

SECTION III OPERATION

3-1 INTRODUCTION

3-2 This operating section explains the functions of the controls and indicators of the Model 8018A Data Generator. Front and rear panel connectors are identified and briefly described in Figure 3-1, which should be read before continuing with the more detailed descriptions in the following paragraphs.

3-3 The 8018A front panel controls can be divided into 4 areas: —

- Data Generation
- Clocking
- Cycling
- Output Parameters

These four areas provide the 4 main sub-sections of the following control descriptions.

3-4 SPECIAL OPERATING CONSIDERATIONS

3-5 The following steps must be taken before applying power to the Model 8018A.

- a) Read the safety summary at the front of this manual.
- b) Be sure the power selector switches are set properly for the power source being used to avoid instrument damage.

CAUTION

Do not change the LINE SELECTOR Switch setting with the instrument on or with power connected to the rear panel.

- c) In the event of a channel A output being connected to an external terminating resistor or attenuator, ensure that the external device cannot be overloaded by the 8018A 15 V output amplitude.

3-6 OPERATOR'S CHECKS.

3-7 Use the performance checks in SECTION IV to verify proper operation of the Model 8018A.

3-8 DATA GENERATION

3-9 The front panel controls comprising the data generation group set the content, format and configuration of the Model 8018A data outputs. The selected configuration also determines the positioning of the WORD TRIG, FIRST BIT and LAST BIT output pulses as described in the following paragraphs.

3-10 WORD MODE

3-11 Word data generation mode is selected by pressing the WORD MODE pushbutton. In this mode the data frame comprises N words of M bits/word. The NUMBER OF WORDS thumbwheel switch sets N from 1-99, and the WORD LENGTH thumbwheels set M from 3-32 (the maximum 32 corresponding to the maximum bit number programmable via Data Programming pushbuttons).

3-12 When programming the word content via the Data Programming pushbutton row, the WORD ADDRESS thumbwheels select the memory location for loading the set pattern. The same thumbwheel also select the memory location from which data is fetched to the front panel LED display.

NOTE:

Although Data Programming pushbuttons can be assigned to program bits 1-32, bits higher than the selected WORD LENGTH cannot be programmed. e.g. WORD LENGTH 22 selected, bit 23 and higher cannot be loaded.

The desired bit pattern is set via the Data Programming pushbuttons. Pushing LOAD transfers the word into the addressed memory location of the selected channel. Pressing FETCH displays the addressed word content of the selected channel on the front panel LED'S. For fast memory loading of an all '1' or all '0' data pattern, the CHANNEL SET/ CHANNEL CLEAR toggle switch sets (1) or clears (0) the complete 1024 memory bits of the channel selected by the CHANNEL SELECT pushbutton.

3-13 In either case (fast loading or via ROW ADDRESS) only NxM bits will be outputted, the WORD TRIG, FIRST BIT and LAST BIT outputs providing the sync pulses to define the data stream. Any change to the N and M settings after programming causes the positions of the sync pulses to change. Figure 3-2 illustrates an output configuration for N and M set to 4. Changing M to 3 and leaving N set to

4, the output configuration will change to that shown in Figure 3-3. Finally, changing N also to 3, the output configuration changes further to that shown in Figure 3-4

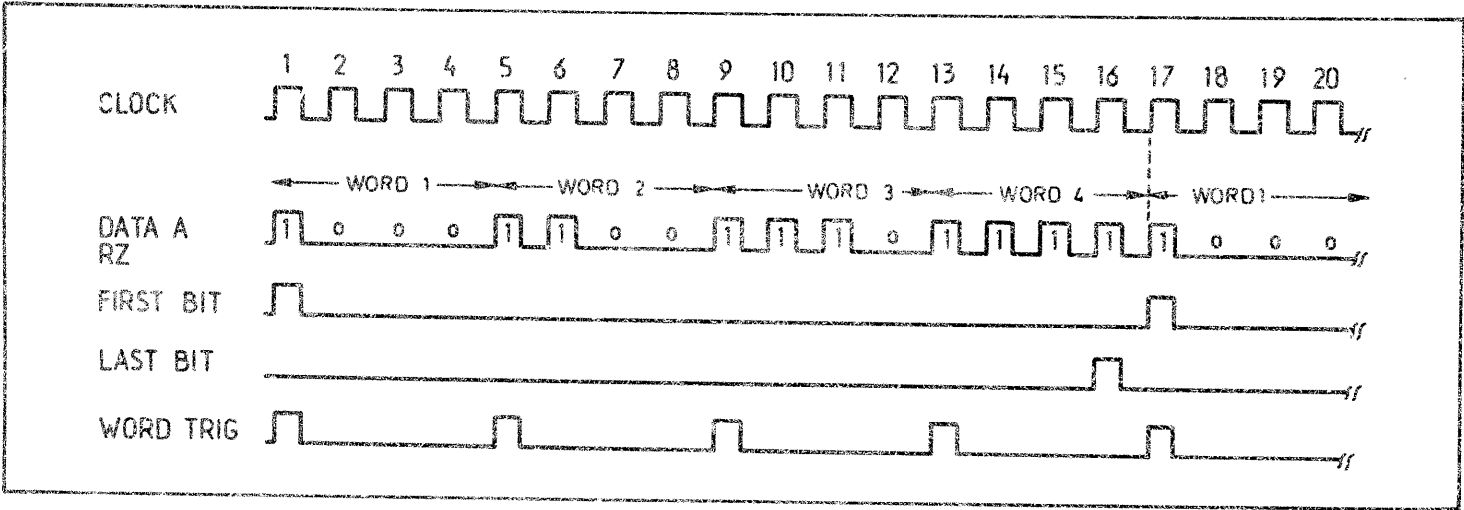


Figure 3-2 Word Mode Output Configuration for N and M set to 4.

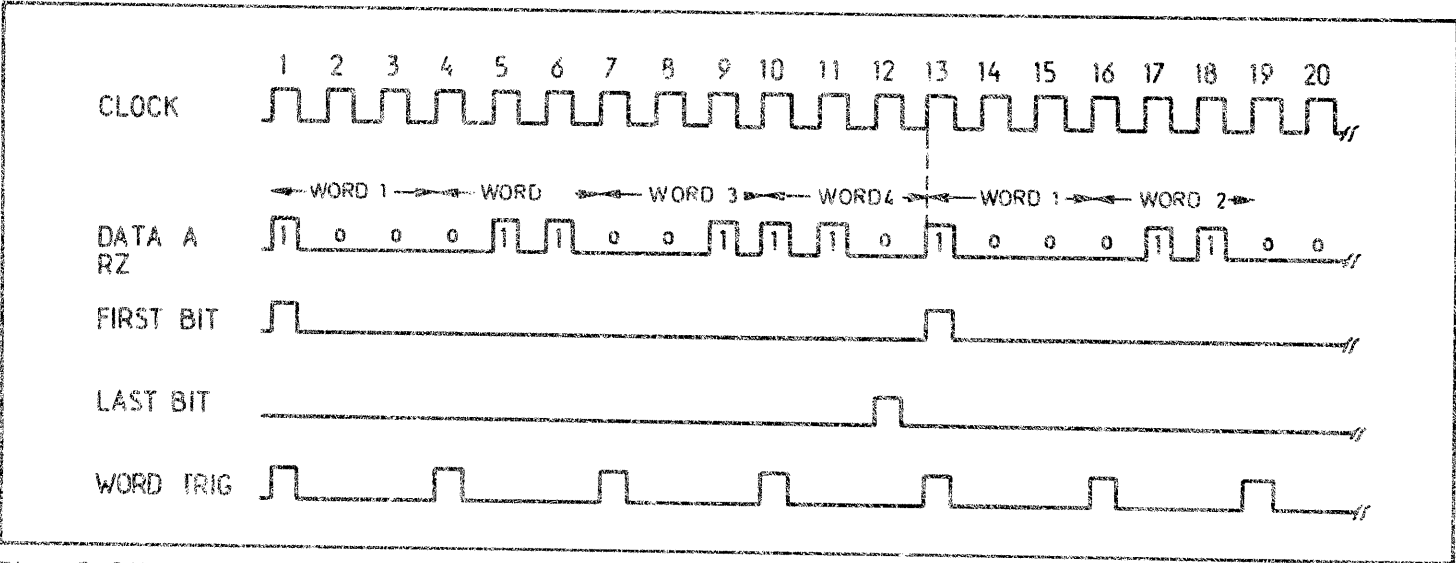


Figure 3-3 Word Mode Output Configuration for N=4, M=3

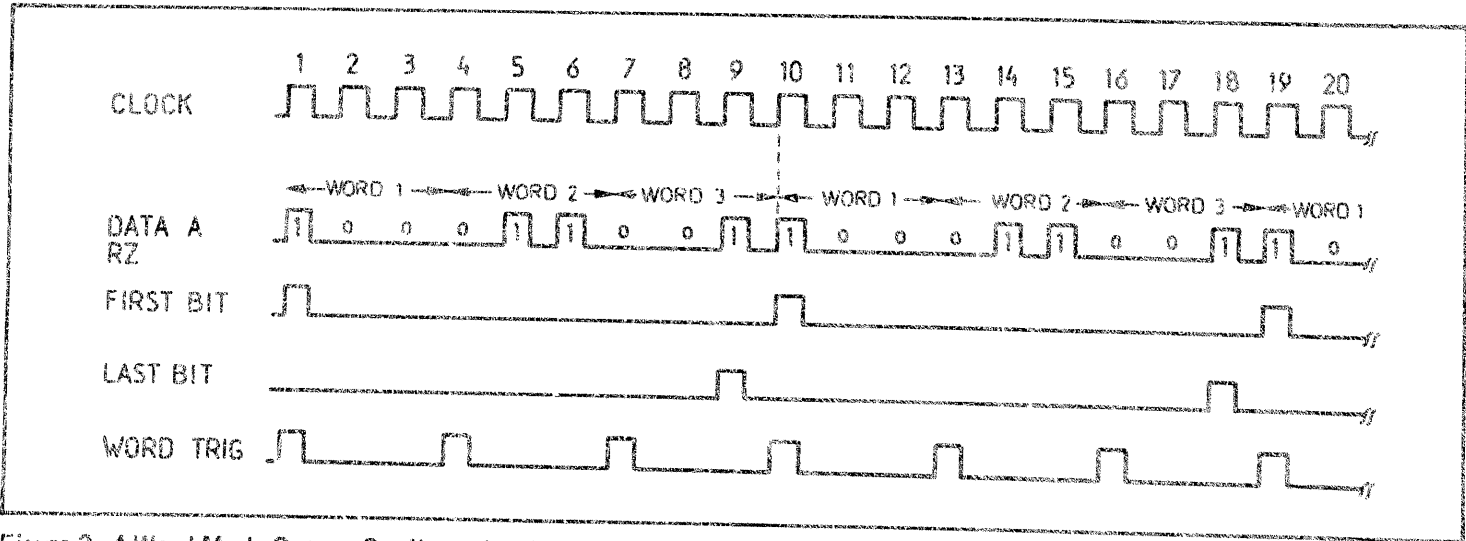


Figure 3-4 Word Mode Output Configuration for N=3, M=3

3-14 DATA MODE

3-15 This data generation mode is selected by pressing the DATA MODE pushbutton. In this mode, data frame comprises a continuous pattern from 3 to 2048 bits long, the length being set by the 4-digit thumbwheel switch located on the front panel.

3-16 When entering data in DATA MODE, the data stream is artificially broken down into 16-bit segments, the currently entered segment being selected by the WORD ADDRESS thumbwheel switch. ROW ADDRESS 17-32 is therefore inoperative. e.g. to set bit 143 in a 200-bit data stream, WORD ADDRESS should be set to 09, then ROW ADDRESS bit 15 corresponds to bit 143 and can be loaded as in WORD mode using the LOAD pushbutton. Similarly, when data needs to be fetched, the WORD ADDRESS thumbwheel is used to select the 16-bit memory location, then pressing the FETCH pushbutton returns the 16 bits to the ROW ADDRESS LED display.

For fast memory loading of an 'all 1' or 'all 0' data pattern, the CHANNEL SET / CHANNEL CLEAR toggle switch sets (1), or clears (0), the complete 1024 memory bits of the channel selected by the CHANNEL SELECT push-buttons.

3-17 In either case (fast loading or via ROW ADDRESS) only the selected DATA STREAM LENGTH will be outputted, the FIRST BIT and LAST BIT outputs providing the framing pulses for the data stream. Any

change to the setting of the DATA STREAM LENGTH thumbwheels after programming causes the position of the LAST BIT pulse to change correspondingly. Figure 3-5 shows an output configuration for a DATA STREAM LENGTH of 415. Referring to Figure 3-5, if the DATA STREAM LENGTH (DSL) thumbwheel setting is changed to 365, only 365 bits will be outputted, the LAST BIT framing pulse corresponding to the 365th bit. Should the DSL thumbwheel setting be increased to 500 bits, the content of the first 500 bits of memory will be outputted, the LAST BIT pulse then corresponding to the 500th bit.

3-18 PRBS MODE.

3-19 The PRBS data generation mode is selected by pressing the PRBS pushbutton. In this mode, a pseudo-random binary sequence (PRBS) and its complement is output from DATA A and DATA B respectively. The sequence length is $2^n - 1$ bits, n being set to 9, 10, 15 or 20 via the 2-digit thumbwheel switch located on the front panel. Also in this mode, a rear panel connector, PRBS TRIG, outputs a pulse identifying the start of each sequence. FIRST BIT, LAST BIT and WORD TRIGGER outputs should not be used in PRBS mode.

3-20 MIXED MODE.

3-21 The mixed data generation mode is selected by simultaneously pressing the WORD MODE and PRBS push-buttons. In this mode, the output data pattern comprises N words of M bits/word, with a PRBS sequence inserted

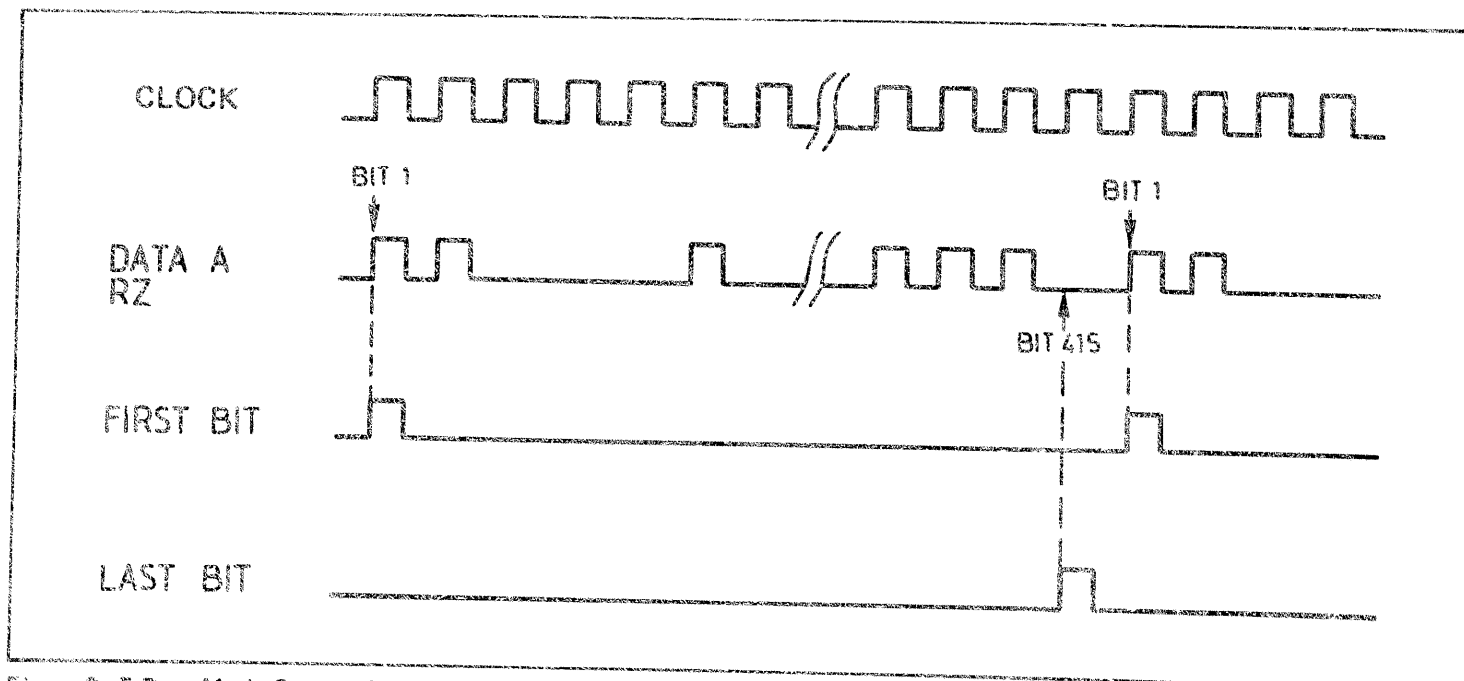


Figure 3-5 Data Mode Output Configuration

after every odd-numbered word. Figure 3-6 provides a simplified diagram of a typical mixed mode data output sequence. The NUMBER OF WORDS thumbwheel switch sets N from 1-99, and the WORD LENGTH thumbwheels set M from 3-32. The PRBS 'n' factor can be set to 9, 10, 15 or 20 via the 2-digit thumbwheel switch.

3-22 Entering data in mixed mode is as described in para 3-12 for word mode.

3-23 The data output pattern is as defined by the 4-digit and 2-digit thumbwheel switches located on the front panel. The WORD TRIG, FIRST BIT and LAST BIT sync pulses also being positioned by these switches. Figure 3-7 shows a data/sync output configuration for a NUMBER OF WORDS setting of 4.

NOTE

The NUMBER OF WORDS should be set to a multiple of 2 to ensure a 2-word enclosure for each PRBS sequence.

Any change in the M and N settings will change the word data content and sync pulse sequence as illustrated in the Word Mode description (para 3-13).

3-24 CYCLING

3-25 In the Model 8018A, data can be cycled automatically, bit-by-bit, word-by-word, or frame-by-frame, dependent on which data generation mode is selected. Table 3-1 lists which cycling modes apply to which data generation modes.

Table 3-1 Cycling Mode Selection

DATA	GENERATION MODE	CYCLING				MODE
		AUTO	BIT	WORD	FRAME	
WORD	MODE	YES	YES	YES	YES	
DATA	MODE	YES	YES	YES*	YES	
PRBS		YES	YES	NO	NO	
MIXED	MODE	YES	YES	YES*	YES	

* entire frame is triggered

3-26 AUTO

3-27 Auto cycle mode is selected by pressing the AUTO pushbutton, data then being recycled continuously.

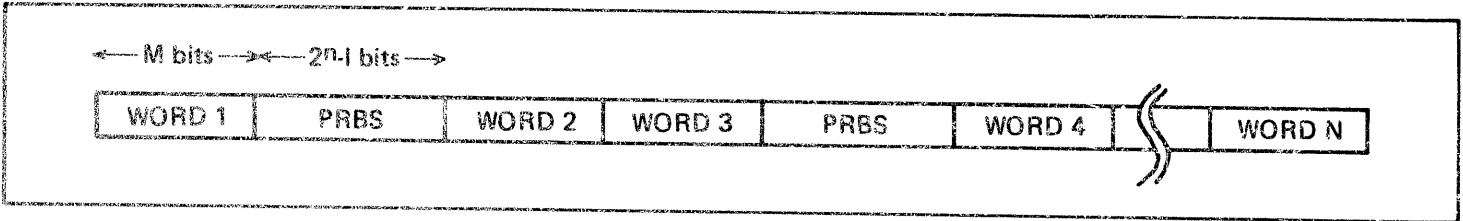


Figure 3-6 Typical Data Output Sequence in Mixed Mode

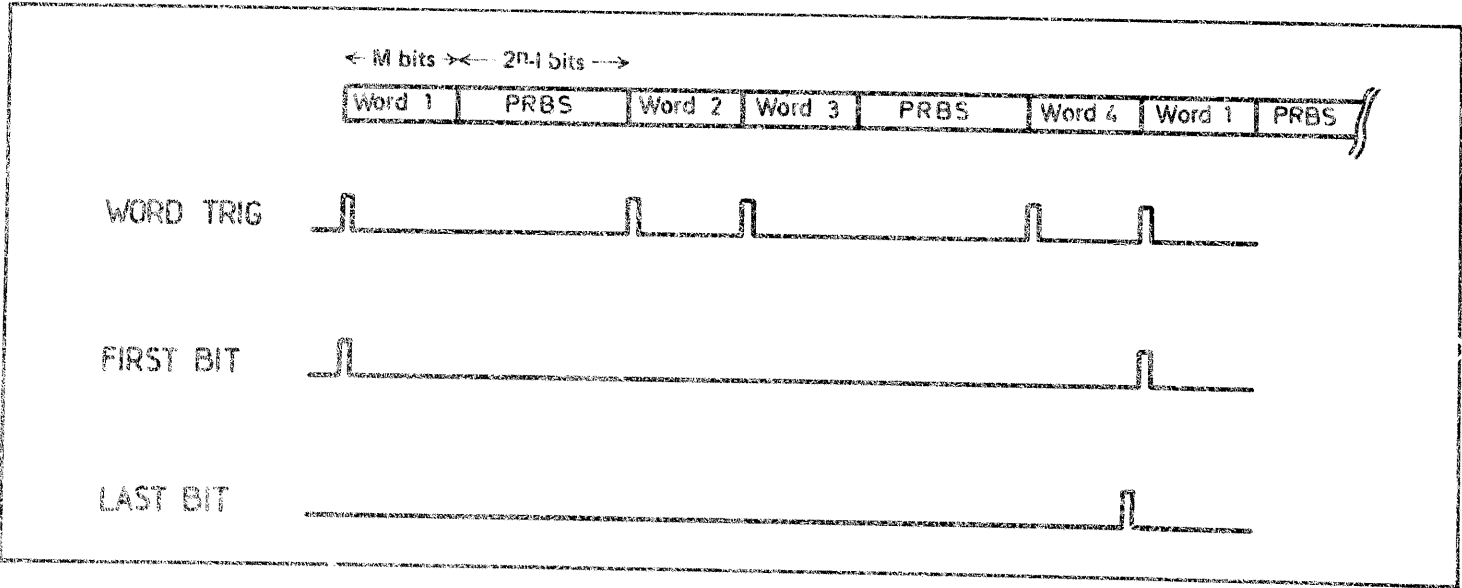


Figure 3-7 Data/Sync Output Configuration in Mixed Mode

3-28 BIT

3-29 Bit cycle mode is selected by pressing the BIT pushbutton. In this mode, bits can be individually triggered or gated in blocks by signals applied to the CYCLE INPUT. Short, positive-going pulses at the CYCLE INPUT, or operation of the RESET/MAN toggle switch, trigger single bits. If the CYCLE INPUT is held high, data bits are generated continuously, data generation ceasing when the CYCLE INPUT goes low. On returning the input to the high state, generation continues from where it stopped (unless RESET/MAN is switched to RESET in between high states, in which case data generation recommences at bit one on return to high state). Figure 3-8 provides examples of single bit and gated cycle functions with BIT cycle mode and DATA MODE selected.

3-30 By means of an internal switch located on board A3, the CYCLE INPUT can be switched from 50 Ω input

impedance (position 1) to high impedance (position 2). Figure 3-9 illustrates pulse input requirements for each of these positions.

3-31 WORD

3-32 Word cycle mode is selected by pressing the WORD pushbutton. In this mode, words can be individually triggered or multiply-gated by signals applied to the CYCLE INPUT. Short, positive-going pulses at the CYCLE INPUT, or operation of the RESET/MAN toggle switch, trigger single words. If the CYCLE INPUT is held high, data words are generated continuously, word generation ceasing on completion of the current word when the CYCLE INPUT goes low. On returning the input to the high state, word generation continues from where it stopped (unless RESET/MAN is switched to RESET in between high states, in which case word generation recommences with word 1).

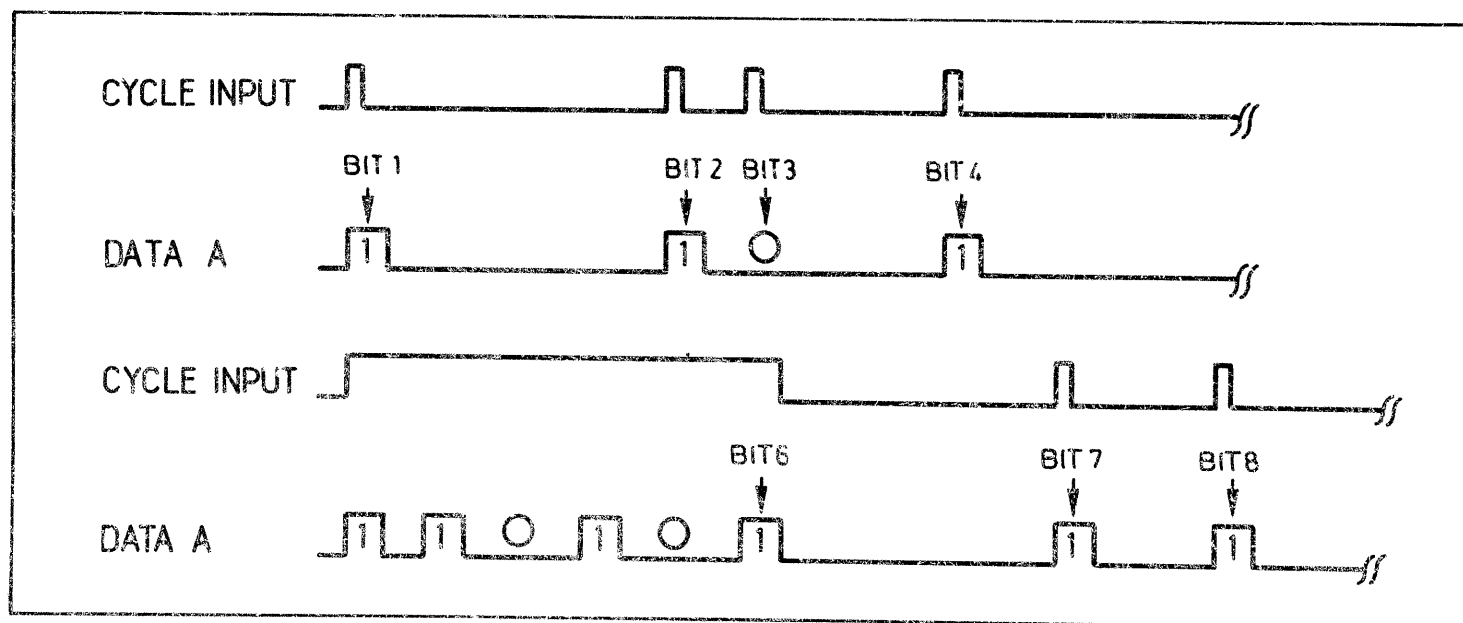


Figure 3-8 Single Bit and Gate Functions in Bit Cycle Mode

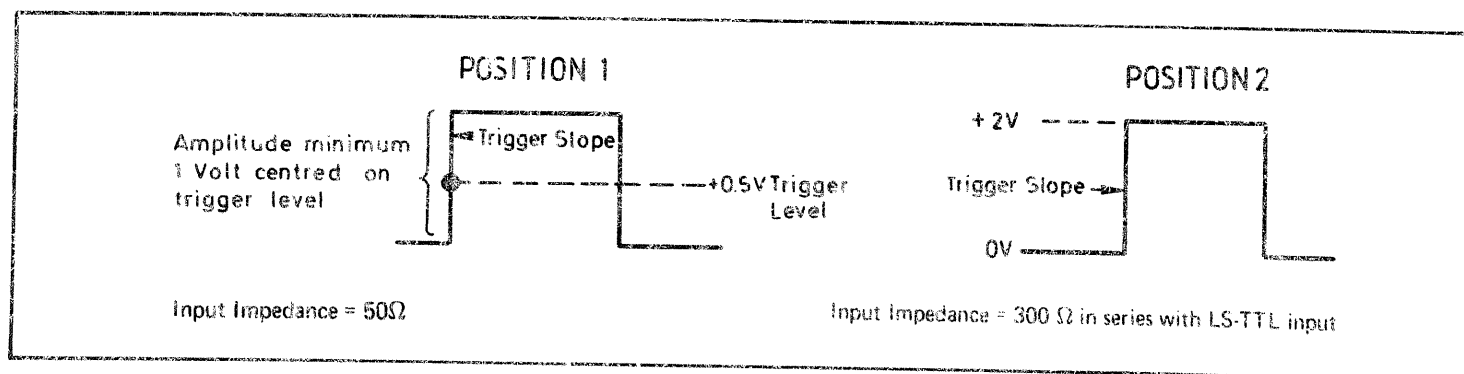


Figure 3-9 Input Pulses for Different Positions of Cycle Input Internal Impedance Switch

Figure 3-10 provides examples of the single and gated cycle functions with WORD cycle mode and WORD data generation mode selected.

3-33 As in bit cycle mode, the internal switch located on board A3 switches the CYCLE INPUT from 50 Ω input impedance to high impedance. In each switch position, the required input pulse is as illustrated in Figure 3-9.

3-34 FRAME

3-35 Frame cycle mode is selected by pressing the FRAME pushbutton. In this mode, frames can be individually triggered or multiply gated by signals applied to the CYCLE INPUT. Short, positive-going pulses at the

CYCLE INPUT, or operation of the RESET/MAN toggle switch, trigger single frames. If the CYCLE INPUT is held high, frames are continuously generated, frame generation ceasing on completion of the current frame when CYCLE INPUT goes low. On returning the input to the high state, frame generation continues from where it stopped (unless RESET/MAN is switched to RESET in between high states, in which case frame generation recommences with frame 1). Figure 3-11 shows the frame output cycle for a given CYCLE INPUT signal in MIXED MODE, WORD MODE and DATA MODE. (Frame does not apply in PRBS — see Table 3-1).

3-36 As in bit and word cycle modes, the switch located on board A3 changes the CYCLE INPUT impedance from

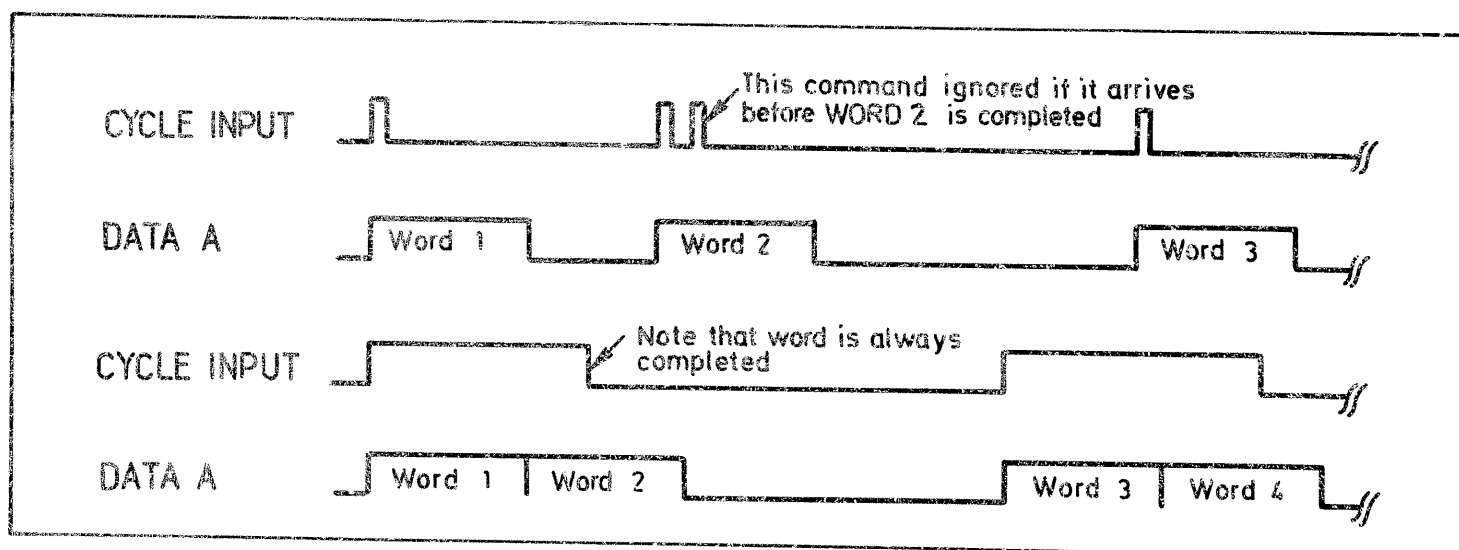


Figure 3-10 Single Word and Gate Functions in Word Cycle Mode

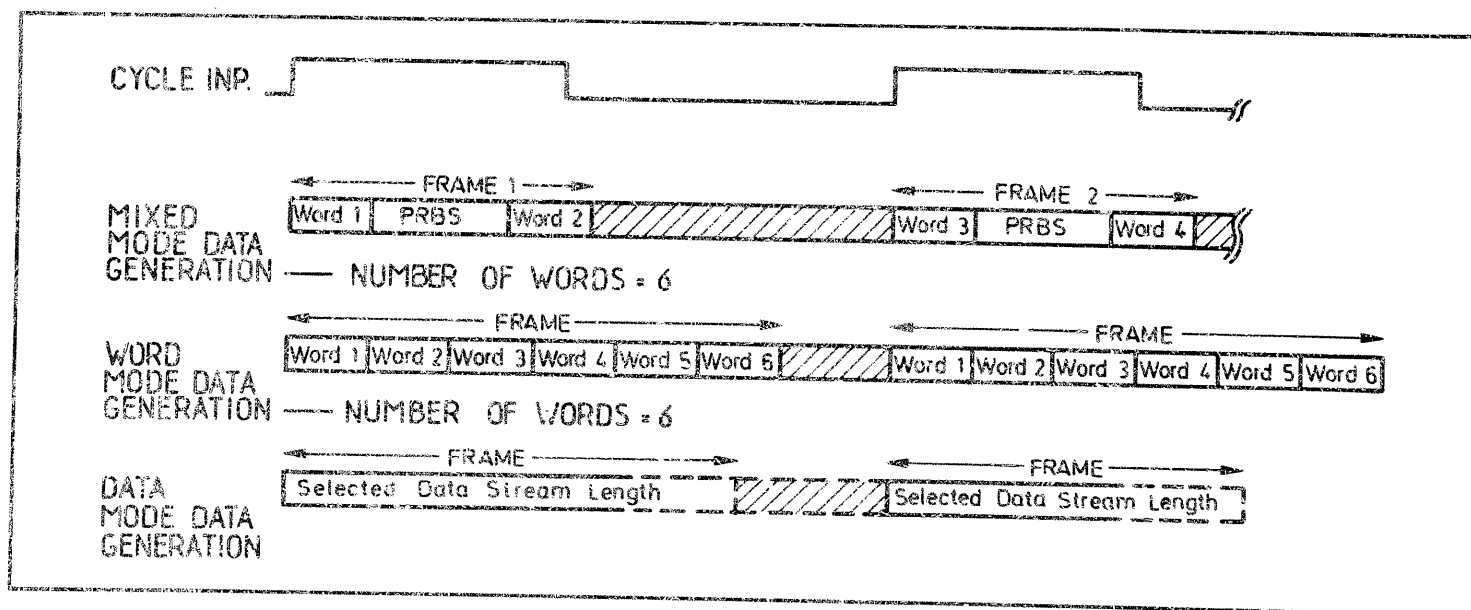


Figure 3-11 Frame Output Cycle for Different Data Generation Modes

50 Ω to high Z. In each switch position, the input pulse requirement is as illustrated in Figure 3-9.

3-37 CLOCKING

3-38 INTERNAL

3-39 The internal clock is selected by pressing the INT CLOCK pushbutton. Frequency is then set via the BIT RATE pushbutton row and the 3-turn VERNIER, running at 50MHz (40MHz in MIXED MODE) down to 50Hz.

3-40 EXTERNAL

3-41 There are two pushbuttons for selecting an external clock, EXT (+) and EXT (-).

3-42 The EXT (+) selection allows clocking from positive going pulses such as defined in Figure 3-12. Also, when EXT (+) selected, an internal switch located on board A3 changes the clock input impedance from 50 Ω - GND (position 1) to high impedance (position 2). In either case, triggering is on the positive slope of the input clock signal.

3-43 The EXT (-) selection allows clocking from ECL levels or other below-ground pulses such as defined in

Figure 3-13. When EXT (-) selected, the internal impedance switch, referred to in the previous paragraph, must be set to position 1.

3-44 MANUAL

3-45 The manual clocking mode is selected by pressing the EXT (-) MAN pushbutton, a single bit then being output from each channel every time the MAN pushbutton (16 in Figure 3-1) is pressed.

3-46 In the AUTO CYCLE MODE resetting via the RESET/MAN toggle switch ensures that next operation of the MAN pushbutton outputs the first bit.

3-47 OUTPUT PARAMETERS.

3-48 AMPLITUDE

3-49 The Model 8018A DATA A and DATA A output amplitudes are determined primarily by the AMPLITUDE pushbutton row and the AMPLITUDE VERNIER. Also affecting these output amplitudes are the 8018A source impedance, selectable via the Zs switch, and the load impedance.

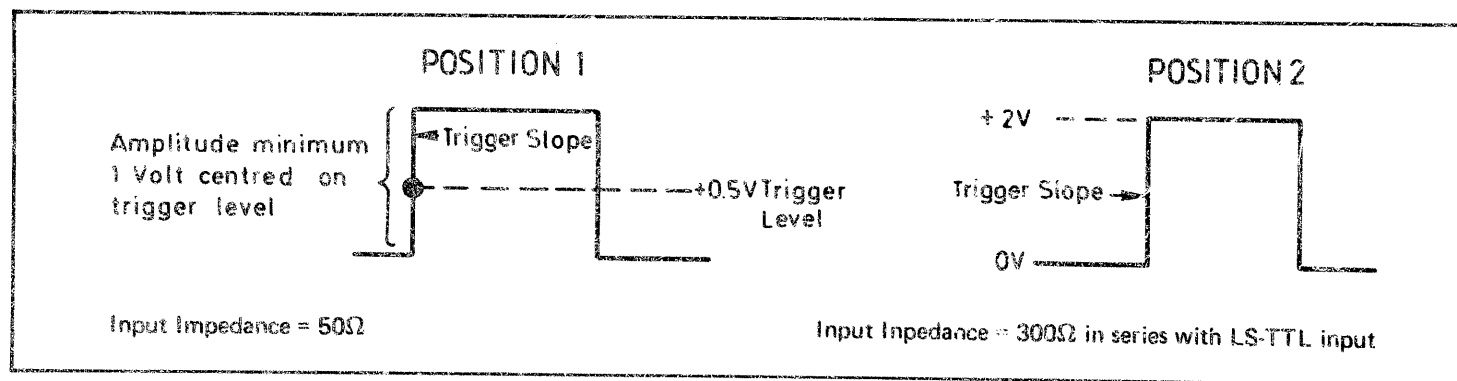


Figure 3-12 Ext (+) Input Pulses for Different Positions of Clock Input Internal Impedance Switch

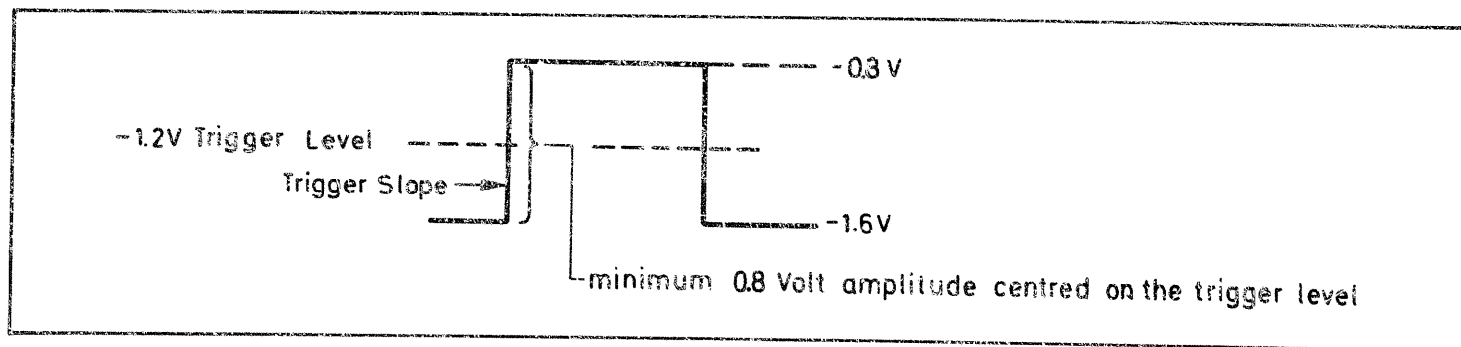


Figure 3-13 Ext (-) Clock Pulse

3-50 In the case of the three non-ECL pushbuttons, the lower scale applies with a $50\ \Omega$ source and $50\ \Omega$ load impedance. With the VERNIER providing continuous adjustment, the full amplitude range is then $1.25\text{V} - 7.5\text{V}$. The upper scale for these three pushbuttons applies either when the Zs switch is set to 1K , or the load impedance is removed. (NOTE: one $50\ \Omega$ termination must remain). The amplitude is then doubled to provide a range $2.5\text{V} - 15\text{V}$.

3-51 For applications requiring amplitudes up to 7.5V , the $50\ \Omega / 50\ \Omega$ configuration provides minimum reflections. In applications requiring higher voltages up to 15V , the operator can choose the optional configuration, $50\ \Omega / \text{open circuit}$ or $1\text{K} / 50\ \Omega$, for minimum reflections.

3-52 When ECL selected, true ECL levels are achieved only if the Zs switch is set to $50\ \Omega$, and both the DATA A and DATA A outputs are terminated externally in $50\ \Omega$ (even if one of these outputs is not used). In this range the front panel AMPLITUDE VERNIER is inoperative. ECL amplitude and offset can be internally adjusted via two potentiometers located on board A8. The levels are as shown in Figure 3-14.

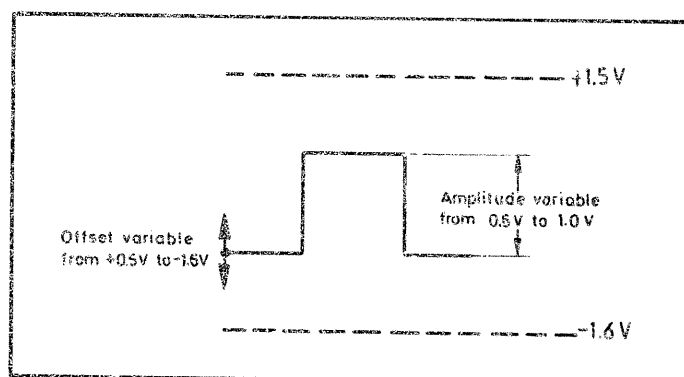


Figure 3-14 ECL Output Levels

3-53 All other Model 8018A outputs i.e. DATA B, CLOCK, FIRST BIT, LAST BIT, WORD TRIG and PRBS TRIG, are of fixed amplitude and fixed $50\ \Omega$ source impedance. The DATA B and CLOCK outputs

provide a minimum 2.4V into $50\ \Omega$ load and minimum 4.8V into open circuit. The FIRST BIT, LAST BIT, WORD TRIG and PRBS TRIG, provide a minimum 1.2V into $50\ \Omega$ load, and minimum 2.4V into open circuit.

3-54 FORMAT

3-55 Each of the data channel outputs, DATA A and DATA B are provided with an RZ/NRZ format pushbutton. When a switch is set to RZ, a logic '1' output from the associated channel returns to zero before the bit period ends. If the switch is set to NRZ, then the associated output remains high during the entire clock cycle, and stays high should the following bit be logic '1'. In the event of the following bit being logic '0', the NRZ output returns to zero. The significance of 'return to zero' and 'non-return to zero' is shown in Figure 3-15.

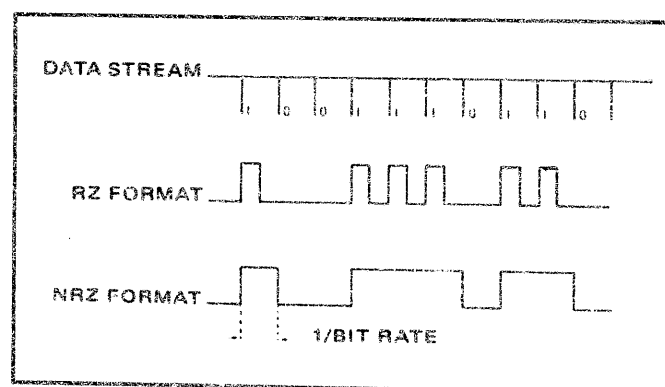
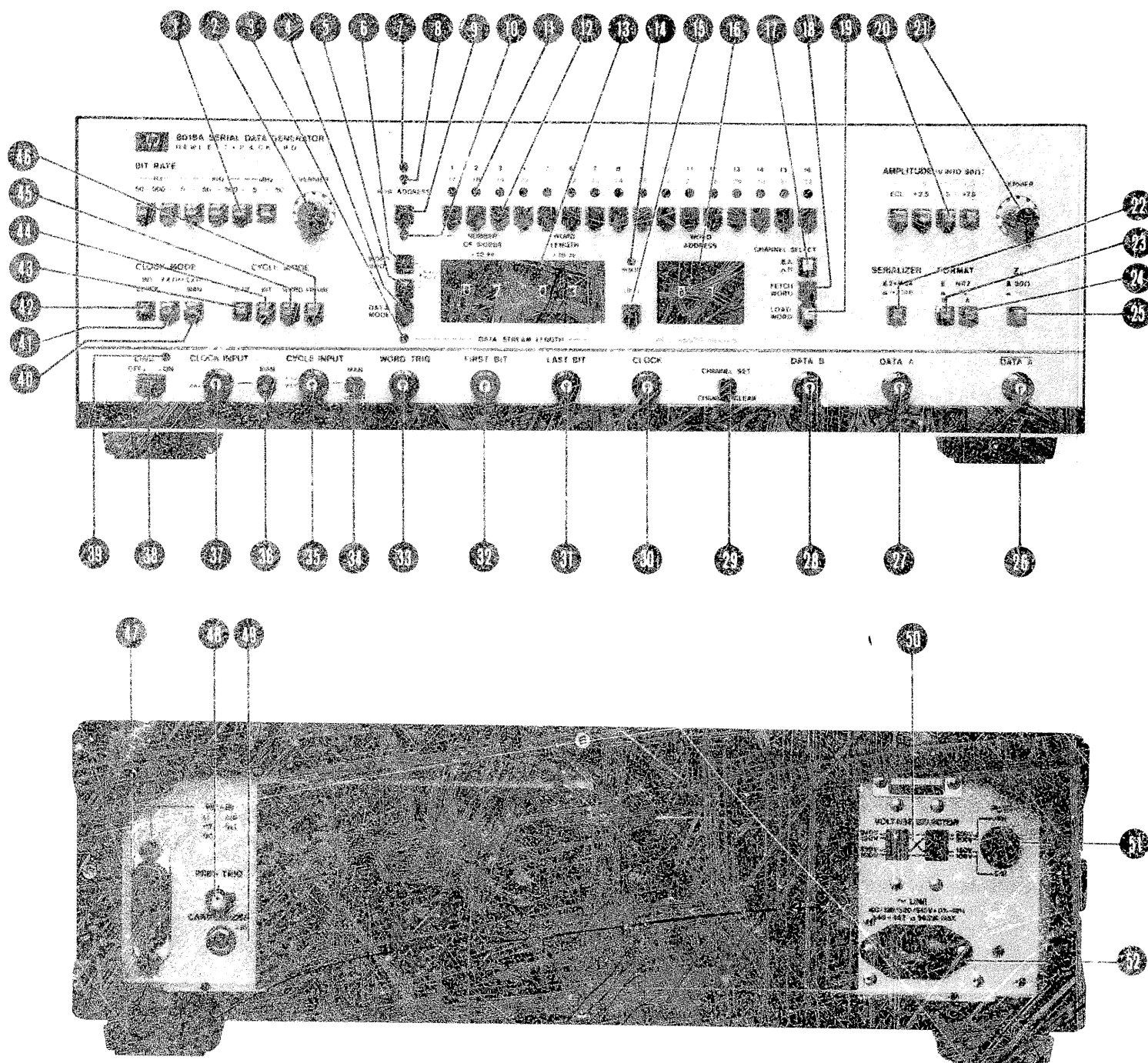


Figure 3-15 Comparison of RZ and NRZ Formats

3-56 CHANNEL SERIALIZATION.

3-57 The Model 8018A memory may be configured in either of two ways as determined by the CHANNEL SERIALIZER switch ( in Figure 3-1). Pressing this switch provides one 2048-bit channel (A) for loading and outputting. (CHANNEL SELECT switch is then disabled). Releasing this switch provides two 1024-bit channels (A and B) for loading and outputting.



1 BIT RATE. Mutually exclusive pushbuttons for selecting range of bit rate when INT CLOCK **9** selected. When EXT (+) or EXT (-) (**10** and **11**) selected, BIT RATE pushbuttons are disabled.

7 VERNIER. For continuous adjustment of the bit rate within the range selected at **1**

Clockwise rotation increases the bit rate.

7 DATA MODE LED. Indicates that DATA MODE is selected and that thumbwheel switch **16** is used to set length of data stream.

11 DATA MODE. Pushbutton for selecting data to be outputted as a continuous stream of preselected

length. This length can be set from 3 to 2048 bits by thumbwheel switch **16**

15 PRBS. Pushbutton for selecting data to be outputted as a pseudo-random binary sequence of length 2^n-1 bits. The factor 'n' is set by thumbwheel switch **16** to 9, 10, 15 or 20 (see also MIXED MODE).

Figure 3-1. Front and Rear Panel Controls, Connectors and Indicators.

- 
- 6 WORD MODE.** Pushbutton for selecting data to be outputted as a frame consisting of N words of length M bits/word. N is set by the first two digits of thumbwheel switch **16**, and M is set by the last two digits of the same switch. (See also MIXED MODE).

MIXED MODE. Selected by pressing WORD MODE and PRBS pushbuttons simultaneously. Data is then outputted as described in WORD MODE except that PRBS is inserted after every odd-numbered word.

- 7 1-16 ROW ADDRESS LED.** Indicates that pushbutton row **12** can be used to set bits 1-16 in a 32-bit word.

- 8 17-32 ROW ADDRESS LED.** Indicates that pushbutton row **12** can be used to set bits 17-32 in a 32-bit word.

- 9 ROW ADDRESS.** Pushbutton which determines whether bits '1-16' or '17-32' can be set by pushbutton row **12**. LED's **7** and **8** give a visual indication of which bit sequence is selected.

- 10 WORD MODE LED.** Indicates that WORD MODE is selected i.e. thumbwheel switch **16** is used to set NUMBER OF WORDS (first two digits) and WORD LENGTH (last two digits).

- 11 LED ROW.** Gives visual indication of the bit pattern being loaded or fetched. An illuminated LED indicates data bit is set to logic '1'.

- 12 DATA PROGRAMMING.** A row of pushbuttons used for setting a 16-bit buffer register, the set pattern being transferred to memory on pushing LOAD pushbutton. The set 16-bit word can be assigned to the first half or second half of a 32-bit word using ROW ADDRESS pushbutton **9**. Visual indication of the set 16-bit pattern is given by LED row **11**.

- 13 DATA FORMATTING THUMBWHEELS.** Switch whose function depends on the data generation mode selected. When WORD MODE or MIXED MODE is selected, then the first two digits set the number of words to be outputted; the last two digits set the number of bits in each word. When DATA MODE is selected, all four digits are used to set the data stream length for loading and outputting.

- 14 REMOTE LED.** Provides visual indications that the 8018A is in the REMOTE state. In this state memory programming can only be accomplished via the HP-IB (i.e. front panel LOAD pushbutton disabled). Data formatting thumbwheel switches and the CYCLE INPUT function are also programmable.

- 15 LOCAL/RESET.** Returns the 8018A from REMOTE state to local (front panel) control.

- 16 WORD ADDRESS.** Thumbwheel switch for selecting the memory address to/from which data is loaded/fetched respectively.

- 17 CHANNEL SELECT.** Pushbutton which selects the channel for loading, fetching, setting and clearing.

- 18 FETCH WORD.** Operating this pushbutton recalls data from the memory address, selected by **16**, to the LED register **11**.

- 19 LOAD WORD.** Operating this pushbutton transfers data, set by pushbutton row **12**, to the memory location selected by thumbwheel switch **16**.

- 20 AMPLITUDE.** Mutually exclusive pushbuttons for selecting the amplitude of DATA A and DATA A outputs. Amplitude depends on source and load impedances. ECL pushbutton sets DATA A and DATA A outputs to ECL compatible levels (levels internally adjustable).

- 21 VERNIER.** For continuous adjustment of the amplitude selected, ECL selection excluded.

- 22 A PAR B/A SER B.** Pushbutton for configuring memory as two 1024 bit (2x1024/1x2048) channels (A and B) or one 2048 bit channel (A).

- 23 FORMAT B.** Selects RZ or NRZ format for DATA B output.

- 24 FORMAT A.** Selects RZ or NRZ format for DATA A and DATA A outputs.

- 25 ZS.** Sets the source impedance, 50 Ω or high Z, for DATA A and DATA A outputs. When ECL amplitude selected at **20**, then ZS switch should be set to 50 Ω for true ECL levels.

- 26 DATA A BNC connector** for outputting the complement of channel A data.

- 27 DATA A** BNC connector for outputting channel A data.
- 28 DATA B** BNC connector for outputting the channel B memory content.
- 29 CHANNEL SET / CHANNEL CLEAR.** Toggle switch for setting (logical 1's) or clearing (logical 0's) the complete memory content of the channel selected by **17**.
- 30 CLOCK.** BNC connector for outputting the 8018A clock signal.
- 31 LAST BIT.** BNC connector for outputting an RZ pulse corresponding to the last bit of the data pattern.
- 32 FIRST BIT.** BNC connector for outputting an RZ pulse corresponding to the first bit of the data pattern.
- 33 WORD TRIGGER.** BNC connector for outputting an RZ pulse corresponding to the first bit of each word in WORD or MIXED mode.
- 34 RESET/MAN.** In MAN position, gives cycle command for data generation as defined by switches **41** and **45** e.g. if BIT selected, then one bit is generated. Pressing this toggle switch to RESET ensures that the next bit delivered is the first bit of the data pattern.
- 35 CYCLE INPUT.** BNC connector for signal to trigger data generation in BIT, WORD or FRAME cycle mode.
- 36 MAN.** Pushbutton for providing a manual clock signal when MAN CLOCK MODE selected at **40**.
- 37 CLOCK INPUT.** BNC connector for providing an external clock signal when EXT CLOCK MODE selected at **40** or **41**.
- 38 LINE OFF/ON.** Switch for applying primary ac power to the instrument.
- 39 LINE LED.** Indicates when primary ac power is applied to the instrument.
- 40 EXT (-) / MAN.** Pushing this button enables the generator to be clocked manually (via **36**) or by a negative external clock signal.
- 41 EXT (+).** Pushing this button enables the data generator to be clocked by an external positive clock signal.
- 42 INT CLOCK.** Pushing this button selects the internally generated clock signal for clocking the data generator.
- 43 AUTO.** When AUTO is selected, data is cycled continuously.
- 44 BIT.** Pressing this pushbutton enables data to be delivered bit by bit upon cycle commands applied to connector **33**, or by pressing switch **34** to MAN.
- 45 WORD.** Pressing this pushbutton, enables data to be delivered word by word upon cycle commands to connector **33**, or pressing switch **34** to MAN.
- 46 FRAME.** Pressing this pushbutton, enables data to be delivered frame by frame upon cycle commands to connector **33**, or pressing switch **34** to MAN.
- 47 HP-IB.** Space for fitting the HP-IB remote connector when Option 001 included in instrument (see Appendix A).
- 48 PRBS TRIG.** BNC connector which outputs an NRZ pulse to identify the beginning of each PRBS pattern.
- 49 CARD READER.** +5V supply output connector for the Option 002 Card Reader.
- 50 VOLTAGE SELECTOR.** These switches connect the internal power transformer to accept the primary power source voltage. BOTH SWITCHES must be set to the position marked for power source being used.
- 51 FUSE.** Accepts standard fuses to provide instrument protection in case of current overload. A 1A slow-blow fuse must be used when operating from 240V/220V power source. A 2A fuse is used when operating from 100V/120V power source.
- 52 LINE.** A three-prong receptacle to provide chassis ground through the power cable for operator protection.