IBM® Customer Engineering

Reference Manual

753 Tape Control

Printed in U. S. A.

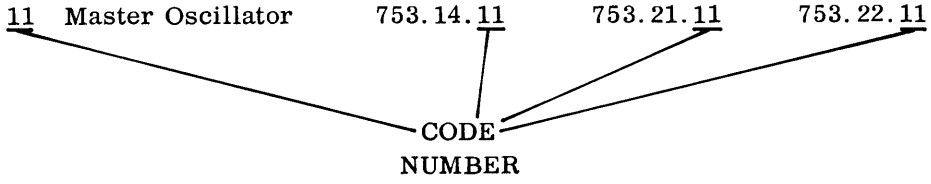
CONTENTS

NOTICE

Each different unit, item and test of this machine has been assigned a "Reference Manual Code Number." This code number is located in the tens and units position of each section number. All numbers over .50 have been assigned to waveshapes in each section. Therefore, waveforms between each manual will not have the same numbers. Numbers in the tape drive also will differ.

The following index chart can be used to find the location of the appropriate maintenance information.

		Clean/Inspect	Removals	Adjustments/ Timings
11	Master Oscillator	753.14.11	753.21.11	753.22.11



Figures may be larger than one page and are put on two or more pages. The same figure number is used on all pages and are defined by a letter following the figure number. As an example: 60-1a, 60-1b.

MAINTENANCE INDEX CHART

AREA	REF. MAN CODE NO.	ITEM	CLEAN/ INSPECT	WAVE FORMS & LEVELS	REMOVALS	ADJUST/ TIMINGS
BASE	01	General Heat Problems	753.14.01			
	02	Appearance and Filters	753.14.02		753.21.02	
	03	Motors and Blowers	753.14.03		753.21.03	
	04	Pluggable Units & Pnl Pins	753.14.04			
	05	Thermals	753.14.05			753.22.05
TEST PANEL	06	Operator's Panel	753.14.06		753.21.06	
	07	C.E. Test Panel	753.14.07		753.21.07	753.22.07
COMPONENTS	08	Relays	753.14.08			753.22.08
	09	Resistors, Transformers	753.14.09			
	10	Rectifiers	753.14.10			
	11	Oscillator Assembly	753.14.11			753.22.11
	12	Fuses	753.14.12			
	13	Tubes	753.14.13			
TESTING METHODS	14	Vibration	753.14.14			
	15	Pulse Checking	753.14.15	753.15.15		753.22.15
	16	Marginal Checking	753.14.16	753.15.16		
	17	Power Supply	753.14.17	753.15.17	753.21.17	
	18	Inter-Record Gaps	753.14.18			
WAVE FORM SCOPING	50	Clock Pulse	753.15.50			
	51	Write Pulse	753.15.51			
	52	Ring Drive	753.15.52			
	53	Clock Pulse and Write Pulse	753.15.53			
	54	Oscillator Output	753.15.54			
	55	Initiate Write Delay	753.15.55			
	56	Delayed R/W Call	753.15.56			
	57	10-ms Write Delay	753.15.57			
	58	Write Clock Gate	753.15.58			
	59	Backspace Call Test	753.15.59			
	60	Write Fwd Before Bksp	753.15.60			
	61	Fwd-to-Bkwd Delay	753.15.61			
	62	Read Delay from Bksp	753.15.62			
	63	BOR Search	753.15.63			
	64	Disc Delay when BOR Falls	753.15.64			
	65	Backward Reset Delay	753.15.65			
	66	Read After Write Delay	753.15.66			

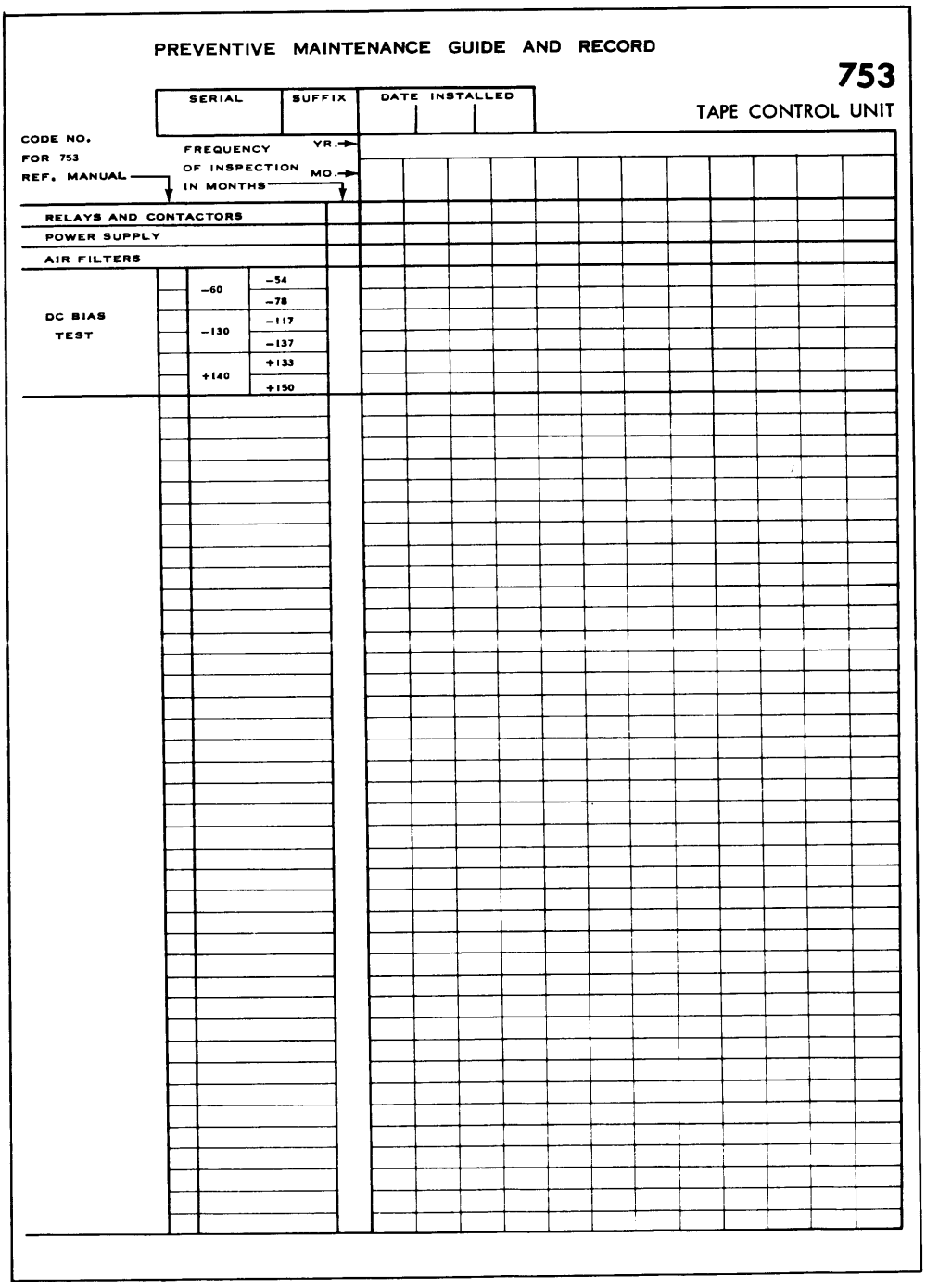
753.10.00 PREVENTIVE MAINTENANCE

A customer engineer is called upon to perform two types of maintenance - corrective and preventive. Corrective maintenance is the finding and correcting of a trouble after it has occurred. Preventive maintenance is the work which is performed on a regularly scheduled basis to correct potential trouble, minimize service calls, and maintain machine availability to the customer.

The importance of regularly scheduled preventive maintenance is shown in two ways. First, it is important to the customer, because the work is done on the machine during off-peak load periods. Second, it is important to the customer engineer, because it enables him to schedule his activities and use his time to the greatest advantage.

By applying preventive maintenance techniques, more machine time is available to the customer. Overscheduling of preventive maintenance is as undesirable as underscheduling. The objective is to increase machine availability to the customer by reading total maintenance time.

For the first three months of operation, preventive maintenance should be performed as recommended in section 753.12.00 (P.M. Procedure). By this time, the customer engineers of each installation should have filled in the frequency of inspection on the P.M. Guide and Record (Section 753.11.00). Also by this time, they should have developed their own preventive maintenance schedule.



PREVENTIVE MAINTENANCE GUIDE AND RECORD

753

TAPE CONTROL UNIT

SERIAL	SUFFIX	DATE INSTALLED

CODE NO. FOR 753 REF. MANUAL

FREQUENCY OF INSPECTION IN MONTHS

YR.→

MO.→

RELAYS AND CONTACTORS

POWER SUPPLY

AIR FILTERS

DC BIAS TEST

−60	−54
	−78
−130	−117
	−137
+140	+133
	+150

753.12.00 PREVENTIVE MAINTENANCE PROCEDURE

Abnormal DC-Voltage Tests 1 mo. .3 hr.	Vary the following voltages and obtain one minute of error-free operation at each limit while running a suitable program. Nominal Voltage: - 60; -130; +140 Recommended Test Limits: - 54, - 78; -117, -137; +133, +150	Single Shots 3 mo. 2.0 hr.	Check the single shots listed in section 753.15.15. Check for proper duration, timing and output amplitude. All single shots should be checked during customer operation if possible. Most single shots that are difficult to check during customer operation can be checked in P.M. period using 4T18.
		Relays and Contacts 12 mo. 0.1 hr.	Check for dirty or pitted points, air gap and rise, and binding pivots.
		Power Supply 12 mo. 1 hr.	Check tubes in power supply
		Air Filters 2 mo. .2 hr.	Inspect air filters and replace all those that will impede air flow because of dirt.

753.13.00 LUBRICATION CHART

The 753 unit should be lubricated on the average of once every three months, unless trouble occurs from the lack of lubrication.

Code No.	Description	Type of Lubrication				
		6	9	12	17	20
2	Cover and door hinges		X			
2	Cover latch cams				X	
2	Cover door rollers		X			
8	Duo relay pivots (pipe cleaner)		X			
8	Duo relay operating pads (light film)				X	
8	Wire relay pivot		X			
8	Wire relay latch (if latch type)		X			

753.14.00 CLEAN AND/OR INSPECT

753.14.01 General Heat Problems

Refer to Section 704.14.01 for methods and tests used for heat problems.

753.14.02 Appearance and Filters

Clean any large accumulations of dust or dirt with an approved vacuum cleaner. Clean all covers with IBM polish. Check all covers for good latching and unlatching. Check all tape control air filters for a good air flow. Replace any filter that is dirty. Do not try to clean or recondition any dirty filter.

753.14.03 Motors and Blowers

When power is down be sure blower is free to turn. With power up be sure motor is running. Check the motor and blower for quiet running operation and check the bearing to be sure they are not overheated. Methods to check for bearing temperatures are found in Section 704.14.01. Check tube panel for a good air flow.

753.14.04 Pluggable Units and Panel Pins

Pluggable Units

Some jumper wires between pluggable units are too tight. Check to see if the insulation is broken and occasionally grounding out on the tight jumper wires.

Panel Pins

Check for spread and misaligned panel pins. Some crack and break near the bottom of the contact area. These should be checked each time a pluggable unit is removed from the machine.

I/O Shoes, Receptacles and Connections

Check for bent, broken or dirty contacts. Check for loose, grounded or shorted connections. Prongs and contacts are cleaned by wiping with a clean cloth or with your finger. Any approved solvent can be used. Never burnish, sand, file or stone the contacts for the special contact surface will be damaged.

753.14.05 Thermal

Check thermal contact alignment and clean points for a good "make" surface. Make sure power is knocked down when the contact points operate. Check connections to make sure they are not loose, grounded, or shorted. The thermal is set to operate at 130° F ± 5° F. Make sure that with all covers off the tube unit, the thermal operates to knock down power. Section 704.14.05 contains the description and adjustments of the thermal contact and switch.

753.14.06 Operators Panel

Check to be sure that the correct function of each button is executed and the proper lamp lights for each function. Particular attention should be given to the thermal light. Make sure it comes on when the thermal contacts operate.

CE Test Panel Switches, Keys, and Buttons

Check the following for proper operation:

Tape Unit Select Switch. A dial switch which conditions the test circuits and selects the tape drive.

Write Bus Toggle Switches. A group of seven switches which can be used to condition the write buses. These switches have a dual function. They are double-pole switches. On 70.04.02 they are wired to control the input to the manual check register.

Read. A push button switch which sets the read circuits. Reading continues until an EOR is sensed, or the reset button is depressed.

Start Write. A push button switch which sets the write circuits.

Stop Write. A push button switch which resets the write circuits.

Write Tape Mark. A push button switch which provides a manual write-end-of-file operation.

Rewind Tape. Sets the rewind circuits which return the tape to load point.

Backspace. Sets the backspace circuits which return the tape to the beginning of the record.

Backspace File. Sets the backspace circuits which return the tape to the beginning of the file.

Note: This feature is optional and may or may not be on the 753.

Set Tape Indicator. Sets the tape indicator trigger in the selected tape drive.

Reset Tape Indicator. Resets the tape indicator trigger in the selected tape drive.

Reset Manual Check Register. Resets the manual check register.

Cycling Operation Switch. A toggle switch used in write status, to cause the drive unit to write a series of records about one-half inch long. When the system is in read status with this switch on, the tape will be read until the tape mark is recognized. An automatic rewind is set up and the machine will repeat the reading of the file. This operation continues to repeat, thus allowing the investigation of read circuits, under dynamic conditions.

Stop on Error. A toggle switch which can be used to control the stopping of a read or write operation on a longitudinal redundancy error.

753.14.07 CE Test Panels

CE Test Panel

Check all neons and lamps for proper operation. Check all keys and switches to see the correct operation is completed by each.

Inverse/Normal. A toggle switch which is located in the A section of the pluggable unit panel. The inverse position allows the tape to be written or read in a modified binary coded decimal mode (test operation), and normal position (test operation) allows the tape to be written or read in the binary mode.

Note: For main frame operation control of binary or BCD mode, this switch must be left in the normal position.

Panel Neon Indicators. The customer engineering panel includes neons for the various important registers in the tape control unit; they are: line register, manual check register, and the write clock, positions 1-6. The long redundancy check register has neon indicators below the customer engineering test panel. There are also major command line neons such as read, write, go, and so on.

Note: Manual operations are designed to activate the normal operating circuits of the tape system. Circuit additions have been made to initiate the normal circuits. These additions will now be considered in two different modes of operation. The tape can be operated by direct manipulation of the control buttons, or the cycling switch can be turned on causing repeat operations.

The Bit Registers (753)

Read Register. The read register is the input register from the tape drive to the tape control unit. During a write operation, the read register will be set by the write echo pulses, indicating that a bit of a character has been written. During a read operation, the read register will be set from the read preamplifiers of the 727. The inputs will be gated long enough to insure that all bits of the character are read. During backspace operations, the read register will receive pulses from the 727 which will be used to determine when the tape has reached the beginning of record or beginning of file.

Line Register. The primary purpose of the line register is as an output register to the 704 from the tape control unit. Information will be held in the line register to allow the 704 adequate time for sampling. In test operations, the line register is compared with the test bit switches to determine an error. This error is then sampled in the manual check register.

Manual Check Register. The manual check register is used by the customer engineer only for testing purposes. If the line register and bit switch comparison does not agree, bit for bit, the error is set into the manual check register indicating which channel is in error. It is held there until a reset of the manual check register under push button control is called for by the customer engineer. The presence of a bit in the manual check register indicates an error.

Longitudinal Redundancy Check Register (LRCR). All bits written or read in any channel are recorded in one position of the longitudinal redundancy check register. This register may keep track of whether an odd or even number of bits has been read or written in any one channel. At the end of a record, after writing the check character, all bits of the LRCR should be zero. Any LRCR position neon on would indicate an error in that particular channel. The tape check indicator is set to remember if the LRCR had an odd number of bits. This information is available both to the customer engineer and to the customer.

753.14.08 Relays

Sequencing Relays

Relays 1-3 and 15 are duo relays and the complete preventive maintenance procedures are found in Section 704.14.08. Relays 5-14 are wire contact relays and the complete preventive maintenance write-up is found in Section 704.14.08.

753.14.09 Resistors, Capacitors, and Transformers

Filament Transformers and Capacitors

Check for loose, grounded or shorted connections. Make sure there is no accumulation of dirt grounding out the transformers or capacitors. Make sure the capacitors have not popped their expansion plugs.

Resistors

Check for any hot or burned resistors. Check for loose, grounded or shorted connections. An extremely hot resistor can be found by the burning odor it gives off. See Section 704.14.01 for operating resistor temperatures.

753.14.10 Rectifiers

Check all rectifiers for loose or grounded terminals and for any shorted plates.

753.14.11 Oscillator Assembly

The oscillator is made up of a 476 kc crystal with a choke, tuning capacitor, oscillator and a cathode follower output. Scope the output to make sure the oscillator has a complete cycle every 2.1 usec. Check crystal to be sure it is in tight and the contacts are made.

753.14.12 Fuses

DC Fuses

Located in two rows just to the left of the CE test panel. Check fuse bail operation and make sure DC is knocked down when it is operated. Check fuse clips to see that all are not loose, bent or burned.

AC Fuses

Located in two rows to the left of the DC fuse blocks. Check the fuse bail for free movement and make sure all power is knocked down when the bail is operated.

753.14.13 Tubes

Block tube test only after biasing and pulse checking fail to locate general troubles. An occasional visual check should be made for open filaments on parallel cathode followers.

753.14.14 Vibration

Vibration testing is done where there is no other means of locating a trouble. The trouble area is the only section vibrated and the machine is thoroughly checked after vibration to be sure no other troubles have been added. To effectively vibrate a panel, the tube is tapped lightly with your finger or a pencil eraser. Never vibrate any harder than described above. However, the 753 tape control must be capable of performing all normal operations without failure while the pluggable unit panel and pluggable units are vibrated sufficient to interrupt any faulty electrical connection or defective component.

753.14.15 Pulse Checking

A scheduled procedure must be set up to scope and check on critical and important pulses. These pulses are found in 753.15.15. Refer to that section for any scope setups, waveshapes, levels, rise and fall times that are needed.

753.14.16 Marginal Checking

The tape control is biased by the use of the bias cart. With a tape diagnostic running the +140v must be biased from 133v to 150v, the -60v is changed from -54v to -78v, and the -130v is biased from -120v to -137v. Under any of these limits the diagnostic must operate correctly.

753.14.17 Power Supply

Check all voltages and make sure they are within limits. The ripple content should be held to within ± 1 volt. Occasionally check the thyratron rectifier and the constant voltage tube. Check terminals for loose or grounded connections. Check other tubes in the power supply.

753.14.18 Inter-Record Gaps

Write Delay Single Shot

It is recommended that the tape inter-record gaps are checked physically at least once a week. This is achieved by manually writing two records (tape marks) from the control unit. This gives the effect of an infinite stop delay which represents the worst condition. The tape is developed and the distance between the two records is checked with a steel scale. This is measured from the last character of one record (not the check character) to the first character of the next record. This provides the customer engineer with a visual check on the tape drive adjustments and the write delay SS timing.

After the installation of the new SS_E circuits, check all control units with a write delay SS to insure that the write delay is not greater than 10 1/2 ms. This insures that the average access time to a record on tape is kept within the limits advertised in our sales manuals.

The original engineering specifications on the gap was 3/4 of an inch ± 1/16. This is now changed to 3/4 of an inch + 1/16, -1/8.

753.15.00 WAVEFORMS AND LEVELS

753.15.15 Pulse Checking

PULSE	SYS. DIAG.	TEST POINT AND SYNC. POINT	TIMING AMPLI-TUDE ETC
Tape Gate Trigger	6.03.01	MF2 L02-3	12 us.
Ring Shift Cntl.	6.03.02	MF2 L01-7	6 us.
Tape Rdn. Ctr.	6.03.03	MF2 D03-8	1 us. pulses
Tape Sel. Tgr.	6.02.01	MF3 G03-7	
Start Sync Clock Trigger	6.02.01	MF3 Q04-8	
Start Tape Cycle Trigger	6.02.02	MF3 R01-1	10 us.
Tape Ctr. Gr. Tgrs.	6.02.03	MF3-E04-4 E04-2	1 us.
Inverse Control	6.01.01	MF3-Q04-6	
Rewind Trigger	6.02.04	MF3-J04	
Bkwd. to Fwd. Delay	70.01.01	S09-W6	-25 ms.
Fwd. to Bkwd. Delay	70.01.01	S07-W4	+25 ms.
Bkwd. Reset Delay	70.01.01	S04-F1	+3 ms.
Wr. Fwd. Before Bksp.	70.01.02	S08-U3	+6 ms.
Disconnect Delay	70.03	S06-P2	+400 us.
Wr. Trigger Reset Delay	70.03	S06-R4	+125 us.
Bkwd. Stop Delay	70.03	S06-M5	-1 ms.
Reset Wr. Tgr.	70.03	S08-Q7	+10 us.
Reset LRCR Reg.	70.06	S09-H7	+10 us.
End of File	70.08	S09-P6	-24 ms.
Wr. L. P. Delay	70.09	S08-D3	-54 ms.
Wr. Sliver Control	70.09	S18-K1	-35 us.
Wr. Delay	70.09	S04-D3	+10 ms.
Rd. L. P. Delay	70.09	S08-D7	-20 ms.
Rd. Delay	70.09	S04-D3	+4 ms.
Clock Gate Delay	70.09	S09-B6	+20 us.
Rd. After Wr. Delay	70.09	S04-D3	+6 ms.

PULSE	SYS. DIAG.	TEST POINT AND SYNC. POINT	TIMING AMPLI-TUDE ETC.
Clock Reset	70.10.02	S04-S5	+10 us.
Character Gate Rd.	70.10.02	S05-R8	+33.6 us.
Character Gate Wr.	70.10.02	S05-R8	+16.8 us.
Rd. Response	70.10.02	S05-N5	+6 us.
Sync Sel. Delay	70.11.01	S18-V2	+10 us.
Reset Button S.S.	70.13	S07-L3	+20 us.
Write Cycling	70.14	S05-B6	+6 ms.
R/W Cycling Delay	70.14	S05-F6	-16 ms.
Write Pulse	70.10.01	S03-B5	+8.4 us.
Output of Oscillator	70.10.01	S04-U7	+2.1 us.
B.O.R. Recognition	70.03	S06-K6	+500 us.
Record Gate	70.06	S09-C8	+150 us.

753.15.16 Marginal Checking

Each voltage should be biased to the following limits and a suitable program (4T01) must run error free for one minute at each bias limit.

NOMINAL VOLTAGE	BIAS TEST LIMITS
-130	-120
	-137
+140	133
	150
-60	-54
	-78

753.15.17 Power Supply

Ripple Content

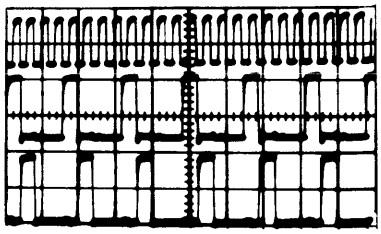
Tolerance of plus or minus one volt is allowed on the marginal limits of -60v, -130v, and +140v in the tape control unit.

753.15.50 Clock Pulse

Ring drive pulses

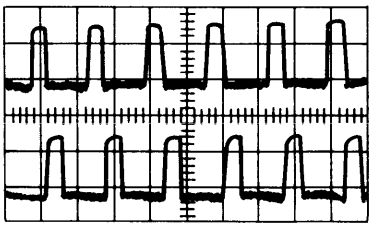
T_1 output

T_2 output



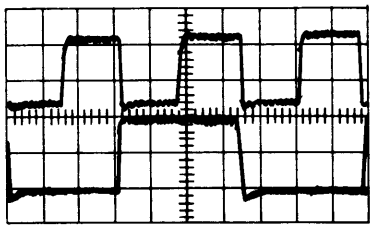
T_3 output

T_4 output



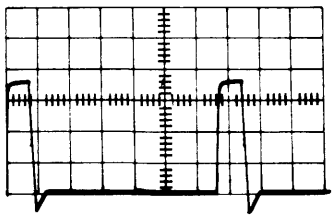
T_5 output

T_6 output



K circuit output 70.10.01
10 usec/cm 20 volts/cm
Sync - Fall of T6

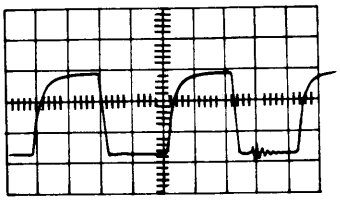
753.15.51 Write Pulse (Sync)



S03A-B5 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

753.15.52 Ring Drive

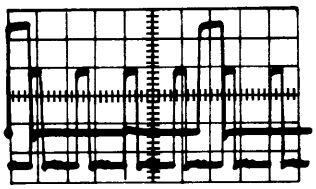
S04S-U7 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



753.15.53 Clock Pulses and Write Pulse

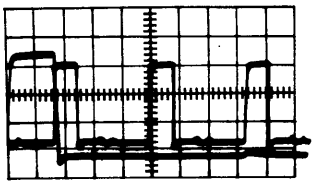
A Position #1

S05S-T2 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



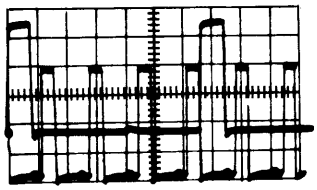
B Position #1

S05S-T2 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

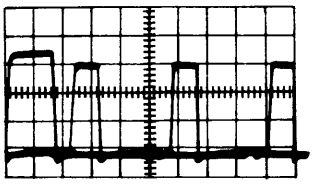


C Position #2

S05S-T6 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

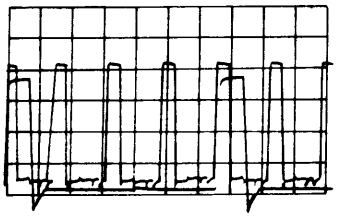


D Position #2



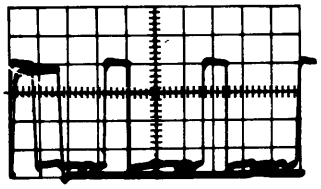
S05S-T6 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

E Position #3



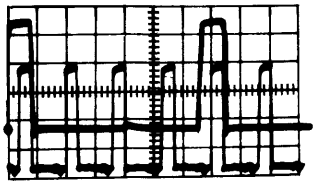
S05S-W2 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

F Position #3



S05S-W2 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

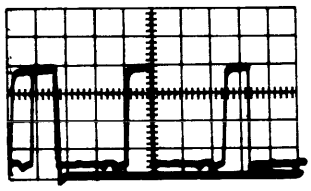
G Position #4



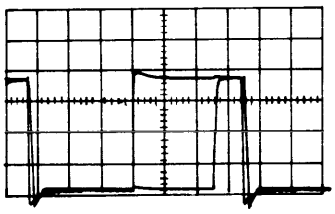
S05S-W6 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

H Position #4

S05S-W6 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



L Position #6

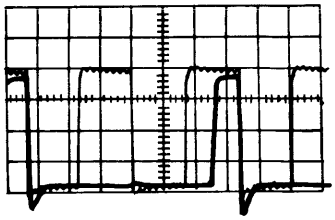


S08J-L3 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

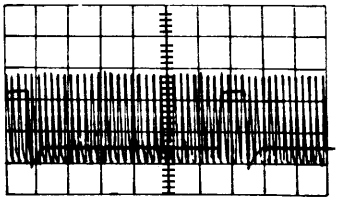
753.15.54 Oscillator Output

I Position #5

S05S-Y2 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



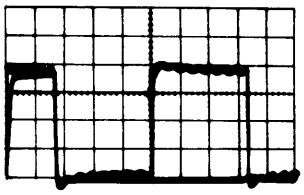
A



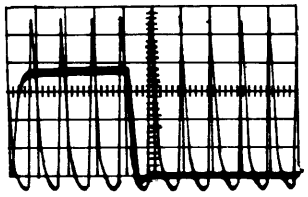
S04S-X5 70.10.01
10 usec/cm 20 volts/cm
Sync - Write Pulse (S03A-B5)

J Position #5

S05S-Y2 70.10.01
5 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



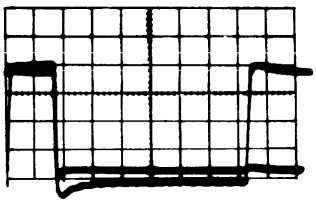
B



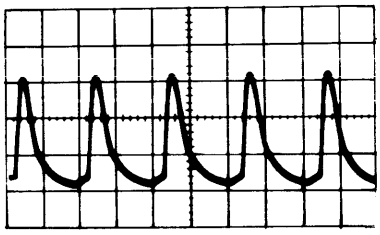
S04S-X5 70.10.01
2 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)

K Position #6

S08J-L3 70.10.01
10 usec/cm 10 volts/cm
Sync - Write Pulse (S03A-B5)



C



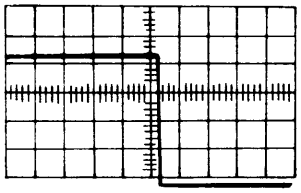
S04S-X5 70.10.01
1 usec/cm 20 volts/cm
Sync - Internal

The following pictures from 753.15.54 to 753.15.67 were taken with the following program running:

```
0000    WRS    221
0001    CPY
0002    BST    221
0003    TRA    0000
```

753.15.55 Initiate Write Delay

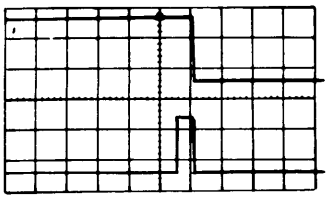
S08A-A6 70.09
2 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)



753.15.56 Delayed R/W Call

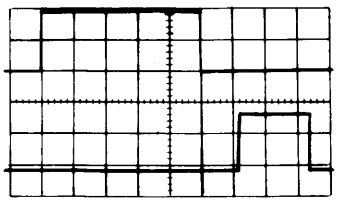
A

S09A-B1 70.09
2 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

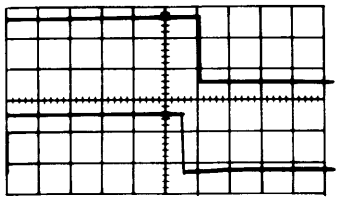


B

S09A-B1 70.09
5 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)

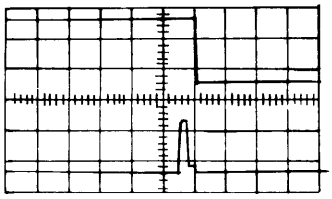


753.15.57 10 Msec Write Delay



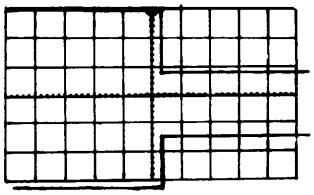
S07A-C7 70.09
2 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

753.15.58 Write Clock Gate



S08A-G3 70.09
2 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

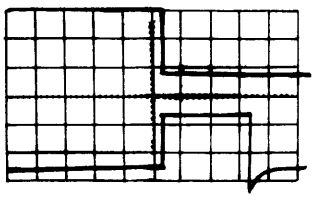
753.15.59 Backspace Call Test



S06A-D6 70.01.01
1 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

753.15.60 Write Forward Before Backspace

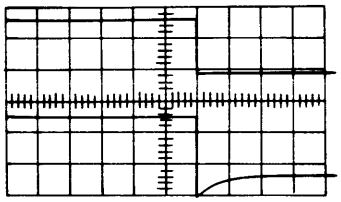
A



S08S-U3 70.01.02
2 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

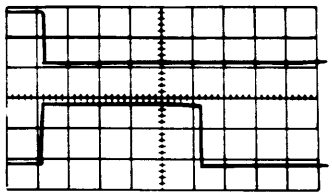
B

S08S-U3 70.01.02
1 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)



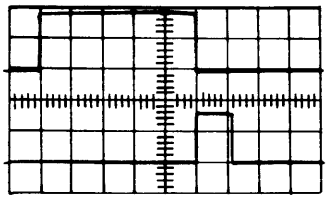
753.15.61 Forward to Backward Delay

S07S-W4 70.01.01
5 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)



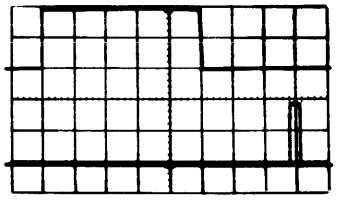
753.15.62 Read Delay from Backspace

S08A-E2 70.09
5 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)



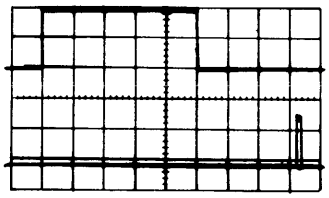
753.15.63 BOR Search

S06J-K6 70.03
1 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)



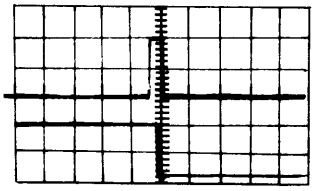
753.15.64 Disc Delay When BOR Falls

A



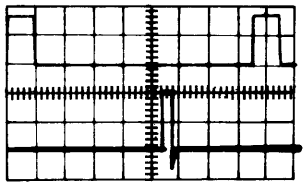
S06J-P2 70.03
5 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)

B



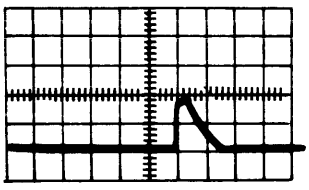
S06J-P2 70.03
5 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-A6)

753.15.65 Backward Reset Delay



S04A-F1 70.01.01
5 msec/cm 20 volts/cm
Sync - Initiate Write Delay
(S08A-D6)

753.15.66 Read After Write Delay



S04A-D3 70.09
5 msec/cm 20 volts/cm
Sync - Backspace Call Test
(S06A-D6)

753.20.00 CORRECTIVE MAINTENANCE

753.21.00 REMOVALS

753.21.02 Filters and Appearance

Open up front tube panel gate. The filters are located at the inside bottom of the gate. They can be lifted out after the two holding screws are removed.

753.21.03 Blower Motor and Blower

The blower motor is attached to the base by four holding bolts. These are removed and the motor can be lifted out.

753.21.06 Operators Panel

The lamps can be replaced by pushing and twisting out. The indicator lamps under the plastic inserts are removed the same way after the insert is snapped out with a small screwdriver.

753.21.07 CE Test Panel Components

Almost all the switches, buttons and keys are held to the test panel by large knurled nuts at the base of each component. These are removed and the component can be removed from the rear of the test panel. The main line indicator lamp is replaced by opening test panel gate and unscrewing from the rear. The neons are replaced by removing the two screws at the rear of test panel neon group. Remove this cover which leaves the neons exposed so they can be replaced.

753.21.17 Power Supply

All power supply voltages are located on drawers and can be pulled out to work on any of the drawer components. To remove drawers, remove two holding screws and gently slide from rear of machine. Be extremely careful that power is down and these are extremely heavy.

753.22.00 ADJUSTMENTS AND TIMINGS

753.22.05 Thermals

The adjustment procedures are given in Section 704.22.05 and 704.14.05.

753.22.07 CE Test Panel

The adjustment of the microswitches and keys are found in Sections 704.14.07 and 704.22.07.

753.22.08 Relays

The adjusts for the wire contact relays and the potted relays are found in Section 704.22.08.

753.22.11 Oscillator

The oscillator uses a 476 KC crystal. The output from the oscillator is a 0-80v positive going spike with a rise time of .1 usec. Adjust the tuning capacitor for maximum output at the cathode then add enough capacity to make the output stable.

753.22.15 Pulse Checking - - SS Tolerances

Systems	Location	Name	Duration	Acceptance	Capacitor Resistor
70.01.01	S09S	Bkwd to Fwd Delay	25 ms	19 to 28 ms	0.1 mfd, 1.6 meg
70.01.01	S07S	Fwd to Bkwd Delay	25 ms	19 to 28 ms	0.1 mfd, 1.8 meg
70.01.02	S08S	Wr. Fwd before Rew/Bksp	12 ms	10.8 to 13.2 ms	.047 mfd, 560 K
70.03	S06J	BOR Recog.	500 us	450 to 550 us	470 uuf, 220 uuf, 2.2 meg
70.01.01	S04A	Bkwd Reset Delay	8 ms	7.2 to 8.8 ms	.022 mfd, 820 K
70.03	S06J	Disc. Delay	400 us	360 to 440 us	.002 mfd, 1.0 meg
70.03	S06J	Wr. Tgr. Reset Delay	125 us	112.5 to 137.5 us	270 uuf, 1.8 meg
70.03	S08J	Wr. Tgr. Reset	10 us	8 to 12 us	47 uuf, 430 K
70.06	S09A	Record Gate	150 us	135 to 165 us	120 uuf, 47 uuf, 2.2 meg
70.06	S09A	Reset LRCR	10 us	8 to 12 us	47 uuf, 390 K
70.09	S08A	Rd. Load Point Delay	20 ms	16 to 24 ms	0.1 mfd, 1.8 meg
70.09	S08A	Wr. Load Point Delay	54 ms	42 to 60 ms	0.12 mfd, 1.0 meg
70.09	S09A	Clock Gate Delay	20 us	16 to 24 us	47 uuf, 910 K
70.09	S08A	Rd. Delay	4 ms	3.7 to 4.5 ms	0.01 mfd, 1.8 meg
70.09	S07A	Wr. Delay	10 ms	9.5 to 10.5 ms	0.022 mfd, 1.0 meg
70.09	S04A	Rd. after Wr. Delay	12 ms	10.8 to 13.2 ms	.057 mfd, 1.2 meg
70.13	S07J	Power On Reset	20 us	16 to 24 us	47 uuf, 910 K
70.14	S05A	Wr. Cycling	6 ms	4.8 to 7.2 ms	0.02 mfd, 1.8 meg
70.14	S05A	R/W Cycling Delay	16 ms	12 to 18 ms	0.05 mfd, 1.8 meg
70.10.02	S04S	Clock Reset	10 us	8 to 12 us	47 uuf, 438 K
70.10.02	S05J	Response	6 us	4 to 8 us	47 uuf, 330 K
70.08	S09J	End of File	24 ms	20 to 28 ms	0.033 mfd, 2.2 meg, .03 mfd
70.01.01	S07S	Bkwd Delay	8 ms	7.2 to 8.8 ms	.022 mfd, 820 K
70.09	S18J	Sliver Ctrl	35 us	28 to 42 us	47 uuf, 1.0 meg
70.11.01	S18S	Synch Sel. Delay	10 us	9 to 11 us	47 uuf, 620 K
70.02	S03A	WEOF/Bksp Disc	12 us	10.2 to 13.8 us	47 uuf, 560 K

753.30.00 DIAGNOSTIC OR RELIABILITY TESTS

753.31.00 DIAGNOSTIC FORMAT

The diagnostic tests for tape and tape control are written to follow the general routines of 4DEPR. The sense switches control similar things in each test and the print-outs use similar routines. Each will be discussed under the appropriate program. Load routines necessary to load these programs are discussed in 704.33.00 (Form R23-9385).

In this section we will speak of a tape system which must consist of a CPU, core storage, tape control with a number of tape drives. A printer is also needed for a print-out of error conditions.

753.32.00 TAPE SYSTEM DIAGNOSTIC AND RELIABILITY TESTS

753.32.01 Random Number Tape Test - 4T01

Scope of Test

This program tests the ability of the tape system to execute correctly, all legitimate instructions without error.

Test Operations

Following is a list of operations the machine must perform accurately and the sequence in which they are tested:

Test Load Tape Button
Test Sense Tape Check
Test Backspacing at Load Point
Test for WEF Tape Mark
Test Rewind at Load Point
EOR and EOF Test
Test for EOR Timing
Test Multiple Write With No Copy for Tape Noise
Binary Write Test
Binary Read Test
Test Multiple Read and Backspace
Backspace Read Test
Backspace Write Test
Check Two Files Test
Test Write First Character Line after Read EOF Condition
Test for WEF Tape Mark BCD Mode
BCD, EOR and EOF Test
BCD Write Test
BCD Read Test
BCD Write and Backspace Read Test

Error Indication

The error print-out indication is in the form of 4DEPR I/O tests. In the case of error stop indications, display index register C for the 2's compliment of the error address. The word generated is in the accumulator, and the word written is in the MQ.

An important function of the error indication is the error address. This address permits the customer engineer to refer to the routine in the program which failed. In analyzing this routine with the aid of the comments on the listing, the cause of the machine failure is determined.

Sense switch 5 has a dual function. The first is to provide a load tape button test in the down position and also to by-pass the BCD test while in the down position. If it is desired to execute both the load tape button test and the BCD test, sense switch 5 is restored to the up position when the program halt occurs.

Diagnostic Characteristics

The program is written to run on one tape drive. By inserting a control card between cards 093 and 094, the test is performed on the number of tape drives indicated on the control card. The test can be changed to use up to 10 tape drives.

An asterisk is placed to the left of some of the mnemonic operations in the listing to indicate those instructions which are only executed when there is an error condition. This is to help simplify the understanding of the test.

753.32.02 Random Number Tape Test - 4T19

This test is exactly the same as 4T01 except it is devised to run in 35 seconds. This is for a fast round robin check to be used in machine check-out.

753.32.03 Individual Tape Diagnostic and Multiple Tape Reliability Test - 4T20A

Scope of Test

The program is used to diagnose any tape problems which are detected on 4T01 or 4T19.

Method of Testing

The test has two separate sections.

Individual Tape Diagnostic. The write, read and compare routines are separately set up under sense switch 1 control to repeat operations. This is not true of all routines but where the program uses numerous records SSW1 is used.

The description and method of each routine is given in the listing in front of each routine. The location of each routine is given in the program write-up. It is also given here under the test index. This section is executed when all sense switches are up.

Multiple Tape Reliability Test. This section used tape drives 1, 2, 3 and 4. Each complete routine is under SSW1 control with only one TSX instruction check. This section is used more as a reliability test since 4 tape drives make diagnosis more difficult. Sense switch 5 controls which section of the test is tested.

Diagnostic Characteristics

Both sections use the standard sense switch setting of print-out program.

An asterisk is placed to the left of the listings to indicate the instructions used on an error condition.

Index of Test Routine Sequence

Section I - Individual Tape Diagnostic

1. Test rewind at load point
2. Test RTT indicator
3. Test indicator for on status
4. Test MQ ring shift when writing on tape
5. Test read select without copy for MQ reset to zero, then check I/O delay and MQ for word written in MQ ring shift routine
6. Test read tape copy reset MQ to zero
7. Test for writing consecutive copies
8. Test block tape mark entry to MQ after reading EOF - MQ should be zero
9. Test tape writing and echo pulses
10. Test write copy and read copy
11. Test writing two consecutive EOF gaps in BCD mode and check for EOF skip in binary mode
12. Test writing EOF in BCD for EOF skip when reading gap in binary mode
13. Test writing EOF in binary at load point and read in BCD mode
14. Test writing EOF character at load point in BCD mode and reading in BCD
15. Test EOR skip after backspace over EOF in binary mode
16. Test EOF skip after backspace over EOF in BCD mode
17. Test writing and read circuits

Test Translators and Inverse Control

18. Test writing binary characters in inverse control
19. Test writing BCD characters in binary mode
20. Test writing in alternate binary and BCD modes
21. Test backspacing 15 consecutive times for backward and forward creep

Section II - Multiple Tape Test

1. Test writing and reading of 4 tape drives in binary mode
2. Test writing and reading in reverse modes
3. Test backspacing 15 consecutive times for backward and forward creep of 4 tape drives
4. Test writing and reading checkerboard words
5. Test write, backspace and read

753.33.00 TAPE DRIVE TESTS

753.33.01 Tape Unit Address Test

Scope of Test

This tests the ability of the 704 to select any or all on line tape drives.

Method Test

The sense switches are interrogated to determine the units tested. The program rewinds, writes, rewinds and reads a record on each tape drive in sequence.

753.33.02 Writing of Multiple Tapes

4T06 tests writing of two tapes using tapes 1 and 5, then 2 and 5, 3 and 5, 4 and 5 and then repeating.

4T07 tests writing simultaneously on three drives.

753.33.03 Random Walk Tape Test - 4T08

Method of Test

After the routine is loaded tape 1 is rewound and 10,000 octal records are written on the tape. The records are written in binary and are of random length ranging from one word to sixty-four words in length. After this file is written several minutes are required to position the tape near the center of the file. The random walk test begins after this positioning. The tape is alternately backspaced and read forward. The number of records executed in each direction is random. As the motion proceeds, count is kept in the accumulator of the record number currently being passed over. Each record on tape contains its own sequence number. At any time the number of the record on tape does not agree with the number in the accumulator, an error routine is entered. After the error is detected, information is printed and a new file of random length records is written and the operation continues.

The printer prints out from left to right, the number of the record just read, the number of the record that should have been read, the home position at which the last backspacing began, the number of backspaces given, and the number of reads that were given.

Comparison of the number of the record just read with the computed record and you can tell if a record was skipped or an extra record was read. If the record that should have been read is the difference between the home position and the number of backspaces and the record read is larger than what should have been read, then the error is in backspacing.

753.33.04 Tape Reading Interchangeability - 4T09

This program tests the ability of a tape drive to write a tape which can be read on any other drive, and tests the ability to read a tape that was written on any other drive.

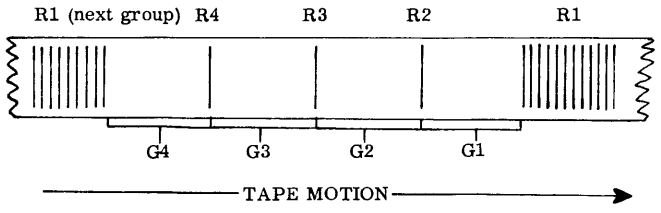
753.33.05 Tape Inter-record Gap and Creep Test - 4T16

This test is divided into two sections with the first section checking inter-record gaps and the second section checking creep.

Method of Test

Section I

1. The test is so designed that inter-record gaps are written under the most adverse conditions. This is done by writing repeated groups of records which will develop as follows:



Record R1

The length of record R1 is proportionate to the time the go line is down. This is variable between records.

1. This time can be calculated by multiplying record length in inches by .78 x 8. The result will be the time in milliseconds the go line was down during the write operation.

   The last word of R1 contains a number which is an index count. This corresponds to the number of milliseconds the go line was down.

Gap G1

Gap G1 is generated when the go line has been down 10 milliseconds. This gap is a function of the single shot timing and start - stop timing.

Record R2

Record R2 is a marker for Gap G1. Since it follows the gap the go line is down 10 milliseconds. Record R2 is referred to in the program listing as -10- record.

Gap G2

Gap G2 is generated with the go line down a variable length of time corresponding to the length of record R1. This time and the length of record R1 are increased with each group of records.

If the tape gaps vary as a result of the length of record written or the length of time the go line is held down during any program operations, this gap will vary in size as the length of time the go line is held down and record R1 increases.

Record R3

Record R3 is a marker for gap G2. Since it follows the gap, go line is down variable milliseconds. Record R3 is referred to in the program listing as -V- record.

Gap G3

Gap G3 is generated with the go line effectively up steady. This gap is a function of SS timing only. Start-stop time does not affect this gap. Consequently, if gap G3 is correct then any variation in gap G1 must be due to start-stop time.

Record R4

Record R4 is a marker for gap G3, -0- record.

Gap G4

Gap G4 is the utility gap used as a stopping point in the program. Tape must run continuously through other gaps so all calculating and print out is done at this gap.

After this group of records is written the variable delay go line down is increased and the next group of records is written. This loop continues until the maximum delay time K & 3 is reached. See sense switch 5 under write. Each tape unit called for by control card is written in sequence, then each will be read in sequence.

Section II

The method used to test the maximum backspacing on the 727 tape drive is as follows:

1. Write 4 one word records
   Record 1 - 771111111177
   Record 2 - 152222222215
   Record 3 - 003333333377
   Record 4 - 774444444477
2. Read the records written.
3. Rewind and read records again and when 3rd read select is given, the inter-record gap is measured for initial millisecond timing, between 2nd and 3rd records.
4. Backspace over 4th and 3rd record and rewrite 3rd and 4th record.
5. Read check the 4 records again and measure between the 2nd and 3rd record.
6. The backspacing and the measurement is executed 15 times making a loop.
7. At the end of a loop, a standard print out is executed giving an average creep from the initial gap in milliseconds. A plus figure indicates there was a forward creep and a minus figure indicates there was backward creep.
8. At the end of a loop the test is started over by rewriting 4 records and repeated as above. A total of 20 loops are executed.
9. The average creep on print out for successful loop may vary. The minimum creep should be 5 milliseconds and the maximum 8 milliseconds. This depends on the condition and age of drives. Also a proper analyzation of the creepage on any one drive tells of the tendency of a forward or backward creep on each loop. Also the tape drives should be thoroughly cleaned. This includes the tape columns and tape heads.

753.34.00 TAPE CONTROL TEST

753.34.01 Tape Sync Single Shot Program - 4T18

The program is used to execute all the tape functions to give the customer engineer a chance to scope single shots during these controlled functions.

753.41.00 GENERAL TAPE DIAGNOSTIC TROUBLE

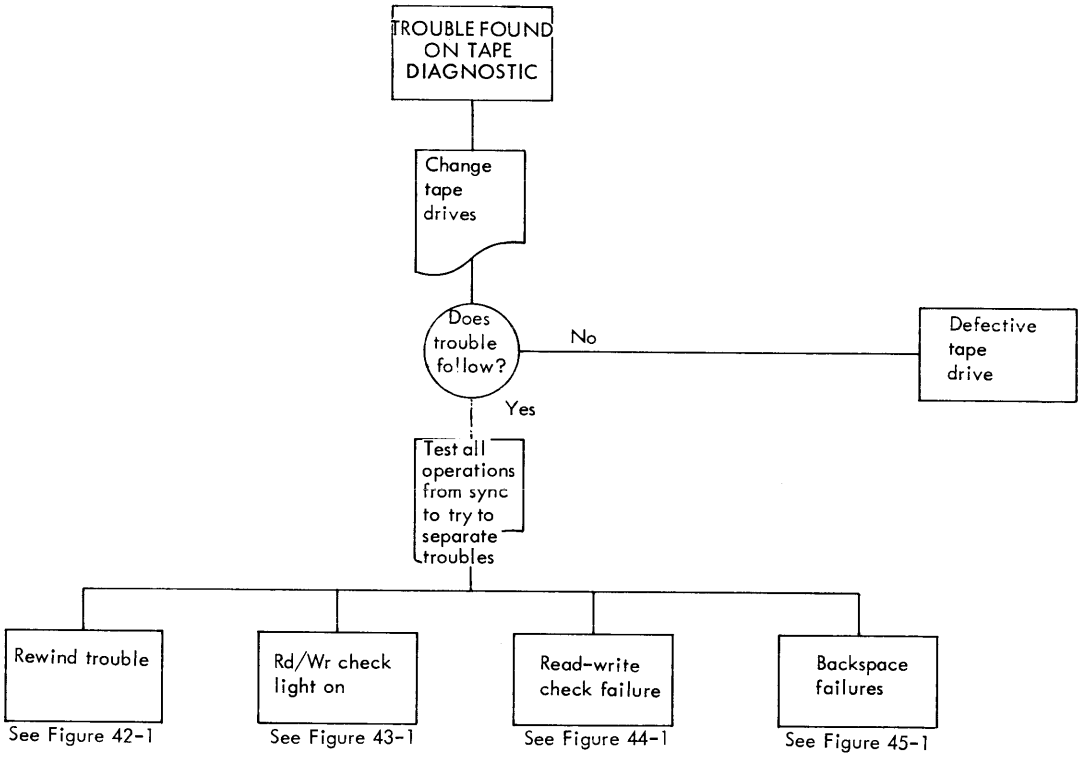


FIGURE 41-1

753.42.00 REWIND TROUBLES

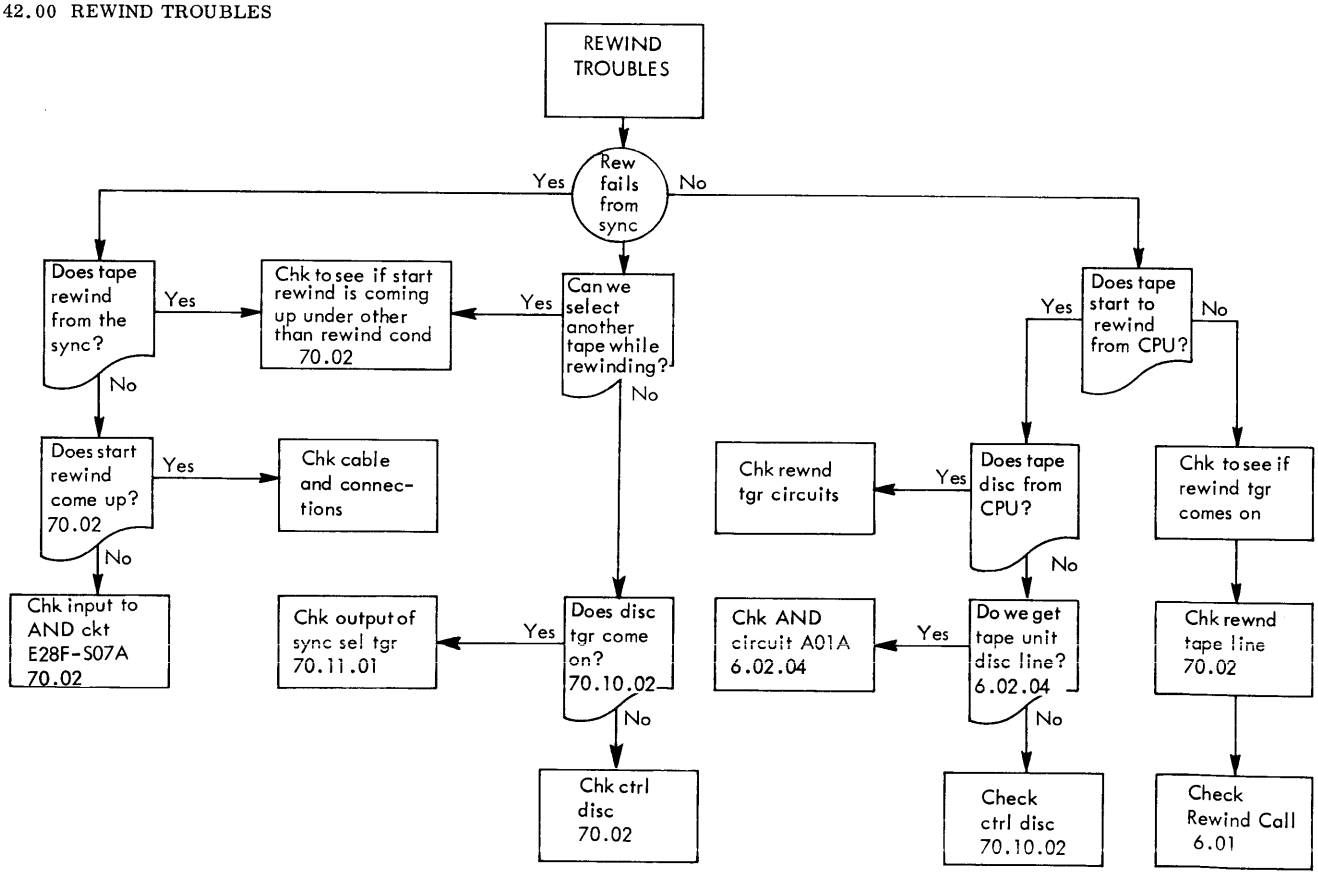


FIGURE 42-1

753.43.00 READ/WRITE CHECK LIGHT ON

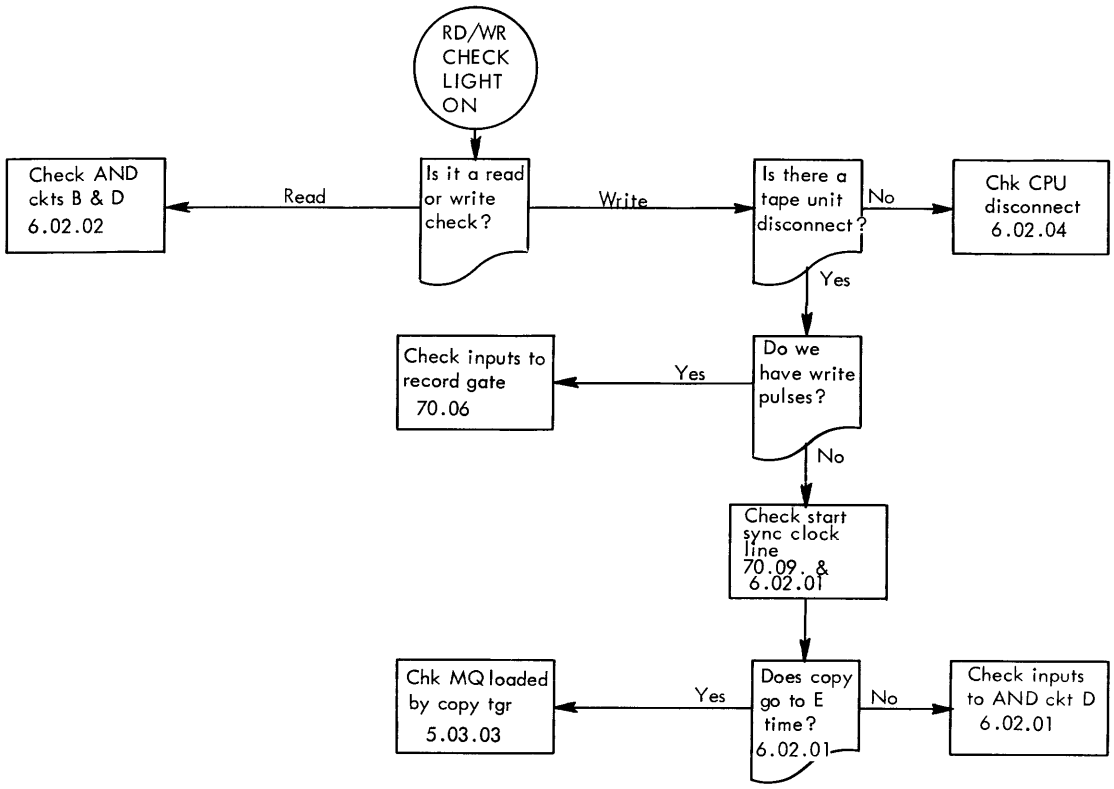


FIGURE 43-1

753.44.00 READ-WRITE FAILURES

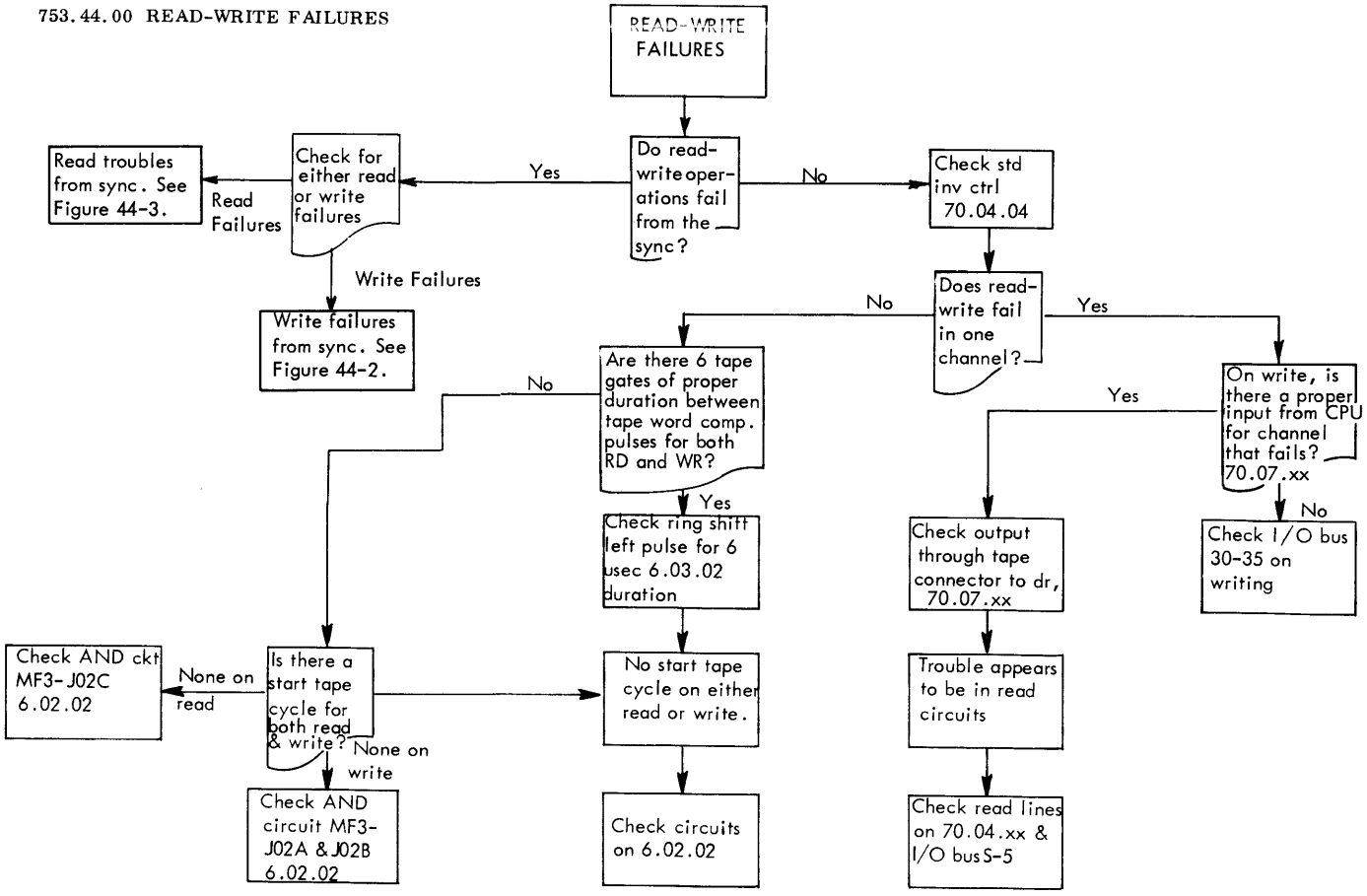


FIGURE 44-1

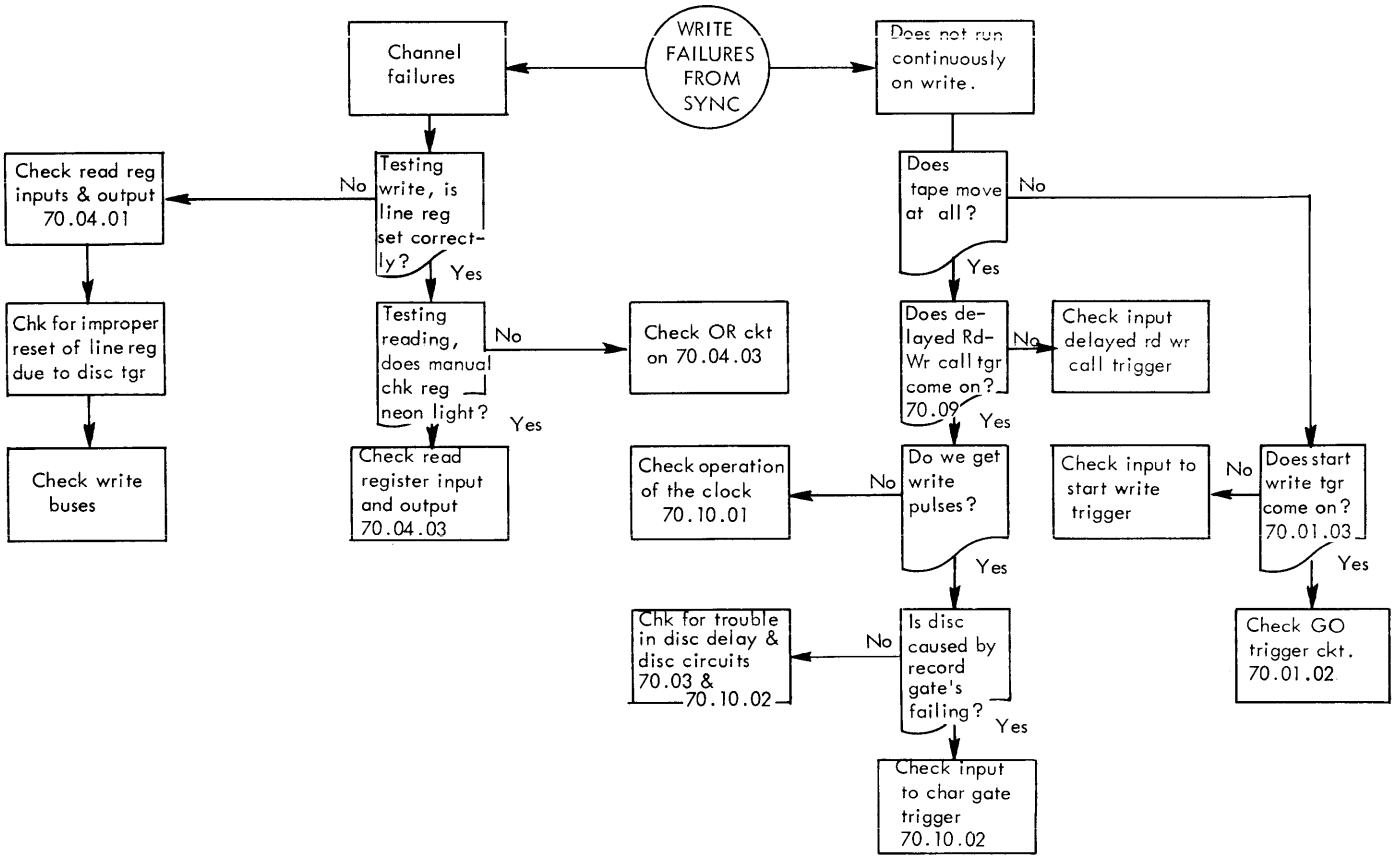


FIGURE 44-2

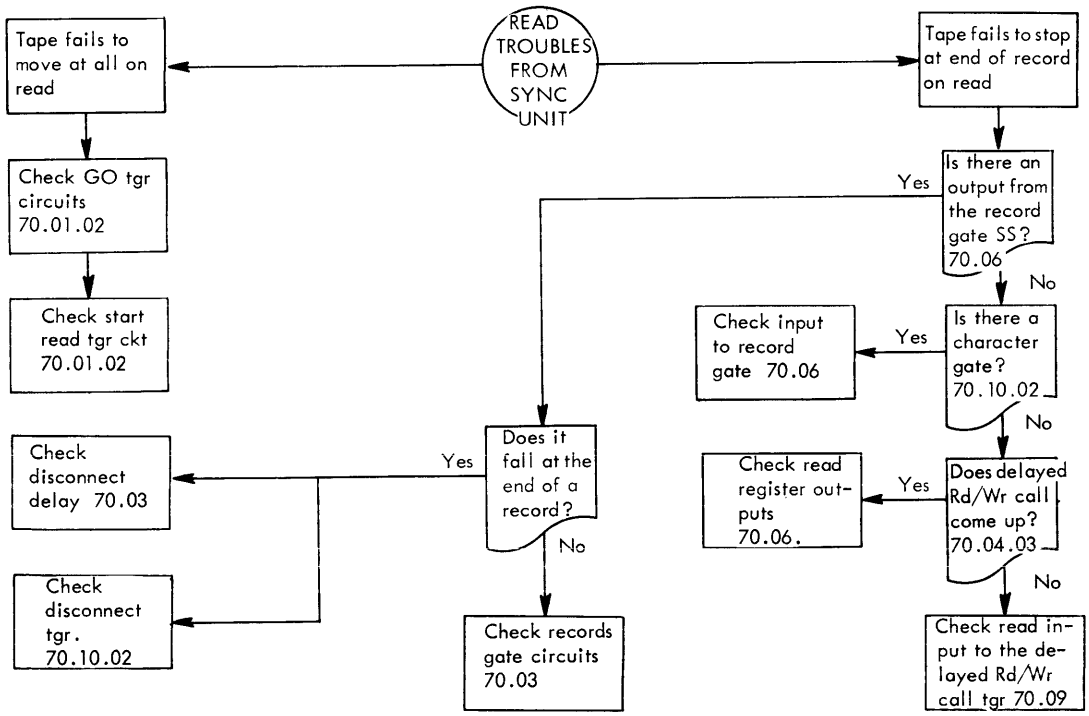


FIGURE 44-3

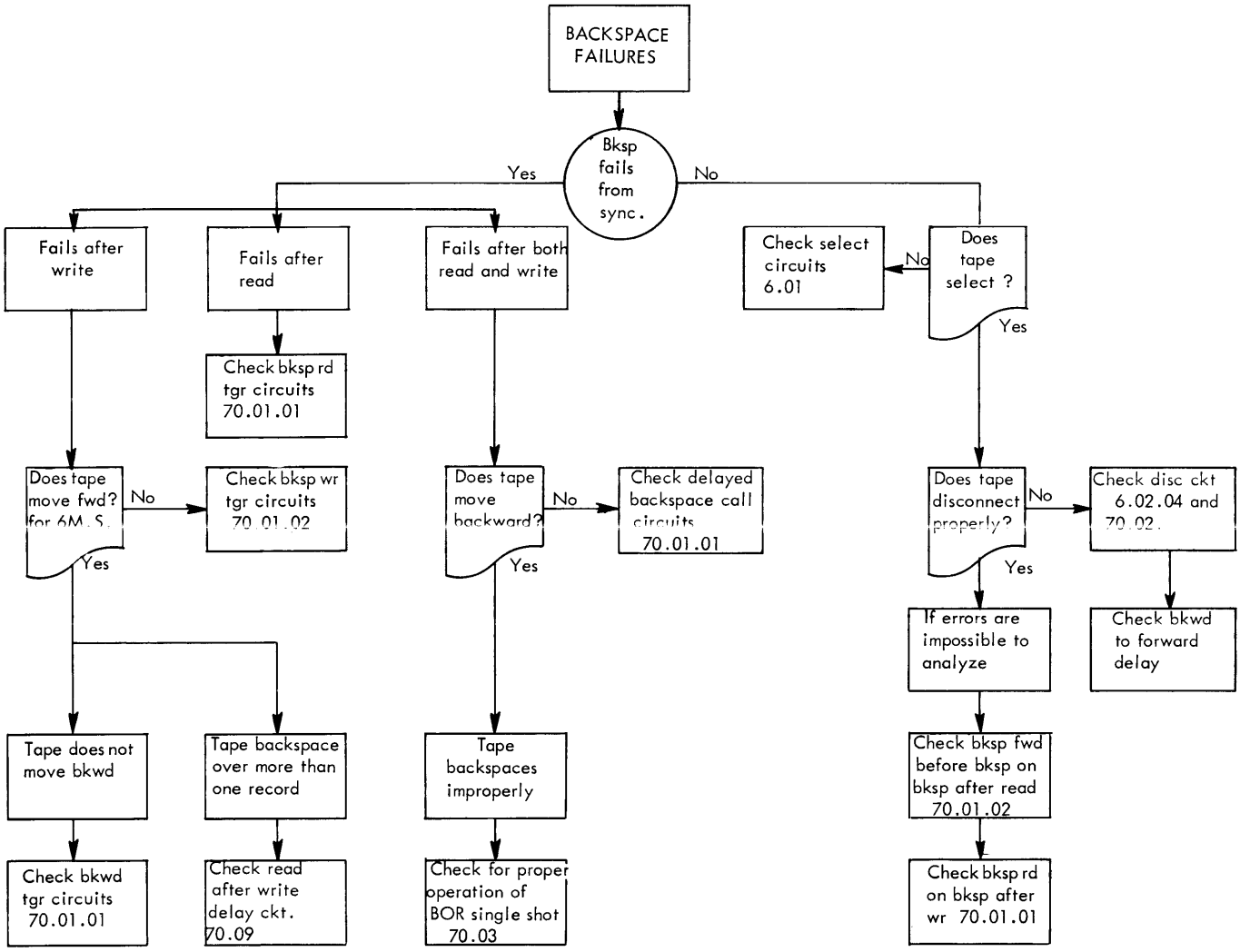

BACKSPACE FAILURES
Bksp fails from sync.
Yes
No
Fails after write
Fails after read
Fails after both read and write
Check select circuits 6.01
No
Does tape select ?
Yes
Check bksp rd tgr circuits 70.01.01
Does tape move fwd? for 6M.S.
No
Check bksp wr tgr circuits 70.01.02
Yes
Does tape move backward?
No
Check delayed backspace call circuits 70.01.01
Yes
Does tape disconnect properly?
No
Check disc ckt 6.02.04 and 70.02.
Yes
If errors are impossible to analyze
Check bkwd to forward delay
Tape does not move bkwd
Tape backspace over more than one record
Tape backspaces improperly
Check bksp fwd before bksp on bksp after read 70.01.02
Check bkwd tgr circuits 70.01.01
Check read after write delay ckt. 70.09
Check for proper operation of BOR single shot 70.03
Check bksp rd on bksp after wr 70.01.01

FIGURE 45-1

753.51.00 FUSE CHARTS

753.51.01 AC Block 1 (Circuit Breakers)

Symbol No.	Page No.	Coil Amps 1	2	3	Circuit Fused
CB1	91.03.01	3			Unregulated 208v AC to blower motor
			30		Unregulated 208v AC phase 1 to power plug 1
				30	Unregulated 208v AC phase 1 to power plug 2
CB2	91.03.01	3			Unregulated 208v AC to blower motor
			30		Unregulated 208v AC phase 2 to power plug 1
				30	Unregulated 208v AC phase 2 to power plug 2
CB3	91.03.01	30			Unregulated 208v AC phase 3 to power plug 1
			30		Unregulated 208v AC phase 3 to power plug 2
CB4	91.03.01	10			Marginal check supply outlet - 236v AC regulated

753.51.02 AC Block 2

Symbol No.	Page No.	Amp	Type	Circuit Fused
F1	91.03.01	8	FNM	110v AC to power plug 1 and AC outlet
F2	91.03.01	8	FNM	110v AC to power plug 2
F3	91.03.01	8	FNM	110v AC to power plug 1 and AC outlet
F4	91.03.01	8	FNM	110v AC to power plug 2
F5	91.03.01	4	FNA	Regulated 236v AC to filament transformer
F6	91.03.01	10	FNA	Regulated 236v AC to power plug 1
F7	91.03.01	10	FNA	Regulated 236v AC to power plug 2
F8	91.03.01	4	FNA	Regulated 236v AC to filament transformer
F9	91.03.01	10	FNA	Regulated 236v AC to power plug 1
F10	91.03.01	10	FNA	Regulated 236v AC to power plug 2

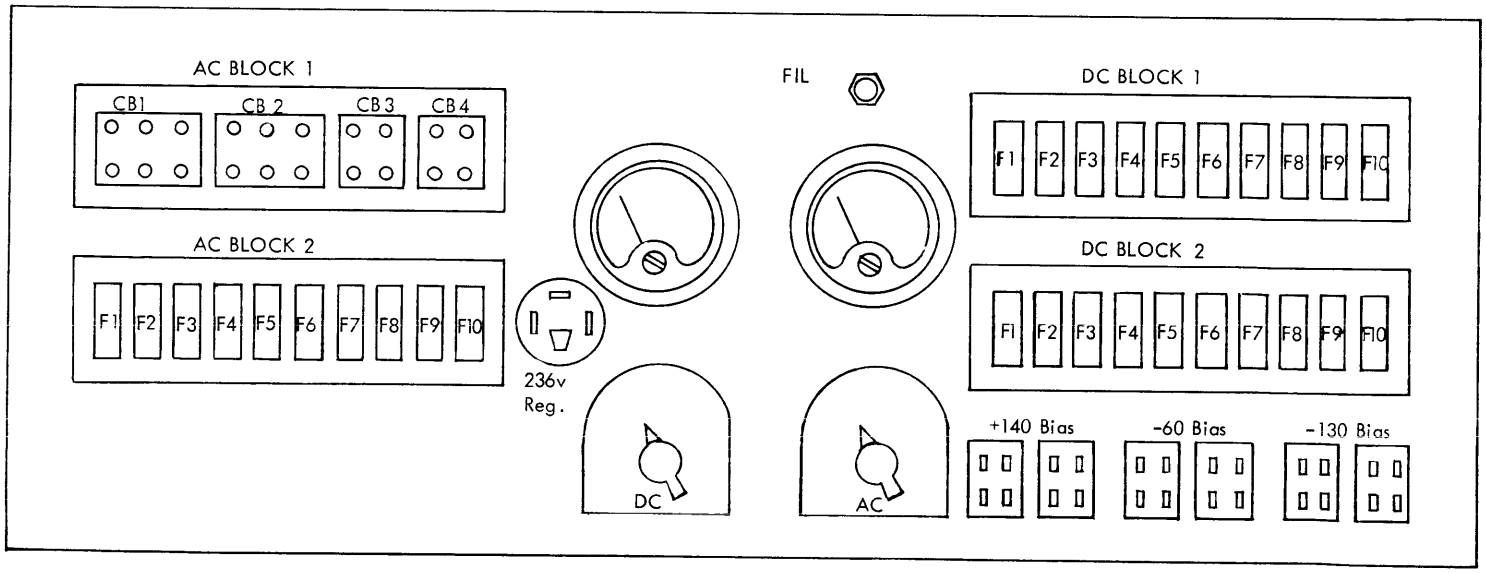


FIGURE 51-1. FUSE PANEL

753.51.03 DC Block 1

Symbol No.	Page No.	Amp	Type	Circuit Fused
F1	91.03.02	1/2	MIC	+270v DC to tube gate
F2	91.03.02	1	MIC	+270v DC to power plug 1
F3	91.03.02	1	MIC	+270v DC to power plug 2
F4				
F5				
F6				
F7				
F8	91.03.02	1/2	MIC	-270v DC to tube gate, power plug 1 and 2
F9				
F10				

753.51.04 DC Block 2

Symbol No.	Page No.	Amp	Type	Circuit Fused
F1	91.03.02	3	MIC	+140v DC to tube gate
F2	91.03.02	4	MIC	+140v DC to power plug 1
F3	91.03.02	4	MIC	+140v DC to power plug 2
F4	91.03.02	2	MIC	-60v DC to tube gate
F5	91.03.02	2	MIC	-60v DC to power plug 1
F6	91.03.02	2	MIC	-60v DC to power plug 2
F7	91.03.02	3	MIC	-130v DC to tube gate, power plug 1 and 2
F8		0.5	MIC	
F9				
F10				

753.51.05 Sequence Control Fuses

Symbol No.	Page No.	Amp	Type	Circuit Fused
F1	91.01.01	6.25	FNM	AC to tuned transformer primary
F2	91.01.01	15	FRN	AC to convenience outlet transformer
F3	91.01.01	15	FRN	AC to convenience outlet transformer
F4	91.01.01	3.2	FNM	AC to "master on-off" switch
F5	91.01.01	6.25	FNM	AC to CV transformer primary
F6	91.01.01	3.2	FNM	AC to "master on-off" switch
F7	91.01.03	1	FNM	Secondary of T8 to rectifier
F8	91.01.03	1	FNM	Secondary of T8 to rectifier
F9	91.01.03	1/2	AGC	+140v DC int. reset

Characters (Channel)	Within 704 Zone B A	Within 704 Numerical 8 4 2 1	Recorded on Tape Zone B A	Recorded on Tape Numerical 8 4 2 1
0	0 0	0 0 0 0	0 0	1 0 1 0
1	0 0	0 0 0 1	0 0	0 0 0 1
2	0 0	0 0 1 0	0 0	0 0 1 0
3	0 0	0 0 1 1	0 0	0 0 1 1
4	0 0	0 1 0 0	0 0	0 1 0 0
5	0 0	0 1 0 1	0 0	0 1 0 1
6	0 0	0 1 1 0	0 0	0 1 1 0
7	0 0	0 1 1 1	0 0	0 1 1 1
8	0 0	1 0 0 0	0 0	1 0 0 0
9	0 0	1 0 0 1	0 0	1 0 0 1
# *	0 0	1 0 1 1	0 0	1 0 1 1
@ *	0 0	1 1 0 0	0 0	1 1 0 0
& *	0 1	0 0 0 0	1 1	0 0 0 0
A	0 1	0 0 0 1	1 1	0 0 0 1
B	0 1	0 0 1 0	1 1	0 0 1 0
C	0 1	0 0 1 1	1 1	0 0 1 1
D	0 1	0 1 0 0	1 1	0 1 0 0
E	0 1	0 1 0 1	1 1	0 1 0 1
F	0 1	0 1 1 0	1 1	0 1 1 0
G	0 1	0 1 1 1	1 1	0 1 1 1
H	0 1	1 0 0 0	1 1	1 0 0 0
I	0 1	1 0 0 1	1 1	1 0 0 1
(+) 0	0 0	0 0 0 0	0 0	1 0 1 0
	0 1	1 0 1 1	1 1	1 0 1 1
	0 1	1 1 0 0	1 1	1 1 0 0
-	1 0	0 0 0 0	1 0	0 0 0 0
J	1 0	0 0 0 1	1 0	0 0 0 1
K	1 0	0 0 1 0	1 0	0 0 1 0
L	1 0	0 0 1 1	1 0	0 0 1 1
M	1 0	0 1 0 0	1 0	0 1 0 0
N	1 0	0 1 0 1	1 0	0 1 0 1
O	1 0	0 1 1 0	1 0	0 1 1 0
P	1 0	0 1 1 1	1 0	0 1 1 1
Q	1 0	1 0 0 0	1 0	1 0 0 0
R	1 0	1 0 0 1	1 0	1 0 0 1
(-) 0	0 0	0 0 0 0	1 0	1 0 1 0
$	1 0	1 0 1 1	1 0	1 0 1 1
*	1 0	1 1 0 0	1 0	1 1 0 0
Blank *	1 1	0 0 0 0	0 1	0 0 0 0
/	1 1	0 0 0 1	0 1	0 0 0 1
S	1 1	0 0 1 0	0 1	0 0 1 0
T	1 1	0 0 1 1	0 1	0 0 1 1
U	1 1	0 1 0 0	0 1	0 1 0 0
V	1 1	0 1 0 1	0 1	0 1 0 1
W	1 1	0 1 1 0	0 1	0 1 1 0
X	1 1	0 1 1 1	0 1	0 1 1 1
Y	1 1	1 0 0 0	0 1	1 0 0 0
Z	1 1	1 0 0 1	0 1	1 0 0 1
±	1 1	1 0 1 0	0 1	1 0 1 0
,	1 1	1 0 1 1	0 1	1 0 1 1
%	1 1	1 1 0 0	0 1	1 1 0 0

* The 704 prints the following characters instead of the data processing codes listed above.

Data Processing Character	704 Character
#	+
@	-
&	+
Blank	0

753.53.00 MACHINE TROUBLES WITH FIXES (LEVELS)

We have not tried to develop these troubles in sequence but have just listed them in level, timing, noise and reliability troubles with the particular fix for each.

753.53.01 Rewind Trigger

To fix the down level of the outputs of the rewind trigger, two 5.6K resistors in series are used in the plate circuit of the rewind trigger.

753.53.02 Loading of Select Ready and Read Line

To improve the up level of this line the cathode follower driving it is changed to a 5965 tube and the AND and OR circuit resistors are increased to decrease the line load.

753.53.03 Tape Select

To improve the down level of the select line on 6.02.01 place a one legged OR circuit in the DC input to trigger 06.

753.53.04 Start Write Trigger

If in scoping the start write trigger the up level is found to be down, check the trigger to be sure it is changed to a T and not a TA. This is checked by observing the plate resistors which are 4.3K and 3.9K in series, plate inductors of 500 uh and 22 uuf capacitors in the inputs.

753.54.00 TIMING

753.54.01 Tape Inter-Record Gap

The gap between records should occasionally be checked. The gap can be checked by writing two tape mark records from the tape control. This gives the effect of an infinite stop delay which is the worst condition. The tape is developed and the gap distance measured with a steel scale. This distance should be measured from the last character of the record (not the check character) to the first character of the following record. This gives a visual check of the tape drive adjustments and the write delay SS timing.

The write delay should not be longer than 10 1/2 msecs. This makes the gap within the specifications of 3/4 of a inch + 1/16, -1/8.

753.54.02 First Character Tape Mark

To avoid a timing condition on the first character tape mark trigger, the reset of the trigger is now changed to a DC reset of a disconnect.

753.54.03 Backspace Read

If trouble is encountered on a backspace read operation and no particular trouble can be found, lengthen the "backspace read" pulse slightly by slowing the fall of "not backward" to see if this eliminates the trouble.

753.55.00 NOISE

753.55.01 Backspace Disconnect

If trouble is experienced in the backspace disconnect, the WEOF/Bksp line is fed into a GA_F, SS_E and K and using this output as the new backspace disconnect. This removes the backspace disconnect sliver condition.

753.55.02 Write Forward Before Rewind

Write forward before rewind has been changed by BM 564212 to perform the same as write forward before backspace operation. This eliminates the undesirable effects caused by half-amplitude noise pulses generated on tape when the rewind instruction is given and the tape was in write status. This SS along with "Read After Write Delay" SS have been changed from 6 msec. to 12 msec.

753.55.03 Backward Delay

To prevent "tape slap" during a capstan transfer, the setting and resetting of the backward trigger is delayed by inserting an 8 msec. SS_E.

753.55.04 Clipping Voltage

To make the noise sensitivity of all seven tracks on tape the same, be sure the clipping voltage for all seven tracks are the same.

753.56.00 RELIABILITY

753.56.01 Tape Check Light

The tape check light does not turn on when a record does not have an even multiple of six characters because the "tape word complete" is now removed from circuits to turn on the tape check light.

753.56.02 Tape Coding Selector

A CF is now added after the OR circuit B on 6.01.01 to take card of the overload of driving the two AND circuits in the selector. This gives more reliable operation especially under bias conditions.

753.56.03 Load Point Delay SS

If trouble is experienced in the EOF gap sensing the timing resistor for the load point delay SS is increased to improve the recovery time. This improves the EOF gap sensing. Changing the SS to a SS_F will also give a more reliable operation.

753.56.04 Tape Mark

If a problem of writing a tape mark on inverse control is encountered, the line "WEOF call trigger off" should be added to AND circuit G13F on 70.07.01.

753.56.05 Write First Character (Reliability)

To improve writing the first word, when reading EOF the "write first character" line is gated with "test write call" on 70.08.

753.56.06 Tape Load Button Operation

To improve reliability of the load tape button, the tape coding trigger, tape group counter and the MQ are reset when the load tape button is depressed.

753.56.07 727 Pre-amp Switch Change

To be sure the 753 is compatible with all tape drives the "read bus" clamp diode is replaced by a 12K resistor in all amplifiers and the cathode follower load is changed to 12.4K.

753.56.08 Power Supply Voltage Overshoot

To regulate the voltage overshoot when a rapid power off power on condition exists, B/M 562257 is installed. This involves a change in RC network to reduce sharp output waveforms.

753.57.00 PHASE PROTECTION

Installing of B/M 560913 gives phase protection in the following way:

Relays R1 and R2 are energized to complete the 40v circuit to the power on relay when the power on key is depressed.

If R1 and R2 do not close the +40v is not applied to the sequencing circuit. The picking of R1 is dependent on the correct phasing of the AC input. The picking of R2 is dependent on phase 2 and 3 being correct.

If phase 1 (fuse 2) is lost R1 will not close.

If phase 2 (fuse 4) is lost R2 will not close.

If phase 3 (fuse 6) is lost neither relay will close.

The reversal of any two phases will prevent R1 from closing due to the phase shift network.

753.61.00 GENERAL INFORMATION

753.61.01 Tape Logic

One full word on the 704 contains 36 bits. Since information is written on the tape on six channels only, the 704 full word must be broken into groups of six bits in order to write a full word on tape. It makes six of these groups of six bits to complete the writing of a word from the MQ. This method of writing in groups of six leaves one tape track unused. As seen in Figure 61-1, the seventh track is used for a redundancy check. While writing is in progress, the number of bits that are to be written on the tape in each group is counted. If the counted number of bits in a group of six is even, a bit is written on the seventh, or redundancy track. This makes the number of bits written in any group odd. If the counted number of bits in a group of six bits is odd, a bit is not written in the redundancy channel of the tape. The number of bits in this case is odd. This is true for "normal mode of operation." Another mode, called "inverse mode of operation," is used when the 704 is used with peripheral equipment. In this mode the groups of 704 bits are rearranged or decoded from the 704 modified binary coded decimal system into the 705 modified binary coded decimal system. In "inverse mode," the seventh channel on tape will be written on, if there is an odd number of bits to be written in any group of six. This makes the total number of bits even in any group of six, when written in inverse mode. It is necessary to make the tape written in 704 modified binary coded decimal compatible with that written in the 705 modified binary coded decimal system.

The configuration of the bits on tape for one record can be seen in Figure 61-2. A record is one or more words, written consecutively in groups of six, at a repetition rate of 67.2 usecs per group. An EOR gap is written after every record. Within this EOR gap, the tape is stopped when one record is completed and started again in preparation for the next record. This EOR gap is about 3/4" of erased tape, because the tape is moving and the erase head remains on. At the beginning of each record, a delay is necessary to allow the tape to get up to speed (75"/sec.). This will also appear as part of the EOR gap (3/4" erased tape). On Figure 61-2, this is represented by the 10-ms delay just after the load point delay. A load point delay (62 ms), at the beginning of the first record on the tape, allows variations between the time required to stop the tape at load point for various tape drive units after a load or rewind operation.

At the end of the tape record in Figure 61-2, there is a 150-usec delay between the last group of the record and the fall of the record gate. The fall of the record gate starts EOR and disconnect. The long-redundancy-check character (LRCC) is written 225 usecs after the last character by resetting the write triggers in the tape drive. This LRCC insures an even number of bits in any channel. By checking for an odd number of bits vertically, and an even number of bits longitudinally (by channel), a method is available for checking for a properly recorded record.

753.61.02 Data Logic

Two instructions from the main frame are required for a write-tape operation and a read tape operation. A select instruction is required to bring the tape control into operation and to select the

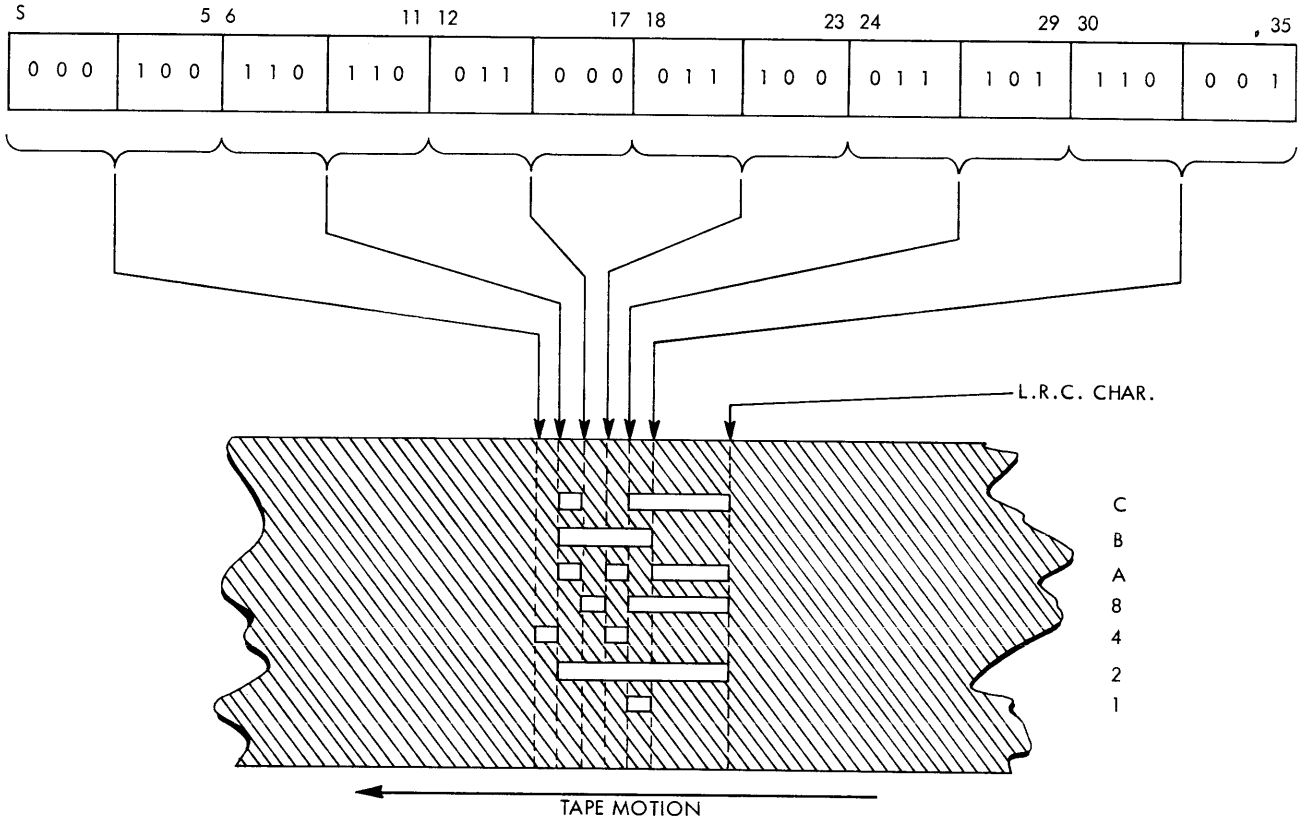


FIGURE 61-1. A BINARY WORD ON TAPE (ONE-WORD RECORD)

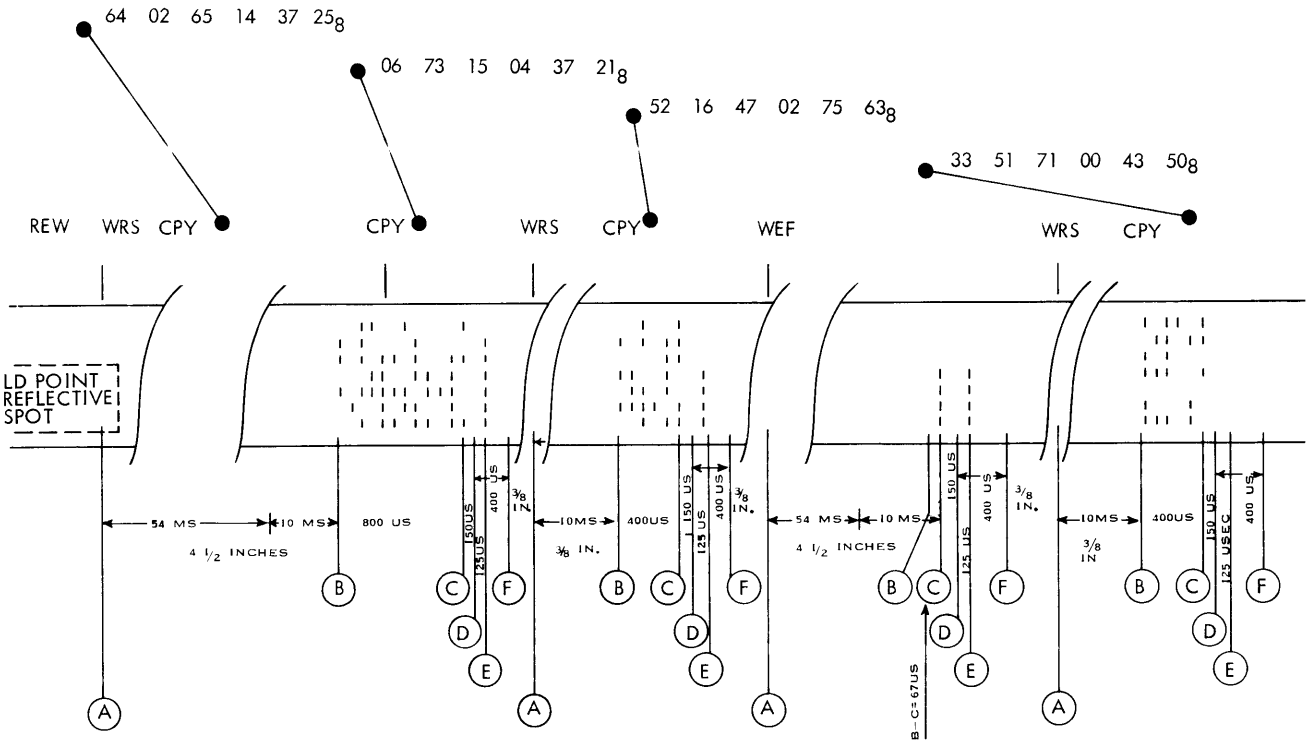
tape drive. For a write operation, the select instruction is write select (0766), and for a read operation, read select (0762). The address portion of these instructions designate the type unit (tape class, 20 or 22), and the individual tape unit (unit, 01-12) desired. The select instruction performs the function of starting the 753 operation. It starts the tape moving in the proper direction, depending upon the instruction, and if the tape was previously in ready status. Interlocking circuits are also initiated to prevent interference from other types of I/O units, or other tape drives. These interlocks remain in operation until a disconnect is initiated. Interlocking and disconnecting are discussed as a function of the individual instructions.

For read select and write select, copy instructions must be supplied if information is to be written on or read from the tape. Copy (0700) on a write select operation, is used to obtain a word from storage, place the word in the MQ, and gate the writing circuits of the 753. Copy (0700), for a read select operation, gates the read circuits of the 753, and places the word from the MQ into storage after a full word has been read from tape.

A copy instruction must be supplied for each word written or read. On a write operation, a word is supplied to the tape control unit from the MQ, and in a read operation a word is supplied to the MQ from the tape control. Since the tape can only handle a 6-bit character at a time, the MQ is used to provide a shifting register for the disassembling of words to be written into 6-bit groups, and the reassembling of characters on read into a 36-bit word (Figure 61-2). Shifting of the MQ, and storing of the word are functions of the copy instruction.

During a write tape operation, "ring shift MQ left 6" rotates the MQ left six positions for each character written on tape (Systems diagram, 6.03.02). The sign (S) position S of the MQ is rotated to MQ position 35 (Figure 61-1). A parity bit is developed by taking an odd-even count of each 6 bits rotated out of the sign position. This parity check is used to develop the check bit, which gives the odd lateral redundancy check to all characters written on the tape. In a read operation, the check bit is used to provide an initial set to the parity checker, and the shifting operation of the MQ is now used to record whether an odd number of bits from each character was read. When a binary tape is written, six characters are written for each copy instruction, or six characters are written for each word received in the MQ. When a tape is read, six characters are read from the tape for each copy instruction, or six characters are read into the MQ before a store operation places the word in storage.

Redundancy checking on write is limited to a long redundancy check. This is done at the end of a record when the LRCR is checked for an even condition (all triggers off). However, on a read operation, in addition to the long redundancy check, each character is checked for odd redundancy. Either discrepancy condition on read may set the tape check trigger, thus indicating an error.



A - TAPE STOPPING POINT
B - WRITE CLOCK STARTS
C - LAST CHARACTER WRITTEN
D - RECORD GATE FALLS
E - RESET WRITE TGRS.: WRITE L.R.C. CHAR.
F - DROP GO; BEGIN STOPPING TAPE

Illustrating inter-record, load point, end-of-file spacing; single- and multiple-word records; LRC characters; a record with no LRC character; and an LRC character resembling a tape mark.

FIGURE 61-2. MULTIPLE-RECORD TAPE, WRITTEN FROM CPU (WRS, CPY, WEF)

A total of 14 information buses connect the tape control unit with the main frame. There are six information buses from the MQ to tape control, which connect MQ positions 30 to 35 with the tape write buses. The seventh write bus (C) is connected to the output of the tape redundancy counter. On a read operation, information from the tape control is transmitted to storage, from the line register to positions S-5 of the MQ. The C-channel is transmitted as an input to the tape redundancy counter. Other control lines connect the two units.

Note: There are no power connections between the 753 and the main-frame-power-supply circuits. All lines are for information transmission, or control lines for simultaneous unit operation.

When going through read select and write select operations note that the main frame is free for calculations between copies. However, it must be realized that the MQ may not be used for any calculations during this time. Once the MQ is tied up with a select and copy operation, any information entered may be destroyed or altered during the tape operation. By the same logic, information to be written on or read from the tape may be destroyed or altered by the calculated information.

Since copy may control disconnect, the time at which copy must be available is critical. This is primarily a programming problem, however, some consideration should be given to timing with relation to copy in the discussion of each operation.

The other select instructions, rewind, write EOF, backspace record, and backspace file, do not require a copy instruction. Their functions are primarily tape positioning functions. No useful information is received from these operations. They vary somewhat in the disconnecting and interlocking functions. These differences are discussed under the individual operation.

The other two instructions, redundancy tape test, and end-of-tape test are completely a function of the main frame. Their purpose is to test a trigger that is being used to indicate a specific condition. In the case of RTT, this trigger indicates a redundancy error, and when tested by an RTT instruction provides a skip to the next sequential instruction, if no error has occurred. If an error has occurred and the trigger is on, no program skip is provided and the next sequential instruction is executed. This may be a transfer instruction to a correction or repeat loop of the program. The same general logic applies to the end of tape test instruction. In this case the end-of-tape trigger is set as a result of passing the end-of-tape reflective spot. If the end-of-tape-test instruction is given and the end-of-tape trigger is off, a skip is provided over the next sequential instruction. However, if the end-of-tape reflective spot is sensed, and the end-of-tape trigger is on when this instruction is given, the next sequential instruction is taken and programming may provide the corrective measures to be taken. An example would be the selection of a new tape drive, and the rewinding of the completed tape.

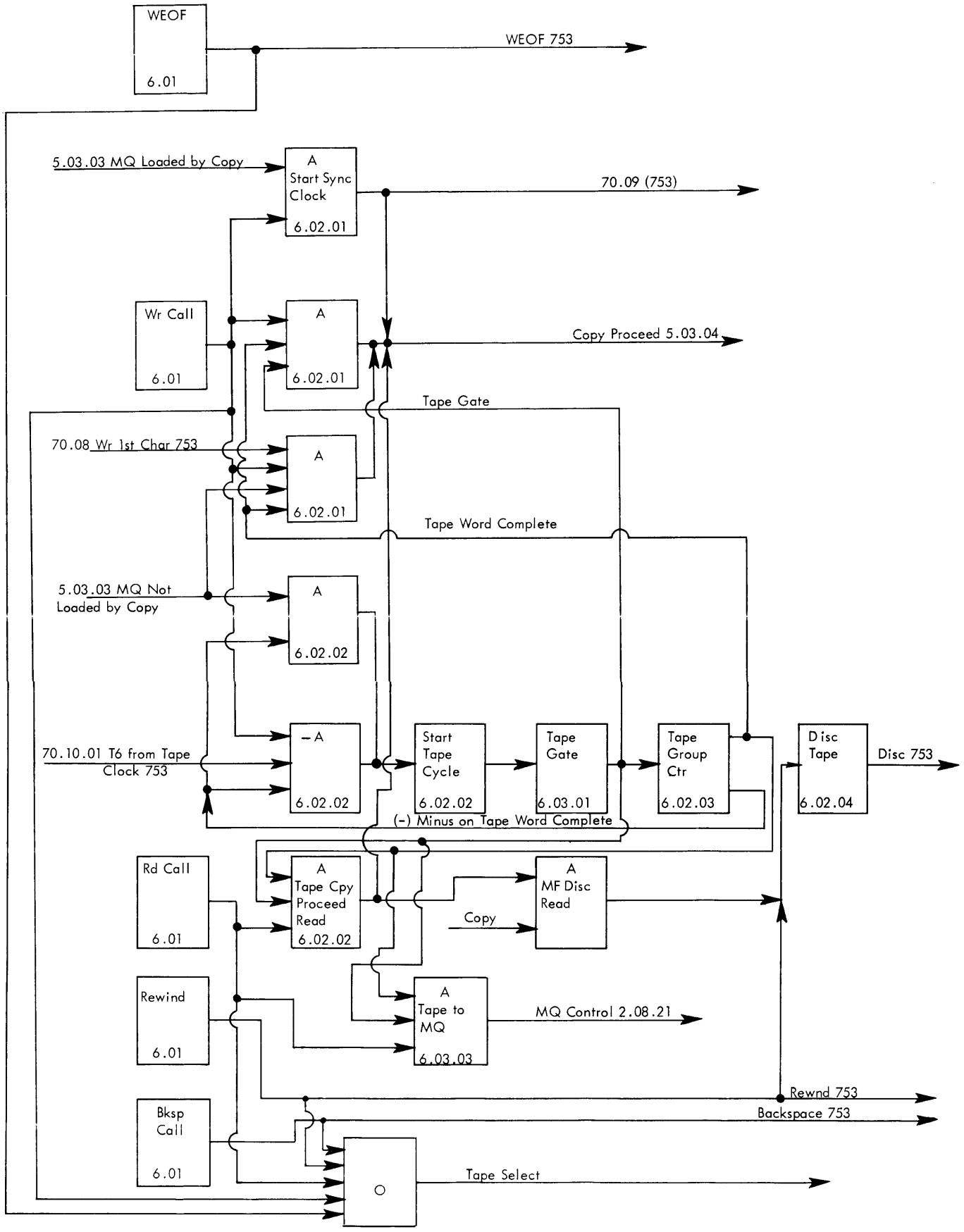


FIGURE 61-3. CPU TAPE OPERATION LOGIC (753 AND 727 ATTACHED)

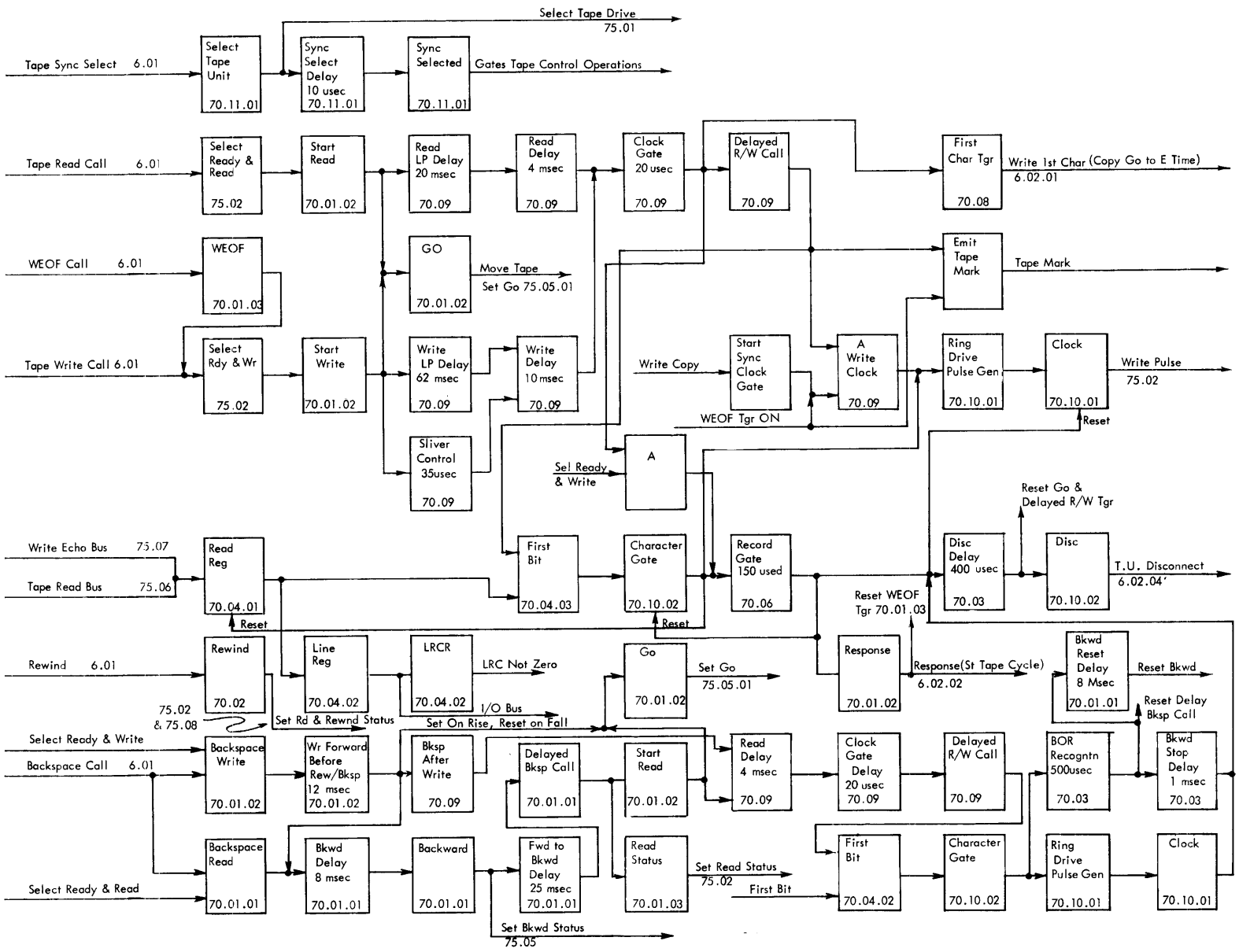


FIGURE 61-4. TAPE CONTROL OPERATION LOGIC

753.62.00 WRITE TAPE SEQUENCE

Write Call 6.01
a. Set write status 70.01.03
b. Select, ready and write 75.02

Select, Ready and Write
a. Start write 70.01.03
b. Initiate write delay 70.01.03 to 70.09
c. Set go 70.01.03 to 70.01.02

Go
a. Write tgr reset delay (75 us) 70.03
b. Start tape in motion 75.05.01

Initiate Write Delay
a. Write load point delay (40 ms) 70.09
b. Write delay (10 ms) 70.09

Fall of Write Delay
a. Reset clock 70.10.02
b. Set first character tgr 70.08
c. Start clock gate delay 70.09

Clock Gate Delay
a. Reset read register 70.04.01
b. Start record gate 70.06

Fall of Clock Gate Delay
a. Turn on delayed read and write call tgr 70.09

Delayed Read and Write Call
a. Write clock gate 70.10.01
b. Condition character gate reset 70.10.02
c. Condition first bit circuit 70.04.03

Clock Running
a. T3, T5 and T6 write pulse 70.10.01

Write Echo Pulse
a. Sets read register 70.04.01

First Bit
a. Starts character gate 70.10.02

Character Gate
a. Clock gate 70.10.01
b. Reset line register 70.06
c. Pulses record gate 70.06

Rise of T5
a. Resets character gate tgr 70.10.02

Fall of Character Gate
a. Reset read register 70.04.01
b. Reset first character tgr 70.08

Fall of Read Register
a. Set line and LRCR registers 70.04.02

The sequence is repeated for each group written. If the sequence is for the sixth group, the following sequence will take place in the case of disconnect. "Not copy" mixed with the logic that the sixth group is being written will drop the line "start sync clock." This takes place on 6.02.01.

Fall of Start Sync Clock
a. Stop the clock 70.10.01

Fall of Record Gate (After 150 us)
a. Start disconnect delay (400 us) 70.03
b. Write tgr reset delay (75 us) 70.03
c. Reset clock 70.10.02
d. Reset disconnect tgr 70.10.02

Reset Write Tgrs (Write Check Bits)
a. Echo pulse sets read register 70.04.01

Read Register Up
a. First bit 70.04.03

First Bit
a. Start character gate 70.10.02

Character Gate
a. Start clock 70.10.01
b. Reset line register 70.06
c. Fall of T5 turns off character gate 70.10.02

Fall of Character Gate
a. Reset read register 70.04.01

Fall of Read Register
(Sets line and LRCR registers) 70.04.02

After 150 us Disconnect Delay Falls 70.03
a. Turns on disconnect tgr 70.10.02
b. Resets go tgr 70.01.02
c. Resets delayed read and write call tgr 70.09

Disconnect Tgr On
a. Start clock 70.10.01
b. Reset rwd tgr 70.02
c. T3, T5 and disconnect reset line register 70.06

Fall of T5
a. Reset disconnect tgr 70.10.02

Fall of Disconnect Tgr
a. Reset tape unit select tgr 70.12.01
b. Reset sync selected tgr 70.11.01
c. Reset T.M. tgr 70.03

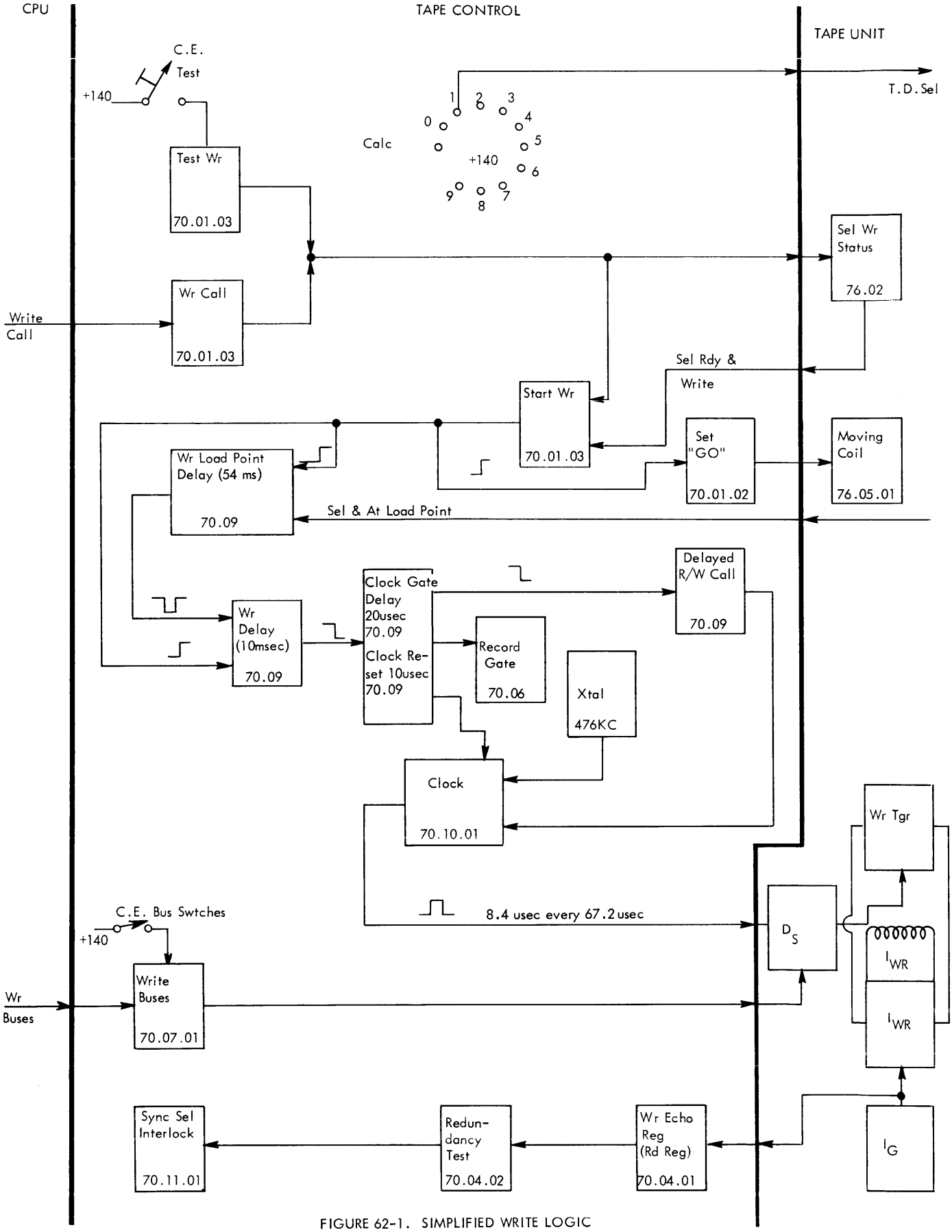


FIGURE 62-1. SIMPLIFIED WRITE LOGIC

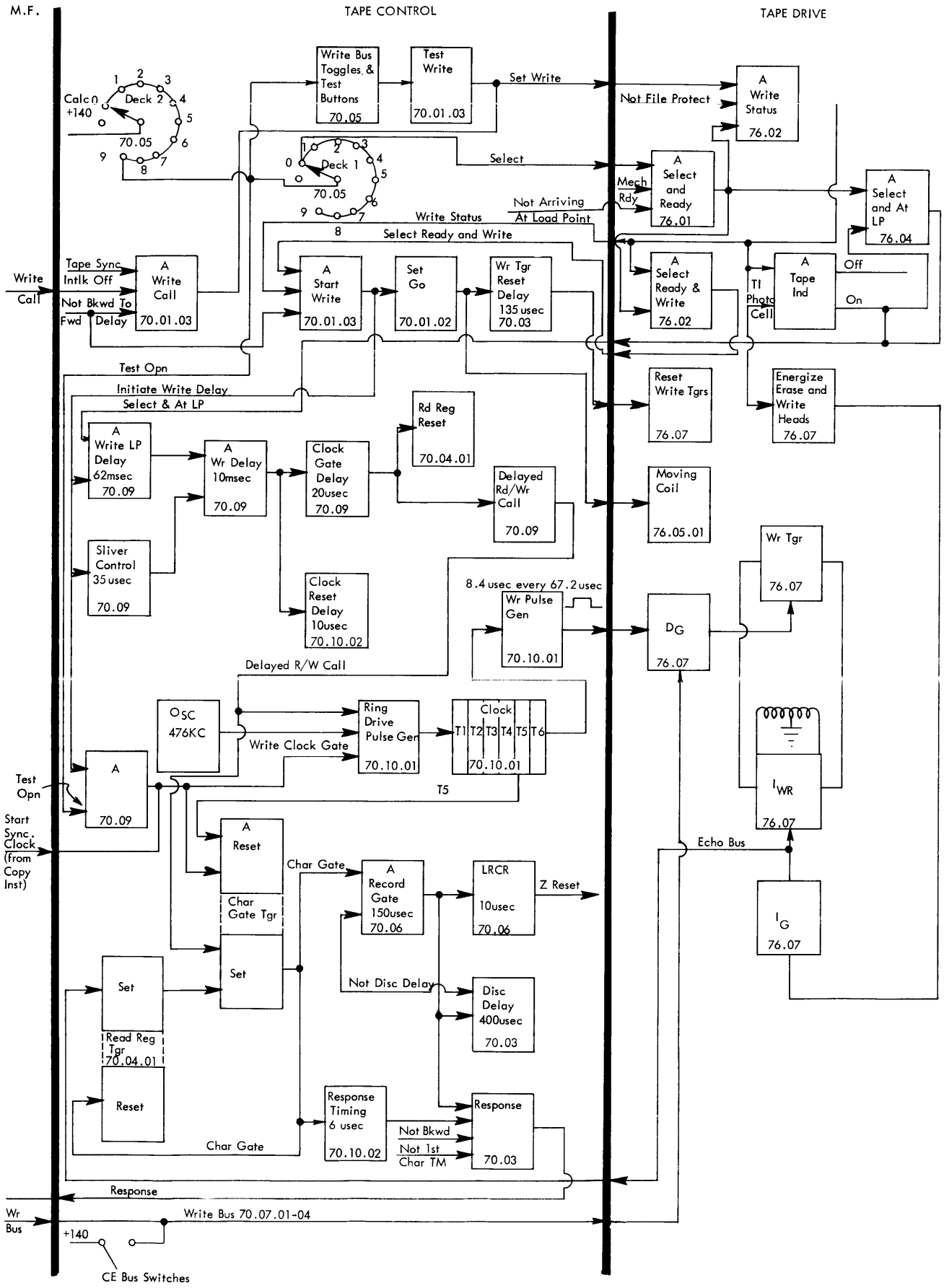


FIGURE 62-2. WRITE LOGIC

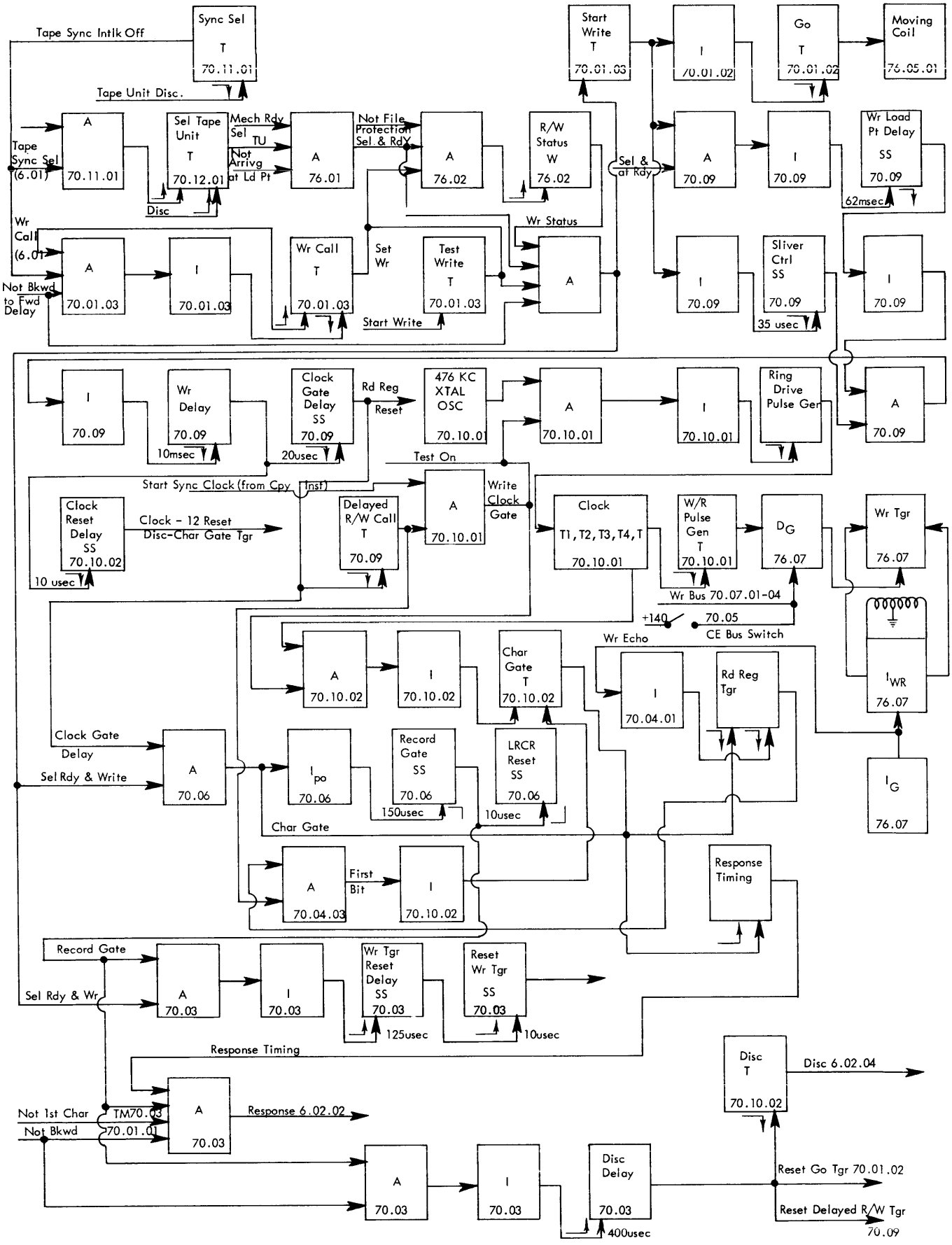


FIGURE 62-3. WRITE CIRCUITS

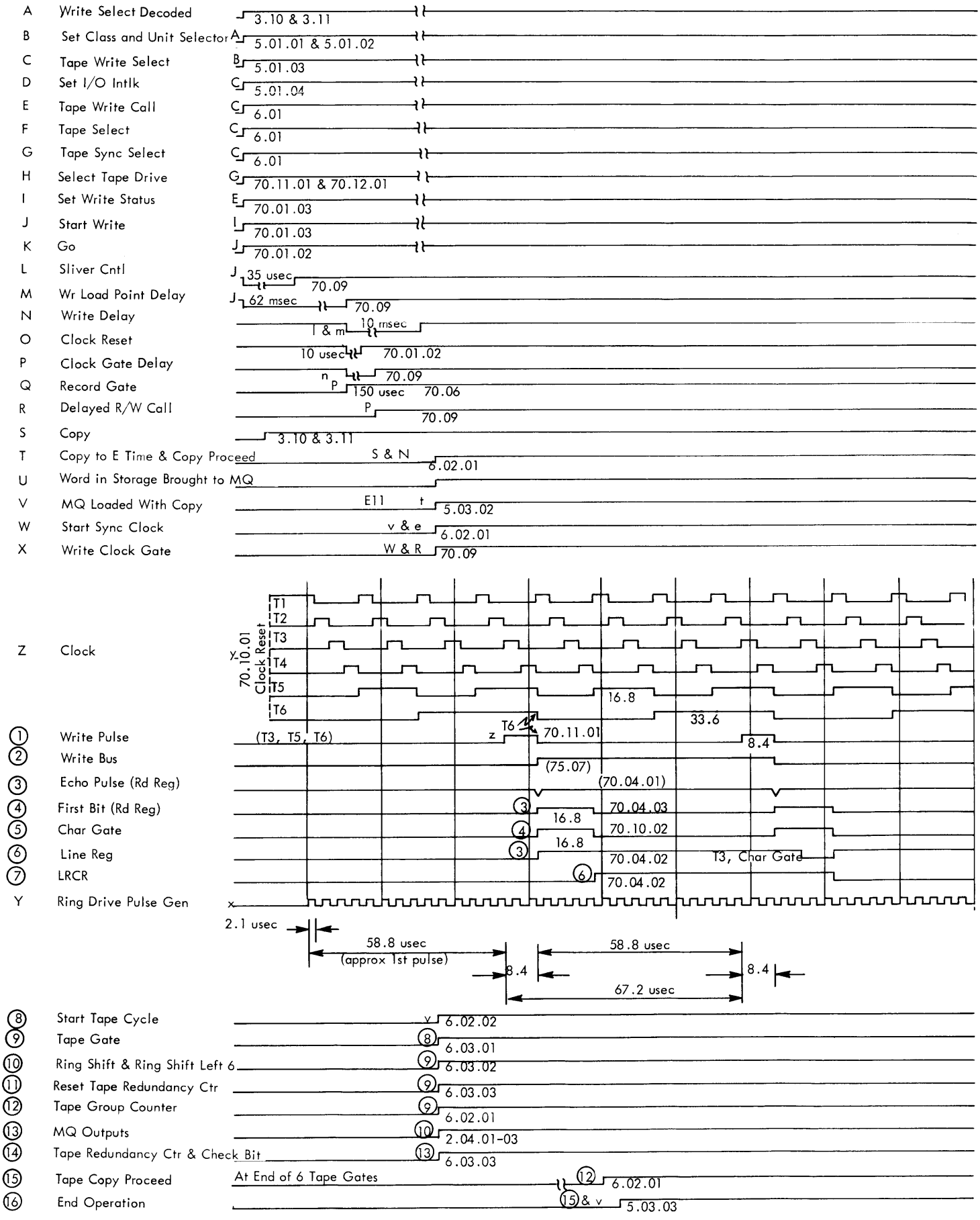


FIGURE 62-4. WRITE OPERATION

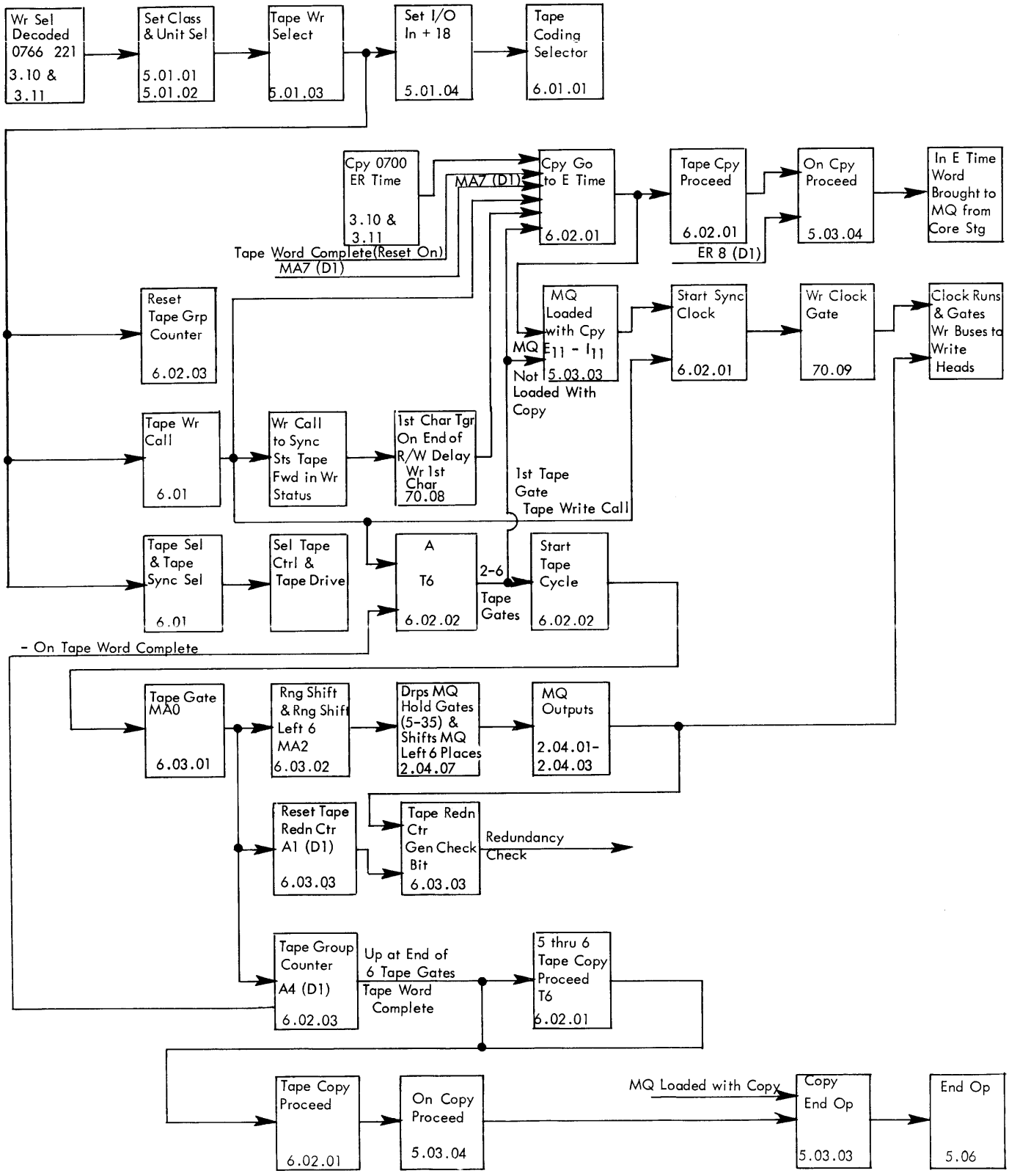


FIGURE 62-5. WRITE SELECT TAPE

753.63.00 WEOF SEQUENCE

Write End of File Call	6.01
Mf disconnect	6.01
Turn on WEOF Tgr	70.01.03
Set Write Status	70.01.03
Select, Ready and Write	75.02
Start Write Tgr On	70.01.03
Initiate Write and Load Point Delay	70.09
Set Go Tgr	70.01.02
Read and Write Delay Falls	70.09
a. Set first character tgr	70.08
b. Reset clock	70.10.02
c. Start clock gate delay	70.09
Clock Gate Delay	70.09
a. Starts record gate	70.06
b. Resets read register to 70.04.01	70.09
Clock Gate Delay Falls	
a. Delayed write and read call	70.09
Delayed Write and Read Call	
a. Write clock gate	70.10.01
b. Emit tape mark to 70.07.03, 04	70.01.03
Write Pulse (write on 1,2,4 & 8)	70.10.01
Echo Pulse Sets Read Register	70.04.01
First Bit, Character Gate Start	70.10.02
a. Pulse record gate	70.06
Character Gate Falls (on rise of T5)	70.10.02
a. Reset read register (sets line and LRCR)	70.04.01
b. Reset WEOF tgr	70.01.03
Record Gate Falls After 150 us	70.06
a. Start disconnect delay (400 us)	70.03
b. Write tgr delay (125 us)	70.03
Reset Write Tgrs (Writes Check Characters) to 75.05	70.03
a. Echo pulse sets read register	70.04.01
First Bit Starts Character Gate (33.6 us)	70.10.02
a. Character gate starts clock	70.10.01
b. T3 and T5 and character gate resets line register	70.10.01
c. Fall of T5 turns off character gate	70.10.02
d. Fall of character gate resets read register	70.04.01
e. Sets line and LRCR	70.04.02
Disconnect Delay Falls	70.03
a. Turns on disconnect tgr	70.10.02
b. Drops read and write call	70.09
c. Drops go	70.01.02
Disconnect Tgr Starts Clock	70.10.01
T3, T5 and Disconnect Resets Line Register	70.10.01
Fall of T5 Resets Disconnect Tgr	70.10.02
a. Reset tape mark tgr	70.03
b. Reset tape unit select tgr	70.12.01

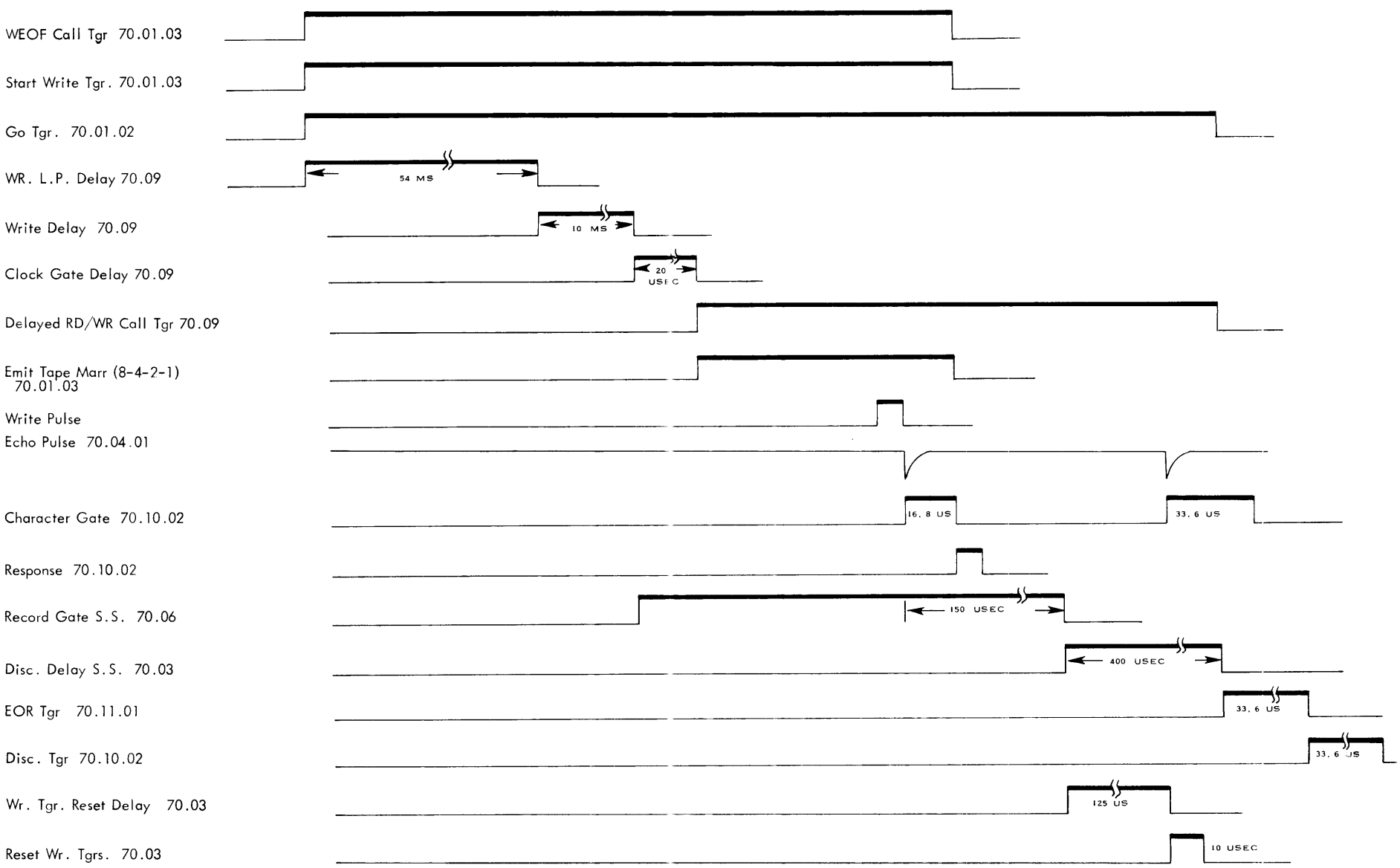


FIGURE 63-1. WRITE END OF FILE

753.64.00 READ TAPE SEQUENCE

Tape Read Call 6.01.01
- a. Set read status 70.01.02
- b. Select, ready and read 75.02

Select, Ready and Read
- a. Turn on start read tgr 70.01.02
- b. Initiate read delay 70.09 70.01.02
- c. Set go tgr on 70.01.02

Go
- a. Start tape in motion 75.05.01
- b. Reset write tgrs 70.03

Initiate Read Delay
- a. Read load point delay (20 ms) 70.09
- b. Read delay (4 ms) 70.09

Fall Read Delay
- a. Clock reset 70.10.02
- b. Set first character tgr 70.08
- c. Start clock gate delay 70.09

Clock Gate Delay
- a. Reset read register (20 us) 70.04.01

Fall Clock Gate Delay
- a. Delayed read and write call 70.09

Delayed Read and Write Call
- a. Conditions first bit and circuit 70.04.03

Read First Bit
- a. Character gate 70.10.02

Character Gate
- a. Starts clock 70.10.01
- b. T3, T5 and character gate reset line reg. 70.10.01
- c. Record gate (150 us) (reset LRCR) 70.06

Fall of T5 Drops Character Gate 70.10.02
- a. Stops clock 70.10.01
- b. Resets read register (set line and LRCR) 70.04.01
- c. Reset first character tgr 70.08
- d. Starts response 70.10.02

Response
- a. Starts tape cycle 70.03 to 6.02.02

Record Gate Falls 70.06
- a. Clock reset 70.10.02
- b. Starts disconnect delay 70.03

First Bit of Check Characters
- a. Start character gate 70.10.02

Character Gate
- a. Starts clock 70.10.01
- b. T3, T5 character gate (reset line register) 70.10.01

Fall of T5 Drops Character Gate 70.10.02
- a. Stops clock 70.10.01
- b. Resets read register (set line and LRCR) 70.04.01
- c. Reset first character tgr 70.08
- d. Starts response 70.03

Disconnect Delay Drops
- a. Turns on disconnect tgr 70.10.02
- b. Turns off go tgr 70.01.02
- c. Turns off delayed read and write call tgr 70.09

Disconnect Tgr On
- a. Tape unit disconnect 6.02.04
- b. Clock gate (starts clock) 70.10.01
- c. T3, T5 and disconnect (reset line reg.) 70.10.01
- d. Test for redundancy error 70.11.01

Fall of T5 Resets Disconnect Tgr 70.10.02
- a. Reset T.M. tgr 70.03
- b. Reset tape unit select tgr 70.12.01

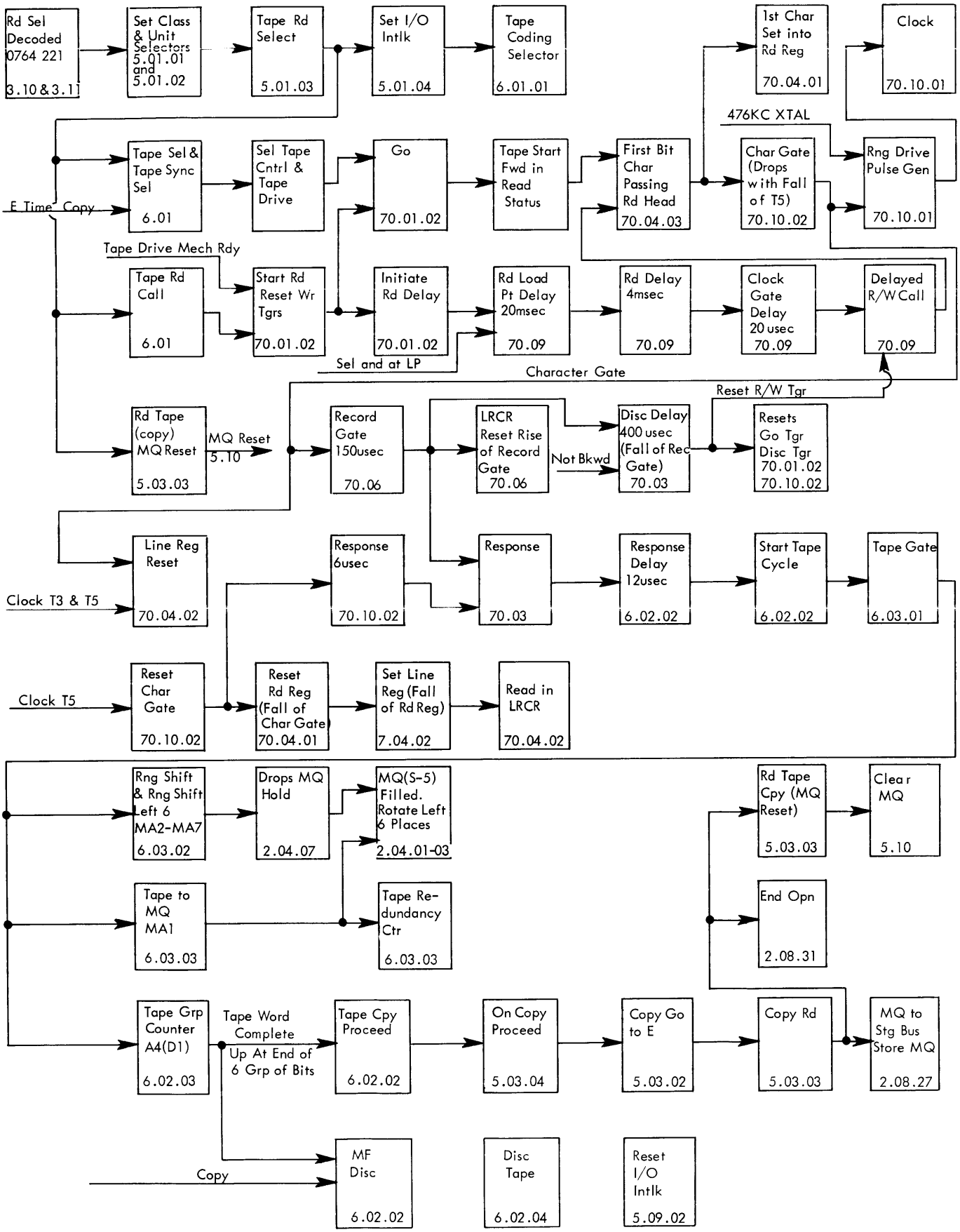


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FIGURE 64-1. READ LOGIC

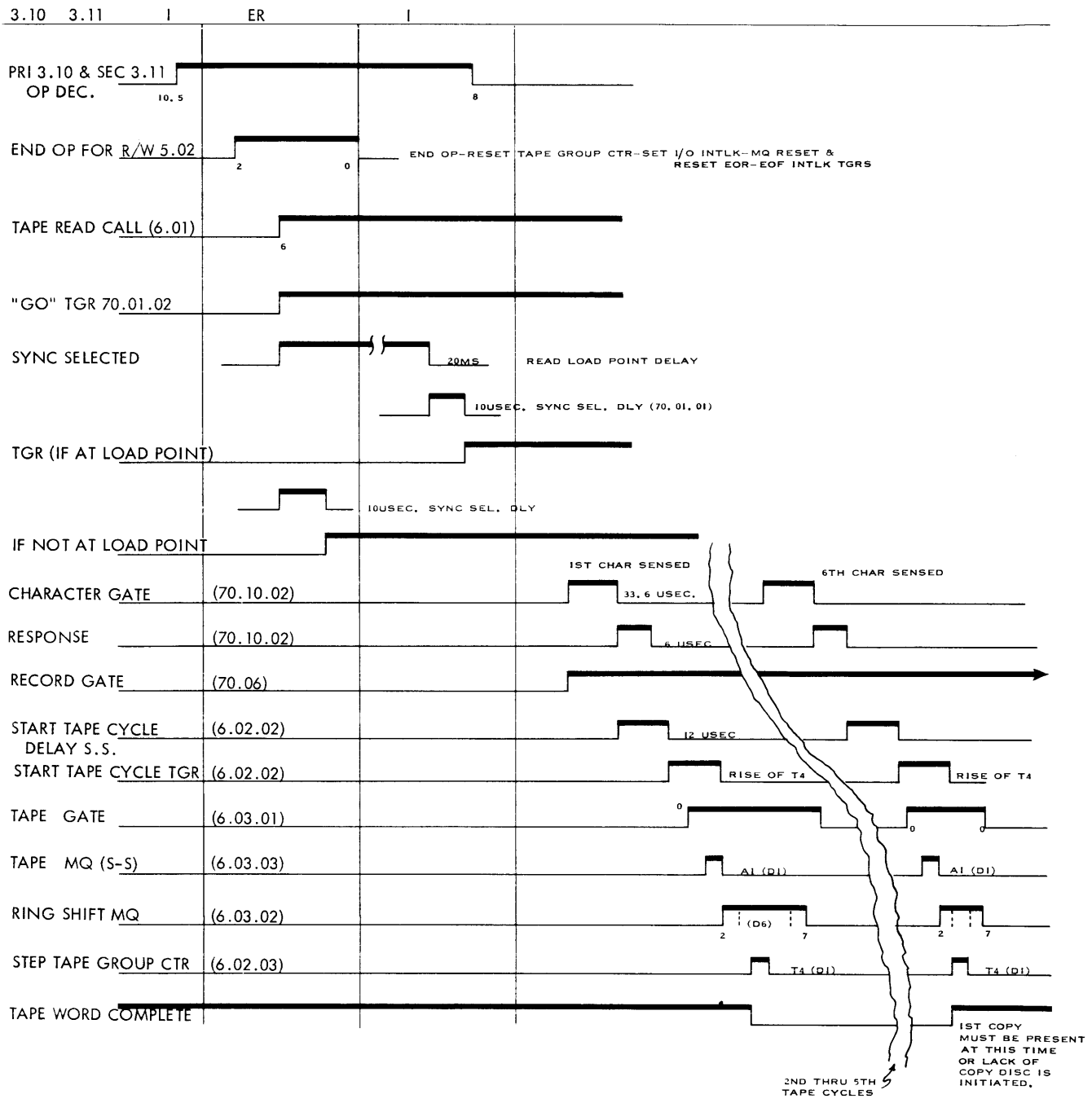

FIGURE 64-2. RDS TAPE FOLLOWED BY COPY

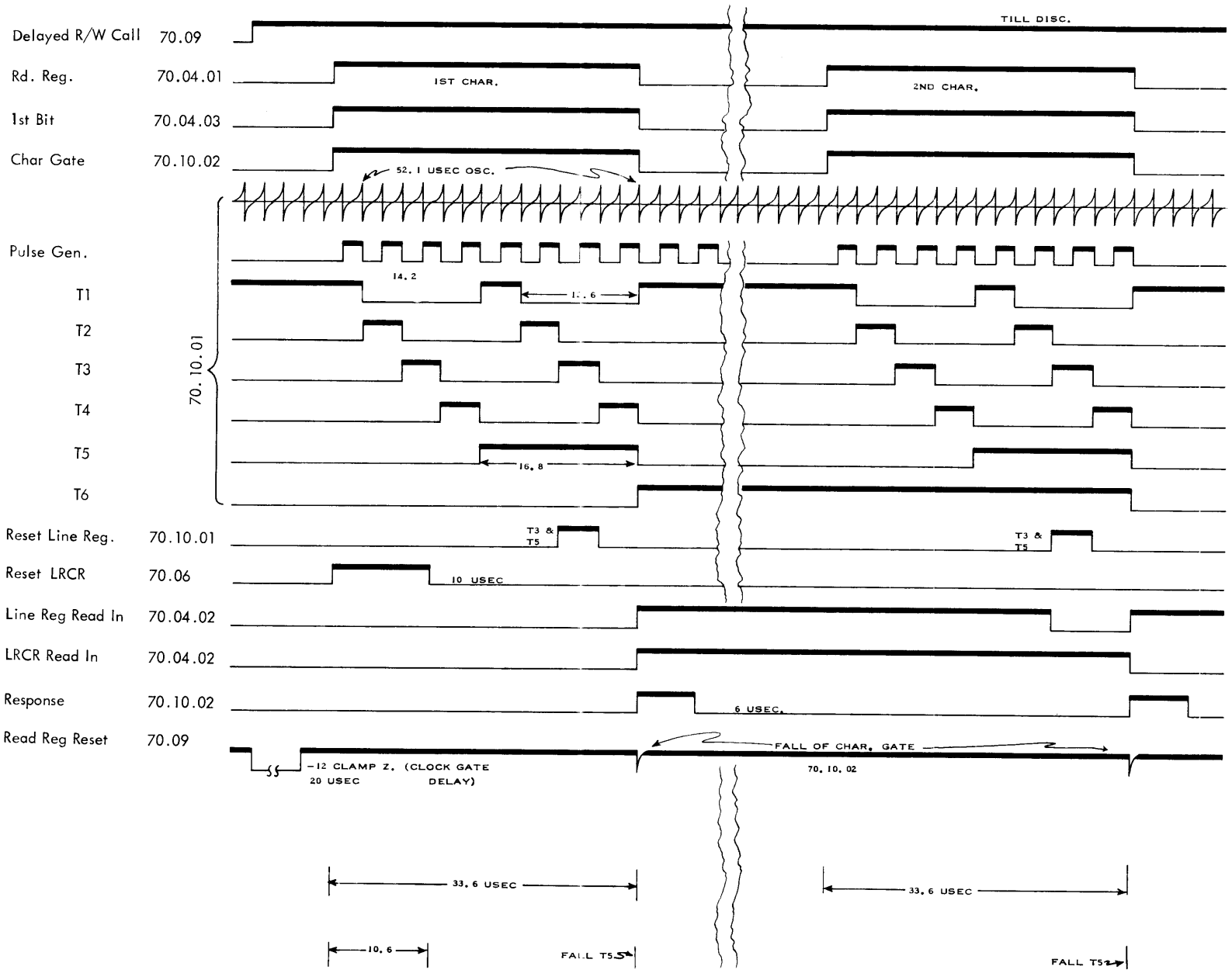

FIGURE 64-3. TAPE READ, CLOCK AND TIMINGS

753.65.00 BACKSPACE SEQUENCE

Write Status

Backspace Call 6.01
- a. Set backspace write tgr 70.01.02
- b. Start write forward before bksp delay 70.01.02
- c. Start go tgr (resets write tgrs) 70.01.02

Fall of Wr/Fwd Before Bksp Delay
- a. Turns off go tgr 70.01.02
- b. Turns on bksp after write tgr 70.09
- c. Turns on backward tgr 70.01.01
- d. Gives Mf disconnect 6.02.04

Backward Tgr On
- a. Sets reverse status 75.05
- b. Forward to backward delay (12 ms) 70.01.01

Fall of Forward to Backward Delay
- a. Turn on delayed backspace call 70.01.01

Read Status

Backspace Call 6.01
- a. Set backspace read tgr 70.01.01
- b. Mf disconnect 70.02

Bksp Read Tgr
- a. Turns on bkwd tgr 70.01.01

Bkwd Tgr
- a. Sets reverse status 75.05
- b. Forward to bkwd delay (25 ms) 70.01.01

From this point on sequence for read or write status are the same.

Delayed Bksp Call
- a. Set read status 70.01.03
- b. Initiate read delay (4 ms) 70.09
- c. Start go 70.01.02

Go
- a. Reset write tgrs 70.03
- b. Start tape in motion

Read Delay Falls
- a. Start clock gate delay 70.09
- b. Set first character tgr 70.08
- c. Reset clock 70.10.02

Clock Gate Delay
- a. Reset read register 70.04.01

Clock Gate Delay Falls
- a. Delayed Rd/Wr call 70.09

First Bit Starts Character Gate 70.10.02

Character Gate and Delay Bksp Call
- a. Beginning of record delay (500 us) 70.03

Beginning of Record Delay Falls
- a. Bkwd stop delay (1 ms) 70.03
- b. Resets delayed bksp call tgr 70.01.01
- c. Reset delay of bkwd tgr 70.01.01

Bkwd Stop Delay Comes Up
- a. Starts disconnect delay 70.03

Reset Delay of Bkwd Tgr Falls
- a. Reset bkwd tgr 70.01.01
- b. Reset bkwd after write tgr 70.09

Bksp Call Tgr Going Off
- a. Backward to forward delay (8 ms) (Inhibits any use of the tape unit till forward can be set mechanically.) 70.01.01

Disconnect Delay Falls
- a. Turns on disconnect tgr 70.10.02
- b. Turns off go tgr 70.01.02
- c. Turns off delayed Rd/Wr call tgr 70.09

Disconnect Tgr On
- a. Tape unit disconnect 6.02.04
- b. Clock gate 70.10.01
- c. T3, T5 & disconnect (reset line register) 70.10.01

Fall of T5
- a. Reset disconnect tgr 70.10.02

Disconnect Tgr Going Off
- a. Reset tape mark tgr 70.03
- b. Reset tape unit select tgr 70.12.01

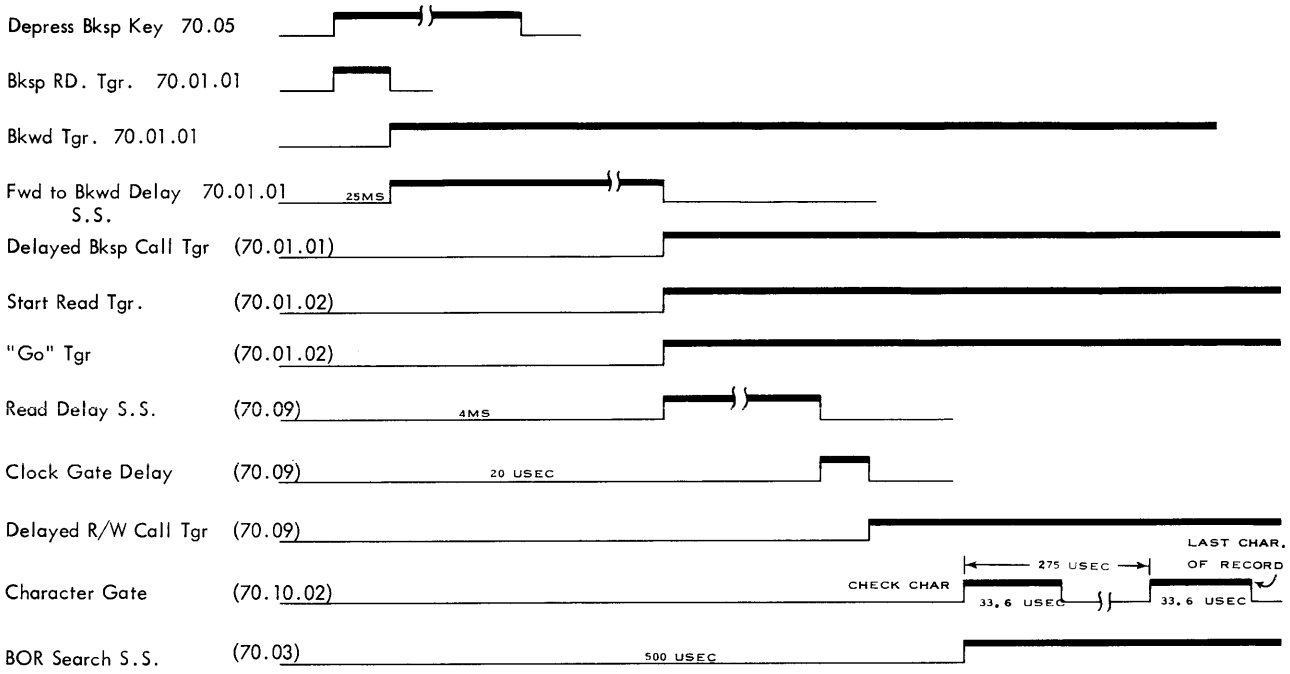

FIGURE 65-1. BACKSPACE FROM READ STATUS

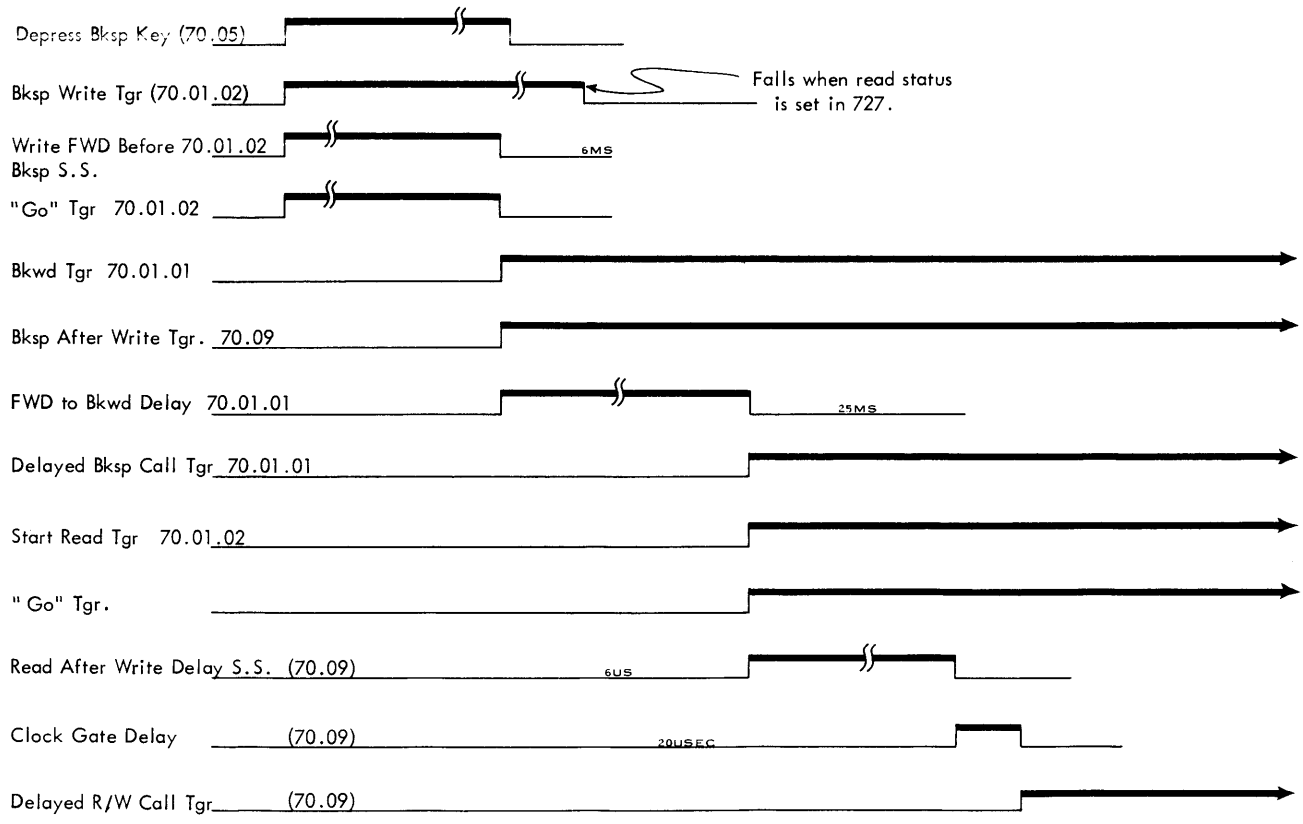

FIGURE 65-2. BACKSPACE AFTER WRITE STATUS

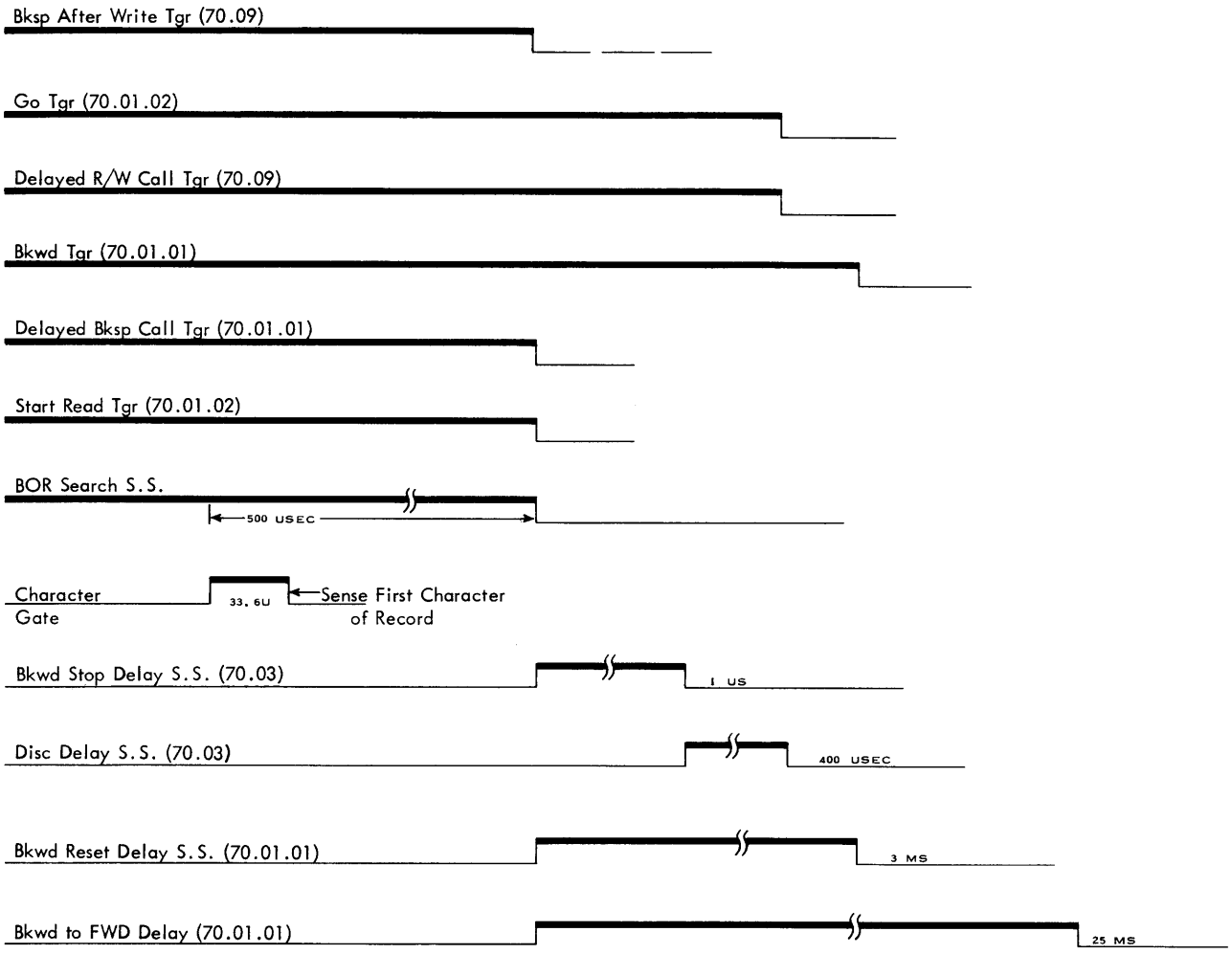

FIGURE 65-3. DISC FROM BKSP (READ OR WRITE)

753.66.00 SPECIAL INSTRUCTION LOGIC

753.66.01 End of Tape Test ETT (-0760) 011

This new instruction was added to help test for the tape indicator on condition while writing on tape. The instruction has an I cycle and one execution cycle and operates as follows:

1. The ETT instruction must be given while the tape unit is selected (i.e. after the WRS instruction and before tape disconnects approximately 500 microseconds after the last copy).
2. If the tape indicator of the selected tape unit is off, the program will skip one instruction.
3. If the tape indicator is on, it will be turned off and the program will take the next instruction in sequence (no skip).
4. The machine will not hang up if the tape indicator is on in the selected tape unit. All of the tape instructions will operate in the normal manner.

753.66.02 Backspace File (-0764) 008

This instruction was added for more flexibility to get to first record of a file. The instruction operates as follows:

When at load point, the instruction is interpreted as no operation; the calculator proceeds to the next instruction. When not at load point, the instruction causes the tape to move in a backward direction to the beginning of its file, with the R/W heads in the file gap. The calculator takes the next instruction from the next address plus one (skip an instructions).