IBM Field Engineering
Service Index

2302 Disk Storage

2302 Disk Storage Service Index

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2302 / 7631 — SERVICE INDEX

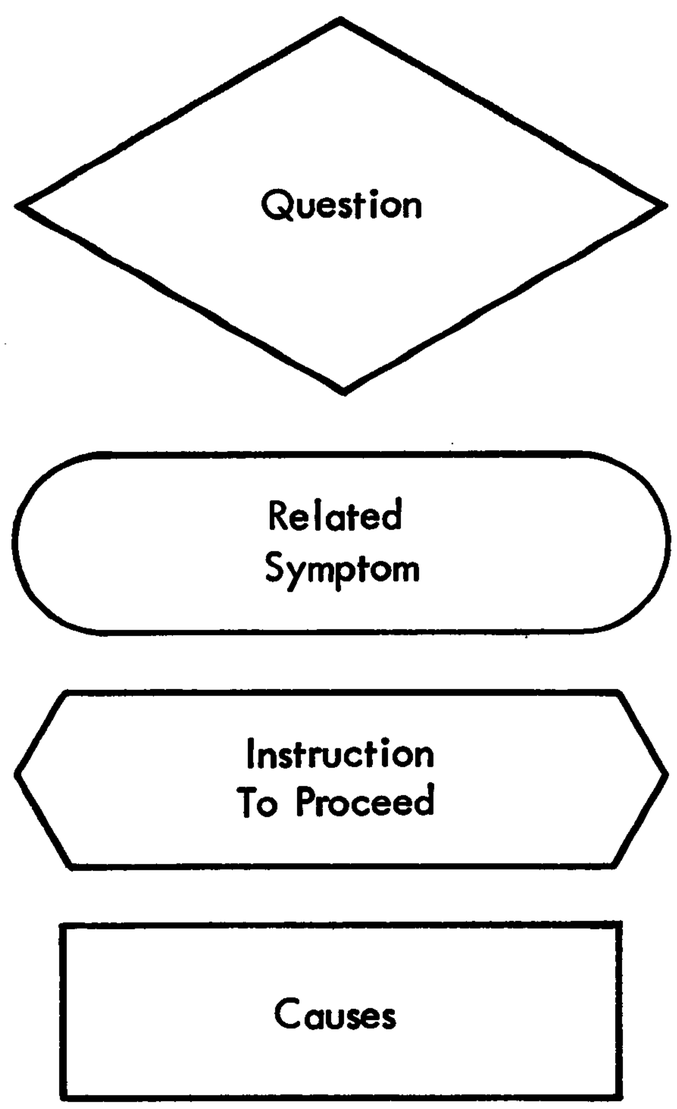
This Service Index is a guide for the Customer Engineer when troubleshooting the 2302 Disk Storage and its attached 7631 File Control Unit.

Due to the large number of systems that use the 2302/7631, this Service Index will assume that the error condition is appearing while running from the 7631 CE Panel.

A thorough understanding of the functions and use of the CE Panel is required. Because of this, operating instructions for the CE Panel have been included in the Service Hints portion of the Service Index.

The error flow charts assume a solid failure; however, they may be used as a guide or source of ideas when troubleshooting an intermittent failure.

Additional information for difficult-to-analyze troubles has been provided in the Service Hints section.



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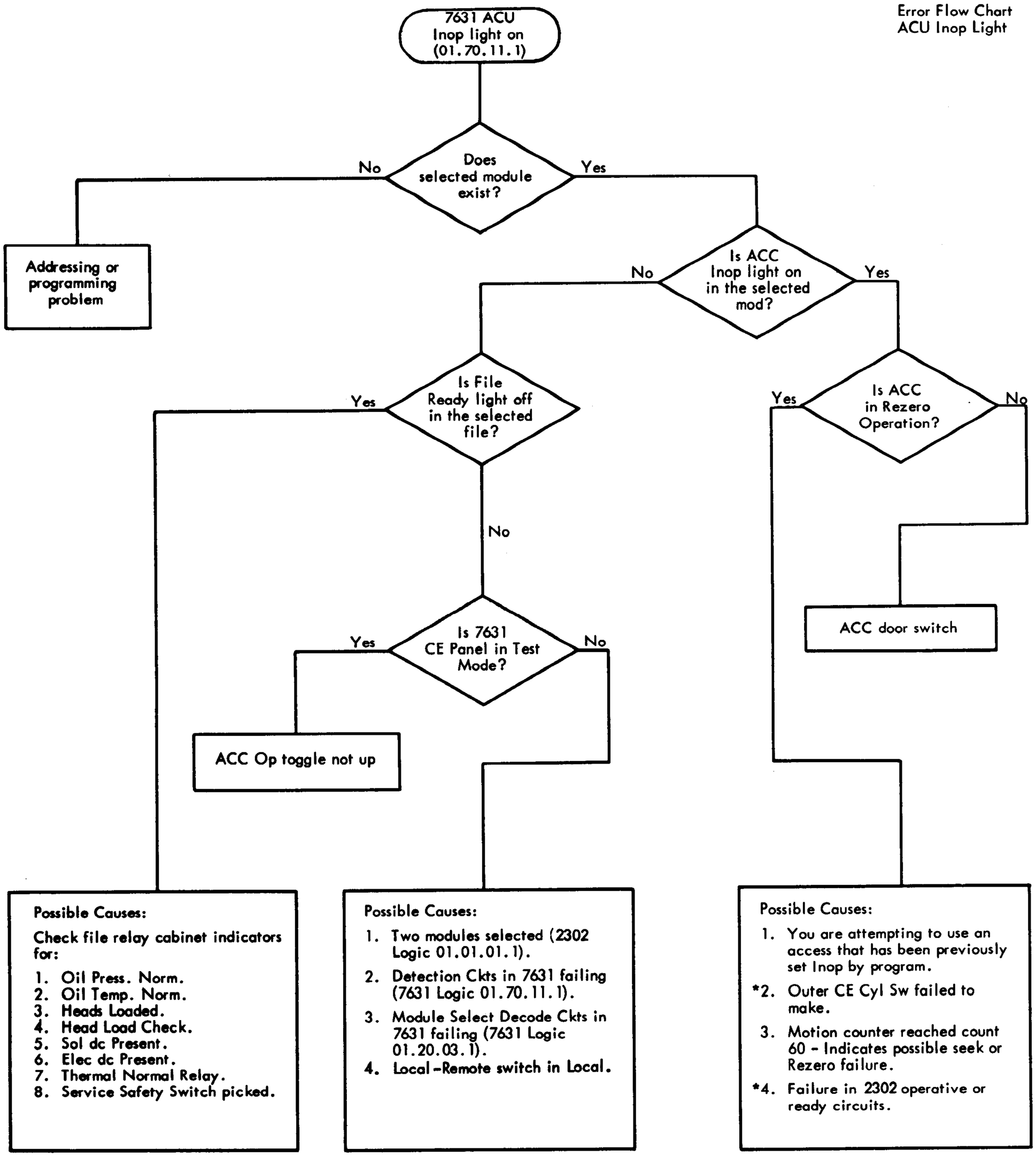
Error Flow Chart
ACU Inop Light



* It is difficult to tell if an access was set Inop erroneously by programming or whether it failed on a seek Op for mechanical reasons. If it failed to arrive at an address because of a bind, and also failed to arrive at the outer CE Cyl until after count 60, access Inop would be set. (See Rezero Failure Service Hints, section 18.0)

26002 *

Figure 1-1 7631 ACU Inop Light

*NOTE: The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is unrelated to the subject matter.

Error Flow Chart
ACU Not Ready Light

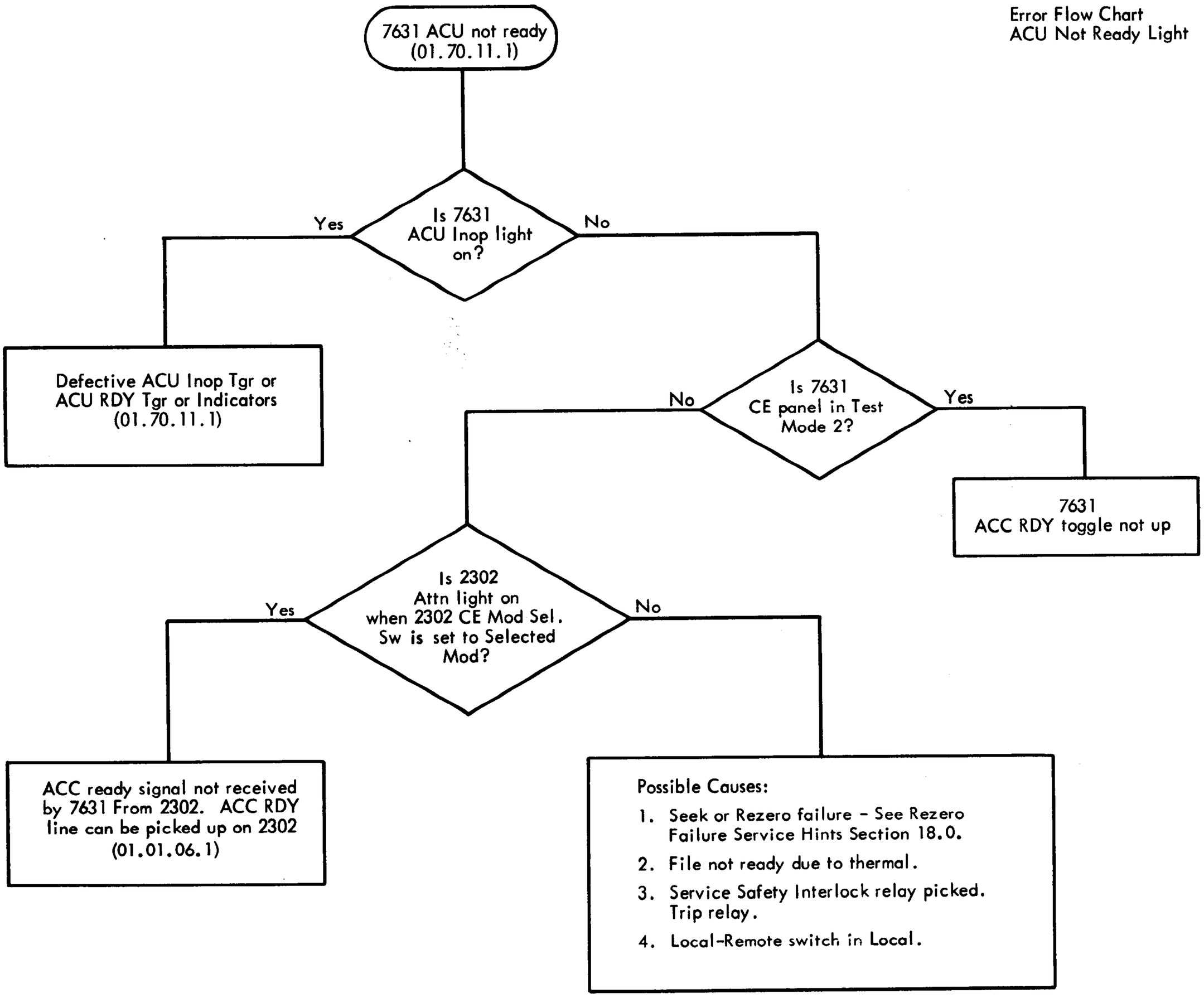


Figure 2-1 7631 ACU Not Ready Light

26003

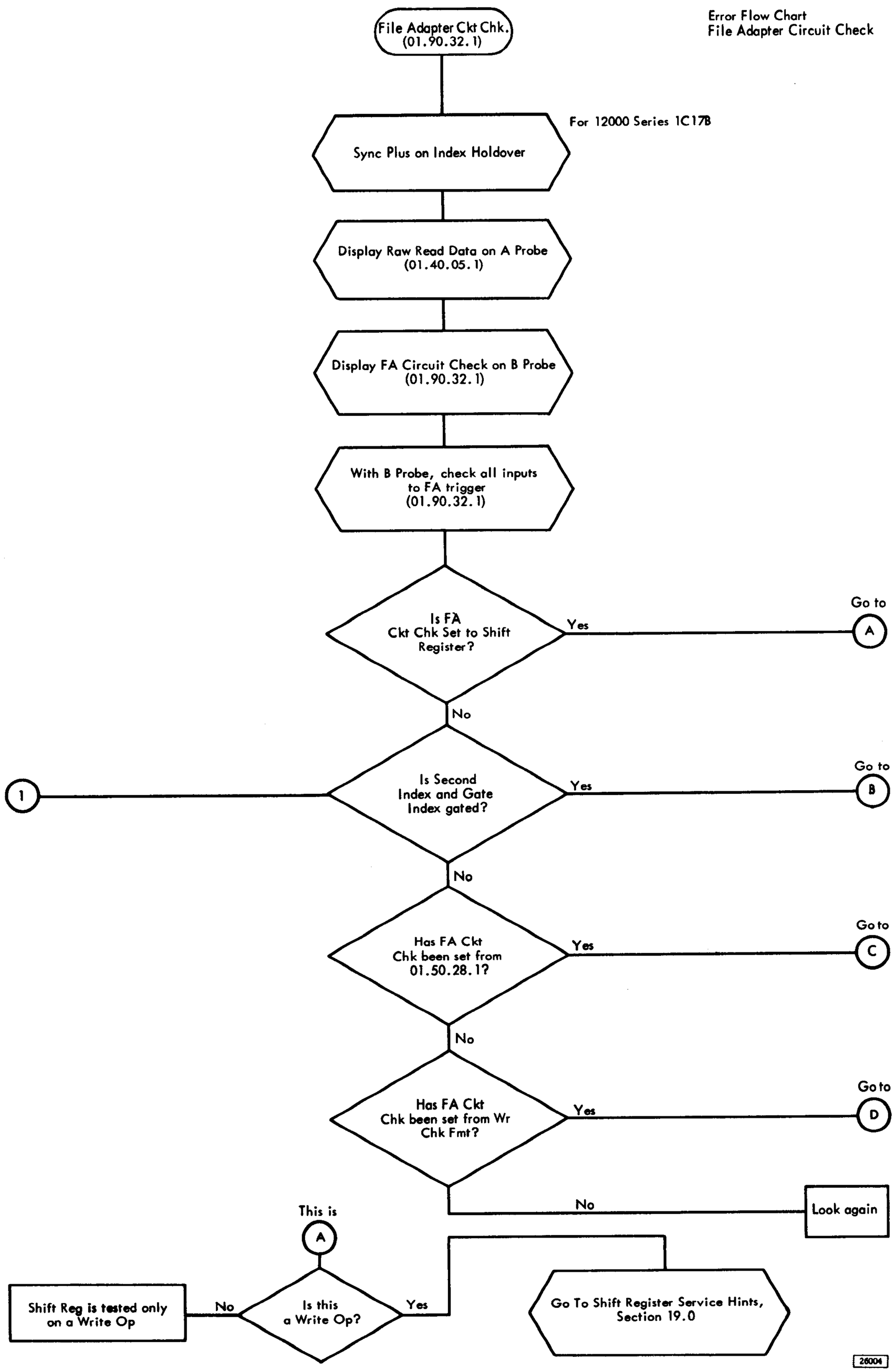


Figure 3-1 7631 File Adapter Circuit Check Light

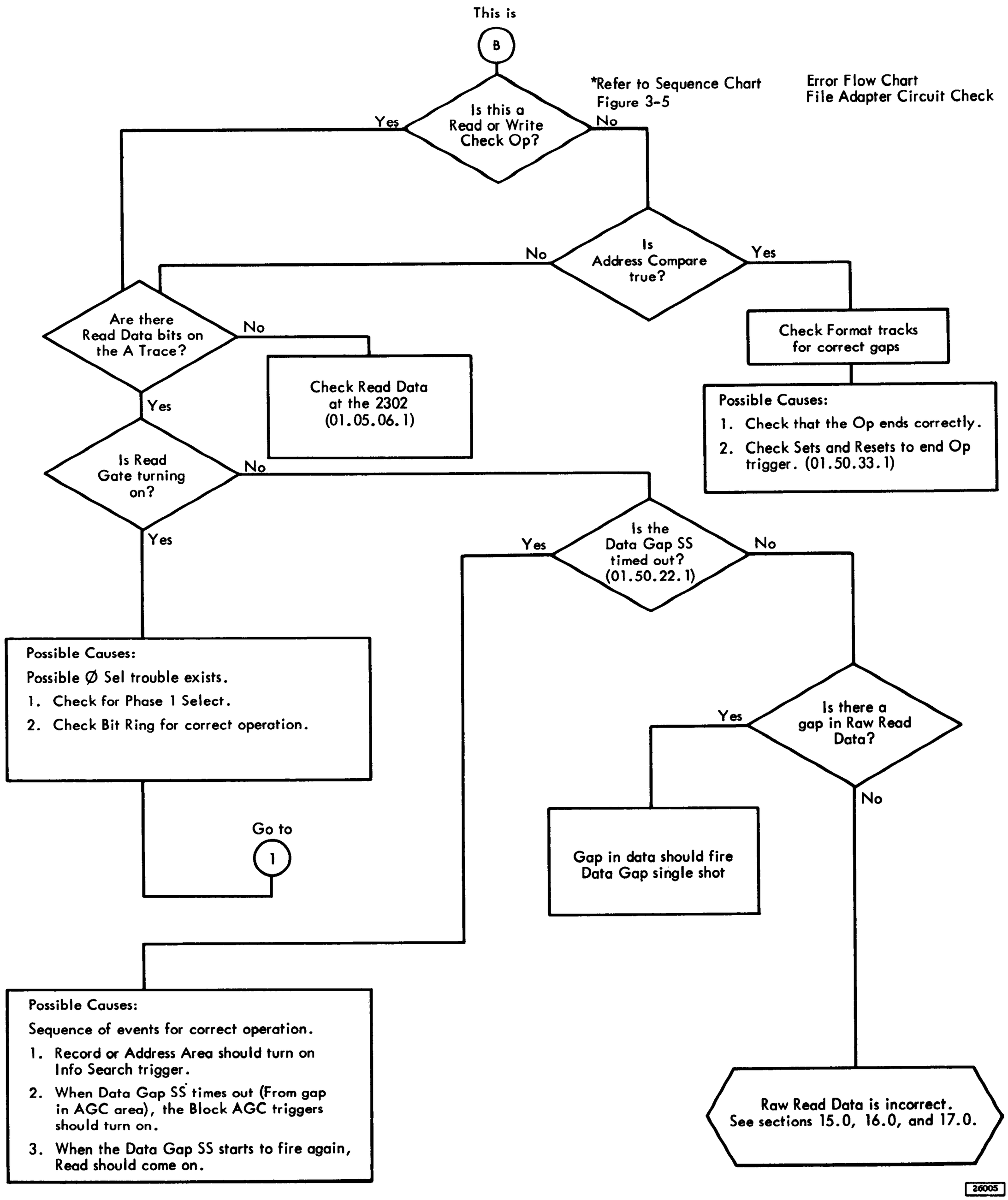


Figure 3-2 7631 File Adapter Circuit Check Light

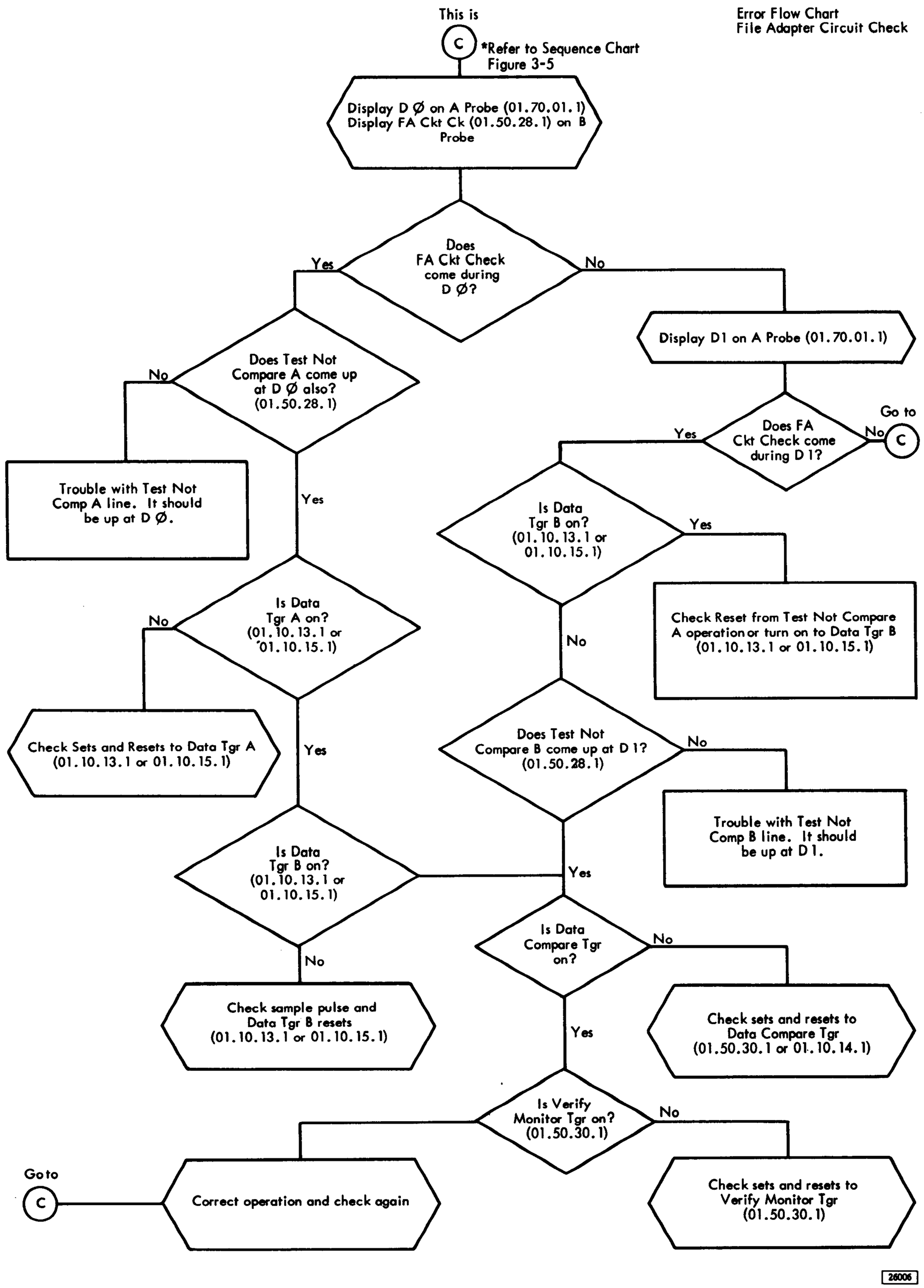


Figure 3-3 7631 File Adapter Circuit Check Light

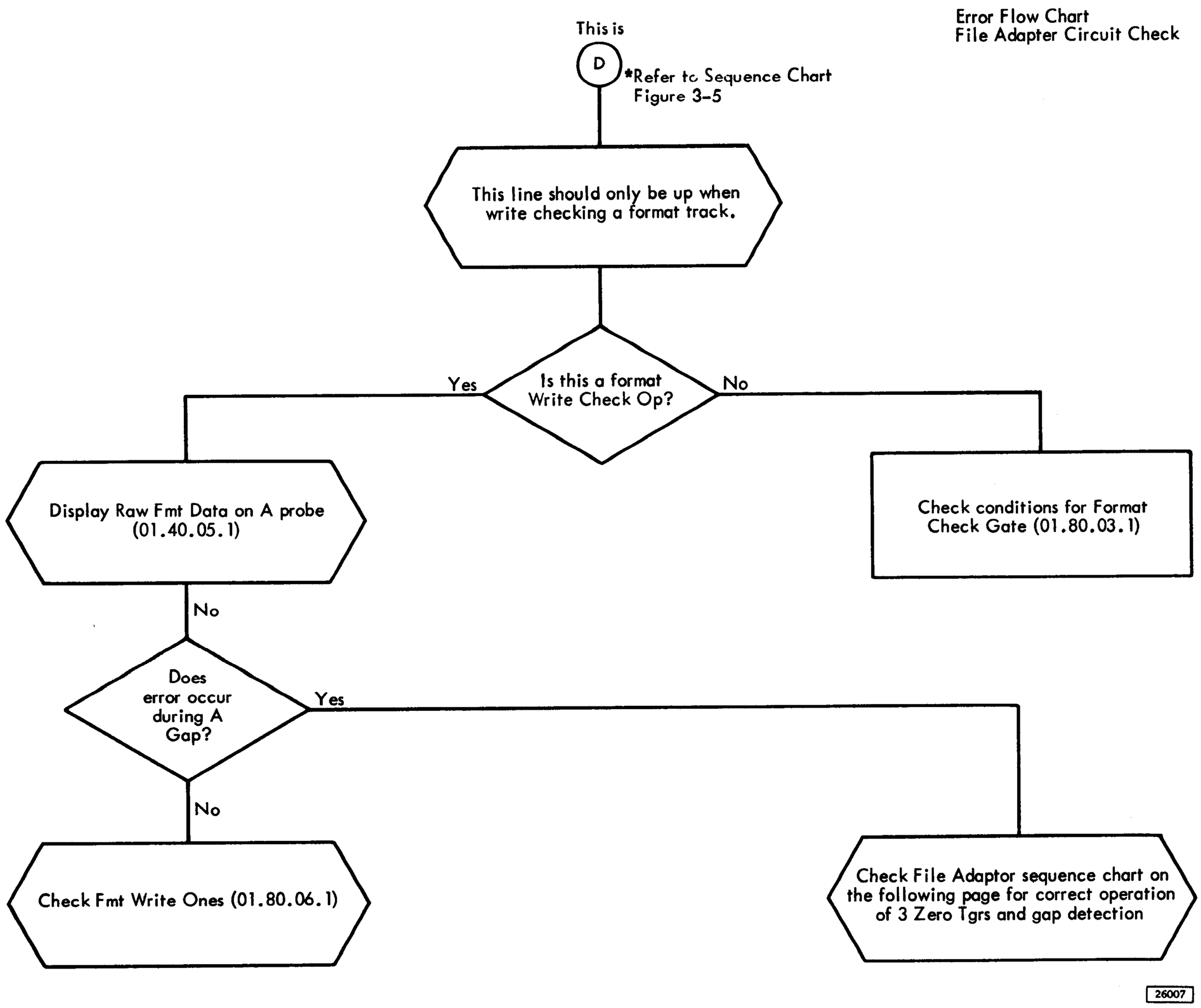


Figure 3-4 7631 File Adapter Circuit Check Light

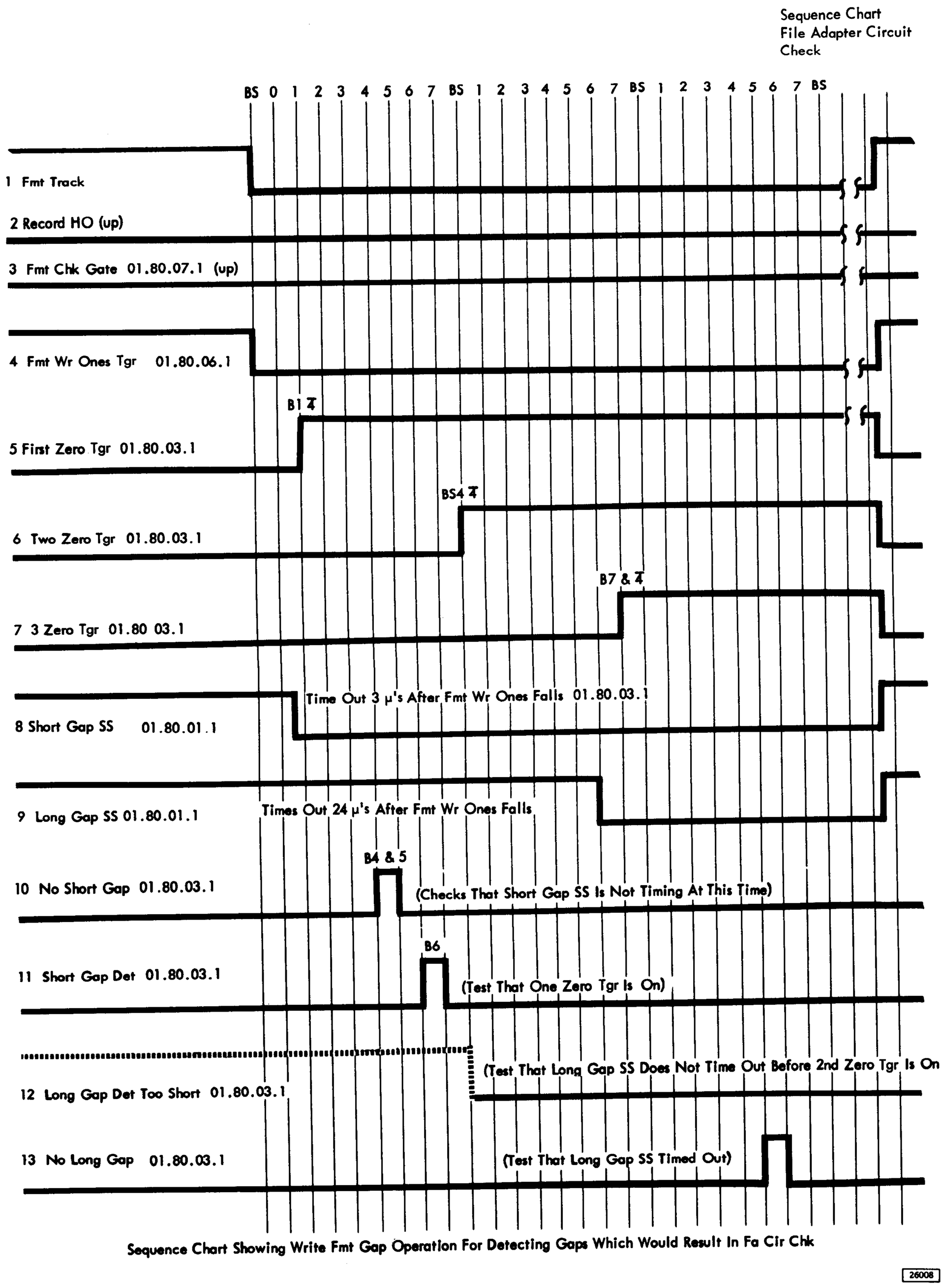


Figure 3-5 7631 File Adapter Circuit Check Sequence Chart

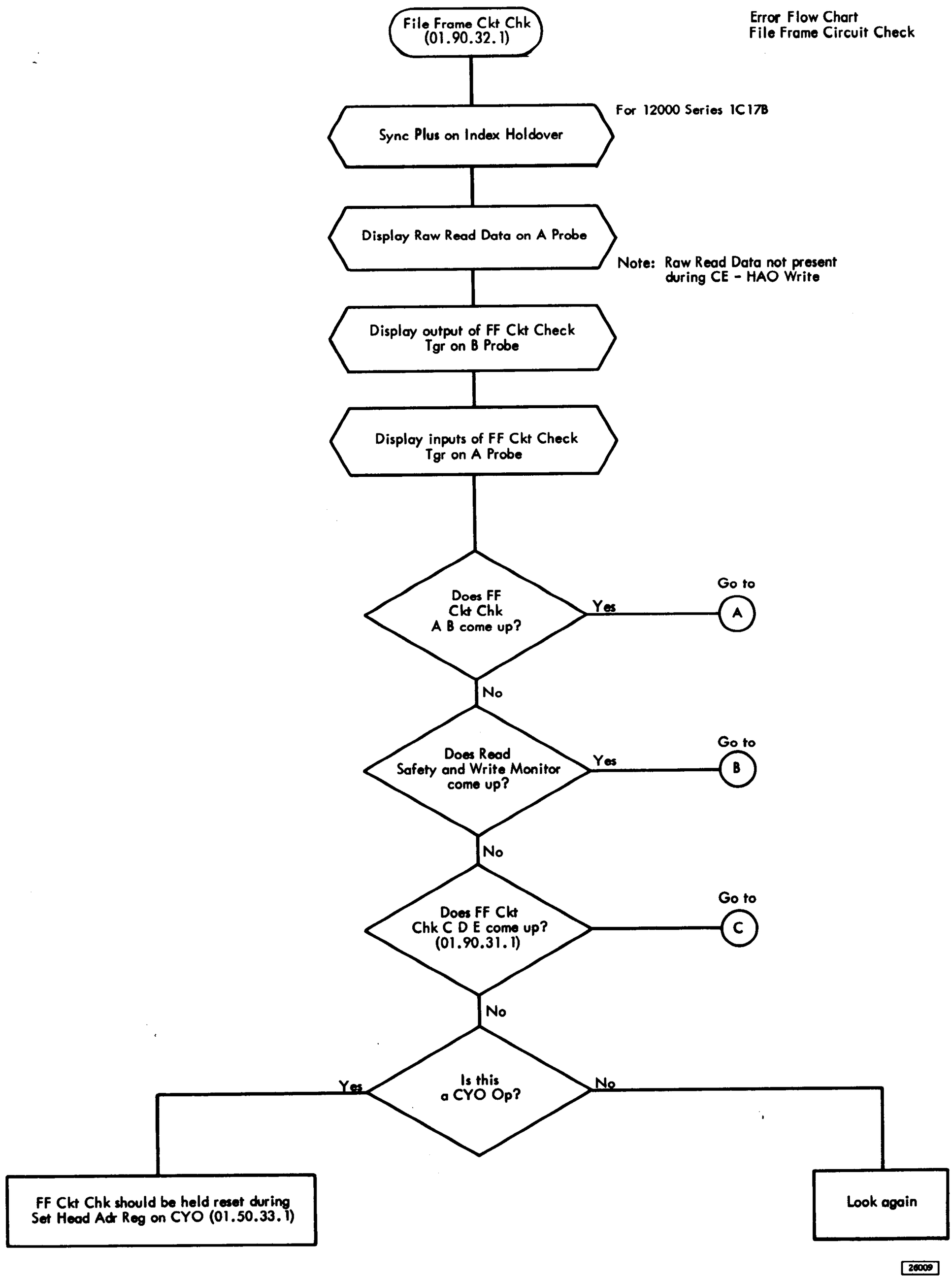


Figure 4-1 7631 File Frame Circuit Check Light

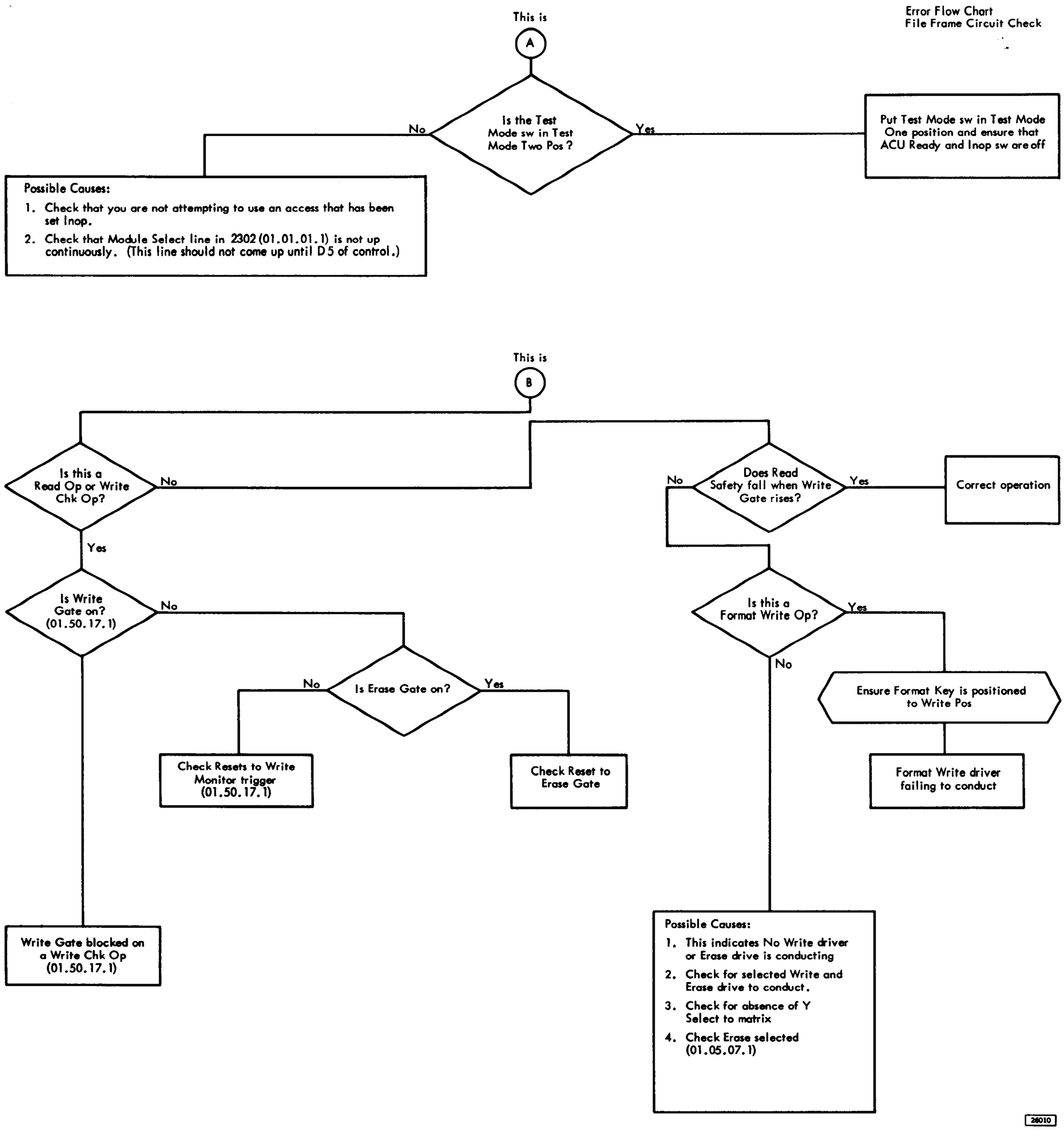


Figure 4-2 7631 File Frame Circuit Check Light

Error Flow Chart
File Frame Circuit Check

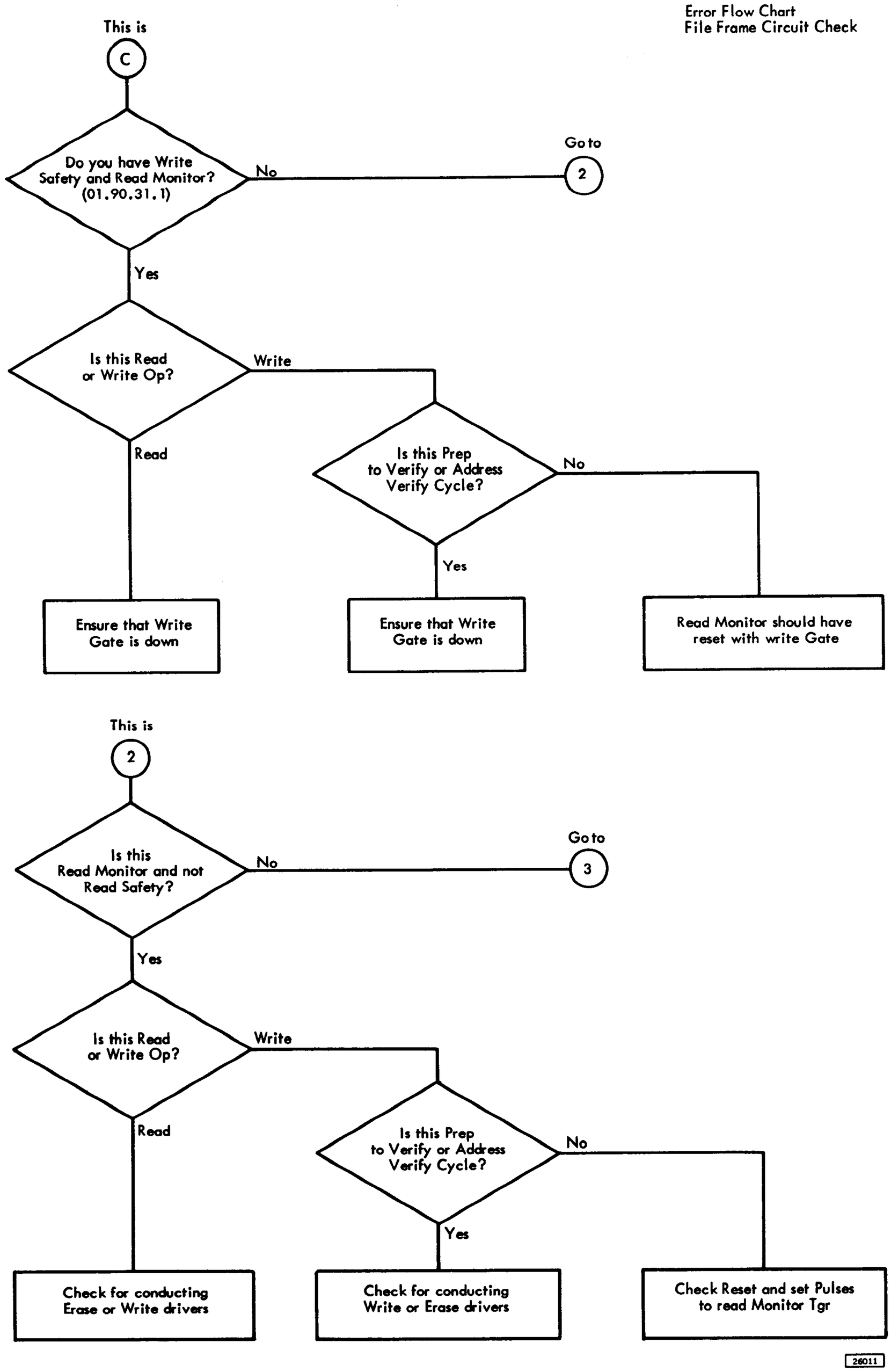


Figure 4-3 7631 File Frame Circuit Check Light

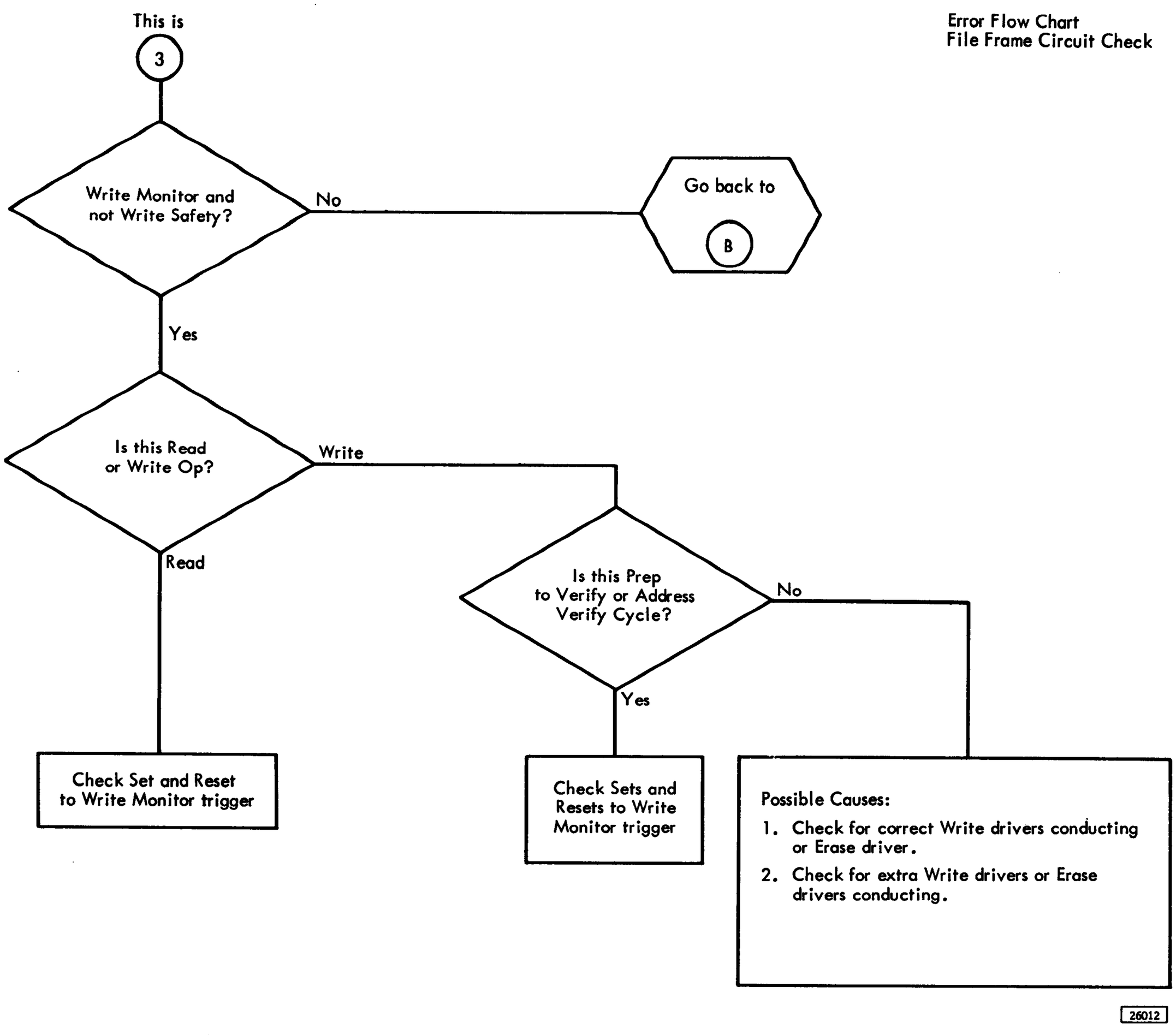


Figure 4-4 7631 File Frame Circuit Check Light

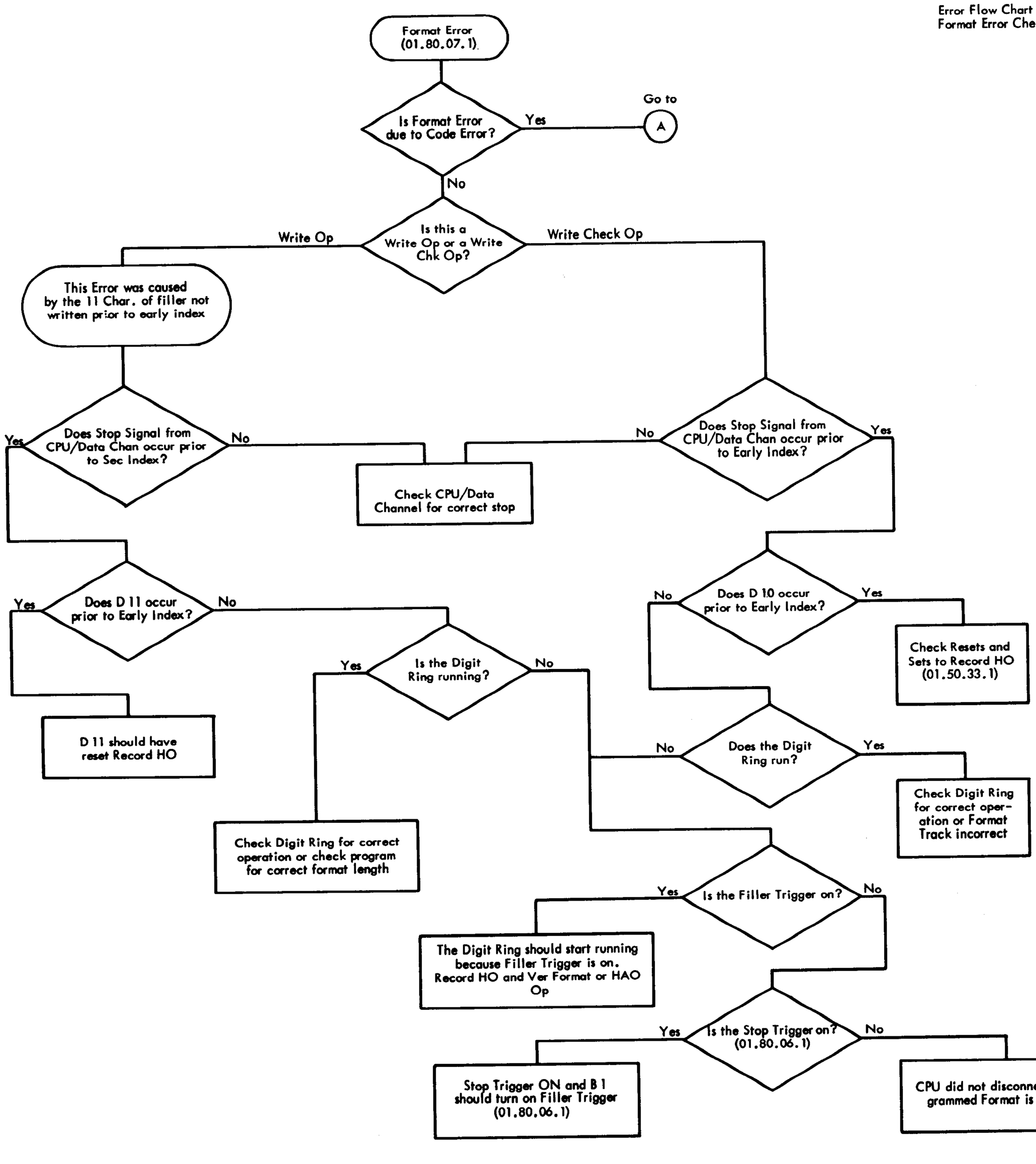


Figure 5-1 7631 Format Error Light

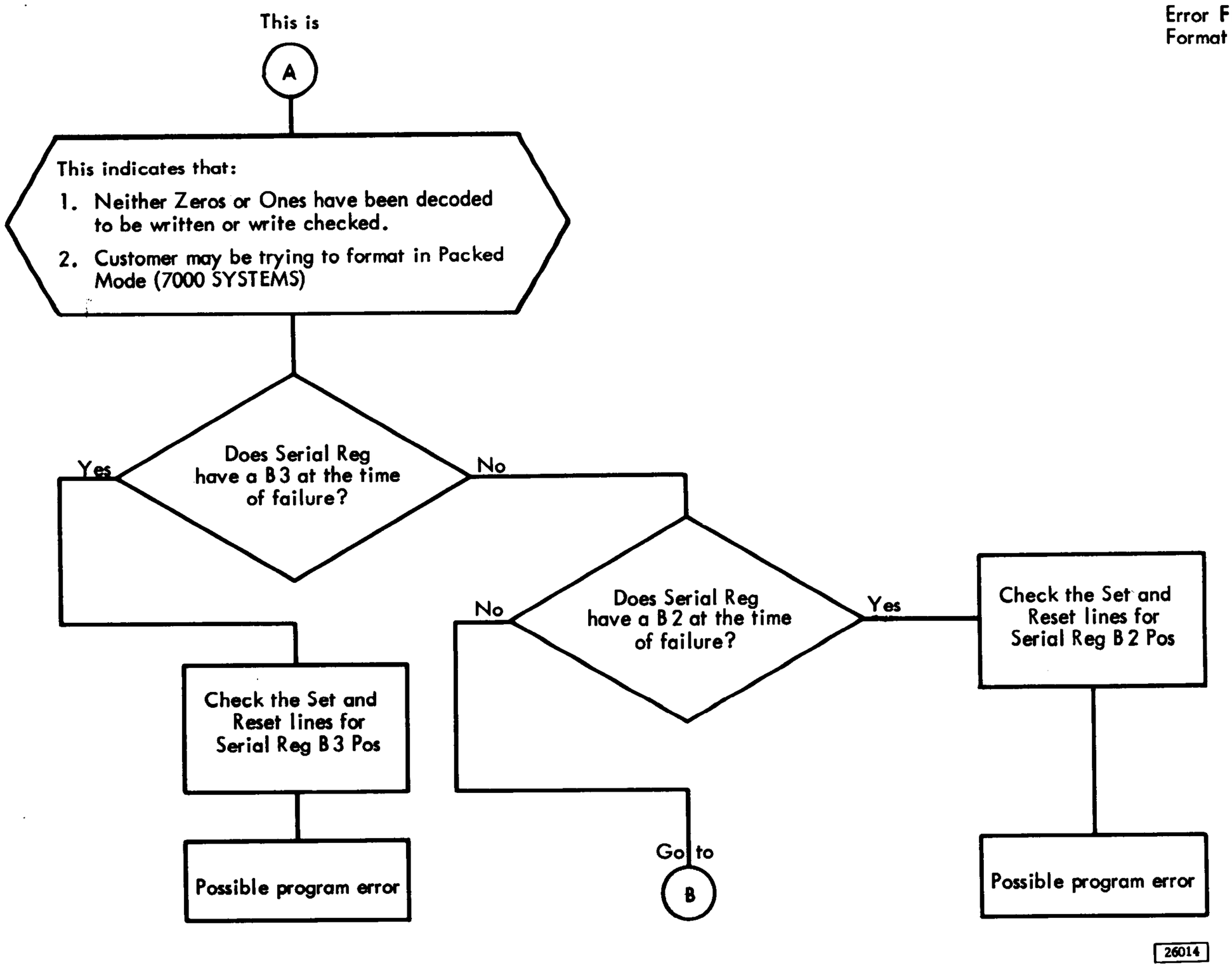


Figure 5-2 7631 Format Error Light

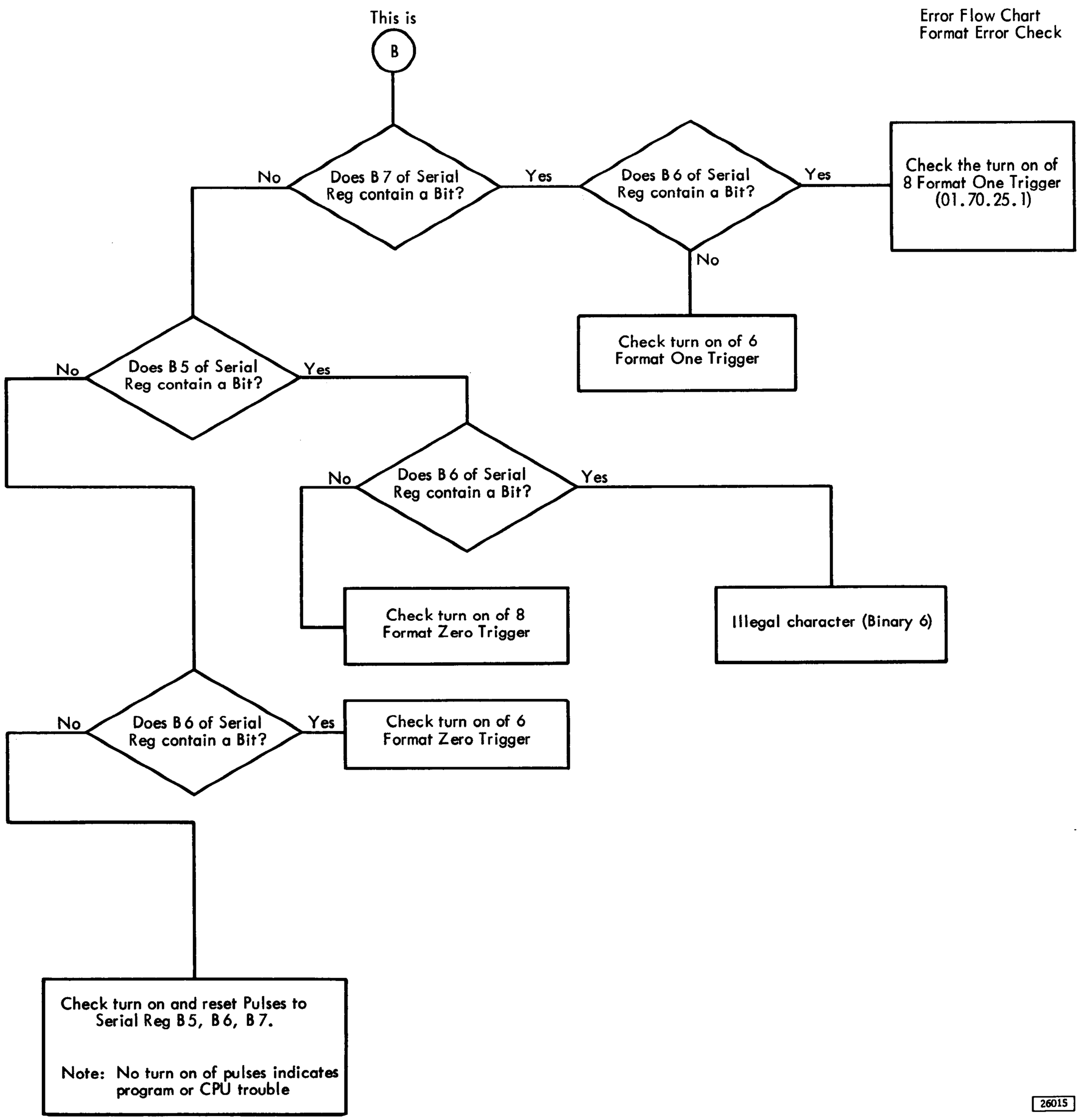
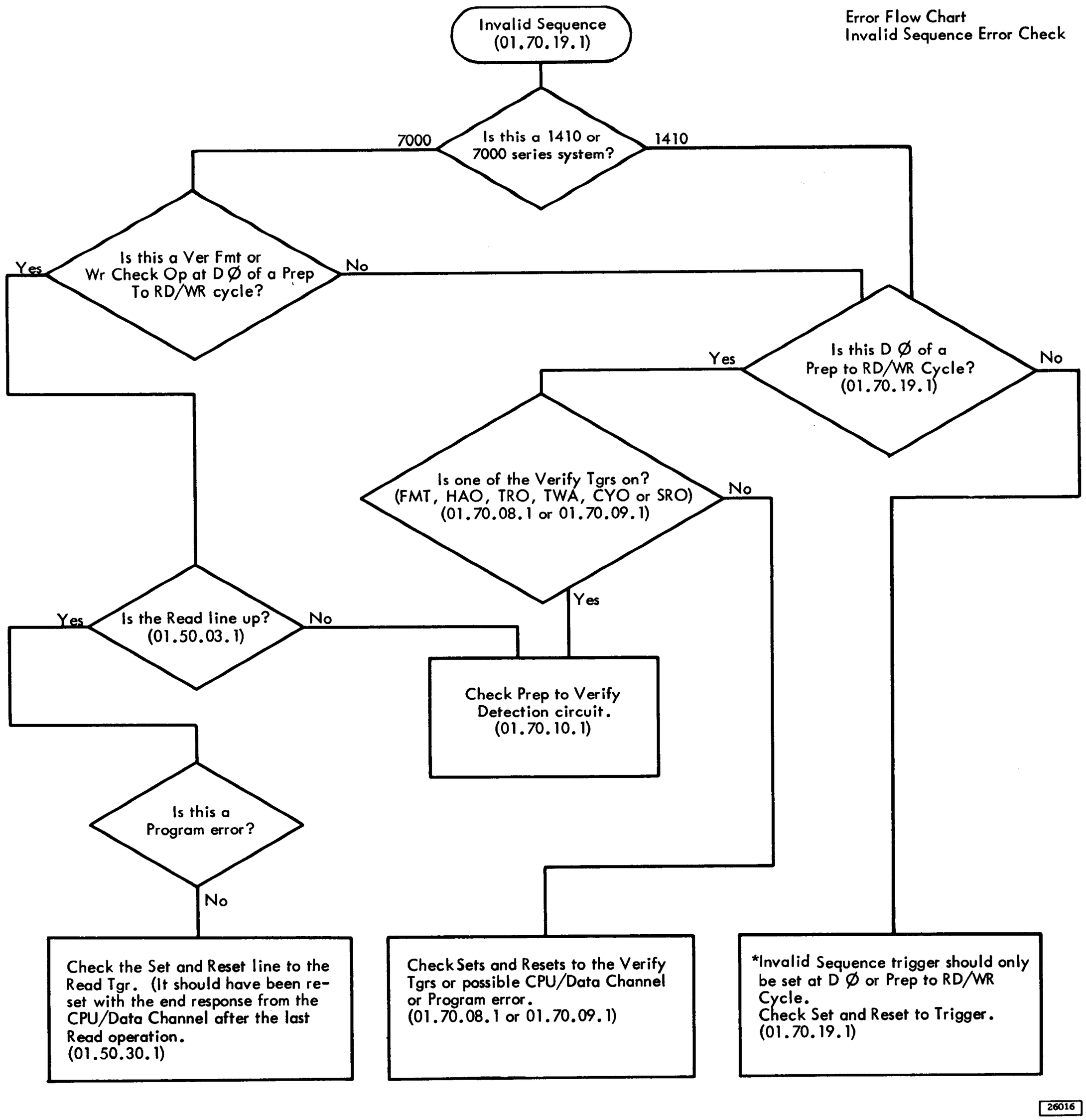


Figure 5-3 7631 Format Error Light



*The invalid sequence error is caused by a RD/WR command without a Prepare to Verify order or when a Read Command follows a Write Check or Verify FMT order.

Figure 6-1 7631 Invalid Sequence Error Light

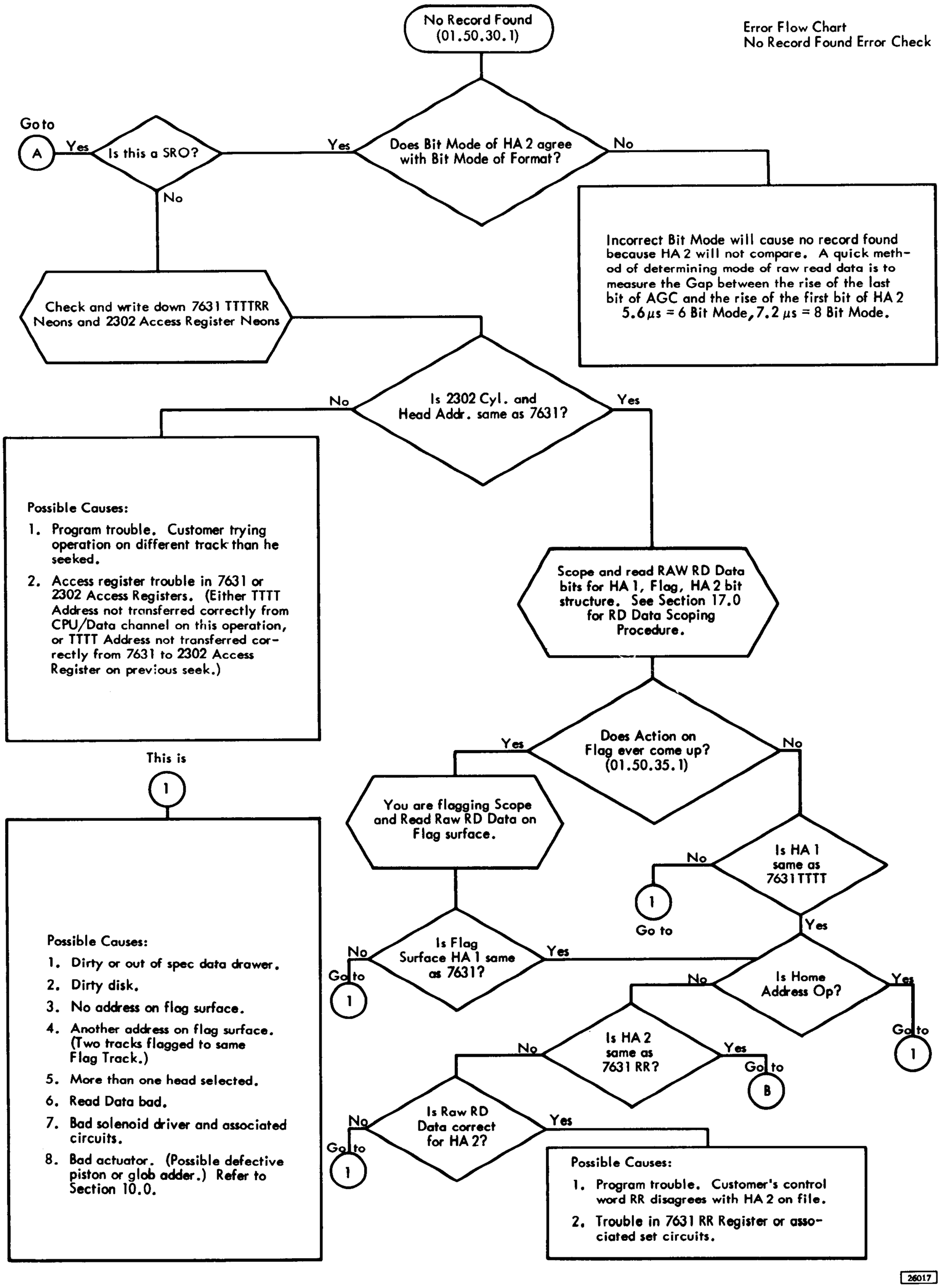


Figure 7-1 7631 No Record Found Error Light

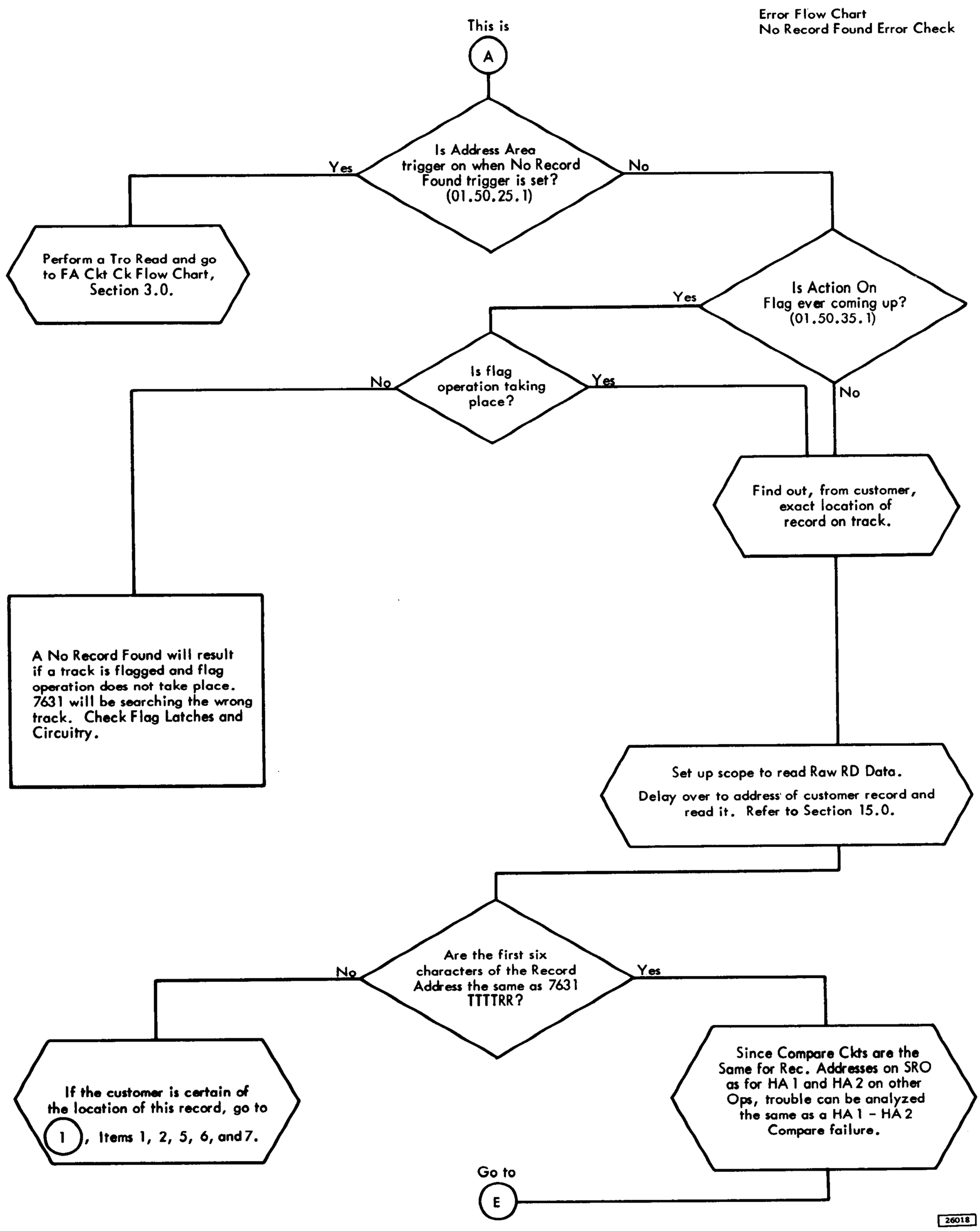


Figure 7-2 7631 No Record Found Error Light

Error Flow Chart
No Record Found Error Check

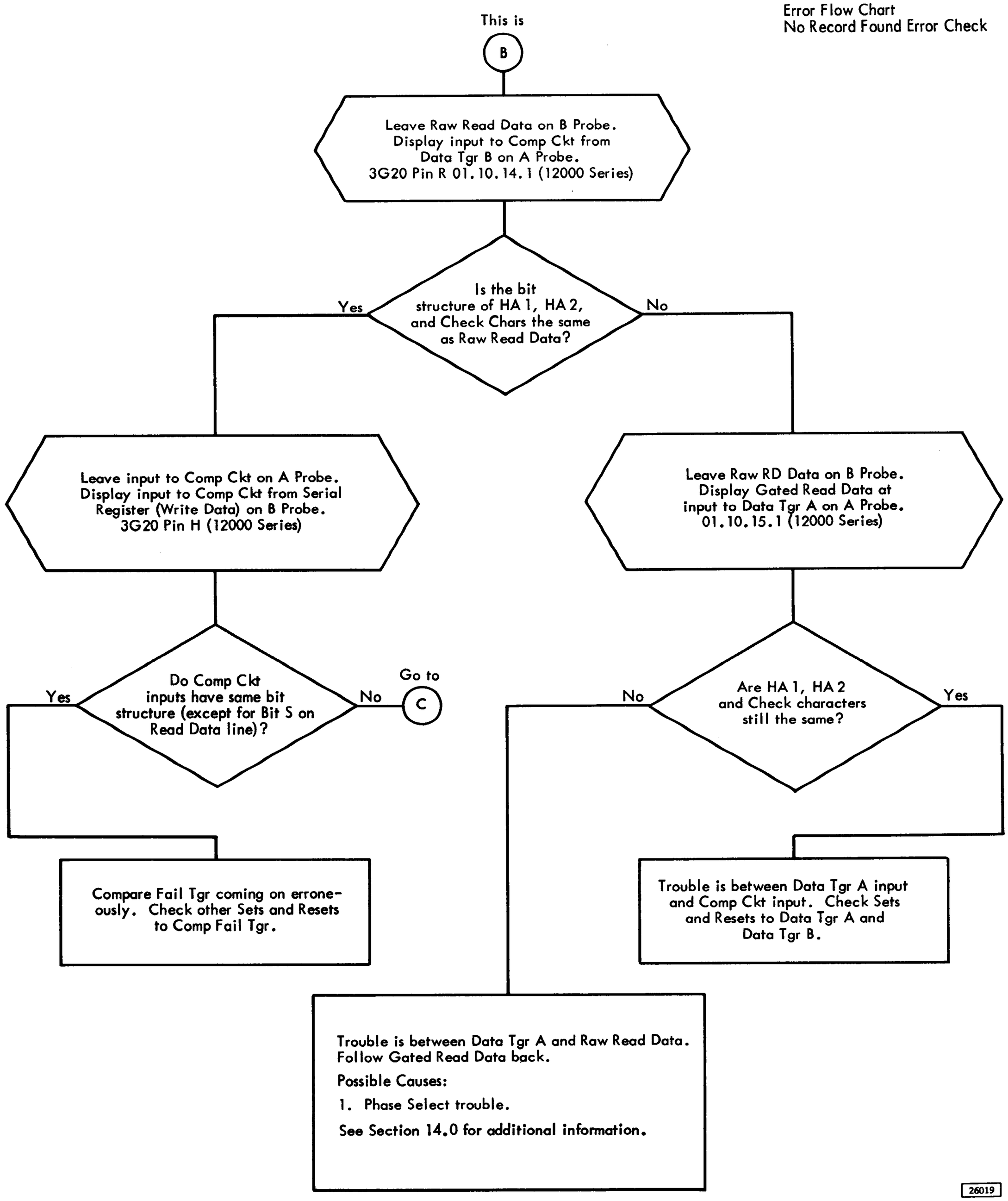


Figure 7-3 7631 No Record Found Error Light

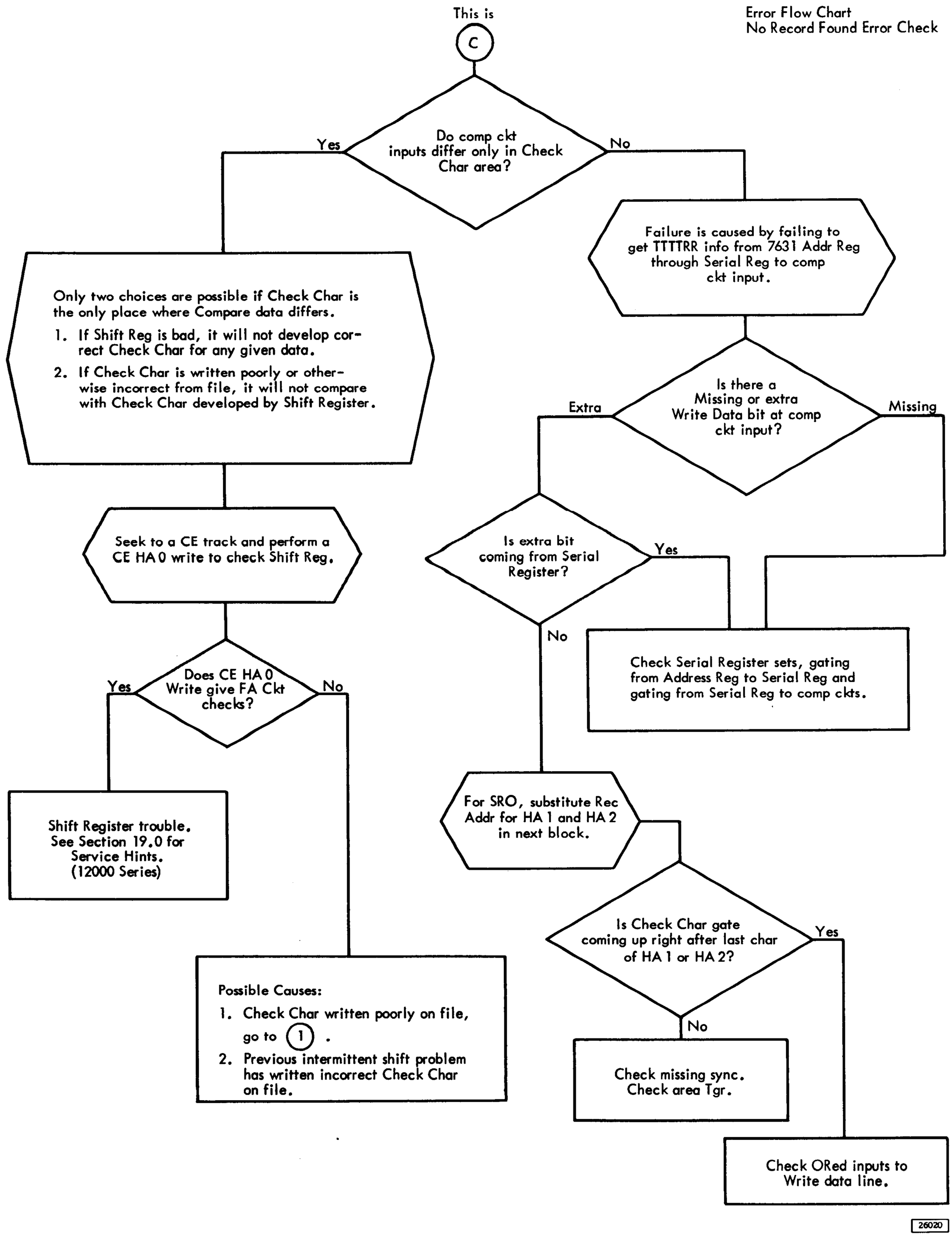


Figure 7-4 7631 No Record Found Error Light

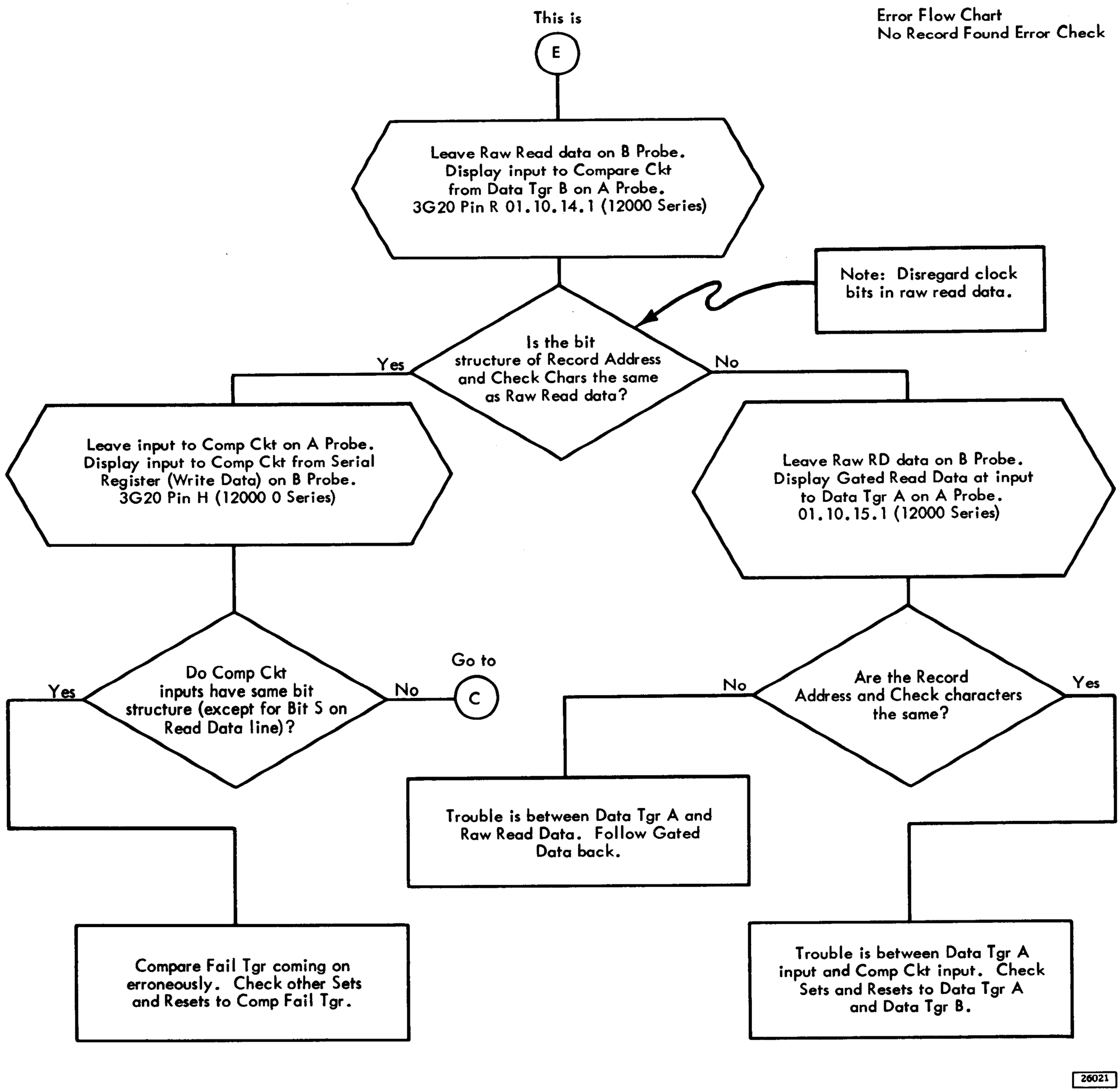


Figure 7-5 7631 No Record Found Error Light

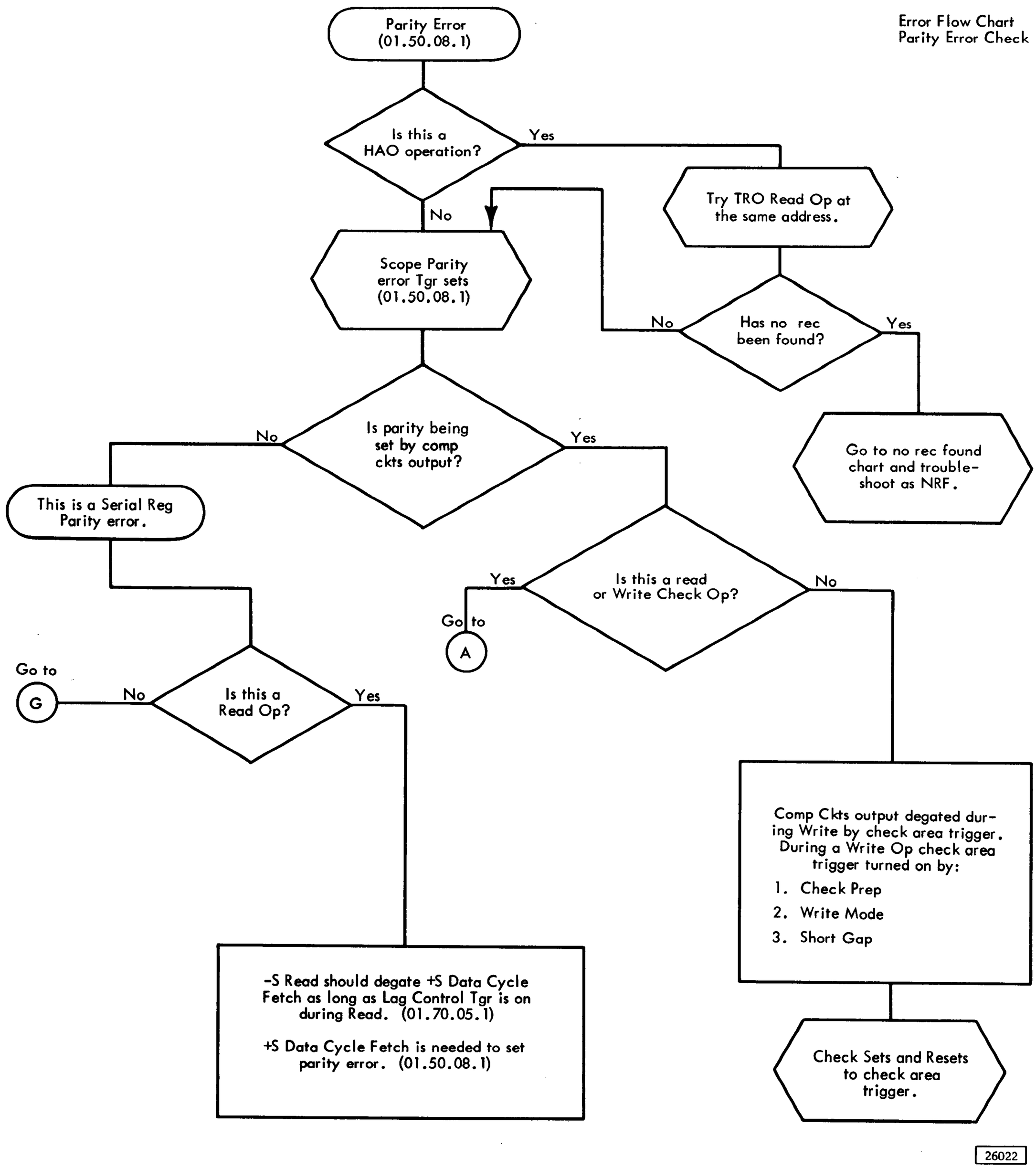


Figure 8-1 7631 Parity Error Light

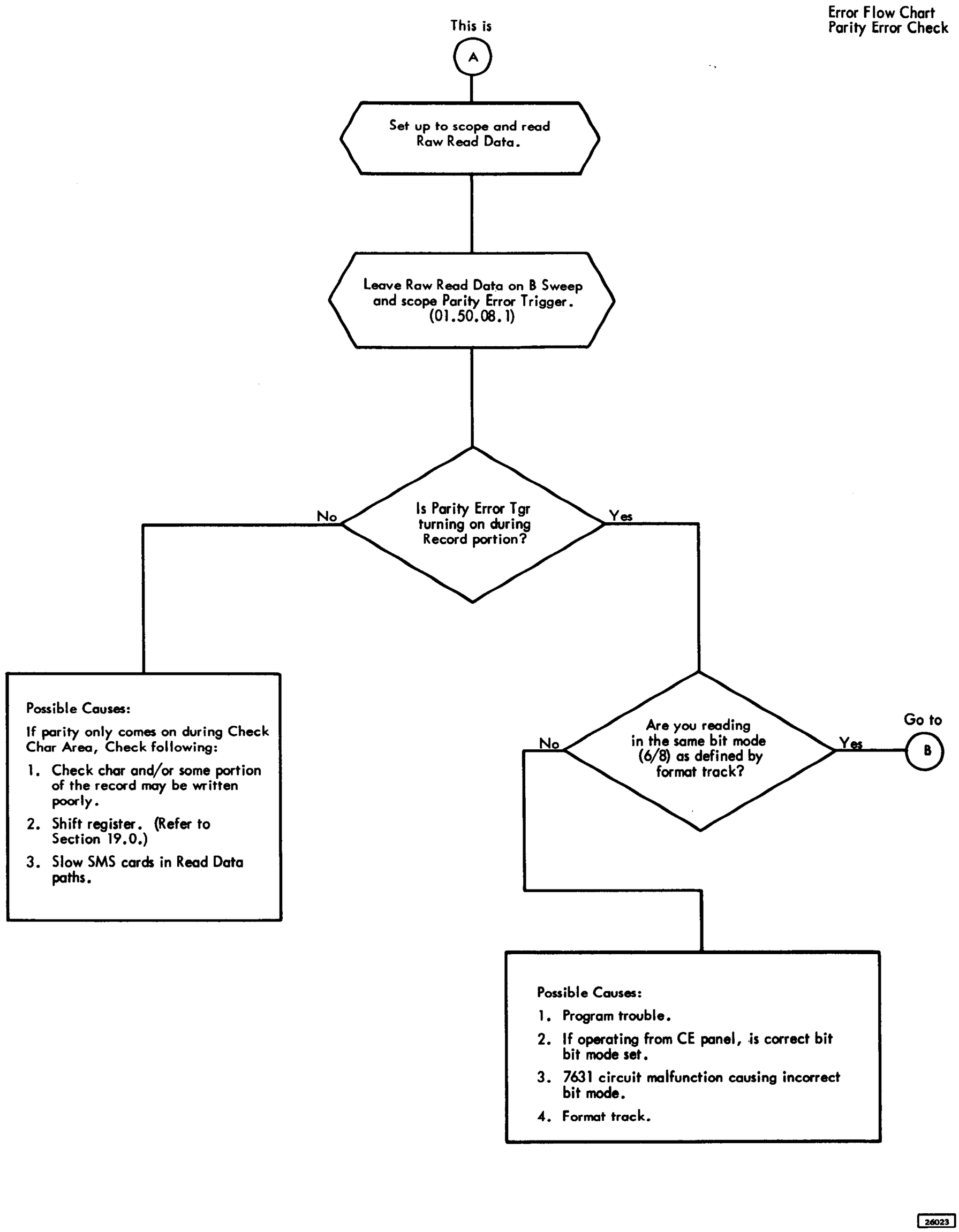


Figure 8-2 7631 Parity Error Light

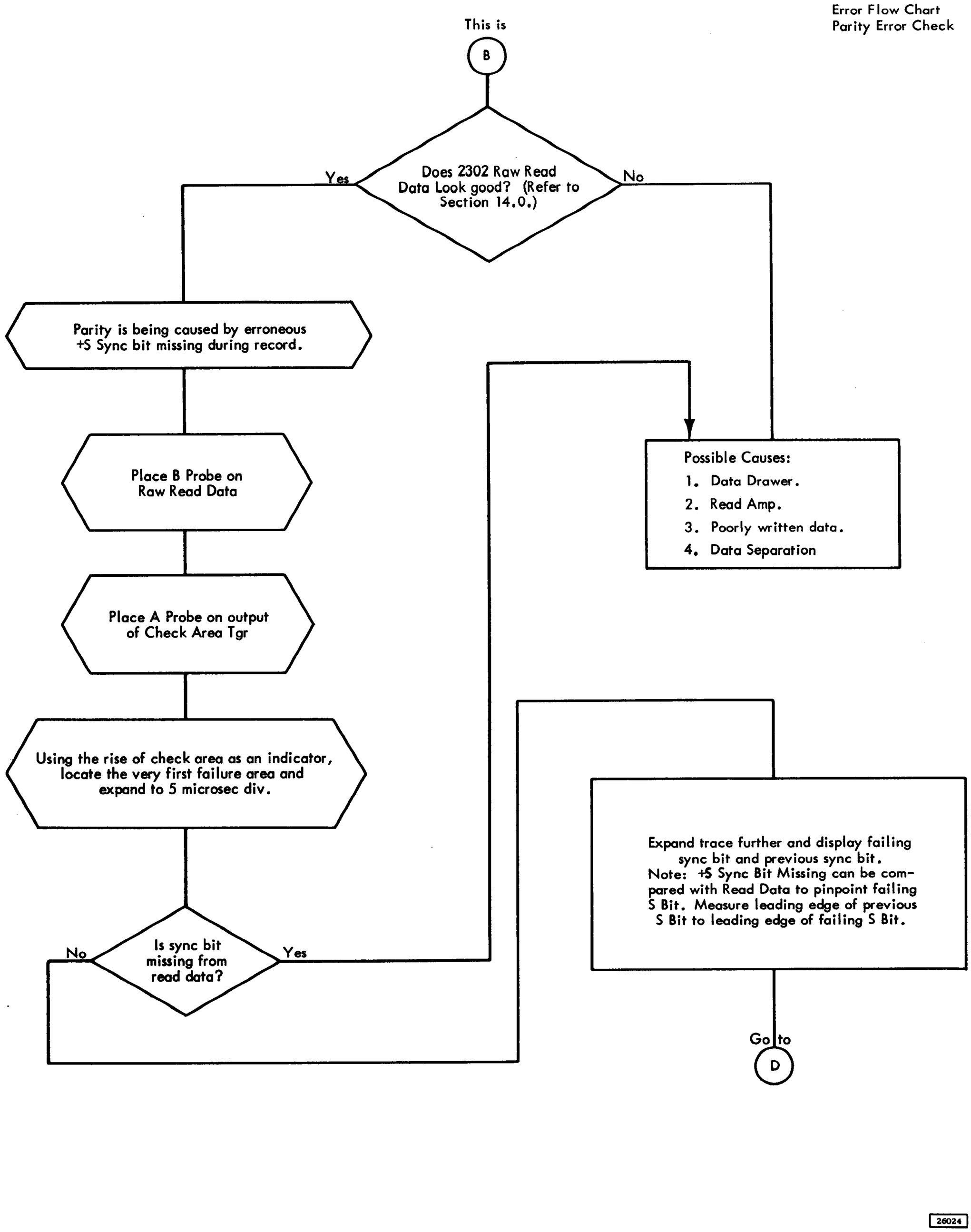


Figure 8-3 7631 Parity Error Light

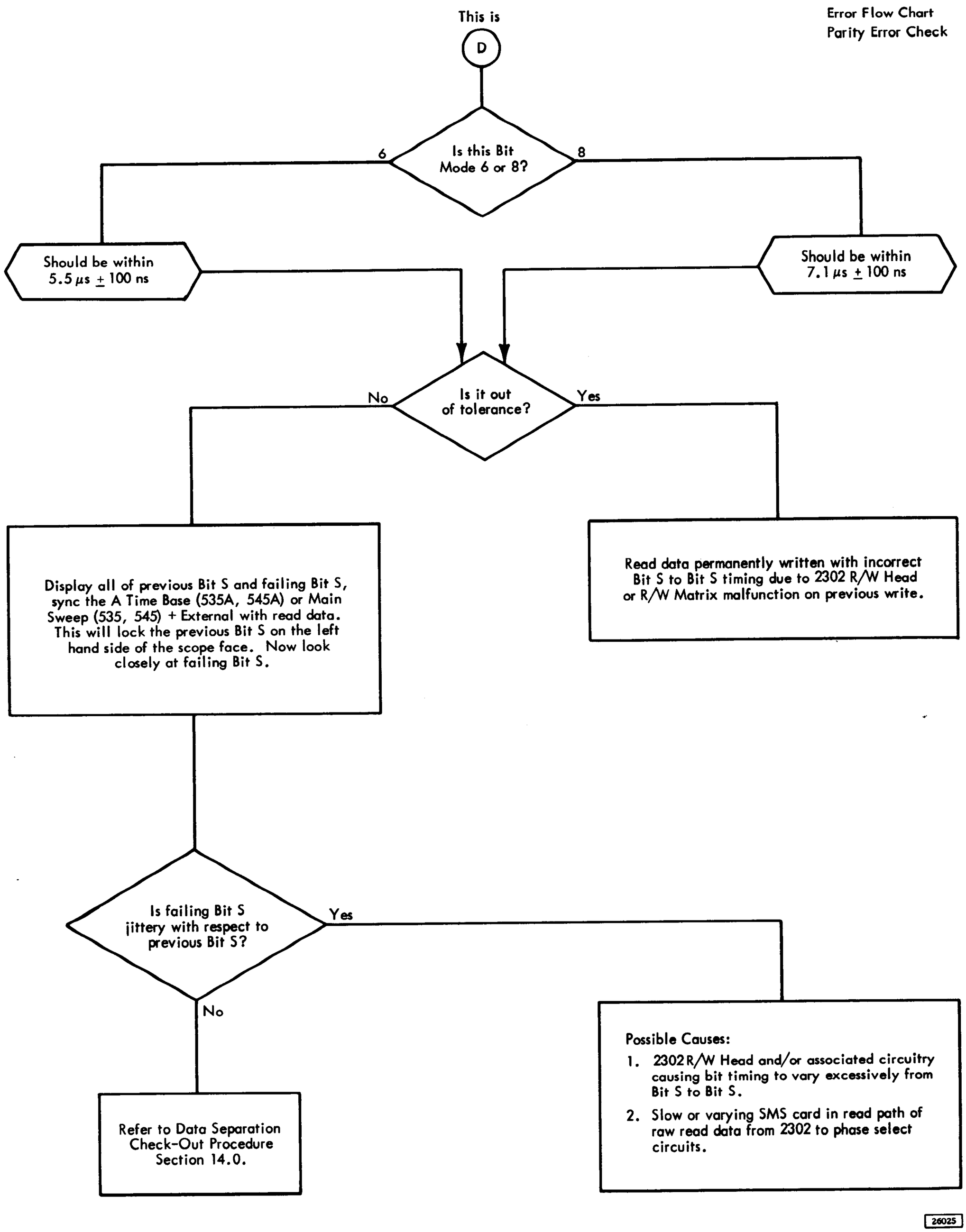


Figure 8-4 7631 Parity Error Light

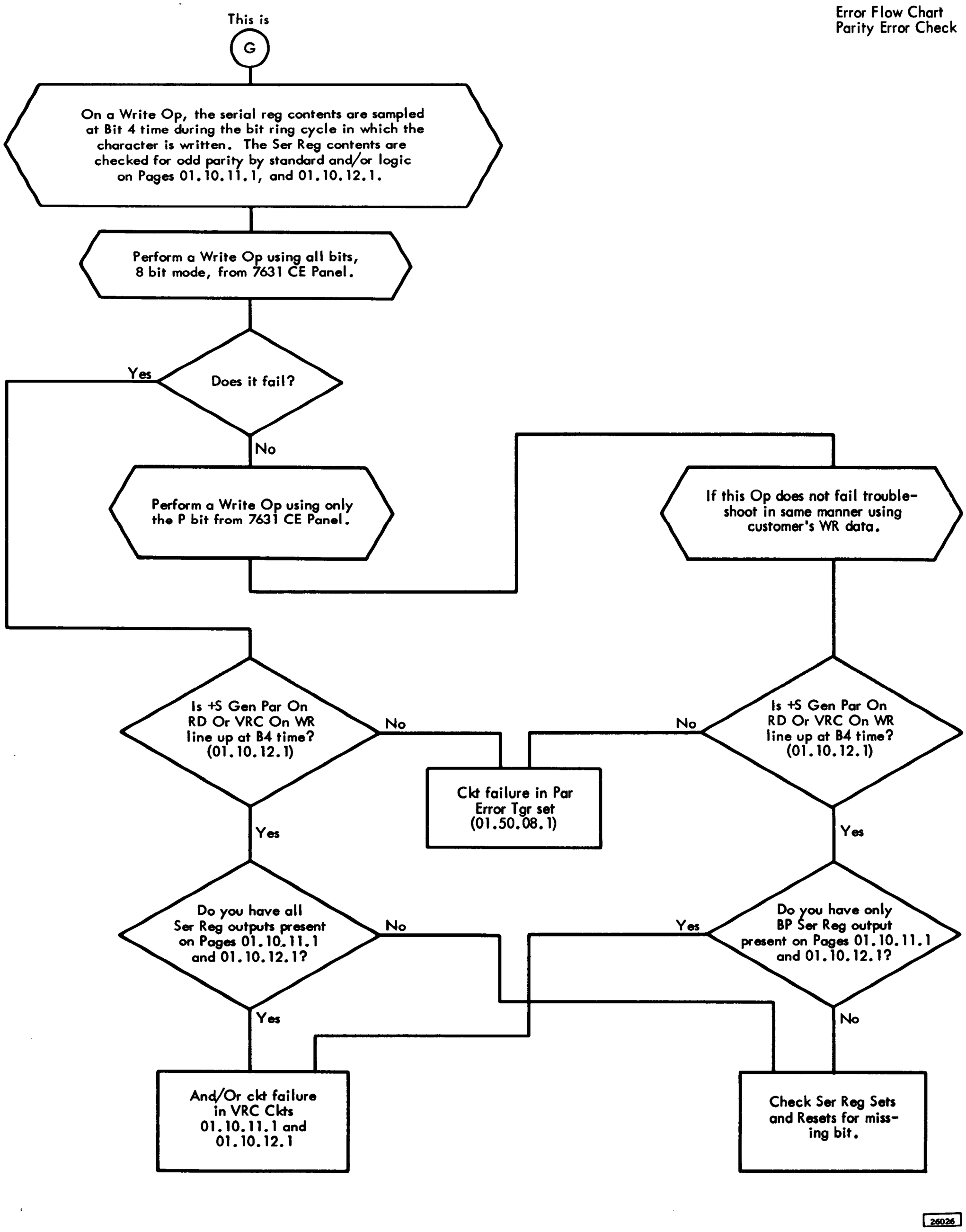


Figure 8-5 7631 Parity Error Light

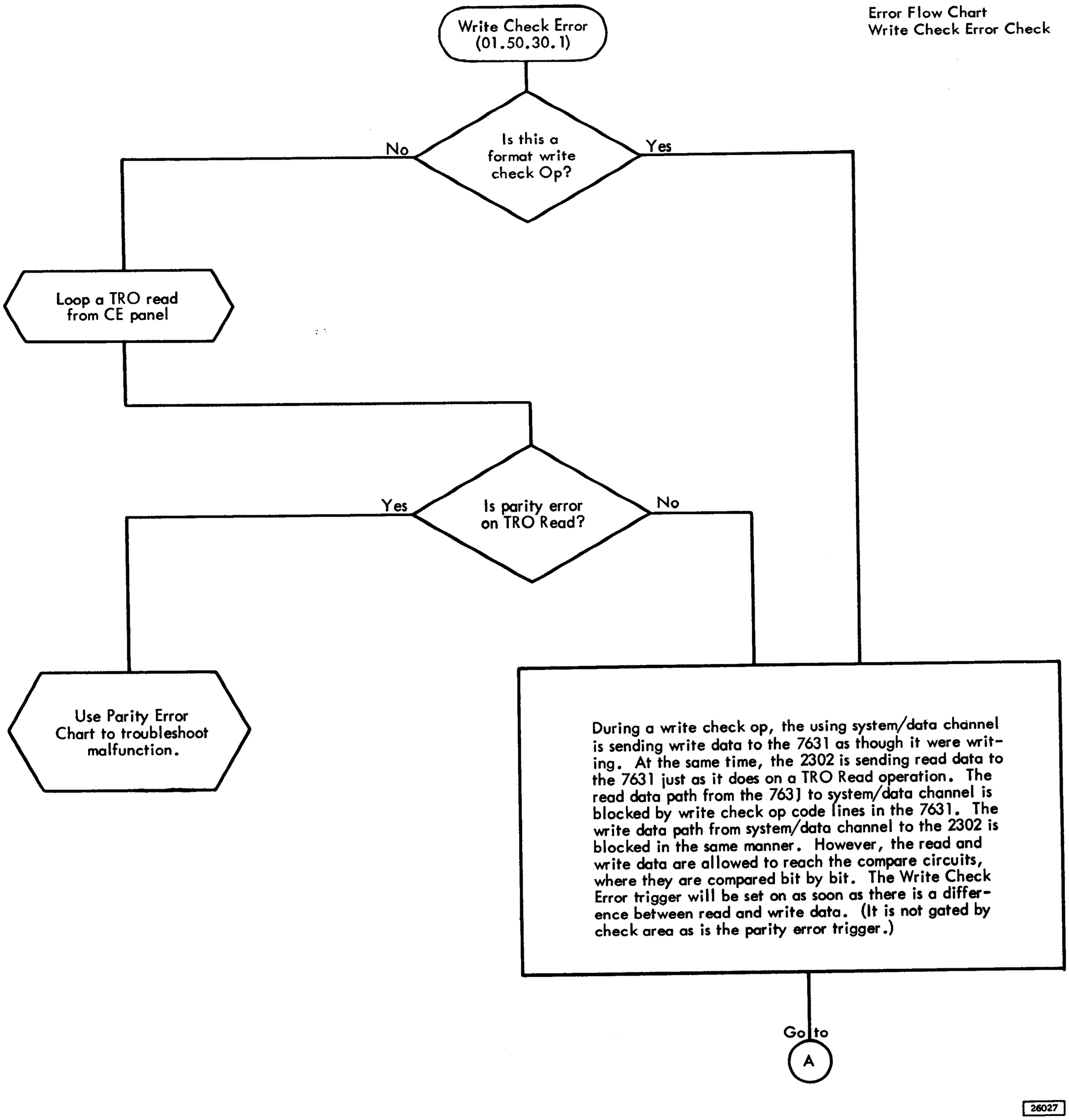


Figure 9-1 7631 Write Check Error Light

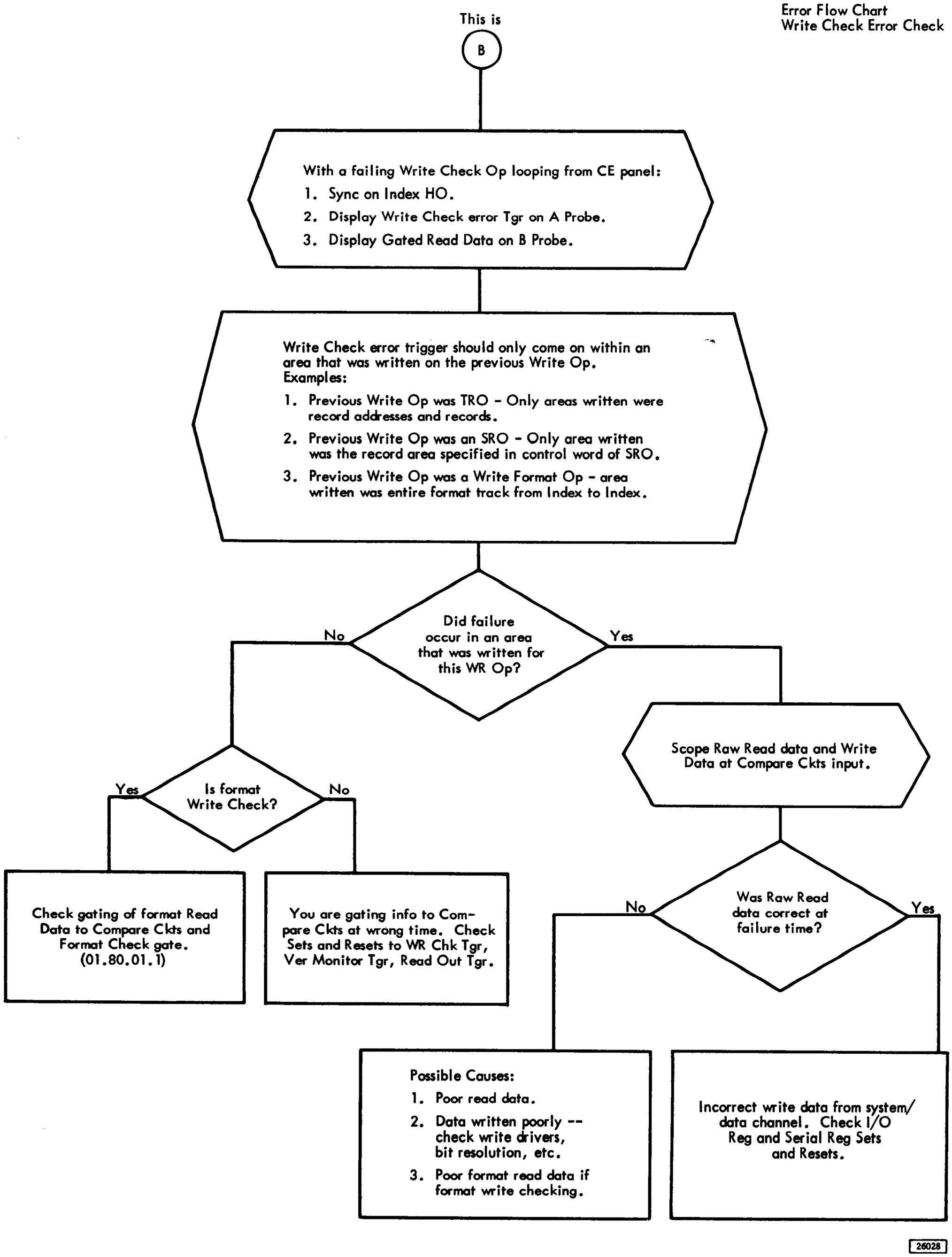


Figure 9-2 7631 Write Check Error Light

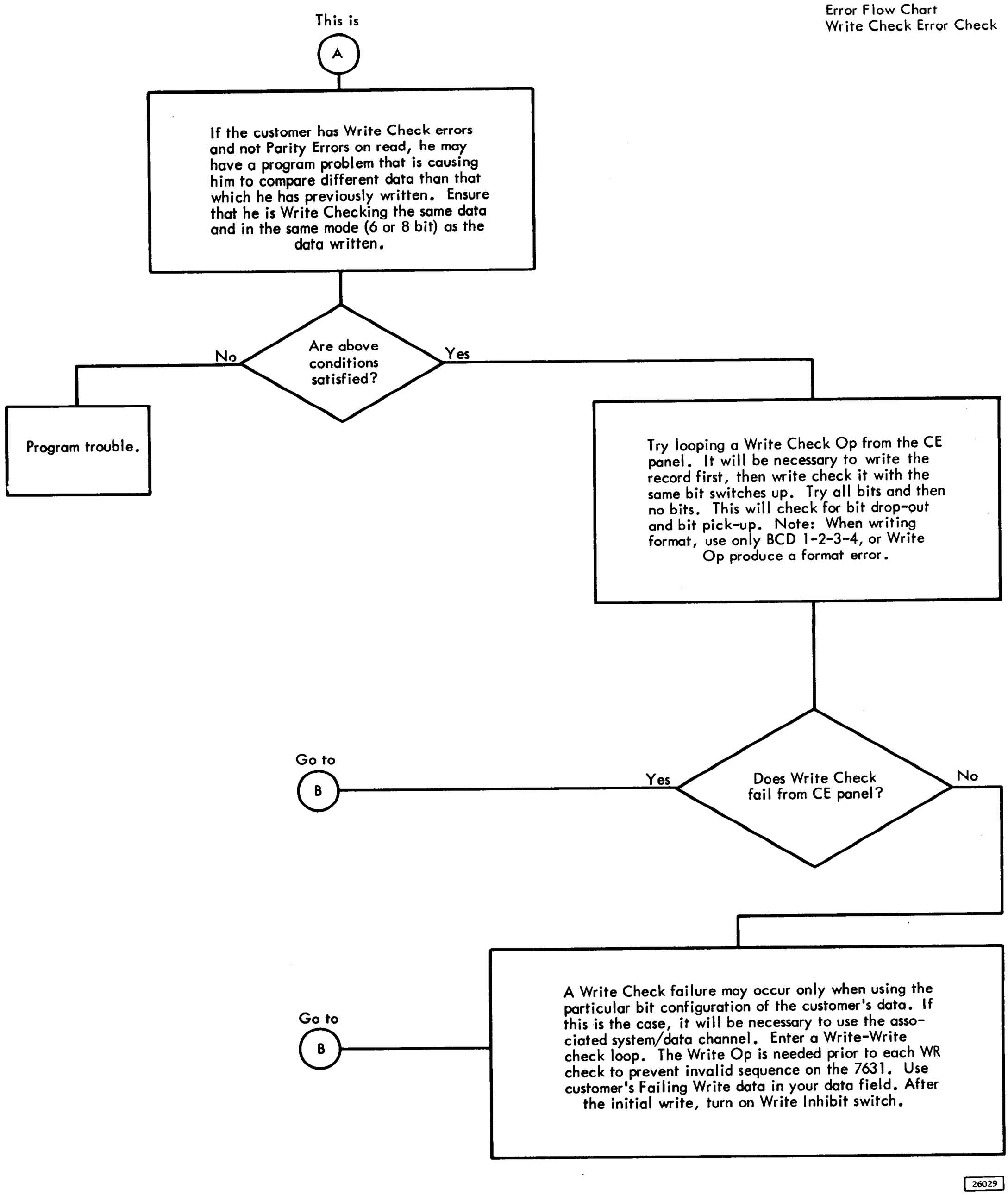


Figure 9-3 7631 Write Check Error Light

10.0 Hydraulic Actuator Service Information

To assist in determining if a hydraulic actuator solenoid is defective, resistance checks can be made. This should be done by removing connector H02, located on top of the actuator.

Resistance across the detent and rezero coils should be between 38 and 42 ohms. Resistance across the piston and glob coils should be between 25 and 30 ohms. When taking these resistance readings, refer to logic page 01.31.01.0 for the correct pin locations on plug H02.

The resistance of the primary and secondary of the detector will vary from one actuator to another because different types of detent detector coils are being used. The only accurate method of measuring the detent detector output can be found in paragraph 21.0.

The following chart, (Figure 10-1), is provided to assist in determining which piston or glob should be picked for any given address.

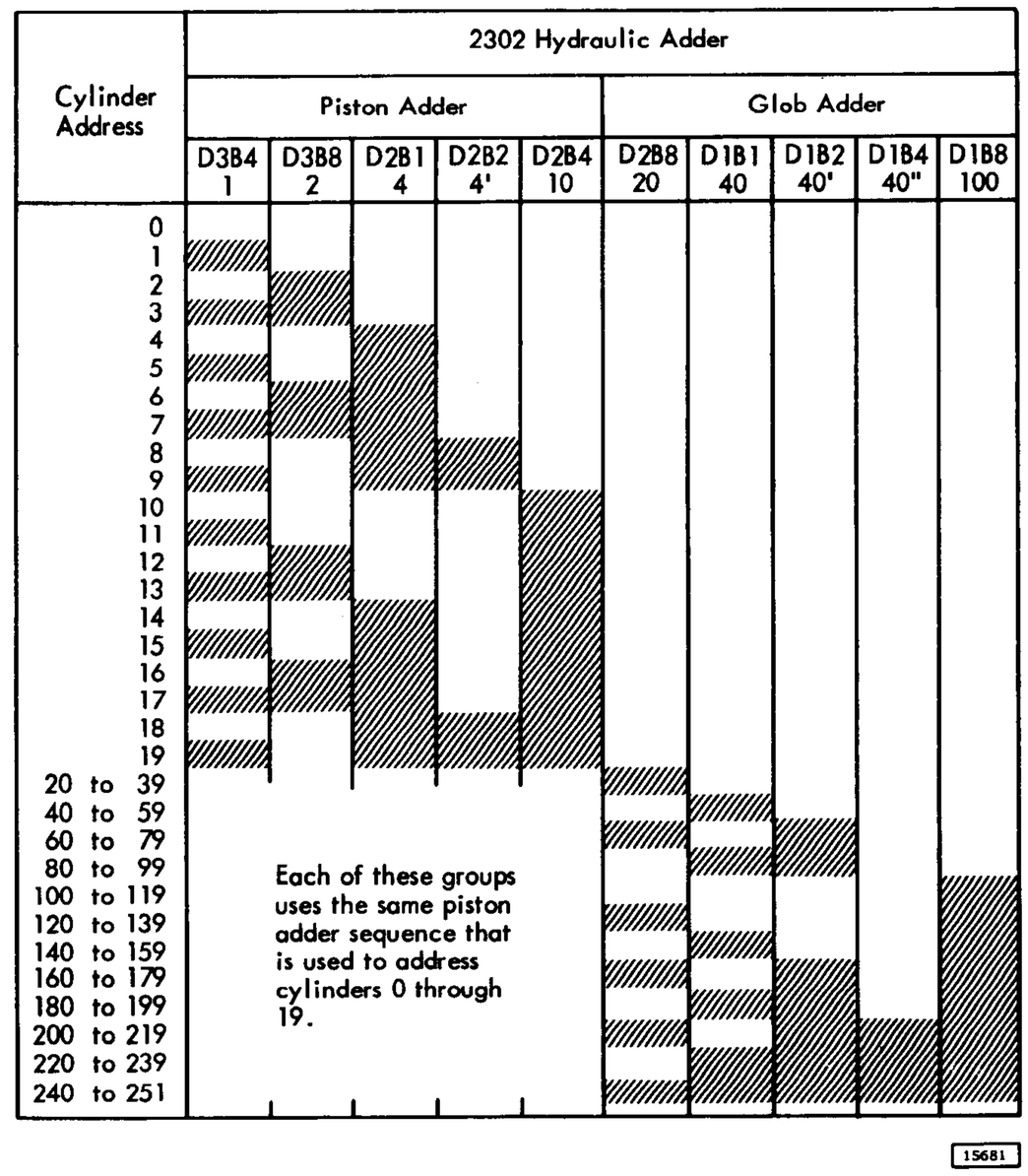


Figure 10-1 Selection of Actuator Pistons and Globs

10.1 Wave Forms of Solenoid Drivers

The following oscilloscope patterns, (Figure 10-2), are typical wave forms which are obtained when scoping the solenoid drivers.

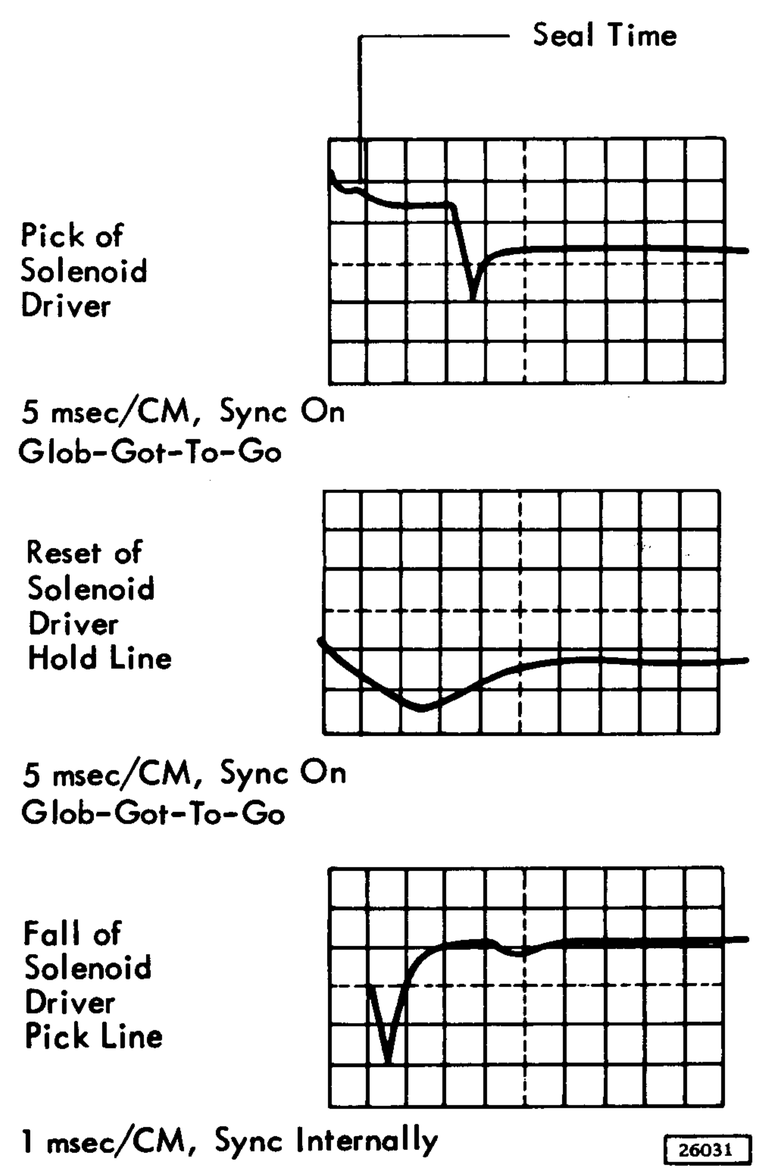


Figure 10-2 Solenoid Driver Wave Form Patterns

11.0 7631 CE Panel Operating Instructions

The following procedure may be used on all models of the 7631. When the CE Panel is not in use, all switches must be returned to their off position.

11.1 7631 Model I or V

Address Transfer Cycle:

1. Set ROTARY SWITCH to test mode 1 (TM 1).
2. Set BLOCK OSC switch on.
3. Set OP CODE switch on.
4. Set FILE OP switch on.
5. Press SINGLE CYCLE button until the digit ring does not step (two depressions of button).
6. Set FILE START GATE up and then down.

7. Set ACCESS BYTE into BIT SWITCHES.

8. A. Press SINGLE CYCLE button until ACCESS REGISTER is set (five depressions of button).

B. Press SINGLE CYCLE button until MODULE, TRACK, and RECORD REGISTER are set (change BIT SWITCHES as desired for each BYTE).

Read or Write After Address Transfer:

9. Set READ or WRITE switch on.

10. Set LOOP MODE switch on.

11. Set FILE START GATE up.

12. Choose mode required (6 bit or 8 bit).

13. Set BIT SWITCHES for character to be written (write operation only).

14. Set BLOCK OSC switch off.

15. STOP ON ERROR on, if desired.

To Return to on line Operation:

16. Set all toggle switches down.

17. Press MACHINE RESET button.

18. Set ROTARY SWITCH to normal position (N).

11.2 7631 Model II and IV

Address Transfer Cycle:

1. Set ROTARY SWITCH to test mode 1 (TM 1).

2. Set BLOCK OSC switch on.

3. Set CONTROL switch up and then down.

4. Press SINGLE CYCLE button until SERVICE REQUEST light comes up (two depressions of button).

5. Set BIT SWITCHES up and then down for first BYTE of OP CODE.

6. Set SERVICE RESPONSE switch up.

7. Press SINGLE CYCLE button.

8. Set BIT SWITCHES up and then down for second BYTE of OP CODE.

9. Press SINGLE CYCLE button (repeat Steps 8 and 9 until ACCESS, MODULE, TRACK, and RECORD REGISTERS are set).

10. Press SINGLE CYCLE button until END light comes on (two depressions of button).

11. Press END RESPONSE button.

To Read or Write After Address Transfer:

12. Set READ OR WRITE switch on.

13. Set LOOP MODE switch on.

14. Set BIT SWITCHES for character to be written (write operation only).

15. Set BLOCK OSC switch down.

16. STOP ON ERROR on if desired (if error occurs, turn off).

17. If needed, push END RESPONSE to continue looping.

To Return to ON LINE Operation:

18. Set all toggle switches down.

19. Press MACHINE RESET button.

20. Set ROTARY SWITCH to normal (N).

11.3 7631 Model III Channel 1

1. Set ROTARY SWITCH to test mode 1 (TM 1).

2. Set BLOCK OSC switch on.

3. Set CONTROL switch up and then down.

4. Press SINGLE CYCLE button until SERVICE REQUEST light comes on (two depressions of button).

5. Set BIT SWITCHES up and then down for first BYTE of OP CODE.

6. Set SERVICE RESPONSE switch up.

7. Press SINGLE CYCLE button.

8. Set BIT SWITCHES up and then down for second BYTE of OP CODE.

9. Press SINGLE CYCLE button (repeat Steps 8 and 9 until ACCESS, MODULE, TRACK, and RECORD REGISTERS are set).

10. Press SINGLE CYCLE button until END light comes on (two depressions of button).

11. Press END RESPONSE button.

To Read or Write After Address Transfer:

12. Set READ OR WRITE switch on.

13. Set LOOP MODE switch on.

14. Set BIT SWITCHES for character to be written (write operation only).

15. Set BLOCK OSC switch down.

16. STOP ON ERROR on if desired (if error occurs, turn off).

17. If needed, push END RESPONSE to continue looping.

To Return to ON LINE Operation:

18. Set all toggle switches down.

19. Press MACHINE RESET button.

20. Set ROTARY SWITCH to normal (N).

11.4 7631 Model III Channel 2

Address Transfer Cycle:

1. Set ROTARY SWITCH to test mode 1 (TM 1).

2. Set BLOCK OSC switch on.

3. Set OP CODE switches.

4. Set FILE OP switch on.

5. Press SINGLE CYCLE button until the digit ring does not step (two depressions of button).

6. Set FILE START GATE up and then down.

7. Press SINGLE CYCLE button twice.

8. Set BIT SWITCHES up and then down for ACCESS BYTE.

9. Press SINGLE CYCLE button until MODULE, TRACK, and RECORD REGISTER are set (change BIT SWITCHES as desired for each BYTE).

To Read or Write After Address Transfer:

10. Set READ OR WRITE switch on.

11. Set LOOP MODE switch on.

12. Set FILE START GATE up.

13. Choose mode required (6 bit or 8 bit).

14. Set BIT SWITCHES for character to be written (write operation only).

15. Set BLOCK OSC switch off.

16. STOP ON ERROR on if desired.

To Return to ON LINE Operation:

17. Set all toggle switches down.

18. Press MACHINE RESET button.

19. Set ROTARY SWITCH to the normal position (N).

11.5 CE Panel Functions

The following will explain the specific function of each of the 7631 CE Panel Switches. It is equally important to understand the function of a switch as it is to know how to operate the switch.

1. Block Oscillator Switch-The Block OSC switch activated will prevent the oscillator from driving the bit ring. This switch must be activated to drive the bit ring with the SINGLE STEP OR SINGLE CYCLE switch.

2. Single Step Switch-This switch will allow the bit ring to advance one-half bit each time the switch is activated up or down. At the end of each bit ring cycle, the digit ring will advance one digit if the digit ring RUN lamp is on.

3. Single Cycle Switch-Each depression of this pushbutton switch will cause the machine to advance through a complete cycle of the bit ring and advance the digit ring one digit if the digit ring RUN lamp is on.

4. Rotary Switch-This switch in the TM 2 position allows the simulation of the computer and file lines to the file control. The TM 2 position is used to test the file control by itself. This switch in the TM 1 position allows the simulation of the computer lines to the file control. The TM 1 position is used to test the file control with a file.

This switch in the NORMAL position is for operation of the file control with a computer and a file. All the CE PANEL SWITCHES except MACHINE RESET, WRITE CE TRACK and HAO must be in the normal position when the CE PANEL ROTARY SWITCH is in the N position.

5. Step Decimal Counter Switch (Step Dec Cntr)-(This switch is used on machines with the CYO FEATURE). This switch activated will allow single stepping of the Track Registers T2 and T3 until the number 39 is indicated on the CE PANEL. The CE Panel ROTARY SWITCH must be in the TM 1 or 2 position, and the BLOCK OSCILLATOR must be activated. Each flip of the SINGLE STEP Switch will advance the counter one step.

6. Machine Reset-This pushbutton switch activated will cause all triggers in the file control to be reset to their initial condition. If the file control is in 8 BIT MODE, it will change to the 6 BIT MODE.

7. Read Switch-This switch activated will allow reading to be executed in the following modes:

a. Home Address HAO

b. Track Without Addresses TWA

c. Single Record Operation SRO

d. Track Operation TRO

e. Cylinder Operation CYO-optional feature

In 7631 Models II, III and IV, the READ SWITCH activated will turn on the READ trigger and lamp, if the channel commands of WRITE, SENSE, OR CONTROL are not being performed.

These READ OPERATIONS can be performed with the CE PANEL ROTARY SWITCH in the TM 1 position. With the CE PANEL ROTARY SWITCH in the TM 2 position, a PREPARE TO READ CYCLE will allow the digit ring to go through digit 4 and then reset the ring.

8. Write Switch-This switch activated will allow writing to be executed in the following modes:

a. Home Address HAO

b. Track Without Addresses TWA

c. Single Record SRO

d. Track Operation TRO

e. Format (The format operation can be performed, but a valid format cannot be written without a system).

f. Cylinder Operation (CYO)-optional feature

In 7631 Models II, III, and IV, the WRITE SWITCH activated will turn on the WRITE trigger and lamp, if the channel commands of READ, SENSE, OR CONTROL are not being performed. In 7631 Models I and V, the CONTROL trigger off and the FILE START GATE Switch and the WRITE Switch activated will turn on the WRITE lamp. These WRITE operations can be performed with the CE PANEL ROTARY SWITCH in TM 1 position. With the CE PANEL ROTARY SWITCH in the TM 2 position, a PREPARE TO WRITE cycle will allow the digit ring to go through digit 4 and then reset the ring.

9. Stop Switch-This switch activated will terminate data flow in the file control and turn on the STOP lamp.

10. Loop Mode Switch-This switch activated will allow continuous repetitions of the READ OR WRITE functions for debugging purposes. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position.

11. Stop on Error Switch-This switch activated will cause the file control to stop when a check condition occurs. The CE PANEL ROTARY SWITCH must be in the TM 1 or 2 position.

12. Control Switch (used on 7631 Models II, III, and IV)-This switch activated will turn on the CONTROL trigger and lamp. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position. The CONTROL switch will allow the proper manual operation of all the orders under the CONTROL command.

13. Sense Switch (used on 7631 Models II, III, and IV)-This switch activated will turn on the SENSE trigger and lamp. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position. The SENSE switch will allow the data of the ten four bit bytes of error and attention information, to be transferred from the status latches to the SERIAL REGISTER and then to the INPUT/OUTPUT REGISTER.

14. Service Response Switch (used on 7631 Models II III, and IV)-This switch activated will simulate the computer SERVICE RESPONSE. This switch will allow the resetting of the SERVICE REQUEST trigger and lamp. The CE Panel Rotary Switch must be in the TM 1 or TM 2 position. The SERVICE RESPONSE switch, when the rotary switch is in the TM 1 position, will allow the gating of WRITE DATA through the file control.

15. End Response Switch (used on 7631 Models II, III, and IV)-This switch activated will reset the four basic COMMAND triggers of READ, WRITE, CONTROL, SENSE, the END trigger, and the UNUSUAL END trigger. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position.

16. Attention Response Switch (used on 7631 Models II, III, and IV)-This switch activated will reset the ATTENTION 1 and 2 triggers and the ATTENTION lamp. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position.

17. Bit Switches-These switches activated on the 7631 Models II, III, and IV will turn on their respective Input REGISTER trigger and lamp. The ZERO BIT switch is not used on 7631 Models I and V. These switches activated on 7631 Models I and V will allow their respective SERIAL REGISTER trigger and lamp to turn on. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position.

18. Access Ready Switch-This switch activated will simulate a FILE READY signal from a file. If this switch is activated before the MONITOR trigger is turned on during a CONTROL, READ OR WRITE operation, the File Frame Circuit Check FF CKT lamp will turn on. If this switch is activated after the Monitor trigger is on, no ACU NOT READY check should occur. The CE PANEL ROTARY SWITCH must be in the TM 2 position.

19. ACCESS OPERATIVE SWITCH-This switch activated will simulate an ACCESS OPERATIVE line from a file. If this switch is activated before the MONITOR trigger is turned on during a CONTROL, READ, OR WRITE operation, the FILE FRAME CIRCUIT CHECK FF CKT lamp will turn on. If this switch is activated after the MONITOR trigger is on, the ACU INOP check will not occur. The CE PANEL ROTARY SWITCH must be in the TM 2 position.

20. Write Safety Switch-This switch activated will simulate the WRITE SAFETY line from a file. The READ SAFETY switch activated with the WRITE MONITOR trigger on (When writing) should turn on the FILE FRAME CIRCUIT CHECK FF CKT lamp. If the WRITE MONITOR trigger is on prior to WRITE SAFETY being activated (when writing), the FF CKT lamp should turn on. The FF CKT lamp should not turn on when writing while the WRITE SAFETY, ACCESS READY, and ACCESS OPERATIVE switches are active. THE CE PANEL ROTARY SWITCH must be in the TM 2 position.

21. Read Safety Switch-This switch activated will simulate the READ SAFETY line from a file. The WRITE SAFETY switch activated with the READ MONITOR trigger on (when reading) should turn on the FF CKT lamp.

If the READ MONITOR trigger is on prior to READ SAFETY being activated (when reading,) the FF CKT lamp should turn on. The FF CKT lamp should not turn on (when reading) while the READ SAFETY, ACCESS READY, and ACCESS OPERATIVE switches are active. The CE PANEL ROTARY SWITCH must be in the TM 2 position.

22. Write CE Track Switch-This switch activated will allow writing on a 2302 INNER CE TRACK (Track 254).

23. HAO Switch-This switch activated will allow reading or writing the physical HOME ADDRESS HAl.

24. Channel 2 Switch (used on 7631 Models I, III, and V)-This switch in the normal position will allow the FILE OP switch to simulate FILE OPERATION ONE. This switch in the transferred position will allow the FILE OP switch to simulate FILE OPERATION TWO. On 7631 Model III, the CHANNEL 2 switch must be in Channel 2 position in order for the FILE OP, FILE START GATE, 8 BIT MODE, SEEK TEST, and OP CODE switches to be active. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position.

25. File Operation Switch (used on 7631 Models I, III, and V). — This switch activated and the CHANNEL 2 switch in the normal position (7631 Models I and V only) will turn on the CONTROL trigger and will permit the AVAILABLE 1 lamp to turn on. In 7631 Model III this switch activated, and CHANNEL 2 switch transferred will allow the AVAILABLE 2 lamp to turn on. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position for the above conditions.

26. File Start Gate Switch (used on 7631 Models I, III, and V). — This switch activated will simulate system 1 or 2 sending the FILE START GATE line to the file control. This switch used in conjunction with the FILE OP switches will allow completion of the control instructions. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position. The CHANNEL 2 switch must be in the Channel 2 position for 7631 Model III.

27. 8 Bit Mode Switch (used on 7631 Models I, III, and V).—This switch activated will cause reading and writing in the 8 BIT MODE. The 8 BIT MODE lamp will turn on. The CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position. The CHANNEL 2 switch must be in the Channel 2 position for 7631 Model III.

28. Seek Test Switch (used on 7631 Models I, III, and V).—This switch activated will simulate a system CPU to FILE SEEK Test. This switch used in conjunction with a SEEK operation will prevent the file access mechanism from moving; will turn on the END OP trigger and prevent the VER SRO,

VER TRO, and VER TWA and VER HAO triggers from being reset. The CE PANEL ROTARY SWITCH must be in the TM1 or TM 2 position.

The CHANNEL 2 switch must be in the Channel 2 position for 7631 Model III.

29. OP Code Switches (used on 7631 Models I, III, and V).—These switches activated will allow the proper CONTROL OPERATION trigger to turn on. The FILE START trigger and the CONTROL trigger must be on and the CE PANEL ROTARY SWITCH must be in the TM 1 or TM 2 position. The CHANNEL 2 switch must be in the Channel 2 position for 7631 Model III.

30. +12 Volt and -12 Volt Switch.—This switch in the -12 position will cause -12 volts to appear at the (-) METER Jack and ground to appear at the (+) METER Jack. This switch in the +12 position will cause ground to appear at the (-) METER Jack and the +12 volts to appear at the (+) METER Jack.

31. Communication Channel Jacks-Ground will always appear at the GROUND TEST JACK. A sync signal sent from the file will appear at the SIGNAL JACK.

32. Block Parity Switch-This switch will, when activated, block the turn on of the PARITY ERROR trigger.

33. I/O Register Reset-This switch, when depressed, will reset the I/O REGISTER (used on Models II, III, and IV).

12.0 Hydraulic Actuator Replacement Service Hints

1. When replacing an actuator on a 2302 the only special tools required are the torque wrench and accessory kit, P/N 2108470. This is the same torque wrench required for 1301 actuator replacement.

2. Prior to replacement of an actuator, it is absolutely necessary that the customer data, serviced by the defective actuator, be unloaded on Magnetic Tape. In the event that the actuator defect will not allow for unloading of customer data, the new actuator should be installed, and through one or a series of yoke adjustments, the customer data should be unloaded and then rewritten after rewriting HAI's. When adjusting the yoke differential screw you cannot Peak Up on the address or record areas of a data track. The area on the data track to be used for peaking adjustments is an unerased burst of bits approximately 6 characters after early index. (Refer to Paragraph 20).

3. In the process of actuator replacement, the receiver can be removed without removing the drawers; however, extreme caution should be taken to avoid damage to any of the drawers. This fact cannot be over emphasized. Be sure that the receiver with the drawers is temporarily placed where the drawers will not be bumped or damaged.

4. There are two different actuators, (front and rear), used on the 2302. This is because the front actuators operate on the outer band of 250 cylinders and the rear actuators operate on the inner band of 250 cylinders. The part numbers of these actuators are P/N 2163901 (Front) and P/N 2163902 (Rear).

13.0 Procedure for Checkout of Decimal Step Counter on 7631 for Suspected Failure of Counter on CYO

The Decimal Step Counter is stepped only once every revolution of the disk array during a Cylinder Operation CYO. Because of the slow repetition rate of the counter advance pulses, trouble shooting an intermittent problem is difficult. Therefore, a faster method of stepping the counter has been devised as a service hint. With the following jumpers installed, the 1.6-microsecond main oscillator pulses can be used to step the counter.

Obtain DAX Card, P/N 370084. Plug this card into any unused and unwired spot in panel three. Using jumpers, wire the DAX card according to Figure 13-1. Follow the 7631 logics when installing to understand the logic and avoid any mistakes.

When finished bring up power and turn on Step Counter or CYO switch on CE Panel. No operation is necessary. With this temporary jumper hookup, the step counter should be stepping once every main osc pulse. Its performance can be monitored very easily by scoping the input pulses and the Carry Ten Trigger (01.20.12.1) at the same time. For every ten input pulses, the Carry Ten Trigger should produce one pulse. Display exactlv ten (or exact multiples of ten) input pulses and look for variations in the Carry Ten Trigger output.

14.0 VFO and Data Separation Checkout Procedure

Oscilloscope Techniques to be used for Variable Frequency Oscillator (VFO) Adjustment are given below.

Correct oscilloscope techniques must be used for accurate displays and proper oscilloscope synchronization. Because most of the file control adjustments are made with the oscilloscope, the following techniques should be used:

1. Ground all oscilloscope probes at the nearest pin J.

2. The oscilloscope pre-amplifier and main amplifier must have a maximum rise time of ten nanoseconds.

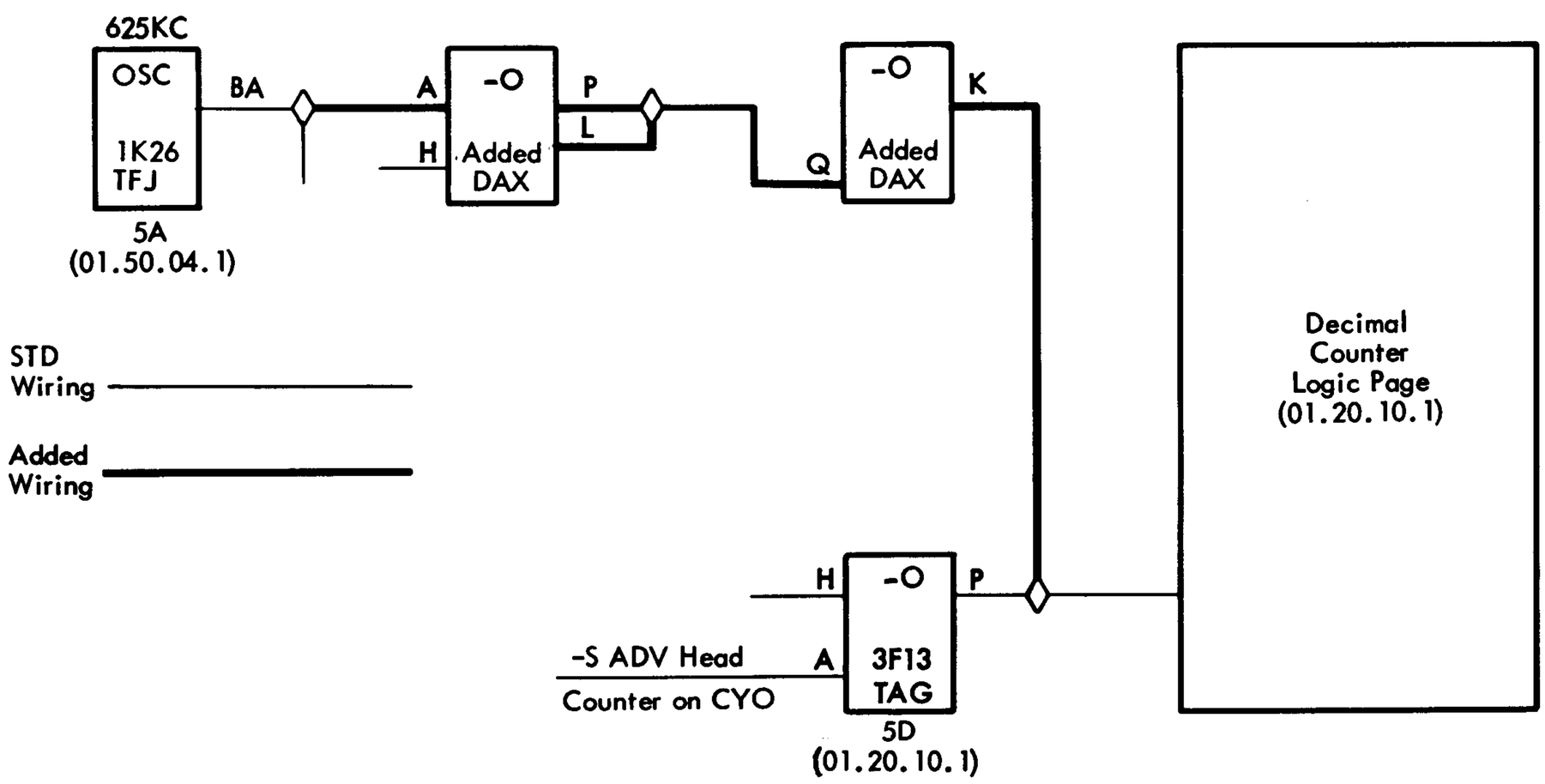
3. Use a dual-trace oscilloscope such as a Tektronix 545 or a 535A with a CA pre-amplifier.

4. The oscilloscope must have a main sweep delay feature and a secondary synchronization that will respond to a 1.25-megacycle synchronization input.

5. A grounded probe must be used when an external secondary synchronization is required for the adjustment.

Adjustments and Procedures:

VFO Gain Adjustment-The VFO gain adjustment sets the correction current generated by the error detector section of the VFO. To adjust the VFO gain, connect a voltmeter between pins 7K13A and 7K13D and adjust the 200-ohm potentiometer at 7J13 for one volt. Because this adjustment affects



Oscilloscope Points

Input Pulses	Series 12000	01B3F13P	Logic 01.20.10.1
Carry Output	Series 12000	01B3B13K	Logic 01.20.10.1

26032

Figure 13-1 Series 12000 Step Counter Checkout Wiring Diagram

the VFO frequency, the frequency adjustment must be made after the gain has been adjusted.

VFO Frequency Adjustment-The required frequency adjustment is accomplished by adjusting the free running VFO frequency to a value of four times the 2302 clock track frequency.

1. Perform a seek operation to CE cyl.

2. Turn on WRITE INHIBIT switch.

3. Load an HAO operation from the CE PANEL.

4. Turn on HAO-CE switch.

5. Turn on bit switch 4 (BCD8).

6. Turn on WRITE switch.

7. Turn LOOP MODE SW ON.

8. Unblock the oscillator.

Display clock track phase one (ALD 01.40.19.1, pin 1H04A) on one sweep and the VFO selected phase (ALD 01.10.16.2, pin 7K12F) on the other sweep. Set the secondary synchronization controls for internal synchronization and positive transition. Delay the sweep 400 microseconds to display some area prior to the end of the index area. If the correct area is displayed, there will be an absence of VFO synchronization input (pin 7J13E) pulses at this time.

Adjust the oscilloscope horizontal speed to display five clock pulses; one clock pulse should appear on every other vertical line. Adjust the 1K-ohm potentiometer at 7J13 to display one VFO selected phase cycle (pin 7K13F) for each of the ten vertical lines. Return the horizontal speed control to the calibrated position. Continue with the following adjustments:

Format Gap Singleshot Adjustments-The format long and short gap singleshots (SS) must be adjusted for reliable format recognition circuit operation.

Gap Detector Adjustments-The three-gap SS in the 7631 must be adjusted to the following settings for proper operation:

Short Gap SS	(01B7H20)	3.4 μ sec
Long Gap SS	(01B7H21)	10.0 μ sec
Data Gap SS	(01B7H22)	3.0 μ sec

NOTE: Adjustment of Data Gap SS must be accomplished after separation check has been completed.

The gap SS must be adjusted dynamically with a 2302 file. They may be adjusted off-line through the 7631 CE panel or on-line with the system in a loop in any one of the prepare to verify and read operations of TRO, SRO, or TWA. If only the short and long gap SS must be adjusted, a format write check loop may be used.

Description of Gap Adjustments-To adjust the gap SS, use an oscilloscope that can display two signals simultaneously, and has a continuously variable delayed synchronization.

The setting of a gap SS is to be measured from the fall of the last pulse of a long train of pulses at the input, to the rise at the output of the gap SS.

The data-gap SS should not be adjusted on a few random data bits. An AGC burst must be used from the following connection points:

Gap SS input	pin C
Gap SS output	pin H

To adjust a gap SS off-line through the 7631 CE panel, set up any of the above mentioned connections prepare to verify control instructions, then loop 7631 in a continuous read. This should form a repetitive loop on one operation that will supply format or data information to the inputs of the gap SS.

All of the above instructions assume that some format and data are present on the file. In the case of a new file or one that has been recently restacked, the format must first be written. With format write check loop, adjust the long and short gap SS; next, write HA1, and then loop on HA1 write check or read and adjust the data gap SS.

Write HAO-CE-Turn off the write inhibit switch and add a temporary jumper from 1A10D to 1A10J. Perform a write HAO-CE operation using bit

switch 4 (BCD 8) without errors.

Separation Circuit Adjustments-The separation circuit adjustments are needed for optimum separation circuit operation. Load a read HAO-CE. Before a successful read can be performed, the following circuits must be adjusted.

Delay Line Adjustment-The data delay line at 7K11 (ALD 01.10.16.4) contains a fixed delay of 90 nanoseconds and three optional delays. The optional delays are:

1. 20 nanoseconds between pins B and C.
2. 10 nanoseconds between pins D and E.
3. 5 nanoseconds between pins F and G.

Pin	A	B	C	D	E	F	G	P
	·	·	·	·	·	·	·	·
		20		10		5		

This delay line delays raw read data to permit proper gate generator adjustment. Use wire jumpers on the back panel to connect the 20-nanosecond optional delay. Connect output pin A to pin B, and connect pin C to load resistor pin P. All necessary delays must be connected in series between output pin A and load resistor pin P.

Gate Generator Adjustments-Gate generator adjustments are to be accomplished as follows:

Observe the unseparated read data at 7K10 M with one sweep and the data gate at 7K10P with the other sweep. These are DIF logic levels and they should swing between 0 to +3 volts (ALD 01.10.16.4). Delay the sweep until the 2F HA1 AGC character is displayed. Set the horizontal speed at 100 nanoseconds per division and use an external synchronization probe connected to 7K12C.

Adjust the top potentiometer at 7J14 so that the trailing edge (negative transition) of the data gate precedes the leading edge (negative transition) of the following clock bit by 250 nanoseconds. Move the probe from 7K10P to 7K09Q. Adjust the lower potentiometer at 7J14 so that the leading edge (positive transition) of the data gate precedes the leading edge of the following data bit by 140 nanoseconds (Figure 1).

If the adjustment limits are too low or too high, add or subtract delay as described in the delay line adjustments and then repeat the gate generator adjustments.

15.0 Procedure for Reading Addresses and Data on 2302 Using 535 Oscilloscope with Reticule Provided in 2302 Shipping Group

1. Set the access to INOP. If it is a Model II File, set both MOD O and MOD 1 INOP.

2. Seek to the desired address.

3. Turn on HEAD SELECT.

4. Look at Read Data at 5B09E. Invert preamplifier input so data is plus.

5. Connect synchronization, EXT. SWEEP IN, to Late Index 5E07C.

6. Set delaying sweep TIME/CM to 20 μs/CM.

7. Set main sweep TIME/CM to 0.1 μs/CM.

8. Set main sweep TRIGGER SLOPE TO INT +.

9. Set horizontal display to MAIN SWEEP DELAYED.

10. Set main sweep STABILITY & TRIGGERING LEVEL fully clockwise.

11. Adjust delaying sweep STABILITY & TRIGGER LEVEL to synchronize read data.

12. Set main sweep MULTIPLIER to 12 - 5.

13. Adjust main sweep STABILITY & TRIGGERING LEVEL to remove jitter from read data. It may be necessary to adjust the delaying sweep DELAY TIME MULTIPLIER slightly to remove all jitter from read data.

14. By adjusting the delaying sweep MULTIPLIER, locate the two characters of all bits about 80 μs

after Late Index.

15. Following this is one blank character (8 clock pulses).

16. The next data bit is the S bit of the first character of HA1.

17. By adjusting the HORIZONTAL POSITION and delaying sweep MULTIPLIER line up, the S bit in read data with the S bit on oscilloscope reticule.

18. Adjust variable knob on MULTIPLIER so there is one clock bit per division on oscilloscope reticule.

19. The bit ring in the 7631 always runs in 8 bit mode during HA1;

S C $^{W}_{M}$ B A 8 4 2 1 S C etc.

20. Every ninth bit is an S bit. After data is correctly lined up with oscilloscope reticule, read the first two characters of address.

21. By adjusting the delaying sweep MULTIPLIER, move the last S bit to the left to line up with oscilloscope reticule.

22. Read the last two characters of the address.

23. There is one blank character between the HA1 and the check characters.

24. By adjusting the delaying sweep MULTIPLIER with this procedure, the read data will move one full bit at a time. By adjusting the control carefully between the points,the read data will shift over one bit and become very stable with no jitter.

16.0 2302 Matrix Selection and Read Amplifier. (See Figure 16-1)

17.0 Procedure for Determining if One and Only One Head is Selected.

The procedure for determining multiple Y select is contained in Figure 17-1.

18.0 Rezero Failure Service Information

The procedure for isolating Rezero Failure malfunctions is contained in Figure 18-1.

18.1 Rezero

The Rezero positive logic circuit diagram is contained in Figure 18-2.

19.0 7631 Shift Register Checkout Procedure (7631, Series 12,000 with 2302 Attached).

The shift register is tested for correct operation prior to any write operation. No test is made prior to a read operation. Figure 19-1 provides a reference timing chart for pre-test of shift register prior to HAO Write Operation.

The test is made during writing of each AFC area. At this time, 28 pulses are available at input to the shift register. The time that AFC bits begin to enter the shift register differs with each bit mode of the operation. In 8 bit mode, two reset pulses, one at D3 B3 and one at D7 B6 permit only 28 ones and two zeros to be shifted into the shift register. In 6 bit mode, two reset pulses, one at D2 B1 and one at D7 B6 permit the same number of ones and zeros to be shifted into the shift register.

No shifting takes place in either mode during BS of any digit time (page 01.50.20.1), nor from D7 B1 to D8 BS when the NO SHIFT trigger is on.

The following procedure provides for checkout of the shift register:

1. Turn on WRITE INHIBIT switch.

2. Turn on the CUSTOMER HOME ADDRESS switch.

3. Turn on the CE HOME ADDRESS switch.

4. Seek the 2302 to cylinder 250.

5. From the 7631 CE Panel, perform a Write HAO with all bit switches on.

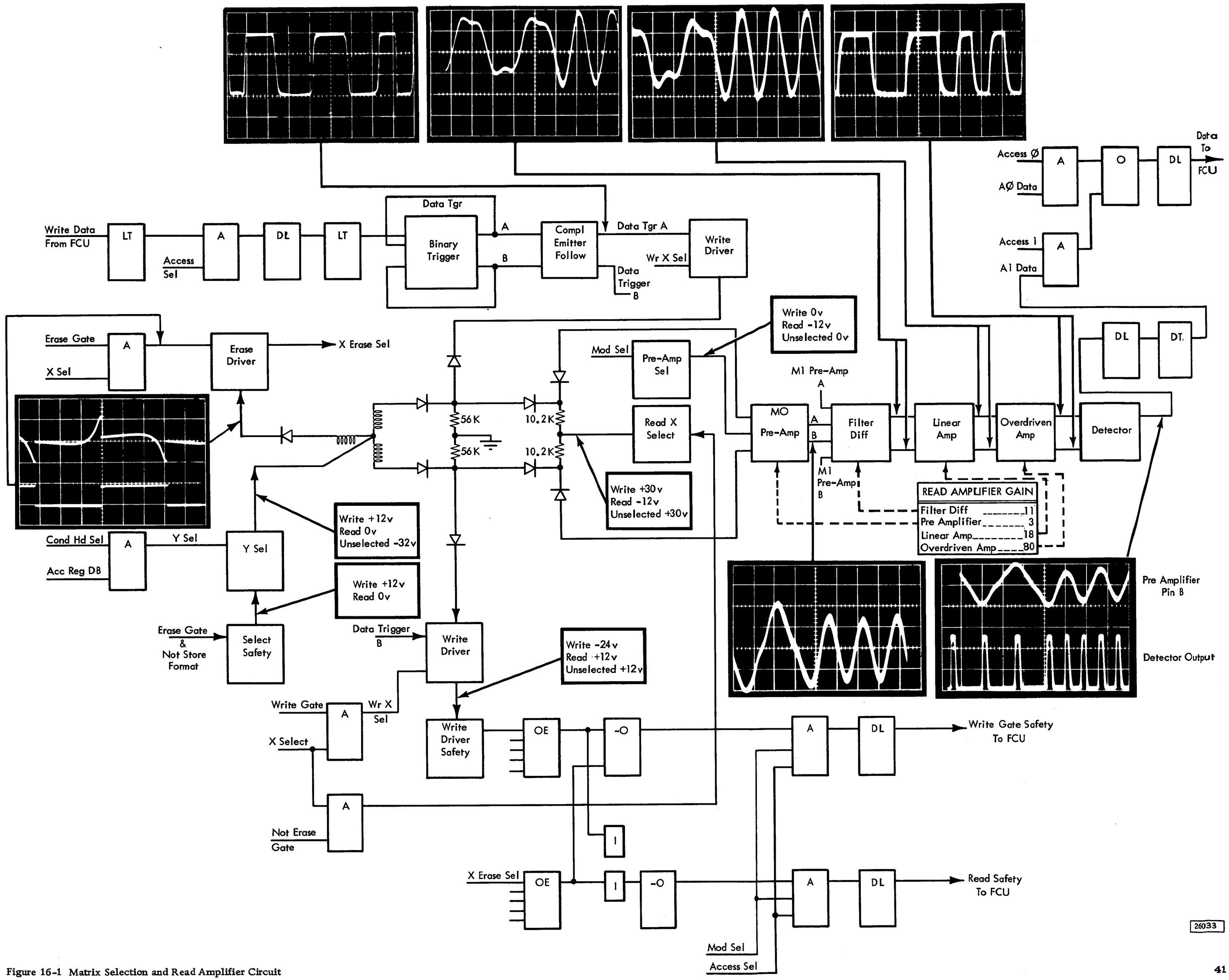


Figure 16-1 Matrix Selection and Read Amplifier Circuit

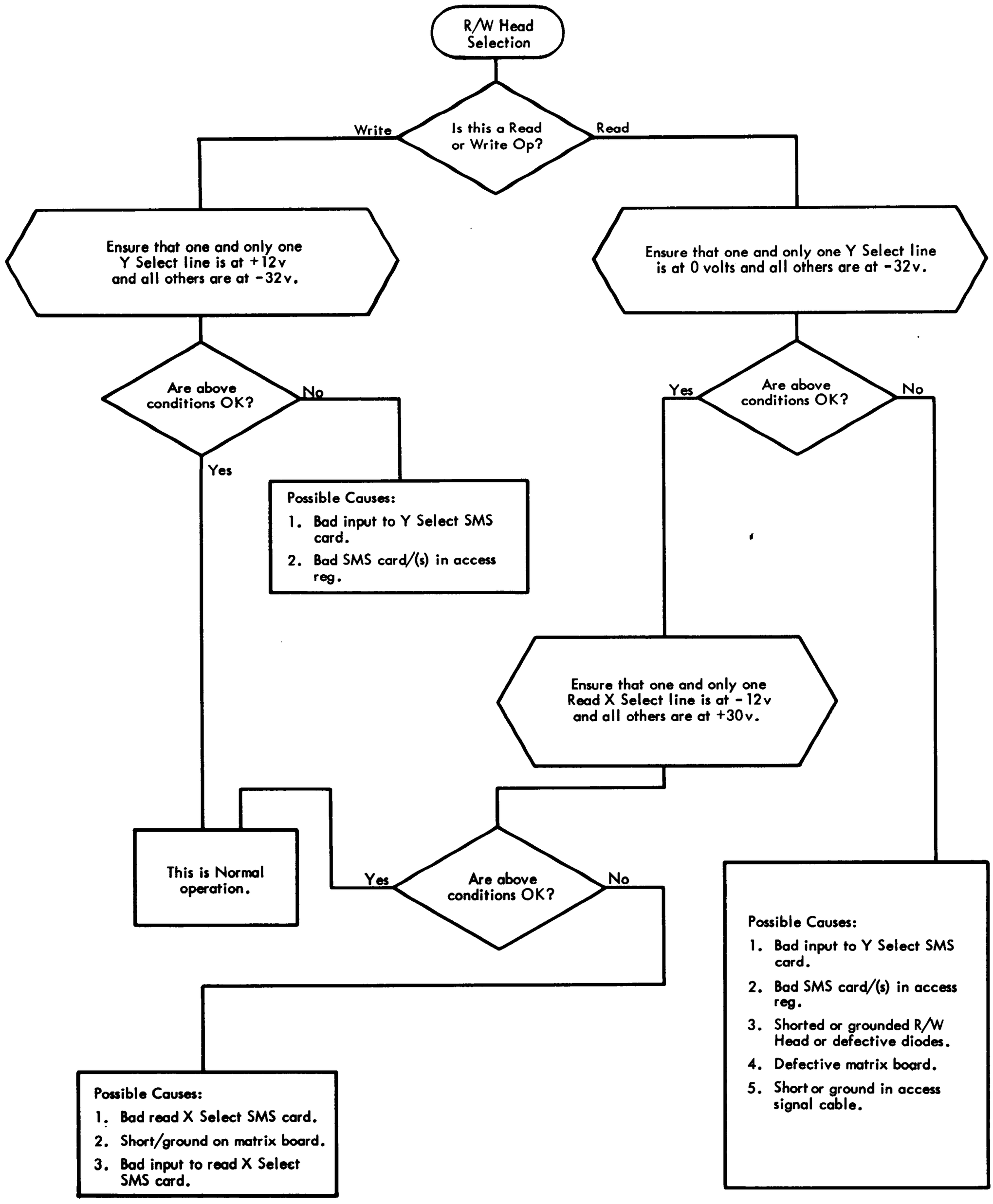


Figure 17-1 Read-Write Head Selection Circuit Check

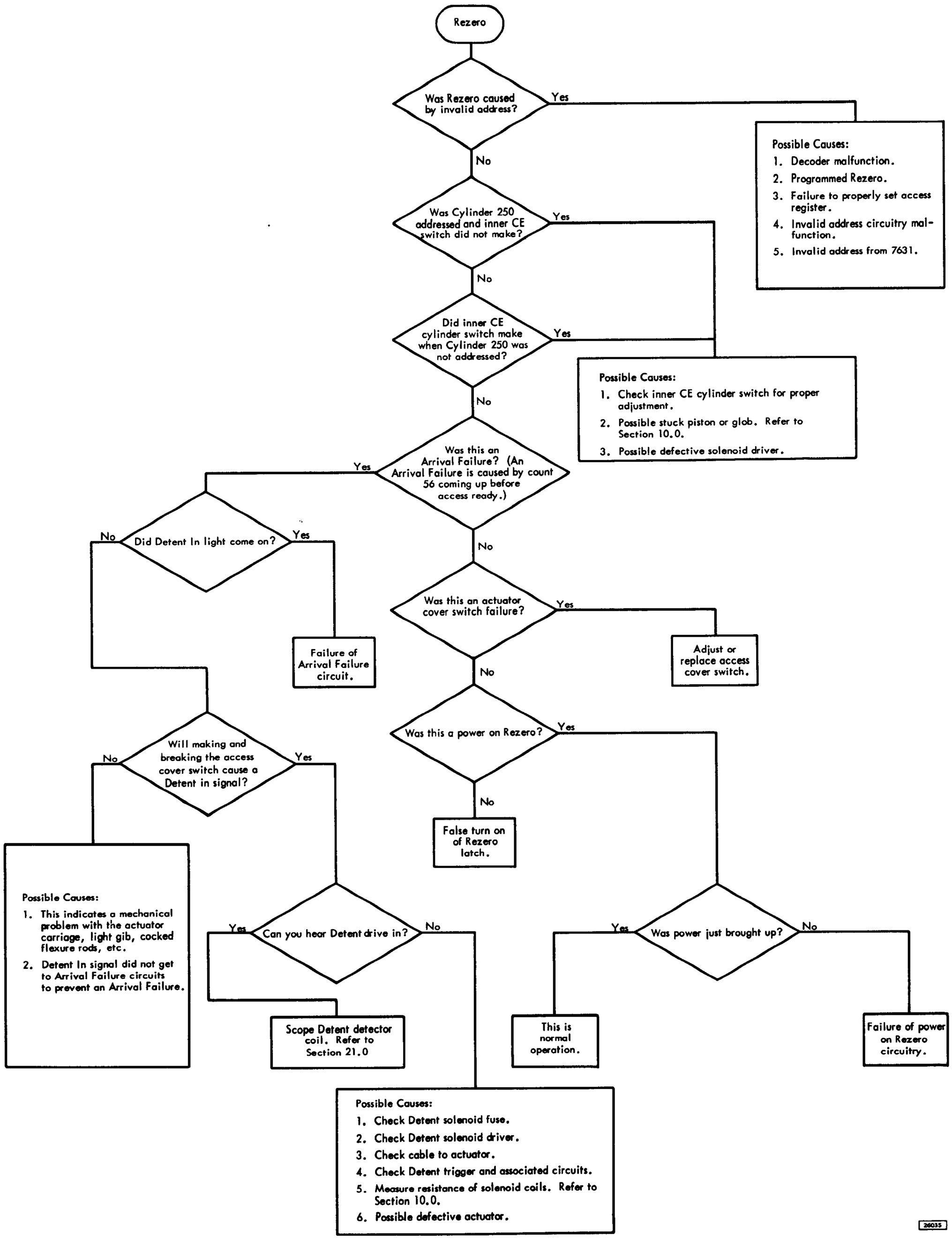


Figure 18-1 Rezero Failure Circuit Check

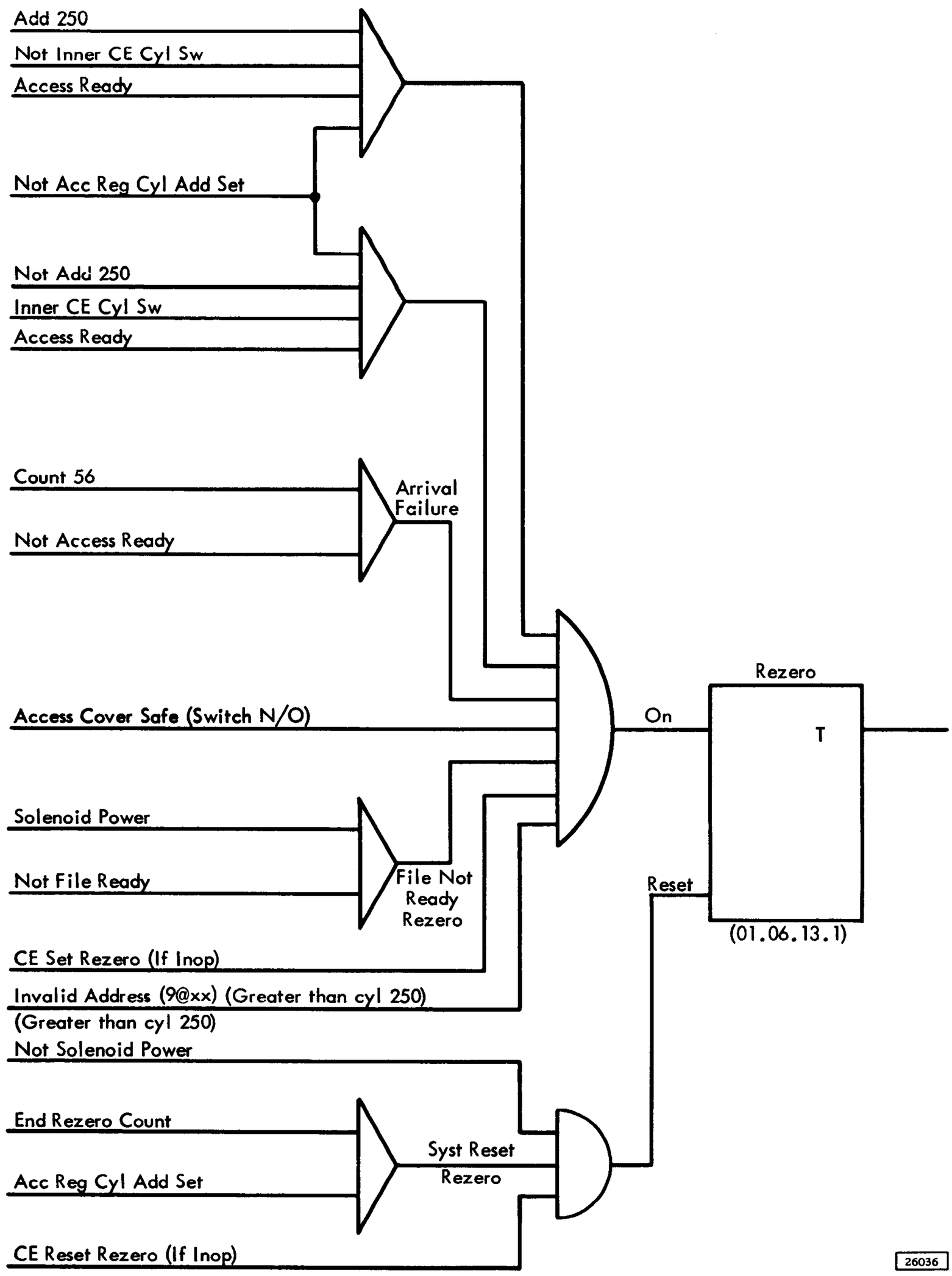


Figure 18-2 Rezero Positive Logic Circuit Diagram

Note: Shift Register Test (Eight-Bit Mode).
HAO-CE Write, AGC/AFC of HA-1.
For convenience, set write inhibit switch on.
All locations Panel 1.
Logics Pages: 01.30.01.1 thru 01.30.06.1

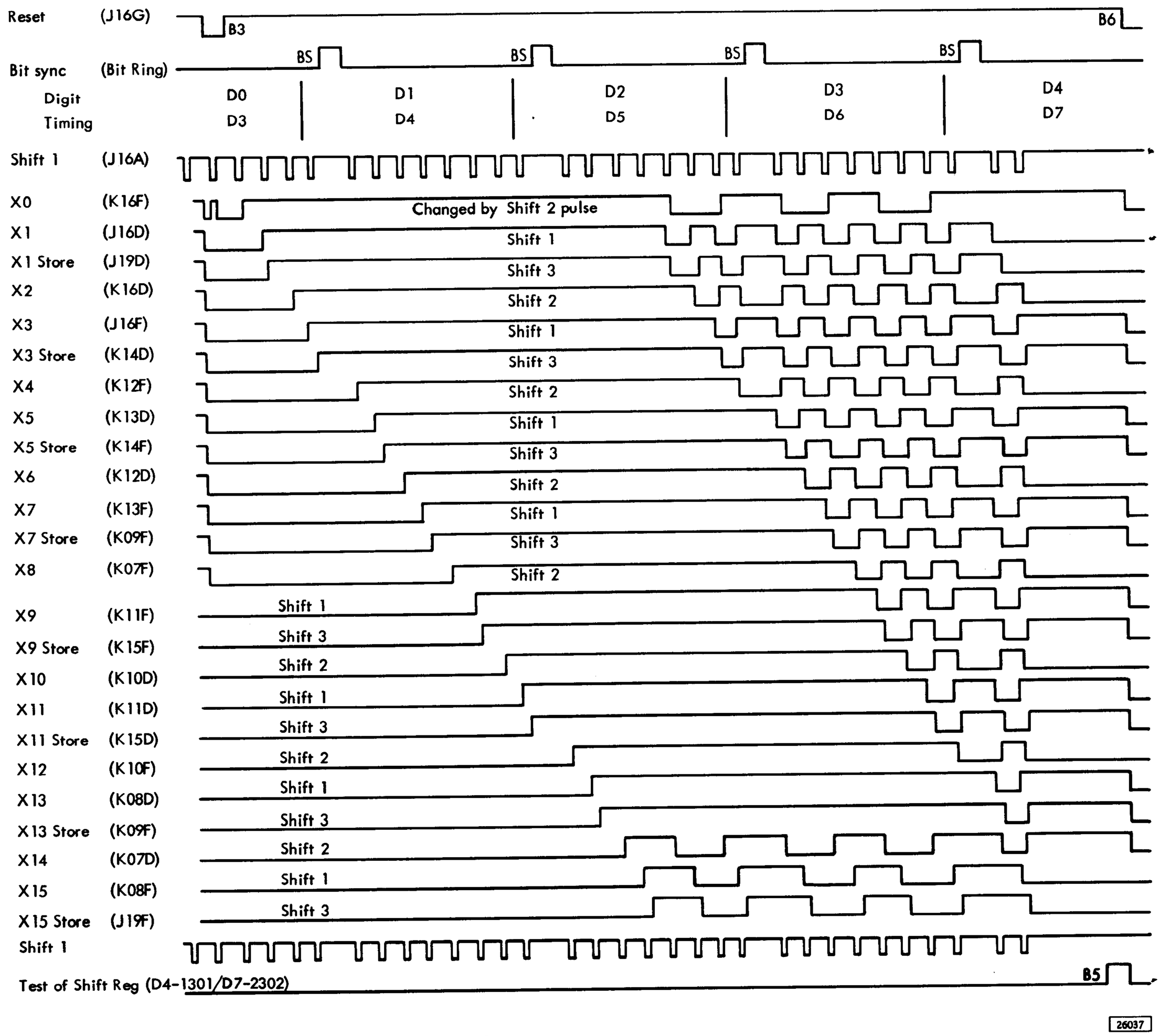


Figure 19-1 Shift Register Test Sequence Chart (Eight Bit Mode)

6. Sync B time base osc on index 110.

7. Double sync the A time base osc on line titled, +Y RST SHIFT ON 2302 (Page 01. 10. 16. 5).

8. Check that all triggers are reset at reset time.

9. Scope the Shift 1, Shift 2, Shift 3, and Shift 3A pulses (Pages 01. 10. 19. 1 and 01. 10. 20. 1). Note that Shift 1 and Shift 2 do not produce a pulse during BS time, and that Shift 3 and Shift 3A do produce a pulse during BS time.

10. Display Shift 1 pulses on A probe.

11. Use the B probe to scope all shift trigger outputs for correct turn on and turn off. A quick check of this condition can be made by observing the Shift 1 pulses after reset time and counting out 17 Shift 1 pulses after reset. At the time of the 17th Shift 1 pulse, observe on the B probe that X15 stored trigger has turned on. If it has not turned on at this time, move the B probe back to the X15 trigger and observe if it has turned on with the 16th Shift 1 pulse. This pattern can be followed until a shift register trigger turning on with the correct Shift 1 pulse is observed. (For example: The X7 stored trigger turns on with the 8th shift 1 pulse.) This example would establish that the problem is in the X8 position of the shift register.

20. 0 2302 Format and Data Track

The sequence chart for Format and Data track layout is contained in Figure 20-1.

21. 0 2302 Detent Detector Coil Checkout Procedure

Checkout of the Detent Detector Coil is to be accomplished as follows: (See Figure 21-1.)

1. An arrival failure will set the REZERO latch. Arrival Failures can be caused by a failure of the Detent Detector Coil. This coil cannot be adjusted or replaced, but it can be checked for normal operation.

2. The minimum differential signal measured at 01A5E08C and 01A5E09C, 2302 Logic Page (01. 05. 03. 1) should be a minimum of 70 millivolts. This minimum should be measured after a change in the logic signal of the DETENT IN line. The frequency of the differential signal is 20-25 KC. The differential signal amplitudes at DETENT IN and DETENT OUT positions do not have to be equal.

The null point amplitude should not exceed 25 mv peak to peak.

The time between the energization of the Detent Solenoid and the point at which the null is present should not exceed 15 milliseconds.

3. If the detent is resting on a land, a low-level DETENT OUT signal (approximately 30 mv to 65 mv.) is present at the input to the LA cards. This low-level DETENT OUT voltage is lower than the normal 70 mv. DETENT OUT voltage and higher than the null point (25 mv). See Figure 20-1.

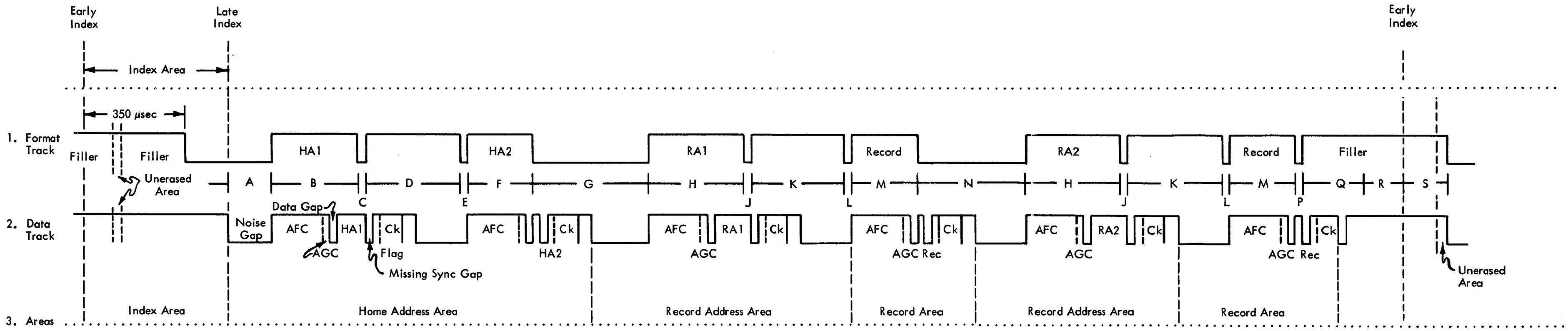
4. Check for proper System pressure on the Hydraulic Power Supply Gauge. The System Pressure should be adjusted for 550 PSI from the System Pressure Relief Valve.

22. 0 Read Write Safety Timing Chart

The 2302 Read Write safety timing chart is contained in Figure 22-1.

23. 0 Data Flow Charts

The 2302 Data Flow Charts are contained in Figures 23-1, 24-1, 25-1, 26-1, and 27-1.



Format Area Constants

Area	No. Char	6 Bit or 8 Bit Mode	BCD Code
A	6	8	4
B	12	8	3
C	1	8	4
D	13	8	3
E	1	8	4
F	9 min.	6 or 8	1 or 3
G	15	6 or 8	2 or 4
H	13 min.	6 or 8	1 or 3
J	1	6 or 8	2 or 4
K	13	6 or 8	1 or 3
L	1	6 or 8	2 or 4
M	9 min.	6 or 8	1 or 3
N	15	6 or 8	2 or 4
P	1	6 or 8	2 or 4
Q	11 min.	6 or 8	Controlled by 7631
R	0 min. (*See Note)		
S	6 abs	6 or 8	

Areas F, H, and M must be 7 plus the desired number of data characters.

*Note: Area R filler is needed when less than a full format track is written.

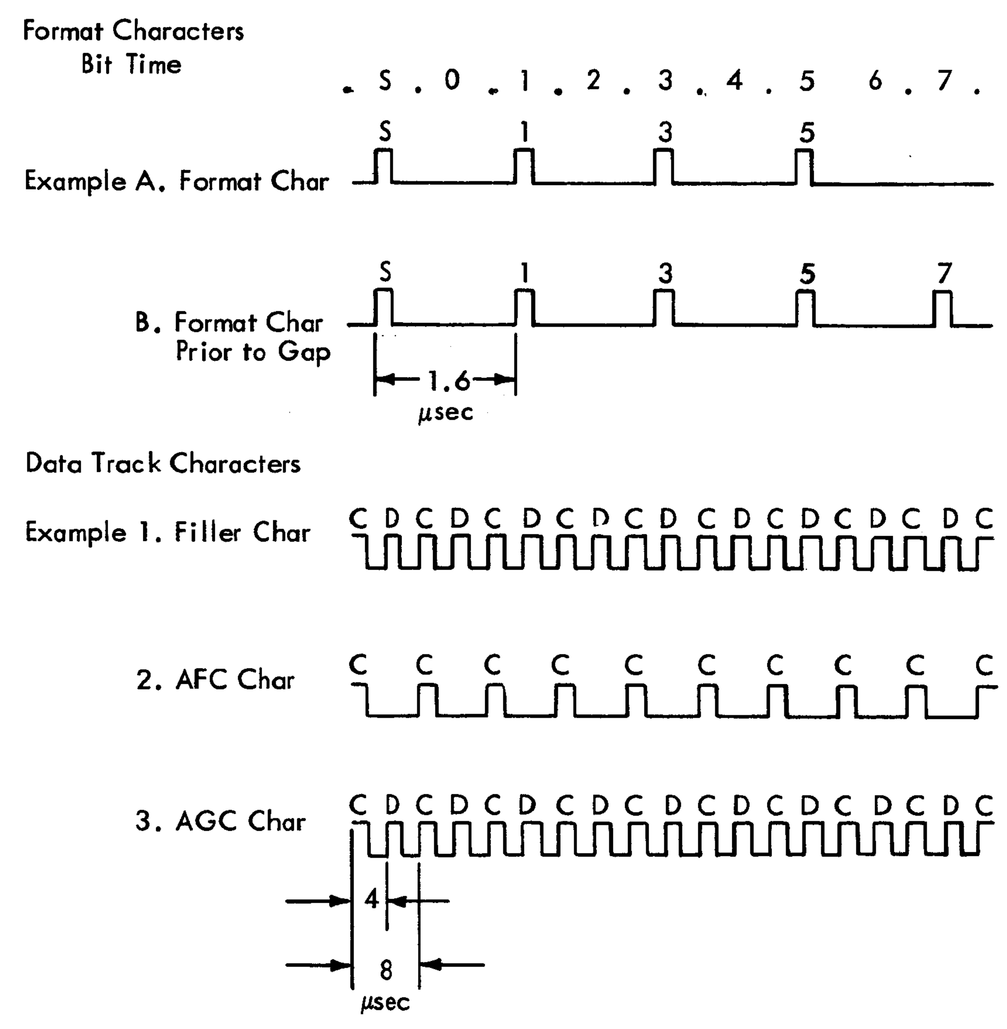


Figure 20-1 Format and Data Tracks Layout

26038

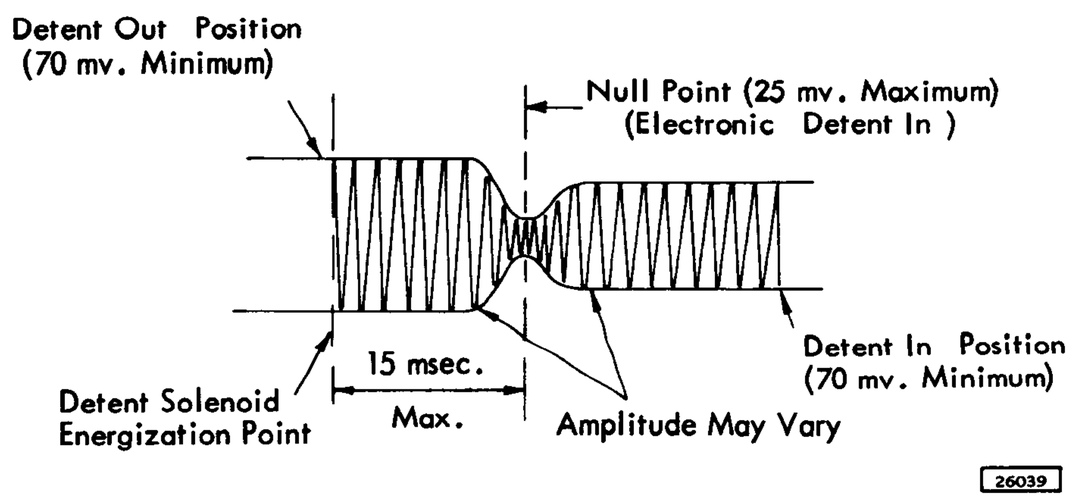


Figure 21-1 Detent Detector Coil Operating Parameters

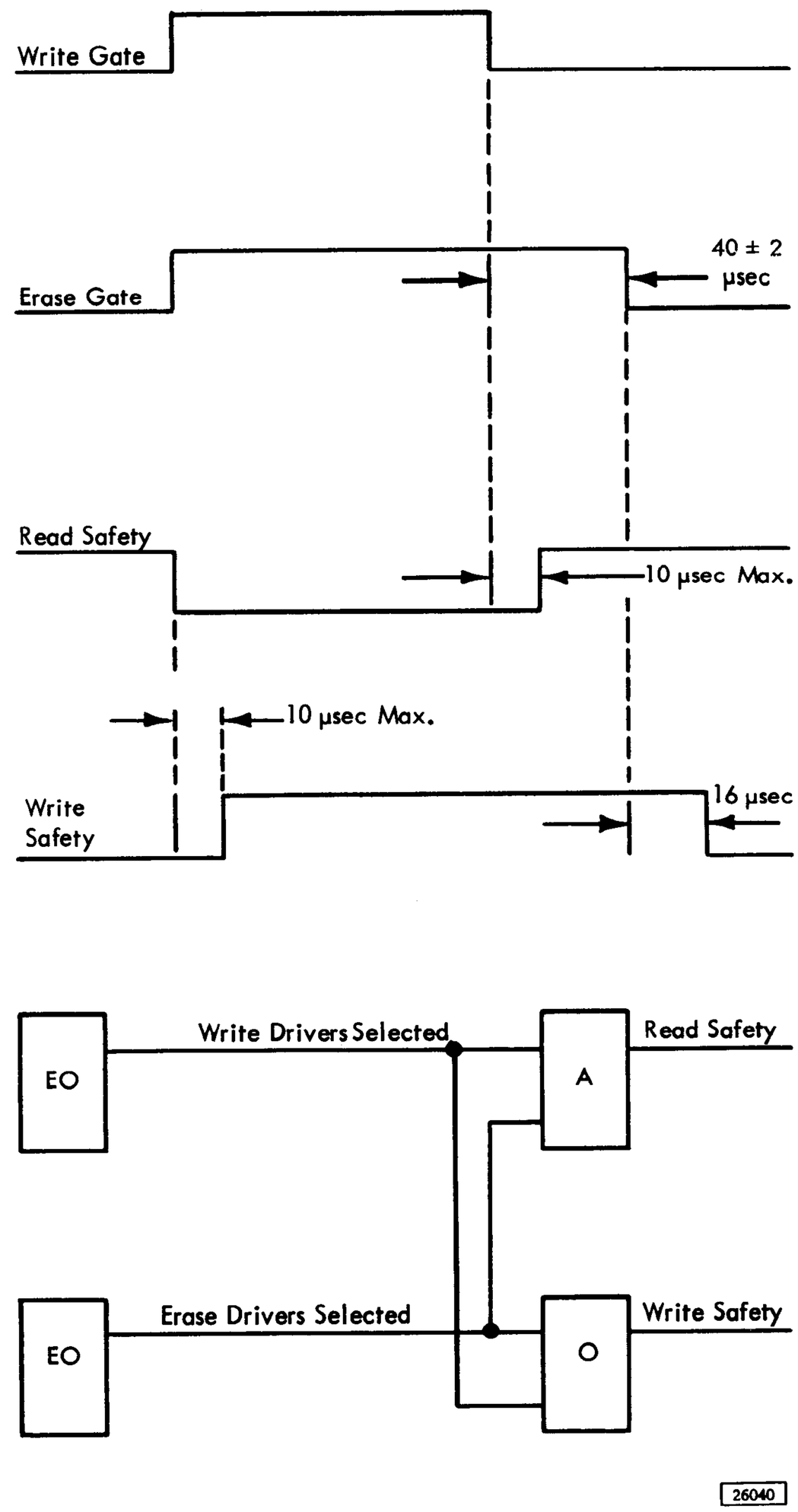


Figure 22-1 Read-Write Safety Timing Chart

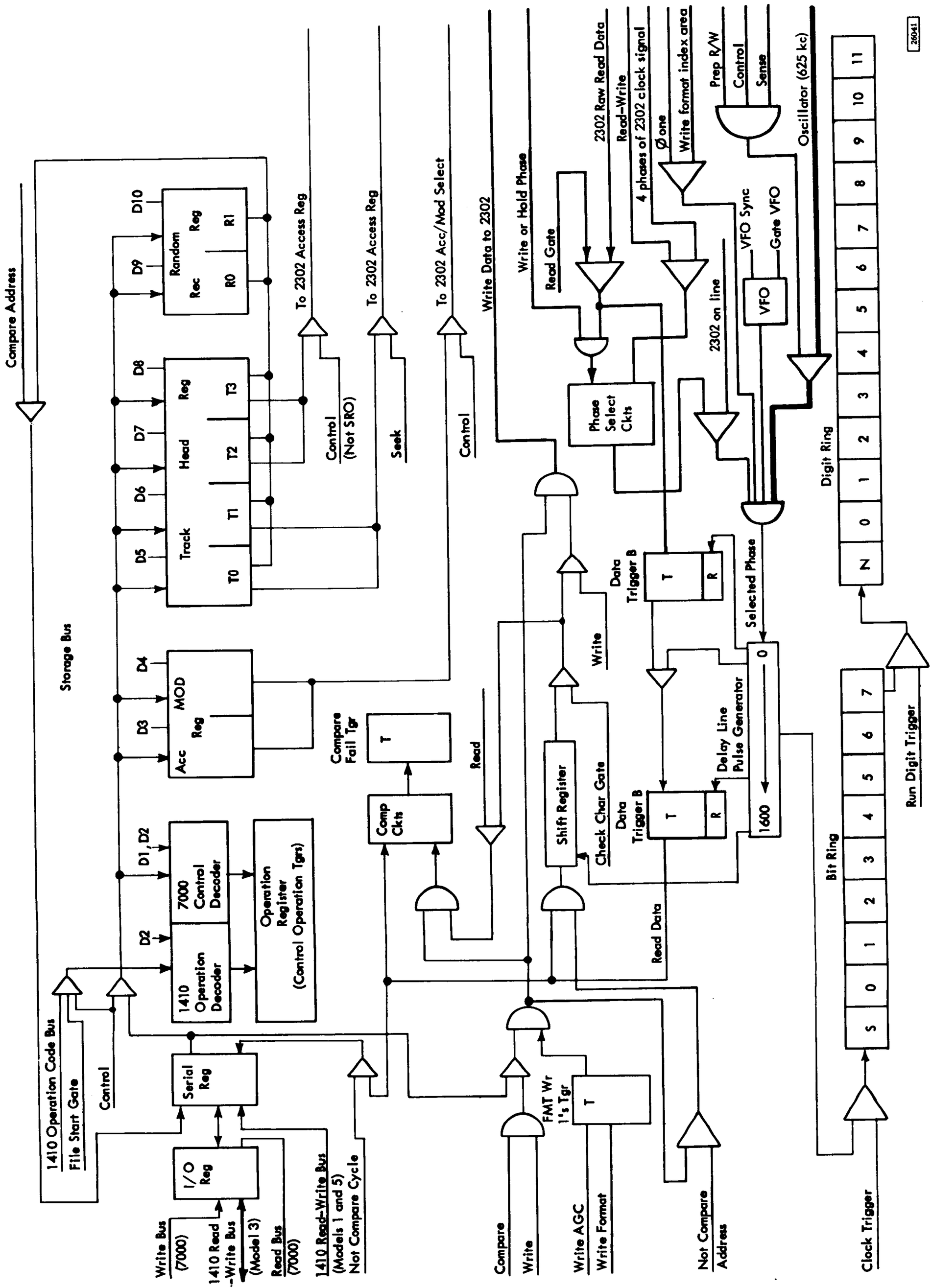


Figure 23-1 Data Flow – Basic

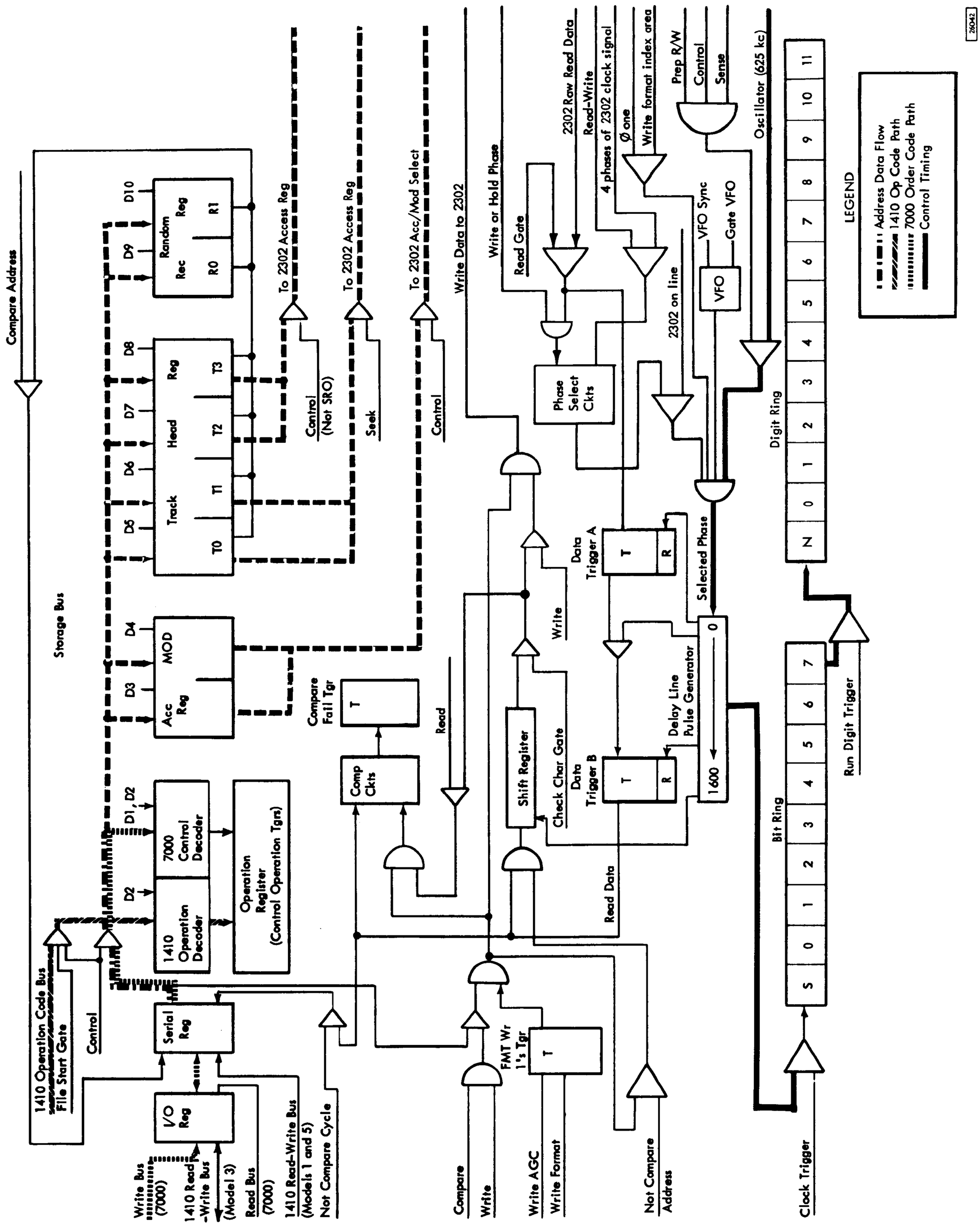


Figure 24-1 Data Flow - Control

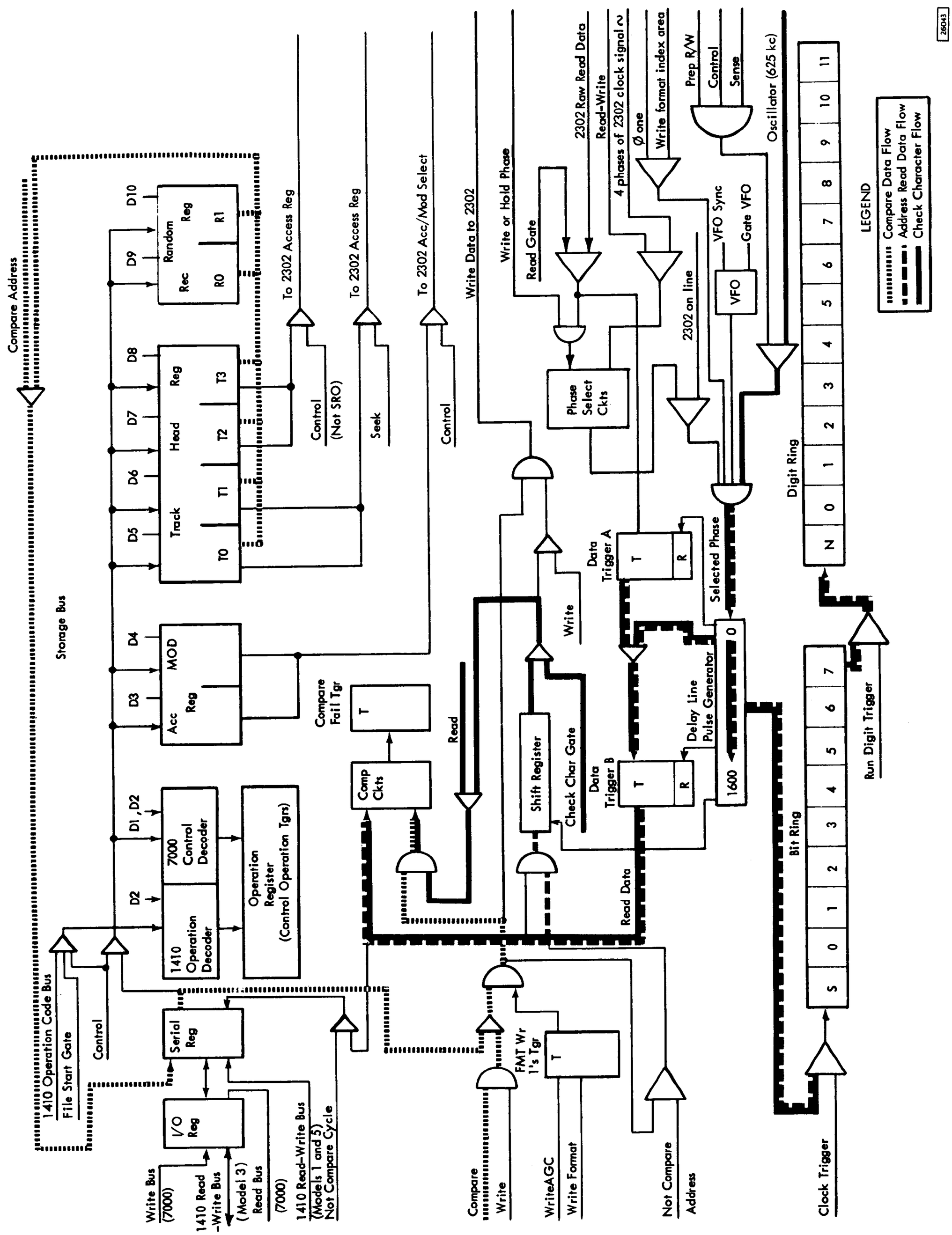


Figure 25-1 Data Flow - Verify Address

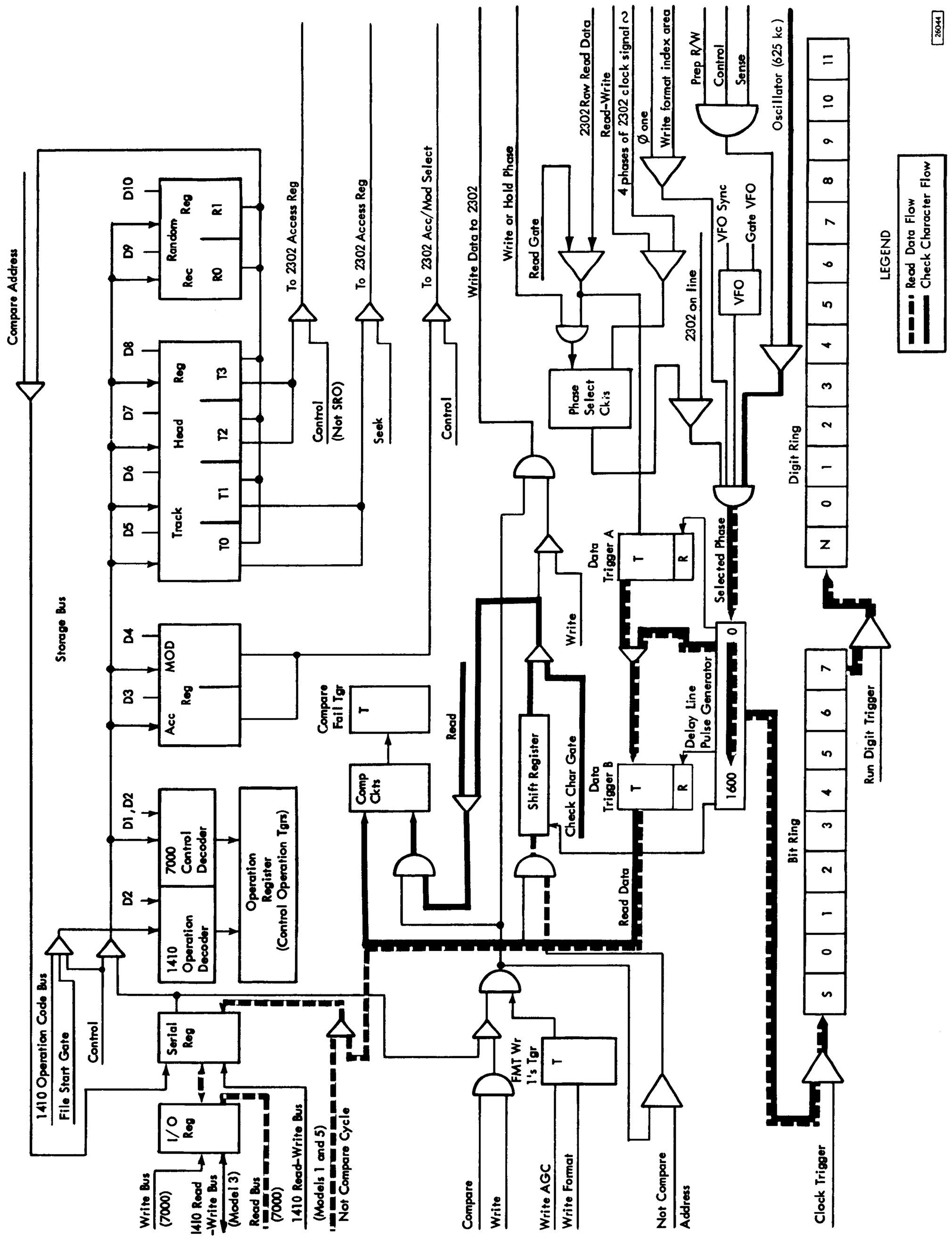


Figure 26-1 Data Flow - Read

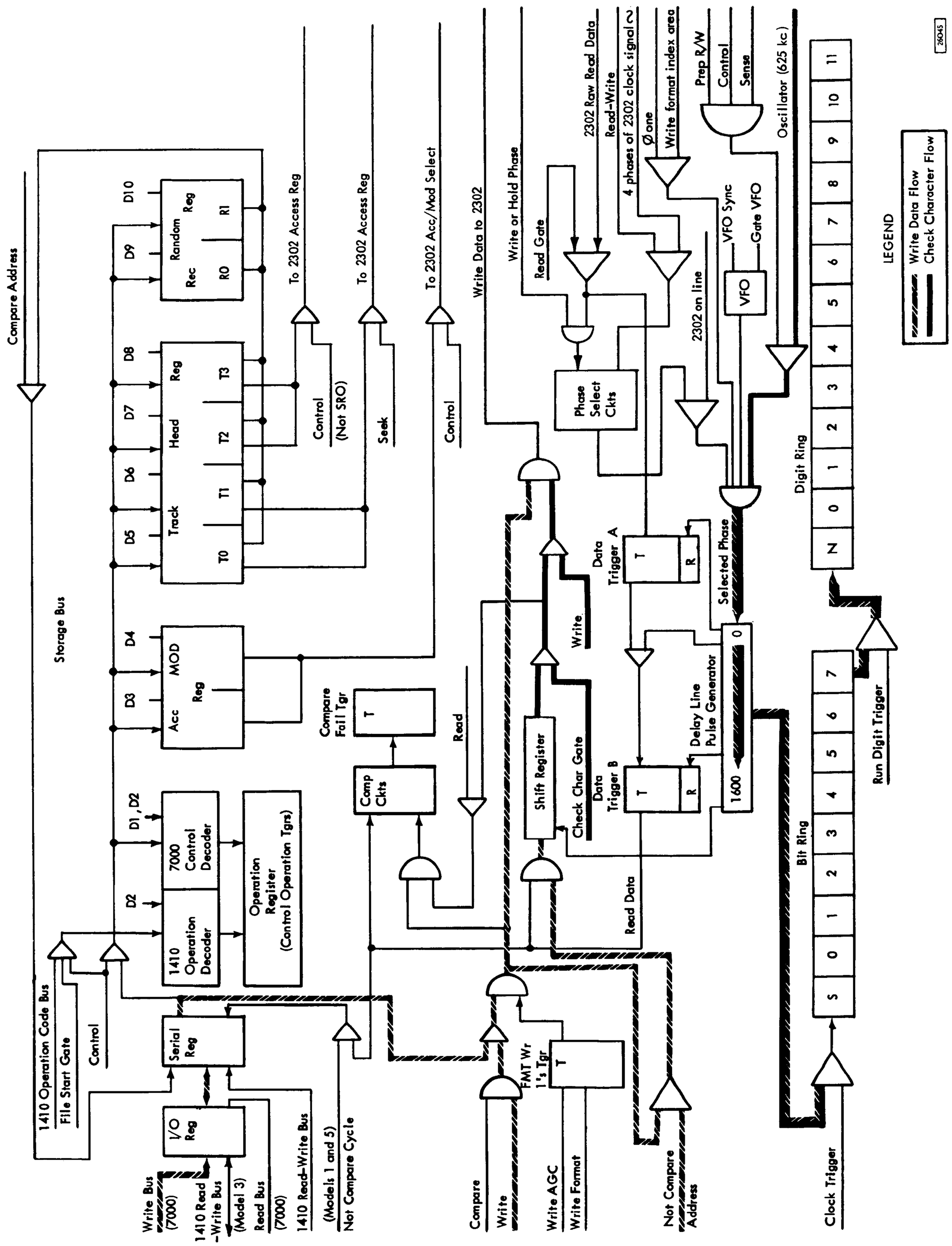


Figure 27-1 Data Flow - Write

COMMENT SHEET

IBM 2302 Disk Storage with 7631 File Control -
Analysis Guide and Service Index
Form 229-3587-0

FROM

NAME _____

OFFICE NO. _____

FOLD

CHECK ONE OF THE COMMENTS AND EXPLAIN IN THE SPACE PROVIDED

FOLD

☐ SUGGESTED ADDITION (PAGE , TIMING CHART, DRAWING, PROCEDURE, ETC.)

☐ SUGGESTED DELETION (PAGE)

☐ ERROR (PAGE)

EXPLANATION

CUT ALONG LINE

FOLD

FOLD

NO POSTAGE NECESSARY IF MAILED IN U.S.A.
FOLD ON TWO LINES, STAPLE, AND MAIL

STAPLE

STAPLE

FOLD

FIRST CLASS
PERMIT NO. 2078
SAN JOSE, CALIF.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN U. S. A.

POSTAGE WILL BE PAID BY

IBM CORPORATION
MONTEREY & COTTLE RDS.
SAN JOSE, CALIFORNIA
95114

ATTN: FIELD ENGINEERING - TECHNICAL OPERATIONS DEPT. 904

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