APPLICATION NOTE 167-10
DATA DOMAIN MEASUREMENT SERIES

Using the 1620A for serial pattern recognition

HEWLETT hp PACKARD

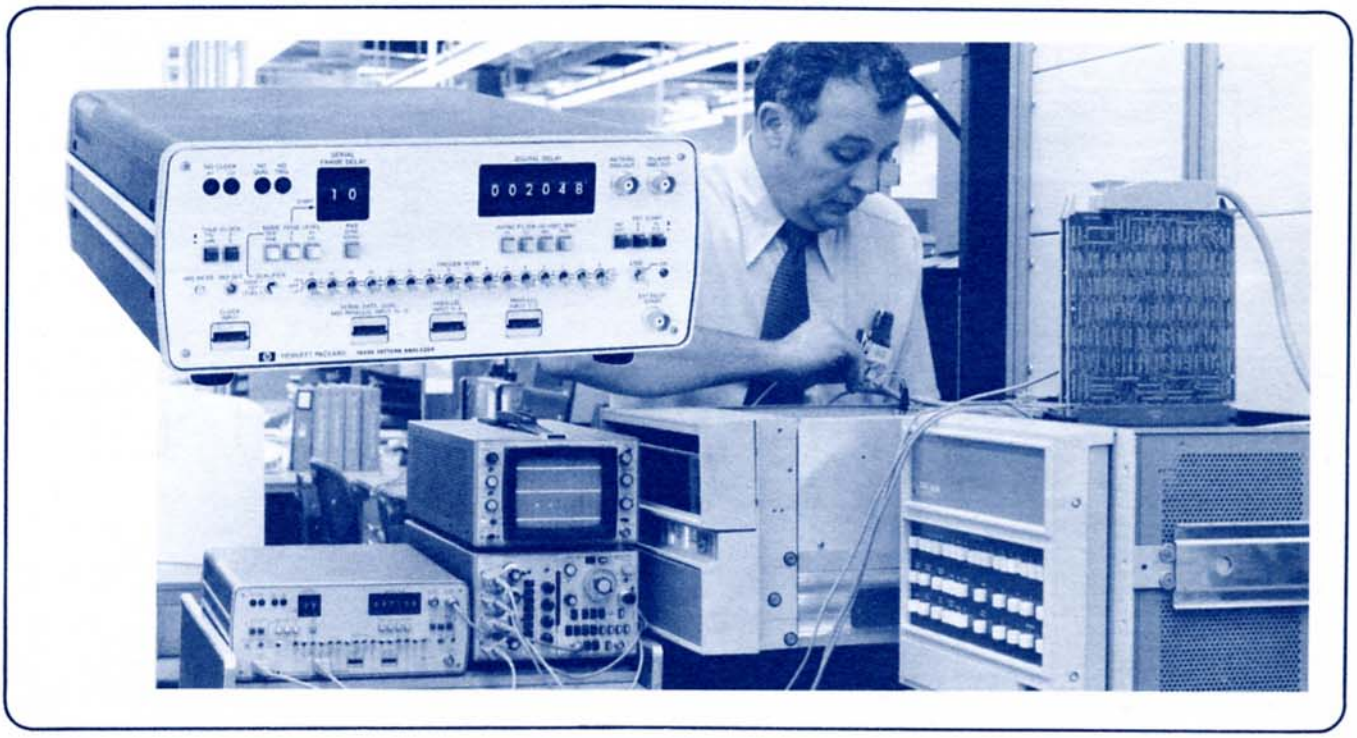
INTRODUCTION

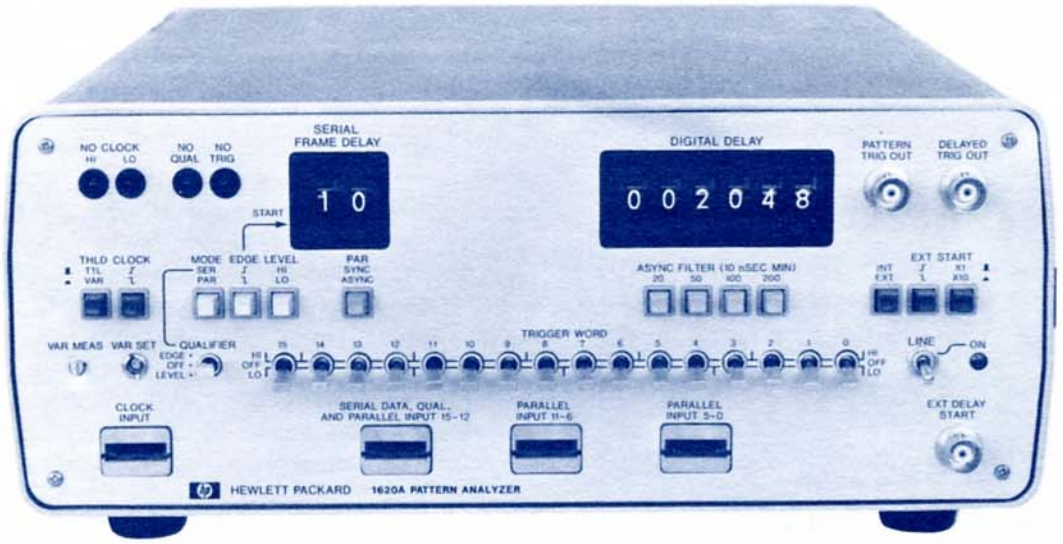
The oscilloscope is the ubiquitous instrument used to examine the parameters of electrical events in real time. As the nature of these electrical events becomes more digital, the difficulty of triggering at the point in time of interest increases. The traditional scope trigger circuit is voltage level sensitive, usually over a wide bandwidth. A digital word typically has many valid trigger level points within a word which makes it very difficult to locate one valid trigger point, even with the variable hold-off technique. So the problem is: "How can you view, with a scope, a particular point in time in a complex digital pulsetrain?"

One answer is to identify a unique digital pattern and generate a trigger whenever this pattern occurs. This trigger can then be supplied to a standard oscilloscope trigger circuit to permit viewing of the pattern at the desired point in time. Suppose we were transmitting a string of ASCII characters such as "VIC LOVES MARY". We might discover that each time we transmit our message, the "Y" is transmitted as a "K". One can imagine the confusion caused by sending a "K" whenever the "Y" key is pressed.

To see what happens in real time (i.e., to view the pulses and associated signals that occur when the "K" is generated) we can recognize the pattern for character "R" in MARY and generate a trigger for our scope. Then, using digital delay, the signals that generate the "K" instead of the "Y" can be analyzed.

The 1620A Pattern Analyzer has the capability to identify a pattern in a serial data stream and generate a trigger when that pattern occurs. It can operate on as many as 16 bits occurring at rates up to 20 MHz with capability for positive identification of sequential words and for delaying the output trigger pulse in integer steps from 1 to 999 999.





ASCII

One of the more common serial codes in use is ASCII (American Standard Code for Information Interchanges). One of its uses is the transfer of information between a computer and some of its peripherals such as teletypes and terminals. Figure 1 shows what a basic teleprinter system block diagram might look like.

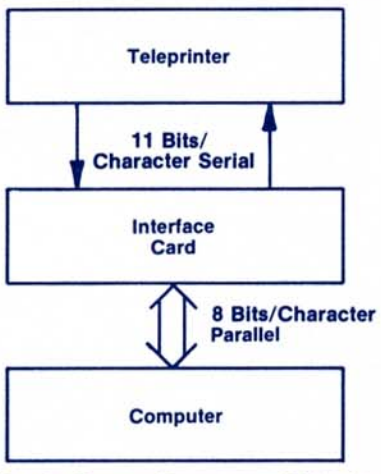


Figure 1. Bit Transfer Between Computer and Teleprinter.

The data format to and from the teleprinter might look like the following:

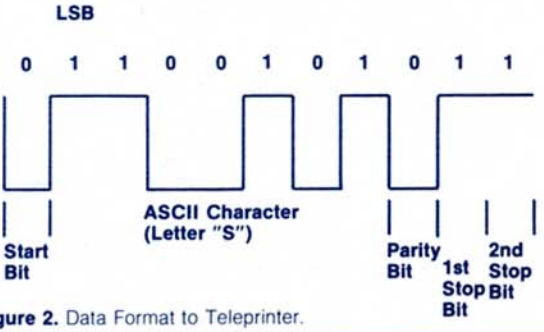


Figure 2. Data Format to Teleprinter.

The interface card inserts a start bit (always zero) and two stop bits (always ones) to make an eleven bit serial word with a parity bit of zero for even parity.

There are several other signals of interest when transmitting ASCII characters in the serial mode. These are the clock and framing pulses (the framing pulse is sometimes called an STC or Set Control pulse). Figure 3 shows the relationship of these waveforms.

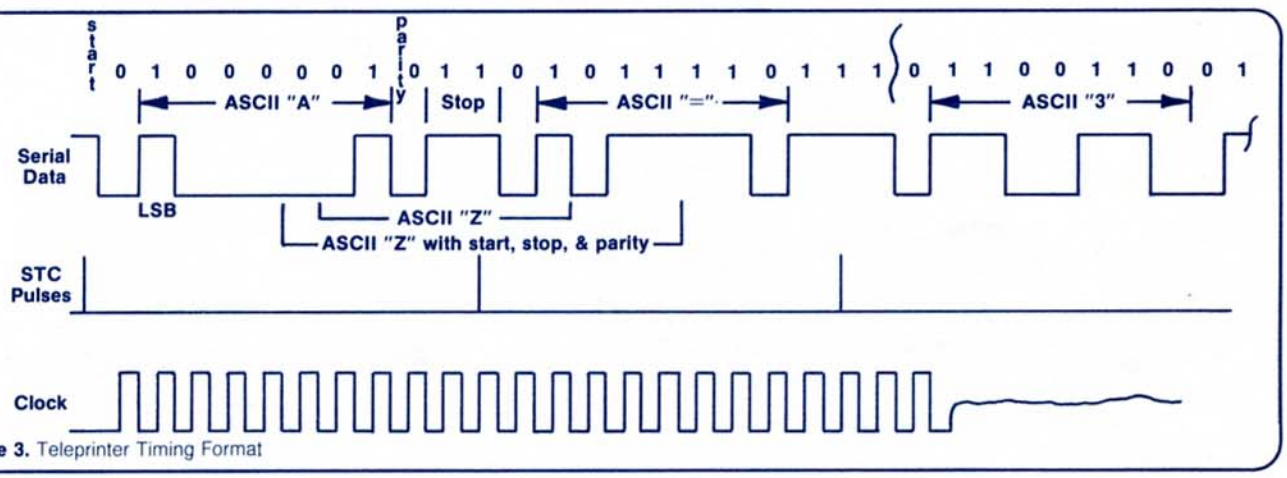


Figure 3. Teleprinter Timing Format

Connections for serial pattern recognition are made to the 1620A rear panel connectors using standard 10:1 high impedance (10 MΩ) divider probes as shown in figure 4. A X10 switch to allow for the probe attenuation is provided on the rear panel.

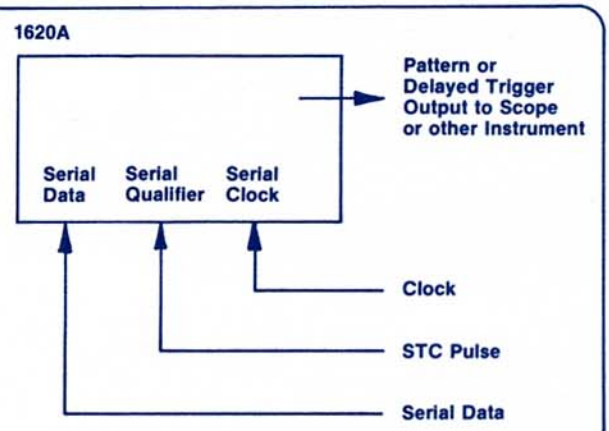


Figure 4. Pattern Analyzer Connection Diagram.

PATTERN RECOGNITION

Typically, it is desired to trigger on a specific ASCII character. To trigger on the ASCII character 3 the 1620A TRIGGER WORD switches are set as shown in figure 5.

SWITCH NO.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SWITCH POSITION	1	1	0	0	1	1	0	0	1	1	0	OFF	OFF	OFF	OFF	OFF
											LSB					

Figure 5. Trigger Word Switch Settings for ASCII '3'.

Notice that the LSB (least significant bit) is on the right on the 1620A front panel, and is on the left in the timing diagram (as it appears on the oscilloscope trace). Also, recognition of the 11 bits is set to occur on switches 15 through 5 rather than 10 through 0. This is because data is loaded with the least significant bit first starting at bit 15 on the 1620A. If the switches 10 through 0 were used, trigger recognition would occur 5 bits later and you would not be able to view 5 bits of the character following the recognition character.

To be certain that you trigger on the desired character, the serial qualifier must be used to identify specific characters in a long string. As an example, suppose it was desired to trigger on an ASCII 'Z'. Without serial qualification, the 1620A would trigger on the 'Z' bit pattern as shown in figure 3. The pattern looks like a 'Z' (including parity, start, and stop pulses) when it is actually a combination of 'A' and '='. The STC pulse is the serial qualifying or framing pulse which occurs once per serial character and allows positive identification of any specific character.

Set the 1620A QUALIFIER switch to EDGE and set the SERIAL FRAME DELAY to 10. Notice that the SERIAL FRAME DELAY is set to 10 and not 11. This is because the 1620A starts counting at 0 and not 1 and there are actually 11 counts when set to 10.

Once a character has been recognized, DIGITAL DELAY can be used to generate a trigger to an oscilloscope (or other instrument) a selected number of bits downstream up to 999 999. For example if the message was

1 ⟶ 12
A=35 MICROSECONDS

and we wanted to look at the 'D', we could trigger on the '3' and set the Digital Delay to 132 bits; (12 characters) (11 bits/character)=132 bits.

An actual troubleshooting example of the 1620A serial triggering capability occurred with a teleprinter terminal that occasionally generated unassigned ASCII characters. (The teleprinter doesn't have a complete ASCII character set; therefore, unassigned characters show up as 'spaces' when transmitted back to the teleprinter. The unassigned characters can be recognized by the computer, however, since it has a complete ASCII character set.) Using a storage oscilloscope triggered by the 1620A, the bit patterns were examined and it was noted that a hard press on the space bar occasionally generated unassigned ASCII characters. A close visual examination of the space bar reed relay switch revealed that its damping pad had worked up on its shaft. This permitted the switch to bounce and generate characters that are not assigned in the terminal. After replacing the damping pad, the system operated properly.

CONCLUSION

The 1620A Pattern Analyzer is not limited to ASCII codes and can be used for serial character identification on any code up to 16 bits long. This serial pattern recognition has proved to be a useful troubleshooting aid in serial systems with its ability to provide a trigger pulse at a desired point in time which permits transmitted bit patterns to be analyzed.

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