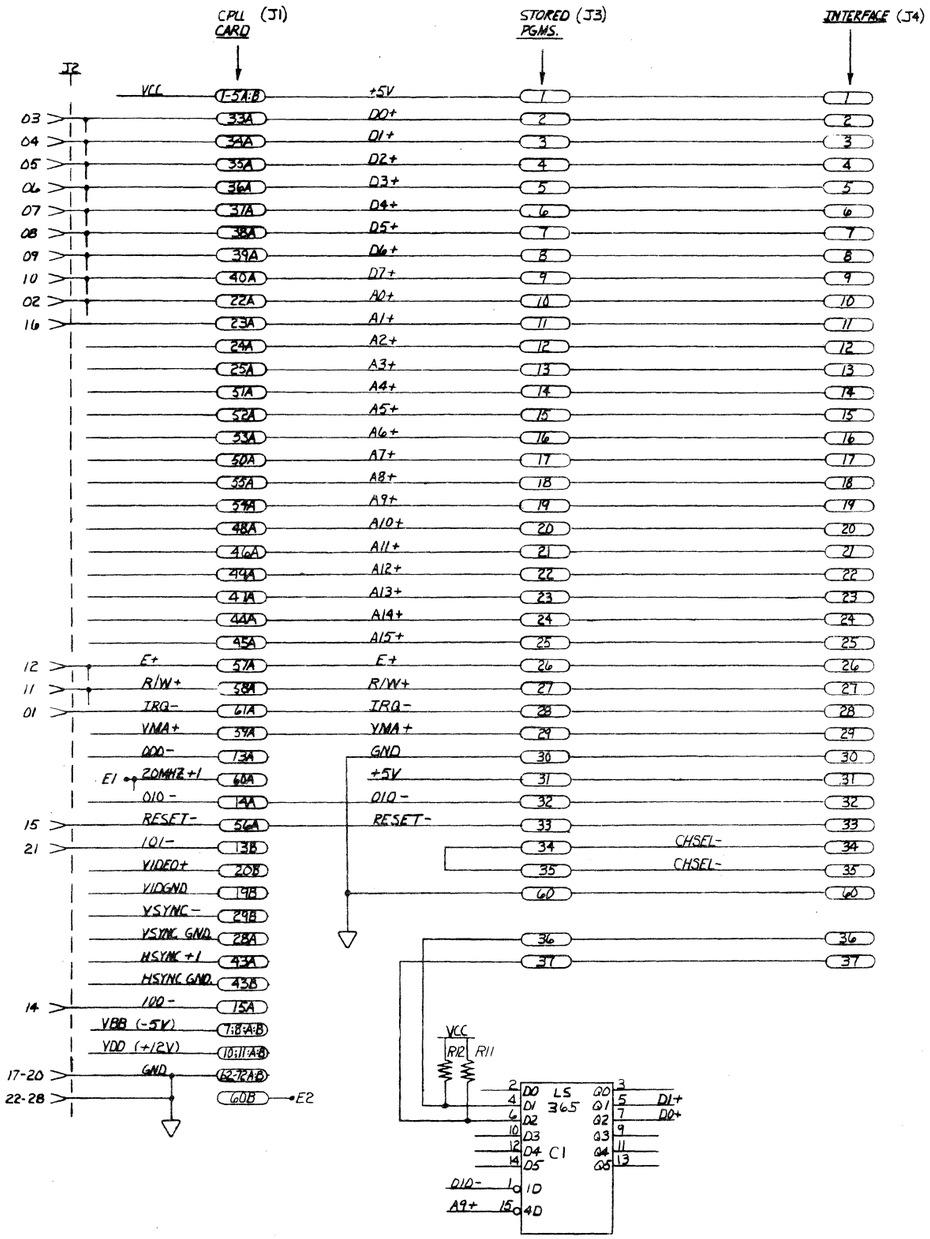
ASSY/LBD LOWER LOGIC PNL. RS-660

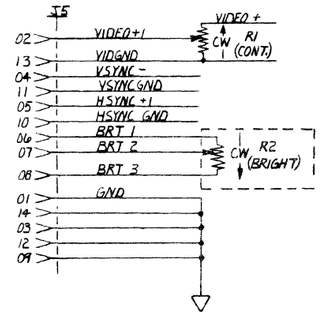
SHT. 2 OF 4 | 55613 | 100111633

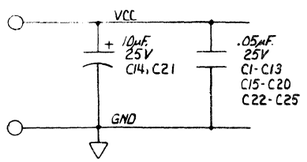


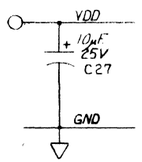
interface TECHNOLOGY			
SCALE: NTS	APPROVED BY:		DRAWN BY RE
DATE: 6-8-79			REVISED
ASSY/LBD, LOWER LOGIC PANEL RS-660			
SHT. 3 OF 4		55613	DRAWING NUMBER 1001163

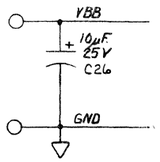
22284 PRINTED ON NO. 1000H - 10 CLEARPRINT FADE-OUT







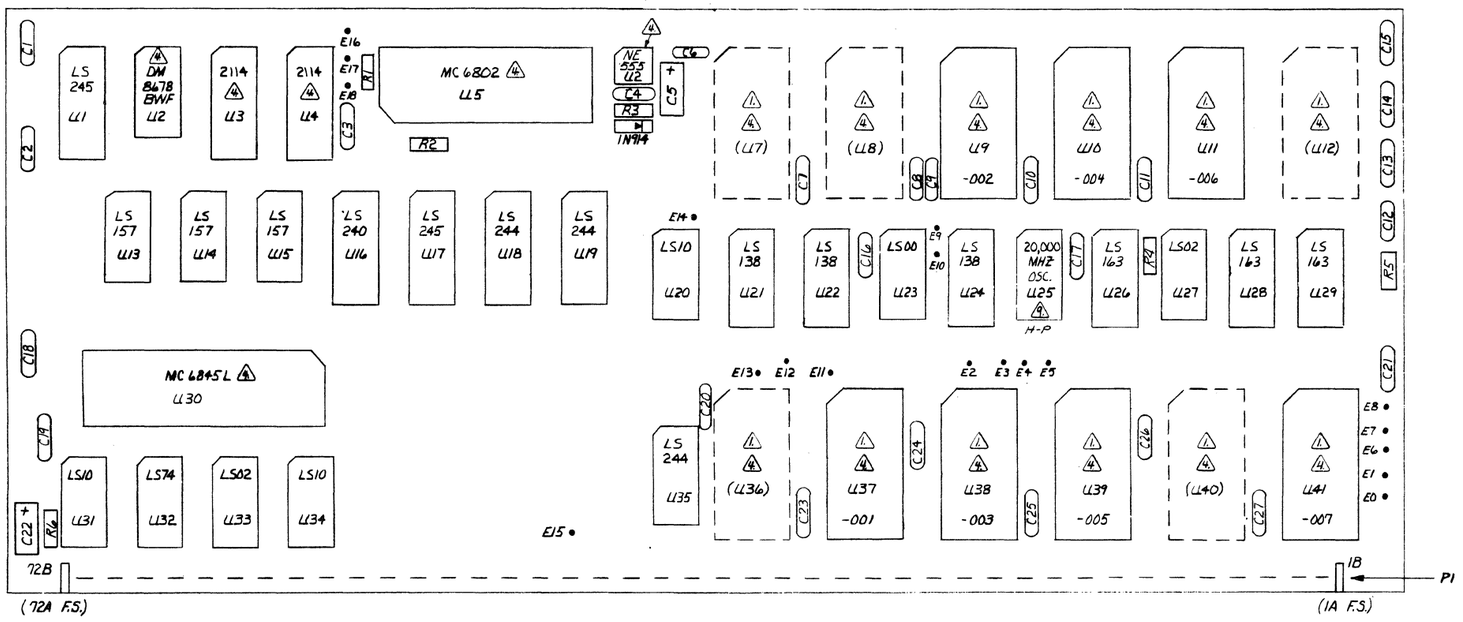




interface TECHNOLOGY		
SCALE: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 9-12-79		REVISED
ASSY/LBD LOWER LOGIC PNL. RS-660		
SHT 4 OF 4	55613	DRAWING NUMBER 1001163

22X34 PRINTED ON NO. 1000H-10 CLEARPRINT PAPER-DUT

REVISIONS			
LTR	DATE	APPR	DESC



ASSEMBLY SIDE

△4 H-P DESIGNATES HIGH-PROFILE SOCKET.

8. RESISTORS R1 IS 10KΩ, R2 IS 3KΩ, R3 IS 22KΩ, R4-R6 ARE 1KΩ, ALL ARE ¼W CARBON COMP.
7. CAPACITOR C9 IS A .01μF AT 25V CERAMIC DISC.
6. CAPACITORS C1-C3, C6-C27 ARE .05μF AT 25V CERAMIC DISC.
5. CAPACITORS C5 & C22 ARE 10μF 25V ELECTROLYTIC
△4 ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
3. REFER TO 10011164 FOR PCB.
2. JUMPER E16-E17 → RAM ENABLE TO 6802 (DISABLE).

△1

PROM TYPE	JUMPER INSTALLATIONS					ACTIVE LOCATIONS	OMIT CAPACITORS	EPROM P/N 10011291
TMS 2516 →	E2-E3,	E4-E5,	E7-E8,	E12-E13,	E14-E15	U7-U12, U36-U41	C9, C13, C23, C27.	
TMS 2716 →	E0-E1,	E3-E4,	E6-E7,	E12-E13,	E14-E15.	U7-U12, U36-U41		
INTEL 2716 →	E2-E3,	E4-E5,	E7-E8,	E12-E13,	E14-E15	U7-U12, U36-U41	C9, C13, C23, C27.	
INTEL 2732 →	E2-E3,	E4-E5,	E9-E10,	E11-E12,	E14-E15	U36, U37, U38, U39, U41	C7, C9, C10, C13, C14, C23, C24, C26, C27.	

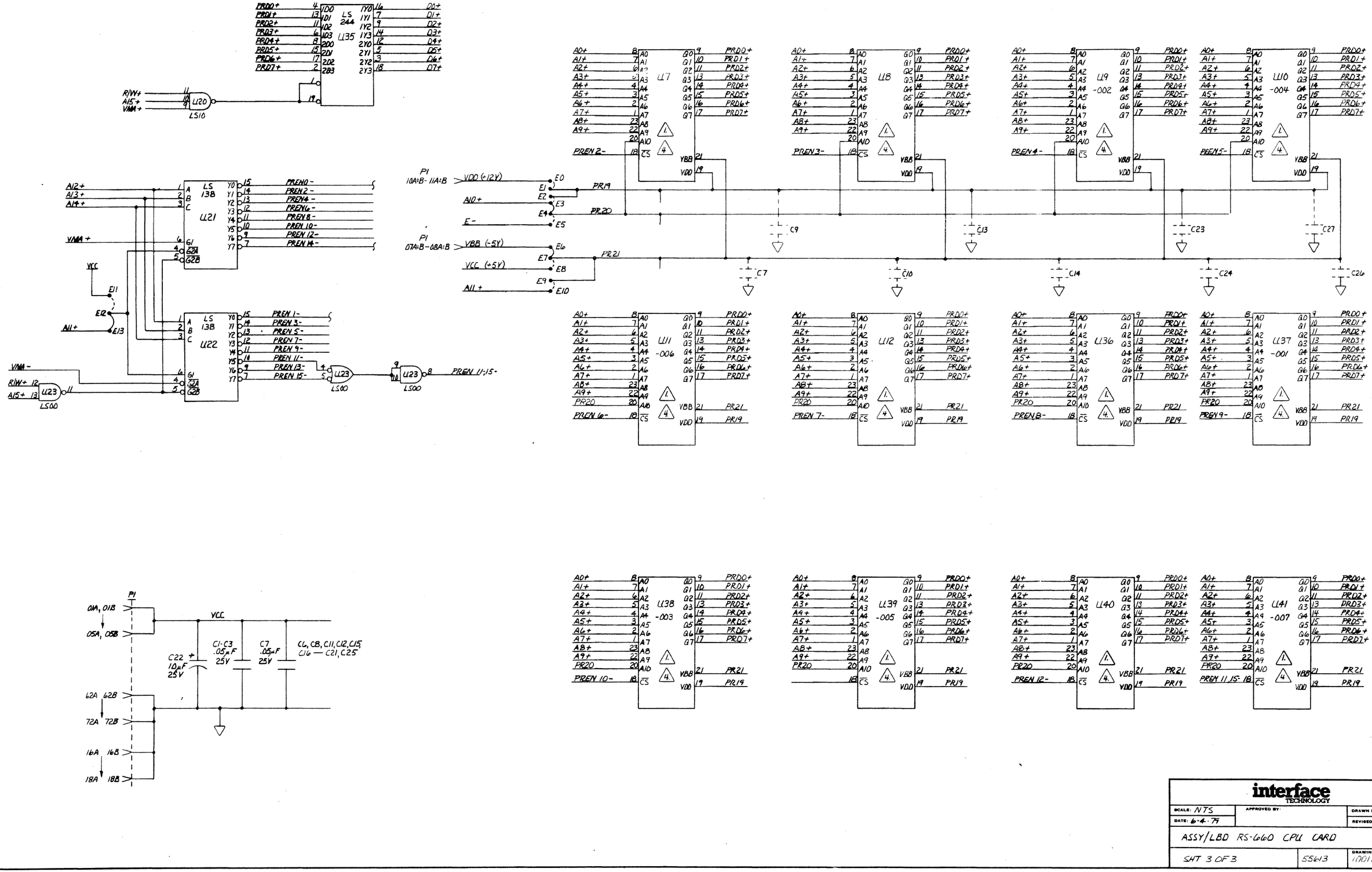
NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY			
SCALE: NTS	APPROVED BY:		DRAWN BY RK
DATE: 6-5-79			REVISED
ASSY/LBD RS-660 CPU CARD			
SHT. 1 OF 3		55613	DRAWING NUMBER 10011165

52284 PRINTED ON NO. 1000H-10 CLEARPRINT PAPER-DWT

VCC
C5 10µF 10V
U16 NE 555
RESET
DISCH
THRESHOLD
TRIG
CONT GND
D1 1N914
R3 22K
.04µF C4
P1 56A
RESET-
U5 MC 6802
XTAL
EXTAL
HALT
NMI
RE
BA
R1 10K
PRCLK+
PULL1+
E18
E17
E16
+5V
R2 3K
IRQ-
MR
R/W
E
VMA
U7 LS 245
DAT00+ DAT01+ DAT02+ DAT03+ DAT04+ DAT05+ DAT06+ DAT07+
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15
RW-
DIR
U18 LS 244
ADR00+ ADR01+ ADR02+ ADR03+ ADR04+ ADR05+ ADR06+ ADR07+
U19 LS 244
ADR08+ ADR09+ ADR10+ ADR11+ ADR12+ ADR13+ ADR14+ ADR15+
P1 45A 54A 48A 46A 49A 47A 44A 45A
U16 LS240
E+1 E- E+ VMA+1 VMA- VMA+ R/W+1 R/W- R/W+
P1 57A 59A 58A
R4 1K
PULL2+
U26 LS 163
ENT ENP LD CP CLR TC
LINCK+
LS10 U31
E-
LS02 U33
DIV 3+1
R5 1K
PULL 3+
U29 LS 163
DIV3+
20MHZ-1
U27 LS02
ASCCY-
20 MHZ OSC. U25
20MHZ+1
P1 60A 60B
SPARE 12A SPARE 12B
U24 LS 138
A10+ A11+ A12+
A15+ VMA-
Y0- Y1- Y2- Y3- Y4- Y5- Y6- Y7-
P1 13A 14A 15A 13B
LS02 U27
A14+ A13+
U28 LS 163
PRCLK+
PULL3+
CTCRY+
CTCRY-
U15 LS 157
MA0+ MA1+ MA2+ MA3+
U14 LS 157
MA4+ MA5+ MA6+ MA7+
U13 LS 157
MA8+ MA9+
AB+ A9+
U4 2114 RAM 1K×4
U3 2114 RAM 1K×4
ASL0+ ASL1+ ASL2+ ASL3+ ASL4+ ASL5+ ASL6+ ASL7+ ASL8+ ASL9+
A0+ A1+ A2+ A3+ A4+ A5+ A6+ A7+
I/O1 I/O2 I/O3 I/O4
WE CS1
RW+
LS10 U34
CHWT-
011-A
011-
U2 DM 8678
OUT
PULL1+
STB LOAD DOT CLK LINE CLK CLK CNTL CLEAR OE
U1 LS 245
BIT 7+ BIT 6+ BIT 5+ BIT 4+ BIT 3+ BIT 2+ BIT 1+ BIT 0+
D7+ D6+ D5+ D4+ D3+ D2+ D1+ D0+
CHVID+
U33 LS02
VIDEO-
VIDEO+ 20B
19B
R6 1K
PULL4+
U32 LS74
VIDEN
VIDEN-
PULL 4+
U30 MC 6845
D0+ D1+ D2+ D3+ D4+ D5+ D6+ D7+
E+ CS- RS R/W+ CHAR CLK RESET-
RA0 RA1 RA2 RA3 RA4 VSYNC HSYNC DISP EN CURSOR
LPSTB GND GND VCC
MA0+ MA1+ MA2+ MA3+ MA4+ MA5+ MA6+ MA7+ MA8+ MA9+
RA2+ RA3+ VSYNC+ HSYNC+ DSPEN+ CUREN+
DSPEN-
LINCK+
R/WCT-
U20
VSYNC-
29B 28A
E14 E15
U35
HSYNC+1
43A 43B

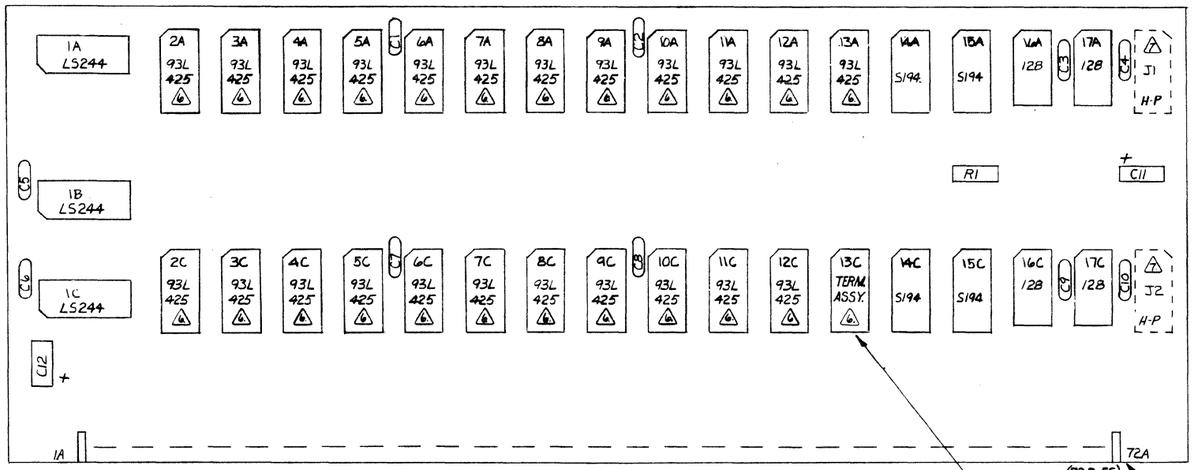
interface TECHNOLOGY		
SCALE: N.T.S.	APPROVED BY:	DRAWN BY R.J.N.
DATE: 1-12-79		REVISED
ASSY/LBD RS-660 CPU CARD		
SHT 2 OF 3	55613	DRAWING NUMBER 10011165

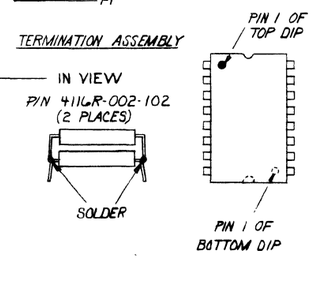


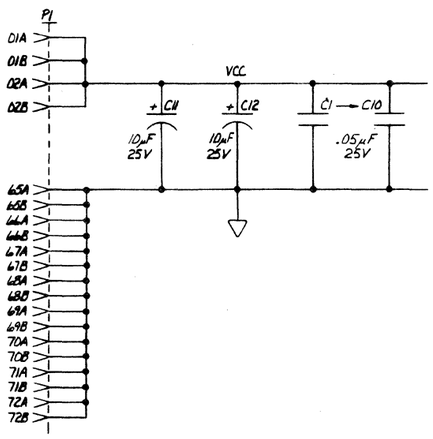
interface TECHNOLOGY		
SCALE: NTS	APPROVED BY:	DRAWN BY RK
DATE: 6-4-79		REVISED
ASSY/LBD RS-660 CPU CARD		
SHT 3 OF 3	55613	DRAWING NUMBER 10011165

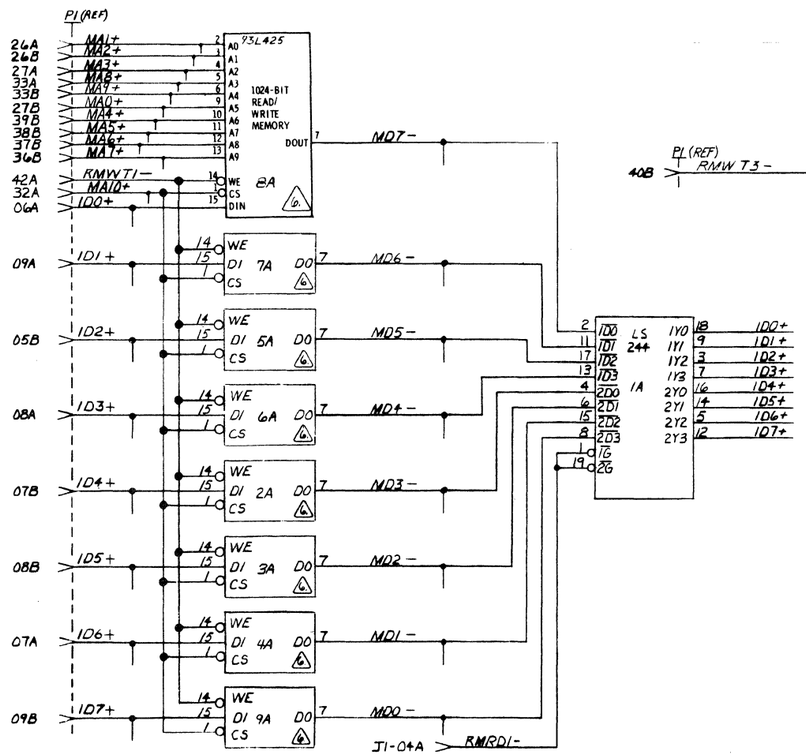
2234 PRINTED ON NO. 1000H - 10 CLEARPRINT FADE-OUT

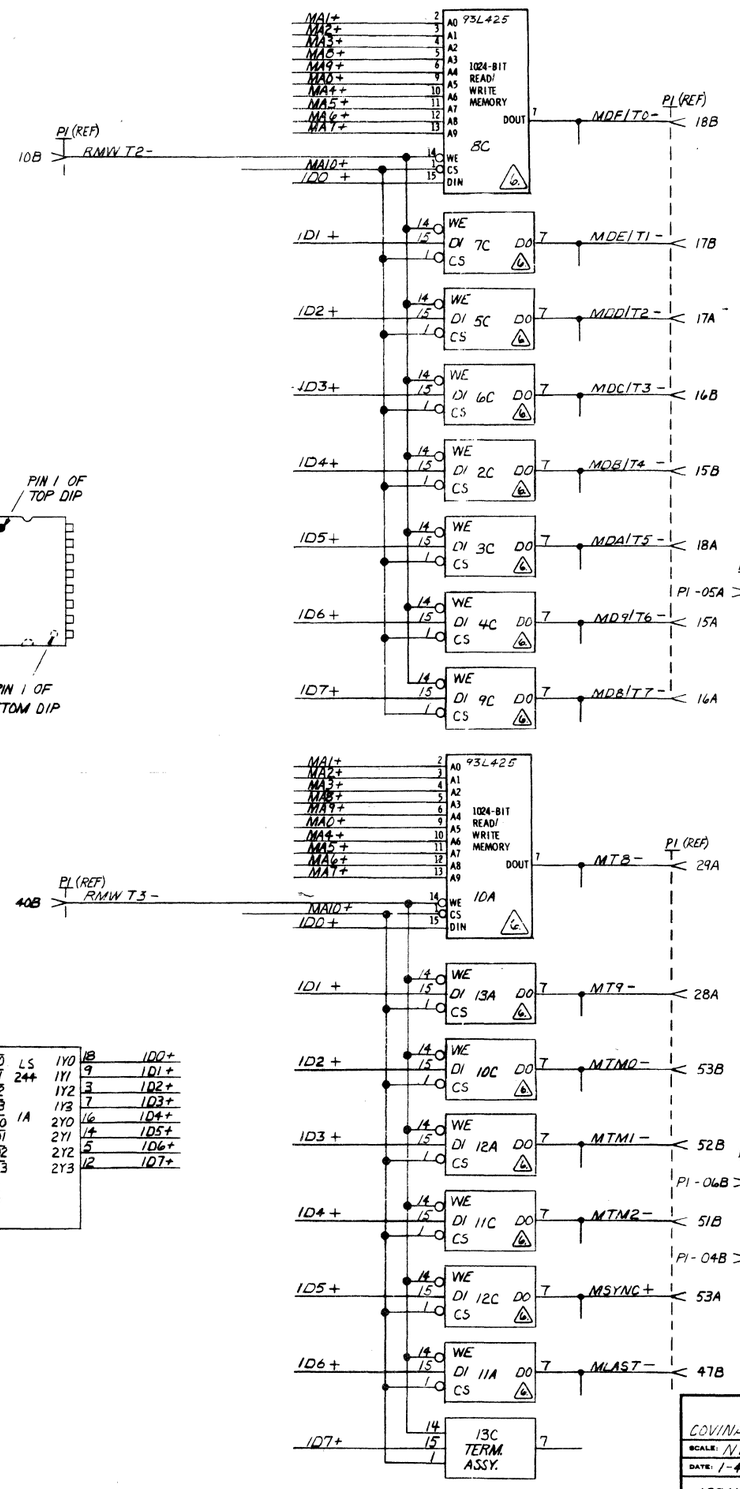
REVISIONS			
LTR	DATE	APPR	DESC











⚠ H-P DESIGNATES HIGH PROFILE SOCKETS.

△ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.

5. RESISTOR R1 IS A 1KΩ ¼W CARBON COMP.

4. CAPACITORS C1 THRU C10 ARE .05μF AT 25V CERAMIC DISC.

3. CAPACITORS C11 & C12 ARE 10μF AT 25V ELECTROLYTIC.

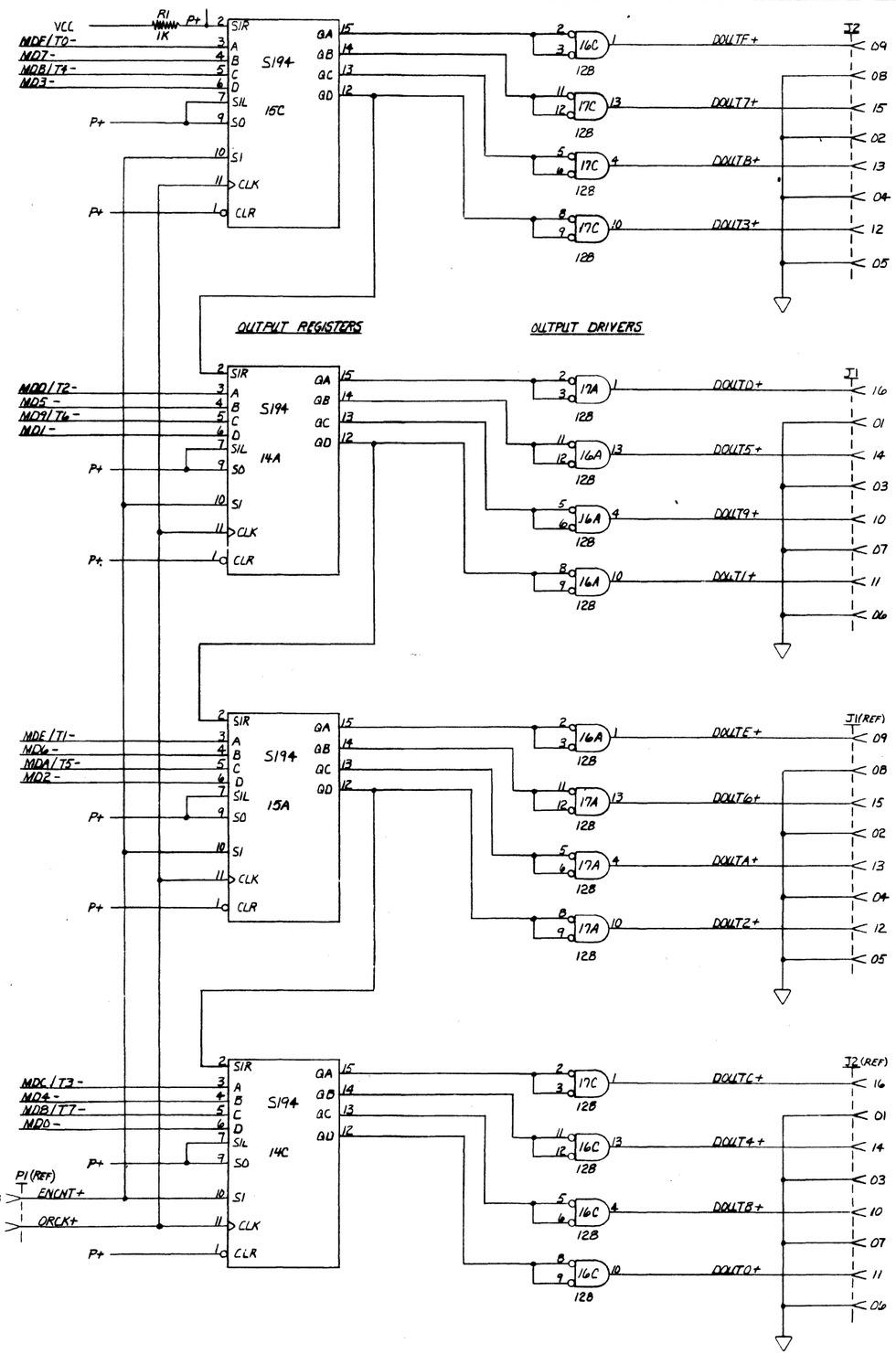
2. REF. 1001154 FOR PCB.

1. 93L425 INSTALLED IN 23 PLACES. ADDRESS LINES MA0+ THRU MA9+ ARE CONNECTED TO A0 THRU A9 OF ALL 23 CHIPS.

NOTES:

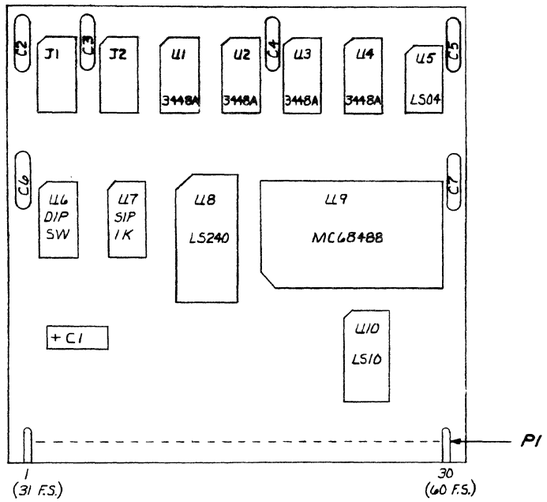
COVINA	interface TECHNOLOGY		CA. 91724
SCALE: NTS	APPROVED BY: EHK		DRAWN BY: RCP
DATE: 1-4-79			REVISED
ASSY/LBD, RS-660 1K MEMORY CARD			
SHEET 1 OF 2			DRAWING NUMBER 1001155

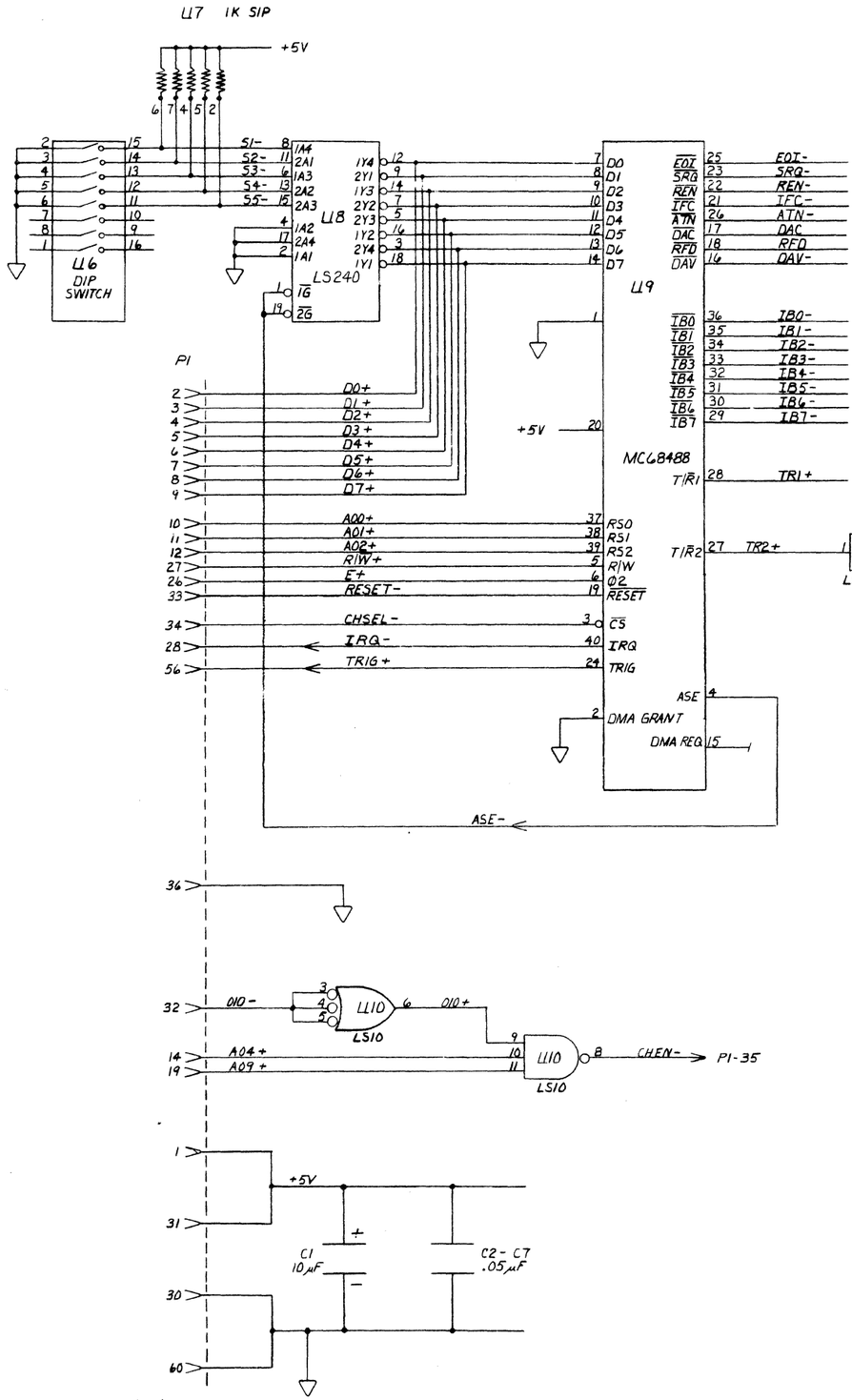
PRINTED ON NO. 1000H - 10 CLEARPRINT FADE-OUT

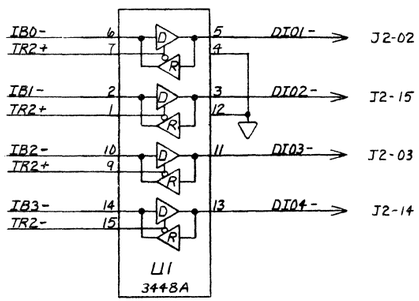


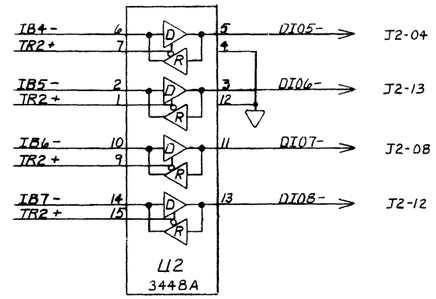
interface TECHNOLOGY			
SCALE: NTS	APPROVED BY:		DRAWN BY RK
DATE: 1-4-79			REVISED
ASSY LBD RS-660 1K MEMORY CARD			
SHT. 2 OF 2		55619	DRAWING NUMBER 100111155

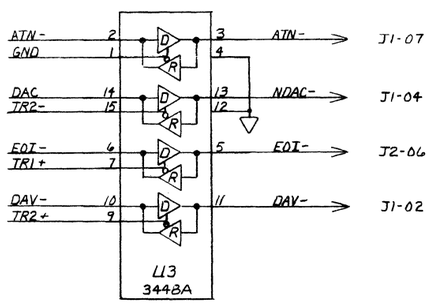
PRINTED ON NO. 1000H - 10 CLEARPRINT FADE-OUT

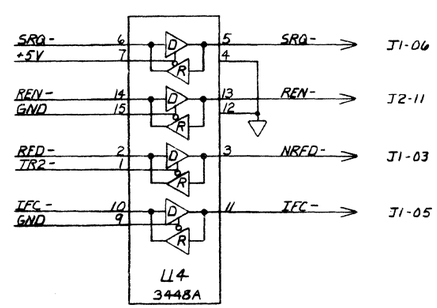












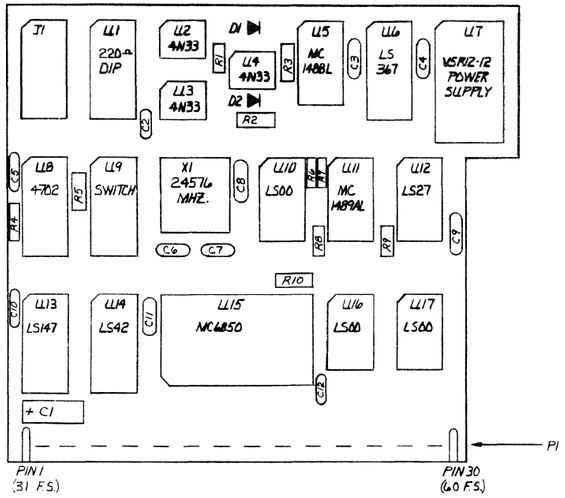
REVISIONS			
LTR	DATE	APPR	DESC

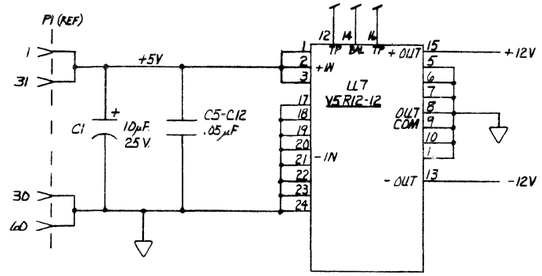
NOTES: UNLESS OTHERWISE SPECIFIED

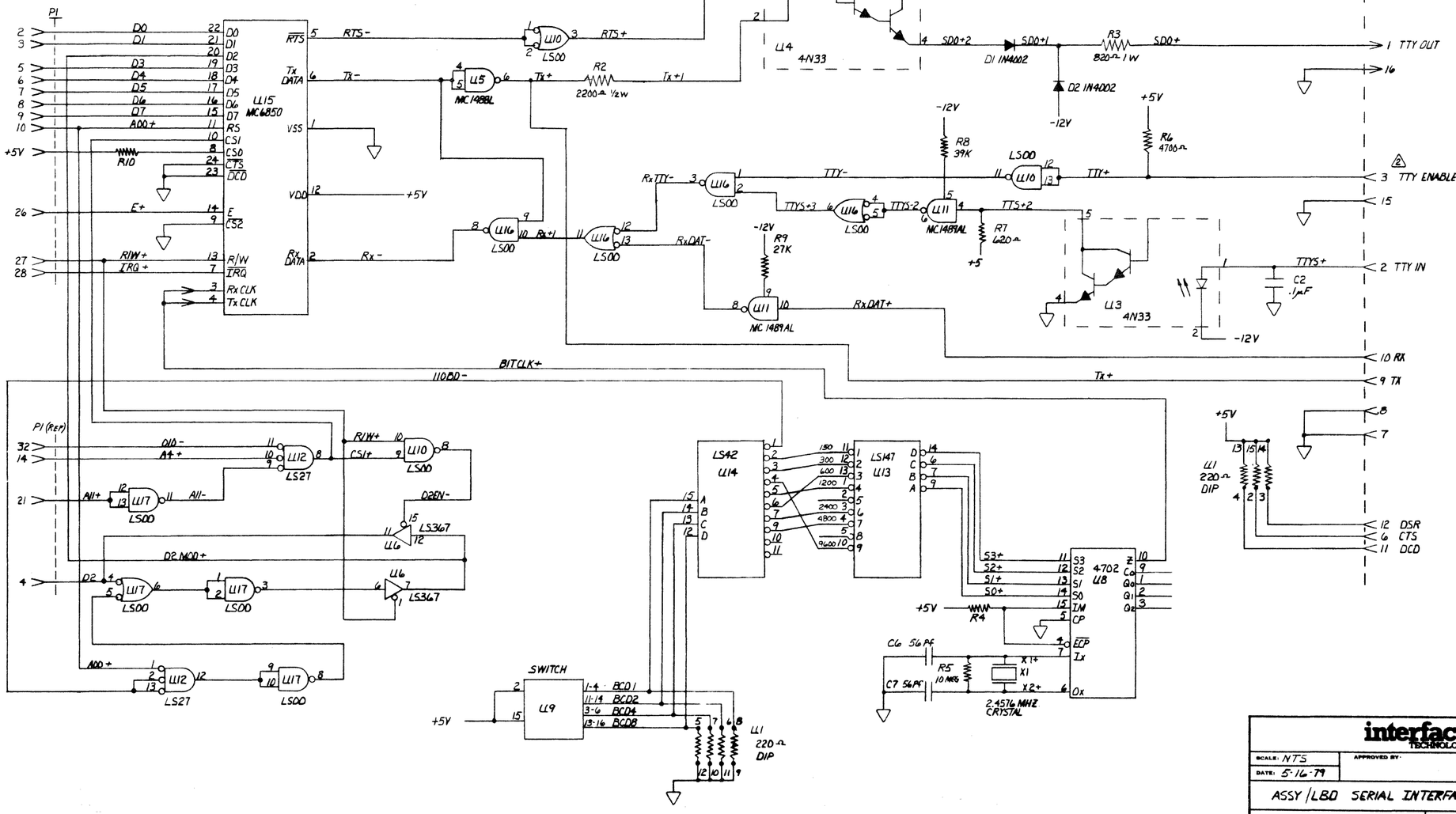
1. REFER TO 10011133 FOR PCB.
2. ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.

interface TECHNOLOGY		
SCALE: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 4-4-79		REVISED
ASSY/LBD IEEE INTERFACE CARD		
SHT. 1 OF 1	55613	DRAWING NUMBER 10011134

REVISIONS			
LTR	DATE	APPR	DESC





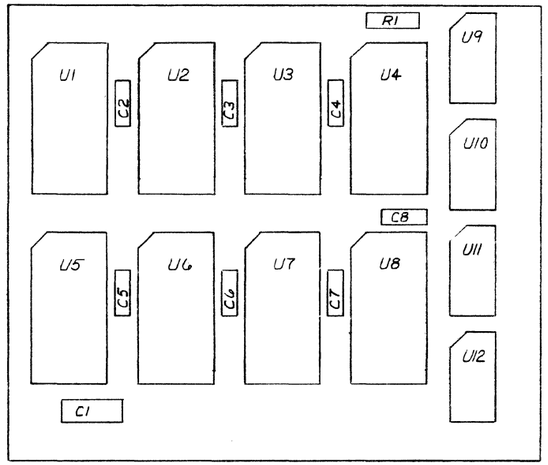


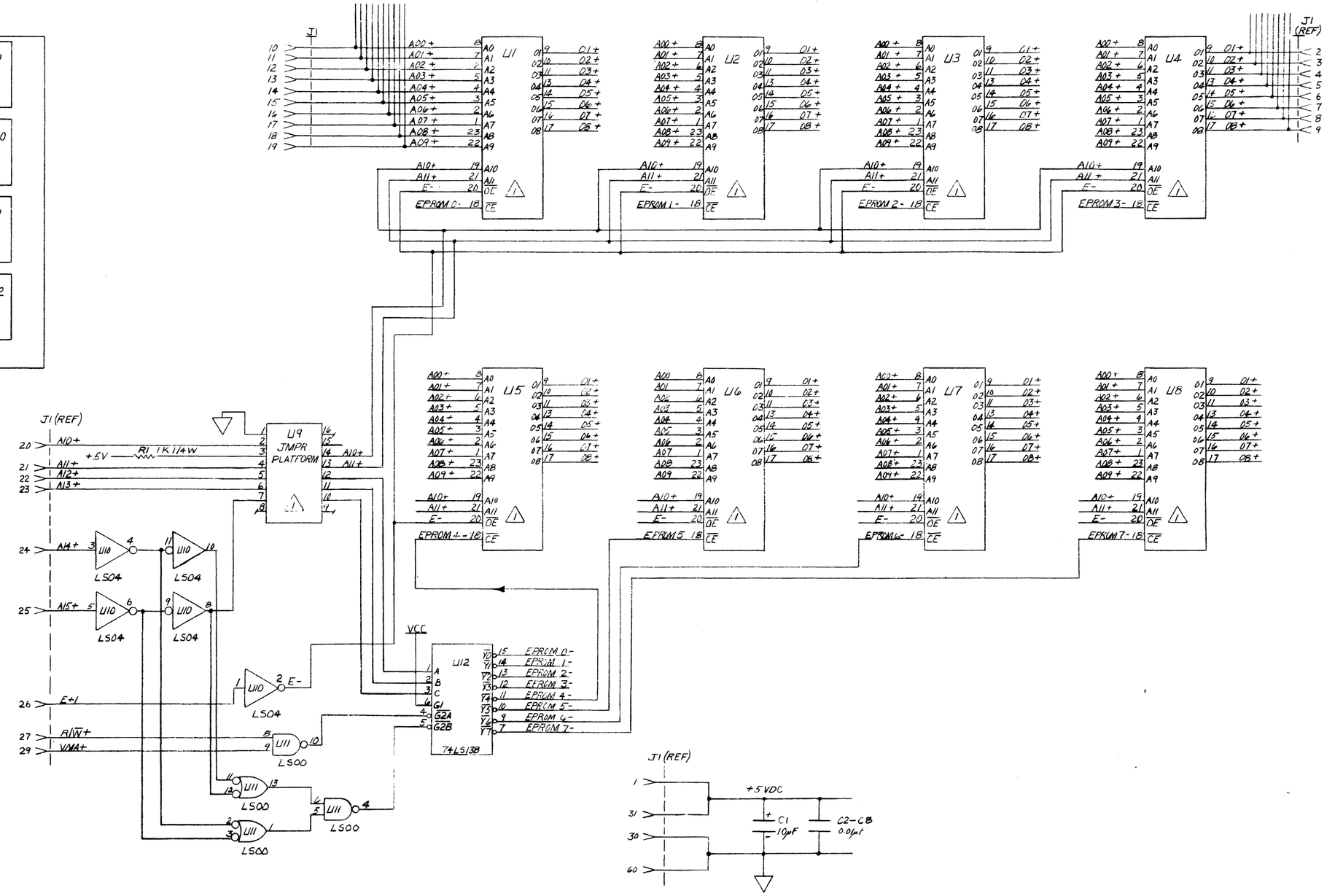
1. ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
6. REF. 10011131 FOR PCB.
5. ALL RESISTORS ARE 1KΩ ¼W CARBON COMP. UNLESS NOTED.
4. ALL CAPACITORS ARE 0.05μF 50V. CERAMIC UNLESS NOTED.
3. C1 IS A 10μF 25 WVDC ELECTROLYTIC CAPACITOR.
2. GROUND ON EXTERNAL CABLE TO ENABLE TTY.
1. REVERSE CABLE PLUG 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		REVISED	
ASSY/LBO SERIAL INTERFACE CARD			
SHT 1 OF 1		55613	DRAWING NUMBER 10011132

REVISIONS			
LTR	DATE	APPR	DESC





4. CAPACITORS C2-C8 ARE 0.05μF CERAMIC
3. CAPACITOR C1 IS 10μF. 25 V.
2. RESISTOR R1 IS 1K-Ω 1/4 WATT CARBON

EPROM TYPE	FROM U9 PIN NO. 14	13	12	11	10
TO U9 PIN NO.					
2758	1	3	2	4	5
2716	2	3	4	5	6
2732	2	4	5	6	7
2516	2	3	4	5	6

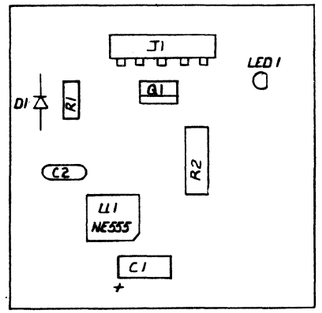
⚠1. U1-U8 MAY USE INTEL 2758, 2716, 2732 OR TI 2516; INSTALL FOLLOWING JUMPERS ON U9.

NOTES:

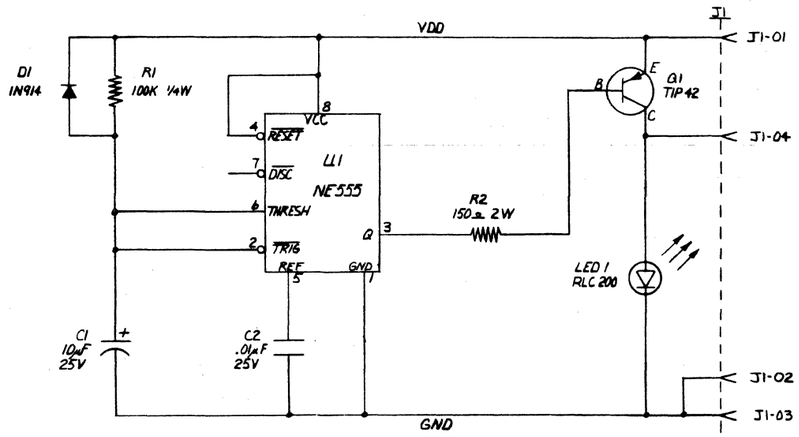
interface TECHNOLOGY			
SCALE: N.T.S.	APPROVED BY:	DRAWN BY: R.J.K	
DATE: 1-8-79		REVISED	
ASSY/LBD, STORED PGM CARD MODEL 488			
SHT. 1 OF 1	55613	DRAWING NUMBER 10011130	

82204 PRINTED ON NO. 10000-10 CLEARPRINT PAPER-DUT

REVISIONS			
LTR	DATE	APPR	DESC



COMPONENT SIDE



5. REF. 10011280 FOR PCB.
4. RESISTOR R2 IS A 150Ω 2W CARBON COMP.
3. RESISTOR R1 IS A 100KΩ ¼W 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.

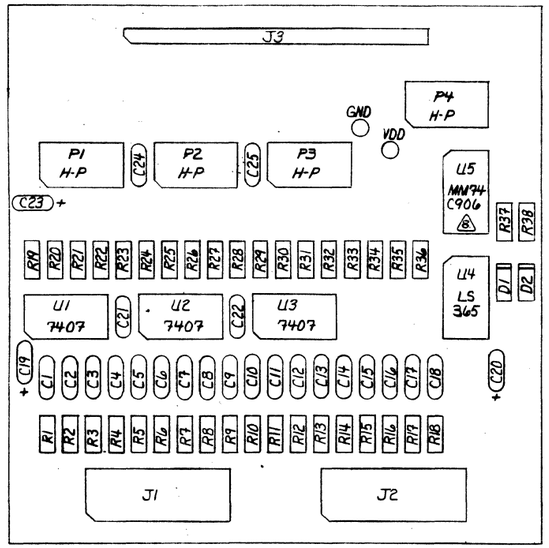
interface TECHNOLOGY

SCALE: NTS	APPROVED BY: GNK	DRAWN BY RK
DATE: 6-1-79		REVISED

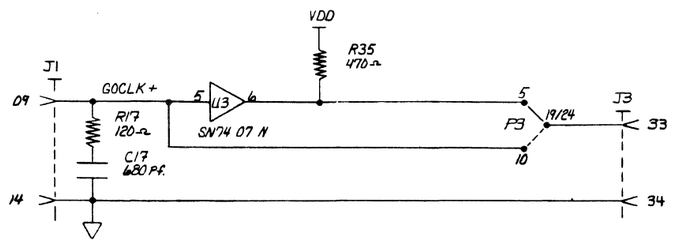
ASSY LBD RS-660 CRT DELAY CIRCUIT AB

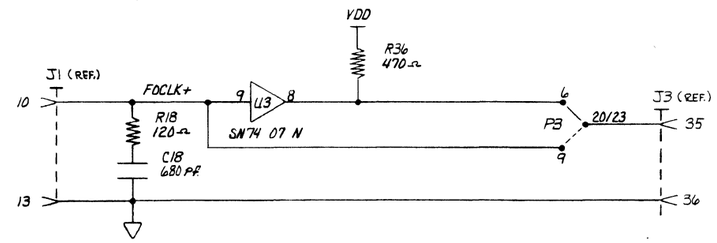
SHT 1 OF 1	55613	DRAWING NUMBER 10011281

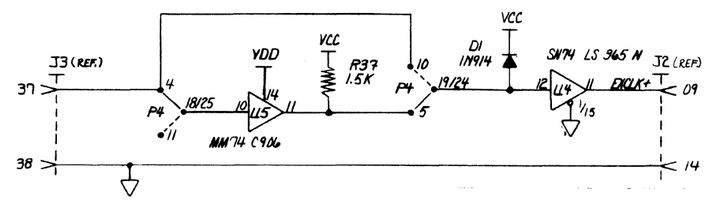
REVISIONS			
LTR.	DATE	APPR.	DESC

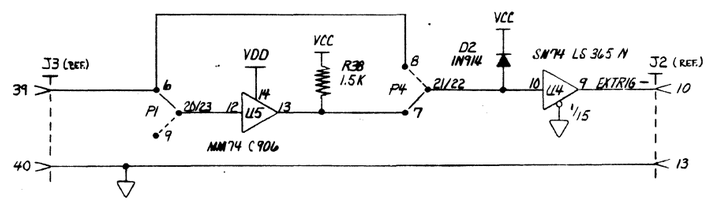


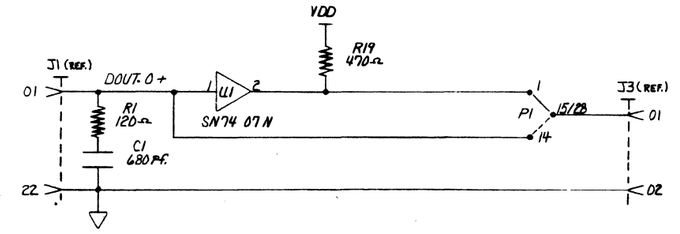
ASSEMBLY SIDE

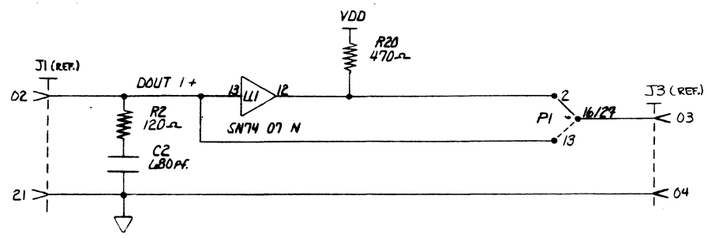


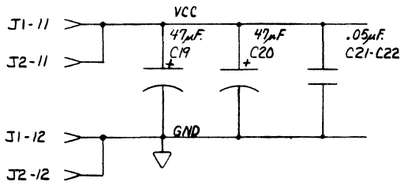


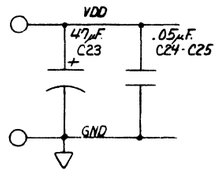


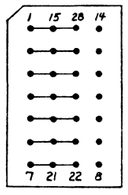










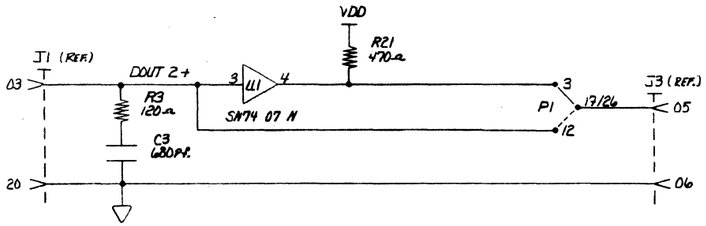


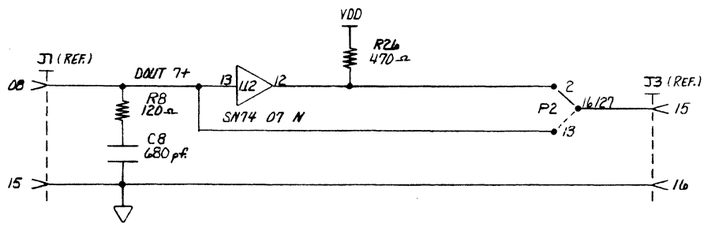
TYPICAL: P1 - P4

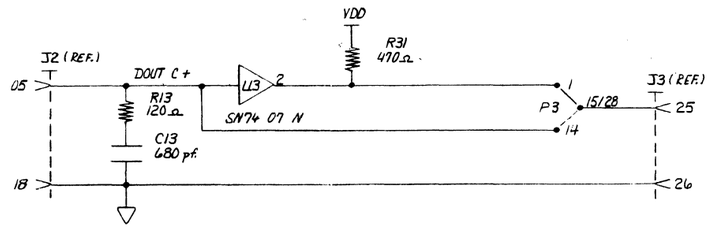
10. P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN 1 DENOTES CMOS; P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN 8 DENOTES TTL.
9. REF. 1001309 FOR PCB.
8. ALL INTEGRATED CIRCUITS ARE SN74 XX UNLESS NOTED
7. D1 AND D2 ARE IN914 DIODES.
6. R37 AND R38 ARE 1.5KΩ 1/4 W CARBON COMP. RESISTORS.
5. R19 - R36 ARE 470Ω 1/2 W CARBON COMP. RESISTORS.
4. R1 - R18 ARE 120Ω 1/4 W CARBON COMP. RESISTORS.
3. C21, C22, C24 AND C25 ARE .05μF. AT 25 WVDC CERAMIC DISC CAPACITORS.
2. C1 - C18 ARE 680 pf. AT 25 WVDC CERAMIC DISC CAPACITORS.
1. C19, C20 AND C23 ARE 47μF. AT 25 WVDC TANTALUM CAPACITORS.

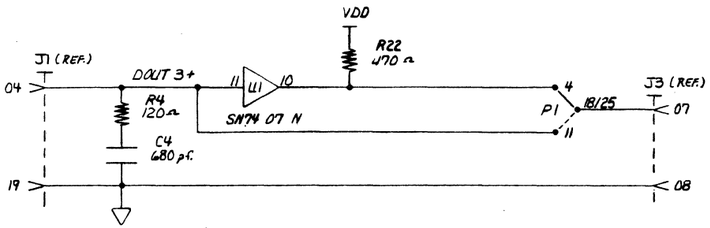
NOTES: UNLESS OTHERWISE SPECIFIED

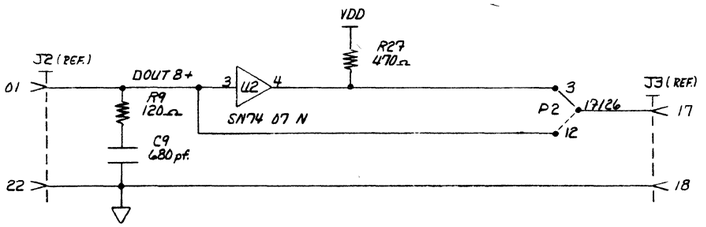
interface TECHNOLOGY			
SCALE: NTS	APPROVED BY:	DRAWN BY RK	
DATE: 8-7-79		REVISED	
CCA / LBD, POD			
SHT. 1 OF 2	55613	DRAWING NUMBER 1001 1310	

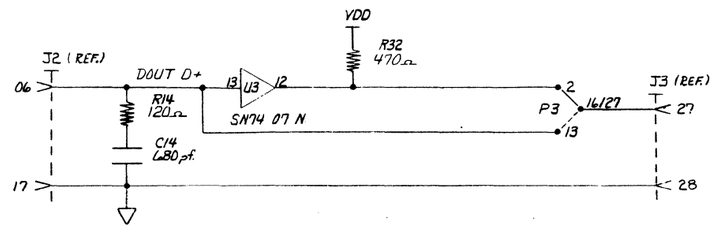


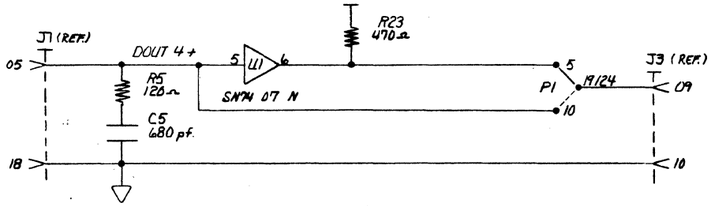


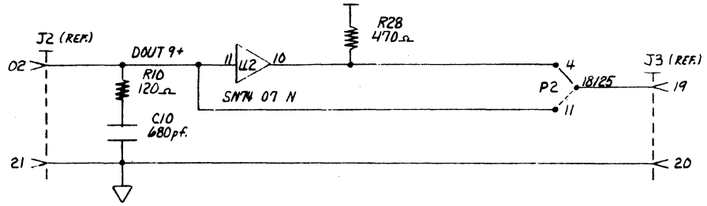


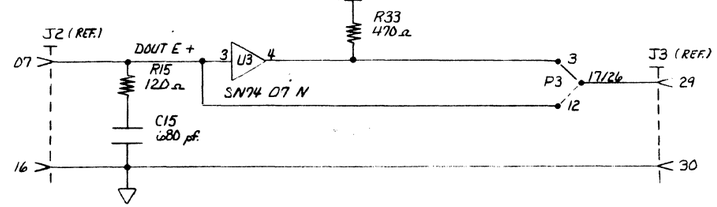


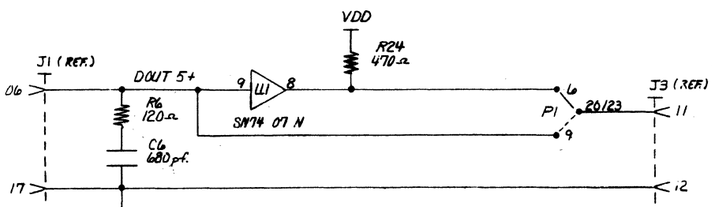


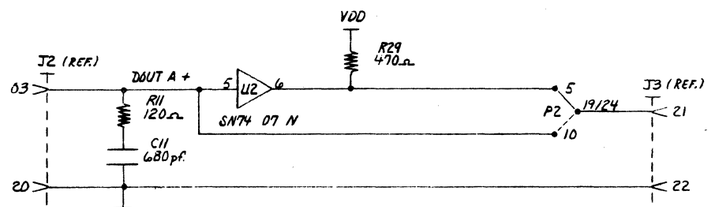


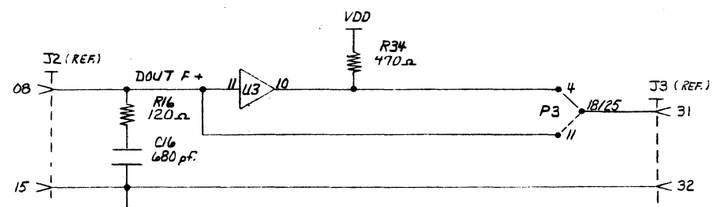


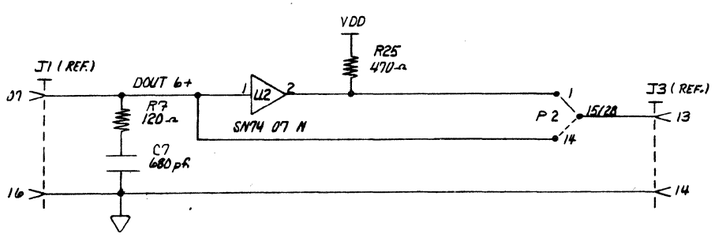


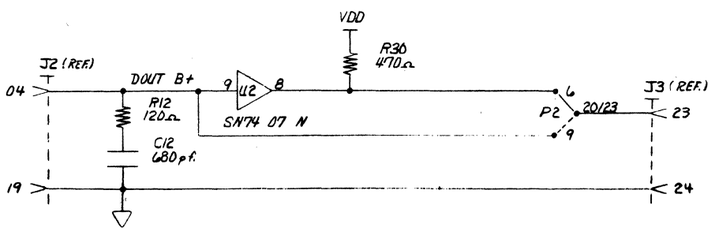












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