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1.0 INTRODUCTION

The Model RS-4004 is the fourth generation digital signal generator and test subsystem manufactured by Interface Technology. It is a dual microprocessor controlled digital word generator, comparator and logic recorder. The Model RS-4004 combines word generator/timing simulator digital output capability with digital input, compare and record capability to perform complex digital testing. The unit is configurable, allowing the users to generate, test, and record anywhere from 16 to 1024 simultaneous channels.

The Model RS-4004 is completely programmable at a variety of levels. The user may have prestored programs on floppy disk and simply call them. He may program in any of the several higher level prompted operating modes, or he may decide it necessary to program at the MACRO language level. In every case, the user has access to the various stimulus memories, expected value memories, mask memories and record memories that may be contained in the Model RS-4004. Test rates to 20 MHz may be achieved with parallel output pattern depths to 4096 words. Serial modes of operation are also available.

The Model RS-4004 features a menu driven, user interface using a function keyboard and CRT display. The user is prompted through and assisted in the programming of the various modes, data tables and control parameters. A standard LSI microprocessor aids in the prompting, display formatting and the programming protocol for the bit slice microprocessor.

Numerous applications are envisioned for the Model RS-4004. It can be used to generate complex digital signals to test CCD's, to modulate RF synthesizers, to control and synchronize test systems, etc. It can be used to test integrated circuits, hybrids, or PC cards. It can be used in laboratory evaluation or be built into a large ATE system. It can be used to record a large number of parallel channels for monitoring of digital boards or systems. The Model RS-4004 can also be used to upgrade existing automatic PC card, IC or in-circuit testers giving them 10 MHz functional testing capability.

1.1 STANDARD FEATURES

The RS-4004 employs a dual microprocessor architecture and modular, plug-in I/O cards to provide high speed pattern generation and test capabilities. The System CPU (SCPU) is a Motorola 68000 microprocessor and the Bit Slice Microprocessor (BSM) is AM2900-based. The I/O cards provide flexible pattern generation, recording and testing capabilities with pattern depths of 1024 or 4096. Several standard remote control interfaces are also provided. Figure 1-1 is a simplified block diagram of the RS-4004 organization.

The System CPU handles all interaction between the operator, the instruments's front panel, and the remote interfaces. It also communicates with the BSM and the I/O cards to handle programming, data entry, data recall, start, stop, and status control functions.

The BSM is responsible for controlling the Word Generator/Timing Simulator section. Here, it provides the control over the clock rate, serial or parallel operation, what pattern memory locations to output, the number of loops through a pattern and start/stop conditions. The Word Generator section contains the clock and addressing logic required to control the I/O cards, which contain the pattern memories that are executed to accomplish the testing, pattern generation, or pattern recording.

Three remote control interfaces are standard on the RS-4004: the IEEE 488-1978, RS-232C, and a high speed 16 channel parallel interface.

Other standard features of the RS-4004 include clock signals, synchronizing signals, and a composite video output. The clock signals include both input clocks and output clocks, synchronized with data patterns. Synchronizing signals include trigger, program address sync output, word pattern output sync, and force outputs to tri-state. The video output allows for video monitor operation or video printer reproduction of CRT images.

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7. Mechanical

Main Chassis: 17" W x 8.75" H, 22" D, 75 lbs. maximum
Expansion Chassis: 17" W x 8.75" H x 22" D, 65 lbs. maximum

8. Power

Standard 110 VAC, Option 4030 for 220 VAC operation

Main Chassis: 110 VAC ±20%, 7A maximum, 50/60 Hz
220 VAC ±20%, 3.5 maximum, 50/60 Hz

Expansion Chassis: 110 VAC ±20%, 5A maximum, 50/60 Hz
220 VAC ±20%, 2.5 maximum, 50/60 Hz

9. Environmental

Temperature: 0° to 40°C, all specifications valid at 25°C
Humidity: 80% relative humidity, noncondensing

10. Mating Connectors Ordering Information

All Data I/O, Timing Generator and Bit Slice I/O: P/N 609-4030 plus 609-4031 SP Extractor handle.

11. Remote Interfaces

IEEE: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2

RS-232C: Half duplex, 110, 150, 300, 600, 1200, 2400, 4800, 9600 baud, switch selectable

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Timing Generator skew between channels:	< 3 ns typ
Force tri-state input to data out:	30 ns typ
Pulse control input to data out:	35 ns typ

5. Driver/Receiver Characteristics

- Data Output signals, Option 4003X, 4004X: user removable 100 Ω series terminated, capable of driving two TTL loads; with termination removed sink current = 256 ma, source current = 60 ma.
- Output Clocks, Data Output Signals, Option 4006X, and Auxiliary Output Signals Option 4003X: user removable 100 Ω series terminated, capable of driving two TTL loads; with termination removed sink current = 128 ma, source current = 30 ma.
- Output Flags, Pulses: user removable 100 Ω series terminated, capable of driving two TTL loads; with termination removed sink current = 64 ma, source current = 15 ma.
- Output Sync: user removable 50 Ω series terminated, capable of driving two TTL loads; with termination removed sink current = 128 ma, source current = 30 ma.
- Input Data:
- Input Flag and Pulse:
- External Clocks:
- External Force Tri-state:
- External Pulse Control:
- External Trigger:
- External Window:
- External Clock Qualifiers:

One STTL load with 10K Ω pull up resistor or user configurable for 120 Ω termination with resistive pad consisting of 180 Ω to +5, 390 Ω to ground

6. CRT Video

75 Ω, composite video vertical sync = 17 ms, horizontal sync = 60 us.

Oscillator: (Option 4007)	100 MHz, frequency stability/accuracy = ±0.005%
External Clock:	20 MHz max for Word Generator Mode, 10 MHz max for Test Generator Mode, 20 ns. min pulse width
External Window/Sample:	10 MHz max for Test Generator Mode, synchronized to fall within period of external input clock; 20 ns. min pulse width
Trigger Input:	20 ns. min pulse width; high to low transition triggers

4. Clock/State/Sync Relationships

Gated Output Clock to any data channel output:	35 ns typ
External Clock to Gated Output Clock:	30 ns typ
Data channel to any other data channel, same card:	5 ns typ
Data channel to any other data channel, same chassis:	10 ns typ
Data channel to any other data channel, any chassis:	20 ns typ
Gated Output Clock to Table/Loop/ Word Output sync:	15 ns typ
External trigger to data channel output (Gated Output clock):	25 ns + clock period, typ
Input data to external window/ sample set up and hold time:	-30 ns set up, + 35 ns hold, typ
External window/sample to gated output window:	27 ns typ
External clock qualifier to external clock set up and hold time:	10 ns setup, 5 ns hold, typ
Timing Generator Clock to any data channel:	70 ns typ
Timing Generator sample clock to gated output window:	32 ns typ

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1.4 TECHNICAL SPECIFICATIONS

1. Bit Slice Microprocessor

- 200 nsec. bit slice instruction execution rate
- 1024 word bit slice program RAM
- 4 level bit slice subroutine
- 4 internal bit slice loop counters
- 16 arithmetic logic outputs under bit slice control
- 20 discrete output lines that can be set, reset, pulsed
- 20 discrete input lines that can be tested for set, reset or pulse and condition
- Bit slice program address sync pulse output
- Macro language programmable

2. Word/Pattern/Timing Generator

- Serial or parallel I/O operation
- 4096 state loop counter
- Modular I/O cards for user configurability (16, 32 and 64 channel cards)
- Expansion chassis available to accommodate a maximum of 16 I/O cards
- TTL and TTL tri-state level I/O signals
- Bidirectional TTL signals
- Programmable crystal controlled clock generator
- Optional 100 MHz timing generator for output clocking and input sampling (10 ns. resolution)
- 16 to 1024 output channels with up to 4096 bits per channel
- 16 to 1024 input channels with up to 4096 bits per channel
- Input data can be recorded or compared against prestored expected data
- Input data comparison on edge or window with bit masking

3. Clocks

Internal Oscillator: 40 MHz, frequency stability/accuracy = ±0.1%

Internal Period Counter: (50% duty cycle, true and complement output available)

Range	Resolution
50 ns - 102.35 µs	50 ns
102 µs - 1023 µs	1 µs
1.02 ms - 10.23 ms	10 µs
10.2 ms - 102.3 ms	100 µs
102 ms - 1023 ms	1 ms

With Option 4007 100 MHz Timing Generator: 50 ns - 5 sec, 10 ns

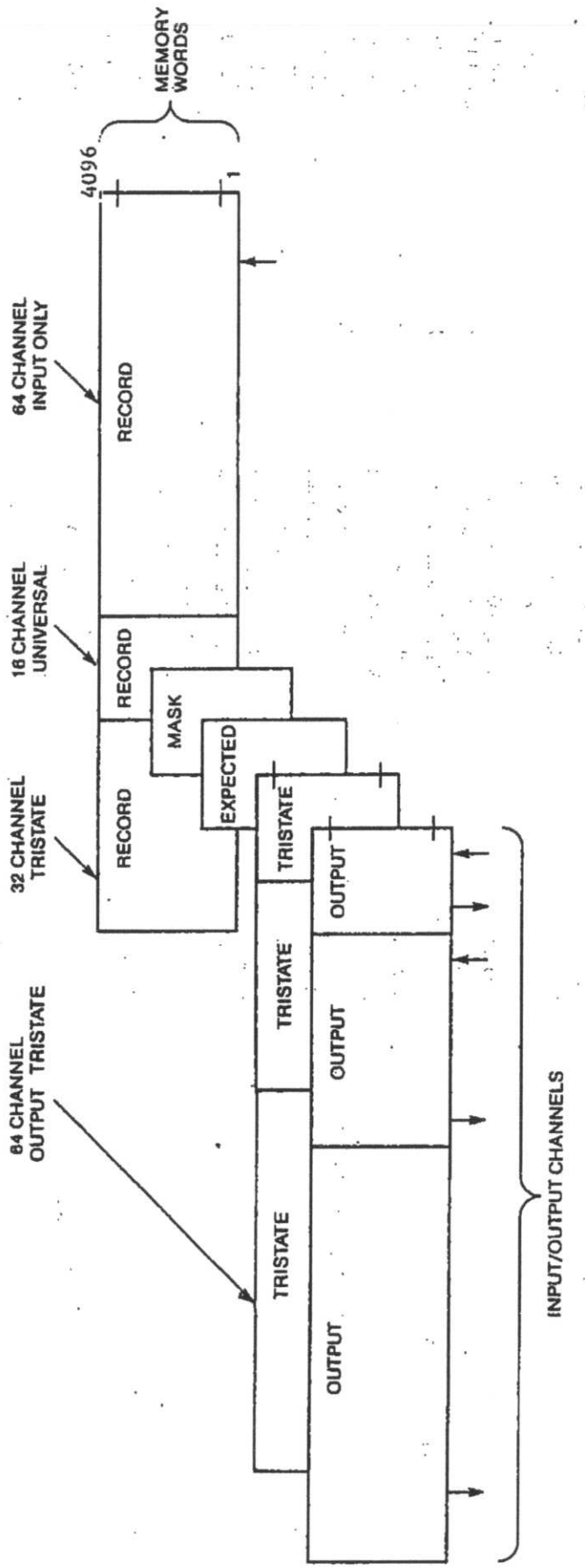
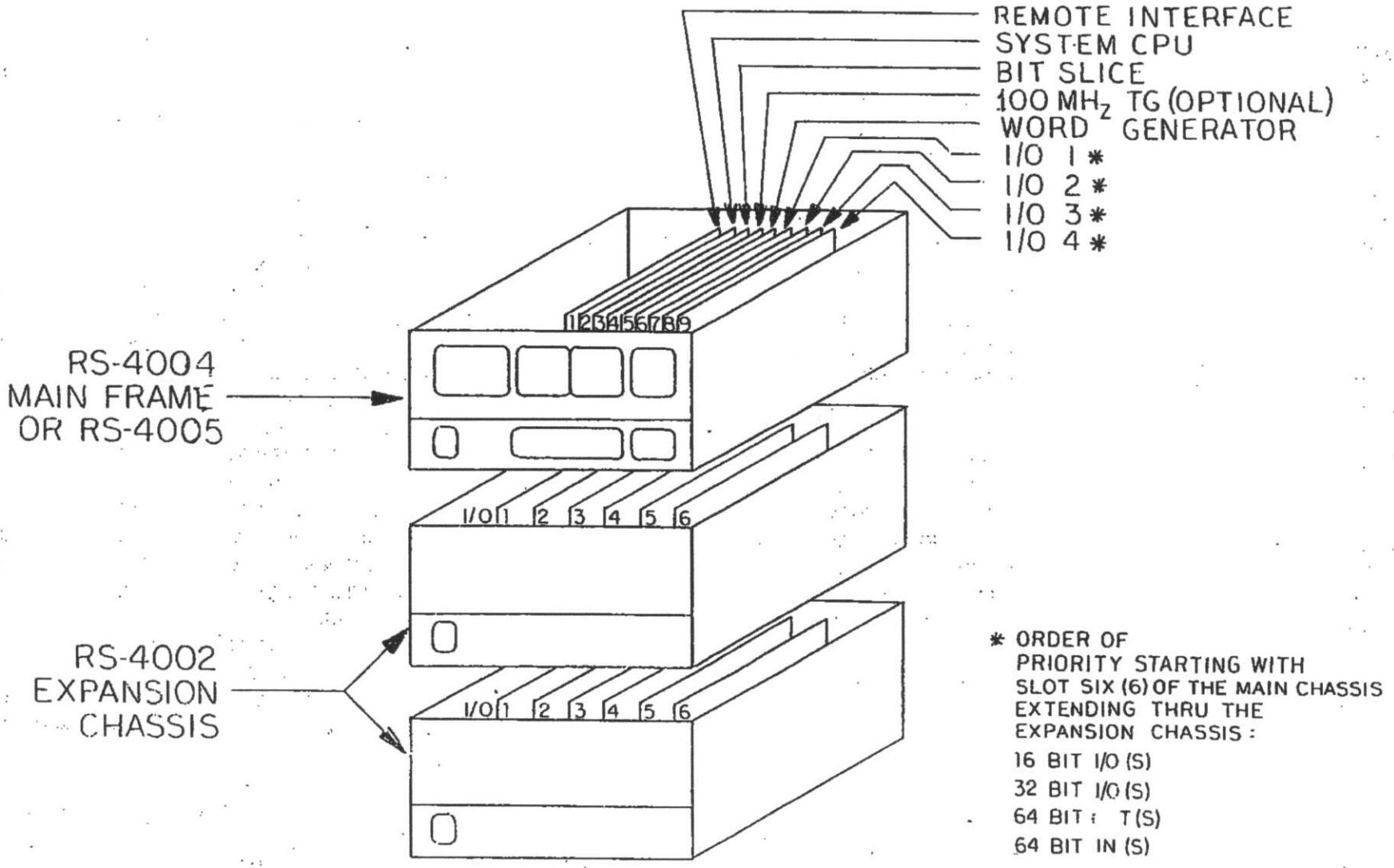


FIGURE 1-7. MEMORY ORGANIZATION FOR STANDARD I/O CARD TYPES

FIGURE 1-6

RS-4004 SYSTEM I/O CARD CONFIGURATION



1.3 CONFIGURATION

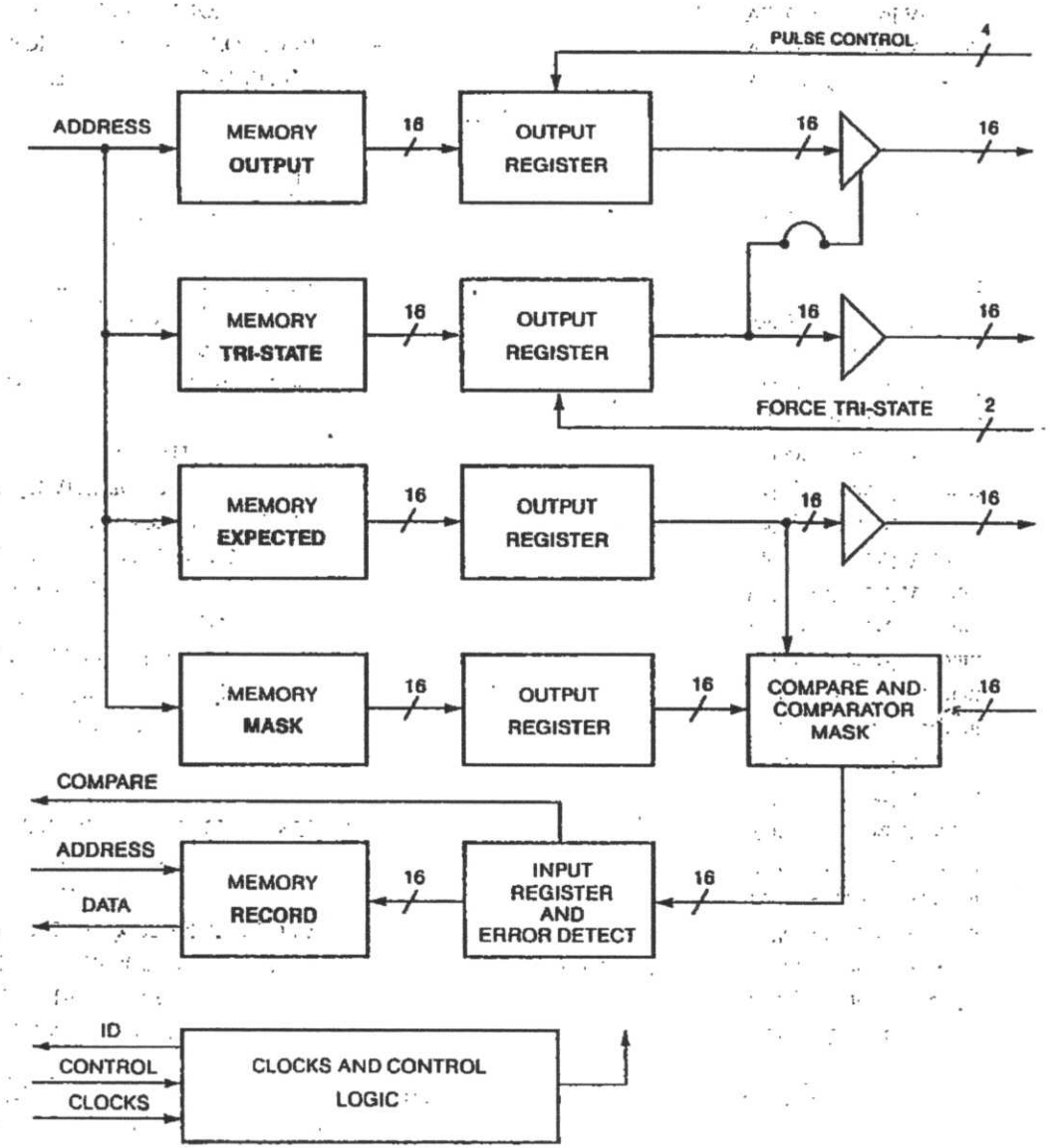
The Model RS-4004 is a modular instrument to allow the user to configure a system to suit his particular needs. The basic mainframe has five option card slots. One slot is dedicated to the 100 MHz Timing Generation option while the others are available for the I/O card options.

The mainframe configuration is shown in Figure 1-6. If more than four I/O cards are desired, a maximum of two Model RS-4002 expansion chassis may be added to any RS-4004 system, providing a maximum of 16 card slots.

For users not requiring the CRT and keyboard for programming purposes, the Model RS-4005 is available. The 4005 can be expanded with up to two RS-4002 expansion chassis to provide a total system configuration of 16 I/O cards.

I/O option cards may be intermixed or added as needed. System expansion is simple because I/O cards may be installed in the field. An example of the RS-4004 configured, with one of each of the available I/O cards, is shown in Figure 1- . Note how the memories are organized. System configurations may extend to over 512 parallel channels.

FIGURE 1-5. 16 CHANNEL UNIVERSAL I/O CARD BLOCK DIAGRAM



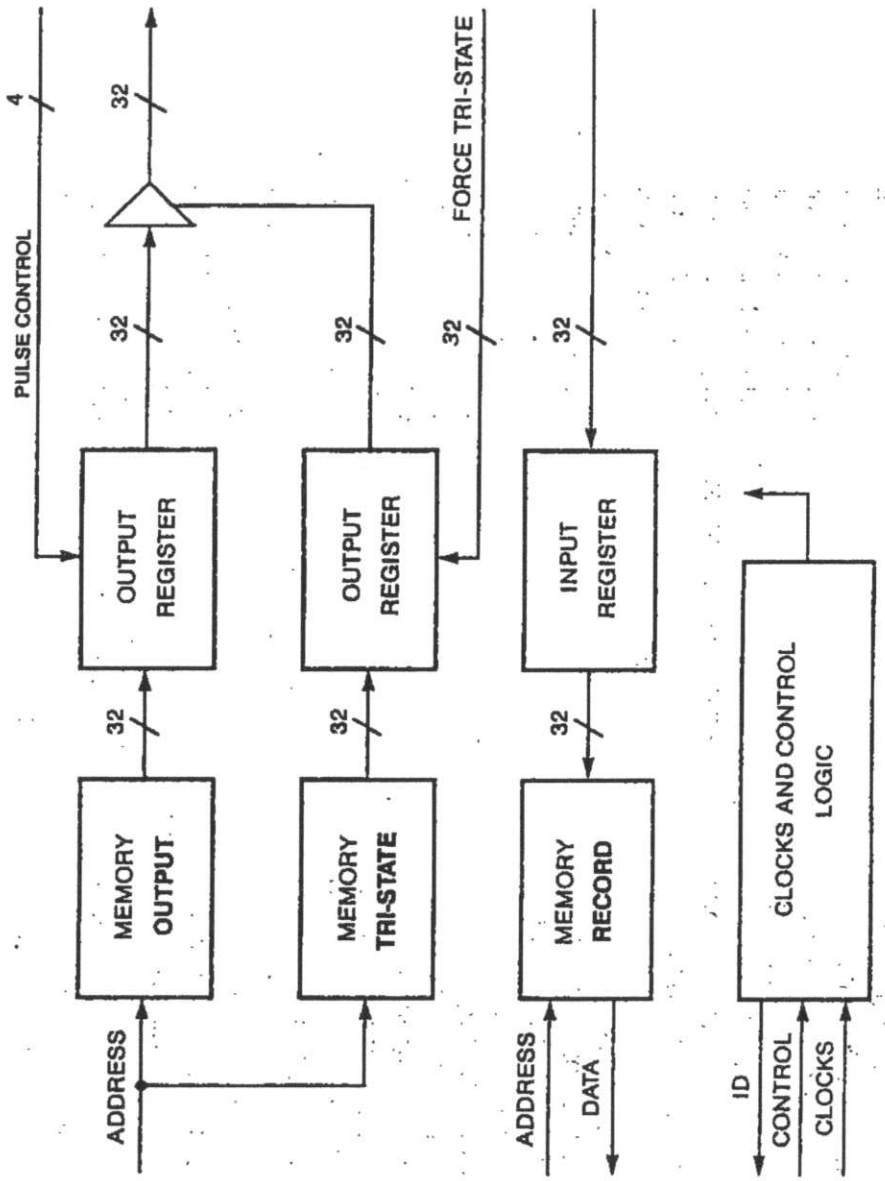


FIGURE 1-4. 32 CHANNEL TRI-STATE I/O CARD

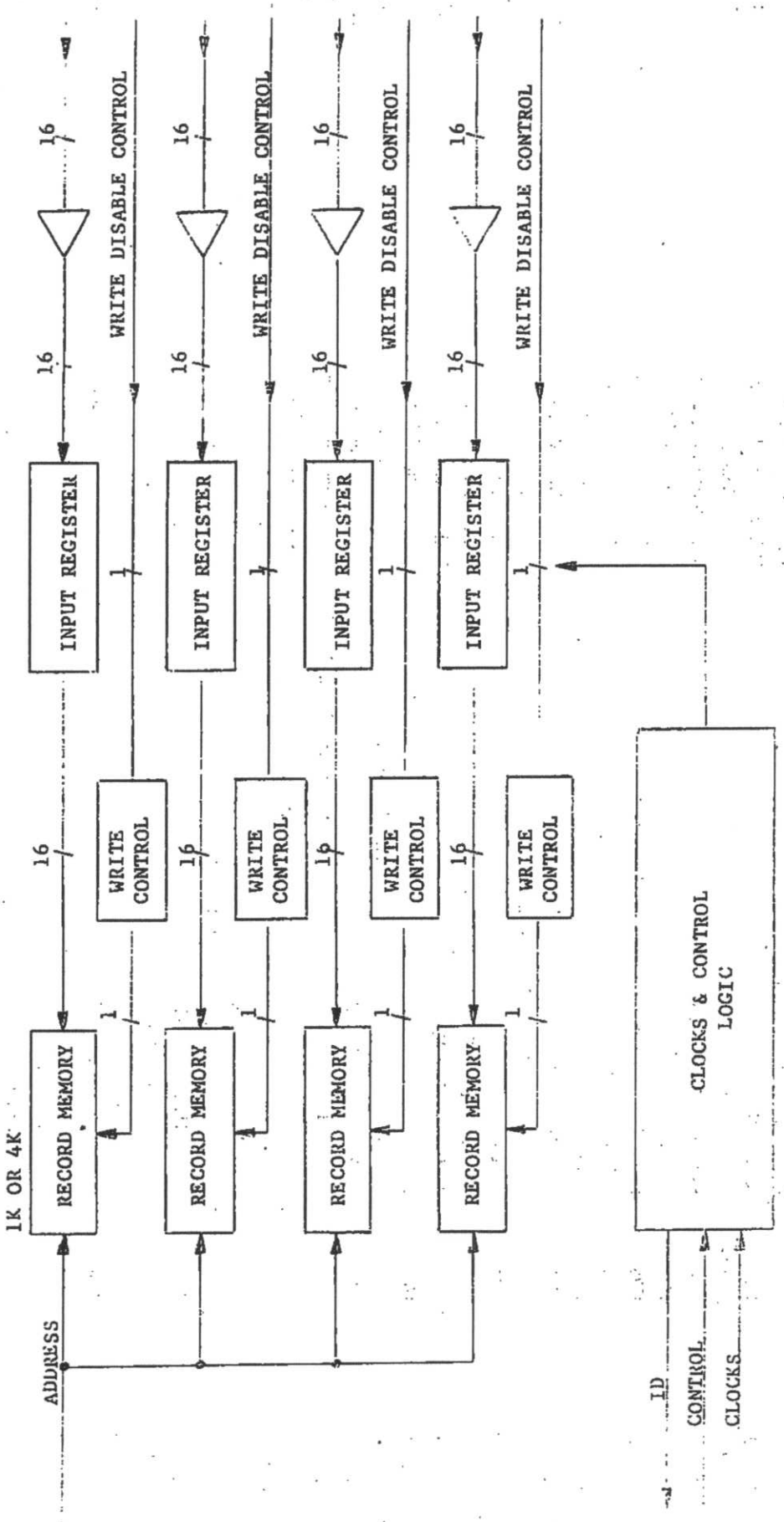


FIGURE 1-3. 64 CHANNEL INPUT CARD

output state. This means that the user can now define, on a clock to clock basis, when a channel is outputting data and when it's in the high impedance tri-state mode.

The 64-channel input card (see Figure 1-3) provides 64 input (record) channels organized in four groups of 16 channels. This card, too, may be provided with 1024 or 4096 words per channel. It also operates in either a parallel or serial mode of operation, with serial modes permitting four serial channels to be recorded simultaneously.

The 32-channel tri-state I/O card (see Figure 1-4), combines both input and output. Thirty-two channels are dedicated to output with independent tri-state control.

Thirty-two channels of this tri-state card are dedicated to input, permitting recording of UUT response data. If the tri-state controlled output channels are tied to the input record channels prior to being connected to the unit under test, this card provides 32 channels of bidirectional capability. Thus selected channels can stimulate the UUT while other channels receive response data to be recorded.

The 16 channel universal I/O card (see Figure 1-5), is also a combination input and output card, but it has even further enhancements over the 64 or 32 channel cards because it provides a digital comparison capability. In addition to an output memory, a tri-state control memory and an input record memory, this I/O card also has an expected value memory and a compare mask memory. The expected value memory contains data that the user expects from the UUT in response to the stimulus provided by the outputs. The mask memory contains data the ser provides to mask off channels and/or bits within cxhannels which need not contribute to the digital compare function. The user now has the capability to stimulate the unit under test, receive response data, compare it against what was expected, mask off channels or bits which can be ignored for test purposes, and declare a pass or fail result for each clock state. Further, if the tri-state controlled output channels are jumpered to the input channels, bidirectional test capabilities are available.

The 16 channel I/O card provides other functions. It can compare and store errors or simploy sample and store raw UUT response data. It also may be programmed for edge sample, edge compare or window compare modes. In the edge mode, the edge of the sample window (either internal or external) determines when input data is recorded or compared. In window mode, the duration of the sample window is used and input data must remain stable d=for the entire window width. Any changes in state during the window will cause latching and an error indication. The latched error data will be recorded in the record memory.

The 16 channel I/O card also operates in single channel serial or 16 channel parallel modes. Memory can be provided for each channel in 1024 or 4096 depths, with a maximum test clock rate of 10 MHz. Independent clocking of output and input sections is permitted within a clock period.

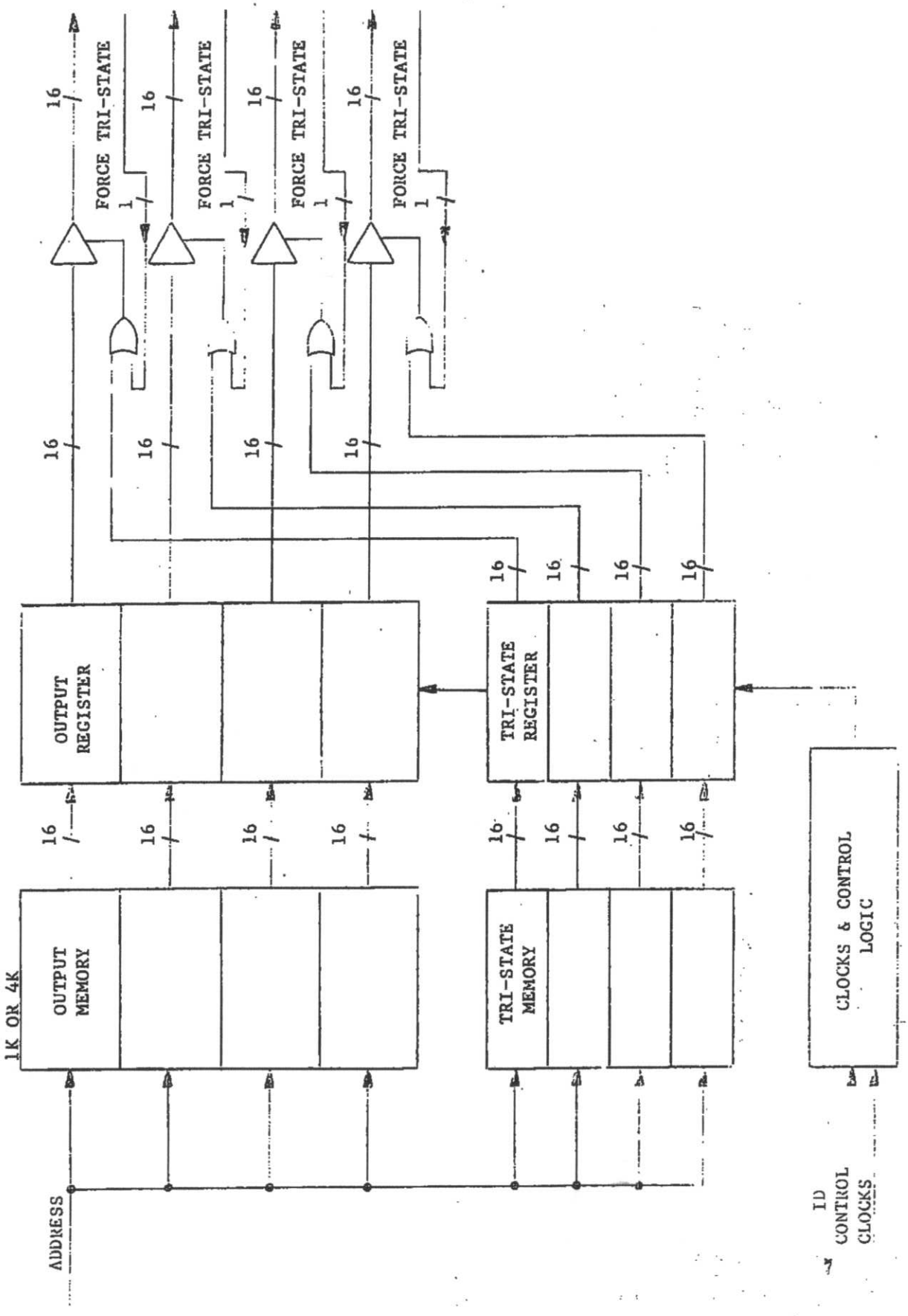


FIGURE 1-2. 64 CHANNEL OUTPUT/TRI-STATE CARD

1.2 OPTIONS

The floppy disk option is provided so users can save and recall data patterns and programs. A second RS-232 port provides the communication path at up to a 9600 baud rate.

The optional 100 MHz Timing Generator module serves two functions: it can be 12-channel, 256-state Timing Simulator which can be programmed to function as an independent, asynchronous 10 nanosecond resolution Timing Generator. Or it can be used to provide a high resolution (10 nanoseconds) clock generation capability for test purposes, where input data comparison sampling with a time delayed window strobe is required. While channel numbers 0, 1, 2, and 3 are output, they may also be internally for RS-4004 output clocking and input sampling. Channels 4 through 11 are used externally only. These channels can represent clocks, strobes, enables, or any timing signals to the UUT. They are particularly useful for strobing patterns into the unit under test.

There are a wide variety of I/O card options which can be added to the RS-4004. These provide the data pattern width and depth, and determine the stimulate, compare, and record capabilities. These card types are:

- 64-Channel Output/Tri-state card
- 64-Channel Input-Only card
- 32-Channel Tri-state I/O card
- 16-Channel Universal I/O card

The 64-Channel Output/Tri-state card (see Figure 1-2) contains 64 parallel channels arranged in four groups of 16 channels. Each channel has a standard memory depth of 1024 or 4096 bits. Each group of 16 channels can be forced into the tri-state or high impedance state, by an external input. This allows them to be tied to tri-state UUT buses or to other 16 channel groups for extended output memory word depth applications.

Each group of 16 channels may also be used as a single serial channel, by operating the output register as a parallel-in, serial-out register. In this serial mode, four serial bit streams may be generated, each having 65,536 bits per channel.

Clock rates are 10 MHz maximum for parallel operation either internally or externally, and 20 MHz maximum for the serial mode. A 20 MHz clock rate is achievable for parallel operation at half the number of parallel output channels but with twice the depth of memory. For example, 20 MHz may be achieved at 32 channels with 2048 bits per channel using the 64 channel output/tri-state card with 1024 bit memory.

As an option, the 64-Channel Output/Tri-state card may be ordered with a 4096 memory depth. Each output channel is capable of independent tri-state control. Tri-state control is provided via an additional set of memories permitting the channel-to-channel and state-to-state (word to word) control over each channel's

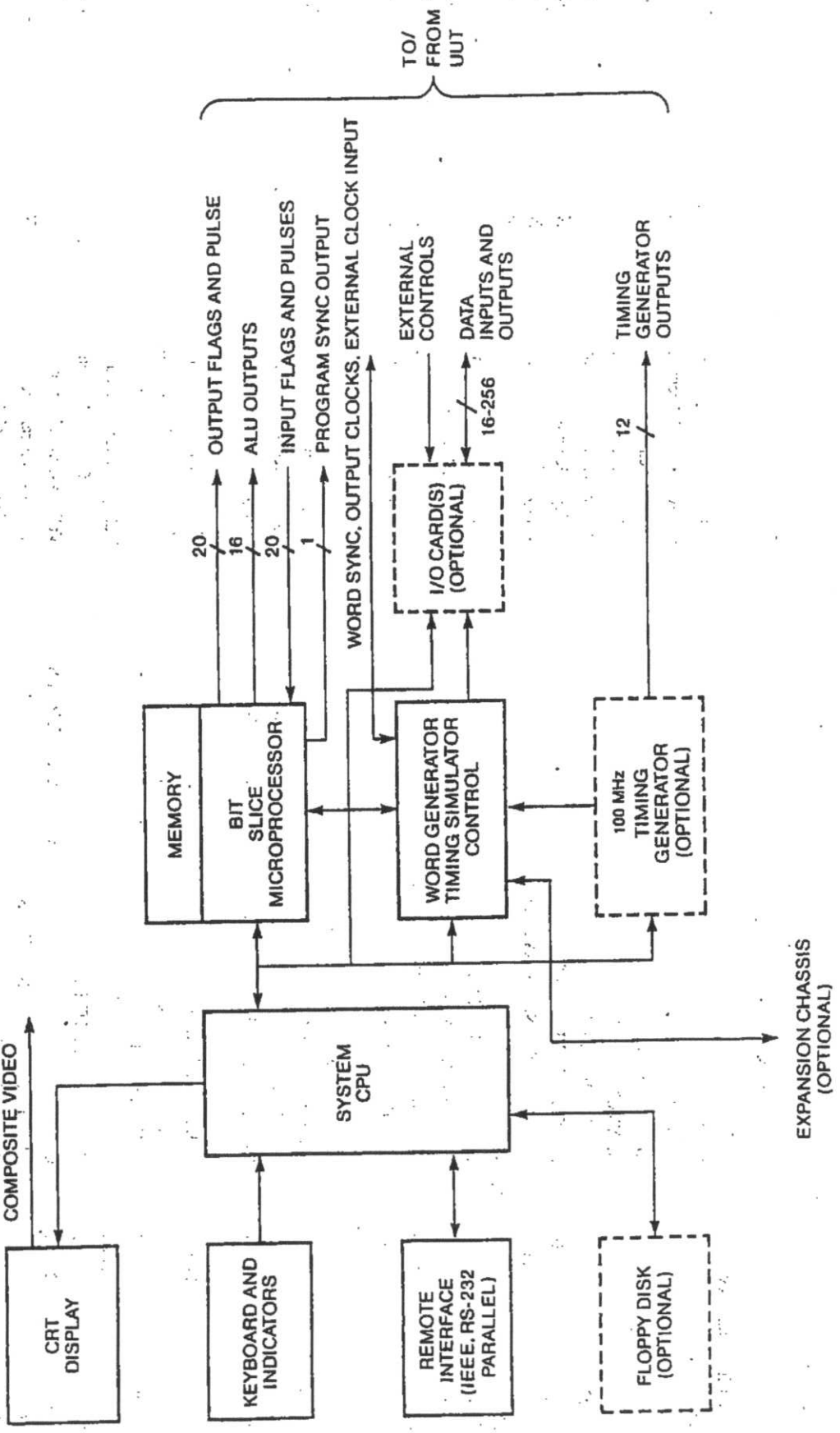


FIGURE 1-1. MODEL RS-4004 BLOCK DIAGRAM