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**IBM** Customer Engineering Reference Manual

**1620 Data Processing System**

## MACHINE RECORD

MACHINE CODE	SERIAL # <i>10756</i>	SUFF <i>E</i>	AC _____ VOLTAGE DC _____	CYCLES <i>60</i>	PHASE <i>1</i>	DATE INSTALLED
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### Factory Installed Special Features

	1620	1621	1622	1623	1624
AUTO. DIVISION	_____	_____	_____	_____	_____
TNS, TNF, MF	_____	_____	_____	_____	_____
(ADDITIONAL OP CODES)	_____	_____	_____	_____	_____
INDIRECT ADDR- ESSING	_____	_____	_____	_____	_____
<i>20,000 Char Feature</i>	_____	_____	_____	_____	_____
<i>20 T 1/13/61</i>	_____	_____	_____	_____	_____
<i>1622 PFS-b</i>	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

### RPQ's and Field Installed Special Features

MACH TYPE	DESCRIPTION	MES #	B/M #	INSTALLED		REMOVED	
				MAN #	DATE	MAN #	DATE

**MAJOR REVISION – JUNE, 1961**

This manual, Form 227-5500-2, is a major revision of the preceding edition and obsoletes Form 227-5500-1. Numerous minor changes and additions were made throughout the entire text. The adjustment procedures and specifications for the 1621 read and sync photo diodes and read head mechanics have been completely revised.

The manual contains maintenance information given in Customer Engineering Memorandums through Number 35 and in Service Information Letters through Number 23.

# IBM 1620 Data Processing System

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## Safety

**CAUTION:** Even though the voltage range on this machine is low, extreme caution should be exercised in the power supply area. Twenty amperes flow in some sections of the power supply. Each heat sink is at an electrical potential. Do not short heat sinks to each other or to the machine frame. Remove the power plug to the machine, when working on power supplies.

**CAUTION:** When working on the 1621 machine with power ON, be aware that the pinwheel drive is under control of the 1620. It is possible for this mechanism to start at any time. The reel drive motors are under control of the buffer arms; therefore, caution should be exercised whenever the arms are moved. To stop all motors on the 1621; turn the mainline switch OFF, open the tape guides, or move either buffer arm assembly upward until the upper limit switch is operated. The 1621 mainline switch removes AC voltage, +12v, -12v, and +48v DC developed in the 1620, and -48v DC developed in the 1621. The 1621 mainline switch does not open the convenience outlet circuit or the -12v DC to the integrators on 02.00.30.1.

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**Installation Instructions**

Installation problems and time can be measurably reduced by carefully reading and adhering to the following instructions.

**WARNING:** Verify that customer's power outlet has the correct potentials at each terminal of the outlet. Be especially certain that the ground terminal is grounded.

Refer to power supply voltage change in Section 4 (4.7.2) and Figure 1.

1. Remove packaging and inspect each unit for physical damage. Inventory shipping group parts and supplies against the check list in Section 8.1. Locate the two units in their proper location in the room. If it is necessary to provide physical assistance be sure that there are enough customer personnel available to handle the equipment. It is recommended that johnson bars or similar equipment be used. Necessary service clearances are listed under Machine Specifications. Remove casters after machines are located. Casters are installed to facilitate handling during shipment. Return casters to San Jose in carton provided.
2. Remove 1620 right rear table top. Four screws hold it on; two on the right end of the machine, and two available after opening gates A and B. Remove

brackets on top of 1620 front legs. The reader table can now be installed without binds. Remove typewriter shipping braces. Two nylon rods are clamped to the front guide rail on each side of the typewriter carriage. Two rubber inserts are on each side of the type basket. When installing typewriter ribbon spools make certain that teeth on top of spools point toward rear of machine.

3. Install 1620 reader table (nine screws). Open display panel to allow access room to tighten four screws at back of reader table. Place the typewriter on table and connect electric cable. Install typewriter carriage guard and rubber trim. Install right rear table top.
4. Remove tape securing console display panel and mechanical parts.
5. Mount the center roll feed (CRF) tub on the 1621.
6. Check all moving parts for freedom of movement and binds. Specifically:
  - a. Move buffer arms for full limit of their travel in both directions.
  - b. Check for binds.
  - c. Operate tape guides, checking for proper operation.
  - d. Check for freedom of movement of tape tension bar and tape runout bar.
  - e. Pull pinwheel drive motor through by hand checking for binds.
  - f. Check for binds by rotating pinwheel.
  - g. Check for freedom of movement and proper detenting of the CRF idler roller. **NOTE:** Later models have a brake mechanism instead of a detent.
7. Connect signal cable between 1620 and 1621. Connect power cable to 1621. Figure 2 indicates 1621 power cable terminals for 1620 A and B suffix without 1622 or 1623 installed. Figure 3 indicates 1621 power cable terminals for 1620 after B suffix. Figure 4 shows a sample arrangement of the 1620 System. Figure 6-3 in Section 6 shows the physical location of the 1620 isolated ground bars.
  - a. Check all X, Y, and Shoe connectors for dual contact terminals which may have backed out.

Unit	System Diagram	208V	230V
T1	01.90.10.1	Term 1 & 2	Term 1 & 3
T2	01.90.10.1	Term 1 & 2	Term 1 & 3
1250W Reg.	01.90.20.1	Term 1 & 4	Term 1 & 5
415W Reg.	01.90.20.1	Term 1 & 4	Term 1 & 5
1621 48V Supply	02.70.10.1	Term T4-1 & T4-2	Term T4-1 & T4-3

Figure 1. Power Supply Voltage Change Connections

SYSTEM DIAGRAM	1620 TERMINAL FIGURES 6-3,6-19	LINE NAME	1621 TERMINAL FIGURE 6-10	WIRE COLOR	SYSTEM DIAGRAM
01.90.30.1	PSTB1-3	-12v	T2-1	Blue	02.70.10.1
01.90.30.1	PSTB2-2	+12v	T2-2	Orange	02.70.10.1
01.90.30.1	PSTB1-8	+48v	T2-3	Red	02.70.10.1
01.90.35.1	DC ISOL GND	DC GROUND-ISOL	T2-4	Black	02.70.10.1
01.90.10.1	F4L	110v AC CON. OUT.	T2-5	Black	02.70.10.1
01.90.35.1	AC ISOL GND	AC GROUND-ISOL	T2-6	White	02.70.10.1
01.90.35.1	FRAME GND	FRAME GROUND	FRAME GND	Black	02.70.10.1
01.90.10.1	F7L	*208/230 VAC	T3-1	Black	02.70.10.1
01.90.10.1	F8L	*208/230 VAC	T3-2	White	02.70.10.1

For A and B Suffix without 1622 or 1623 Installed \* 195/220/235 VAC on 50 cycle machines.

Figure 2. 1620-1621 Power Cable Terminals A and B Suffix

- b. Check sms card seating by pressing in on the cover slats.
- c. Check for tightness of console lamp terminal connectors.
- d. Check for tightness of all screw type terminals including all ground connections.
8. Turn 1620 and 1621 mainline switches OFF. Verify that the power supplies are wired for the correct AC input voltage. Refer to power supply voltage change in Section 4 (4.7.2). Check the power supply terminals for tightness. Plug in 1620 power cord. Read voltage at input terminals.
9. Check emergency off switch operation as follows:
  - a. Pull emergency off switch.
  - b. Turn 1620 mainline switch ON.
  - c. Turn ON console power on switch.
  - d. Nothing should happen.
  - e. Turn 1620 mainline and console power on switches OFF, then reset emergency off switch.
10. Turn ON 1620 mainline switch. Depress RESET to turn OFF thermal light. Turn ON console power on switch. MACHINE READY will be delayed from 1.5 to about 8 minutes when the system is cold. The ready light will not turn ON until core memory reaches operating temperature.
11. Check to see that proper DC voltages are present.
12. Verify that all cooling fans are circulating air properly. On the 1620 there are fans in gates A, B, C, D, in each of the four power supply boxes, and one inside the front plenum on the memory unit. Air should circulate from bottom to top in the gates, and power supply boxes.

System Diagram	1620 Terminal	Line Name	1620 Terminal	Wire Color	System Diagram
01.90.32.1	PSTB4-3	-12V	TB2-1	Blue	02.70.10.1
01.90.32.1	PSTB5-10	+12V	TB2-2	Orange	02.70.10.1
01.90.32.1	PSTB4-9	+48V	TB2-3	Red	02.70.10.1
01.90.35.1	DC ISOL Gnd	DC ISOL Gnd	TB2-4	Black	02.70.10.1
01.90.32.1	PSTB5-1	110V AC Con out	TB2-5	Black	02.70.10.1
01.90.35.1	AC ISOL Gnd	AC ISOL Gnd	TB2-6	White	02.70.10.1
01.90.35.1	Frame Gnd	Frame Gnd	Frame Gnd	Blk or Green	02.70.10.1
01.90.32.1	PSTB5-5	208/230V AC*	TB3-1	Black	02.70.10.1
01.90.32.1	PSTB5-4	208/230V AC*	TB3-2	White	02.70.10.1

For A and B Suffix with 1622 or 1623 Installed and All C suffix and later

\* 195/220/235V AC on 50 cycle machines.

Figure 3. 1620-1621 Power Cable Terminals C suffix and later

13. Turn on the 1621 mainline switch. Record the outputs of all photo diodes. See Section 4 (4.8.3 Adjustment procedure Step 3).
14. Perform 1620 console checkout, error free once, at normal machine voltages.
15. Load the computer unit (CU 01) DFT. Run this test once at normal voltage. Then transfer the five MC switches (Figure 6-22). Run CU 01 once at +15% MC voltages and once at -15% MC voltage. The test should be error free during all runs.

NOTE: To set MC voltage, stop clock, place voltmeter switch in +12M position. Check to see that reading is zero percent. If meter reading is not zero percent move MC rheostat to obtain zero percent reading. Transfer (one, two, three, four, or five) MC switches. Then move MC rheostat until you obtain meter reading desired,  $\pm 15\%$  (+10.2 or +13.8v). Figure 6-22 shows location of the above items. Be certain that MC voltage is at 0% whenever any MC switch is operated. Return all MC switches to normal after tests have been completed.

16. Load parity check (CU 02) DFT. Run this test error free once at normal voltage. Run it error free with all five MC check switches transferred once at +15% MC voltage and once at -15% MC voltage.

NOTE: For Test CU 02, CE switch 9, MAR stop bypass, should be on "Bypass." Remote start key must be used. See Section 2 (2.3.1).

### Preparation for Shipment

If needed, order the following B/M's from San Jose, California. Use these B/M's to prepare the system for shipment by air or padded van.

Machine Type	Packaging Instruction Number	Carrier Type
1620	7351620V	Van
	7351620A	Air
1621	7351621V	Van
	7351621A	Air

### Machine Specifications

The following material is for your information only. Any unique problems involving machine location, air conditioning, or power requirements should be referred to District Physical Planning through the customer's salesman. Detailed information on physical planning can be found in the IBM 1620 Physical Planning Manual, Form #A26-5501.

### Power Requirements

Average full load current:	11 amps at 230v
Customer's fuse size:	13 amps at 208v
Permissible voltage variation:	±10%
Permissible line frequency:	60 $\pm 0.5$ cps
* For 50 cycle machines.	50 $\pm 0.5$ cps *

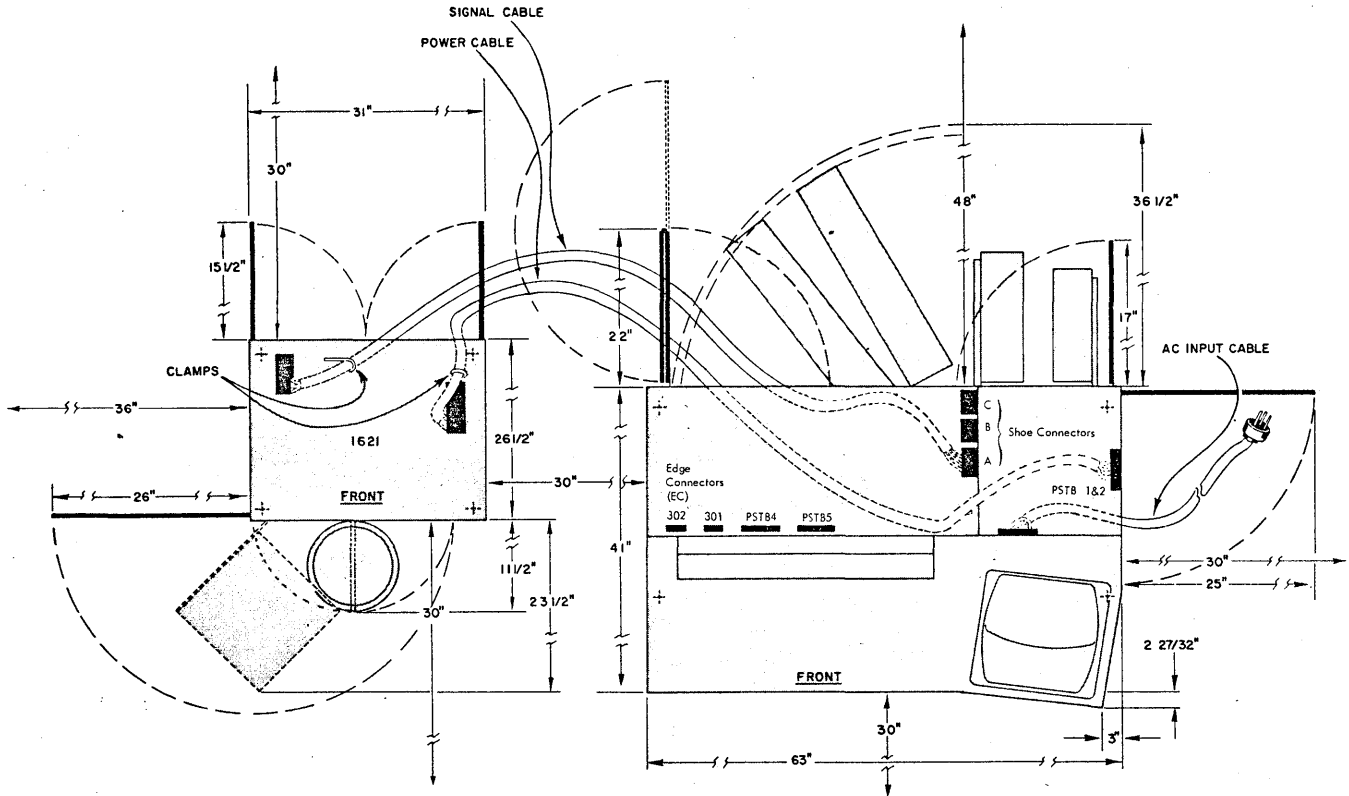


Figure 4. Sample arrangement 1620-1621

**Weights**

Unit	Total	L-End	R-End
1620 Central Processing Unit	1210#	634#	576#
1621 Paper Tape Reader	302#		
961 Paper Tape Punch	46#		

**Service Clearances**

Unit	Front	Rear	L-Side	R-Side
1620	30"	40"	30"	30"
1621	30"	30"	24"	24"

**Unit Dimensions with Covers**

Unit	Length	Depth	Height
1620 Central Processing Unit	63"	44"	44"
1621 Paper Tape Reader	31"	26.5"	44"

**Temperature Requirement**

The air entering the 1620 System must be between 60° and 90°F whenever the system is operating. Normal heat dissipation for the 1620 is 5,000 BTU/hour. Normal heat dissipation for the 1621 is 2,000 BTU/hour.

**Unit Dimensions without Covers**

Unit	Length	Depth	Height
1620 Central Processing Unit	59"	29"	44"
1621 Paper Tape Reader	30"	25"	44"

**Air Filtration Requirement**

Normal filtration of the area, for dust control, can be met with filters that have an efficiency rating of 20% by the National Bureau of Standard Discoloration Test method. Special air filtration is necessary in only those installations which will be subject to corrosive gases, salt air, or unusual dirt or dust conditions.

# 1 Scheduled Maintenance

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### 1.1 Approach to Scheduled Maintenance

The prime objective of any maintenance activity is to provide maximum machine availability to the customer. Every scheduled maintenance operation should assist in realizing this objective. Unless a scheduled maintenance operation cuts machine down time, it is unnecessary.

Do not adjust or disassemble a unit that is working properly, even if tolerances vary from specification.

#### 1.1.1 Visual Inspection

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, cracks, binds, burnt contacts, and loose connections and hardware. Alertness in noticing these items may save later machine downtime.

#### 1.1.2 Electronic Circuits

Diagnostic programs, marginal checking, and pulse checking are the three basic tools used in scheduled maintenance of electronic circuits. All of these are effective in locating potential and intermittent troubles. These items are also excellent troubleshooting tools. When using them for scheduled maintenance, use them only as directed on the scheduled maintenance chart.

Do not adjust pulses unless the condition of the machine warrants it.

#### 1.1.3 Mechanical Units

The three basic scheduled maintenance steps performed on every mechanical or electromechanical machine are clean, lubricate, and inspect. Remember, do not do more than recommended scheduled maintenance on equipment that is operating satisfactorily.

### SCHEDULED MAINTENANCE ROUTINE

Code	Unit or Routine	Frequency	Operation
8	Marginal Tests	13	Run DFT #CU01 and CU02, at +15% on the +12M supply. Correct all troubles indicated by these Tests.
0	Filters	26	Check for dirty filters. Replace as required. Check that the cooling fans are operating.
3	CB's		Lubricate Cams, Rollers, Pivots. Visually check for proper air gap and contact burning.
9	Misc		Check for loose D gate voltage jumpers. Inspect for loose voltage jumpers to panels from laminar bus strip on Gates A and B. Check ground connections on laminar bus terminal block, AC-DC isolated ground. Check adjustments of selector common contacts.
2	Typewriter	52	Lubricate Drive Motor. Clean and lubricate carriage rails. Brush out dirt. Check belts, linkage, power roll, platen and other functional components for looseness and wear. For detailed information refer to C.E. Reference Manual "BI Electric Typewriter", Form 223-6652.
7	Relays		Check for burned points, air gap and rise. Check that pick, hold and coil common contacts are not pushed back.
8	Power Supplies		Check cables and wiring for loose terminals and overheated insulation.
			1620 Group



SCHEDULED MAINTENANCE ROUTINE

Code	Unit or Routine	Frequency	Lubricate - Clean	Observe
1	Read (Tape Reader)	26	Drive Motors and pivot points #6. Cam Surfaces and detents #17.	Drive belts for wear and tension. Idler Rollers for freedom of movement. Relay and contact rise and contact point condition.
			Remove head left side cover and carefully remove paper dust. Look for excessive dust accumulation around pinwheel. Then if necessary, remove head left side and clean. Clean photo diode window thoroughly and surrounding external area.	
4	Punch (1624 Tape Punch)	52	Lubricate punch clutch, pivot points, motor and C.B. rollers and pivots.	Observe drive belt tension and check for wear.
8	Power Supplies			Check cables and wiring for loose terminals or overheated insulation.
			Photo diode outputs, sync, clutch, and brake adjustments do not require scheduled maintenance but may if failures are experienced in these areas.	
				1621 Group

**1.2 Marginal Checking**

A pulse, as it travels through successive stages, may experience a decrease or increase in width, which if serious enough, will cause incomplete switching or improper timing.

Marginal checking is a preventive maintenance technique used to detect the marginal operation of circuits within a machine system.

By varying the +12M the CE can inspect a machine system and replace circuit assemblies which are approaching a failure condition.

This technique will reduce downtime of the system during customer operation.

Running the diagnostic function test (CU 01) with the +12M reduced -13% (-1.8v) increases transition delay time in the transistors. If transition time has deteriorated, this test can be used to show the area involved. Transition delays are cumulative. The most critical areas are where a number of logic blocks are in series, such as the incr/decr switch.

The Diagnostic Function Test Manual gives test routines with associated flow charts for aiding the Customer Engi-

neer in locating trouble. The tests can be used to check machine performance following PM.

**1.2.1 Marginal Check Unit**

The marginal check unit consists of a special power supply with a variable output voltage. This unit is placed in series with the +12v supply and permits the Customer Engineer to change the +12v a maximum of  $\pm 3$  volts.

**WARNING:** The MC voltage must be at zero before any MC switches are transferred. Adjust the MC rheostat for a zero percent meter reading.

Five switches are provided (Figure 6-22) to allow control of the voltage by gate (A1, B2, etc.) Any one or more may be used at a time. In the normal (down) position the 12M supply is fed directly from +12v supply. With the switches transferred (up) the marginal check unit is in series with the +12v supply and the MC rheostat can be used to vary the 12M supply to the gate selected by the switch or switches.

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### 2.1 Troubleshooting

Rapid and effective diagnosis depends upon thorough knowledge of the machine logic and efficient use of diagnostic tools.

When a failure occurs that stops the machine, make a note of all pertinent information. Record the contents of the memory address register (MAR), the memory buffer registers (MBR), the memory data register (MDR), the operation register, and other console and panel indicators. This check of indicators will usually reveal the operation and the particular step of the operation being performed when the error occurred.

Check power supply voltages. If any are not within specified limits, correct the condition. This may be the trouble.

Try to localize the trouble before operating the machine. It is possible that a static check, with the computer remaining in the error condition, will reveal the trouble. If it doesn't, try to reconstruct the operation (instruction) using the same addresses and data. Single cycle through the I and E cycle, observing all indicators. Analysis of indicators and data may point to the trouble.

The Diagnostic Function Tests, CU 01 and CU 02, and the CE test panel are effective aids in diagnosis.

### 2.2 Diagnostic Function Tests

The Diagnostic Function Test manual provides:

1. A console check out procedure.
2. A fault detection test to check for proper functioning of all standard operation codes, DFT CU 01.
3. A fault detection test to check for proper functioning of the VRC circuits, DFT CU 02.

The fault detection tests are made up of a number of subroutines. Test CU 01 checks an operation code for specific conditions. Each subroutine can be run as an individual test. Test CU 02 causes invalid information to be presented to the various checking circuit. Each CU 02 subroutine can be run as an individual test.

For a complete description of this test program see the Diagnostic Function Test manual.

**NOTE:** When running CU 02, CE switch 9, MAR stop bypass should be on "Bypass." Remote start key must be used. See Section 2.3.1.

### 2.3 Customer Engineering Test Panel

The CE test panel (Figure 2-1) contains switches and circuits to provide a means for checking the operation of memory and associated circuits, operating the clock without a program, and repeating a specific cycle. The panel contains a light which, when lit, indicates the clock is running.

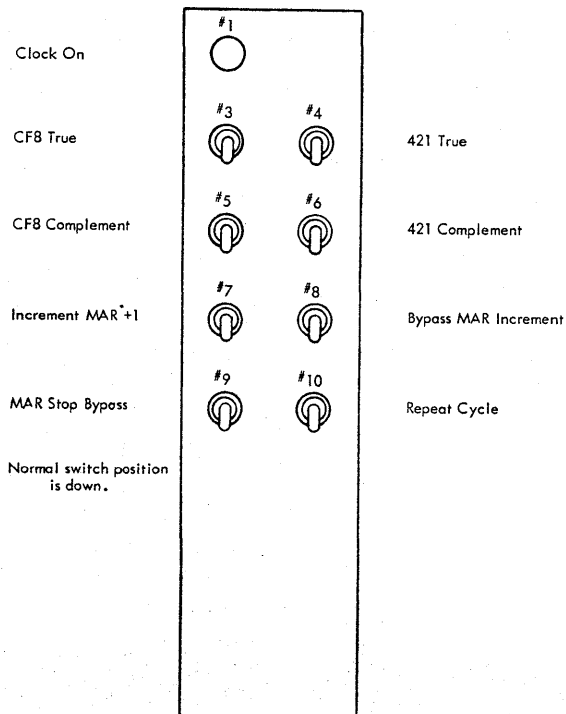


Figure 2-1. Customer Engineering Test Panel Switches

### 2.3.1 CE Switch Functions

#### CE SWITCH 7 INCREMENT MAR +1

This switch, when transferred, suppresses instruction cycles and allows MAR to increment by one when the clock is running. This switch may be used to start the computer cycling beginning with any address stored in IR -1. It is located on 01.05.50.1.

#### CE SWITCH -8 BYPASS MAR INCREMENT

This switch, CE SW8 on 01.05.50.1, when transferred causes MAR to remain at the address which is stored in the IR -1 register of MARS. With this switch and CE switch 7 transferred and the clock running, the 1620 will continually read and write at the same memory address, the address in IR -1.

#### TRUE/COMPLEMENT SWITCHES

The true/complement switches are CE switches 3, 4, 5, and 6 seen on 01.05.50.1. These four switches are used in various combinations. They allow a CE to perform the operations described below:

*True Operation.* All four true/complement switches are set normal (down). At read time, data in memory is placed in MBR. At write time, the data in MBR is written into memory. The data in MBR controls the Z or inhibit drivers.

*Complement Operation.* All four true/complement switches are placed in the transferred (up) position. At read time the data in memory is placed in MBR. At write time the data in MBR is passed through the inhibit control logic. The bit complement of the data is then written in memory. For example, the bits C, F, and 1 are read from memory at read time. The bits 8, 4, and 2 are written back into memory.

*Force Operation.* The setting of the true/complement switches controls what is written into memory. They may cause data to be stored in every bit position of a memory address, called forcing all bits. They may cause no data to be stored in each of the six positions, called blanking memory. They may cause data to be stored in the C, F, and 8 bit positions, called forcing flag-eights. They may cause data to be stored in the 4, 2, and 1 bit positions, called forcing 7's.

When forcing, data is read from memory into MBR at read time. At write time, MBR has no control over what is to be written back into memory. The true/complement switches control writing. The table below shows the proper switch settings for forcing operations.

CE Switches	#3	#4	#5	#6
Operation	CF8 True	421 True	CF8 Complement	421 Complement
Force all bits	Normal	Normal	Transferred	Transferred
Blank Memory	Transferred	Transferred	Normal	Normal
Force "flag-8's"	Normal	Transferred	Transferred	Normal
Force "7's"	Transferred	Normal	Normal	Transferred

**WARNING:** Set CE switches 3, 4, 5, and 6 to true (down) before returning computer to customer.

#### CE SWITCH 9 MAR STOP BYPASS

Transferring this switch allows the clock to run when there is a MAR check. Transferring it also cripples the console start switch. With this switch transferred, the clock may be started (1) by the CE remote control box or (2) by depressing the console SIE or SCE key. (Transferring CE switch 7 allows the console SIE key to substitute for the console start key.)

This switch should be used for diagnosing trouble in the clock, MAR, MARS, and increment-decrement circuitry. It is not recommended for use in analyzing memory troubles, because a MAR error would adversely affect memory operation.

#### CE SWITCH 10 REPEAT CYCLE

This switch when transferred prevents the A/B trigger from changing. Use it when it is desired to repeat a particular cycle during machine analysis. This switch must be transferred in the cycle preceding the one to be repeated. For example, to repeat a particular E14 cycle:

1. Single cycle to the E13 cycle known to precede it.
2. Transfer (up) CE switch 10.
3. Start clock.

**NOTE:** During this operation, addresses will change unless bypass MAR increment, CE switch 8, is transferred. Also certain logic conditions may have to be grounded to give a complete repeat cycle.

## 2.4 Trouble Symptoms and Cures

### 2.4.1 Dropping or Picking Up Bits in Memory

1. Intermittent dropping of bits in memory can be caused by the voltage difference between the +30 and the +12 being less than stated on the power supply voltage specification chart (Figure 2-2). Adjust the voltages to specifications.

Intermittent picking up of extra bits in memory can be caused by the voltage difference between the +30v and +12v being greater than specified. Adjust the voltages to specifications.

To test with worst case bit pattern, depress INSERT; type 3100016000127788; RELEASE; START. The test pattern should now be reading and writing progressively through memory.

Nominal Voltage	Meter Reads	Nominal Voltage	Meter Reads
-36	%	10.2	%
-12A	%	Norm	%
-12B	%	13.8	%
+12	%	+24	
+48	%	+30	

+12M

The Difference Between The +12 And +30 Supplies Must Be Volts  $\pm$  4% For Optimum Memory Operation. The Set Points Shown Provide This Difference.

Figure 2-2. Power Supply Voltage Specification Chart

**WARNING:** The +30v is set at the factory for optimum memory operation. It is not to be changed unless tests and checking with a precision voltmeter calibrated to  $\pm 0.25\%$  indicate the power supply output checked at the gate is incorrect.

2. A defective WY card (pre-sense amplifier) in the memory area will drop a particular bit every fourth cycle while incrementing through memory. That is, every other odd or every other even cycle in the less than 50 or greater than 50 address area.

As a rule only one side of a card will fail. Therefore it will accept a pulse of only one polarity.

Set the CE switches to increment through memory with a bit pattern to include the dropped bit (determined by MBR-VRC). If the failure shows every fourth cycle, replacement of that particular WY card is indicated.

#### 2.4.2 Input-Output Failures

##### TYPEWRITER

To ensure reliable 1620 operation, all typewriter contacts must be carefully adjusted for proper contact air gap, adequate strap tension and sufficient over-travel when made.

1. A maladjusted selector common contact may cause MAR to increment when the flag key is activated. (MAR should not increment.) A bouncing contact may send double digits into memory (31224 instead of 3124). Selector common contact #1 must make before and break after the #2 contact. In addition, the keyboard contacts must make before and break after selector common contact #1. Selector common contact #2 should have a minimum duration of 10 ms. See Section 4 (4.6.1) for adjustments.
2. A bouncing carriage return contact may cause skipped I/O instructions, multiple I cycles and/or simultaneous I and E cycles. The n/o contact should have at least .010" rise from its support strap. This .010" minimum rise must be maintained during the entire length of the carriage return.

3. Insufficient strap tension of the tab interlock contact will cause contact bounce that results in skipped I/O instructions. The n/o strap must be adjusted for a .020" to .030" contact rise when made.
4. Characters may fail to print if the clearance between the print magnet armature stop bail and the print magnet armature is greater than .075" with the armature attracted.

##### PAPER TAPE READER

1. Dropping of the first character (usually on short records) after the EL indicates a brake or clutch failure. Check adjustments.
2. Dropping of the first character after a record mark is usually caused by the pin wheel shaft not stopping fast enough. This is due to insufficient brake or too much clutch action. For adjustment see Sections 4.11.2 and 4.11.3.
3. Correct sync timing must be maintained. A maladjusted sync can cause intermittent read failures that are difficult to diagnose. Erroneous read-ins from the paper tape may show up as data checks in MBR Odd-Even without a read check if the sync timing is not properly adjusted.  
NOTE: Clogged or dirty holes in the sync timing disk can result in occasional loss of a sync pulse.
4. To ensure that the punched paper tape feeds and reads reliably in the IBM 1621, the tape must be in good registration. To check tape registration, use Tape Gage, P/N 460005. The adjustment procedure is on page 50 of the IBM 870 Document Writing System CE Reference Manual, Form 223-6890. This manual is included in the tools and supplies that are sent with all 1620 systems leaving the plant.
5. Dirt, lint, and dust on the read head assembly can cause photo diode sensing failures. It is recommended that customer personnel lightly brush the read head assembly prior to each eight hour operating shift. Frequency of cleaning should be adjusted to meet environment and operating conditions.

#### MISCELLANEOUS I/O FAILURES

Intermittent input/output failures have been traced to loose voltage connections in "D" gate. The voltage jumpers to the SMS pins connect to edge connectors on the right side of the gate by means of a round barrel type terminal that slips over the small pins in the edge connector blocks. If the barrel terminal is malformed, or if it is not fully inserted on the pin, a poor connection exists.

#### 2.4.3 Miscellaneous Failures

1. If the output of an emitter follower (DE) goes to +12v, the DE transistor is burned out or the DE input is floating.
2. If the value of an S line goes to +2v or more, a possible cause is a broken line to the Q pin (+12v) of an emitter follower (DE). The cause may be found on the DE developing the S line or on a DE whose output line is common with other S lines at an "A" block. An example of the latter situation is on 01.55.29.1 at the AND switch 01A1B24. If pin F of this switch was at +2v, the cause could be pin H at +2v. The +2v at pin H could be caused by pin Q on DE 01A1B12 on 01.55.15.1 being open.
3. Inadequate air circulation has caused random data checks (MAR, MBR) and other intermittent machine malfunctions as a result of a burned out, frozen, or slow turning muffin fan. These failures are usually hard to diagnose because the gate thermals do not always kick out to initiate a power down sequence.

4. A maladjusted or binding start key will lock the machine in an error status when a machine RESET is attempted. Triggers that should be reset will remain on and, in general, the console display will be difficult to interpret.
5. Loose XY, slipon, and terminal connectors can cause intermittent troubles that are difficult to diagnose. Loose XY connector pins can be detected by a visual check of the rear of the connector for pins that have slipped back from the plastic XY block. The crimped end of the XY connector pins should all have a uniform projection from the rear of the XY block. The use of a flashlight or trouble light is recommended.

#### 2.4.4 Static Electricity

Static electricity discharging through the machine frame to ground can induce noise spikes throughout the machine circuitry. These spikes will, at times, be of sufficient amplitude and duration to cause random failures that are almost impossible to diagnose.

The static electricity is usually caused by low humidity coupled with the existence of carpets in the area of the 1620. Machine failures as a result of static electricity can be directly related to personnel or objects that are statically charged contacting the machine frame. If it is determined that this condition exists, contact the local IBM Physical Planning representative or Plant Customer Engineering, San Jose.

### 3 Condensed Logic

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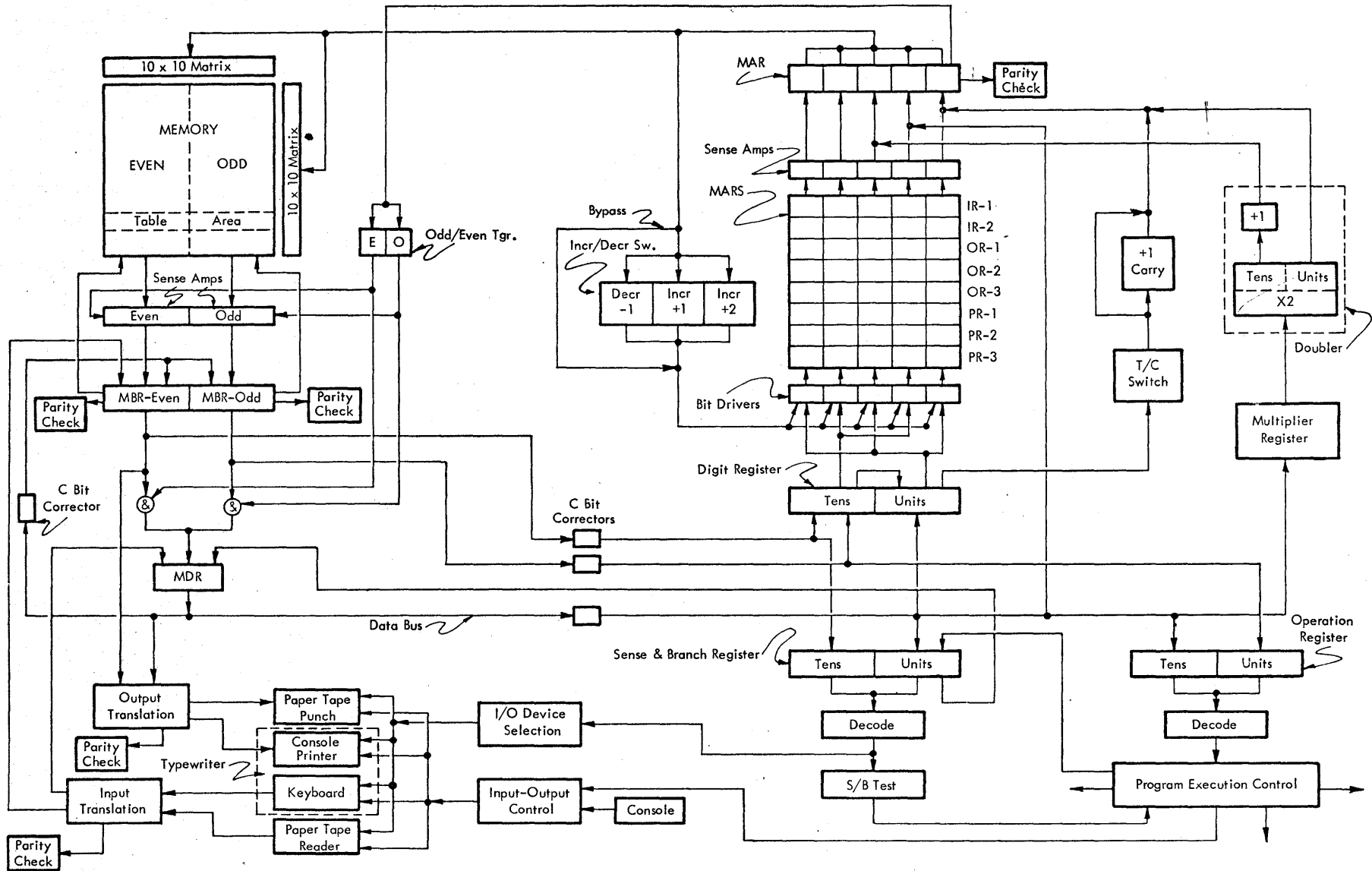


Figure 3-1. Data Flow

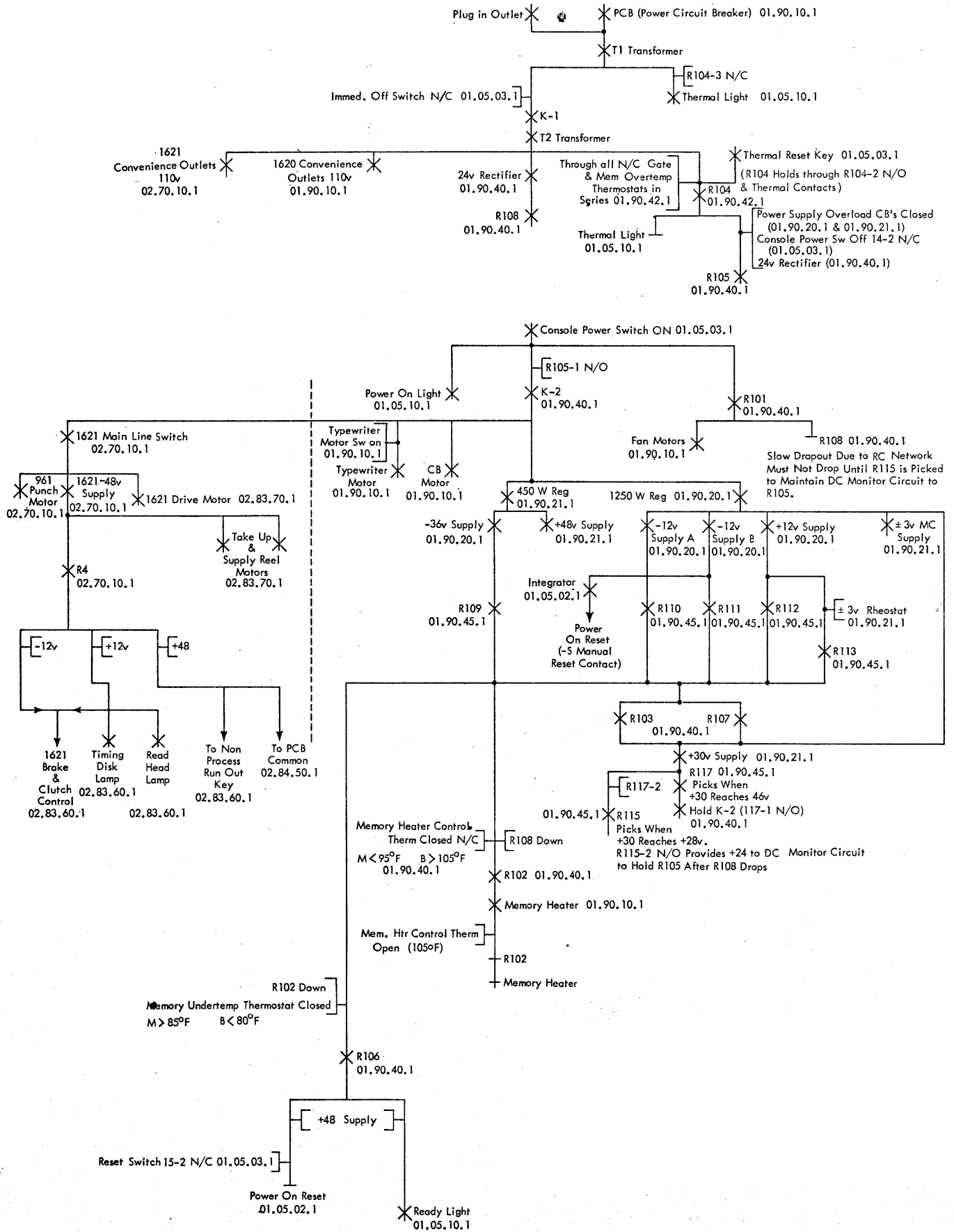


Figure 3-2. Power On Sequence



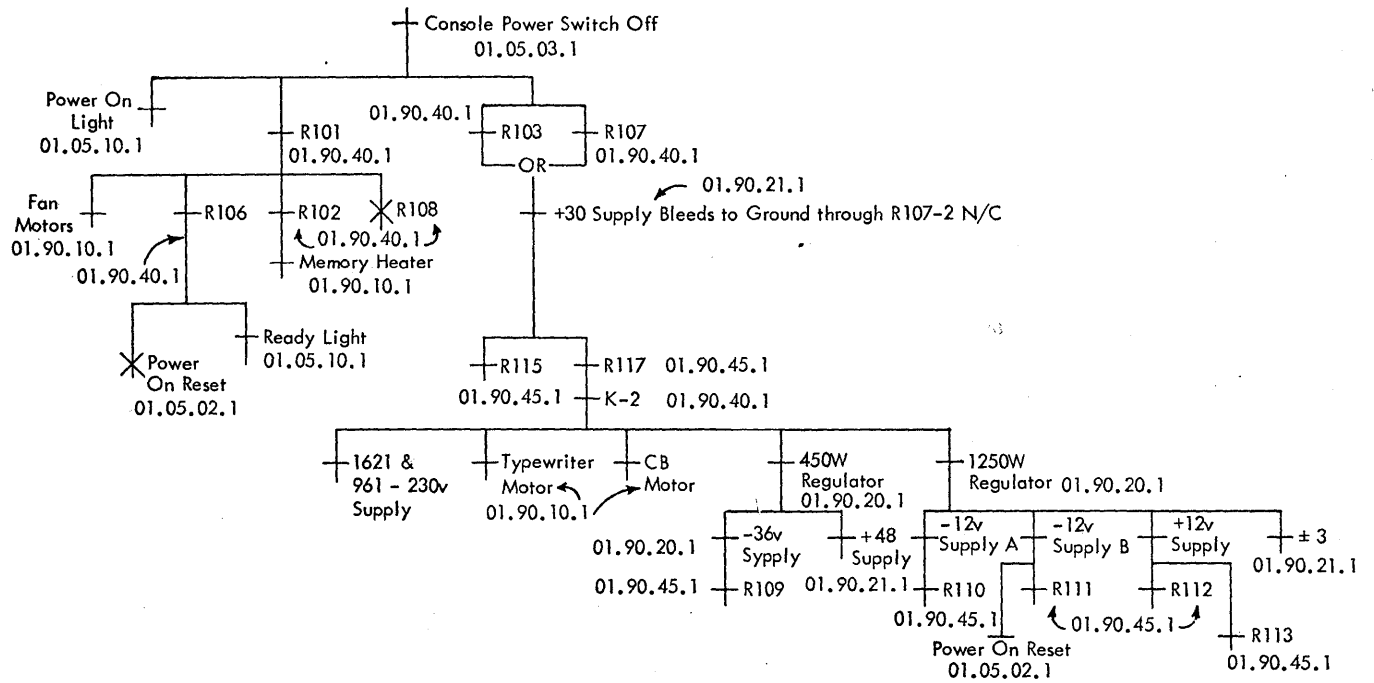


Figure 3-3. Console Power Switch Off

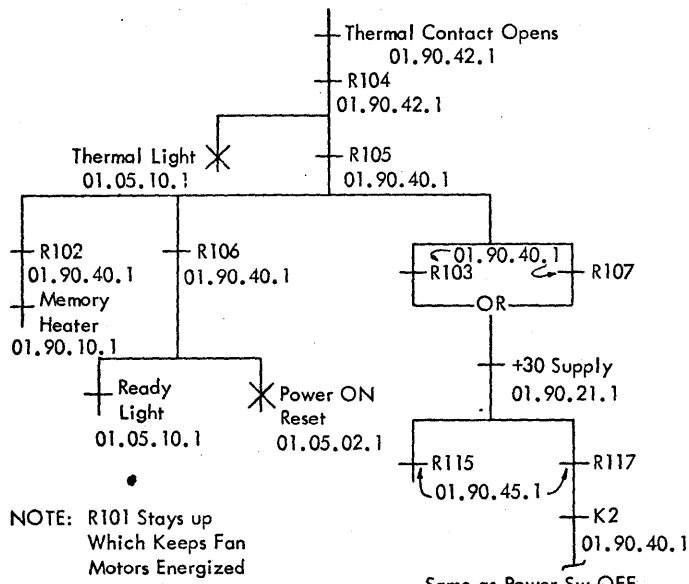


Figure 3-4. Thermal Overtemperature Trip

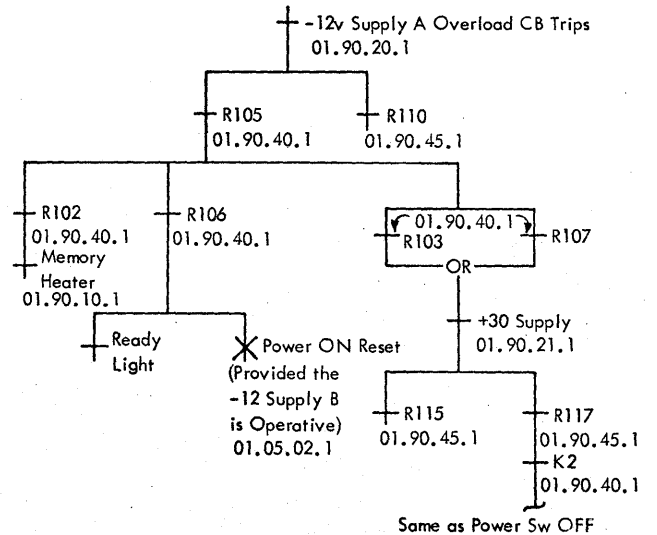


Figure 3-5. sms dc Power Supply Overload Trip

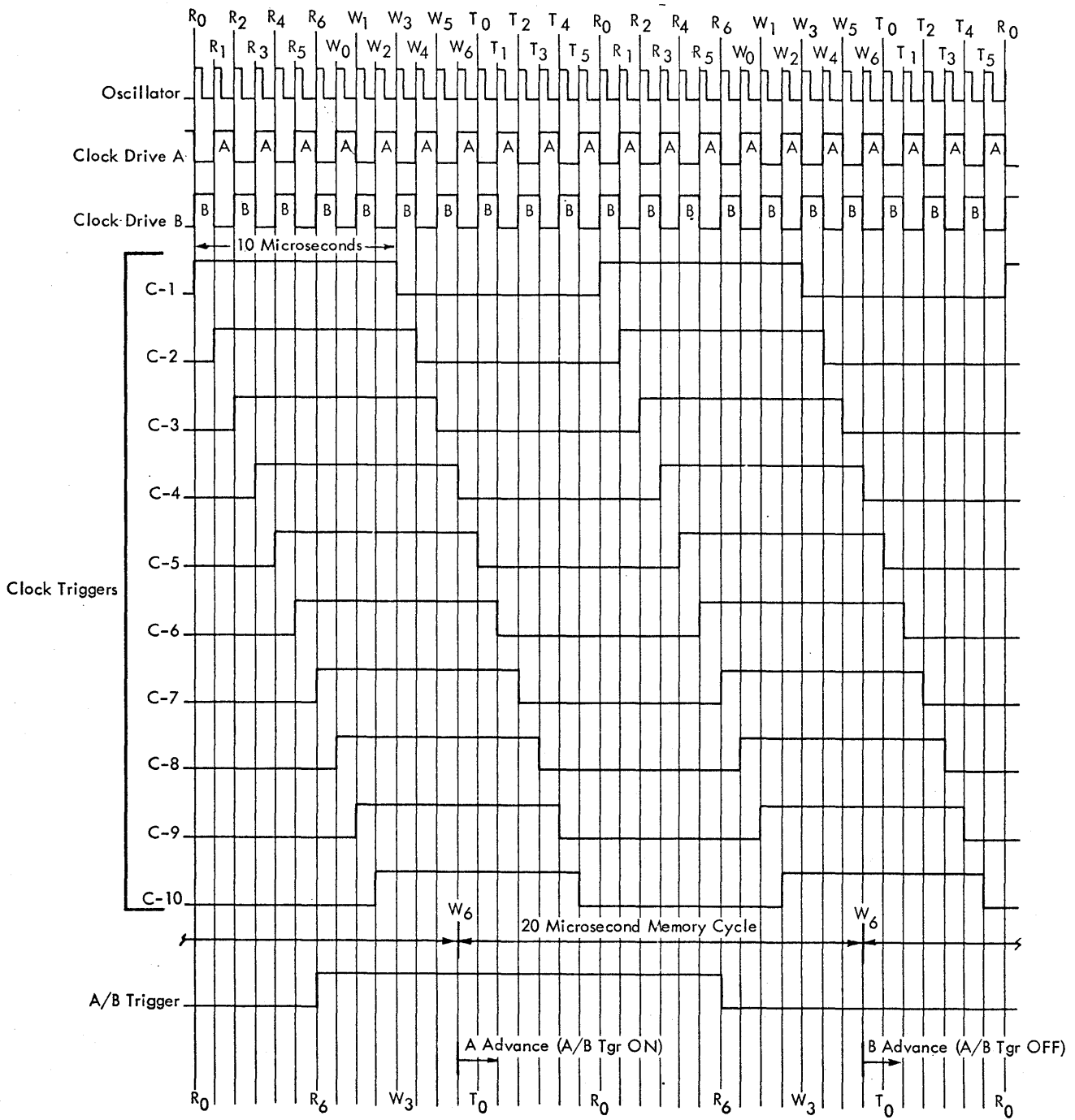


Figure 3-6. Clock Sequence and Timing Chart

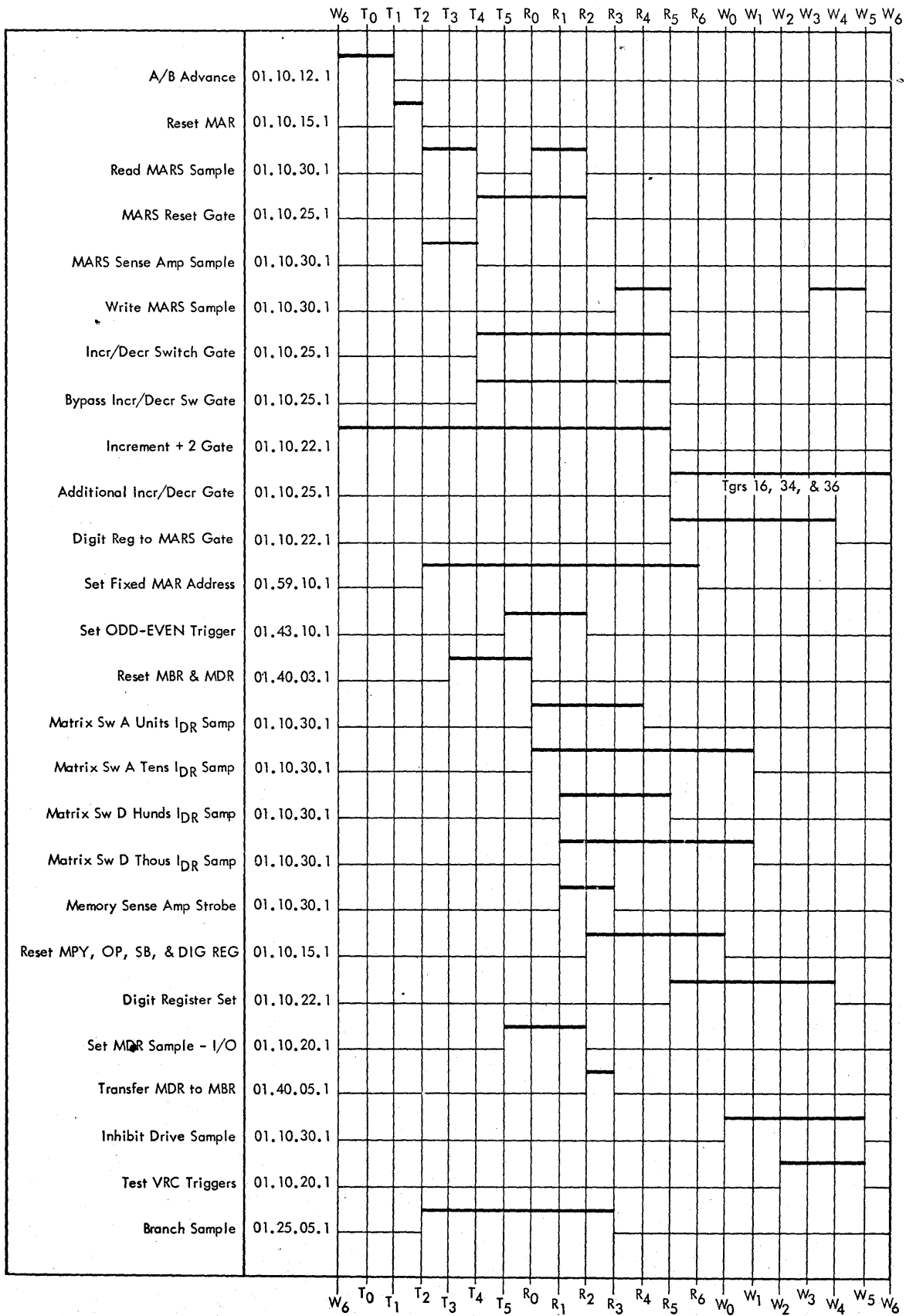


Figure 3-7. Timing Chart

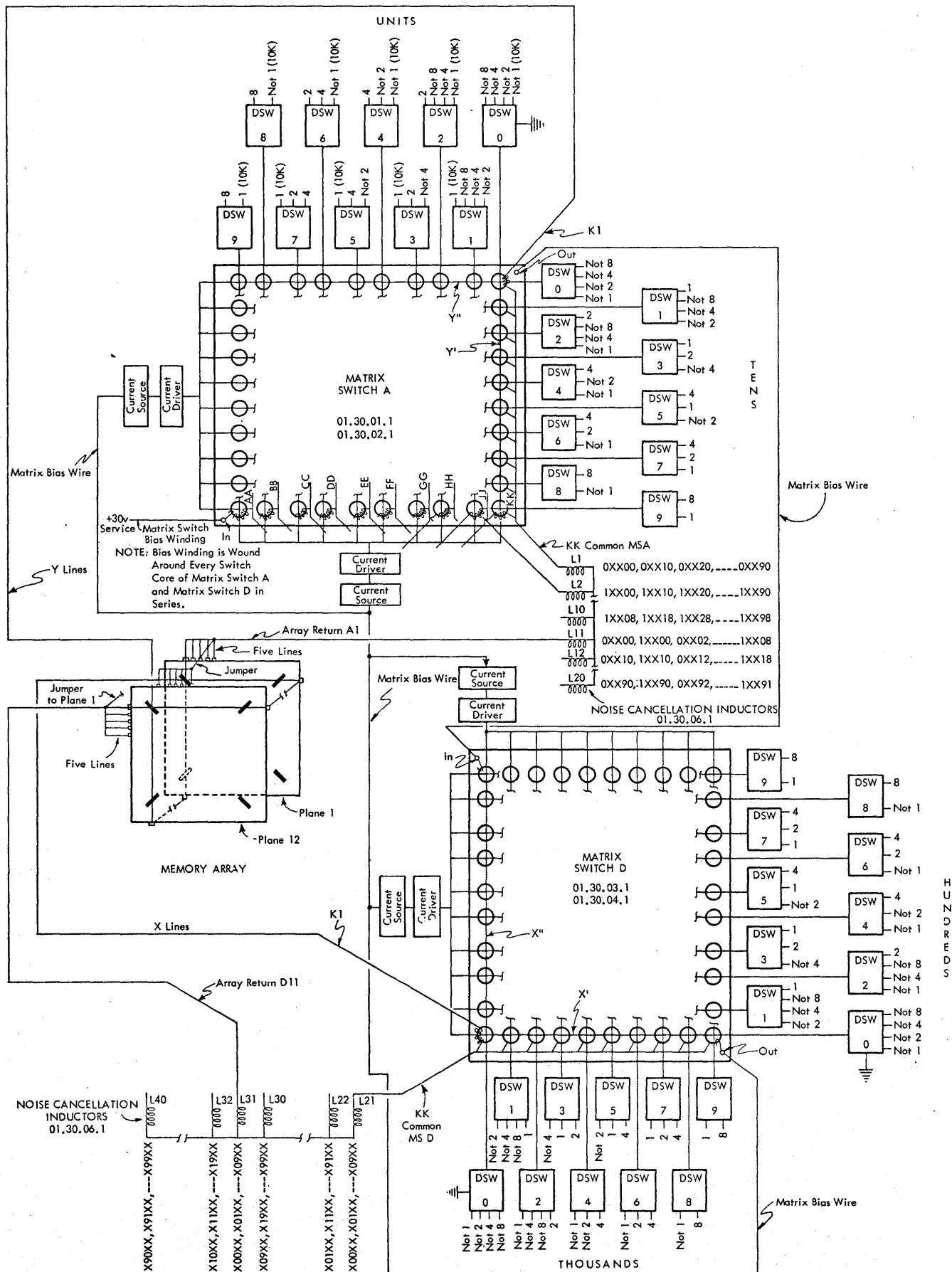


Figure 3-8. Selecting Memory Cores

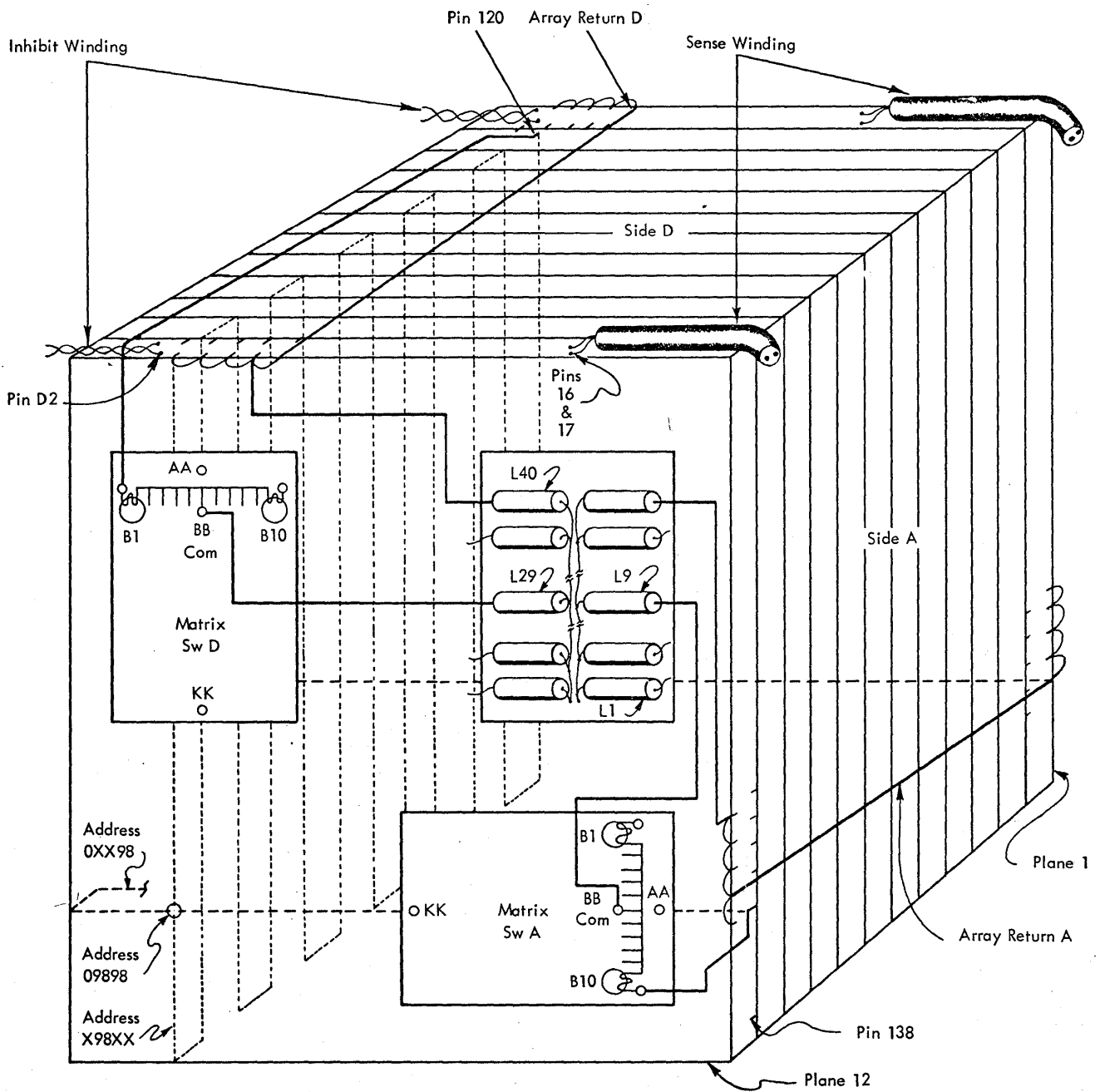


Figure 3-9. Memory Unit Physical Location Layout

Function Chart Symbols

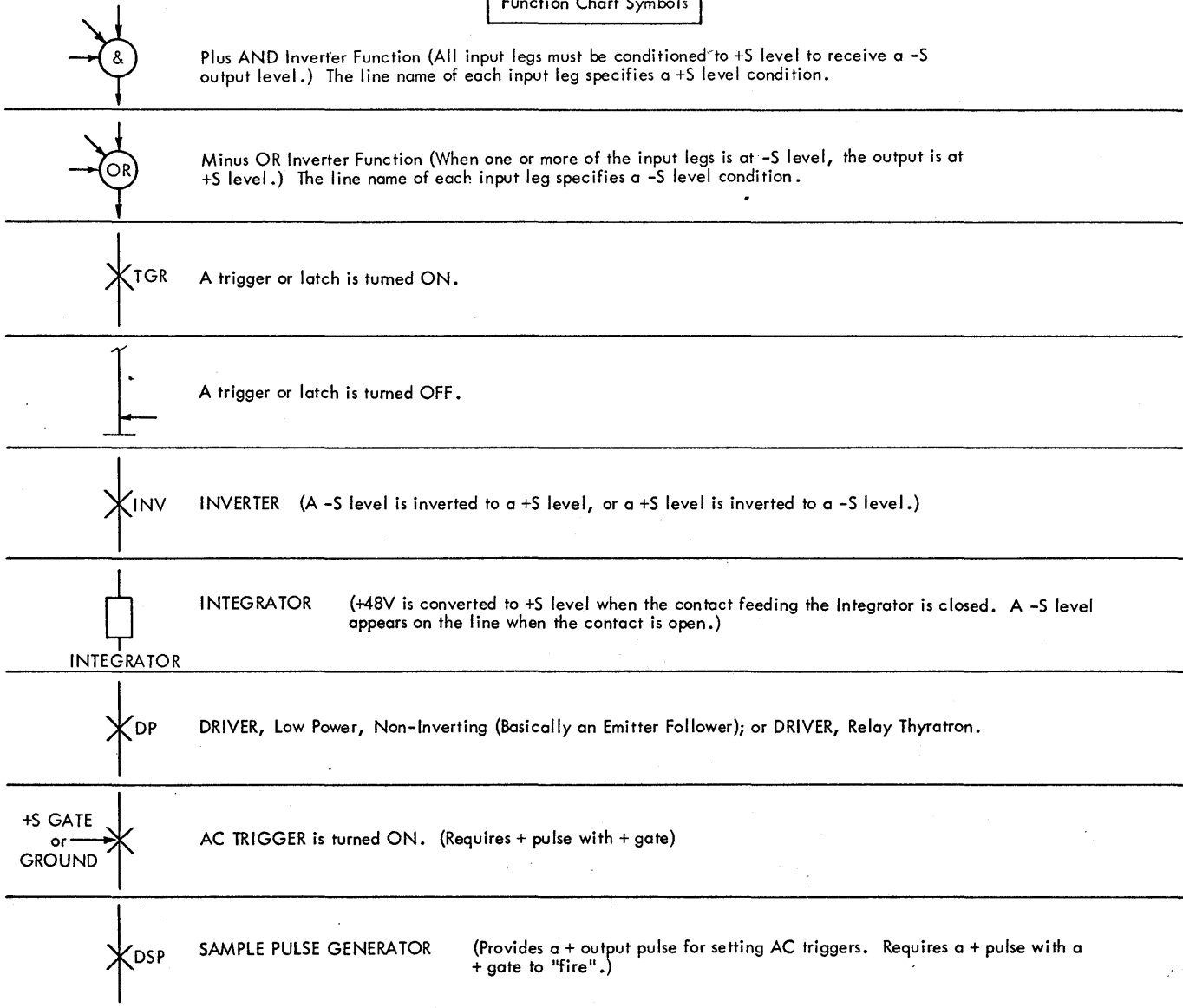


Figure 3-10. Function Chart Symbols

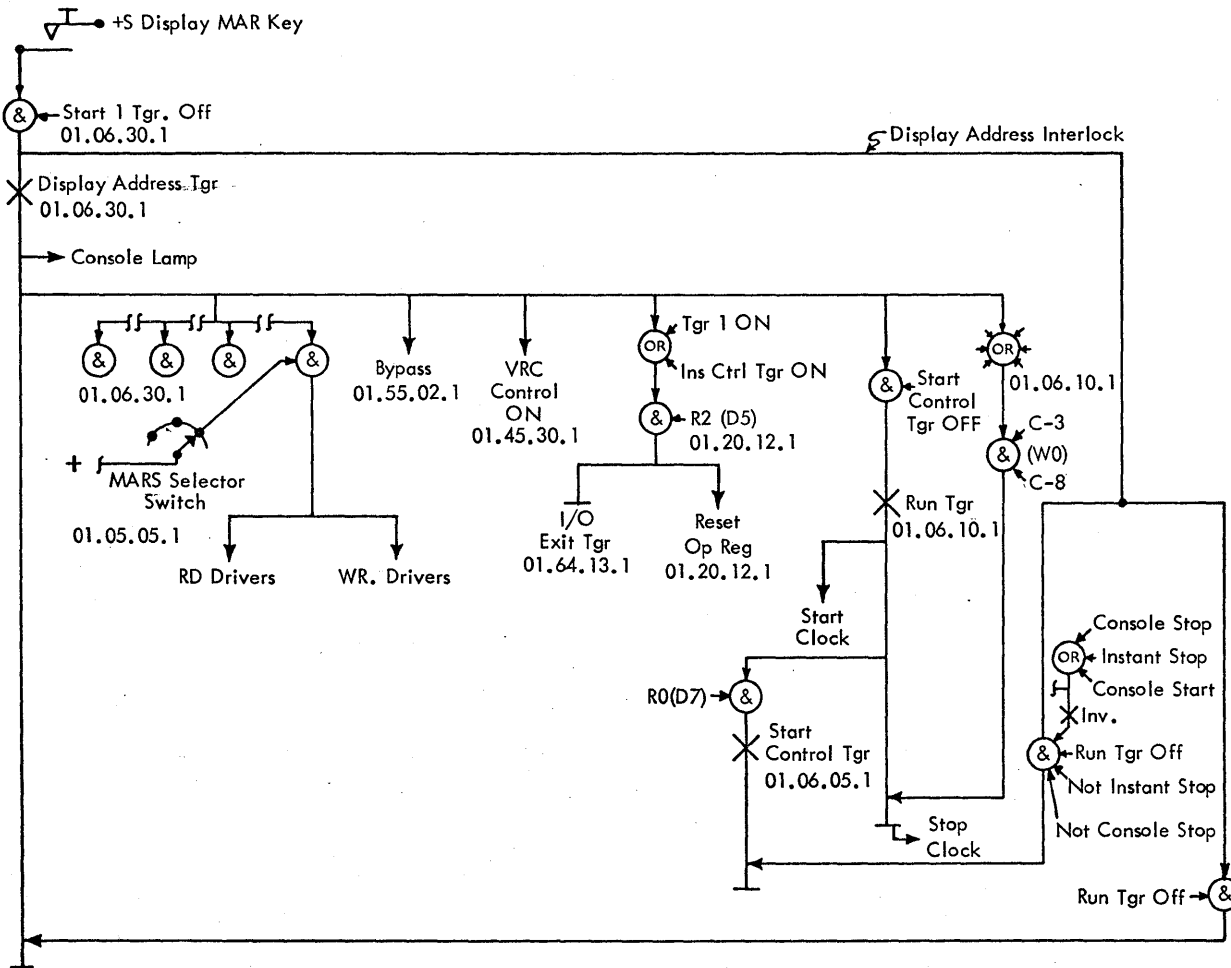


Figure 3-11. Display MAR

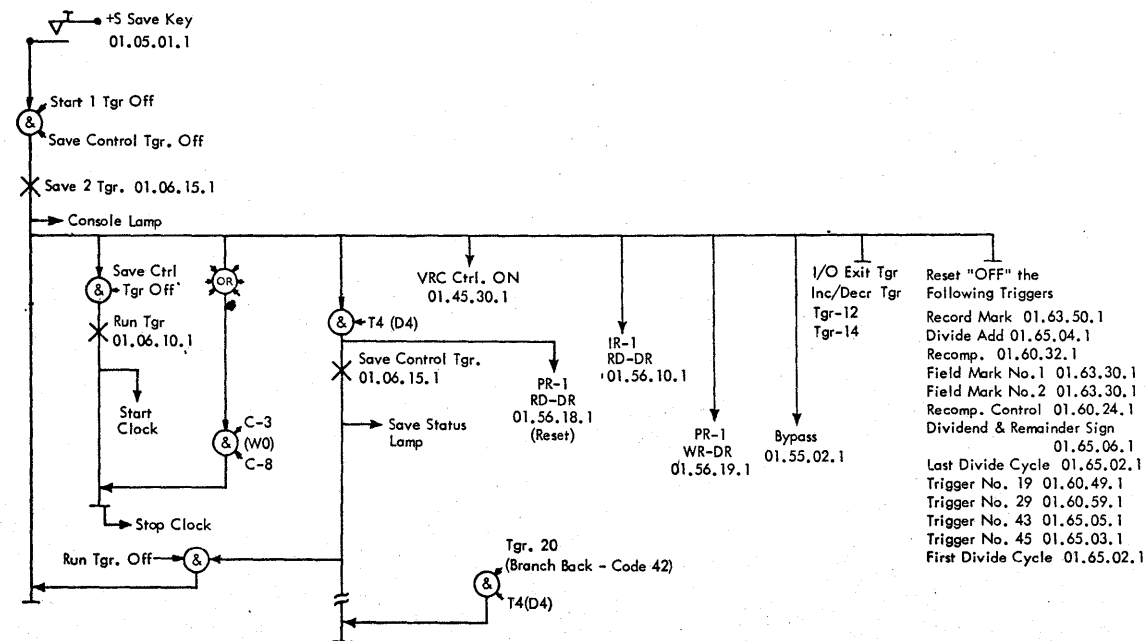


Figure 3-12. Save

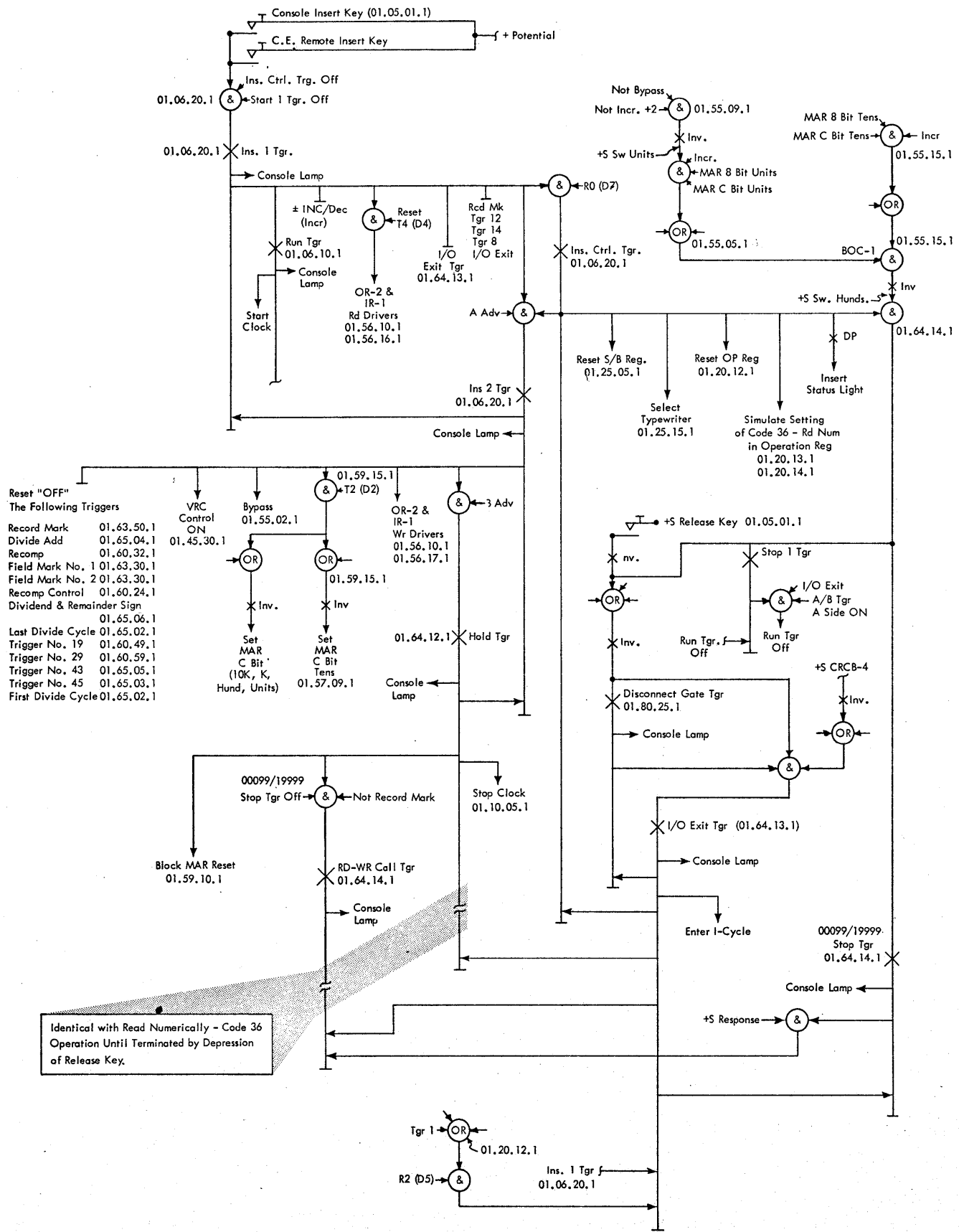


Figure 3-13. Insert



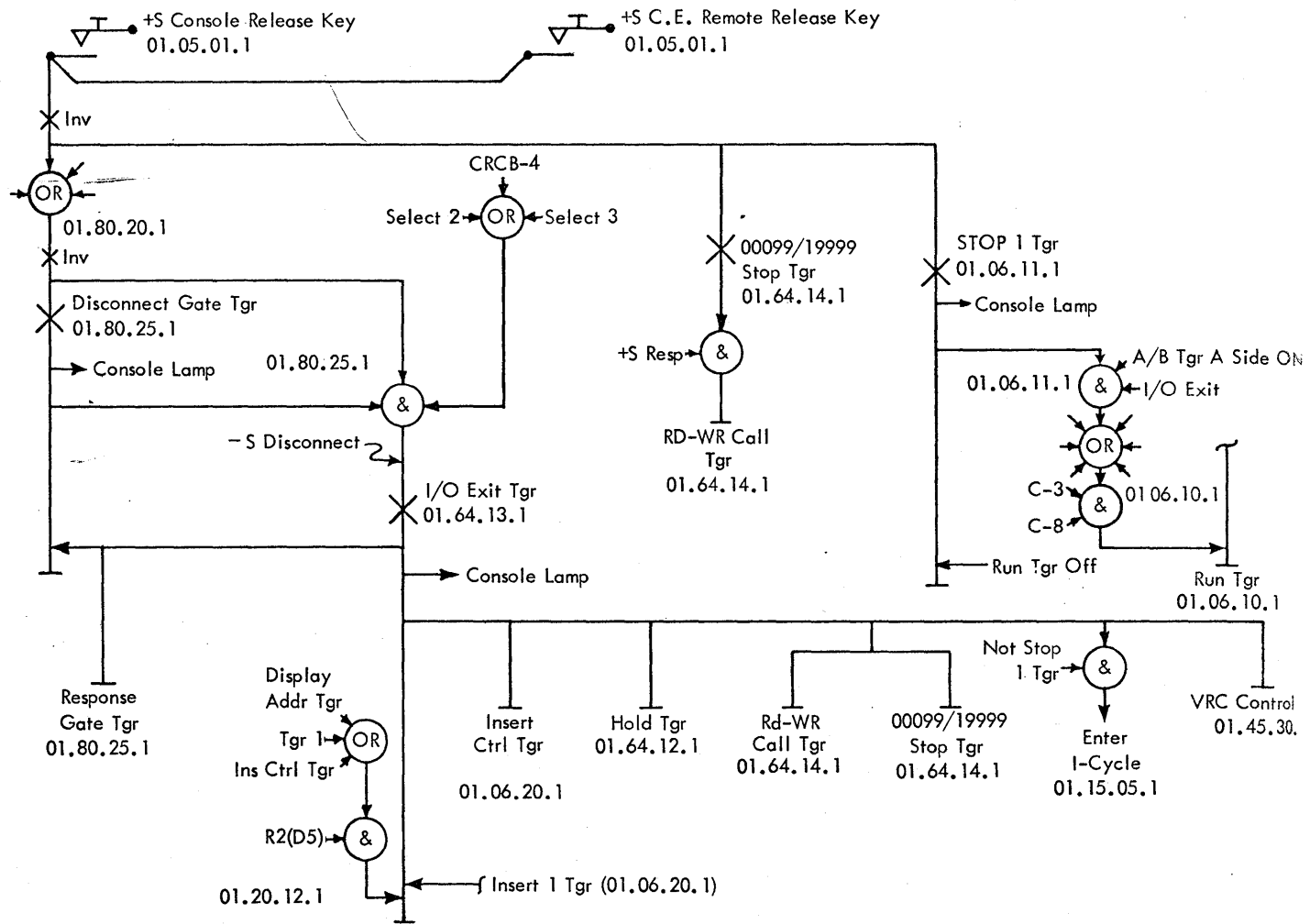


Figure 3-14. Release

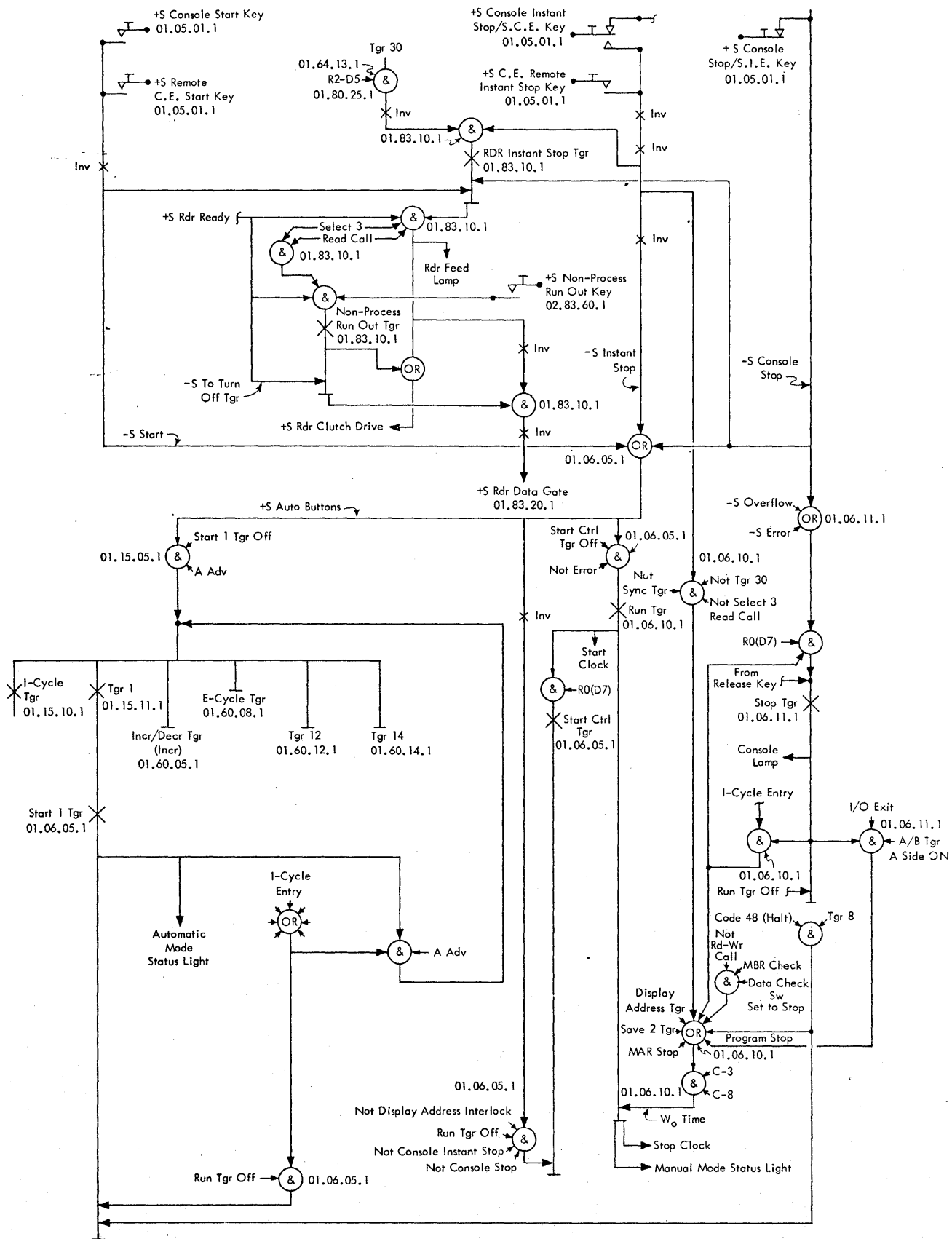


Figure 3-15. Start - Stop

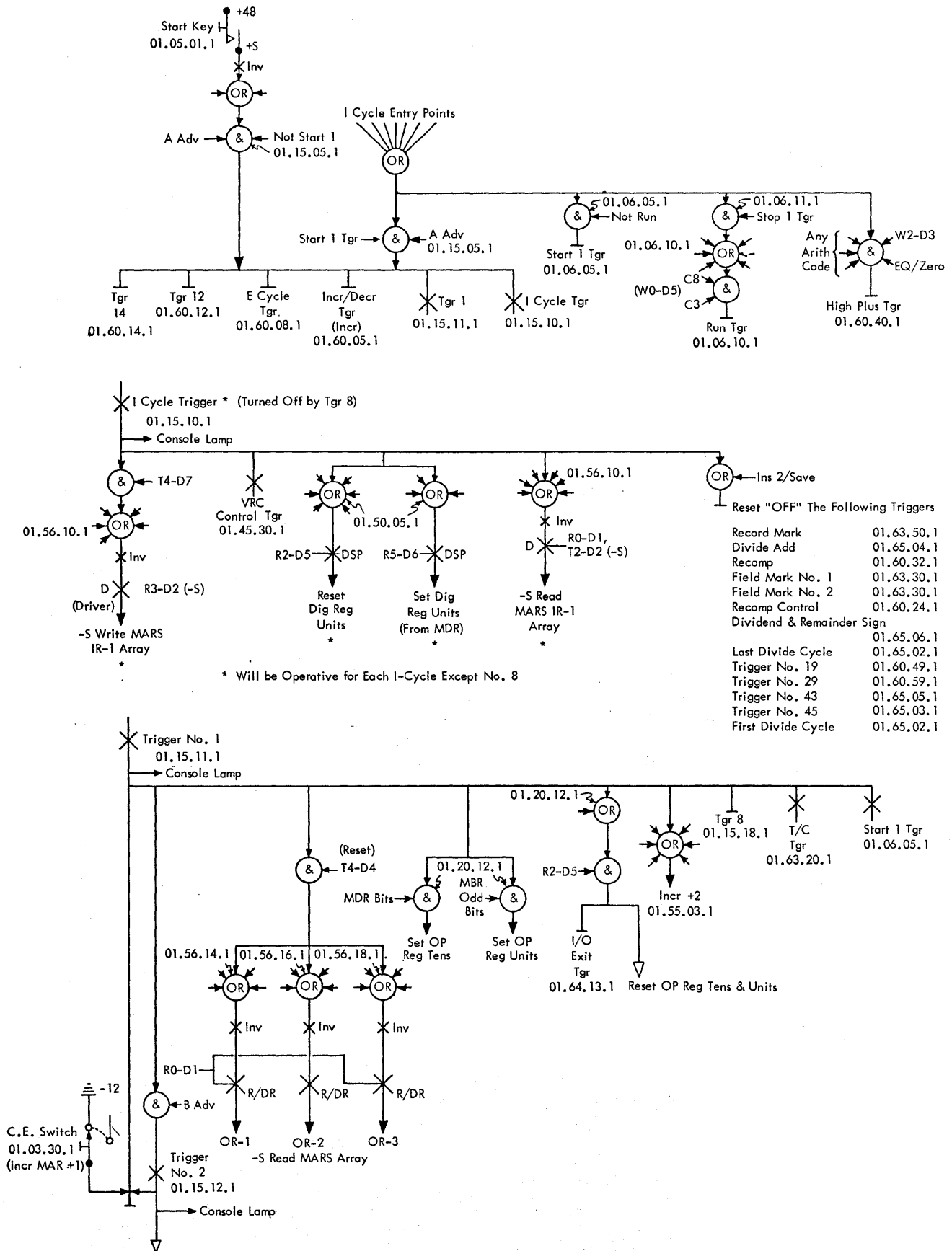


Figure 3-16a. Instruction Cycle

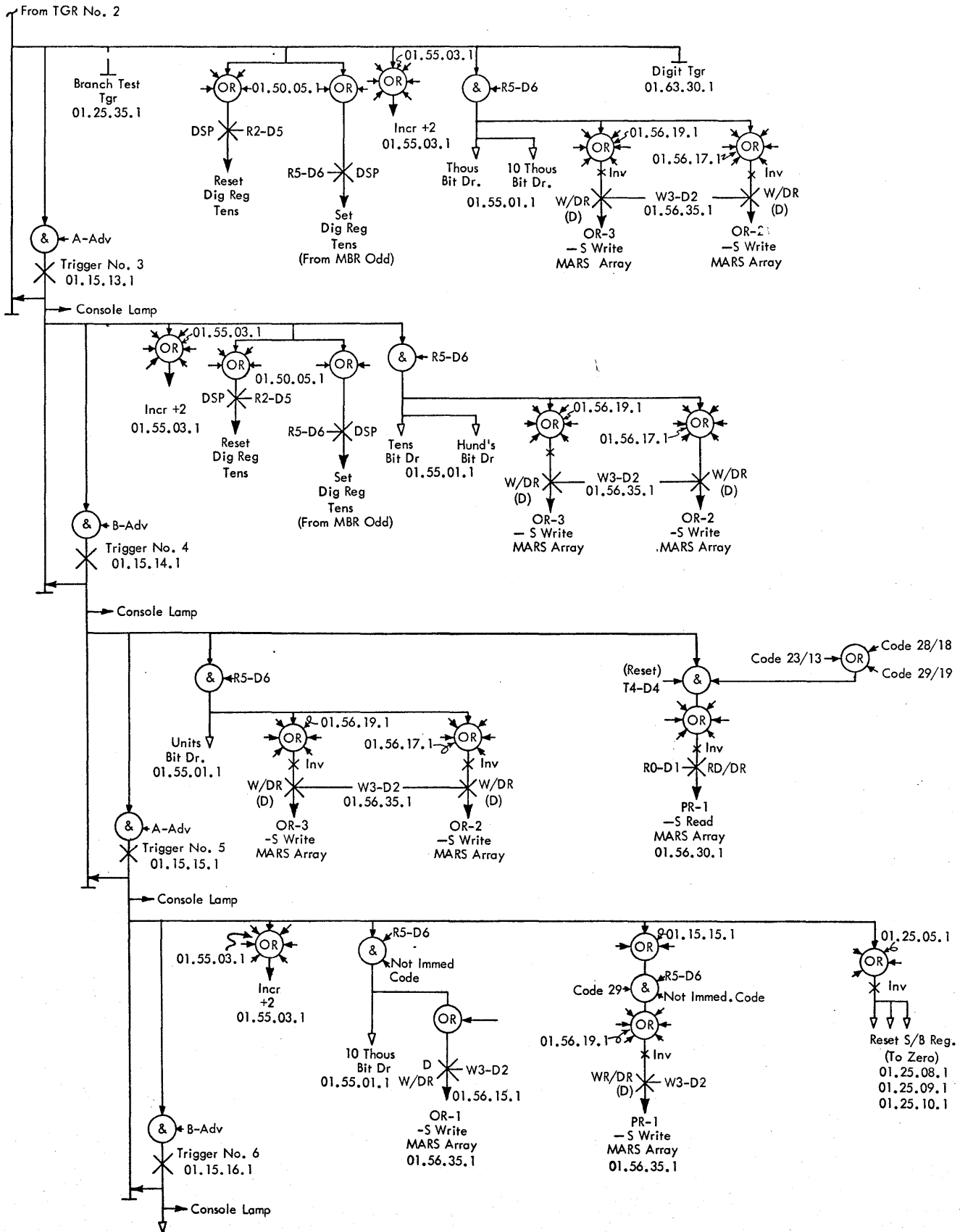


Figure 3-16b. Instruction Cycle

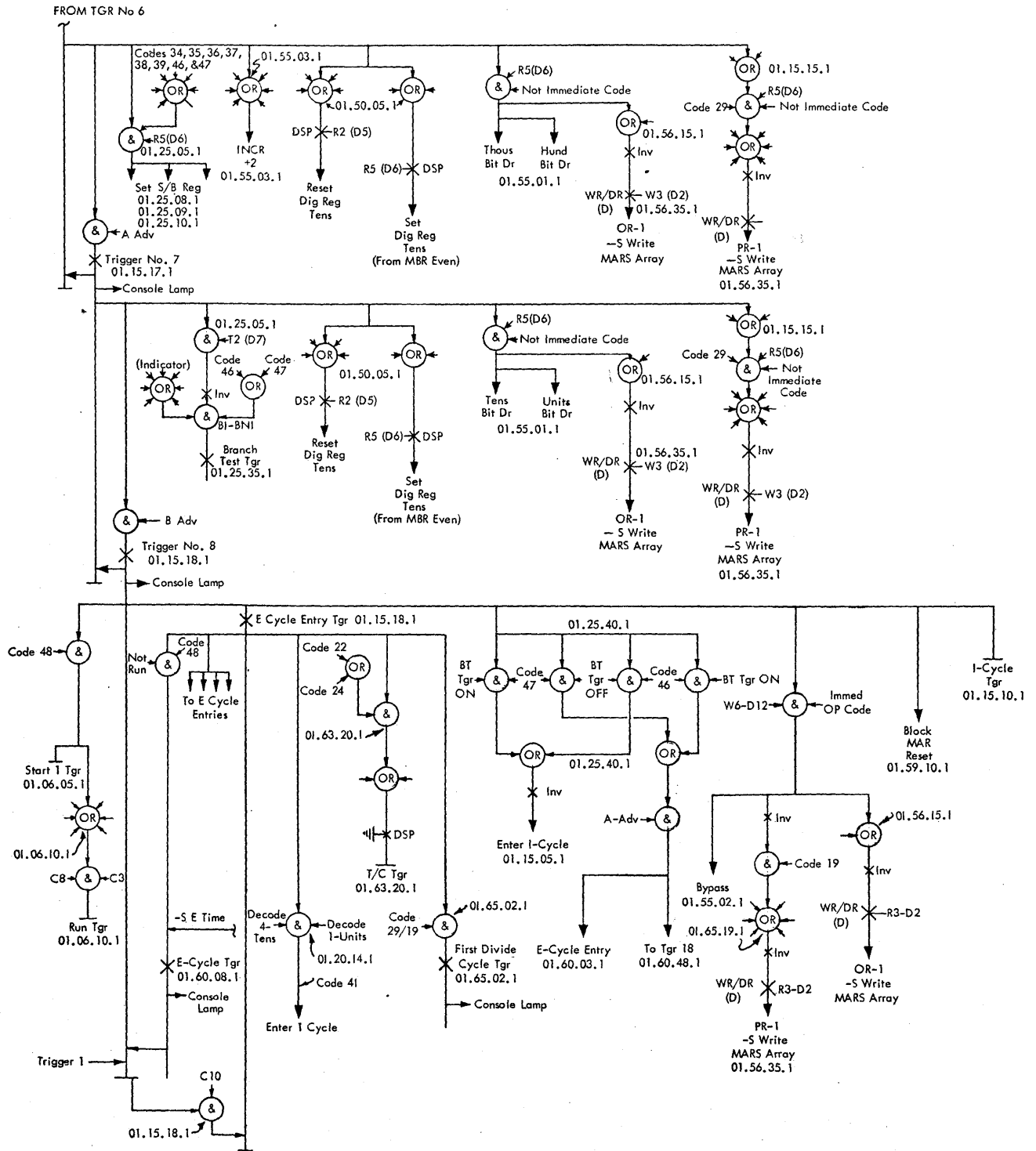


Figure 3-16c. Instruction Cycle

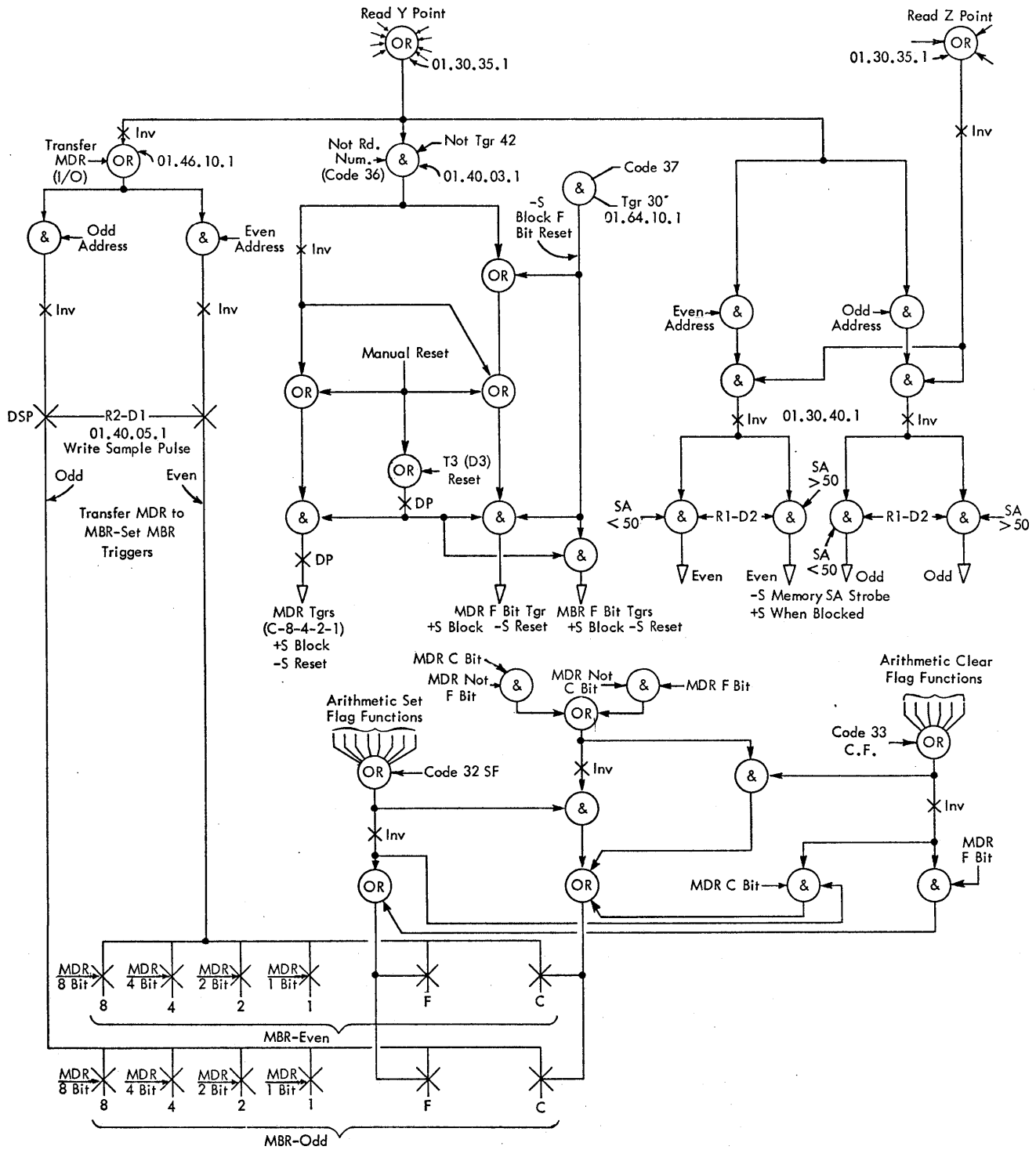


Figure 3-17. Read Y and Read Z Points

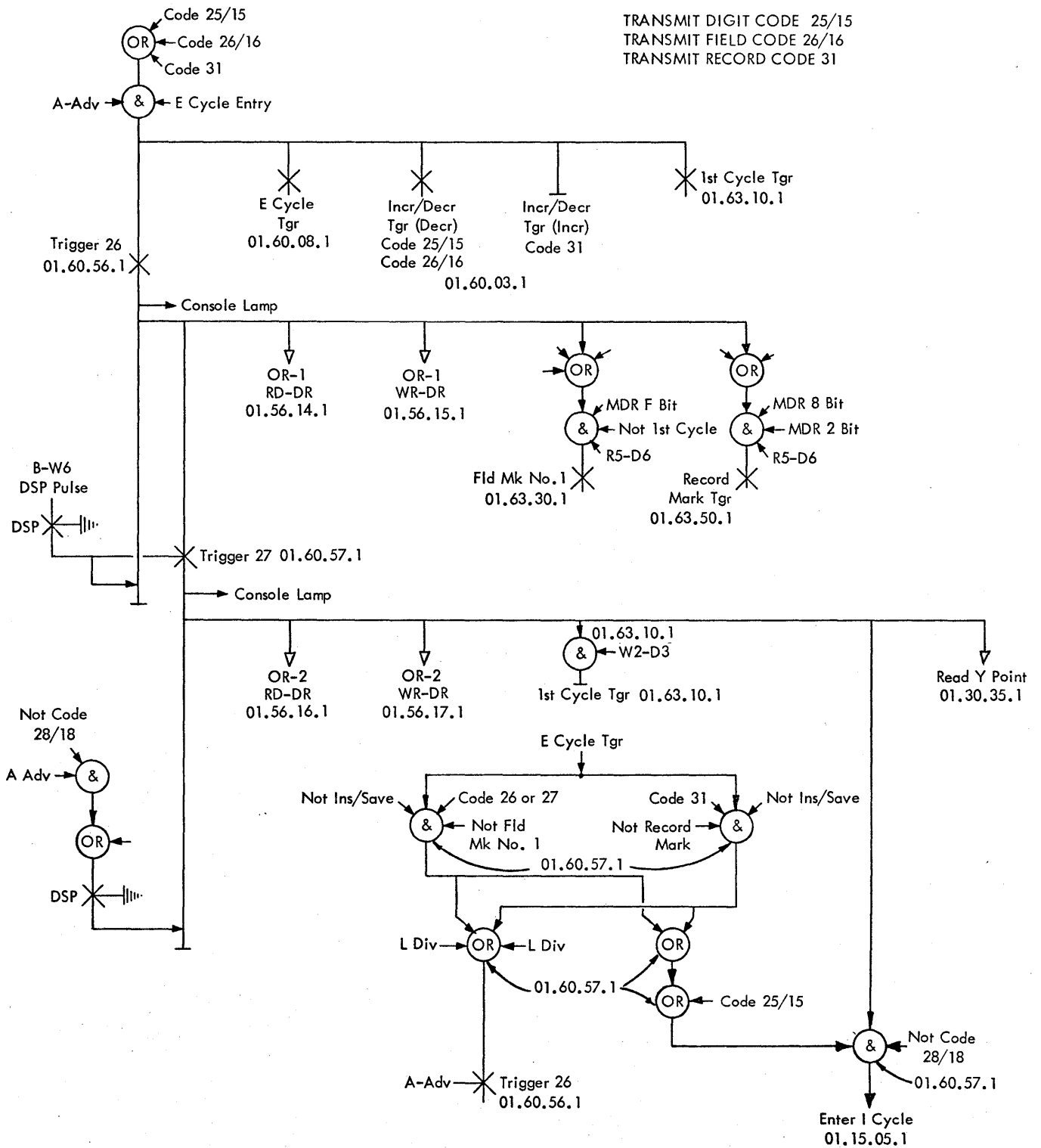


Figure 3-18. Transmit Digit, Field and Record

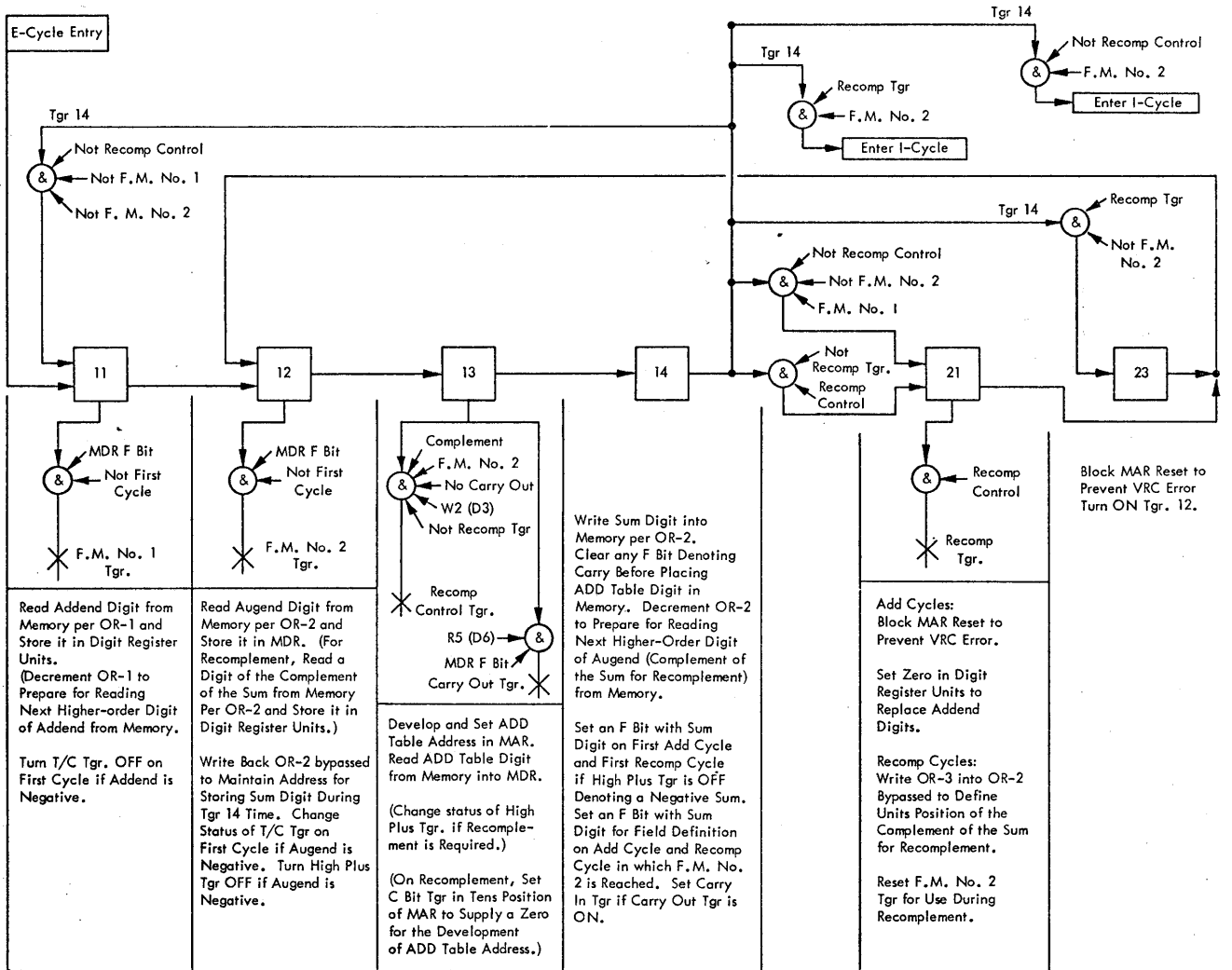


Figure 3-19. Add Flow Diagram



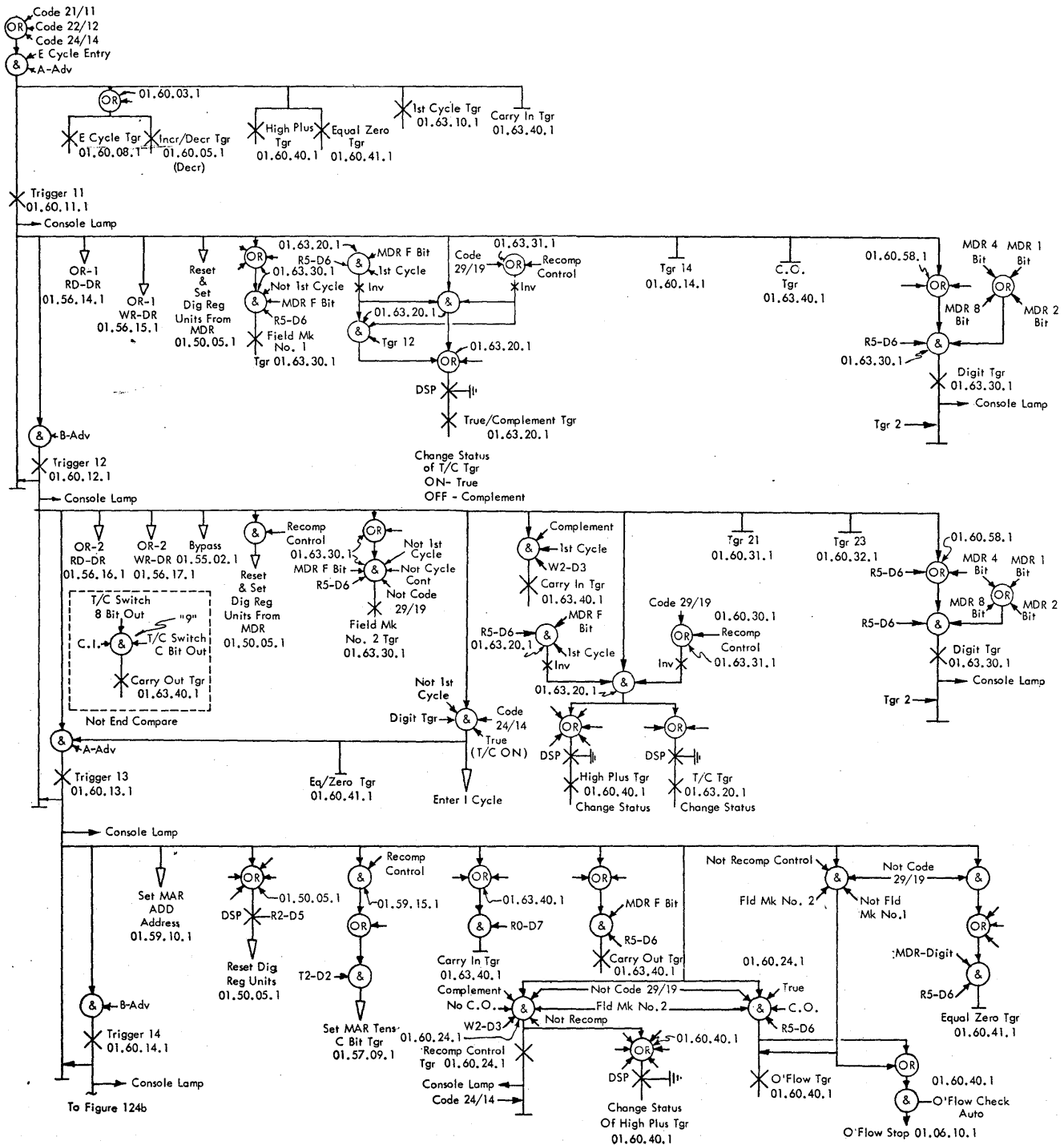


Figure 3-20a. Add-Subtract-Compare



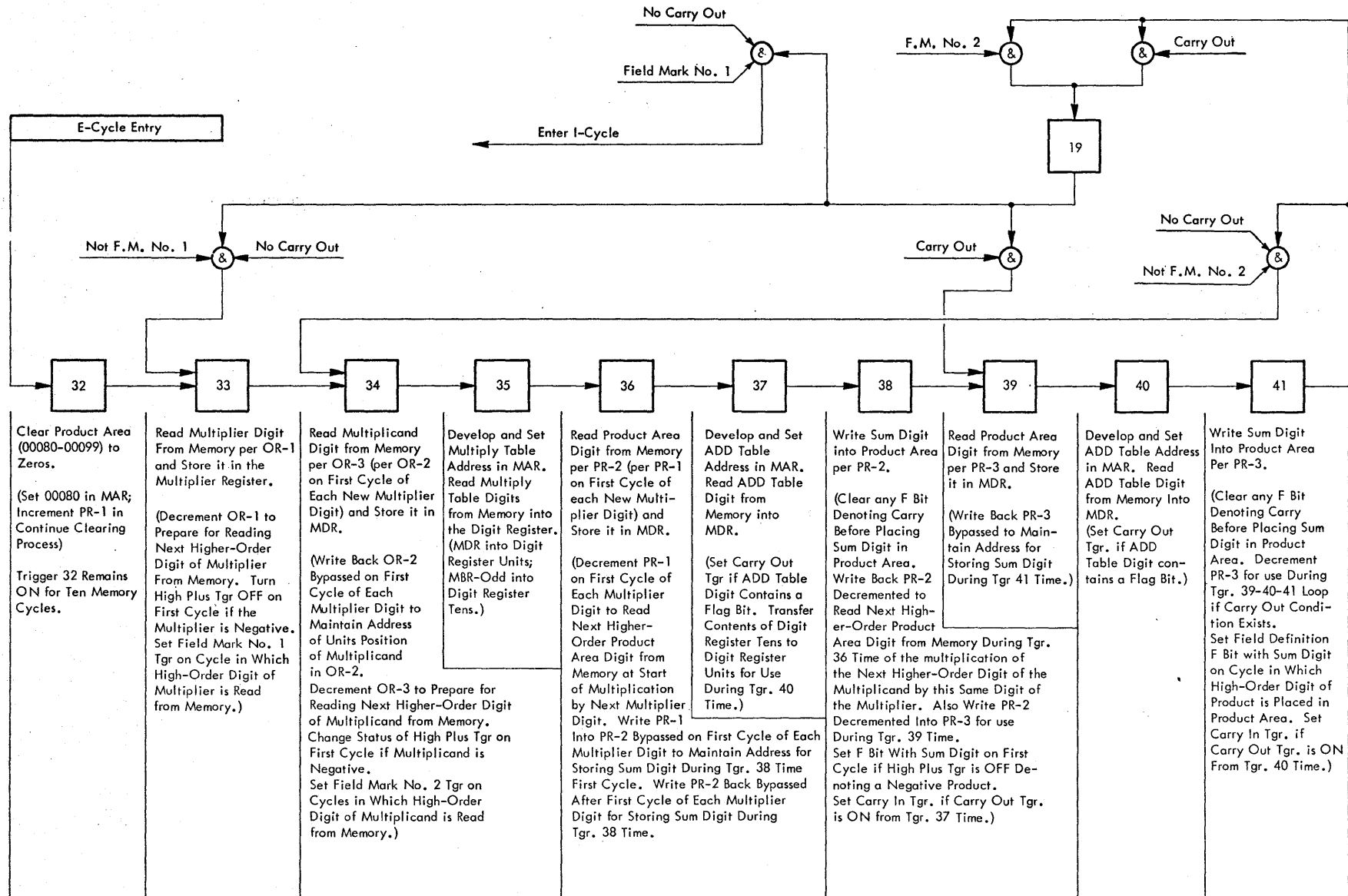


Figure 3-21. Multiply Flow Diagram

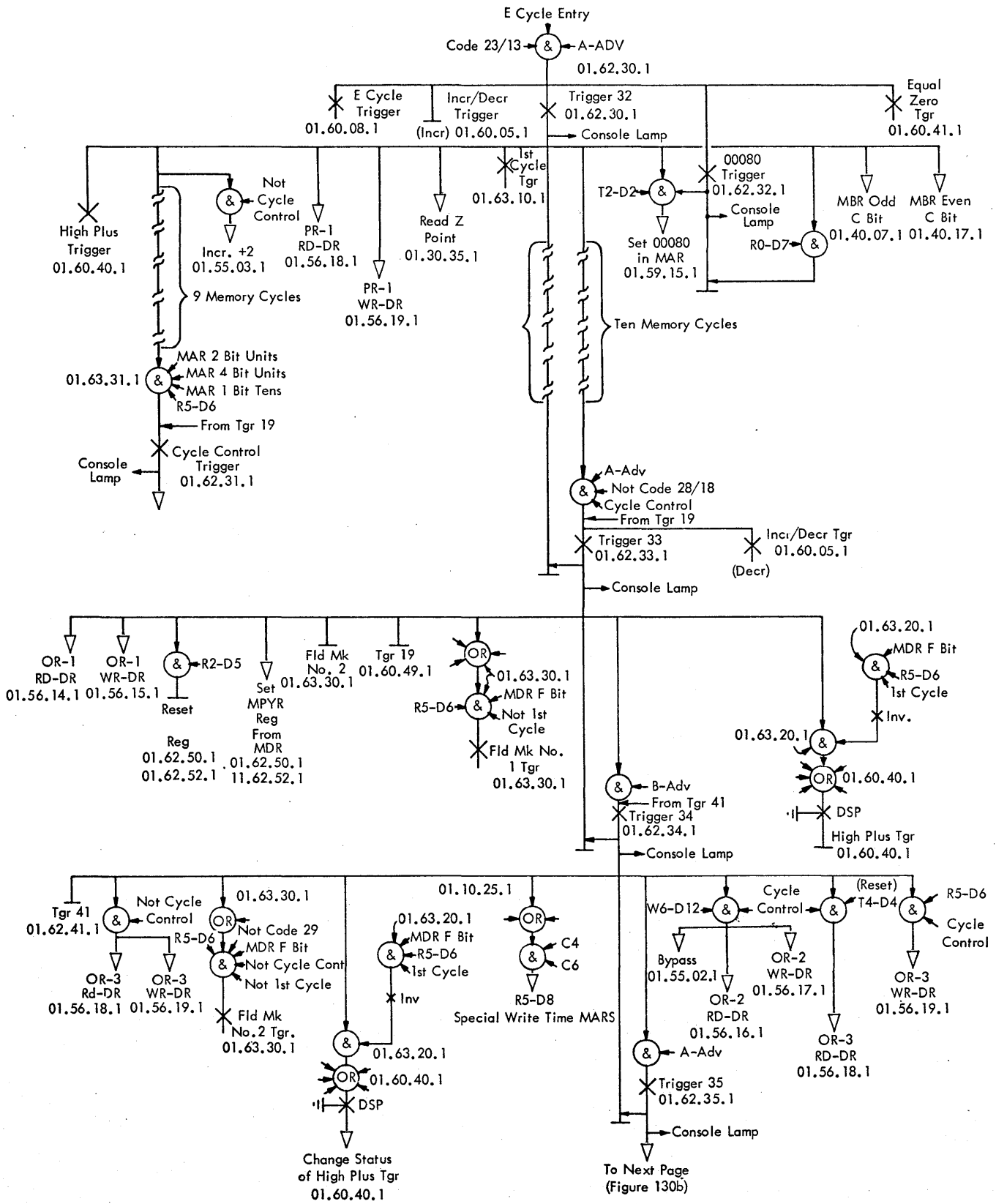


Figure 3-22a. Multiply

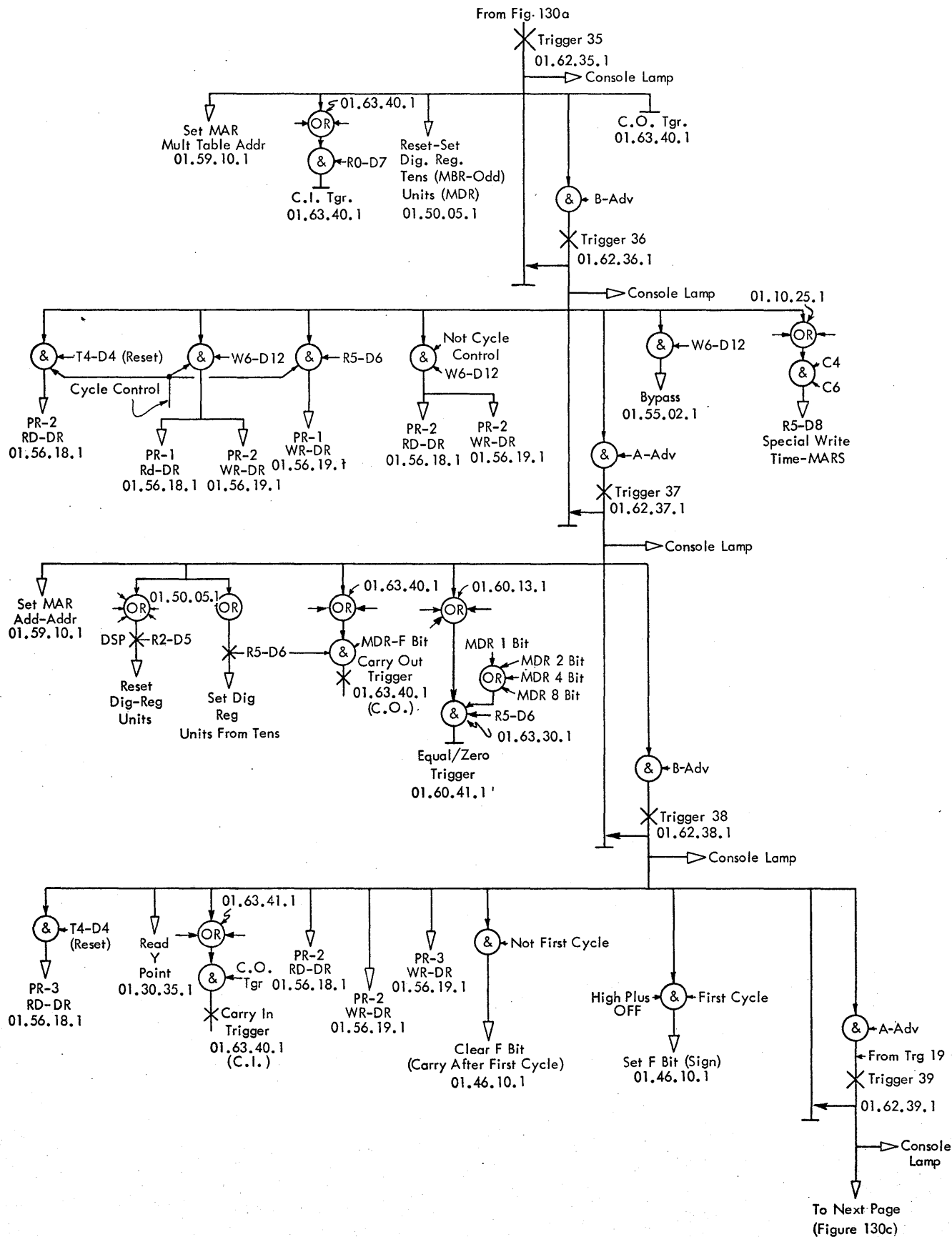


Figure 3-22b. Multiply

From Fig. 130b

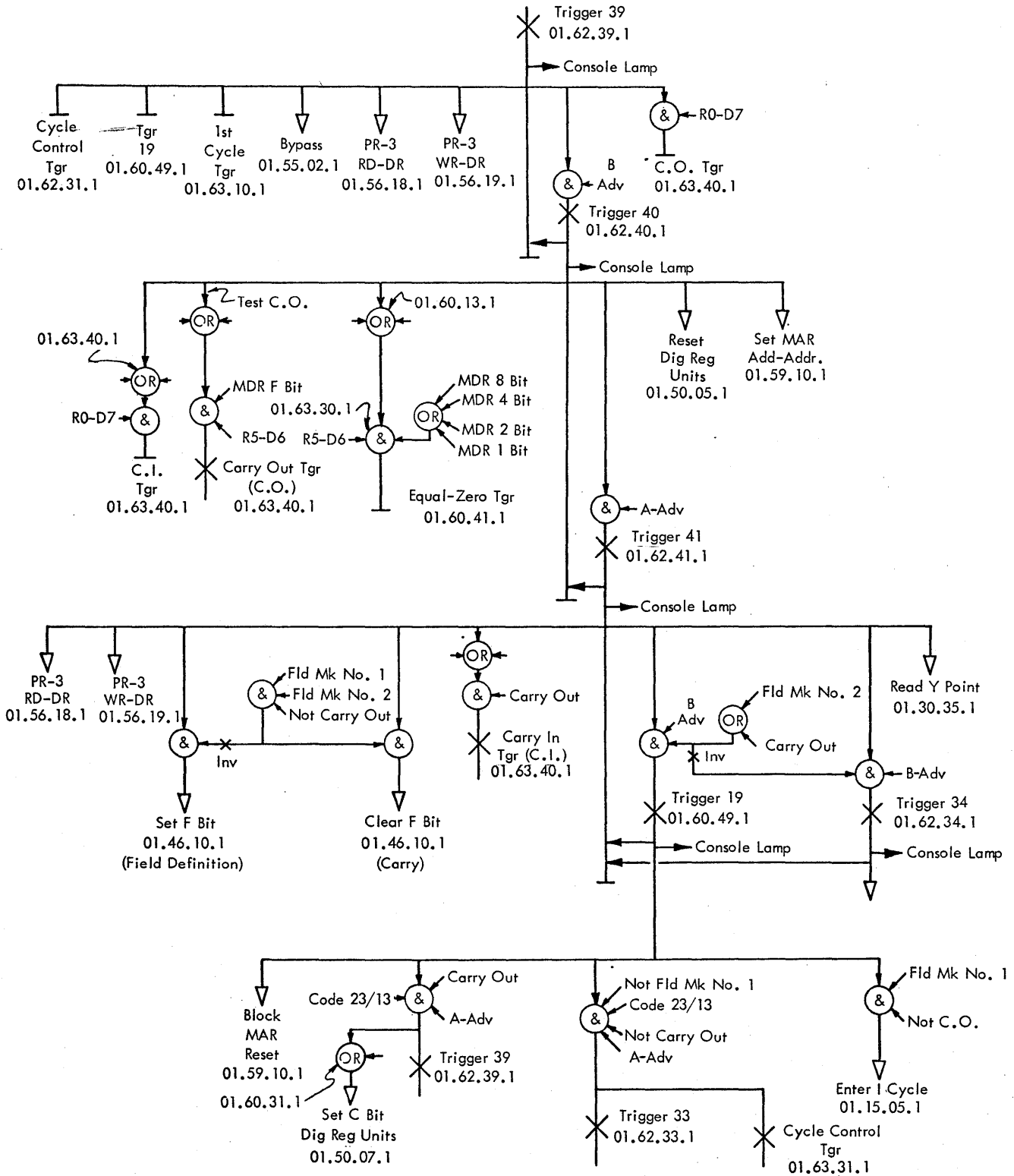


Figure 3-22c. Multiply



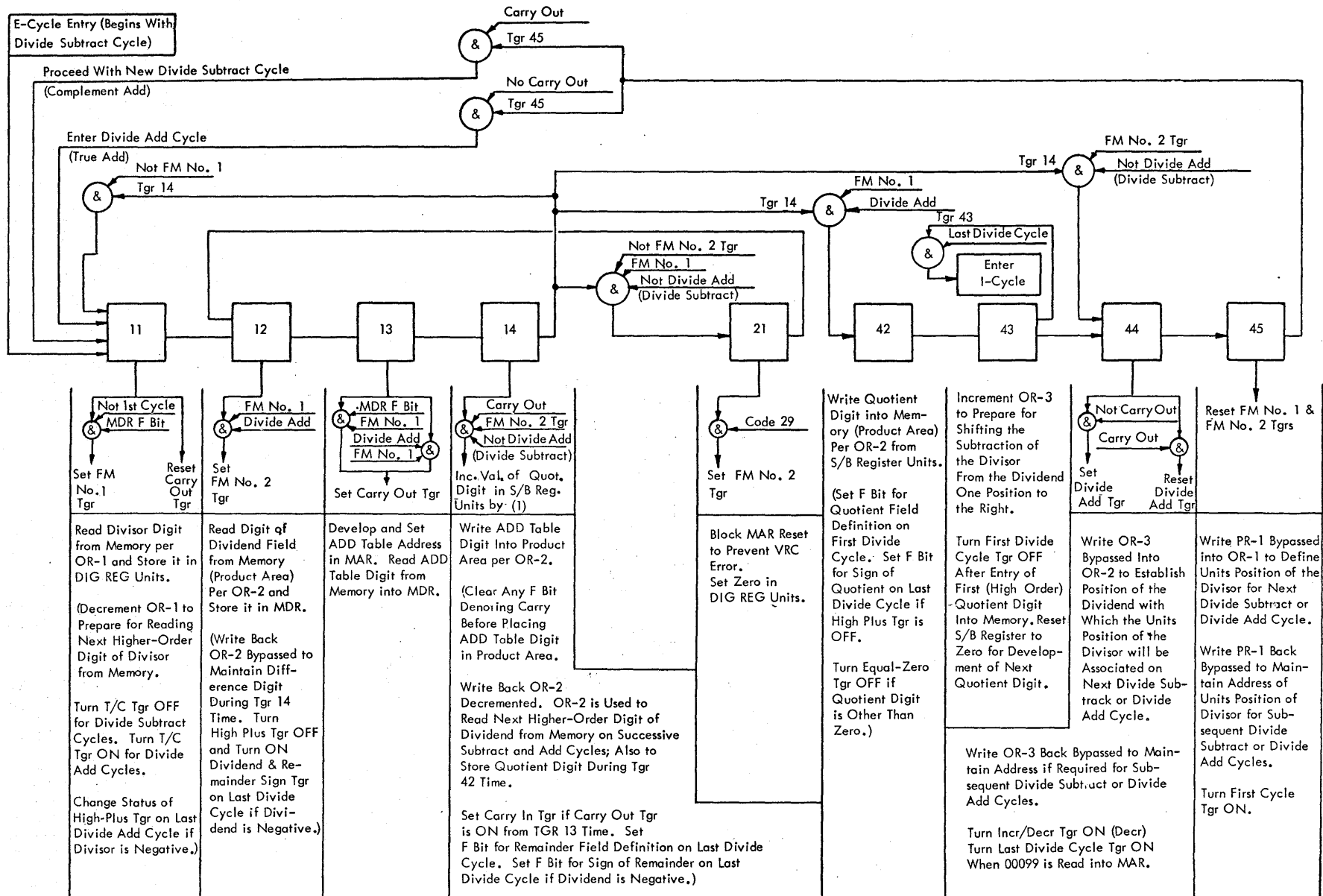


Figure 3-24. Divide Flow Diagram



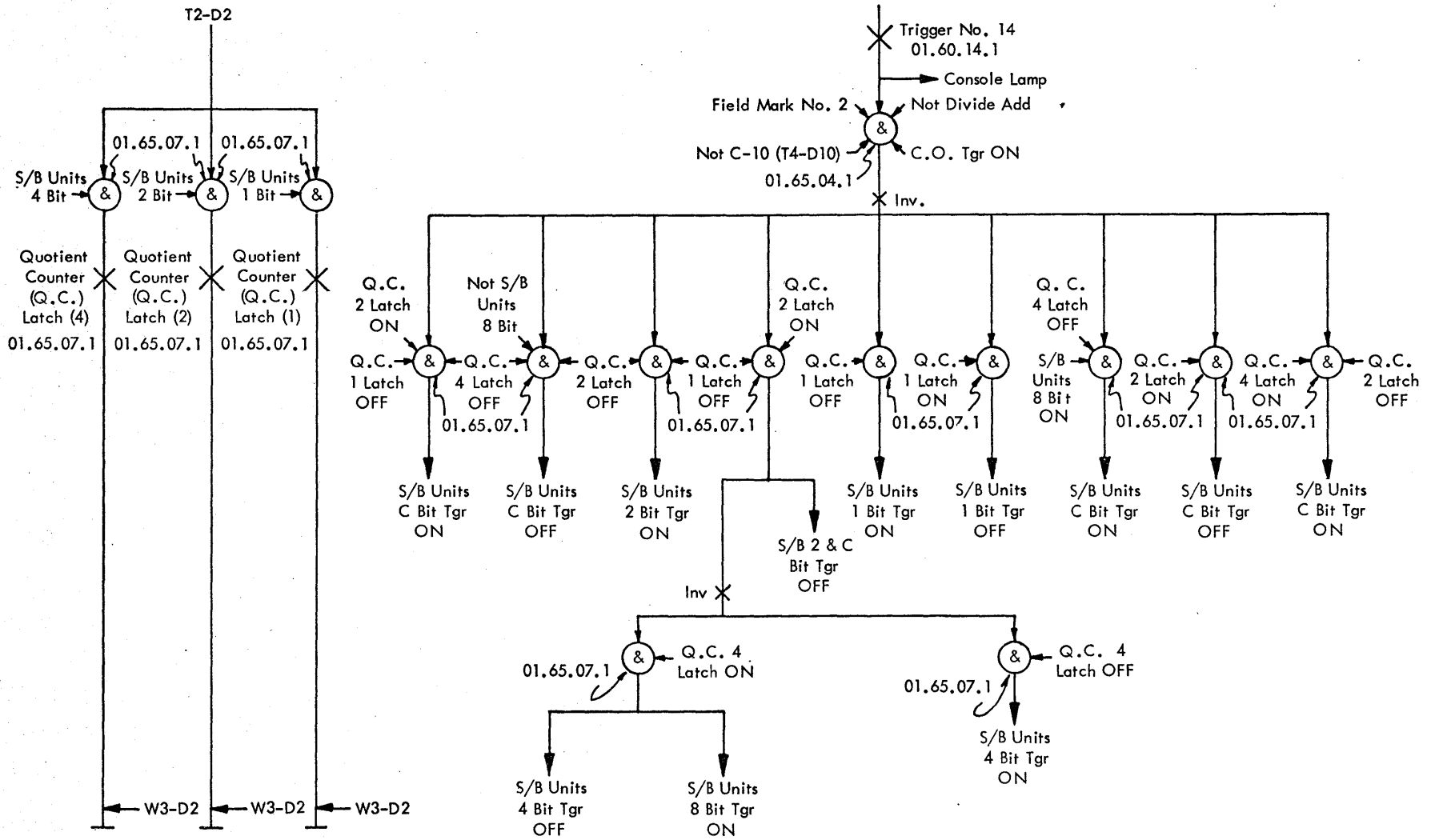


Figure 3-25. Quotient Counter

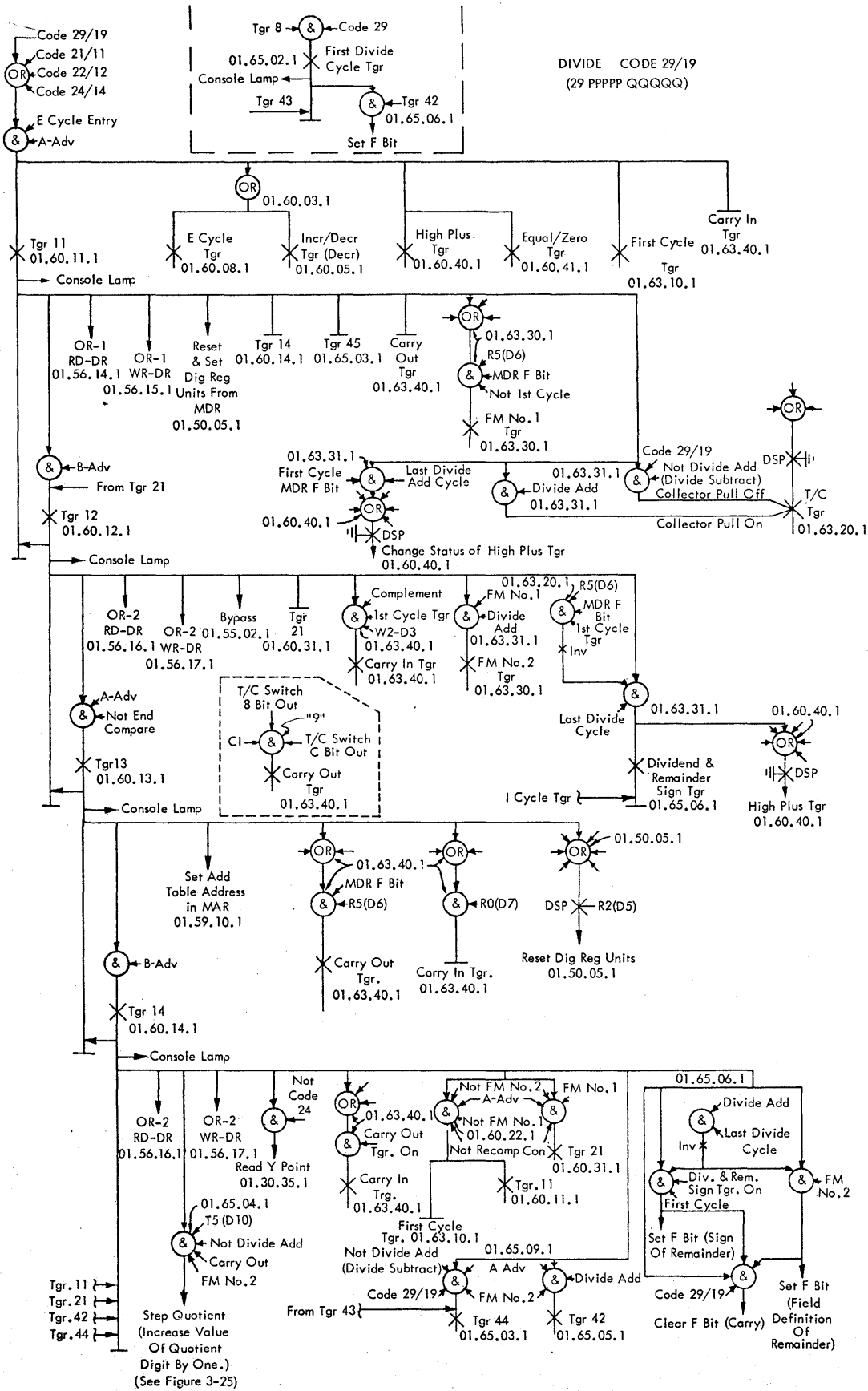


Figure 3-26a. Divide

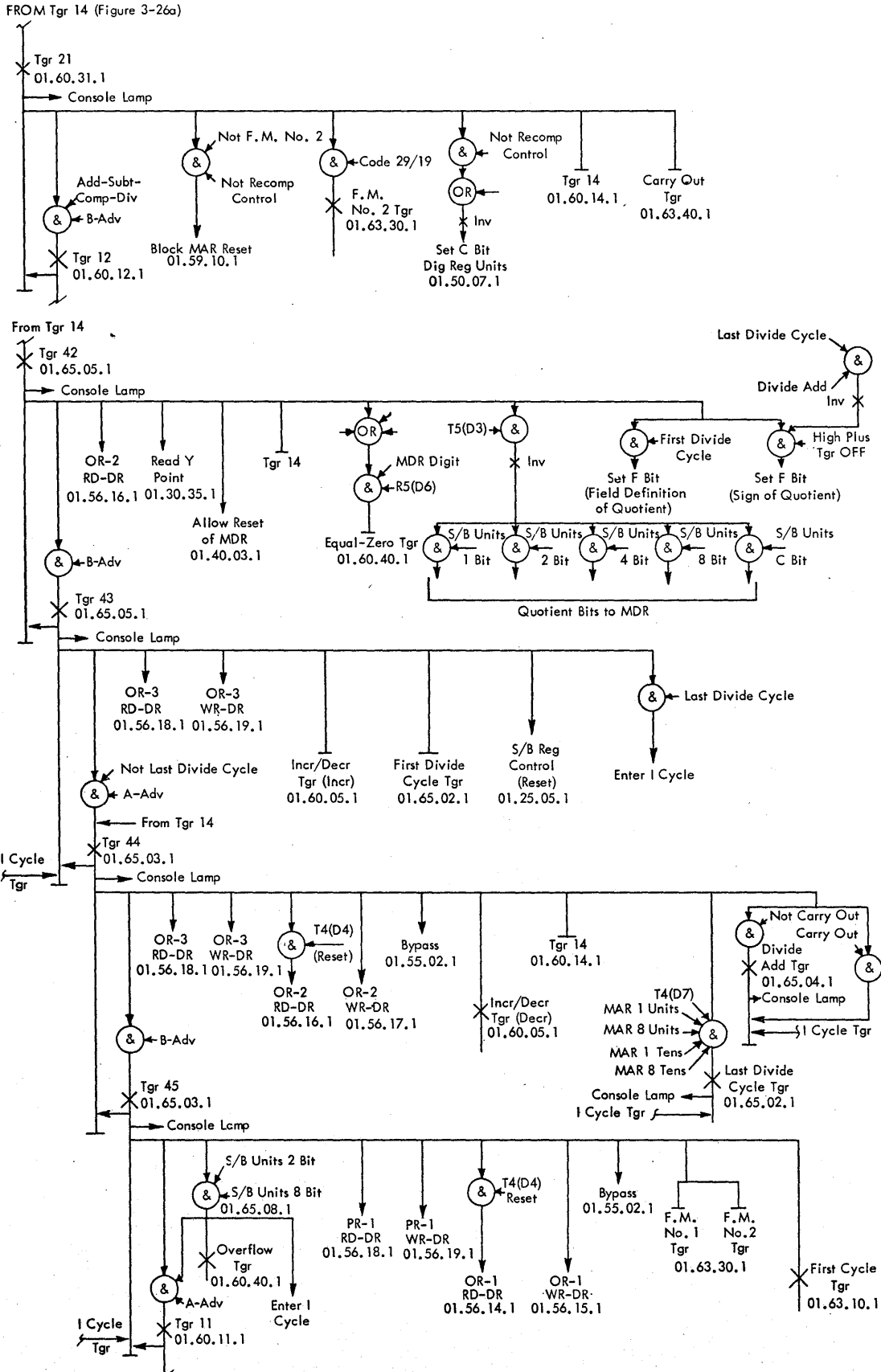


Figure 3-26b. Divide

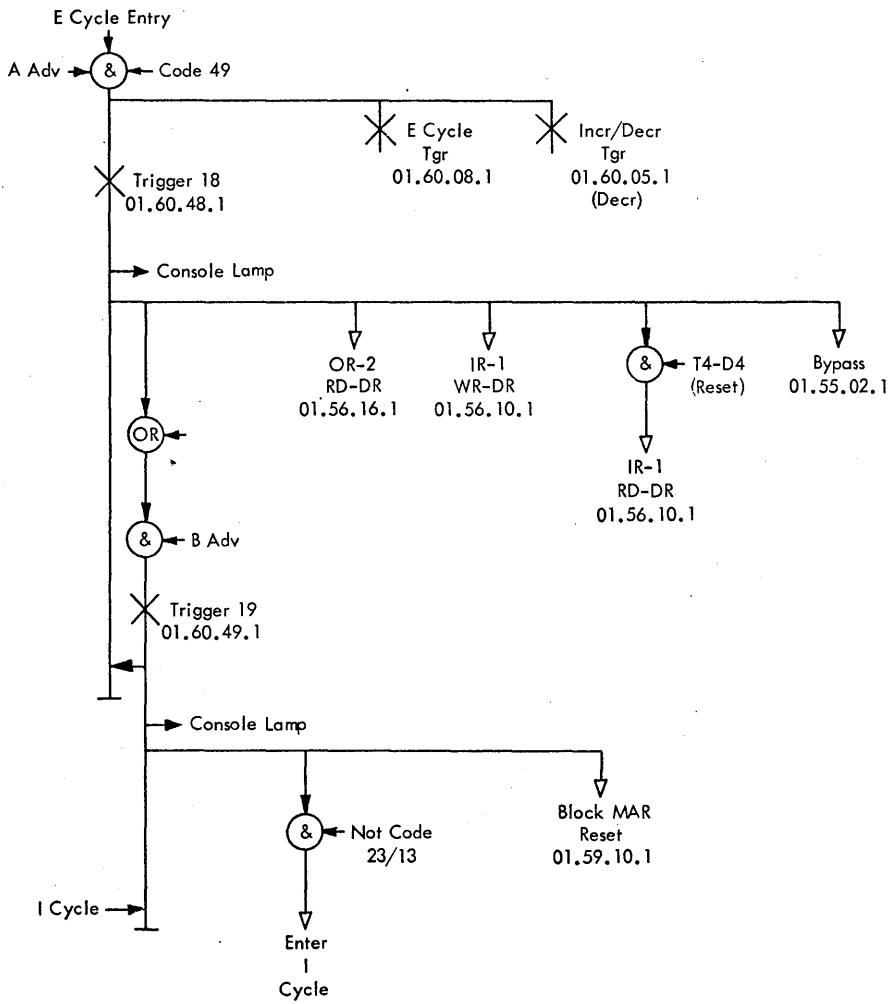


Figure 3-27. Branch

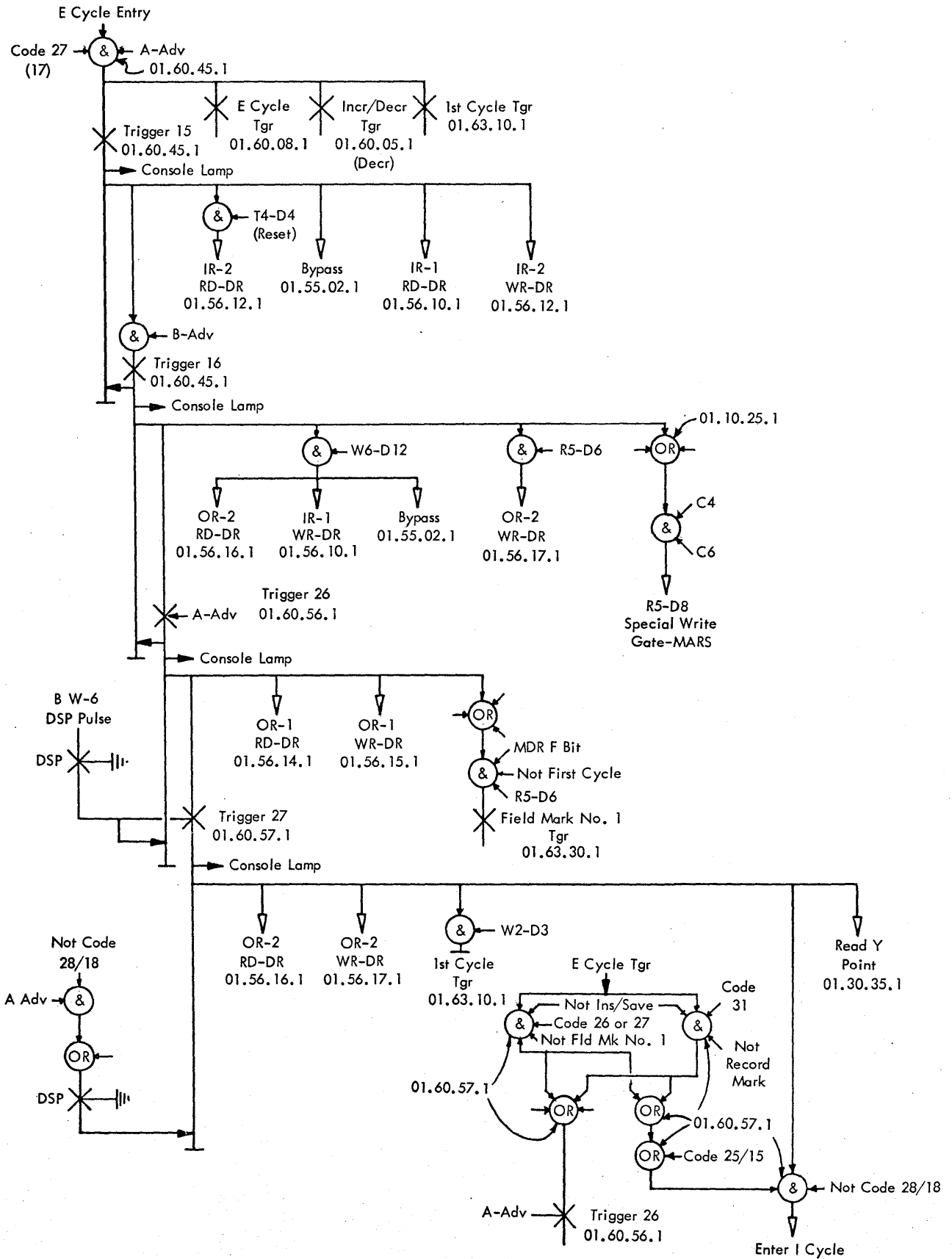


Figure 3-28. Branch and Transmit

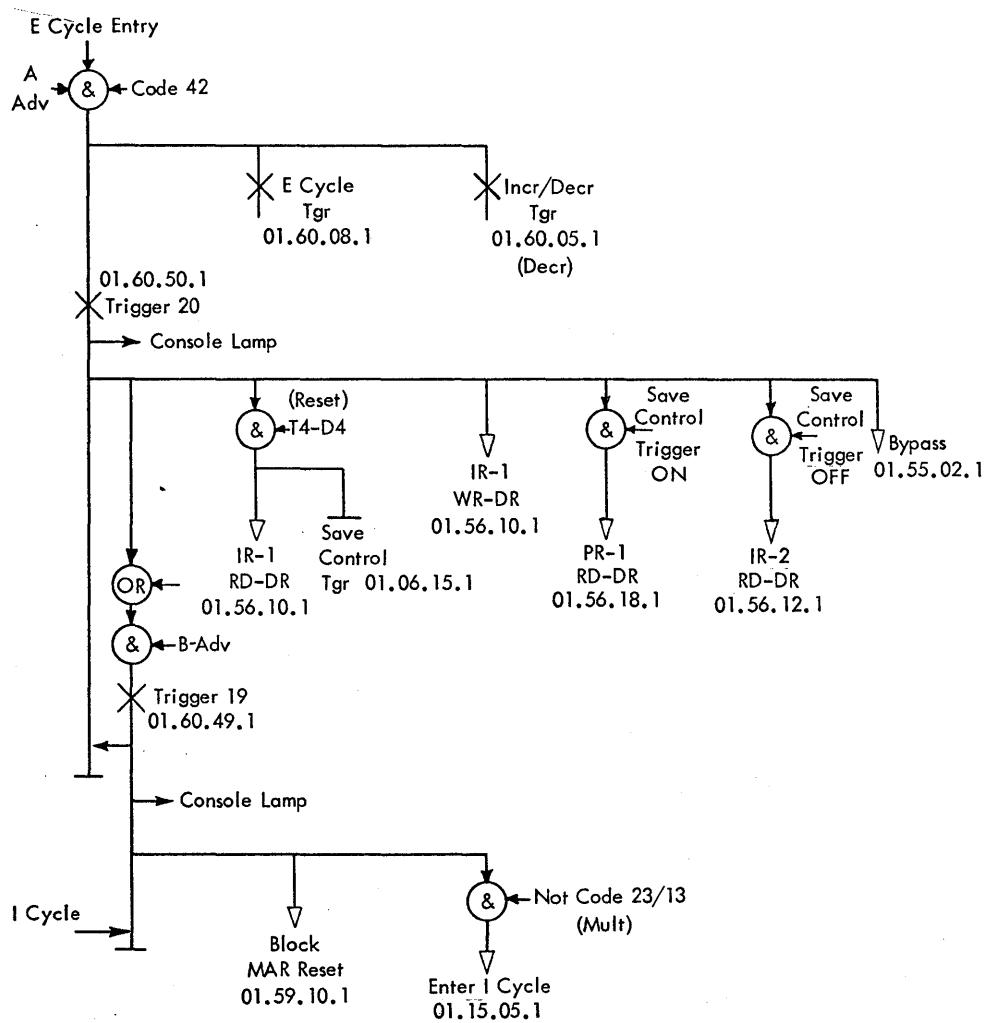


Figure 3-29. Branch Back

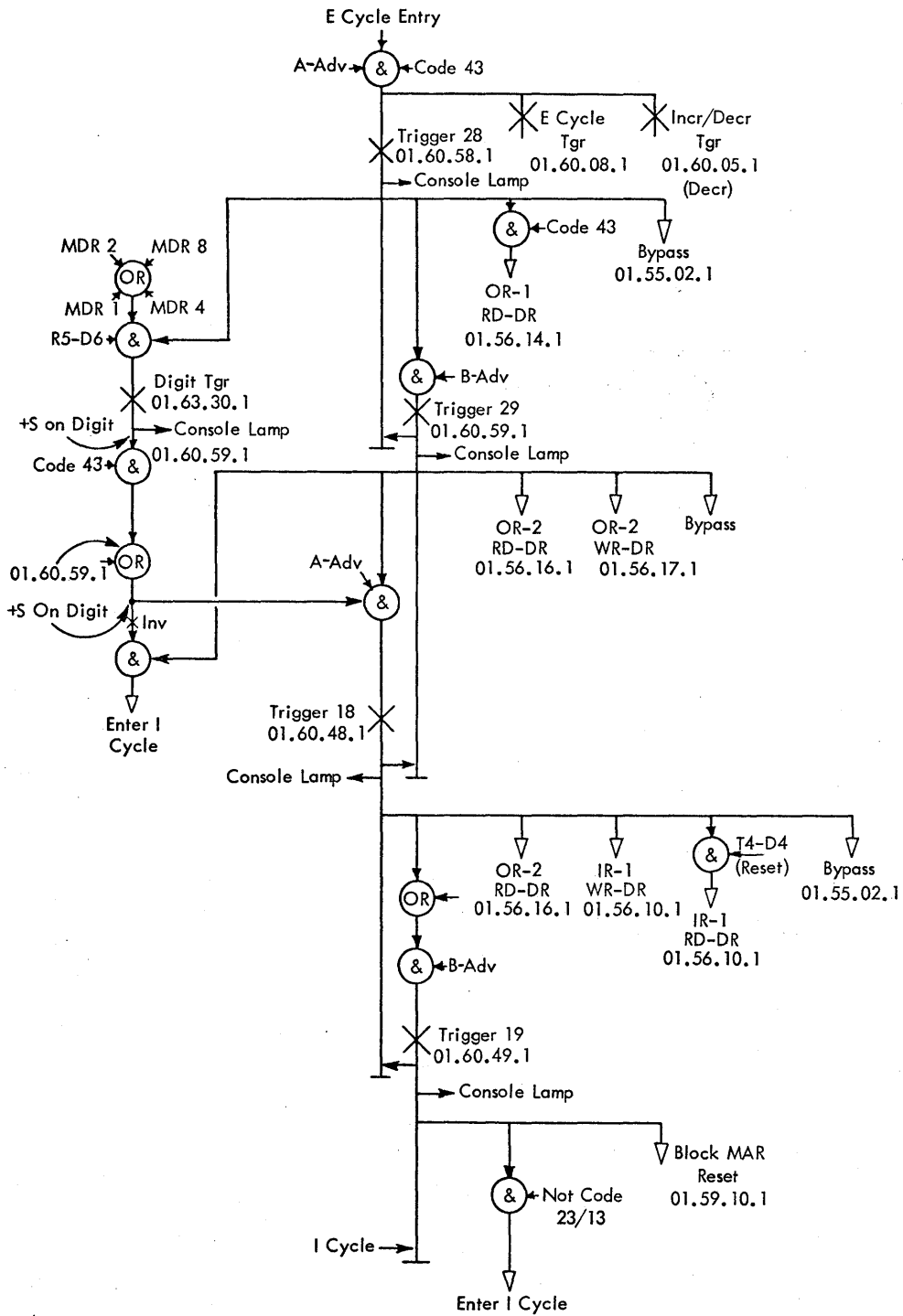


Figure 3-30. Branch On Digit

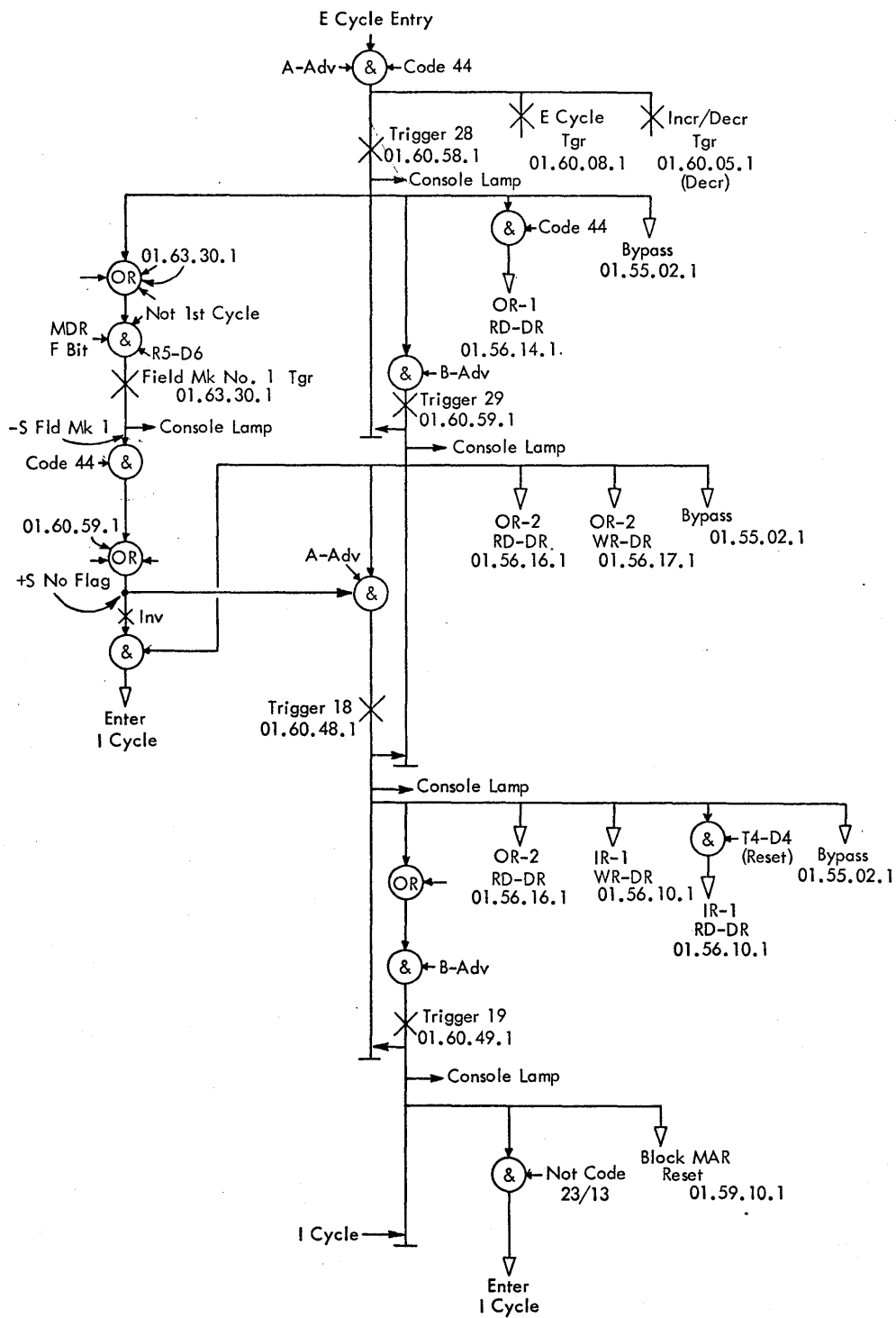


Figure 3-31. Branch No Flag



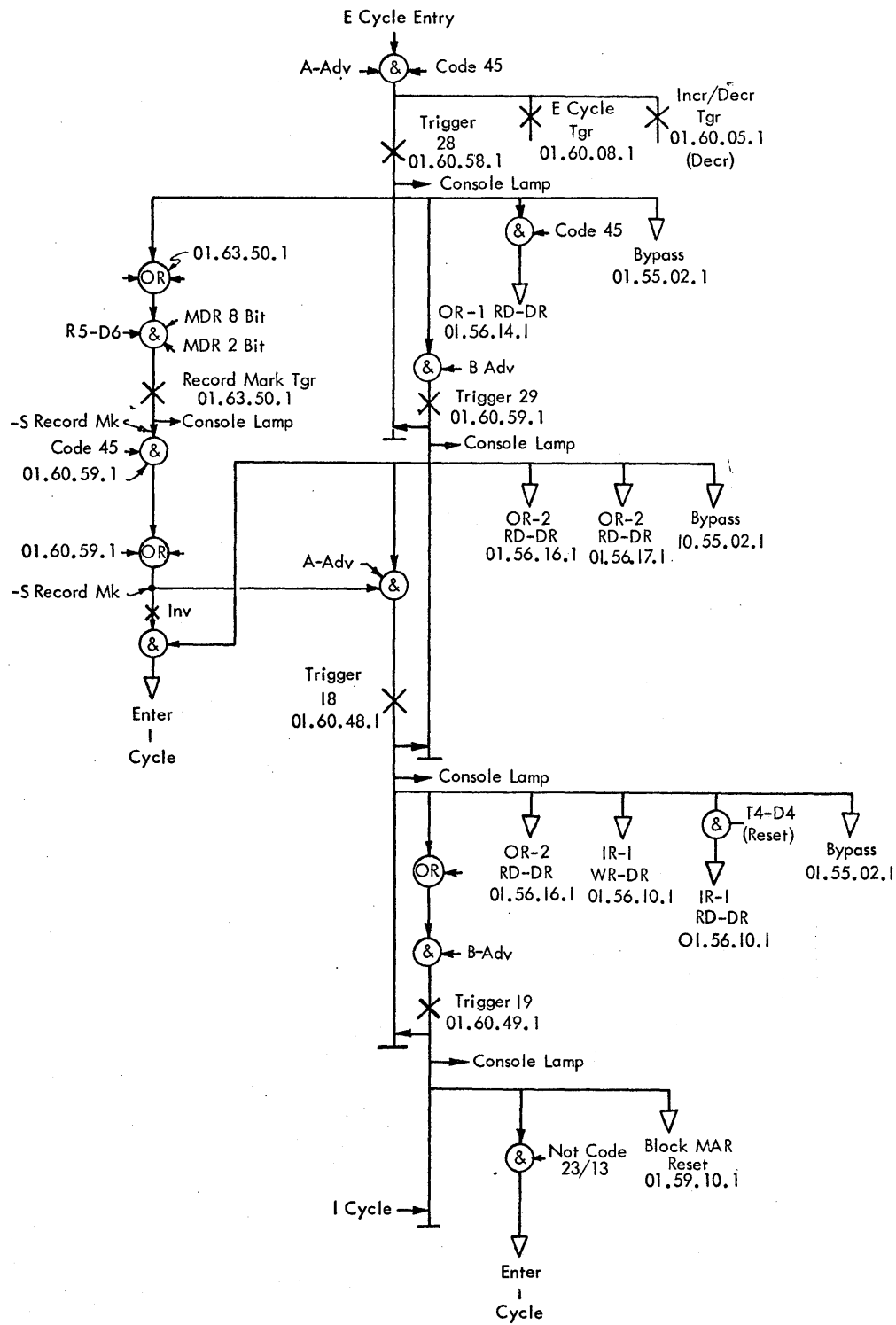
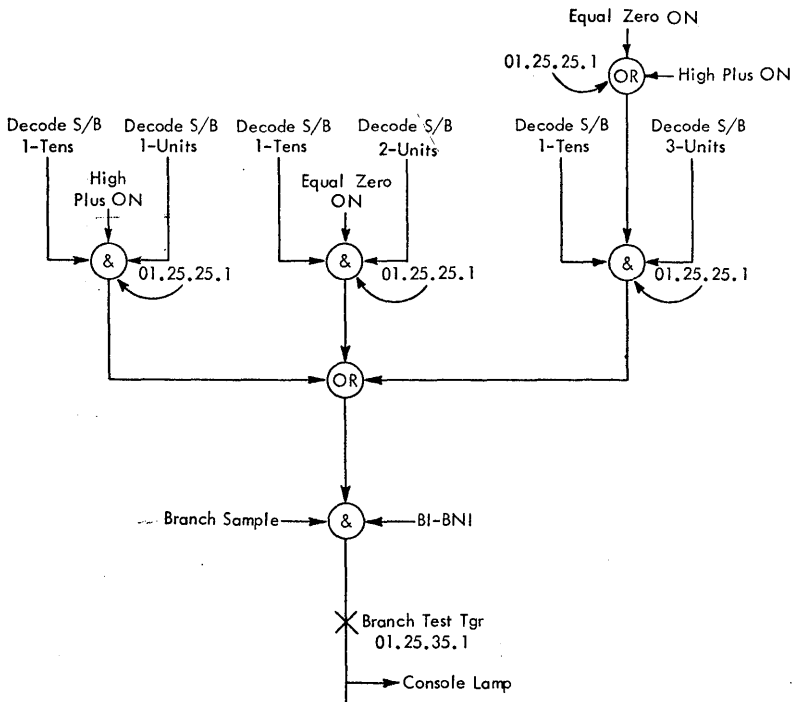
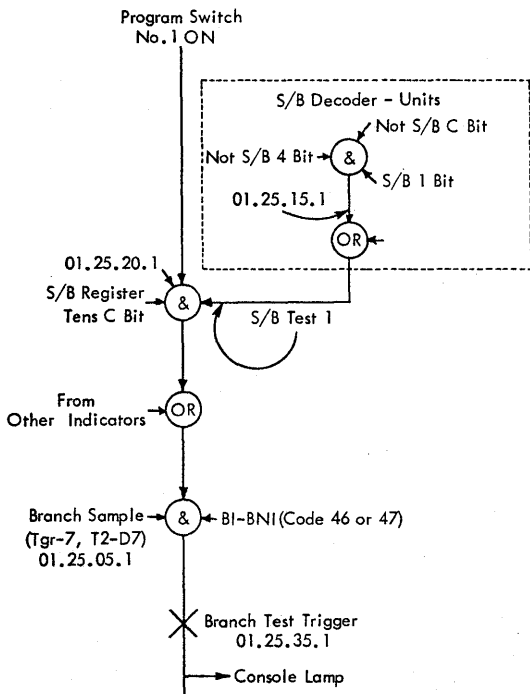


Figure 3-32. Branch No Record Mark



Code 46: Branch Can Occur if Either High Plus OR Equal Zero Trigger is ON.  
 Code 47: Branch Can Occur Only if Both High Plus AND Equal Zero Triggers are OFF.

Figure 3-33. Branch Indicator-Branch No Indicator-Indicator Codes 11-12-13



NOTE: For Program Switches 2, 3, & 4 the S/B Decoder Units Will Decode A 2, 3, or 4. Remainder of Function is Identical.

Figure 3-34. Branch Indicator-Branch No Indicator-Program Switch Indicator Code 01

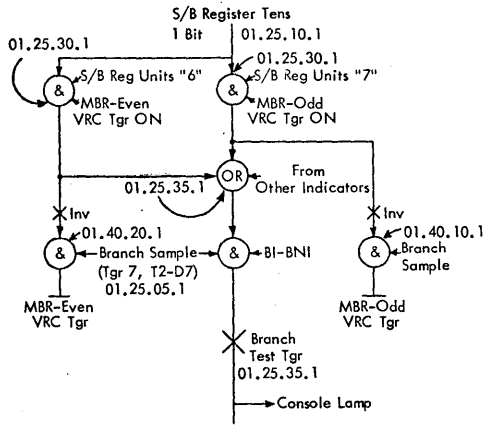


Figure 3-35. Branch Indicator-Branch No Indicator-MBR VRC Tgrs Indicator Codes 16-17

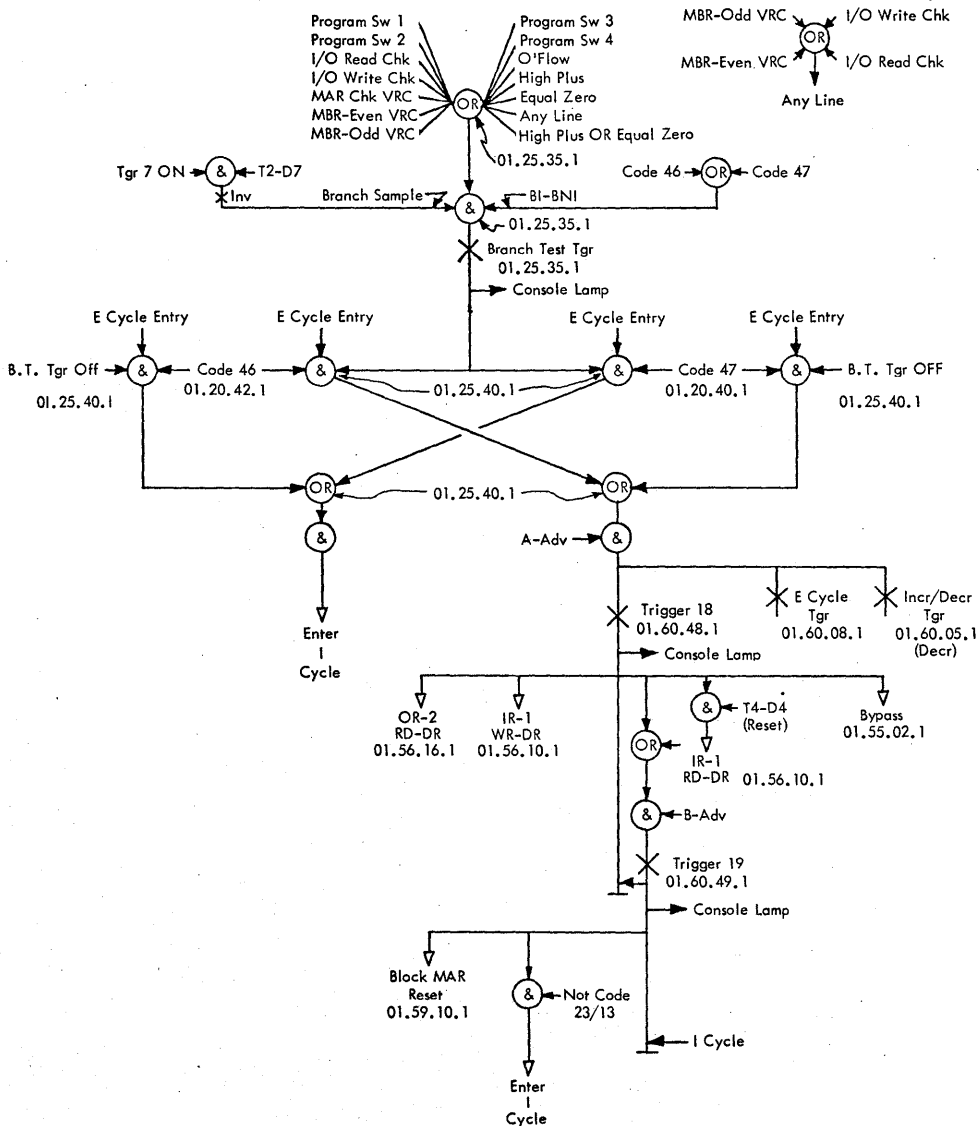


Figure 3-36. Branch Indicator - Branch No Indicator

Set Flag Code 32  
 Clear Flag Code 33  
 "C" Bit Correction For MDR To MBR Transfer

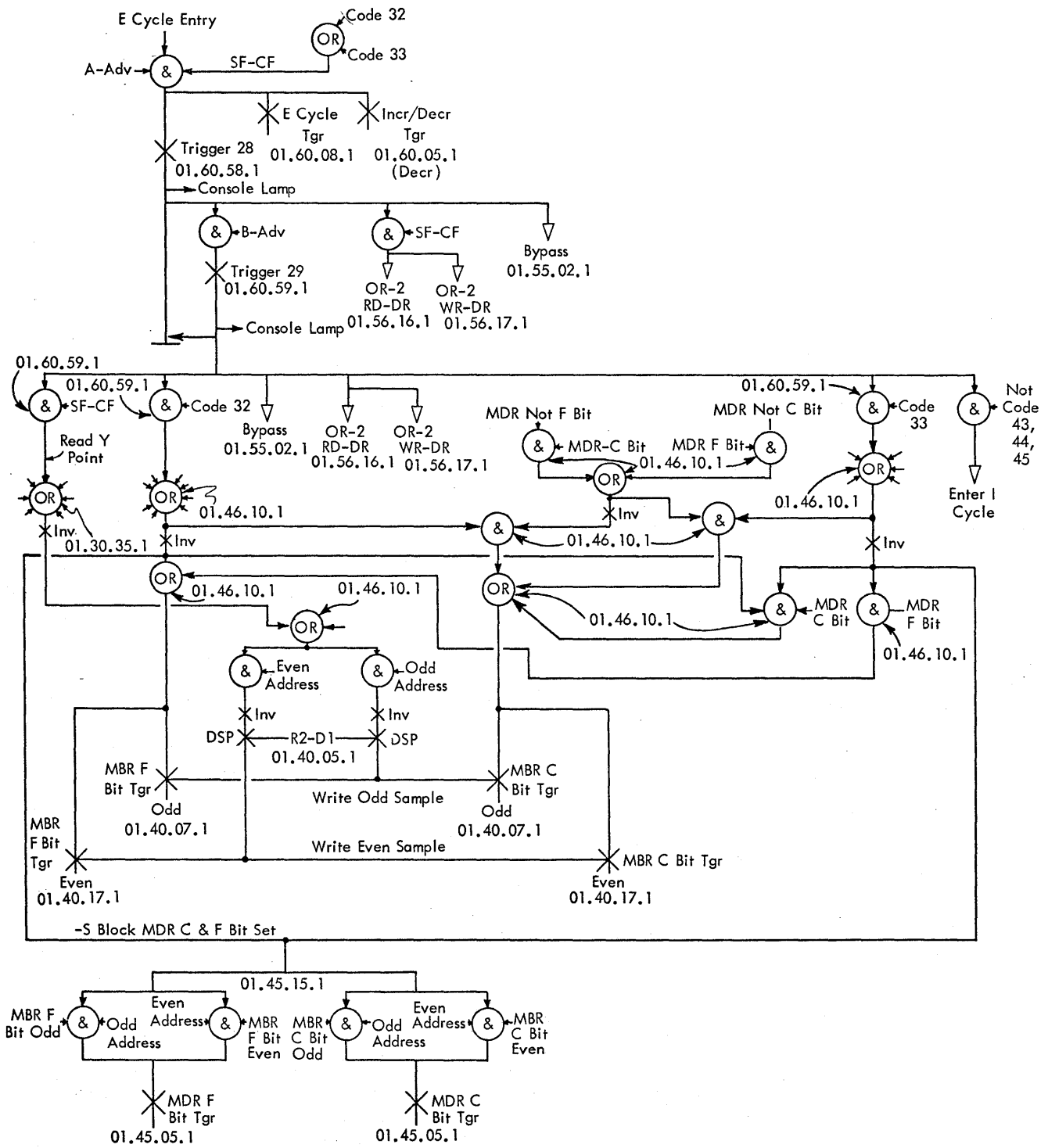


Figure 3-37. Set Flag-Clear Flag

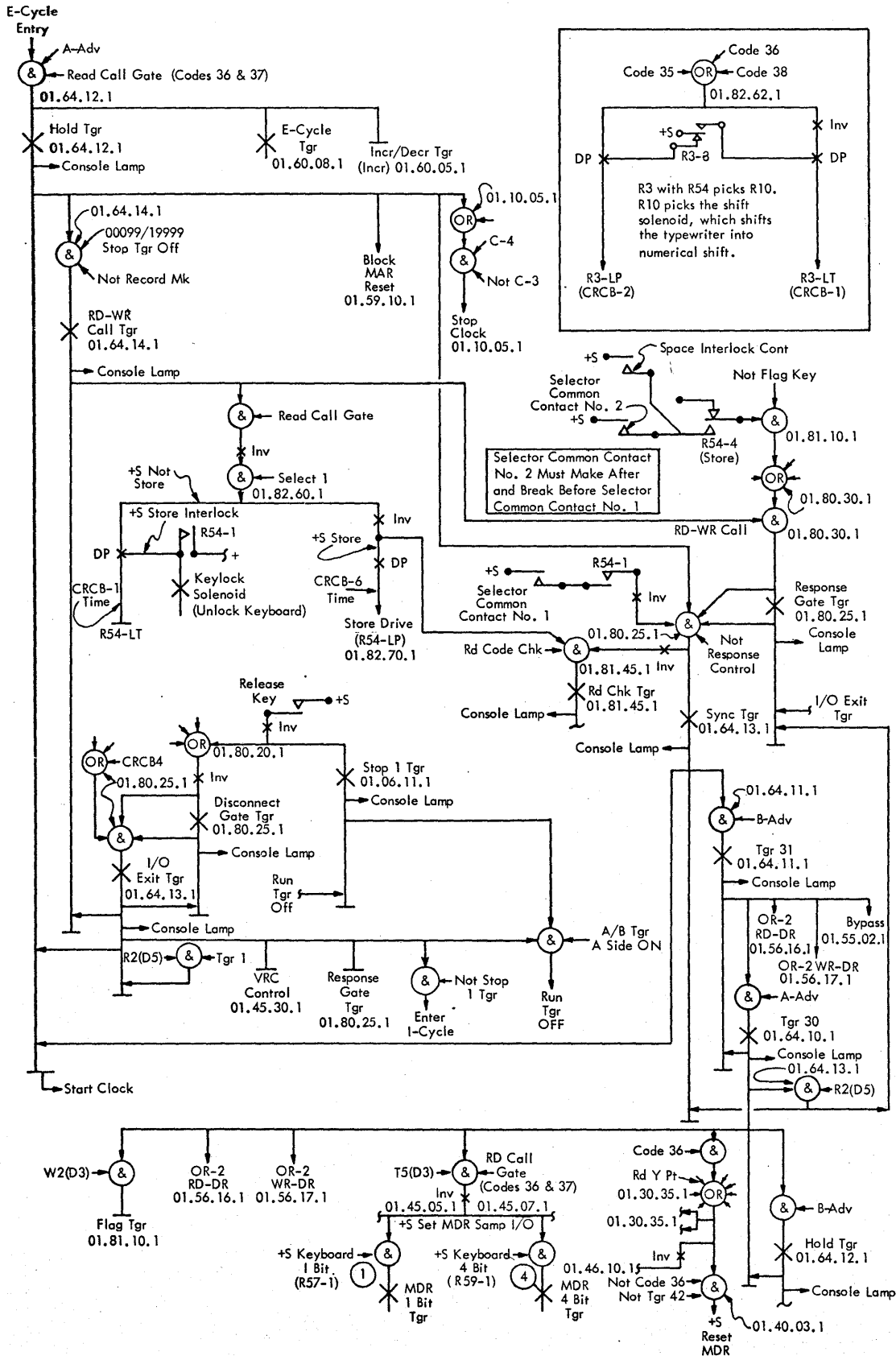


Figure 3-38. Read Numerically—Code 36 (36 P P P P P Q 0 1 Q Q)



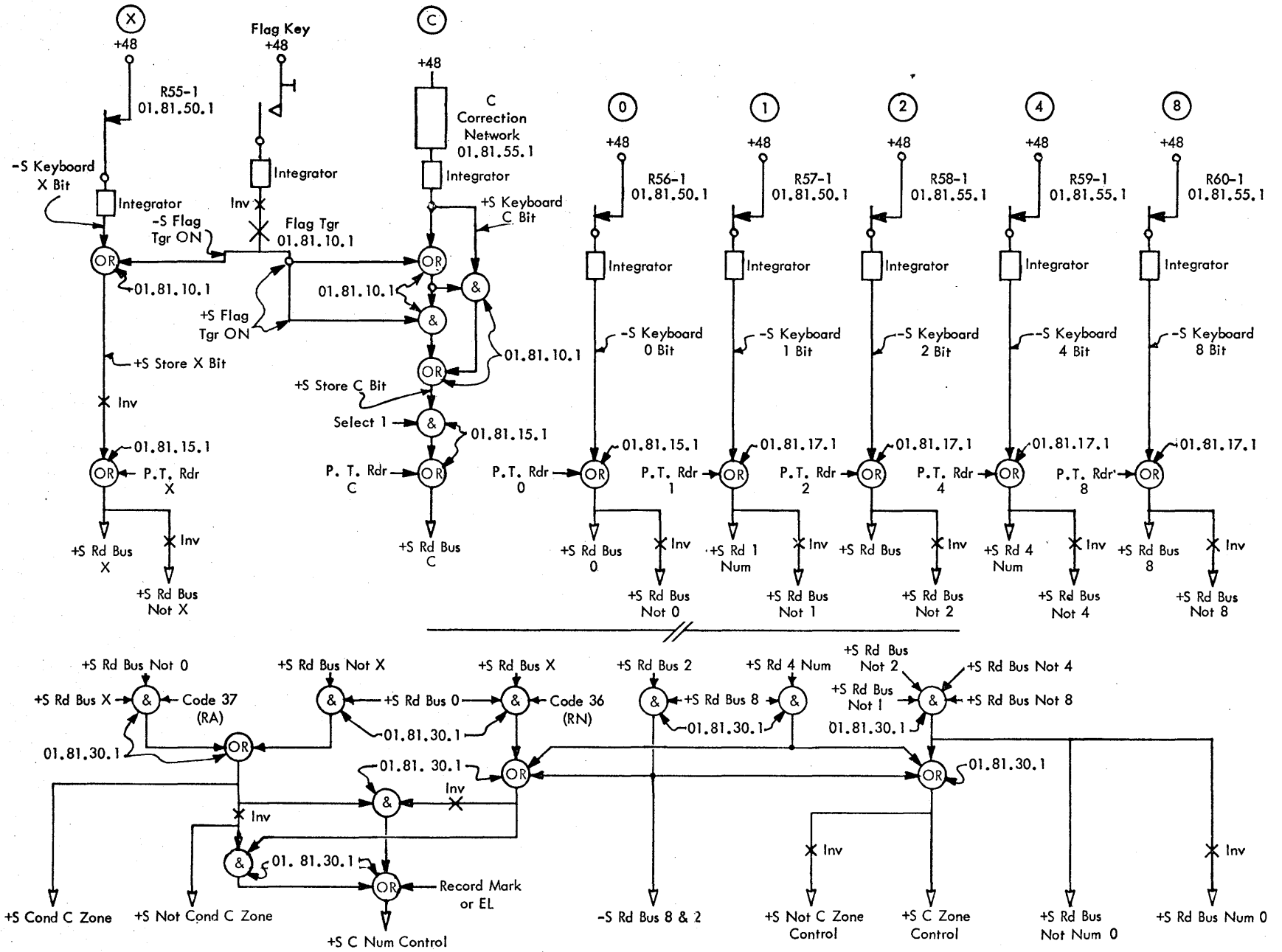


Figure 3-40a. Input Translator

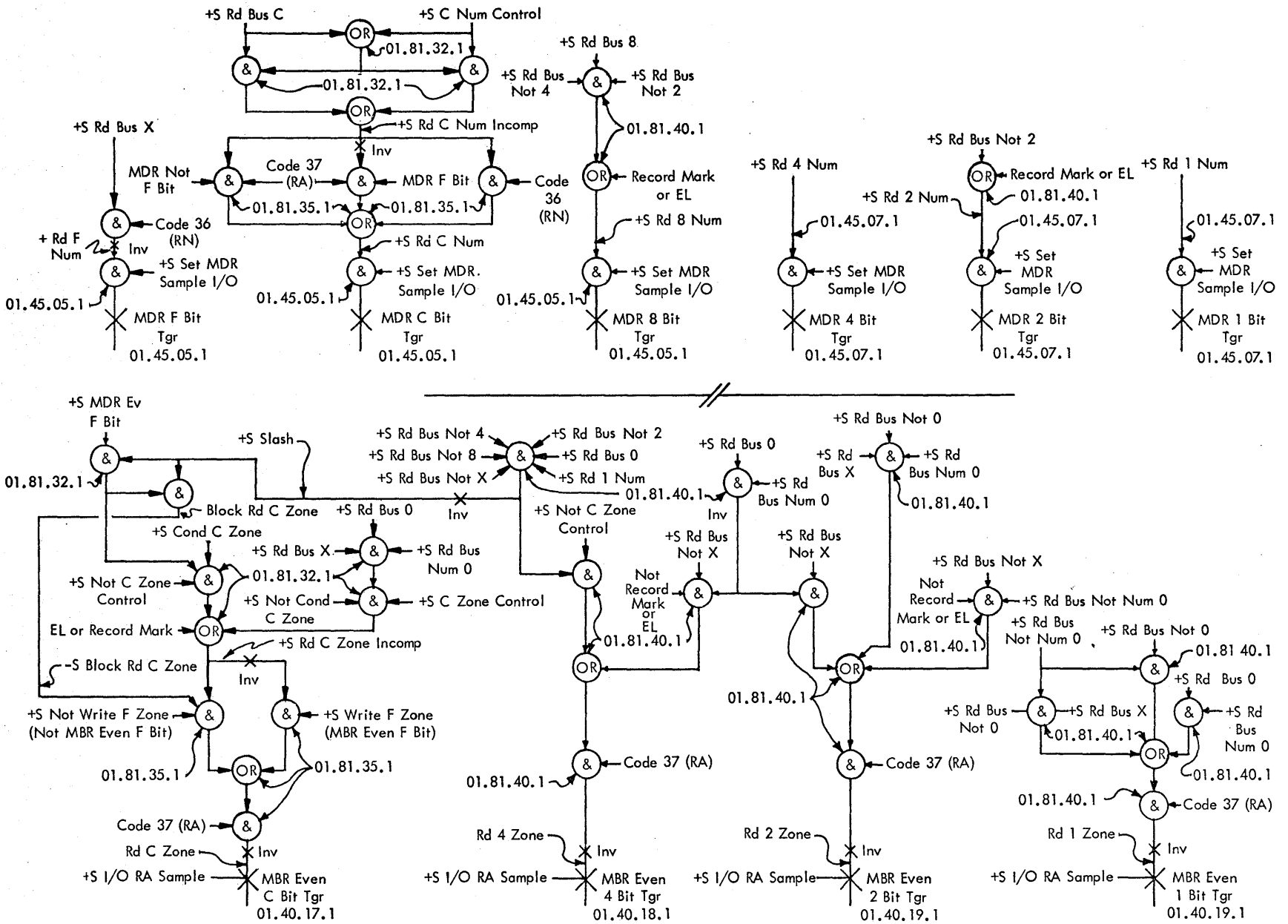


Figure 3-40b. Input Translator



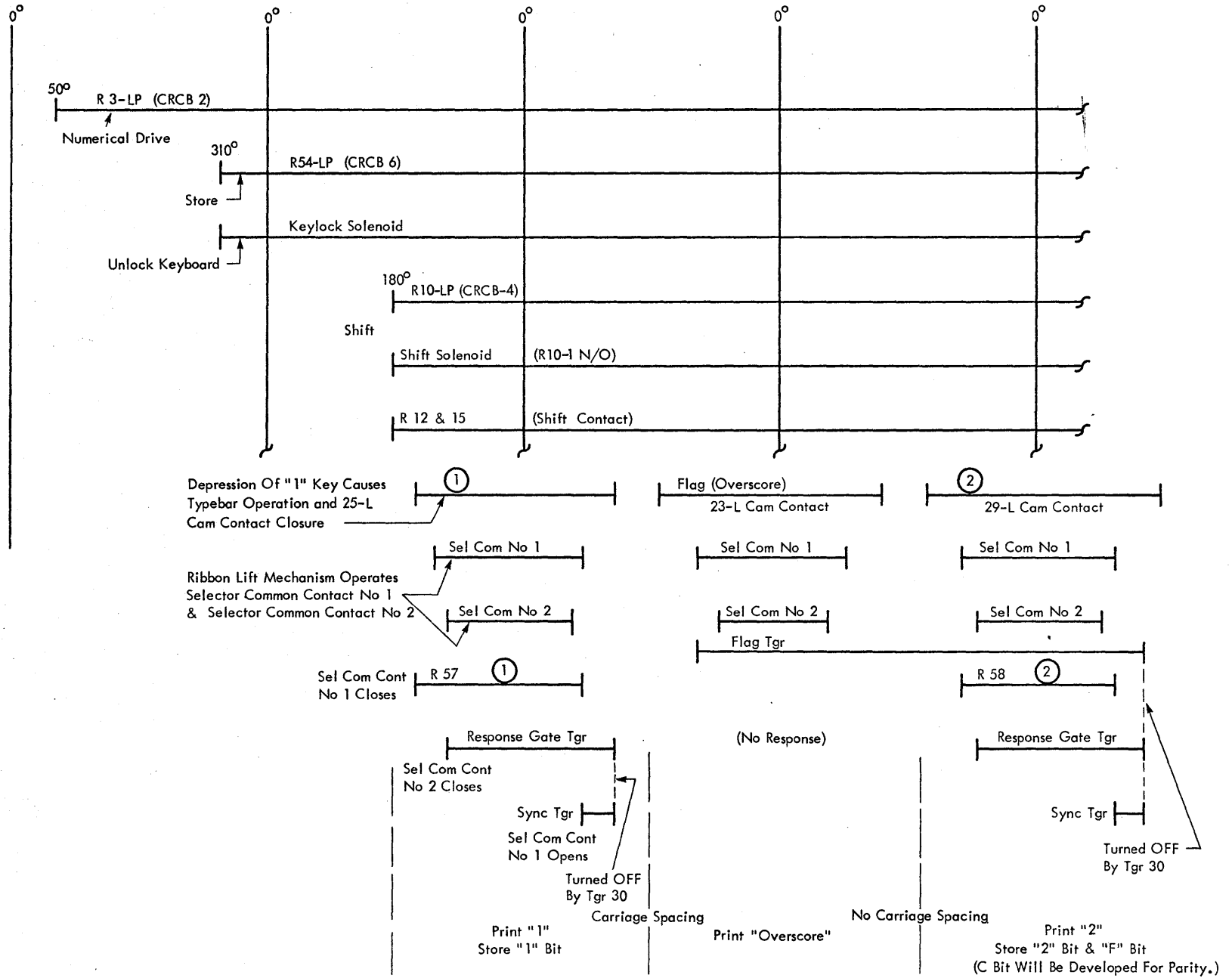
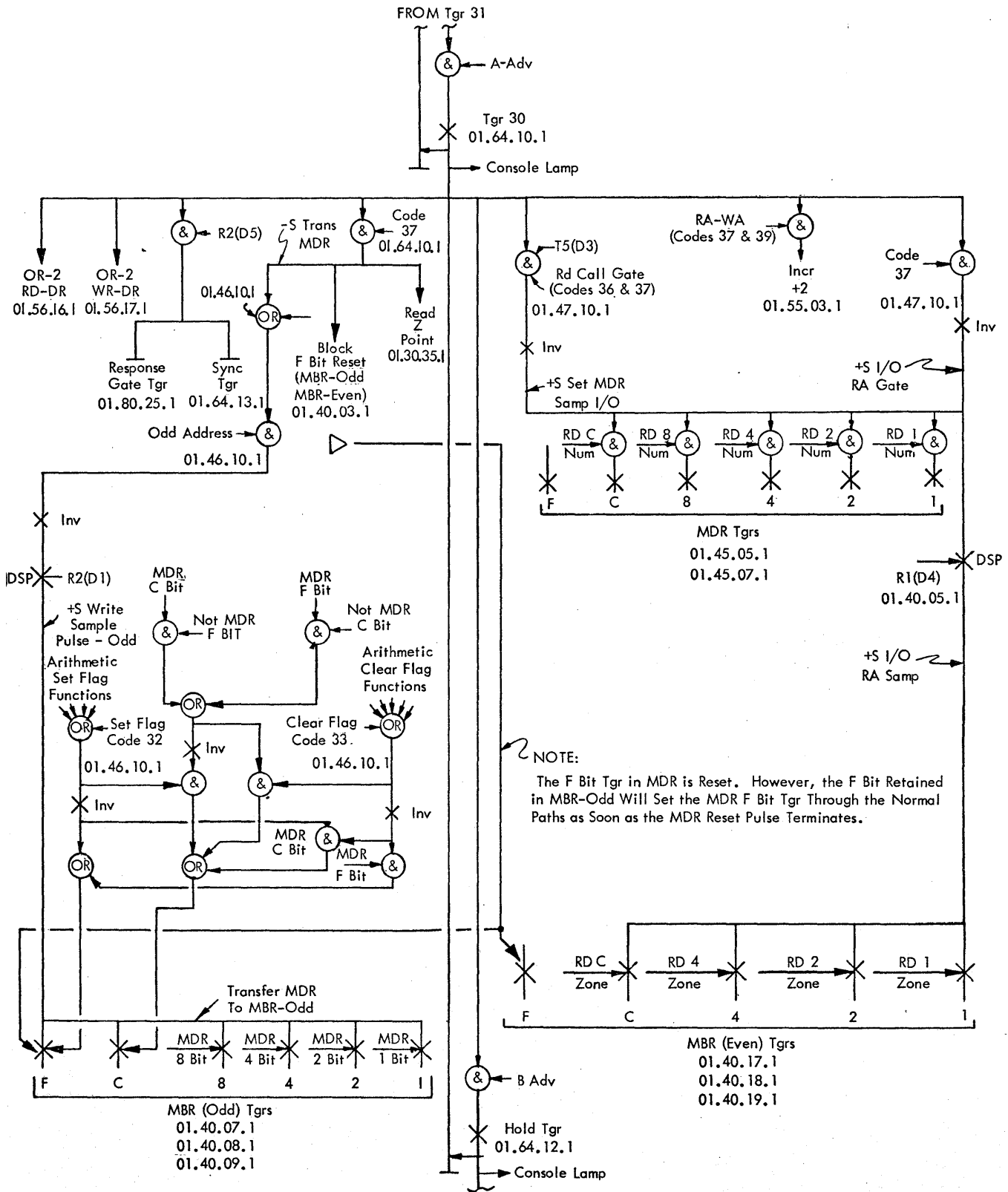


Figure 3-41. Typewriter Used as Input Device (Numerical)

(See Read Numerically-Code 36 Function Charts, Figures 3-38 and 3-39 for Functions Other than those Accomplished by tgr 30.)



NOTE:  
The F Bit Tgr in MDR is Reset. However, the F Bit Retained in MBR-Odd Will Set the MDR F Bit Tgr Through the Normal Paths as Soon as the MDR Reset Pulse Terminates.

Figure 3-42. Read Alphanumeric - Code 37 (37 P P P P P Q 0 1 Q Q)

Write Numerically - Code 38 (38 P P P P P Q 0 1 Q Q)

Dump Numerically - Code 35 (35 P P P P P Q 0 1 Q Q)

Write Alphanumerically - Code 39 (39 P P P P P Q 0 1 Q Q)

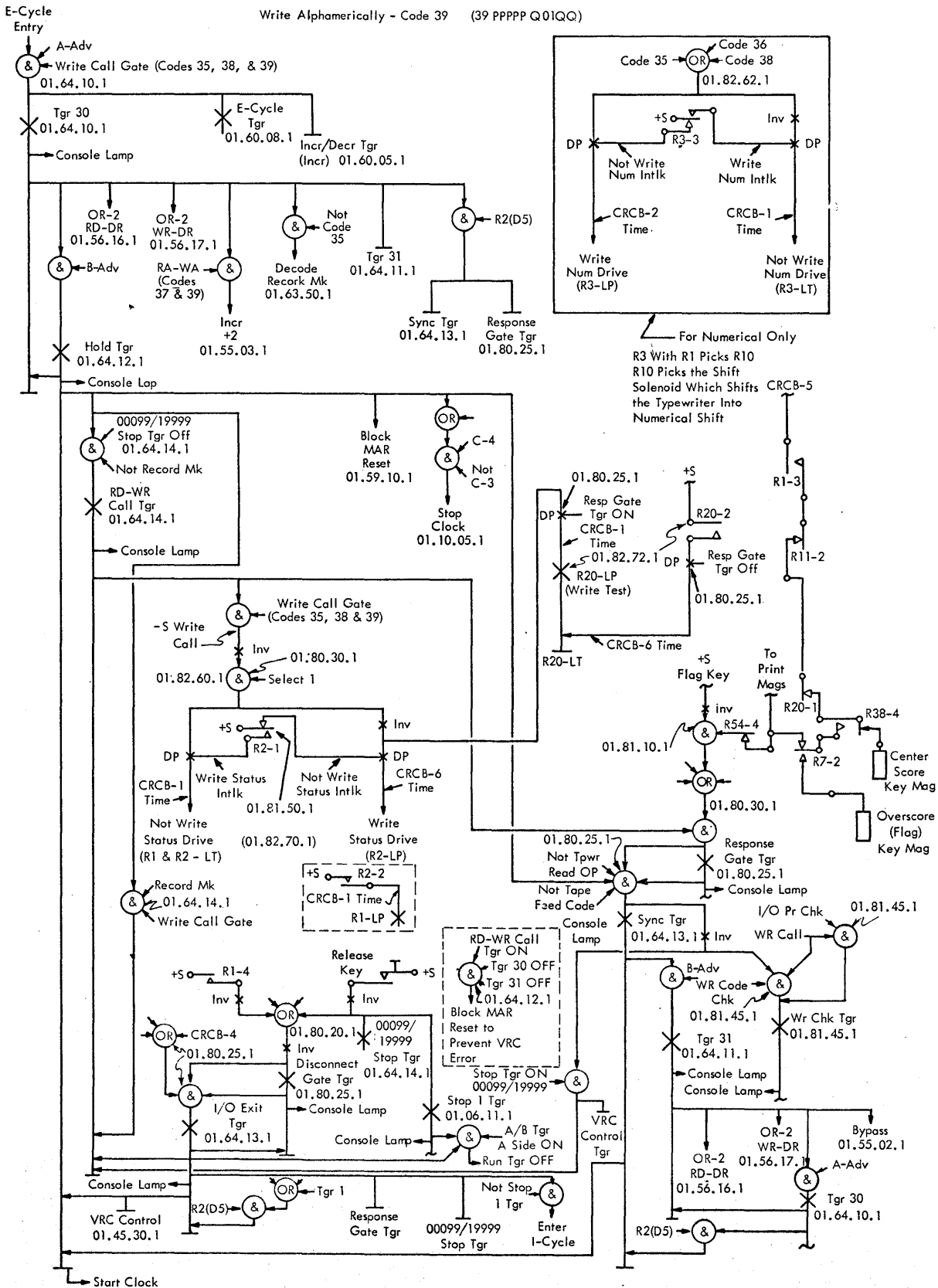


Figure 3-43. Write Numerically—Code 38, Write Alphanumerically—Code 39, Dump Numerically—Code 35 (Q01QQ)

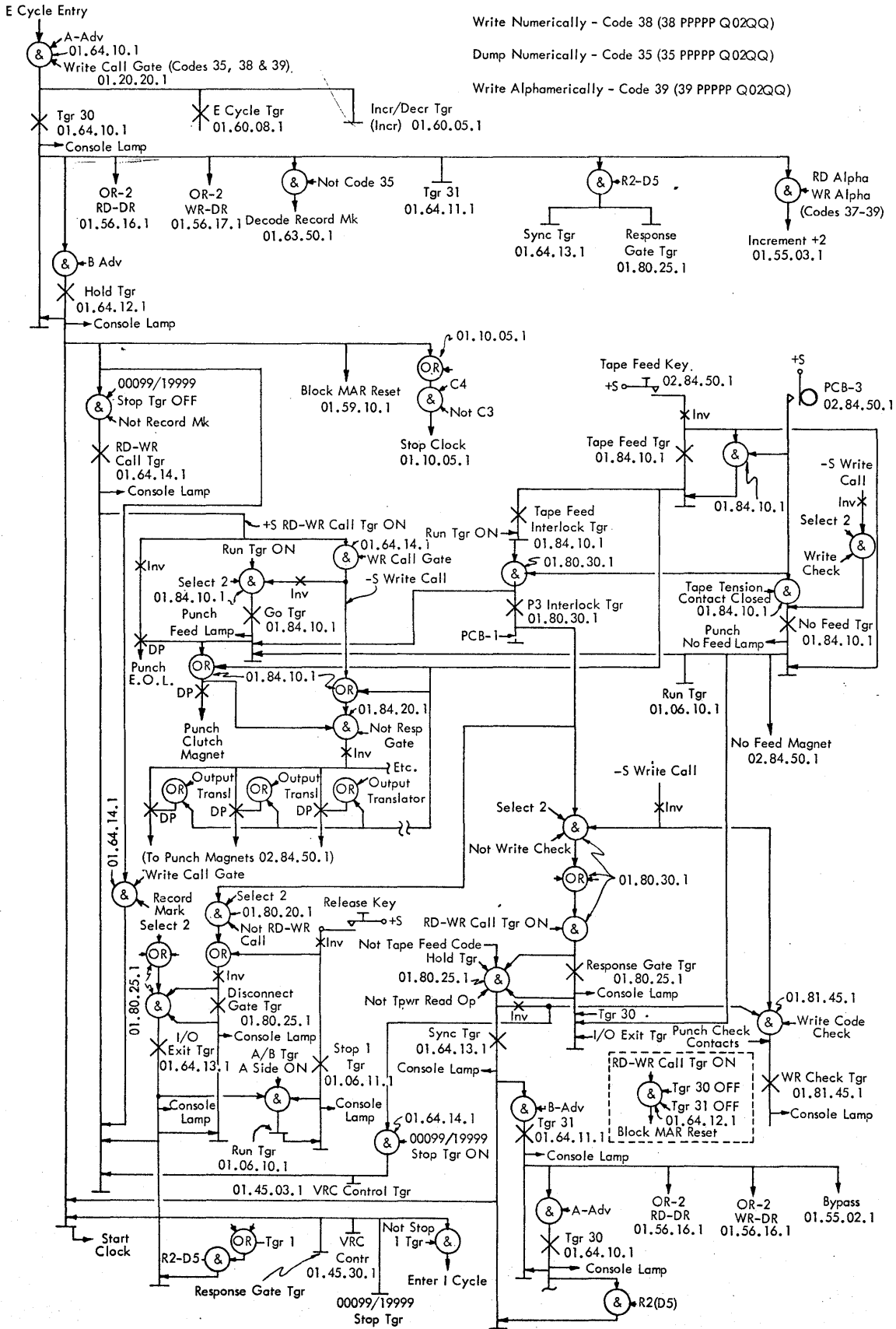


Figure 3-44. Write Numerically—Code 38, Write Alphanumerically—Code 39, Dump Numerically—Code 35 (Q02QQ)

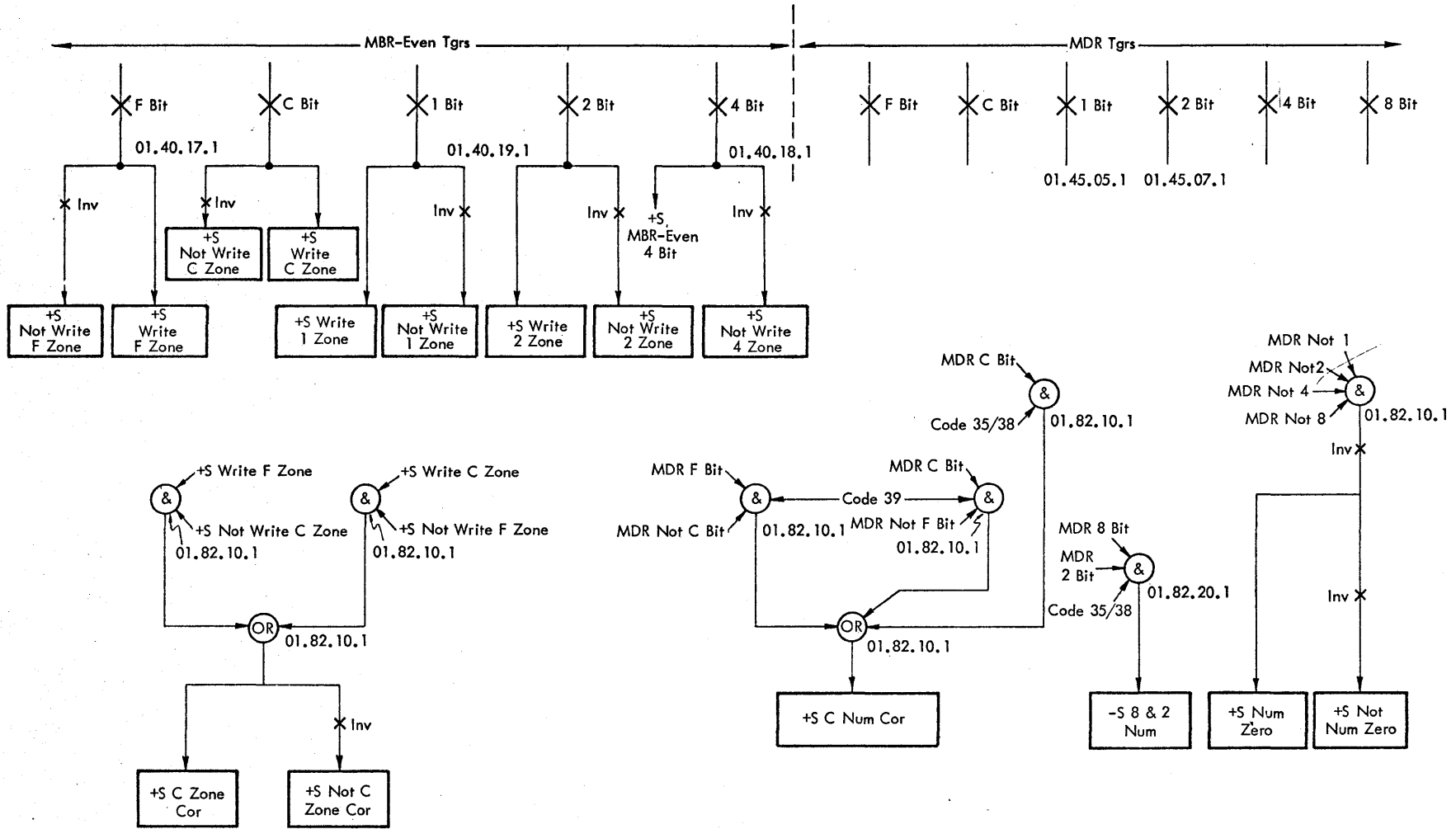


Figure 3-45a. Output Translator

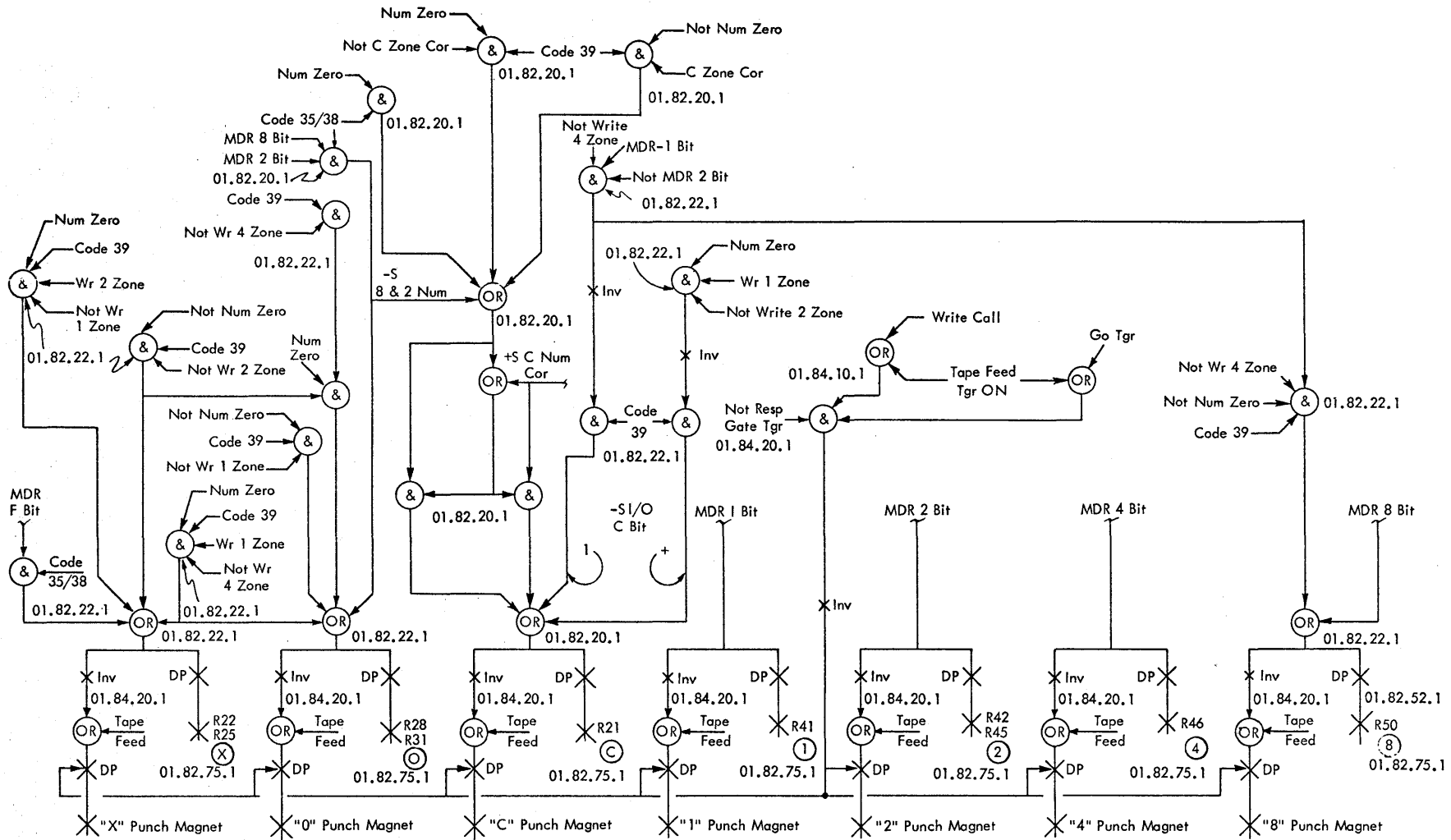


Figure 3-45b. Output Translator

Typewriter Used as Output Device (Numerical)

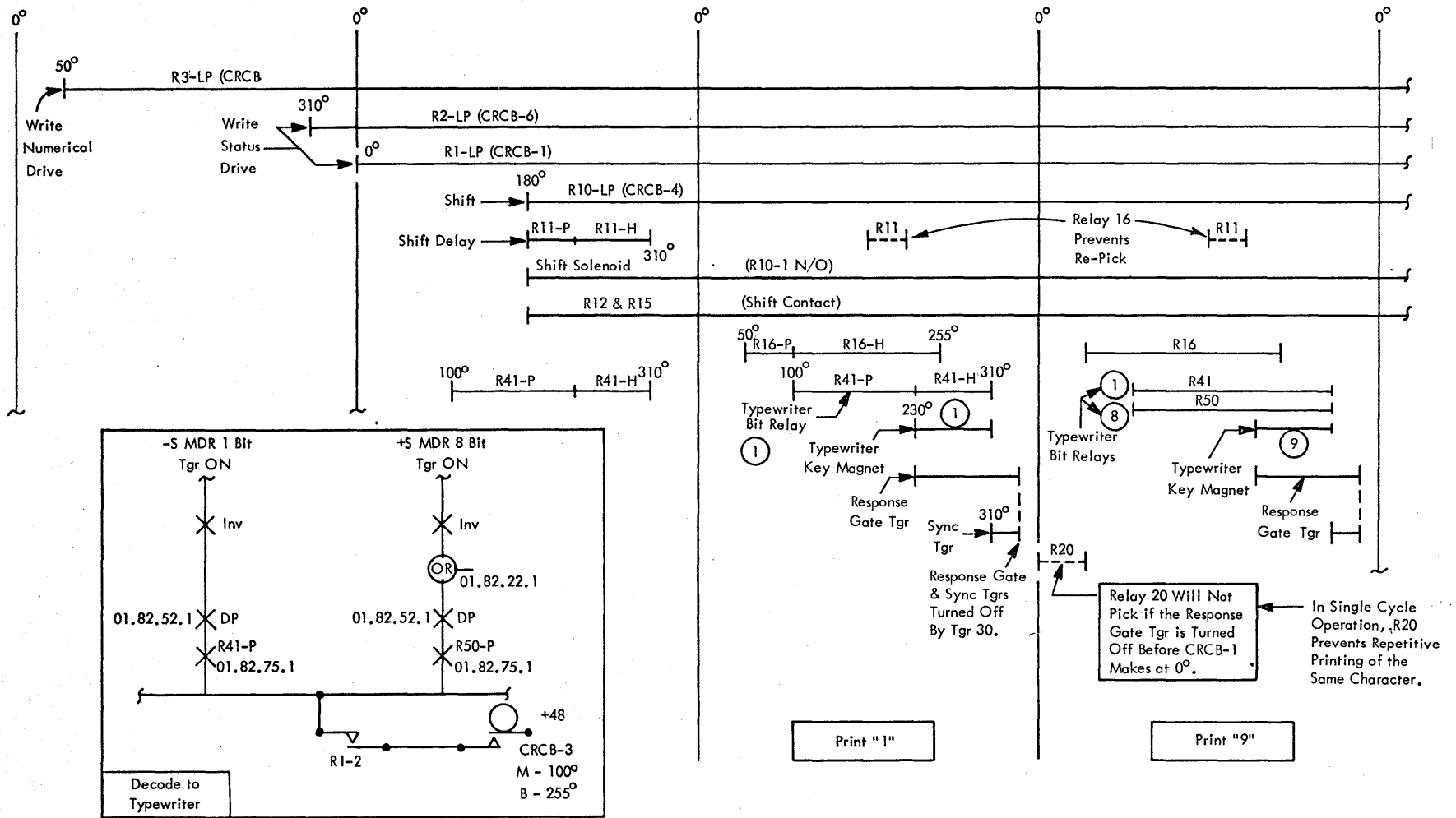


Figure 3-46. Typewriter Used as Output Device (Numerical)

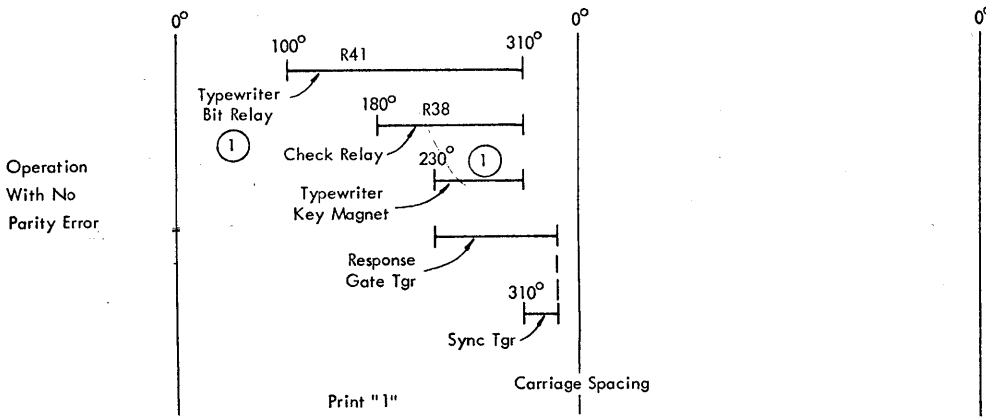


Figure 3-47a. Typewriter Operation with No Parity Error

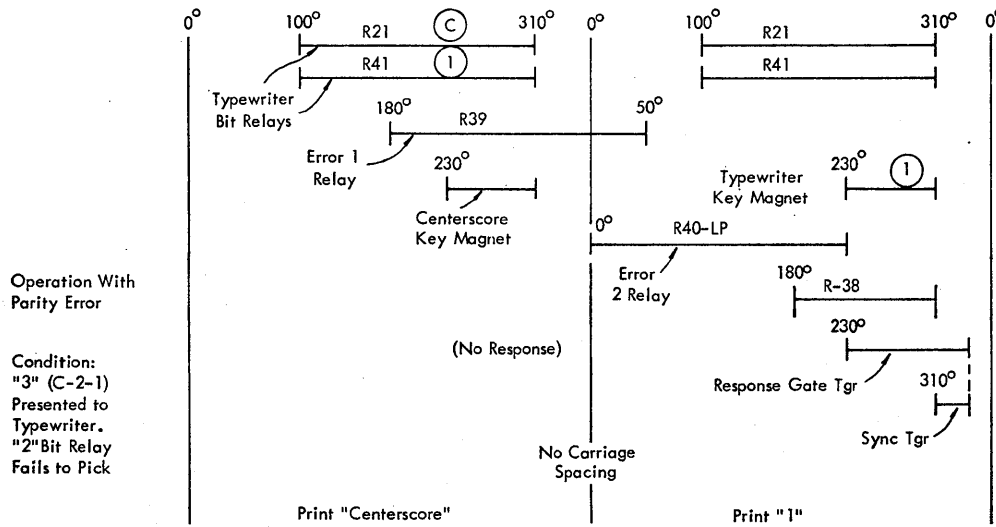


Figure 3-47b. Typewriter Operation with Parity Error

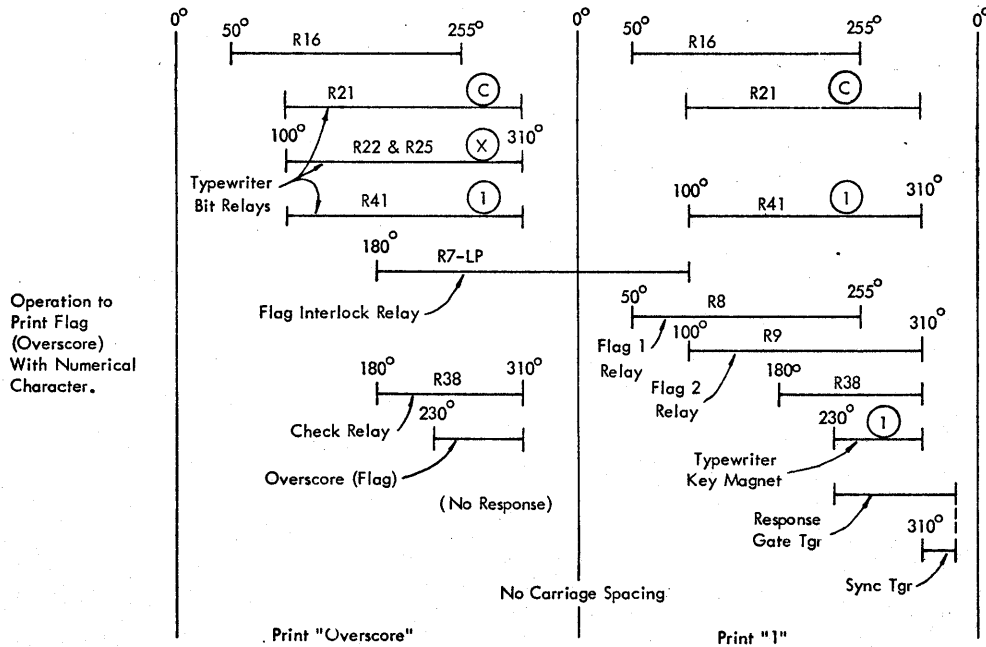


Figure 3-47c. Typewriter Operation to Print Flag (Overscore) with Numerical Character



Control - Code 34 (34 P P P P P Q 0 1 Q 1)

2  
8

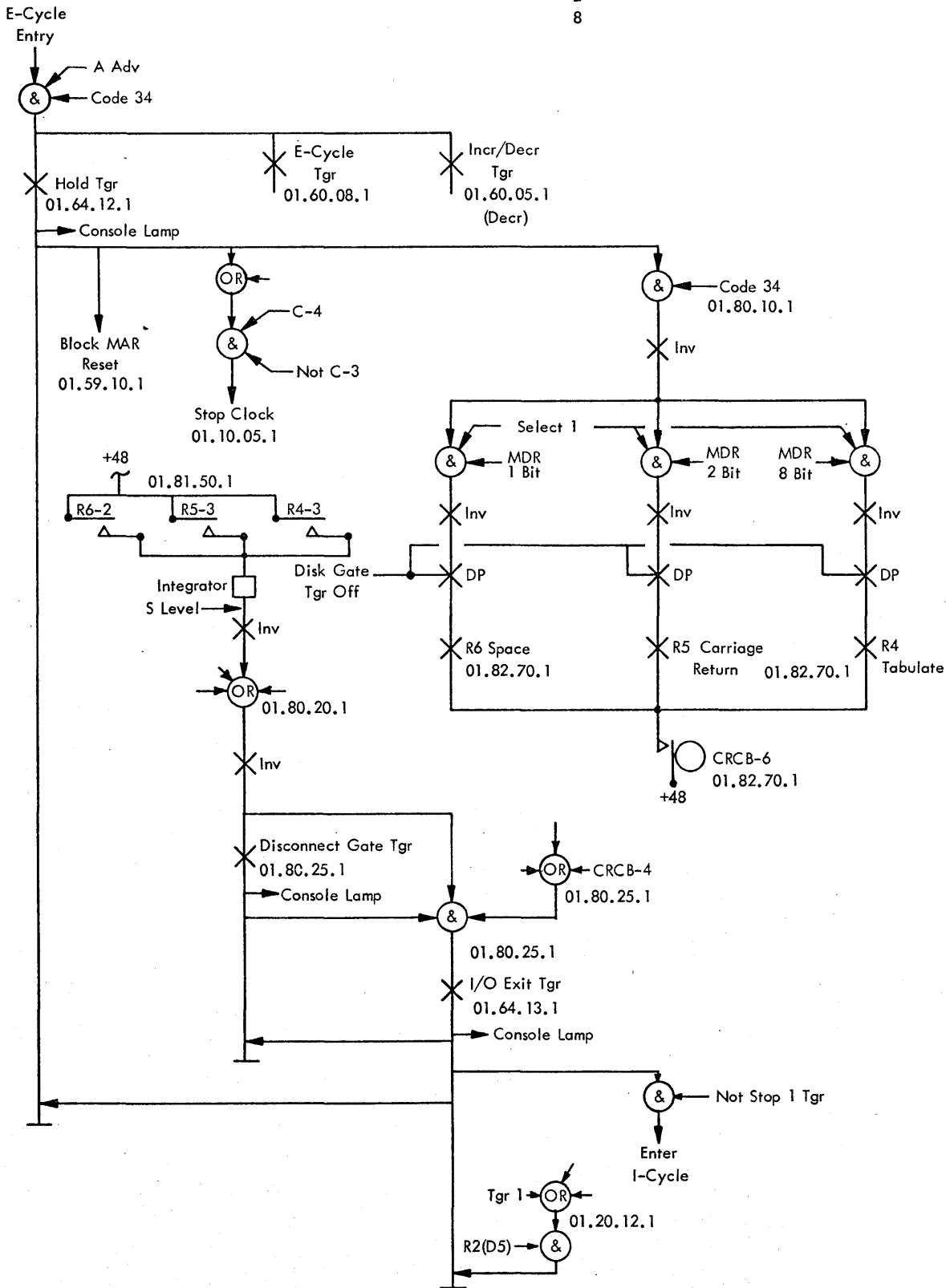


Figure 3-48. Control-Code 34 (34 P P P P P Q 0 1 Q 1  
 1 Space  
 2 Carriage Return  
 8 Tabulate)

Character	Alphameric Mode					Numerical Mode	
	Memory Code				Typewriter & Paper Tape Code	Memory Code	Typewriter & Paper Tape Code
	Zone		Numeric				
	Digit	Bits	Digit	Bits			
		C 4 2 1		C 8 4 2 1	X 0 C 8 4 2 1	C F 8 4 2 1	X 0 C 8 4 2 1
bl space	0	C	0	C	C		
.	0	C	3	C 2 1	X 0 8 2 1		
)	0	C	4	4	X 0 C 8 4		
+	1	1	0	C	X 0 C		
\$	1	1	3	C 2 1	X C 8 2 1		
*	1	1	4	4	X 8 4		
-	2	2	0	C	X		
/	2	2	1	1	0 C 1		
'	2	2	3	C 2 1	0 C 8 2 1		
(	2	2	4	4	0 8 4		
=	3	C 2 1	3	C 2 1	8 2 1		
@	3	C 2 1	4	4	C 8 4		
A	4	4	1	1	X 0 1		
B	4	4	2	2	X 0 2		
C	4	4	3	C 2 1	X 0 C 2 1		
D	4	4	4	4	X 0 4		
E	4	4	5	C 4 1	X 0 C 4 1		
F	4	4	6	C 4 2	X 0 C 4 2		
G	4	4	7	4 2 1	X 0 4 2 1		
H	4	4	8	8	X 0 8		
I	4	4	9	C 8 1	X 0 C 8 1		
J	5	C 4 1	1	1	X C 1		
K	5	C 4 1	2	2	X C 2		
L	5	C 4 1	3	C 2 1	X C 2 1		
M	5	C 4 1	4	4	X C 4		
N	5	C 4 1	5	C 4 1	X C 4 1		
O	5	C 4 1	6	C 4 2	X C 4 2		
P	5	C 4 1	7	4 2 1	X C 4 2 1		
Q	5	C 4 1	8	8	X C 8		
R	5	C 4 1	9	C 8 1	X C 8 1		
S	6	C 4 2	2	2	0 C 2		
T	6	C 4 2	3	C 2 1	0 C 2 1		
U	6	C 4 2	4	4	0 C 4		
V	6	C 4 2	5	C 4 1	0 C 4 1		
W	6	C 4 2	6	C 4 2	0 C 4 2		
X	6	C 4 2	7	4 2 1	0 C 4 2 1		
Y	6	C 4 2	8	8	0 C 8		
Z	6	C 4 2	9	C 8 1	0 C 8 1		
0	7	4 2 1	0	C	0	C	0
1	7	4 2 1	1	1	1	1	1
2	7	4 2 1	2	2	2	2	2
3	7	4 2 1	3	C 2 1	C 2 1	C 2 1	C 2 1
4	7	4 2 1	4	4	4	4	4
5	7	4 2 1	5	C 4 1	C 4 1	C 4 1	C 4 1
6	7	4 2 1	6	C 4 2	C 4 2	C 4 2	C 4 2
7	7	4 2 1	7	4 2 1	4 2 1	4 2 1	4 2 1
8	7	4 2 1	8	8	8	8	8
9	7	4 2 1	9	C 8 1	C 8 1	C 8 1	C 8 1
Record Mark ‡	0	C	‡	C 8 2	0 8 2	C 8 2	0 8 2 or E.L.
Flag						F	X

Figure 3-49. Character Code Chart



Operation Code	E-Cycle Entry	E-Cycle	Incr/Decr	First Cycle	Field Mk. No. 1	Field Mk. No. 2	T/C	High/Plus	Equal-Zero	Carry Out	Carry In	Recmp. Cntl.	Recmp.	Cycle Cntl.	0080	Dividend & Remainder Sign	Divide Add	First Divide Cycle	Last Divide Cycle	Save Cntl.	Record Mark	Digit	Branch Test	Response Gate	Sync	Disconnect Gate	I/O Exit	Step 1	RD-WR Call	Write Chk.	Read Chk.	0009/1999 Stop	Overflow	Flag	Go	
11 & 21	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
12 & 22	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
13 & 23	Δ	Δ	I&D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																					
14 & 24	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
15 & 25	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
16 & 26	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
17 & 27	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
18 & 28	Δ	Δ	I&D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
19 & 29	Δ	Δ	D&I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
31	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
32	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
33	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
34	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
35	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
36	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
37	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
38	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
39	Δ	Δ	I	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
41	Δ	Δ		Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
42	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
43	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
44	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
45	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
46	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
47	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
48	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						
49	Δ	Δ	D	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ																						

Figure 3-51. Auxiliary Trigger Chart



Register	Trigger Name	System Diagram Page Number
Multiplier	C Bit, 8 Bit, & 4 Bit	01.62.50.1
	2 Bit & 1 Bit	01.62.52.1
Operation	C Bit, 8 Bit, & 4 Bit (Units)	01.20.07.1
	2 Bit & 1 Bit (Units)	01.20.09.1
	C Bit, 8 Bit, & 4 Bit (Tens)	01.20.10.1
	2 Bit & 1 Bit (Tens)	01.20.12.1
Sense & Branch	C Bit, 8 Bit, & 4 Bit (Units)	01.25.08.1
	2 Bit, & 1 Bit (Units)	01.25.09.1
	C Bit & 1 Bit (Tens)	01.25.10.1
MBR - Odd	C Bit & F Bit	01.40.07.1
	8 Bit & 4 Bit	01.40.08.1
	2 Bit & 1 Bit	01.40.09.1
MBR - Even	C Bit & F Bit	01.40.17.1
	8 Bit & 4 Bit	01.40.18.1
	2 Bit & 1 Bit	01.40.19.1
MDR	C Bit, F Bit, & 8 Bit	01.45.05.1
	4 Bit, 2 Bit, & 1 Bit	01.45.07.1
Digit	C Bit, 8 Bit, & 4 Bit (Units)	01.50.07.1
	2 Bit & 1 Bit (Units)	01.50.09.1
	C Bit, 8 Bit, & 4 Bit (Tens)	01.50.17.1
	2 Bit & 1 Bit (Tens)	01.50.19.1
MAR	C Bit & 8 Bit (Units)	01.57.05.1
	4 Bit & 2 Bit (Units)	01.57.07.1
	1 Bit (Units)	01.57.09.1
	C Bit (Tens)	01.57.09.1
	8 Bit & 4 Bit (Tens)	01.57.16.1
	2 Bit & 1 Bit (Tens)	01.57.18.1
	C Bit & 8 Bit (Hundreds)	01.57.20.1
	4 Bit & 2 Bit (Hundreds)	01.57.22.1
	1 Bit (Hundreds)	01.57.24.1
	C Bit (Thousands)	01.57.24.1
8 Bit & 4 Bit (Thousands)	01.57.26.1	
2 Bit & 1 Bit (Thousands)	01.57.28.1	
C Bit, 2 Bit, & 1 Bit (10 Thousands)	01.57.30.1	

Figure 3-54. Register Triggers Drop in for Servicing Procedures



## Servicing Procedures

SERVICING PROCEDURE CHART					
Functional Unit or Circuit	Item Description	Service Check	Adjustment	Removal/Replacement	Waveforms/Levels
4.1 Memory Unit	Thermoswitches Circulating Fan			74 74	
4.2 Cooling Fans			74	74	
4.3 Cable Connectors and Terminals	Dual Contact Terminals Wire Wrapped Terminals			74 75	
4.4 SMS Cards	Transistor Measurement Lubrication Oscillator Sample Pulse Generator Signal Levels Transistor Delay Times	75 76 76 76 76	75		76
4.5 CRCB Unit			77		
4.6 Typewriter	Selector Common and Letter Cam Contacts		77		
4.7 1620 Power Supply	Specifications Voltage Change Individual Power Supply	78	78	78	
4.8 Read Head and Light Assembly	Read Lamp & Lens Holder Read Window Read Photo Diode	79	79 80	79 79 79	81
4.9 Timing Disk Lamp and Photo Diode	Timing Disk Lamp Timing Disk Photo Diode		81 82	82 82	79
4.10 Tape Transport and Control	Tape Guides Tape Load Microswitch Clevis Assembly Tape Runout Bar Tape Runout Microswitch Tape Tension Bar Tape Tension Microswitch Center Roll Feed Tape Guide Buffer Arm Assemblies Supply Buffer Arm Takeup Buffer Arm Idler Roller Arm Assembly Reel Motors Motor Drive Belts Center Roll Feed Spindle Assem		83 83 83 83 84 84 84 85 85 86 86 87 87 87 87 88		87
4.11 Center Plate Assembly	Pinwheel Shaft Clutch Assembly Brake Assembly		88 88 89	88 88 89	
4.12 1621 Power Supply		90			
4.13 IBM 1624 Tape Punch		90			
4.14 Waveforms and Levels		90			



## 4.1 Memory Unit

If analysis of a memory failure proves the cause to be within the memory unit, contact Customer Engineering Technical Operations, Department 901, San Jose, for further information.

To prevent damage to the main memory and its associated soldered lead-in wires, the memory unit must be securely fastened. On each corner of the memory array is a T shaped bracket that fastens to a slotted bar (P/N 2129404, Figure 16 of 1620 parts catalog). The slotted bar is then held onto the gate frame in Panel A2 by three retaining screws. If misalignment of the memory unit is noted, it will be necessary to position the slotted bar by shifting the screws in the T bracket.

### 4.1.1 Memory Thermostats

The operating temperature range for the memory unit is 95 degrees F to 105 degrees F. Three thermostats are located inside the memory unit. Two of the thermostats control the memory temperature. The third thermostat will cause a power-off sequence if the memory unit overheats. The thermostats are not adjustable. The N/C over temperature thermostat on 01.90.42.1 is designed to open when the memory unit reaches 120 degrees F. The memory under temperature thermostat on 01.90.40.1 opens when memory is below operating temperature. The heater control thermostat on 01.90.40.1 controls memory temperature.

#### REMOVAL

1. Remove all power to the system.

**WARNING:** Use extreme caution when working around memory. Do not disturb the core planes. Do not leave the memory unit unattended when a plenum is removed.

2. Remove the 12 screws from the front plenum (cover). Place a cloth or piece of paper over the SMS cards below memory so that screws or other small parts will not fall between cards. Move the plenum only far enough to disconnect the leads to the muffin fan and thermostats mounted on the duct.
3. The over temperature thermostat is mounted on the top side of the duct. The heater control thermostat is located on the bottom side of the duct. The lower limit thermostat is located on the right side of the front plenum. These switches are on system diagram 01.90.40.1. Remove the duct before attempting to remove either of the switches mounted on it.
4. Replace by reversing steps 1 through 3.

### 4.1.2 Memory Circulating Fan

The memory circulating fan circulates the warmed air to maintain an even temperature throughout the memory unit.

The fan in the memory unit has sealed bearings and is lubricated for life.

#### REMOVAL

1. Remove all power from the machine.

**WARNING:** Use extreme caution when working around the memory unit. Do not disturb the core planes or leave the memory unit unattended when the covers are removed.

2. Remove the 12 screws from the front plenum (cover). Place a cloth or piece of paper over the SMS cards below memory so that screws or other small parts will not fall between cards. Move the plenum only far enough to disconnect the leads to the muffin fan and thermostats mounted on the duct.
3. Identify the top of the duct so it can be reinstalled correctly. Remove the 8 screws holding the duct to the memory assembly.
4. Note the direction of the two arrows on the fan and the location of the leads. Remove the fan from the duct.
5. Replace by reversing steps 1 through 4. Mount the fan to blow air at the core planes.

## 4.2 Cooling Fans

The muffin fans in the card gates and memory unit have sealed bearings and are lubricated for life. Two arrows on the side of the fan indicate correct air flow and rotation. Refer to these arrows when installing a fan. Air circulates from the bottom of a card gate to the top.

#### REMOVAL AND REPLACEMENT

1. Turn off all power. Unplug line cord from the power receptacle. (Hazardous voltages exist within the fan housing).
2. Remove four screws holding laminar bus to fan housing. (This is to prevent damage to the laminar bus.) NOTE: If laminar bus is bolted, replace bolts with sheet metal screws.
3. Remove fan leads from terminal block located on the underneath side of the fan housing. NOTE: The leads are soldered on the fan.
4. Remove the screws holding the fan housing to the gate frame.
5. Lower the housing.
6. Muffin fans are mounted on a plate which is mounted on the inside bottom surface of the fan housing. Remove the plate and fan assembly from the fan housing.
7. Remove the fan from the plate.
8. To install the new fan, reverse the removal procedure.

## 4.3 Cable Connectors and Terminals

Dual contact terminals are used in X, Y, and shoe connectors.

### 4.3.1 Dual Contact Terminals

#### REMOVAL OF INDIVIDUAL CONTACT

1. Loosen the captive cap screw. Disconnect the two connector blocks.

2. Locate the dual contact terminal you want to remove. Each terminal is numbered on both sides of the block. See Figure 6-6.
3. Push the ear of the contact back until it clears the edge of the hole. See Figure 4-1. Pull the contact from the hole.

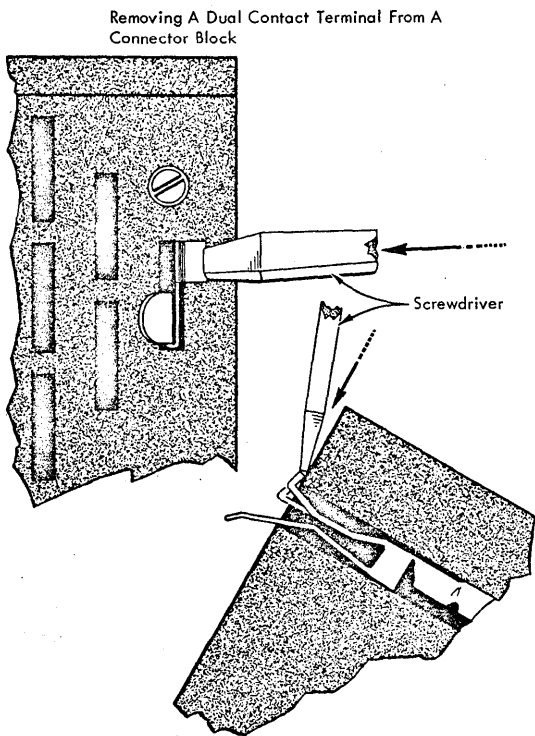


Figure 4-1. Removing a Dual Contact From a Connector Block

#### 4.3.2 Wire-Wrapped Terminals

Each wire-wrapped terminal is limited to a maximum of 10 rewrips. The terminal should be replaced when this limit is reached, or if it loses tension on the SMS card side. Do not rewrap a wire that has been unwrapped.

#### REMOVAL

**WARNING:** Damage to the bus bar or ground plane will occur if it is exposed to excessive heat. Therefore, apply just enough heat to release the pin or to resolder the connection. If damage to the bus bar or to ground plane occurs, repair by wrapped wire connections between pins affected.

1. Remove all wires wrapped on terminal.
2. Remove SMS card behind terminal to be removed.
3. If pin to be removed is soldered, heat solder iron tip, P/N 451111, before proceeding to step 4. If pin is not soldered, disregard instructions about soldered pins, and use cold solder iron tip.
4. Insert solder iron tip over terminal to terminal's full length or until it bottoms.

5. As solder flows, tap plunger extension with pliers to release terminal. Remove terminal.
6. To replace insert new terminal, then pull it into place with pliers.
7. Use solder iron tip to resolder terminal to land pattern.

## 4.4 SMS Cards

### 4.4.1 Transistor Measurement

**WARNING:** Always use the X100 scale of the ohmmeter to protect transistors from excessive current.

A good-bad test to indicate open or shorted transistor junctions may be performed on a transistor without removing it from the printed circuit card. For the test, transistors are considered as two back-to-back diodes arranged in NPN or PNP configuration. Check forward and reverse resistance of each diode with an ohmmeter adjusted to the X100 ohm scale (Figure 4-2). If the resistance is high in both directions, the transistor is open. If the resistance is low in both directions, the transistor is shorted.

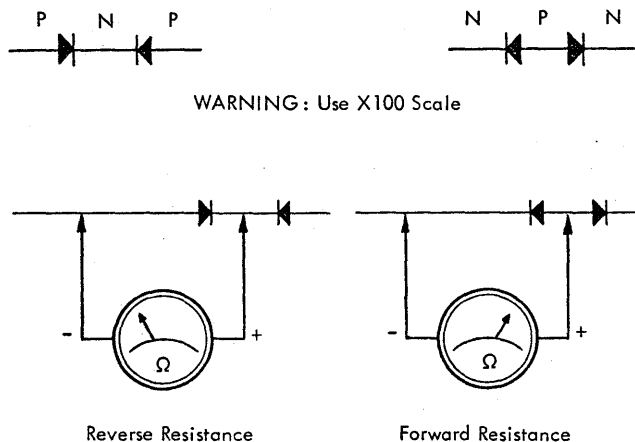


Figure 4-2. Transistor Measurement

**NOTE:** Before removing and discarding the transistor as a result of this test, check the printed card to establish that an apparently shorted transistor junction is not the result of its being shunted by a low resistance component. See Section 5.5 for SMS card emergency repair procedures.

### 4.4.2 Lubrication

When an SMS card is removed, it should be cleaned and lubricated before it is reinstalled if the card tab contacts are visibly contaminated with foreign particles such as dust or the card tabs have been handled excessively. If there is doubt about contamination, relubricate. Cleaning and lubricating can be done any number of times without affecting contact reliability.

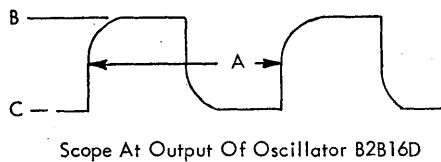
Do the following to ensure low contact resistance and reduce wear of the gold plated contact surfaces:

1. Apply lubricant, P/N 451053, to contacts with a saturated, clean, lint-free cloth or tissue.
2. Wipe with cloth from leading edge toward component section of card.
3. Rub contacts with clean piece of cloth until there is no visible trace of lubricant. Cloth will darken if contacts are not clean.
4. Repeat steps 1, 2 and 3, if necessary, until contacts are clean.

**WARNING:** Do not allow the lubricant to get on the plastic coating on the printed circuit portion of the card. The plastic coating will dissolve and insulate the tab contacts.

#### 4.4.3 Oscillator

The frequency of the IBM 1620 oscillator, B2B16D on 01.10.05.1, is 1 megacycle  $\pm$  0.1%. See Figure 4-3.



- A Max 1.1  $\mu$  Sec
- A Min 0.9  $\mu$  Sec
- B Min Up Level -0.5v.
- C Min Down Level -4.5v.

Figure 4-3. Oscillator Output

#### 4.4.4 Sample Pulse Generator

The output pulse width of the sample pulse generator (for example, the DSP on 01.10.05.1) should fall within the range of 92 to 370 m  $\mu$ sec (millimicroseconds). The nominal output pulse width is 200 m  $\mu$ sec.

#### 4.4.5 Signal Levels

Acceptable signal levels for the different signals in the circuitry are as follows:

Use	Signal	Acceptable Range
DE, TB, A, O, DSP, ID	+S	-0.5 to -0.1v
	-S	-10.0 to -7.0v (drift)
		-10.0 to -5.6v (alloy)
R (1.30.85.1) Current Probe	+R	0 ma
	-R	250 to 300 ma
Thyratron (DP) Output	Not Fired	+43.0 to +53.0v
	Fired	0.0 to +0.5v
DSP, TB AC SETS	+SET	0 to -0.5v
	-SET	-4.5 to -6.2v

#### 4.4.6 Transistor Delay Times

The two types of transistors used in the 1620, alloy and drift, have an inherent delay time; that is, it requires time to saturate the transistor and time to unsaturate the transistor. See Section 1.2. In general, it takes longer to unsaturate than to saturate a transistor. These delay times are known as "Turn ON delay" and "Turn OFF delay," and are a function of the type of logic block under consideration and also whether the output is rising or falling.

The following list of SMS cards gives the turn ON delay and turn OFF delay times for these cards and indicates whether the turn ON or turn OFF delay is associated with a rising or falling output pulse. The cards listed comprise approximately 90% of the cards used in the 1620. The remaining 10% of the cards are special purpose cards such as: thyratrons, thermoswitches, load resistors, current sources, current drivers, and decode switches.

The following alloy cards have a turn ON delay of 0.24 to 0.62  $\mu$ sec on a rising output pulse, and a turn OFF delay of 1.28 to 3.9  $\mu$ sec on a falling output pulse.

Card Code	Part Number
CD	371029
MX	371661
CAB	371931

The following alloy card has a turn ON delay of 0.34 to 1.6  $\mu$ sec on a falling output pulse, and a turn OFF delay of 0.27 to 2.3  $\mu$ sec on a rising output pulse.

Card Code	Part Number
CE	371487

The following alloy card has a turn ON delay of 0.1 to 0.7  $\mu$ sec on a rising output pulse, and a turn OFF delay of 0.2 to 3.0  $\mu$ sec on a falling output pulse.

Card Code	Part Number
MH	371487

The following drift cards have a turn ON delay of 12 to 140 m  $\mu$ sec on a rising output pulse and a turn OFF delay of 38 to 175 m  $\mu$ sec on a falling output pulse.

Card Code	Part Number
DAW	370083
DAX	370084
VE	371869
VF	371870

The following drift card has a turn ON delay of 2 to 26 m  $\mu$ sec on a falling output pulse, and a turn OFF delay of 4 to 48 m  $\mu$ sec on a rising output pulse.

Card Code	Part Number
VM	371871

The following drift card has a turn ON delay of 0 to 14 m  $\mu$ sec on a falling output pulse, and a turn OFF delay of 2 to 14 m  $\mu$ sec on a rising output pulse.

Card Code	Part Number
DAR	370082

The total delay in a series of logic blocks is the sum of the individual delays. If too long a delay is experienced in a series of logic blocks, the individual logic blocks should be scoped to see which block has too long a delay.

NOTE: Turn OFF delays (unsaturating) are generally the longest.

See Section 5 (5.2.12) for method of measuring transistor delay.

#### 4.5 CRCB Unit

##### ADJUSTMENT

1. Position the drive motor so that there is 0.5" deflection in the drive belt when the belt is depressed midway between pulleys. The drive motor can be moved toward the front or back of the machine when its four mounting screws are loose.
2. CB cam index rotation is clockwise as seen in Figure 4-4.

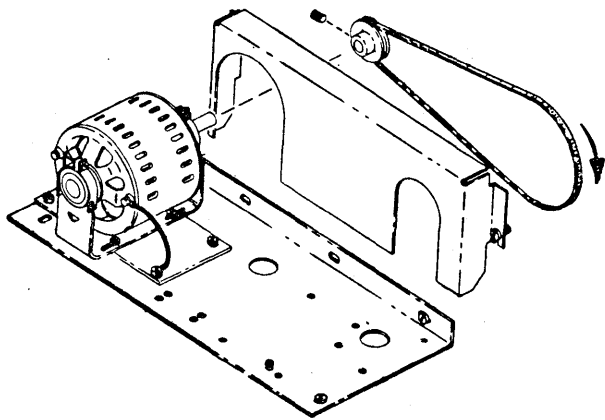


Figure 4-4. CRCB Drive Motor

3. Cam shaft speed should be  $600 \pm 25$  RPM ( $100 \pm 2.4$  m sec per revolution). To check speed, sync scope on CB1; scope CB1. There should be  $100 \text{ m sec} \pm 2.4 \text{ m sec}$  maketime to maketime.

#### 4.6 Typewriter

The typewriter used with the 1620 is modified IBM B1 Electric Typewriter for data processing equipment. The Customer Engineering Reference Manual, Form 223-6652 explains all adjustments, lubrications, and maintenance procedures except those on the 1620 type selector common contact.

##### 4.6.1 Selector Common and Letter Cam Contacts

The selector common contact in the 1620 machine consists of two N/O contacts. Maintaining the timing relationship between selector common contact No. 1 and No. 2 and the

timing relationship between letter cam contacts and the selector common contacts is very important. Failure to do so can cause intermittent problems that are difficult to diagnose. See Section 2 (2.4.2). An oscilloscope is required to satisfactorily measure the contact durations.

##### SELECTOR COMMON CONTACT — PRELIMINARY ADJUSTMENT

1. Form the N/O strap supports to give an air gap of  $1/32$ " when the contacts are normal.
2. Position the contact mounting bracket so that the contact closes when any typebar is about  $3/8$  of the distance from the platen. For preliminary adjustment of letter cam contact assembly, see CE Reference Manual, B1 Electric Typewriter, Form 223-6652.

##### TIMING REQUIREMENTS

1. Letter cam contacts 35 to 45 m sec duration.
2. Selector common No. 1, 25 to 34 m sec duration.
3. Selector common No. 2, 12 to 18 m sec duration.
4. The letter cam contacts must make before and break after selector common contact No. 1 with equal overlap at both ends.
5. Selector common contact No. 1 must make before and break after selector common contact No. 2 with equal overlap at both ends.
6. Adjust selector common contact No. 1 to make after the letter cam contacts stop bouncing.
7. Adjust selector common contact No. 2 to make after selector common contact No. 1 stops bouncing.

Contact bounce can be identified by a ripple in the scope trace.

##### ADJUSTMENT PROCEDURE

The following procedure gives steps for checking timing relationships between the two selector common contacts and the letter cam contacts.

1. Read the following program into the 1620 starting at location 00800.

LOC	00800	46	00860	00100	BI (sw 1)
	812	46	00884	00200	BI (sw 2)
	824	46	00908	00300	BI (sw 3)
	836	46	00932	00400	BI (sw 4)
	848	48	00000	00000	Halt
	860	39	00401	00100	WA
	872	49	00800	00000	B
	884	39	00401	00100	WA
	896	49	00800	00000	B
	908	39	00601	00100	WA
	920	49	00800	00000	B
	932	39	00701	00100	WA
	944	49	00800	0000‡	B

2. Read the following data into the 1620 starting at location 00401. Read in about 20 characters.

LOC	00401	QQQQQQQQQQQQQQQQQQQQQQ‡
	501	VVVVVVVVVVVVVVVVVVVVV‡
	601	IIIIIIIIIIIIIIII‡
	701	\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$‡

This program allows observation of four letter cam contacts spaced across the keyboard depending upon program switch settings. Letter cam timings will vary depending upon key locations.

It is suggested that this program be made up on paper tape or on cards, depending upon I/O equipment, and used for scheduled maintenance routine.

3. With test program and data in machine turn off power.
4. Short relay 54-1 N/O (01.81.60.1) to place 48v on selector common contact No. 1 and the common of the letter cam contacts.
5. Insulate relay 54-1 N/C (01.81.60.1) to prevent interference with the normal "Write" response during the test.
6. Short relay 1-4 N/C (01.81.50.1) to place 48v on selector common contact No. 1 and the common of the letter cam contacts.
7. Insulate relay 15-2 N/C (01.82.70.1) to prevent continuous energization of relay 1. Continuous energization of the LP coil will injure the coil. NOTE: Relay 1 must be picked by hand when ready to make dynamic test.
8. Remove cover from CRCB unit. CRCB-1 is used as the sync point for scoping the contacts.
9. Tip typewriter up on its back and remove bottom cover. Be sure the carriage is all the way to the left. Positioning the carriage to the left decreases the possibility of a carriage return motion causing physical damage to the typewriter or the computer.
10. Remove all wires from the N/O contact of selector common No. 1 (01.81.60.1). Place the letter cam contact common wire, just removed, on the operating strap of selector common contact No. 1 to provide 48 v directly to the letter cam contacts. The letter cam contact duration may now be scoped without selector common No. 1 affecting the duration indicated by the scope.
11. Wrap two thicknesses of paper around the platen to prevent wear on the platen when testing.
12. Turn power on. Insert 49 00800; RELEASE and START.
13. Pick relay 1 by hand.

Program switch 1 ON will cause Q's to print (letter cam contact 1-U).

Program switch 2 ON will cause V's to print (letter cam contact 16-U).

Program switch 3 ON will cause I's to print (letter cam contact 29-U).

Program switch 4 ON will cause \$'s to print (letter cam contact 42-U).

14. Sync scope ON CRCB-1. Wrap scope sync wire around CB wire.

**WARNING:** Connecting the sync wire directly to the CB can damage the sync circuits in the scope.

15. With the machine running, scope the letter cam contacts, selector common contact No. 1, and selector common contact No. 2. The insulation on the letter cam contact assembly can be slipped back to expose the terminals. Adjust the contacts to meet the adjustment specifications given previously.

16. Before returning machine to the customer, restore wires to proper terminals, remove shorts and insulating materials from relay points, and replace all covers.

#### 4.6.2 Carriage Return Contact

The N/O contact must have a minimum of .010" rise from its support strap. The 010" rise must be maintained during the entire length of the carriage return.

#### 4.6.3 Tab Interlock Contact

The N/O strap must be adjusted for a .020" to .030" contact rise when made.

### 4.7 Power Supply

#### 4.7.1 Power Specifications

The IBM 1620 System operates from either a 208 or a 230v, 60 cycle, single phase, three wire service line. To change the voltage input to the system refer to Voltage Change, Section 4.7.2.

Input voltage may have a total variation of  $\pm 10\%$  of the rated voltage. Line frequency must be  $60 \pm 0.5$  cps.

The power circuit breaker (PCB), mainline switch, is designed to trip when the input current reaches 30 amps. It must be reset manually.

The 50 cycle version of the 1620 requires an input voltage of 195v AC, 220v AC, or 235v AC. The 195v supply can vary between the limits of 175v and 215v. The 220v supply can vary between the limits of 198v and 242v and the 235v supply can vary between 211v and 259v.

**WARNING:** The emergency off switch is to be used for emergencies only. Data in memory may be destroyed if the emergency switch is operated when the machine is running. The switch is manually reset by tipping the console panel forward and pushing the spring loaded interlock plunger downward to clear the interlock plate.

**CAUTION:** Extreme care must be exercised when servicing or inspecting the power supply. Dangerous voltages and currents are present even when the system is in a power off status. If necessary to connect a test instrument within the power supply, or to reach into it for any reason, the main line cord should be disconnected. Discharge capacitors before working near them. Each heat sink is at an electrical potential. Do not short heat sinks to each other or to the machine frame.

#### 4.7.2 Voltage Change

Converting to a different source of voltage (208-230) effects five wires on the IBM 1620. These wires lead to transformers T1 and T2 on 01.90.10.1, to the regulated supplies on 01.90.20.1 and to the IBM 1621 48v power supply on 02.70.10.1. See Figure 1 in Introduction.

Converting to a different source of voltage (195, 220, 235) affects five wires on the 50 cycle machine. These wires lead to transformers T1 and T2 on 01.90.10.1, to the regulated supplies on 01.90.20.1 and on the IBM 1621 48v power supply on 02.70.10.1.

When ordering parts for 50 cycle machines, check the cross index in the 1620, 1621, and 1623 parts catalogs for special parts used with 50 cycle systems.

#### 4.7.3 Individual Power Supply

##### SPECIFICATIONS

For normal operation, the SMS power supply DC output voltages must be maintained within the following levels:

- +12 from +11.52 to +12.48
- +48 from +43.20 to +52.80 (Measured at power supply)
- 36 from -34.56 to -37.44
- 12 from -11.52 to -12.48
- +3 from +2.94 to +3.06

All machine functions must operate correctly when the +12M DC supply is set between +10.2 and +13.8 (Marginal test).

• Experience has shown that optimum operation is obtained when the 48v supply is maintained at +48 to 52 volts.

##### REMOVAL

1. Turn off the mainline switch. Remove the line cord. Bleed capacitors. To discharge (bleed) capacitors:
  - a. Short posts 6 and 7 on SMS power supplies.
  - b. Short posts 6 and 8 on AC regulators.(See System Diagrams 01.90.20.1 and 01.90.21.1.)
2. Disconnect the leads to the particular supply to be removed.
3. Lift the two catches on the power supply rails. Slide the supply forward and out of the machine.

##### REPLACEMENT

When a 30v DC power supply is replaced set the 30v variac so that the difference in potential at A gate between the +12v DC and +30v DC is the value recorded on the right side of power supply gate 4. Make all voltage measurements at gate A with a precision voltmeter calibrated to  $\pm 0.25\%$ . Clamp the variac setting when its proper position has been determined. Record the reading of the box 4 voltmeter at this setting.

##### VOLTAGE CHECK

The output of both regulators should be 133v AC  $\pm 4\%$ . All DC voltages, except the +30v, should be within  $\pm 4\%$  of their labeled values.

If an MC switch fails to make contact when transferred, voltages will not be varied at the gate controlled by the switch. If an MC switch fails on the N/C side, the +12v will not reach the gates. However, the marginal check voltmeter will indicate just as if everything were operating correctly.

Loose wires at voltage distribution connectors can cause loss of voltage to the gates while the voltmeter indicates correctly.

For installation and PM routine, measure all DC voltages at the card gates.

The setting of the +30v is determined at the factory and its setting is recorded on the right side of power supply box 4. The 30v variac is then clamped. Do not vary this setting. This setting allows optimum memory operation.

## 4.8 Read Head and Light Assembly

### 4.8.1 Read Lamp and Lens Holder

Light from the read lamp must straddle the read window and mask. This condition is met by positioning the reading lamp lens holder. A quick check for correct adjustment can be made by placing a piece of semitransparent paper flat across the read head window and noting if the window and mask are completely straddled by the rectangular block of light (about  $\frac{3}{8}$ " wide). For maximum light intensity, position the lamp so that its filament is parallel to the lens.

##### REPLACEMENT OF READING LAMP

1. Note position of lamp in its socket, then loosen two lamp holding screws and remove lamp.
2. Place new lamp in socket in same position as lamp removed. Tighten holding screws.
3. Verify adjustment by performing Step 7 of read photo diode adjustments. If specifications are not met do the entire read photo diode adjustment procedure.

### 4.8.2 Read Window

Read photo diode output is greatly effected by the front to back positioning of the read window mask assembly. If the read window is removed for any reason, its position should be noted so that it can be reinstalled in the original spot. Marginal outputs of only one or a few diodes may be the result of a maladjusted window. In some cases correct outputs can be obtained by repositioning the window. This can eliminate time consuming adjustments of individual diodes.

The window must be flush against the surface of the read head assembly. If diode is pushed too far into the head it will strike the window and cause it to bow or break. The diode may also be damaged.

##### REPLACEMENT

1. Loosen four small screws holding two window clamps.
2. Remove window from beneath clamps.
3. Insert new window beneath clamps. Align openings in gasket so that all eight diodes may be seen through the window.
4. Push clamps down on window then tighten screws evenly to prevent twisting or breaking window.
5. With light on the diodes and no tape in machine, observe voltage of all read head photo diodes at A4-A04 B, D, H, G, and A4-A05 B, D, H, G on 01.83.50.1. All readings should meet specifications given in step 6 of the adjustment procedures. If specifications are not met, do the entire read photo diode adjustment procedure.

### 4.8.3 Read Photo Diode

Removal of the center plate assembly prior to installing new diodes has been found to facilitate the replacement of diodes. See Section 4.12.

##### REPLACEMENT

**WARNING:** Use care when inserting photo diodes to avoid breaking the diode, the diode leads, or the read head

window. Minimize movement of wires on previously installed diodes to prevent rotating them out of adjustment. Avoid damage to the potting compound that covers the leads at the base of the diode. If these leads become exposed, they can ground to the read head frame.

1. Loosen diode clamping screw.
2. Remove old diode from read head and disconnect diode leads from terminal block.
3. Tie new diode leads to disconnected leads of old diode.
4. Pull new diode leads through by use of old leads.

Each diode has one spot on a 360 degree arc where it is most sensitive to light. To locate the sensitive spot, first set diode potentiometer to center position then scope the diode output (A4-A04 B, D, H, G and A4-A05 B, D, H, G) and gradually rotate the diode in steps of about 20° until the greatest negative potential is obtained. Tighten diode clamping screw. Without changing scoping point; adjust diode potentiometer for a -10v diode output reading. See read diode adjustment procedure.

#### ADJUSTMENT OBJECTIVES

1. Maintain a minimum potential across read lamp to prolong its life (ideally 11v or less).
2. Have the dynamic operating range of the photo diodes greater than 14v and centered around the minimum operating range of -8v to +6v.
3. Have maximum diode potentiometer adjustment remaining when procedure is completed to allow a wider range of adjustment as components age.

The proper adjustment of a diode depends on various factors such as: position and intensity of reading lamp; position of lens assembly; position of read window and mask; position of the diode; dust on the head; and proper voltage output of the +12 and -12 SMS power supplies in the 1620. A variation of either one of the 12v power supplies can cause a variation in the photo diode outputs.

The following steps presume: (a) the read lamp and lens position; (b) diode sensitivity position (rotation); (c) read window, mask, and gasket; (d) +12 and -12 volt power supplies are all properly adjusted. If a specific value given in a step cannot be obtained; that is potentiometer against stop, and voltage levels are not within specifications, items a, b, c, and d listed previously in this paragraph should be rechecked.

#### ADJUSTMENT PROCEDURE

Before the following diode adjustments are made, clean the read head area to remove all dust from the read window. Make certain that the +12 and -12v power supplies are adjusted to the nominal values given on the 1620 voltage specification chart.

1. Center diode potentiometers 1 through 8.
2. Set read lamp potentiometer for minimum intensity.
3. Record diode output with no tape in machine. Scope channels 1 through 8 at A4A04B, D, H, G, and A4A05B, D, H, G on 02.83.50.1.
4. Select a diode that has an output that is near to the average output of all diodes and use it as a reference or base for steps 5 and 6. For example, see Figure 4-5.

Channel	Scope Point	Voltage Reading
1	A4A04 B	-10.0v
2	" D	- 8.0v *
3	" H	- 9.2v
4	" G	- 6.4v
5	A4A05 B	-11.3v
6	" D	- 2.2v **
7	" H	- 9.8v
8	" G	-10.4v
		-67.3

$$8 \sqrt{\frac{8.4v}{67.3}} \text{ Ave}$$

\* Use this diode as the reference diode because it is closest to the calculated average.

\*\* This diode may need to be rotated, the mask may be dirty or out of adjustment, the gasket may be out of place or the diode may need to be replaced if it cannot be brought to specified levels.

Figure 4-5. Picking a Reference Diode

5. With no tape in the machine, scope the reference diode selected in step 4 and adjust the read lamp potentiometer until the diode output is -10v. Ideally, the potential on the read lamp should not exceed 11v.
6. Scope the remaining diodes and adjust the individual read diode sensitivity potentiometers for a -10.0v output at each diode. This is a starting point for the following adjustments:

If -10v cannot be obtained, it may be necessary to change the read lamp potentiometer adjustment, keeping in mind the ideal potential for the lamp. If the read lamp potentiometer is readjusted, the diode outputs should be rechecked and the diode potentiometers readjusted if necessary.

7. (a) Punch up a length of tape with 1, 2, 4, 8, C, O, X, EL, etc., in consecutive positions. This can be done by inserting a read alphameric instruction with the typewriter designated as the input device (37 00501 00100). RELEASE and START. Depress the shift key and type 1, 2, 4, 8, space bar, O, -,  $\frac{1}{2}$ . Now set up a program loop to write alphamerically on the punch (39 00500 00200 49 00000 00000). RELEASE and START. The paper tape punch should now be punching the desired pattern. Form the punched tape into a loop and place on the read head. A good splice can be made by cutting the tape on an angle, about 45°; holding the ends of the tape, with channel 1 toward you, overlap tape end in LEFT hand OVER tape end in RIGHT hand by  $\frac{1}{16}$ " to  $\frac{3}{8}$ ". Glue in this position, with feed holes aligned, using a quick setting glue such as IBM tape mucilage part #221030.

(b) Set 1621 switch for strip mode.

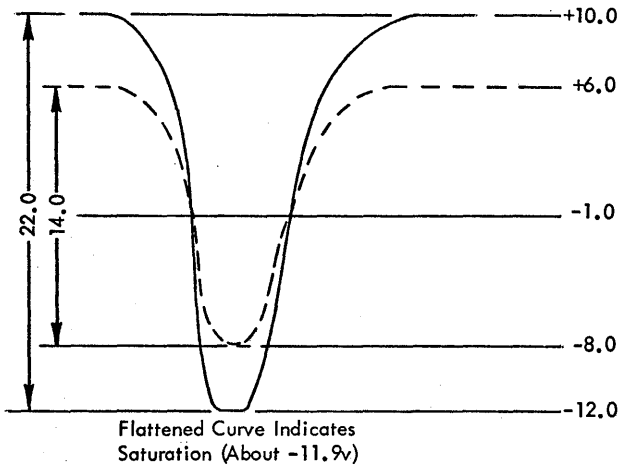
(c) Depress NONPROCESS RUNOUT. The loop of tape should now be running over the read head.

(d) Measure the peak-to-peak voltage swing at the points given in step 3. The diode swing is a result of the change in light when reading through tape (posi-

tive level) to a light through a code hole (negative level) and is a function of diode sensitivity and tape transparency. The diode potentiometers will adjust the plus and minus levels up or down simultaneously.

(1) The peak-to-peak voltage swing must be at least 14.0 volts. If a diode fails to meet the minimum 14.0 volt swing with the power supplies at their nominal values, and rotation of the diode does not increase the sensitivity thereby increasing the swing, replace the diode.

(2) For diodes with peak-to-peak voltages between 14.0 volts and 22.0 volts, center the voltage swing about -1.0 volt reference with the diode potentiometer. For example, a diode with a minimum swing of 14.0 volts would be set to +6v and -8.0v. See Figure 4-6.



Proper Adjustment For Diodes With Peak To Peak Swing From 14.0v To 22.0v

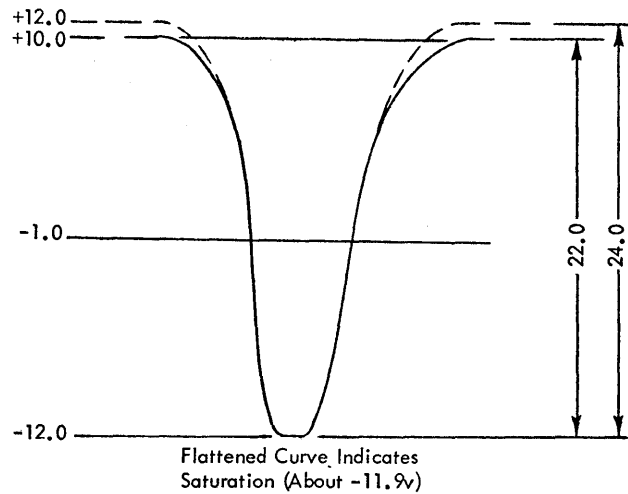
Figure 4-6. Diode Voltage Adjustment (14 to 22 v swing)

(3) For diodes with peak-to-peak voltages greater than 22.0 volts, set the negative peak to -12.0 volts (just in saturation). The positive peak will be between +10.0 and +12.0v. See Figure 4-7.

(e) Measure the +S amplifier outputs at 4A07G, K, C, L, and 4A08G, K, C, and 4A09C. The + signals must be at least 2.0 milliseconds in duration.

(f) Changes in voltage, temperature, and dust on the read window will cause the voltage level to move up or down from their initial values. An average cyclic shift of 1 volt is to be expected. Readjust any diode as per 7d when the power supplies are adjusted to their nominal setting and any one of the following conditions exist. See Figure 4-8.

(1) The positive level is more negative than +5.0 volts.

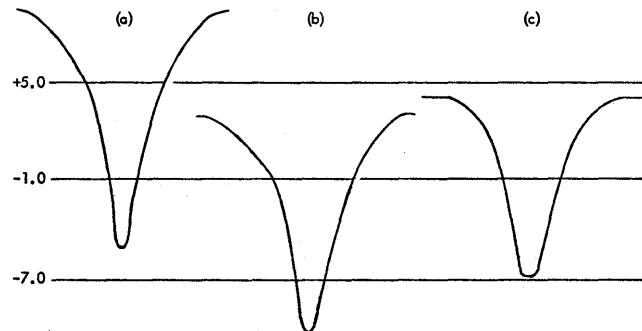


Proper Adjustment For Diodes With Peak To Peak Swing Greater Than 22.0v

Figure 4-7. Diode Voltage Adjustment (Over 22 v swing)

(2) The negative level is more positive than -7.0 volts.

(3) The +S amplifier signals at points listed in 7e are less than 2.0 milliseconds in duration.



Readjust Per Step 7 if any of the above conditions exist (c) Indicates A Diode with less than the minimum 14.0v swing

Figure 4-8. Effect of Change in Voltage, Temperature, and Dust on Read Window

#### 4.9 Timing Disk Lamp and Photo Diode

The timing disk lamp must be adjusted so that both of the following conditions are met:

1. The negative peak of the diode measured at A4A06C must be set to -12 volts (just in saturation).
2. The trailing edge of the sync pulse must be in the center of the code pulse within .5 m sec for all channels.



Whenever the lamp assembly is shifted to obtain the correct timing, a change in diode output will be noted because this adjustment also affects vertical/horizontal positioning of the light source relative to the diode. More or less light reaching the diode alters the sync diode output which in turn causes a wider or narrower sync pulse. Since timing is arrived at using the trailing edge of the sync pulse, the diode output and timing adjustments are interacting. To satisfy conditions 1 and 2 as previously stated, the combined adjustments of the sync lamp potentiometer, lamp, socket, timing disk diode potentiometer, and/or the complete lamp block assembly may be required.

#### REMOVAL AND REPLACEMENT OF TIMING DISK LAMP

1. Remove screw to lamp socket.
2. Remove socket and lamp from bracket.
3. Remove lamp from socket.
4. Replace by reversing steps 1, 2, and 3.
5. Perform Timing Disk Lamp and Photo Diode Adjustment procedure.

#### REMOVAL AND REPLACEMENT OF TIMING DISK PHOTO DIODE

1. Remove diode leads at EC-5C and EC-5A.
2. Remove locking screw below diode and remove diode.
3. Insert new diode into larger hole in bushing. Place small hole in bushing next to timing disk. Make sure that diode and bushing do not touch timing disk. There should be  $.020 \pm .005$ " between diode and timing disk. Replace locking screw. See Figure 4-17.
4. Perform Timing Disk Lamp and Photo Diode Adjustment procedure.

#### ADJUSTMENT

The "anded" output of tape channels 1, 2, 3, 6, and 7 can be used to check the sync pulse timing as follows:

1. Punch up a length of tape with G, EL, G, EL, etc., in consecutive positions. This can be done by inserting a read alphameric instruction with the typewriter designated as the input device. INSERT. Type 37 00501 00100, 39 00501 00200, 49 00012. RELEASE. START. Type G,  $\ddagger$ . RELEASE. START. The paper tape punch should now be punching the desired pattern. Form the punched tape into a loop and place on the read head.
2. Tie D1D14F and D1D14G to ground (system diagram 01.80.30.1). The eight input AND will now be satisfied when reading a "G" character. (Tape channels 1, 2, 3, 6, and 7; and channels 4 and 5 tied to ground). The tape pattern with alternate "G" and "EL" punches is used to obtain a data signal every other character.
3. Set up a program loop to read tape as follows: INSERT; Type 37 00501 00300, 49 00000. RELEASE; START; The reader should now be running the loop of tape.
4. Set scope trigger mode to external minus.
5. Sync scope on "anded" output at D1D14E on 01.80-30.1.
6. Scope D1D14E and place the center of the -S waveform in the center of the scope face. The -S "anded" output must be at least 2 milliseconds in duration.

Failure to meet this requirement indicates an improperly aligned read mask.

7. A time/div. setting of approximately  $500 \mu\text{sec}/\text{div.}$  will spread the -S output waveform across the scope face.
8. Scope the sync diode output at A4A06C on 02.83.50.1.
  - a. Set the timing lamp potentiometer for 10v across the lamp.
  - b. Adjust the timing disk diode potentiometer for a negative peak of -10v on the timing signal (adjust the timing lamp if the potentiometer limit is reached).
  - c. Loosen the two lamp assembly holding screws and adjust the assembly for a maximum negative peak. Make sure that the top of the timing lamp is not touching the drive shaft.
  - d. Readjust the timing disk diode potentiometer to set the negative peak to -12v on the timing signal (just in saturation).
9. Scope the tape sync output pulse at A4A06A and adjust the lamp assembly so that the fall of the sync pulse (+S to -S) occurs in the center of the "anded" output waveform within 0.5 milliseconds (Center of scope face due to Step 6). Scope A4A064 and A4A06C alternately to maintain the negative peak of the diode at -12v while positioning the sync. The negative peak may be readjusted to -12v with the timing diode potentiometer to facilitate this adjustment. See Figure 4-9.

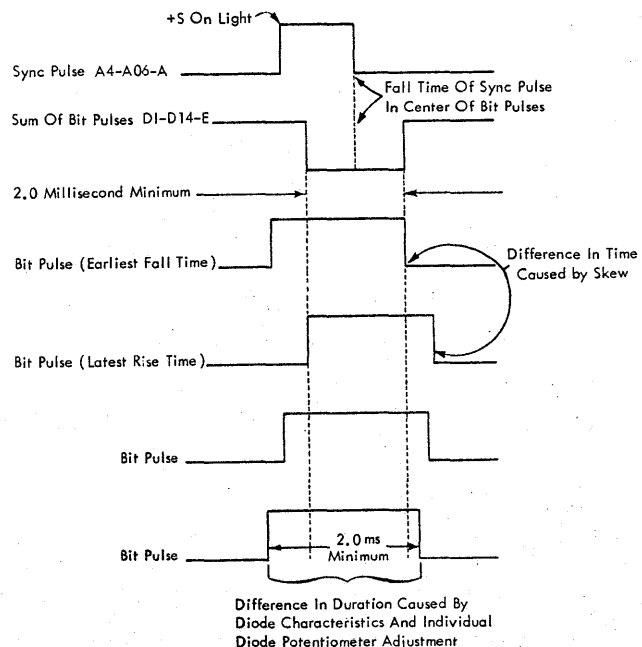


Figure 4-9. Sync Pulse Timing

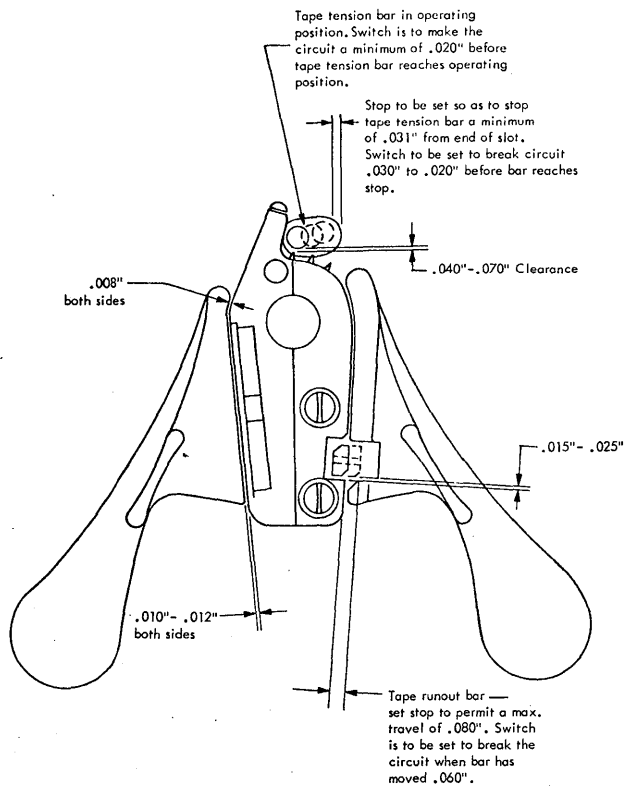


Figure 4-10. Read Head Adjustment

## 4.10 Tape Transport and Control

### 4.10.1 Tape Guides

The tape guides must hold the tape in contact with the read head and in mesh with the pin wheel.

#### ADJUSTMENT

The clearance between the tape guides and read head should be  $.008'' +.001'' - .002''$  at the top, and approximately  $.010''$  to  $.012''$  at the bottom of the guides (see Figure 4-10). Too close adjustment of tape guides (less than  $.005''$ ) causes premature feed hole elongation. Make certain that the curved portion of the tape guide is concentric to the curved portion of the read head. Adjust each tape guide as follows:

1. Loosen the two screws holding the bearing block. Back off tape guide adjusting screw. Check to see that the clevis is allowing the tape guide to strike the read head (see Figure 4-11).
2. Place two pieces of paper tape between the upper part of the read head and the tape guide. Place three pieces of paper tape between bottom part of read head and tape guide.
3. Hold tape guide against tapes placed in step 2. Tighten two screws in the bearing block.
4. Turn tape guide adjusting screw until it touches the tape guide stop lever. Turn this screw to obtain clearances shown in Figure 4-10. Tighten the locknut.

NOTE: Tape guide springs must be free to pivot on hub.

### 4.10.2 Tape Load Microswitch—Switch #9

The tape load microswitch is actuated when the tape guides are in position to feed tape.

#### ADJUSTMENT

1. Loosen the microswitch mounting bracket (Figure 4-11).
2. With a  $.032''$  feeler gage between the tape guide and the read head at the bottom, move the switch bracket so that the switch lever is depressed by the tape guide stop lever and the switch is made. This adjustment prevents tape guide vibration from opening the tape load microswitch during operation.
3. Tighten mounting bracket screws.

### 4.10.3 Clevis Assembly

The clevis assembly links the two tape guides together so that opening or closing one guide causes the other to open or close.

#### ADJUSTMENT

Adjust the length of the clevis assembly (Figure 4-11) to allow either the right or the left tape guide to be moved  $\frac{1}{8}''$  to  $\frac{1}{4}''$  from the head without moving the other tape guide.

NOTE: Make certain that locking nut on clevis bar is locked.

### 4.10.4 Tape Runout Bar

The tape runout bar controls the sequence of operations during runout of the tape by actuating the tape runout microswitch.

#### ADJUSTMENT

1. Rotate the bar so that its operating surface is parallel to the read head surface.
2. Operate the bar with the tape guides closed. It should not strike top edge of the notch in the right tape guide. The bar should be as close to the top of this notch as practical. See Figure 4-10.
3. If it is necessary to move the bar to satisfy item 2, loosen two screws in the tape runout arm pivot block. See Figure 4-11. Then move the block to position the bar properly.
4. Adjust stop to permit maximum travel of  $.080''$  of tape runout bar from flush position with read head, see Figure 4-10. This adjustment is made to prevent the paper tape from being placed on the wrong side of the runout bar when tape is threaded over read head.

If the tape runout bar (Figure 4-10) becomes excessively worn, it may be rotated 180 degrees and used again. To do this:

1. Remove front cover from read head. (Two screws.)
2. Loosen nut that holds bar to tape runout arm. See Figure 4-11.
3. Turn tape runout bar from front with a screwdriver. Tighten nut in step 2.

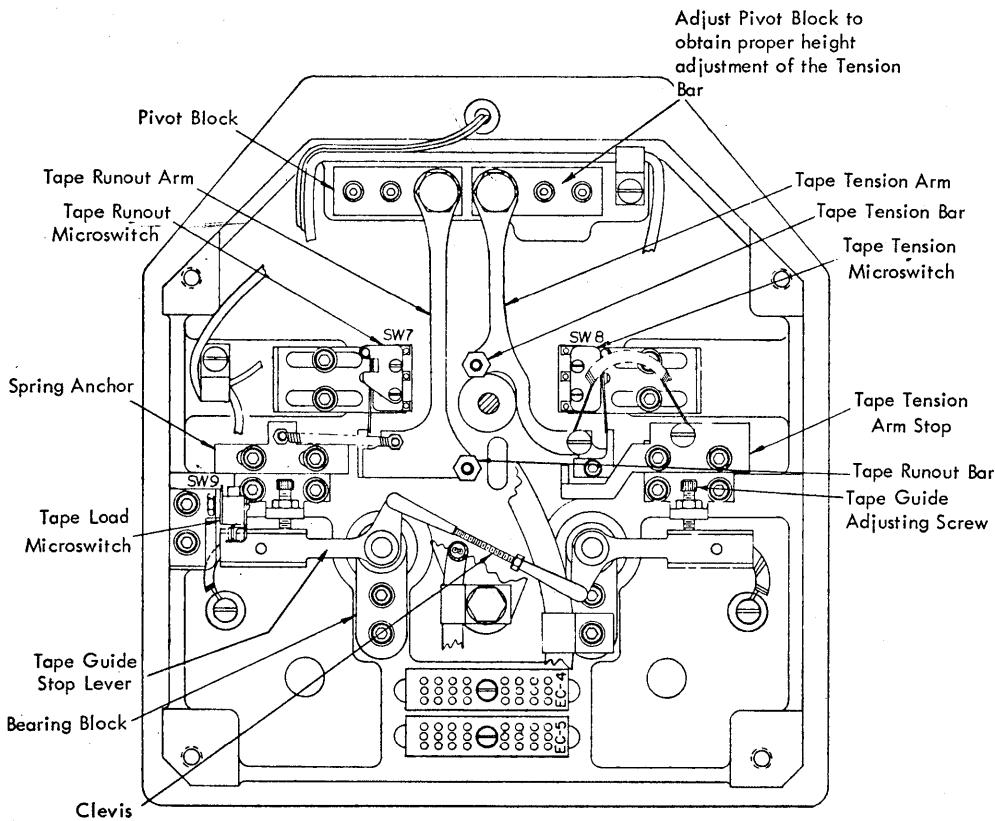


Figure 4-11. Center Plate Casting Assembly – Rear View

#### 4.10.5 Tape Runout Microswitch—Switch #7

##### ADJUSTMENT

1. Loosen two screws in the microswitch mounting plate. See Figure 4-11.
2. Position the tape runout switch so that its contact breaks when the tape runout bar has moved .040" to .060" from its flush position with the read head. See Figure 4-10. This adjustment insures sufficient over-travel for switch operation.
3. Tighten the mounting plate screws.

#### 4.10.6 Tape Tension Bar

##### ADJUSTMENT

1. Position the tape tension arm pivot block in Figure 4-11 so that the tape tension bar moves without touching any part of the read head. See Figure 4-10.
2. Position the tape tension arm pivot block so that a clearance of .040" to .070" exists between the bottom of the tape tension bar and the topmost pin on the pinwheel. See Figure 4-10. This adjustment causes the tape to ride over the window at the most desirable angle.

**NOTE:** The slot in the tape tension bar may have a burr which tends to wear the tape on the channel 1 edge. If this condition exists, deburr the slot.

If the tape tension bar (Figure 4-10) becomes excessively worn, it may be rotated 180 degrees and used again. To do this:

1. Remove the front cover from the read head.
2. Loosen the nut that holds the bar to the tape tension arm. See Figure 4-11.
3. Turn the tape runout bar from the front with a screwdriver. Tighten nut in step 2.

#### 4.10.7 Tape Tension Microswitch—Switch #8

The tape tension microswitch must break the circuit when the tape is mounted so that there is a feed hole between two adjacent pins (loose tape).

##### ADJUSTMENT

1. With no tape in machine, set the tape tension arm stop so that the tape tension bar is approximately .030" from the end of the slot in the front casting. See Figure 4-10.
2. With tape in the machine, move the tape tension microswitch to the right (Figure 4-11) until the switch lever rests on the tape tension arm. Do not preload the switch lever against the tape tension arm.
3. Position the tape tension arm stop so that it is .030" to .020" from tape tension arm when the microswitch opens. See Figure 4-11.

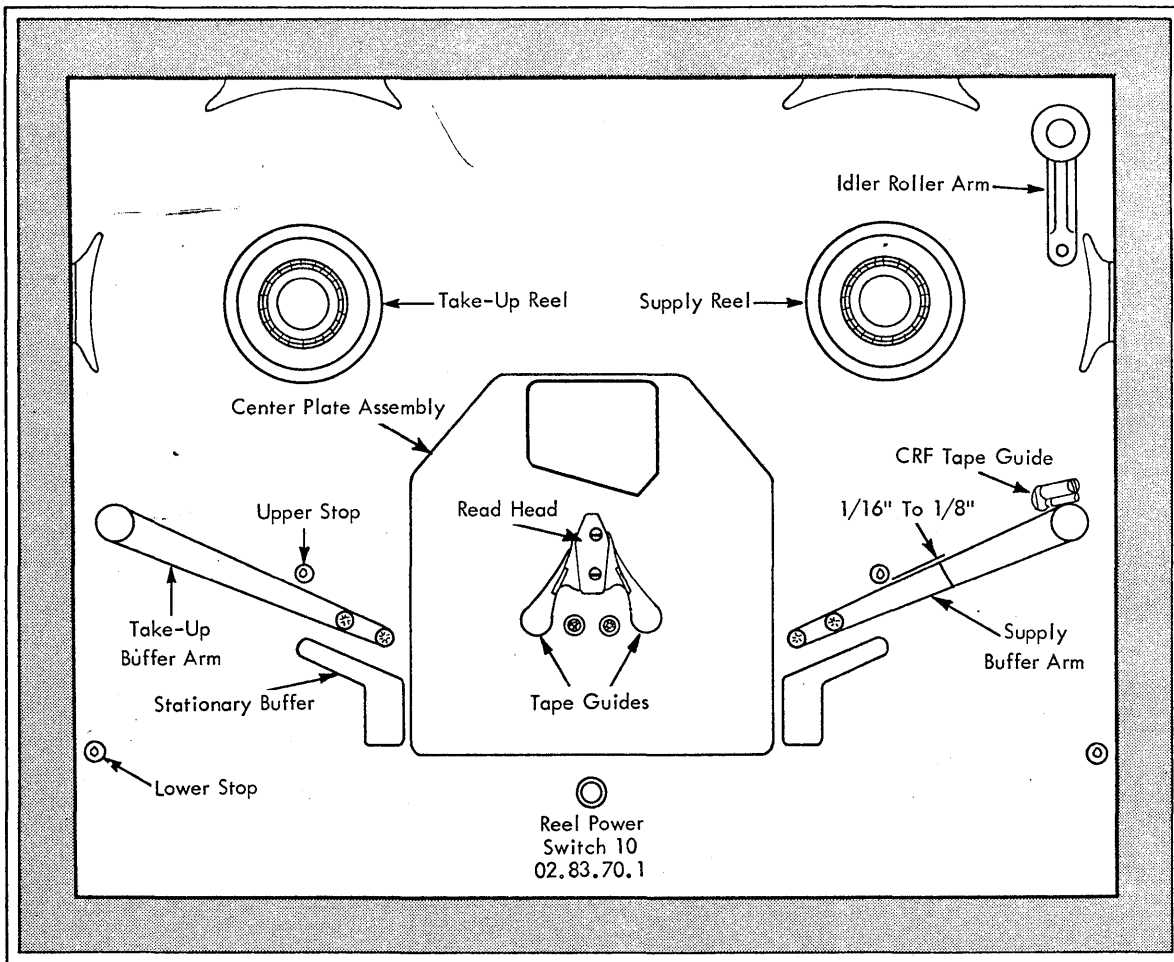


Figure 4-12. 1621 Main Plate - Front View

#### 4.10.8 Center Roll Feed Tape Guide

##### ADJUSTMENT

Adjust the CRF tape guide (Figure 4-12) so that tape will ride on the friction feed roller.

To accomplish this, do the following:

1. Loosen the CRF tape guide set screw (Figure 4-13).
2. Position the tape guide to cause the tape to feed properly.

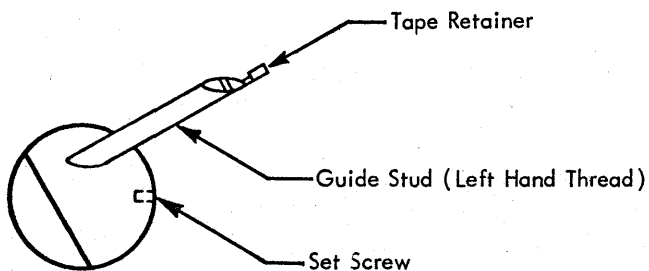


Figure 4-13. CRF Tape Guide

3. Position the tape retainer (Figure 4-13) on the guide assembly so that the left edge is  $\frac{1}{32}$ " from the tape by loosening the slotted guide stud.

**WARNING:** The slotted guide stud has a left hand thread.

#### 4.10.9 Buffer Arm Assemblies

##### ADJUSTMENT

The following applies to both buffer arm assemblies. Adjustments pertaining to one assembly only are listed beneath the name of the assembly.

1. Position the motor control contact operating cam (Figure 4-14) on its shaft so that the buffer arm is  $\frac{1}{16}$  to  $\frac{1}{8}$ " from its upper stop (Figure 4-12) when the cam is fully detented.
2. Move the arm downward. The upper limit switch (Figure 4-14) should make when the buffer arm tape rollers (two) are in line with  $\frac{1}{4}$ " below the stationary buffer rollers (three). Move the switch mounting bracket to accomplish this adjustment.

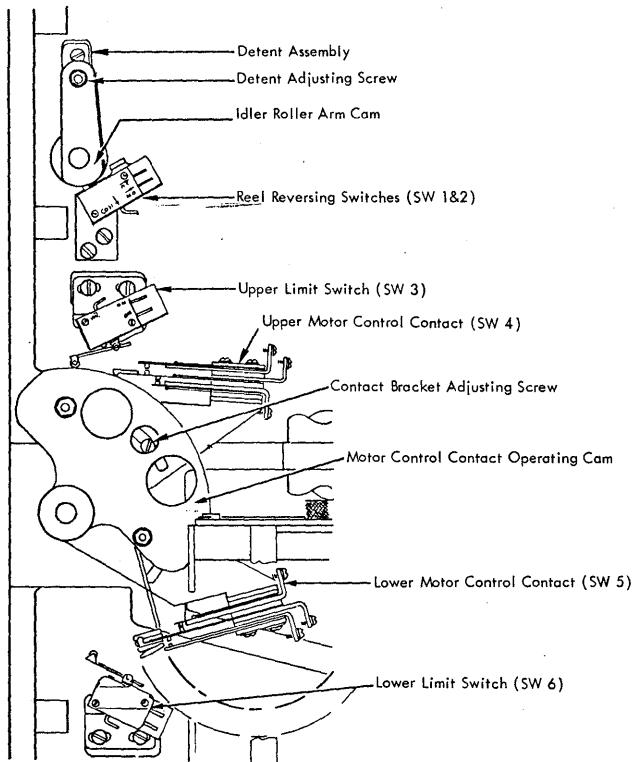


Figure 4-14. Supply Reel Motor Switches

3. Continue to move arm downward. Lower limit switch (Figure 4-14) should break when arm is  $\frac{1}{4}$  to  $\frac{1}{8}$ " from lower stop (Figure 4-12). Move switch mounting bracket to accomplish this adjustment.

#### 4.10.10 Supply Buffer Arm Assembly

##### ADJUSTMENT

Make the following measurements between the upper and lower buffer arm stops and to the top edge of the arm.

1. Move buffer arm upward. Upper N/O motor control contact (Figure 4-14) should make when the arm is approximately  $3\frac{1}{4}$ " from its upper stop, as shown in Figure 4-15. Move the contact bracket to obtain this adjustment.
2. Move the buffer arm downward. The N/O motor control contact (Figure 4-14) should make when the arm is approximately 4" from its upper stop, as shown in Figure 4-15. Move contact bracket to obtain this adjustment.

NOTE: The motor control contacts should have a minimum gap of .010" between the common points and the N/O and N/C points before making the N/O point.

#### 4.10.11 Takeup Buffer Arm Assembly

##### ADJUSTMENT

Make the following measurements between the buffer arm stops and the top edge of the arm.

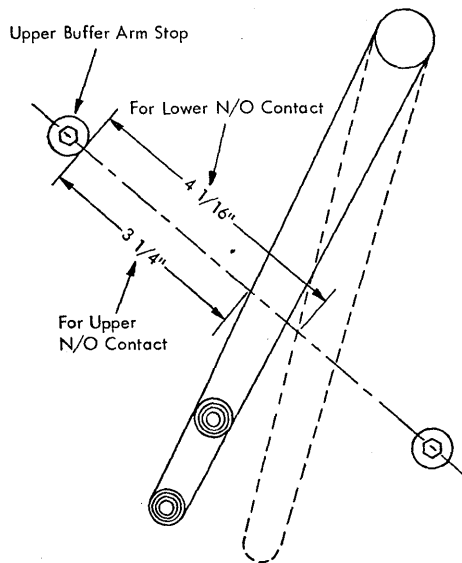


Figure 4-15. Supply Motor Control Contact Adjustment

1. Move buffer arm upward. The upper N/O motor control contact (Figure 4-14) should make when arm is approximately  $2\frac{7}{16}$ " from its upper stop, as shown in Figure 4-16. Move contact bracket to obtain this adjustment.
2. Move the buffer arm downward. The lower N/O motor control (Figure 4-14) should make when the arm is approximately  $3\frac{1}{4}$ " from its upper stop. See Figure 4-16.

NOTE: The motor control contacts should have a minimum gap of .010" between the common points and the N/O and N/C points before making the N/O point.

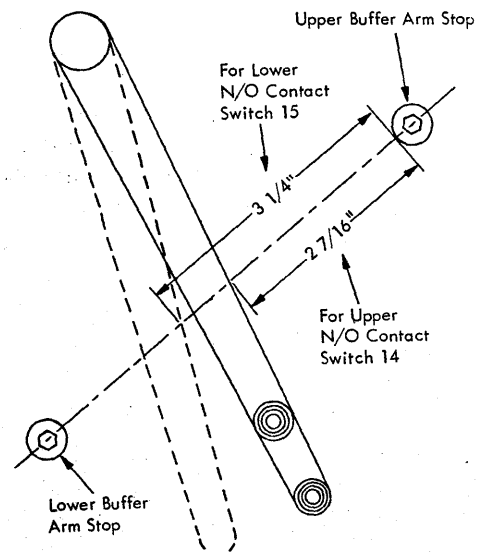


Figure 4-16. Takeup Motor Control Contact Adjustment

#### 4.10.12 Idler Roller Arm Assembly

##### ADJUSTMENT

1. The idler roller arm when detented, must be so positioned that the arm is vertical.
2. Move the detent adjusting screw (Figure 4-14) to obtain a  $\frac{1}{32}$ " clearance between the screw and the detent ball cover.
3. Position the reel reversing switch mounting bracket so that the switch is actuated when the roller arm is half-way between the detented position and the supply reel friction feed roller.

NOTE: A minimum clearance of .062" should exist between the detent arm and the stop tab on the reversing switch bracket, when the idler roller is in contact with the CFR hub. Idler roller, when down, must ride on tape.

#### 4.10.13 Reel Motors

##### ADJUSTMENT

The speed of the reel motors is determined by the values of the variable resistors R11 and R12 on 02.83.70.1. Proper motor speeds are obtained as follows:

1. Check voltage across the motor fields at EC-14E and EC-14F on 02.83.70.1. It should be  $48v \pm .5v$ . If it is not, check the 1621 48v power supply.

2. Adjust the supply reel speed by varying R11 shown on Figure 6-9. The voltage drop across the motor armature measured CE-14C and EC-14D should be  $35 \pm 1v$  with motor running.
3. Adjust the takeup reel speed by varying R12 shown on Figure 6-9. The voltage drop across the motor armature measured at EC-14G and EC-14H should be  $35 \pm 1v$  with the motor running.

NOTE: In later production models the 50 ohm, 50w adjustable resistors have been replaced with 50 ohm 50w non-adjustable resistors. The  $35 \pm 1v$  specification is to be met on both models. In the older machines, the adjustable resistors will have to be adjusted to meet the  $35 \pm 1v$  specifications.

#### 4.10.14 Motor Drive Belts

##### ADJUSTMENT

Position each motor so that each belt can be moved at its center point  $\pm \frac{1}{2}$ ". Position the idler pulley (Figure 4-17) in the idler pulley adjustment slot for  $\frac{1}{2}$ " deflection in the clutch shaft belt.

##### REPLACEMENT OF CLUTCH SHAFT BELT

1. Remove the main drive belt cover and the main drive belt.

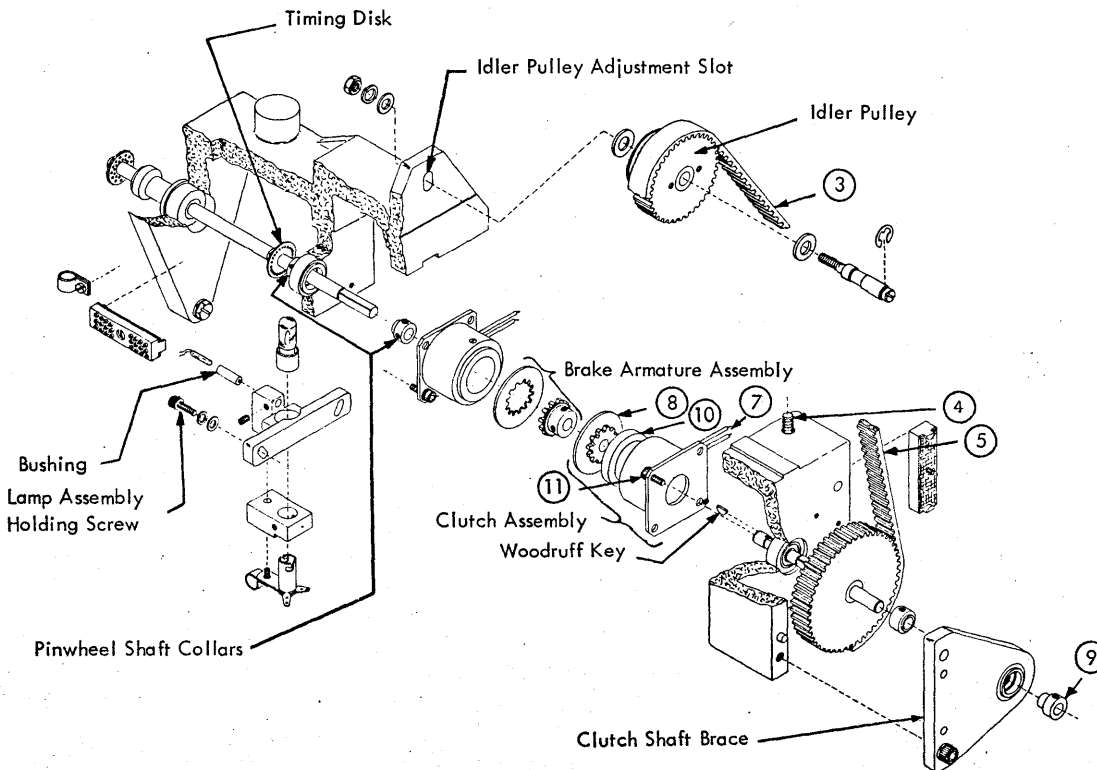


Figure 4-17. Pinwheel Shaft and Clutch Shaft Assembly

2. Remove the screws holding the clutch shaft brace to the frame. Remove the collar on the end of the clutch shaft. Remove clutch shaft brace from end of frame. See Figure 4-17.
3. Install new belt.
4. Replace parts removed.

#### 4.10.15 Center Roll Feed Spindle Assembly

##### ADJUSTMENT

Adjust the center roller (Figure 4-18) so that the lower (5-hole) side of the tape tracks against roller #2 and the upper (3-hole) side of the tape does not touch roller #3. When making this adjustment, make certain there is clearance between roller #6 and the tape as it passes over the center roller.

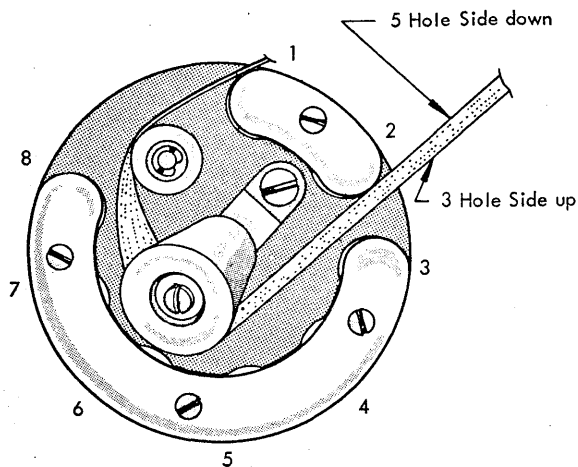


Figure 4-18. CRF Spindle Adjustment

#### 4.11 Center Plate Assembly

Repairs to the clutch, brake, pinwheel shaft, and replacement of read diodes, will be facilitated if the entire center plate assembly is removed from the 1621. This assembly is shown in Figure 4-19.

##### REMOVAL AND REPLACEMENT

1. Turn off all power to the 1621.
2. Remove the main drive belt cover and belt.
3. Remove two screws holding the reel drive motor frame to the brake housing assembly.
4. Remove cable leads from EC6 and EC7.
5. Remove the cable connecting card from A4-A02 location and remove the cable clamp.
6. Remove four clamping screws holding the center plate to the main plate.
7. Remove the assembly from the front of the machine.
8. To reinstall the unit in the machine, reverse steps 1 through 6.

#### 4.11.1 Pinwheel Shaft

##### ADJUSTMENT

The pinwheel should be centered in the read head groove with approximately .010" clearance on each side. This adjustment is accomplished by positioning the two collars shown in Figure 4-17. The brake assembly must be removed to adjust the rear collar. Check the clearance between the timing disk and the photo diode after making this adjustment.

#### 4.11.2 Clutch Assembly

##### REMOVAL AND REPLACEMENT

NOTE: This procedure is for removing the clutch without removing the entire center plate assembly.

Numbered balloons in Figure 4-17 refer to the steps following:

1. Remove all power to the 1621.
2. Remove main drive belt cover.
3. Remove main drive belt from idler pulley.
4. Remove two cap screws in the bearing and housing assembly.
5. Remove the clutch shaft drive belt from idler pulley.
6. Remove assembly from machine.
7. Remove two clutch leads EC-6 (02.83.60.1).
8. Remove clutch armature assembly from pinwheel shaft. There are four set screws in two holes on the splined armature hub. (Armatures and clutches must be replaced in matched pairs.)
9. Remove collar from the end of the clutch shaft.
10. Loosen the set screws holding the clutch rotor to the clutch shaft. Remove rotor. Do not lose the woodruff key between the rotor and the shaft.
11. Remove the four cap screws holding the clutch housing to the mounting plate. Remove clutch frame.
12. To replace reverse steps 1 through 10. Place the clutch armature on the splined armature hub so that the square edge is facing the clutch coil. Position the clutch armature and the splined armature hub to be .045 to .060" from rotor when the clutch is de-energized. (This adjustment ensures that the face of the splined armature hub does not drag on the clutch rotor. If the clutch rotor drags, it may drive the pinwheel shaft when the clutch is de-energized causing a reading failure.) Tighten the four set screws in the two holes of splined armature hub. NOTE: Make certain that the splined hubs do not rub on the rotor.

##### ADJUSTMENT

Adjust the voltage across the clutch to accelerate tape from stop condition to 150 cps within one character length (6.7 m sec). Keep voltage across clutch to minimum for this. Maximum voltage is 3.3v. Check this adjustment as follows:

1. Rotate the clutch potentiometer fully counterclockwise.
2. Punch a tape with following characters: "2, 2, 2, 2, EL, 2, 2, 2, 2, EL, 2, 2, 2, 2, EL, etc." Splice tape into a short loop.

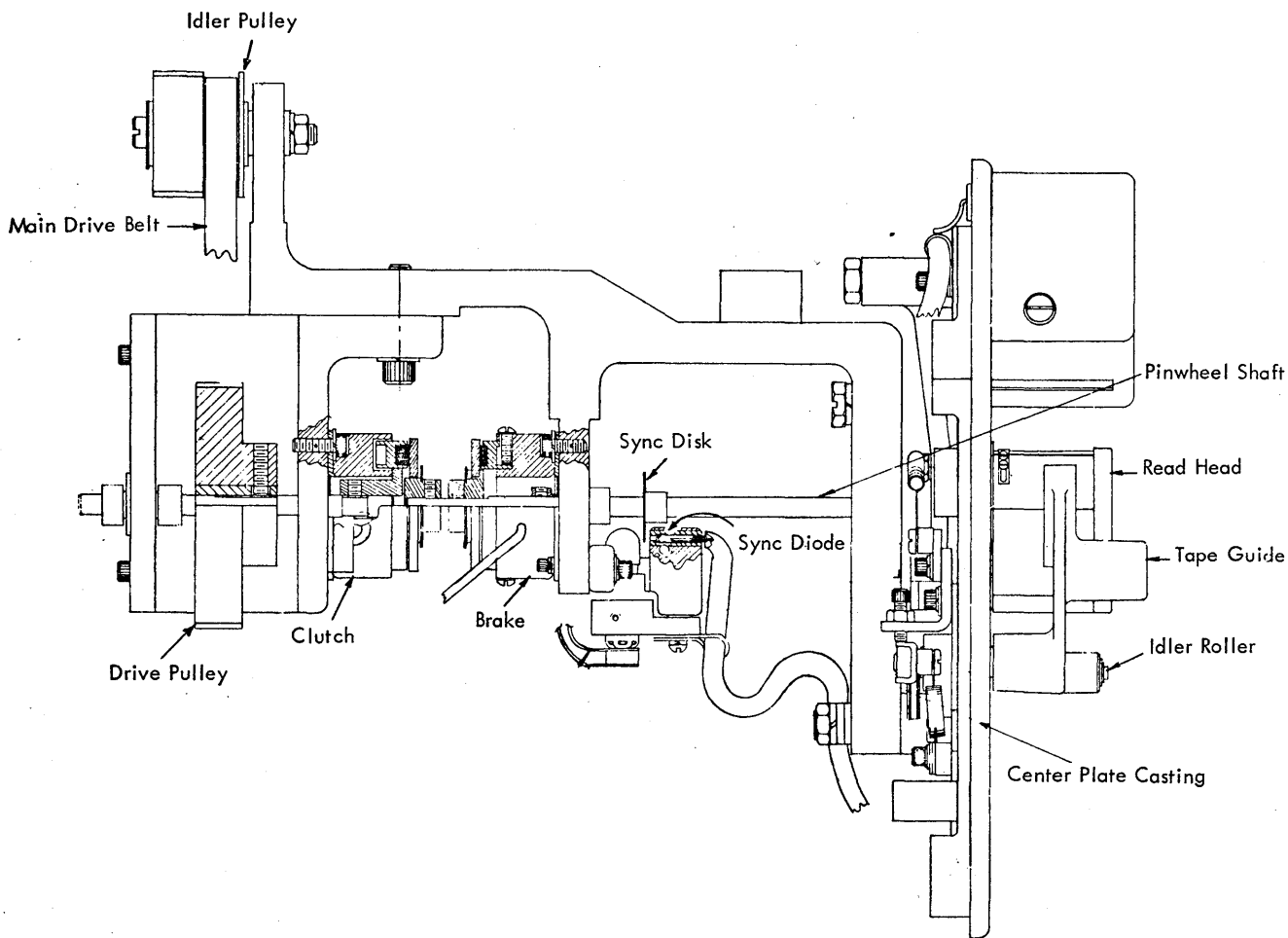


Figure 4-19. Center Plate Assembly

3. Sync oscilloscope on "+S clutch drive," A4-A14-D on 02.83.60.1. Observe "+S tape level 2," A4-A07-K on 02.83.50.1. The length of the first character read should be as close to 6.7 m sec as possible. See Figure 4-20.

#### 4.11.3 Brake Assembly

##### REMOVAL AND REPLACEMENT

**NOTE:** This procedure is for removing the brake without the entire center plate assembly.

1. Follow Steps 1 through 7 of the Clutch Assembly Removal procedure.
2. Remove the brake armature assembly from the pinwheel shaft. There are four set screws in two holes on the splined armature hub.
3. Remove two brake leads at EC-6.
4. Remove four cap screws in the brake coil housing. Remove coil housing.
5. To replace, reverse removal procedure. Position the brake armature to be .005" to .030" from stationary coil with the brake de-energized. (This adjustment

insures that the face of the splined armature hub does not drag on the brake. If the brake drags, it may slow down the pin wheel shaft when it is being driven by the clutch and cause a reading failure.) Tighten the four set screws in the two holes of the splined armature hub. **NOTE:** Make certain that the splined hub does not rub on the rotor.

##### ADJUSTMENT

Adjust the voltage across the brake to stop tape within .090". Keep the voltage drop across the coil at the maximum within.

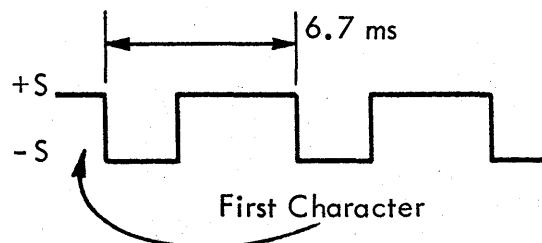


Figure 4-20. 1621 Clutch Adjustment



the range of 5.2v to 6.0v. To perform this adjustment:

1. Set brake potentiometer so that there is a 6.0v drop across the brake coil measured between EC-6B and EC-6C on 02.83.60.1.
2. Read a record on tape reader.
3. Observe where the tape stops. The photo diodes should be just visible beneath the holes of the first character of the next record. If the leading edge of the first character tape hole is more than  $\frac{1}{2}$  way past the photo diode, the tape has not stopped fast enough (Figure 4-21).

A dynamic check of the brake potentiometer adjustment can be made as follows:

- a. Prepare a tape punched 1-2-4-8-EL, 1-2-4-8-EL, etc.
- b. Program the machine to type out each record.
- c. Observe the typeout while adjusting the brake. If a character is dropped, more brake current is needed.

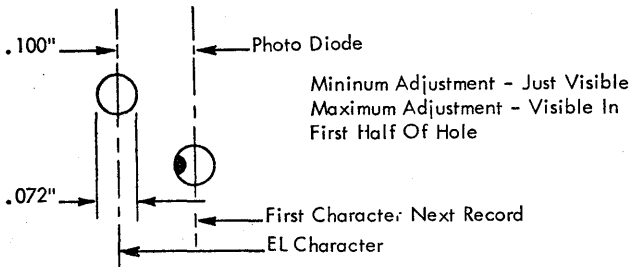


Figure 4-21. 1621 Brake Adjustment

#### 4.12 1621 Power Supply

One 48v, 6 ampere power supply is located in the 1621. See Figure 6-11. The power supply is located on the lower right hand side of the machine, and supplies power for the two reel drive motors, the duo relays and the brake and clutch coils. The specifications for this supply are:

Input Voltage	208v $\pm 10\%$
	230v $\pm 10\%$
Input Frequency	60 $\pm \frac{1}{2}$ cps
Output	51.9v DC at no load
	48.5v DC at peak load
Ripple	2% peak to peak maximum

#### 4.13 IBM 1624 Tape Punch

The removal, replacement, and adjustment procedures for this punch are included in the IBM 870 DOCUMENT WRITING SYSTEM CE Reference Manual, Form 223-6890.

Checks and adjustments on the tape punch are facilitated by removing the punch from the hinged pan in the 1621 and placing it on a table. The tape punch is not fastened to the pan. Lift the punch off the guide blocks. The cable attaching the punch to the 1621 is approximately 8 feet long.

#### 4.14 Waveforms and Levels

Figures 4-22a, 4-22b, and 4-22c show typical waveforms and voltages. The sync point and all test points are indicated on the figures.

The voltage probe is used except where indicated.

The voltages given are typical. However, the voltages may vary from machine to machine. See Section 4.4.6 for acceptable levels.

2  $\mu$ sec/div 5v/div  
 Sync Pt. B2-B22-L (A Adv.) 01.10.12.1

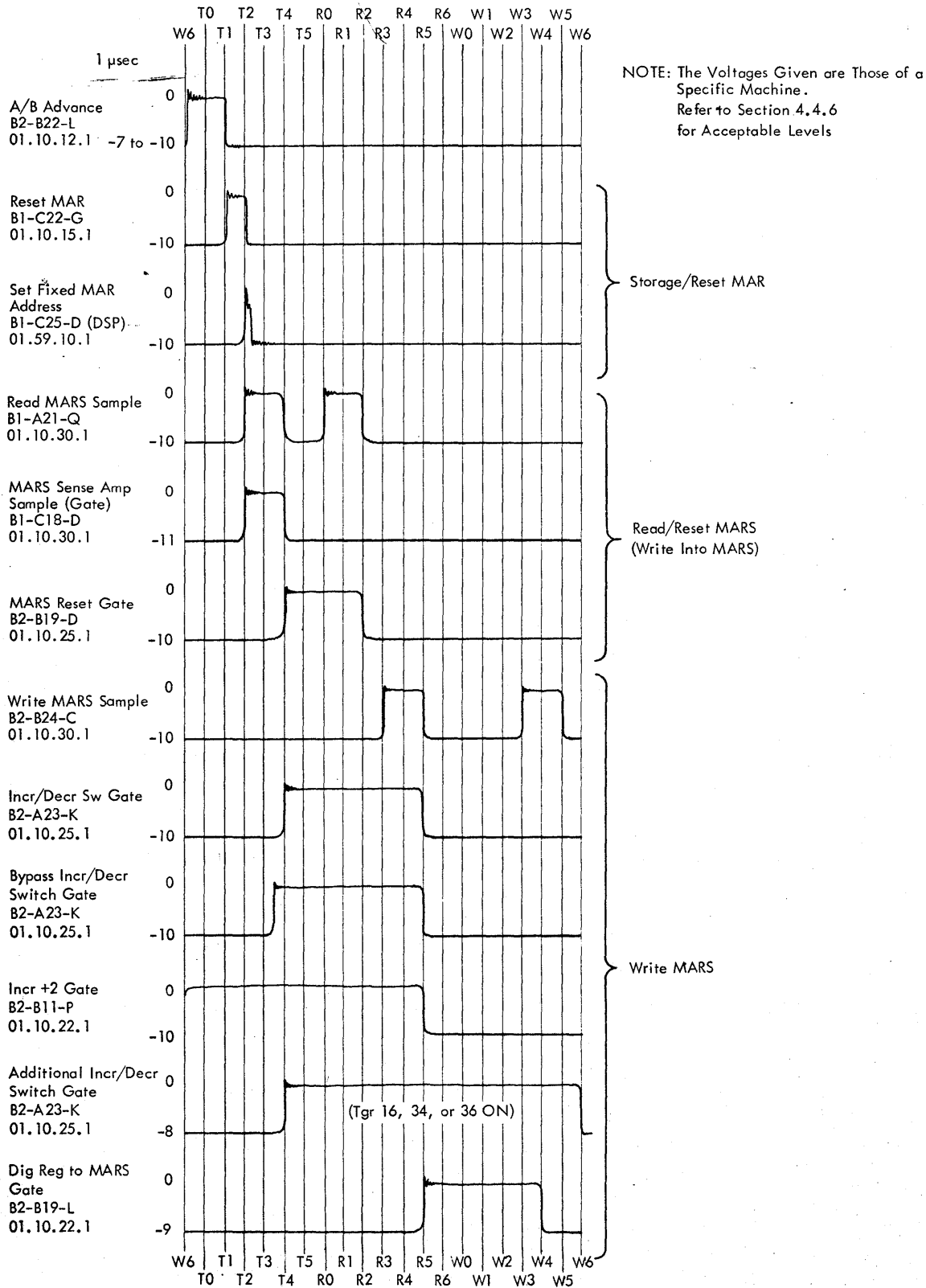
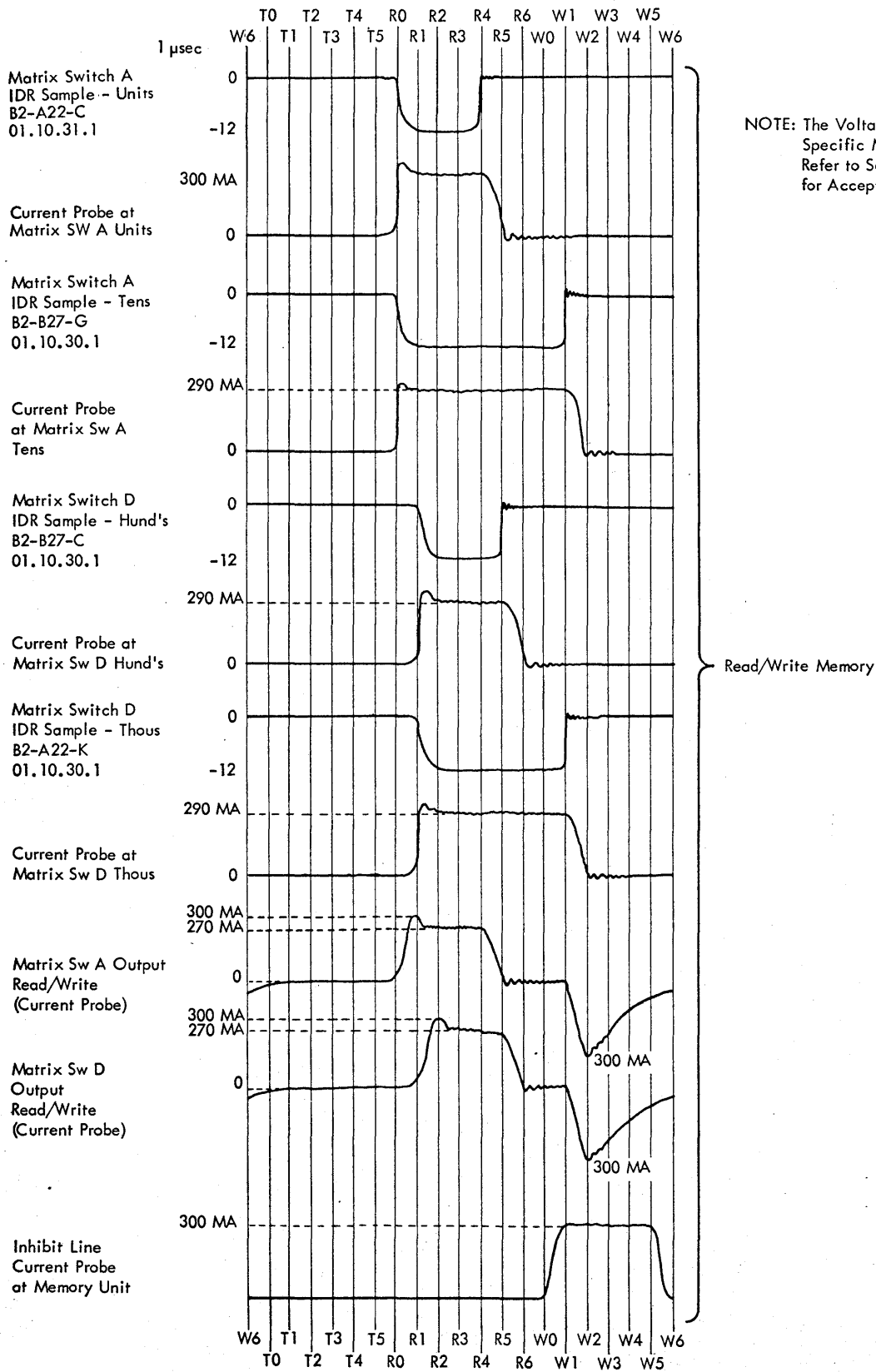


Figure 4-22a. Waveforms and Levels

2  $\mu$ sec/div 5v/div  
 Sync Pt. B2-B22-L (A Adv.) 01.10.12.1



NOTE: The Voltages Given are Those of a Specific Machine. Refer to Section 4.4.6 for Acceptable Levels

Figure 4-22b. Waveforms and Levels

2  $\mu$ sec/div 5v/div  
 Sync Pt. B2-B22-L (A Adv.) 01.10.12.1

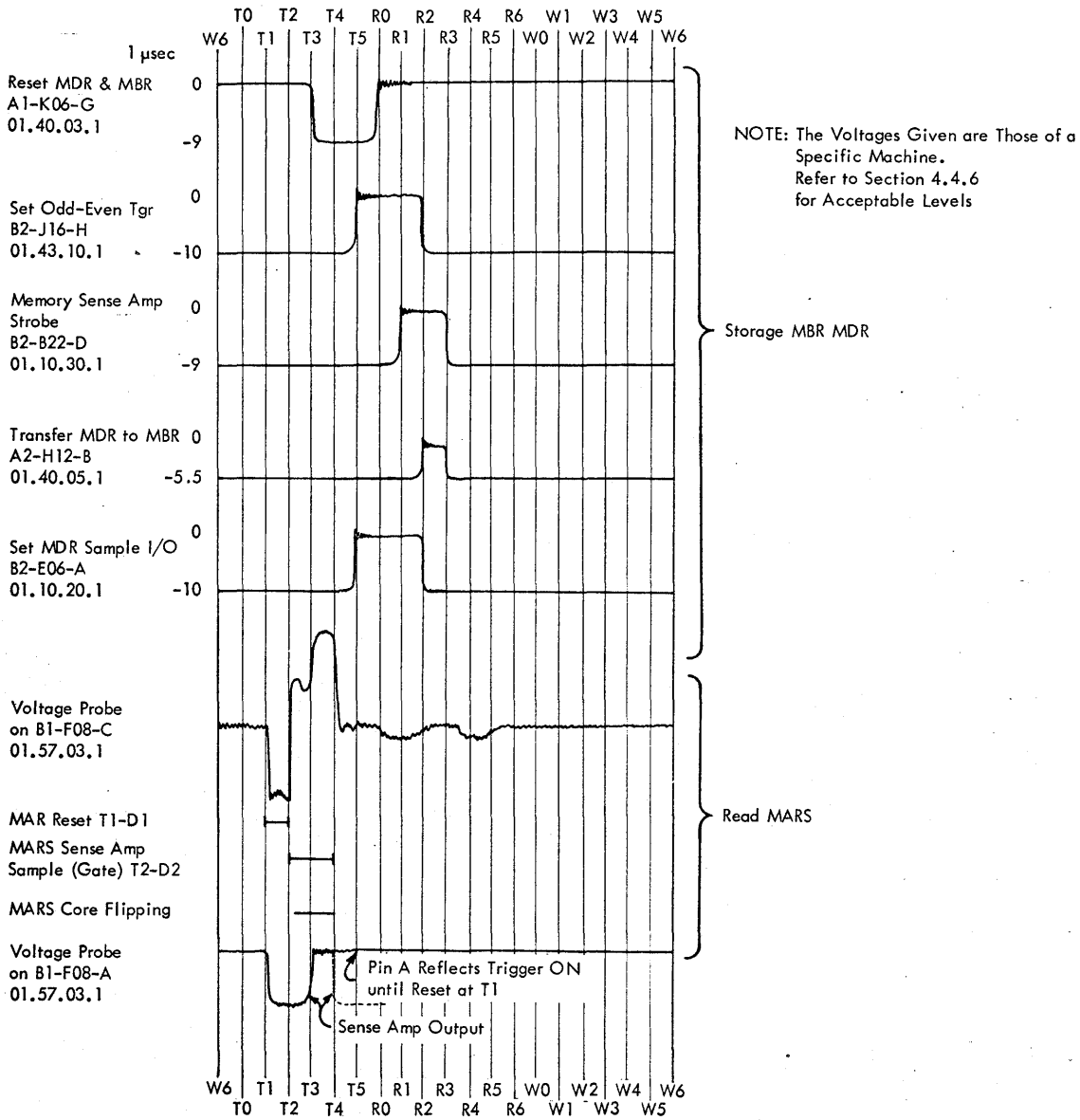


Figure 4-22c. Waveforms and Levels



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**5.1 Precautions**

**WARNING:** Observe the following precautions to avoid damaging the system.

**5.1.1 Oscilloscope**

Do not use the oscilloscope voltage probe when scoping directly on the memory unit. Wave shapes obtained with the voltage probe are not valid. Accidental shorting or grounding with potentials present can destroy decode switches or the bias winding. Destruction of the bias winding may necessitate replacement of one or both matrix switches.

The oscilloscope current probe may be used on the memory unit. For example, at the output of a matrix switch point A10 on system diagram 01.30.01.1.

Use an insulated probe when scoping. Shorting of the +12 or -12v when the +30v is present can destroy the transistors in the memory decode switches.

**5.1.2 Power Supply**

1. Do not pull emergency off switch or turn OFF the main line switch when power is ON unless there is an emergency.
2. When the 1620 is in a power OFF status 24v AC is present on card gate and memory thermal switches.

3. Turn power OFF whenever a thyratron card, memory card (any card in gate A2), or a clock circuit card is removed or replaced.
4. Never turn power ON with a memory card removed.
5. Turn power OFF whenever wrapping or unwrapping wire, or continuity testing.

**5.1.3 Servicing**

1. Never apply -S (-12v) on the input of a trigger as a means of forcing it ON. Transistor in preceding circuits may be destroyed. Apply +S (ground) on the output, turning the trigger ON.
2. Any  $\pm S$  signal level may be grounded during trouble analysis unless that level is at a memory sms card or the output of an emitter follower, DE. If a DE output is tied to +S, the +S will be transmitted to the DE input line and represent a short on the transistor driving the DE.
3. The system should never be returned to the customer with an invalid (even bit count) character in memory. This will cause an unnecessary MBR VRC when the invalid character is read from memory. Depressing reset while the machine is operating may set an invalid character into memory.
4. Use caution when installing or removing plastic covers over terminal blocks A and B (TBA, TBB, Figures 6-2

and 6-3). The cover mounting springs are easily bent so they touch a terminal thereby shorting the terminal to the frame.

5. Avoid operating the system for prolonged periods of time with the SMS card covers removed.

## 5.2 1620 General Troubleshooting Hints

### 5.2.1 Memory Area Failures

#### MATRIX SWITCHES AND ASSOCIATED SMS CARDS

**WARNING:** When an SMS card in the memory area fails, it is possible to damage the remaining cards if the machine is allowed to run continuously for more than four or five minutes.

Use the following procedure to assist in locating the defective card in the least amount of time. Four points are scoped.

1. Scope set up:
  - a. Set time base to observe one memory cycle.
  - b. Set vertical amplifier to 10 volts/division.
  - c. Sync scope on an A-advance.
2. Machine setup:
  - a. Set CE switches to increment through memory and force 7's in all positions.
3. Observe the four scope points for possible defective card patterns. See Figure 5-1a and 5-1b.

**WARNING:** Run clock only long enough to observe pattern. Continuous running can damage other cards.

**NOTE:** Open lines or bad components between MAR triggers and the decode switches give the same indication as an open decode switch. An open wire between pin C of the current driver and a decode switch will also give the same indication as an open decode switch.

#### ADDRESS SET UP

1. Troubles in memory may be peculiar to a particular address. The following procedures show methods of placing an address in MAR. Once this address has been set into MAR, the MAR bypass switch may be transferred and the problem at the address selected may be diagnosed by using the true/complement switches.
  - a. If the failing address is known, it may be placed in MAR by doing the following: Depress RESET then INSERT. Key in 49 01492 00000. The example considers that a failure occurred at address 01492. Depress RELEASE, then single cycle until trigger 18 console lamp comes on. At this time IR -1 has 01492 in it. Depress RESET. Transfer CE switches 7 and 8. Now this memory location can be cycled repeatedly.
  - b. If the failing addresses are not known, it is possible to read out and in at each memory address by doing the following: Depress RESET, then INSERT. This sets

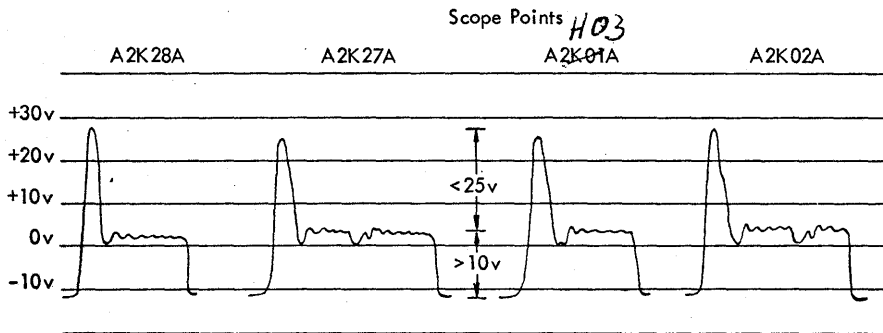


Figure 5-1a. Typical Waveforms for Good Cards

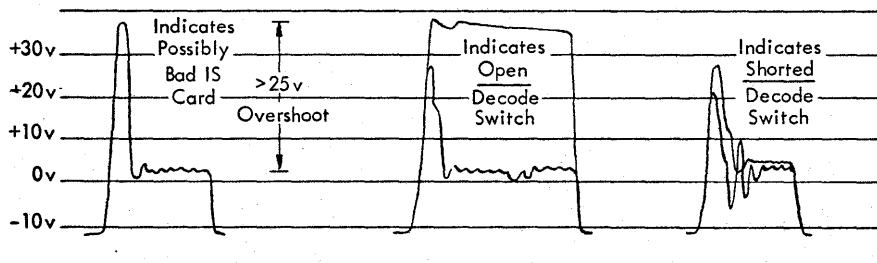


Figure 5-1b. Typical Waveforms for Defective Cards

MAR to 00000, a good known starting point. Transfer the CE increment MAR + 1 switch. Place parity switch in the ON position. This switch setting causes the clock to stop at a memory address where an error is encountered. Depress RELEASE, then START. The machine will read and write at each memory position, then stop at the memory address where an error is found. Follow the procedure in Item 1 to repeatedly read and write at the failing memory address.

2. The following technique may be used to advance past a program without performing its execution cycle or to advance MAR to the address of an instruction that is to be performed. The computer will be ready to start the instruction cycle:
  - a. Depress the single cycle execute (SCE) key 8 times. The machine will have completed trigger 8 time.
  - b. Depress RESET. The machine is then ready to perform the next instruction per IR - 1.
  - c. The instruction at IR - 1 may be by-passed by repeating Items a. and b. above.

### 5.2.2 General Servicing Hints

1. An inverter output may be kept at +S, regardless of its input, by grounding the output (See Figure 5-2).
2. Any  $\pm S$  signal level may be grounded during trouble analysis unless that level is at a memory SMS card or the output of an emitter follower, DE. If a DE output is tied to +S, the +S will be transmitted to the DE input line and represent a short on the transistor driving the DE.

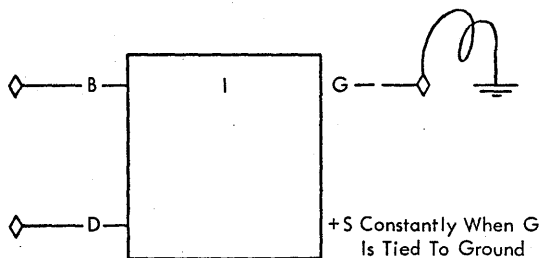


Figure 5-2. Holding an Inverter Output at +S

### 5.2.3 Use of Oscilloscopes

1. When scoping pulses within the 1620, ground the scope probe shell near the probe, preferably on a pin J (ground) of the same gate being scoped. Do not use the machine frame as ground when observing DC voltages. Unwanted noise may appear on the scope.
2. Synchronize an oscilloscope as follows to observe DSP output pulses (92 to 372 m $\mu$ sec). On gated DSP blocks, sync on the logic block supplying the gate. For example, to see the output of A2H11 on 01.40.05.1 sync on B2J12 pin E on 01.46.10.1. On ungated DSP blocks, sync on the AC set input to the DSP, or better, on the input of the block supplying the AC set input. For

example, to see the output of B1C25 on 01.59.10.1 sync on B1C22 pin Q on 01.10.09.1. If possible, use a sweep time of 1  $\mu$ sec per division.

### 5.2.4 Console Indications

Console lights indicate trigger conditions at the end of the 20  $\mu$ sec memory cycle just completed. The instruction and execute cycle triggers indicate which cycle has just been completed. Only one instruction or execute cycle trigger light should be on at any one time.

#### T1 AND T2 CONSOLE LAMPS

Console test lamps T1 and T2 (located below I8) are provided for CE use. Each lamp is equipped with a driver card. The inputs (-S) to the driver can be jumpered to monitor circuits. See system diagram 01.05.50.1 for locations and pins.

Caution should be exercised in the use of test indicator lamps T1 and T2. Incorrect and distorted results can be obtained if the inputs to the lamp driver cards (ID cards at A1E01 and B2E03 01.05.50.1) are connected into an SMS circuit, which is already carrying maximum load, thus overloading the circuit. The test indicator lamps should be used for preliminary diagnostic purposes only.

### 5.2.5 Clock Operation

The 1620 clock will run continuously without processing if the start key is depressed and: 1) no program is available in memory at the address at which the machine is started or; 2) the CE MAR bypass switch is on (up).

### 5.2.6 MAR Analysis

1. When analyzing trouble in MAR (for example, extra bits in a position of MAR) or MBR the sense amplifiers (for example B1E11 on 01.57.01.1) on the input lines of that position may be removed. This technique will assist in determining if an extraneous readout of MARS is the cause of the trouble.
2. The read and write drivers for each MARS register are on the same SMS card. For example: the IR - 1 read driver is at B1H09 on 1.56.30.1. The IR - 1 write driver is at B1H09 on 1.56.35.1.

### 5.2.7 Display MAR

To display MAR between single cycle operations:

1. Single cycle by depressing the SCE key to the point in the execution of the instruction at which it is desired to look at a MARS register.
2. Depress reset. Start 1 trigger must be off in order to initiate a display MAR operation.
3. Position MAR display selector. (If it is desired to look at OR-2, place it at OR-2.)
4. Depress DISPLAY MAR. The selected register is now displayed on the console panel. This operation makes it impossible to complete the instruction.
5. To look at another MARS register repeat steps 3 and 4.



### 5.2.8 Repeat Branch Instruction

To repeat a branch instruction indefinitely:

1. Make the P address of the instruction equal to the O<sub>0</sub> address of the instruction. For example, write the instruction 46 00012 00200, starting at address 00012.
2. Transfer program switch #2. Depress START. The instruction will repeat indefinitely.
3. To check the equal zero indicator, ground the equal zero trigger ON side output at pin E of B2E22 on 01.60.41.1 and modify the Q address appropriately.

### 5.2.9 Input Circuitry

As an aid to analyzing input problems, the 1620 can be made to continually cycle through the input operations as follows:

1. Float (insulate SMS card contact with cellophane tape) D1-B15-H (01.80.25.1).  
This removes the sync trigger from the control of the selector common contacts.
2. Turn on Bypass switch.
3. Depress INSERT.  
This sets up a read numerical operation with the typewriter as the input device.
4. Manually lift a typebar up to the platen and block it in this position. This will cause the coding relay(s) associated with this typebar to stay energized. The 1620 will be going through repetitive input cycles. The input translator, hold trigger, and triggers 30 and 31 can now be scoped.

### 5.2.10 Locating Grounds

1. Remove the green (or black) wire between DC isolated ground and frame ground.
2. Remove the green (or black) wire between AC isolated ground and frame ground.
3. Measure the resistance between any J pin and the frame. The resistance should be in megohms. If not:
  - a. Isolate each gate by taking off terminal No. 1 of the laminar bus terminal block.
  - b. Isolate each row by removing the wire that connects row to the laminar bus.

### 5.2.11 Locating Marginal SMS Cards

If an error shows when running marginal tests, the SMS card giving the trouble can be readily found by:

1. Isolating the gate where problem is located by using switches on marginal check unit.
2. Isolating the rows by transferring the 12 M wire to the 12v terminal one row at a time.

**WARNING:** Turn off power before transferring voltage wires.

**NOTE:** When a row is located that appears to be giving trouble, it may be that the actual marginal card is the card that is driving the card located in the row found by test. This driving card may be in another row.

### 5.2.12 Measuring Transistor Delay Time

Transistor delays (slow response) can cause intermittent machine failures that are difficult to diagnose. A slow card may cause delays on either the rise or the fall of a pulse. The following is a method of measuring transistor delay:

1. Sync scope on the input to the card in question (while the clock is running).
2. Probe the input and note the rise and fall time of the pulse.
3. Probe the output and compare with input pulse. The difference between the rise and fall times is the "Turn on delay" and "Turn off delay" respectively.
4. Compare this information with the data given in Section 4 (4.4.7).

In extreme cases, the delay introduced by the defective card may be so great that the rise or fall time may be as much as one second. In these cases, it will be necessary to progressively increase the oscilloscope sweep time to measure the amount of delay.

## 5.3 Miscellaneous Servicing Information

### TYPEWRITER

1. The invalid typewriter character (X) prints on any bit combination that does not energize any other key magnet. It does not necessarily indicate incorrect parity.
2. As the zero typebar starts to fracture the type moves up causing the zero to print higher than the other typewriter characters. At the first sign of misalignment, it is advisable to replace the typebar to prevent an emergency service call.
3. The usage of the typewriter on the IBM 1620 is usually very high and therefore must be kept well lubricated. Lubrication procedures are given in the Model B1 Electric Typewriter, CE Reference Manual.

Improper positioning of the multiple copy lever can be a contributing factor to typebar fractures.

### SMS CARDS

See Customer Engineering memorandums for part numbers and descriptions of new releases.

### 1621 PAPER TAPE READER

Stopping time of the 1621 is critical. To test for stopping time failures, write a program calling for succession of read (03) followed by write (01) instructions. The 1621 should read in a record and then type it out; read in the next record and type it out; etc. Use records of different lengths so that more or less time is allowed for starting and stopping. Punch a tape consisting of a two digit record followed by a record of four or five digits on up to records of 40 or 50 digits and then reverse the process by gradually reducing the number of digits per record.

Dropping the first digit of a group indicates too much slide. Check adjustments of both brake and clutch if a failure occurs.

## 5.4 1621 General Troubleshooting Hints

### 5.4.1 Precautions

**CAUTION:** When working on the 1621 machine with power on, be aware that the pinwheel drive is under control of the 1620. It is possible for this mechanism to start at any time. The reel drive motors are under control of the buffer arms; therefore, caution should be exercised whenever the arms are moved. To stop all motors on the 1621, turn the main line switch OFF, open the tape guides, or move either buffer arm assembly upward until the upper limit switch is operated. The 1621 main line switch removes AC voltage, +12v, -12v, and +48v DC developed in the 1620, and -48v DC developed in the 1621. The 1621 main line switch does not open the convenience outlet circuit or the -12v DC to the integrators on 02.00.30.1.

1. Do not apply lubricant to the 1621 pinwheel shaft brake and clutch splines. Lubrication on the clutch surface is undesirable.
2. Do not apply lubrication to the paper tape reader idler rolls. Oil on paper tape causes read errors.

### 5.4.2 Operation Procedures

1. To rewind tape on the 1621 when both take up and supply reels are being used:
  - a. Remove the tape from the read head.
  - b. Leave the tape in place on the buffer arms and reels.
  - c. Move the supply buffer arm down until the supply reel rotates backward. Hold the buffer arm in this position until you want to stop rewinding.
2. To stop the paper tape reader pinwheel, raise the tape guide.
3. The 1621 load switch will not cause tape loading when either buffer arm is against a stop. An arm in this position opens a limit switch.

## 5.5 Emergency SMS Card Component Replacement

An emergency situation may arise where it becomes imperative to change a component on an SMS card. This should only occur under most unusual conditions. Under no circumstance should an attempt be made to replace a transistor—heat from the soldering iron will change its operating characteristics and erratic performance will result.

The following outline is a procedure that has been used to replace a resistor. This procedure should be followed to replace a resistor or diode on a card when the situation demands immediate action. The card should be inspected and if you suspect damage from overheating, replace the card as soon as possible.

1. a. Facing the component side of the card, locate the resistor. Cut the two resistor leads as close to the card as possible, using diagonal cutters.
- b. Lay the card on a flat surface, wiring side up, noting the location where the remainder of the resistor leads are soldered.

- c. Using a soldering pencil, heat one of the snipped leads so it can be lifted out by long-nosed pliers. Work fast and accurately so that excessive heat is not applied to damage the transistors. Repeat the procedure to remove the remaining snipped lead.
  - d. If necessary, use the soldering pencil tip to clear excess solder from the holes in the card.
2. a. Add the new resistor in the position made available by the one removed.
  - b. Holding the resistor in the card with the forefinger, wiring side up and gold contacts nearer the installer, bend the leads flat to the card. Right lead bends to the left and the left lead bends to the right.
  - c. Using diagonal cutters, clip the resistor leads so that approximately  $\frac{1}{8}$  inch of wire is all that remains of each lead to hold the resistor in place.
  - d. Being careful not to apply excessive heat, solder the leads making sure a good solder connection is made.
  - e. Inspect the reworked area to be certain there are no shorts between soldered lines or excessive solder on the card.

## 5.6 Installing Circuit Changes

**NOTE:** If practical, system diagrams should be updated to reflect the installation of a B/M before the machine is taken from the customer. This will reduce the amount of downtime to the customer and will generally familiarize the Customer Engineer with the change. In the event trouble exists on completion of the installation, no time will be lost updating the system diagrams before analysis of the problems can begin.

Field Bill of Material instructions on 1620 circuit changes use terms and procedures that are tailored to SMS panel wiring. An understanding of what these terms mean, used in conjunction with the recommended procedures for installing these circuit changes, will result in faster and more accurate installation. Typical 1620 Field Bill of Material instructions are written as follows:

### EXAMPLE ONLY

<i>Network Before Rework</i>	<i>Level</i>	<i>Remove From</i>	<i>To</i>
B2U12B	2	B2U12B	B2A27F
B2A27F	2	B2B17K	B2D10H
B2B17K	1	B2A27F	B2B17K
B2D10H			

<i>Network After Rework</i>	<i>Level</i>	<i>Add From</i>	<i>To</i>
B2U12B	1	B2G27H	B2B17K
B2G27H	2	B2G27H	B2U12B
B2B17K	2	B2B17K	B2D10H
B2D10H			

Network before rework—U12B, A27F, B17K, and D10H are interconnected in panel B2 before the Removals and Additions are performed.

Level—There are 2 levels of wrapped wire on the sms socket pin. Level 1 is the bottom wrap while Level 2 is the top wrap.

No level is given for a wire going to T, or X, Y connectors.

**Example**

Network	Level	From	To
B1B14D	(None)	B1U16D	B1BX19

Remove-Add—All Removals should be performed before Additions.

NOTE: Do not remove wires at T or X, Y connectors. Remove the wire from the sms terminal and let hang until needed then if the wire is too short make a splice using a butt connector (P/N 216230) and crimping pliers (P/N 450898). Butt connectors are not supplied with E/C's.

Network after rework—U12B, G27H, B17K, and D10H are interconnected in panel B2 after the Removals and Additions are performed.

A comparison of the before and after network, Figure 5-3, shows that the effect of the circuit change is to remove B2A27F from the network and add B2G27H in its place. To accomplish this change, the Remove and Add columns show that B2B17K to B2D10H and B2U12B to B2A27F have to be removed to gain access to the wire from B2A27F to B2B17K. After B2B17K to B2G27H is connected in the network, it is then necessary to install B2B17K to B2D10H and B2U12B to B2G27H.

If it becomes necessary to check out a particular portion of a circuit change, a quick continuity check can be made

since each point in a network is one leg of a series circuit. In the example shown (Network after Rework) B2U12B goes to B2G27H; B2G27H then connects to B2B17K; B2B17K then ties to B2D10H. If the change is properly installed, a check between the first point (B2U12B) and the last point (B2D10H) in the net will show continuity.

Figure 5-4 shows the correct way to connect a net. The net should be open ended, that is, two second level wraps are at each end of the net.

Yellow solid wire size No. 24 (P/N 216226) must be used for all standard circuit changes requiring wrapped wire connections. When ordering wire specify quantity desired in feet, otherwise a 6,000 foot spool will be supplied.

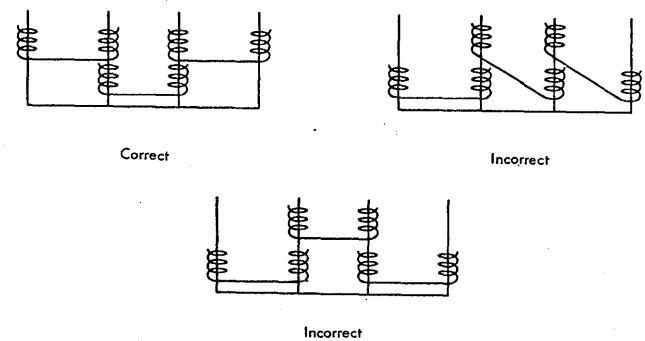


Figure 5-4. Network Wiring

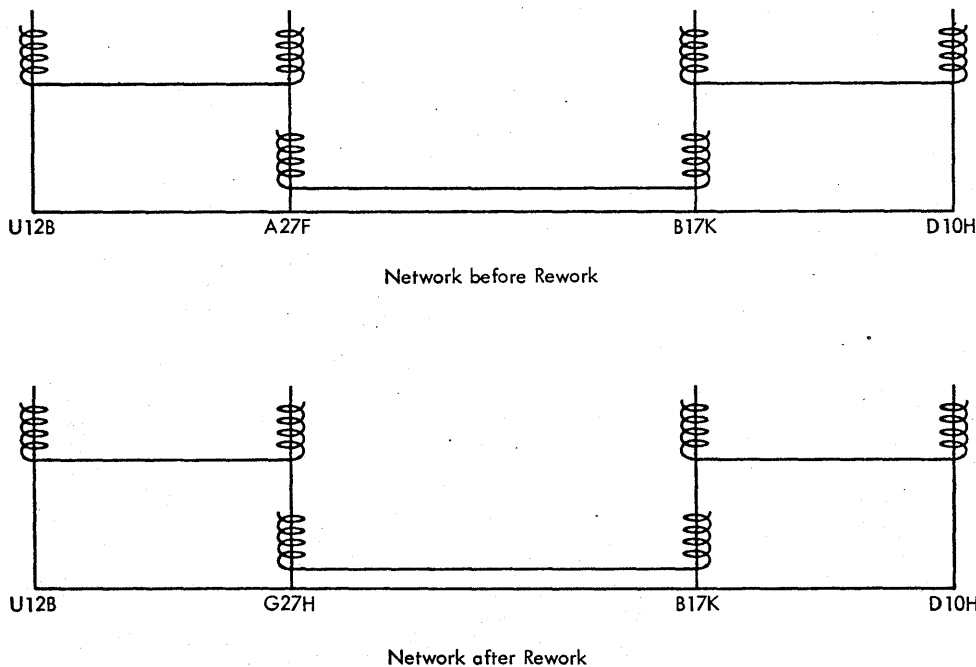


Figure 5-3. Network Before and After Rework

Contents

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     T Connectors ..... 101  
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6.1 SMS Cards

The lettering within a logical block on a System Diagram gives the location of that block in the card gates. It also indicates other pertinent data, as seen in Figure 6-1. Identification of panels, rows, columns, and pins is shown in Figures 6-2, 6-3, and 6-4.

Logic block locations within the System Diagrams are shown on System Diagram Card Location Charts, for example 01.00.14.1. The lettering in the top righthand corner at each card location in the charts indicates the card code. The lettering in the top left-hand corner indicates the functional symbol of the card. If the functional symbol is "2W" or "3W", it refers to the number of inputs available to AND or OR blocks.

6.2 Cables and Connectors

6.2.1 X and Y Connectors

Inter-gate cables are connected to card gates by X connectors and Y connectors. These cables are shown on 01.00.25.1. The connectors are located on the ends of their gates as seen on 01.00.25.1 and Figures 6-2, 6-3, and 6-5.

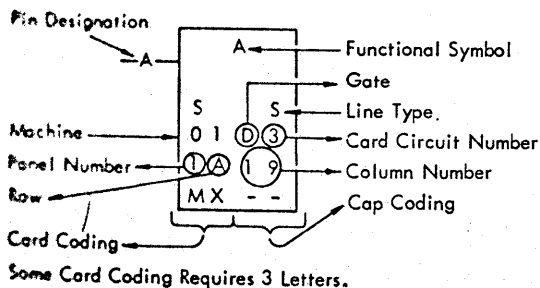


Figure 6-1. IBM 1620 Logic Block Coding

Each terminal within a connector is identified by a code. An example of this code is "01AXB11". This number is in the lower left-hand corner of 01.25.15.1. It represents machine 01 (the 1620; 02 represents the 1621), A gate, X connector, B row, pin 11. The "5" to the left of this code number identifies the connector pin on system diagram 01.25.15.1. The "5" on the system diagram shows that this pin actually connects to PL of the inverter block at 01A1D06. The pin number at the other end of the cable is also numbered on the connectors. They line up on the connectors as shown in Figure 6-6.

6.2.2 T Connectors

T connectors are called out in the System Diagrams by an "\*" and a number. For instance, "\*1" on the top right-hand corner of 01.15.13.1 refers to T connector 01B1U08A at the bottom of the page. This code for the T connector represents machine 01 (the 1620; 02 represents the 1621), gate B, panel 1, U = upper, column 08, pin A. The tables on 01.00.20.1 locate the T connectors in the System Diagrams. Figure 6-4 shows the location of T connector at gate A, panel 1, L = lower, column 03, pin C.

6.2.3 Shoe Connectors

Inter-machine signal cables are attached to the machine by shoe connectors. System Diagram 00.00.20.1 shows the locations of the shoe connector terminals in the System Diagrams. For example, the "Punch EL" terminal is on 01.84.20.1. It is identified by an "\*2" on 01.84.20.1. At the bottom of 01.84.20.1 the "\*2" code number is 01SCA01. This number translates to machine 01, shoe connector A, terminal 01. The terminals are numbered on the connector as seen in Figure 6-7. Figure 6-2 locates shoe connector A on the 1620. Figure 6-8 locates shoe connector A on the 1621.

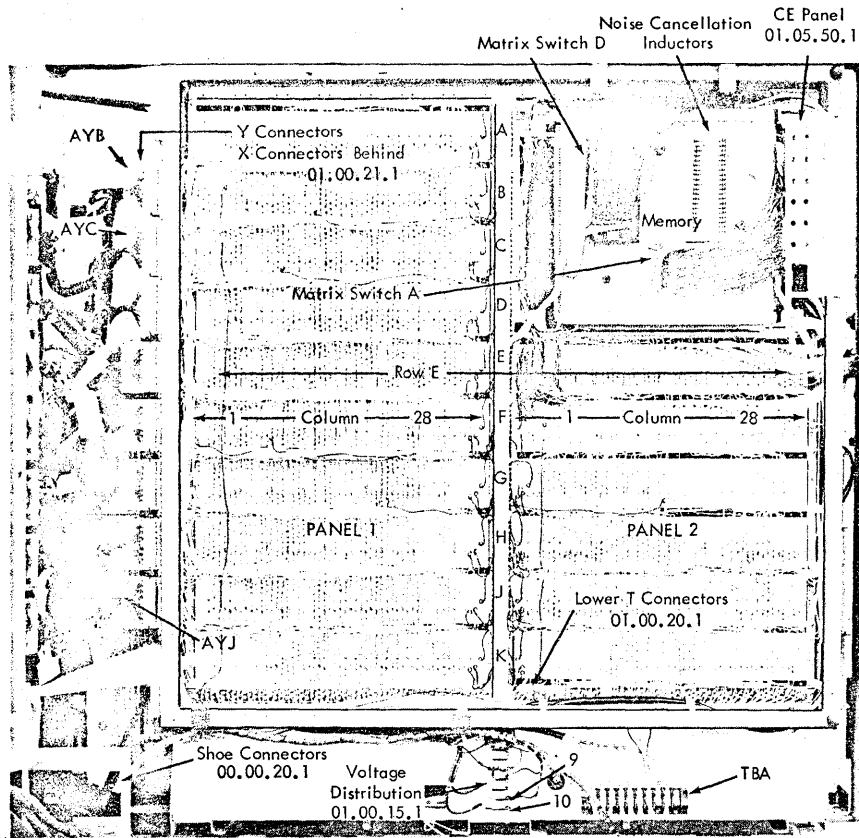


Figure 6-2. IBM 1620 Gate A Wiring Side

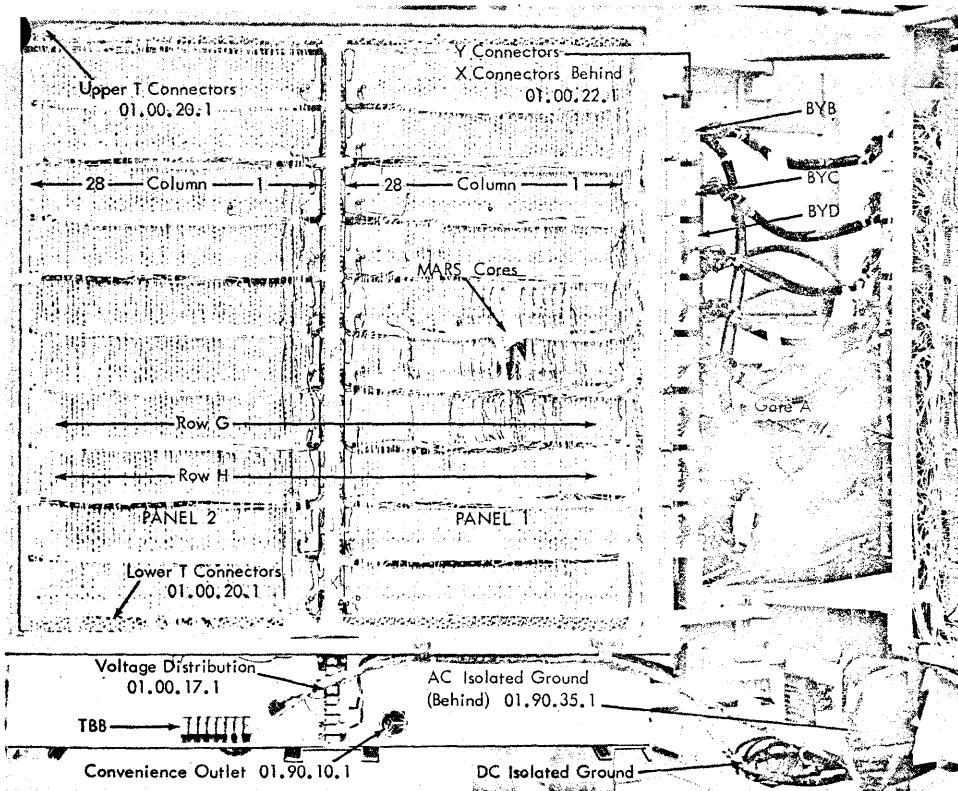


Figure 6-3. IBM 1620 Gate B Wiring Side



Figure 6-4. Card Gate Terminal Identification

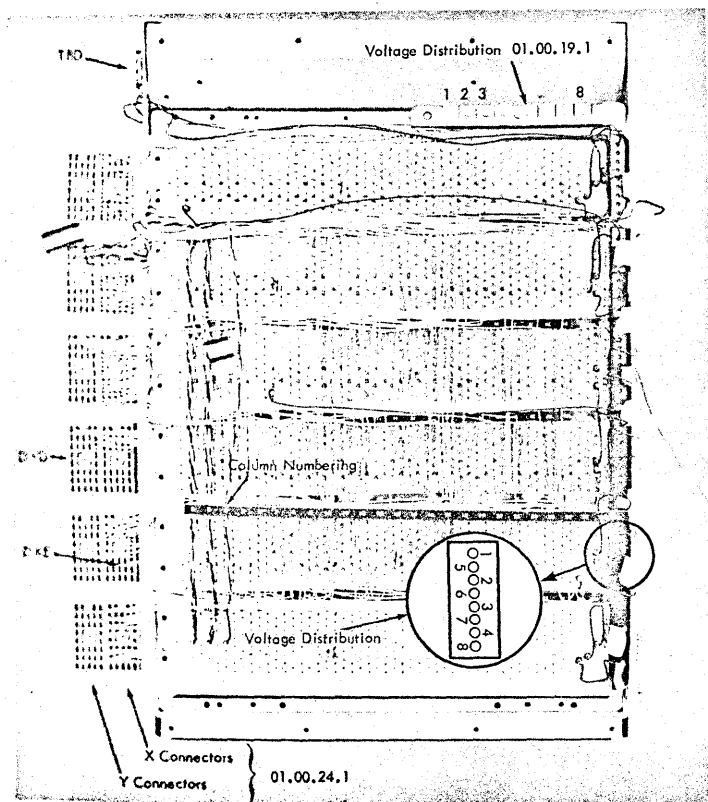


Figure 6-5. IBM 1620 Gate D Wiring Side

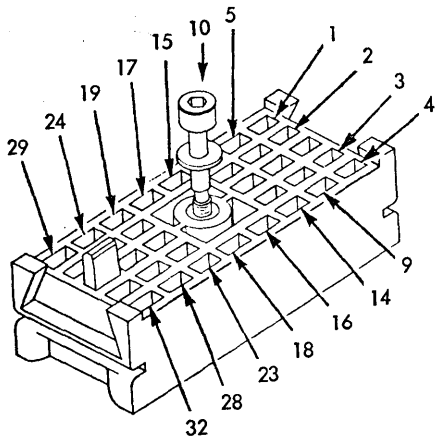


Figure 6-6. Cable Connector Terminal Numbering

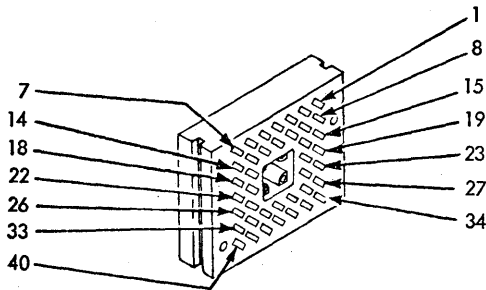


Figure 6-7. Shoe Connector Terminal Numbering

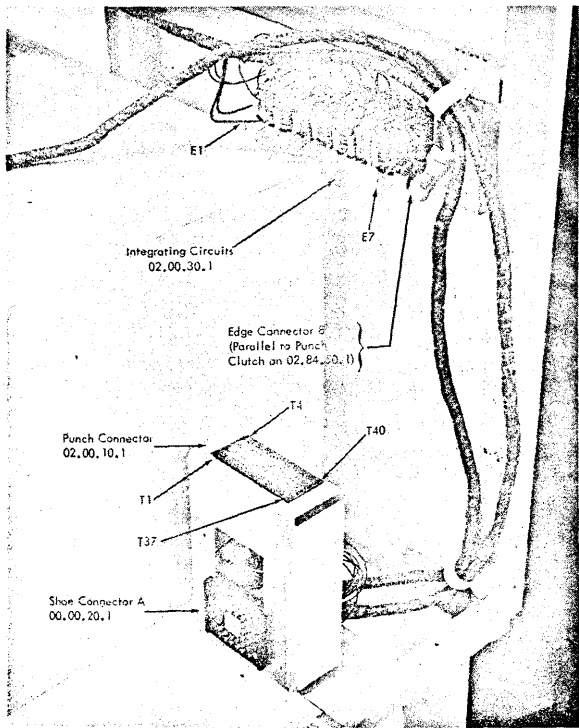


Figure 6-8. IBM 1621 Connector and Integrator Location

### 6.3 Terminal Blocks

There are many terminal blocks within the IBM 1620 and IBM 1621. Their physical location within the 1620 is shown in the Reference Section of the System Diagrams, and by Figure 6-2, 6-3 and 6-5. Their physical location in the 1621 is shown in 02.83.00.1 and Figures 6-9, 6-10, and 6-11. TBM is located on the memory unit (Figure 6-12). The tables of Figures 6-13 and 6-14 should assist you in identifying the various terminal block terminals.

The actual location of a terminal on wire relay type terminal blocks, (TB78 to TB98) is shown in Figure 6-15. All of the "C" hubs are common. The other hubs are common in groups of three; for example the three 6B hubs are common.

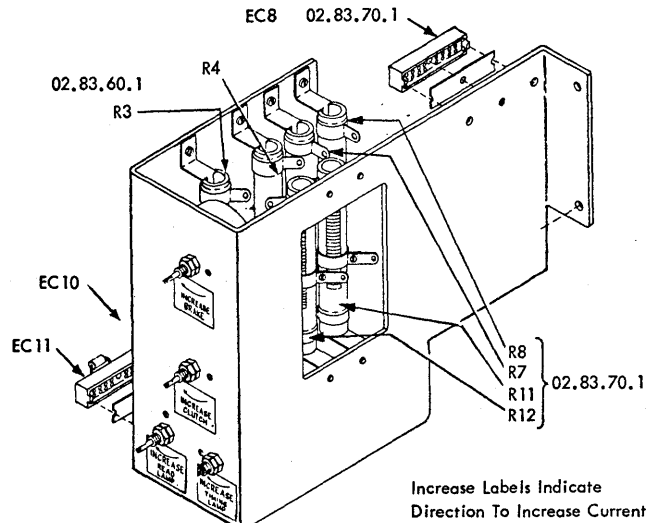


Figure 6-9. IBM 1621 Chassis Assembly Locations

### 6.4 Diode Boards

The diodes on gate C are numbered from 1 to 33. Their location in the System Diagrams is called out on 01.00.35.1. The diodes are numbered from front to back; right to left; when facing the front of the machine. See Figure 6-16.

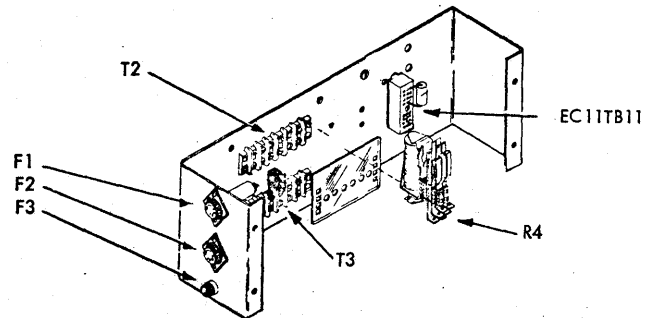


Figure 6-10. IBM 1621 Power Input Panel

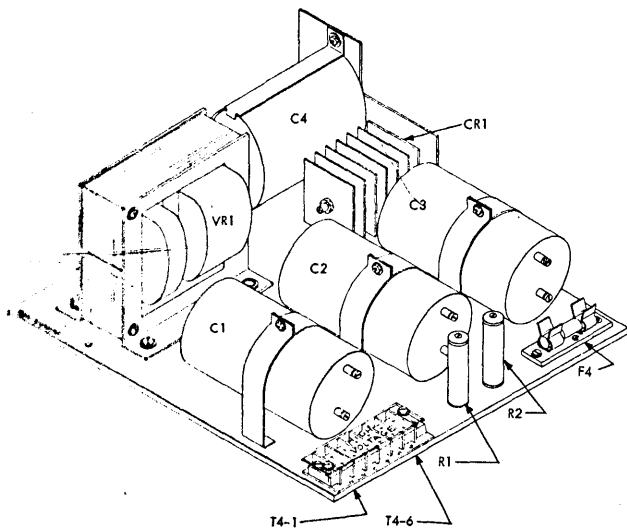


Figure 6-11. IBM 1621 48 v Power Supply

TERMINAL BLOCK	SYSTEM DIAGRAM			
	CALL OUT	EXAMPLE	LOCATION CHART	PHYSICAL LOCATION
T1	T1-6	02.83.70.1		02.83.00.1
T2	T2-4	02.70.10.1		Figure 6-10
T3	T3-2	02.70.10.1		Figure 6-10
EC-1 to EC-14	EC-14C	02.83.70.1		02.83.00.1
T4	T4-3	02.70.10.1		Figure 6-12

Figure 6-14. IBM 1621 Terminal Block Types

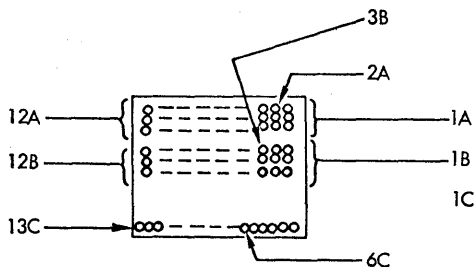


Figure 6-15. Wiring Side of Wire Relay Type Terminal Block

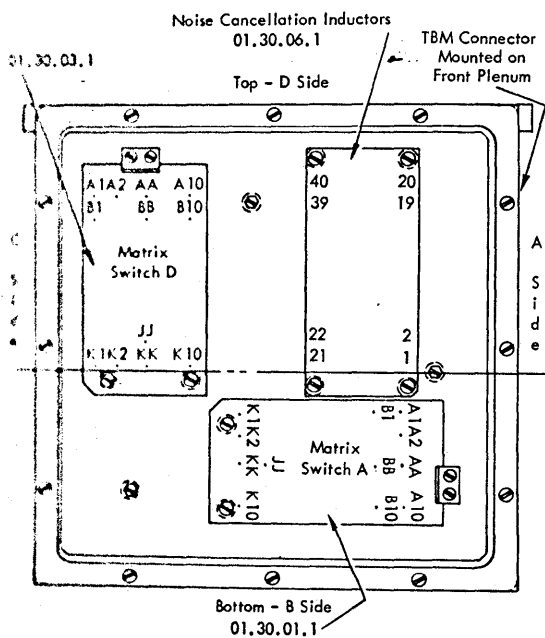


Figure 6-12. IBM 1620 Memory - Rear View

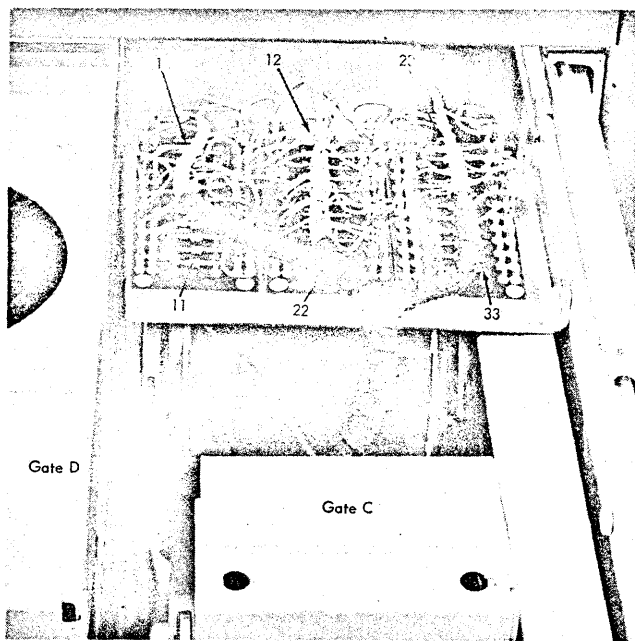


Figure 6-16. IBM 1620 Gate C Diode Board Identification

TERMINAL BLOCK	SYSTEM DIAGRAM			
	CALL OUT	EXAMPLE	LOCATION CHART	PHYSICAL LOCATION
TBA	TBA-1	01.90.10.1		Figure 6-2
TBB	TBB-1	01.90.42.1		Figure 6-3
TBD	TBD-4	01.90.42.1		Figure 6-5
TBE	TBE-7	01.90.10.1		Figure 6-12
PSTB1	PSTB1-5	01.90.30.1		Figure 6-19
PSTB2	PSTB2-4	01.90.30.1		Figure 6-19
Interlocking Switches	105F	01.90.40.1		01.00.80.1
TB7B to TB9B	TB82-10C	01.81.50.1	01.00.35.1	01.00.33.1

Figure 6-13. IBM 1620 Terminal Block Types

### 6.5.1 RC Units

## 6.5 RC Units and Integrators

RC units are mounted in relay positions on the C gate and numbered as relays. The RC unit wiring is shown on their sides. An example of their wiring in the System Diagrams is seen on the lower right-hand corner of 01.82.72.1. Here RC89B-1 terminal is the #1 terminal B side of RC89. It is, connected to R40 LT coil.



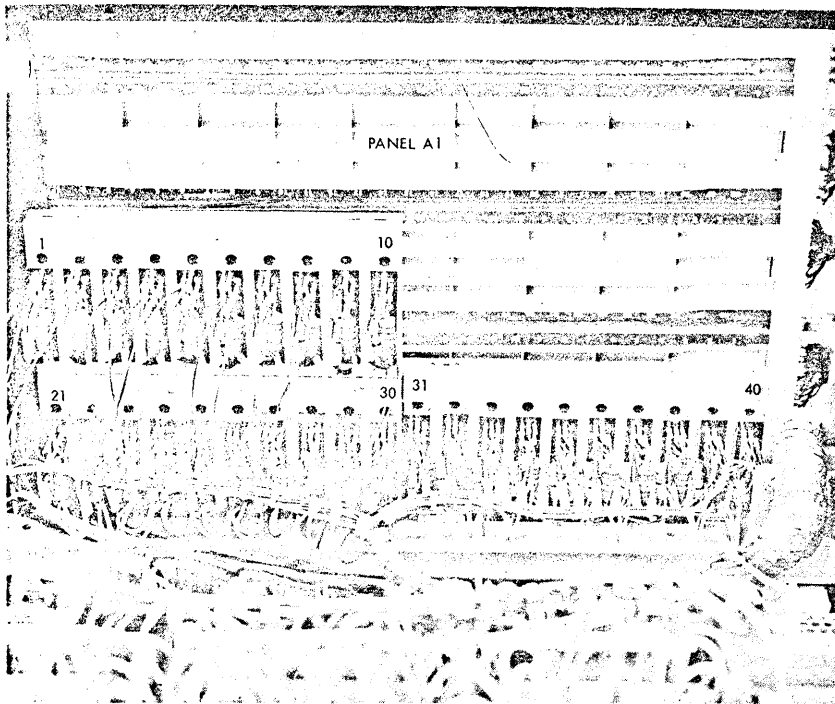


Figure 6-17. IBM 1620 Integrator Identification

### 6.5.2 Integrators

The integrators used in the console circuits of the 1620 are behind the right side of the console display panel. See Figure 6-17. The location of the integrators in the System Diagrams is shown in 01.00.40.1.

## 6.6 Relays

### 6.6.1 Sequence Relays

The sequencing relays are R101 to R106 on 01.00.80.1. They are located on the right side of the 1620. Their contact terminals are numbered left to right as seen in Figure 6-18. Their locations within the system diagrams are indicated on 01.00.81.1. See Figure 6-19.

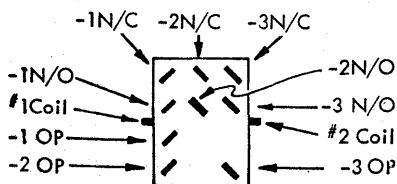


Figure 6-18. Sequencing Relay Terminal Numbering

### 6.6.2 Voltage Sense Relays

The voltage sense relays are R109 to R113, R115 and R117 on 01.90.45.1. They are located on the right side of the 1620 as seen in 01.00.80.1. Their contact terminals are numbered left to right as seen in Figure 6-20.

### 6.6.3 Timer Relay

The timer relay, R108 on 01.90.40.1, has a tube octal plug. Looking at the bottom of the relay, the terminals are numbered one through eight, clockwise beginning at the key. The wiring diagram of the single contact relay is on the side of the relay. See Figure 6-19.

## 6.7 Power Supplies

The power supplies in the 1620 are located in the four boxes across the front of the machine. See Figure 6-21. The eight capacitors for the two regulated AC supplies (01.90.20.1) are mounted on the back side of the box number one. The 48v, 6 amp, DC supply is mounted on the back side of box number three. Items on the back of the boxes are accessible by opening card gates A and B. The power supply system on the 1620 consists of:

- 1 1250 Watt AC Regulator
- 1 415 Watt AC Regulator
- 1 -36v 2 amp DC sms Power Supply
- 2 -12v 20 amp DC sms Power Supplies
- 1 +12v 16 amp DC sms Power Supply
- 1 +30v 4 amp DC sms Power Supply (Memory Supply)

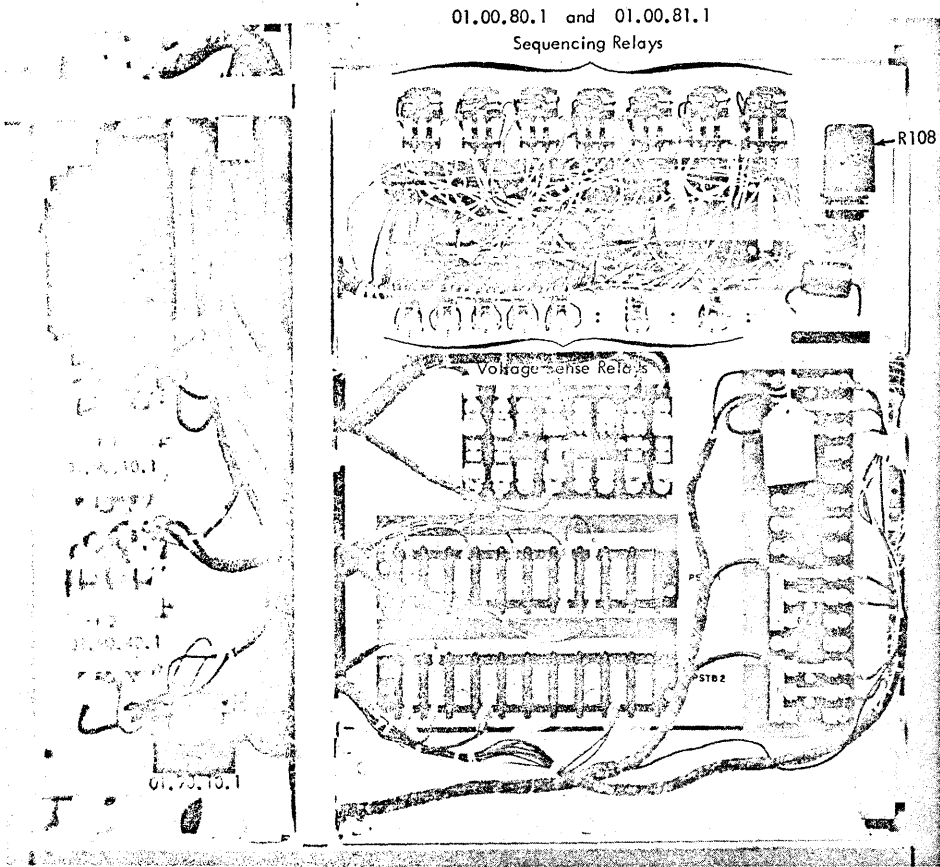


Figure 6-19. IBM 1620 Right Side View

- 1 +45v 6 amp dc Power Supply
- 1 -3v 5 amp dc Power Supply used with the Marginal Checking

The gate mounted in box four contains the five marginal check (MC) toggle switches on 01.90.30.01, the DC meter selector switch on 01.90.45.1, the DC meter, the +30v variac on 01.90.21.1 and the 3v MC rheostat on 01.90.21.1. See Figure 6-22.

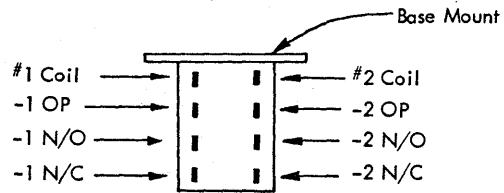


Figure 6-20. Voltage Sense Relay Terminal Numbering

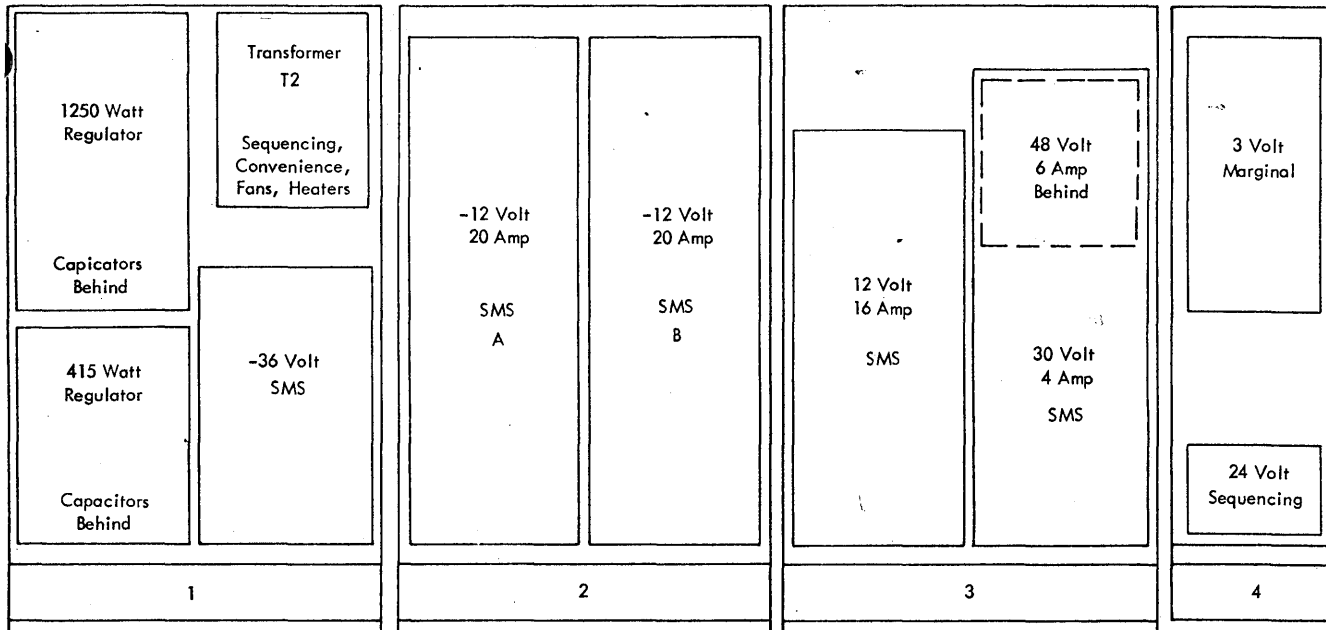


Figure 6-21. Power Supply Boxes 1, 2, 3, and 4

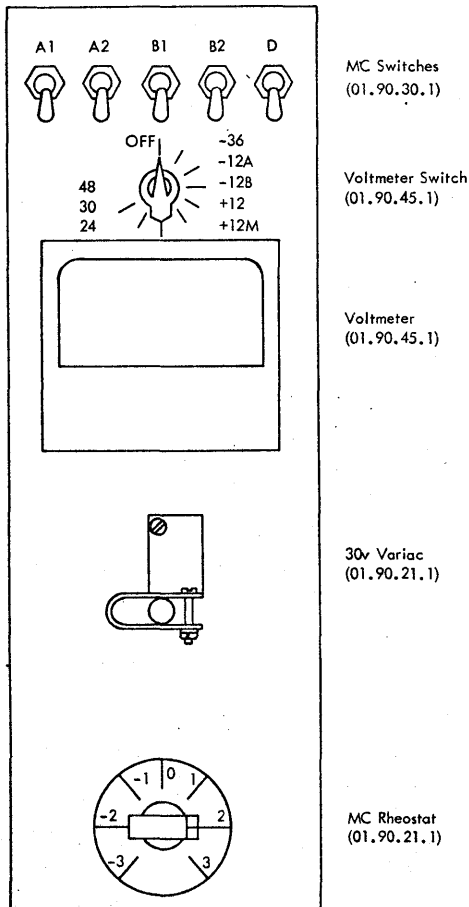


Figure 6-22. Box 4 Marginal Power Supply Controls

### 7.1 Additional Instructions and Functions

#### 7.1.1 Divide and Load Dividend

The divide and load dividend instructions require the addition of SMS cards in specified locations. The basic 1620 is pre-wired for this feature. Diagnostic function test, CU01, includes divide and load dividend.

#### 7.1.2 Transfer Numerical Strip, Transfer Numerical Fill and Move Flag

These instructions require the addition of SMS cards in specified locations. The basic 1620 is pre-wired for this feature. Diagnostic test CU05 provides a test of the three instructions.

#### 7.1.3 Indirect Addressing

The indirect addressing feature requires the addition of SMS cards in specified locations. The basic 1620 is pre-wired for this feature. Diagnostic test CU03 provides a test of this function.

### 7.2 Additional Peripheral Equipment

#### 7.2.1 IBM 1622 Card Read-Punch Unit

The basic 1620 is pre-wired for the card read-punch unit. Installation of the 1622 requires the addition of SMS cards in specified locations and connecting power and signal cables. Diagnostic test IO02 is provided for testing the 1622.

#### 7.2.2 IBM 1623 Core Storage Unit

The basic 1620 is pre-wired for the Core Storage Unit. Installation of the 1622 requires the addition of SMS cards in specified locations and connecting power and signal cables. Diagnostic function test CU04 is provided for testing the 1623.

**NOTE:** Customer Engineering Manual of Instruction, 1620 Data Processing System, Additional Features, Form 227-5513 and CE Reference Manual, 1620 Data Processing System, Additional Features, Form 227-5540 contain information on additional features.



## 8 Test Equipment and Special Tools

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### 8.1 Shipping Group

This list contains special tools and supplies which will be sent with the machine from the factory. These tools will be kept at the installation.

#### 8.1.1 1620 Shipping Group B/M 2128599

	Form #	Part #	Qty.
Parts Catalog	127-0753		1
Reference Manual	227-5500		1
Reference Manual (B1)	223-6652		1
Diagnostic—Console Check		2128300	1
Diagnostic—CU01 Manual Pages		2128301	1
Glide—Frame Leg		2125564	4
Diagnostic—CU01 Program Tape		2128302	2
Diagnostic—CU02 Manual Pages		2128303	1
Diagnostic—CU02 Program Tape		2128304	2
Switch Assembly—CE Remote		2128701	1
Jumper Assembly		2129264	6

#### 8.1.2 1621 Shipping Group B/M 2129499

	Form #	Part #	Qty.
Parts Catalog	127-1754		1
Parts Catalog 1624 (961)	123-7578		1
Reference Manual 1624 (961)	223-6890		1
Tape—Blank Roll Paper		304469	1
Key—Hex Socket Set Screw		2108315	2
Glide Frame Leg		2125564	4
Split Reel		2129572	2
Flange Assembly—Split Reel		2129595	2
Sleeve—Split Reel		2129713	2
Hub Assembly—CRF Conv.		2129738	1

### 8.2 Office Tools

The following tools will normally be located in the branch office and can be obtained when needed.

Meter, Simpson	450597
Meter, 904 Weston, or equivalent (iron vane meter with low range voltage scale)	460880
Scope clip assembly, black	2108156
Scope clip assembly, red	2108157

Scope dual input switch	450934
Scope, 310 Tektronix and accessories	450841
Probe attenuator	450857
Binding post adaptor	
Filter	
Instruction Manual	
Viewing hood	
Test lead, 10' black	450840
Test lead, 10' red	450839
Probe, additional attenuator scope	450857
Probe, direct coaxial scope	461019
Probe tip	450778
Current Probe Adaptor	2108279
Current Probe	2108282
Probe Feed Through Termination	2108281
Wire-Wrap* Pistol Tool	461012
Wrapping Bit Wire Size #24	461009
Sleeve Wire Size #24	461014
Tape Gage	460005
Bare Wire Crimping Tool	450898
#24 gage solid tin copper wire	216226

### 8.3 Tools for SMS Servicing

This list contains the tools and supplies which are not shipped with the machine and should be ordered for each installation.

Un-Wrap Tool	461013
Card Extender—Cable Isolation Tool	451075
sms Card Contact Lubricant	451053
sms Card Insertion—Extraction Tool	451030
Refer to General CEM's for latest information on newly released sms tools and supplies.	

### 8.4 Current Probe

The current probe is used to monitor the input or output of the matrix switches. When probing, orient the probe on the wire so that the core "read" wave shape is positive, and the core "write" wave shape is negative. The vertical deflection of the current wave is read directly as if it were

\*Trademark of the Gardner-Denver Company.

voltage. That is if the scope vertical amplitude is set at 0.1 volt per division a wave deflection of one division is read as 0.1 amp.

The particular wires to be probed may be determined by referring to System Diagram 1.30.01.1 through 1.30.05.1. The following example explains how to locate a pair of wires to be probed:

To probe memory address 12345, refer to the side A table on 1.30.05.1. Locate the address 1XX44. (Only even memory addresses are shown.) This address indicates the matrix switch A output number to be E-5. Refer to this number, E-5, on 1.30.01.1 to find the physical location of the wire. You will see that it is approximately in the center of the matrix switch.

To find the intersecting wire from matrix switch D refer to 1.30.05.1. Locate the number X23XX on the side D table. In the column, matrix switch D outputs opposite X23XX, appears the number, G-8. This number, G-8, on 1.30.03.1 shows the actual position of the wire on matrix switch D.

## 8.5 Wire Wrapping

Tools for wrapping and unwrapping wires from solderless wrapped wire terminations have been made available to the field. Tools necessary for working on the 1620 system are listed under Office Tools in this manual.

Wire-Wrap is a method of making solderless wire connections to terminals. A special Wire-Wrap tool wraps a length of skinned wire tightly around the square corners of a terminal. The resulting connection is one of the most reliable permanent connections available and is readily adaptable to production line manufacturing. Power tools for making Wire-Wrap connections are available as branch office tools to offices having installed systems that use Wire-Wrap terminal connections.

### WIRE-WRAP TOOL

The Wire-Wrap tool is, basically a metal rod containing two holes: a small hole for receiving the skinned wire, and a larger hole for receiving the terminal (Figure 8-1). The metal rod is called the wrapping bit. The skinned wire is placed in the wrapping bit. The bit is placed on the termi-

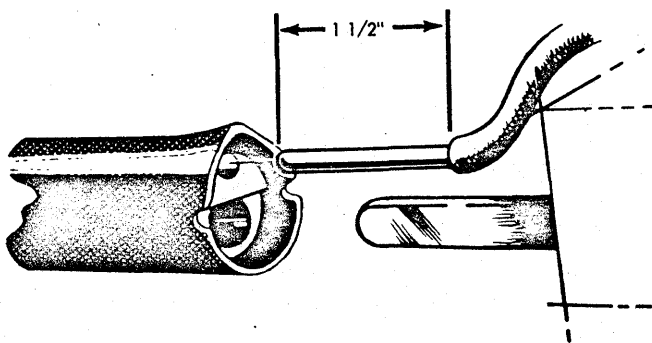


Figure 8-1. End of Wire - Wrap Wrapping Bit

nal and rotated, forming a tightly wrapped coil of wire around the terminal.

The Keller Wire-Wrap tool has an electric motor that drives a wrapping bit. The wrapping bit turns within a sleeve that contains a wire anchoring notch on each side. The notch holds the insulated portion of the lead to prevent the insulation from wrapping around the terminal.

The tool consists of: an electrically operated pistol tool, wrapping bits, and sleeves for the various wire sizes (Figure 8-2). The pistol tool, part #461012, is equipped with a 20 foot, three wire grounding cord.



Figure 8-2. Wire-Wrap Tool

Wrapping bits and sleeves for use with the pistol tool are as follows:

Wire Size	Wrapping Bits		Sleeves	
	IBM P/N	Keller P/N	IBM P/N	Keller P/N
26 Ga.	461008	A-24255	461014	17611-2
24 Ga.	461009	A-17612-2	461014	17611-2
22 Ga.	461010	A-18632	461015	18840
20 Ga.	461011	A-18633	461016	18285

### WIRE-WRAP PROCEDURE

1. Select the bit and sleeve for the wire size to be used.
2. Install bit and sleeve in the nose assembly of the power tool as follows:
  - a. Loosen the collet nut on the nose assembly.
  - b. Insert the wrapping bit into the collet. Rotate the bit while applying slight pressure against the end until it seats itself. NOTE: To remove the bit, reverse this process.
  - c. Place the sleeve over the bit and into the collet. Rotate until sleeve is seated and positioned. With tool running apply slight pressure to the end of the sleeve and tighten collet nut.
3. Skin the wire to desired length. The length of the skinned wire determines the number of turns of wire on the terminal. For example: when using 24 gage wire, about ¼ inch bare wire is required for each turn. Because six turns are required for an acceptable connection, the skinned length should be 1½ inches.
4. Insert the skinned wire into the small hole of the wrapping bit (Figure 8-3a) taking care to insert the wire up to the insulation. Do not bend the skinned portion of the wire, it may be difficult to slide into the bit.

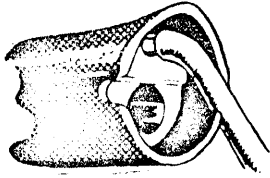


Figure 8-3a. Wire-Wrap Procedure

**WARNING:** If the wire is not inserted in the wrapping bit up to the insulation, a shiner (bare wire between insulation and terminal) may result. There should be  $\frac{1}{4}$  to  $\frac{3}{8}$  of a turn of insulation at the beginning of each wrap.

5. Hold the wire with the fingers and bend the insulated portion of the lead into the retaining notch in the sleeve (Figure 8-3b). Use the right or left notch as determined by the direction of the approach (or exit) of the lead. Place the wrapping bit on the terminal. Be sure the terminal is inserted into the bit as far as it will go. Use reasonable care to hold the tool in line with the terminal.

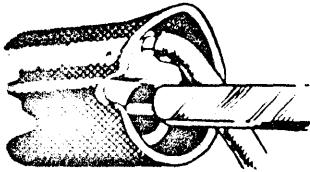


Figure 8-3b. Wire-Wrap Procedure

6. Hold the tool on the terminal and squeeze the trigger to wrap the wire on the terminal. The tool will automatically recede as the wire coils on the terminal. Release trigger and remove tool from terminal. The Wire-Wrap connection is complete (Figure 8-3c).

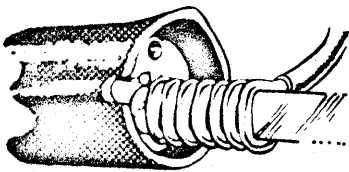


Figure 8-3c. Wire-Wrap Procedure

**NOTE:** If too much pressure is used to push the tool on the terminal, a turn of wire may wrap over a previous turn. If too little pressure is exerted, the adjacent wraps of wire may not touch each other. Maximum separation between individual turns on the terminal must not exceed  $.005''$  excluding the first and last wrap (Figure 8-4).

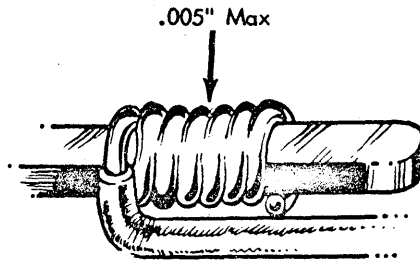


Figure 8-4. Wire-Wrap Connection

#### REMOVAL OF WIRE-WRAP CONNECTIONS

Wires may be removed from a terminal by using hand unwrap tool, part #461013 (Figure 8-5). The open end of the tool is placed over the terminal and rotated to the left screwing the tool under the wraps of wire.

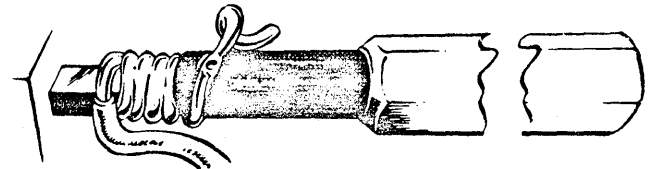


Figure 8-5. Hand Unwrap Tool, P/N 461013

**WARNING:** Once a wire is removed from a terminal, it may not be rewrapped. A new wire must be used or a new section of wire must be spliced to the existing wire. A good quality splice may be made with a butt connector, part #216230 (Figure 8-6). Strip  $\frac{1}{8}$  inch of insulation from wire, insert the wire into the butt connector, and crimp with Bare Wire Crimping Tool, part #450898.

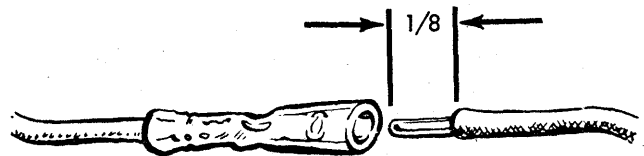


Figure 8-5. Butt Connector, P/N 216230

#### 8.6 Remote Control Box

The remote control box plugs into the CE test panel. It contains five control keys, reset, insert, release, single cycle, and start. These keys perform the same function as their counterparts on the console. The single cycle key causes the system to perform one  $20 \mu\text{sec}$  memory cycle.



