IBM® Field Engineering

Diagram Manual

IBM Confidential

System/360 Model 50

2050 Processing Unit

Z22-2833-4

Fifth Edition (July 1966)

This edition, Form Z22-2833-4, is a major revision of, and obsoletes, Form Z22-2833-3. All IDB's and the CLF's for I-Fetch have been updated to show the latest CAS pages and ROS addresses. The UDC's show additional logic and reference information. IOP pages 201 through 210 have been updated and ROS routines added where applicable.

A new system data flow diagram (SDF 000) shows the following:

1. Major data paths between logical units of the system.
2. Major control lines within the system.
3. Form numbers of manuals related to logical units and control functions within the system.

Changed or new diagrams are indicated by a vertical line in the table of contents and by the symbol • to the left of the diagram title.

Significant changes or additions to the specifications contained in this publication will be reported in subsequent revisions or FE Supplements.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. B96, PO Box 390, Poughkeepsie, N. Y. 12602. A form is provided at the back of this publication for reader's comments. If the form has been removed, comments may be sent to the above address.

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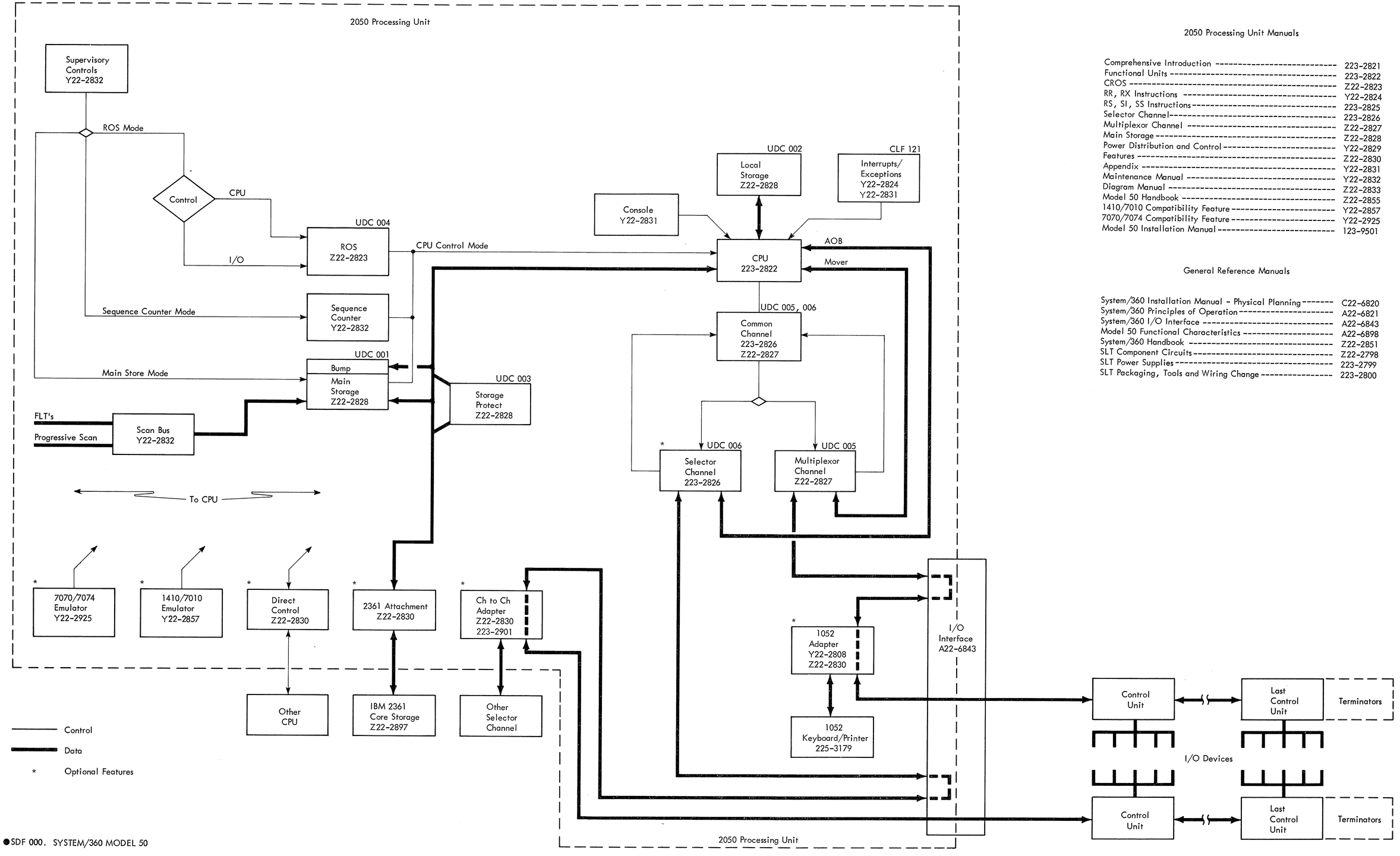

●SDF 000. SYSTEM/360 MODEL 50

2050 Processing Unit Manuals

Comprehensive Introduction	223-2821
Functional Units	223-2822
CROS	Z22-2823
RR, RX Instructions	Y22-2824
RS, SI, SS Instructions	223-2825
Selector Channel	223-2826
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Power Distribution and Control	Y22-2829
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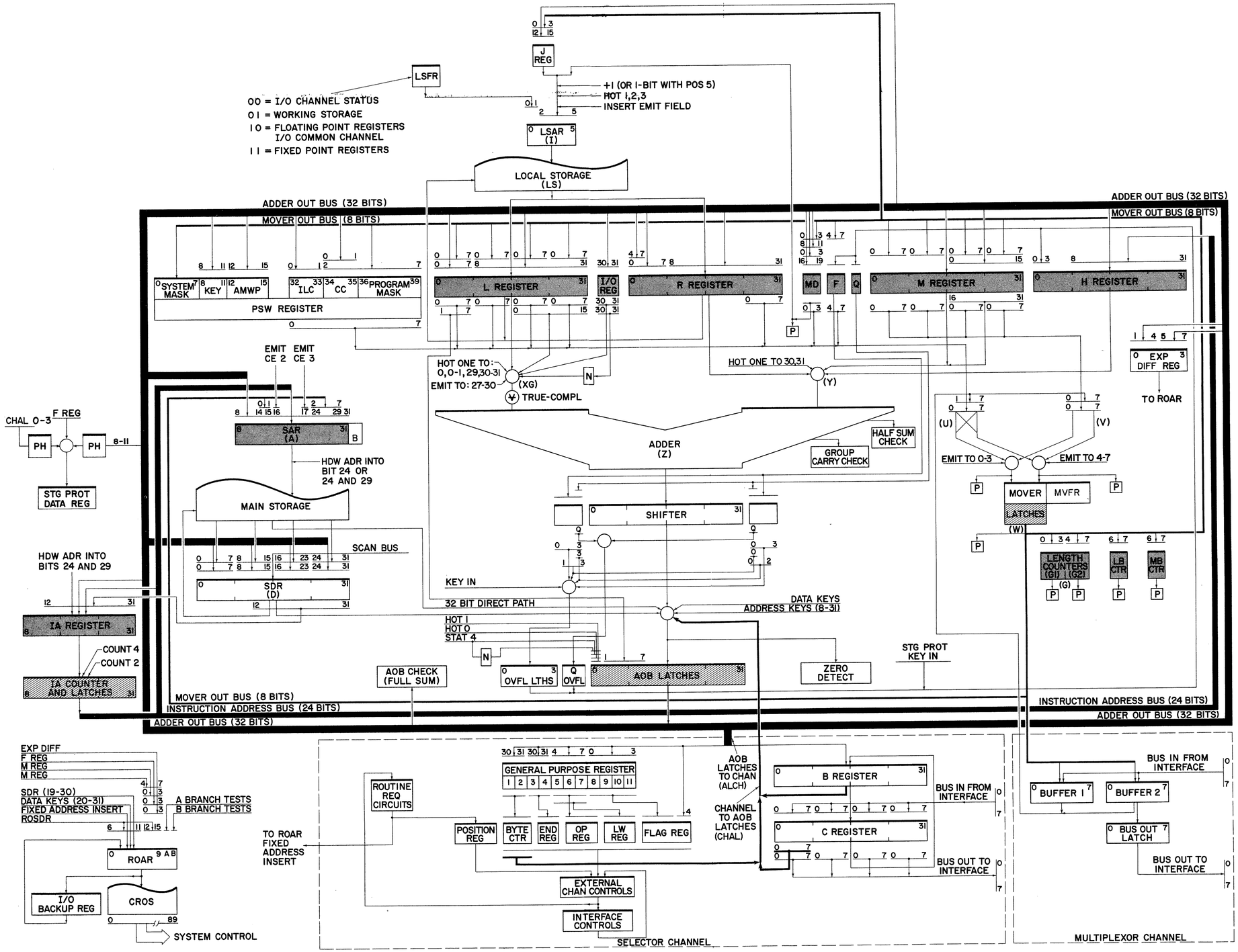
Appendix	Y22-2831
Maintenance Manual	Y22-2832
Diagram Manual	Z22-2833
Model 50 Handbook	Z22-2855
1410/7010 Compatibility Feature	Y22-2857
7070/7074 Compatibility Feature	Y22-2925
Model 50 Installation Manual	123-9501

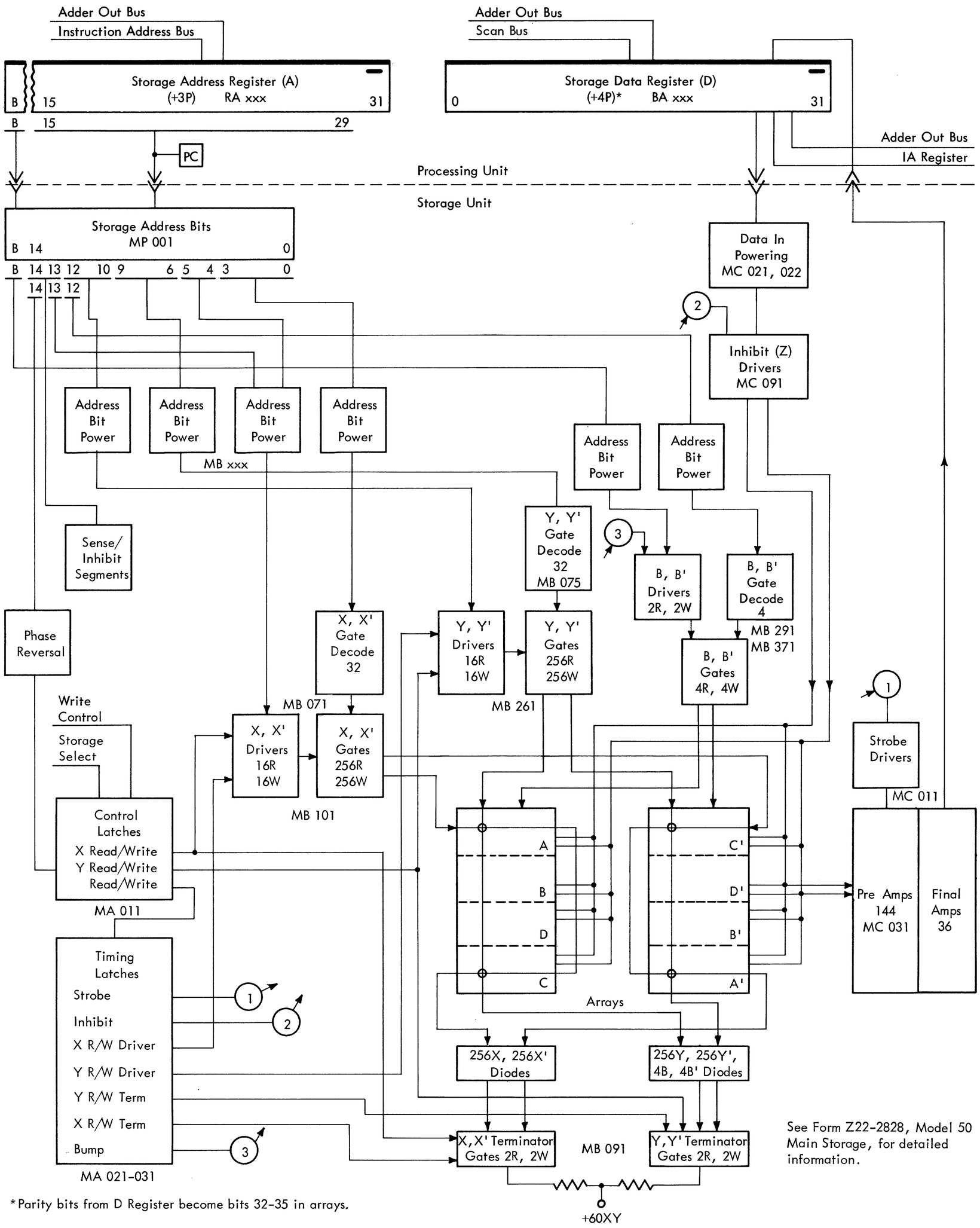
General Reference Manuals

System/360 Installation Manual - Physical Planning	C22-6820
System/360 Principles of Operation	A22-6821
System/360 I/O Interface	A22-6843
Model 50 Functional Characteristics	A22-6898
System/360 Handbook	Z22-2851
SLT Component Circuits	Z22-2798
SLT Power Supplies	223-2799
SLT Packaging, Tools and Wiring Change	223-2800

Form Z22-2833-4
Page Revised 8/1/66
by FES Z22-6600-1



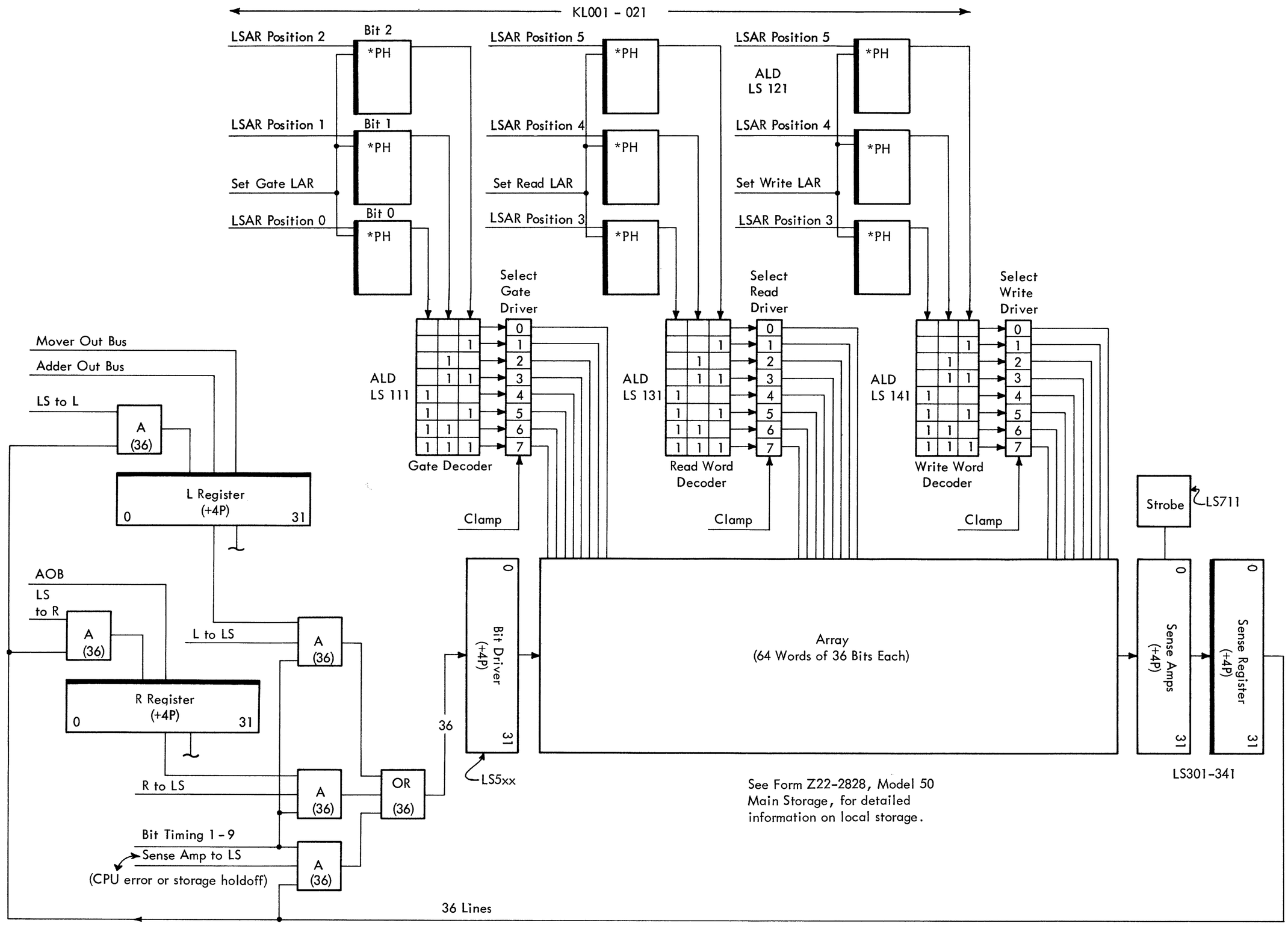
SDF 001. 2050 PROCESSING UNIT DATA FLOW



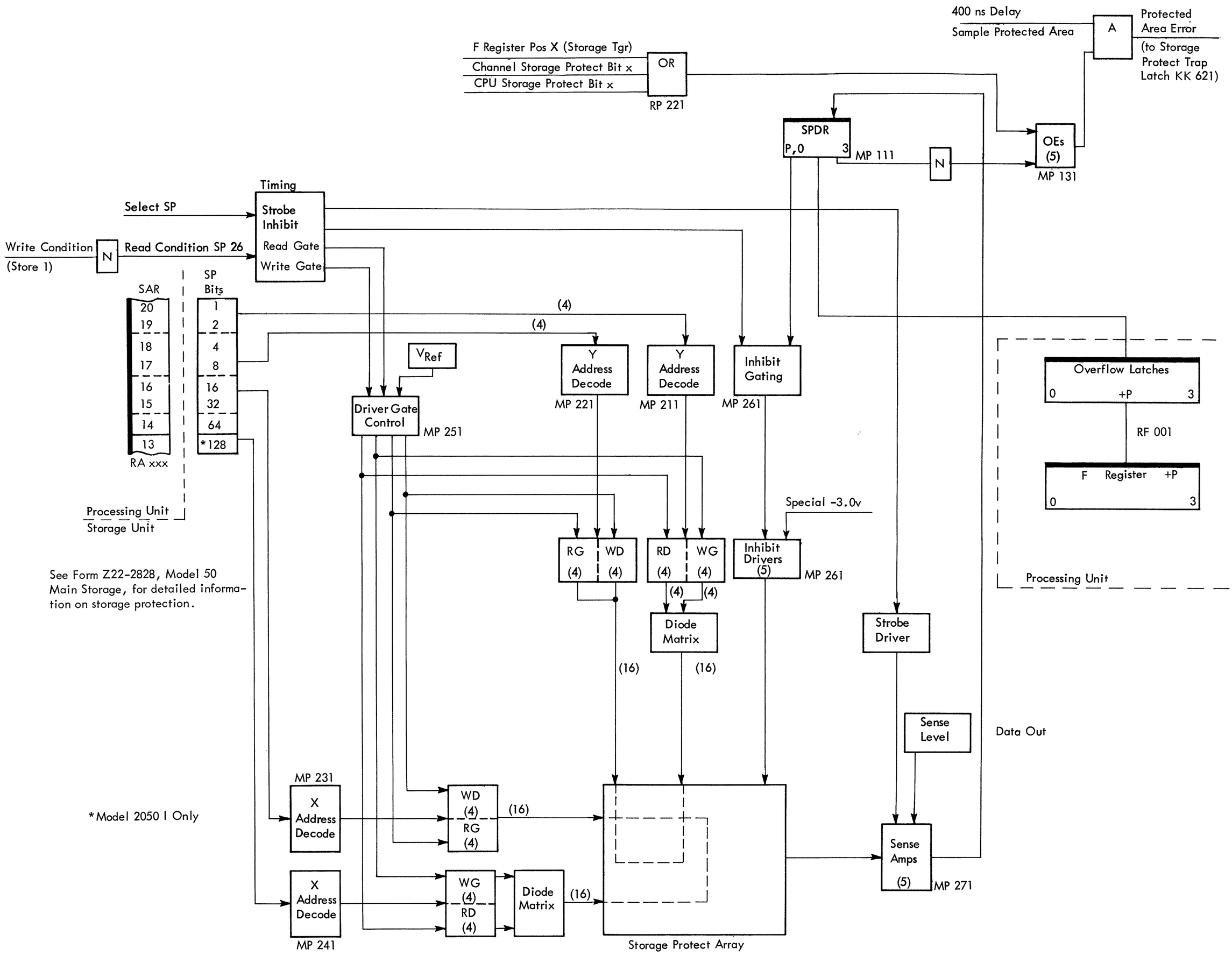
*Parity bits from D Register become bits 32-35 in arrays.

See Form Z22-2828, Model 50 Main Storage, for detailed information.

● UDC 001. MAIN STORAGE

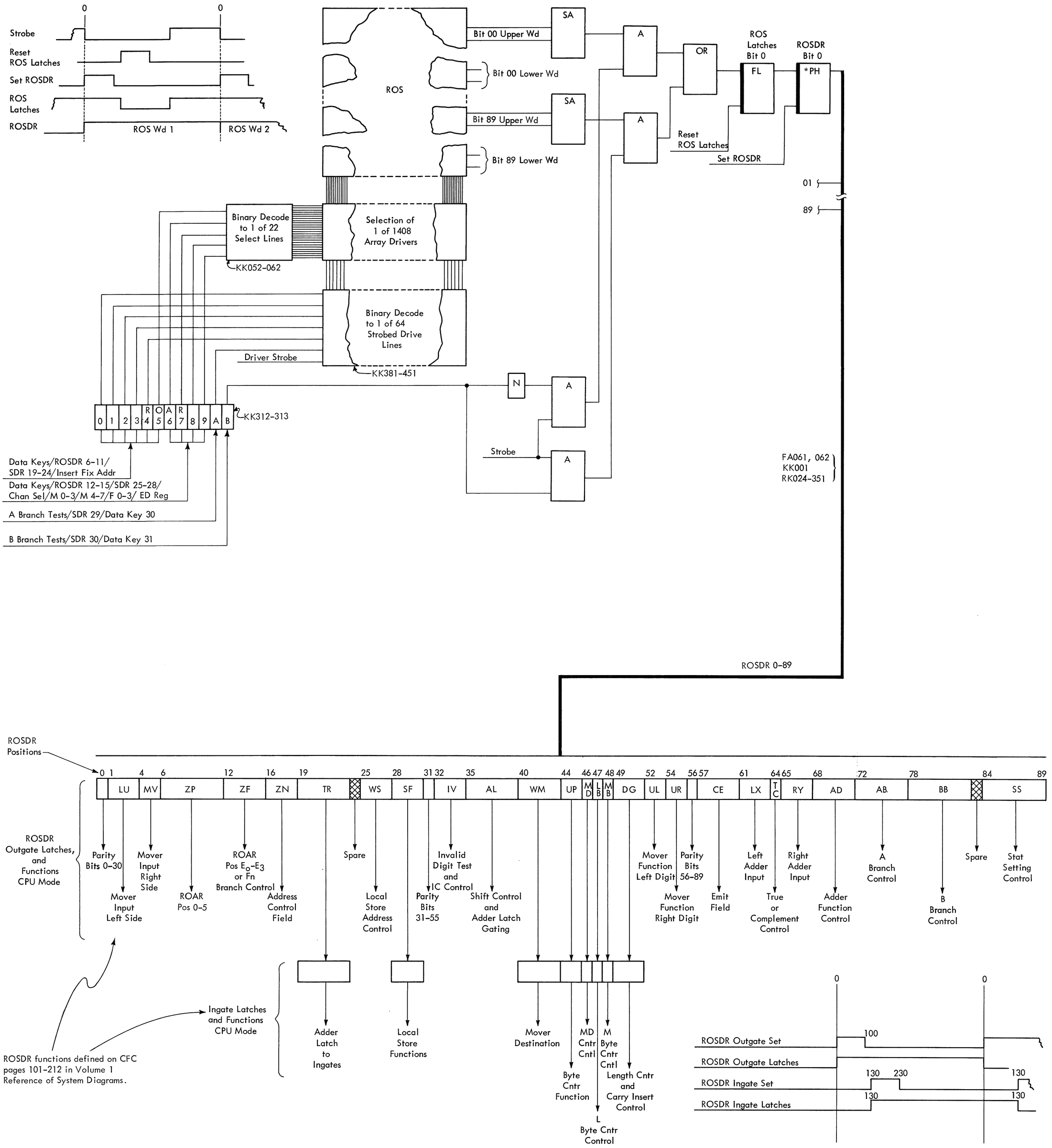


● UDC 002. LOCAL STORAGE

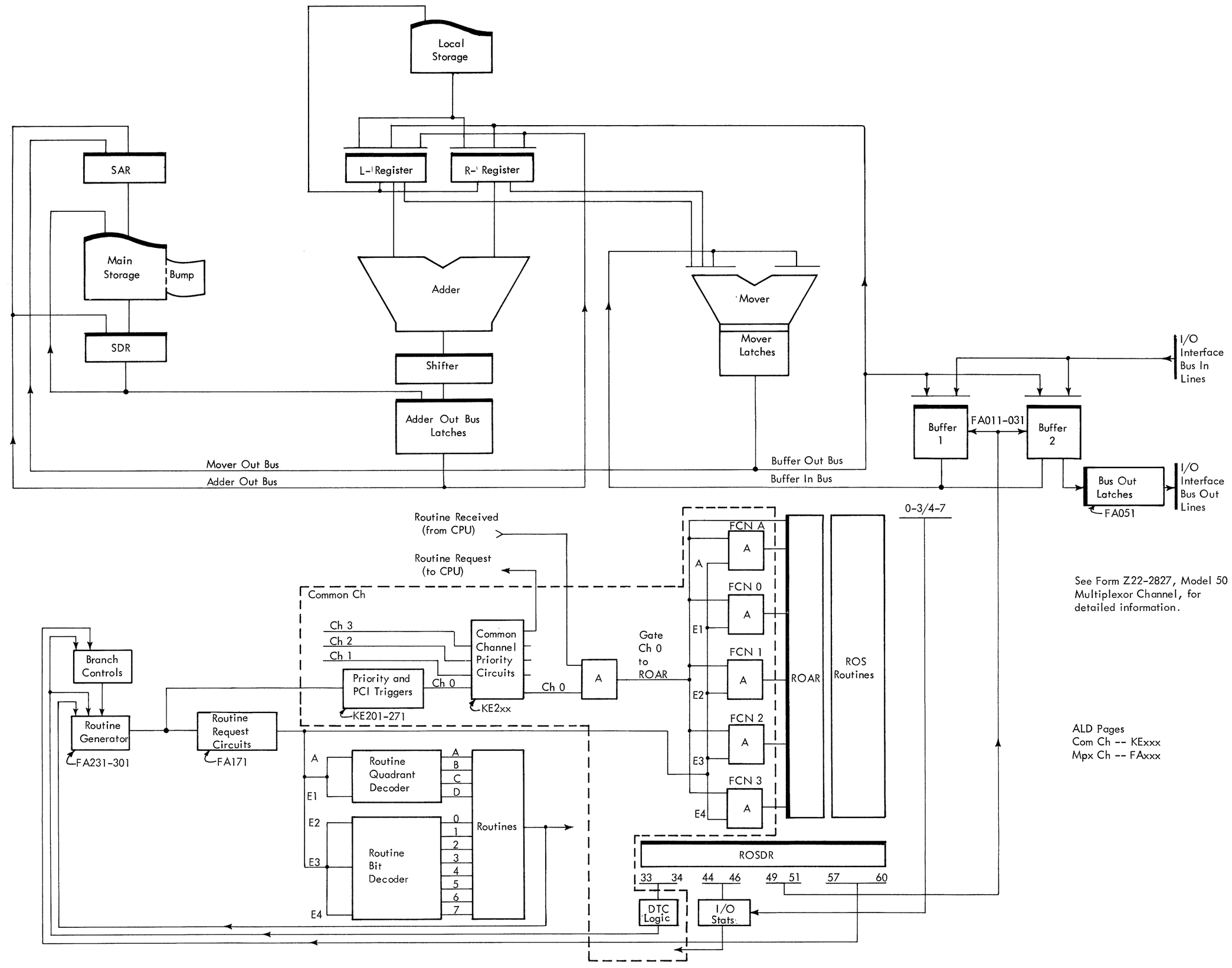


See Form Z22-2828, Model 50 Main Storage, for detailed information on storage protection.

*Model 2050 I Only



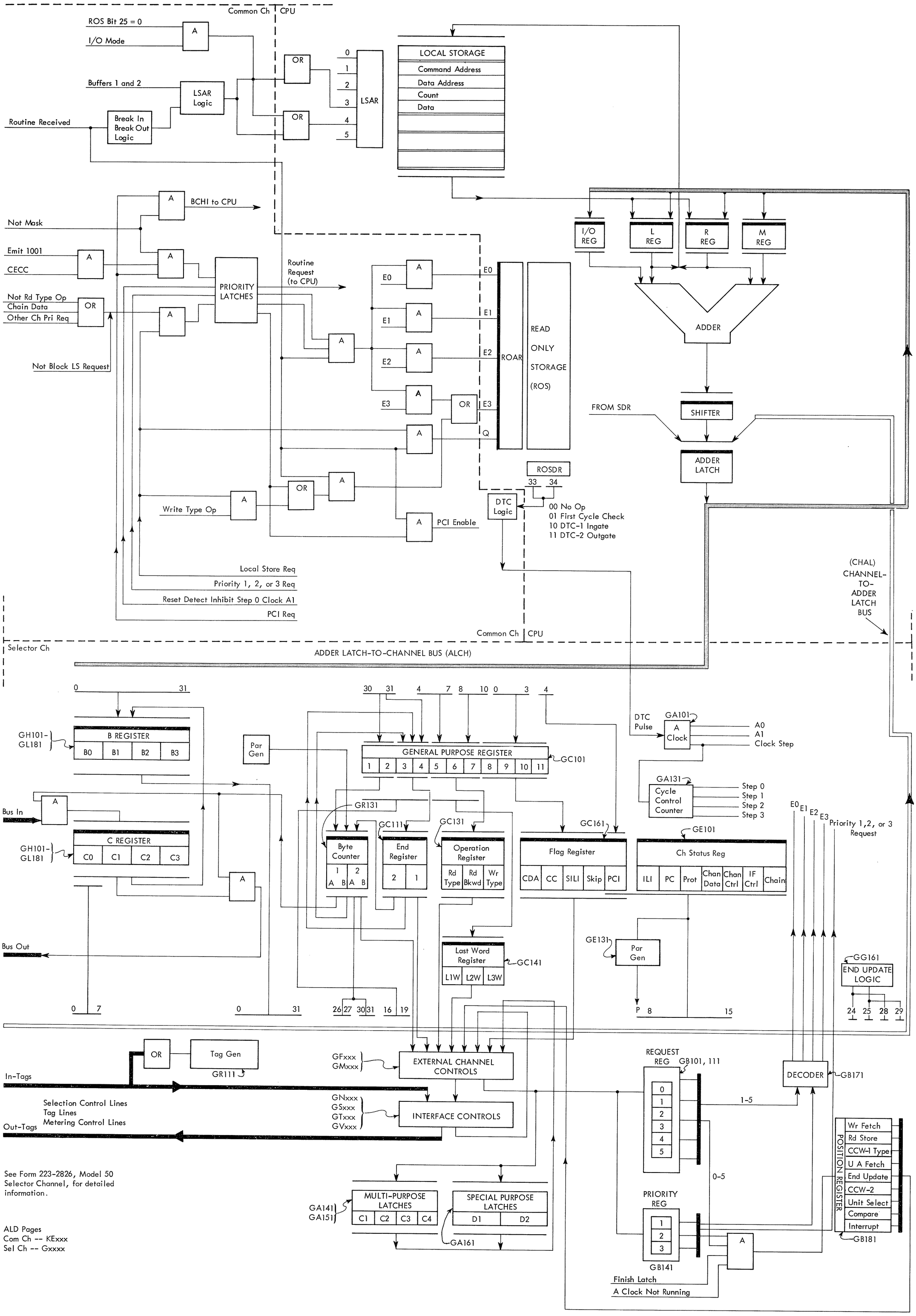
See Form Z22-2823, Model 50 Capacitor Read-Only Storage for detailed information.



See Form Z22-2827, Model 50 Multiplexor Channel, for detailed information.

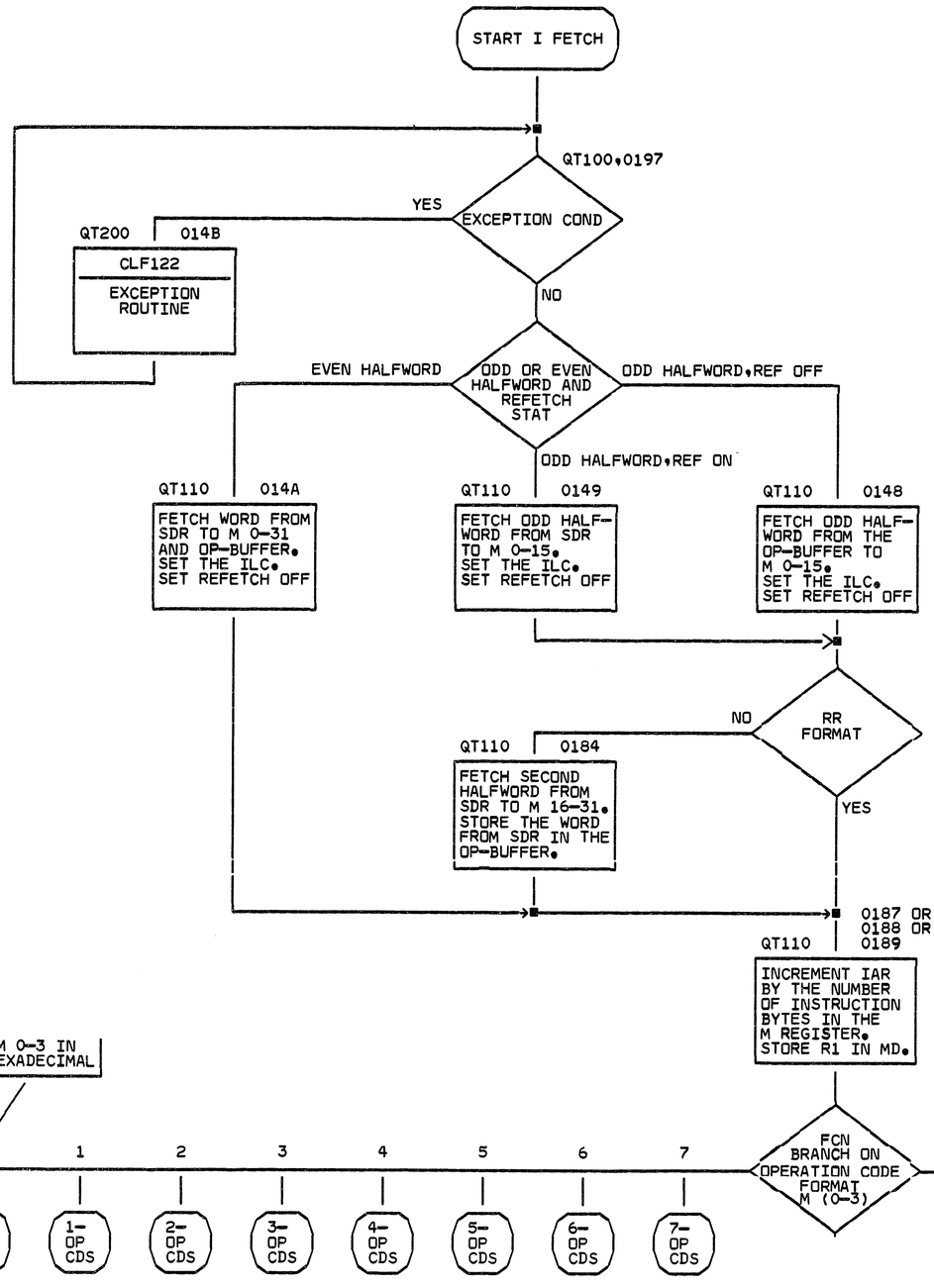
ALD Pages
Com Ch -- KExxx
Mpx Ch -- FAxxx

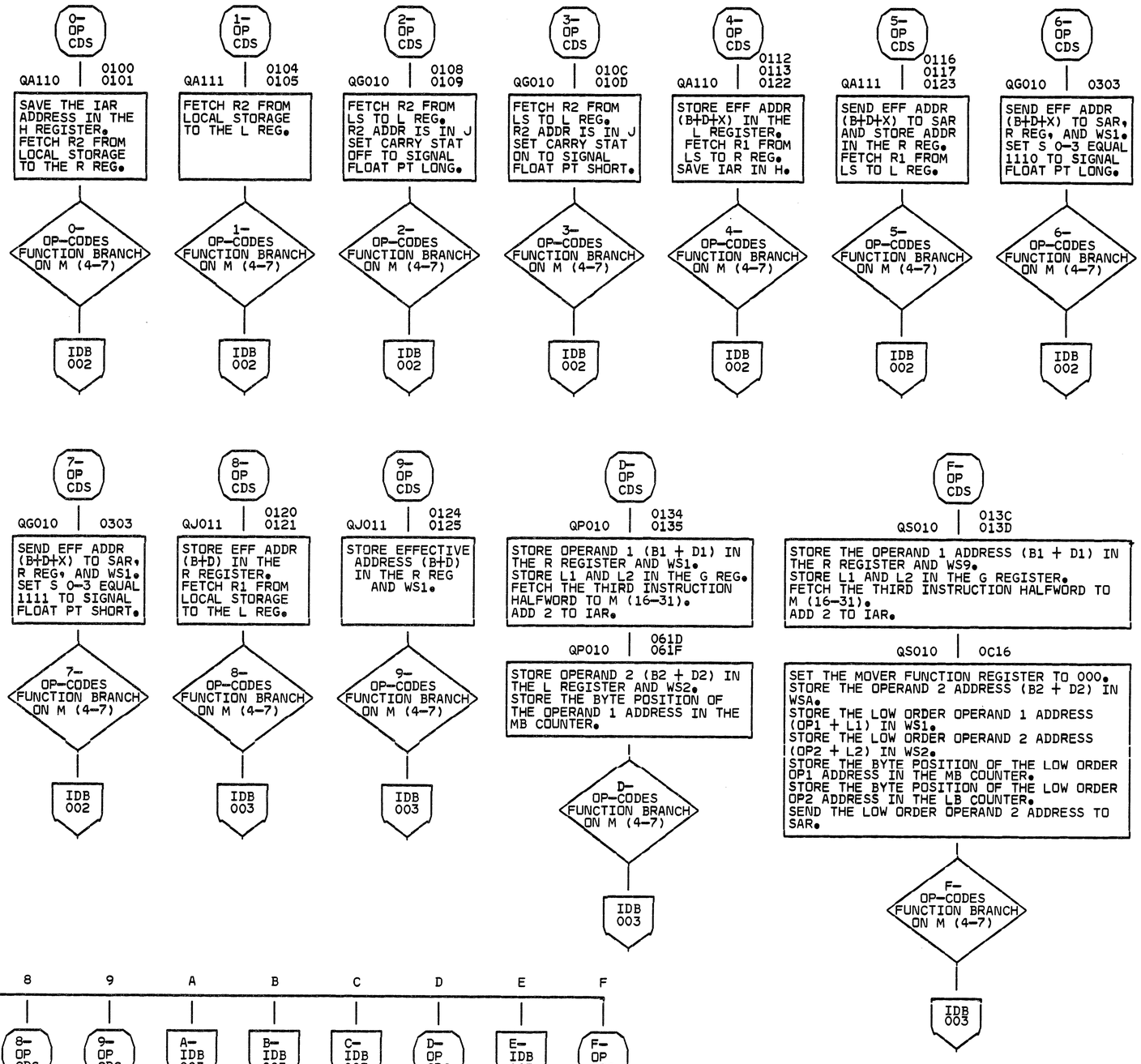
● UDC 005. MULTIPLEXOR CHANNEL



See Form 223-2826, Model 50 Selector Channel, for detailed information.

ALD Pages
Com Ch -- KExxx
Sel Ch -- Gxxxx





IDB 001 I-FETCH
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IDB01

OP CODE IN M 0–7	****0000	****0001	****0010	****0011	****0100	****0101	****0110	****0111	****1000	****1001	****1010	****1011	****1100	****1101	****1110	****1111	TYPE OF OPERATION
	INVALID OP	INVALID OP	INVALID OP	INVALID OP	04 SPM SET PROGRAM MASK	05 BALR BRANCH AND LINK	06 BCTR BRANCH ON COUNT	07 BCR BRANCH ON CONDITION	08 SSK SET STORAGE KEY	09 ISK INSERT STORAGE KEY	0A SVC SUPERVISOR CALL	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	BRANCHING AND STATUS SWITCHING
0000****	0182 QM111 CLF 122	0186 QM111 CLF 122	018A QM111 CLF 122	018E QM111 CLF 122	0192 QA400 CLF 104	0196 QA500 CLF 102	019A QA700 CLF 102	019E QA700 CLF 102	01A2 QA800 CLF 104	01A6 QA800 CLF 104	01AA QA400 CLF 122	01AE QM111 CLF 122	01B2 QM111 CLF 122	01B6 QM111 CLF 122	01BA QM111 CLF 122	01BE QM111 CLF 122	
	10 LPR LOAD POSITIVE	11 LNR LOAD NEGATIVE	12 LTR LOAD AND TEST	13 LCR LOAD COMPLEMENT	14 NR AND	15 CLR COMPARE LOGICAL	16 OR OR	17 XR EXCLUSIVE OR	18 LR LOAD	19 CR COMPARE	1A AR ADD	1B SR SUBTRACT	1C MR MULTIPLY	1D DR DIVIDE	1E ALR ADD LOGICAL	1F SLR SUBTRACT LOGICAL	FIXED POINT FULLWORD AND LOGICAL
0001****	0280 QB100 CLF 110	0284 QB100 CLF 110	0288 QB100 CLF 110	028C QB100 CLF 110	0290 QB400 CLF 104	0294 QB500 CLF 105	0298 QB400 CLF 104	029C QB400 CLF 104	02A0 QB100 CLF 110	02A4 QB500 CLF 105	02A8 QB730 CLF 106	02AC QB730 CLF 106	02B0 QB800 CLF 113	02B4 QB900 CLF 114	02B8 QB750 CLF 105	02BC QB750 CLF 105	
	20 LPDR LOAD POSITIVE	21 LNDR LOAD NEGATIVE	22 LTDR LOAD AND TEST	23 LCDR LOAD COMPLEMENT	24 HDR HALVE	INVALID OP	INVALID OP	INVALID OP	28 LDR LOAD	29 CDR COMPARE	2A ADR ADD NORMALIZED	2B SDR SUBTRACT NORMALIZED	2C MDR MULTIPLY	2D DDR DIVIDE	2E AWR ADD UNNORMALIZED	2F SWR SUBTRACT UNNORMALIZED	FLOATING POINT LONG
0010****	0300 QG100 CLF 108	0304 QG100 CLF 108	0308 QG100 CLF 108	030C QG100 CLF 108	0310 QG200 CLF 107	0314 QM112 CLF 122	0318 QM112 CLF 122	031C QM112 CLF 122	0320 QG300 CLF 107	0324 QG400 CLF 118	0328 QG400 CLF 118	032C QG400 CLF 118	0330 QG700 CLF 119	0334 QG500 CLF 120	0338 QG400 CLF 118	033C QG400 CLF 118	
	30 LPER LOAD POSITIVE	31 LNER LOAD NEGATIVE	32 LTER LOAD AND TEST	33 LCER LOAD COMPLEMENT	34 HER HALVE	INVALID OP	INVALID OP	INVALID OP	38 LER LOAD	39 CER COMPARE	3A AER ADD NORMALIZED	3B SER SUBTRACT NORMALIZED	3C MER MULTIPLY	3D DER DIVIDE	3E AUR ADD UNNORMALIZED	3F SUR SUBTRACT UNNORMALIZED	FLOATING POINT SHORT
0011****	0300 QG100 CLF 108	0304 QG100 CLF 108	0308 QG100 CLF 108	030C QG100 CLF 108	0310 QG200 CLF 107	0314 QM112 CLF 122	0318 QM112 CLF 122	031C QM112 CLF 122	0320 QG300 CLF 107	0324 QG400 CLF 115	0328 QG400 CLF 115	032C QG400 CLF 115	0330 QG700 CLF 116	0334 QG500 CLF 117	0338 QG400 CLF 115	033C QG400 CLF 115	
	40 STH STORE HALFWORD	41 LA LOAD ADDRESS	42 STC STORE CHARACTER	43 IC INSERT CHARACTER	44 EX EXECUTE	45 BAL BRANCH AND LINK	46 BCT BRANCH ON COUNT	47 BC BRANCH ON CONDITION	48 LH LOAD HALFWORD	49 CH COMPARE HALFWORD	4A AH ADD HALFWORD	4B SH SUBTRACT HALFWORD	4C MH MULTIPLY HALFWORD	INVALID OP	4E CVD CONVERT TO DECIMAL	4F CVB CONVERT TO BINARY	FIXED POINT HALFWORD AND BRANCHING
0100****	0700 QE555 CLF 109	0704 QE100 CLF 109	0708 QE100 CLF 109	070C QE100 CLF 109	0710 QE400 CLF 103	0714 QA500 CLF 102	0718 QA700 CLF 102	071C QA700 CLF 102	0720 QE580 CLF 106	0724 QE580 CLF 106	0728 QE580 CLF 106	072C QE580 CLF 106	0730 QE580 CLF 113	0734 QM112 CLF 122	0738 QE800 CLF 111	073C QE900 CLF 112	
	50 ST STORE	INVALID OP	INVALID OP	INVALID OP	54 N AND	55 CL COMPARE LOGICAL	56 O OR	57 X EXCLUSIVE OR	58 L LOAD	59 C COMPARE	5A A ADD	5B S SUBTRACT	5C M MULTIPLY	5D D DIVIDE	5E AL ADD LOGICAL	5F SL SUBTRACT LOGICAL	FIXED POINT FULLWORD AND LOGICAL
0101****	0281 QF100 CLF 109	0285 QM112 CLF 122	0289 QM112 CLF 122	028D QM112 CLF 122	0291 QB400 CLF 104	0295 QB500 CLF 105	0299 QB400 CLF 104	029D QB400 CLF 104	02A1 QF100 CLF 109	02A5 QB500 CLF 105	02A9 QB730 CLF 106	02AD QB730 CLF 106	02B1 QB800 CLF 113	02B5 QB900 CLF 114	02B9 QB750 CLF 105	02BD QB750 CLF 105	
	60 STD STORE	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	68 LD LOAD	69 CD COMPARE	6A AD ADD NORMALIZED	6B SD SUBTRACT NORMALIZED	6C MD MULTIPLY	6D DD DIVIDE	6E AW ADD UNNORMALIZED	6F SW SUBTRACT UNNORMALIZED	FLOATING POINT LONG
0110****	0302 QG300 CLF 107	0306 QM111 CLF 122	030A QM111 CLF 122	030E QM111 CLF 122	0312 QM111 CLF 122	0316 QM111 CLF 122	031A QM111 CLF 122	031E QM111 CLF 122	0322 QG300 CLF 107	0326 QG400 CLF 118	032A QG400 CLF 118	032E QG400 CLF 118	0332 QG700 CLF 119	0336 QG500 CLF 120	033A QG400 CLF 118	033E QG400 CLF 118	
	70 STE STORE	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	INVALID OP	78 LE LOAD	79 CE COMPARE	7A AE ADD NORMALIZED	7B SE SUBTRACT NORMALIZED	7C ME MULTIPLY	7D DE DIVIDE	7E AU ADD UNNORMALIZED	7F SU SUBTRACT UNNORMALIZED	FLOATING POINT SHORT
0111****	0302 QG300 CLF 107	0306 QM111 CLF 122	030A QM111 CLF 122	030E QM111 CLF 122	0312 QM111 CLF 122	0316 QM111 CLF 122	031A QM111 CLF 122	031E QM111 CLF 122	0322 QG300 CLF 107	0326 QG400 CLF 115	032A QG400 CLF 115	032E QG400 CLF 115	0332 QG700 CLF 116	0336 QG500 CLF 117	033A QG400 CLF 115	033E QG400 CLF 115	

RR FORMAT

RX FORMAT

RR/RX OPERATION CODES
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RS/SI FORMAT	****0000	****0001	****0010	****0011	***0100	****0101	****0110	****0111	****1000	****1001	****1010	****1011	****1100	****1101	****1110	****1111	
1000****	80 SSM SET SYSTEM MASK 0702 QJ200 CLF 209	INVALID OP 0706 QM111 CLF 122	82 LPSW LOAD PSW 070A QJ200 CLF 210	83 DIAG DIAGNOSE 070E QY110 CLF 213	84 WRD WRITE DIRECT 0712 QJ400 CLF 211	85 RDD READ DIRECT 0716 QJ400 CLF 212	86 BXH BRANCH ON INDEX HIGH 071A QJ600 CLF 214	87 BXLE BRANCH ON INDEX LOW OR EQUAL 071E QJ600 CLF 214	88 SRL SHIFT RIGHT SINGLE – LOGICAL 0722 QJ080 CLF 201	89 SLL SHIFT LEFT SINGLE – LOGICAL 0726 QJ090 CLF 202	8A SRA SHIFT RIGHT SINGLE 072A QJ100 CLF 203	8B SLA SHIFT LEFT SINGLE 072E QJ110 CLF 204	8C SRDL SHIFT RIGHT DOUBLE – LOGICAL 0732 QJ120 CLF 205	8D SLDL SHIFT LEFT DOUBLE – LOGICAL 0736 QJ130 CLF 206	8E SRDA SHIFT RIGHT DOUBLE 073A QJ140 CLF 207	8F SLDA SHIFT LEFT DOUBLE 073E QJ150 CLF 208	BRANCHING, STATUS SWITCHING, AND SHIFTING
1001****	90 STM STORE MULTIPLE 0902 QK666 CLF 224	91 TM TEST UNDER MASK 0906 QK555 CLF 222	92 MVI MOVE 090A QK222 CLF 220	93 TS TEST AND SET 090E QK300 CLF 220	94 NI AND 0912 QK222 CLF 220	95 CLI COMPARE LOGICAL 0916 QK555 CLF 223	96 OI OR 091A QK222 CLF 220	97 XI EXCLUSIVE OR 091E QK222 CLF 220	98 LM LOAD MULTIPLE 0922 QK666 CLF 224	INVALID OP 0926 QM111 CLF 122	INVALID OP 092A QM111 CLF 122	INVALID OP 092E QM111 CLF 122	9C SIO START I O 0932 QK700 CLF 225	9D TIO TEST I O 0936 QK700 CLF 225	9E HIO HALT I O 093A QK700 CLF 225	9F TCH TEST CHANNEL 093E QK700 CLF 225	FIXED POINT LOGICAL AND I/O
1010****	INVALID FORMAT 0128 OR 0129 QN111 CLF 122	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	
1011****	INVALID FORMAT 012C OR 012D QN111 CLF 122	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	
1100****	INVALID FORMAT 0130 OR 0131 QN111 CLF 122	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	
1101****	INVALID OP 0600 QM112 CLF 122	D1 MVN MOVE NUMERIC 0604 QP800 CLF 232	D2 MVC MOVE 0608 QP800 CLF 232	D3 MVZ MOVE ZONE 060C QP800 CLF 232	D4 NC AND 0610 QP800 CLF 232	D5 CLC COMPARE LOGICAL 0614 QP100 CLF 230	D6 OC OR 0618 QP800 CLF 232	D7 XC EXCLUSIVE OR 061C QP800 CLF 232	INVALID OP 0620 QM112 CLF 122	INVALID OP 0624 QM112 CLF 122	INVALID OP 0628 QM112 CLF 122	INVALID OP 062C QM112 CLF 122	DC TR TRANSLATE 0630 QP900 CLF 233	DD TRT TRANSLATE AND TEST 0634 QP900 CLF 233	DE ED EDIT 0638 QP200 CLF 231	DF EDMK EDIT AND MARK 063C QP200 CLF 231	LOGICAL AND VFL
1110****	INVALID FORMAT 0138 OR 0139 QN111 CLF 122	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	▬▬▬▬▬▬▬▬	
1111****	INVALID OP 0C00 QM111 CLF 122	F1 MVO MOVE WITH OFFSET 0C04 QS502 CLF 244	F2 PACK PACK 0C08 QS500 CLF 243	F3 UNPK UNPACK 0C0C QS600 CLF 245	INVALID OP 0C10 QM111 CLF 122	INVALID OP 0C14 QM111 CLF 122	INVALID OP 0C18 QM111 CLF 122	INVALID OP 0C1C QM111 CLF 122	F8 ZAP ZERO AND ADD 0C20 QS705 CLF 246	F9 CP COMPARE DECIMAL 0C24 QS200 CLF 241	FA AP ADD DECIMAL 0C28 QS110 CLF 240	FB SP SUBTRACT DECIMAL 0C2C QS110 CLF 240	FC MP MULTIPLY DECIMAL 0C30 QS400 CLF 242	FD DP DIVIDE DECIMAL 0C34 QS400 CLF 242	INVALID OP 0C38 QM111 CLF 122	INVALID OP 0C3C QM111 CLF 122	DECIMAL

SS FORMAT

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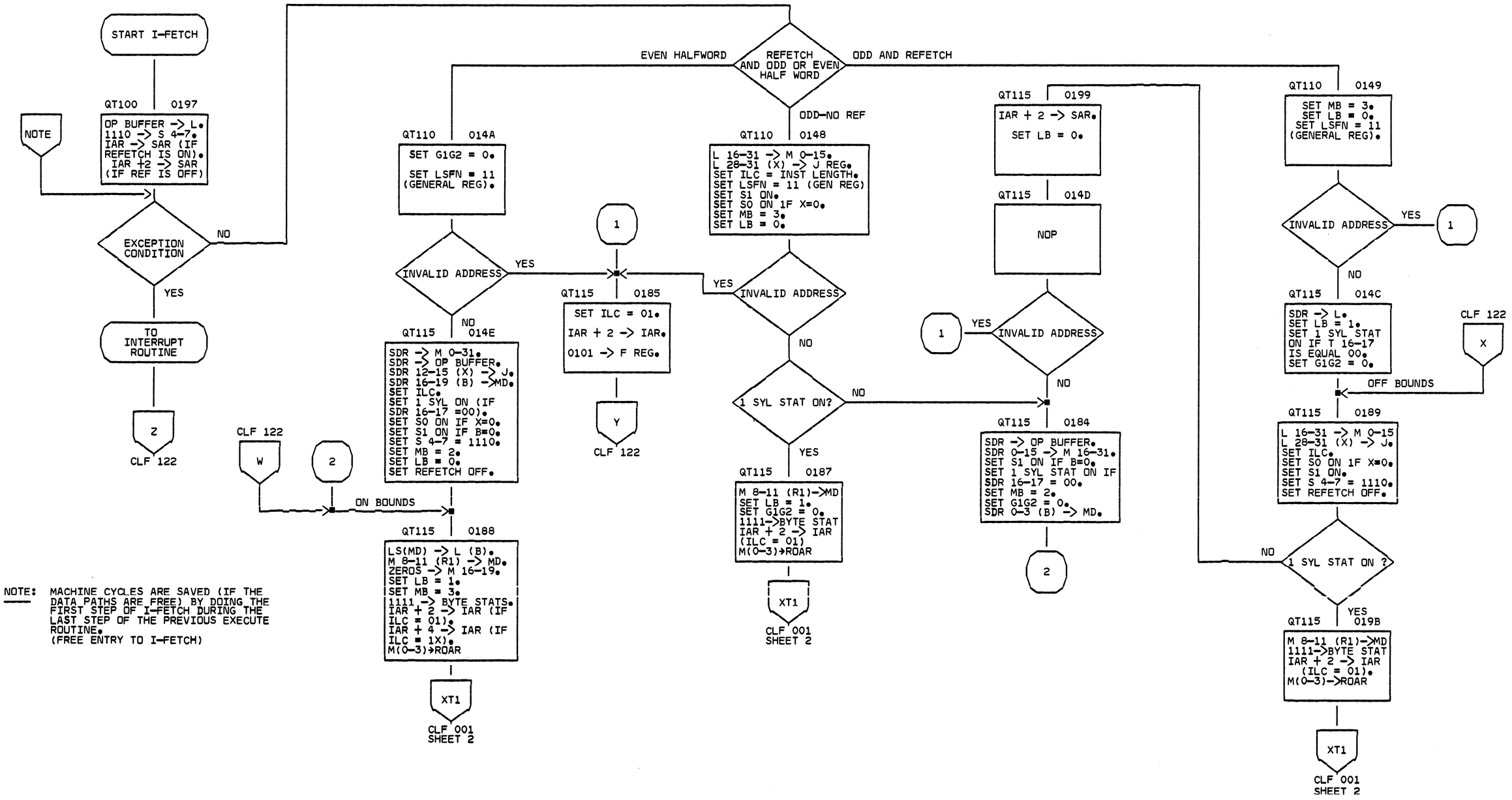

NOTE: MACHINE CYCLES ARE SAVED (IF THE DATA PATHS ARE FREE) BY DOING THE FIRST STEP OF I-FETCH DURING THE LAST STEP OF THE PREVIOUS EXECUTE ROUTINE.
(FREE ENTRY TO I-FETCH)

FIRST LEVEL I-FETCH
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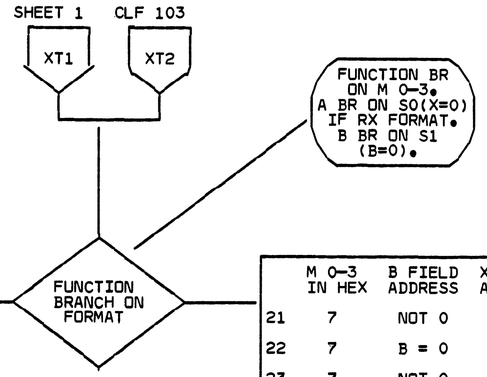
CLF01



	M 0-3 IN HEX	B FIELD ADDRESS	X FIELD ADDRESS	BRANCH ADDRESS	INSTRUCTION FORMAT
1	0	NOT 0	—	0100	RR BRANCHING AND STATUS SWITCHING
2	0	B = 0	—	0101	RR BRANCHING AND STATUS SWITCHING
3	1	NOT 0	—	0104	RR FIXED POINT FULLWORD AND LOGICAL
4	1	B = 0	—	0105	RR FIXED POINT FULLWORD AND LOGICAL
5	2	NOT 0	—	0108	RR FLOATING POINT LONG
6	2	B = 0	—	0109	RR FLOATING POINT LONG
7	3	NOT 0	—	010C	RR FLOATING POINT SHORT
8	3	B = 0	—	010D	RR FLOATING POINT SHORT
9	4	NOT 0	NOT 0	0110	RX FIXED POINT HALFWORD AND BRANCHING
10	4	B = 0	NOT 0	0111	RX FIXED POINT HALFWORD AND BRANCHING
11	4	NOT 0	X = 0	0112	RX FIXED POINT HALFWORD AND BRANCHING
12	4	B = 0	X = 0	0113	RX FIXED POINT HALFWORD AND BRANCHING
13	5	NOT 0	NOT 0	0114	RX FIXED POINT FULLWORD AND LOGICAL
14	5	B = 0	NOT 0	0115	RX FIXED POINT FULLWORD AND LOGICAL
15	5	NOT 0	X = 0	0116	RX FIXED POINT FULLWORD AND LOGICAL
16	5	B = 0	X = 0	0117	RX FIXED POINT FULLWORD AND LOGICAL
17	6	NOT 0	NOT 0	0118	RX FLOATING POINT LONG
18	6	B = 0	NOT 0	0119	RX FLOATING POINT LONG
19	6	NOT 0	X = 0	011A	RX FLOATING POINT LONG
20	6	B = 0	X = 0	011B	RX FLOATING POINT LONG

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

T01 T11 T21 T31 T41 T45 T51 T55 T61 T65
002 003 004 004 005 005 006 006 007 007

T00 T10 T20 T30 T40 T44 T50 T54 T60 T64
002 003 004 004 005 005 006 006 007 007

CLF PAGES

	M 0-3 IN HEX	B FIELD ADDRESS	X FIELD ADDRESS	BRANCH ADDRESS	INSTRUCTION FORMAT
21	7	NOT 0	NOT 0	011C	RX FLOATING POINT SHORT
22	7	B = 0	NOT 0	011D	RX FLOATING POINT SHORT
23	7	NOT 0	X = 0	011E	RX FLOATING POINT SHORT
24	7	B = 0	X = 0	011F	RX FLOATING POINT SHORT
25	8	NOT 0	—	0120	RS SI BRANCHING, STATUS SWITCHING, AND SHIFTING
26	8	B = 0	—	0121	RS SI BRANCHING, STATUS SWITCHING, AND SHIFTING
27	9	NOT 0	—	0124	RS SI FIXED POINT LOGICAL AND I O
28	9	B = 0	—	0125	RS SI FIXED POINT LOGICAL AND I O
29	A	NOT 0	—	0128	INVALID FORMAT
30	A	B = 0	—	0129	INVALID FORMAT
31	B	NOT 0	—	012C	INVALID FORMAT
32	B	B = 0	—	012D	INVALID FORMAT
33	C	NOT 0	—	0130	INVALID FORMAT
34	C	B = 0	—	0131	INVALID FORMAT
35	D	NOT 0	—	0134	SS LOGICAL
36	D	B = 0	—	0135	SS LOGICAL
37	E	NOT 0	—	0138	INVALID FORMAT
38	E	B = 0	—	0139	INVALID FORMAT
39	F	NOT 0	—	013C	SS DECIMAL
40	F	B = 0	—	013D	SS DECIMAL

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

T71 T75 T81 T91 TA1 TB1 TC1 TD1 TE1 TF1
007 007 008 009 012 012 012 010 012 011

T70 T74 T80 T90 TA0 TB0 TC0 TD0 TE0 TF0
007 007 008 009 012 012 012 010 012 011

CLF PAGES

FIRST LEVEL I-FETCH
DATE 3 JUN 66 MACH. 2050
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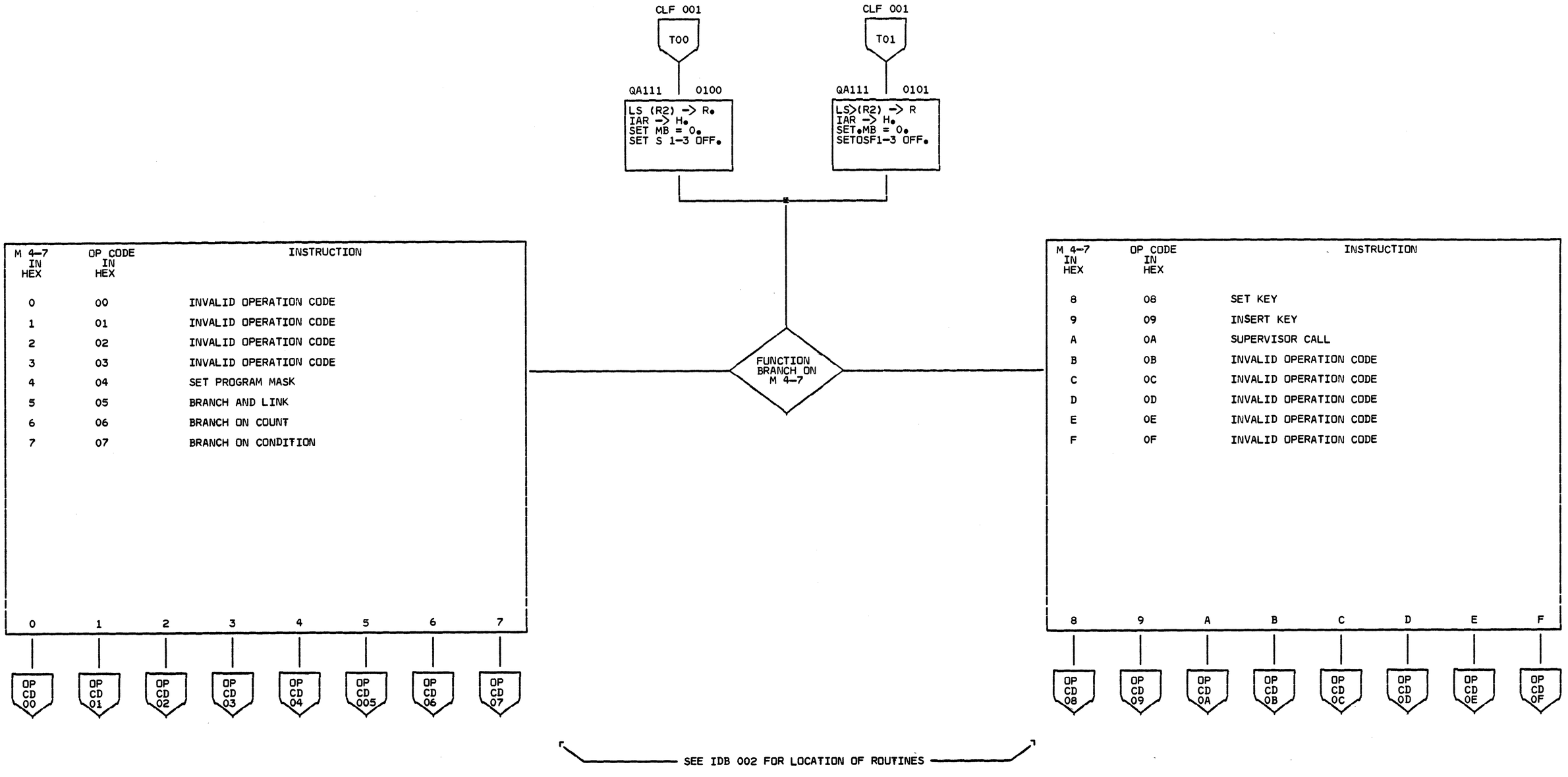
CLF01

●CLF 001 FIRST LEVEL I-FETCH (SHEET 2 OF 2)



SEE IDB 002 FOR LOCATION OF ROUTINES

CLF002
DATE 27 MAY 66 MACH. 2050
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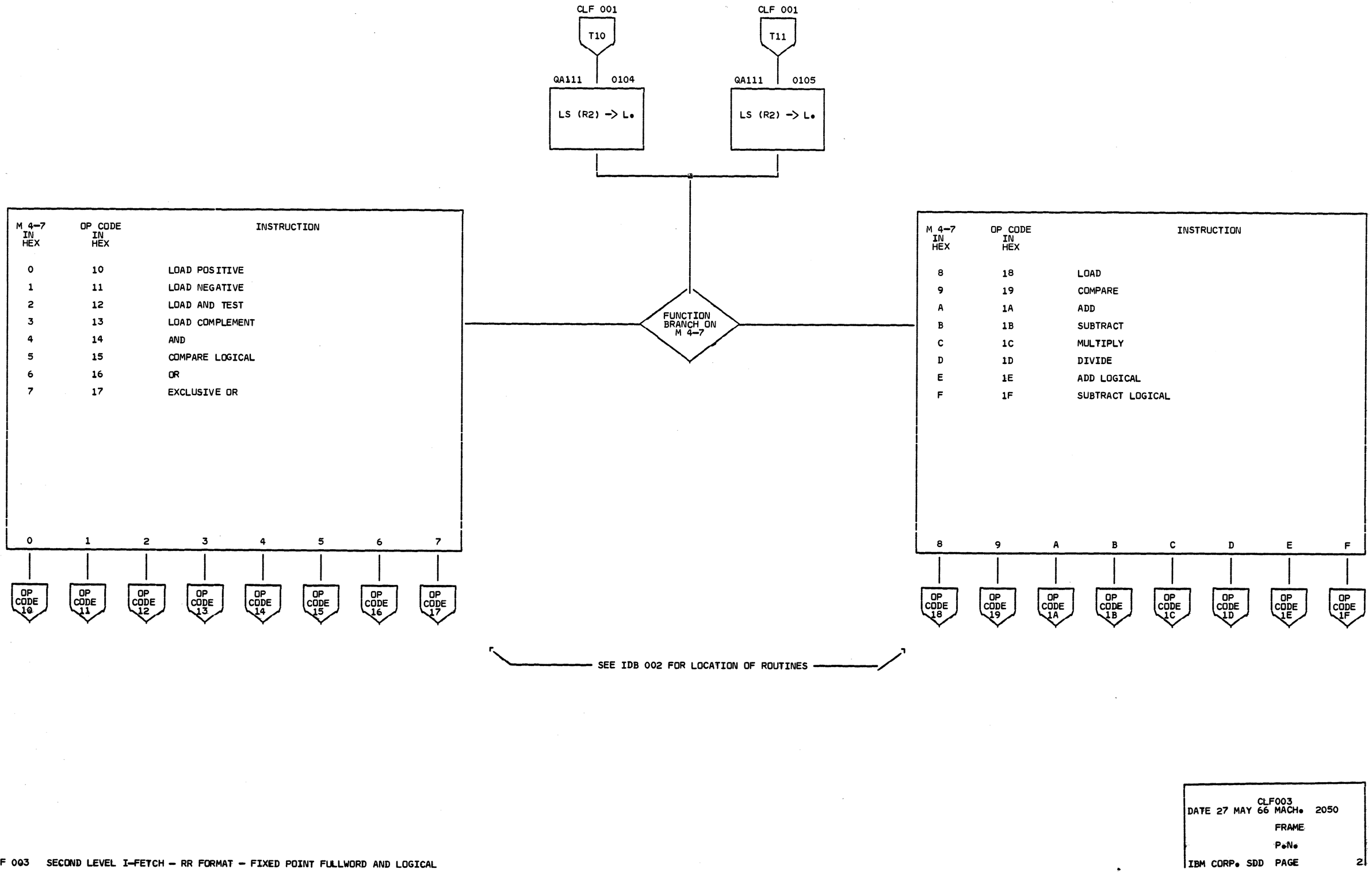
CLF02



SEE IDB 002 FOR LOCATION OF ROUTINES

CLF003
DATE 27 MAY 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CLF03

CLF 001 T20 — QG010 0108

LS (R2) -> L.
10 -> LSFN (FR)
0'S -> F.R REGS
SET CARRY STAT
OFF TO SIGNAL
FLOAT PT LONG.

CLF 001 T21 — QG010 0109

LS (R2) -> L.
10 -> LSFN (FR)
0'S -> F.R REGS
SET CARRY STAT
OFF TO SIGNAL
FLOAT PT LONG.

CLF 001 T30 — QG010 010C

LS (R2) -> L.
10 -> LSFN (FR)
0'S -> F.R REGS
SET CARRY STAT
OFF TO SIGNAL
FLOAT PT LONG.

CLF 001 T31 — QG010 010D

LS (R2) -> L.
10 -> LSFN (FR)
0'S -> F.R REGS
SET CARRY STAT
OFF TO SIGNAL
FLOAT PT LONG.

FUNCTION BRANCH ON M 4-7

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	20	LOAD POSITIVE - FLOATING POINT LONG
	30	LOAD POSITIVE - FLOATING POINT SHORT
1	21	LOAD NEGATIVE - FLOATING POINT LONG
	31	LOAD NEGATIVE - FLOATING POINT SHORT
2	22	LOAD AND TEST - FLOATING POINT LONG
	32	LOAD AND TEST - FLOATING POINT SHORT
3	23	LOAD COMPLEMENT - FLOATING POINT LONG
	33	LOAD COMPLEMENT - FLOATING POINT SHORT
4	24	HALVE - FLOATING POINT LONG
	34	HALVE - FLOATING POINT SHORT
5	25	INVALID
	35	INVALID
6	26	INVALID
	36	INVALID
7	27	INVALID
	37	INVALID

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	28	LOAD - FLOATING POINT LONG
	38	LOAD - FLOATING POINT SHORT
9	29	COMPARE - FLOATING POINT LONG
	39	COMPARE - FLOATING POINT SHORT
A	2A	ADD NORMALIZED - FLOATING POINT LONG
	3A	ADD NORMALIZED - FLOATING POINT SHORT
B	2B	SUBTRACT NORMALIZED - FLOATING POINT LONG
	3B	SUBTRACT NORMALIZED - FLOATING POINT SHORT
C	2C	MULTIPLY - FLOATING POINT LONG
	3C	MULTIPLY - FLOATING POINT SHORT
D	2D	DIVIDE - FLOATING POINT LONG
	3D	
E	2E	ADD UNNORMALIZED - FLOATING POINT LONG
	3E	ADD UNNORMALIZED - FLOATING POINT SHORT
F	2F	SUBTRACT UNNORMALIZED - FLOATING POINT LONG
	3F	SUBTRACT UNNORMALIZED - FLOATING POINT SHORT
		DIVIDE - FLOATING POINT SHORT

0 1 2 3 4 5 6

OP CD 20 30 | OP CD 21 31 | OP CD 22 32 | OP CD 23 33 | OP CD 24 34 | OP CD 25 35 | OP CD 26 36 | OP CD 27 37

8 9 A B C D E F

OP CD 28 38 | OP CD 29 39 | OP CD 2A 3A | OP CD 2B 3B | OP CD 2C 3C | OP CD 2D 3D | OP CD 2E 3E | OP CD 2F 3F

SEE IDB 002 FOR LOCATION OF ROUTINES

CLF004
DATE 27 MAY 66 MACH. 2050
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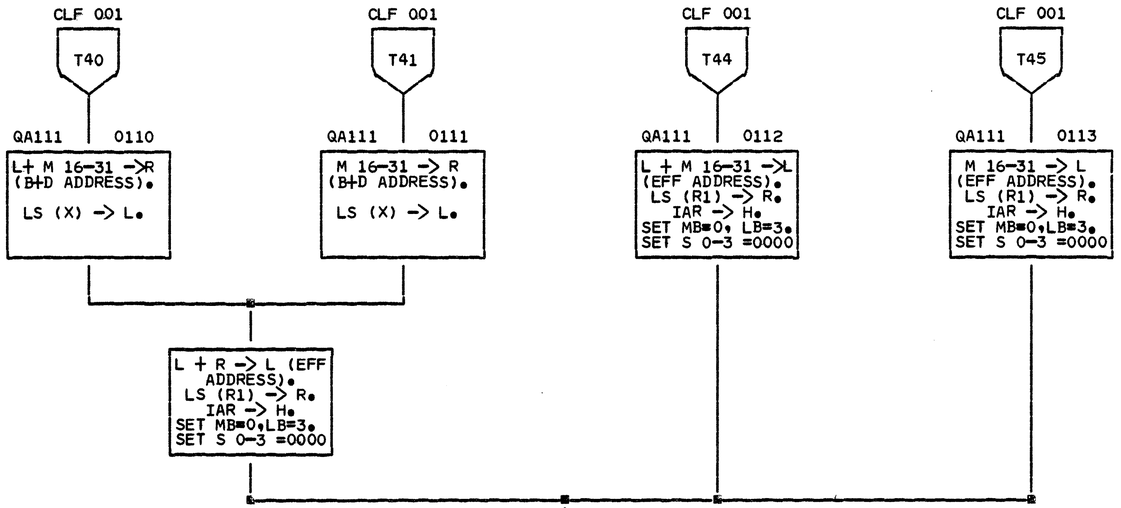
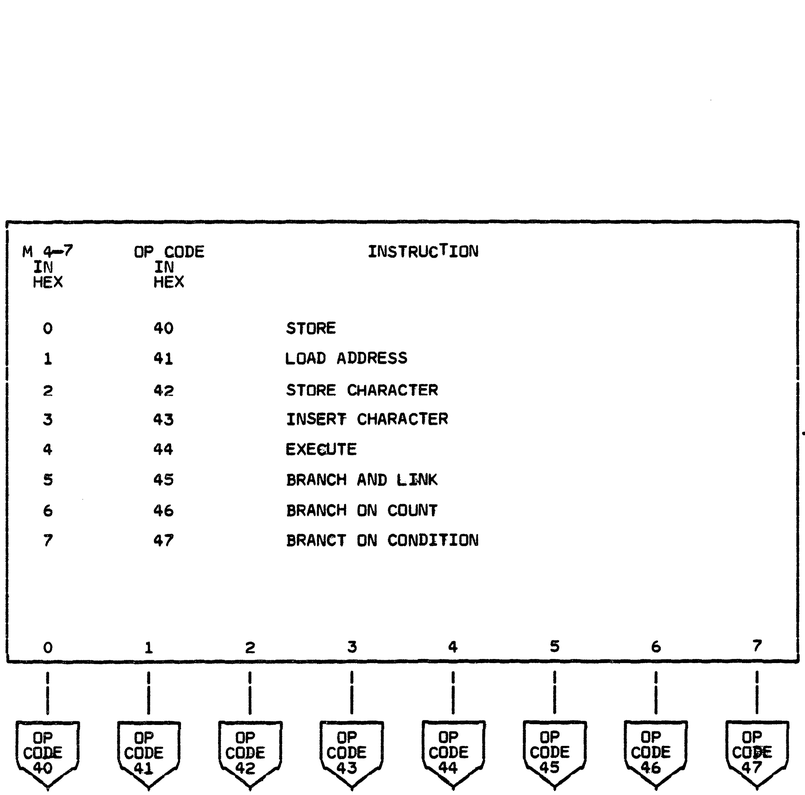
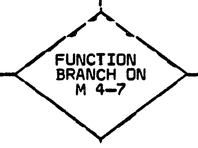
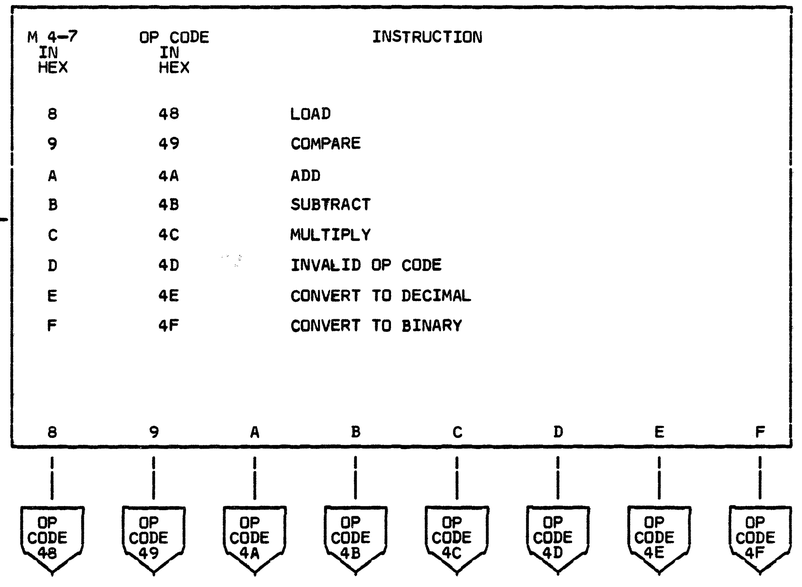
CLFQ4





M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	40	STORE
1	41	LOAD ADDRESS
2	42	STORE CHARACTER
3	43	INSERT CHARACTER
4	44	EXECUTE
5	45	BRANCH AND LINK
6	46	BRANCH ON COUNT
7	47	BRANCT ON CONDITION





M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	48	LOAD
9	49	COMPARE
A	4A	ADD
B	4B	SUBTRACT
C	4C	MULTIPLY
D	4D	INVALID OP CODE
E	4E	CONVERT TO DECIMAL
F	4F	CONVERT TO BINARY

CLF005
DATE 27 MAY 66 MACH. 2050
FRAME
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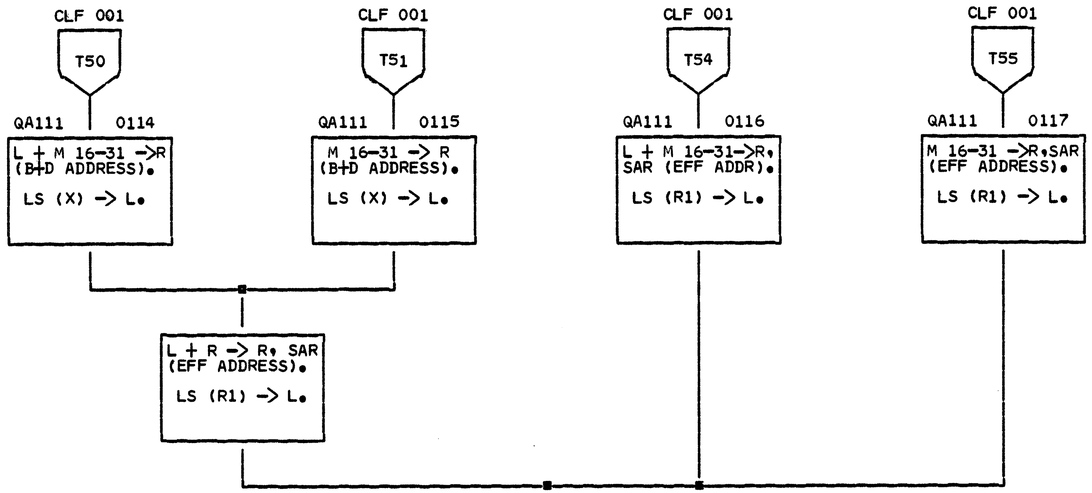
CLF05



M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	50	STORE
1	51	INVALID OP
2	52	INVALID OP
3	53	INVALID OP
4	54	AND
5	55	COMPARE LOGICAL
6	56	OR
7	57	EXCLUSIVE OR

FUNCTION BRANCH ON M 4-7

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	58	LOAD
9	59	COMPARE
A	5A	ADD
B	5B	SUBTRACT
C	5C	MULTIPLY
D	5D	DIVIDE
E	5E	ADD LOGICAL
F	5F	SUBTRACT LOGICAL

0 1 2 3 4 5 6 7 — OP CODE 50, OP CODE 51, OP CODE 52, OP CODE 53, OP CODE 54, OP CODE 55, MP CODE 56, OP CODE 57

SEE IDB 002 FOR LOCATION OF ROUTINES

8 9 A B C D E F — OP CODE 58, OP CODE 59, OP CODE 5A, OP CODE 5B, OP CODE 5C, OP CODE 5D, OP CODE 5E, OP CODE 5F

CLF 006
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CLF 006

CLF 001 T60 — QG010 0118
L + M 16-31 -> R (B+D ADDRESS). LS (X) -> L. SET S 0-3 EQUAL 1110 TO SIGNAL FLOAT PT LONG.

CLF 001 T61 — QG010 0119
M 16-31 -> R (B+D ADDRESS). LS (X) -> L. SET S 0-3 EQUAL 1110 TO SIGNAL FLOAT PT LONG.

CLF 001 T70 — QG010 011C
L + M 16-31 -> R (B+D ADDRESS). LS (X) -> L. SET S 0-3 EQUAL 1111 TO SIGNAL FLOAT PT SHORT.

CLF 001 T71 — QG010 011D
M 16-31 -> R (B+D ADDRESS). LS (X) -> L. SET S 0-3 EQUAL 1111 TO SIGNAL FLOAT PT SHORT.

CLF 001 T64 — QG010 011A
L + M 16-31 -> R, SAR, LS-WS1. SET S 0-3 EQUAL 1110 TO SIGNAL FLOAT PT LONG.

CLF 001 T65 — 00010 011B
M 16-31 -> R, SAR, LS-WS1. SET S 0-3 EQUAL 1110 TO SIGNAL FLOAT PT LONG.

CLF 001 T74 — QG010 011E
L + M 16-31 -> R, SAR, LS-WS1. SET S 0-3 EQUAL 1111 TO SIGNAL FLOAT PT SHORT.

CLF 001 T75 — QG010 011F
M 16-31 -> R, SAR, LS-WS1. SET S 0-3 EQUAL 1111 TO SIGNAL FLOAT PT SHORT.

L+R -> R, SAR, WS1 (EFF ADDRESS). SET F = 0000.

IS R1 ADDR IN MD VALID (VALID FP ADDR ARE 0, 2, 4 OR 6)

NO

SET MD = 0000. SET F = 0110.

Y — CLF 122

YES

SET LSFN = 10 (FP REG). LS (R1) -> R. ZEROS -> M 0-31

FUNCTION BRANCH ON M 4-7

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	60 70	
1	61 71	STORE - FLOATING POINT LONG STORE - FLOATING POINT SHORT
2	62 72	INVALID OP INVALID OP
3	63 73	INVALID OP INVALID OP
4	64 74	INVALID OP INVALID OP
5	65 75	INVALID OP INVALID OP
6	66 76	INVALID OP INVALID OP
7	67 77	INVALID OP INVALID OP

OP CD 60 70 | OP CD 61 71 | OP CD 62 72 | OP CD 63 73 | OP CD 64 74 | OP CD 65 75 | OP CD 66 76 | OP CD 67 77

SEE IDB 002 FOR LOCATION OF ROUTINES

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	68 78	LOAD - FLOATING POINT LONG LOAD - FLOATING POINT SHORT
9	69 79	COMPARE - FLOATING POINT LONG COMPARE - FLOATING POINT SHORT
A	6A 7A	ADD NORMALIZED - FLOATING POINT LONG ADD NORMALIZED - FLOATING POINT SHORT
B	6B 7B	SUBTRACT NORMALIZED - FLOATING POINT LONG SUBTRACT NORMALIZED - FLOATING POINT SHORT
C	6C 7C	MULTIPLY - FLOATING POINT LONG MULTIPLY - FLOATING POINT SHORT
D	6D 7D	DIVIDE - FLOATING POINT LONG DIVIDE - FLOATING POINT SHORT
E	6E 7E	ADD UNNORMALIZED - FLOATING POINT LONG ADD UNNORMALIZED - FLOATING POINT SHORT
F	6F 7F	SUBTRACT UNNORMALIZED - FLOATING POINT LONG SUBTRACT UNNORMALIZED - FLOATING POINT SHORT

OP CD 68 78 | OP CD 69 79 | OP CD 6A 7A | OP CD 6B 7B | OP CD 6C 7C | OP CD 6D 7D | OP CD 6E 7E | OP CD 6F 7F

CLF 007
DATE 27 MAY 66 MACH. 2050
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CLF 007

● CLF 007 SECOND LEVEL I-FETCH - RX FORMAT - FLOATING POINT LONG AND SHORT

CLF 001 T80 — QJ011 0120

L + M 16-31 ->R (EFF ADDRESS).
LS (R1) -> L.
ZEROS -> F REG.

CLF 001 T81 — QJ011 0121

M 16-31 -> R (EFF ADDRESS).
LS (R1) -> L.
ZEROS -> F REG.

FUNCTION BRANCH ON M 4-7

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	80	SET SYSTEM MASK
1	81	INVALID OP
2	82	LOAD PSW
3	83	DIAGNOSE
4	84	WRITE DIRECT
5	85	READ DIRECT
6	86	BRANCH HIGH
7	87	BRANCH LOW-EQUAL

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	88	SHIFT RIGHT SINGLE - LOGICAL
9	89	SHIFT LEFT SINGLE - LOGICAL
A	8A	SHIFT RIGHT SINGLE
B	8B	SHIFT LEFT SINGLE
C	8C	SHIFT RIGHT DOUBLE - LOGICAL
D	8D	SHIFT LEFT DOUBLE - LOGICAL
E	8E	SHIFT RIGHT DOUBLE
F	8F	SHIFT LEFT DOUBLE

0 1 2 3 4 5 6 7 — OP CODE 80, OP CODE 81, OP CODE 82, OP CODE 83, OP CODE 84, OP CODE 85, OP CODE 86, OP CODE 87

SEE IDB 002 FOR LOCATION OF ROUTINES

8 9 A B C D E F — OP CODE 88, OP CODE 89, OP CODE 8A, OP CODE 8B, OP CODE 8C, OP CODE 8D, OP CODE 8E, OP CODE 8F

CLF 008
DATE 27 MAY 66 MACH. 2050
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CLF08

CLF 001 T90

QJ011 0124

L + M 16-31 -> R, LS-WS1 (EFF ADDRESS).

SET S 0-3 =0010

CLF 001 T91

QJ011 0125

M 16-31->R, WS1 (EFF ADDRESS).

SET S 0-3 =0010

FUNCTION BRANCH ON M 4-7

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
0	90	STORE MULTIPLE
1	91	TEST UNDER MASK
2	92	MOVE
3	93	TEST AND SET
4	94	AND
5	95	COMPARE LOGICAL
6	96	OR
7	97	EXCLUSIVE OR

0 1 2 3 4 5 6 7

OP CODE 90 | OP CODE 91 | OP CODE 92 | OP CODE 93 | OP CODE 94 | OP CODE 95 | OP CODE 96 | OP CODE 97

SEE IDB 002 FOR LOCATION OF ROUTINES

M 4-7 IN HEX	OP CODE IN HEX	INSTRUCTION
8	98	LOAD MULTIPLE
9	99	INVALID OP
A	9A	INVALID OP
B	9B	INVALID OP
C	9C	START I/O
D	9D	TEST I/O
E	9E	HALT I/O
F	9F	TEST CHANNEL

8 9 A B C D E F

OP CODE 98 | OP CODE 99 | OP CODE 9A | OP CODE 9B | OP CODE 9C | OP CODE 9D | OP CODE 9E | OP CODE 9F

CLF 009
DATE 27 MAY 66 MACH. 2050
FRAME
P.N.
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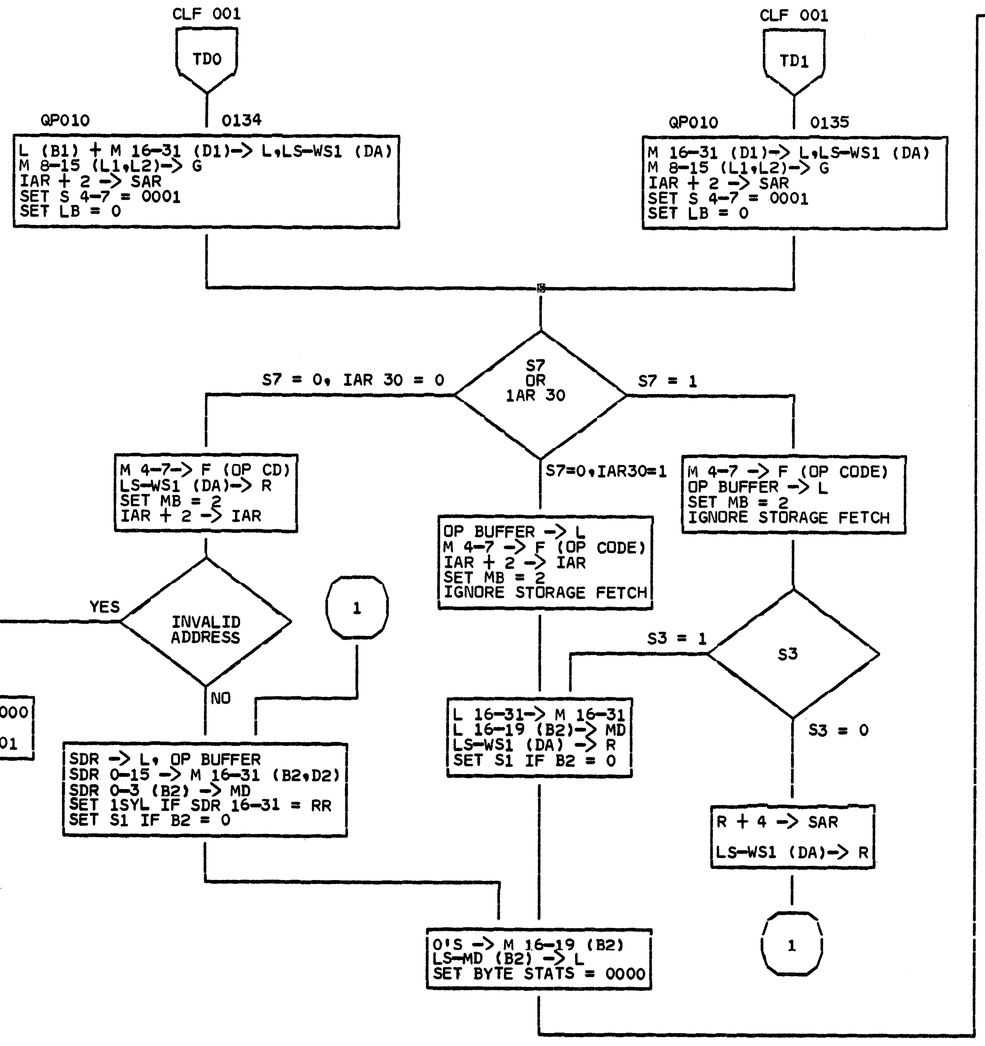
CLF09



CLF010
DATE 27 MAY 66 MACH. 2050
FRAME
P.N.
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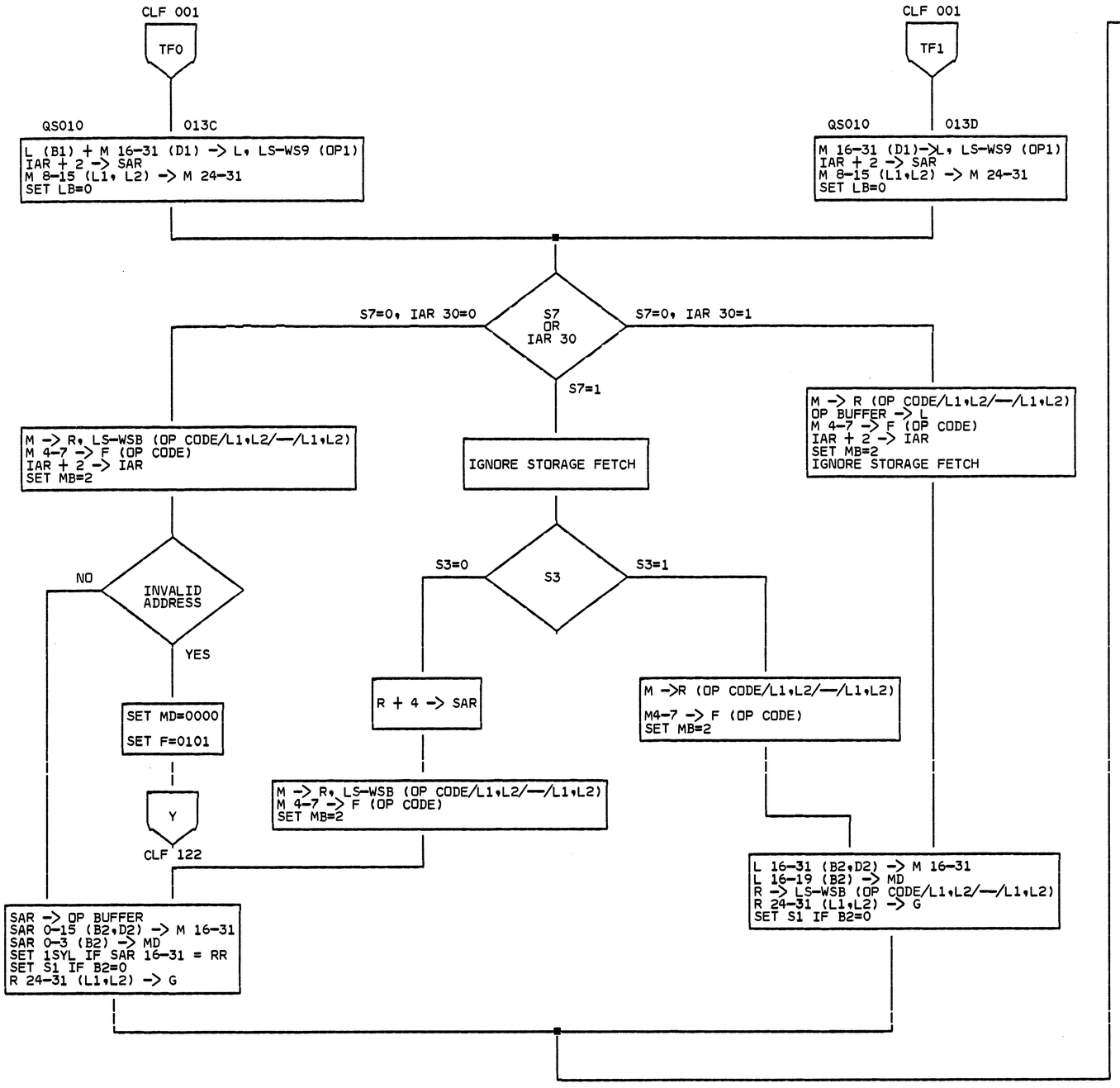
CLF10



CLF 011 (1 OF 2)
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CLF11

● CLF 011 SECOND LEVEL I-FETCH - SS FORMAT - DECIMAL (SHEET 1 OF 2)

SHEET 1

SYX

R ->SAR (LOW ORDER ADDRESS OF OP2 FIELD)

M 30-31-> MB (LOW ORDER BYTE POSITION OF OP1 FIELD)
M (L1 + OP1)-> H (LOW ORDER ADDRESS OF OP1 FIELD)
L-> LS-WS1 (LOW ORDER ADDRESS OF OP1 FIELD)
SET S4-7 = 0000

0	0C00	INVALID OP
1	0C04	MOVE WITH OFFSET
2	0C08	PACK
3	0C0C	UNPACK
4	0C10	INVALID OP
5	0C14	INVALID OP
6	0C18	INVALID OP
7	0C1C	INVALID OP

0 1 3 4 5 6 7

FUNCTION BRANCH ON F

8	0C20	ZERO AND ADD
9	0C24	COMPARE
A	0C28	ADD
B	0C2C	SUBTRACT
C	0C30	MULTIPLY
D	0C34	DIVIDE
E	0C38	INVALID OP
F	0C3C	INVALID OP

8 9 A B C D E F

F0 F1 F2 F3 F4 F5 F6 F7

F8 F9 FA FB FC FD FE FF

OP CODES SEE IDB 002 FOR LOCATION OF ROUTINES.

CONDITIONS AT END OF SECOND LEVEL I-FETCH

WS1 = ADDRESS OF LOW ORDER POSITION OF OP1 FIELD.
WS2 = ADDRESS OF LOW ORDER POSITION OF OP2 FIELD.
WS9 = OP1
WSA = OP2
WSB = OP CODE/L1, L2/—/L1, L2
H REG = ADDRESS OF LOW ORDER POSITION OF OP1 FIELD.
LB REG = LOW ORDER BYTE POSITION OF OP2 FIELD.
MB REG = LOW ORDER BYTE POSITION OF OP1 FIELD.
R SIGN STAT IS OFF.
STATS 0-7 ARE OFF.
MOVER FUNCTION REGISTER SET TO 000

CLF 011 (2 OF 2)
DATE 3 JUN 66 MACH. 2050
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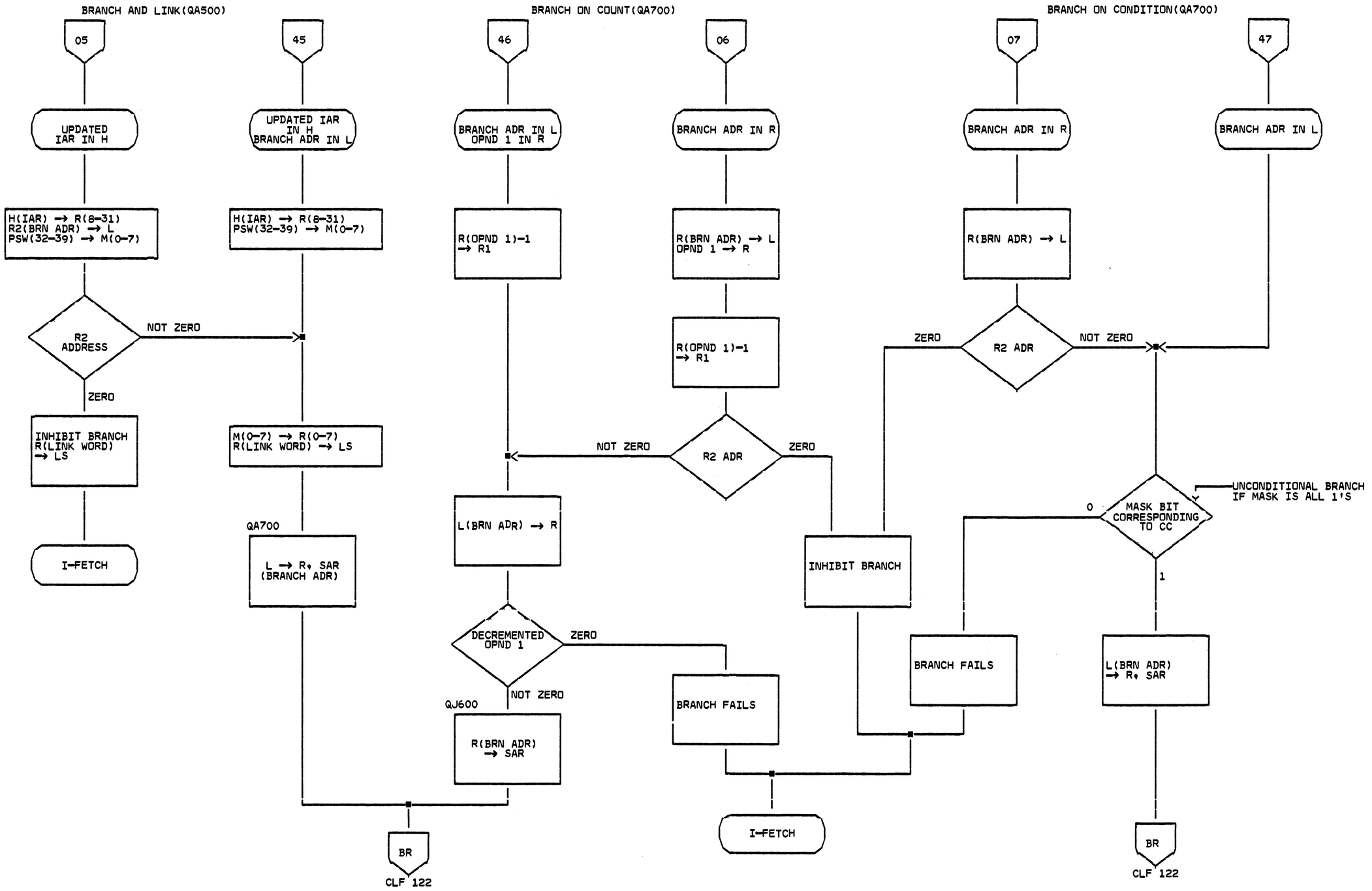
CLF11

● CLF 011 SECOND LEVEL I-FETCH - SS FORMAT - DECIMAL (SHEET 2 OF 2)



CLF 102	
DATE 27 JUN 66	MACH. 2050
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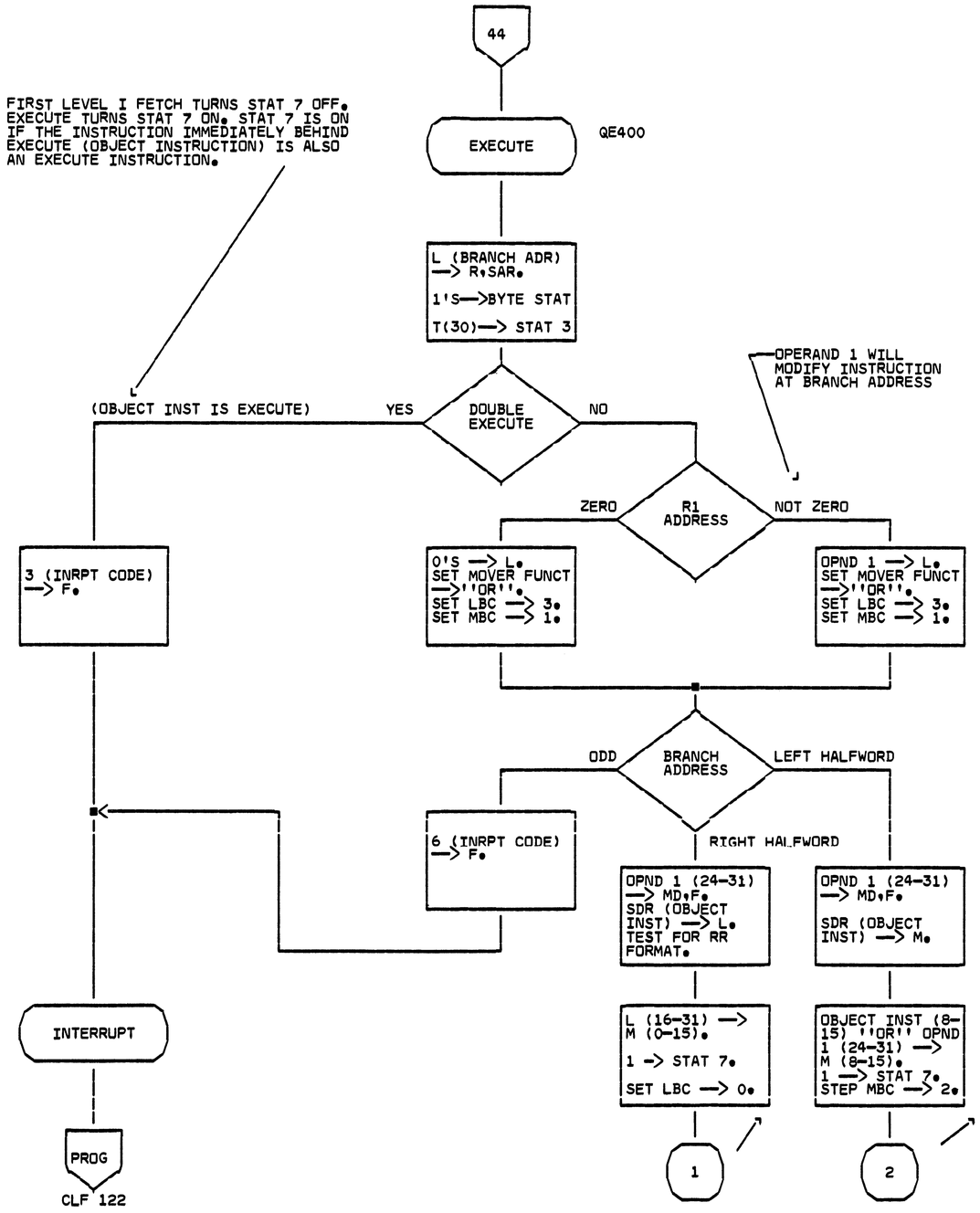
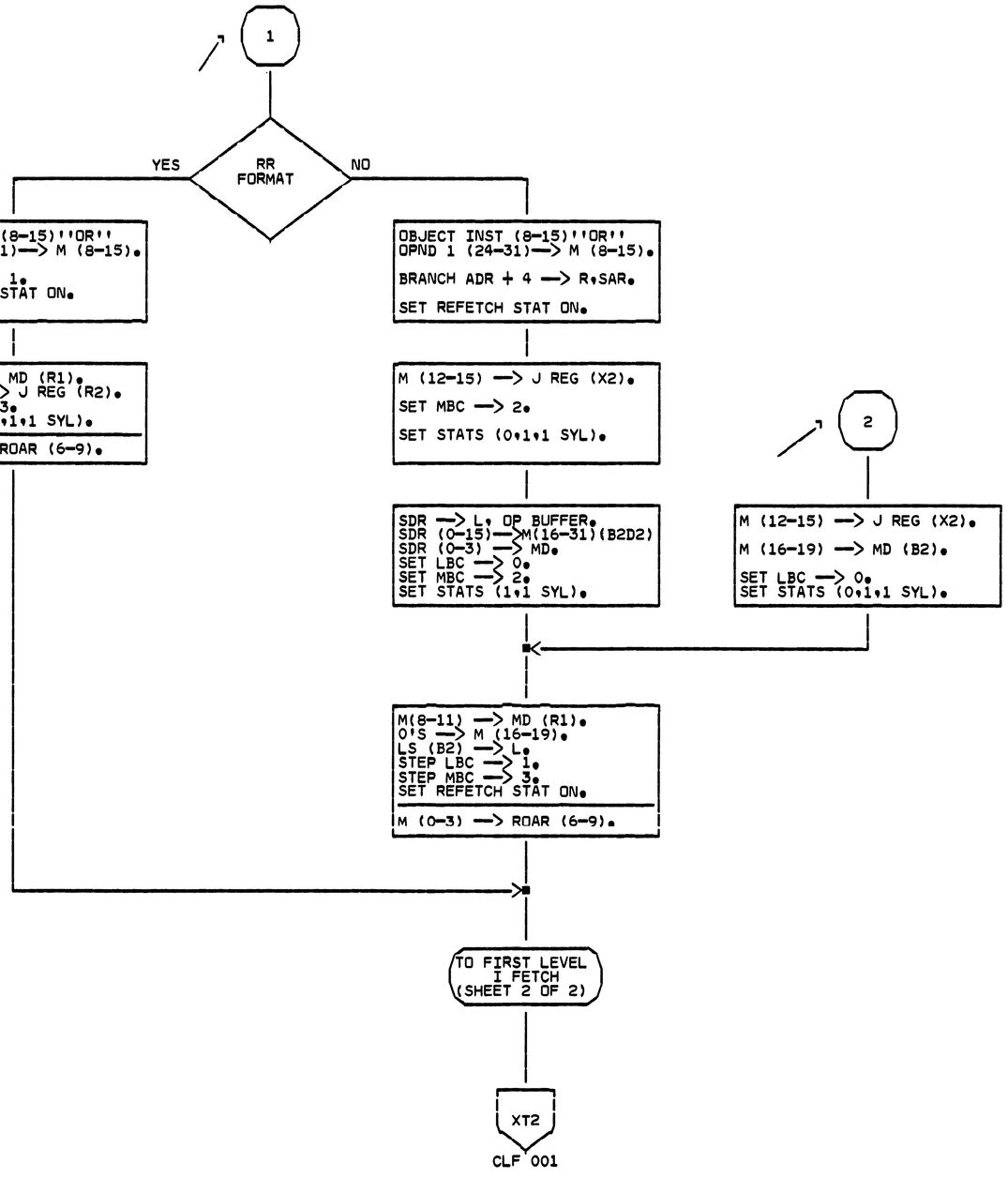
CL102





CLF 103 EXECUTE
DATE 27 JUN 66 MACH• 2050
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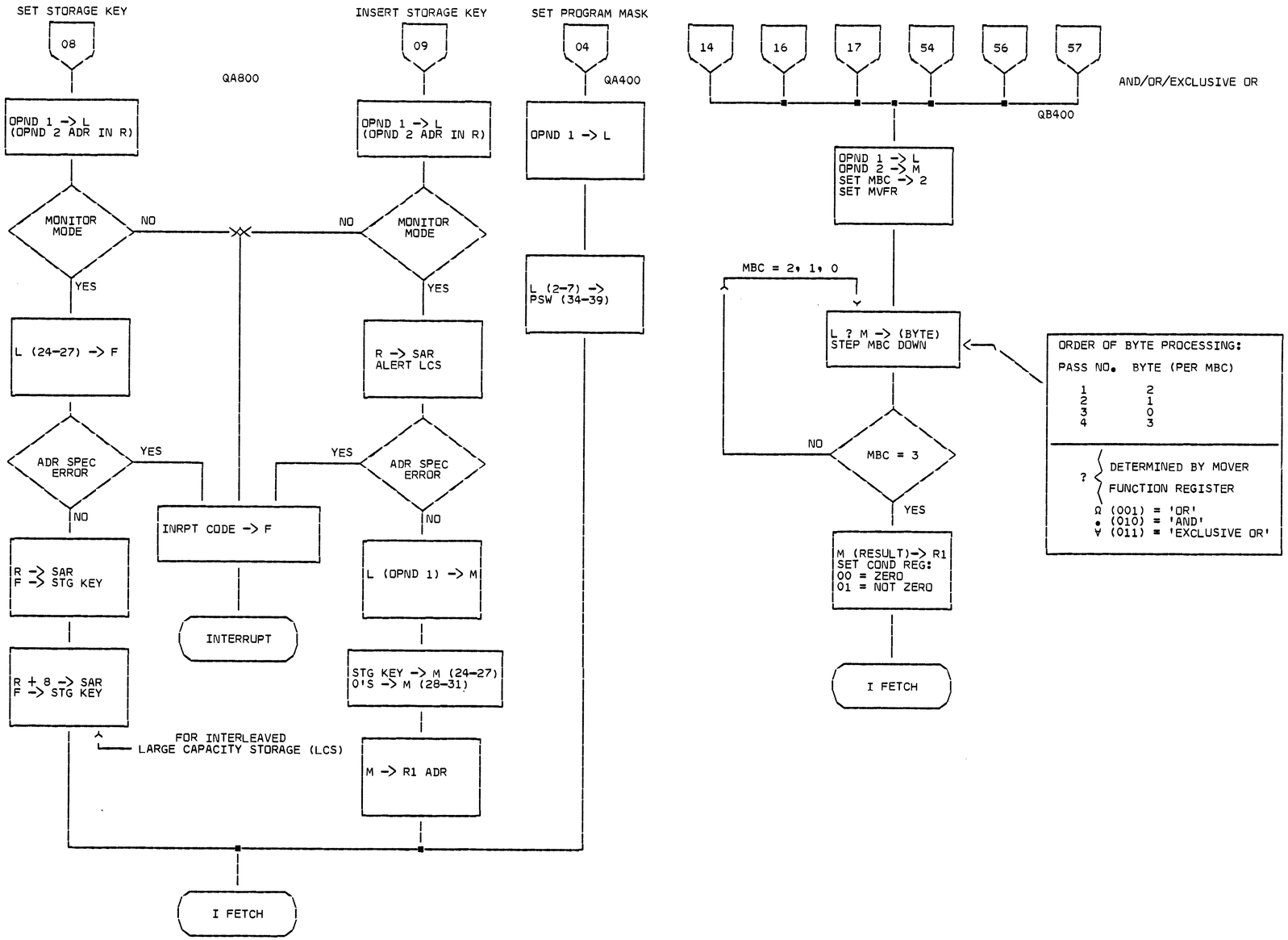
CL103



CLF 104
DATE 23 MAR 65 MACH. 2050
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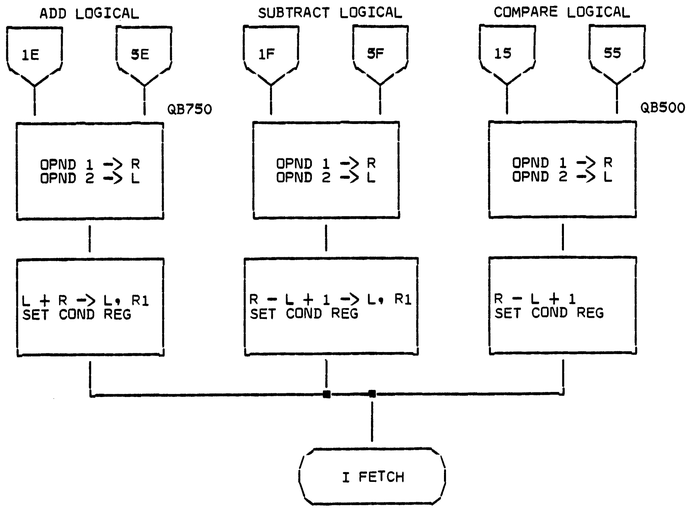
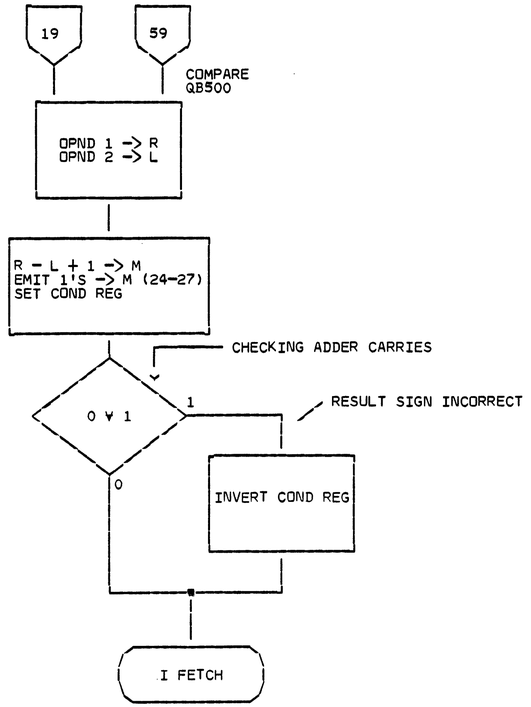
CL104





CLF 105	C
DATE 23 MAR 65 MACH. 2050	L
FRAME	1
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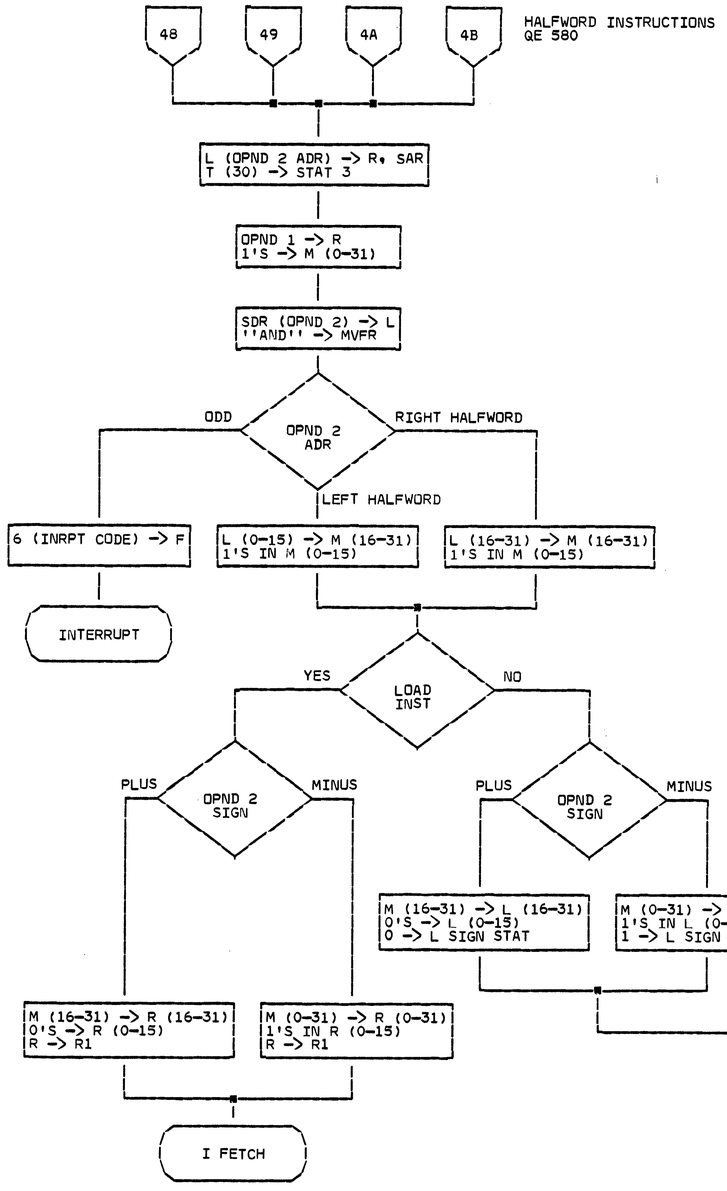
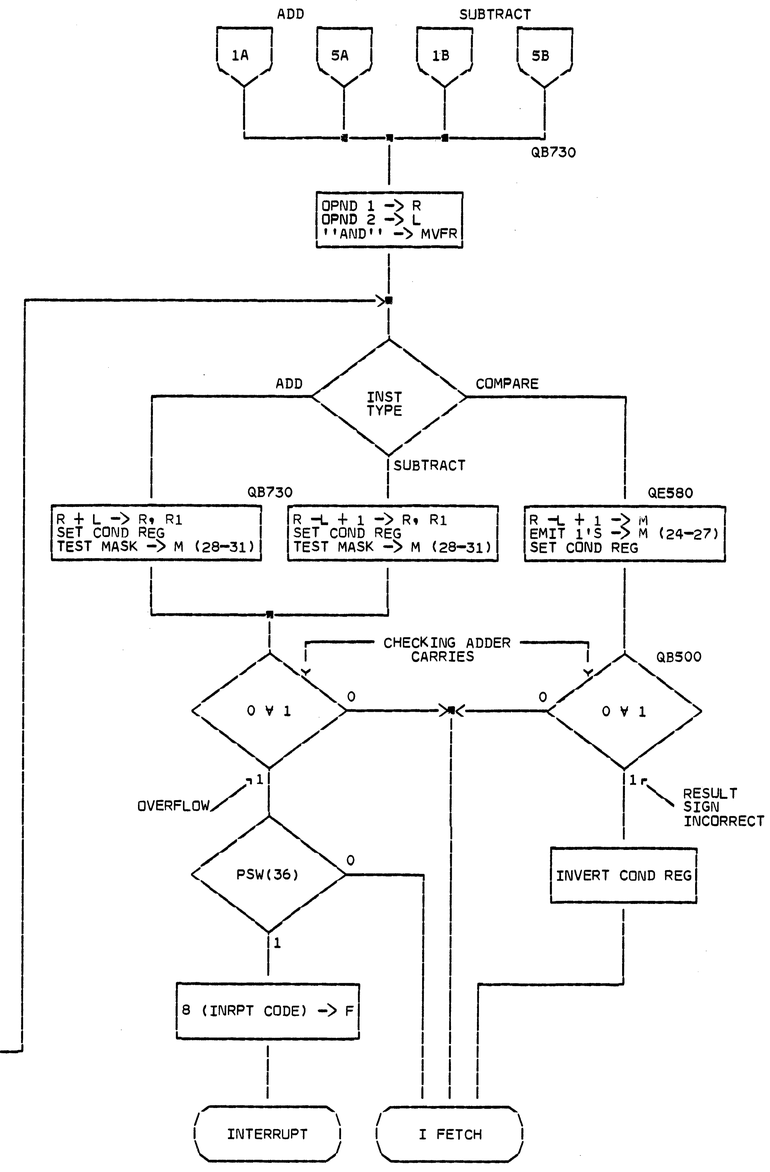
IBM CORP. SDD PAGE 2	5





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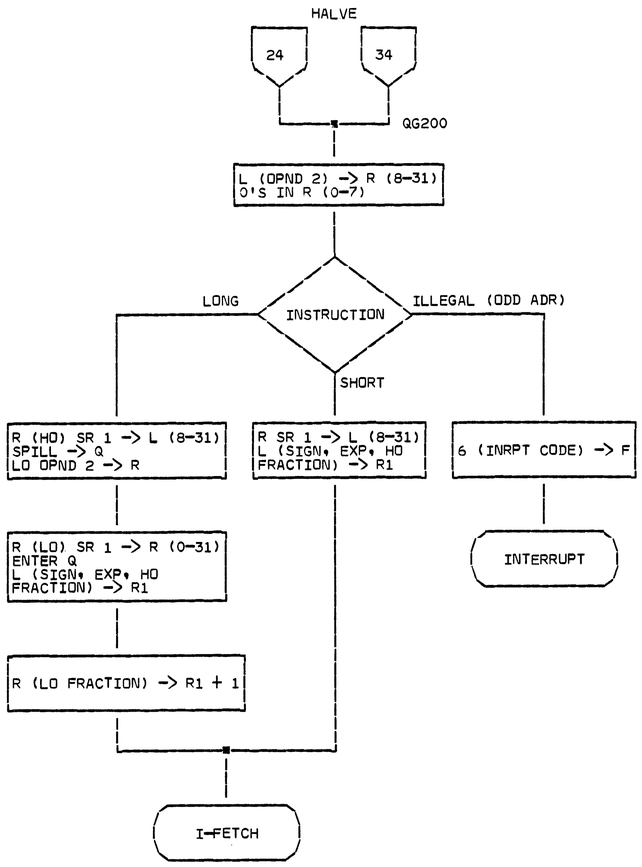
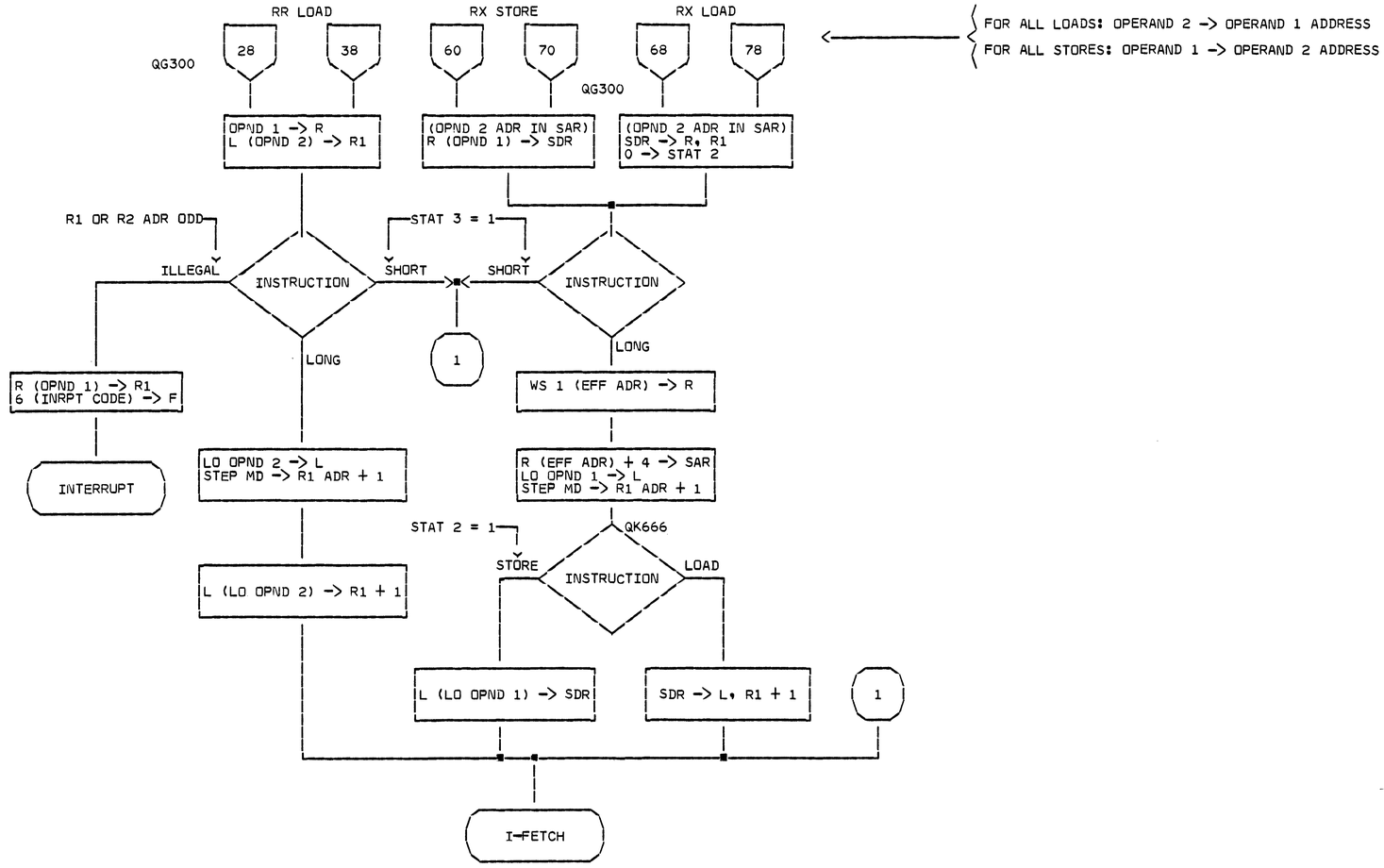
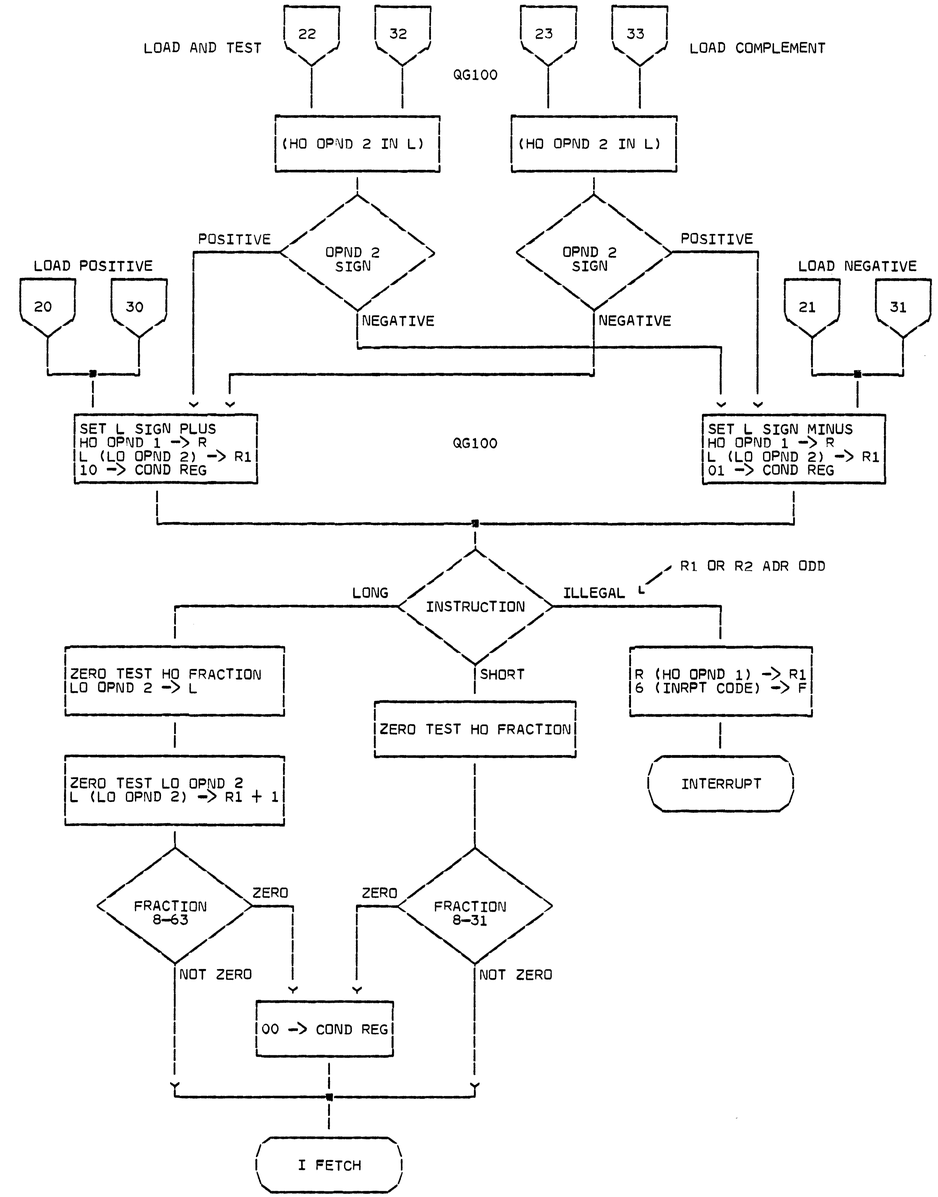
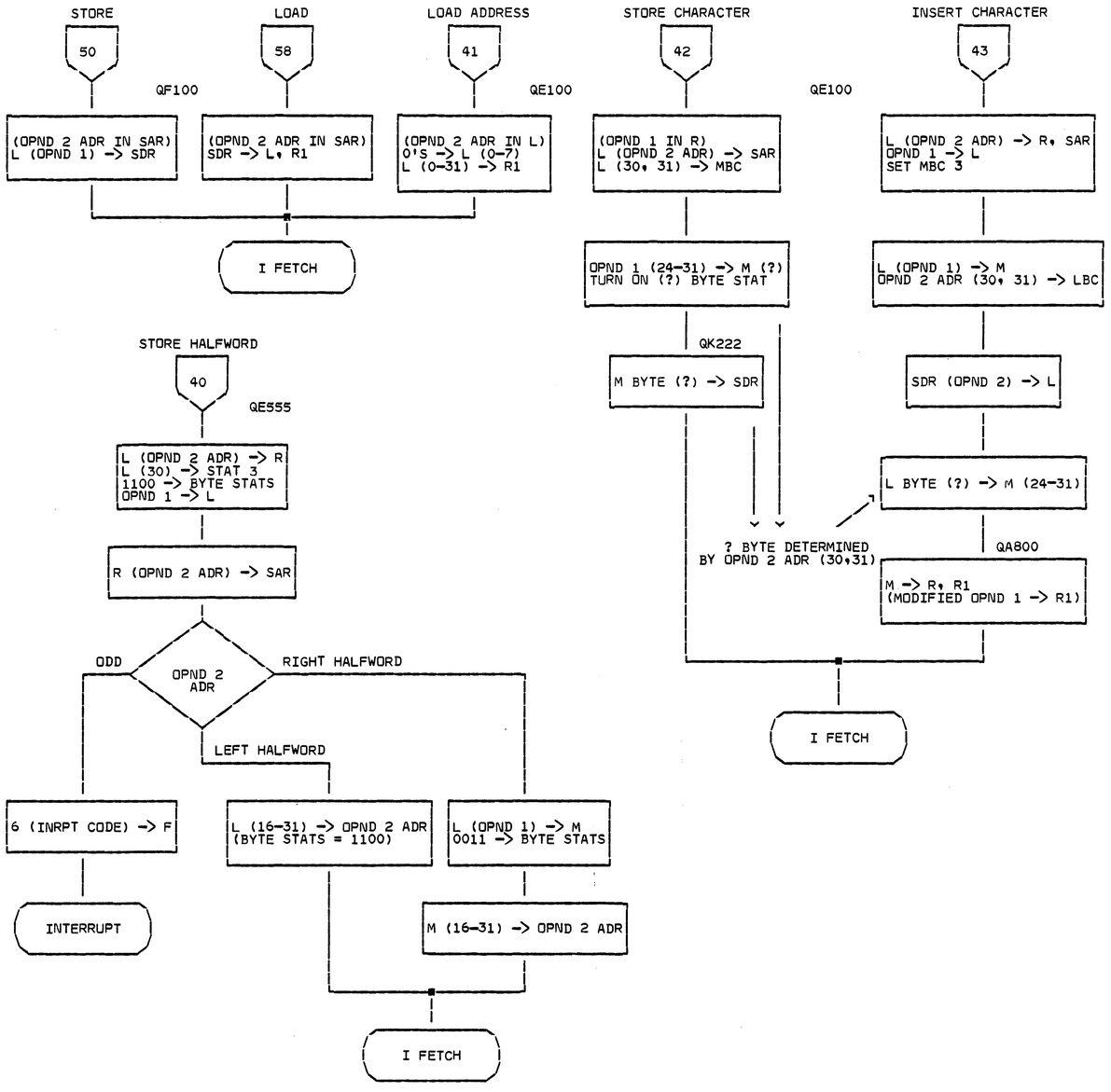
CLF 106 DATE 23 MAR 65 MACH. 2050 FRAME P.N. IBM CORP. SDD PAGE 21	CL106









CLF 109
DATE 23 MAR 65 MACH. 2050
FRAME
P.N.
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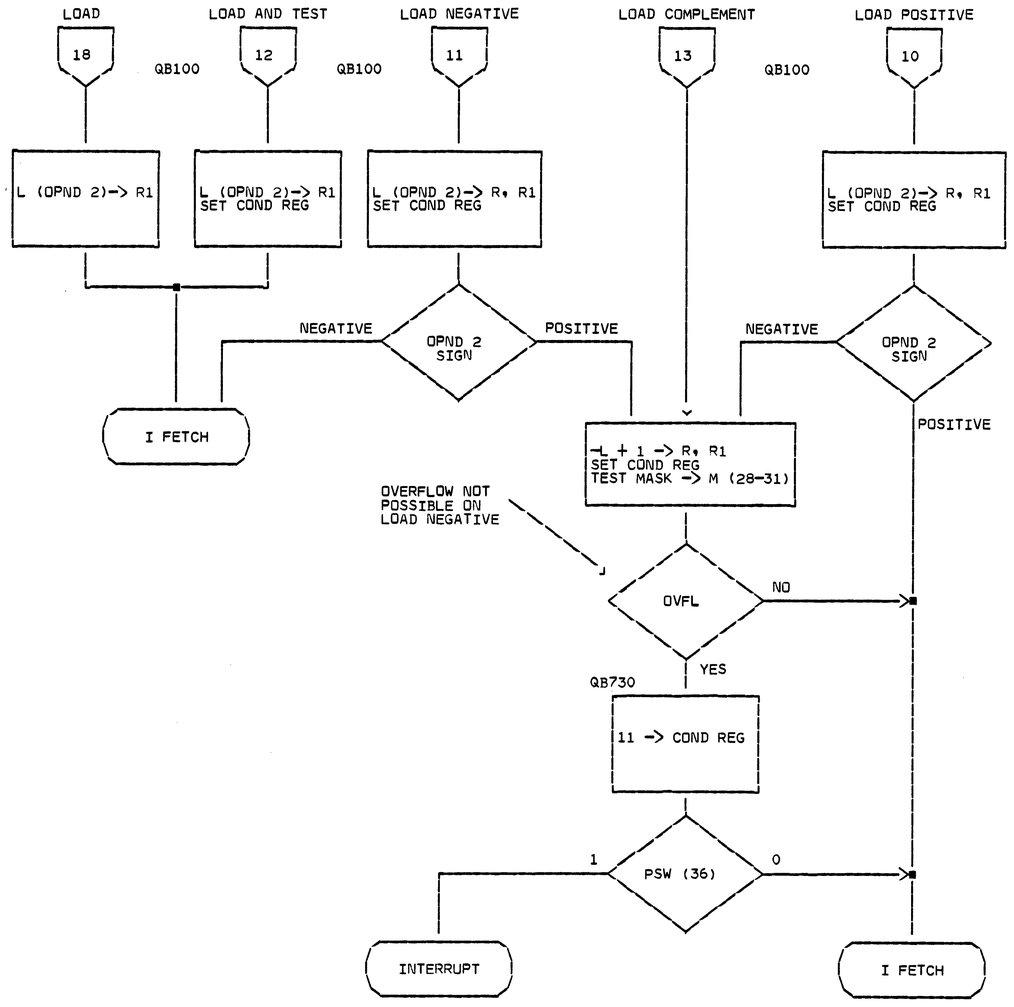
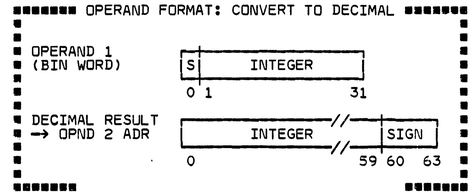
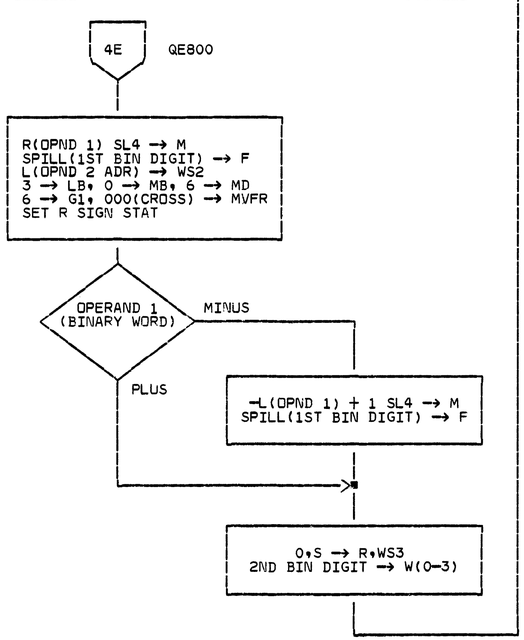
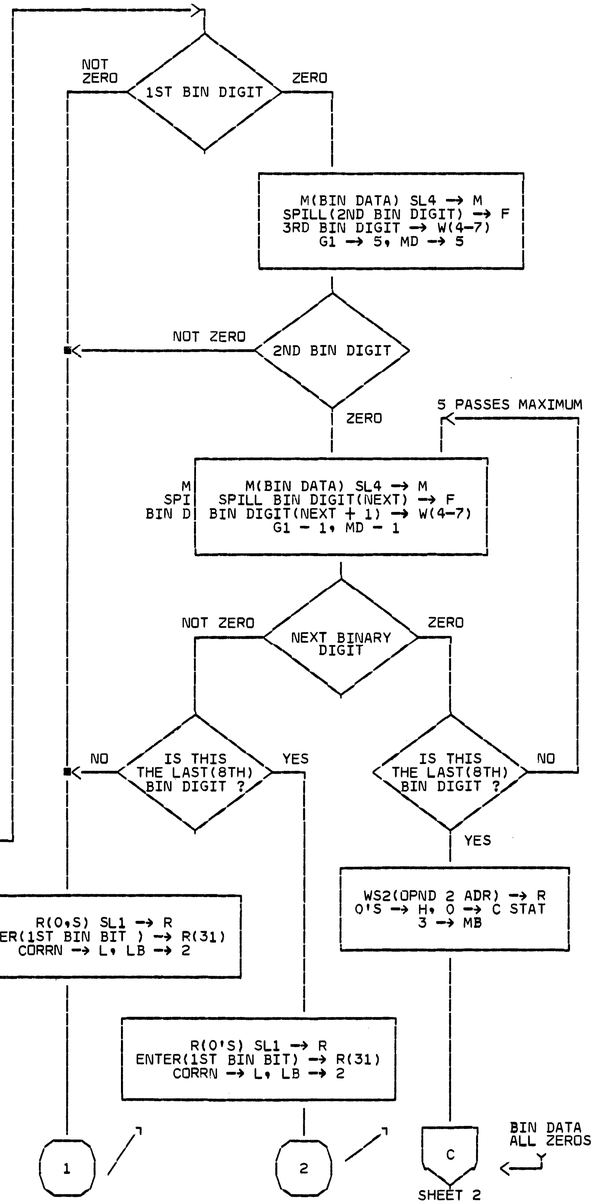
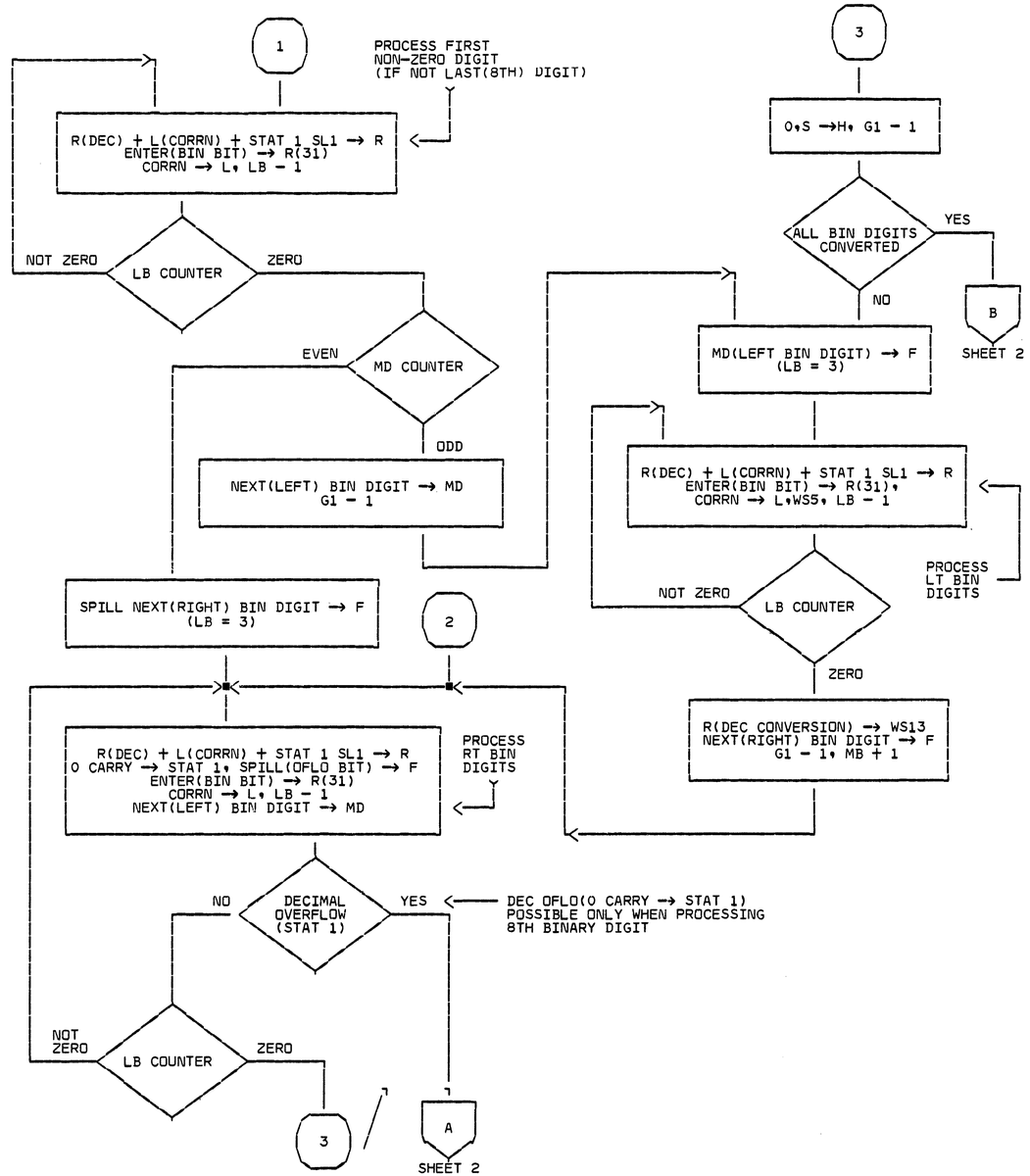
CL109









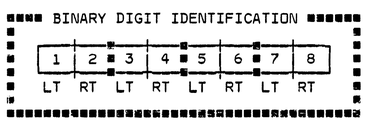


DECIMAL OVERFLOW POSSIBLE ONLY WHEN PROCESSING 8TH BINARY DIGIT. IF DECIMAL CONVERSION OVERFLOWS R REGISTER, RESTORE R AND L REGISTERS TO VALUES PRESENT AFTER PROCESSING THE PRECEEDING (7TH) DIGIT.

WORKING STORAGE LOCATIONS USED FOR DECIMAL OVERFLOW CONDITION(DEC RESULT > 1 FULLWORD):

WS0 LO CORRN FOR DOUBLEWORD DEC RESULT
WS3 HO CORRN FOR DOUBLEWORD DEC RESULT

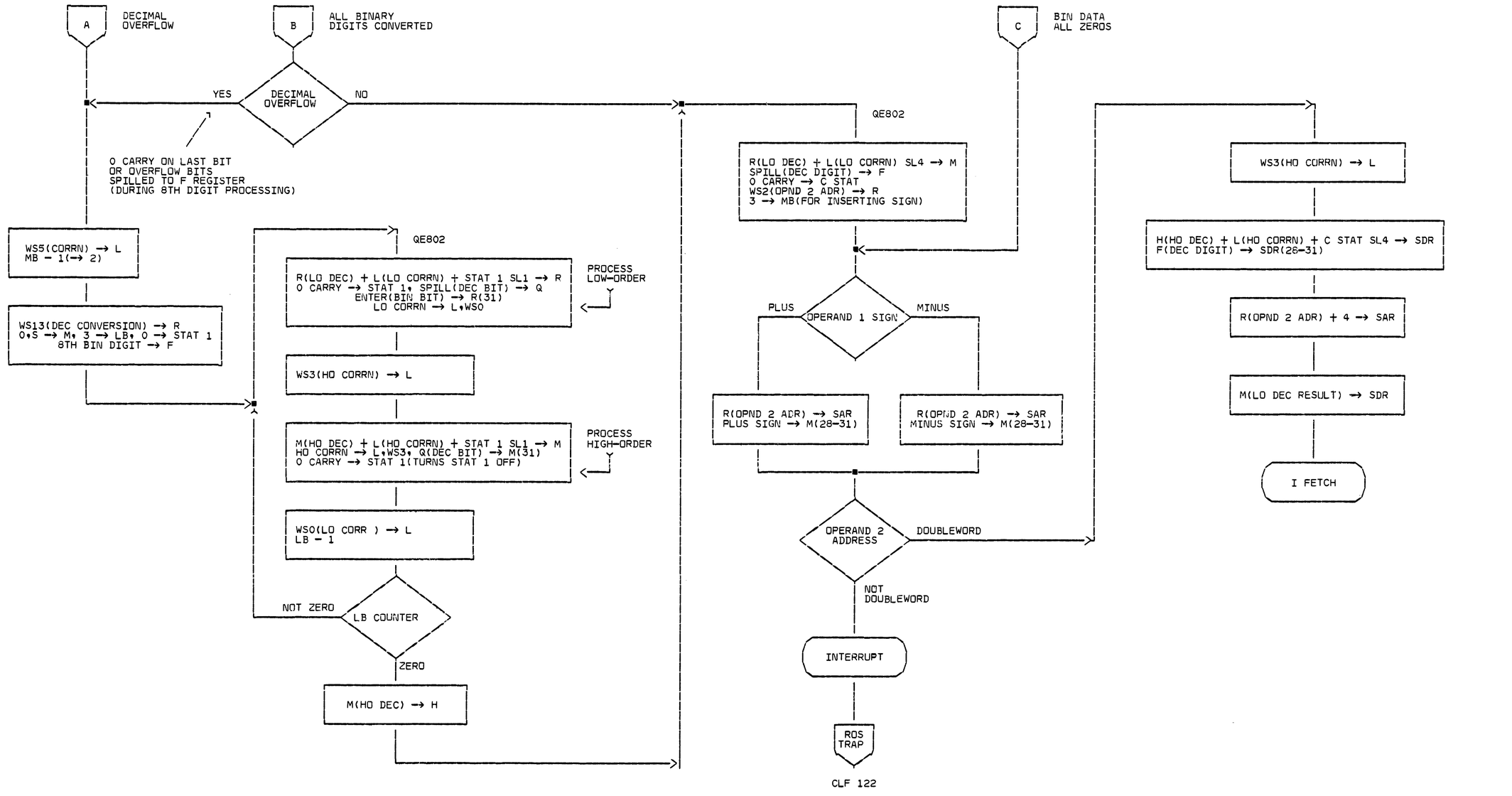
WS5 CORRN FOR 7TH CONVERTED DIGIT
WS13 DEC CONVERSION OF 7TH CONVERTED DIGIT



CLF 111 CONVERT TO DECIMAL (SHEET 1 OF 2)

CONVERT TO DECIMAL (1 OF 2)
DATE 10 JUN 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

CL1111



CONVERT TO DECIMAL (2 OF 2)
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IBM CORP. SDD PAGE 2

CL111

OPERAND FORMAT: CONVERT TO BINARY

OPND 2 (DEC WORD): INTEGER // SIGN — 0 … 59 60 63

BINARY RESULT → OPND 1 ADR: S | INTEGER — 0 1 … 31

4F QE900

L(OPND 2 ADR) → SAR, WS1

DOUBLEWORD ADDRESS?

YES:
- 0'S → M, 6'S → L, WS3
- SDR(HO DEC) → H, WS3(6'S) → R
- H(HO DEC) + L(6'S) → ADDER (CORRN FOR DEC DIGIT CHK → L)
- R(6'S) − L(HO CORRN) + 1 → ADDER (CHECK FOR VALID HO DEC DIGITS), WS1(OPND 2 ADR) → R
- R(OPND 2 ADR) + 4 → SAR, 1'S → G1
- HO DEC DIGIT VALID?
  - NO → 7(IRPT CODE) → F (INVALID DATA) → INTERRUPT → PROG → CLF 122
  - YES → H(HO DEC) SR4 → H, SPILL → F → 1

NO:
- INTERRUPT → ROS TRAP → CLF 122
- VALID DEC SIGN?
  - NO → 7(IRPT CODE) → F (INVALID DATA) → INTERRUPT → PROG → CLF 122
  - YES → 1
- SDR(LO DEC) → R, WS3(6'S) → L, 3 → LB
- HO DEC WORD?
  - ZERO → R(LO DEC) SR4 → R, WS2; F → R(0−3), WS2; 3 → MB, SET L SIGN STAT
  - NOT ZERO → R(LO DEC) SR4 → R, WS2; F → R(0−3), WS2; 0 → MB, SET L SIGN STAT
- R(LO DEC) + L(6'S) → ADDER (CORRN FOR DEC DIGIT CHK → L), WS3(6'S) → R
- R(6'S) − L(LO CORRN) + 1 → ADDER (CHECK FOR VALID LO DEC DIGITS), WS2(LO DEC SR4) → R
- H(HO DEC SR4) SL1 → L
- LO DEC DIGITS VALID?
  - NO → 7(IRPT CODE) → F (INVALID DATA) → INTERRUPT → PROG → CLF 122
  - YES → 2 — AT THIS POINT: R = ORIGINAL LO DEC SR4; H = ORIGINAL HO DEC SR4

2

STAT 5 CONTROL: OFF(0) = PROCESS RIGHT BINARY DIGIT; ON(1) = PROCESS LEFT BINARY DIGIT

- L(HO DEC) → ADDER; HO CORRN → L, WS4; 0 → STAT 5
- MOVER FUNCTION TO CROSS: R(LO DEC SR4) SL1 → L; 000 → MVFR
- L(LO DEC) → ADDER; LO CORRN → L
- SINGLEWORD ROUTINE(MB = 3) → ZERO; DOUBLEWORD ROUTINE(MB = 0) → NOT ZERO
- HO DEC WORD?
  - ZERO → R(LO DEC) − L(LO CORRN) + 1 SR1 → R; SPILL → F(0); CORRN → L, LB − 1 → A → SHEET 2
  - NOT ZERO → R(LO DEC) − L(LO CORRN) + 1 → R; 0 CARRY → C STAT; WS4(HO CORRN) → L, 3 → MB → B → SHEET 2

CONVERT TO BINARY (1 OF 2)
DATE 28 JUN 65 MACH. 2050
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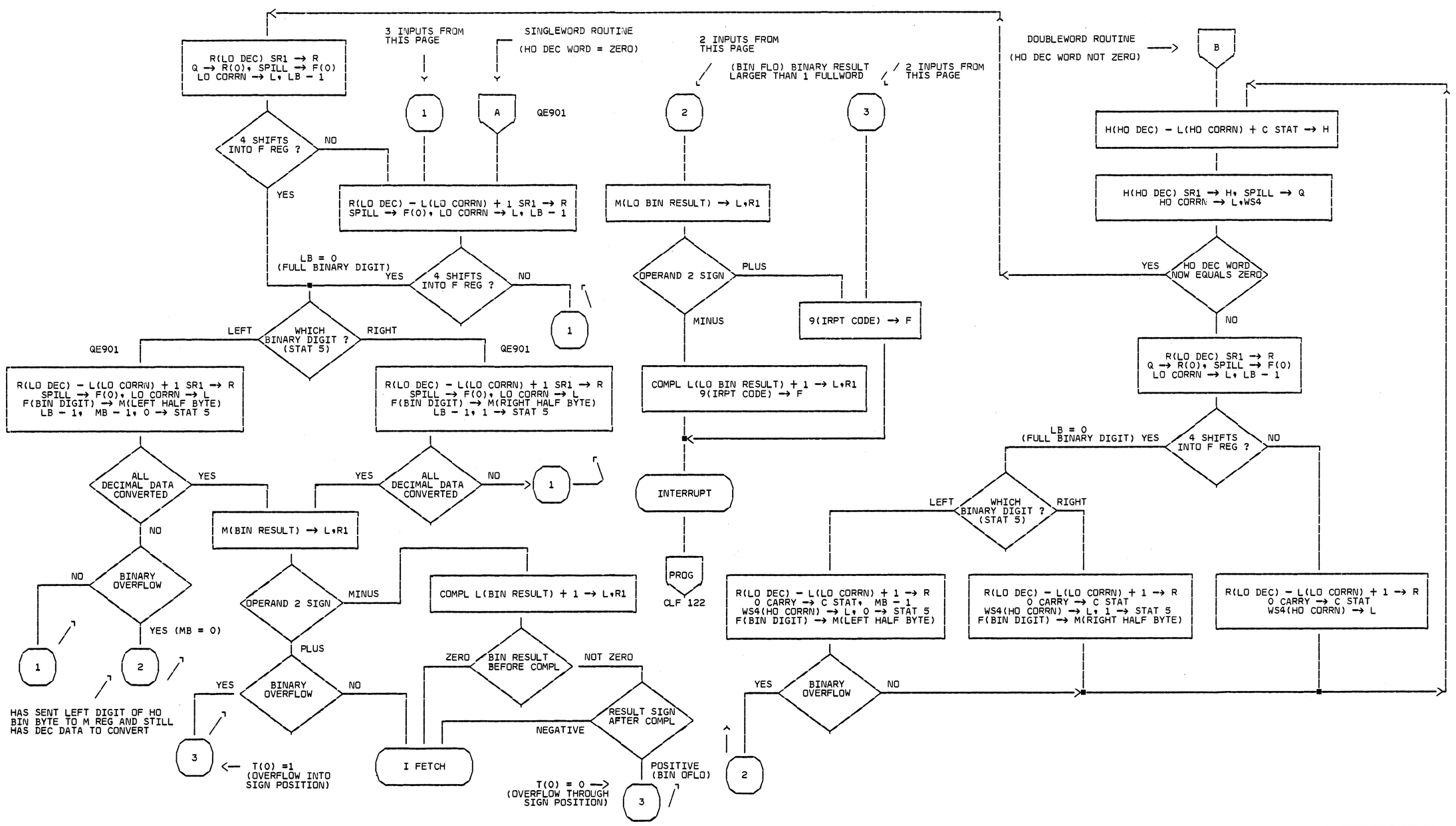
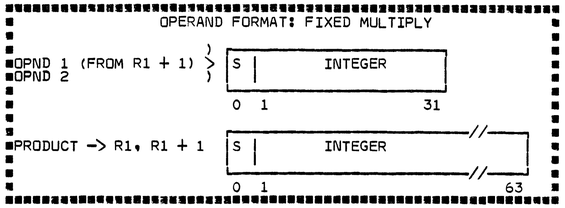
IBM CORP. SDD PAGE 1
CL112

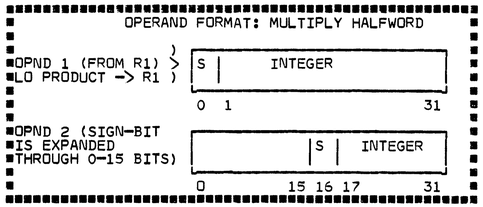
CLF 112 CONVERT TO BINARY (SHEET 1 OF 2)

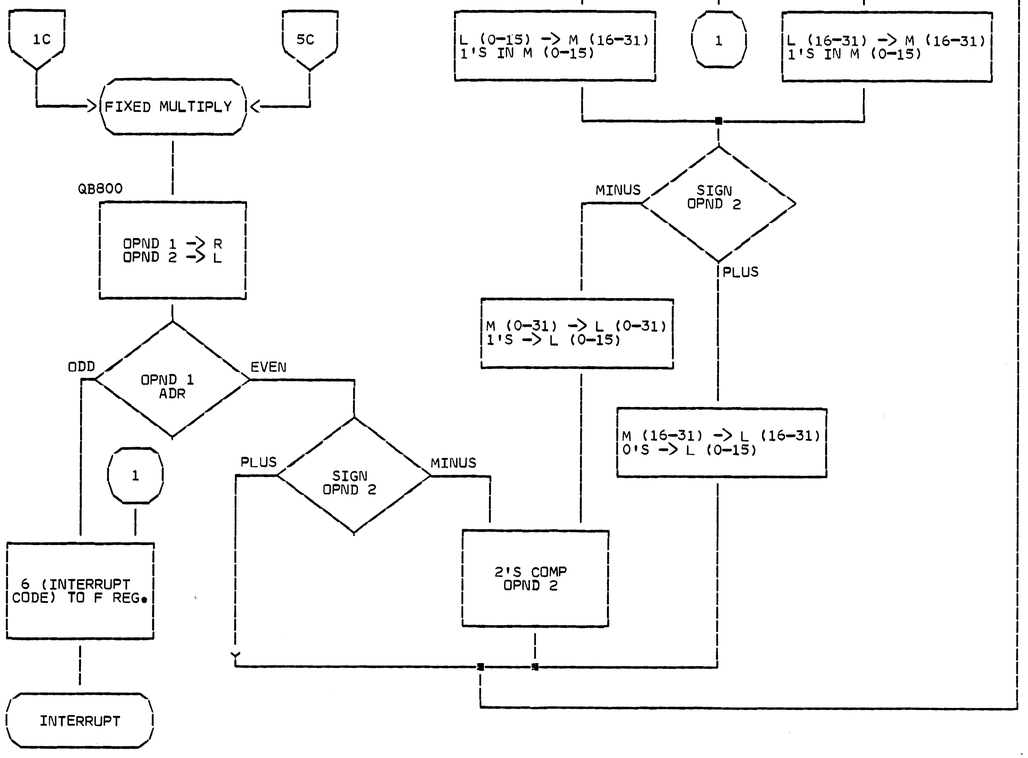


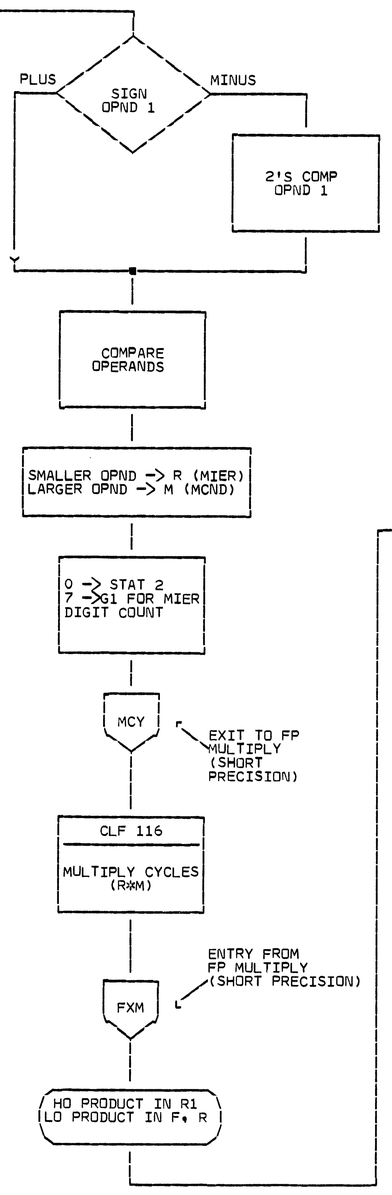
CONVERT TO DECIMAL (2 OF 2)	CL112
DATE 28 JUN 65 MACH. 2050	
FRAME	
P.N.	
IBM CORP. SDD PAGE 2	

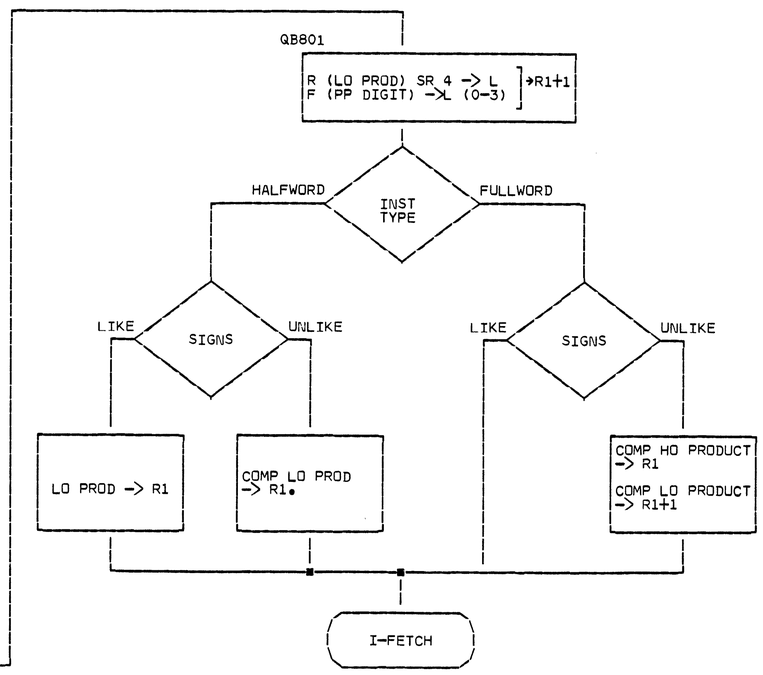
CLF 112
CONVERT TO BINARY (SHEET 2 OF 2)











CLF 113
DATE 7 APR 65 MACH. 2050
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IBM CORP. PAGE 2

CL113

IDB 002 1D — QB900 — IDB 002 5D

OPND 2 (DVR)→ L
SET L SIGN STAT

R1 (HO DVD) → R
SET R SIGN STAT

ODD — R1 ADDRESS — EVEN

EVEN → DIVIDEND SIGN

PLUS — DIVIDEND SIGN — MINUS

HO DVD SL1 → R
LO DVD SL1 → M, R(31)

COMP HO DVD SL1 → R
COMP LO DVD SL1→M,R(31)

ODD → 6 (INRPT CODE)→ F
(SPECIFICATION)

M (LO DVD) SL4 → M
SPILL (0-3)→ F
SET G1 →7 (FOR DIGIT COUNT)

PLUS — DIVISOR SIGN — MINUS

(TRUE DVR IN L)

COMP L (DVR) + 1 → L
(TRUE DVR → L)

(DVR = OR < DVD) — DIVISOR VALUE — (DVR > HO DVD)

ILLEGAL → 9 (INRPT CODE) → F
(FIXED POINT DIVIDE)

OK → QB901

FIRST REDUCTION CYCLE

R (DVD) - L (DVR) SL1→ R
SPILL (QUOT BIT)→ F (3)
ENTER (RMDR BIT)→ R (31)

1

INTERRUPT

OPERAND FORMAT: FIXED DIVIDE

OPND 1 (DVD)	S	INTEGER	0 1 — 63
OPND 2 (DVR)	S	INTEGER	0 1 — 31
REMAINDER → R1			
QUOTIENT→ R1+1			

1 — 2

SUCCESSFUL REDUCTION → 0 — QUOTIENT BIT (F3) — 1 ← OVERDRAW (DVR > DVD)

0 → R (DVD)-L (DVR) SL1→ R
SPILL (QUOT BIT)→ F(3)
ENTER (RMDR BIT)→ R(31)

1 → R (DVD)+L (DVR) SL1→ R
SPILL (QUOT BIT)→ F(3)
ENTER (RMDR BIT)→ R(31)

NO — FULL QUOTIENT DIGIT — YES

(REPEAT 2 TIMES) → 2

(PREVIOUS REDUCTION SUCCESSFUL)

NO — LAST QUOTIENT DIGIT — YES (G1=0)

0 — QUOTIENT BIT (F3) — 1 ← OVERDRAW ON PREVIOUS REDUCTION

M (LO DVD) SL4 → M
SPILL → F (0-3)
F (QUOT DIGIT)→ M (28-31)

R (DVD)-L (DVR) SL1 → R
SPILL (QUOT BIT) → F (3)
ENTER (RMDR BIT) → R (31)
STEP G1 DOWN

M (LO DVD) SL4 → M
SPILL → F (0-3)
F (QUOT DIGIT)→ M (28-31)

R (DVD)+L (DVR) SL1 → R
SPILL (QUOT BIT) → F (3)
ENTER (RMDR BIT) → R (31)
STEP G1 DOWN

2 ← (7 PASSES)

LAST REDUCTION SUCCESSFUL — 0 — QUOT BIT (F3) — 1 — OVERDRAW ON LAST REDUCTION

0 → R (RMDR) SR1 → L, R1
(STORE TRUE RMDR)
R1 (HO DVD) → R

1 → R (RMDR) SR1 → R
1 → R (0)

R (RMDR + L (DVR) → L, R1
(CORRECT AND STORE
TRUE RMDR)
R1 (HO DVD) → R

QB902

PLUS — DIVIDEND SIGN — MINUS

COMP L (RMDR) + 1 → R1
(STORE 2'S COMP RMDR)

R (HO DVD)→ WS1
M (QUOT)SL4 → L, M
F (LAST QUOT DIGIT)→ L,M (28-31)
(QUOTIENT IN 1'S COMP FORM)

COMP L(QUOT)→ R, R1+1
(STORE TRUE QUOTIENT)
R1+1 (LO DVD) → L

SIGNS ALIKE — NO → M(1'S COMP QUOT) +1 → L, R1+1 (STORE 2'S COMP QUOT)

YES — QUOTIENT OVERFLOW — YES → 3

NO → I-FETCH

NO — QUOTIENT OVERFLOW — YES

M(1'S COMP QUOT)+1
(ZERO TEST QUOT)

LARGEST NEGATIVE NUMBER = MINUS ALL ZEROS

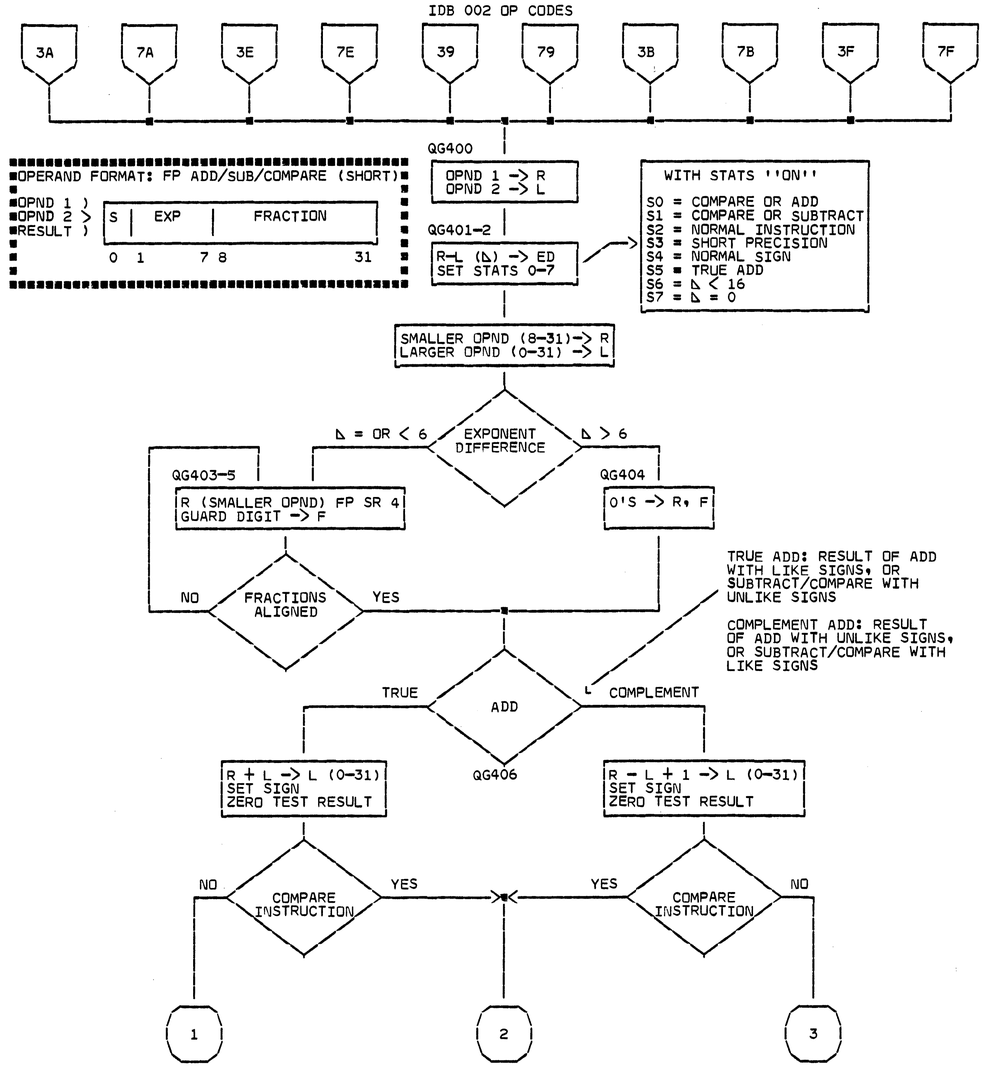
YES — CARRY — NO → POSITIVE NUMBER OVERFLOW

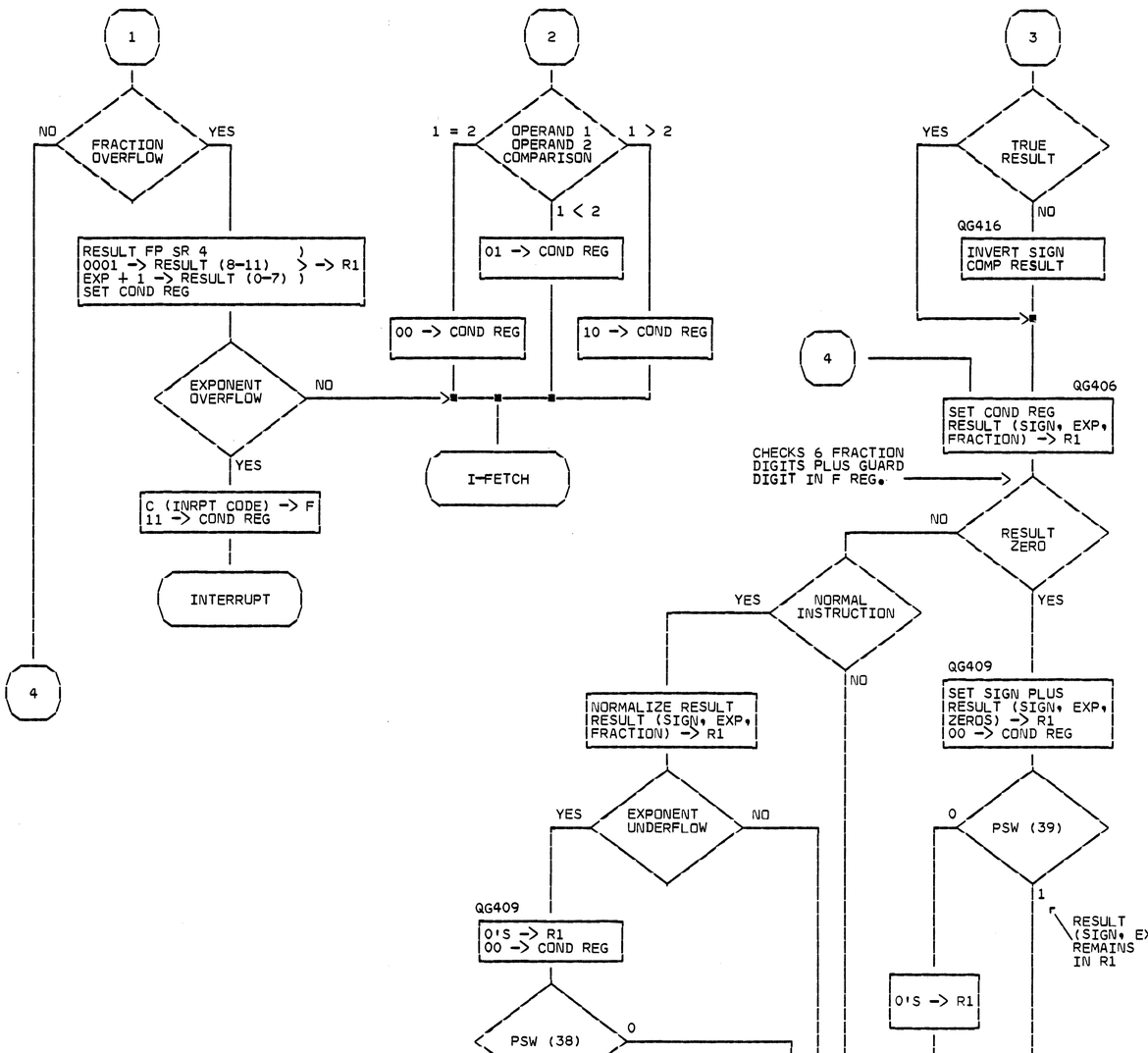
3

9(INTRPT CODE) → F
L(LO DVD) → R1+1
WS1 (HO DVD) → R1

INTERRUPT

CLF 114	
DATE 31 MAR 65 MACH. 2050	C L 1 1 4
FRAME	
P.N.	
IBM CORP. SDD PAGE 2	

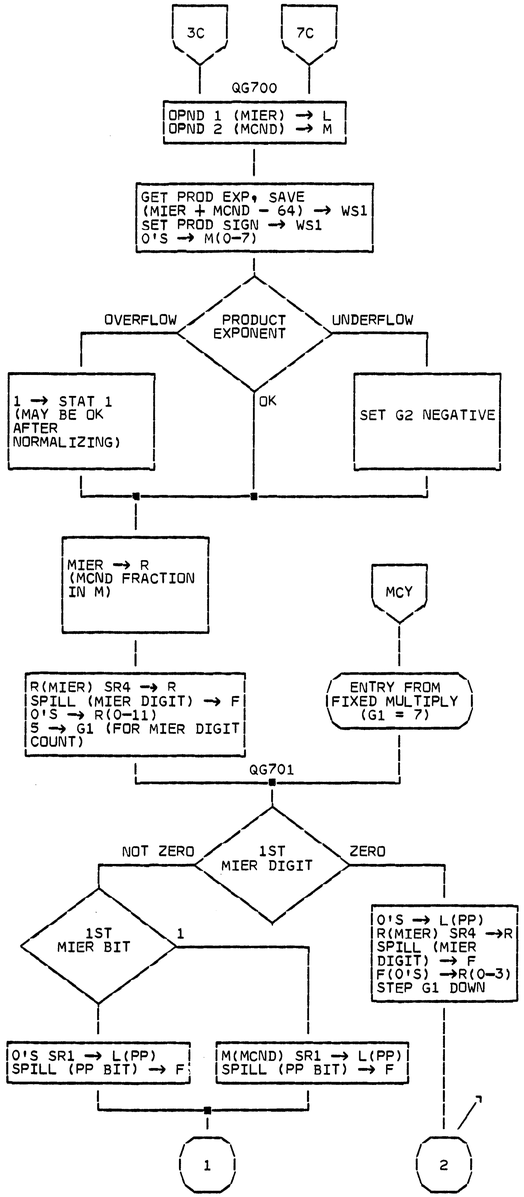


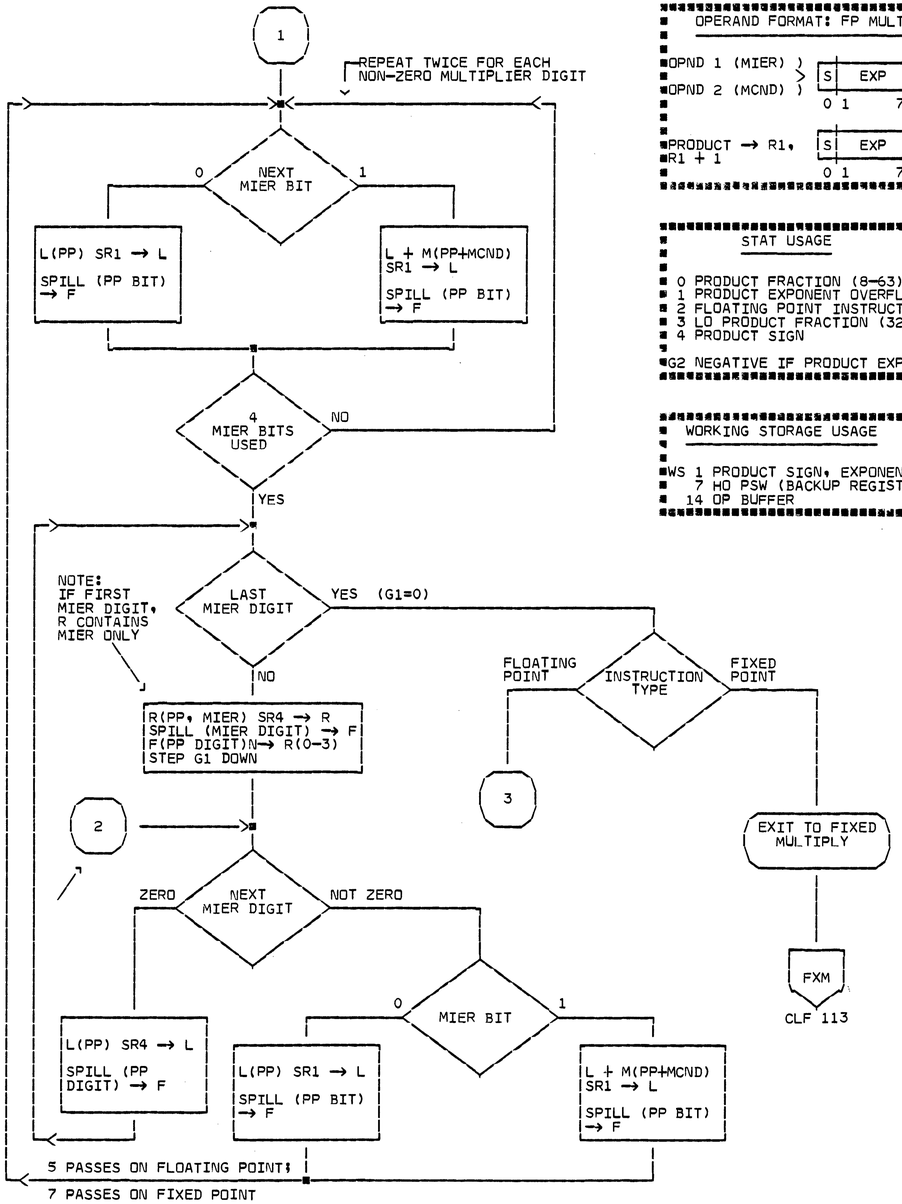


CLF 115
DATE 25 MAR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

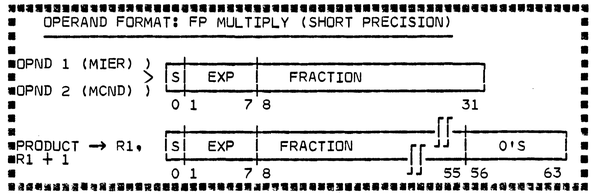
CLF 115

CL115





OPERAND FORMAT: FP MULTIPLY (SHORT PRECISION)



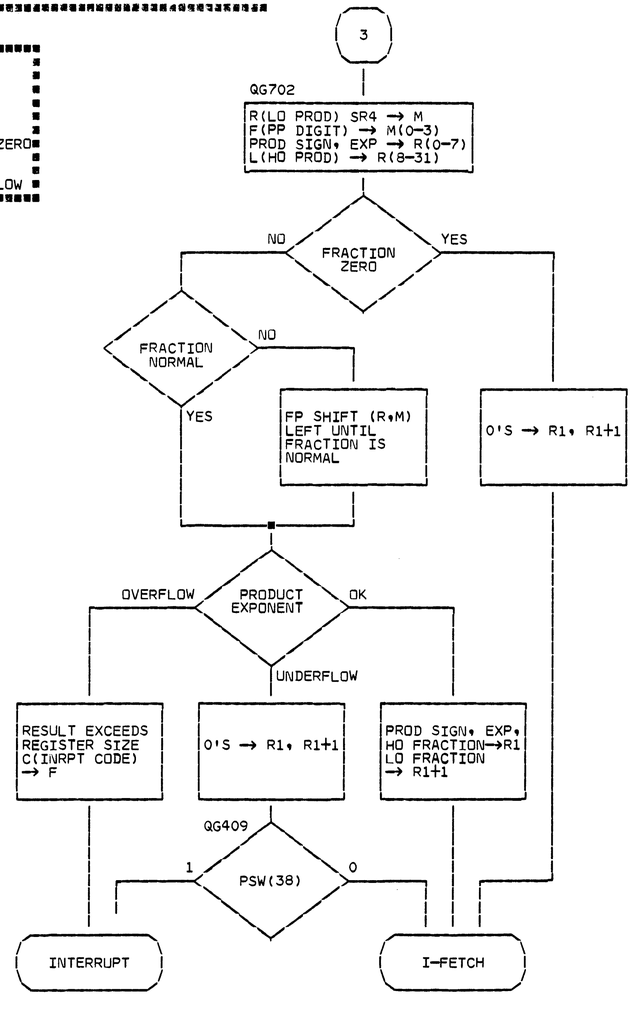
STAT USAGE

0	PRODUCT FRACTION (8-63) = ZERO
1	PRODUCT EXPONENT OVERFLOW
2	FLOATING POINT INSTRUCTION
3	LO PRODUCT FRACTION (32-63) = ZERO
4	PRODUCT SIGN

G2 NEGATIVE IF PRODUCT EXP UNDERFLOW

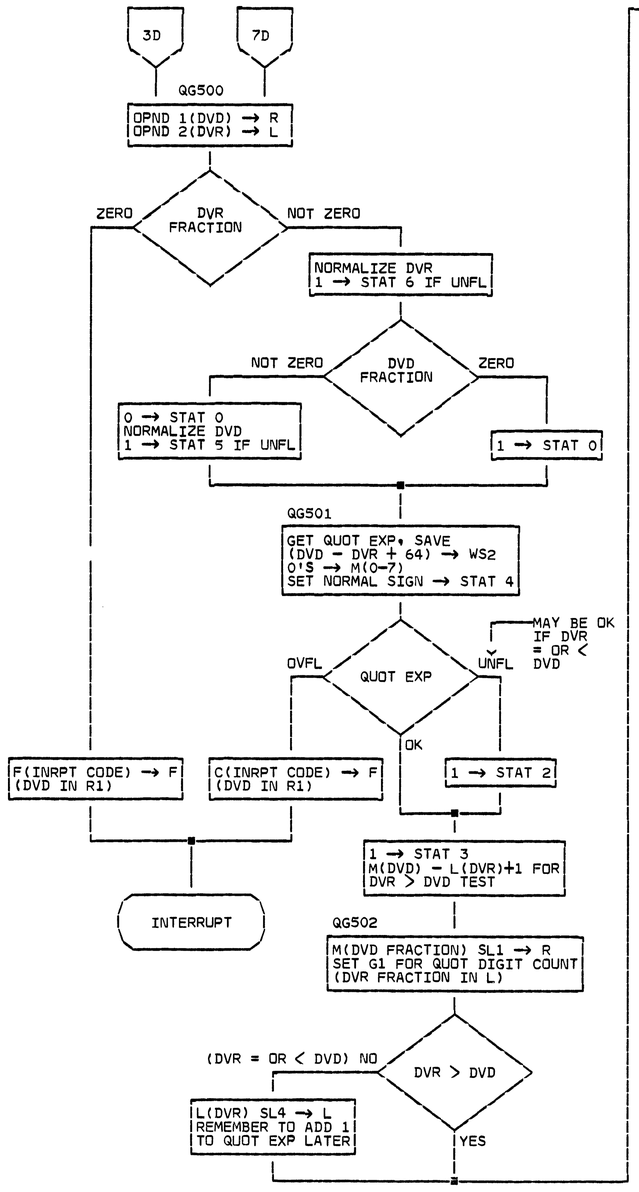
WORKING STORAGE USAGE

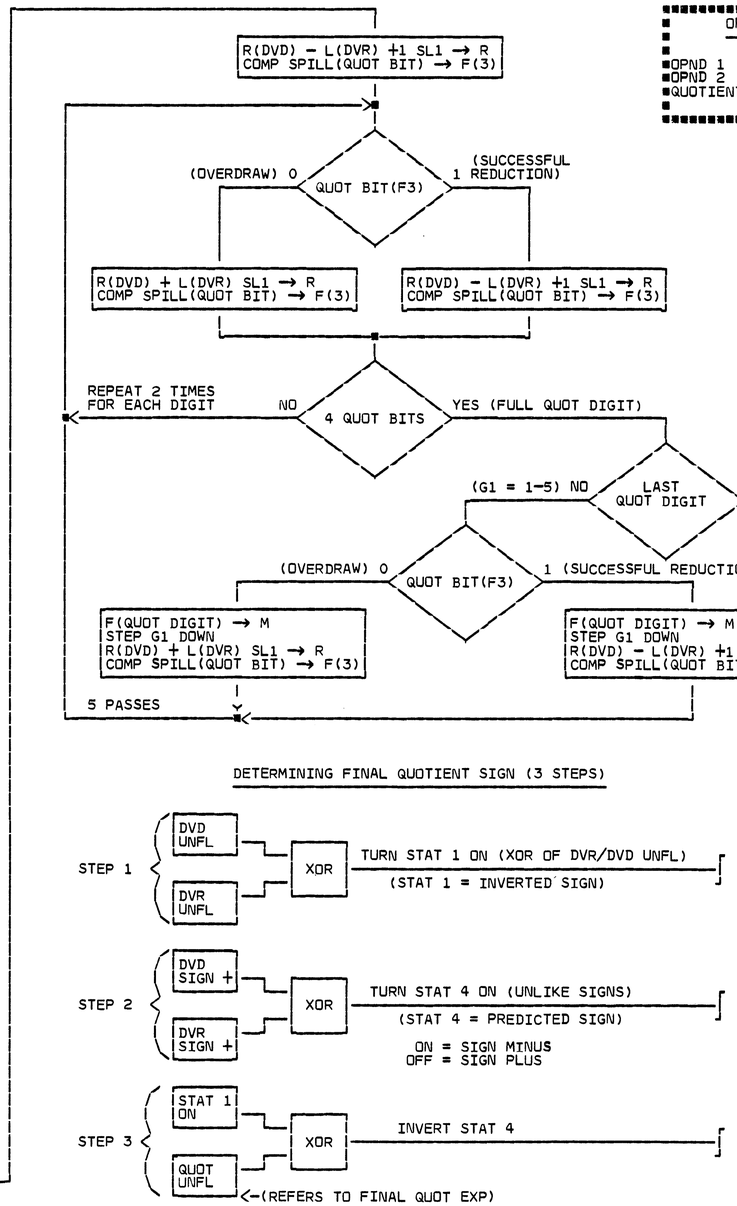
WS 1	PRODUCT SIGN, EXPONENT
7	HO PSW (BACKUP REGISTER)
14	OP BUFFER



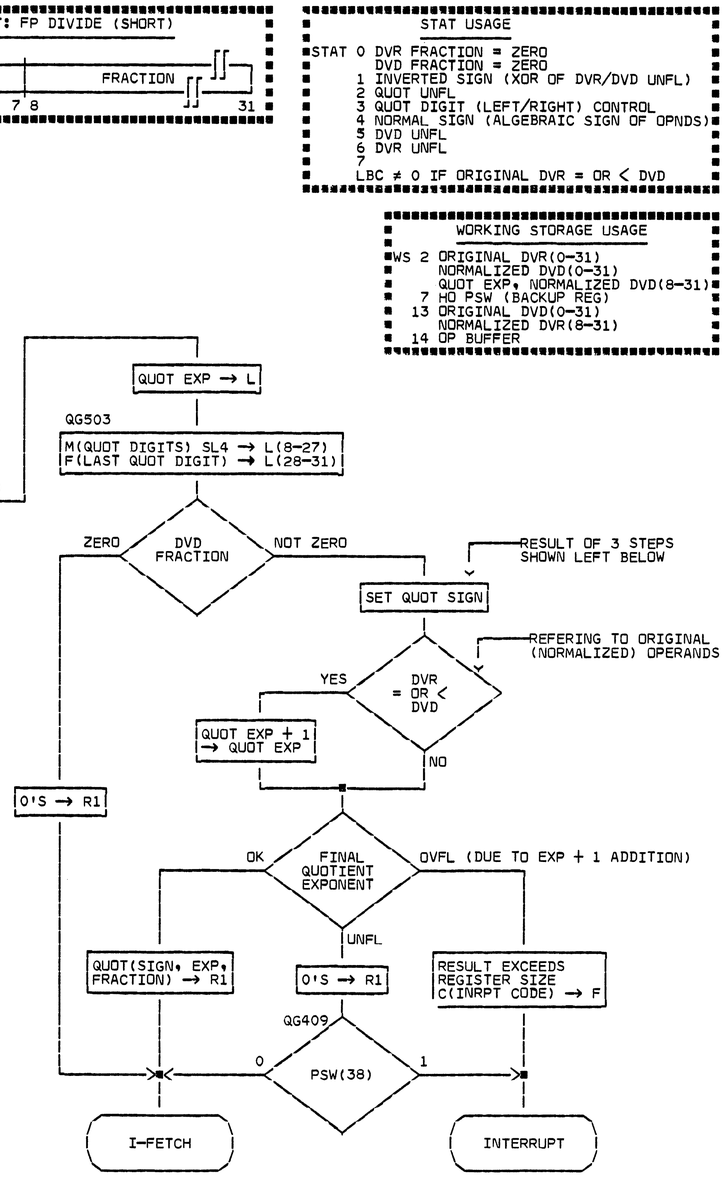
CLF 116
DATE 27 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL116

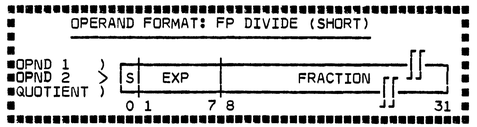




DETERMINING FINAL QUOTIENT SIGN (3 STEPS)



OPERAND FORMAT: FP DIVIDE (SHORT)



STAT USAGE

STAT 0 DVR FRACTION = ZERO
DVD FRACTION = ZERO
1 INVERTED SIGN (XOR OF DVR/DVD UNFL)
2 QUOT UNFL
3 QUOT DIGIT (LEFT/RIGHT) CONTROL
4 NORMAL SIGN (ALGEBRAIC SIGN OF OPNDS)
5 DVD UNFL
6 DVR UNFL
7
LBC ≠ 0 IF ORIGINAL DVR = OR < DVD

WORKING STORAGE USAGE

WS 2 ORIGINAL DVR(0-31)
NORMALIZED DVD(0-31)
QUOT EXP, NORMALIZED DVD(8-31)
7 HO PSW (BACKUP REG)
13 ORIGINAL DVD(0-31)
NORMALIZED DVR(8-31)
14 OP BUFFER

CLF 117
DATE 27 APR 65 MACH. 2050
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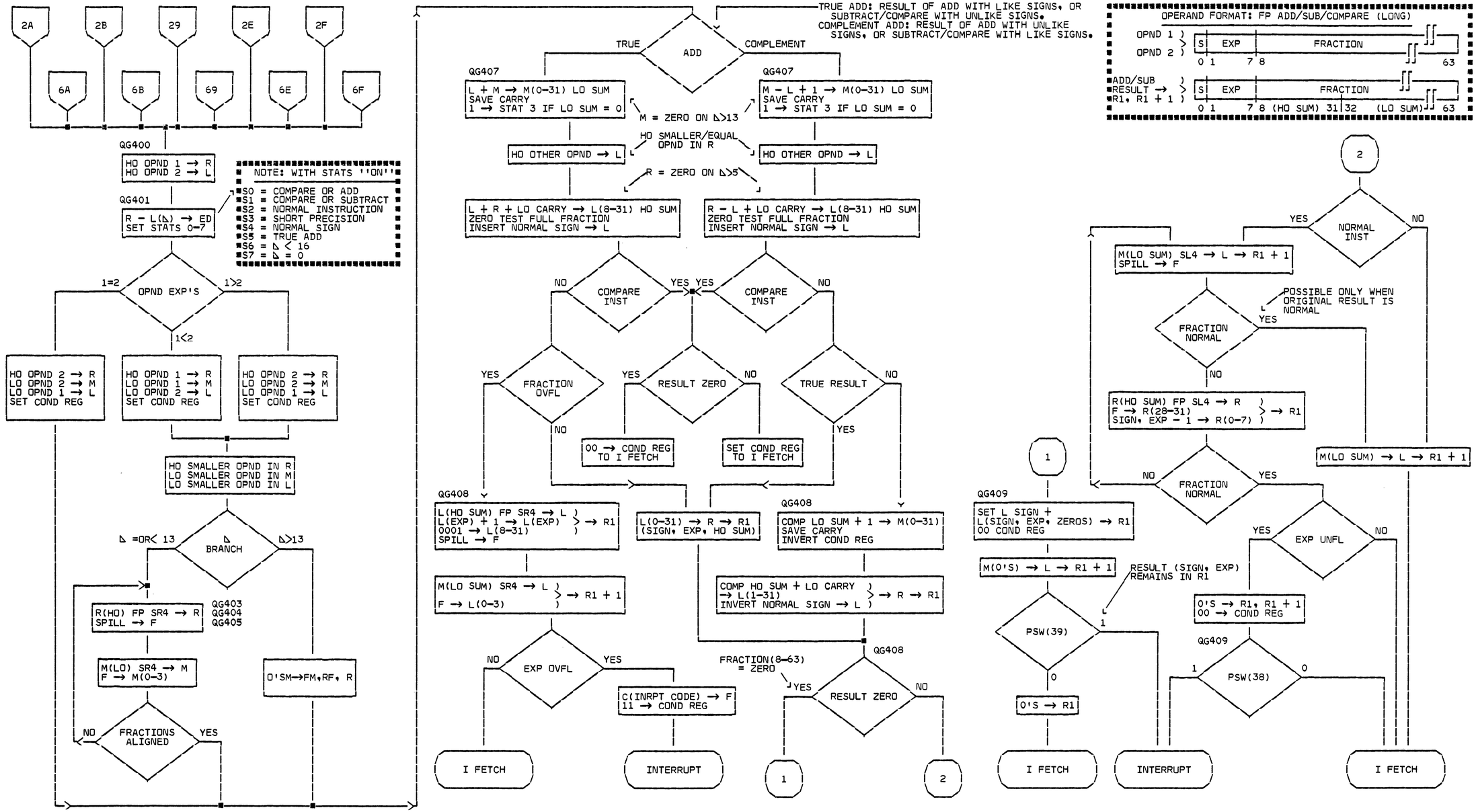
IBM CORP. SDD PAGE 2

CL117



IBM CONFIDENTIAL

CLF 118 FP ADD/SUBTRACT/COMPARE (LONG PRECISION)

CLF 118
DATE 27 APR 65 MACH. 2050
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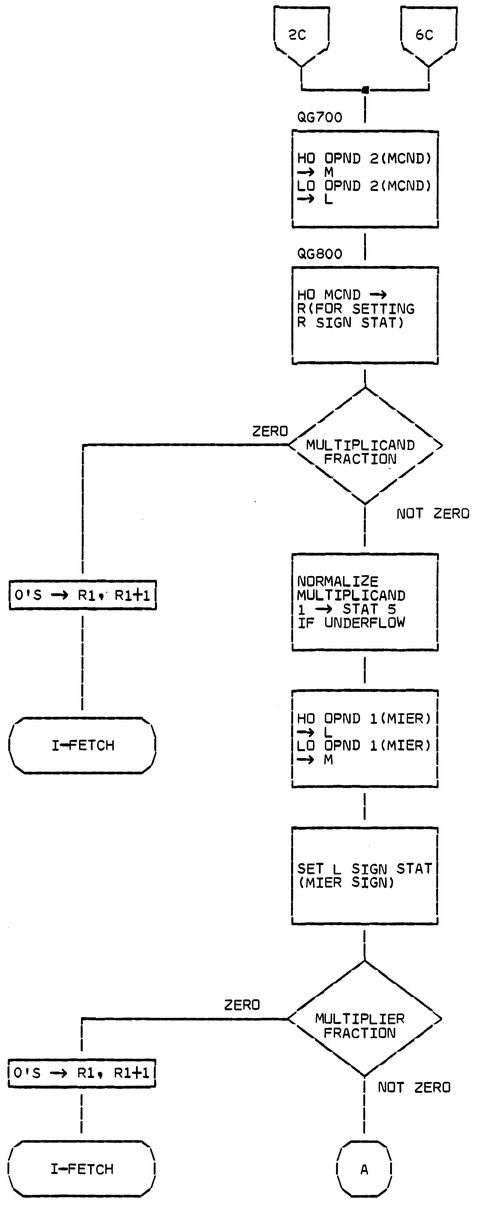
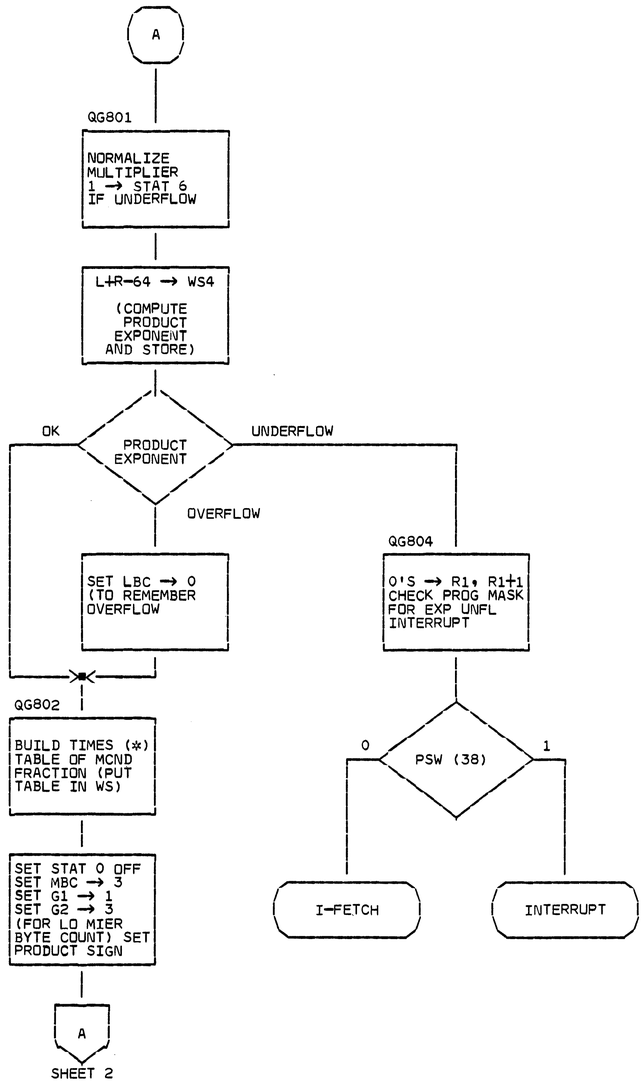
IBM CORP. SDD PAGE 2

CL118






```
OPERAND FORMAT: FP MULTIPLY (LONG PRECISION)

OPND 1(MIER)          )
OPND 2(MCND)          > | S | EXP |  FRACTION |
PRODUCT → R1, R1 + 1  )
                      0 1-7 8 ---------- 63
```

```
WORKING STORAGE USAGE

WS 0-R1 ADR (IN 8-11)
   1-LO 6* MCND
   2-HO 6* MCND
   3-HO MIER
   4-PRODUCT EXPONENT, HO MCND
   5-
   6-
   7-HO PSW BACKUP REGISTER
   8-LO 2* MCND
   9-HO 2* MCND
  10-
  11-ZERO'S
  12-LO 1* MCND
  13-HO 1* MCND
  14-OP BUFFER
  15-LO MCND
```

```
STAT USAGE

STAT 0 (BEFORE MIER PRENORMALIZATION)
       HO MIER = ZERO
       (DURING MULTIPLY ROUTINES)
       BORROW 'ON'
STAT 2 MULTIPLY WITH LEFT MIER DIGIT
     3 LO MIER = ZERO
     4 PRODUCT SIGN
     5 MCND UNDERFLOW
     6 MIER UNDERFLOW
```


CLF 119 FP MULTIPLY (LONG PRECISION) (SHEET 1 OF 2)

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CLF 119 SHEET 1 OF 2
DATE 27 APR 65 MACH. 2050
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P.N.
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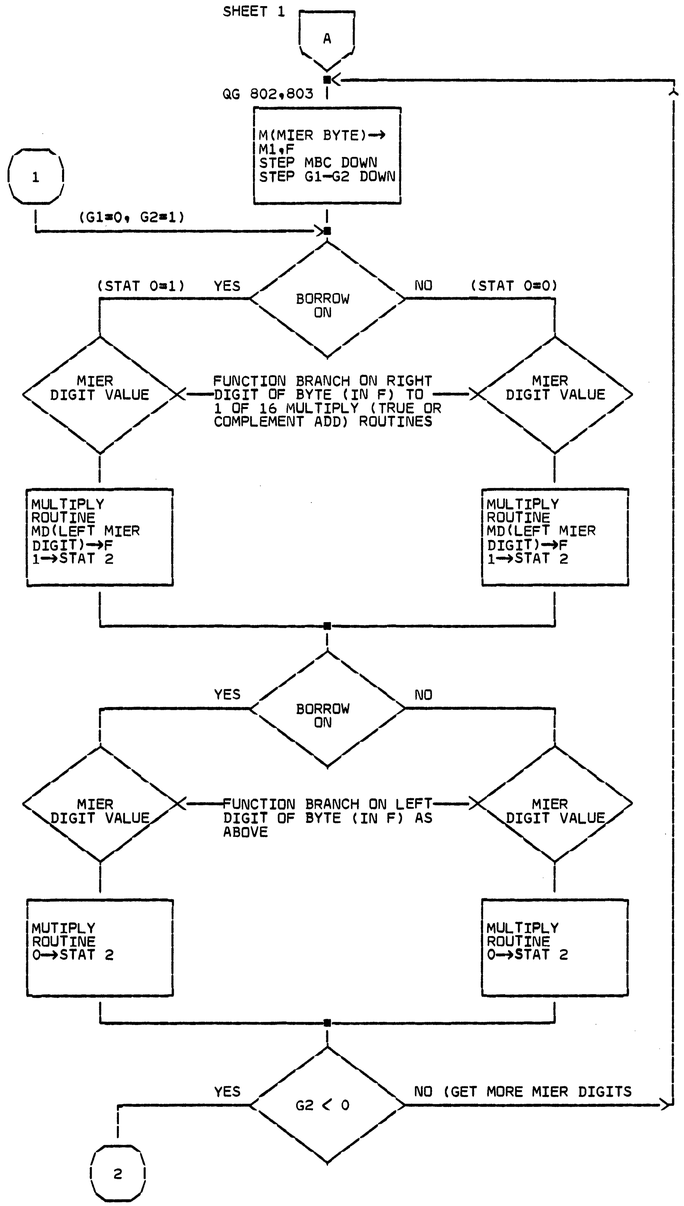
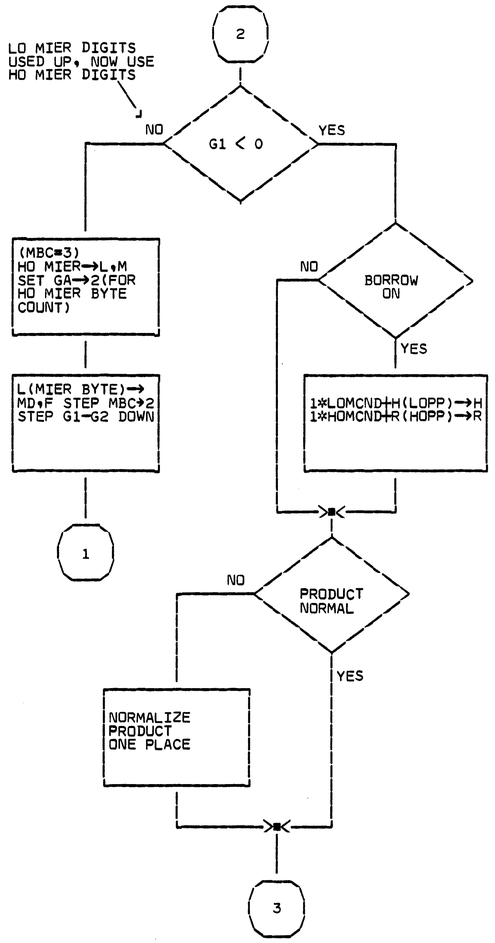
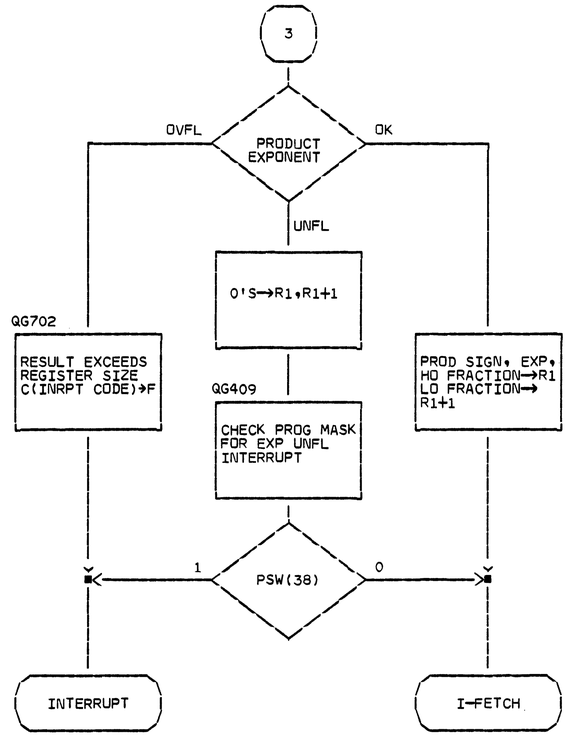
CL119







MIER DIGIT VALUES AND RESULTING ROUTINES

MIER DIGIT	BORROW OFF	BORROW ON
0	- - - -	+1
1	+1	+2
2	+2	+1,+2
3	+1,+2	+6,-2
4	+6,-2	+6,-1
5	+6,-1	+6
6	+6	+6,+1
7	+6,+1	+6,+2
8	+6,+2	-6,-1, B
9	-6,-1, B	-6, B
10	-6, B	-6,+1, B
11	-6,+1, B	-6,+2, B
12	-6,+2, B	-2,-1, B
13	-2,-1, B	-2, B
14	-2, B	-1, B
15	-1, B	B

CLF 119 SHEET 2 OF 2
DATE 27 APR 65 MACH. 2050
FRAME
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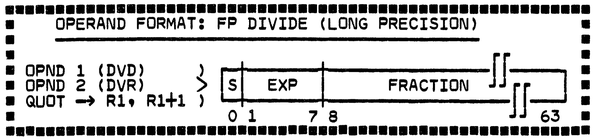
IBM CORP. SDD PAGE 3

CL119

OPERAND FORMAT: FP DIVIDE (LONG PRECISION)



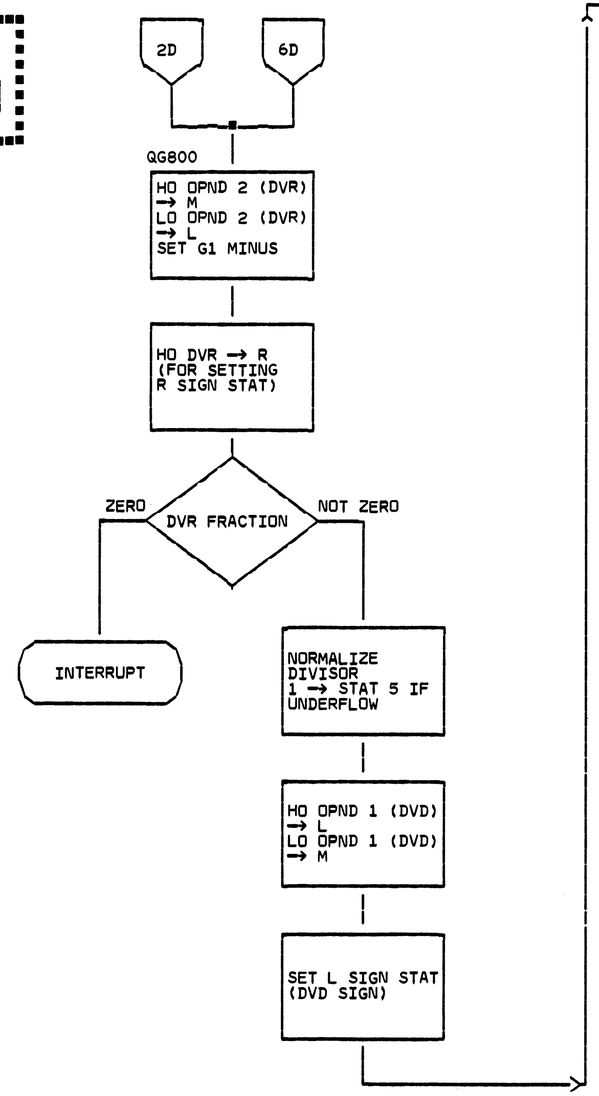
WORKING STORAGE USAGE

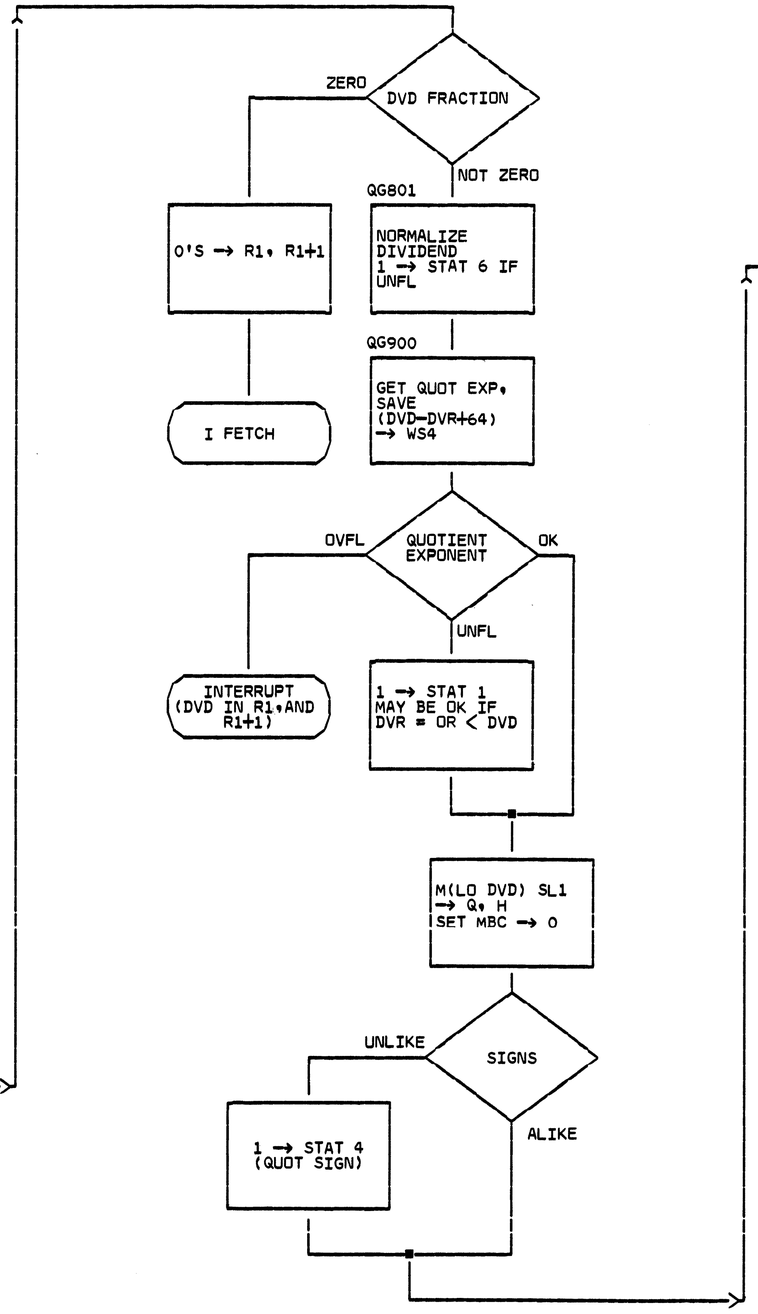
WS 1 HO QUOT
3 HO QUOT
4 QUOT EXP
7 HO PSW (BACKUP REG)
11 HO DVR
12 LO DVR) ORIGINAL
13 HO DVR) NORMALIZED
SL4 WHEN DVR = OR < DVD
14 OP BUFFER
15 LO DVR

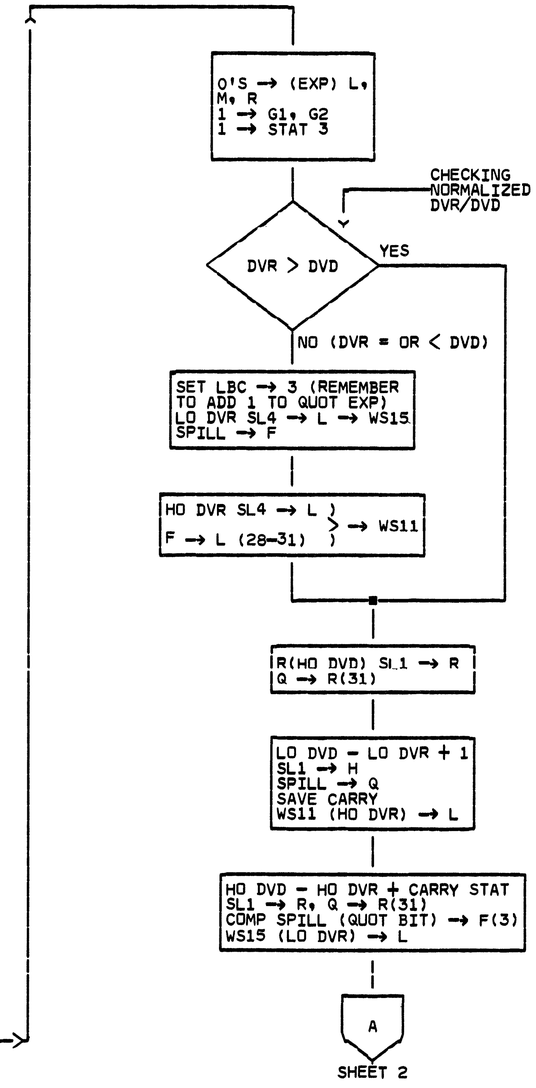
STAT USAGE

CARRY STAT HOLDS LO REDUCTION CARRIES

STAT 1 QUOT EXP UNFL
3 LEFT QUOT DIGIT
4 QUOT SIGN
5 DVR UNFL
6 DVD UNFL







FP DIVIDE (LONG PRECISION)
CLF 120 SHEET 1 OF 2
DATE 27 JUN 66 MACH. 2050
FRAME
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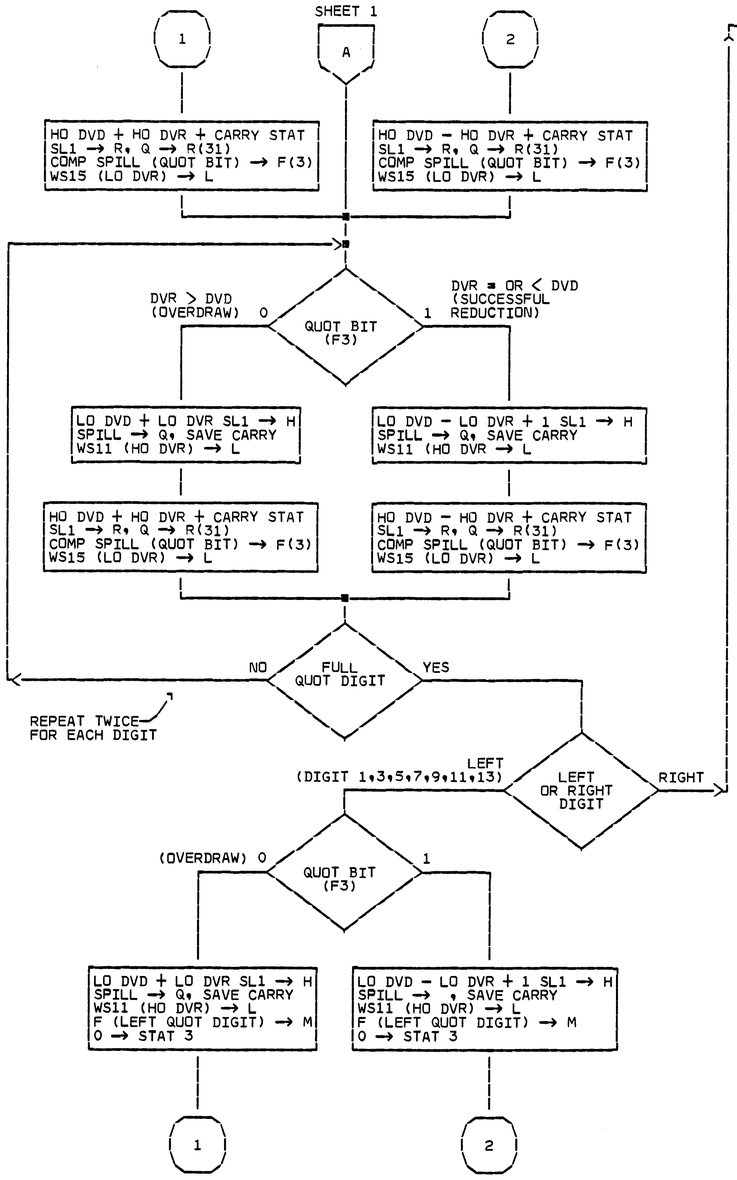
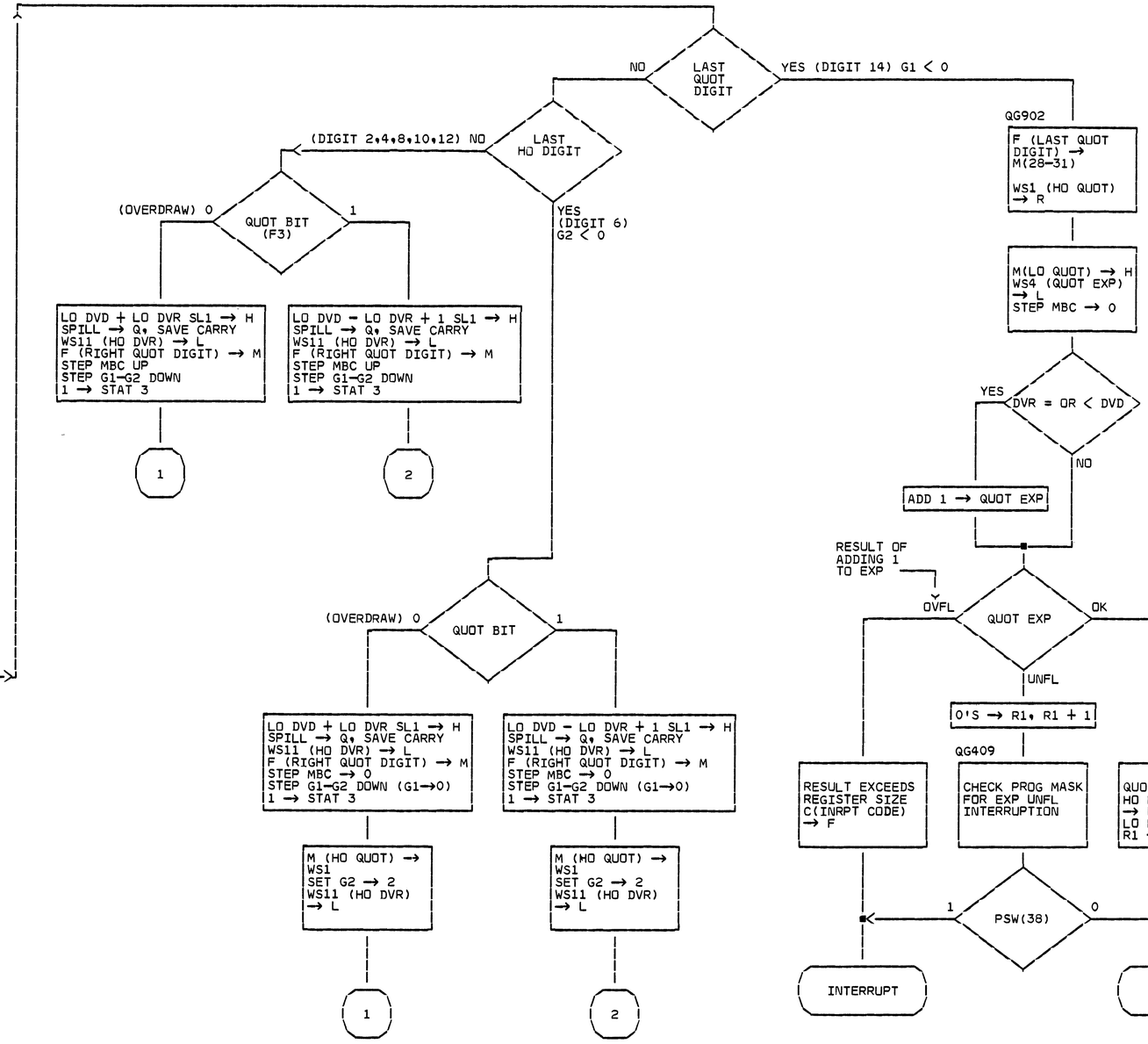
IBM CORP. SDD PAGE 2

CL120

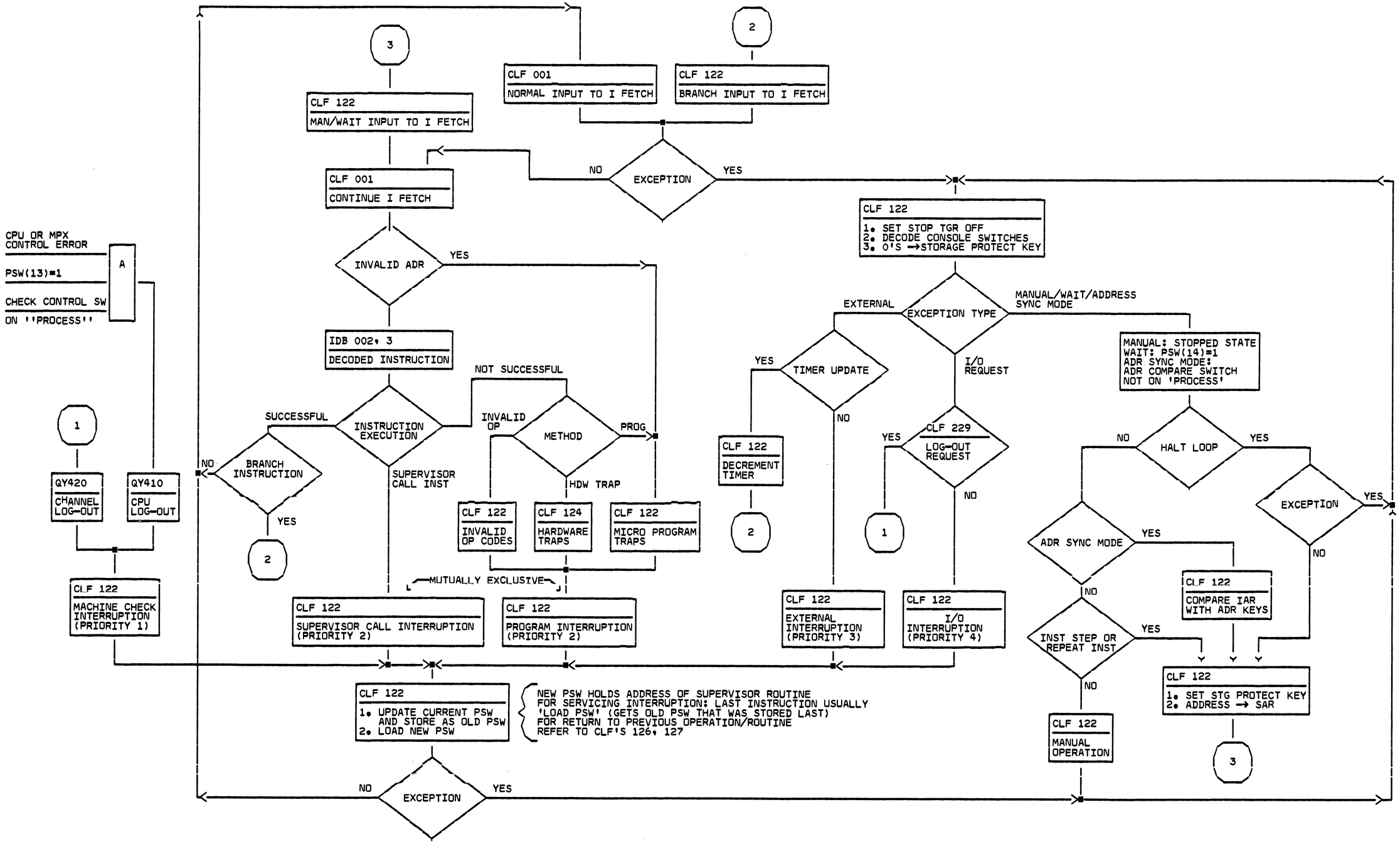




CLF 120 SHEET 2 OF 2
DATE 27 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 3

CL120

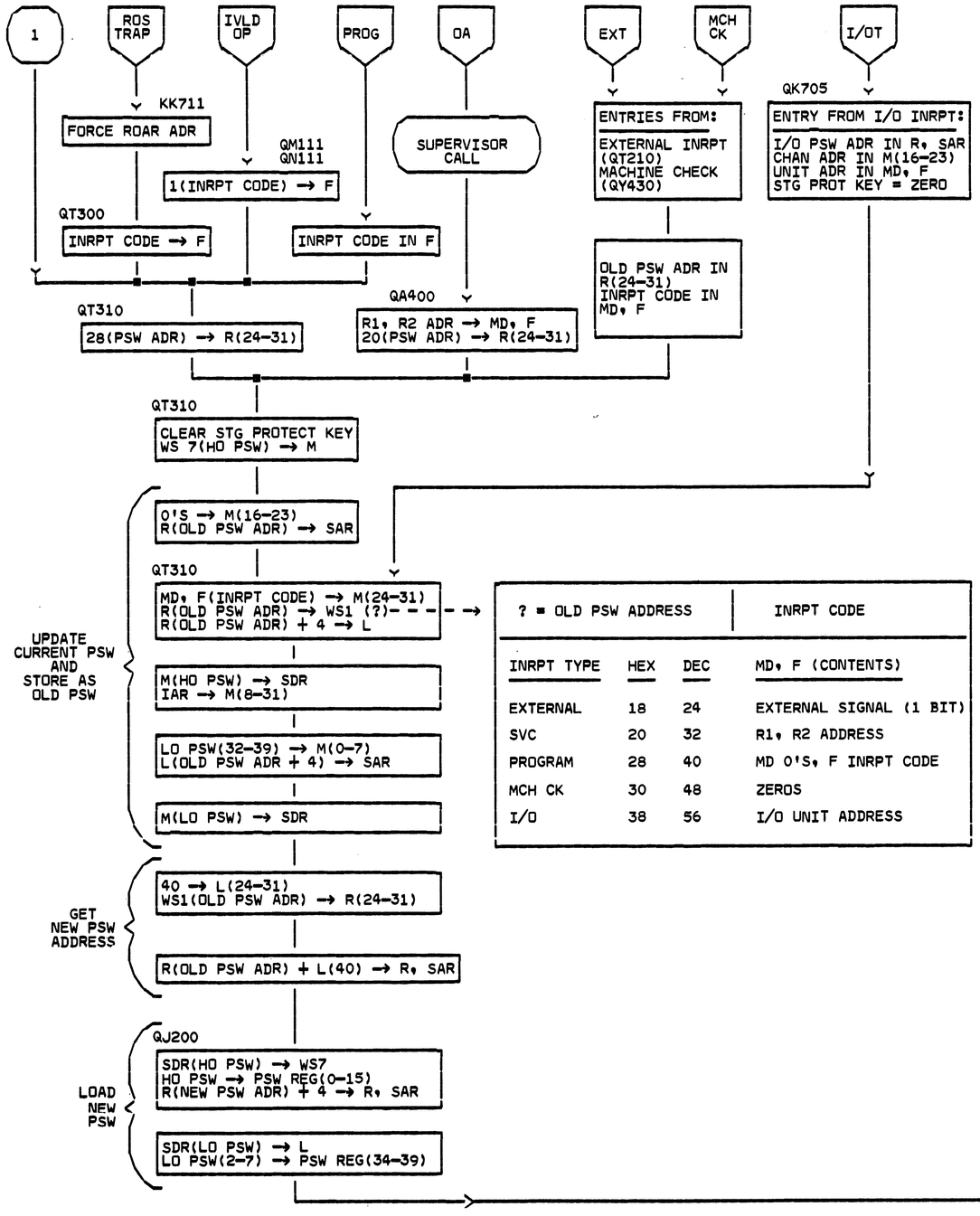
CLF 120 FP DIVIDE (LONG PRECISION) (SHEET 2 OF 2)

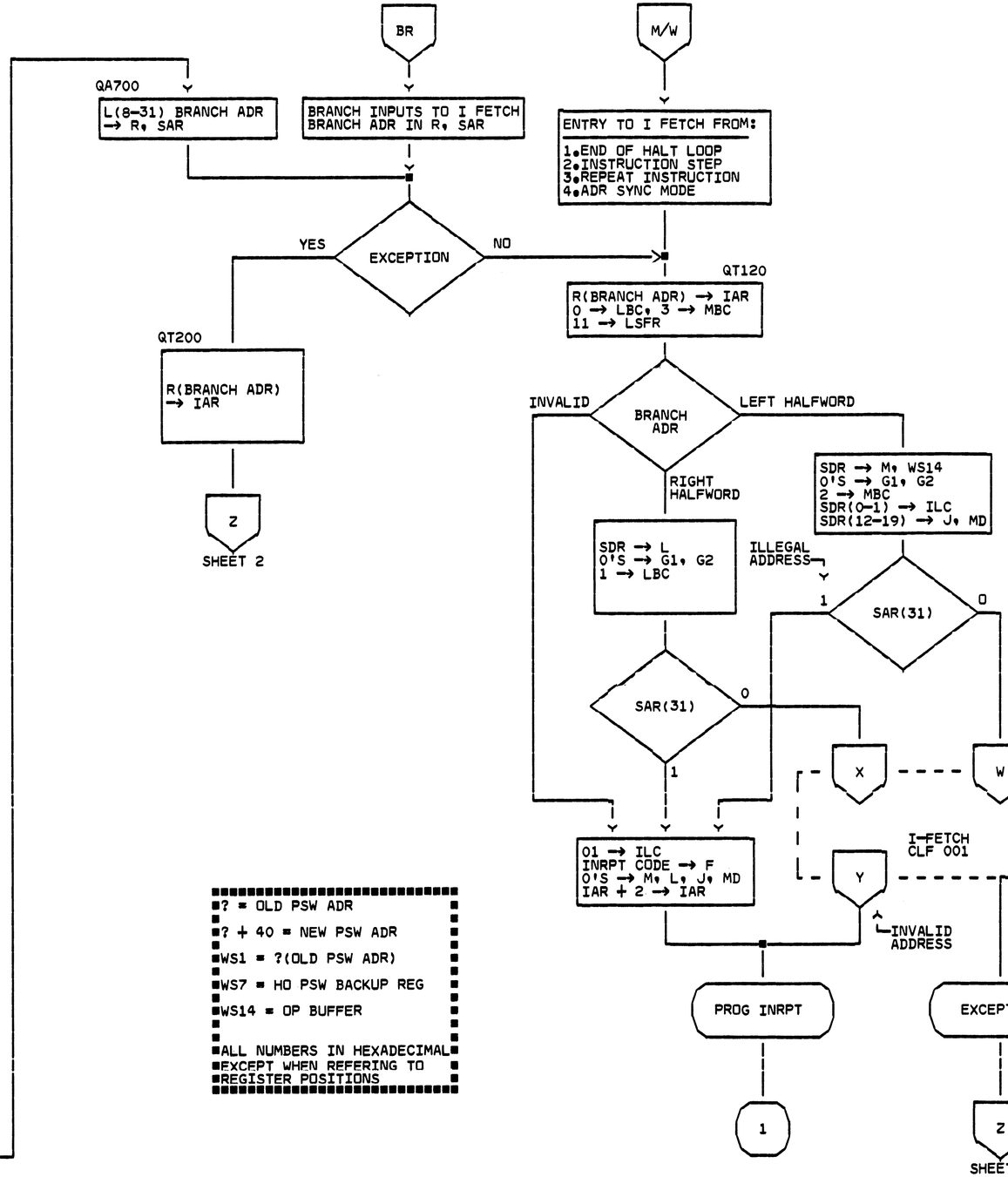


● CLF 121 BASIC INTERRUPTION FLOW

CLF 121
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL121 1





? = OLD PSW ADR

? + 40 = NEW PSW ADR

WS1 = ?(OLD PSW ADR)

WS7 = HO PSW BACKUP REG

WS14 = OP BUFFER

ALL NUMBERS IN HEXADECIMAL EXCEPT WHEN REFERING TO REGISTER POSITIONS

CLF 122 SHEET 1 OF 2
DATE 27 JUN 66 MACH, 2050

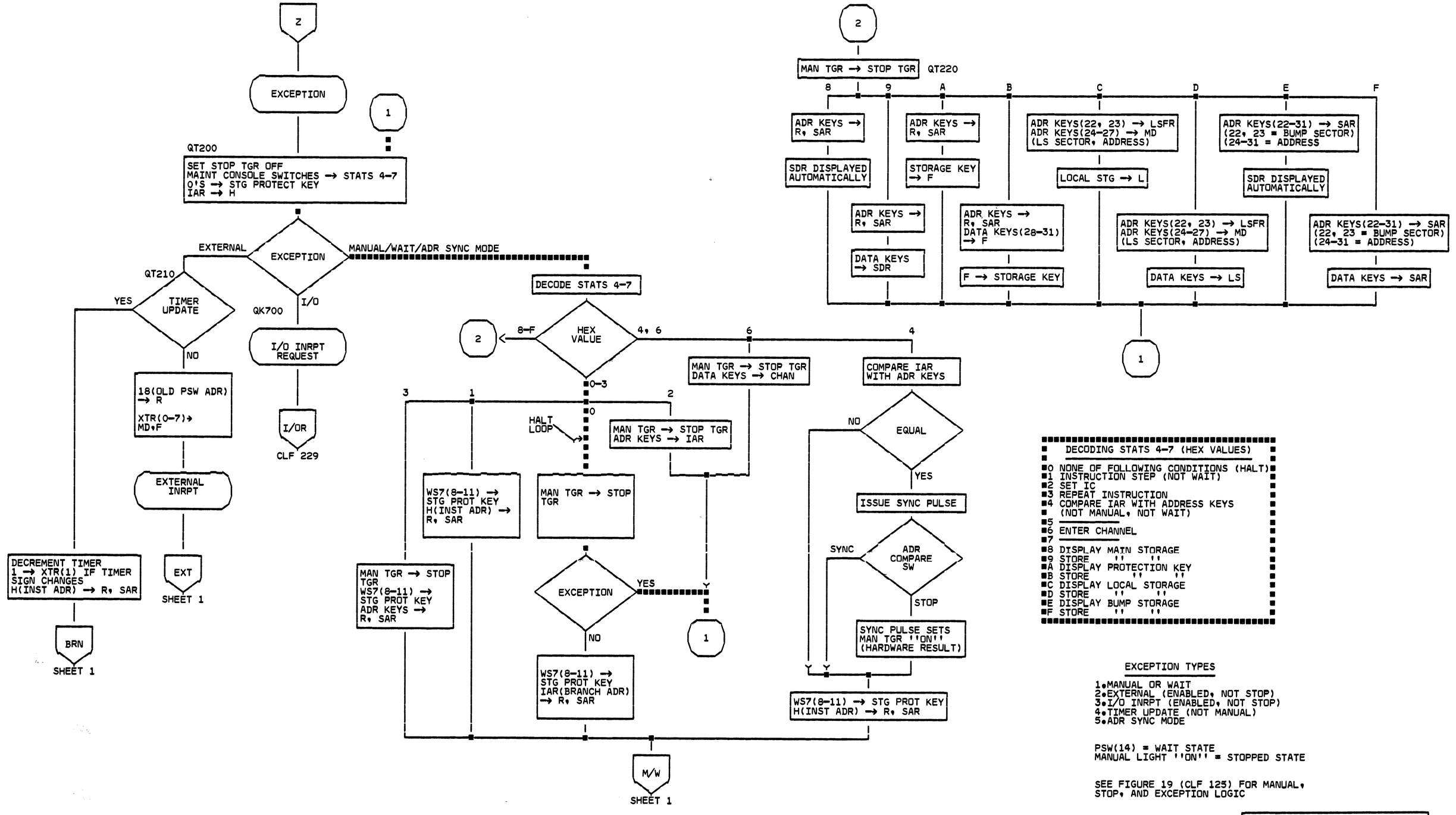
FRAME

P.N.

IBM CORP. SDD PAGE 2

CL122

● CLF 122 INTERRUPTIONS/EXCEPTIONS (SHEET 1 OF 2)



DECODING STATS 4-7 (HEX VALUES)

0 NONE OF FOLLOWING CONDITIONS (HALT)
1 INSTRUCTION STEP (NOT WAIT)
2 SET IC
3 REPEAT INSTRUCTION
4 COMPARE IAR WITH ADDRESS KEYS (NOT MANUAL, NOT WAIT)
5
6 ENTER CHANNEL
7
8 DISPLAY MAIN STORAGE
9 STORE '' ''
A DISPLAY PROTECTION KEY
B STORE '' ''
C DISPLAY LOCAL STORAGE
D STORE '' ''
E DISPLAY BUMP STORAGE
F STORE '' ''

EXCEPTION TYPES

1. MANUAL OR WAIT
2. EXTERNAL (ENABLED, NOT STOP)
3. I/O INRPT (ENABLED, NOT STOP)
4. TIMER UPDATE (NOT MANUAL)
5. ADR SYNC MODE

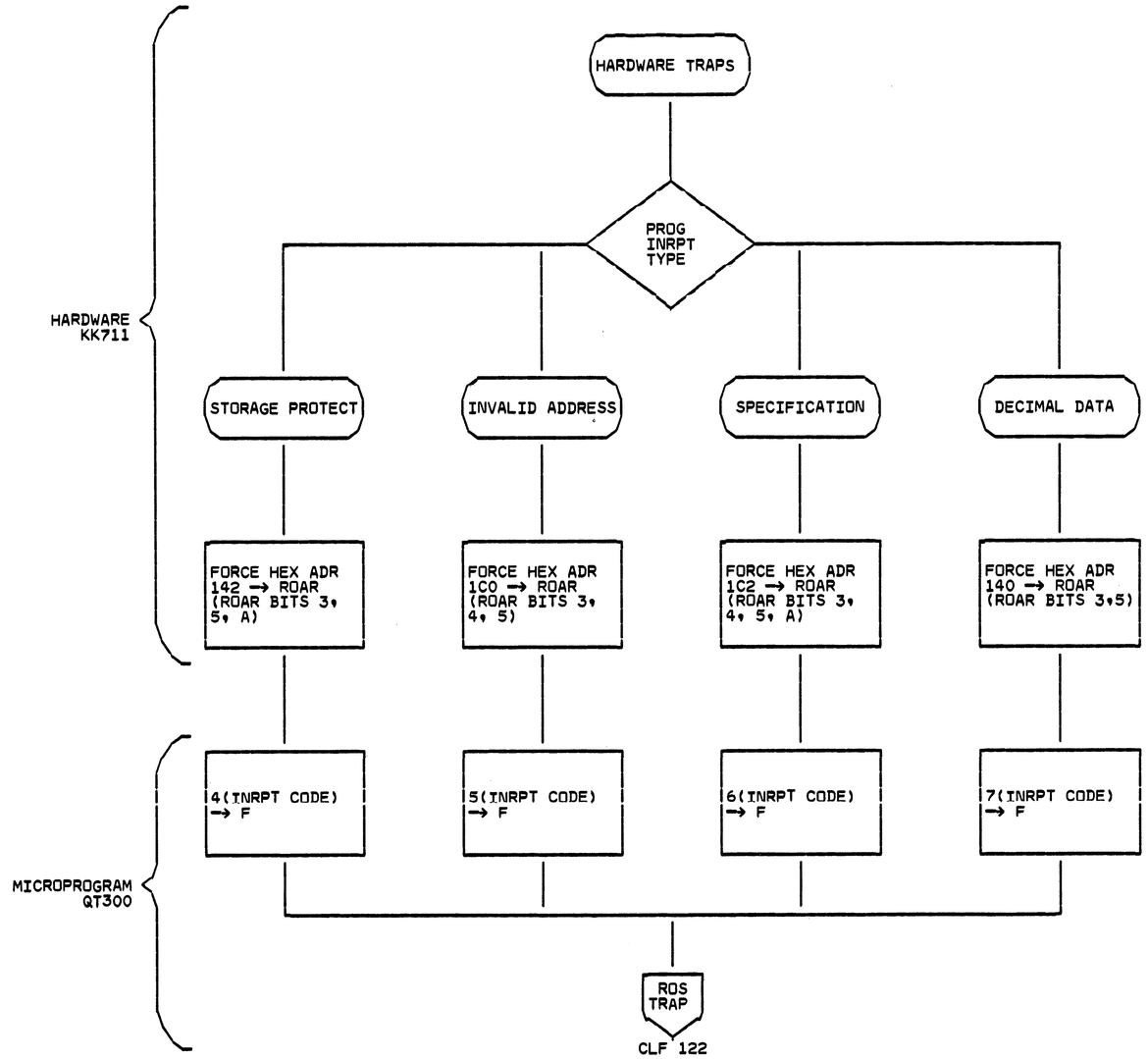
PSW(14) = WAIT STATE
MANUAL LIGHT ''ON'' = STOPPED STATE

SEE FIGURE 19 (CLF 125) FOR MANUAL, STOP, AND EXCEPTION LOGIC

CLF 122 SHEET 2 OF 2
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 3

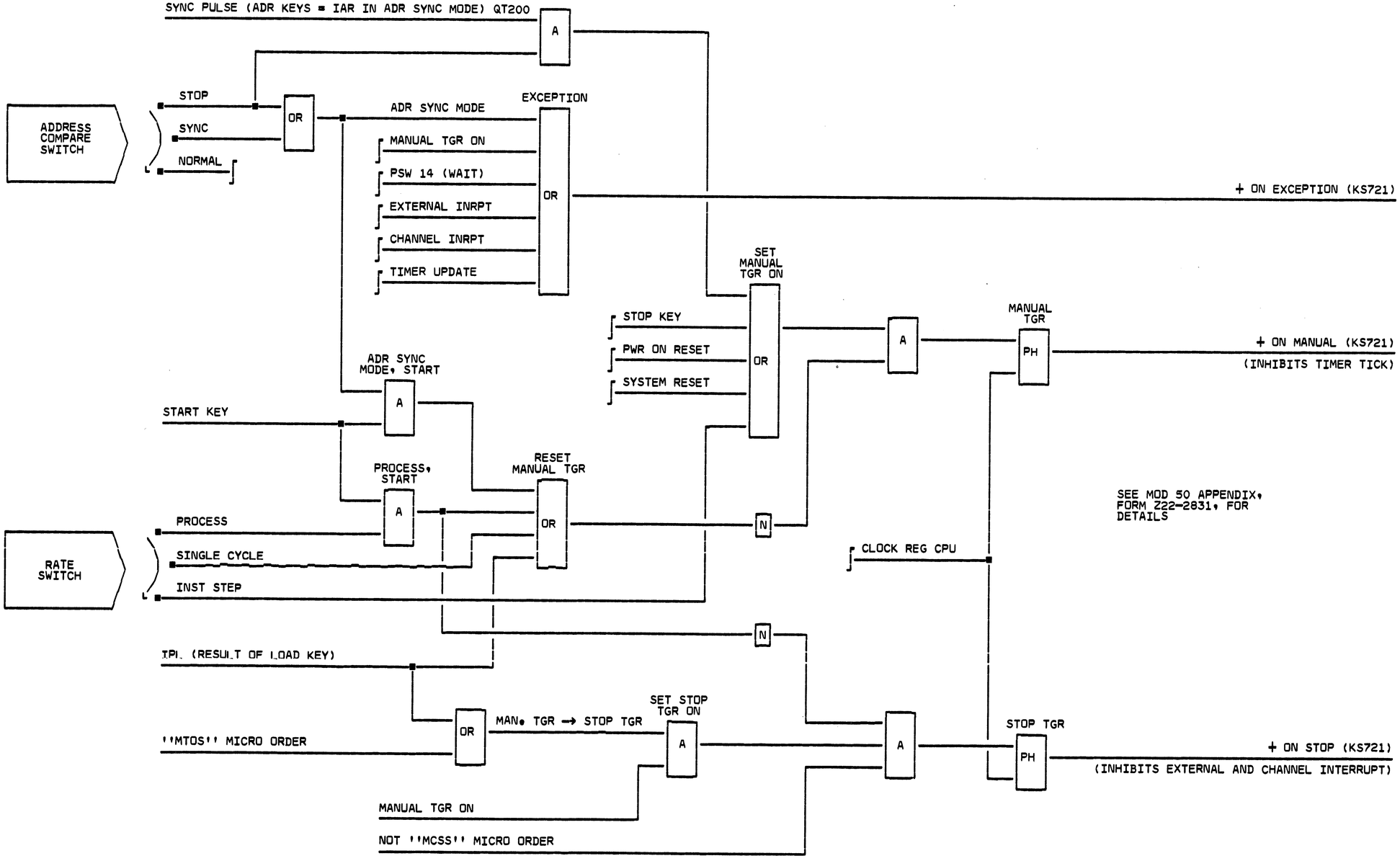
CL122

● CLF 122 INTERRUPTIONS/EXCEPTIONS (SHEET 2 OF 2)



CLF 124
DATE 27 JUN 66 MACH● 2050
FRAME
P●N●
IBM CORP● SDD PAGE 2

CL124

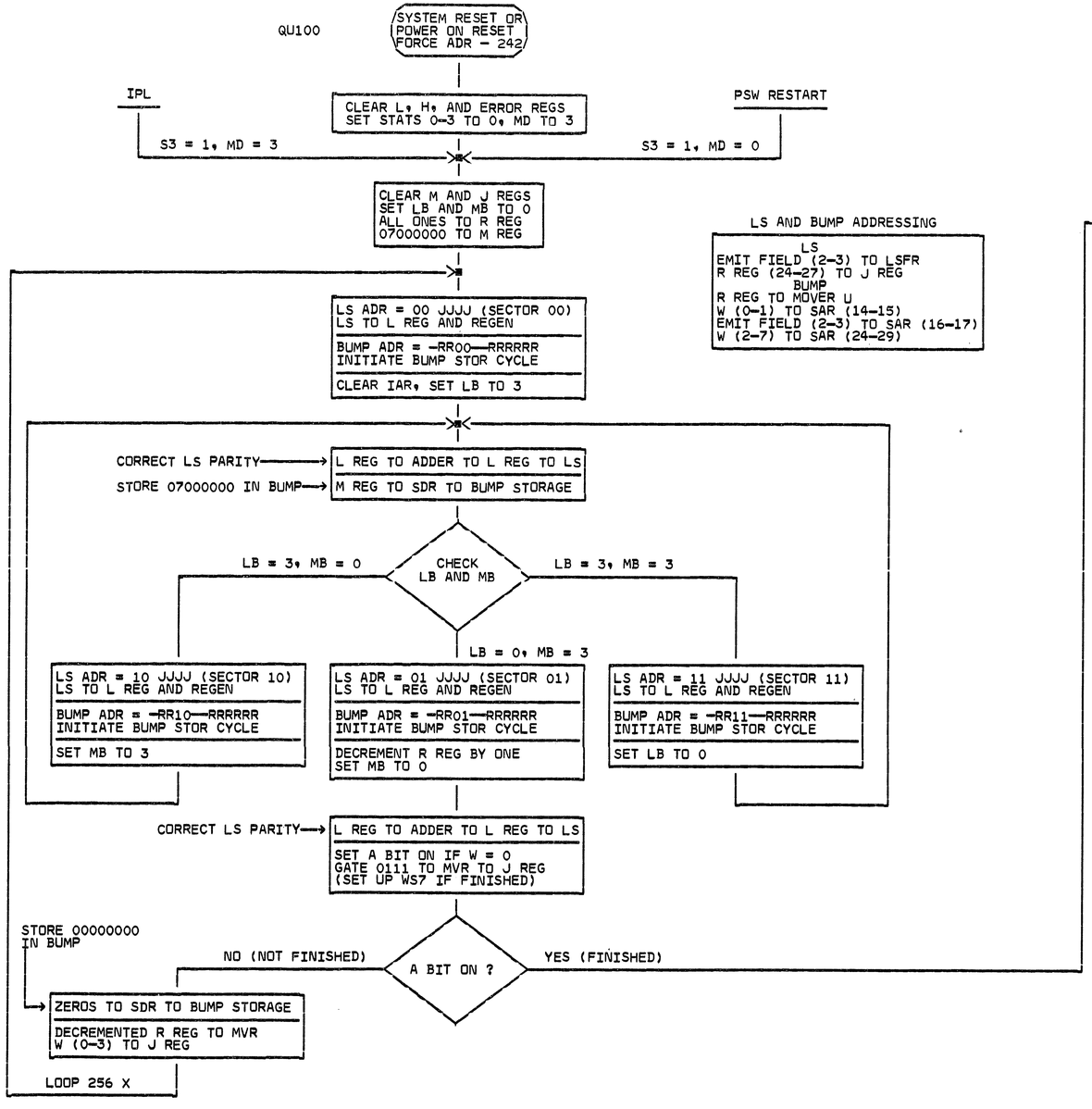


CLF 125 MANUAL/STOP/EXCEPTION LOGIC

CLF 125		
DATE 27 JUN 66	MACH. 2050	
	FRAME	
	P.N.	
IBM CORP. SDD	PAGE	2

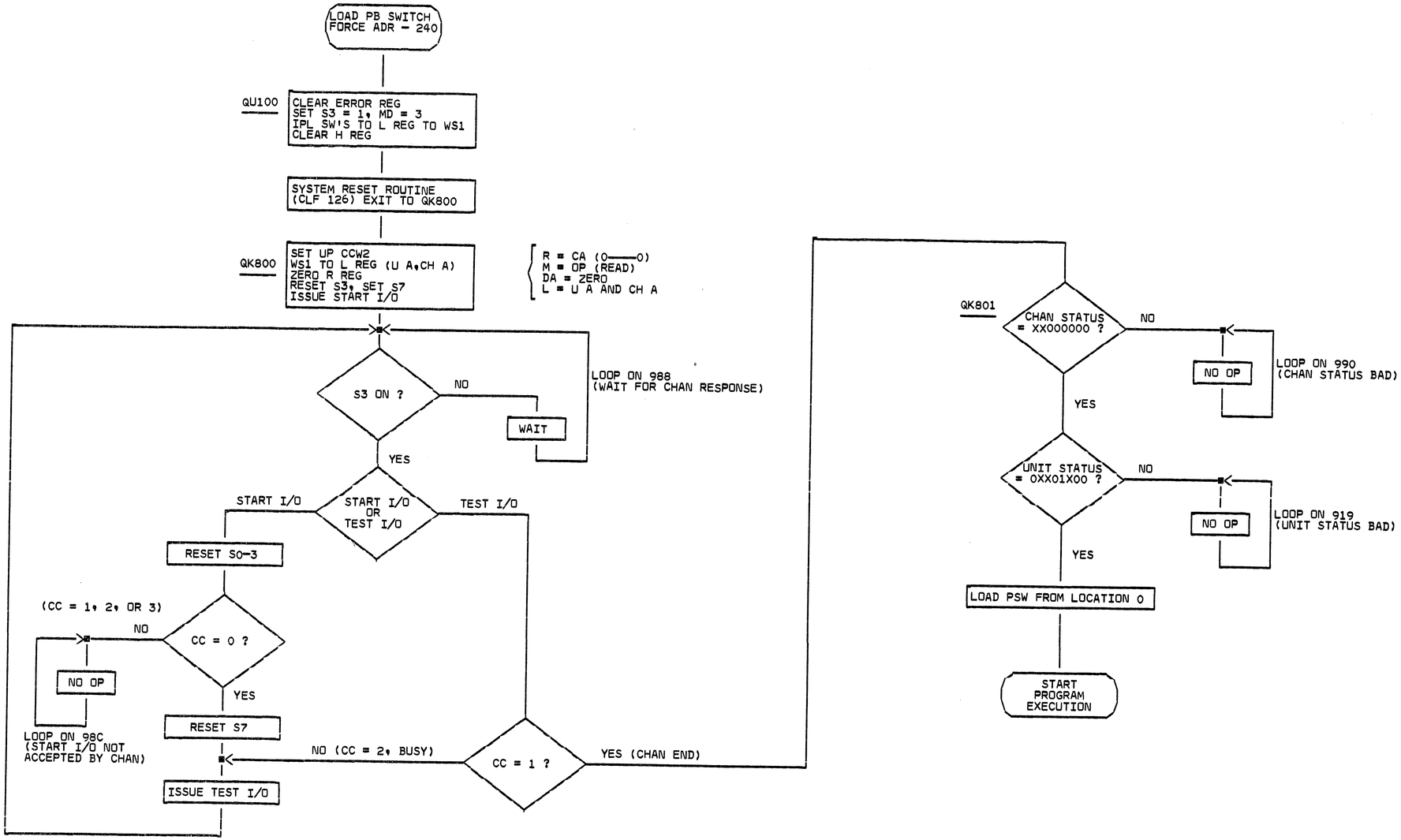
CL1-25

Form Z22-2833-4
Page Added 8/1/66
by FES Z22-6600-1



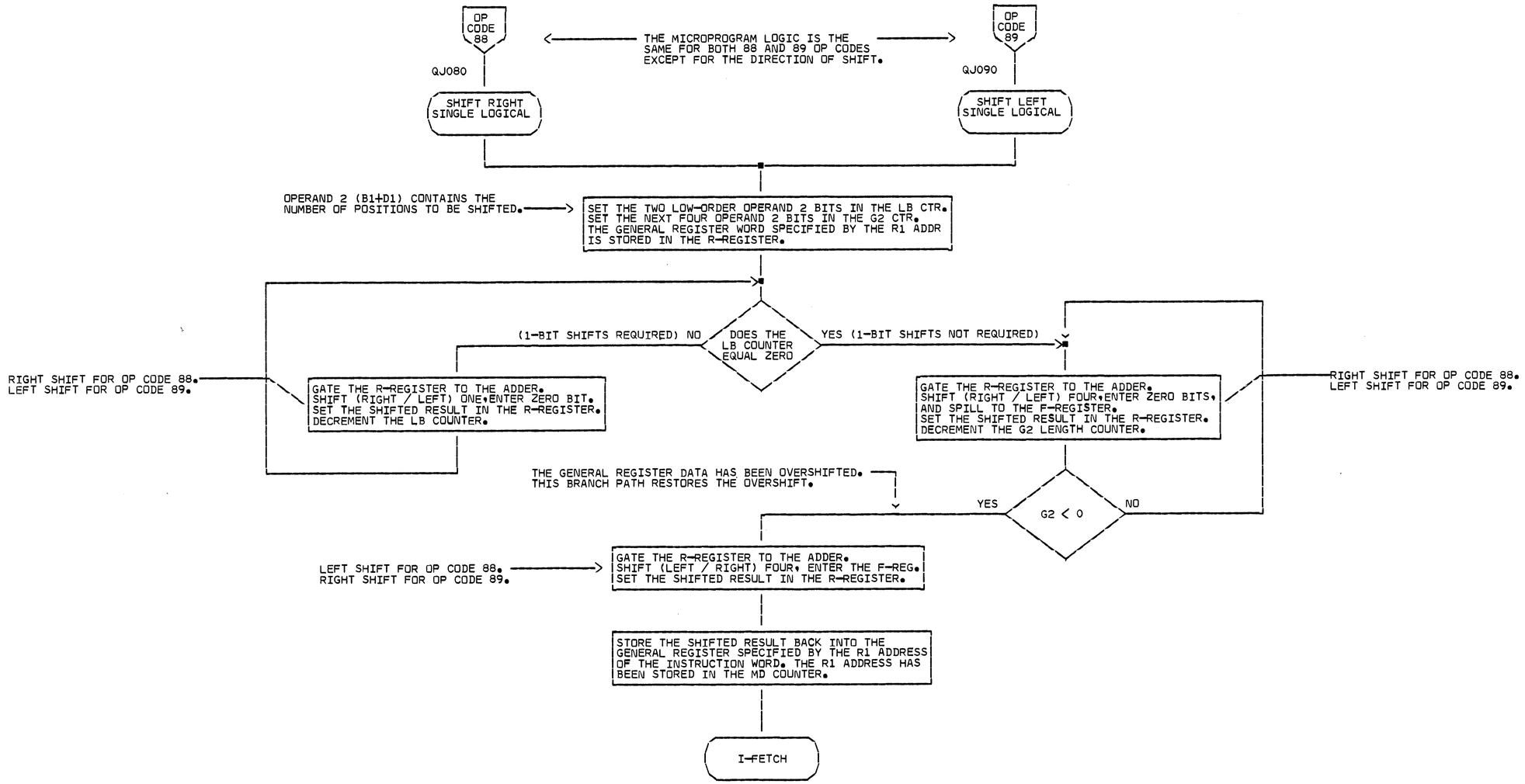
CLF 126 SYSTEM RESET

CLF 126	SYSTEM RESET	
DATE 3 AUG 66	MACH. 2050	CL126
	FRAME	
	P.N.	
IBM CORP. SDD	PAGE 1	

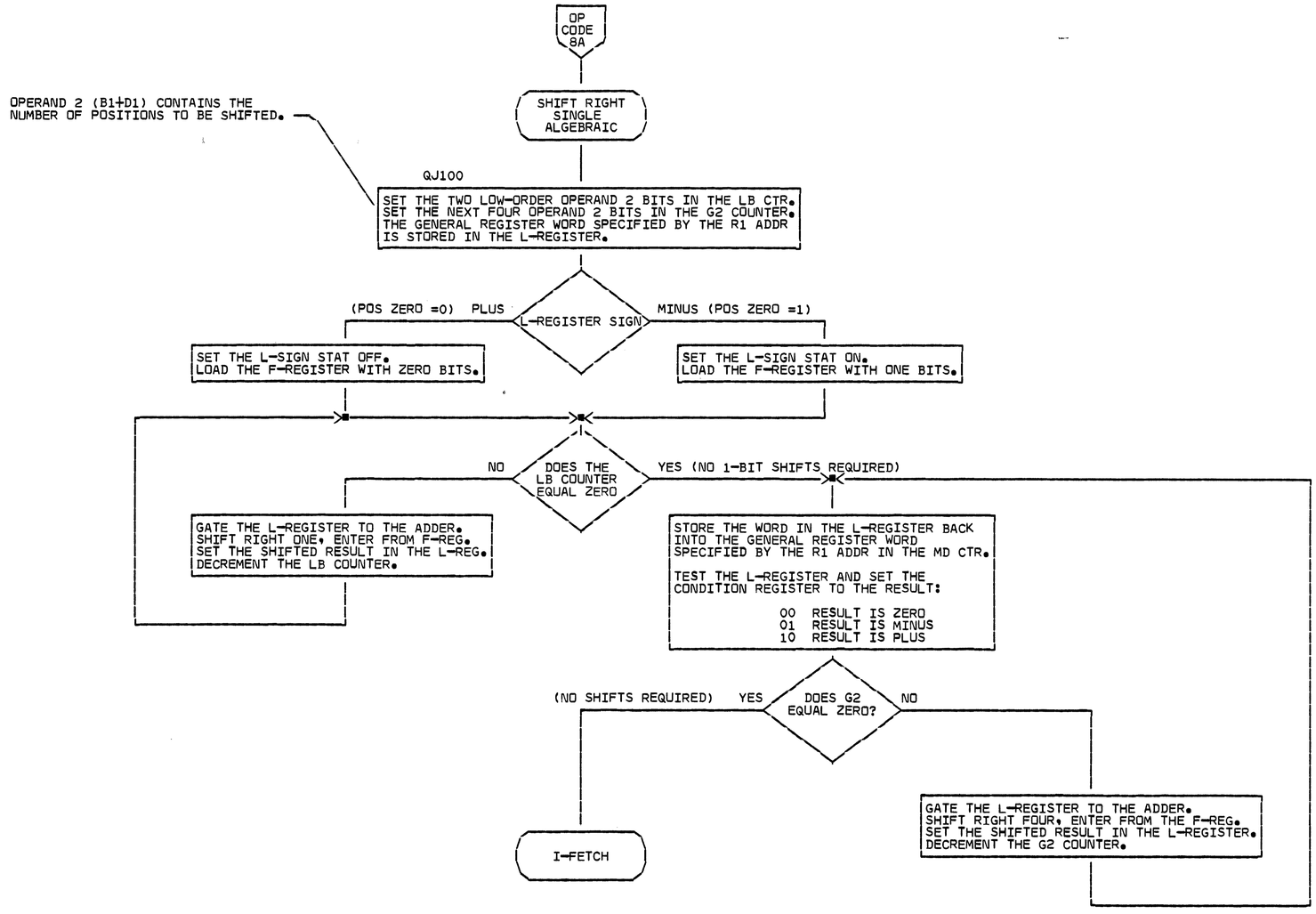


CLF 127 INITIAL PROGRAM LOAD
DATE 3 AUG 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1
CL-127

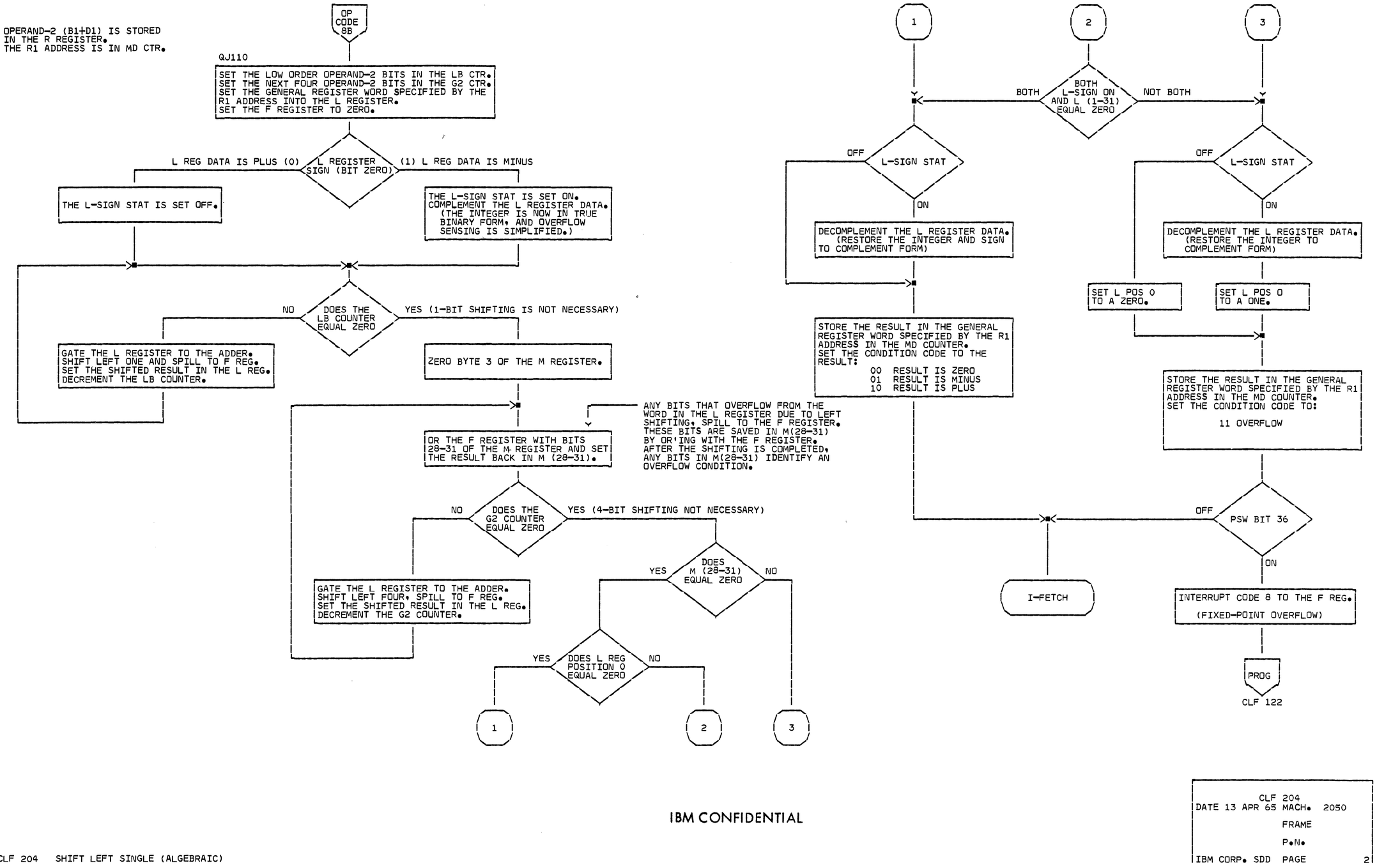
Form Z22-2833-4
Page Added 8/1/66
by FIS Z22-6600-1



CLF 201	C L 2 0 1
DATE 8 APR 65 MACH. 2050	
FRAME	
P.N.	
IBM CORP. SDD PAGE 2	



OPERAND-2 (B1+D1) IS STORED
IN THE R REGISTER.
THE R1 ADDRESS IS IN MD CTR.

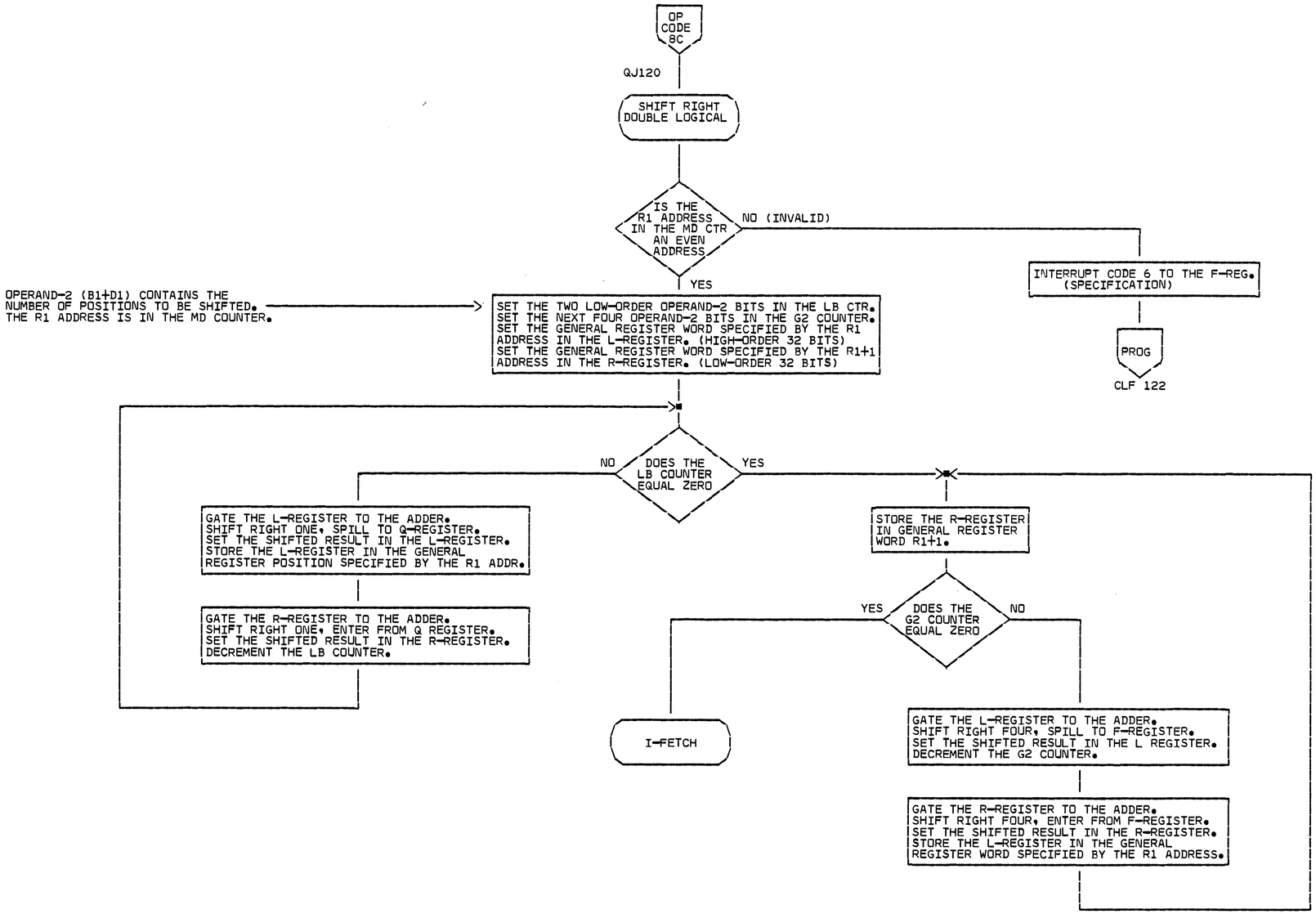


IBM CONFIDENTIAL

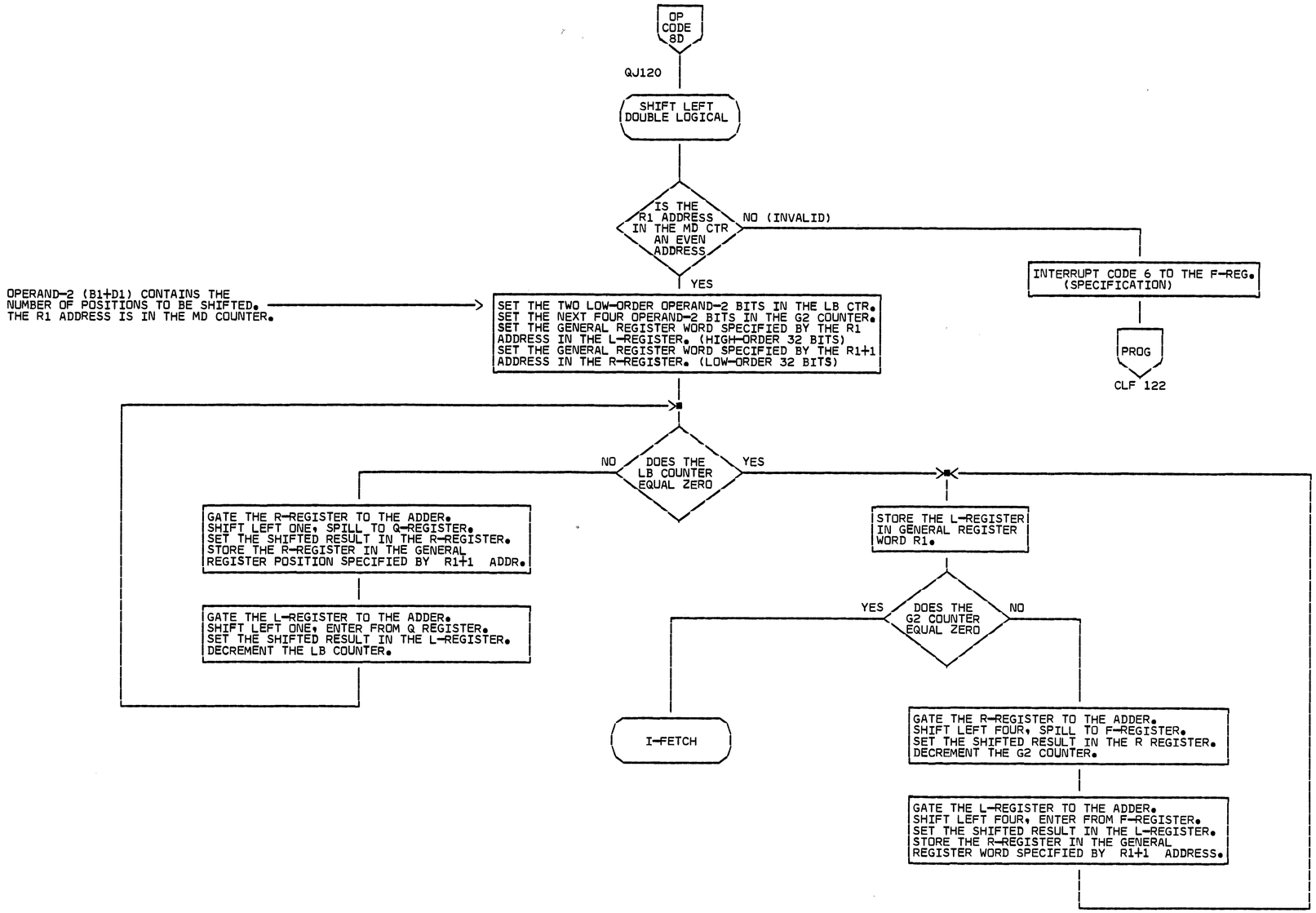
CLF 204 SHIFT LEFT SINGLE (ALGEBRAIC)

CLF 204
DATE 13 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

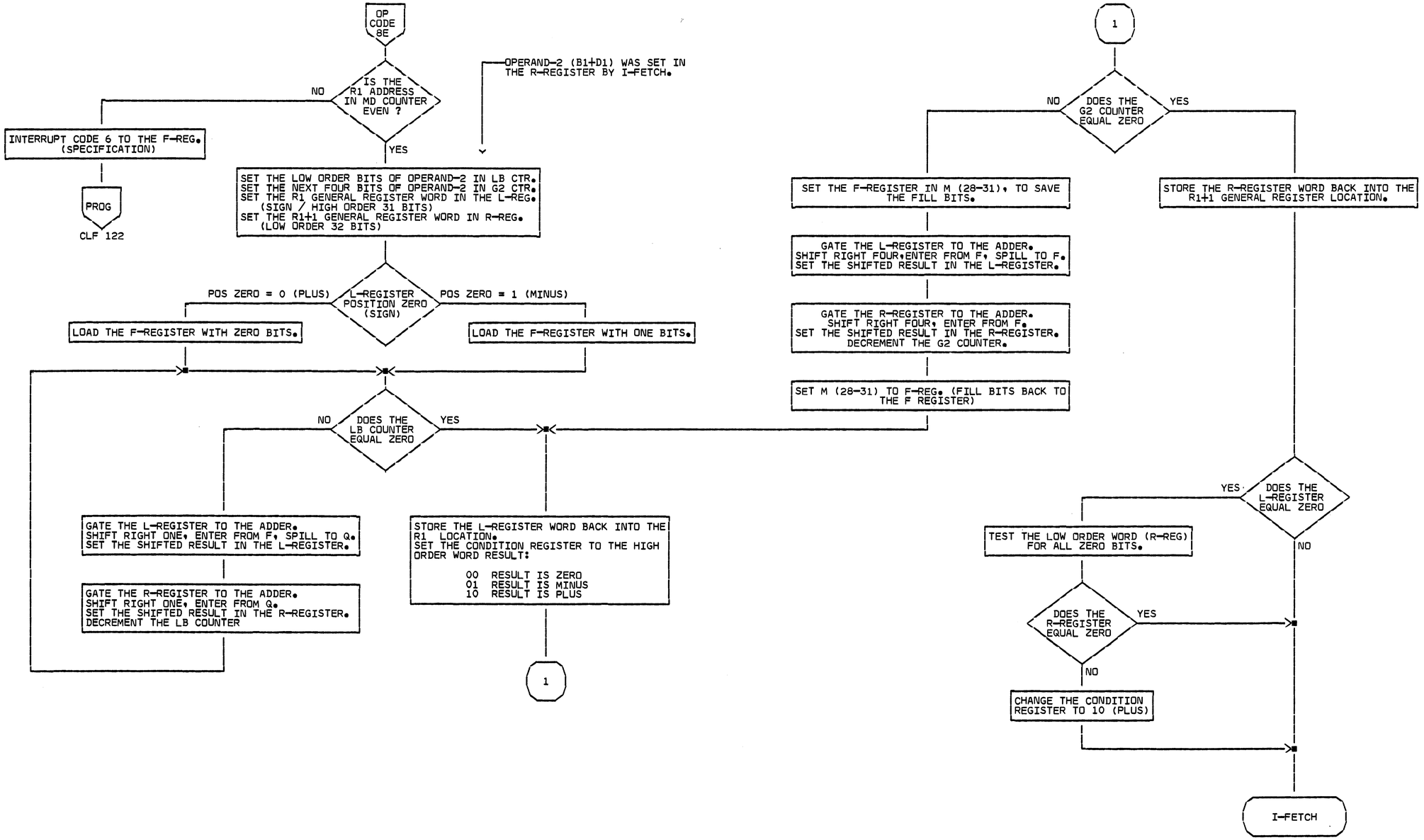
C I 2 0 4



CLF 205	C
DATE 8 APR 65 MACH. 2050	L
FRAME	2
P.N.	0
IBM CORP. SDD PAGE 2	5

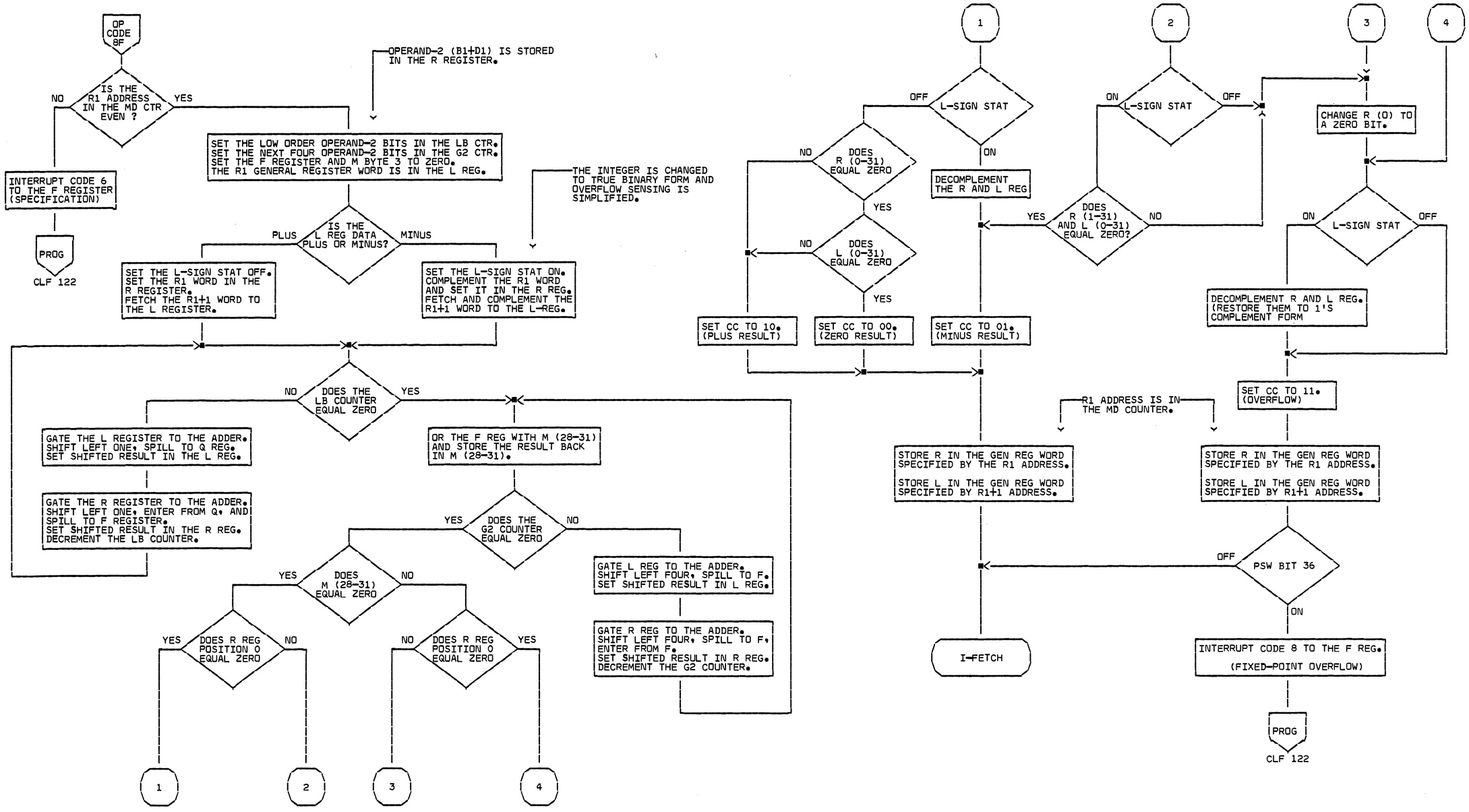


CLF 206
DATE 8 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2
CL206



CLF 207	C
DATE 20 APR 65 MACH. 2050	L
FRAME	2
P.N.	0
IBM CORP. SDD PAGE 2	7

IBM CONFIDENTIAL

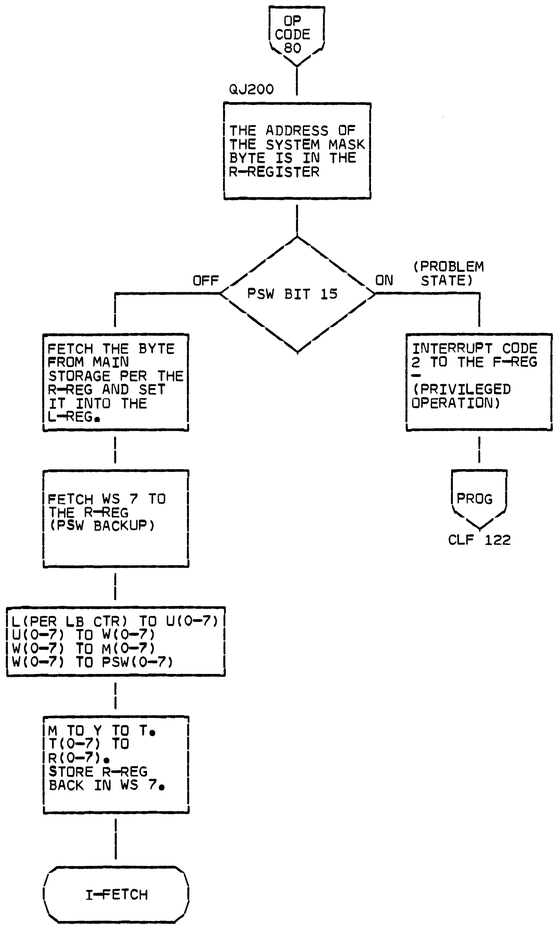


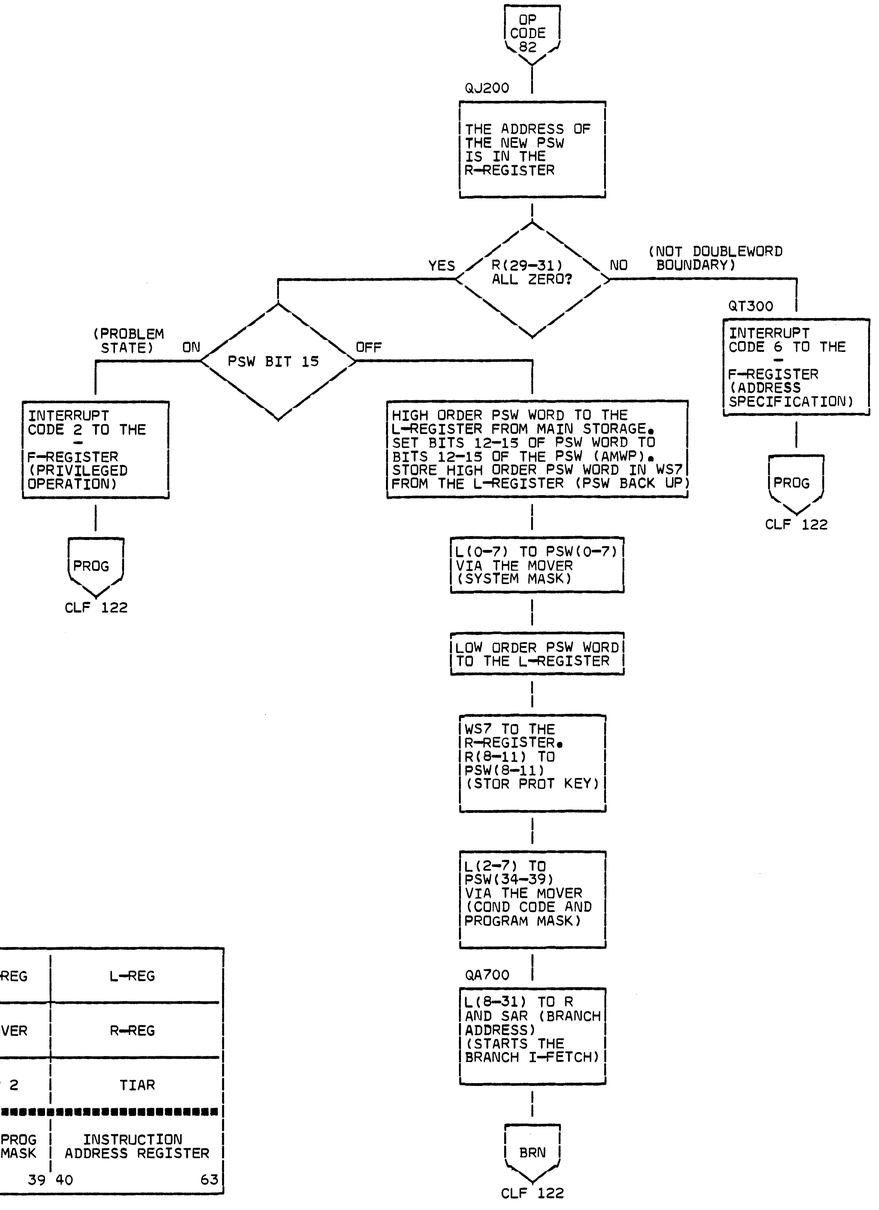
CLF 208 SHIFT LEFT DOUBLE (ALGEBRAIC)

IBM CONFIDENTIAL

CLF 208
DATE 13 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL208

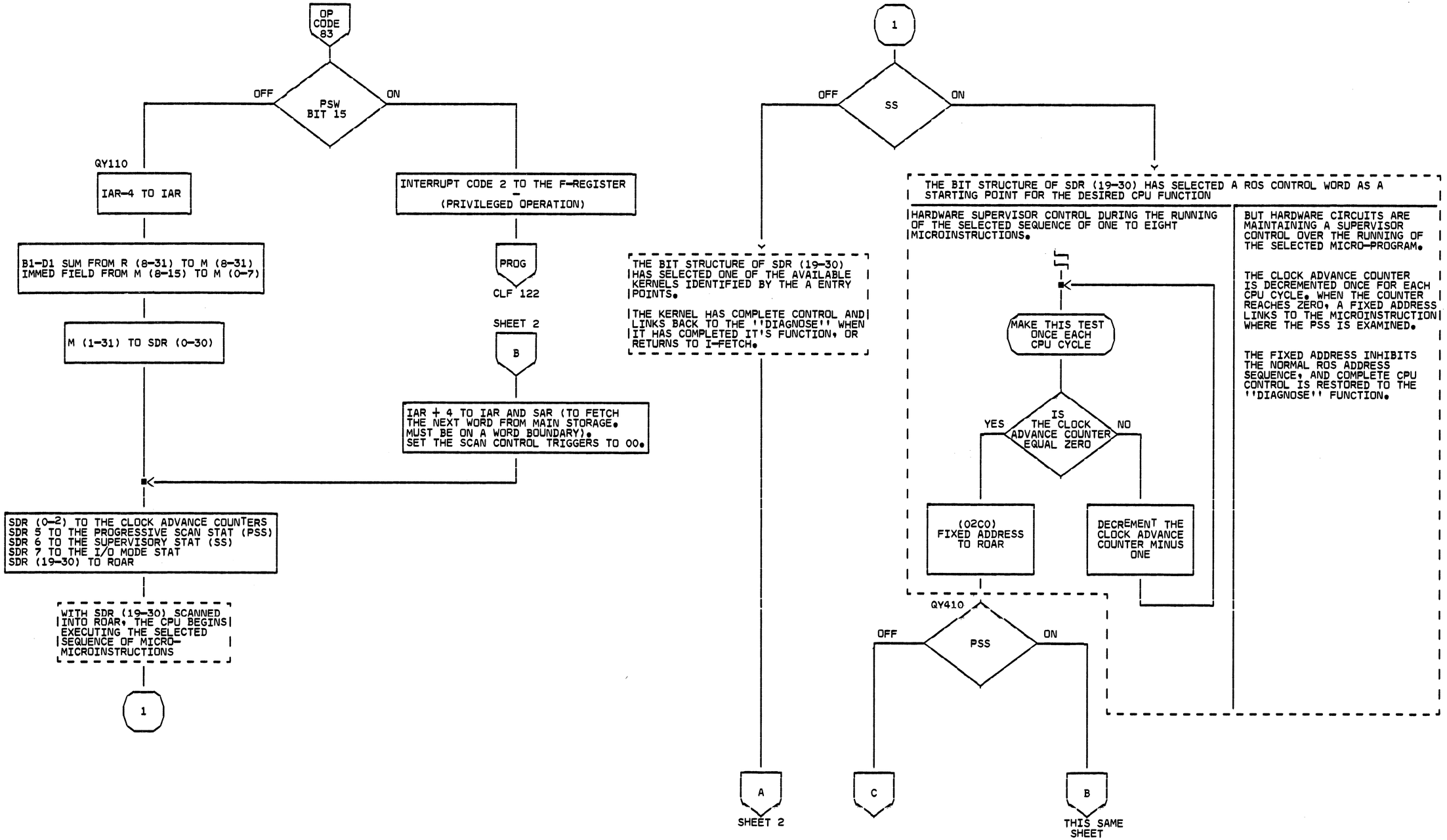




REGISTER	L-REG	R-REG	L-REG		L-REG	L-REG
PATH	MOVER	ADDER	ADDER		MOVER	R-REG
MICRO ORDER	WP 1	TSPM	TWS		WP 2	TIAR
PSW	SYSTEM MASK	SP KEY	AMWP		CC PROG MASK	INSTRUCTION ADDRESS REGISTER
	0 7	8 11	12 15		34 39	40 63

CLF 209
DATE 14 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

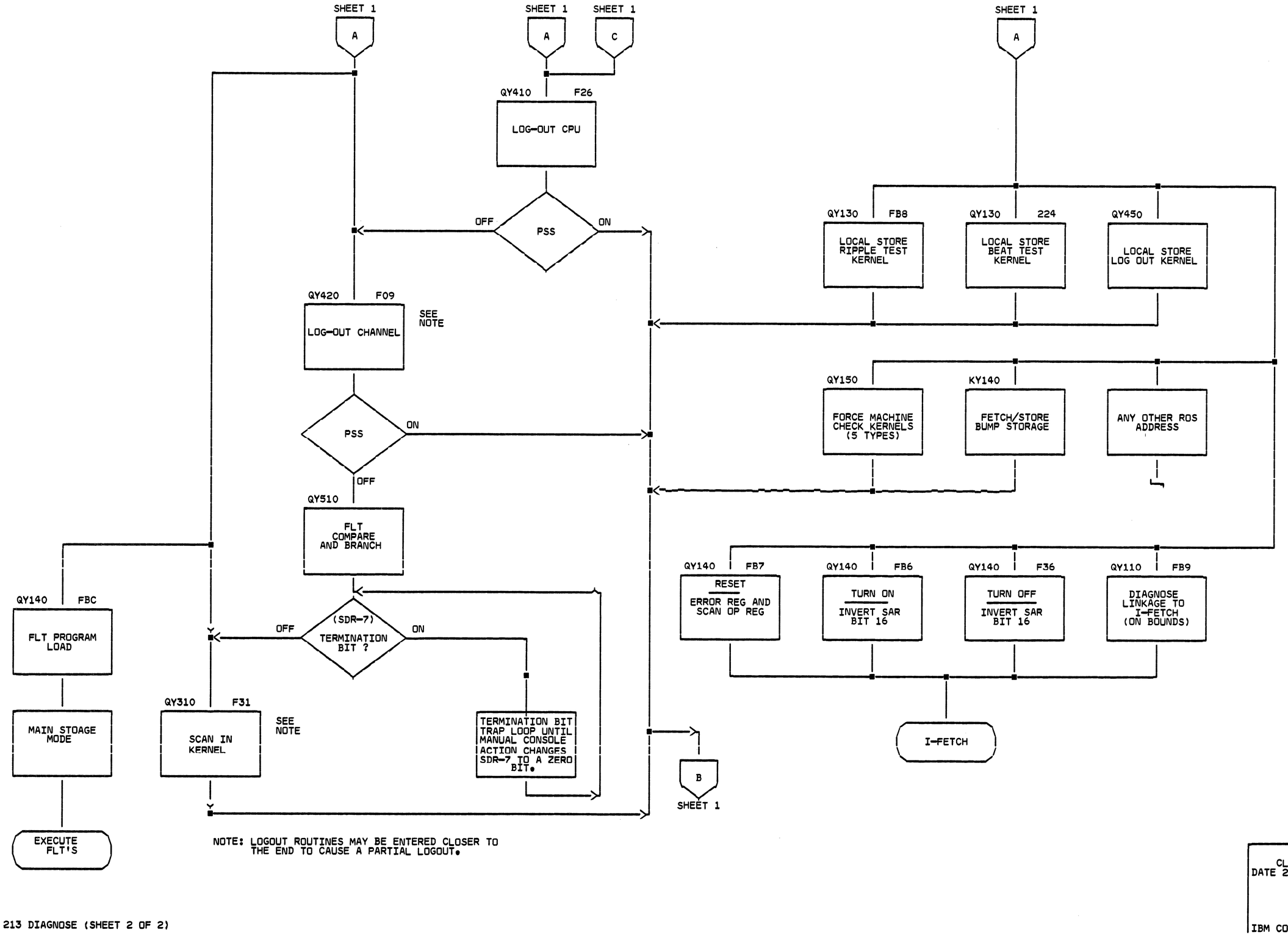
CL209



● CLF 213 DIAGNOSE (SHEET 1 OF 2)

CLF 213 (SHEET 1 OF 2)
DATE 27 JUN 66 MACH● 2050
FRAME
P●N●
IBM CORP● SDD PAGE 2

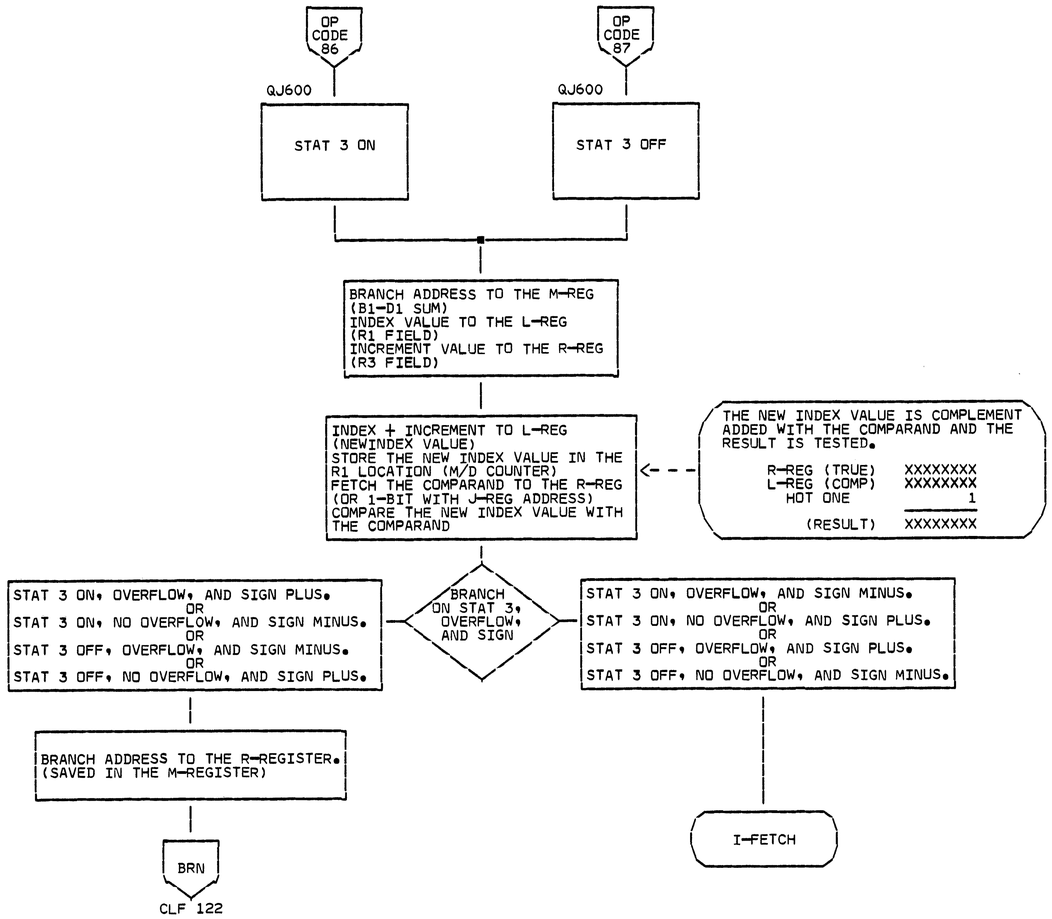
CLF213



NOTE: LOGOUT ROUTINES MAY BE ENTERED CLOSER TO THE END TO CAUSE A PARTIAL LOGOUT.

CLF 213 (SHEET 2 OF 2)
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 3

CLF-213



DEFINITIONS

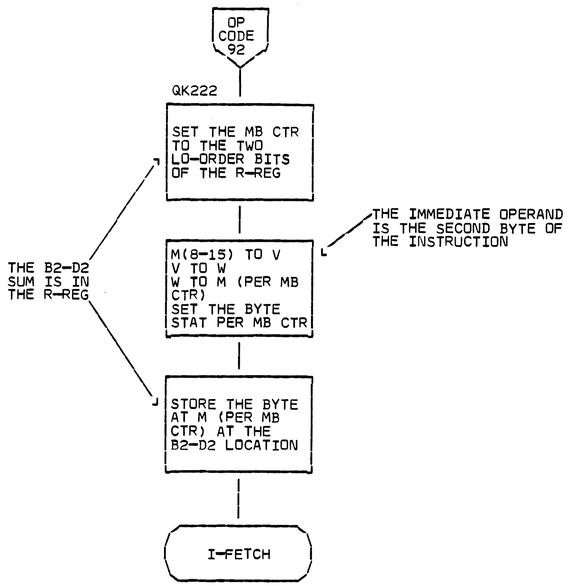
STAT 3: IDENTIFIES THE INSTRUCTION BEING EXECUTED. BRANCH CONDITIONS FOR BXH (STAT 3 ON) ARE I-FETCH CONDITIONS FOR BXLE (STAT 3 OFF).

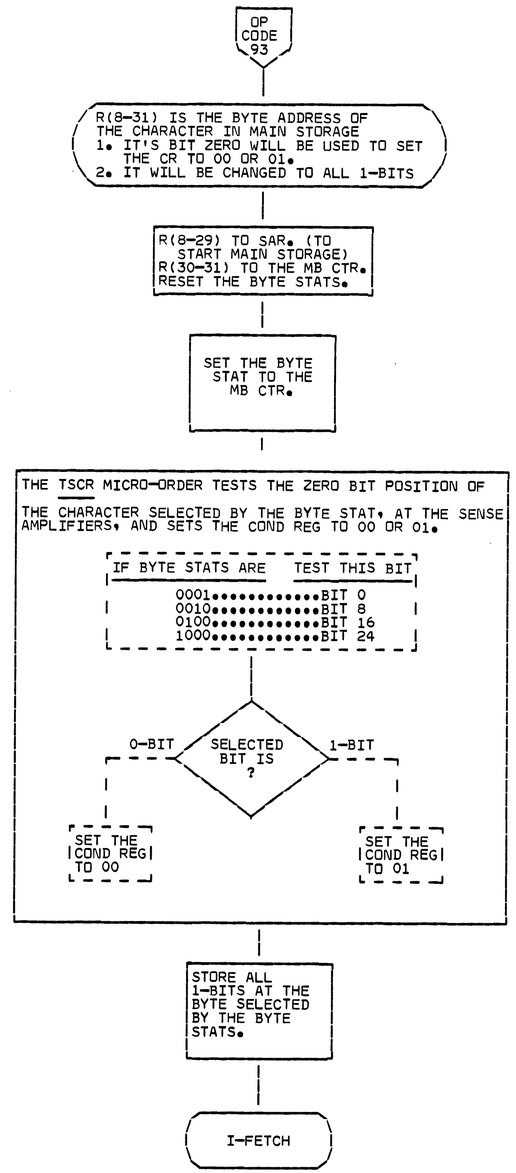
OFLO: OVERFLOW IS IDENTIFIED BY AN EXCLOR OF THE CARRIES FROM POSITIONS ONE AND ZERO DURING THE COMPARE. IT OCCURS WHEN THE DIFFERENCE IS GREATER THAN THE CAPACITY OF A 31 BIT BINARY INTEGER.

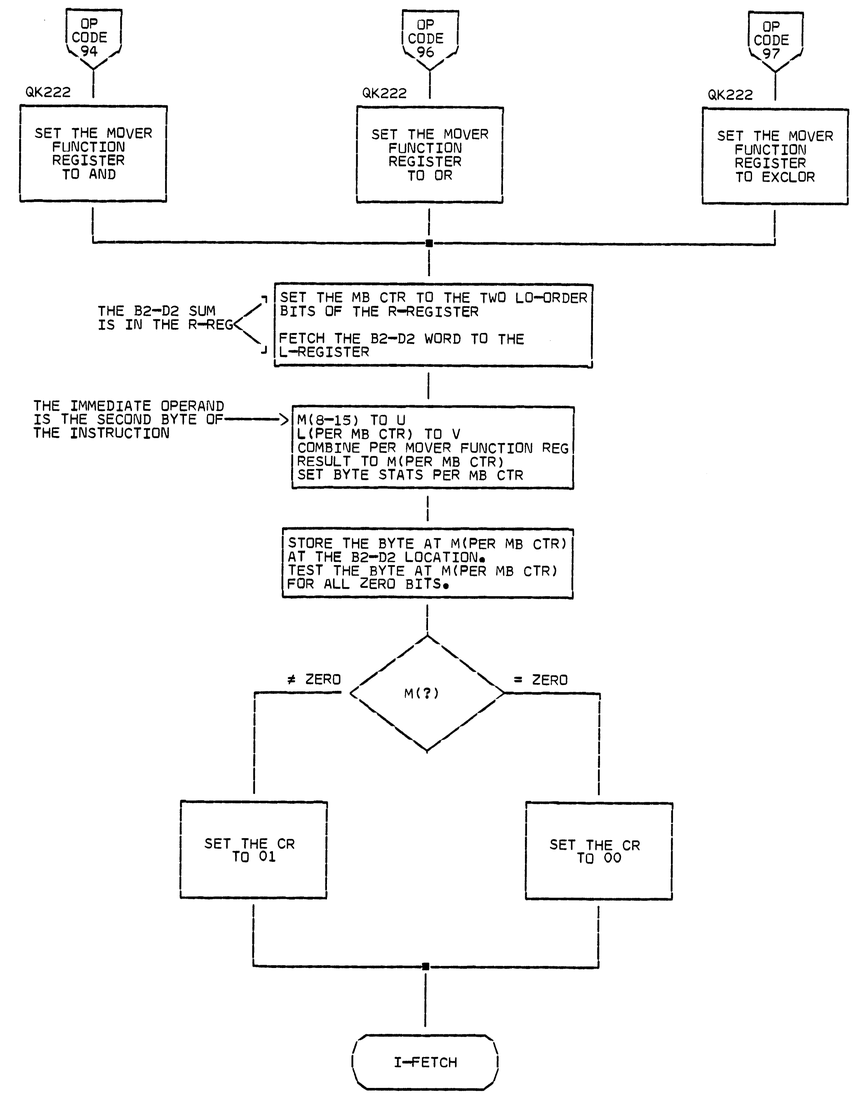
SIGN: THE HIGH ORDER BIT IS EXAMINED TO DETERMINE THE SIGN OF THE RESULT. A 0-BIT IS A PLUS SIGN AND A 1-BIT IS A MINUS SIGN.

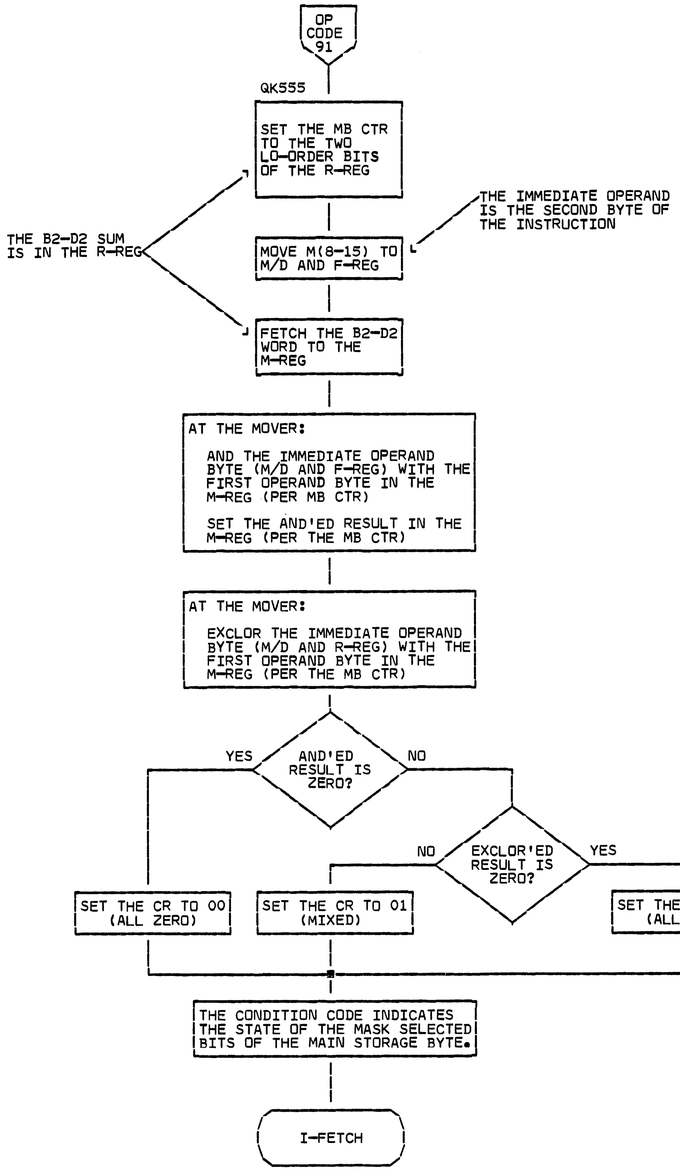
EXAMPLE

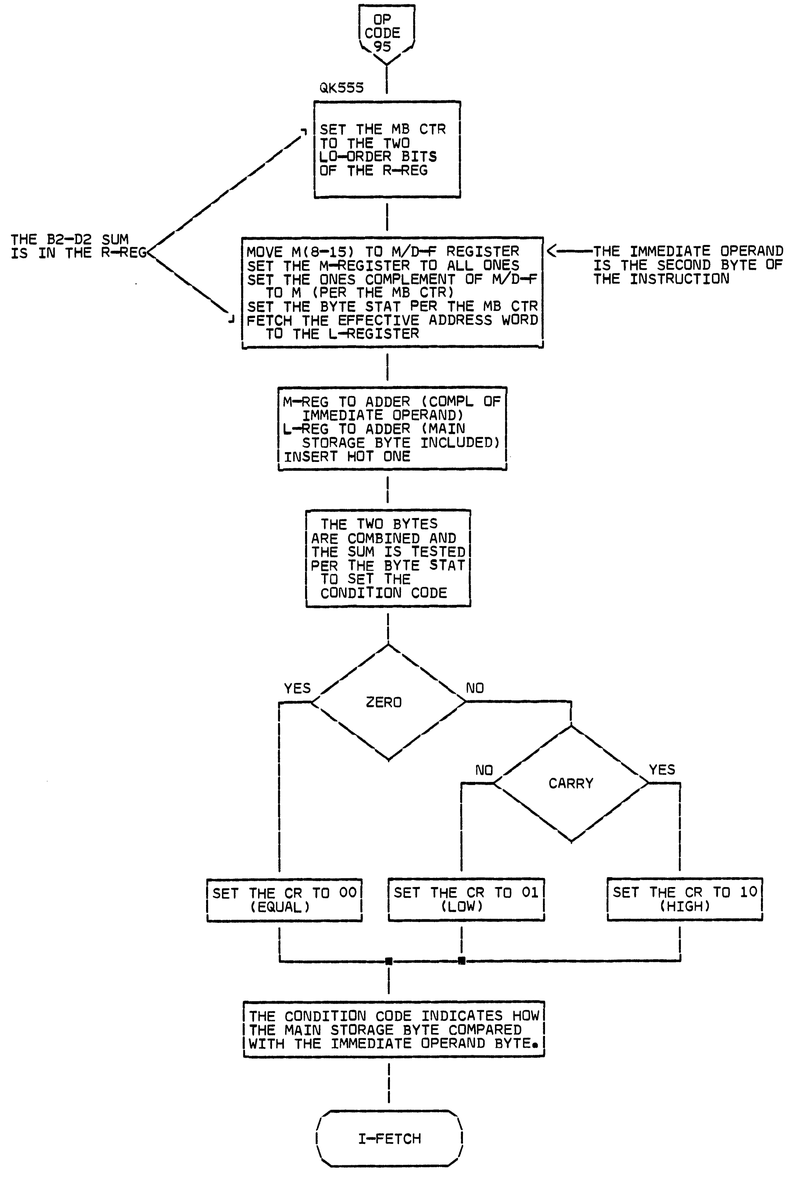
DURING THE COMPARE, THE NEW INDEX VALUE IS COMPLEMENTED. IF THE NEW INDEX VALUE IS HIGH, THE RESULT WILL HAVE A MINUS SIGN IF THERE IS NO OVERFLOW. AN OVERFLOW REVERSES THE EFFECT OF THE SIGN ANALYSIS ON THE BRANCH/I-FETCH CONDITIONS.







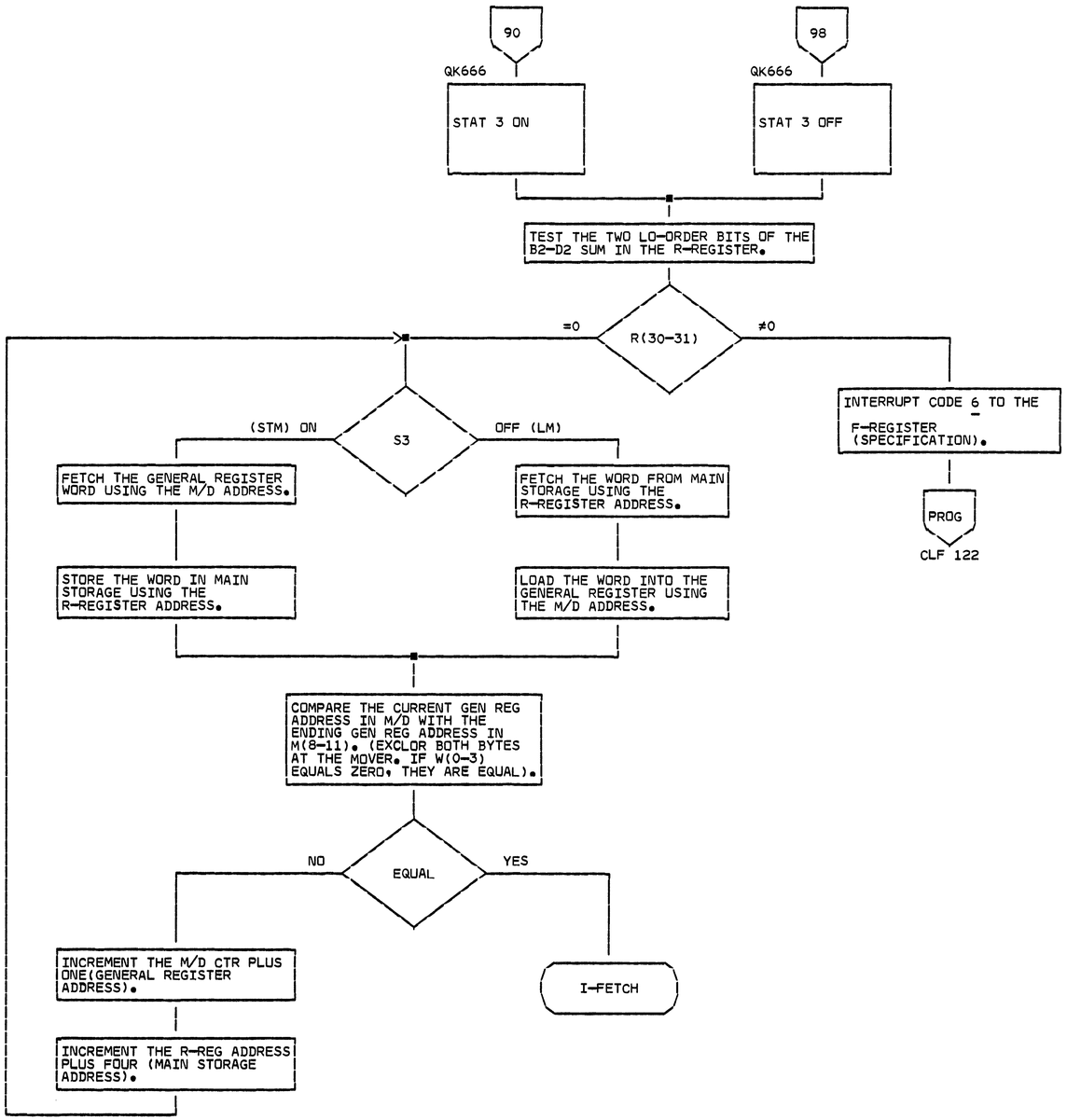




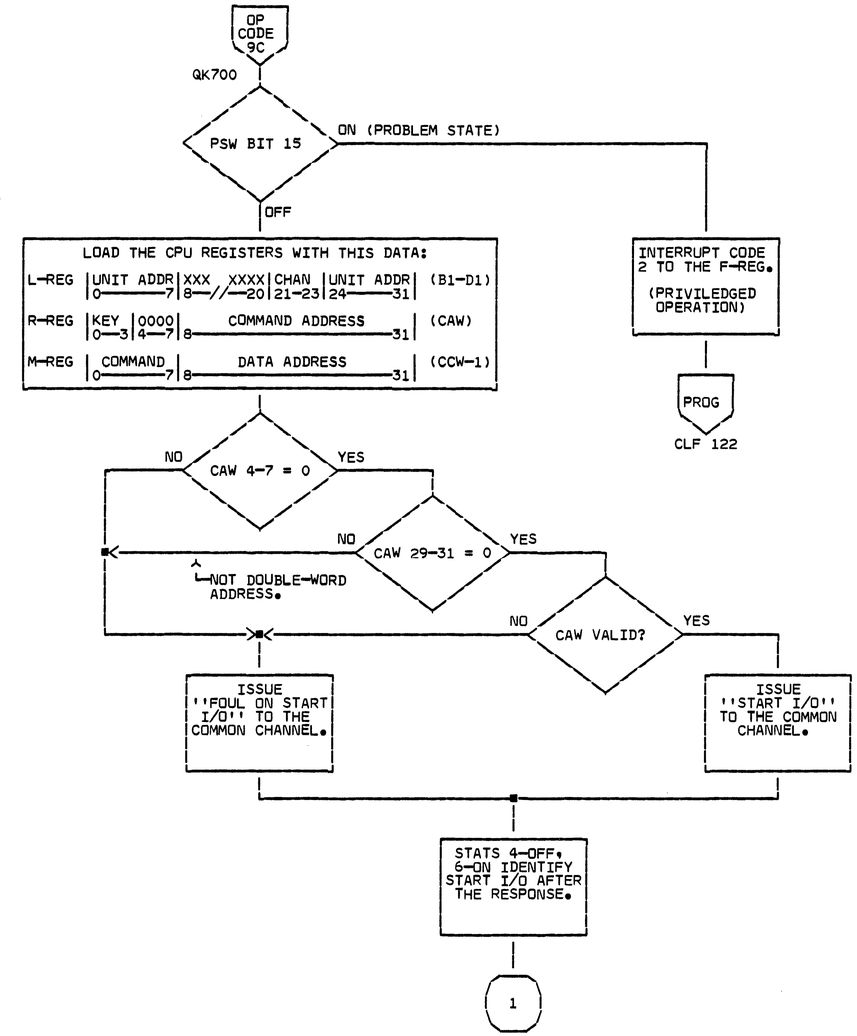
CLF 222 TEST UNDER MASK / COMPARE (IMMEDIATE)

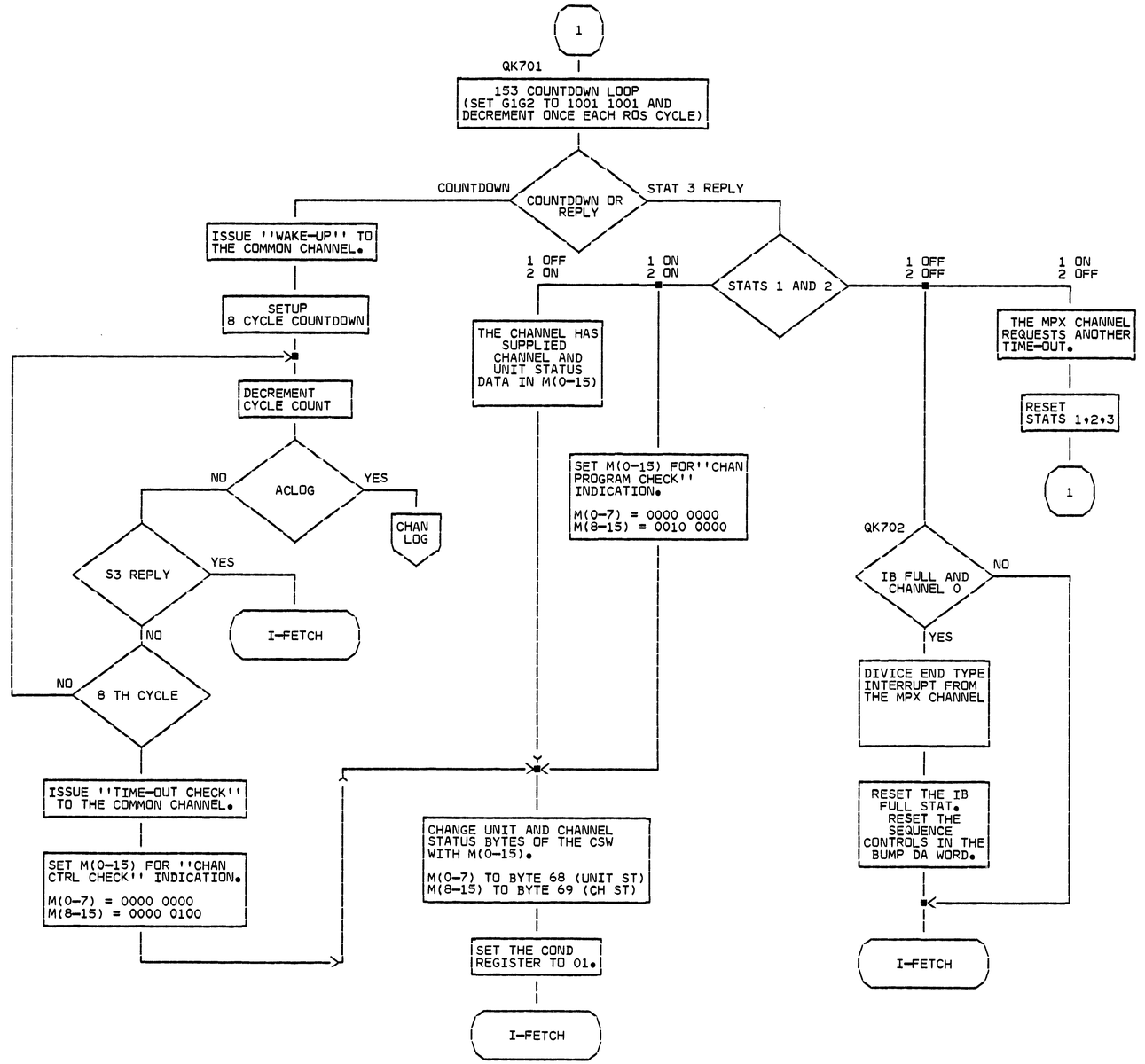
CLF 222
DATE 14 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL222



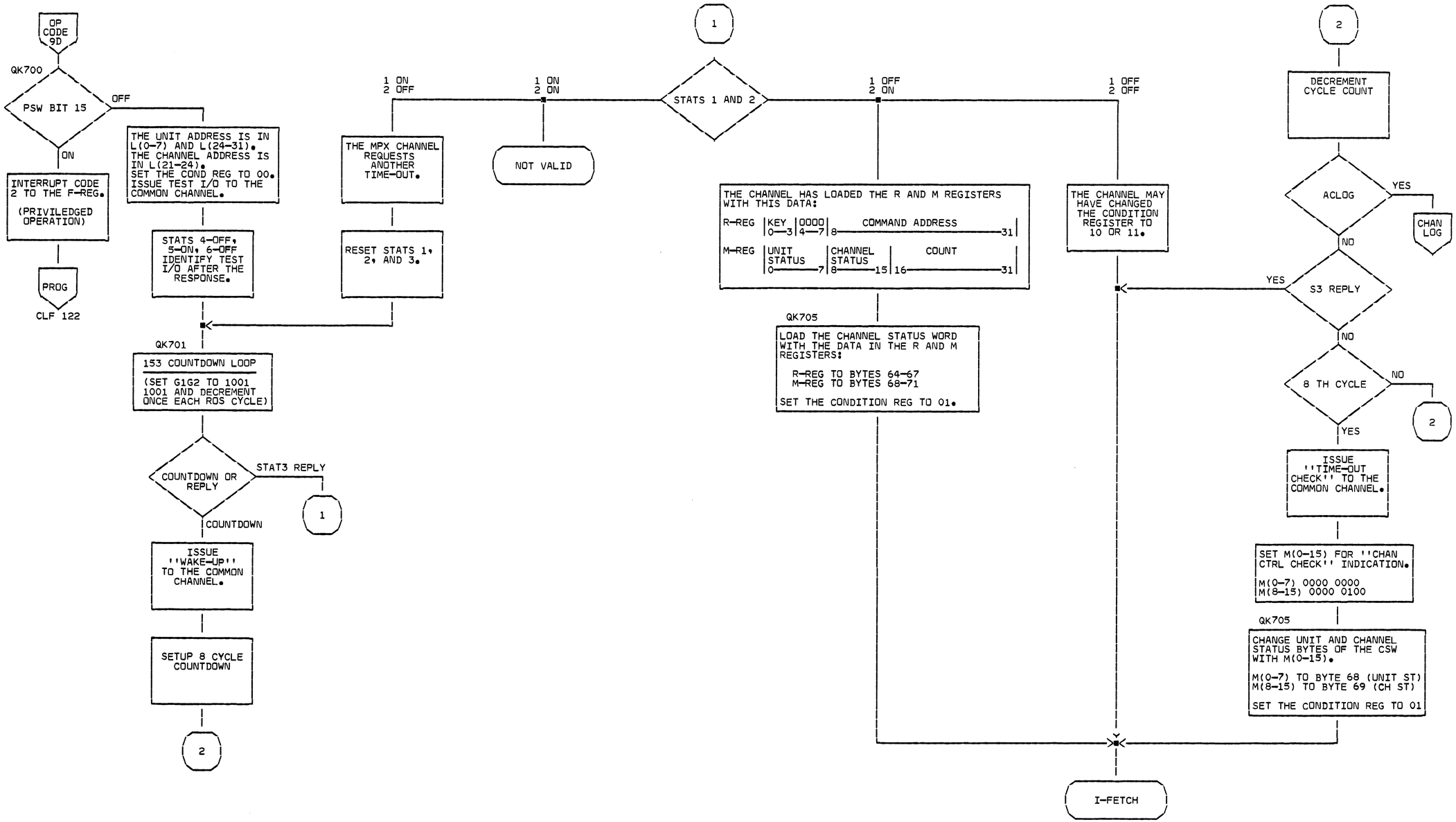
CLF 224
DATE 28 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2
CL224





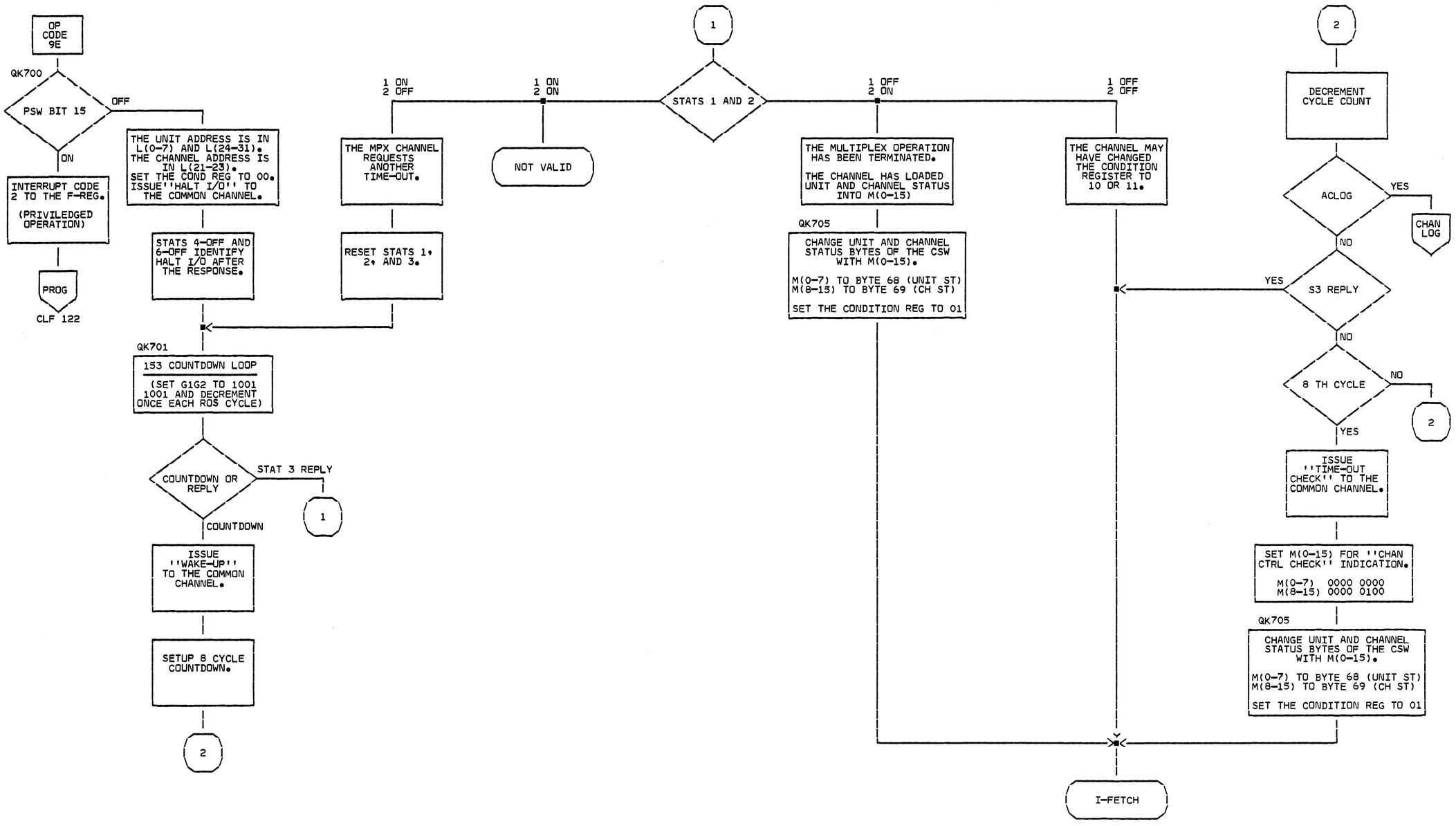
CLF 225
DATE 5 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 21

CLOSE

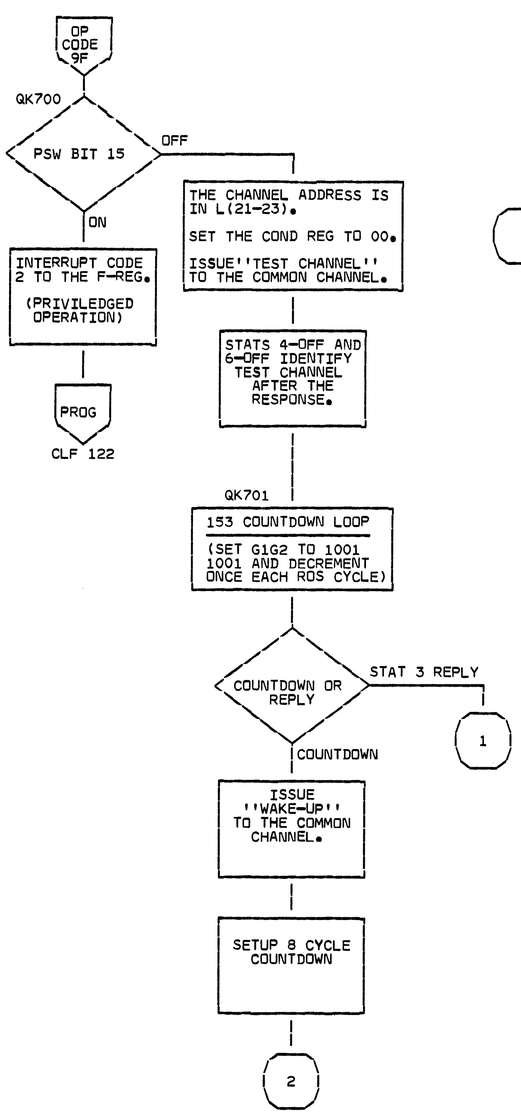


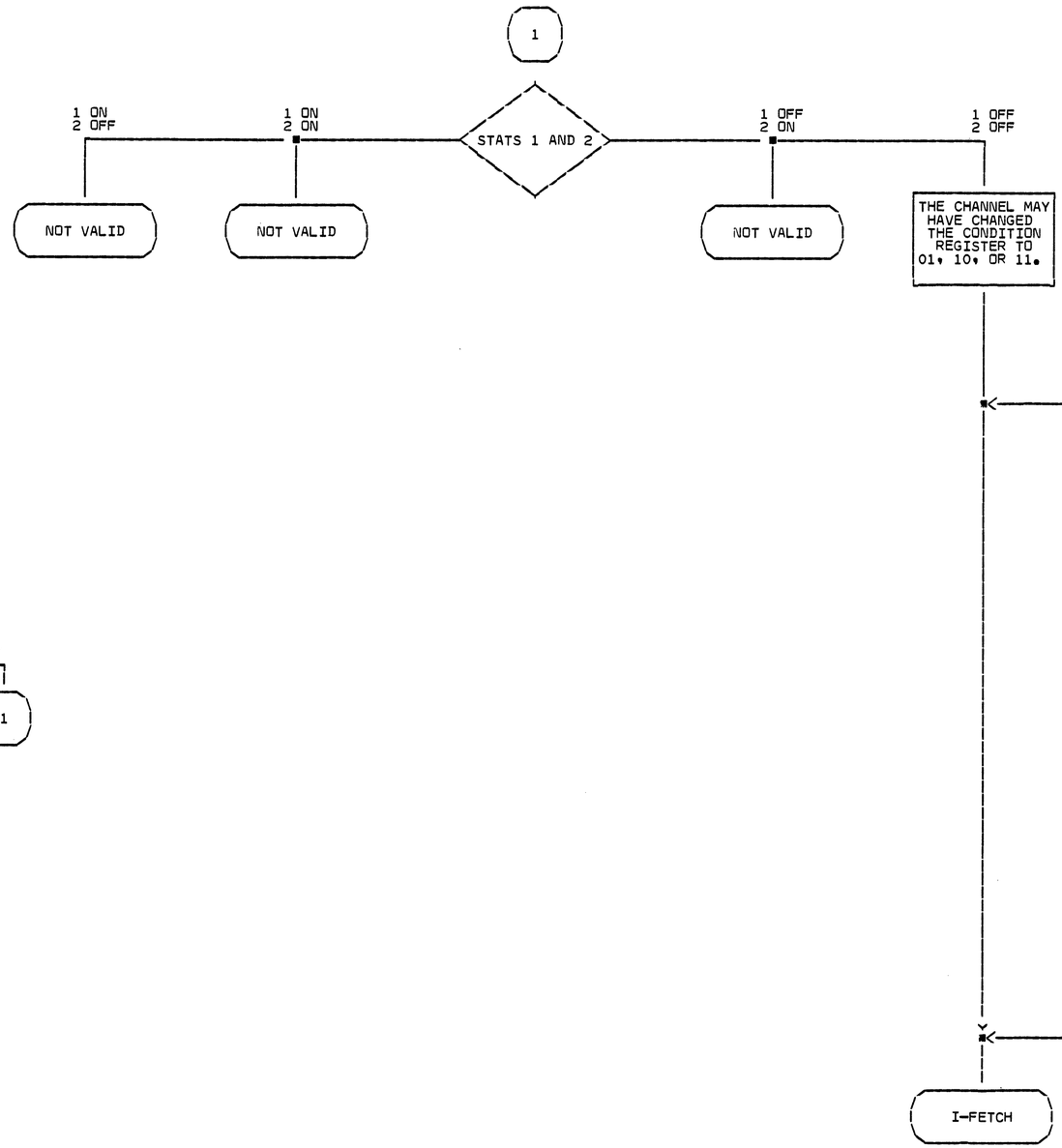
CLF 226
DATE 5 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

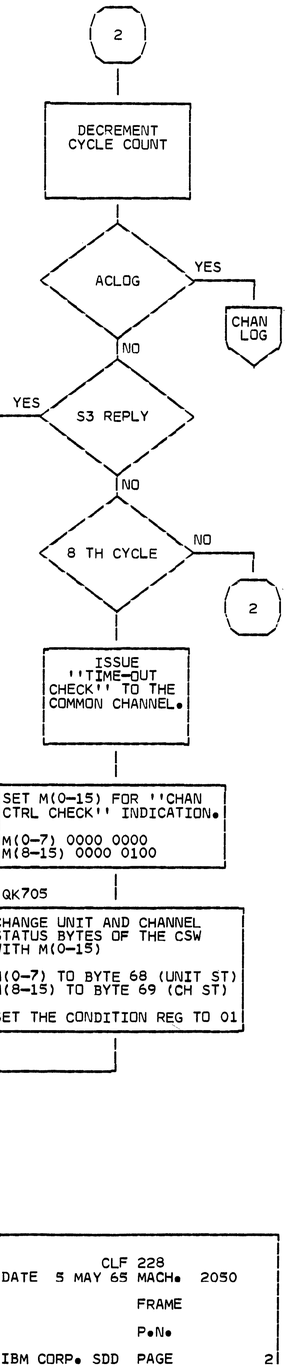
CL226



CLF 227
DATE 5 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2
CL227

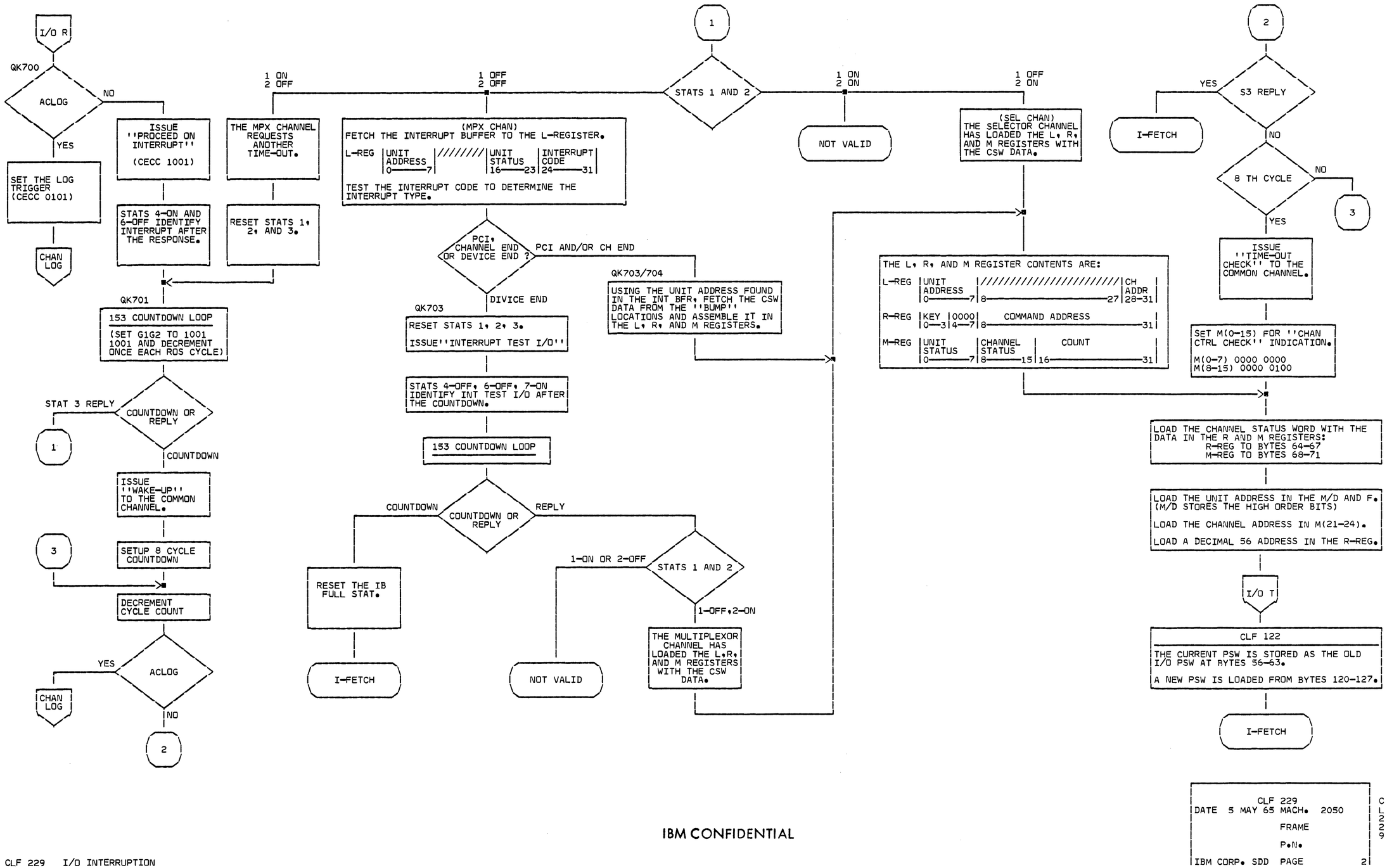






CLF 228
DATE 5 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL228



CLF 229 I/O INTERRUPT

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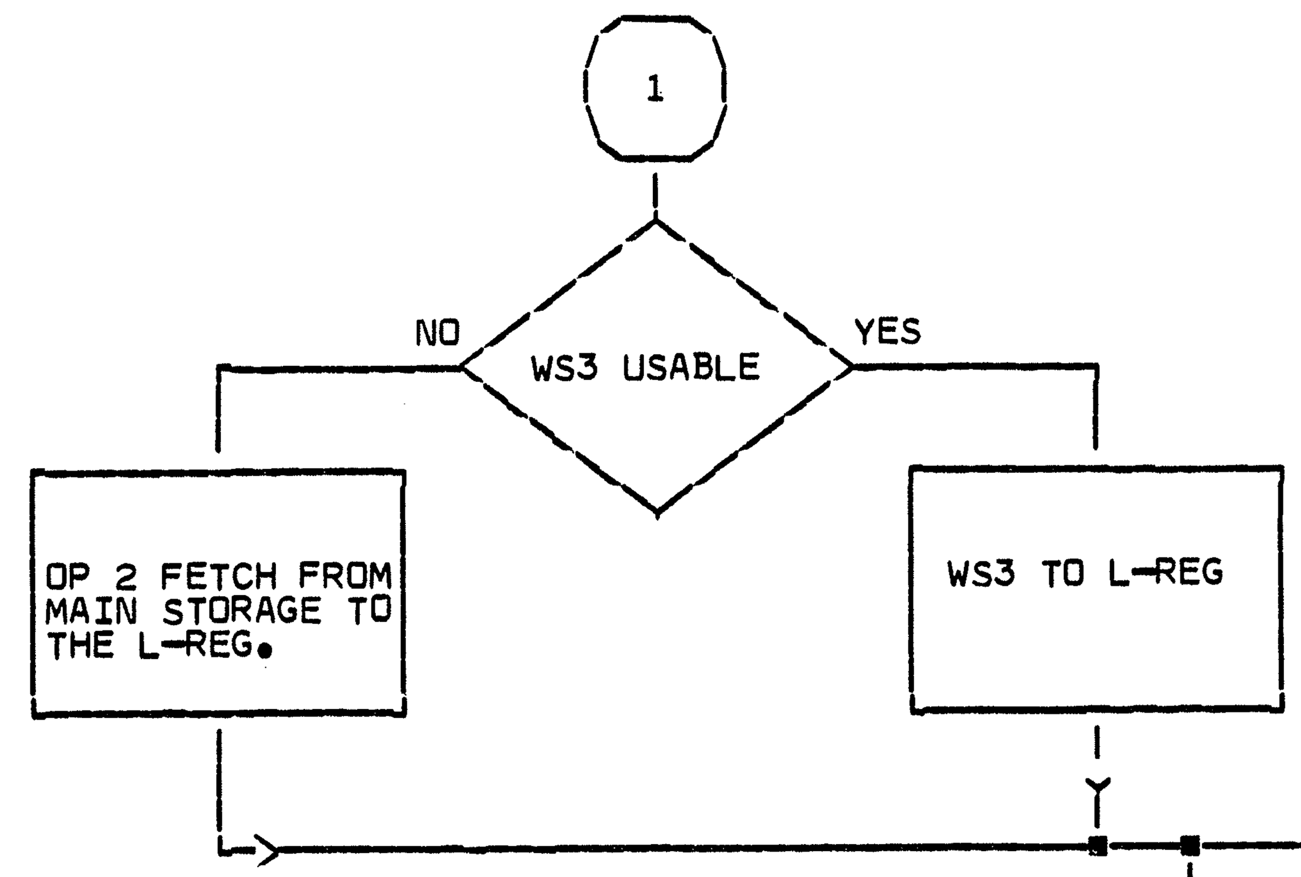
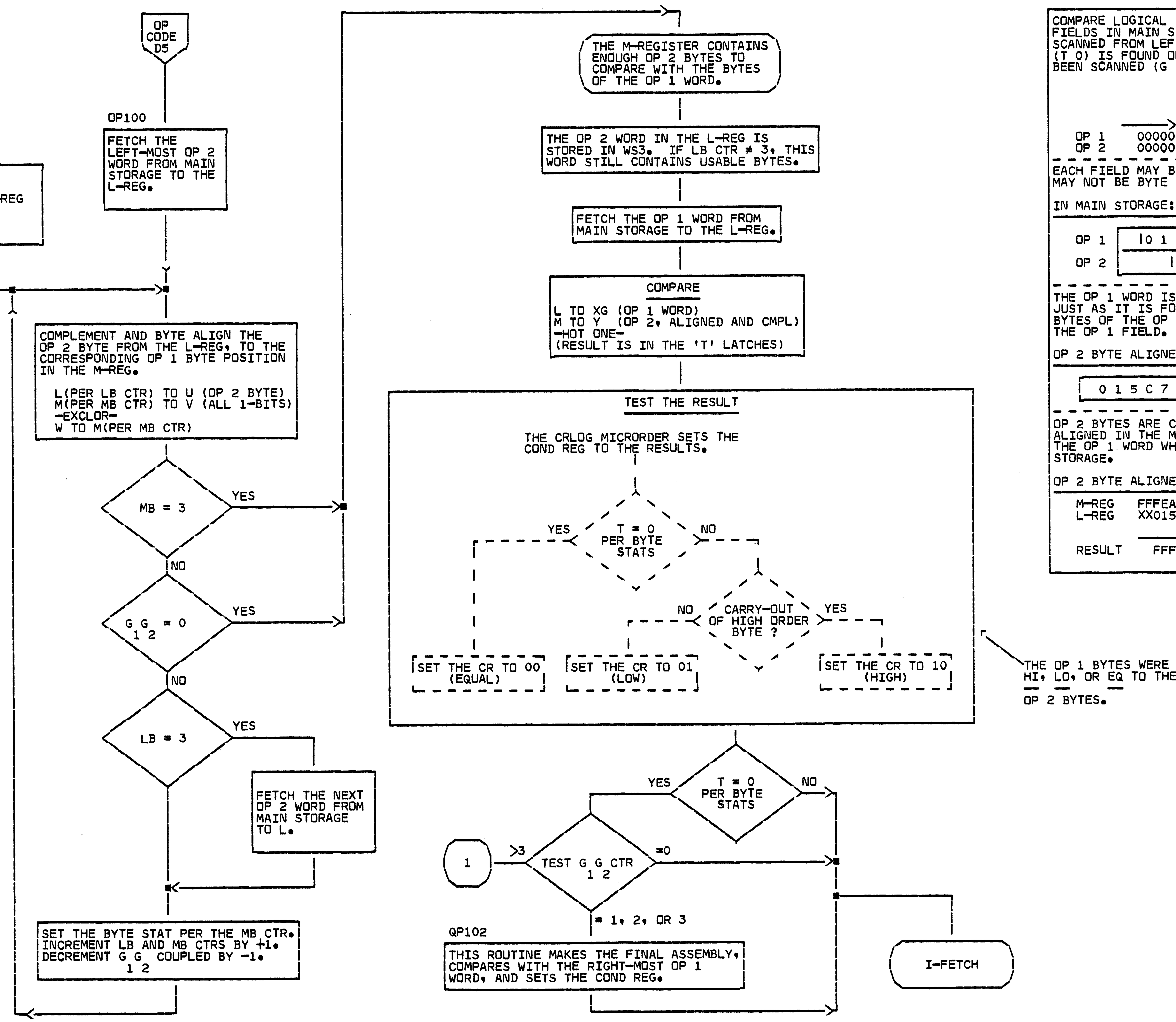
CLF 229
DATE 5 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL229





COUNTERS AND REGISTERS

LB CTR:

SET TO THE TWO LOW-ORDER BITS OF THE OP 2 ADDR.
CONTROLS L-REG OUTGATES.
PLUS ONE AS EACH BYTE IS ASSEMBLED.

MB CTR:

SET TO THE TWO LOW-ORDER BITS OF THE OP 1 ADDR.
CONTROLS THE M-REG OUTGATING AND INGATING.
PLUS ONE AS EACH BYTE IS ASSEMBLED.

$G_1 G_2$ COUPLED:

SET TO THE INSTRUCTIONS LENGTH FIELD.
COUNTS THE NUMBER OF REMAINING BYTES.
MINUS ONE AS EACH BYTE IS ASSEMBLED.

BYTE STATS:

SET FROM THE MB CTR.
CONTROLS CRLOG ZERO/CARRY TESTING.

WS 1:

HOLDS THE CURRENT OP 1 ADDRESS.

WS 2:

HOLDS THE CURRENT OP 2 ADDRESS.

WS 3:

TEMPORARY STORAGE FOR OP 2 WORD. IF LB CTR IS NOT THREE, THIS SAVES A MAIN STORAGE FETCH FOR THE REMAINING USABLE BYTES OF THIS WORD.

L-REG:

HOLDS THE OP 2 WORD DURING THE ASSEMBLY.
HOLDS THE OP 1 WORD FOR THE COMPARE.

M-REG:

SET TO ALL ONES BEFORE THE ASSEMBLY.
HOLDS THE BYTE ALIGNED/COMPLEMENTED OP 2.

R-REG:

USED AS AN ADDRESS REGISTER FOR OP 1/OP 2.

COMPARE LOGICAL IS A BINARY COMPARE OF TWO FIELDS IN MAIN STORAGE. BOTH FIELDS ARE SCANNED FROM LEFT TO RIGHT UNTIL AN UNEQUAL (T 0) IS FOUND OR UNTIL BOTH FIELDS HAVE BEEN SCANNED (G 0).

```
                                      LOW
                                       |
            ------->SCAN----------->   v
OP 1   00000001010111000111000101001100
OP 2   00000001010111000111100101000100
```

EACH FIELD MAY BE UP TO 256 BYTES LONG AND MAY NOT BE BYTE ALIGNED ON WORD BOUNDARIES.

IN MAIN STORAGE:

```
OP 1   |0 1 5 C 7 1|4 C|
OP 2       |0 1 5 C|7 9 4 4|
```

THE OP 1 WORD IS COMPARED A WORD AT A TIME JUST AS IT IS FOUND IN MAIN STORAGE. THE BYTES OF THE OP 2 FIELD ARE BYTE ALIGNED TO THE OP 1 FIELD.

OP 2 BYTE ALIGNED

| 0 1 5 C 7 9 | (BOTH WORDS HAD TO BE FETCHED FROM MAIN STORAGE)

OP 2 BYTES ARE COMPLEMENTED AND BYTE ALIGNED IN THE M-REG FOR COMPARISON WITH THE OP 1 WORD WHEN IT IS FETCHED FROM MAIN STORAGE.

OP 2 BYTE ALIGNED AND COMPL, IN THE M-REG

```
M-REG    FFFEA386 (OP 2 ALIGNED AND C)
L-REG    XX015C71 (OP 1 WORD)
                1 (HOT ONE)
         --------
RESULT     FFFFF8 (NOT ZERO)
                  (NO CARRY OUT)
```

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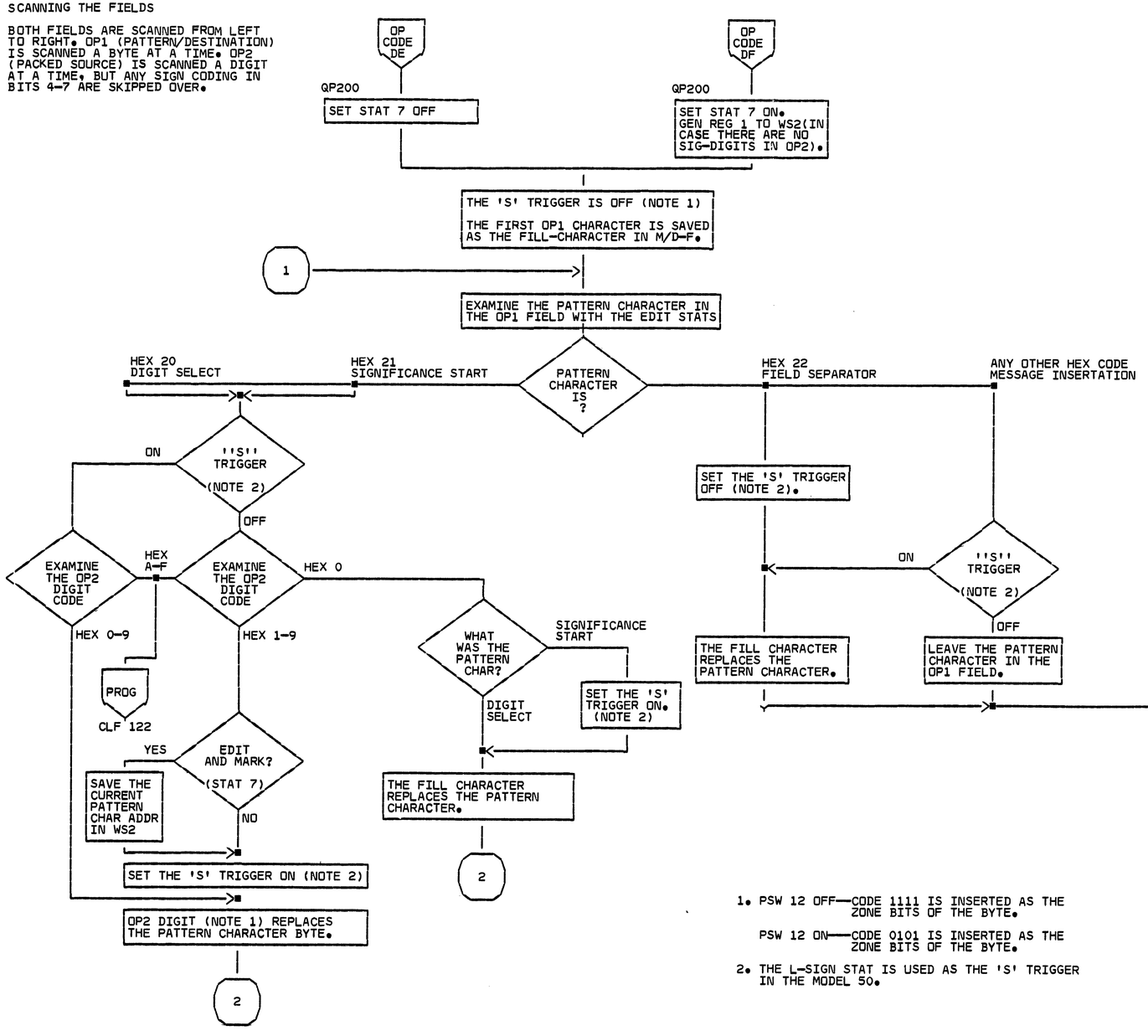
SCANNING THE FIELDS

BOTH FIELDS ARE SCANNED FROM LEFT TO RIGHT. OP1 (PATTERN/DESTINATION) IS SCANNED A BYTE AT A TIME. OP2 (PACKED SOURCE) IS SCANNED A DIGIT AT A TIME, BUT ANY SIGN CODING IN BITS 4-7 ARE SKIPPED OVER.

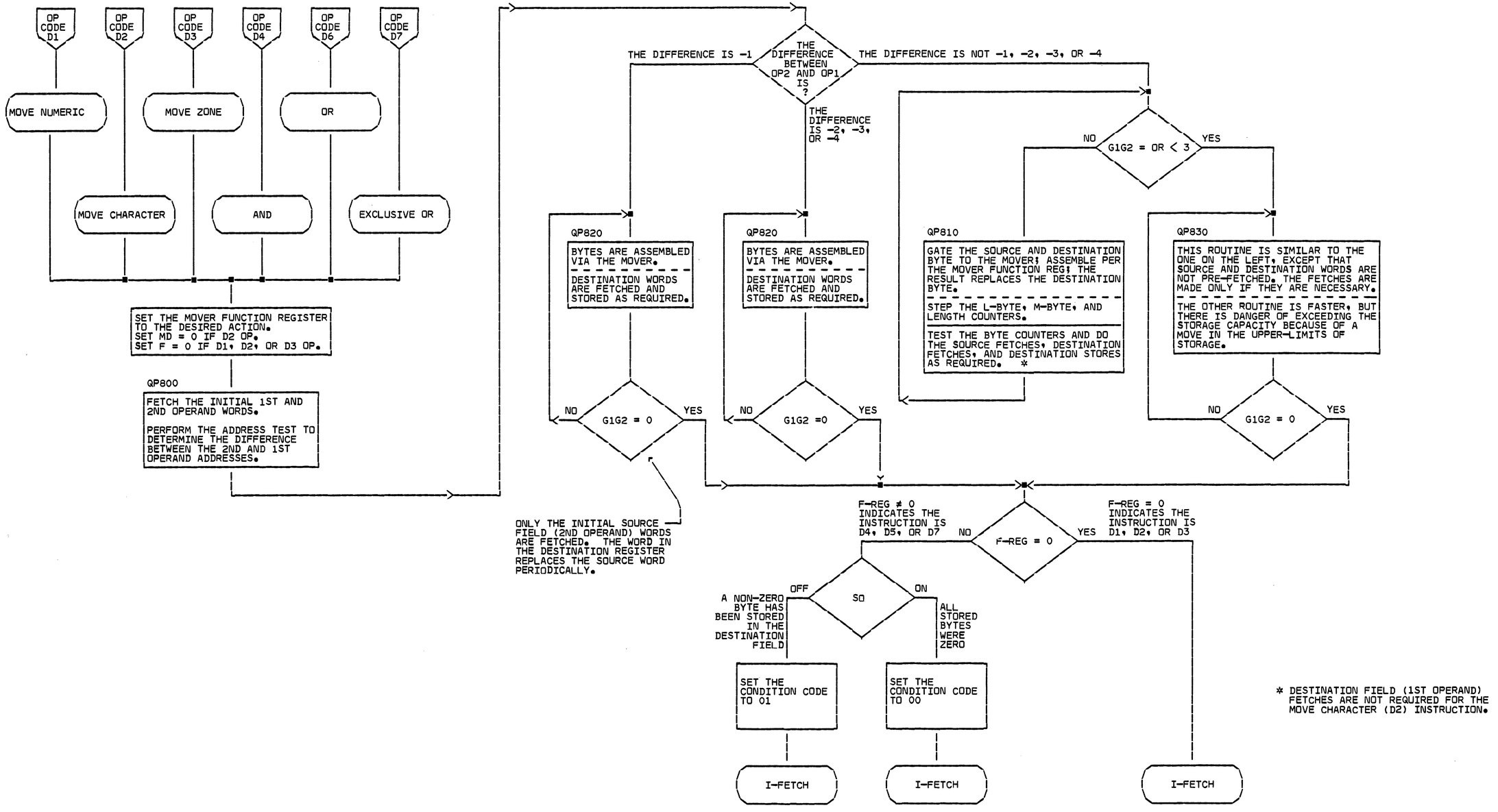


1. PSW 12 OFF—CODE 1111 IS INSERTED AS THE ZONE BITS OF THE BYTE.

   PSW 12 ON—CODE 0101 IS INSERTED AS THE ZONE BITS OF THE BYTE.

2. THE L-SIGN STAT IS USED AS THE 'S' TRIGGER IN THE MODEL 50.

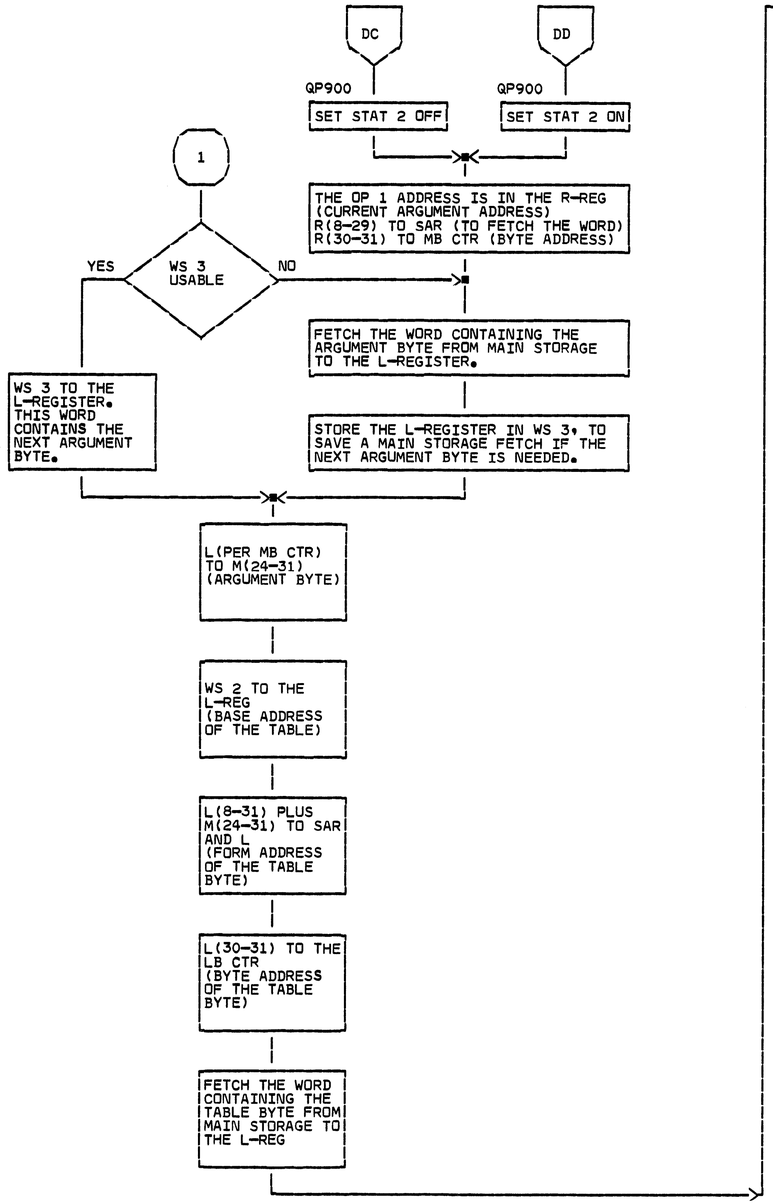
CLF 231 EDIT / EDIT AND MARK	CLF231
DATE 10 SEP 65 MACH. 2050	
FRAME	
P.N.	
IBM CORP. SDD PAGE 1	

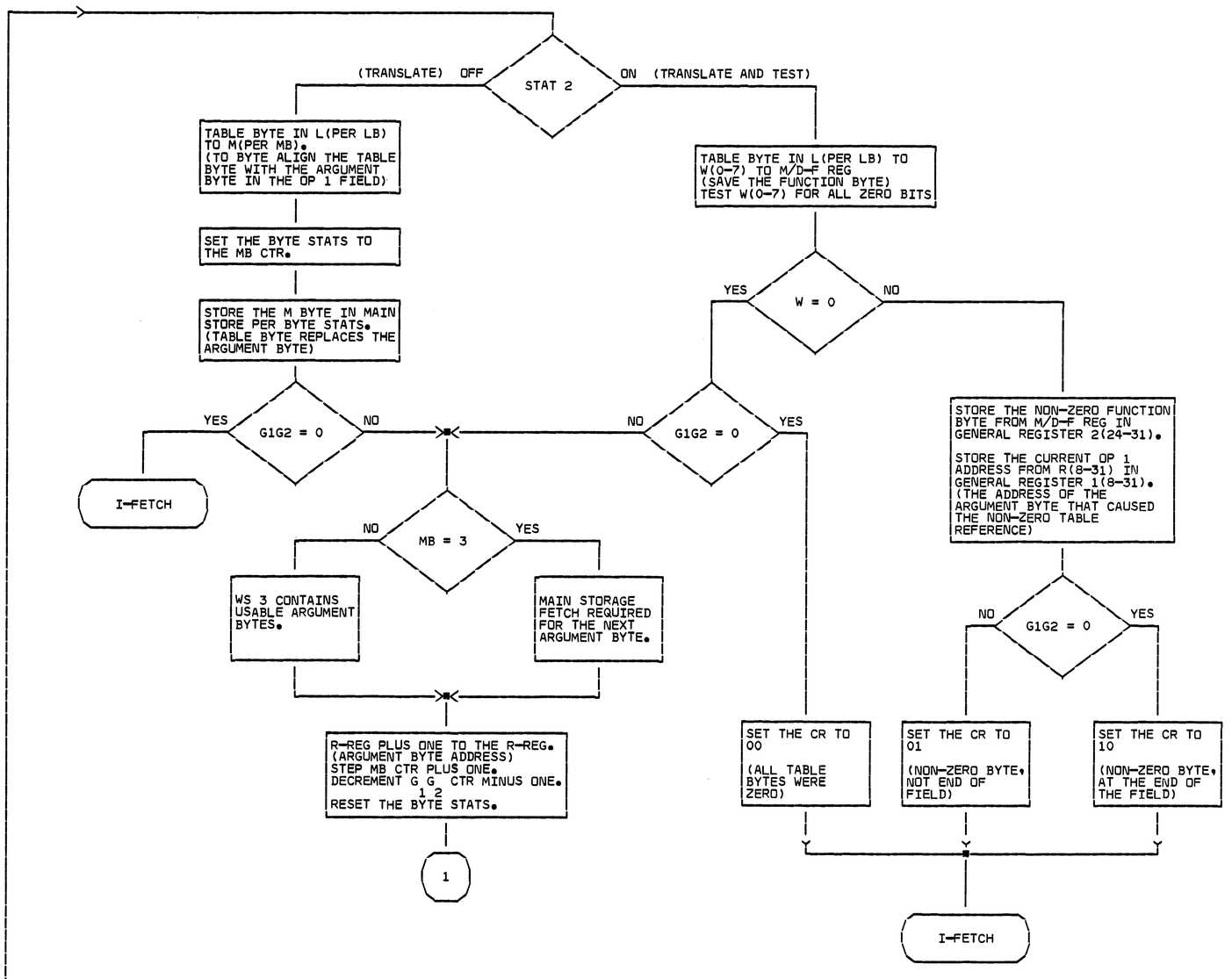


* DESTINATION FIELD (1ST OPERAND) FETCHES ARE NOT REQUIRED FOR THE MOVE CHARACTER (D2) INSTRUCTION.

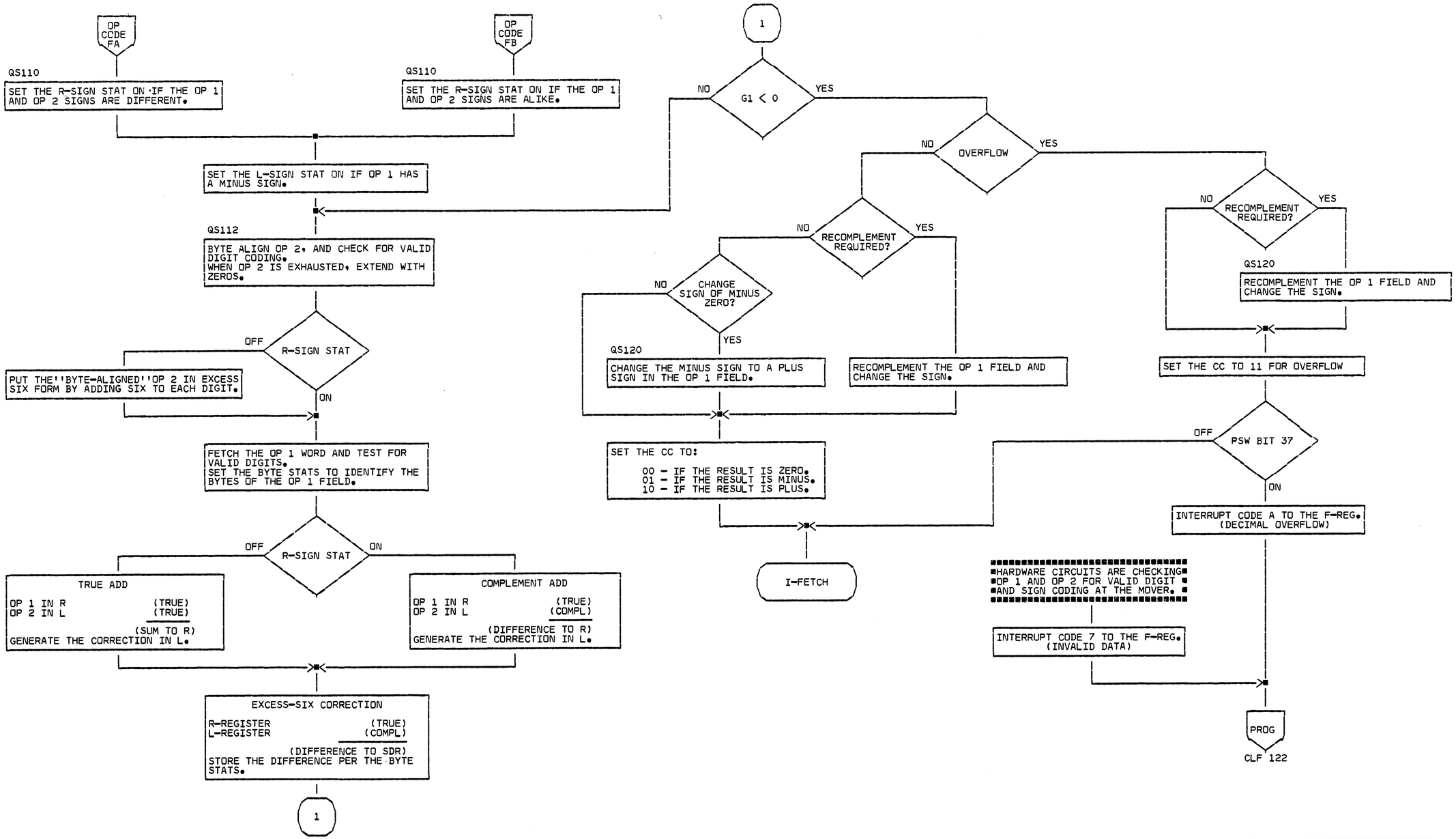
CLF 232
DATE 14 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CLF232





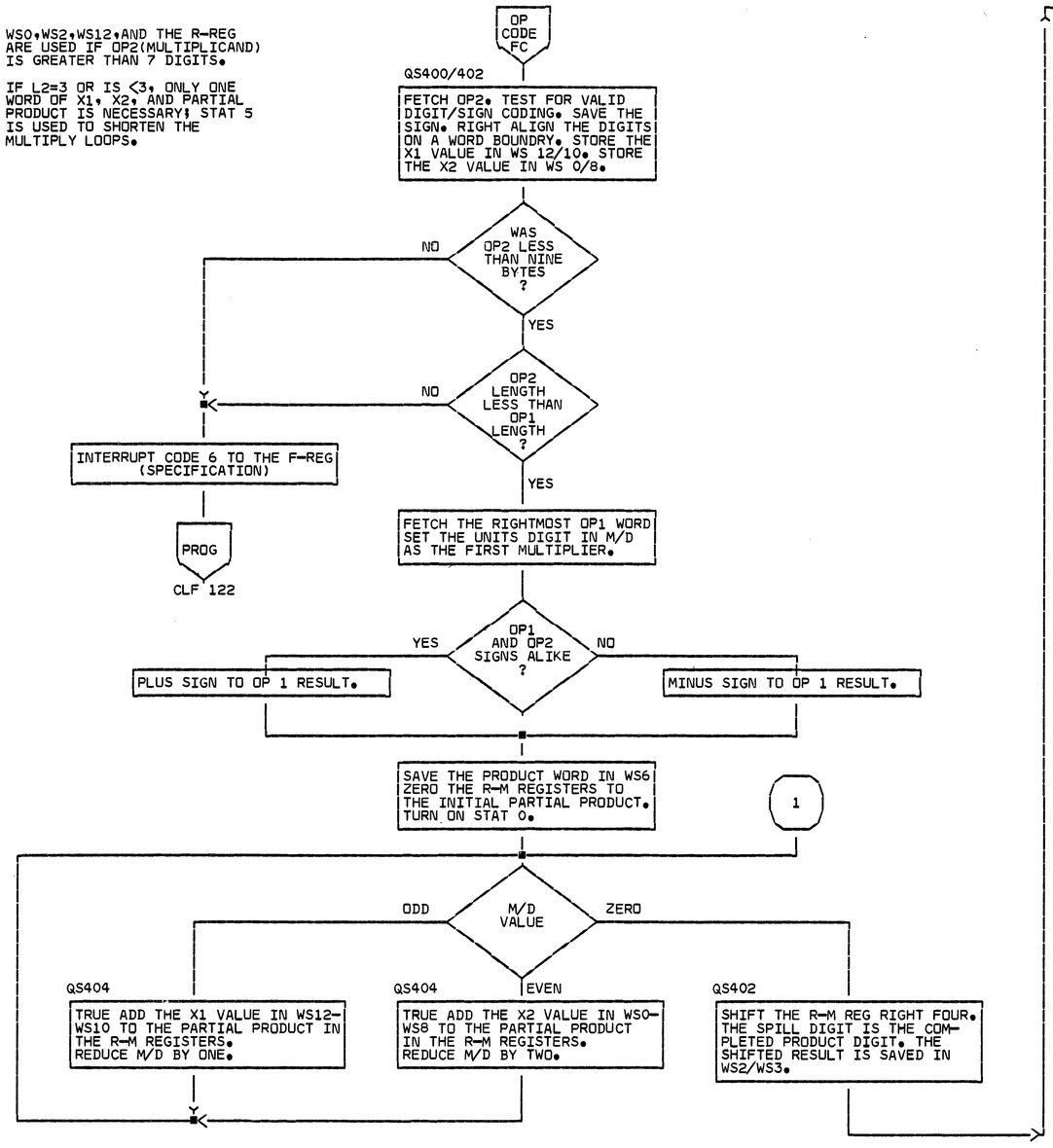
CLF 233
DATE 28 APR 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2
CLF 233

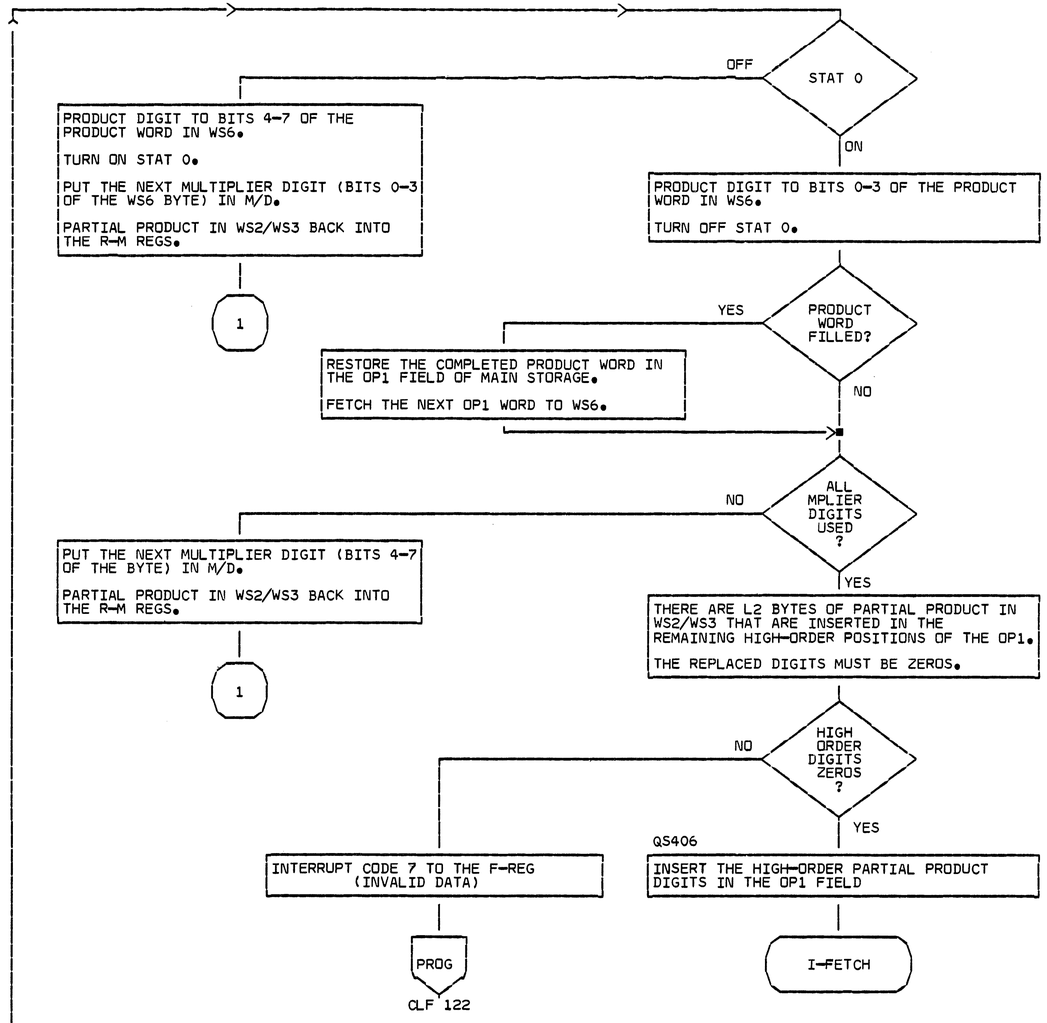


CLF 240 ADD/SUBTRACT (DECIMAL)	
DATE 10 SEP 65 MACH. 2050	CL240
FRAME	
P.N.	
IBM CORP. SDD PAGE 1	

WS0,WS2,WS12,AND THE R-REG ARE USED IF OP2(MULTIPLICAND) IS GREATER THAN 7 DIGITS.

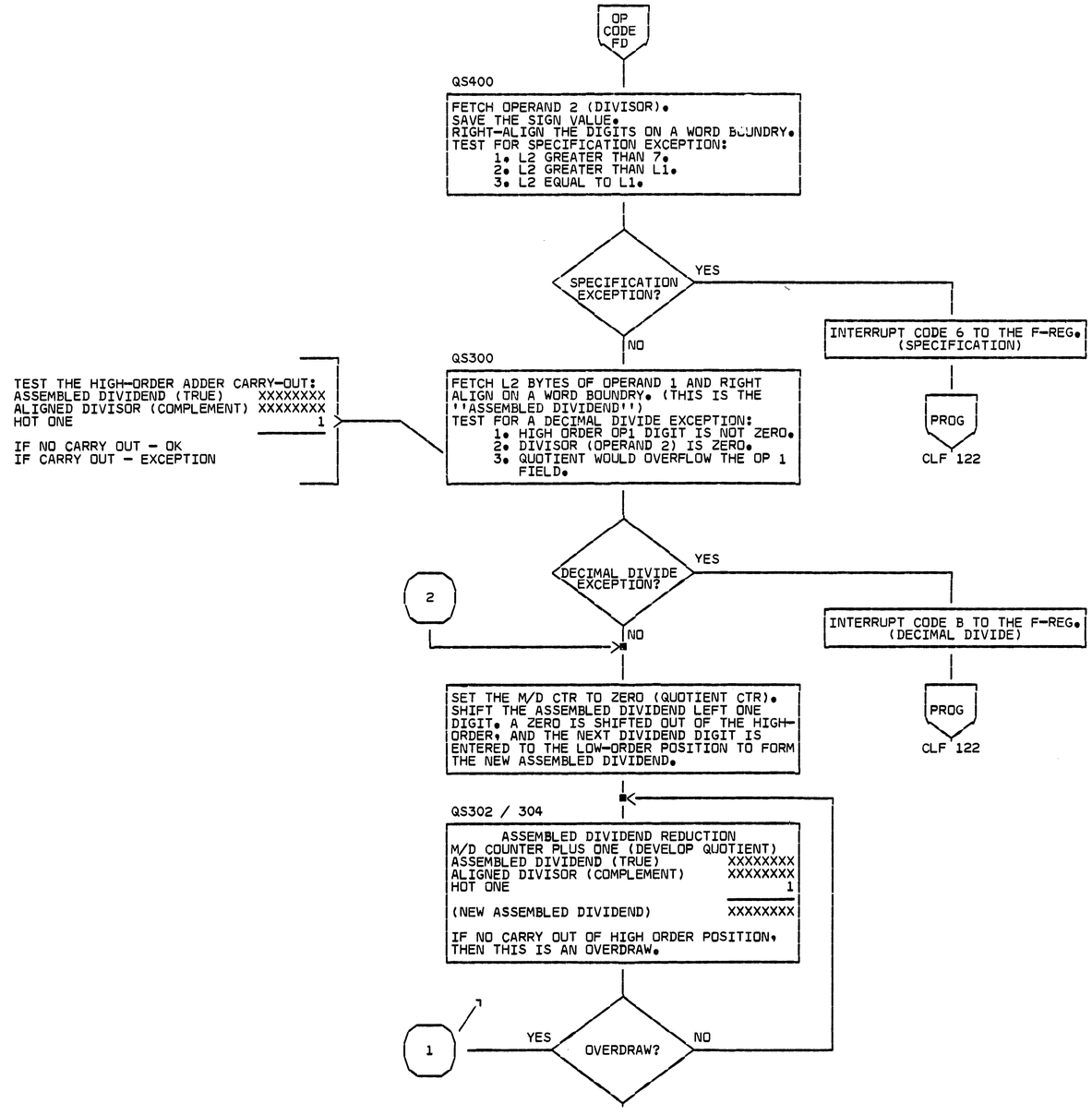
IF L2=3 OR IS <3, ONLY ONE WORD OF X1, X2, AND PARTIAL PRODUCT IS NECESSARY; STAT 5 IS USED TO SHORTEN THE MULTIPLY LOOPS.

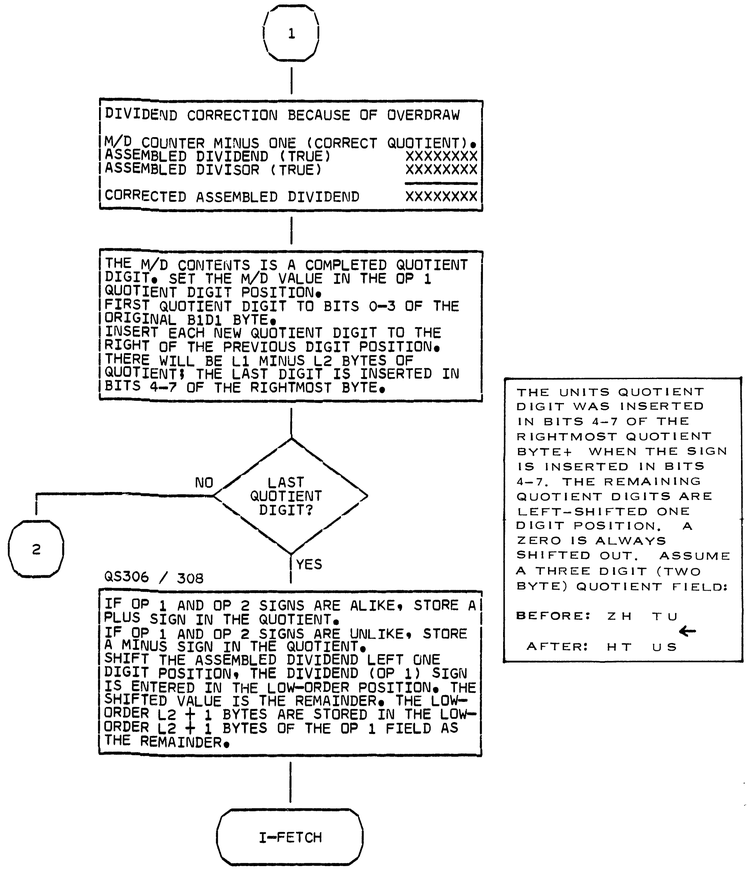




CLF 241 MULTIPLY (DECIMAL)
DATE 10 SEP 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

CL241





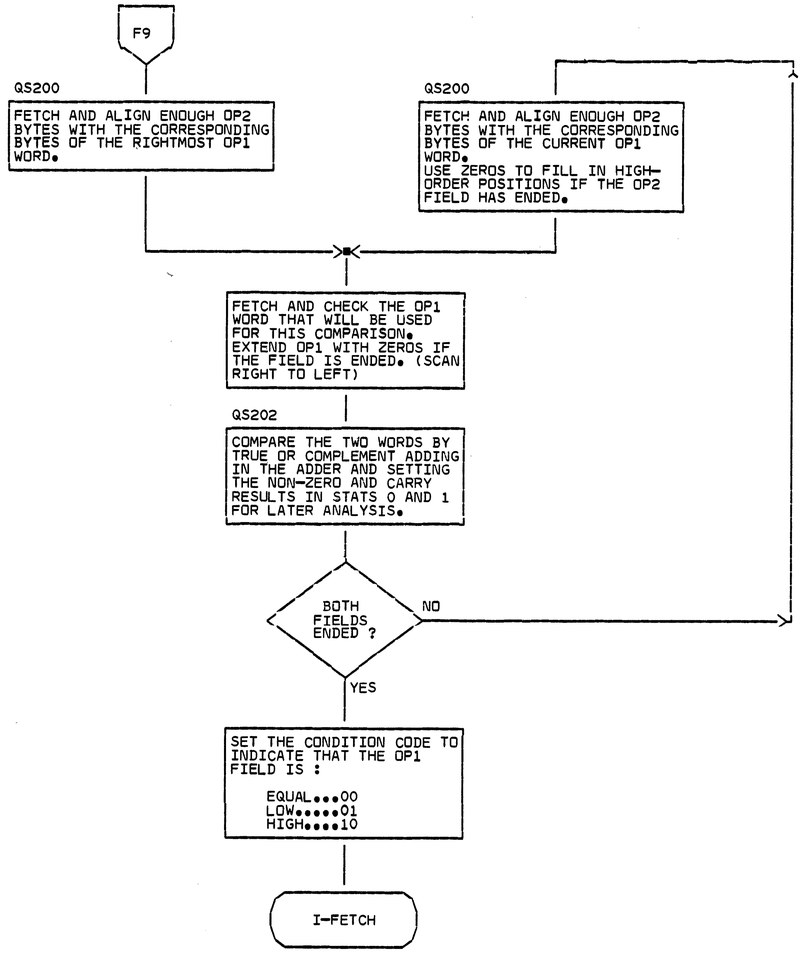
THE UNITS QUOTIENT DIGIT WAS INSERTED IN BITS 4-7 OF THE RIGHTMOST QUOTIENT BYTE+ WHEN THE SIGN IS INSERTED IN BITS 4-7, THE REMAINING QUOTIENT DIGITS ARE LEFT-SHIFTED ONE DIGIT POSITION. A ZERO IS ALWAYS SHIFTED OUT. ASSUME A THREE DIGIT (TWO BYTE) QUOTIENT FIELD:

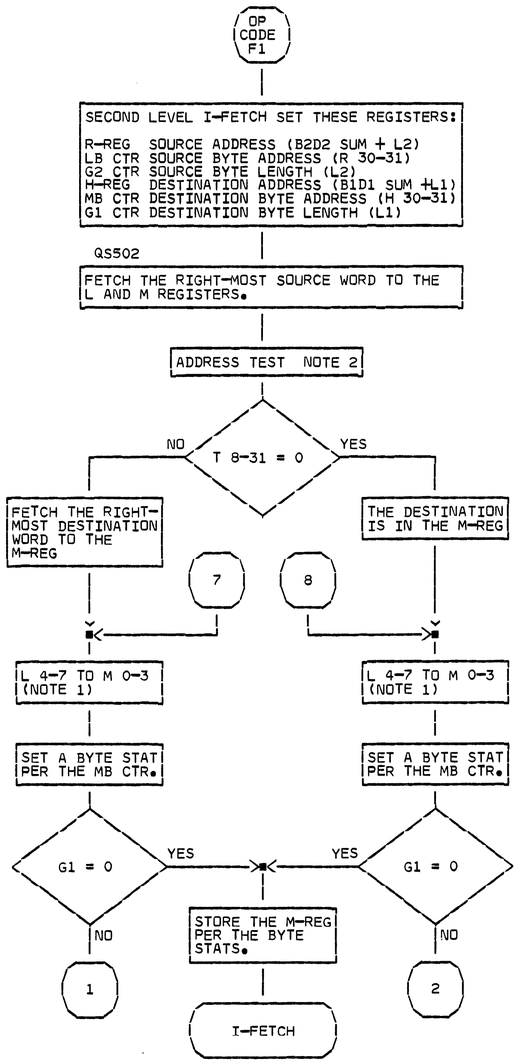
BEFORE: ZH TU

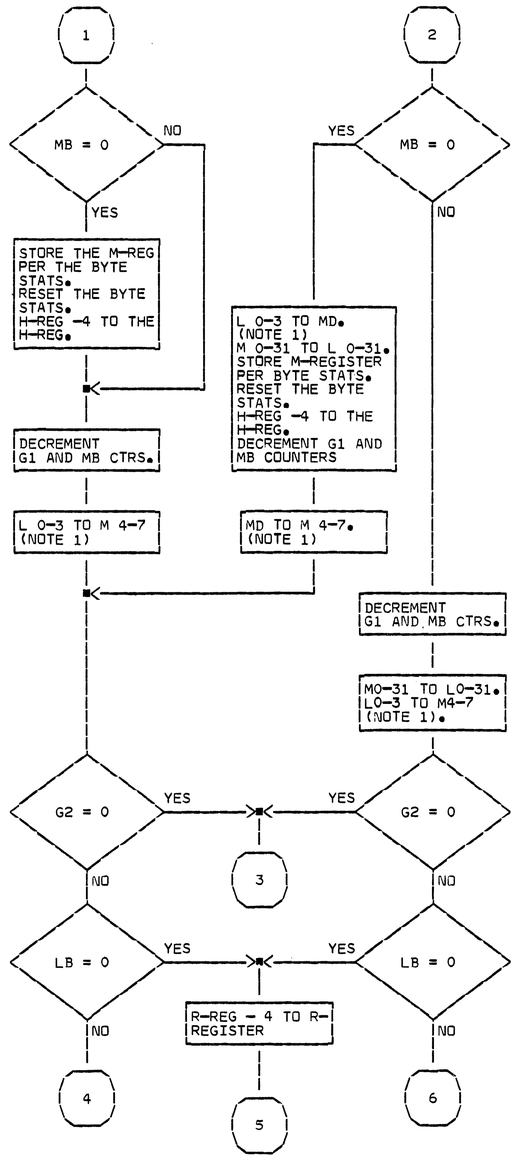
AFTER: HT US

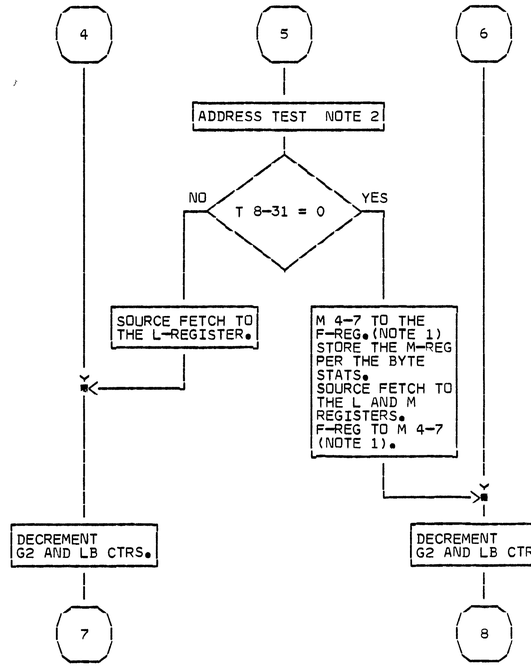
CLF 242 DIVIDE (DECIMAL
DATE 10 SEP 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

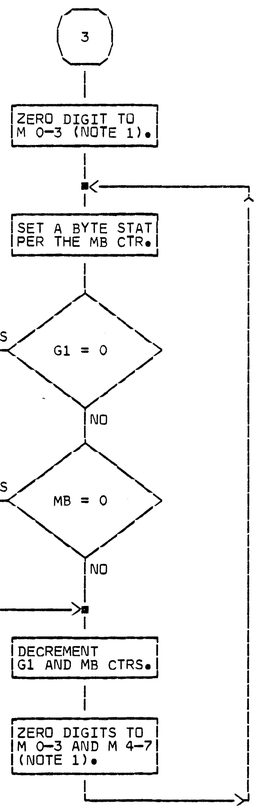
CL242









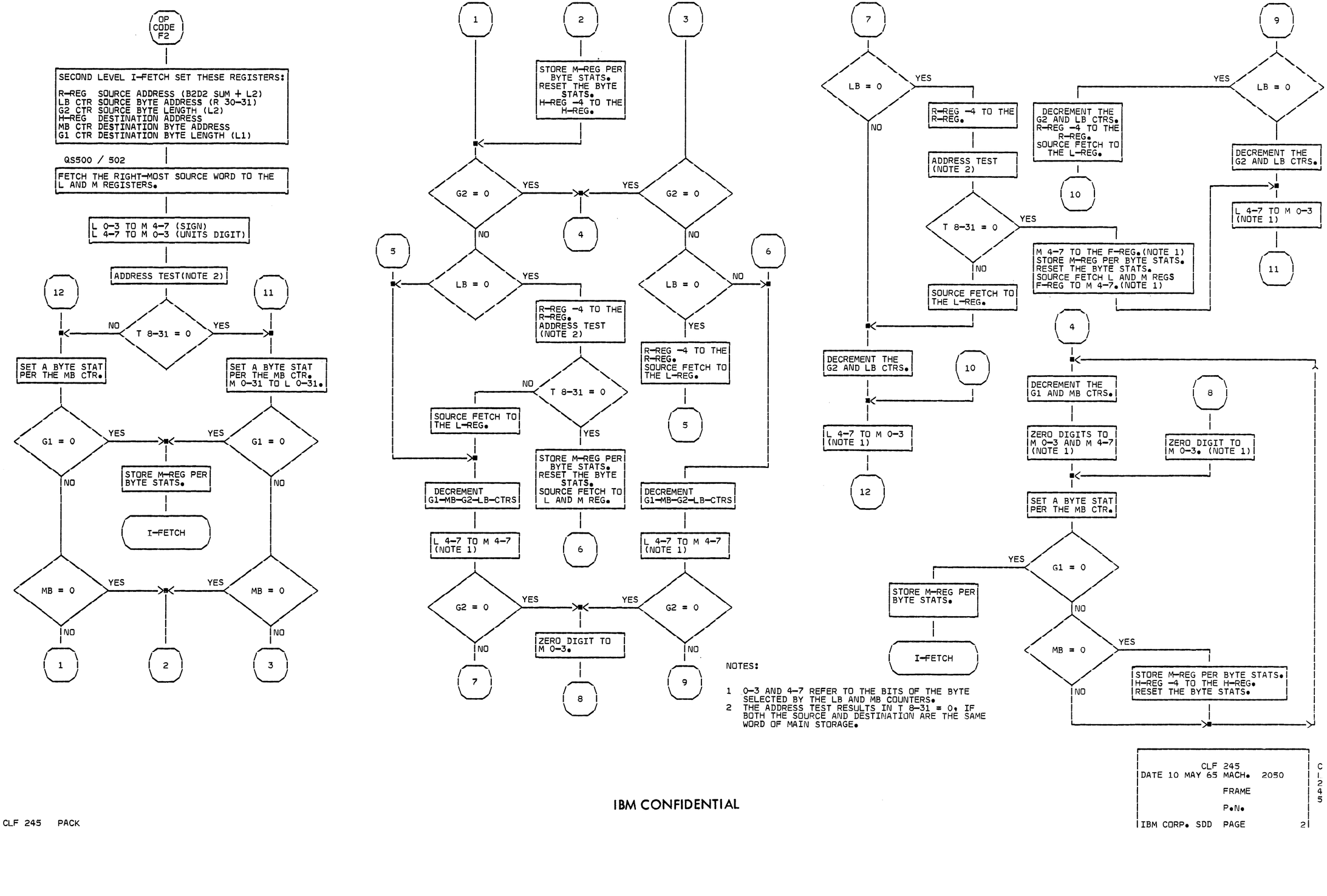


NOTES: 1 0-3 AND 4-7 REFER TO THE BITS OF THE BYTE SELECTED BY THE LB AND MB COUNTERS.

2 THE ADDRESS TEST RESULTS IN T 8-31 = 0, IF BOTH THE SOURCE AND DESTINATION ARE THE SAME WORD OF MAIN STORAGE.

CLF 244
DATE 10 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

CL244

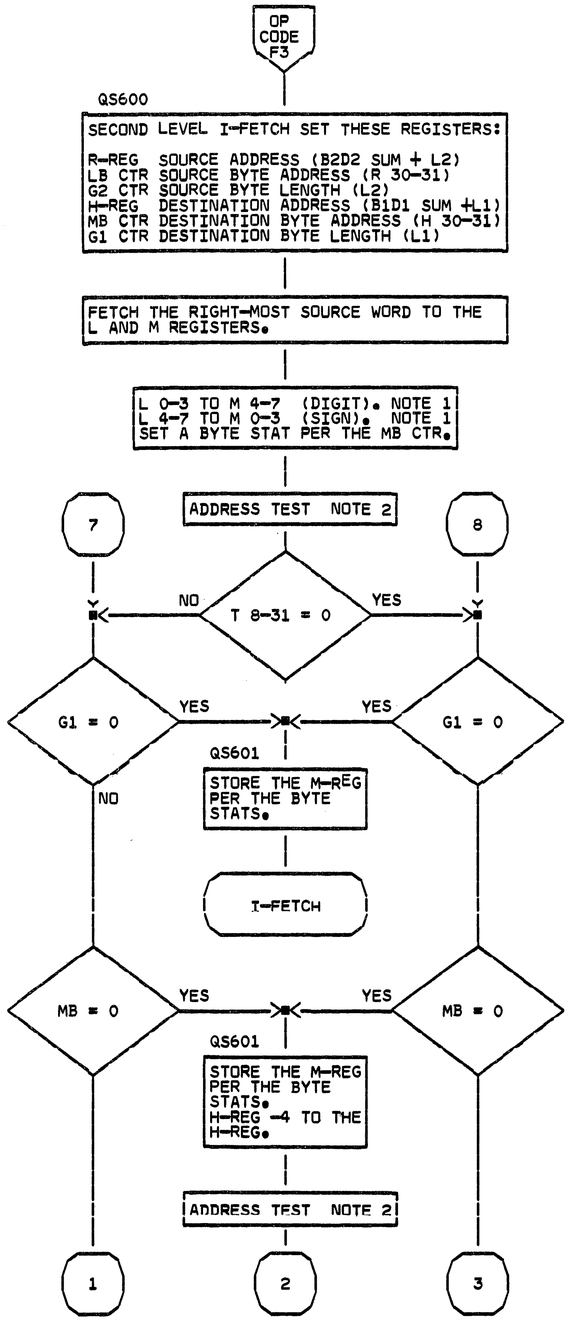


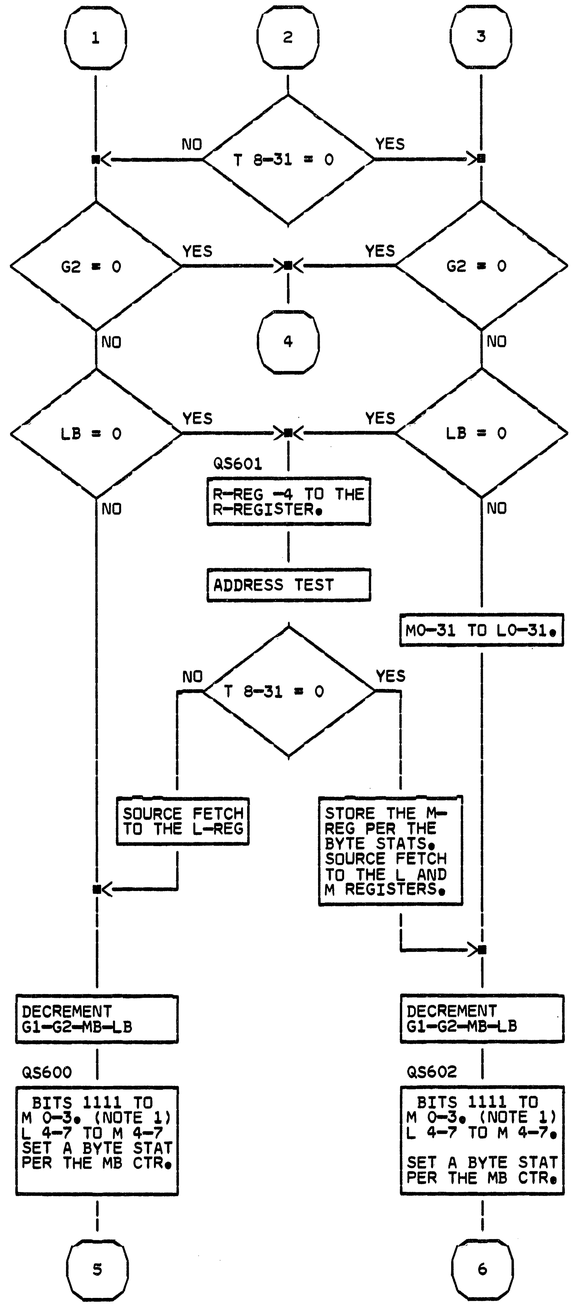
NOTES:

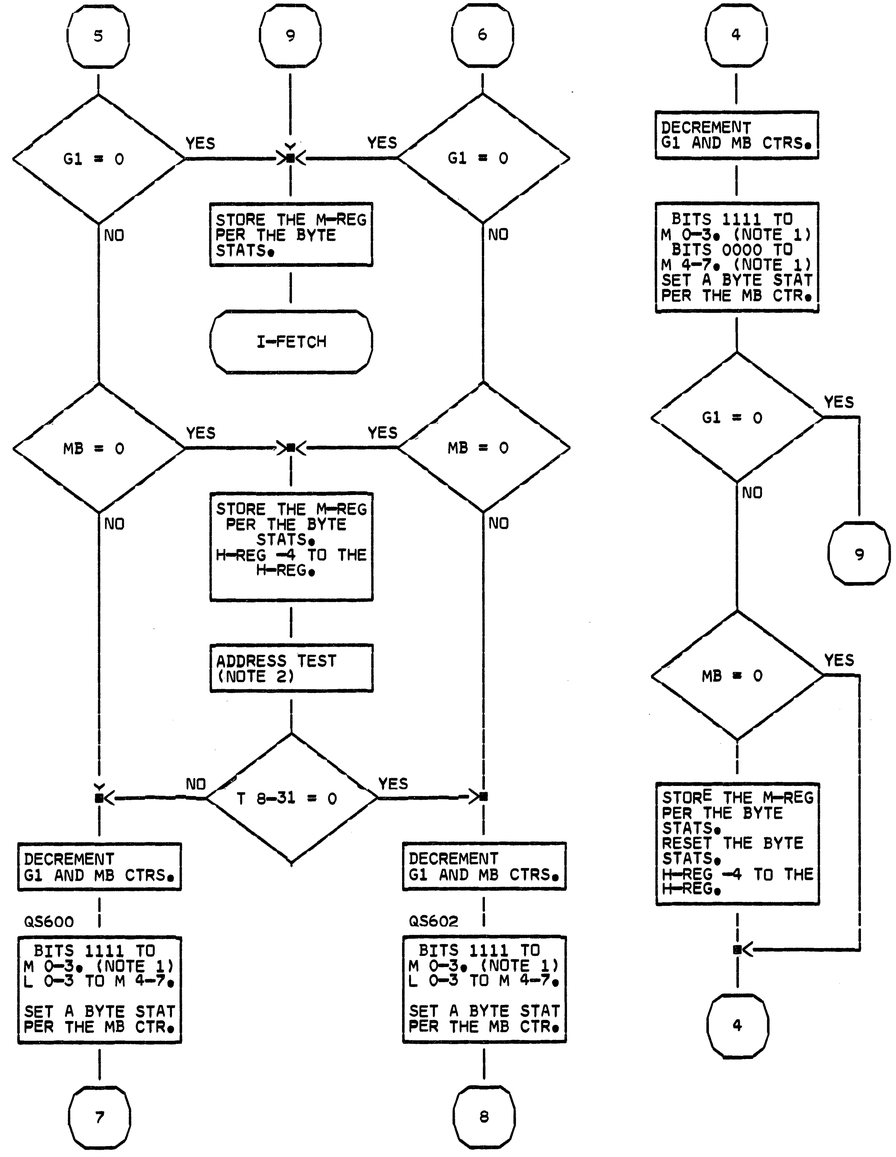
1 0-3 AND 4-7 REFER TO THE BITS OF THE BYTE SELECTED BY THE LB AND MB COUNTERS.
2 THE ADDRESS TEST RESULTS IN T 8-31 = 0, IF BOTH THE SOURCE AND DESTINATION ARE THE SAME WORD OF MAIN STORAGE.

CLF 245
DATE 10 MAY 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

CL245





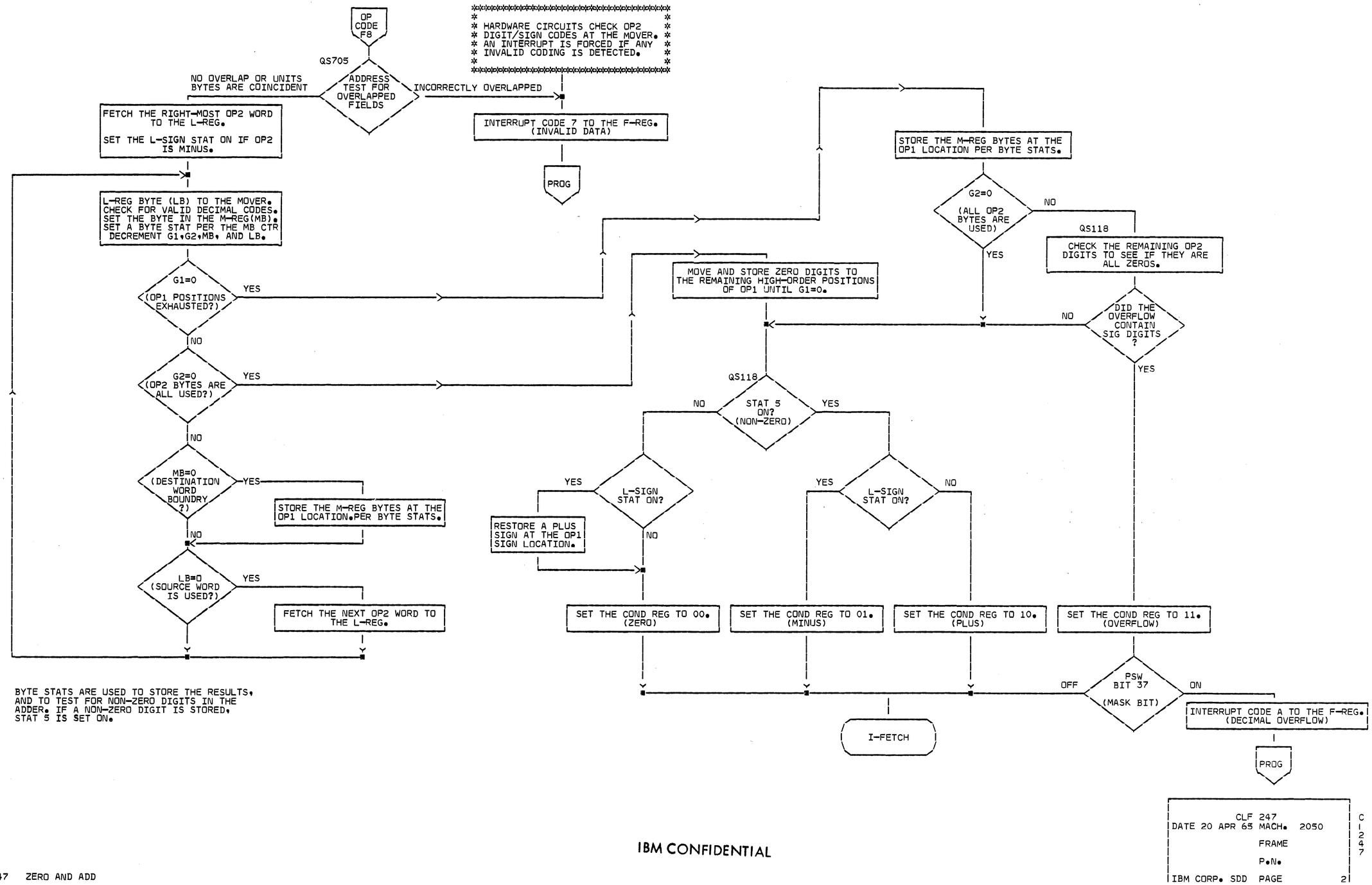


NOTES: 1 0-3 AND 4-7 REFER TO THE BITS OF THE BYTE SELECTED BY THE LB AND MB COUNTERS. BITS 1111 ARE GENERATED FOR ZONE IF PSW 12 IS OFF (EBCDIC). BITS 0101 ARE GENERATED FOR ZONE IF PSW 12 IS ON (ASCII-8).

2 THE ADDRESS TEST RESULTS IN THE T8-31 = 0, IF BOTH THE SOURCE AND DESTINATION ARE THE SAME WORD OF MAIN STORAGE.

CLF 246
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

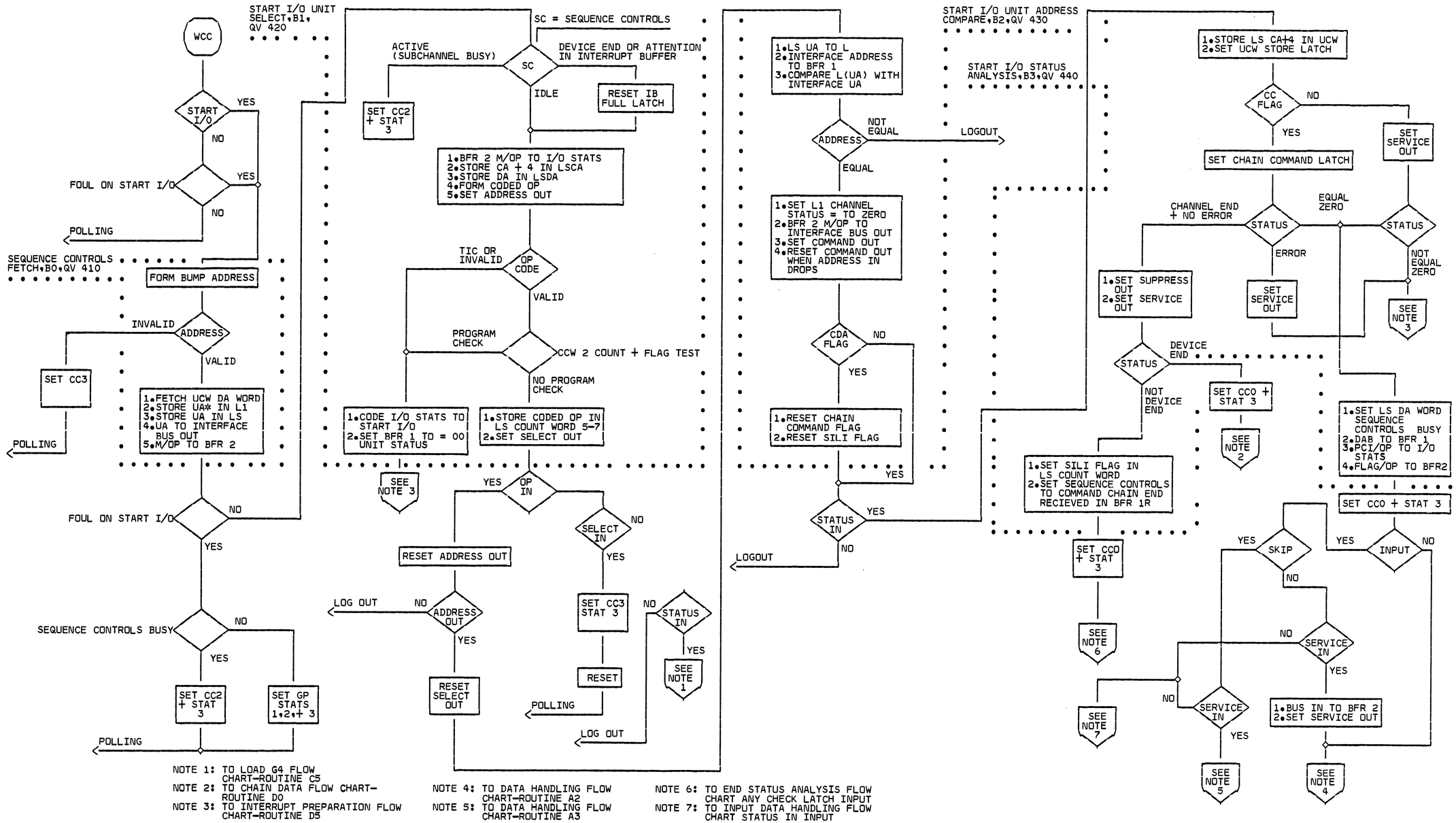
CL246



IBM CONFIDENTIAL

	MPX ROUTINE	CAS QV-	HEX ADD	ROS ADDRESS BASE 0123	E 4501	23AB	ROUTINE REQUEST BUFFER FUNCTION NOT 4 01 23A	ROUTINE NAME
	A0	210	080	0000	1000	0000		COUNT FETCH AND UPDATE
	A1	220	084	0000	1000	0100		DATA ADDRESS FETCH AND UPDATE
S	A2	230	088	0000	1000	1000		DATA HANDLING 1 (OUTPUT)
S	A2	231		FROM	QV	230		DATA HANDLING 1 (INPUT)
S	A3	240	086	0000	1000	1100		DATA HANDLING 2 (OUTPUT)
S	A3	241		FROM	QV	240		DATA HANDLING 2 (READ FWD)
S	A3	242		FROM	QV	240		DATA HANDLING 2 (STOP OR SKIP)
S	A3	243		FROM	QV	240		DATA HANDLING 2 (READ BKWD)
	A4	250	090	0000	1001	0000		END STATUS ANALYSIS
	A5	350	094	0000	1001	0100		COMMAND CHAIN END STATUS ANALYSIS
S	A5	351		FROM	QV	350		COMMAND CHAIN END STATUS ANALYSIS
S	A5	352		FROM	QV	350		COMMAND CHAIN END STATUS ANALYSIS
	A6	820	098	0000	1001	1000		INTERRUPT PREPARATION
	A7	270	09C	0000	1001	1100		COUNT EQUALS ZERO ANALYSIS
				0000				
	B0	410	0A0	0000	1010	0000		SEQUENCE CONTROL FETCH
	B1	420	0A4	0000	1010	0100		START IO UNIT SELECT
	B2	430	0A8	0000	1010	1000		START IO UNIT ADDRESS COMPARE
	B3	440	0AC	0000	1010	1100		START IO STATUS ANALYSIS
	B5	460	0B4	0000	1011	0100		COUNT STORE
	B6	470	0B8	0000	1011	1000		DA STORE
	B7	840	0BC	0000	1011	1100		CHECK HANDLING
				0000				
	C0	260	002	0000	0000	0010		PCI
	C1	520	086	0000	1000	0110		TEST IO UNIT SELECT 1
	C2	540	08A	0000	1000	1010		TEST IO UNIT ADDRESS COMPARE
	C3	550	08E	0000	1000	1110		TEST IO ACCEPT STATUS
	C4	850	092	0000	1001	0010		CONTROL CHECK
	C5	810	096	0000	1001	0110		CONTROL UNIT BUSY
	C6	620	09A	0000	1001	1010		HALT IO UNIT SELECT
	C7	530	09E	0000	1001	1110		TEST IO UNIT SELECT 2
				0000				
	D0	360	0A2	0000	1010	0010		COMMAND ADDR FETCH/STORE
	D1	310	0A6	0000		0110		CHAN CONTROL WORD 1 FETCH
	D2	330	0AA	0000		1010		COMMAND CHAIN UNIT ADDRESS COMPARE
	D3	340	0AE	0000		1110		COMMAND CHAIN INITIAL STATUS ANAL
	D4	320	0B2	0000	1011	0010		FETCH 2ND HALF OF CHAN CTRL WORD
S	D4	321		FROM	QV	320		CHAN CONTROL WORD 2 FETCH
	D5	830	0B6	0000	1011	0110		LOAD 64 PREP (ST IO OR TEST IO QED)
S	D5	831		FROM	QV	830		LOAD 64 PREP (TEST IO NO END QED)
S	D5	832		FROM	QV	830		LOAD 64 PREP (CU BUSY OR HALT IO)
	D7	370	0BE	0000	1011	1110		DATA CHAINING

IOP 101 I-O ROUTINE STARTING ADDRESS



NOTE 1: TO LOAD G4 FLOW CHART—ROUTINE C5
NOTE 2: TO CHAIN DATA FLOW CHART—ROUTINE DO
NOTE 3: TO INTERRUPT PREPARATION FLOW CHART—ROUTINE D5
NOTE 4: TO DATA HANDLING FLOW CHART—ROUTINE A2
NOTE 5: TO DATA HANDLING FLOW CHART—ROUTINE A3
NOTE 6: TO END STATUS ANALYSIS FLOW CHART ANY CHECK LATCH INPUT
NOTE 7: TO INPUT DATA HANDLING FLOW CHART STATUS IN INPUT

DATE 9 SEP 65 MACH•
MULTIPLEXOR FRAME
FOR MODEL 50 P•N•
IBM CORP• SDD PAGE 2

JCMPX

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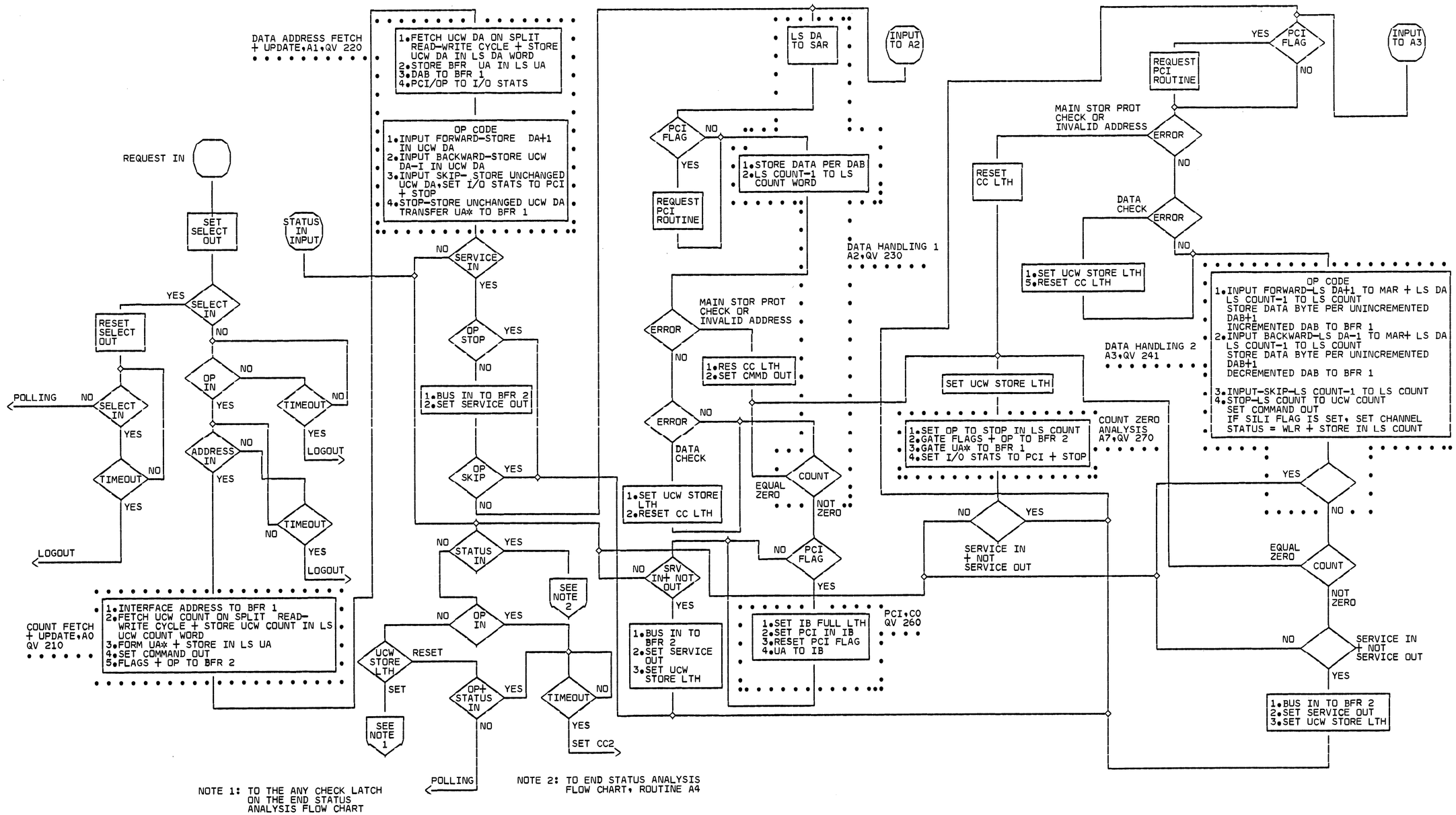

NOTE 1: TO THE ANY CHECK LATCH ON THE END STATUS ANALYSIS FLOW CHART

NOTE 2: TO END STATUS ANALYSIS FLOW CHART, ROUTINE A4

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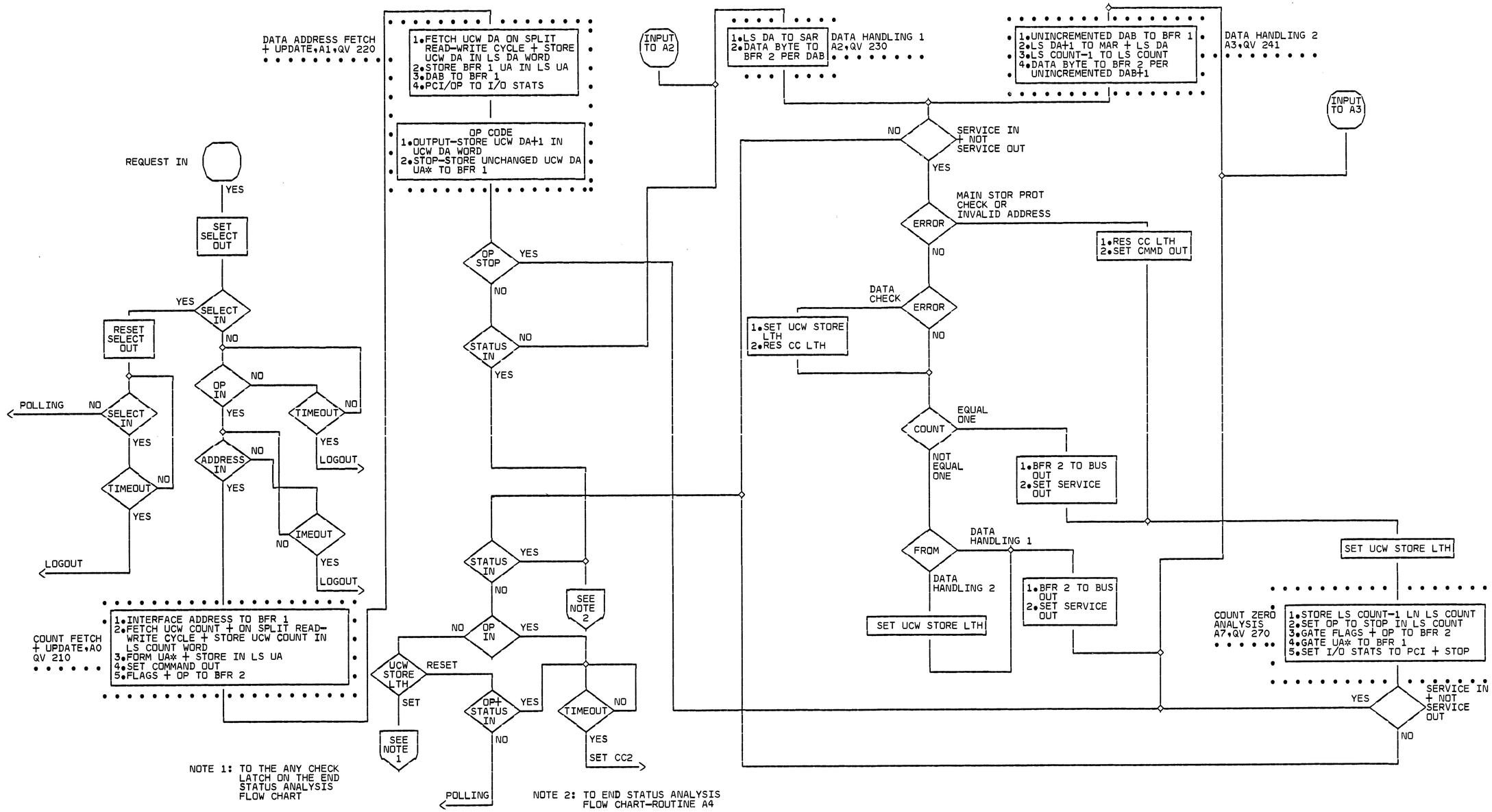
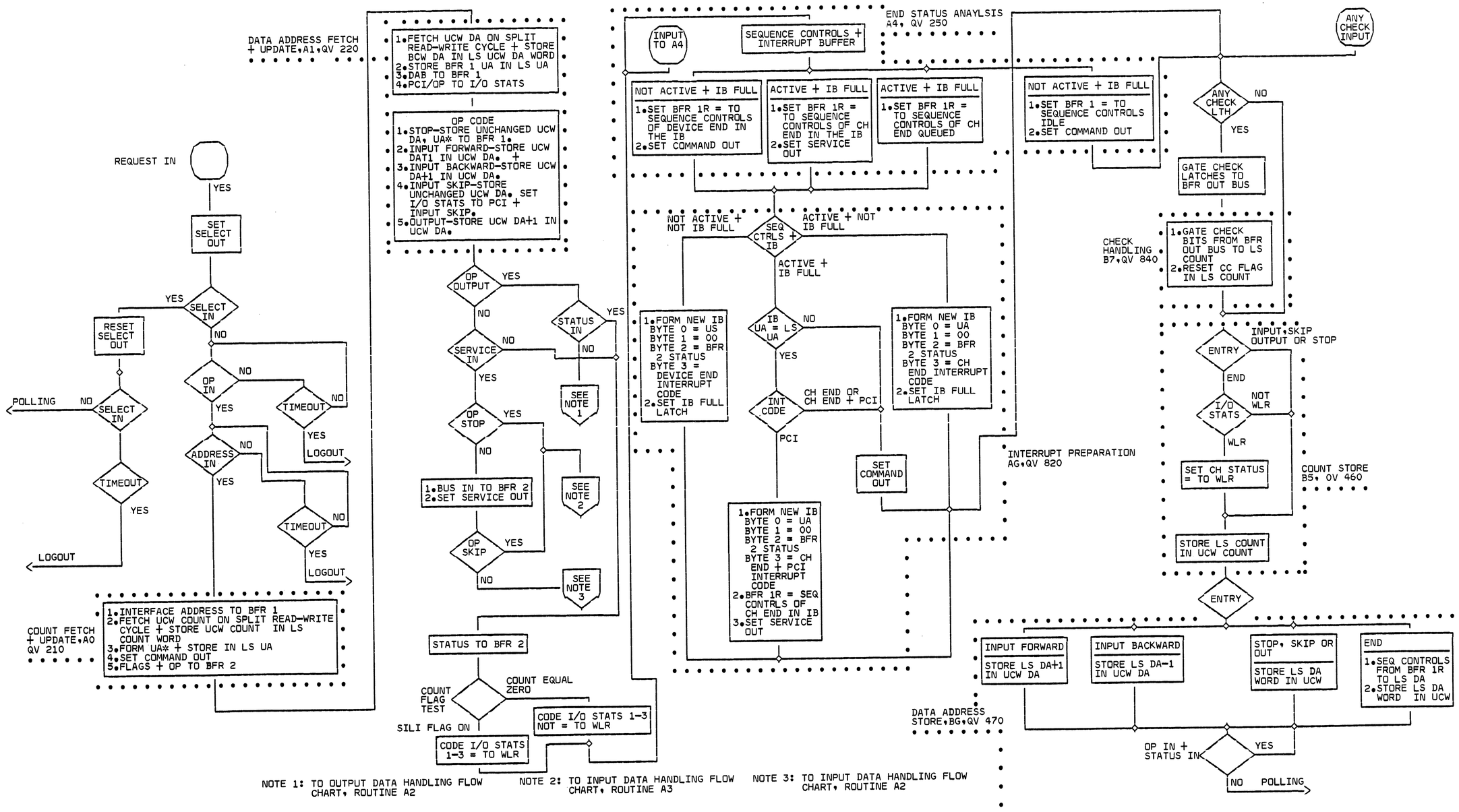
DATE 9 SEP 65	MACH.	JCMPX
MULTIPLEXOR	FRAME	
FOR MODEL 50	P.N.	
IBM CORP. SDD	PAGE 3	



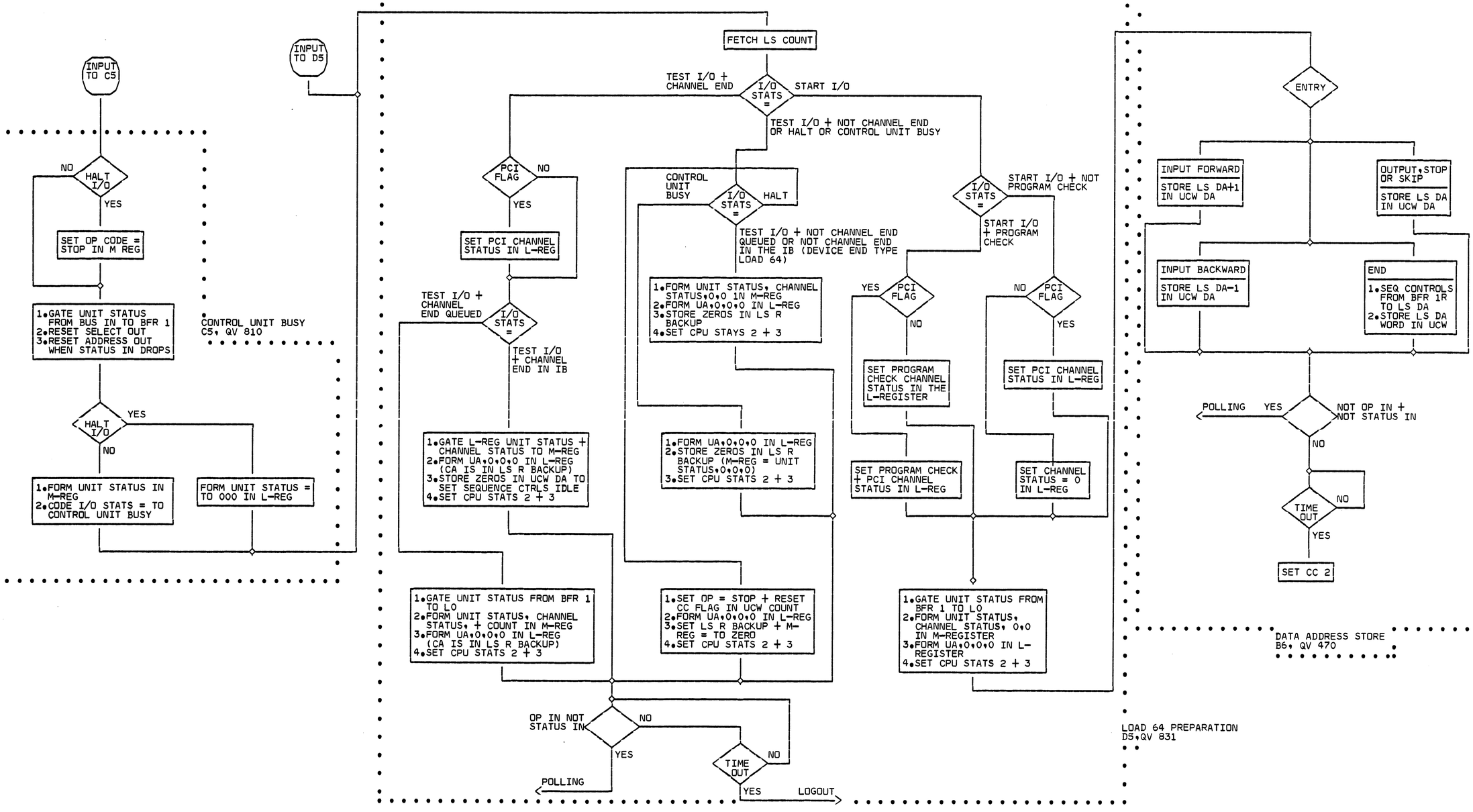
DATE 9 SEP 65	MACH•	JCMPX
MULTIPLEXOR	FRAME	
FOR MODEL 50	P•N•	
IBM CORP• SDD	PAGE 4	



DATE 9 SEP 65 MACH.
MULTIPLEXOR FRAME
FOR MODEL 50 P.N.
IBM CORP. SDD PAGE 5

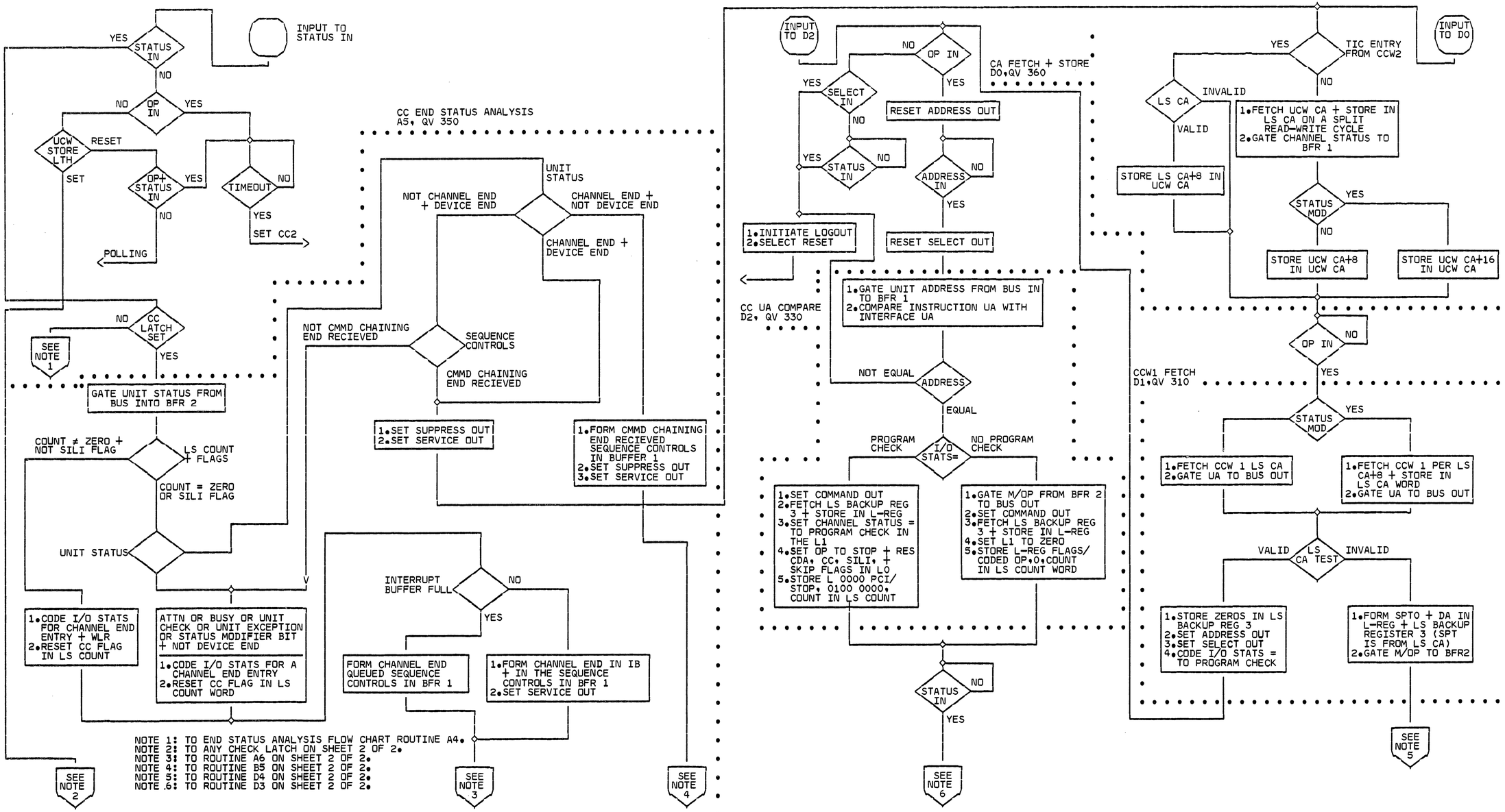
JCMPX

IBM CONFIDENTIAL



DATE 9 SEP 65 MACH.
MULTIPLEXOR FRAME
FOR MODEL 50 P.N.
IBM CORP. SDD PAGE 6

JCMPX



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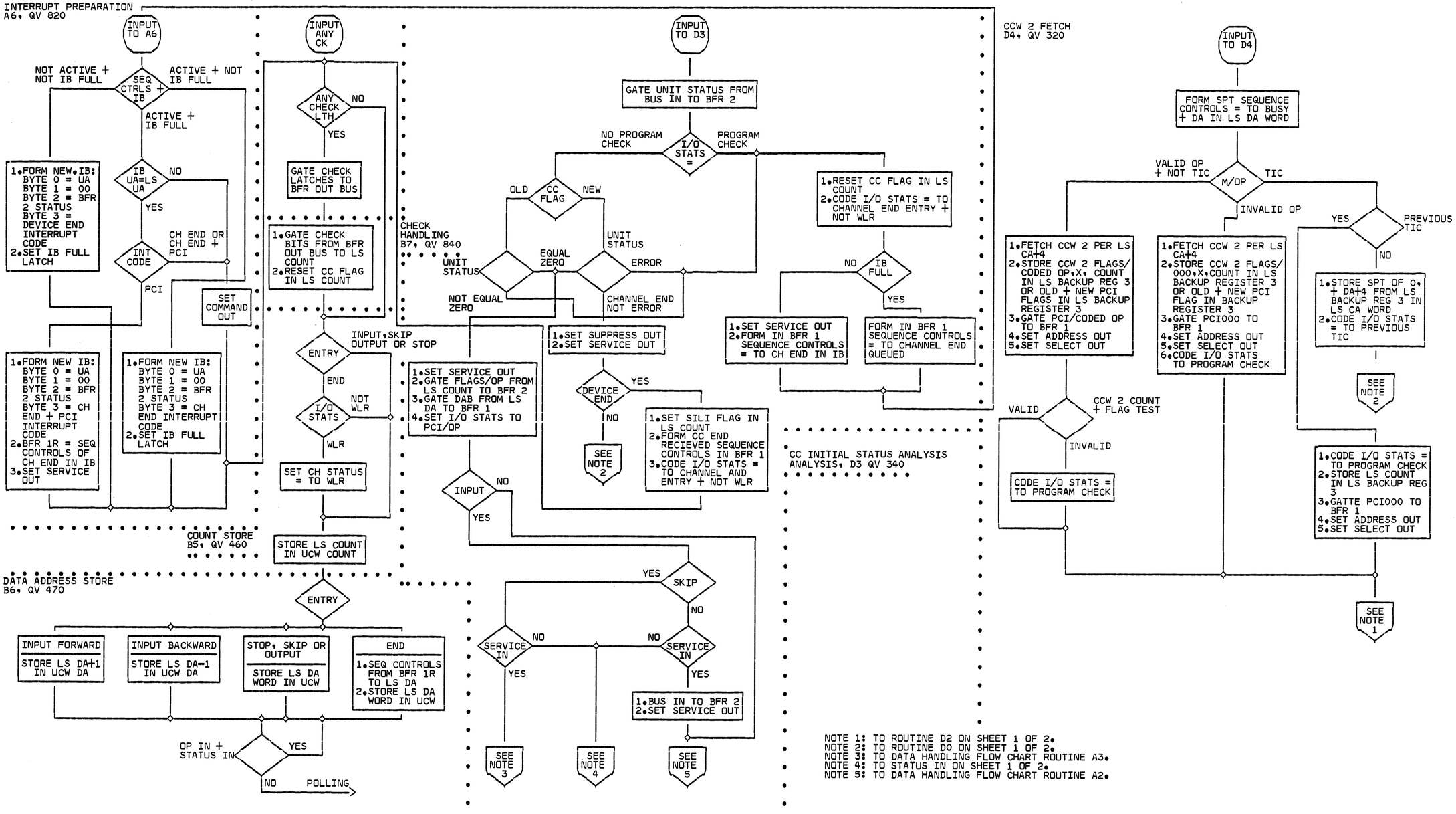
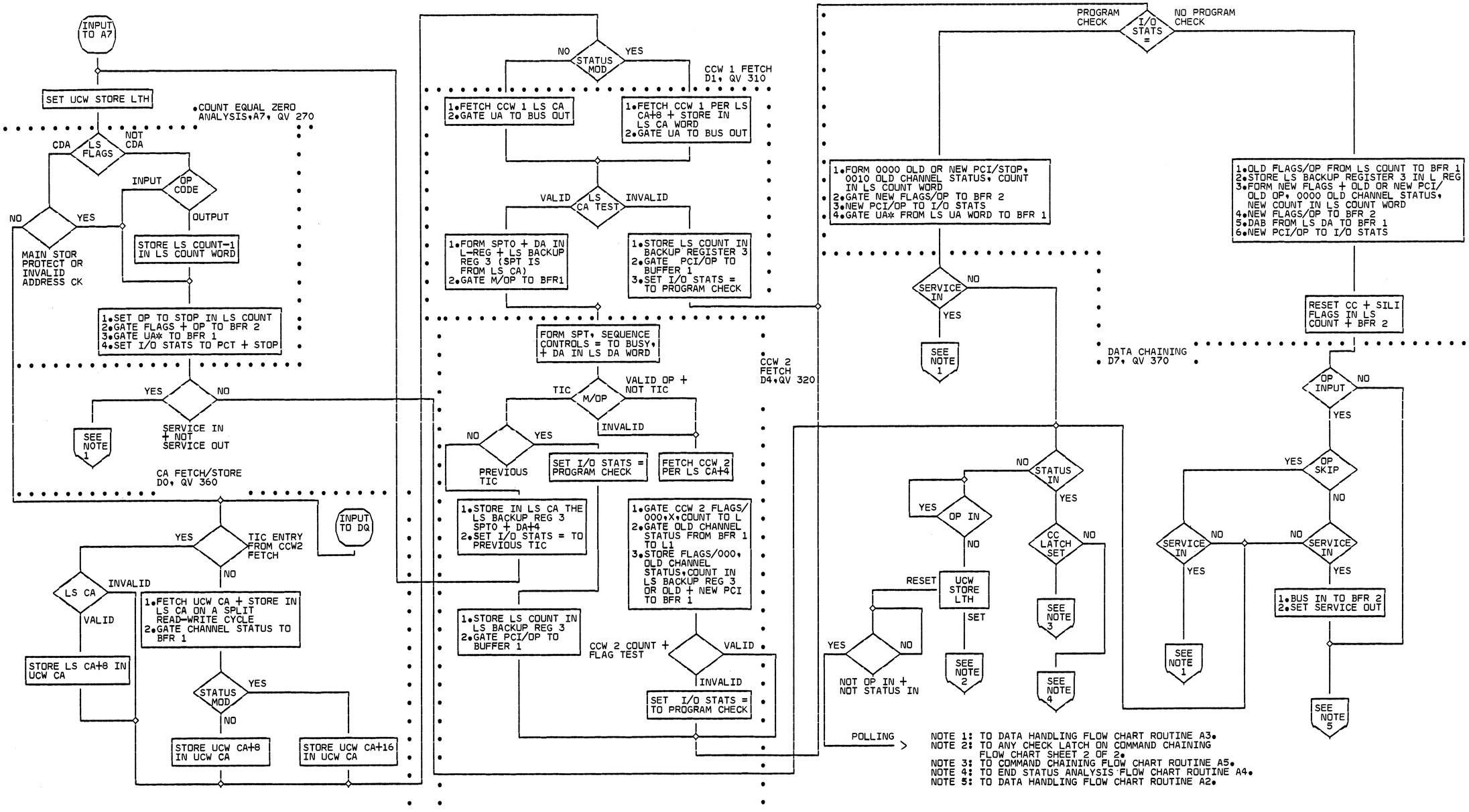
DATE 9 SEP 65 MACH•		JCMPX
MULTIPLEXOR	FRAME	
FOR MODEL 50	P•N•	
IBM CORP• SDD	PAGE 7	



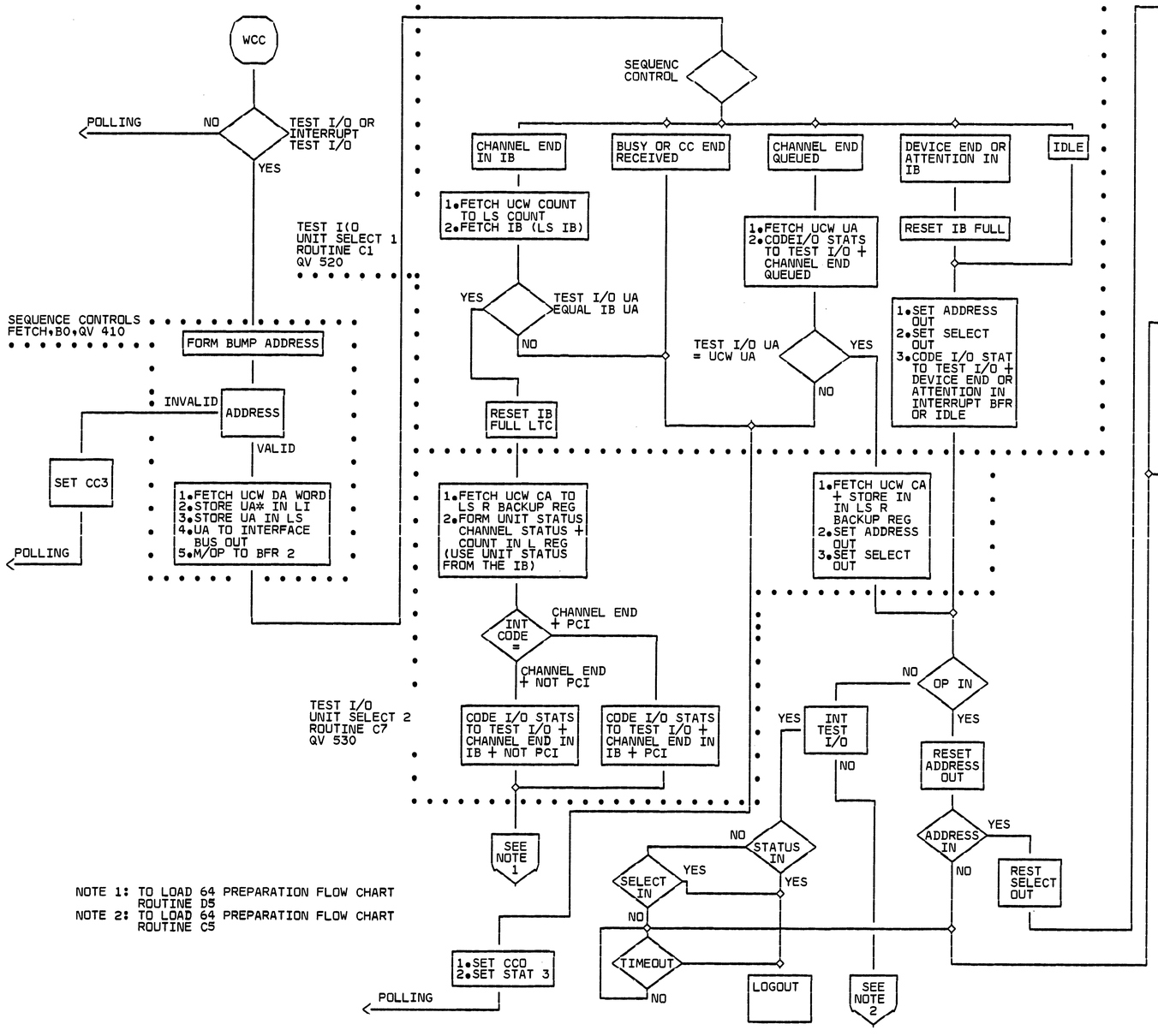
DATE 9 SEP 65	MACH.	
MULTIPLEXOR	FRAME	
FOR MODEL 50	P.N.	
IBM CORP. SDD	PAGE	8

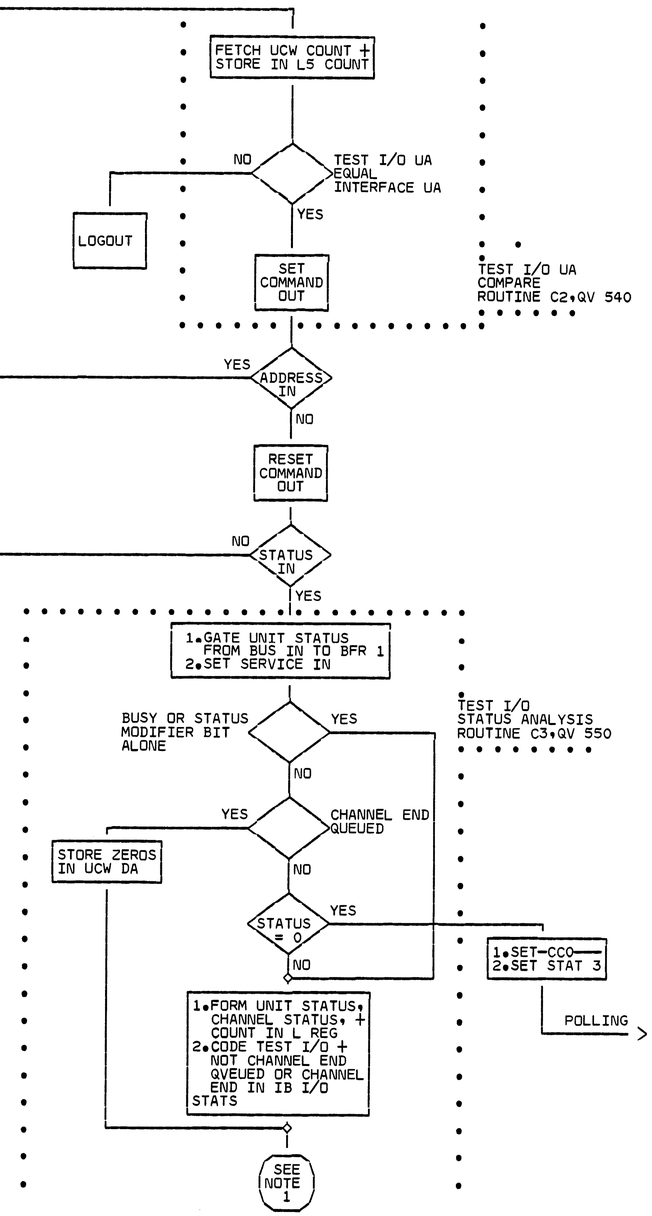
JCMPX



DATE 9 SEP 65 MACH•
MULTIPLEXOR FRAME
FOR MODEL 50 P•N•
IBM CORP• SDD PAGE 9

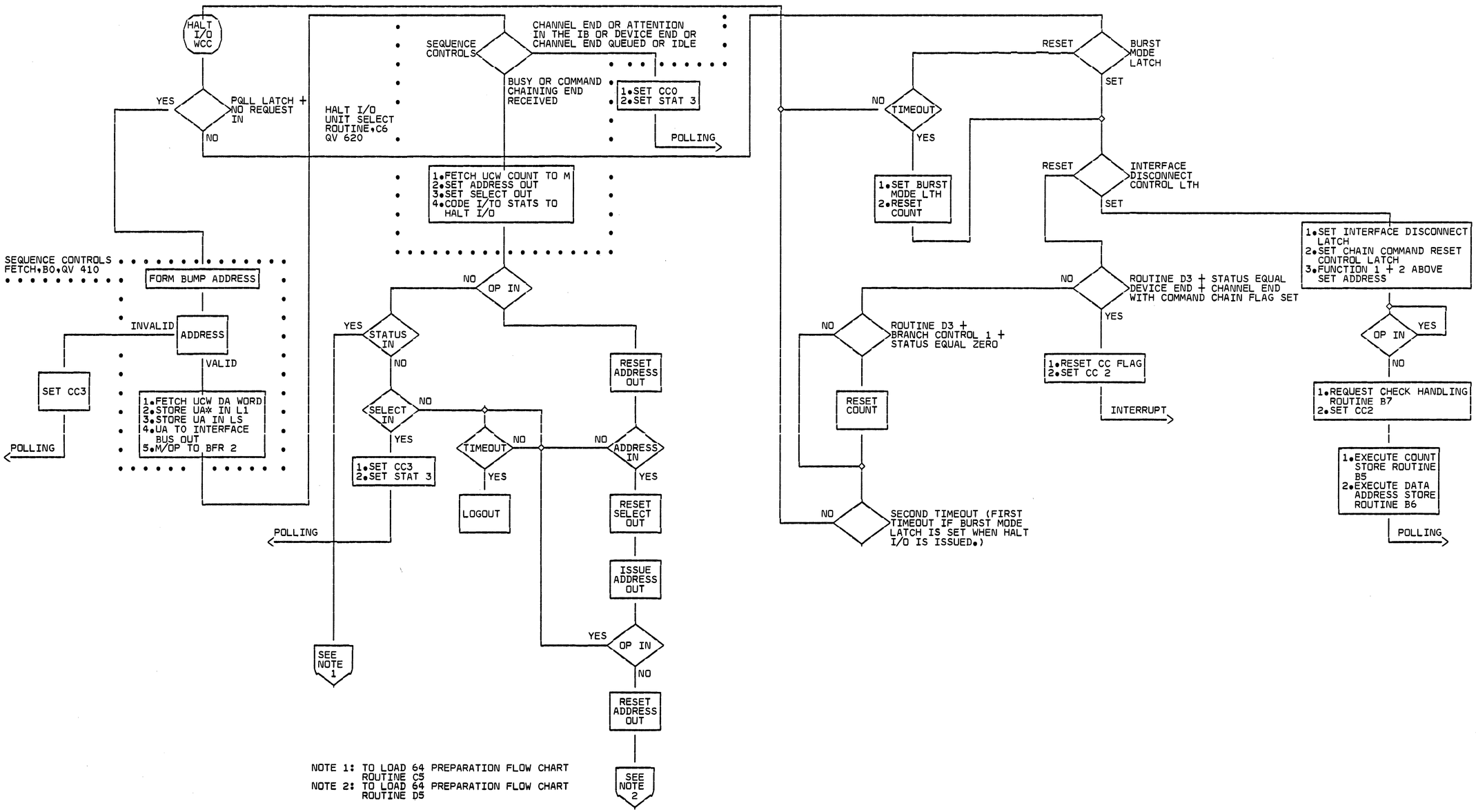
JCMPX



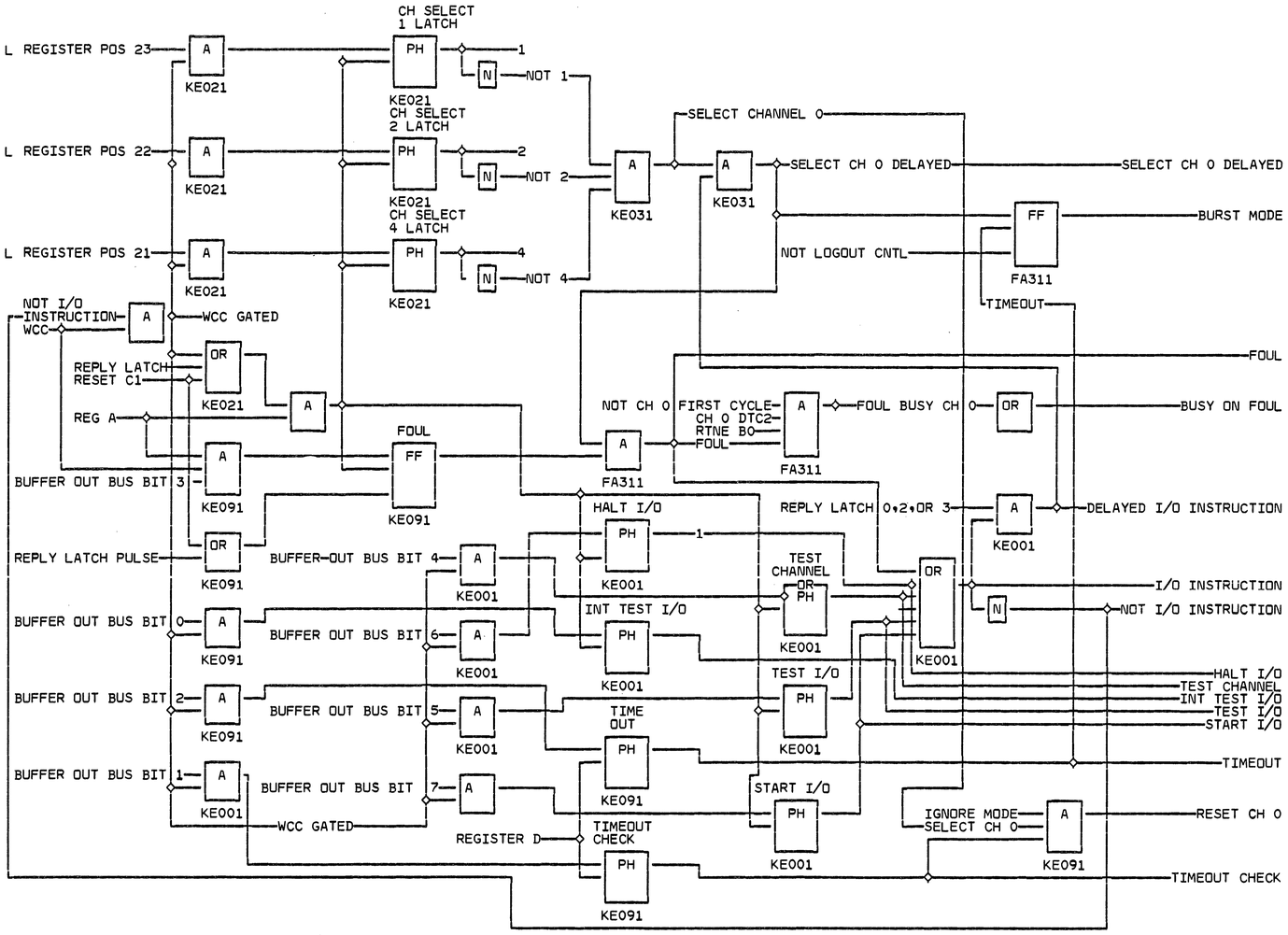


DATE 9 SEP 65 MACH•
MULTIPLEXOR FRAME
FOR MODEL 50 P•N•
IBM CORP• SDD PAGE 10

JCMPX



DATE 9 SEP 65 MACH.
MULTIPLEXOR FRAME
FOR MODEL 50 P.N.
IBM CORP. SDD PAGE 11
JCMPX



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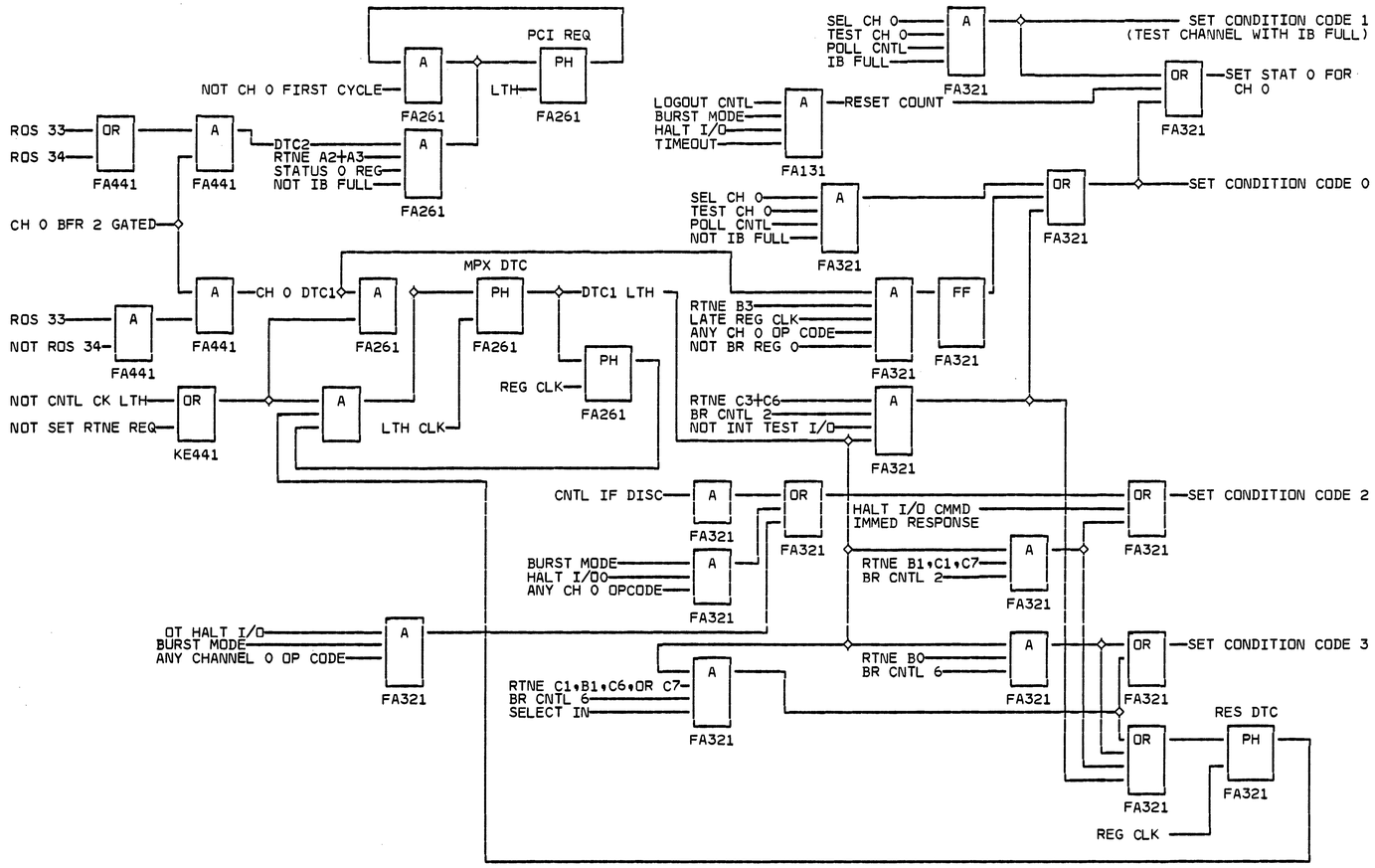
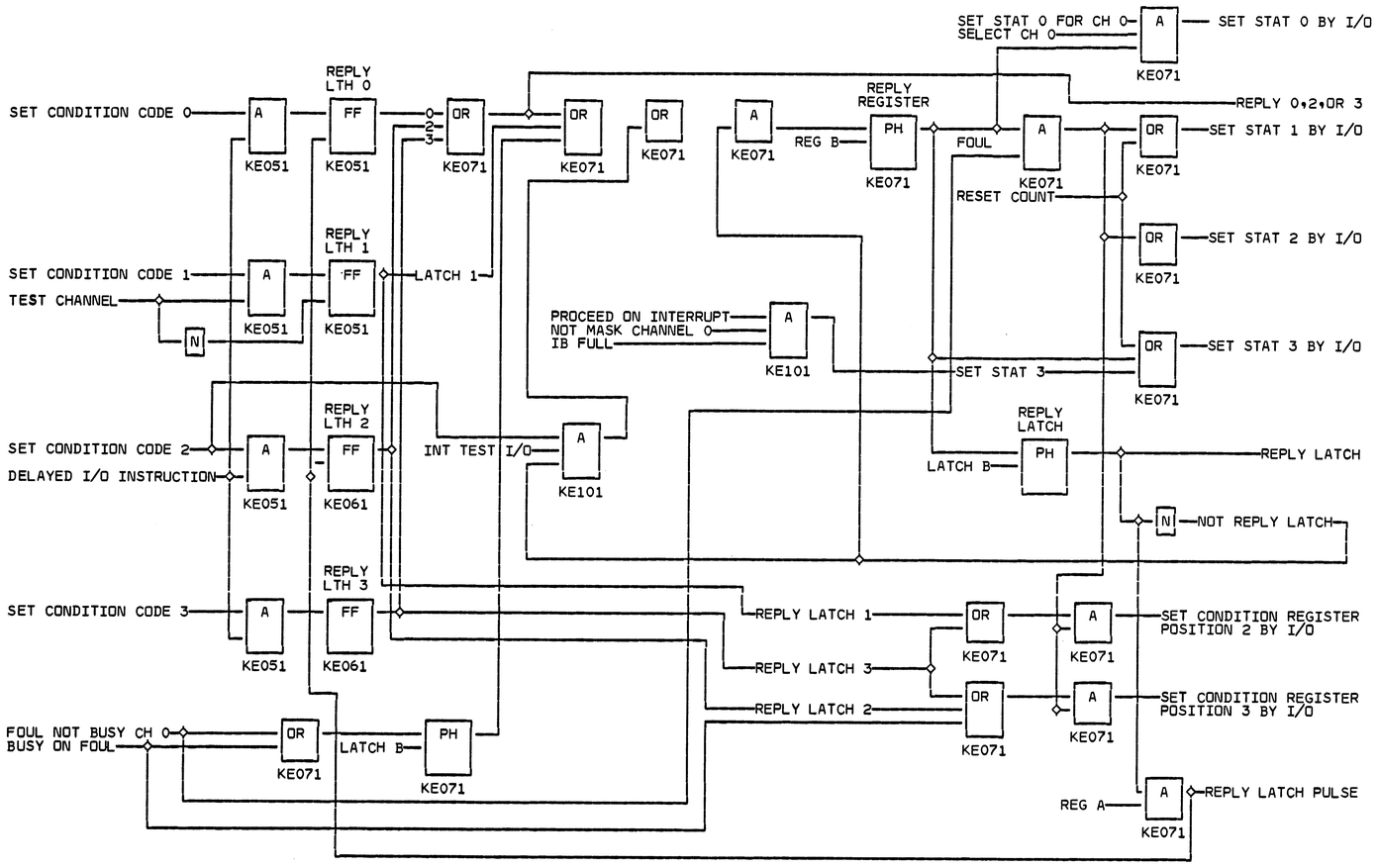
IOP III INITIATE I-O OPERATION (SHEET 1 OF 3)

DATE 9 SEP 65	MACH.	
MULTIPLEXOR	FRAME	
FOR MODEL 50	P.N.	
IBM CORP. SDD	PAGE	14

JCMPX



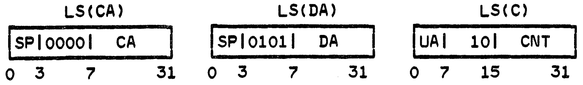


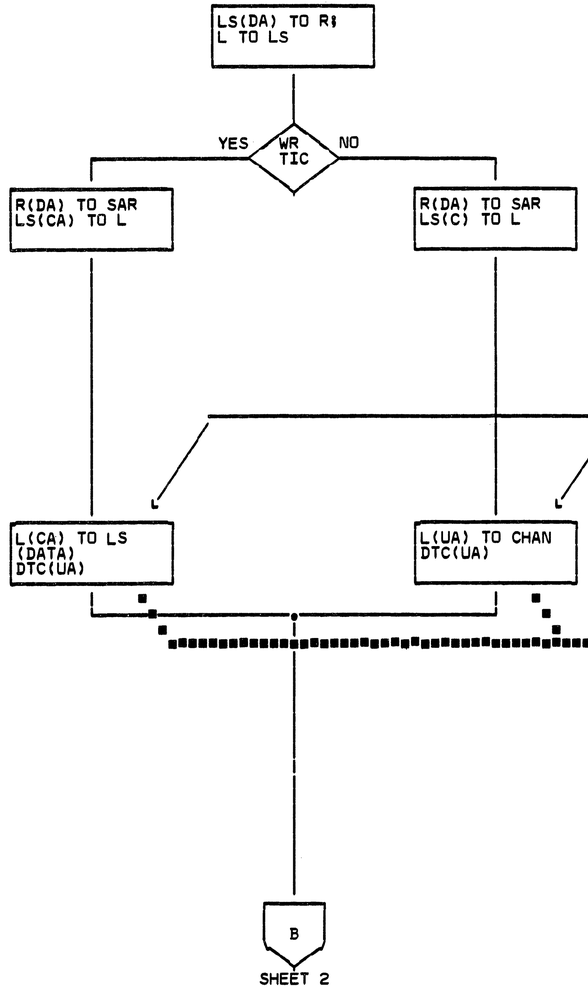
CONDITION REG	SET CONDITION CODE
2 OFF AND 3 OFF	0
2 ON AND 3 OFF	1
2 OFF AND 3 ON	2
2 ON AND 3 ON	3

DATE 9 SEP 65 MACH.
MULTIPLEXOR FRAME
FOR MODEL 50 P.N.
IBM CORP. SDD PAGE 13

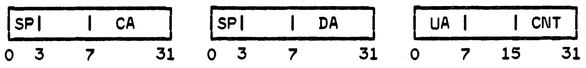
JCMPX

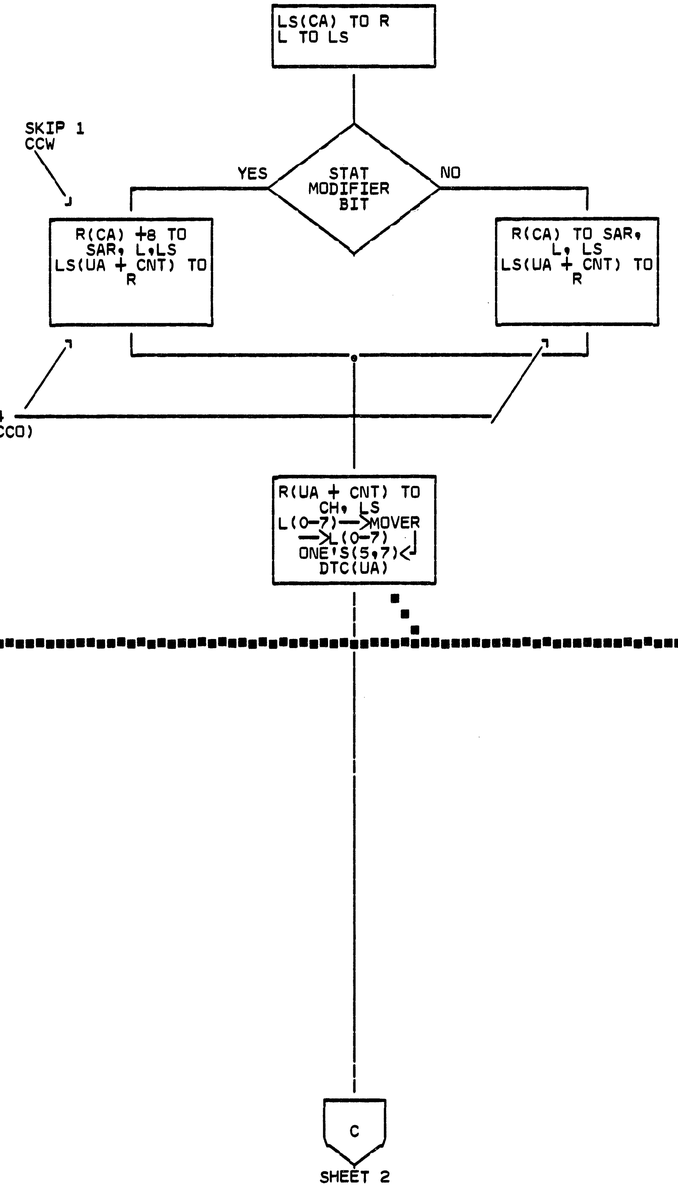
TRANSFER(QV101)



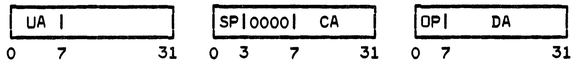


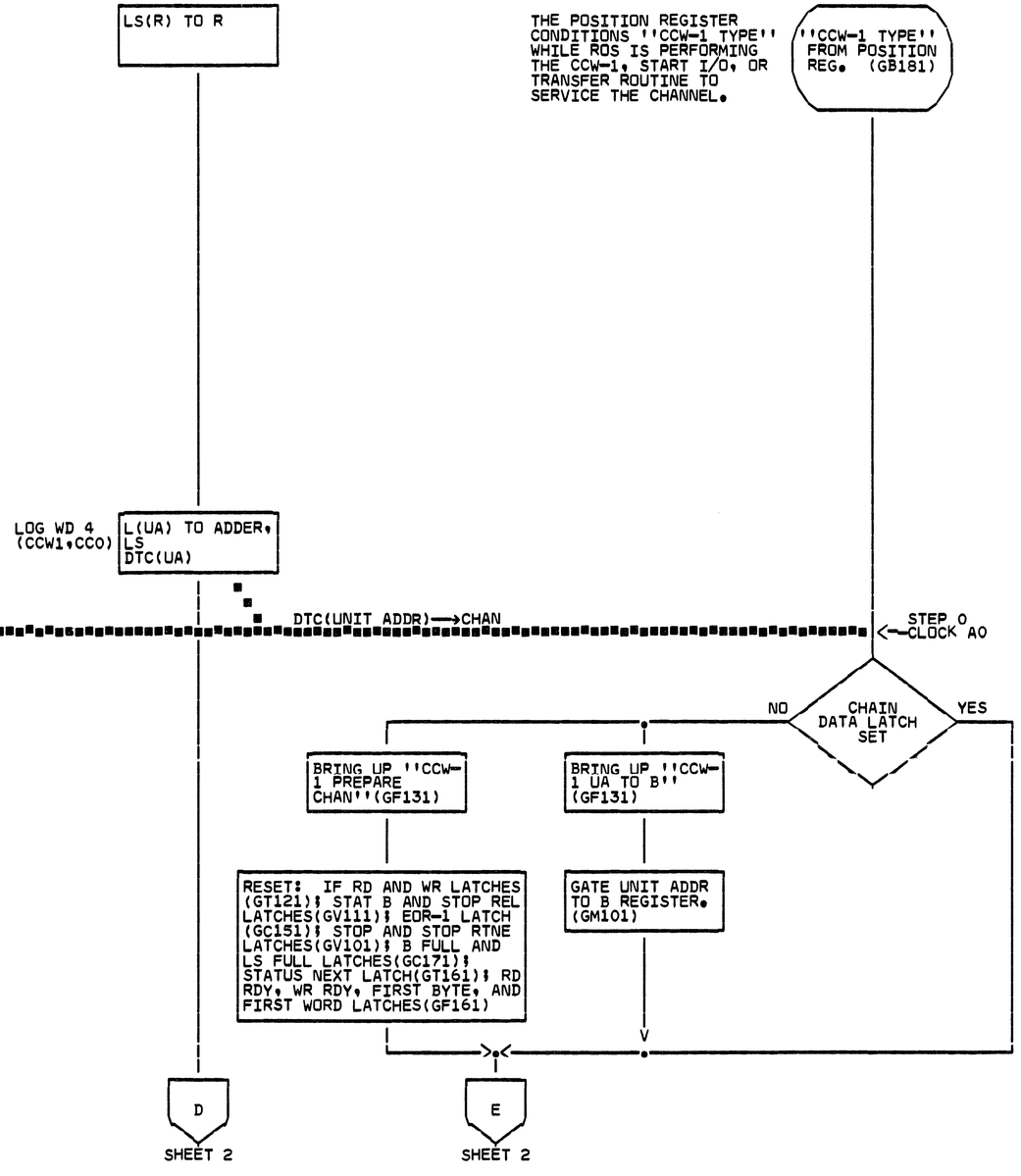
CCW1(QV102)





START I/O(QV100)

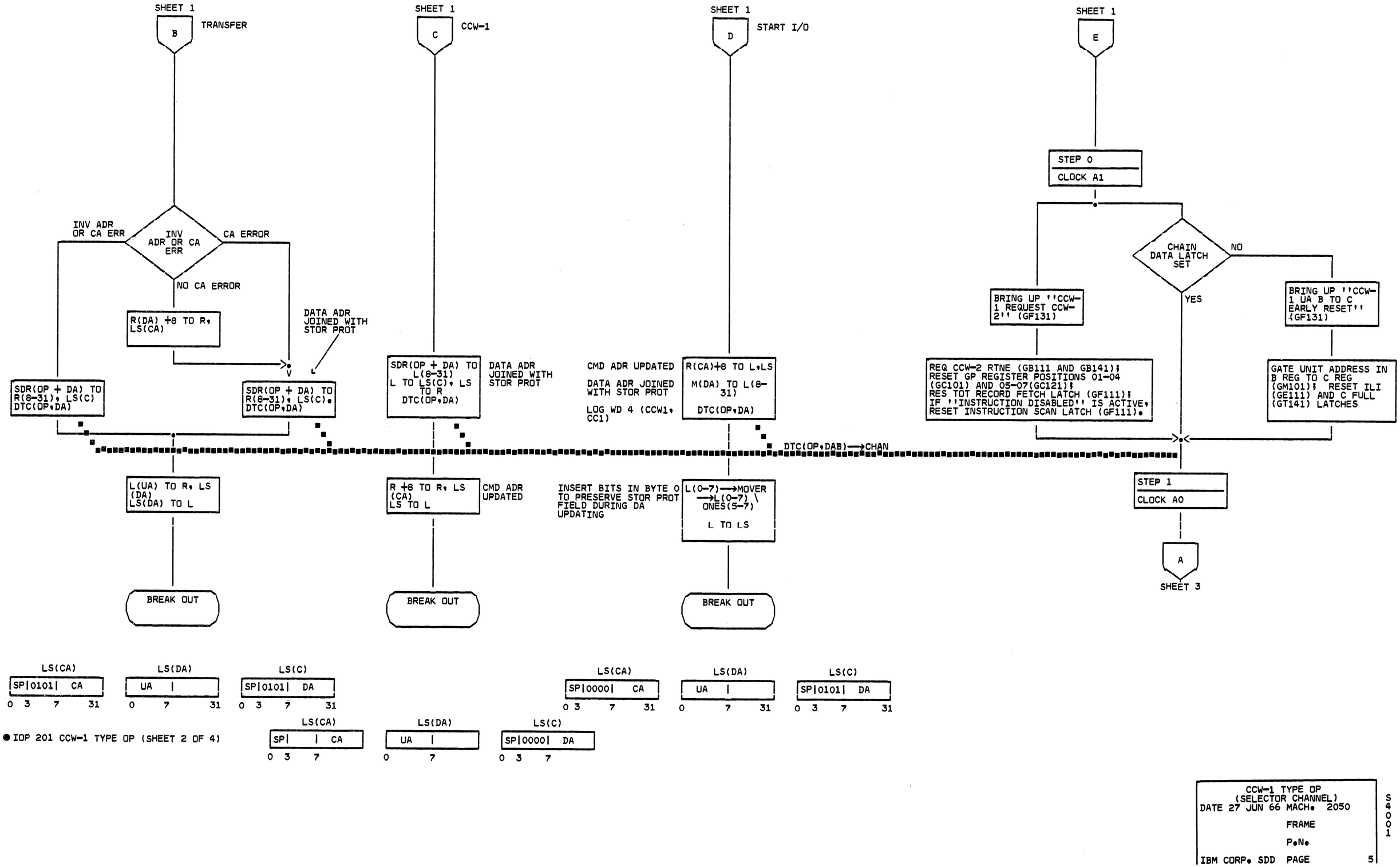




● IOP 201 CCW-1 TYPE OP (SHEET 1 OF 4)

CCW-1 TYPE OP
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 4

S4001



● IOP 201 CCW-1 TYPE OP (SHEET 2 OF 4)

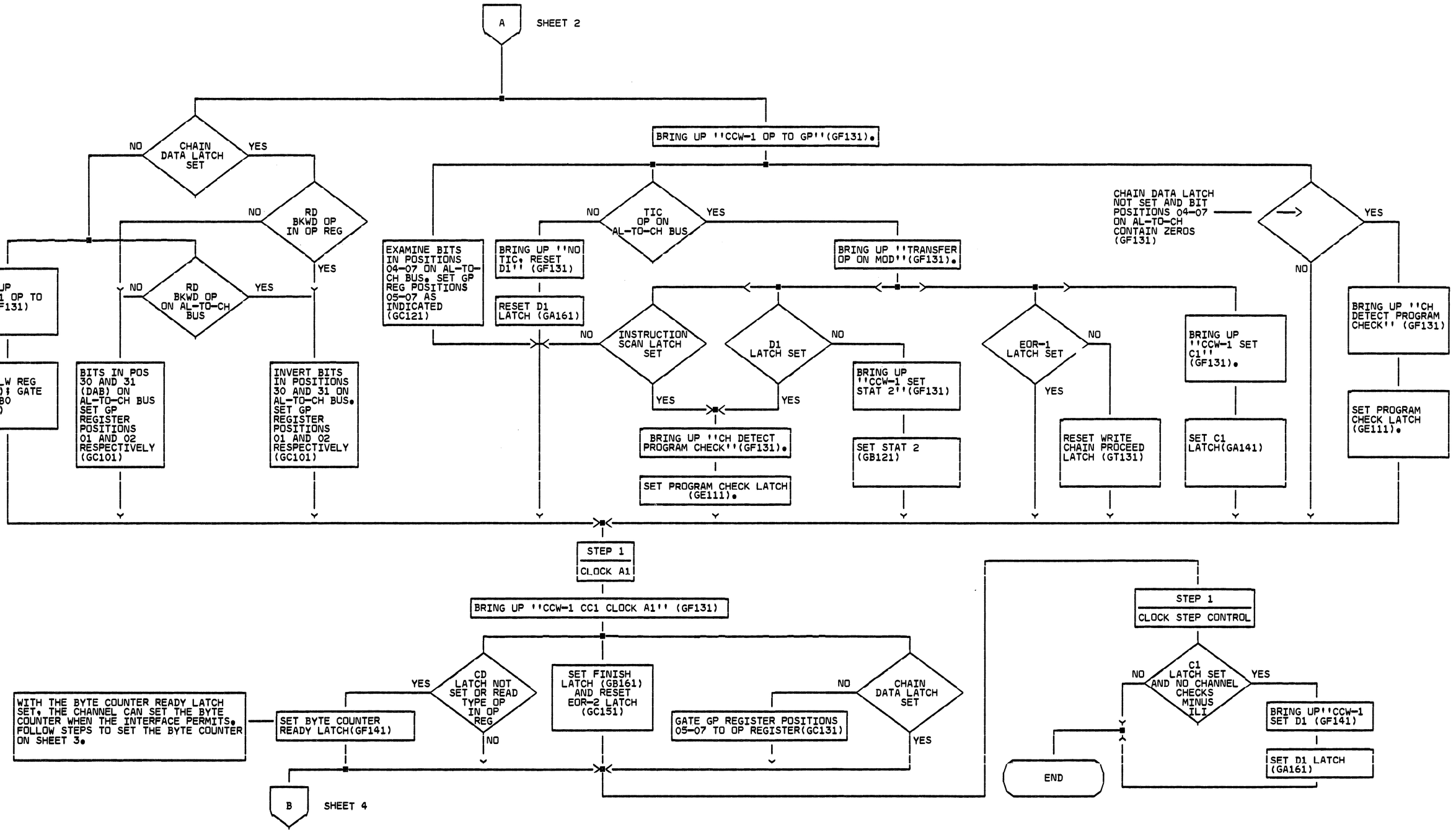
CCW-1 TYPE OP
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 5

S4001



CCW-1 TYPE OP
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

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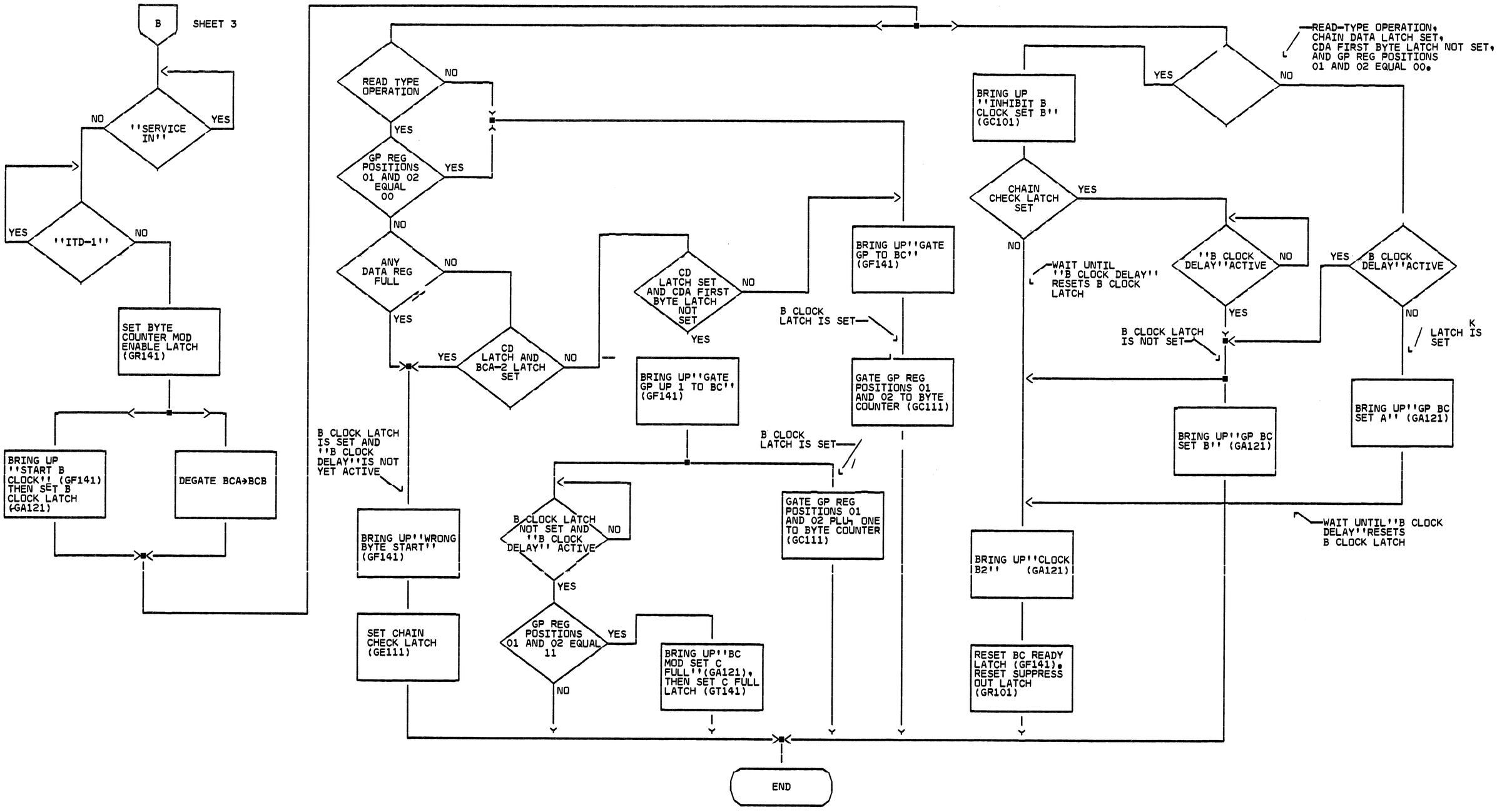
S4001

● IOP 201 CCW-1 TYPE OP (SHEET 3 OF 4)



● IOP 201 CCW-1 TYPE OP (SHEET 4 OF 4)

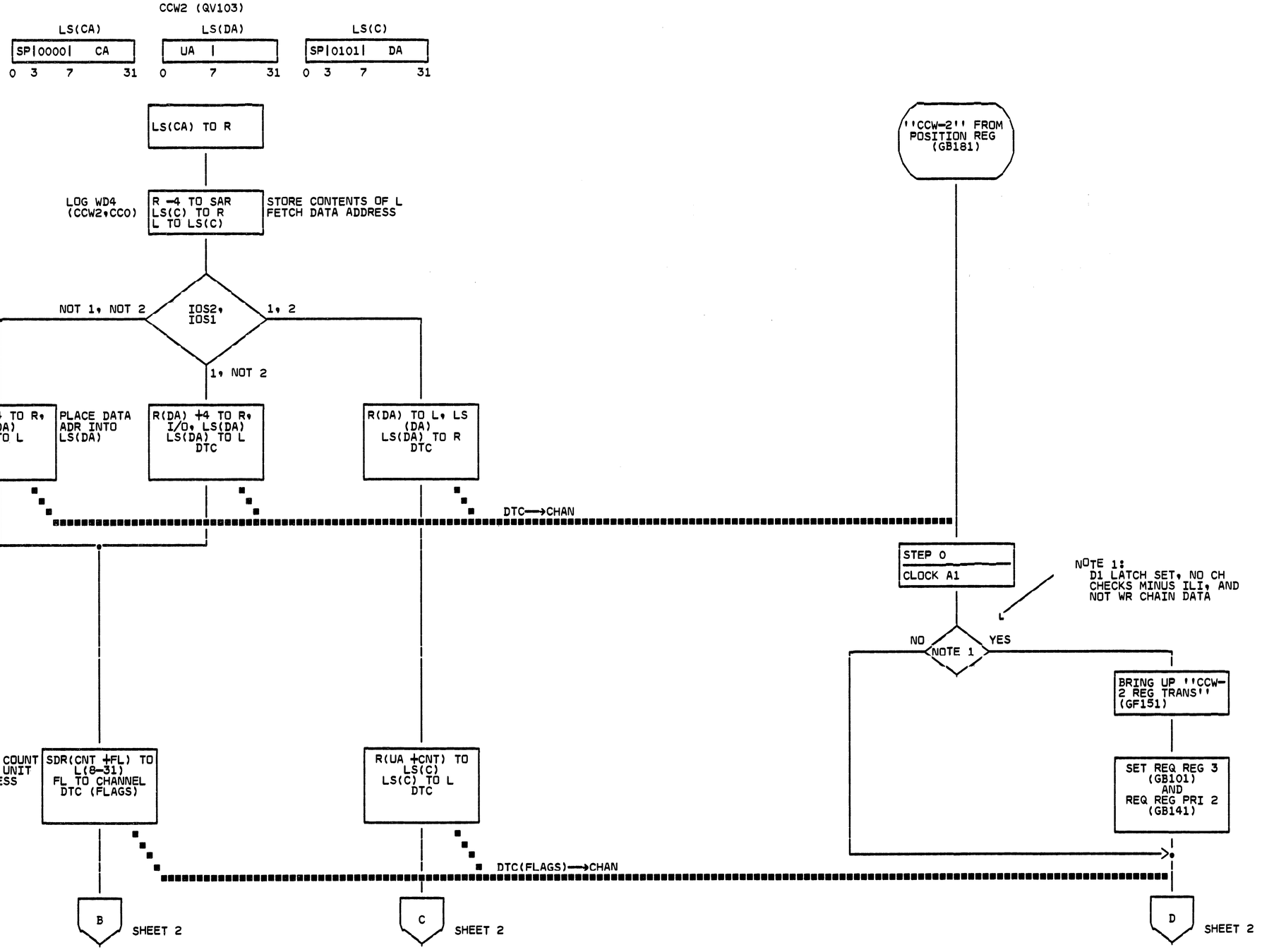
CCW-1 TYPE OP
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 3

S4001



● IOP 202 CCW-2 ROUTINE (SHEET 1 OF 6)

CCW-2 ROUTINE (SELECTOR CHANNEL)	
DATE 27 JUN 66 MACH• 2050	
FRAME	
P•N•	
IBM CORP• SDD PAGE	3

S4002

SHEET 1
B

ON IOS1 OFF

COMP I/O(DAB) TO R 1 TO W(6) TO L(8-16)

PROTECT UA FIELD WHEN COUNT UP-DATING

I/O(DAB) TO R 1 TO W(6) TO L(8-16)

NO HIGH SPEED CHAN OR 256 SUB CHAN OPTION YES

L(CNT) +R(DAB) TO R, LS(C) LS(C) TO L DTC(LW, CNT)

LOG WD 4 (CCW2, CC2)

L(CNT) +R(DAB) TO R, LS(C) 0'S TO L(0-7) DTC(LW, CNT)

BREAK OUT

SHEET 1
C

YES HIGH SPEED CHAN OR 256 SUB CHAN OPTION NO

0'S TO L(0-7) DTC

DTC

1'S TO M
0'S TO L(8-15)

NO STAT 0 OFF AND T(8-11) 0 YES

WAIT

EMIT 1000 TO L (16-23) M(ALL ONES)-L TO M

NO STAT 0 OFF AND T(8-11) 0 YES

TIME OUT

BREAK OUT

SHEET 1
D

STEP 1

BRING UP ''CCW-2 FLAGS TO GP'' (GF151)

RESET: FIRST BYTE LATCH(GF161) GP REG POSITIONS 03-04 (GC101) GP REG POSITIONS 05-07 (GC121)

GATE AL TO CH BUS POSITIONS 0-3 TO GP REG POSITIONS 08-11 (FLAGS). A ''1'' IN POSITION 4 OF THE AL TO CH BUS SETS PCI POSITION OF FLAG REG (GC161)

NO D1 LATCH NOT SET AND IF READ LATCH SET. YES

BRING UP ''RD RESET CDA FIRST BYTE LATCH'' (GA161)

RESET CDA FIRST BYTE LATCH (GT161)

DTC(LW, CNT)→CHAN

STEP 2

A

SHEET 3

LS(CA)

SP	0000	CA
0	3	7 31

LS(DA)

SP	0101	DA
0	3	7 31

LS(C)

UA	10	CNT
0	7	15 31

● IOP 202 CCW-2 ROUTINE (SHEET 2 OF 6)

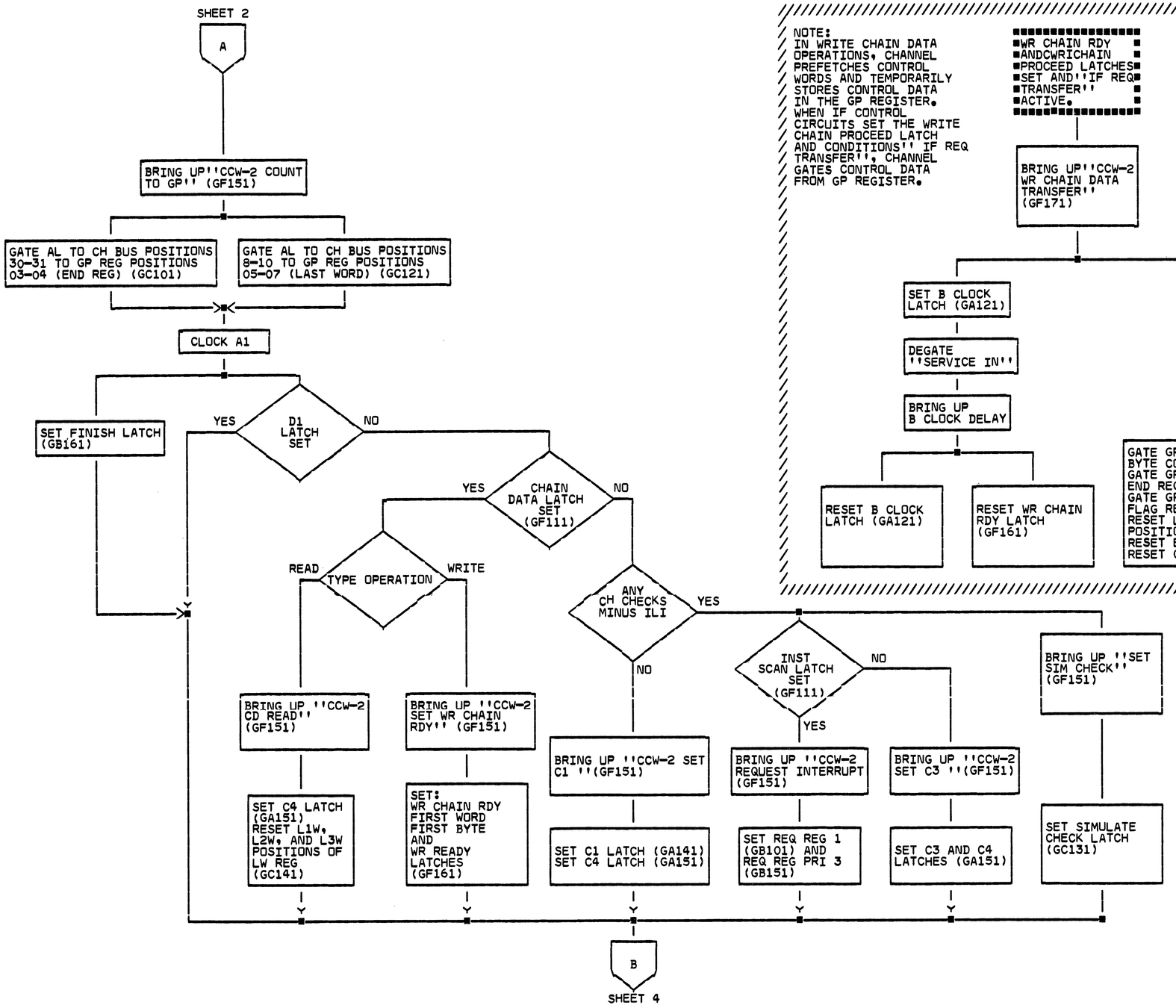
CCW-2 ROUTINE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 4

S4002



IOP CCW-2 ROUTINE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 5

S4002

● IOP 202 CCW-2 ROUTINE (SHEET 3 OF 6)

SHEET 3

B

STEP 3

NOTE 2:
WRITE TYPE OP, CHAIN DATA LATCH SET, NO CH CHECKS, D1 LATCH SET, AND WR CHAIN PROCEED LATCH SET

NOTE 3:
C4 LATCH SET, BC RDY LATCH NOT SET, AND NOT CLOCK STEP CONTROL TIME.

NOTE 2

NO

YES

BRING UP ''CCW-2 WR CD REQ TRA'' (GF171)

SET REQ REG 3 (GB101) AND REQ REG PR1 2 (GB141)

NOTE 3

NO

YES

BRING UP ''CCW-2 BC MOD REQ'' (GF171)

BRING UP ''CCW-1 BC MOD REQ'' (GF141)

SET BC MOD ENABLE LATCH (GR141)

BRING UP ''CCW-2 START A CLOCK'' (GF171)

START A-CLOCK (GA101

STEP 3 CLOCK A0

CHAIN DATA LATCH SET

YES

NO

INST SCAN LATCH SET

YES

NO

BRING UP ''SET INST INHIBIT'' (GF171)

SET INST INHIBIT LATCH (GD131)

BRING UP ''CCW-2 CC3 SET FIRST BYTE LATCH (GF171)

SET FIRST BYTE LATCH (GF161)

BRING UP ''CCW-2 CC3 CLOCK A0'' (GF171)

GATE GP POSITIONS 03-04 TO END REG (GC111)
GATE GP POSITIONS 08-11 TO FLAG REG (GC161)
SET FIRST WORD LATCH (GF161)

CHAIN CHECK LATCH SET

NO

YES

BRING UP''CCW-2 CHAIN CHECK SET C3'' (GF171)

SET C3 LATCH (GF151)

READ OPERATION

NO

YES

ONE REG FULL

YES

NO

L3W (GP07)

NO

YES

SET L2W POSITION OF LW REG (GC141)

L2W (GP06)

NO

YES

SET L1W POSITION OF LW REG (GC141)

TWO REGS FULL

YES

NO

L3W (GP07)

NO

YES

SET L1W POSITION OF LW REG (GC141)

NO DATA REGS FULL

YES

NO

L3W (GP07)

NO

YES

SET L3W POSITION OF LW REG (GC141)

L2W (GP06)

NO

YES

SET L2W POSITION OF LW REG (GC141)

L1W (GP05)

NO

YES

SET L1W POSITION OF LW REG (GC141)

C

SHEET 5

IOP CCW-2 ROUTINE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

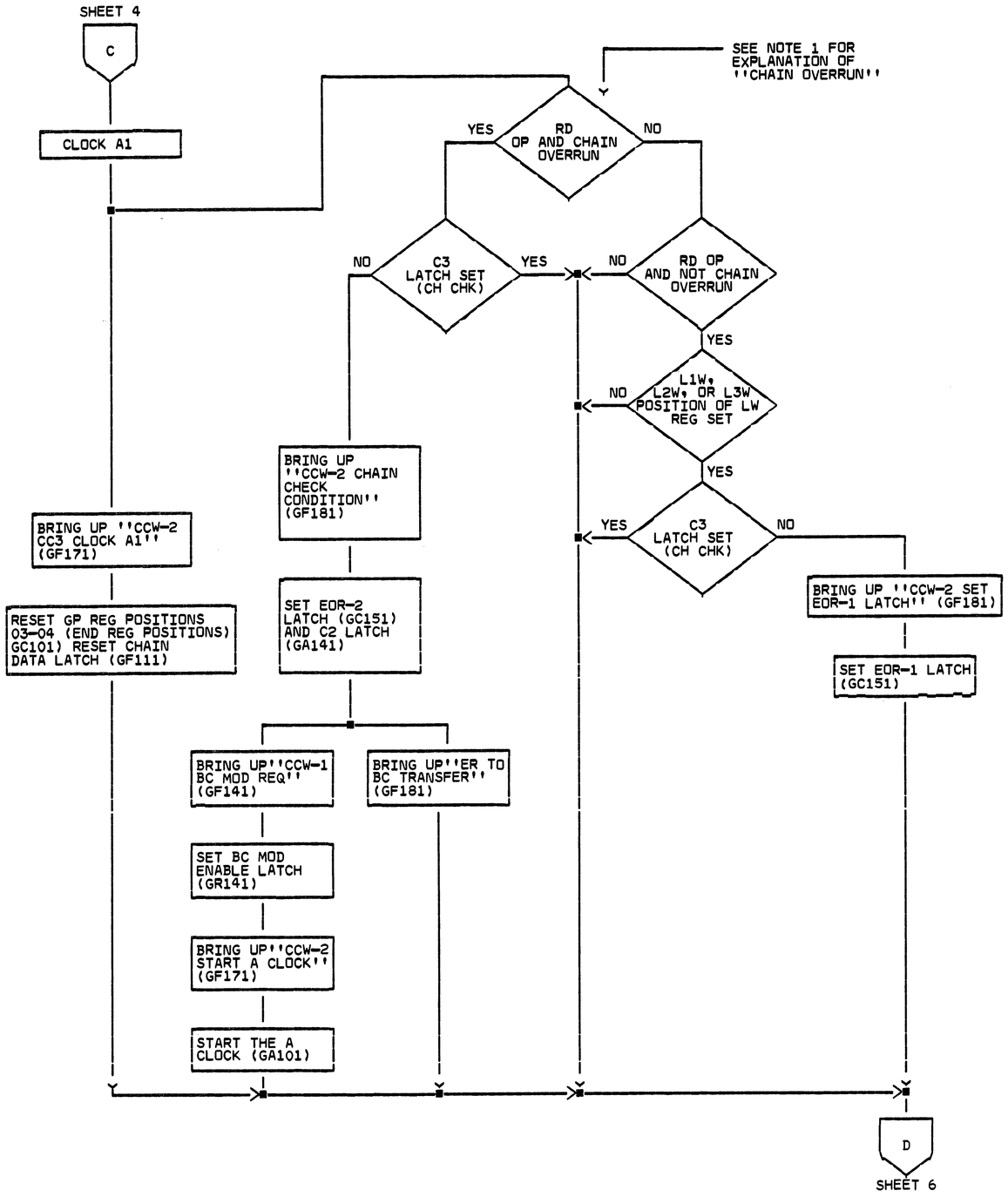
FRAME

P.N.

IBM CORP. SDD PAGE 6

S4002

● IOP 202 CCW-2 ROUTINE (SHEET 4 OF 6)



NOTE 1:

GP 05, 06, OR 07	A	OR
NOT L1W, L2W OR L3W	GF171	
L1W	A	
NOT ER = 00		
ER LESS THAN BC		
L1W	GF171	
NOT ER = 00	A	
BC EQUALS ER		
	GF171	GF171

CHAIN OVERRUN

N — NOT CHAIN OVERRUN

● IOP 202 CCW-2 ROUTINE (SHEET 5 OF 6)

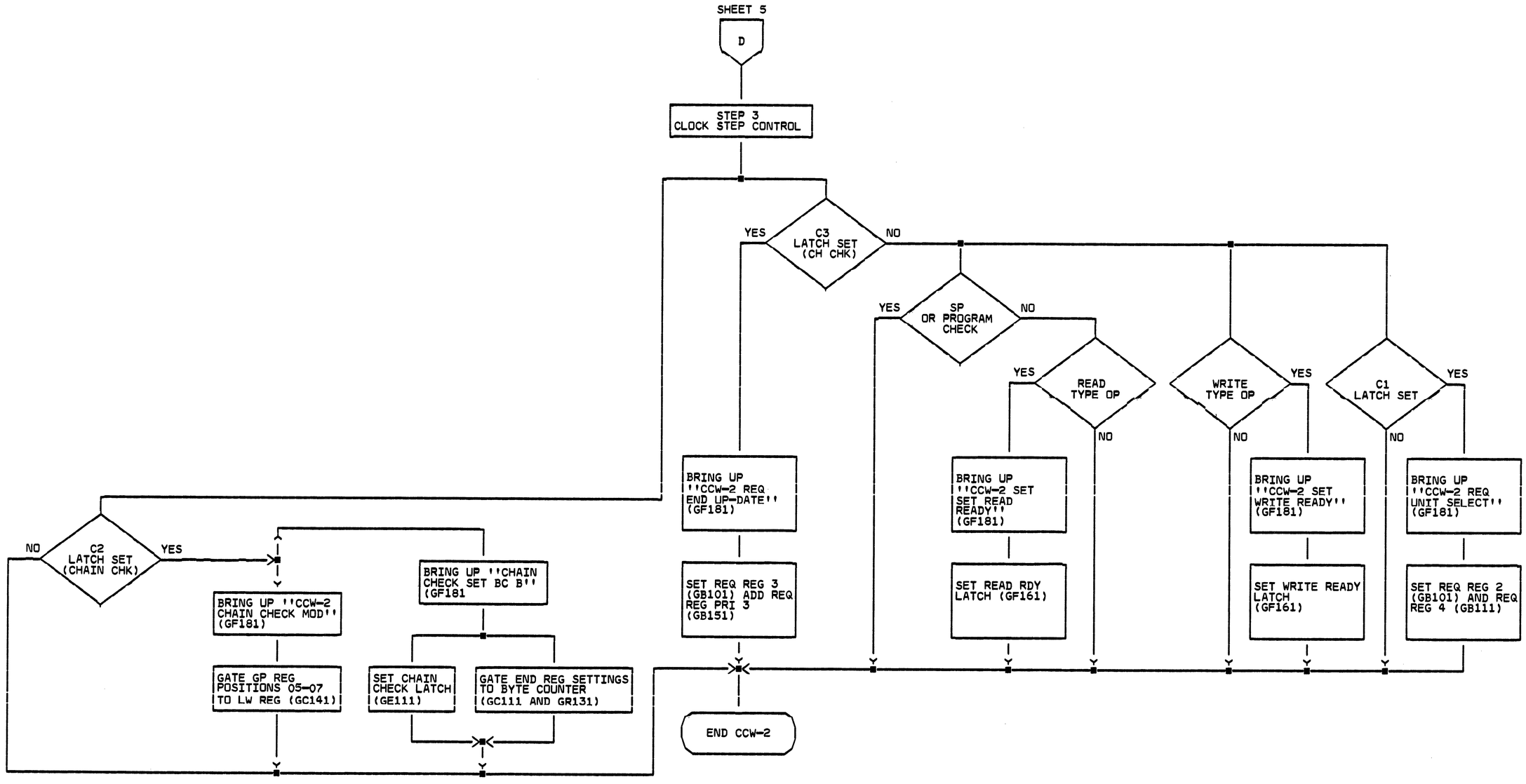
IOP CCW-2 ROUTINE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 7

S4002



IOP CCW-2 ROUTINE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 8

S4002

WRITE FETCH (0V104)

LS(CA)

SP	0000

0 3 7 31

LS(DA)

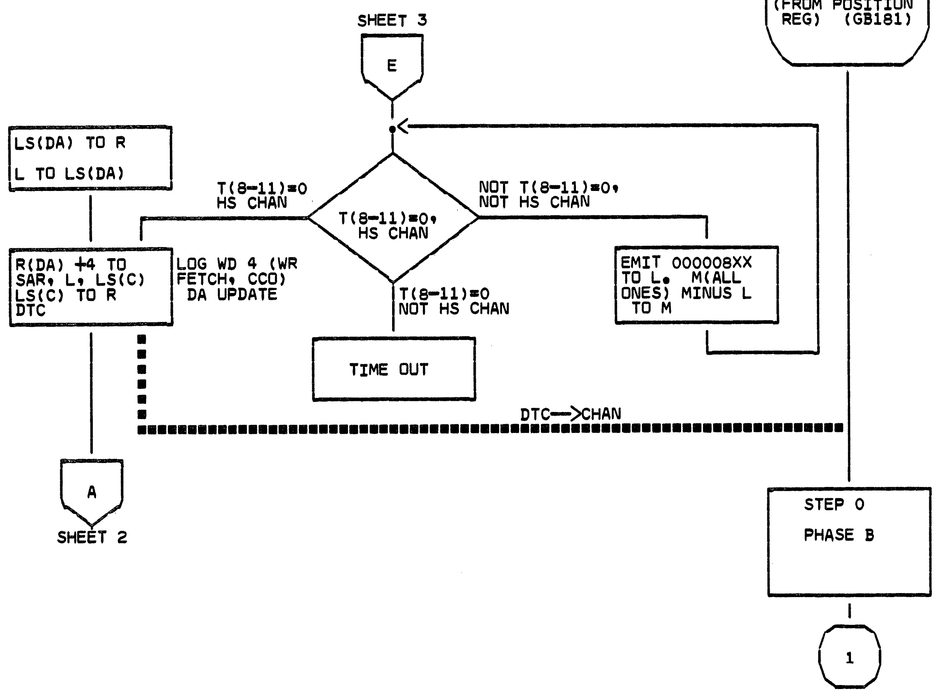
SP	0101	DA

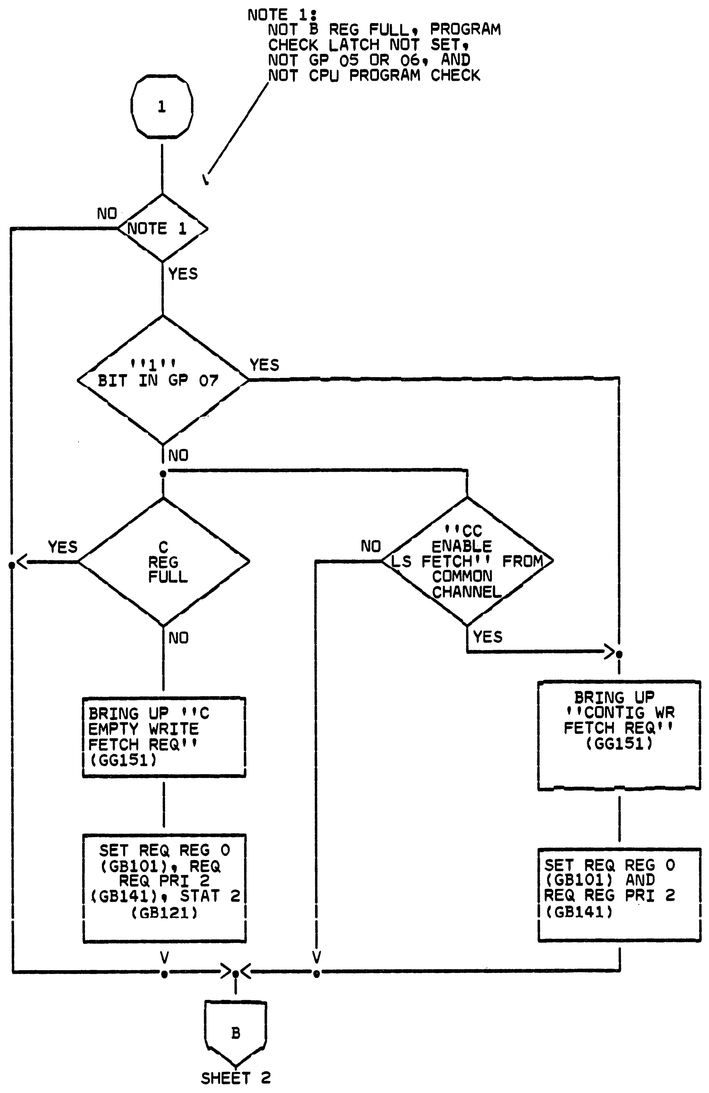
0 3 7 31

LS(C)

UA	10	CNT

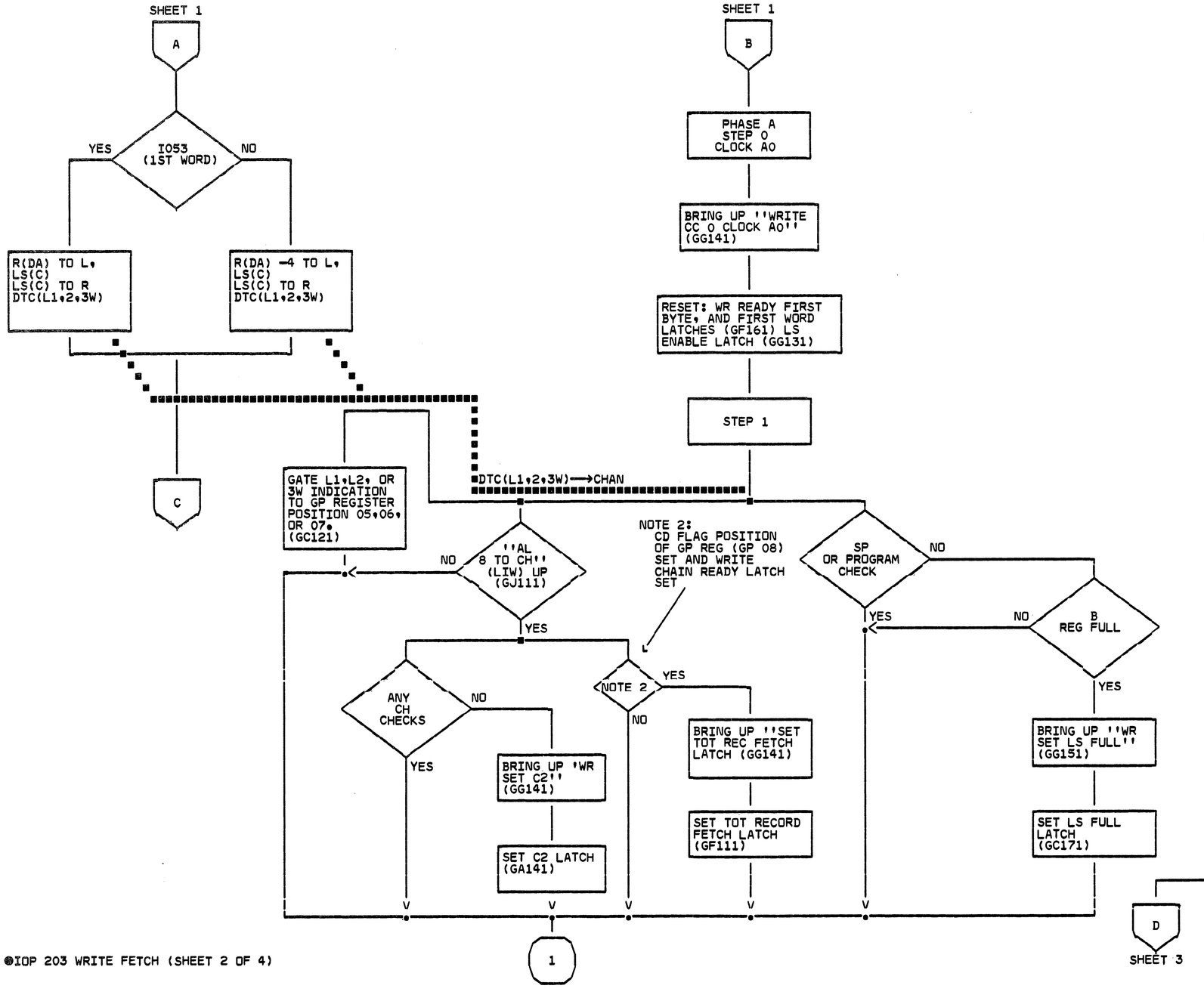
0 7 15 31

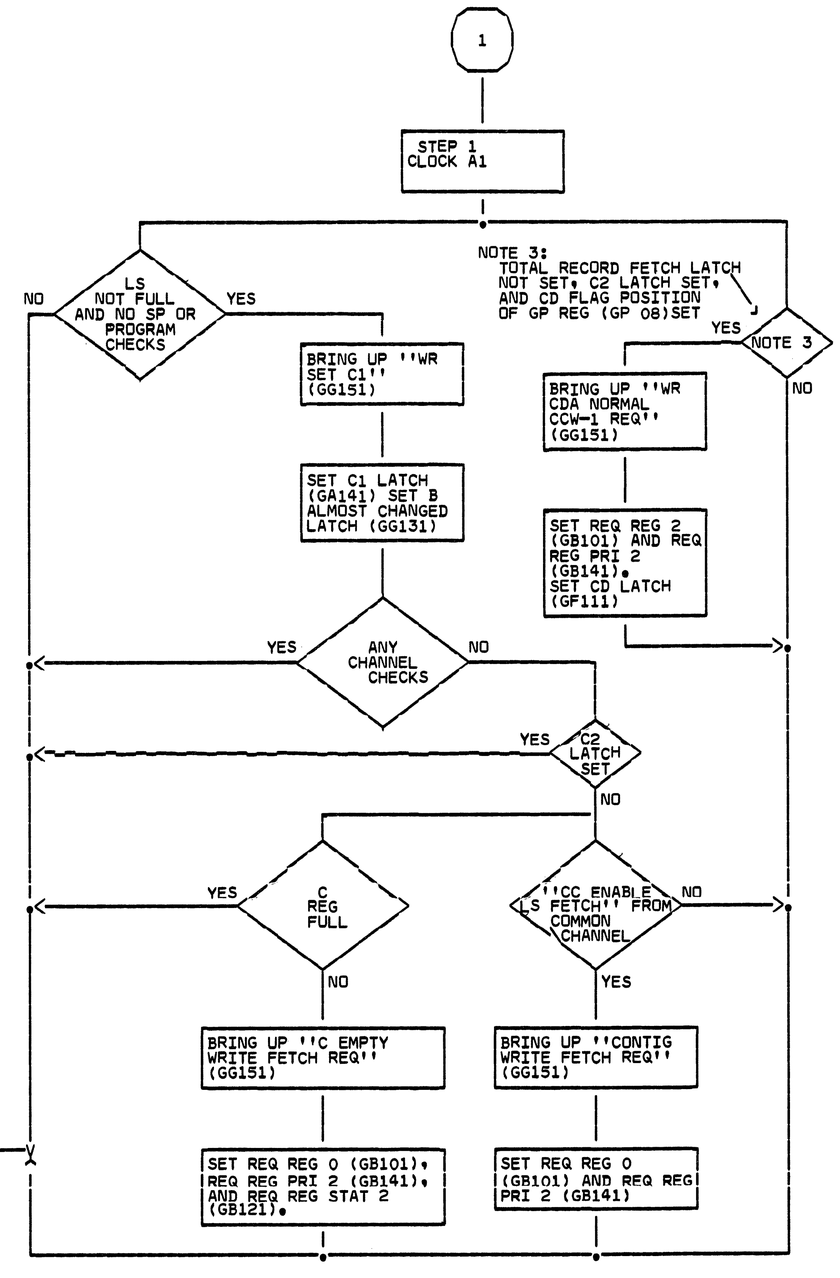




●IOP 203 WRITE FETCH (SHEET 1 OF 4)

WRITE FETCH (SELECTOR CHANNEL)	S4003
DATE 27 JUN 66 MACH● 2050	
FRAME	
P●N●	
IBM CORP● PAGE 3	

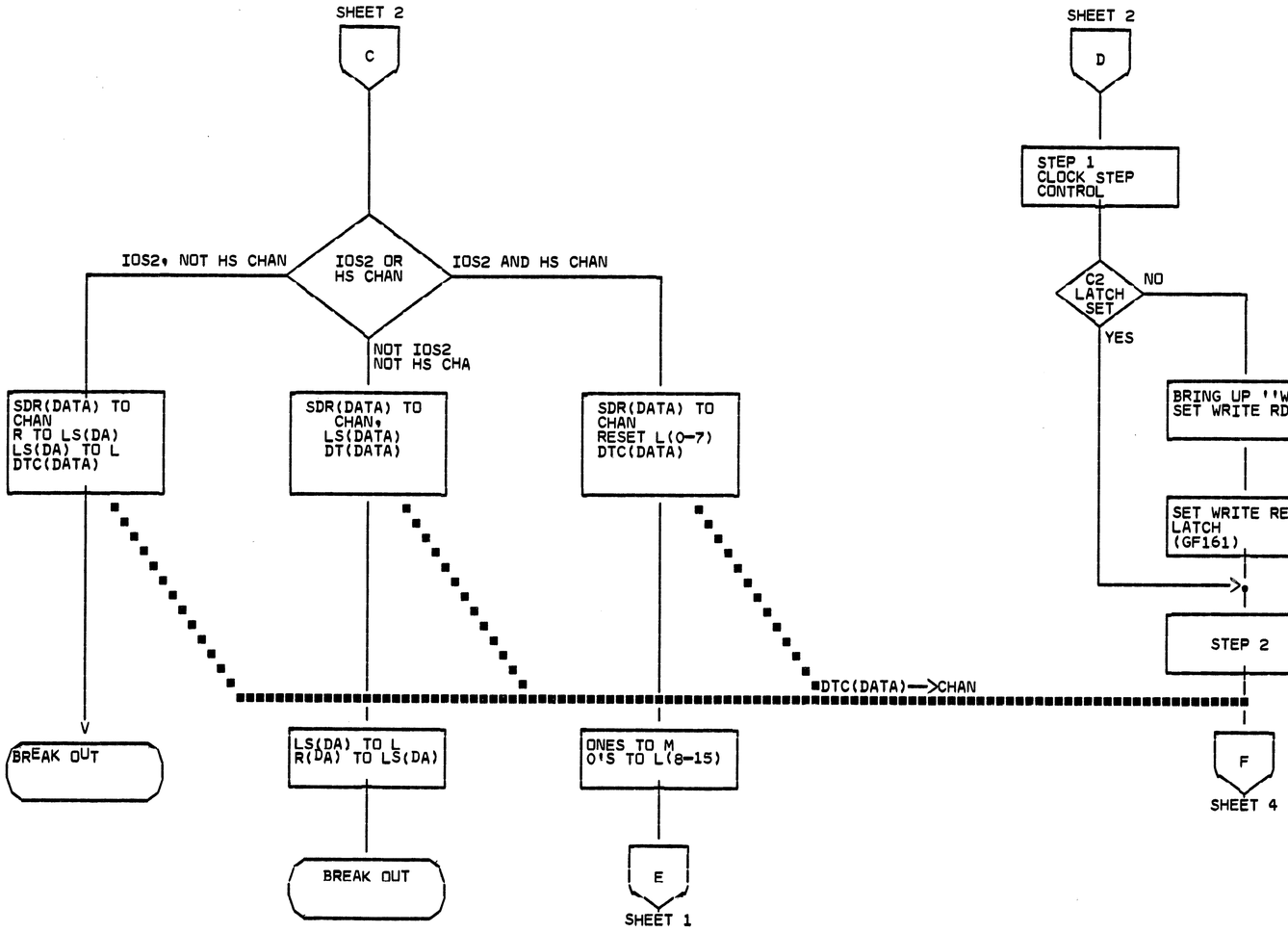




●IOP 203 WRITE FETCH (SHEET 2 OF 4)

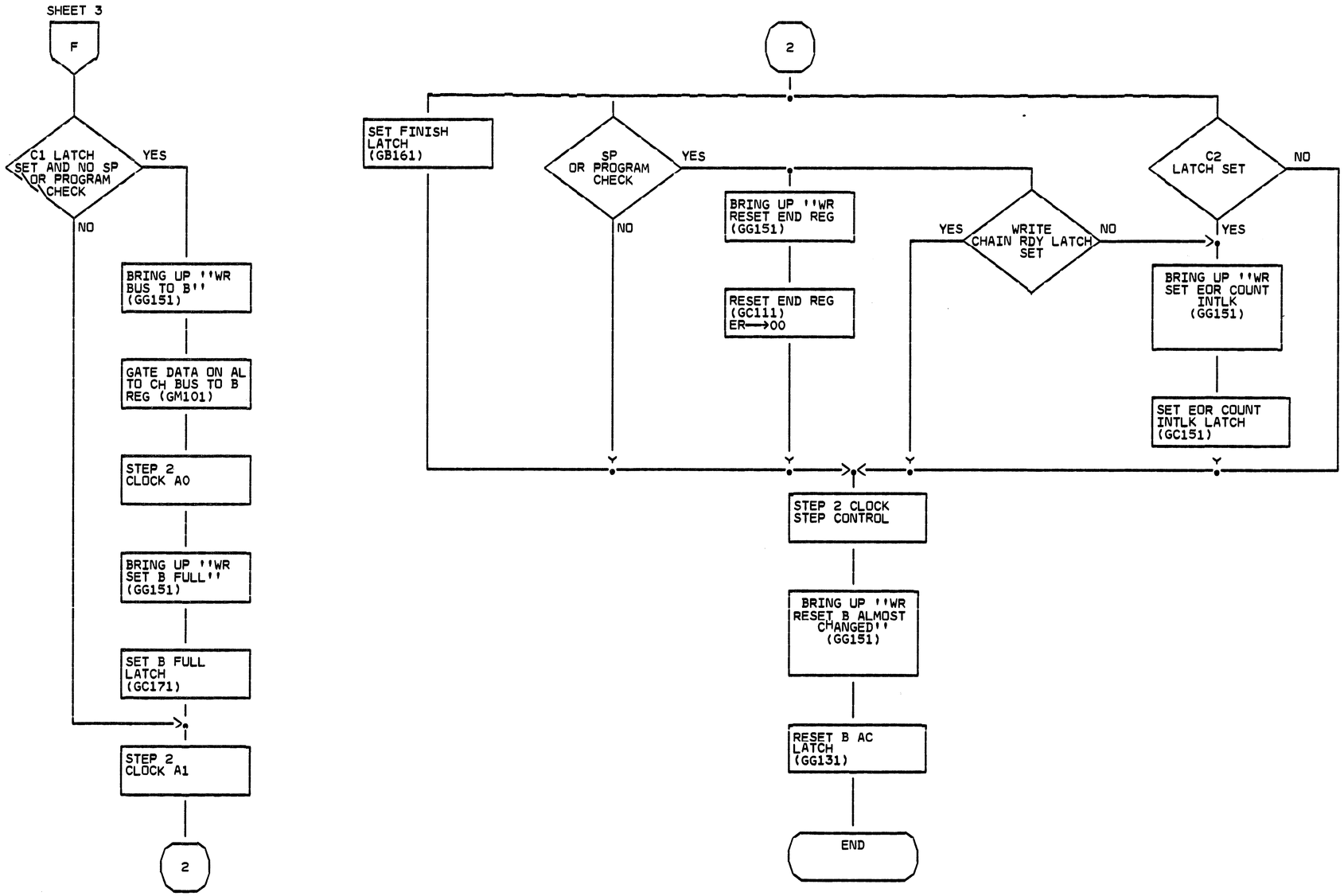
WRITE FETCH (SELECTOR CHANNEL)	
DATE 27 JUN 66 MACH. 2050	
FRAME	
P.N.	
IBM CORP. PAGE	4

S4003



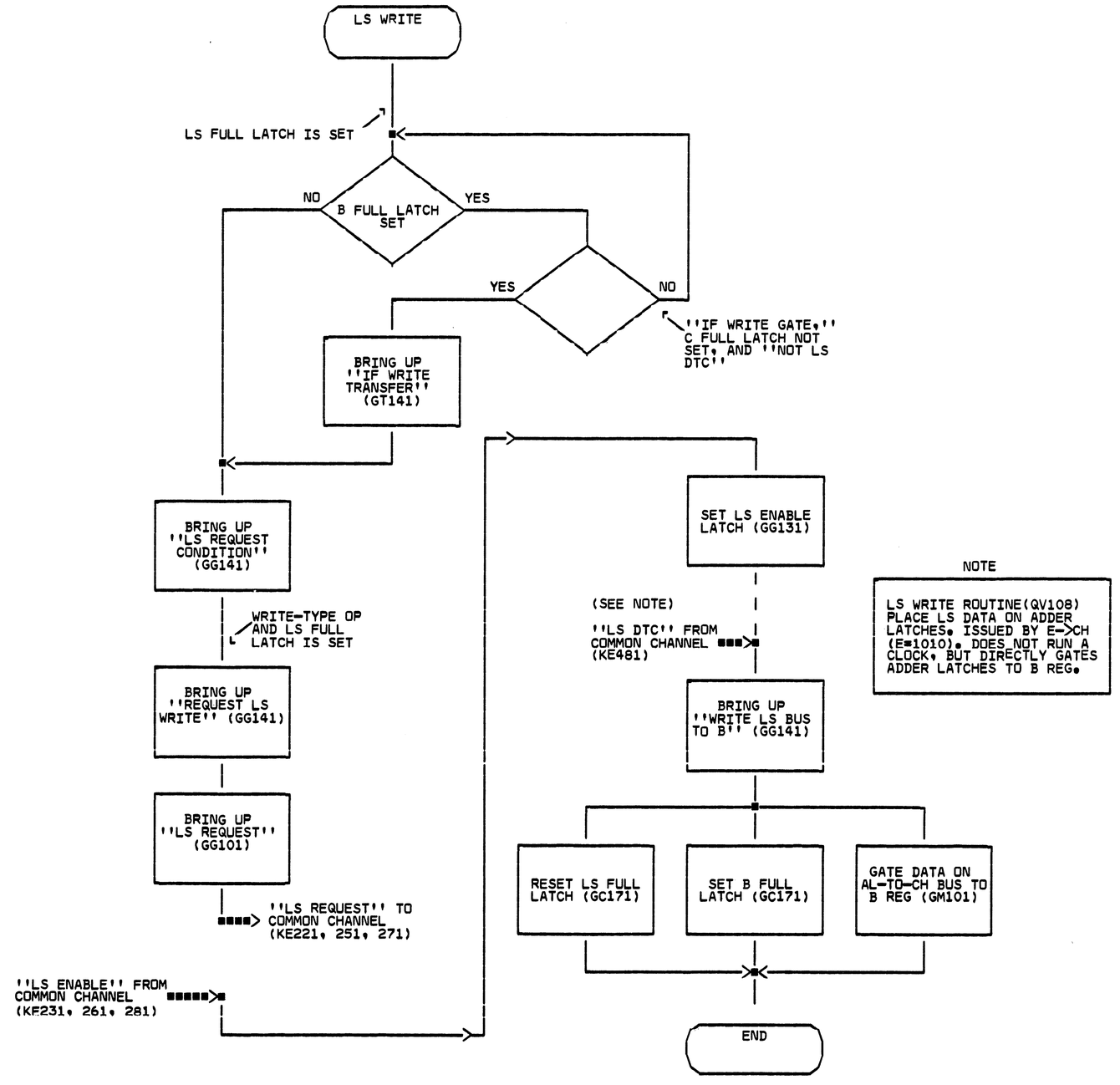
● IOP 203 WRITE FETCH (SHEET 3 OF 4)

WRITE FETCH (SELECTOR CHANNEL)	S4003
DATE 27 JUN 66 MACH. 2050	
FRAME	
P.N.	
IBM CORP. PAGE	5



●IOP 203 WRITE FETCH (SHEET 4 OF 4)

WRITE FETCH (SELECTOR CHANNEL)	S 4 0 0 3
DATE 27 JUN 66 MACH● 2050	
FRAME	
P●N●	
IBM CORP● PAGE 6	



● IOP 204 LOCAL STORE WRITE

LOCAL STORE WRITE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

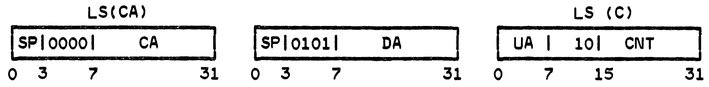
FRAME

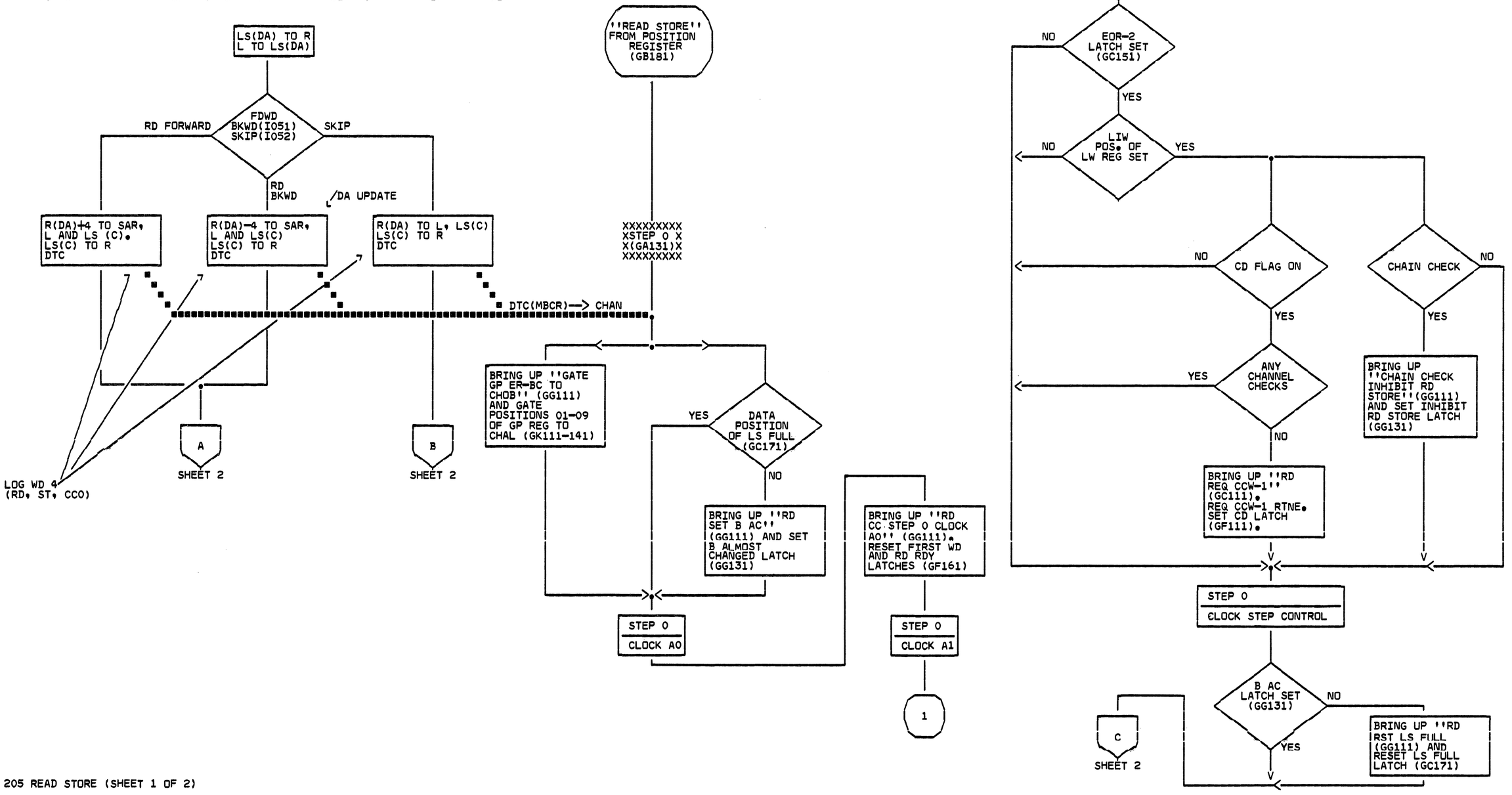
P.N.

IBM CORP. SDD PAGE 2

S4004

READ STORE QV105

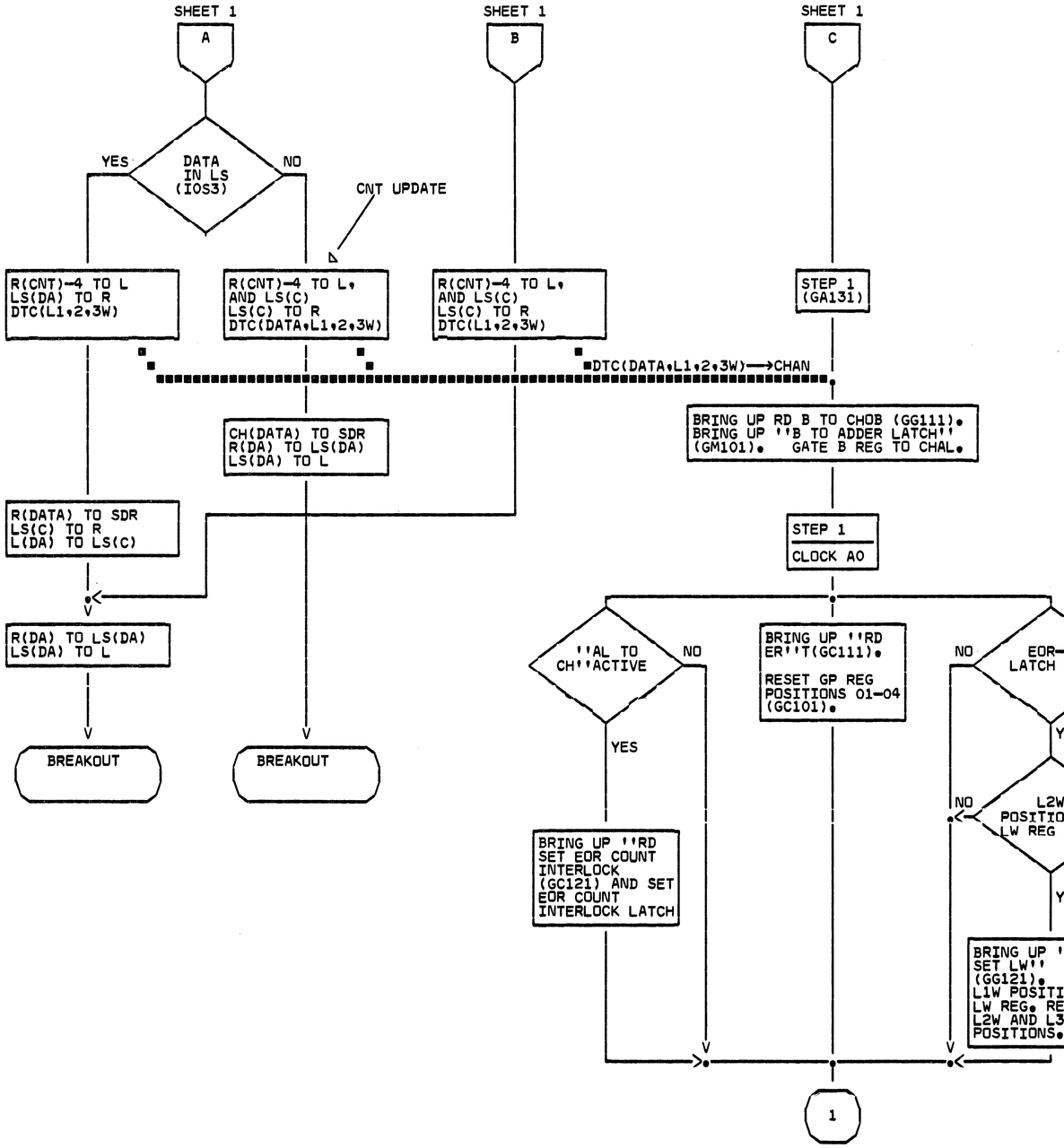


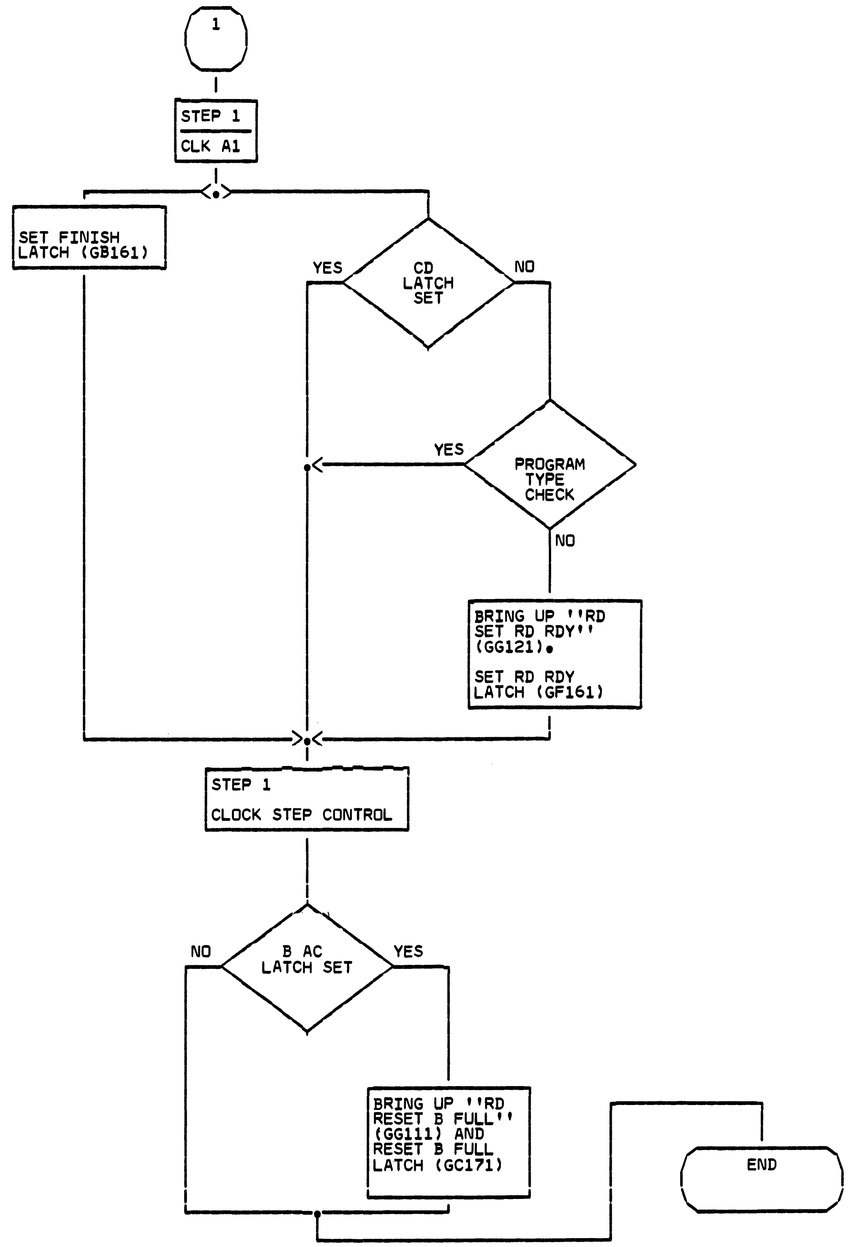


●IOP 205 READ STORE (SHEET 1 OF 2)

READ STORE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 2

S4005

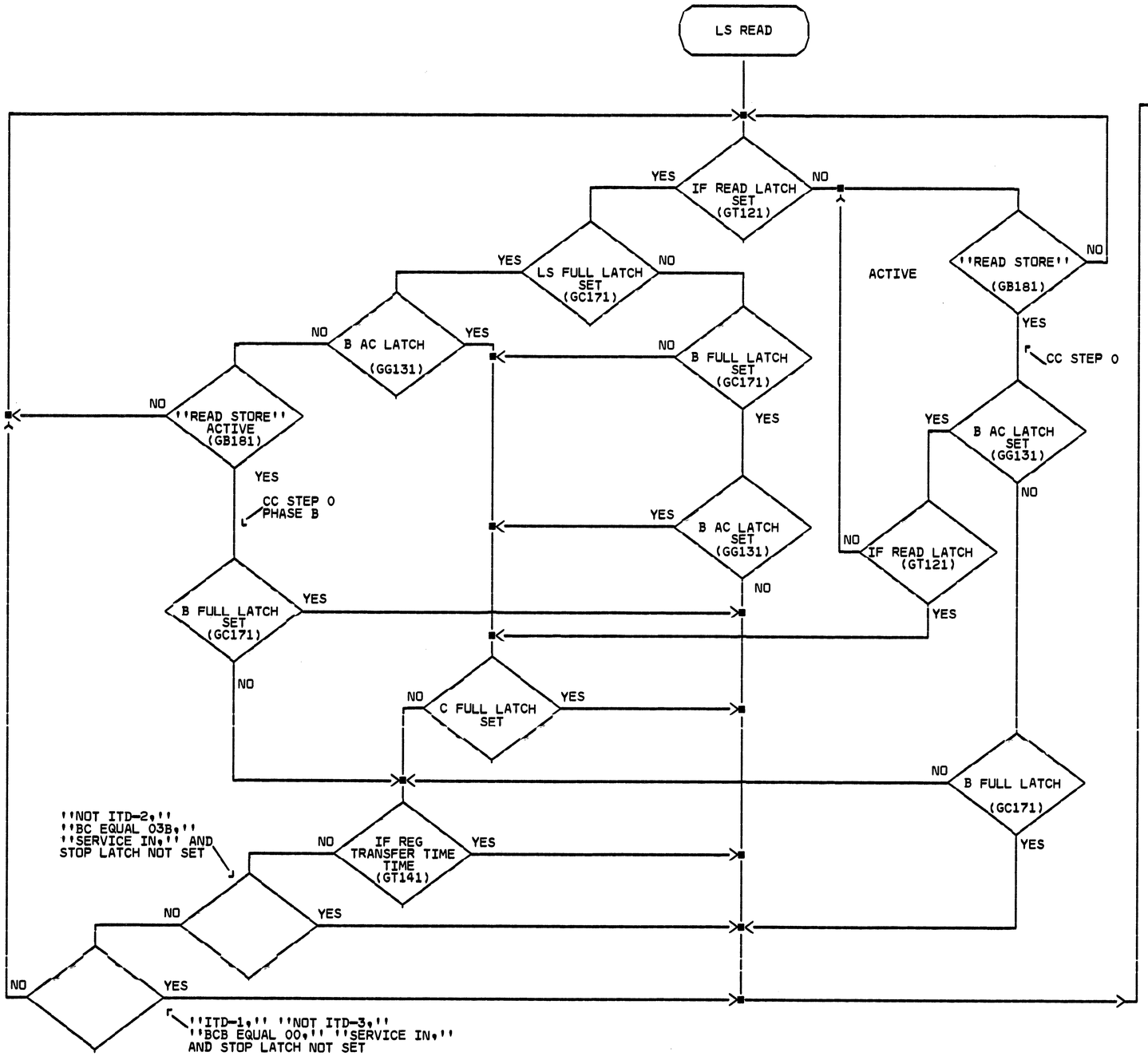


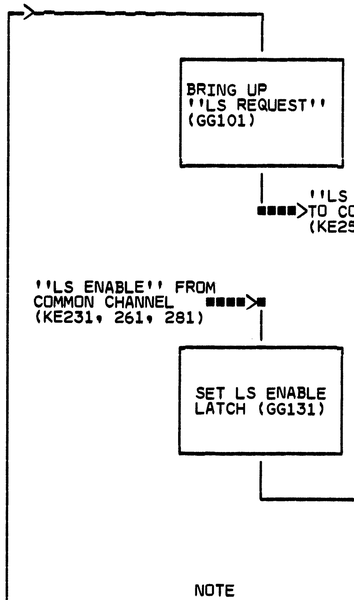


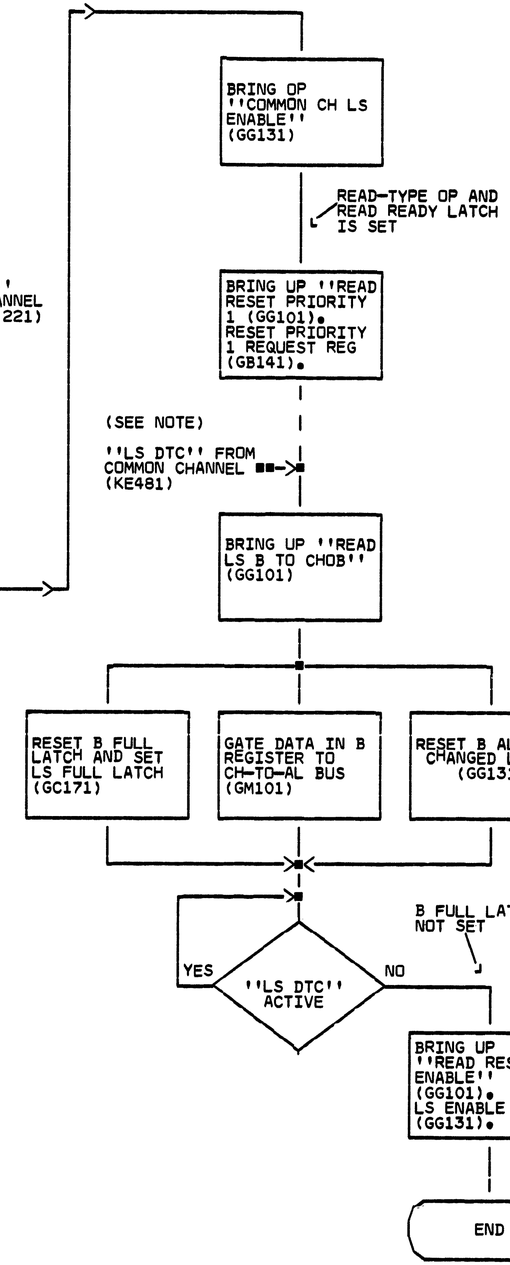
● IOP 205 READ STORE (SHEET 2 OF 2)

READ STORE (SELECTOR CHANNEL
DATE 27 JUN 66 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 3

S4005







NOTE

LS READ ROUTINE (QV109) DTC GENERATED IN CC FROM LS REQUEST. DOES NOT RUN CLOCK, BUT DIRECTLY GATES B REG TO CHOB. LS READ ROUTINE TAKES CHAL TO R TO LS (DATA)

●IOP 206 LOCAL STORE READ

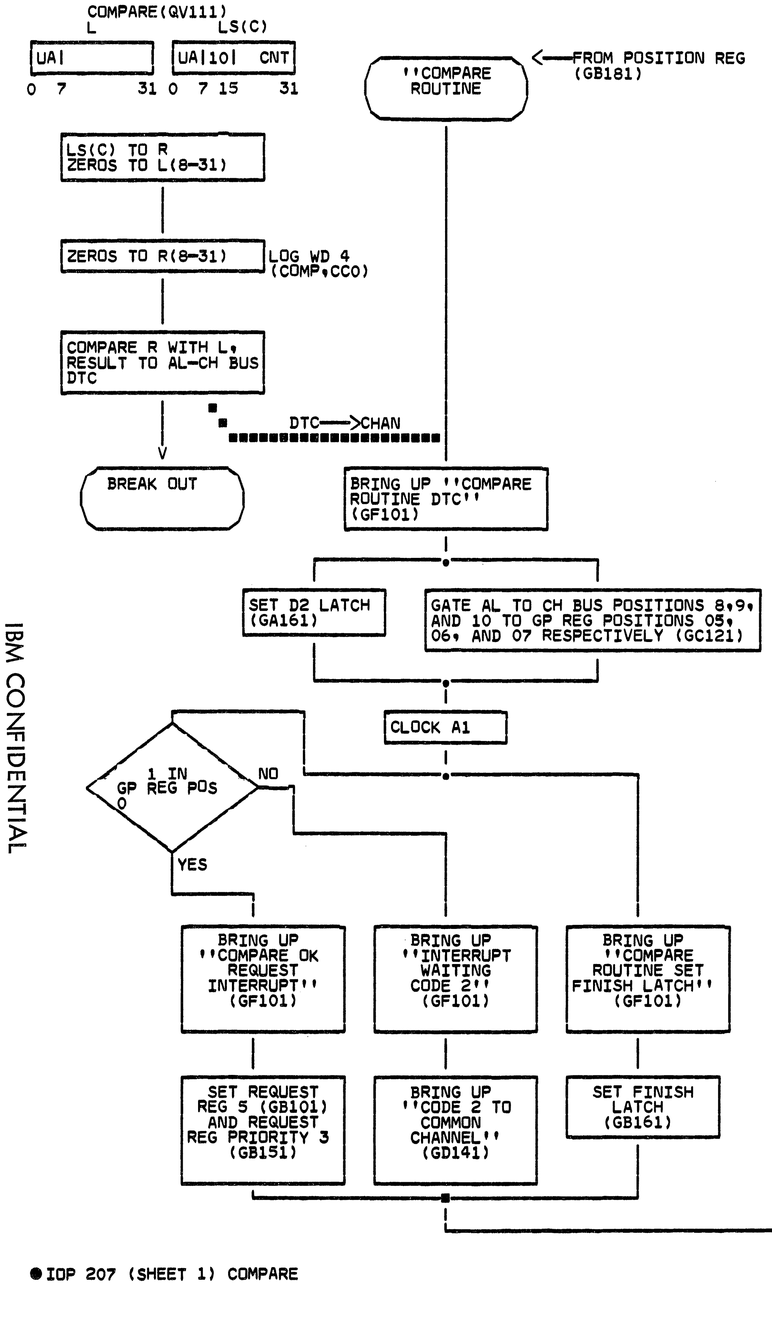
LOCAL STORE READ
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 1

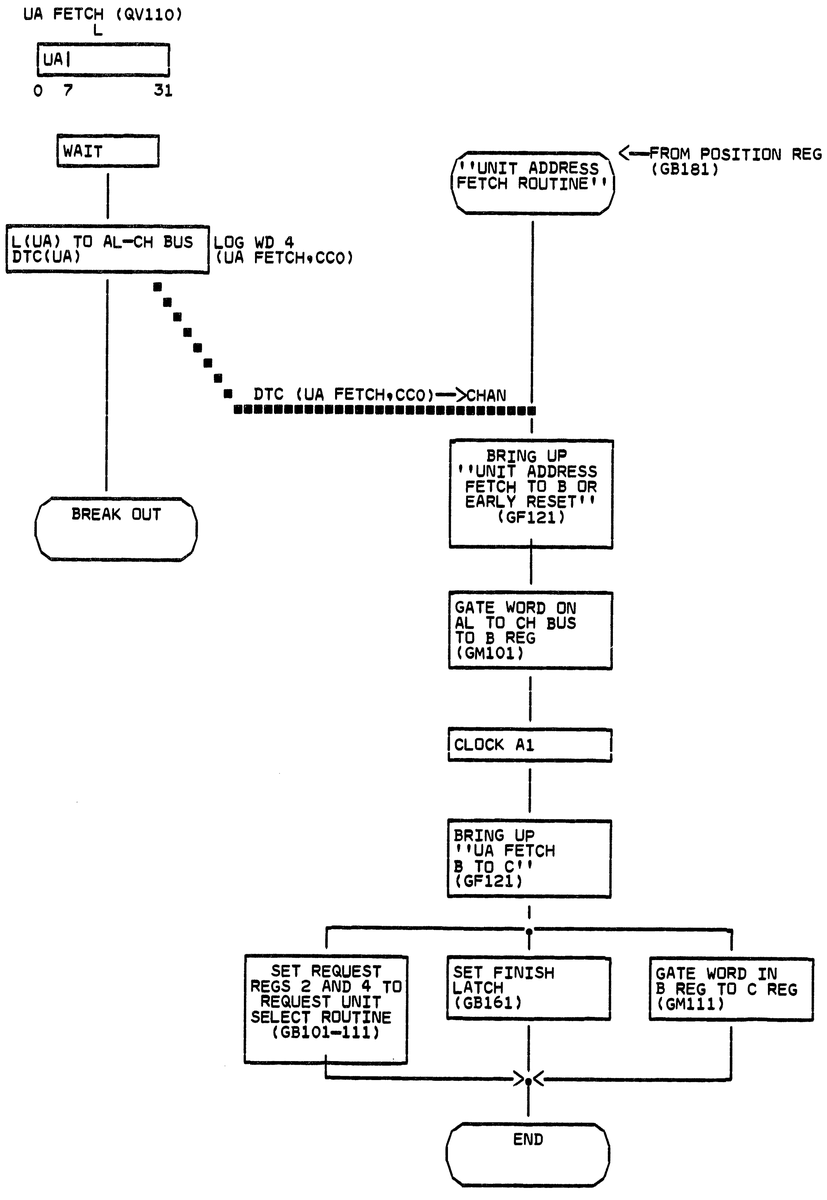
S4006



● IOP 207 (SHEET 1) COMPARE

COMPARE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH● 2050
FRAME
P●N●
IBM CORP● PAGE 2

S4007



●IOP 207 (SHEET 2) UA FETCH

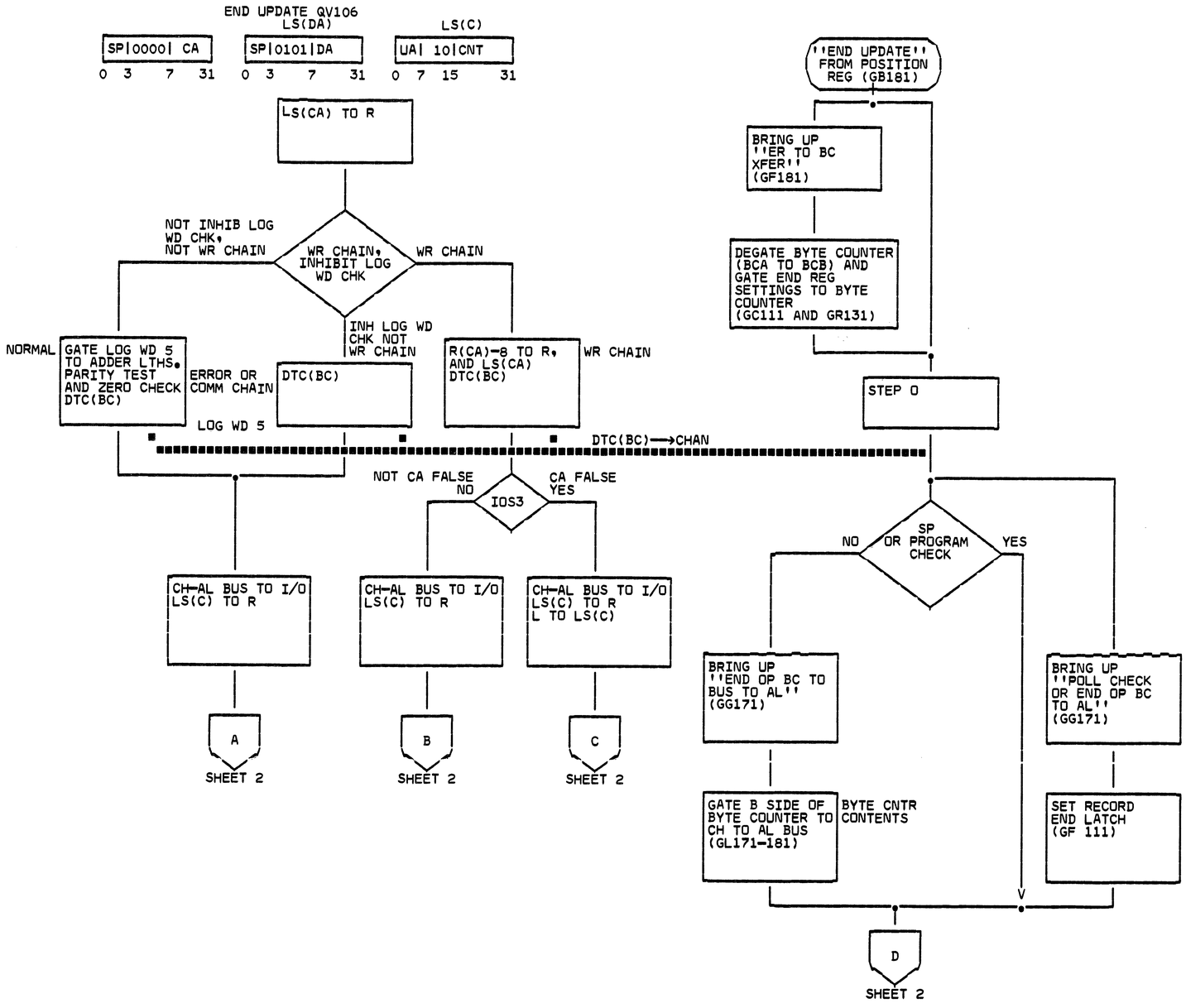
UA FETCH
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH• 2050

FRAME

P•N•

IBM CORP• PAGE 3

S4007

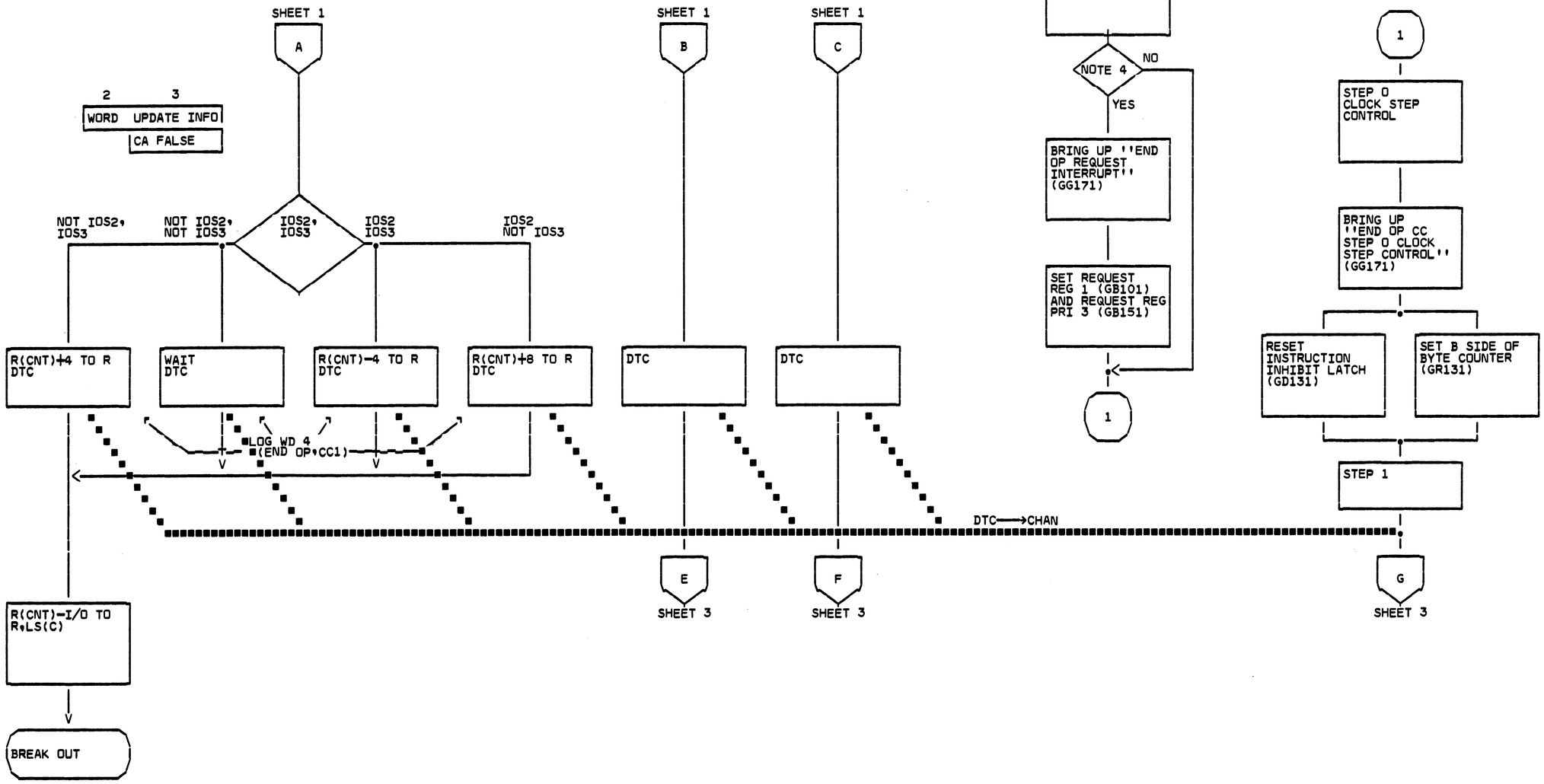


I/O STATS UPON ENTRY TO END UPDATE:
STAT 1 — WR CHAIN DATA AND NEW CCW NOT USED
STAT 2 — NOT 2 REGS FULL AND NOT 1 REG FULL
STAT 3 — NOT 1 REG FULL AND NOT 3 REGS FULL

●IOP 208 END UPDATE (SHEET 1 OF 3)

END UPDATE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH● 2050
FRAME
P●N●
IBM CORP● SDD PAGE 2

S4008



●IOP 208 END UPDATE (SHEET 2 OF 3)

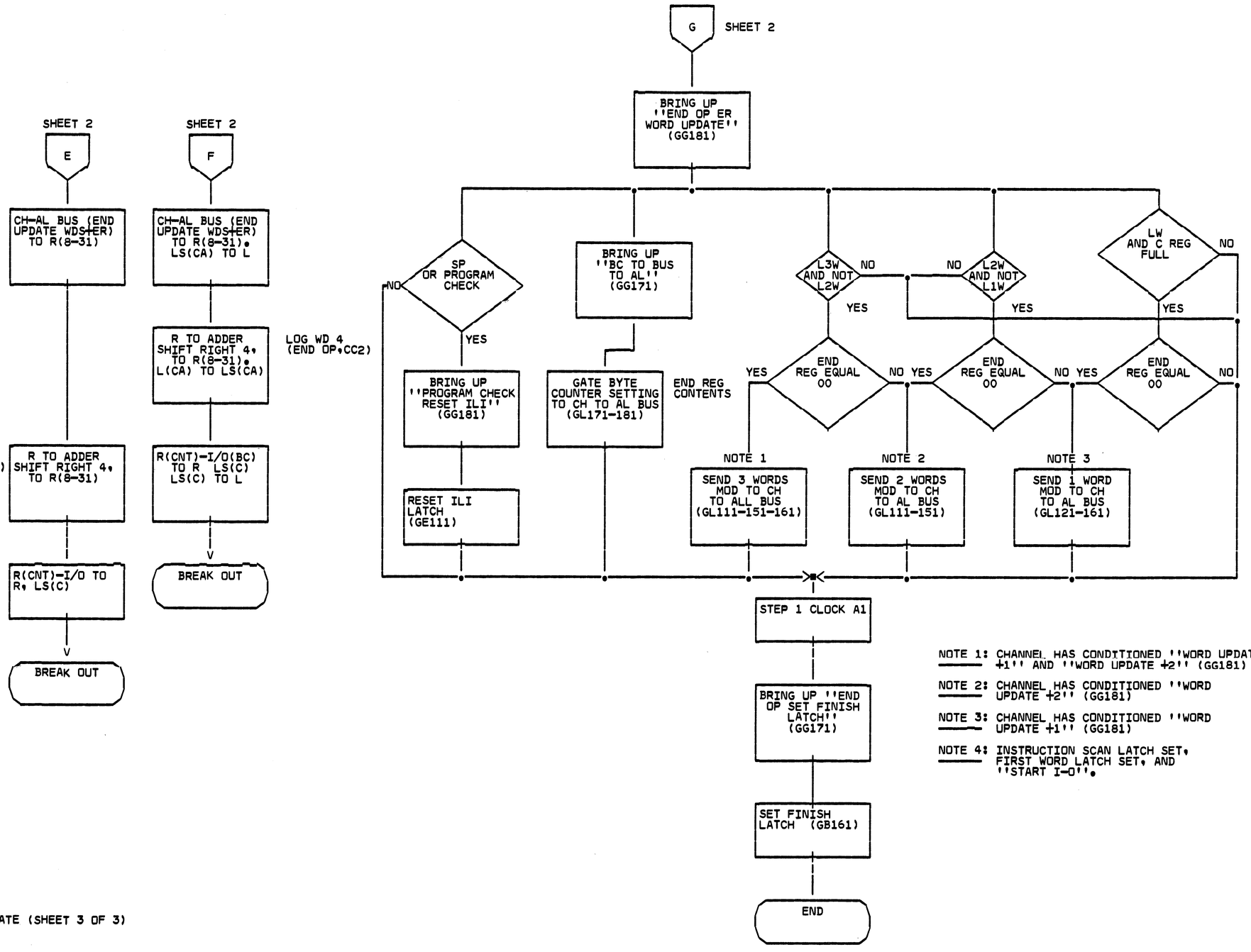
END UPDATE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH● 2050

FRAME

P●N●

IBM CORP● SDD PAGE 3

S4008



NOTE 1: CHANNEL HAS CONDITIONED ''WORD UPDATE +1'' AND ''WORD UPDATE +2'' (GG181)

NOTE 2: CHANNEL HAS CONDITIONED ''WORD UPDATE +2'' (GG181)

NOTE 3: CHANNEL HAS CONDITIONED ''WORD UPDATE +1'' (GG181)

NOTE 4: INSTRUCTION SCAN LATCH SET• FIRST WORD LATCH SET• AND ''START I—O''•

● IOP 208 END UPDATE (SHEET 3 OF 3)

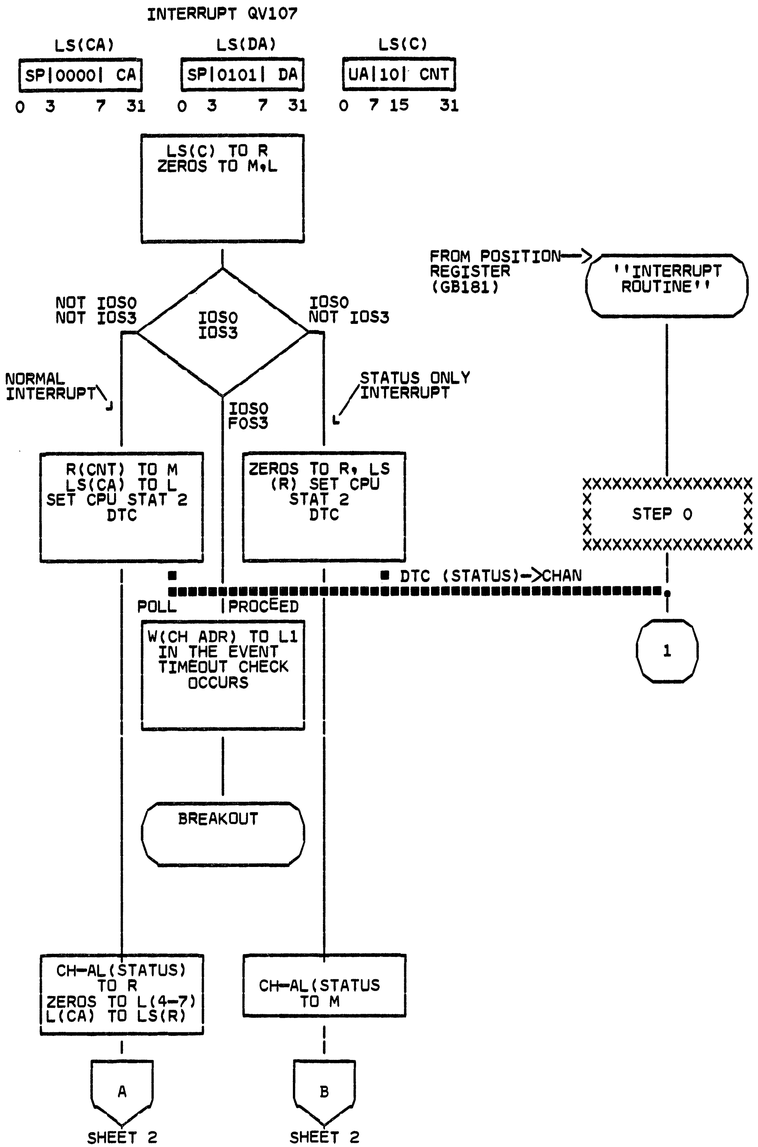
END UPDATE
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH• 2050

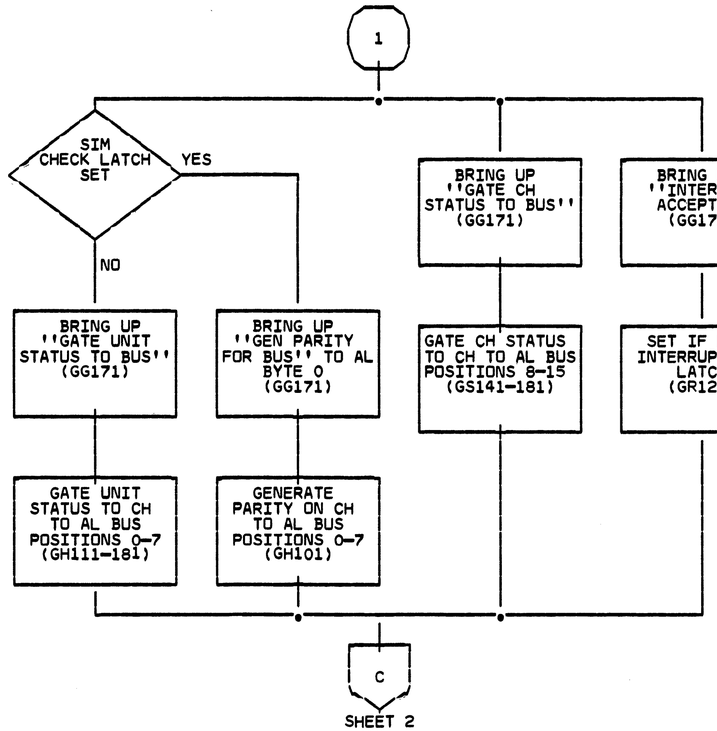
FRAME

P•N•

IBM CORP• SDD PAGE 4

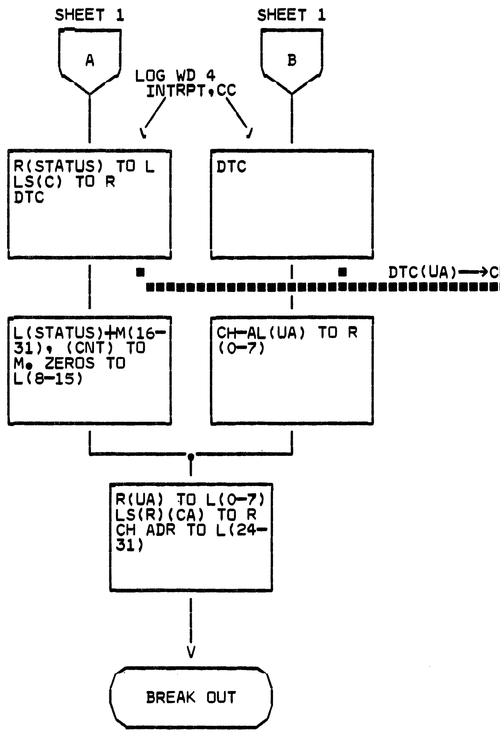
S4008

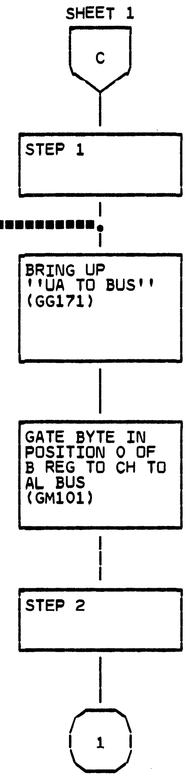


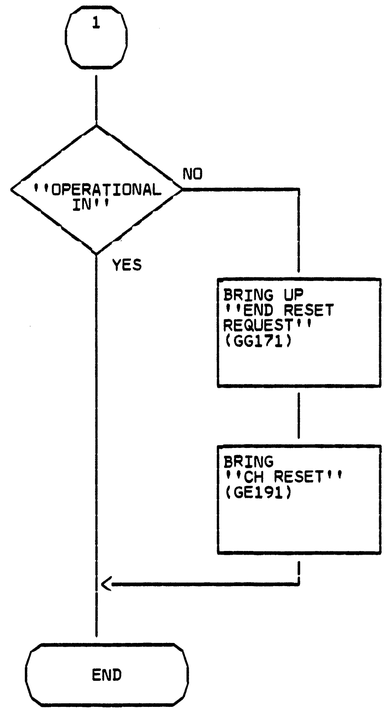


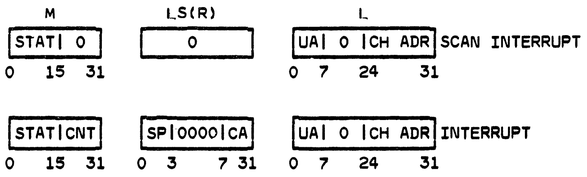
●IOP 209 INTERRUPT (SHEET 1 OF 2)

INTERRUPT (SELECTOR CHANNEL)		S
DATE 27 JUN 66 MACH. 2050		4
		0
FRAME	01	0
P.N.		9
IBM CORP. SDD	PAGE 2	



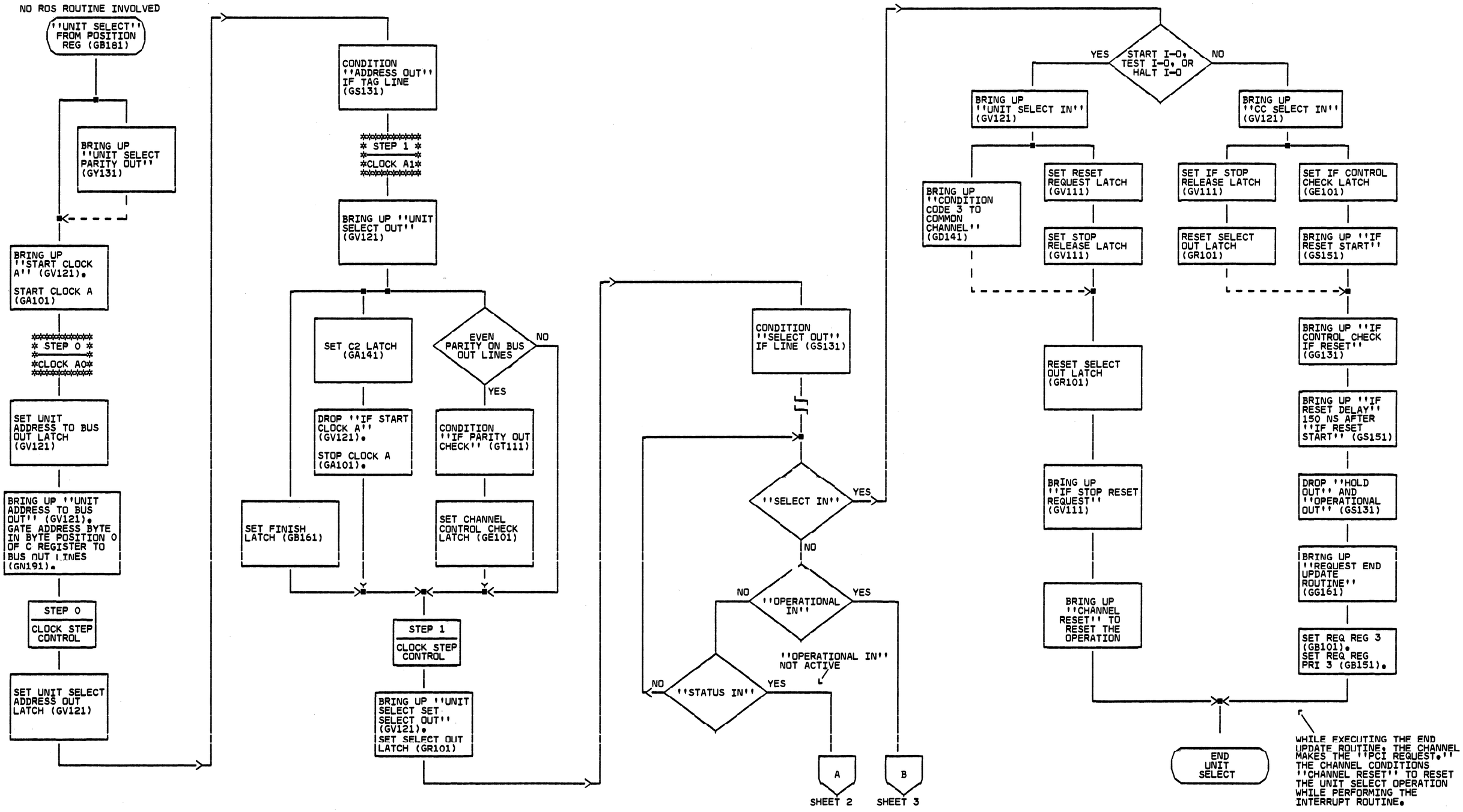






●IOP 209 INTERRUPT (SHEET 2 OF 2)

INTERRUPT (SELECTOR CHANNEL)		S4009
DATE 27 JUN 66 MACH. 2050		
	FRAME	01
	P.N.	
IBM CORP. SDD	PAGE	3



●IOP 210 UNIT SELECT (SHEET 1 OF 6)

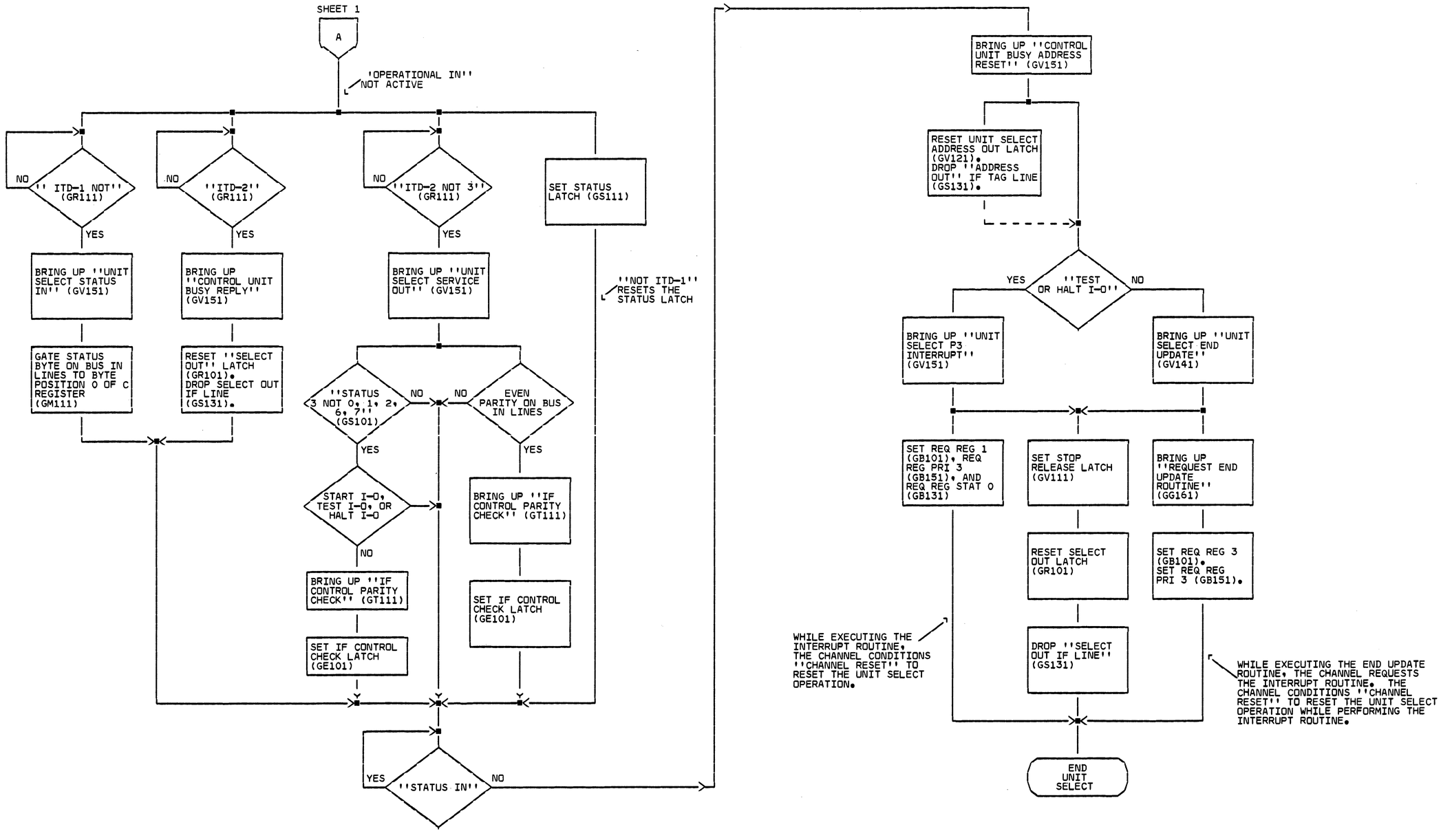
UNIT SELECT
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 2

S4010



4010 UNIT SELECT
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 2

S4010

SHEET 1

B

''HALT I-O'' (GD131)

NO

YES

RESET UNIT SELECT ADDRESS OUT LATCH (GV121)$ DROP ''ADDRESS OUT'' IF TAG LINE (GS131).

''OPERATIONAL IN'' DROPS UNIT SELECT PARITY OUT''. H IS SET.

BRING UP ''IF HALT DISCONNECT'' (GS151)

BRING UP ''UNIT I-O INTP3 (GV141)

BRING UP ''UNIT SELECT P3 INTERRUPT'' (GV151)

BRING UP ''UNIT SELECT PARITY IN'' (GV131)

''IF READ GATE'' IS NOT ACTIVE

NO

''ADDRESS IN'' ACTIVE

YES

BLOCK THE RISE OF ''SERVICE OUT'' (GS131)$ CONDITION ''ADDRESS OUT'' (GS131)$ SET SIM CHECK LATCH (GG131).

SET STOP RELEASE LATCH (GV111)

SET REQ REG 1 (GB101)$ REQ REG PRI 3 (GB151)$ REQ REG STAT 0 (GB131).

THE INTERRUPT ROUTINE INITIATES A CHANNEL RESET.

RESET SELECT OUT LATCH (GR101)

CHANNEL DROPS ''SELECT OUT''. I-O UNIT DROPS ''OPERATIONAL IN''.

BRING UP ''IF HALT END'' (GS151)

BRING UP ''CODE 2 TO COMMON CHANNEL''

END UNIT SELECT

ASSUME THAT THE MODE SWITCH IS SET TO IGNORE MODE. WHILE CLOCK A ADVANCES THROUGH TWO MORE CYCLES, THE IF CONTROL CHECK LATCH INITIATES THE IF DISCONNECT SEQUENCE AND REQUESTS THE END UPDATE ROUTINE. NO SIGNIFICANT ACTIONS OCCUR DURING THE CLOCK CYCLES.

''ITD-2'' AND ''NOT ITD-3''

BRING UP ''SET COMPARE'' (GV131)

EVEN PARITY ON BUS IN LINES

YES

NO

BRING UP ''IF CONTROL PARITY CHECK'' (GT111)

SET IF CONTROL CHECK LATCH (GE101)

''TEST I-O''

NO

YES

DOES ADDRESS ON BUS IN LINES EQUAL ADDRESS TRANSMITTED

YES

NO

1

BRING UP ''IF COMPARE NOT EQUAL'' (GR151)

RESET UNIT ADDRESS TO BUS OUT LATCH (GV121)

SET IF CONTROL CHECK LATCH (GE101)

BRING UP ''TEST I-O INHIBIT START CLOCK'' (GV151)

BRING UP ''UNIT SELECT P3 INTERRUPT'' (GV151)

SET C3 LATCH (GA151)

THE IF CONTROL CHECK LATCH IS SET IN THE TEST I-O OPERATION. WHILE CLOCK A ADVANCES THROUGH ONE CYCLE, THE CHANNEL SETS THE C3 LATCH, REQUESTS THE INTERRUPT ROUTINE, AND BEGINS THE RESET OPERATION. NO SIGNIFICANT ACTIONS OCCUR DURING THE CLOCK CYCLE.

D

SHEET 5

E

SHEET 5

1

BRING UP ''IF COMPARE EQUAL'' (GR151)

BRING UP ''IF COMPARE'' (GR151)

RESET UNIT ADDRESS TO BUS OUT LATCH (GV121)

C3 LATCH IS NOT SET

BRING UP ''IF START CLOCK A'' (GV121).

START CLOCK A (GA101)

C

SHEET 4

UNIT SELECT
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

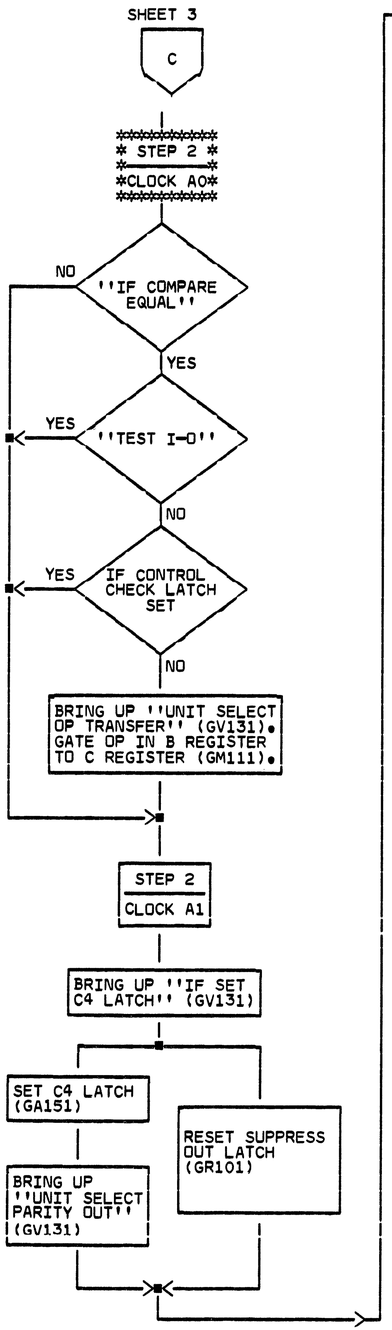
FRAME

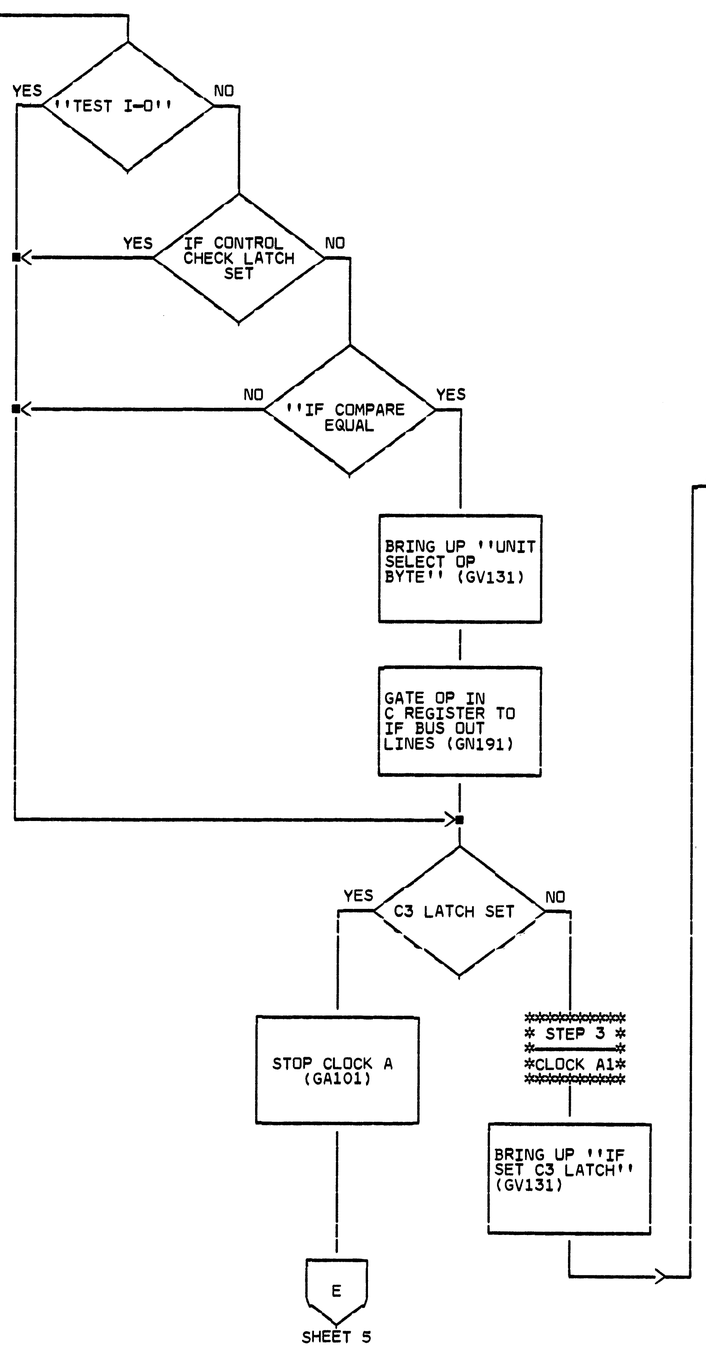
P.N.

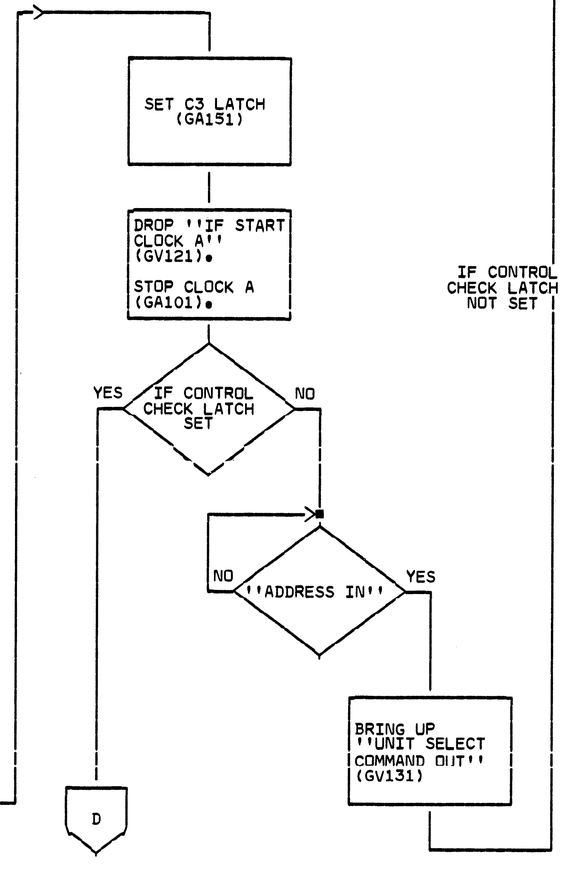
IBM CORP. SDD PAGE 4

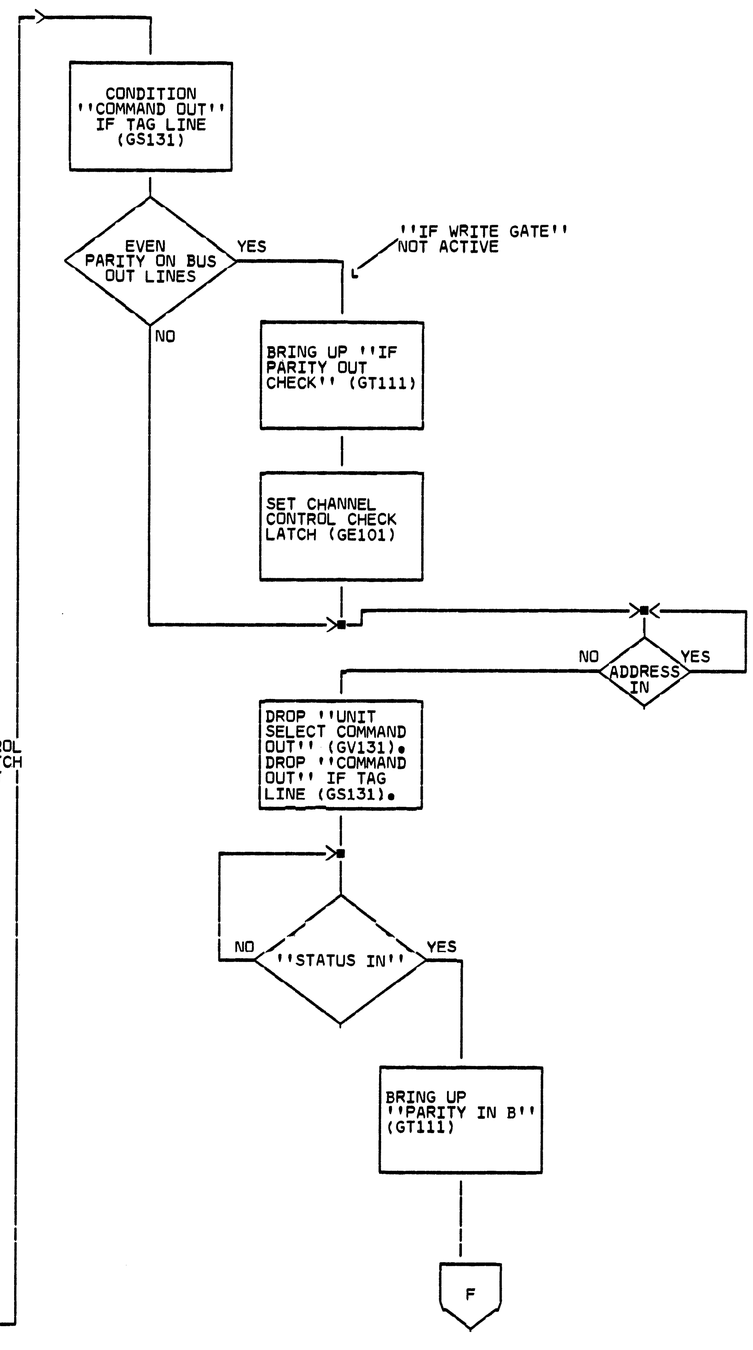
S4010

●IOP 210 UNIT SELECT (SHEET 3 OF 6)









UNIT SELECT
(SELECTOR CHANNEL)
DATE 27 JUN 66 MACH. 2050

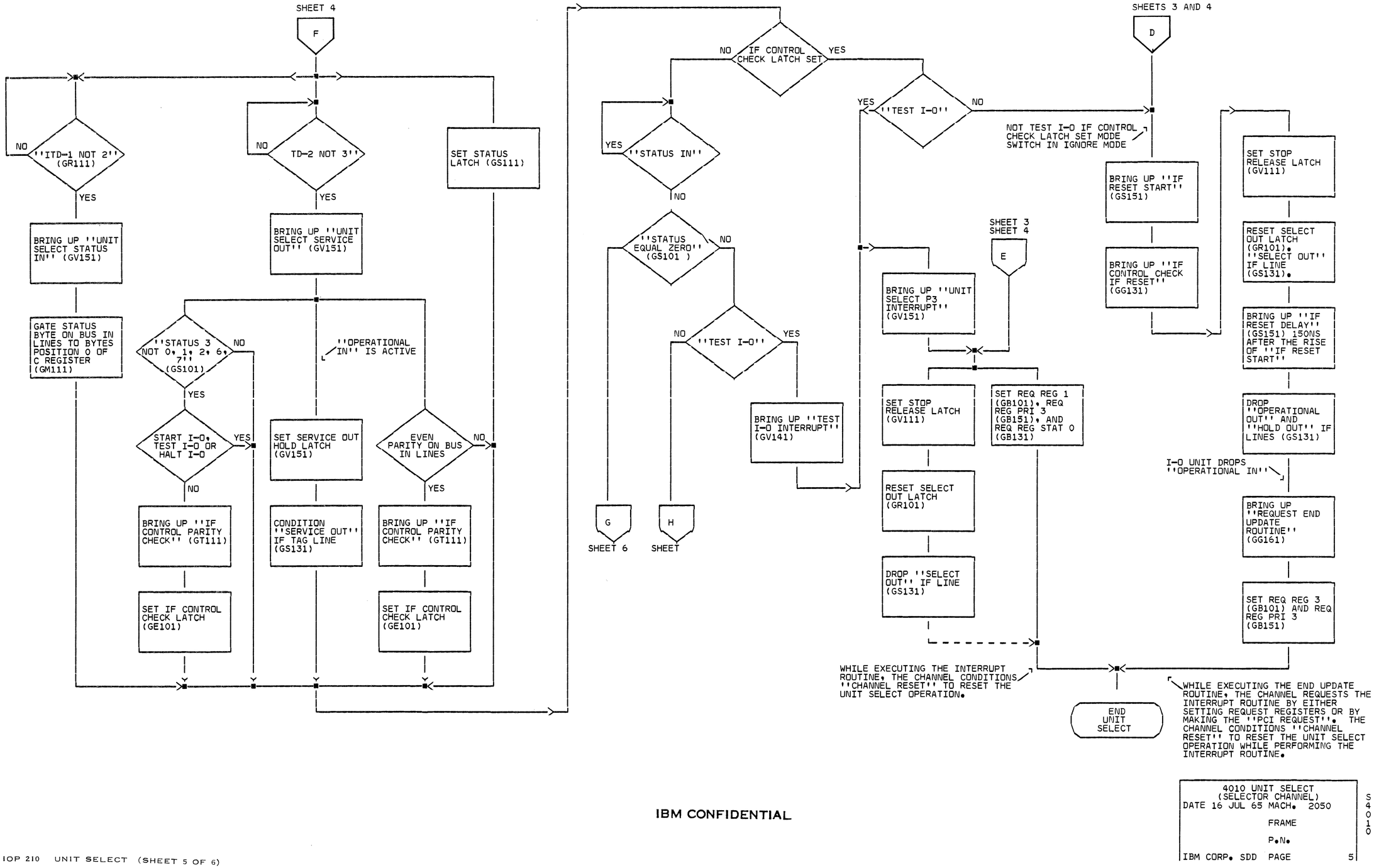
FRAME

P.N.

IBM CORP. SDD PAGE 5

S4010

●IOP 210 UNIT SELECT (SHEET 4 OF 6)



4010 UNIT SELECT
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

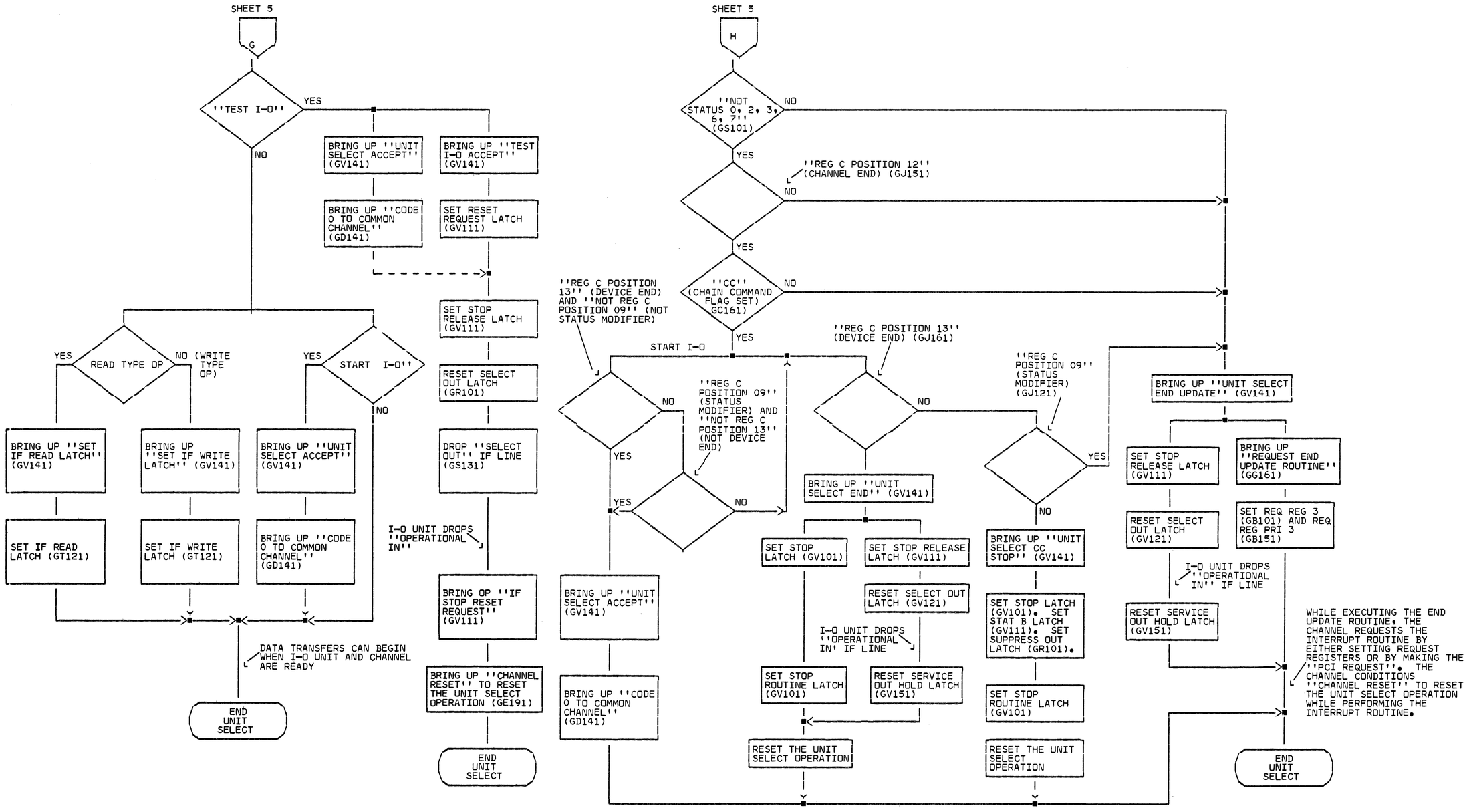
FRAME

P.N.

IBM CORP. SDD PAGE 5

S 4 0 1 0

IBM CONFIDENTIAL



IOP 210 UNIT SELECT (SHEET 6 OF 6)

IBM CONFIDENTIAL

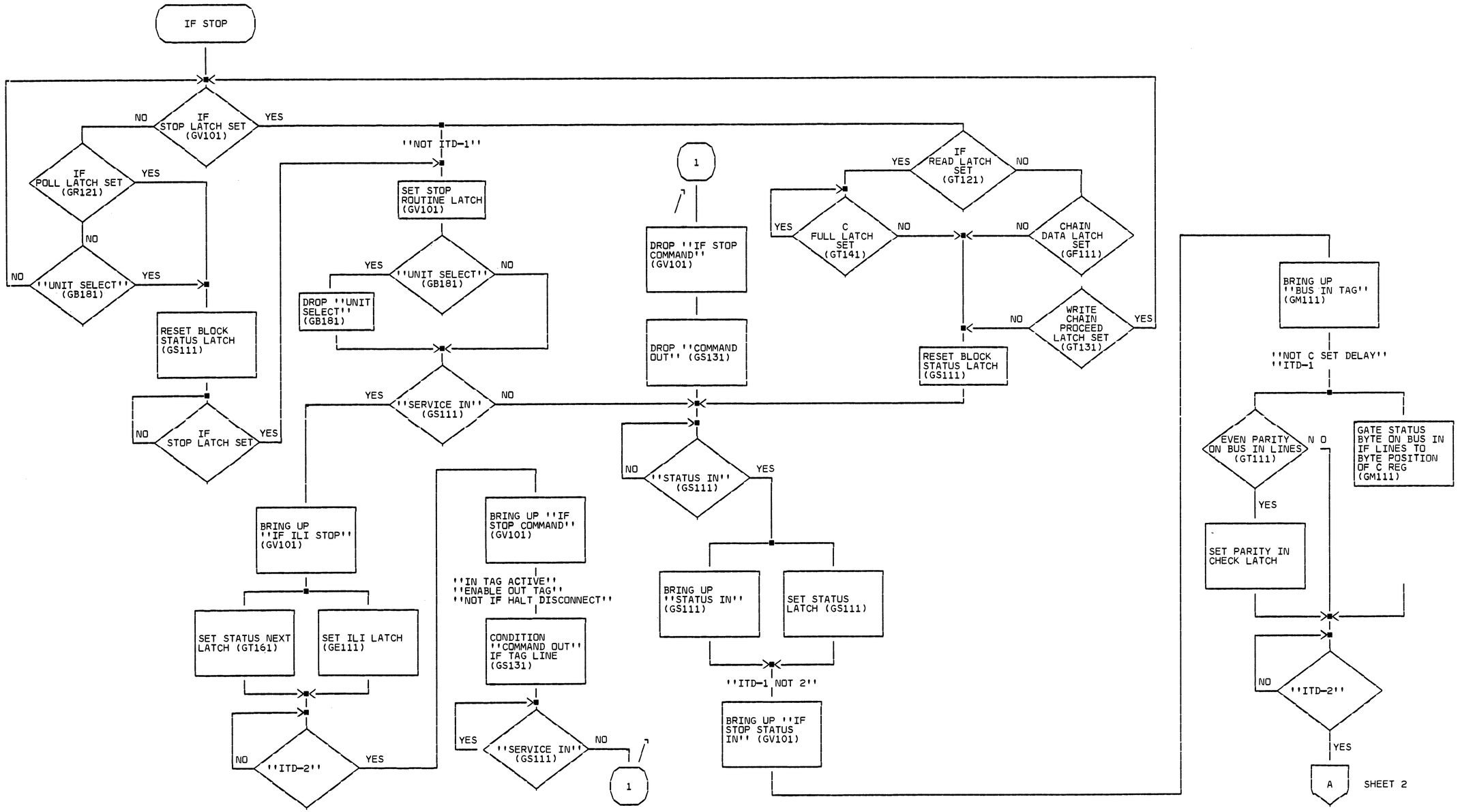
4010 UNIT SELECT
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 6

S4010



4011 IF STOP
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

FRAME

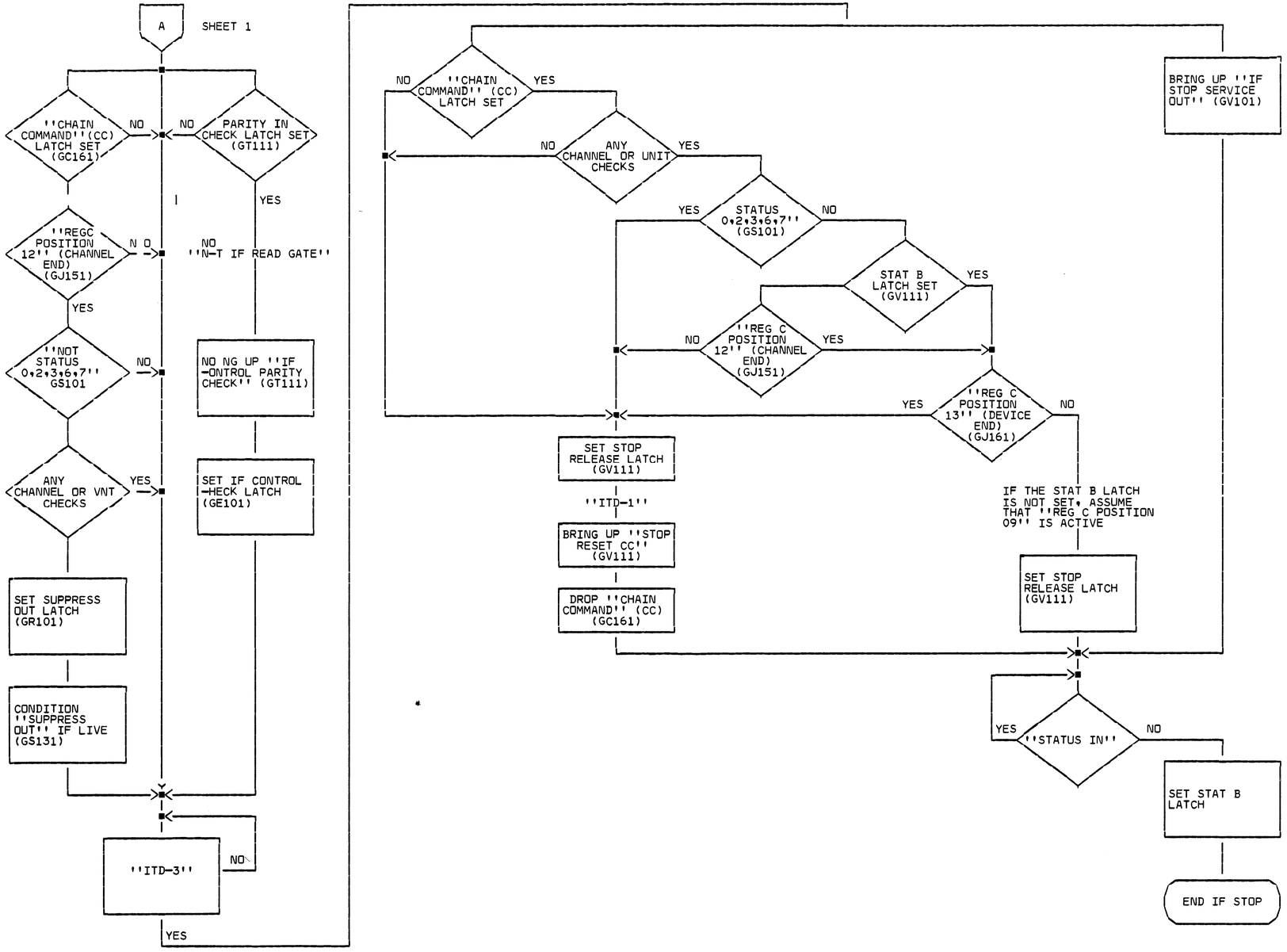
P.N.

IBM CORP. SDD PAGE 1

S 4 0 1 1

IBM CONFIDENTIAL

IOP 211 IF STOP (SHEET 1 OF 2)



IOP 211 IF STOP (SHEET 2 OF 2)

IBM CONFIDENTIAL

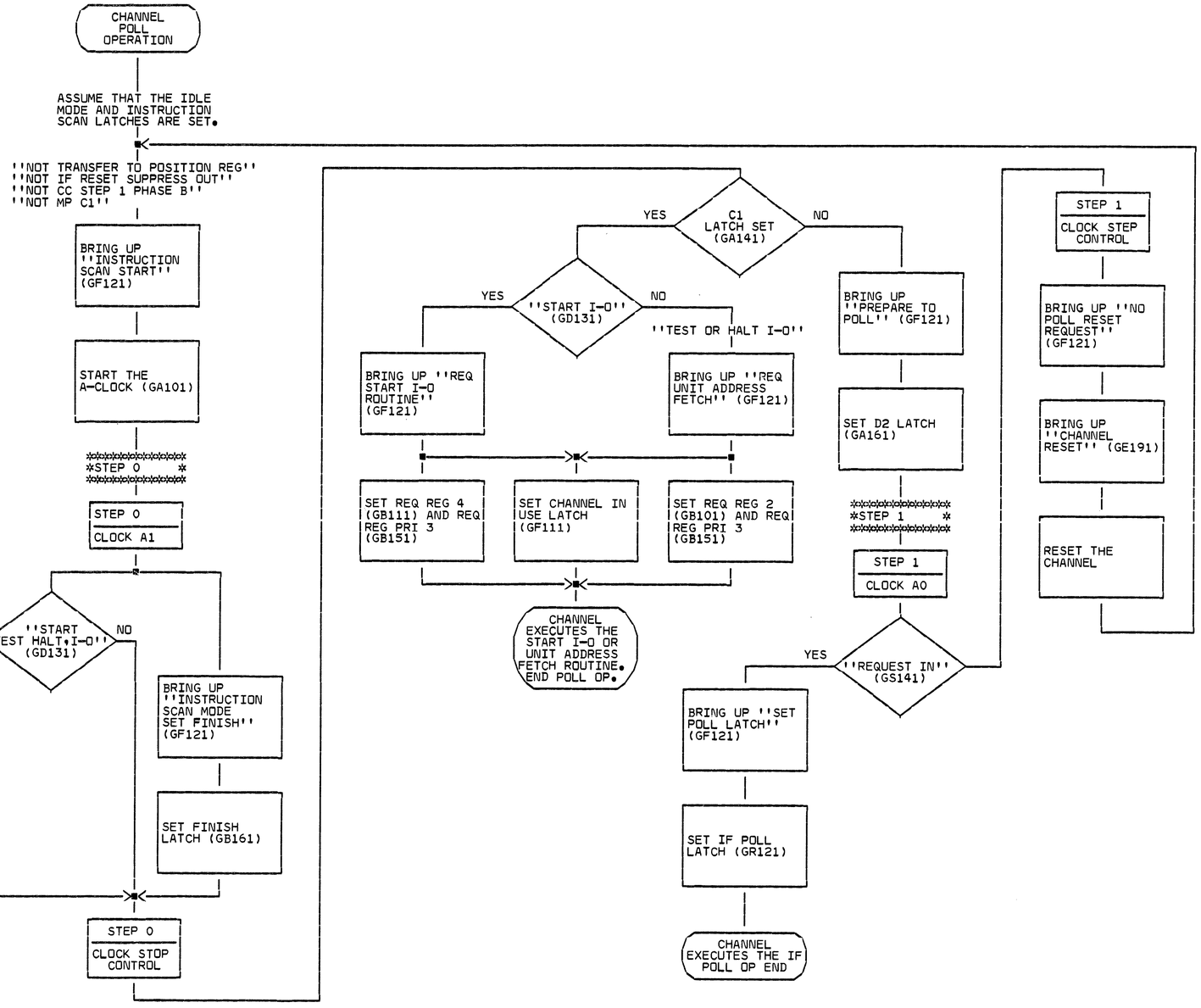
4011 IF STOP
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

FRAME

P.N.

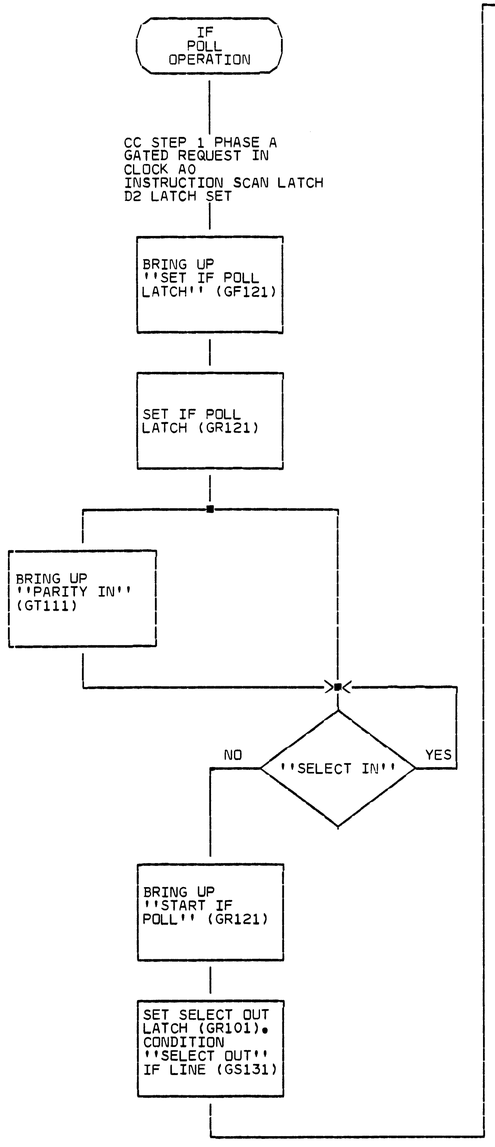
IBM CORP. SDD PAGE 2

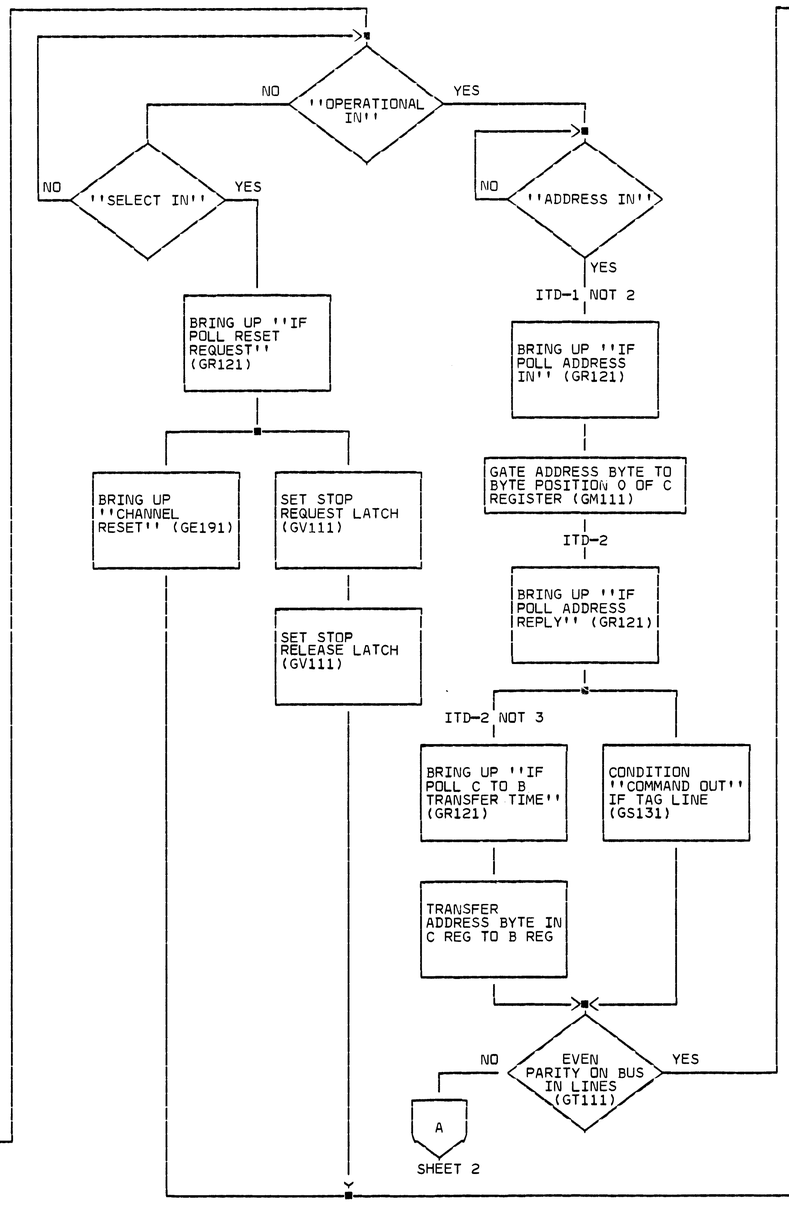
S4011

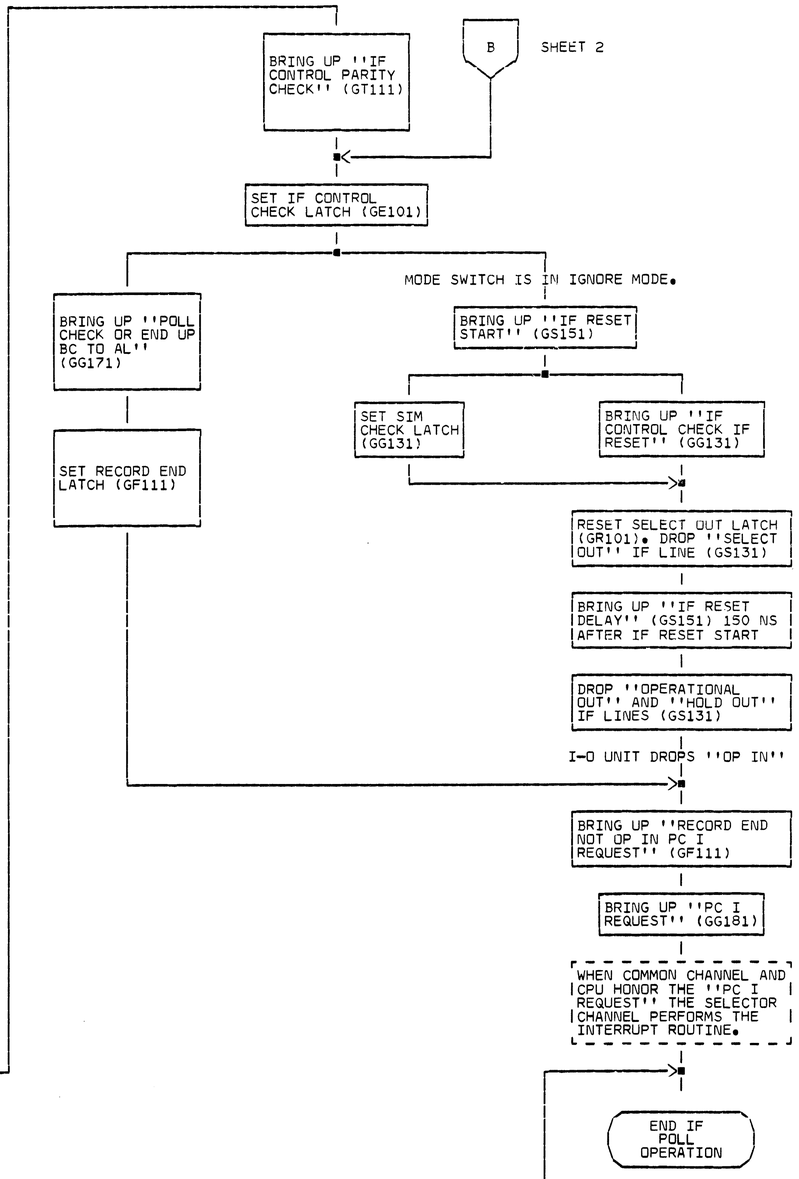


4012 CHANNEL POLL OP
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

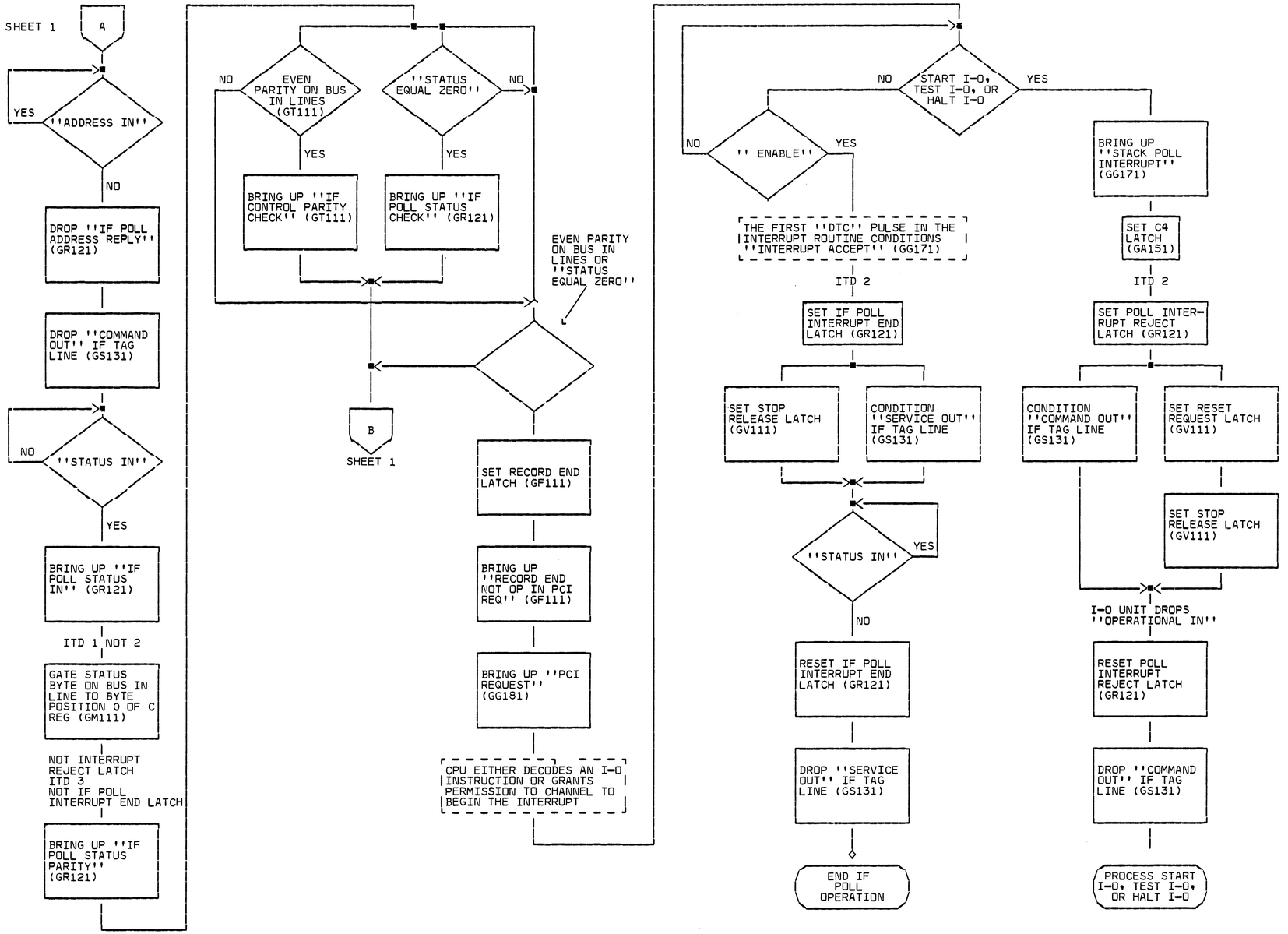
S4012







4013 IF POLL OP (SELECTOR CHANNEL)	S 4 0 1 3
DATE 16 JUL 65 MACH• 2050	
FRAME	
P•N•	
IBM CORP• SDD PAGE 1	



IOP 213 IF POLL OPERATION (SHEET 2 OF 2)

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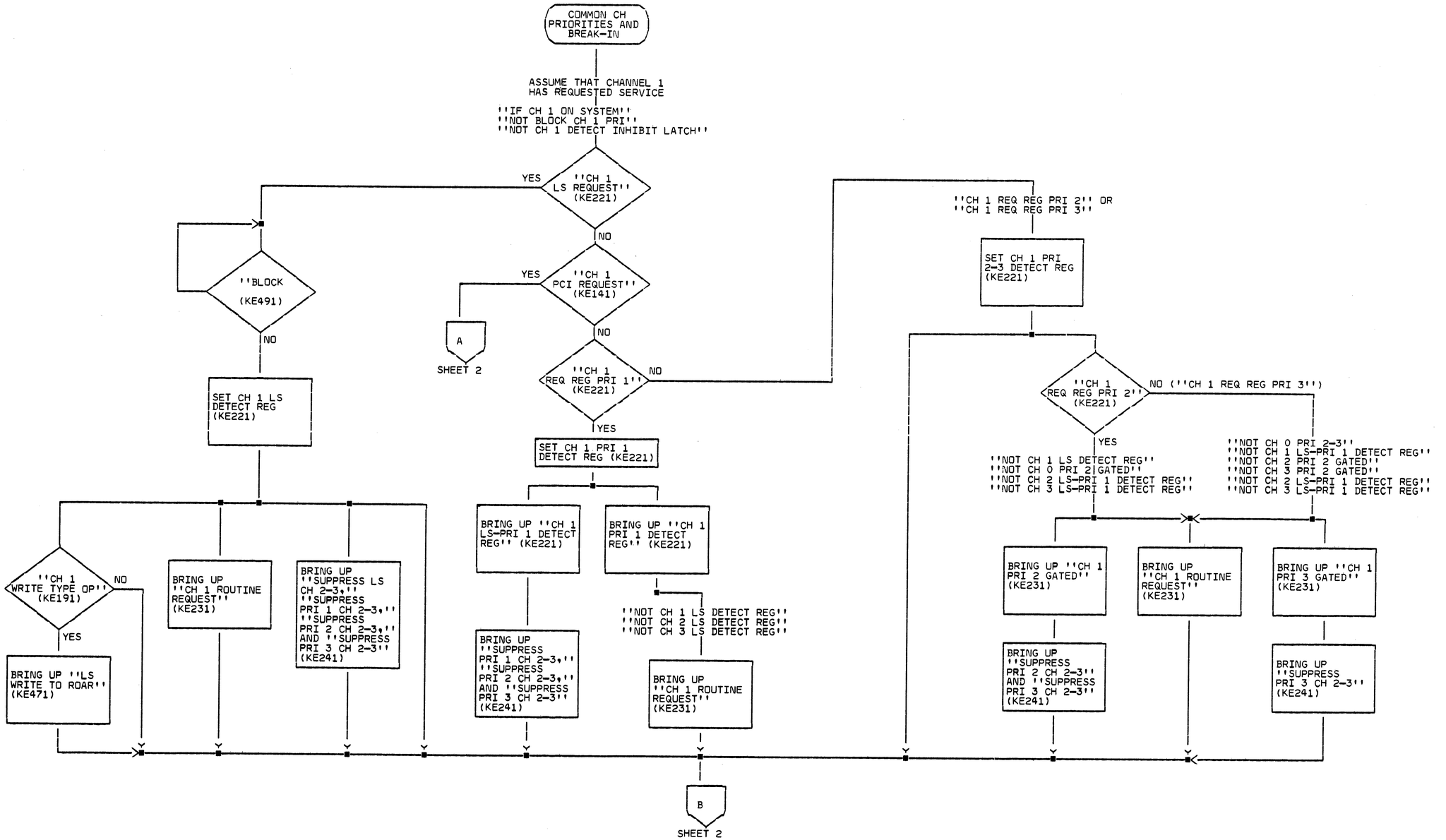
4013 IF POLL OP
(SELECTOR CHANNEL)
DATE 16 JUL 65 MACH. 2050

FRAME

P.N.

IBM CORP. SDD PAGE 2

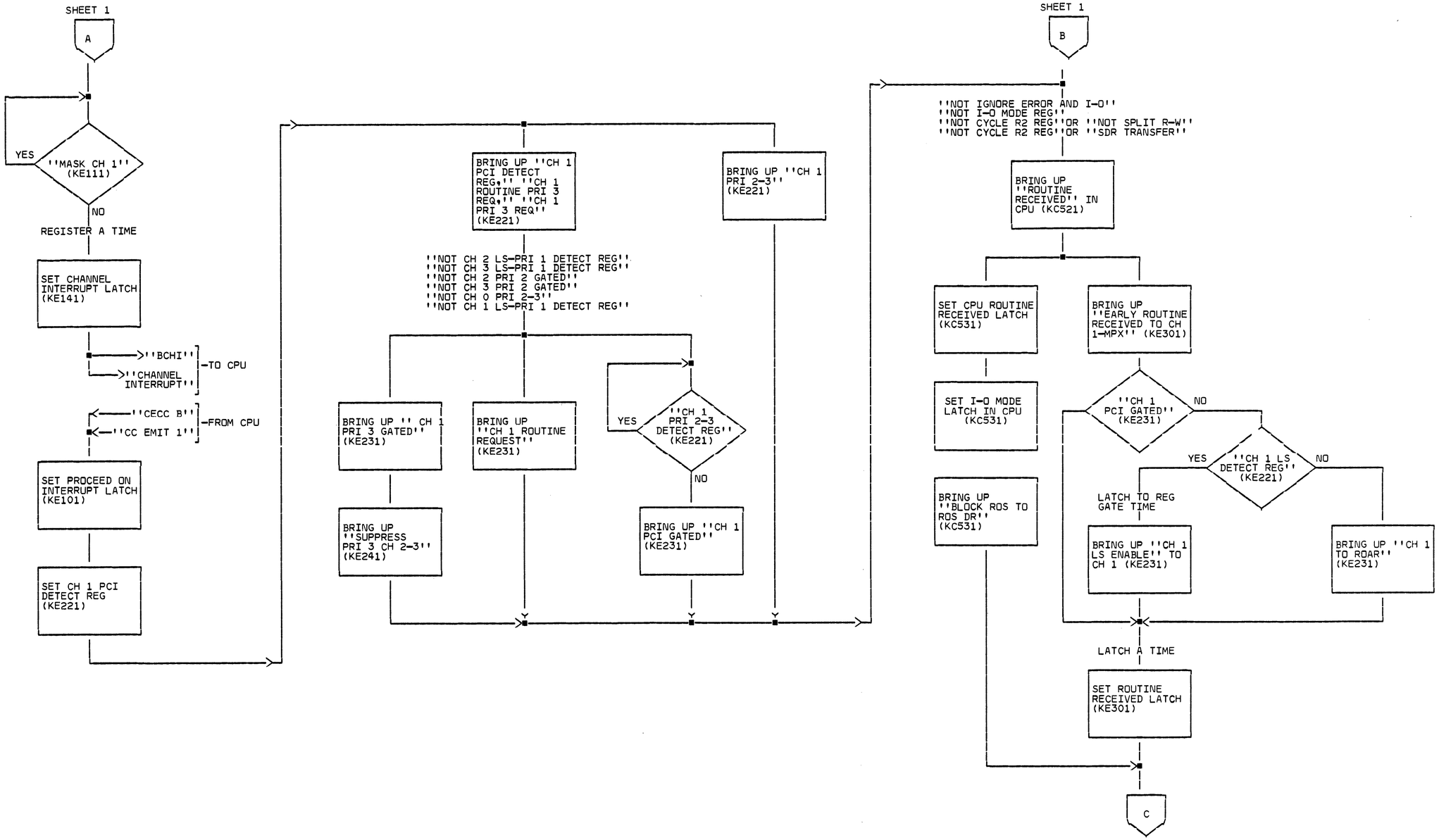
S4013



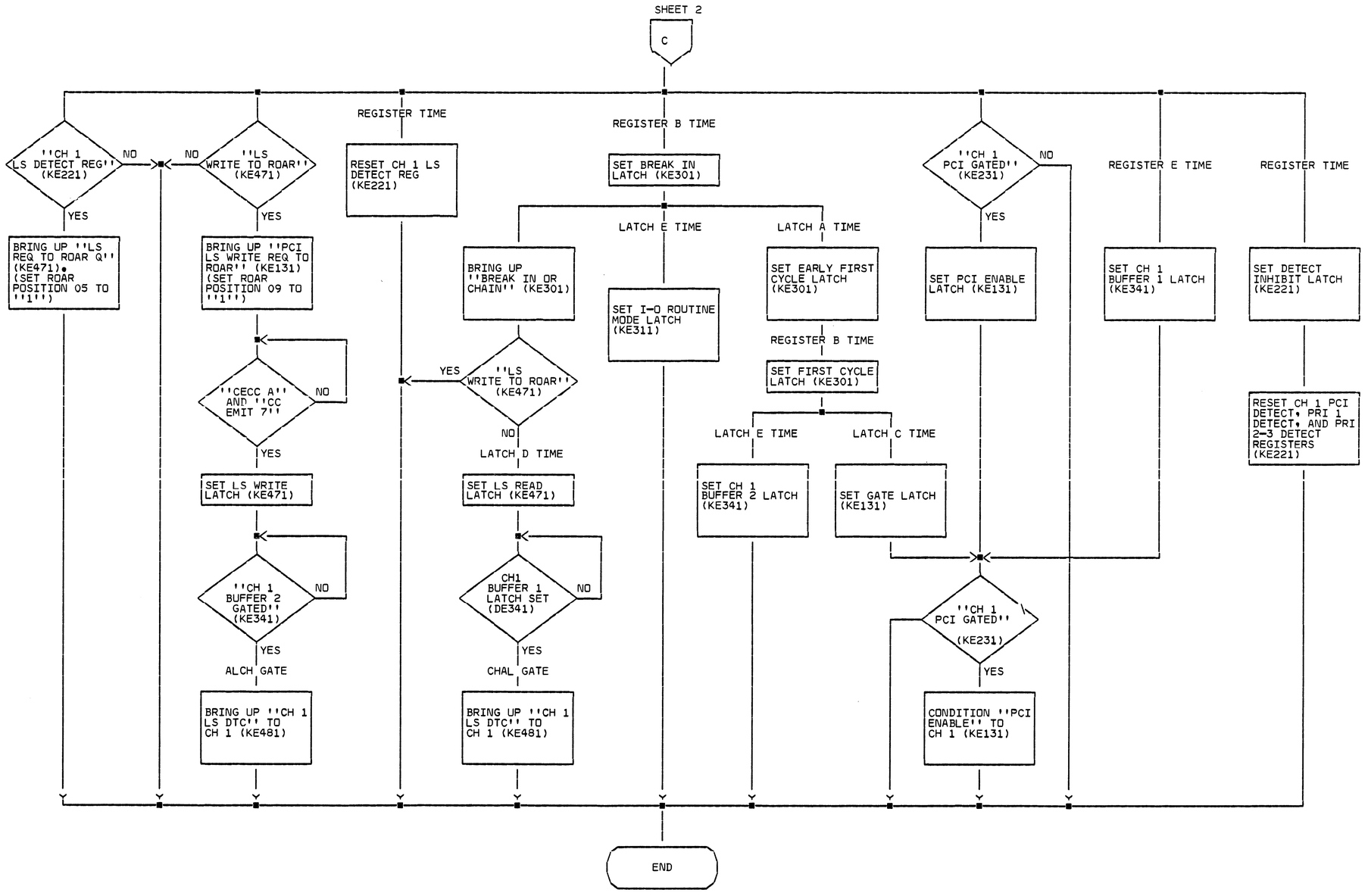
IBM CONFIDENTIAL

4014 COMMON CH PRIORITIES AND BREAK IN	S 4 0 1 4
DATE 16 JUL 65 MACH. 2050	
FRAME	
P.N.	
IBM CORP. SDD PAGE 1	

IOP 214 COMMON CHANNEL PRIORITY AND BREAK IN (SHEET 1 OF 3)

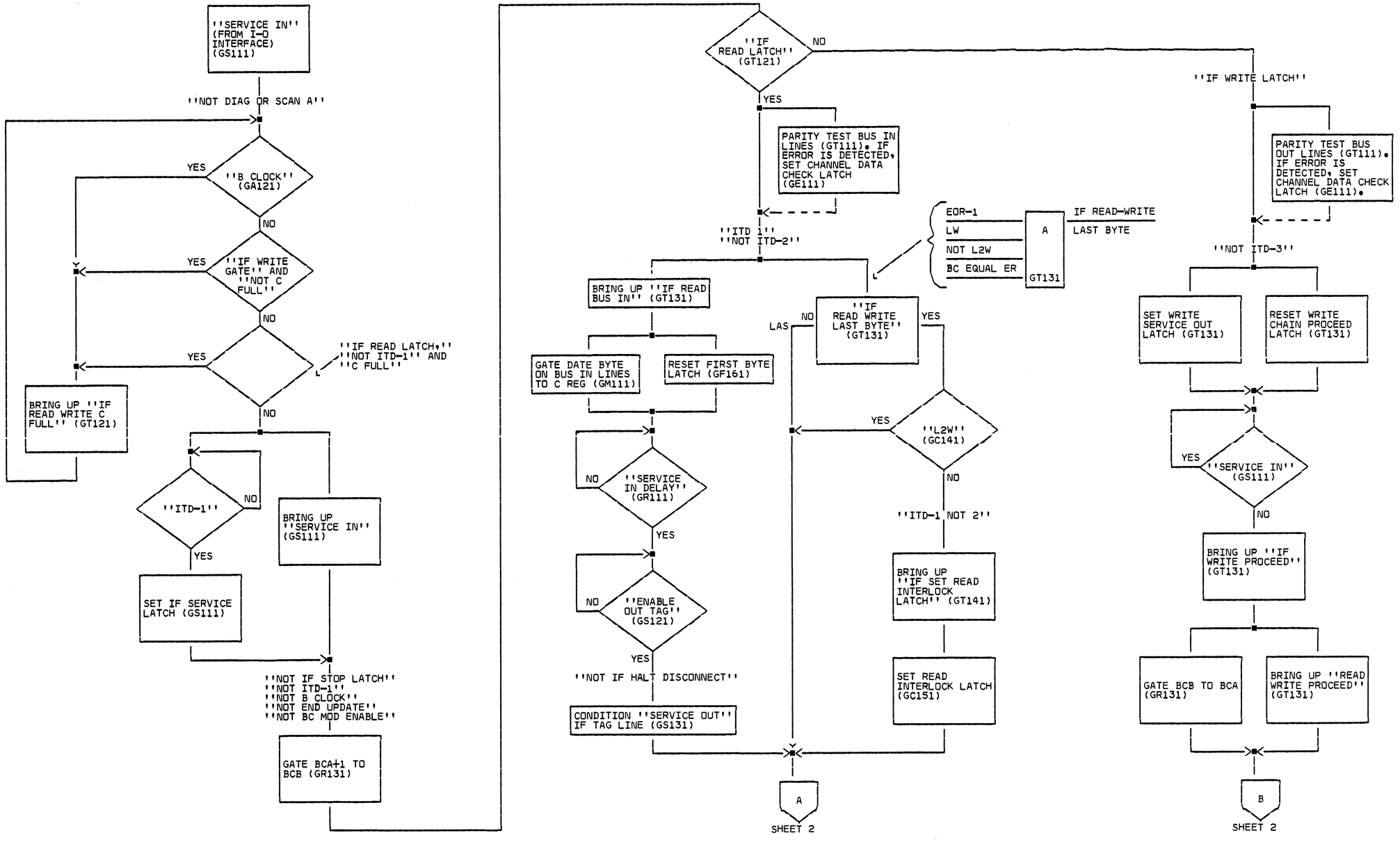


4014 COMMON CH PRIORITIES AND BREAK IN	
DATE 16 JUL 65 MACH. 2050	S4014
FRAME	
P.N.	
IBM CORP. SDD PAGE	2



IBM CONFIDENTIAL

4014 COMMON CH PRIORITIES AND BREAK IN	S4014
DATE 16 JUL 65 MACH• 2050	
FRAME	
P•N•	
IBM CORP• SDD PAGE 3	



4015 SELECTOR CHANNEL
RESPONSES TO Δ)AΔ)ASERVICE INΔ
DATE 16 JUL 65 MACH. 2050

FRAME

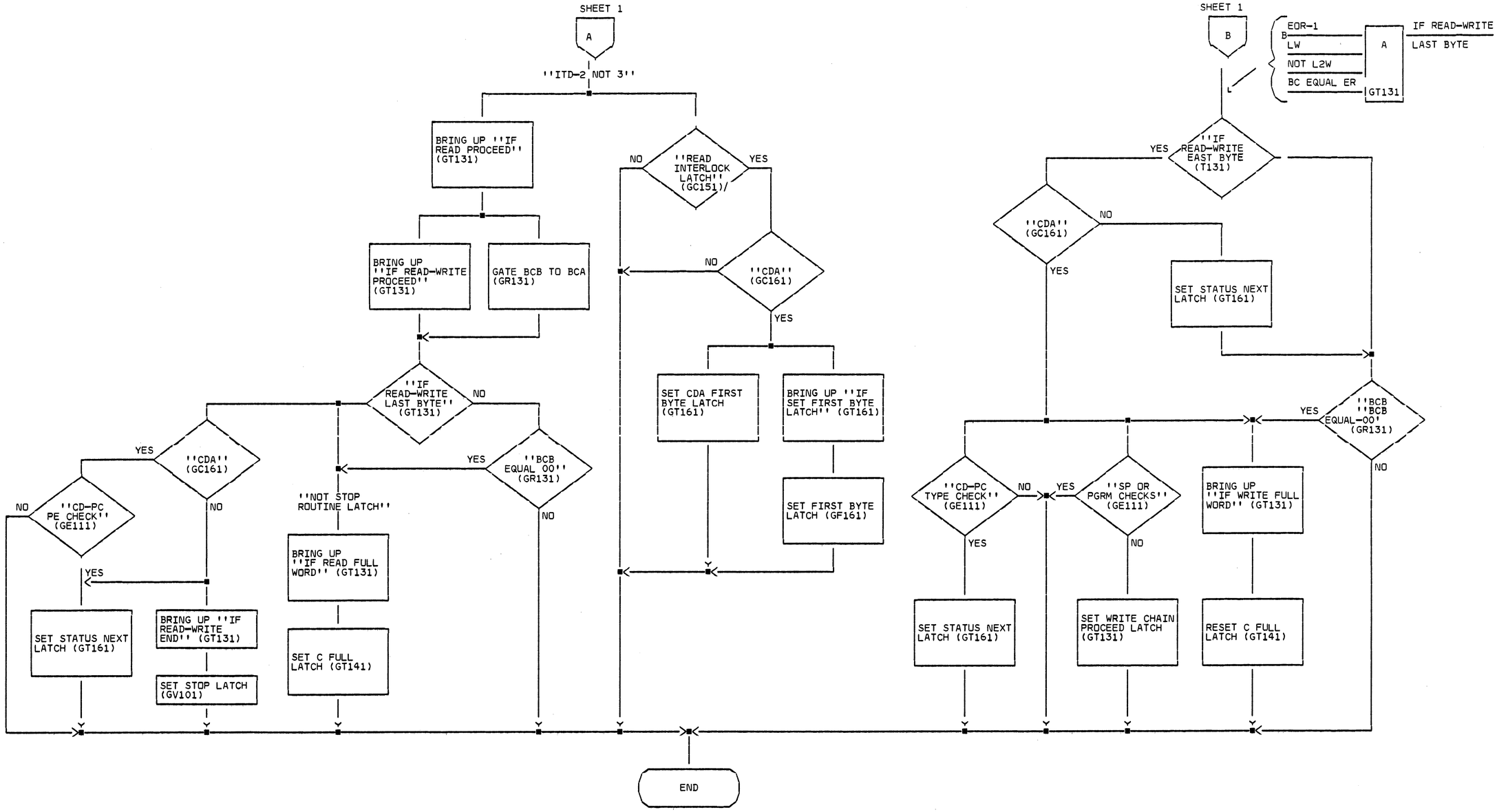
P.N.

IBM CORP. SDD PAGE 1

S4015

IBM CONFIDENTIAL

IOP 215 SELECTOR CHANNEL RESPONSES TO SERVICE IN (SHEET 1 OF 2)



4015 SELECTOR CHANNEL
RESPONSES TO ▷)A▷)ASERVICE IN▷
DATE 16 JUL 65 MACH• 2050

FRAME

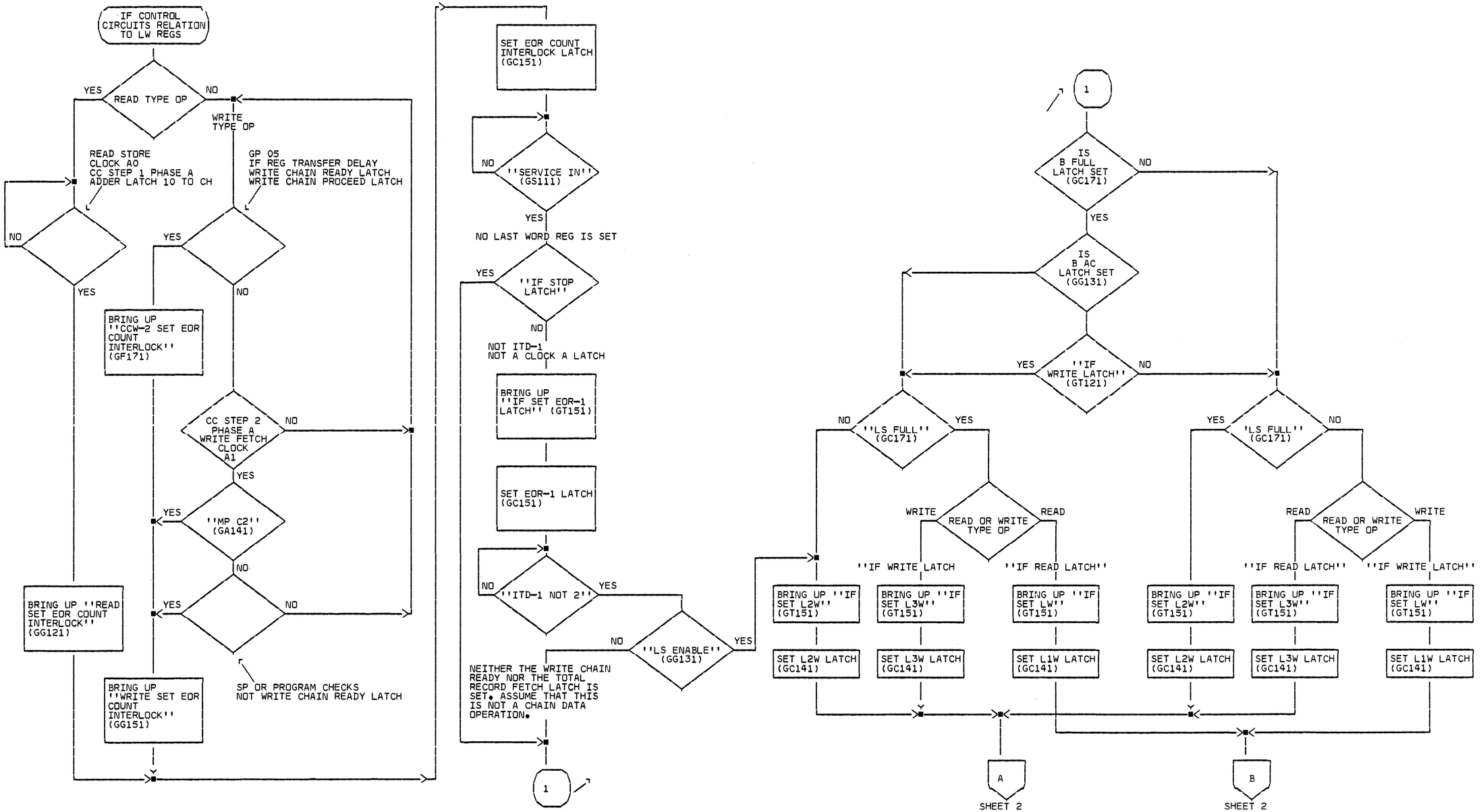
P•N•

IBM CORP• SDD PAGE 2

S 4 0 1 5

IBM CONFIDENTIAL

IOP 215 SELECTOR CHANNEL RESPONSES TO SERVICE IN (SHEET 2 OF 2)

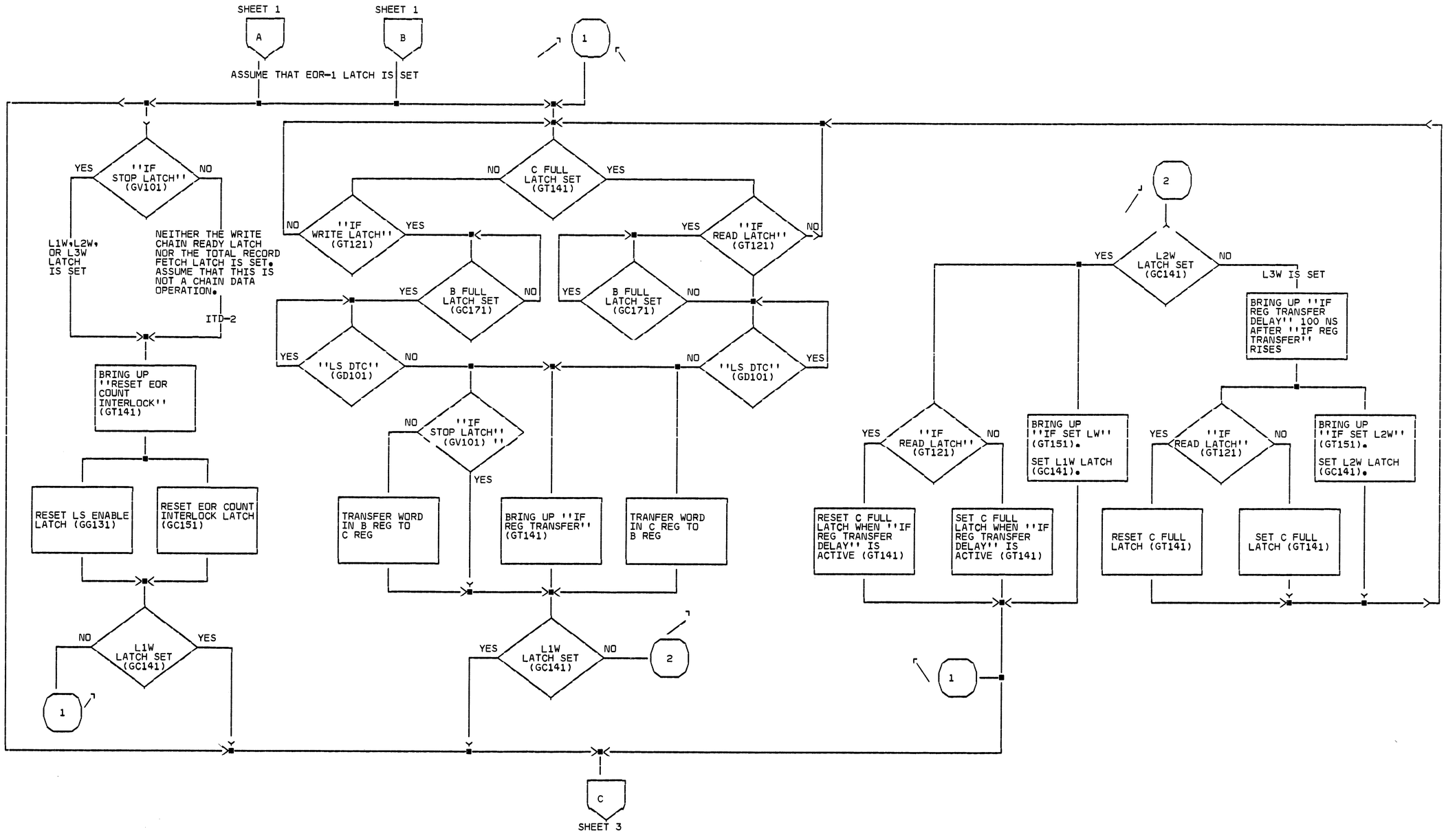


4016 IF CONTROL CIRCUITS RELATION TO LW REGS
DATE 16 JUL 65 MACH. 2050
FRAME
P.N.
IBM CORP. SDD PAGE 1

S 4 0 1 6

IBM CONFIDENTIAL

IOP 216 IF CONTROL CIRCUITS RELATION TO LW REGS (SHEET 1 OF 3)



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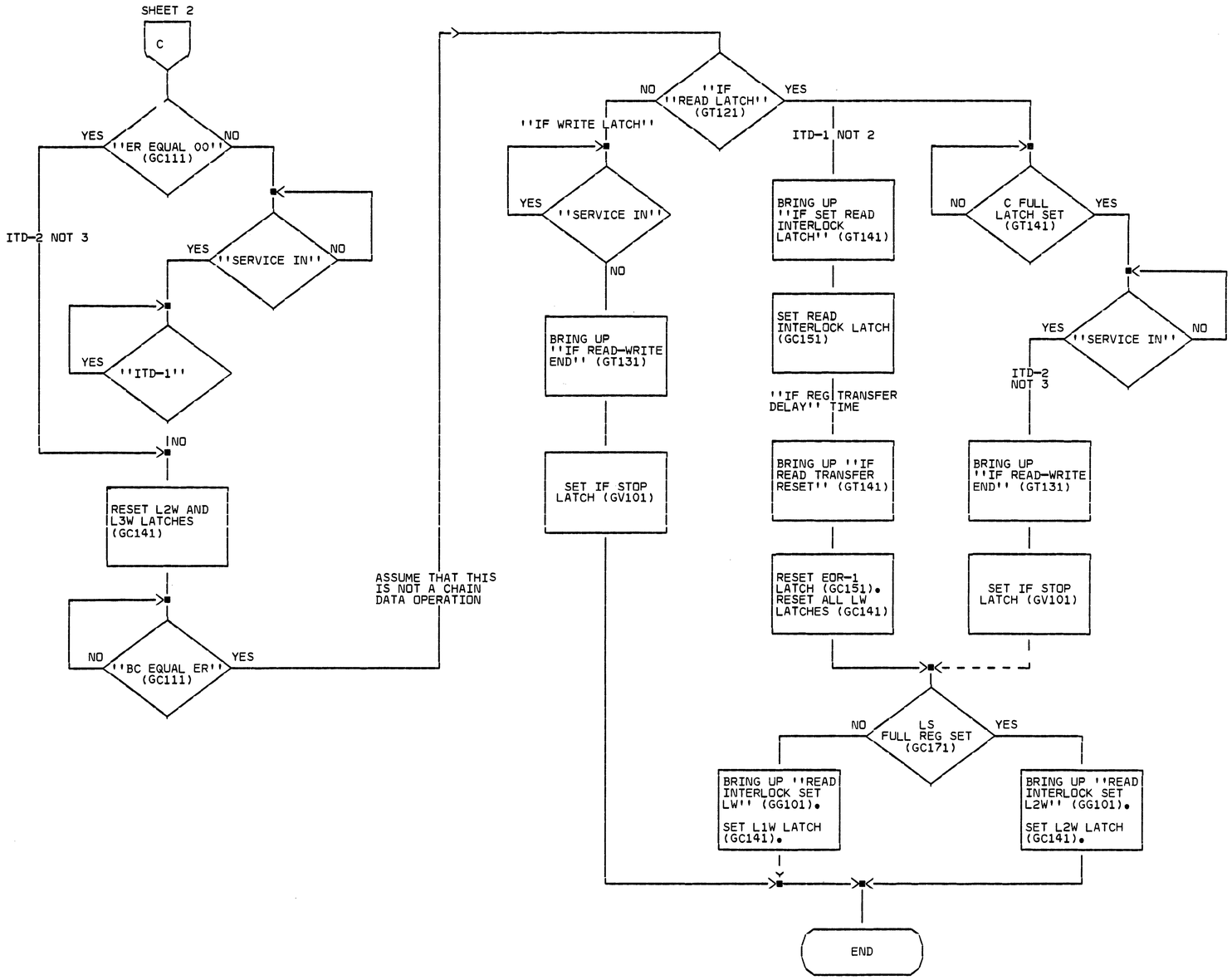
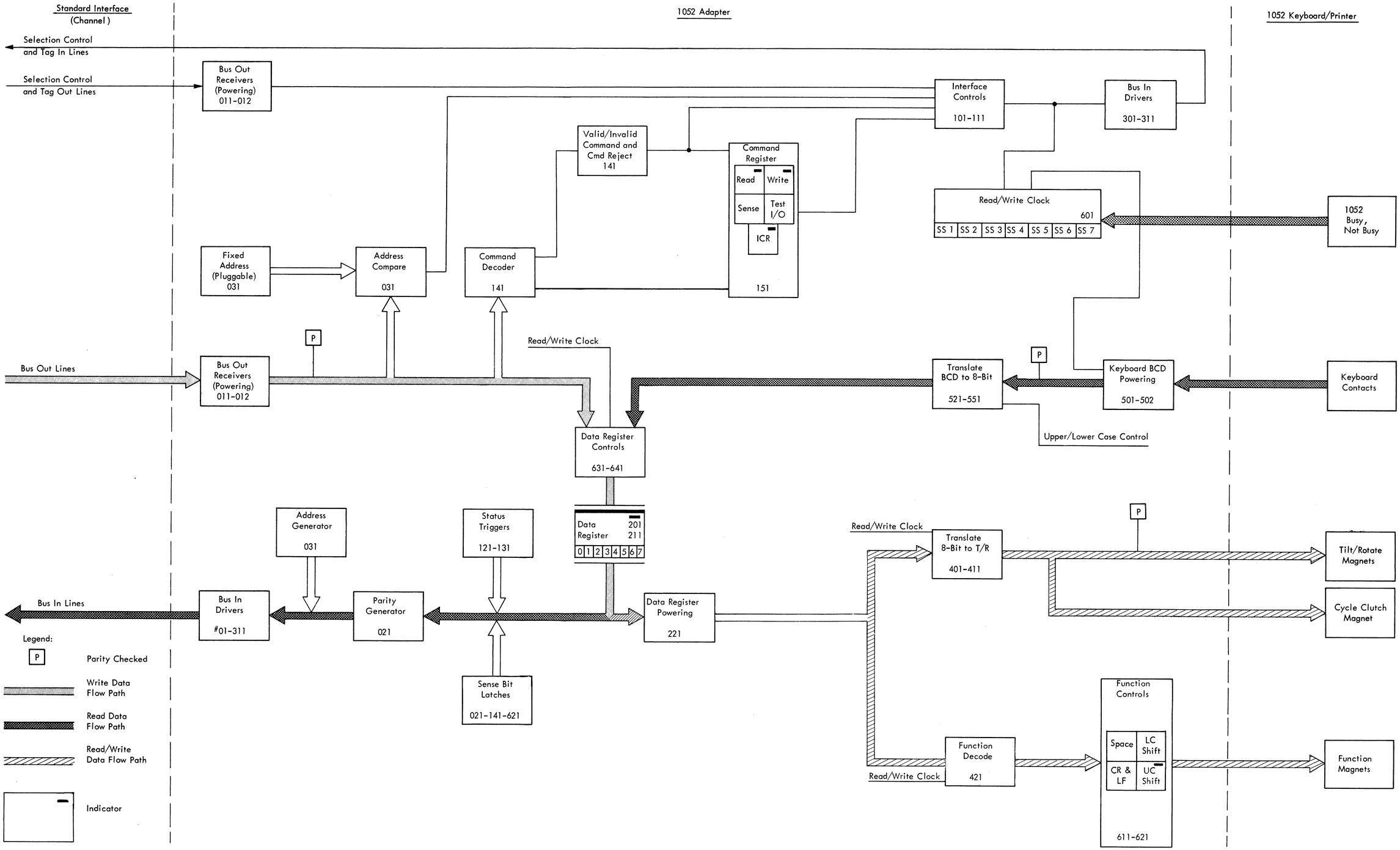
4016 IF CONTROL CIRCUITS RELATION TO LW REGS	S
DATE 16 JUL 65 MACH. 2050	4
FRAME	0
P.N.	1
IBM CORP. SDD PAGE 2	6

IOP 216 IF CONTROL CIRCUITS RELATION TO LW REGS (SHEET 2 OF 3)

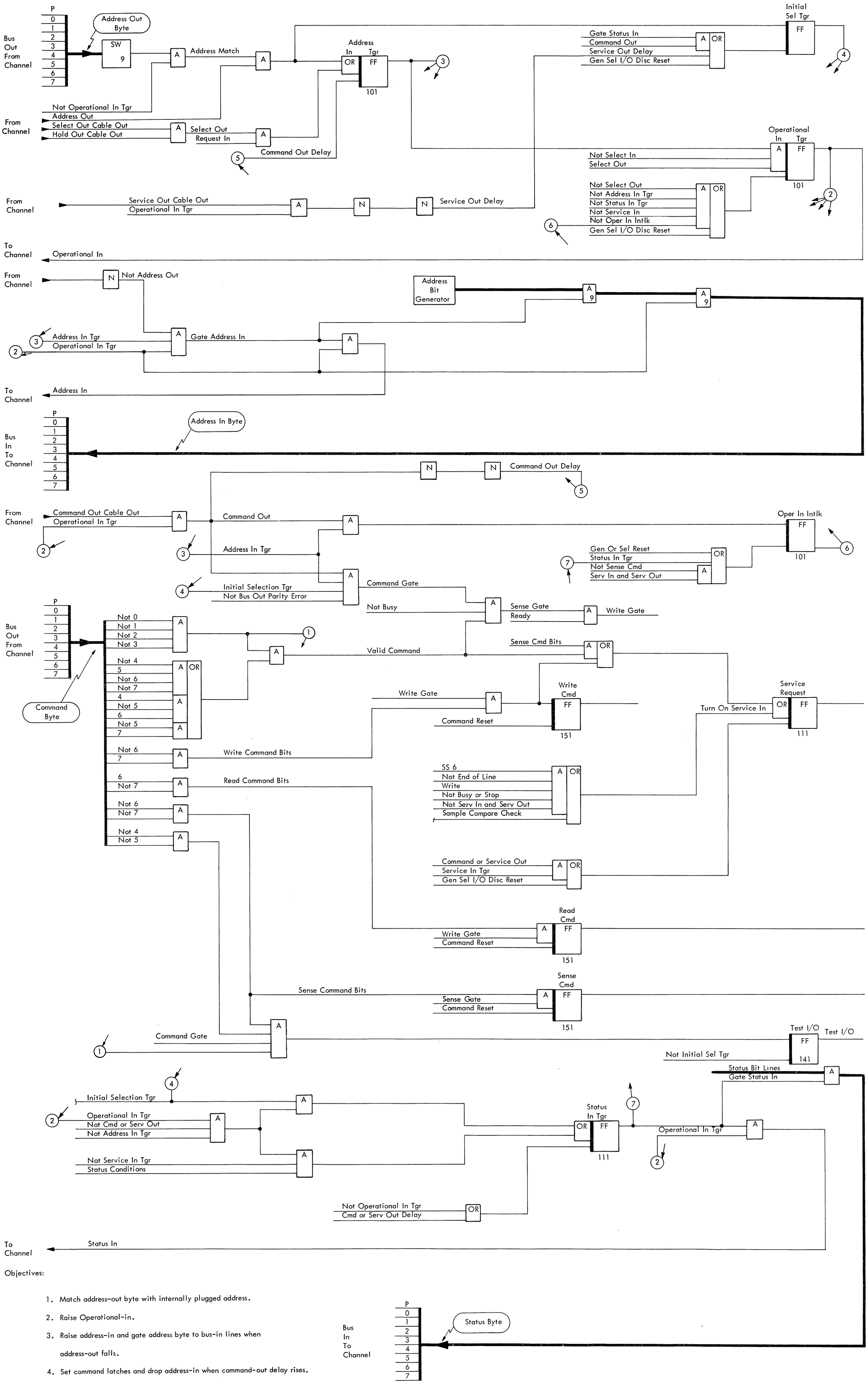


4016 IF CONTROL CIRCUITS RELATION TO LW REGS	S
DATE 16 JUL 65 MACH. 2050	4
	0
FRAME	1
P.N.	6
IBM CORP. SDD PAGE 3	



• FIGURE IOP 301. DATA FLOW--1052 ADAPTER UNIT

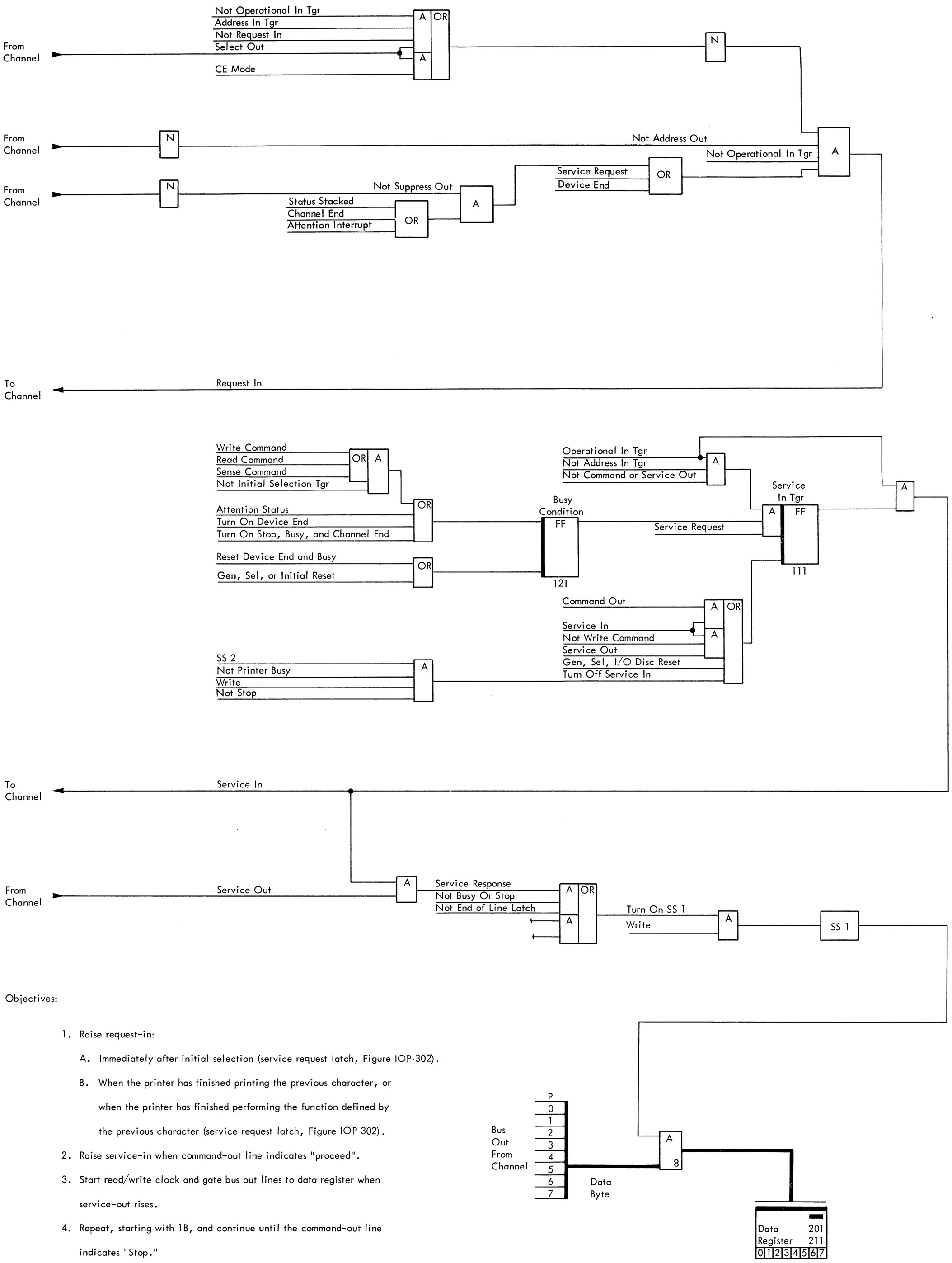
Form Z22-2833-4
Page Revised 8/1/66
by FES Z22-6600-1



Objectives:

1. Match address-out byte with internally plugged address.
2. Raise Operational-in.
3. Raise address-in and gate address byte to bus-in lines when address-out falls.
4. Set command latches and drop address-in when command-out delay rises.
5. Raise status-in and gate status byte to bus-in lines when command-out falls.
6. Drop operational-in and status-in when service-out rises.

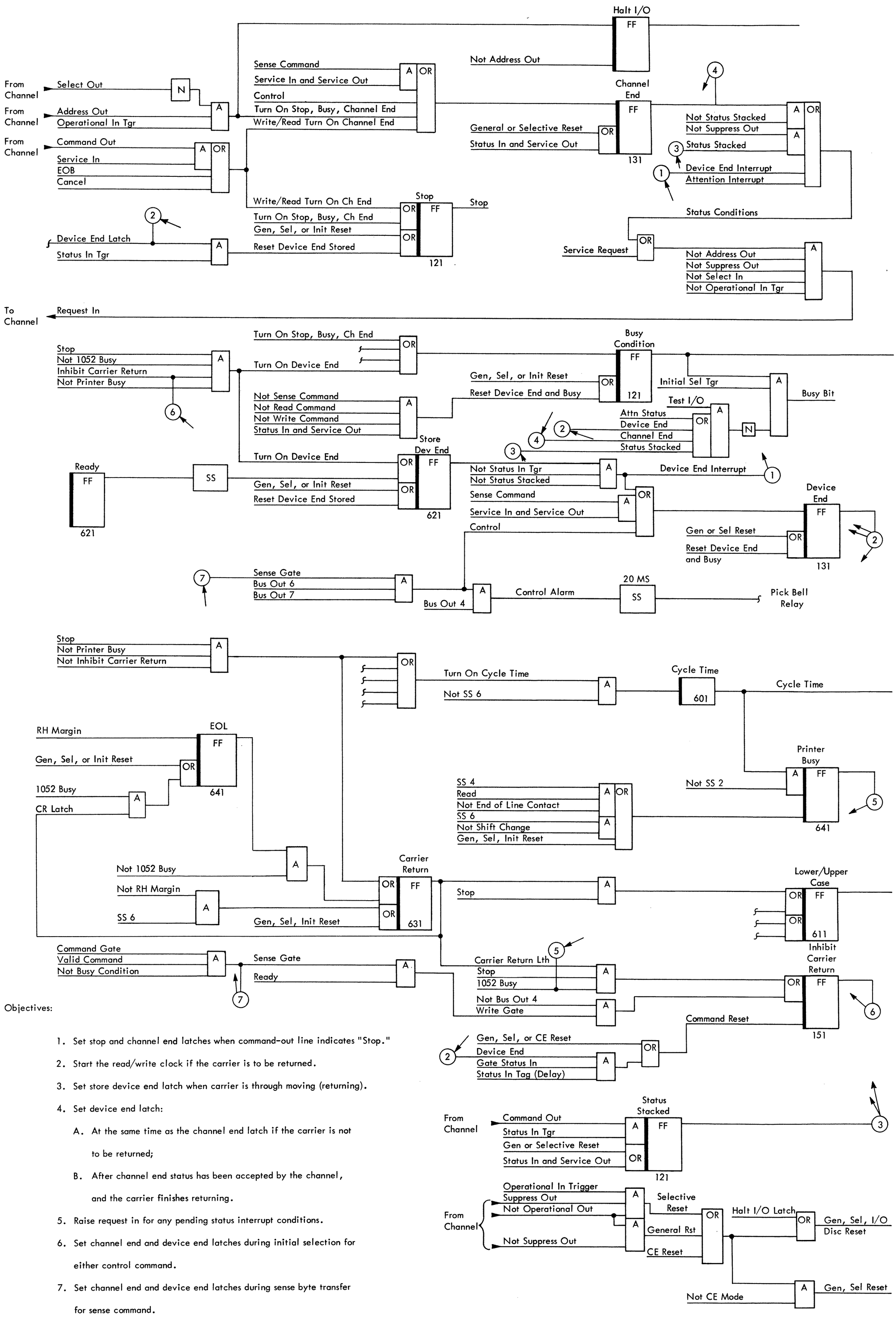
●FIGURE IOP 302. INITIAL SELECTION--READ, WRITE, SENSE (1052)



Objectives:

1. Raise request-in:
   A. Immediately after initial selection (service request latch, Figure IOP 302).
   B. When the printer has finished printing the previous character, or when the printer has finished performing the function defined by the previous character (service request latch, Figure IOP 302).
2. Raise service-in when command-out line indicates "proceed".
3. Start read/write clock and gate bus out lines to data register when service-out rises.
4. Repeat, starting with 1B, and continue until the command-out line indicates "Stop."

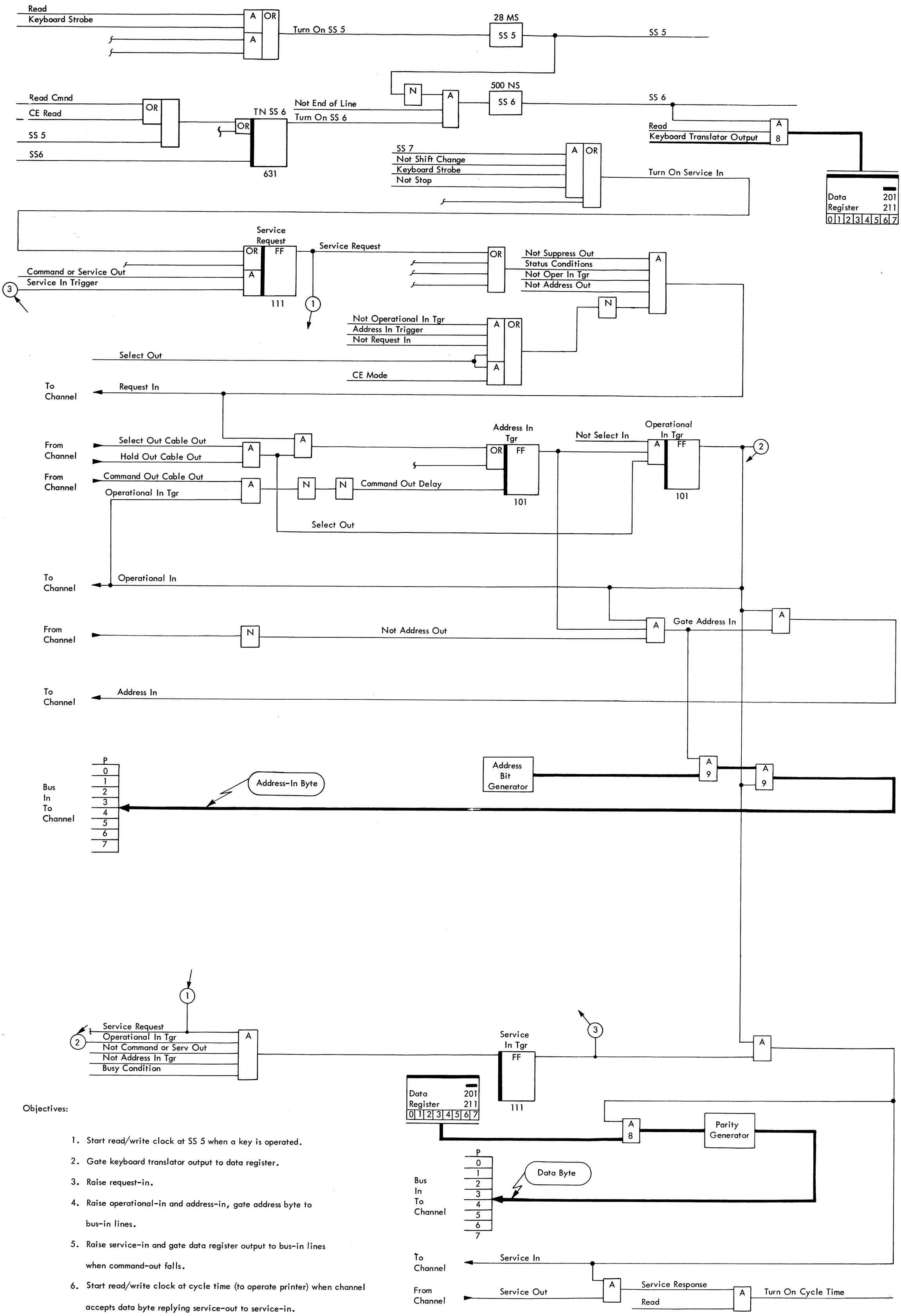
• FIGURE IOP 303. DATA TRANSFER--WRITE (1052)



Objectives:

1. Set stop and channel end latches when command-out line indicates "Stop."
2. Start the read/write clock if the carrier is to be returned.
3. Set store device end latch when carrier is through moving (returning).
4. Set device end latch:
   - A. At the same time as the channel end latch if the carrier is not to be returned;
   - B. After channel end status has been accepted by the channel, and the carrier finishes returning.
5. Raise request in for any pending status interrupt conditions.
6. Set channel end and device end latches during initial selection for either control command.
7. Set channel end and device end latches during sense byte transfer for sense command.

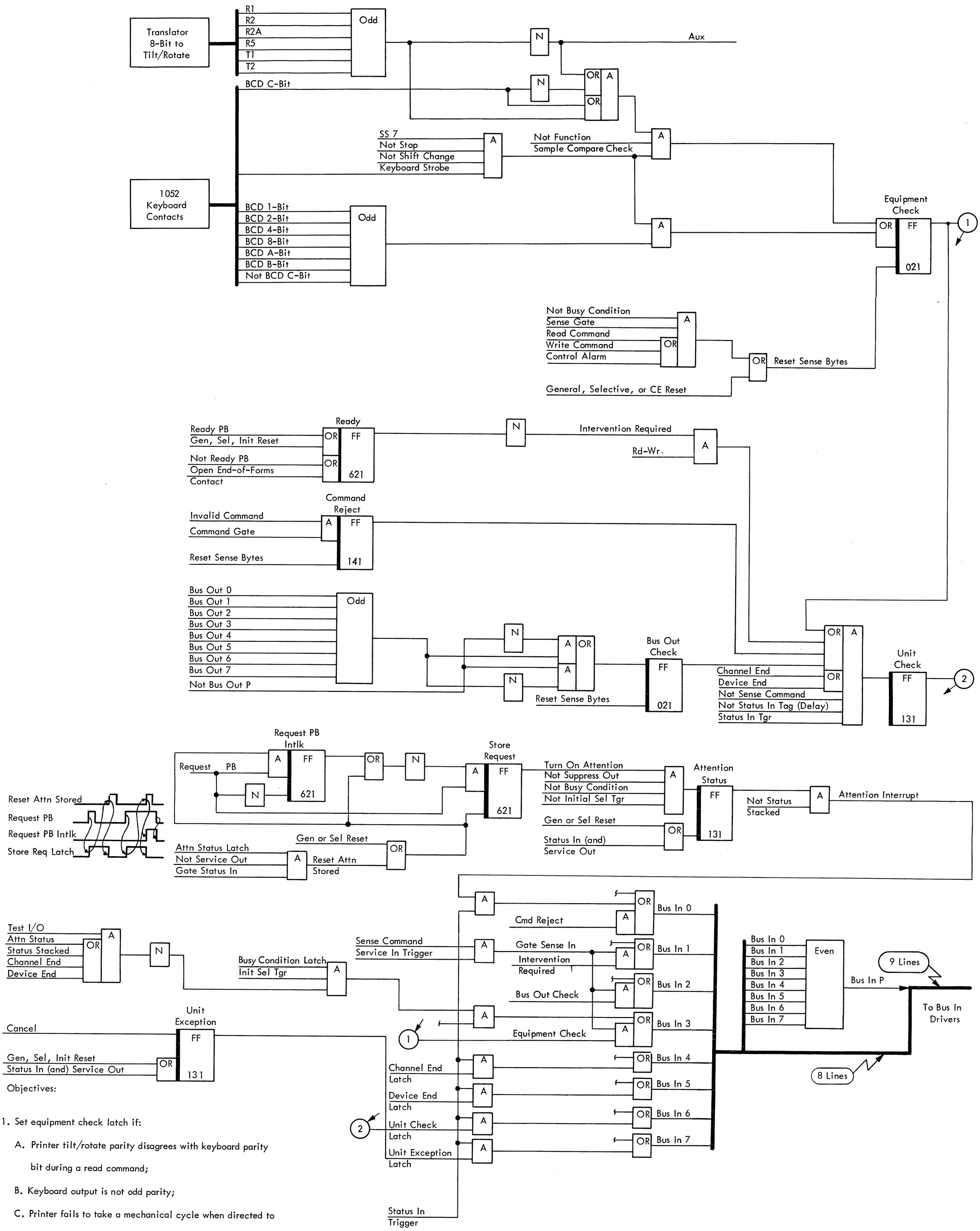
• FIGURE IOP 304. ENDING SEQUENCE (1052)



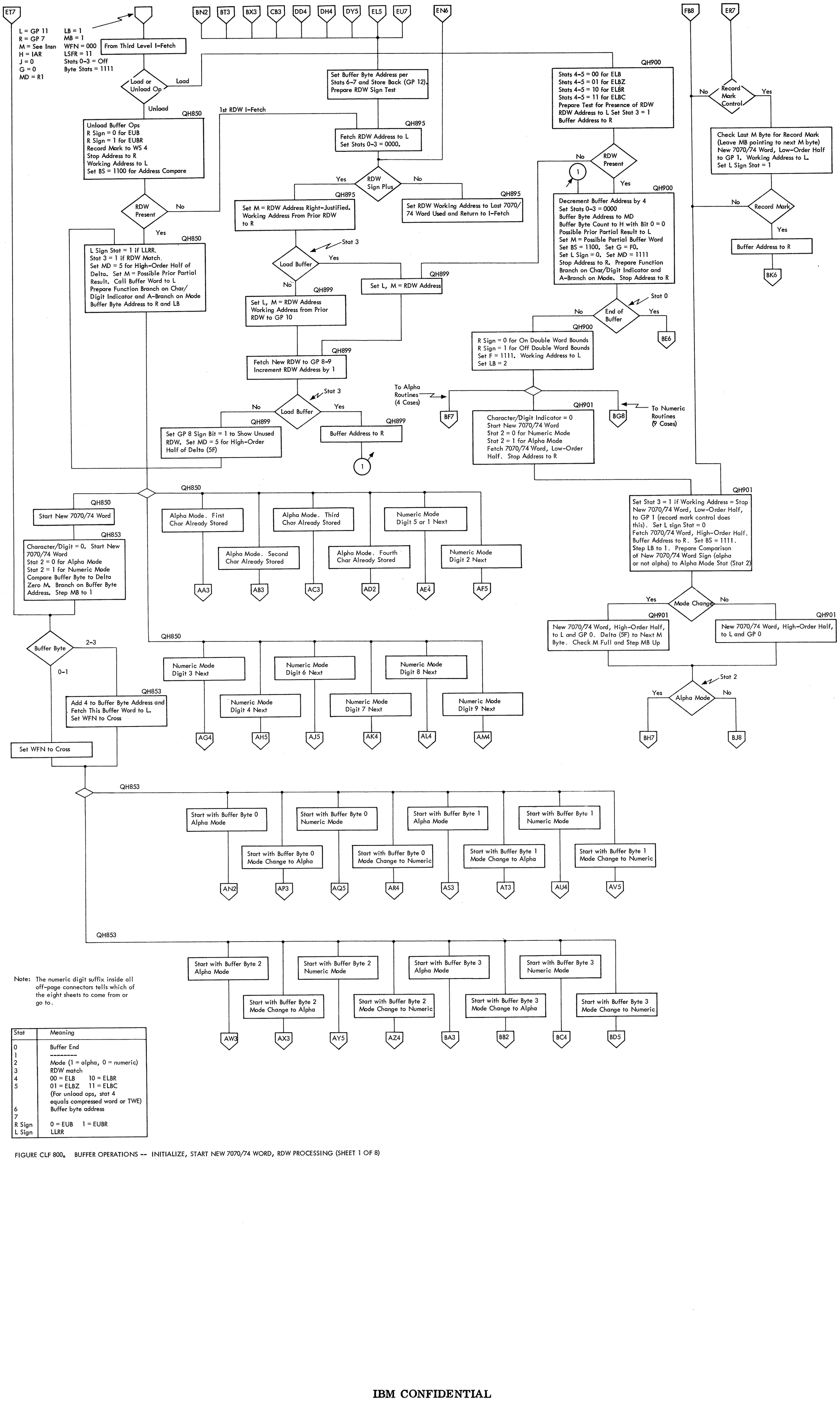
Objectives:

1. Start read/write clock at SS 5 when a key is operated.
2. Gate keyboard translator output to data register.
3. Raise request-in.
4. Raise operational-in and address-in, gate address byte to bus-in lines.
5. Raise service-in and gate data register output to bus-in lines when command-out falls.
6. Start read/write clock at cycle time (to operate printer) when channel accepts data byte replying service-out to service-in.

• FIGURE IOP 305. DATA TRANSFER--READ (1052)



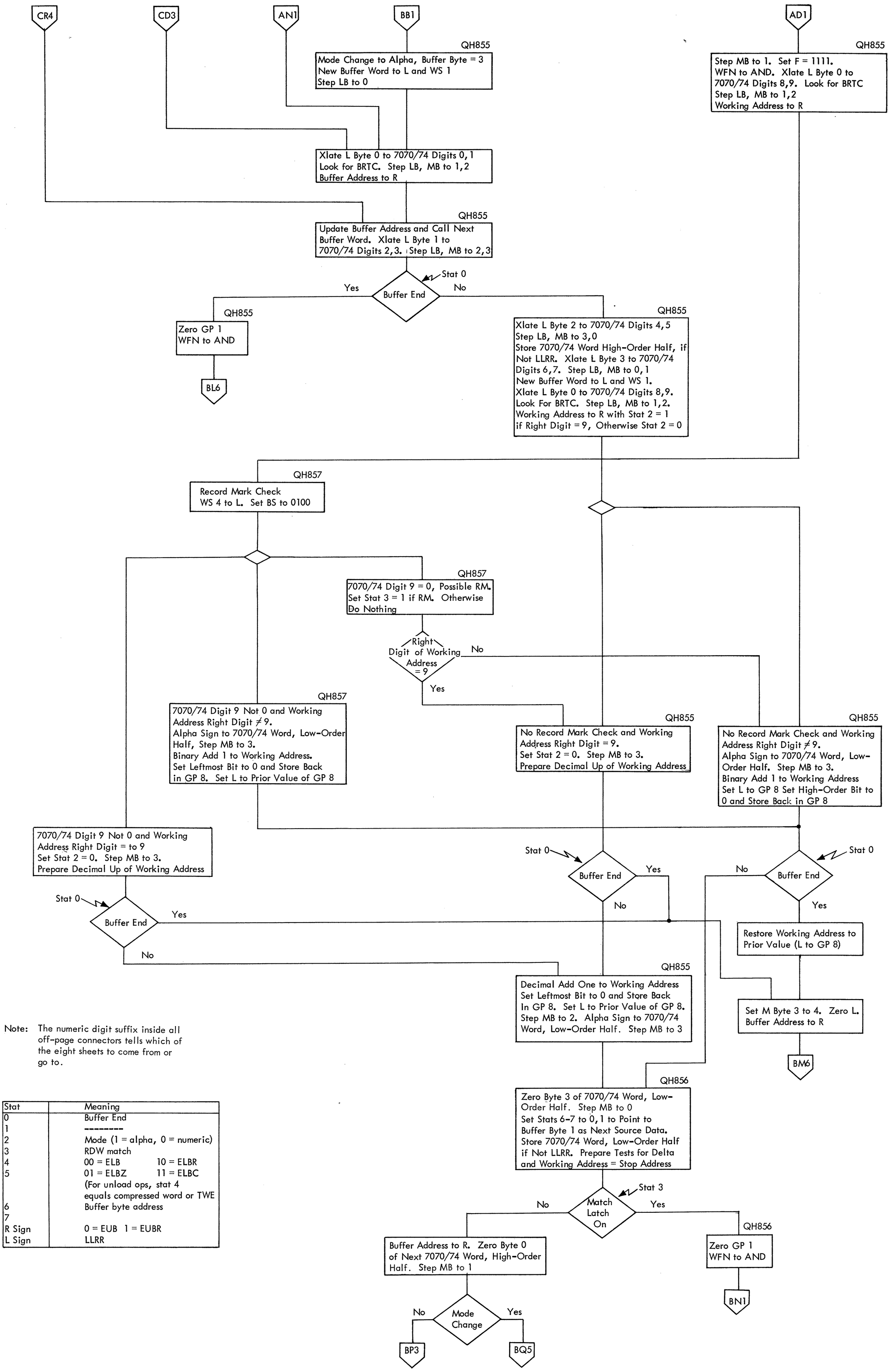
• FIGURE IOP 306. SENSE AND STATUS BYTES (1052)



Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

Stat	Meaning
0	Buffer End
1	--------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

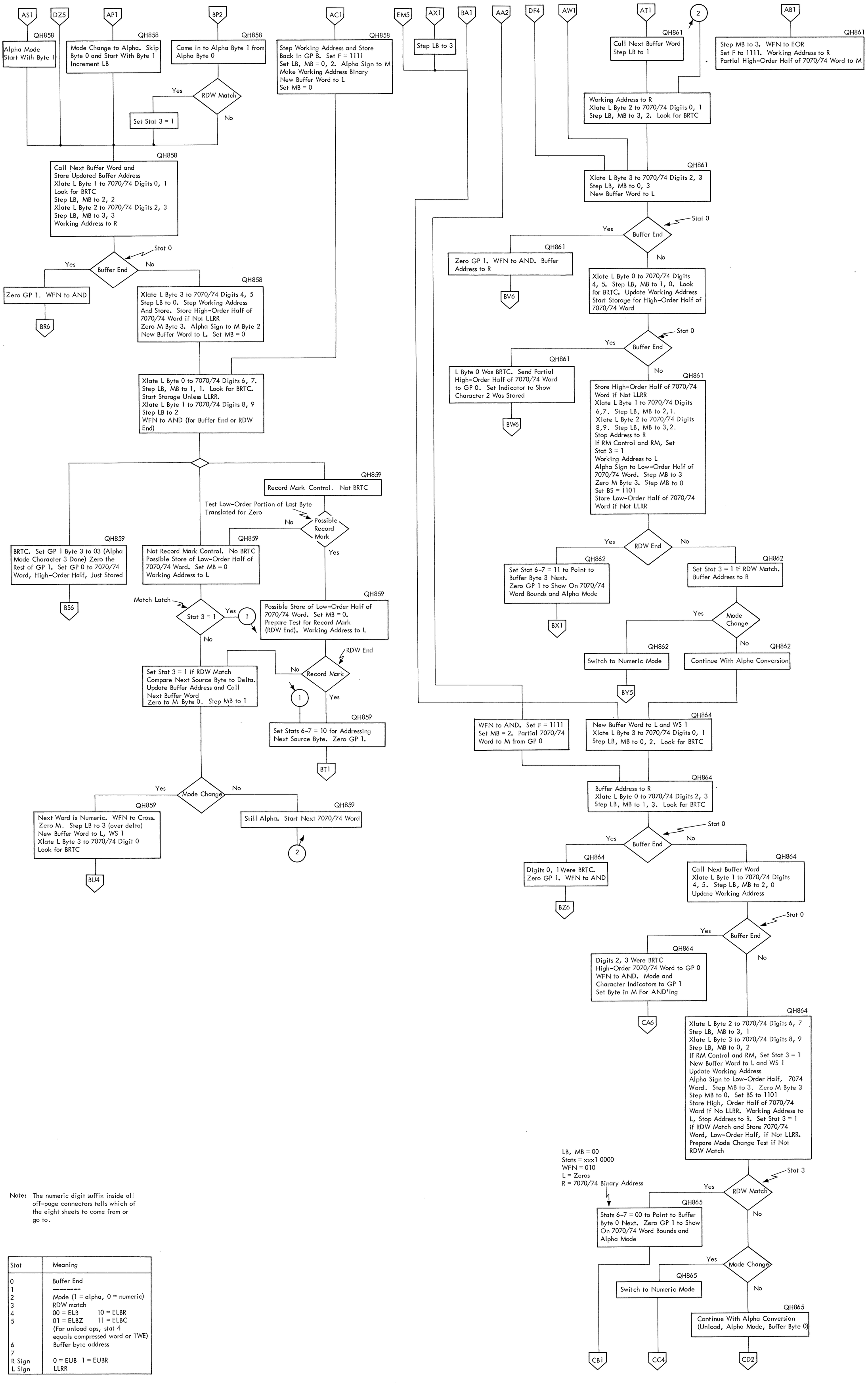
FIGURE CLF 800. BUFFER OPERATIONS -- INITIALIZE, START NEW 7070/74 WORD, RDW PROCESSING (SHEET 1 OF 8)



Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

Stat	Meaning
0	Buffer End
1	--------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC
	(For unload ops, stat 4 equals compressed word or TWE
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

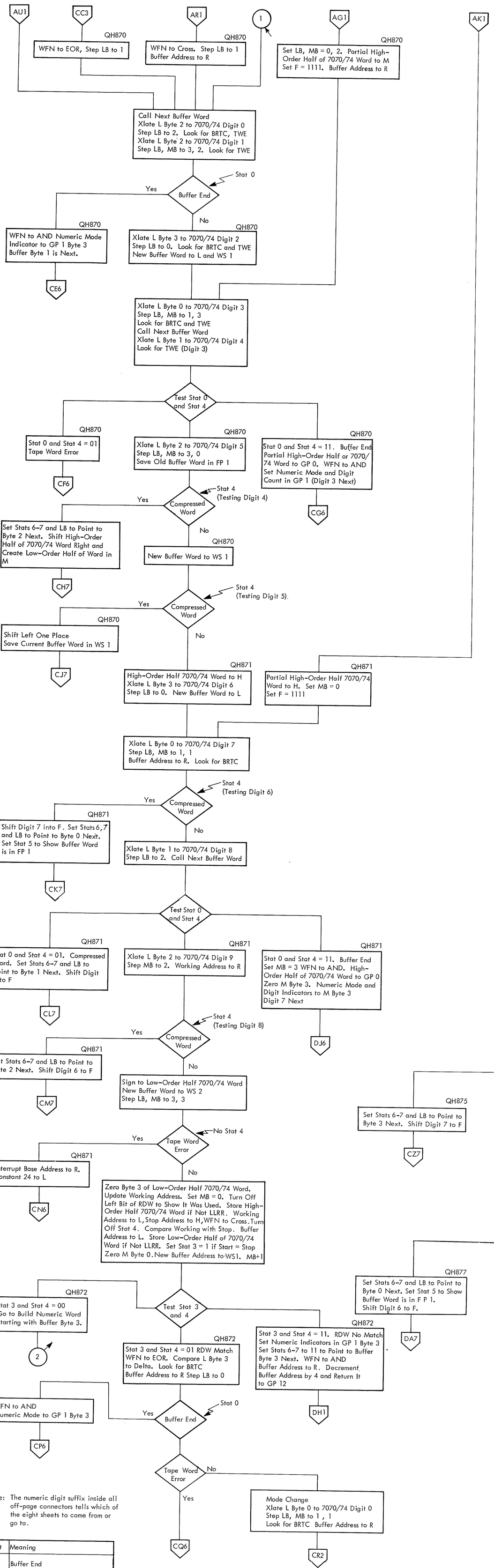
FIGURE CLF 800. BUFFER OPERATIONS -- UNLOAD BUFFER ALPHA MODE, BUFFER BYTE 0 (SHEET 2 OF 8)



Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

Stat	Meaning
0	Buffer End
1	--------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC
	(For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

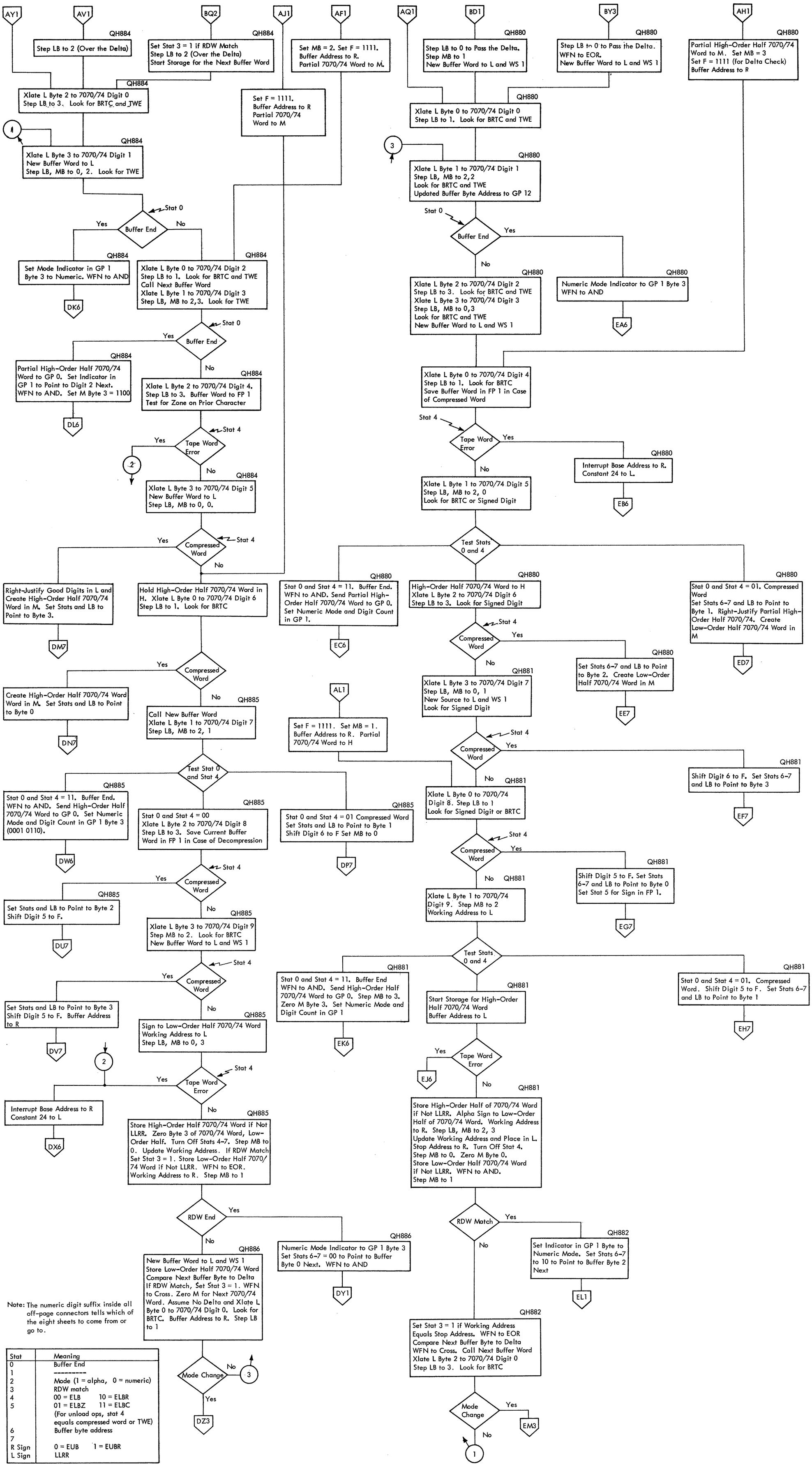
FIGURE CLF 800. BUFFER OPERATIONS -- UNLOAD BUFFER ALPHA MODE, BUFFER BYTES 1, 2, 3 (SHEET 3 OF 8)



Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

Stat	Meaning
0	Buffer End
1	---------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (for unload ops, stat 4 equals compressed word or TWE
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

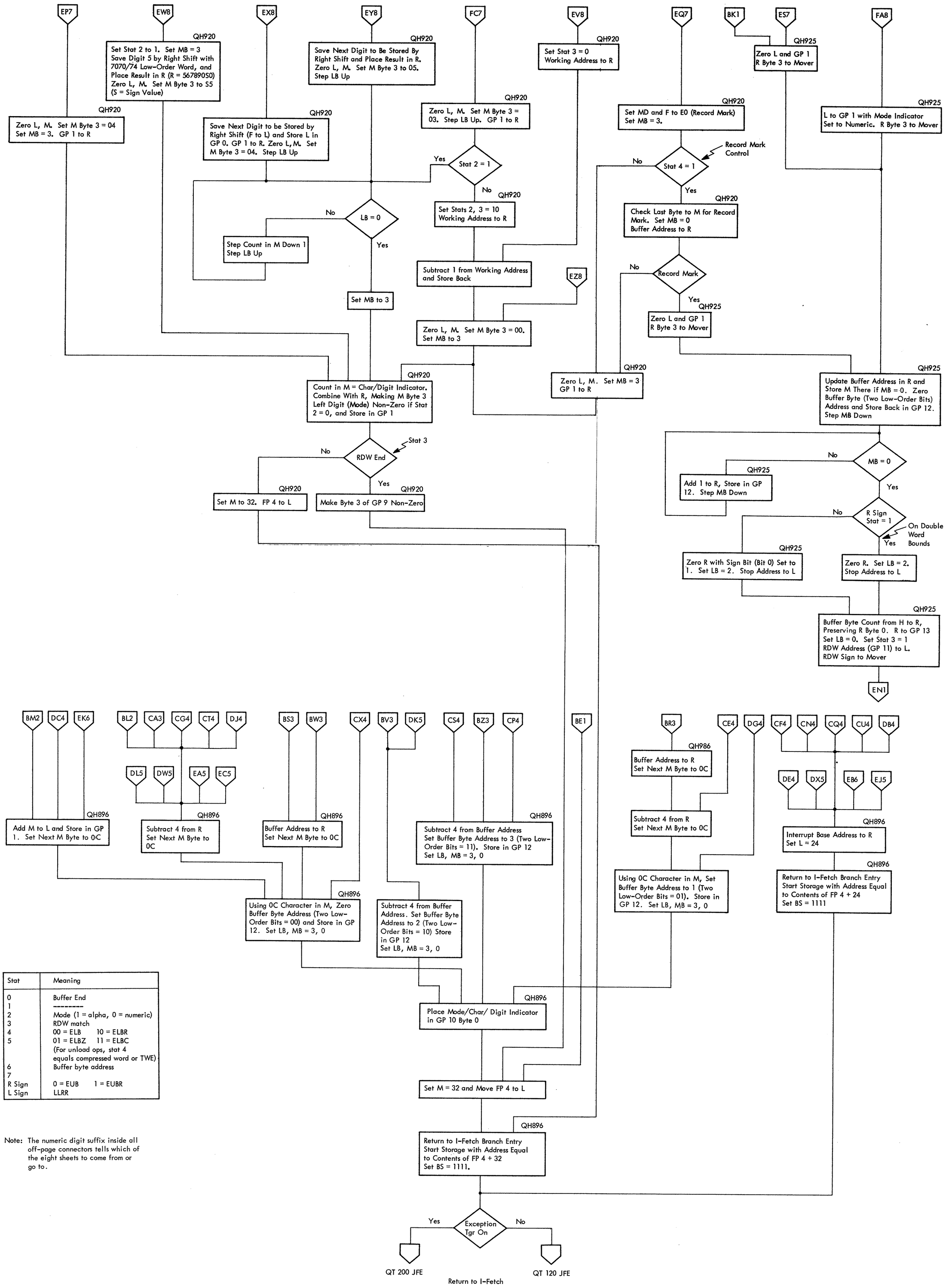
FIGURE CLF 800. BUFFER OPERATIONS -- UNLOAD BUFFER NUMERIC MODE, BUFFER BYTES 1 AND 3 (SHEET 4 OF 8)



Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

Stat	Meaning
0	Buffer End
1	---------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

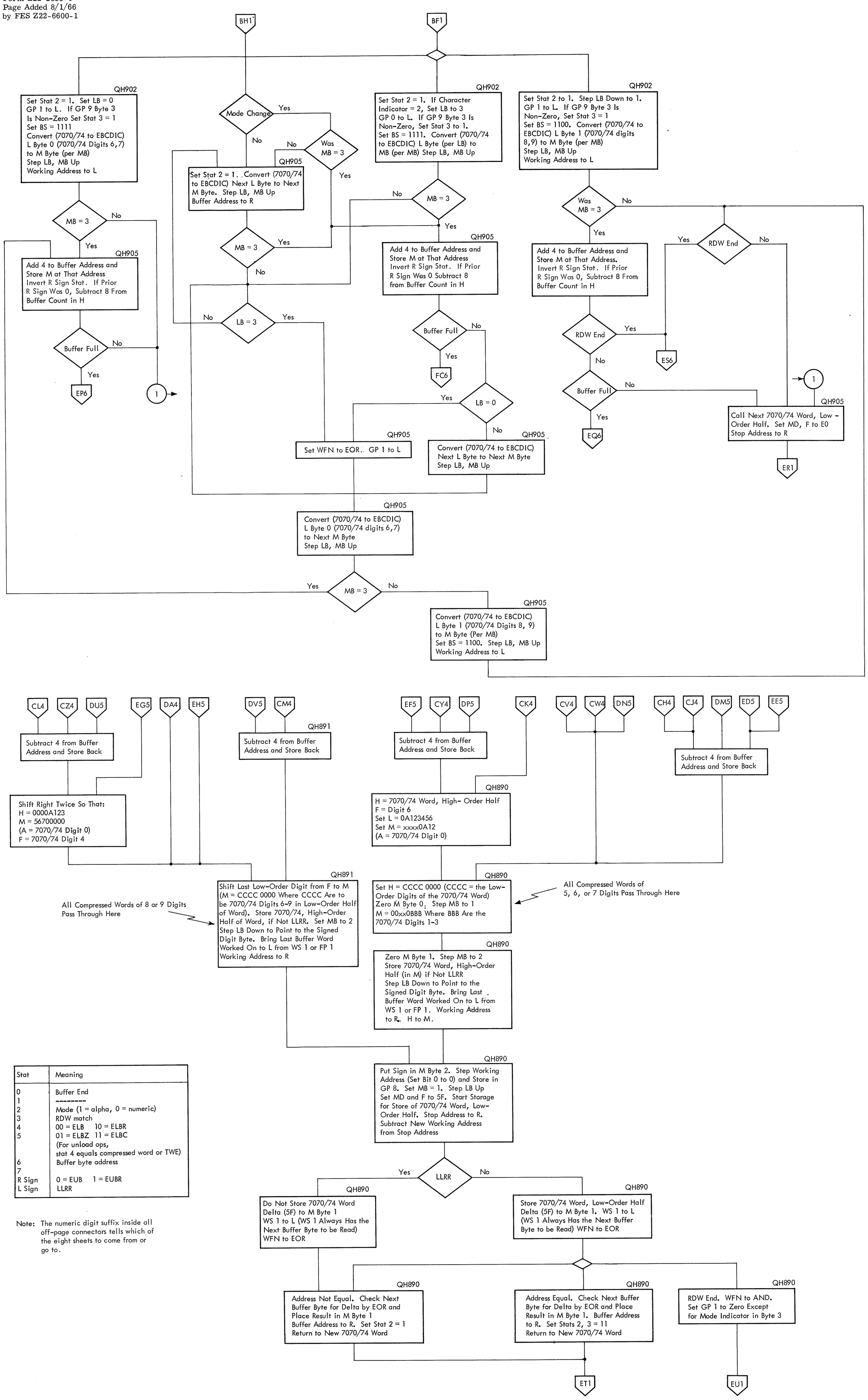
FIGURE CLF 800. BUFFER OPERATIONS -- UNLOAD BUFFER NUMERIC MODE, BUFFER BYTES 0 AND 2 (SHEET 5 OF 8)



Stat	Meaning
0	Buffer End
1	--------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

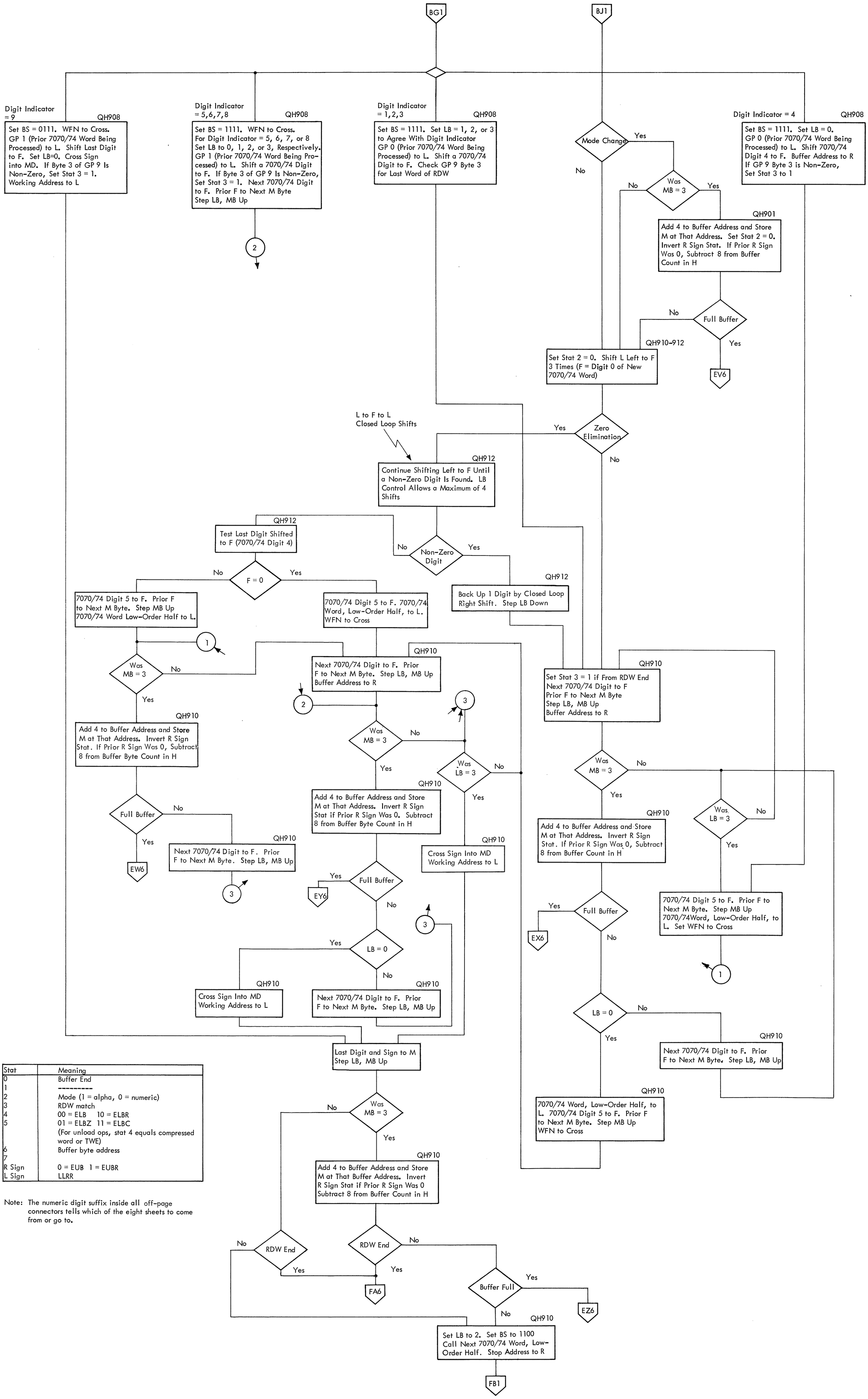
FIGURE CLF 800. BUFFER OPERATIONS -- UNLOAD BUFFER BRTC EXIT, LOAD BUFFER BUFFER END AND/OR RDW END (SHEET 6 OF 8)



Stat	Meaning
0	Buffer End
1	--------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

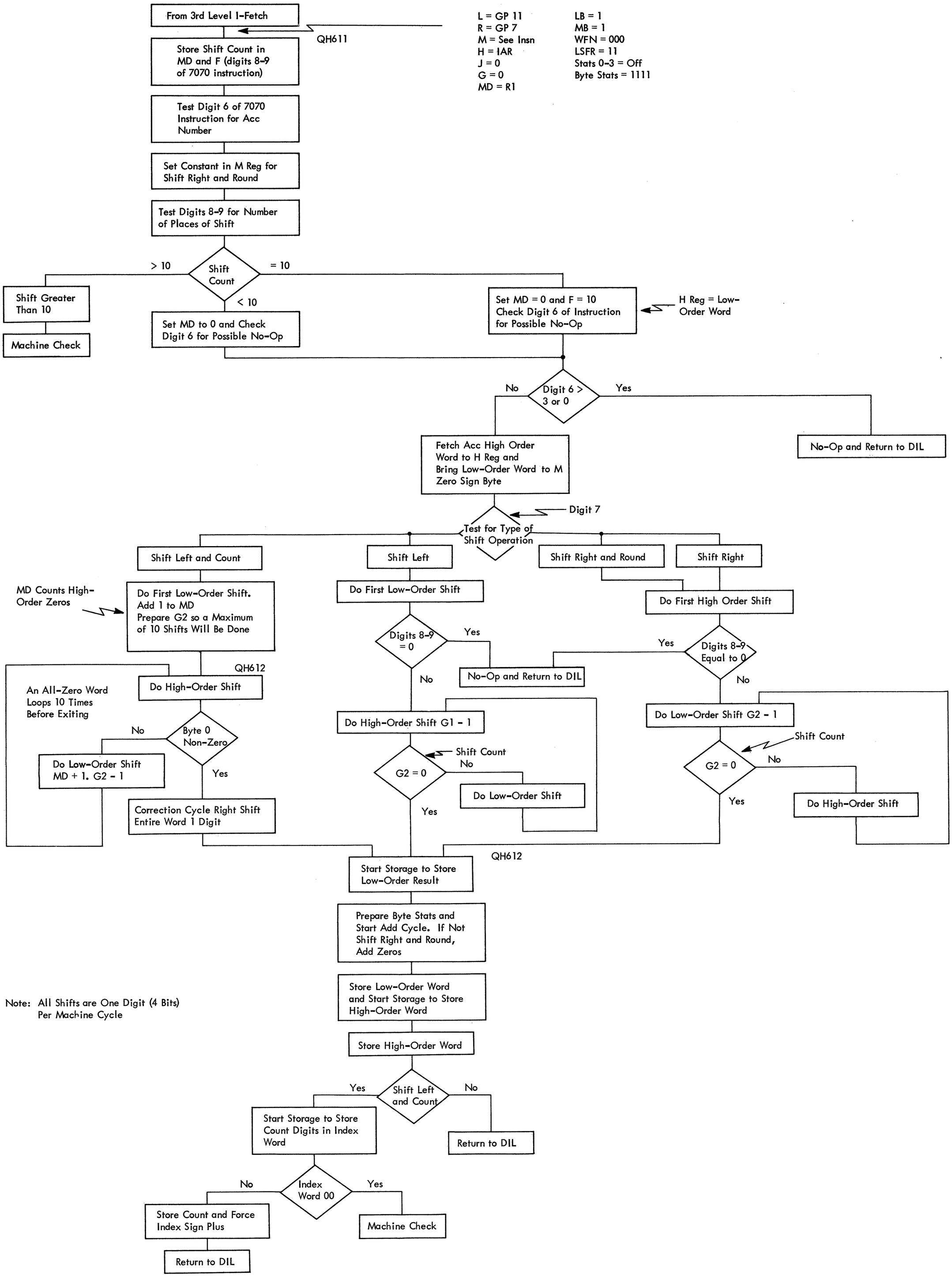
FIGURE CLF 800. BUFFER OPERATIONS -- LOAD BUFFER FROM ALPHA MODE AND UNLOAD BUFFER, DECOMPRESS NUMERIC DIGITS (SHEET 7 OF 8)



Stat	Meaning
0	Buffer End
1	---------
2	Mode (1 = alpha, 0 = numeric)
3	RDW match
4	00 = ELB 10 = ELBR
5	01 = ELBZ 11 = ELBC (For unload ops, stat 4 equals compressed word or TWE)
6	Buffer byte address
7	
R Sign	0 = EUB 1 = EUBR
L Sign	LLRR

Note: The numeric digit suffix inside all off-page connectors tells which of the eight sheets to come from or go to.

FIGURE CLF 800. BUFFER OPERATIONS -- LOAD BUFFER FROM NUMERIC WORD (SHEET 8 OF 8)



Note: All Shifts are One Digit (4 Bits) Per Machine Cycle

FIGURE CLF 802. SHIFT CONTROL (ESC)

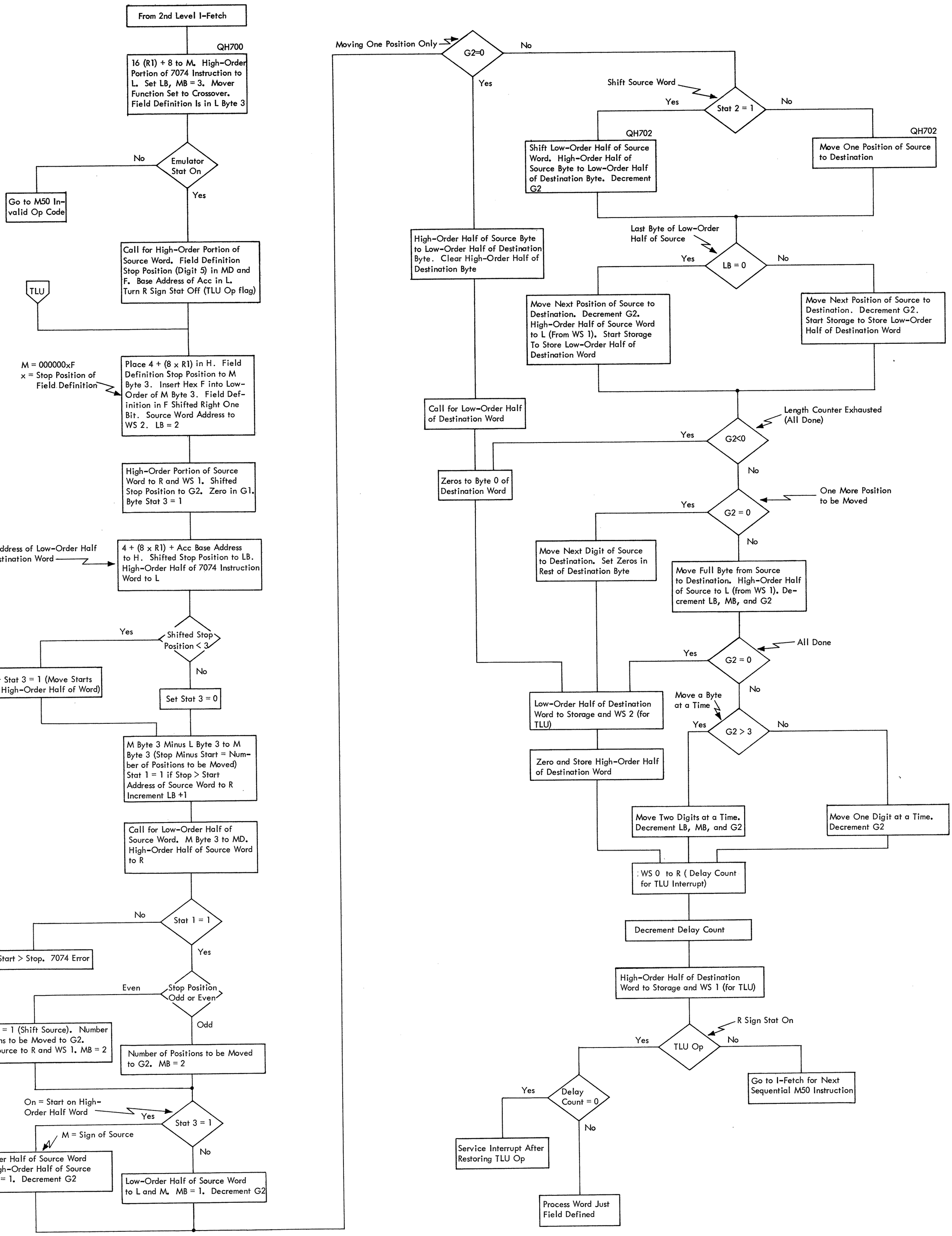
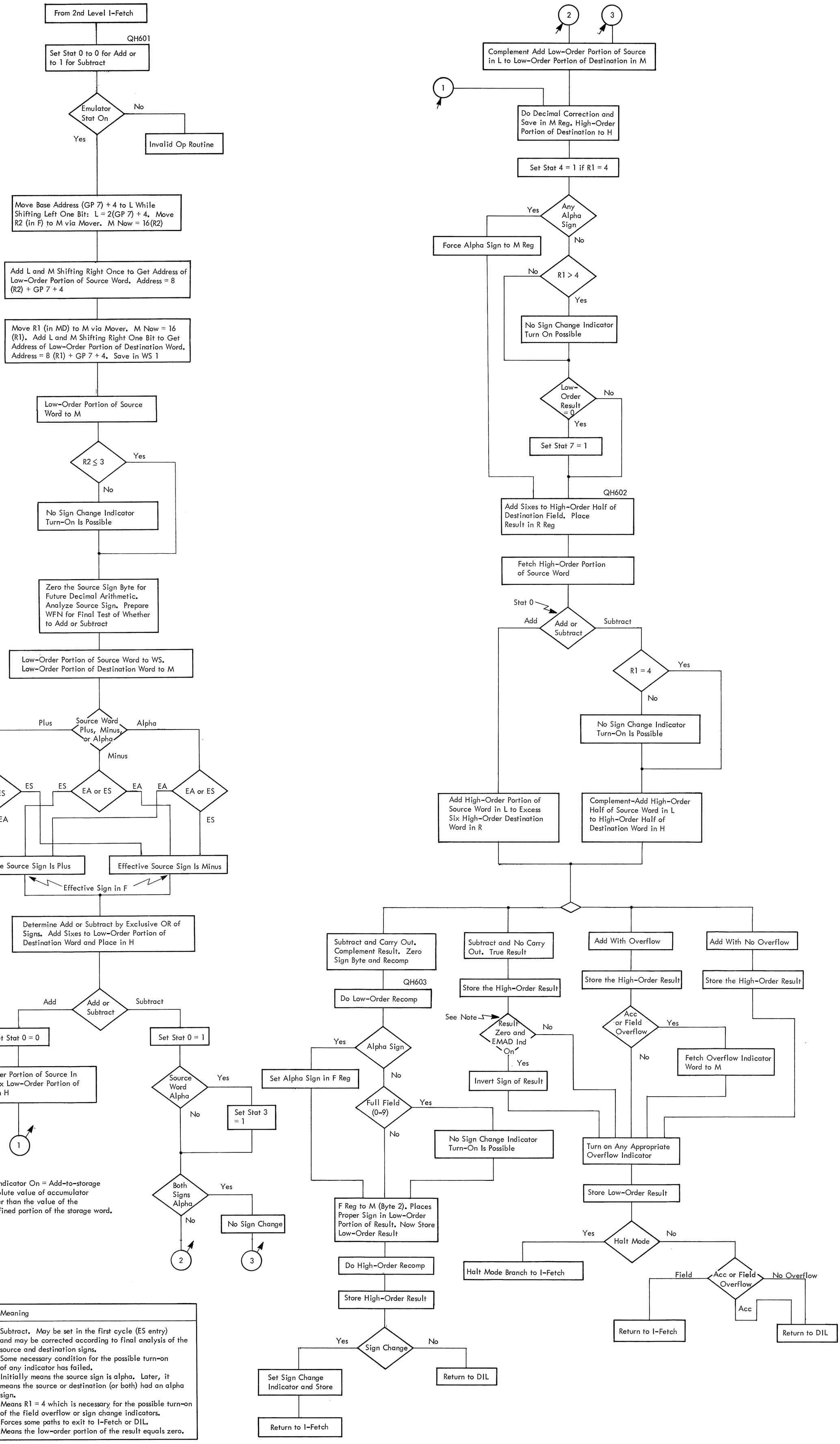


FIGURE CLF 804. FIELD DEFINITION (EFD)



Note: EMAD Indicator On = Add-to-storage and absolute value of accumulator is greater than the value of the field defined portion of the storage word.

Stat	Meaning
S0 = 1	Subtract. May be set in the first cycle (ES entry) and may be corrected according to final analysis of the source and destination signs.
S2 = 1	Some necessary condition for the possible turn-on of any indicator has failed.
S3 = 1	Initially means the source sign is alpha. Later, it means the source or destination (or both) had an alpha sign.
S4 = 1	Means R1 = 4 which is necessary for the possible turn-on of the field overflow or sign change indicators.
S5 = 1	Forces some paths to exit to I-Fetch or DIL.
S7 = 1	Means the low-order portion of the result equals zero.

FIGURE CLF 806. ADD/SUBTRACT (EA, ES)

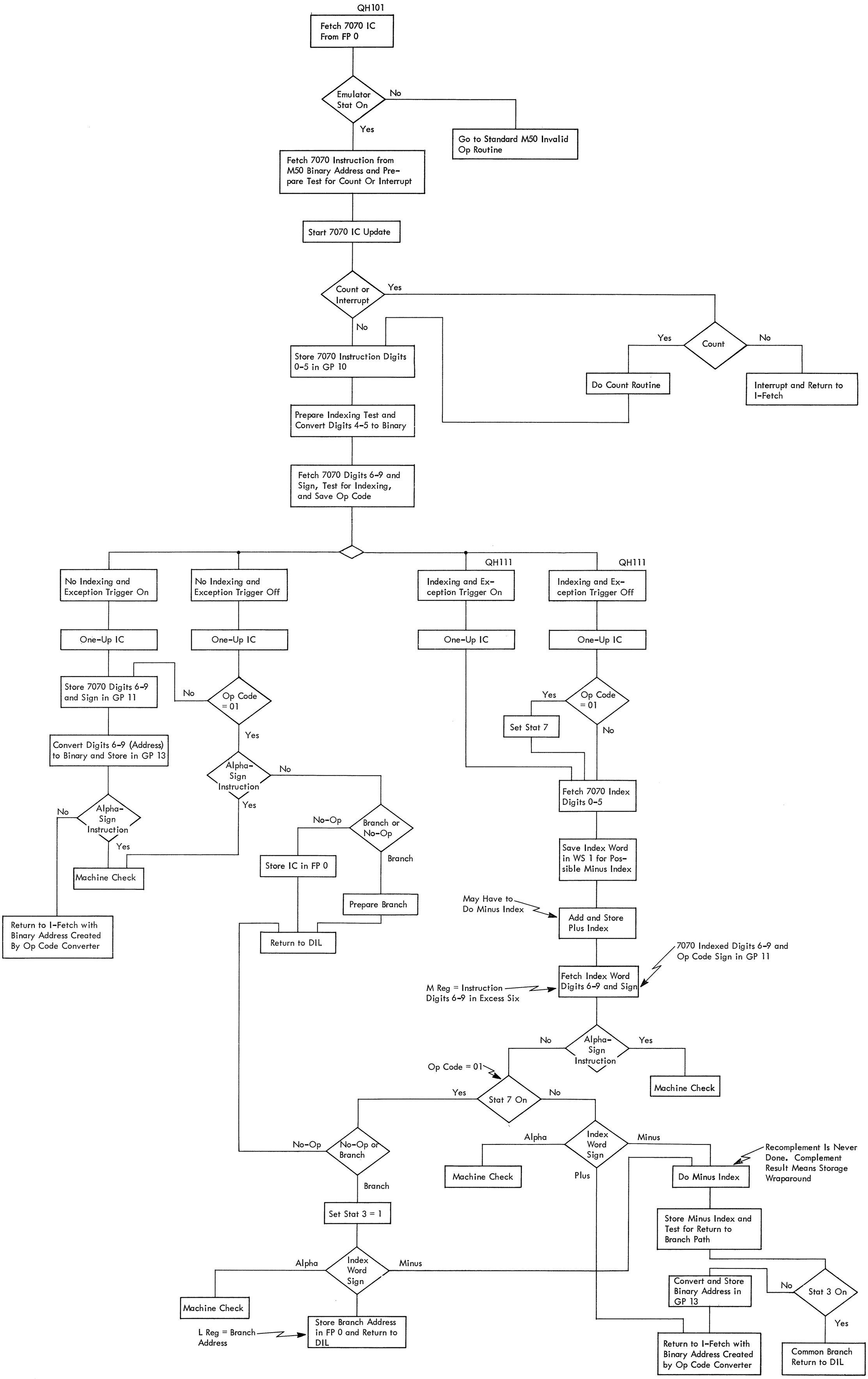
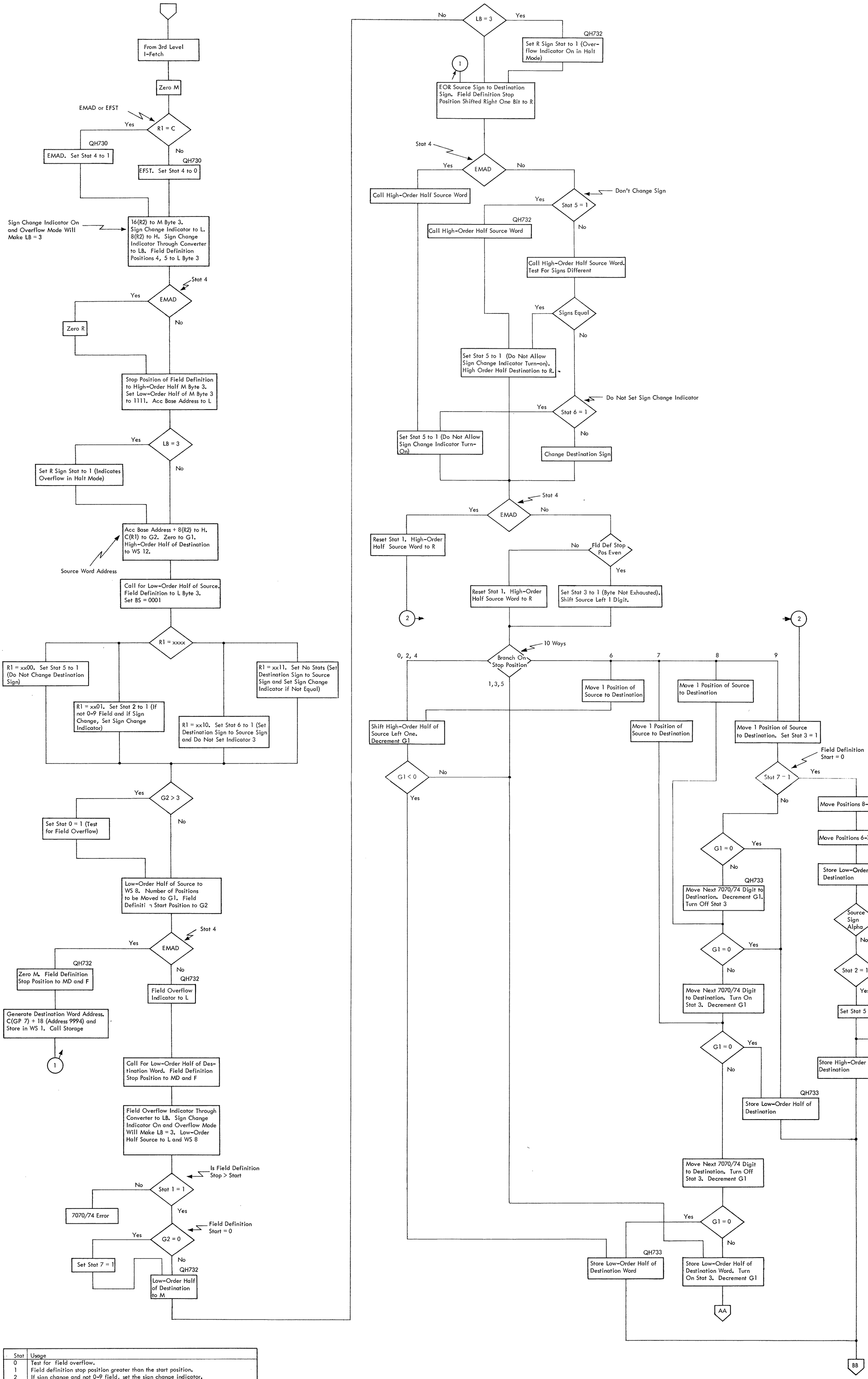
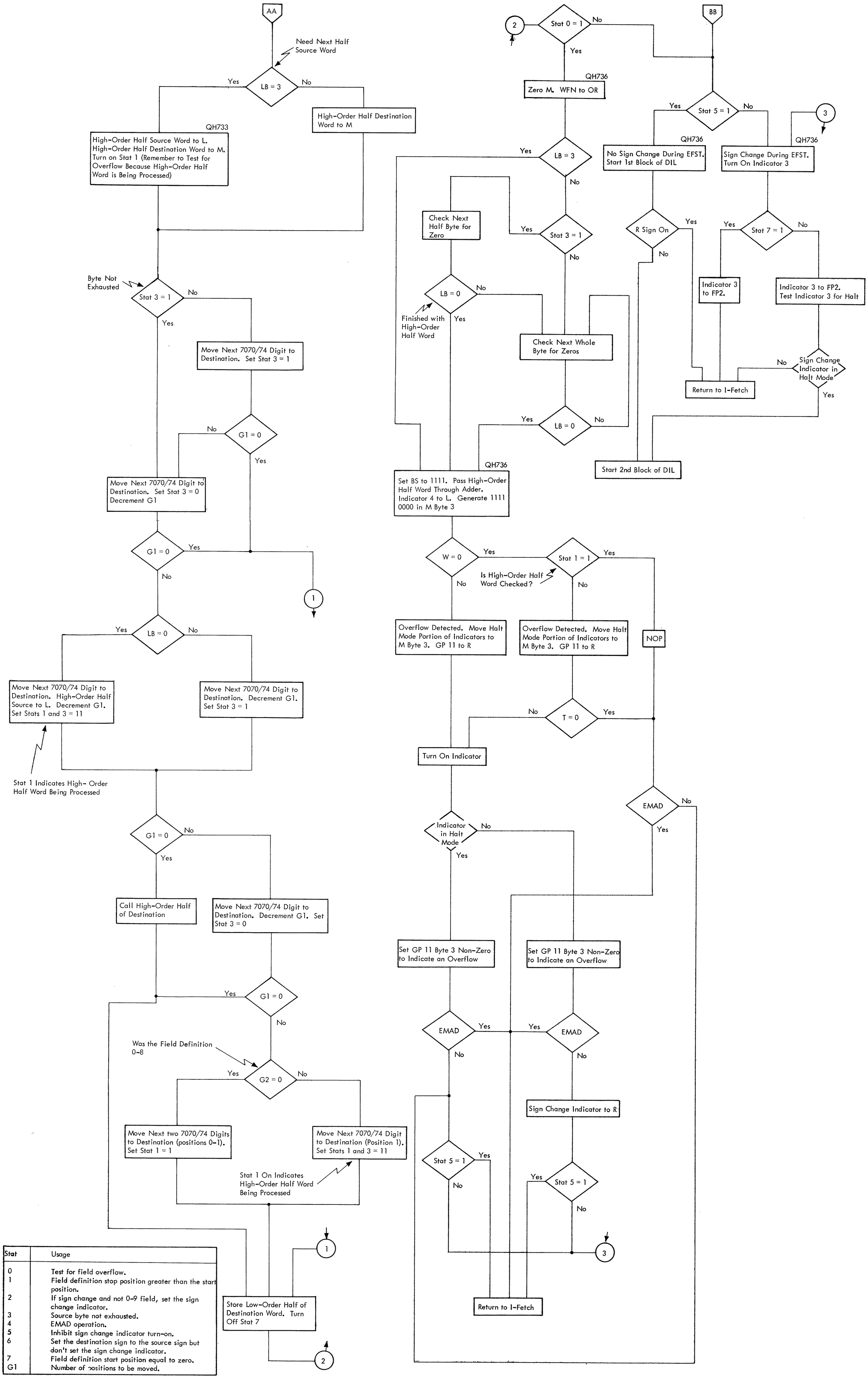


FIGURE CLF 808. DO INTERPRETIVE LOOP (DIL)



Stat	Usage
0	Test for field overflow.
1	Field definition stop position greater than the start position.
2	If sign change and not 0-9 field, set the sign change indicator.
3	Source byte not exhausted.
4	EMAD operation.
5	Inhibit sign change indicator turn-on.
6	Set the destination sign to the source sign but do not set the sign change indicator.
7	Field definition start position equal to zero.
G1	Number of positions to be moved.

FIGURE CLF 810. FIELD STORE (EFST) AND MOVE ACCUMULATOR DIGITS (EMAD) (SHEET 1 OF 2)



Stat	Usage
0	Test for field overflow.
1	Field definition stop position greater than the start position.
2	If sign change and not 0-9 field, set the sign change indicator.
3	Source byte not exhausted.
4	EMAD operation.
5	Inhibit sign change indicator turn-on.
6	Set the destination sign to the source sign but don't set the sign change indicator.
7	Field definition start position equal to zero.
G1	Number of positions to be moved.

FIGURE CLF 810. FIELD STORE (EFST) AND MOVE ACCUMULATOR DIGITS (EMAD) (SHEET 2 OF 2)

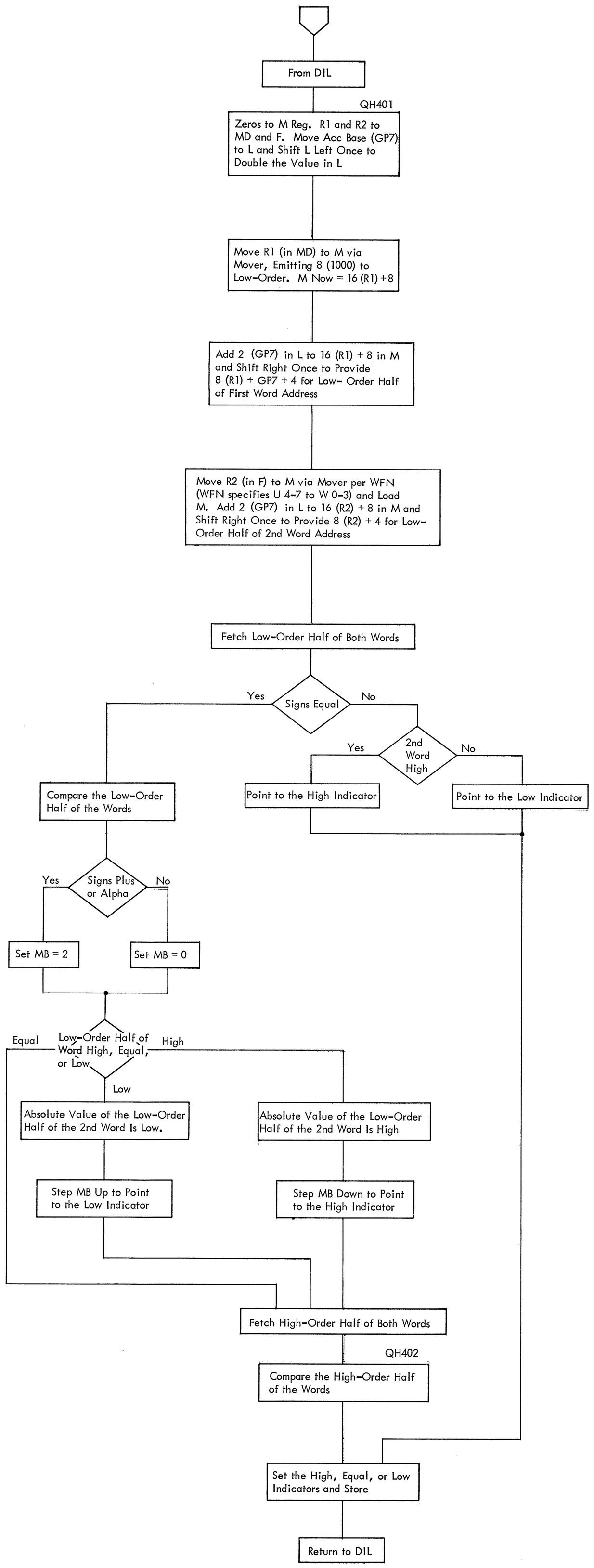


FIGURE CLF 812. COMPARE (EC)

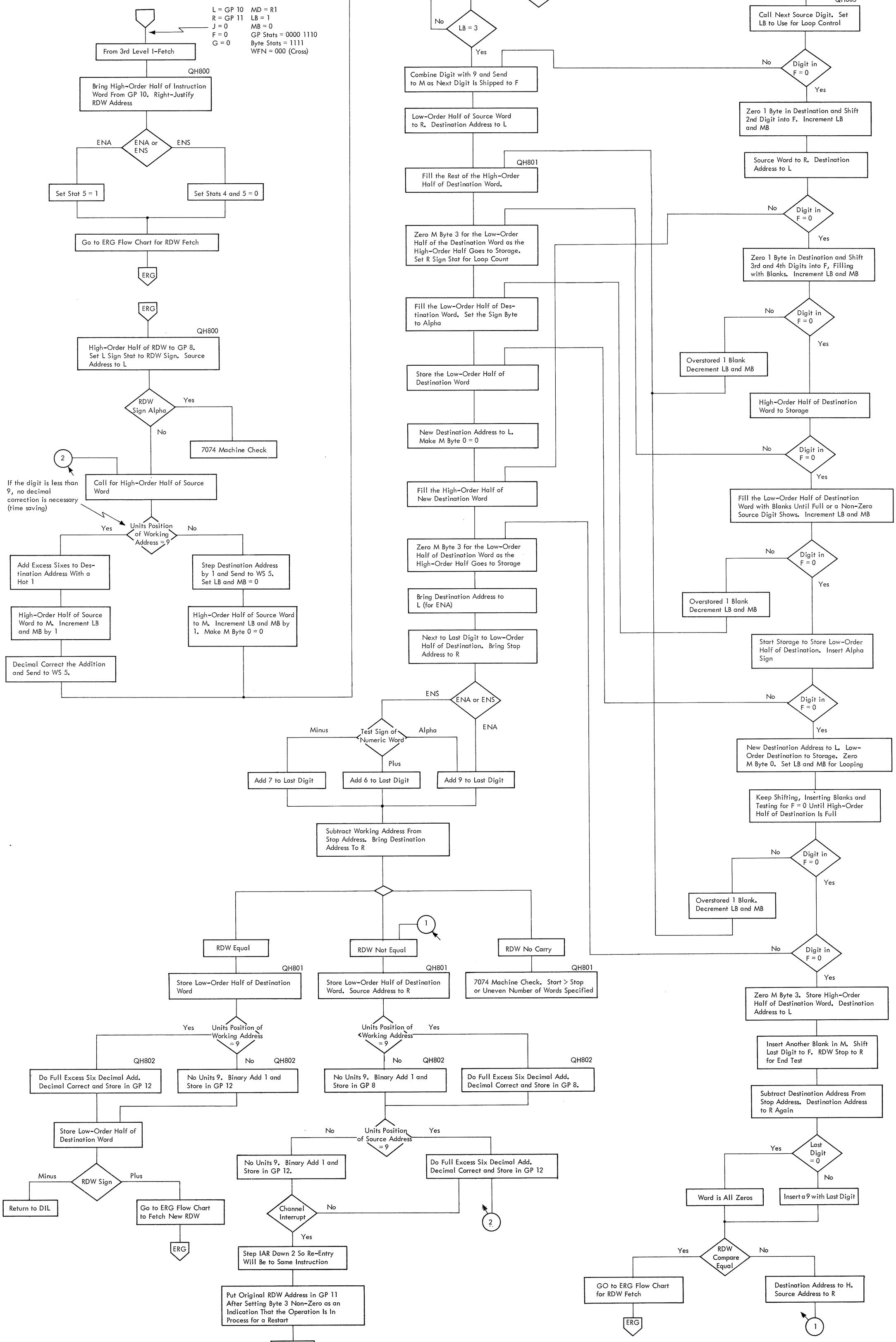


FIGURE CLF 814. EDIT NUMERIC TO ALPHA (ENA, ENS, ENB)

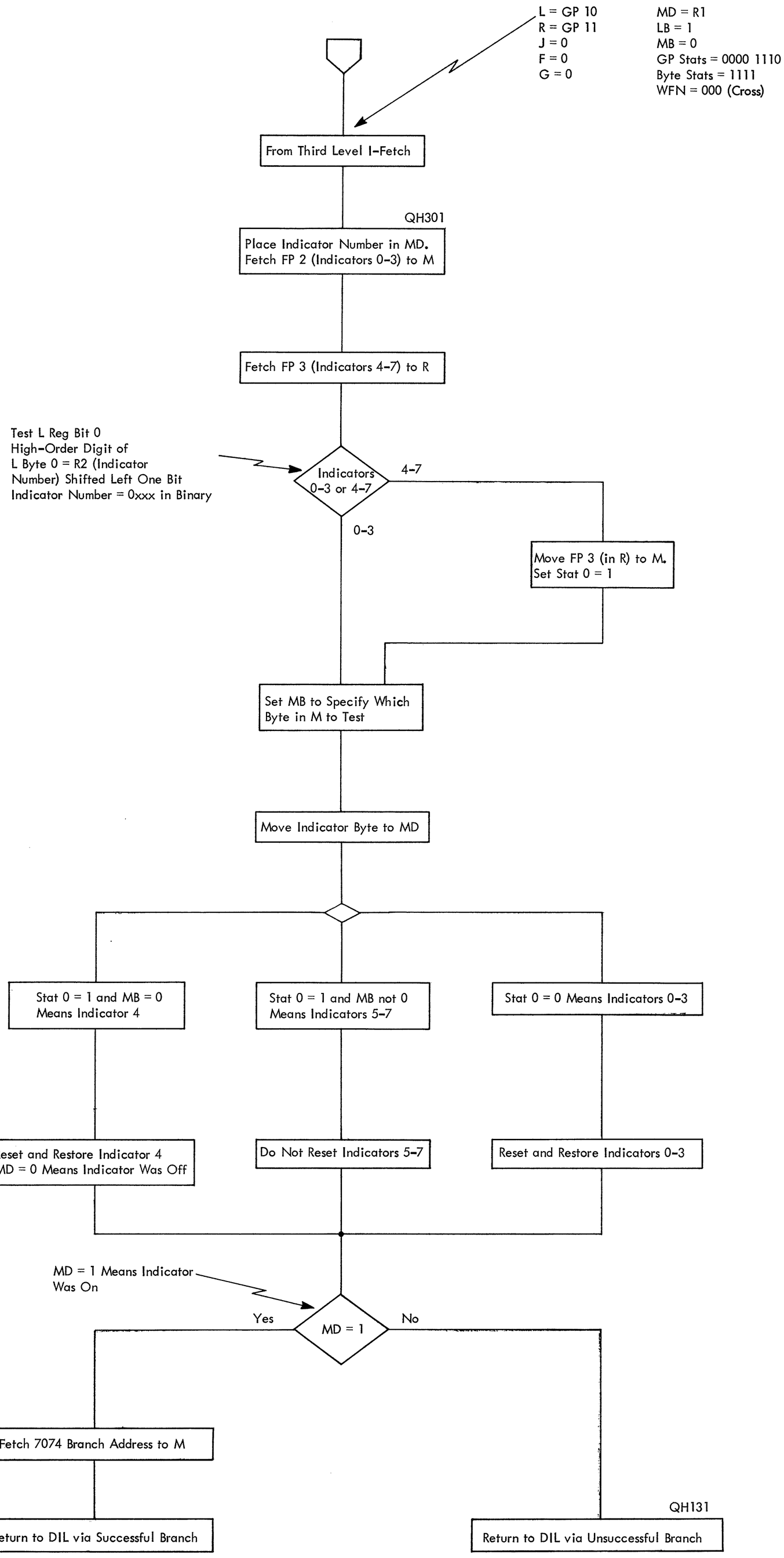


FIGURE CLF 816. BRANCH ON INDICATOR (EBI)

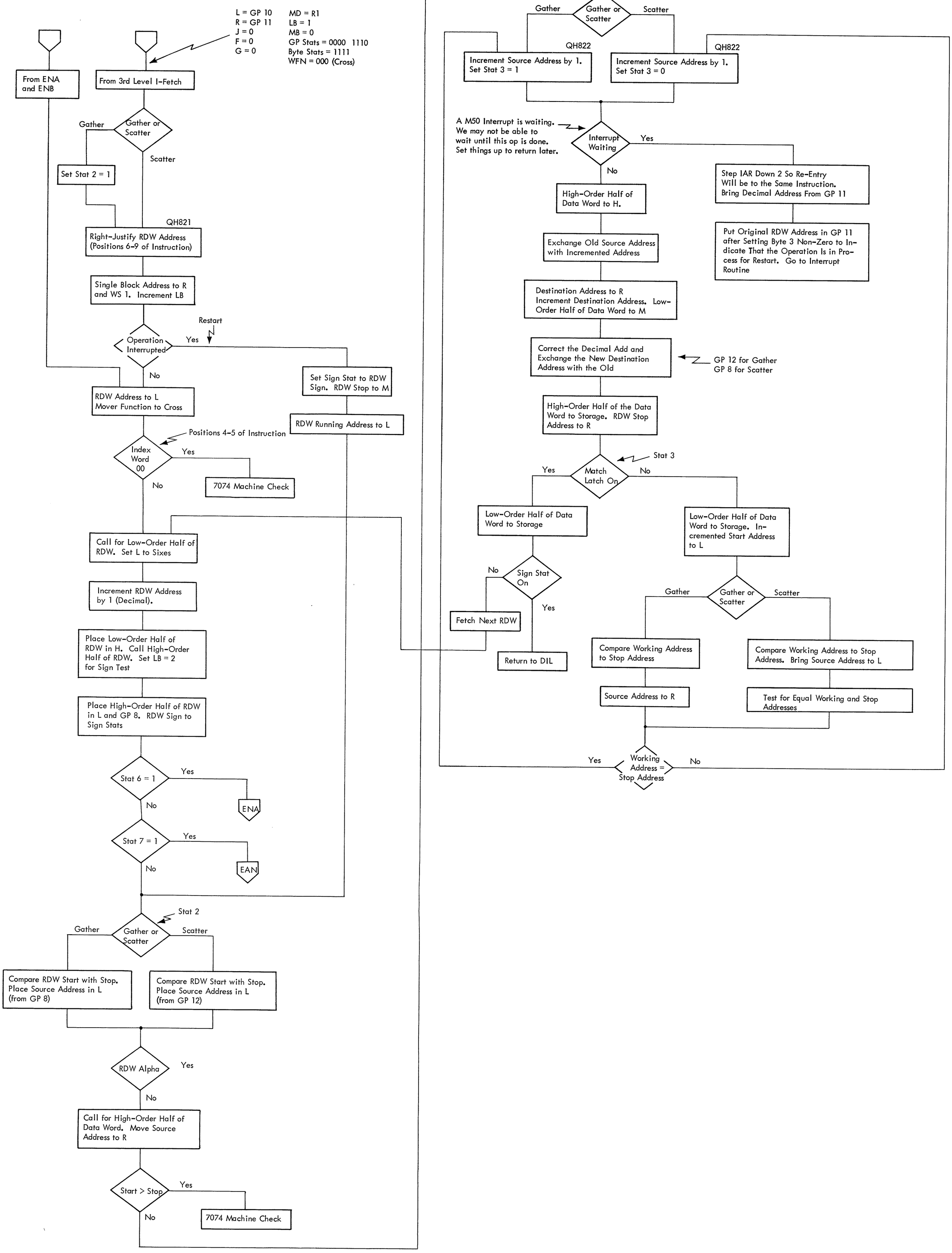


FIGURE CLF 818. RECORD GATHER/SCATTER (ERG, ERS)

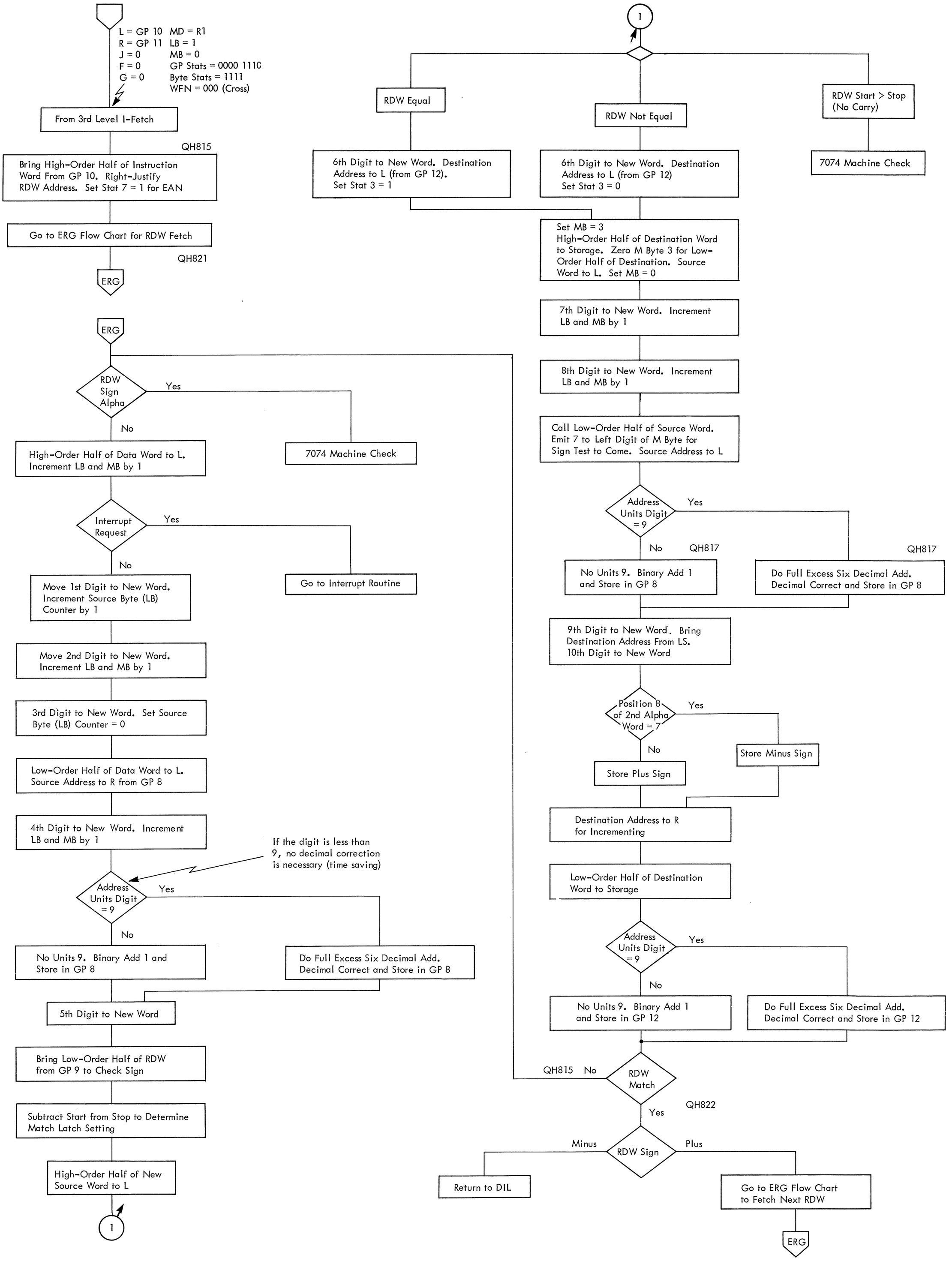
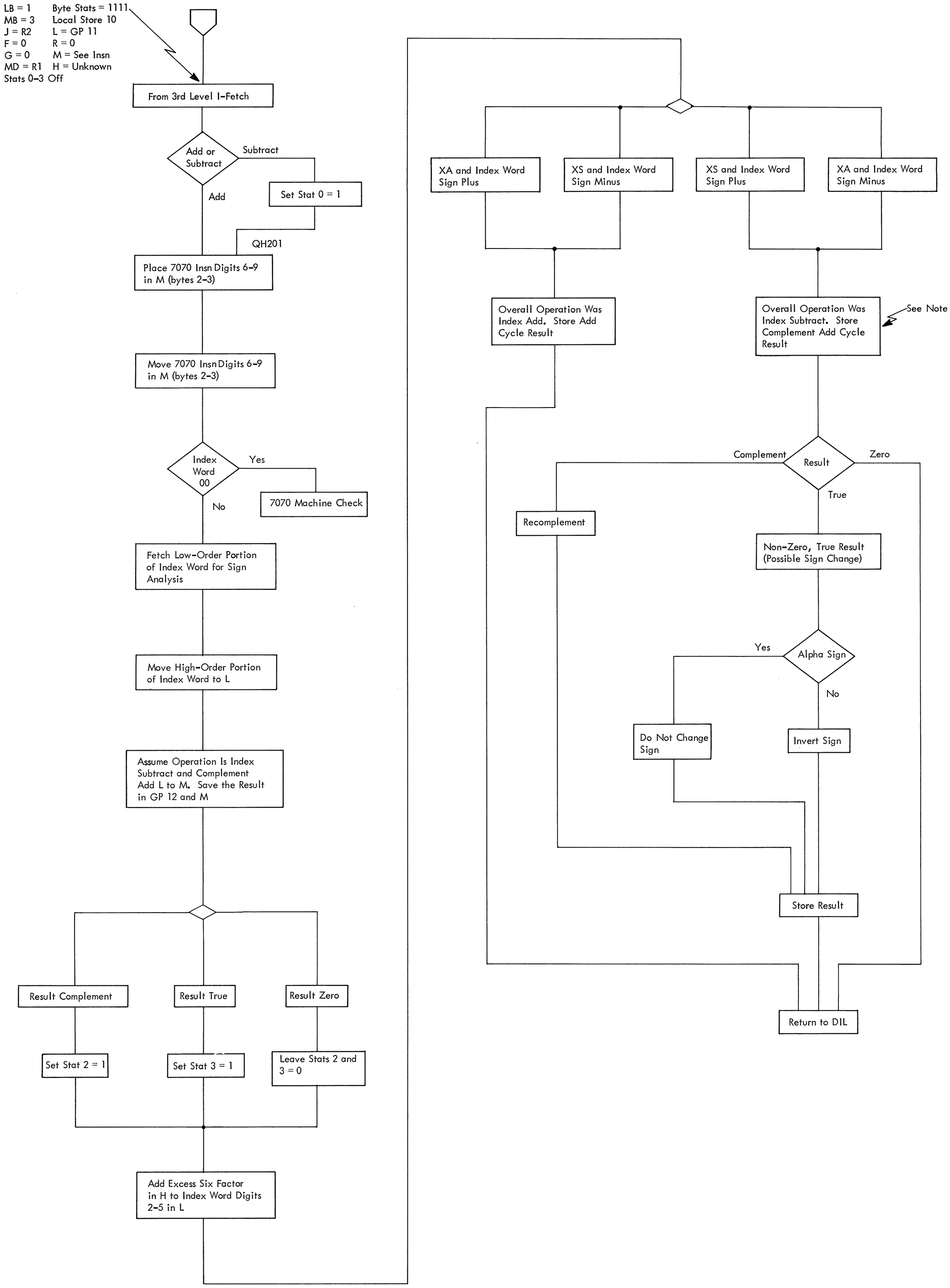


FIGURE CLF 820. EDIT ALPHA TO NUMERIC (EAN)



Note: The somewhat unusual sign manipulation is a result of the operands being reversed from the normal sense when the subtraction is done.

FIGURE CLF 822. INDEX WORD ADD/SUBTRACT (EXA, EXS)

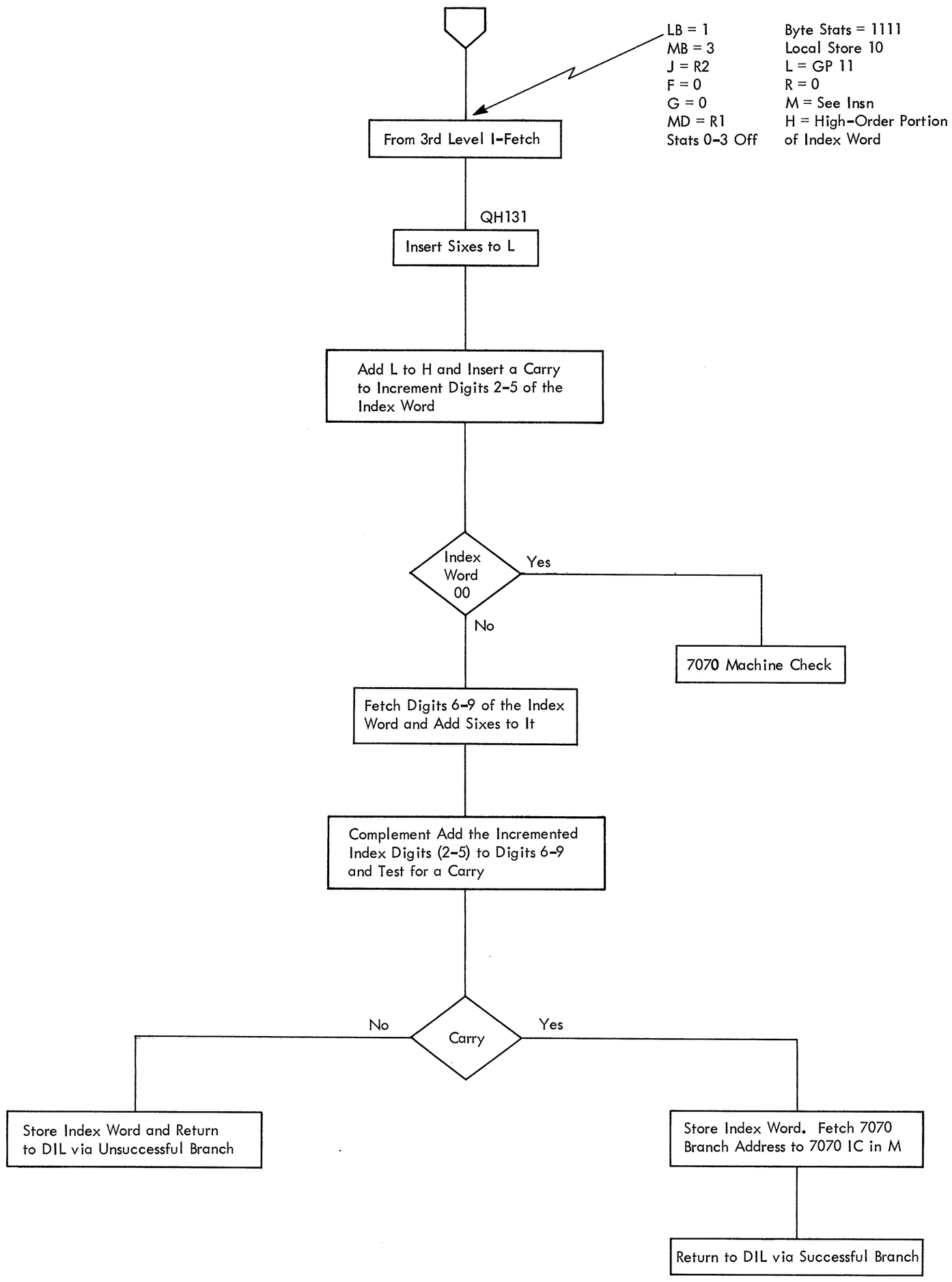


FIGURE CLF 824. BRANCH INCREMENTED INDEX WORD (EBIX)

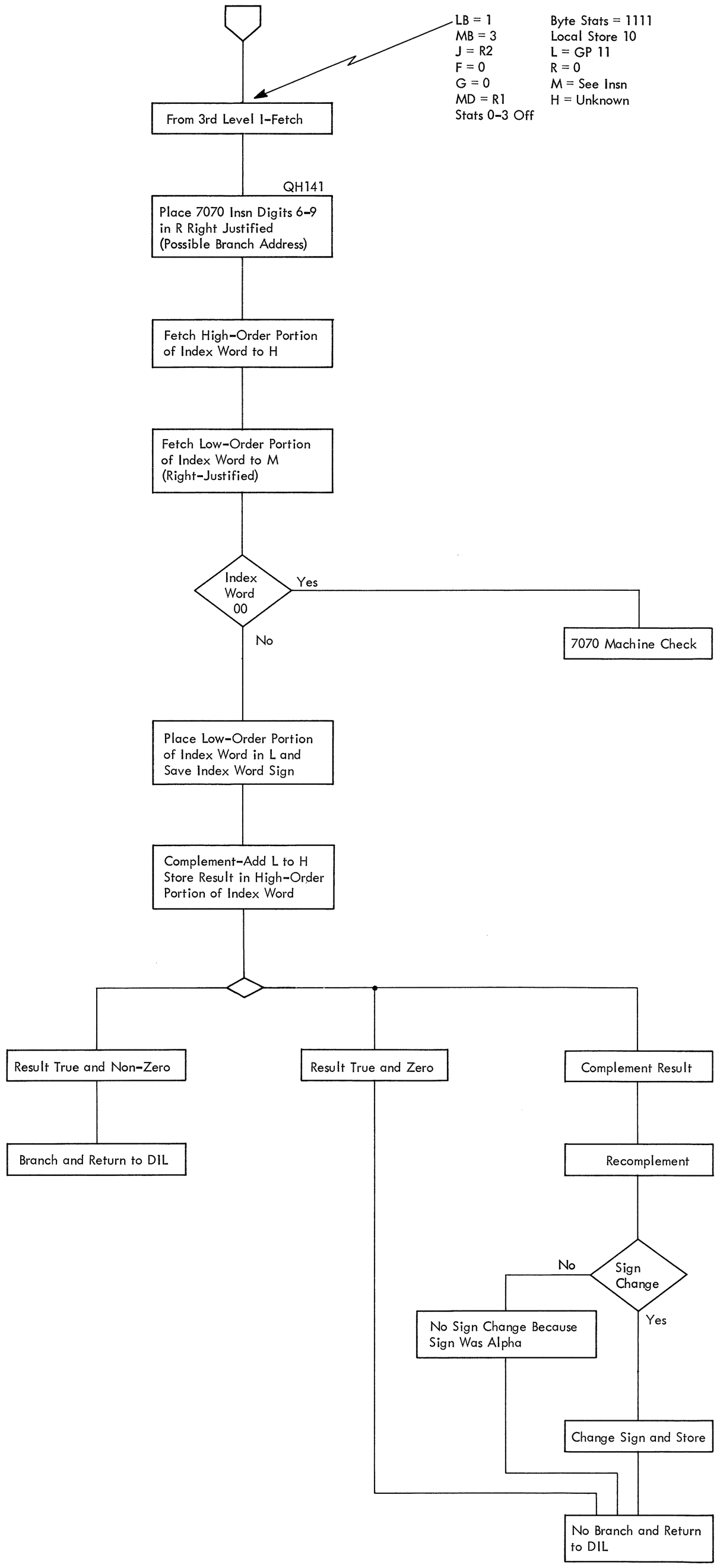


FIGURE CLF 826. BRANCH DECREMENTED INDEX WORD (EBDX)

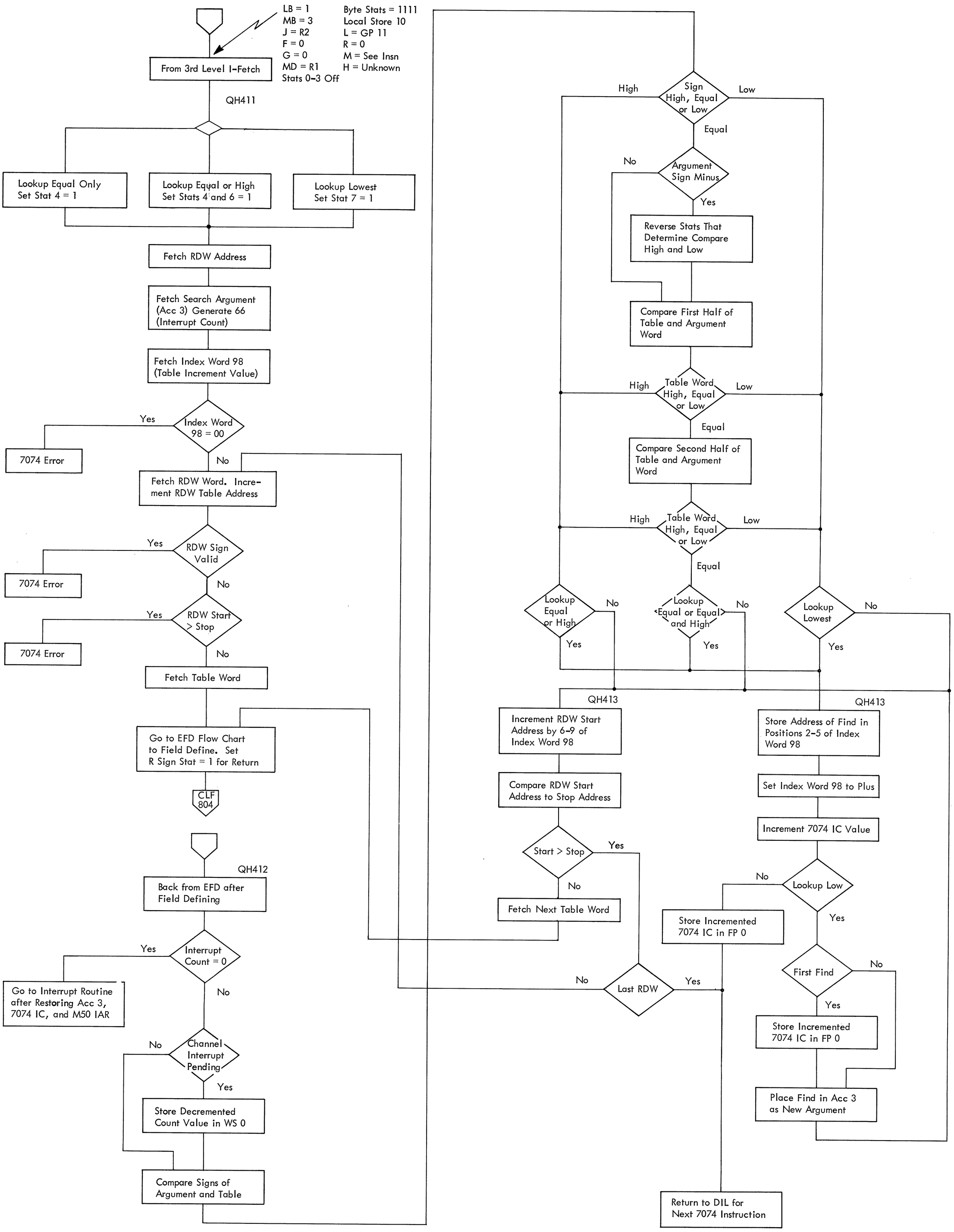
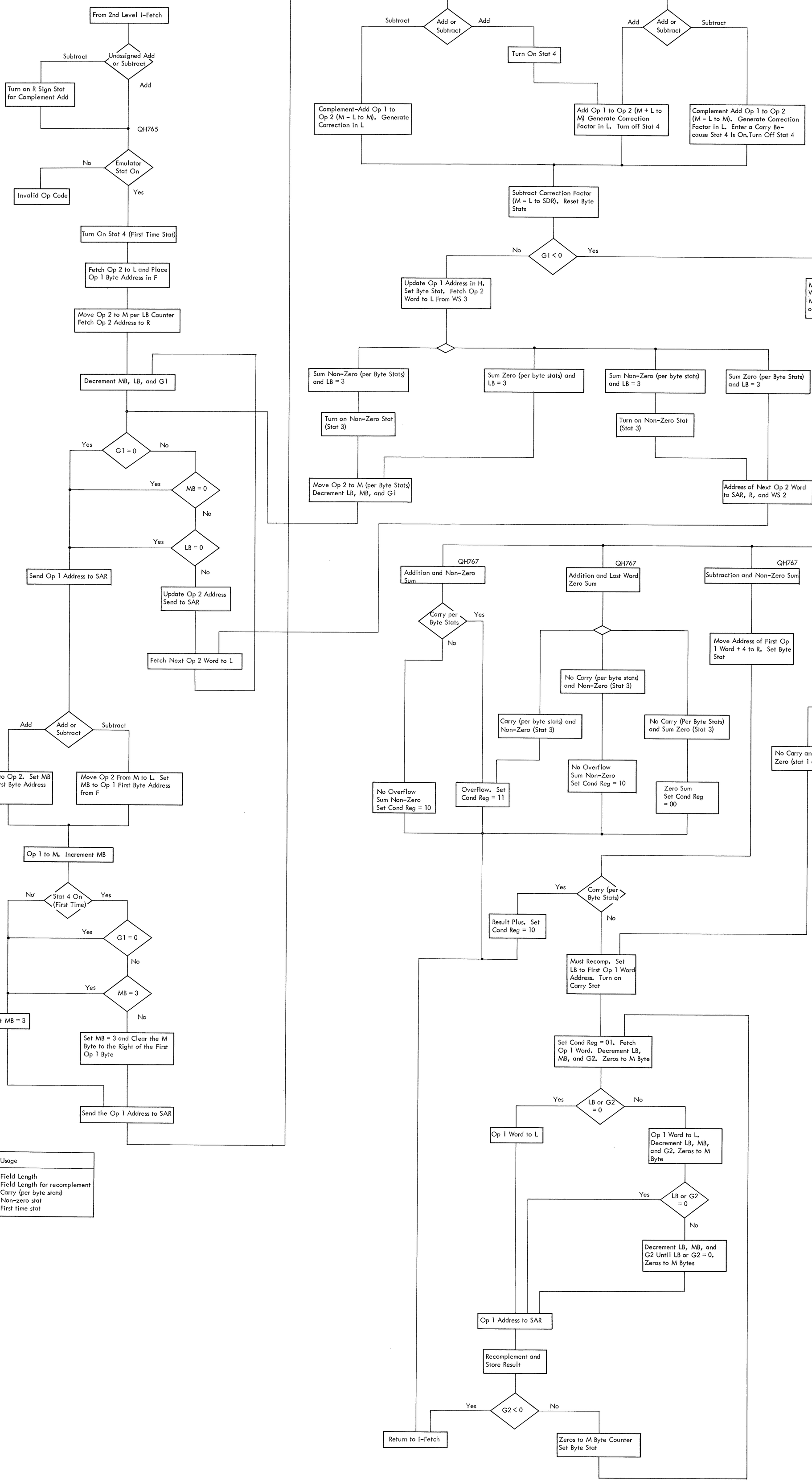


FIGURE CLF 828. TABLE LOOKUP OPERATIONS (ELE, ELEH, ELL)



Stat	Usage
G1	Field Length
G2	Field Length for recomplement
1	Carry (per byte stats)
3	Non-zero stat
4	First time stat

FIGURE CLF 830. UNSIGNED ADD/SUBTRACT (EUNA, EUNS)

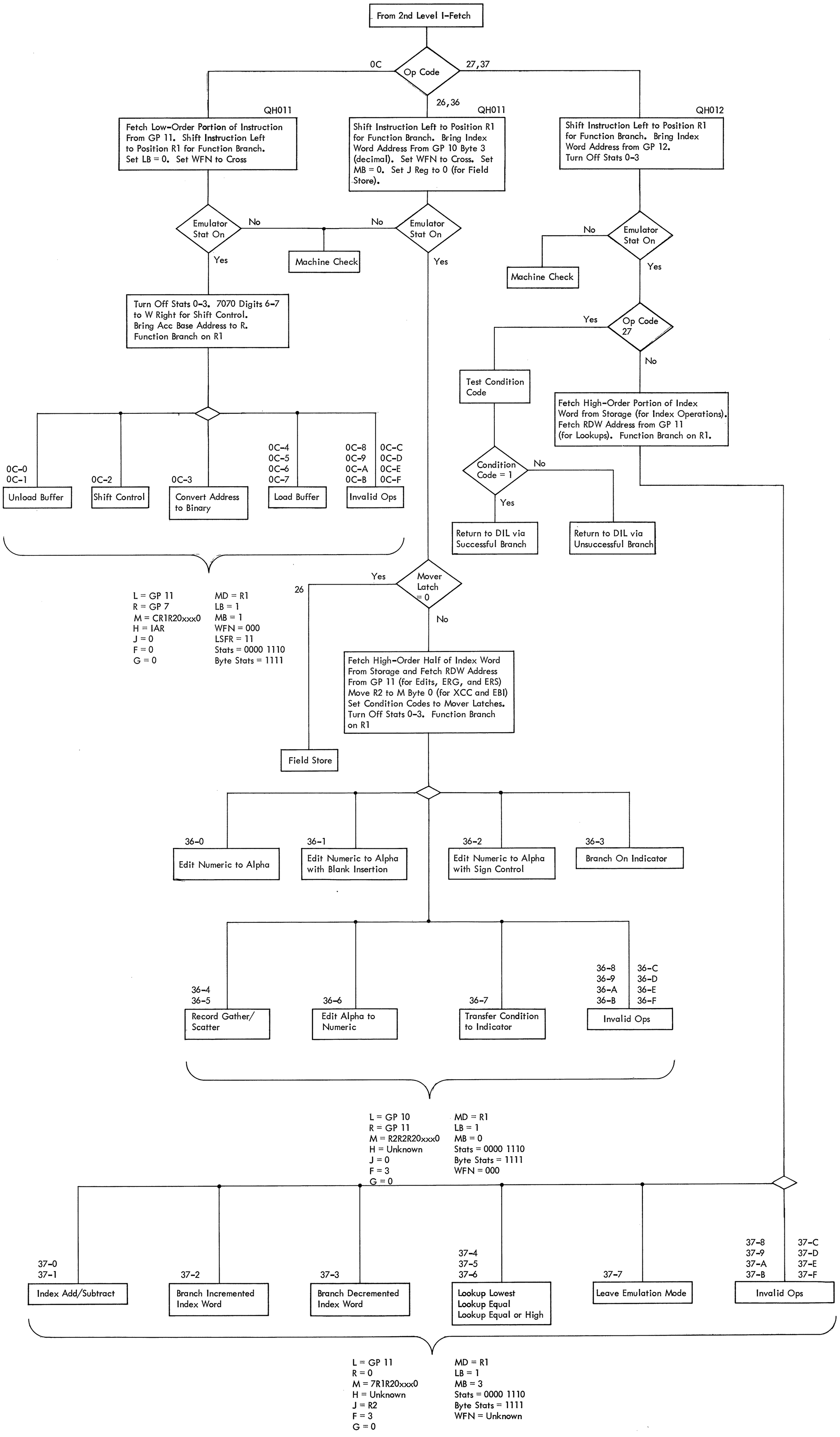
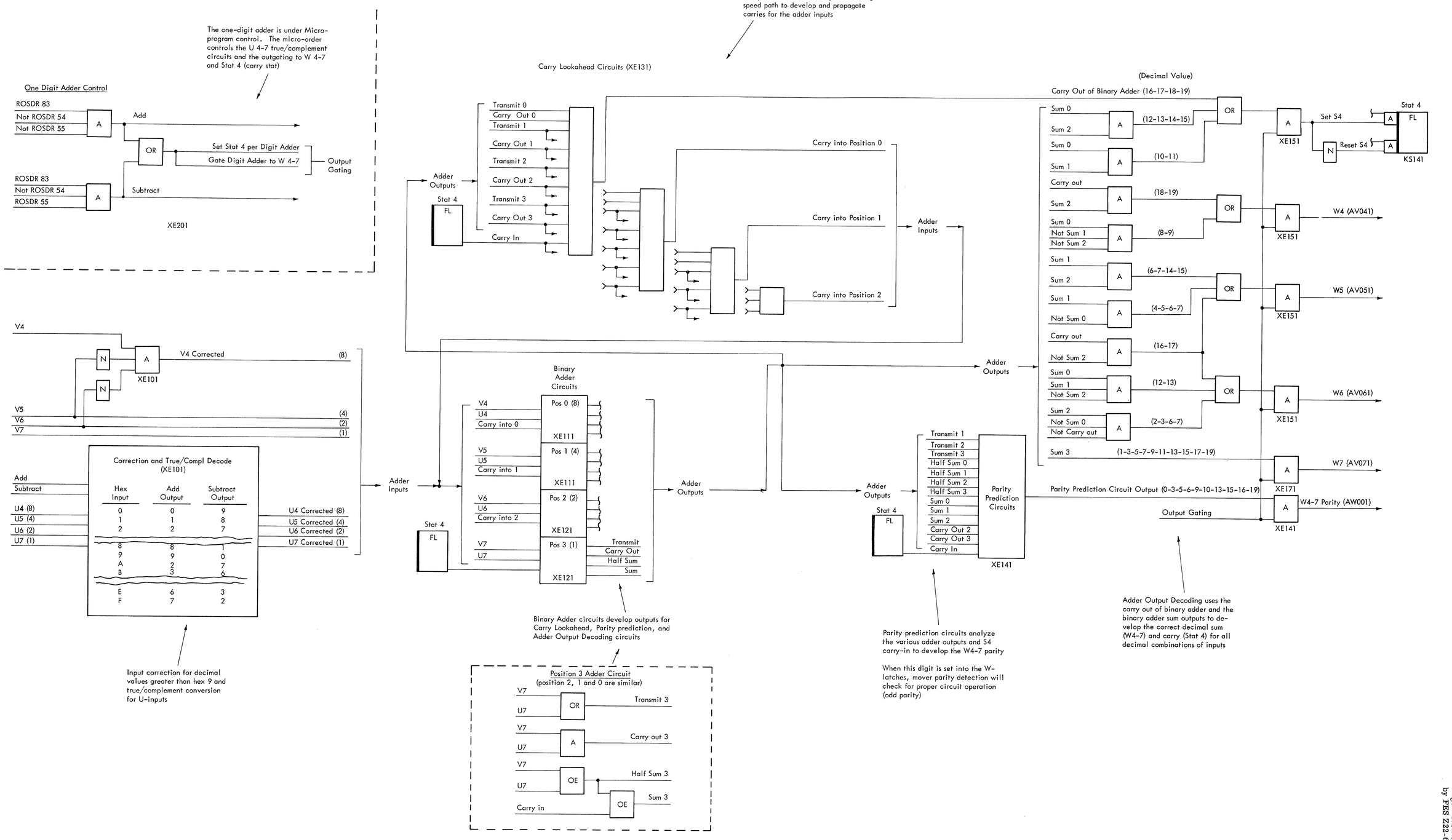


FIGURE CLF 832. THIRD LEVEL I-FETCH

The one-digit adder is under Micro-program control. The micro-order controls the U 4-7 true/complement circuits and the outgating to W 4-7 and Stat 4 (carry stat)

Carry Lookahead circuits provide a high-speed path to develop and propagate carries for the adder inputs



Input correction for decimal values greater than hex 9 and true/complement conversion for U-inputs

Binary Adder circuits develop outputs for Carry Lookahead, Parity prediction, and Adder Output Decoding circuits

Parity prediction circuits analyze the various adder outputs and S4 carry-in to develop the W4-7 parity

When this digit is set into the W-latches, mover parity detection will check for proper circuit operation (odd parity)

Adder Output Decoding uses the carry out of binary adder and the binary adder sum outputs to develop the correct decimal sum (W4-7) and carry (Stat 4) for all decimal combinations of inputs

FIGURE UDC 900. ONE DIGIT ADDER

Form Z22-2833-4
Page Added 8/1/66
by FES Z22-6600-1

Function	Location		
	Channel 1	Channel 2	Channel 3
TRANSLATE			
File Latch, Load Latch, Odd Latch	XE501	XE511	XE511
CAS Control	QR920	QR920	QR920
Translate Latch	XE521	XE521	XE521
CAS Control	QV103	QV103	QV103
WM INSERT/DELETE			
WS Control	XE621	----------XE801---------- *	
WM PRESERVATION			
Sel Ch Read Store Routine	---------- QR860 and QV105----------		
WM Stat Latch	----------XE401----------		
Split R/W Latch	----------KC511----------		
INTERFACE LINES			
(to the Sel Ch)			
Bus In Gating Bits			
P	XE561	----------XE741----------	
0-1	XE531	----------XE711----------	
2-3	XE541	----------XE721----------	*
4-5-6-7	XE551	----------XE731----------	
Special Char Detection	XE571	----------XE751----------	
Service In	XE631	----------XE811----------	
(to the Interface Lines)			
Bus Out Gating Bits			
P-0	XE581	----------XE761----------	
1-2-3	XE591	----------XE771----------	
4-5-6-7	XE601	----------XE781----------	*
Special Char Detection	XE611	----------XE791----------	
Service Out	XE621	----------XE801----------	

* Selector channel 2 and 3 use ALD pages XE701 to XE841. They each have identical card and pin locations

The 'psuedo-location' shown in line 5 of the ALD logic block (gate-board-card) is Y-P4xx, and calls attention to the note that specifies the actual location for each channel

The note points out that the gate and board locations are:

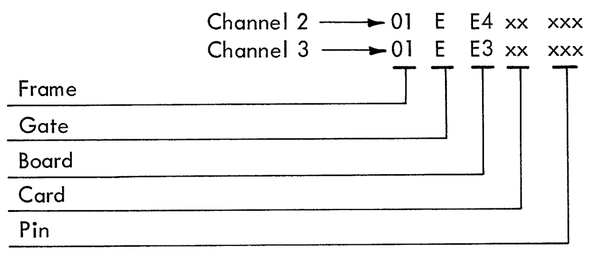


FIGURE IOP 900. 1410 I/O OPERATIONS - ALD/CAS LOCATIONS

	CAW Control			Translation			Wordmark Considerations
	Bit 7	Bit 6	Bit 4	Table	(General Rule) Interface Code → EBCDIC II	Special Character Exceptions	
Read (Bus-in Lines Translation)	Tape	Move	Odd	1	00xx xxxx → 00xx xxxx 10xx xxxx → 01xx xxxx (IF bit one must be zero)	Yes	CCW 39 equal to a 1-bit activates the microprogramming during the sel ch read store routine, so that the wordmarks in 1410 core storage are preserved as the I/O byte is read into bits 1-7 of each location
	Tape	Move	Even	1	01xx xxxx → 00xx xxxx 11xx xxxx → 01xx xxxx (IF bit one must be one)	Yes	
	Disk	Move	Even	1	01xx xxxx → 00xx xxxx 11xx xxxx → 01xx xxxx (IF bit one must be one)	Yes	
	Tape	Load	Odd	1	00xx xxxx → ?0xx xxxx 10xx xxxx → ?1xx xxxx (IF bit one must be zero)	Yes	Wordmark insert/delete circuits are active and block word separator characters on the bus in lines and insert bit zero on the next character (unless the 2nd character is also a word separator character)
	Tape	Load	Even	1	01xx xxxx → ?0xx xxxx 11xx xxxx → ?0xx xxxx (IF bit one must be one)	Yes	
	Disk	Load	Even	No	xx00 xxxx → xx11 xxxx xx01 xxxx → xx10 xxxx xx10 xxxx → xx01 xxxx xx11 xxxx → xx00 xxxx (IF bits 2 and 3 are inverted)	No	
Write (Bus-out Lines Translation)					EBCDIC II → Interface Code		
	Tape	Move	Odd	2	?0xx xxxx → 00xx xxxx ?1xx xxxx → 10xx xxxx	Yes	The EBCDIC II wordmark bit (bit zero) does not affect the translation
	Tape	Move	Even	3	?0xx xxxx → 01xx xxxx ?1xx xxxx → 10xx xxxx	Yes	
	Disk	Move	Even	4	?0xx xxxx → 01xx xxxx ?1xx xxxx → 11xx xxxx	Yes	
	Tape	Load	Odd	2	?0xx xxxx → 00xx xxxx ?1xx xxxx → 10xx xxxx	Yes	Word separator characters are generated and precede each wordmarked character or a word separator character from core storage out to the interface bus out lines
	Tape	Load	Even	3	?0xx xxxx → 01xx xxxx ?1xx xxxx → 11xx xxxx	Yes	
	Disk	Load	Even	No	xx00 xxxx → xx11 xxxx xx01 xxxx → xx10 xxxx xx10 xxxx → xx01 xxxx xx11 xxxx → xx00 xxxx (EBCDIC II bits 2 and 3 are inverted)		

Table 1 Read (IF Bus In to EBCDIC II) Translation

If Bus In Code 4-7 \ 0-3	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	30	00	10	20	30	00	10	20	40	50	60	70	40	50	60	70
1	01	11	61	31	01	11	61	31	41	51	61	71	41	51	61	71
2	30	00	10	20	30	00	10	20	42	52	62	72	42	52	62	72
3	03	13	23	33	03	13	23	33	43	53	63	73	43	53	63	73
4	04	14	24	34	04	14	24	34	44	54	64	74	44	54	64	74
5	05	15	25	35	05	15	25	35	45	55	65	75	45	55	65	75
6	06	16	26	36	06	16	26	36	46	56	66	76	46	56	66	76
7	07	17	27	37	07	17	27	37	47	57	67	77	47	57	67	77
8	30	00	10	20	30	00	10	20	48	58	68	78	48	58	68	78
9	09	19	29	39	09	19	29	39	49	59	69	79	49	59	69	79
A	30	00	10	20	30	00	10	20	4A	5A	6A	7A	4A	5A	6A	7A
B	0B	1B	2B	3B	0B	1B	2B	3B	4B	5B	6B	7B	4B	5B	6B	7B
C	0C	1C	2C	3C	0C	1C	2C	3C	4C	5C	6C	7C	4C	5C	6C	7C
D	0D	1D	2D	3D	0D	1D	2D	3D	4D	5D	6D	7D	4D	5D	6D	7D
E	0E	1E	2E	3E	0E	1E	2E	3E	4E	5E	6E	7E	4E	5E	6E	7E
F	0F	1F	2F	3F	0F	1F	2F	3F	4F	5F	6F	7F	4F	5F	6F	7F

Table bytes are identified by dotted, striped or blank boxes. These serve to identify the translator outputs that are invalid parity and result in Channel Data Check during various types of 1410 I/O translations

Operation	Invalid Parity
tape-move-odd	no pattern
tape-move-even	striped or dotted pattern
disk-move-even	striped pattern
tape-load-odd	no pattern
tape-load-even	striped or dotted pattern
disk-load-even	(all bytes have correct parity)

Word Separator for tape-load-odd is hex 6D: for tape-load-even it is hex 2D

Table 2 Write Translation (tape-move/load-odd)

EBCDIC II 4-7 \ 0-3	0/8	1/9	2/A	3/B	4/C	5/D	6/E	7/F
0	10	20	3A	00	80	90	A0	B0
1	01	11	*21	31	81	91	21	B1
2	12	22	3A	02	82	92	A2	B2
3	03	13	23	33	83	93	A3	B3
4	04	14	24	34	84	94	A4	B4
5	05	15	25	35	85	95	A5	B5
6	06	16	26	36	86	96	A6	B6
7	07	17	27	37	87	97	A7	B7
8	18	28	3A	08	88	98	A8	B8
9	09	19	29	39	89	99	A9	B9
A	1A	2A	*3A	0A	8A	9A	AA	BA
B	0B	1B	2B	3B	8B	9B	AB	BB
C	0C	1C	2C	3C	8C	9C	AC	BC
D	0D	1D	2D	3D	8D	9D	AD	BD
E	0E	1E	2E	3E	8E	9E	AE	BE
F	0F	1F	2F	3F	8F	9F	AF	BF

* EBCDIC II codes 21, 2A, A1, and AA cause unit check because of a bad parity translator output

EBCDIC II codes 2D, or AD are the word separator for tape-load write operations

Table 3 Write Translation (tape-move/load-even)

EBCDIC II 4-7 \ 0-3	0/8	1/9	2/A	3/B	4/C	5/D	6/E	7/F
0	50	60	40	40	C0	D0	E0	F0
1	41	51	*61	71	C1	D1	61	F1
2	52	62	42	42	C2	D2	E2	F2
3	43	53	63	73	C3	D3	E3	F3
4	44	54	64	74	C4	D4	E4	F4
5	45	55	65	75	C5	D5	E5	F5
6	46	56	66	76	C6	D6	E6	F6
7	47	57	67	77	C7	D7	E7	F7
8	58	68	48	48	C8	D8	E8	F8
9	49	59	69	79	C9	D9	E9	F9
A	5A	6A	4A	4A	CA	DA	EA	FA
B	4B	5B	6B	7B	CB	DB	EB	FB
C	4C	5C	6C	7C	CC	DC	EC	FC
D	4D	5D	6D	7D	CD	DD	ED	FD
E	4E	5E	6E	7E	CE	DE	EE	FE
F	4F	5F	6F	7F	CF	DF	EF	FF

* EBCDIC II codes 21 or A1 cause unit check because of a bad parity translator output

EBCDIC II codes 2D or AD are the word separator for tape-load write operations

Table 4 Write Translation (disk-move-even)

EBCDIC II 4-7 \ 0-3	0/8	1/9	2/A	3/B	4/C	5/D	6/E	7/F
0	50	60	7A	40	C0	D0	E0	F0
1	41	51	*61	71	C1	D1	61	F1
2	52	62	*7A	42	C2	D2	E2	F2
3	43	53	63	73	C3	D3	E3	F3
4	44	54	64	74	C4	D4	E4	F4
5	45	55	65	75	C5	D5	E5	F5
6	46	56	66	76	C6	D6	E6	F6
7	47	57	67	77	C7	D7	E7	F7
8	58	68	*7A	48	C8	D8	E8	F8
9	49	59	69	79	C9	D9	E9	F9
A	5A	6A	7A	4A	CA	DA	EA	FA
B	4B	5B	6B	7B	CB	DB	EB	FB
C	4C	5C	6C	7C	CC	DC	EC	FC
D	4D	5D	6D	7D	CD	DD	ED	FD
E	4E	5E	6E	7E	CE	DE	EE	FE
F	4F	5F	6F	7F	CF	DF	EF	FF

* EBCDIC II codes 21, A1, 22, A2, 28, or A8 cause unit check because of a bad parity translator output

FIGURE IOP 901. SELECTOR CHANNEL TRANSLATION FOR 1410 I/O OPERATIONS

Name	1410/7010 Graphic	EBCDIC II Code	Length	Hex ID for Fn Br to Execute	First Execute Page	After I-Fetch: Gen Purpose Stats 0-7	After I-Fetch: A Address	After I-Fetch: B Address	After I-Fetch: d Modifier
No Operation	N	D5	any	—	—	—	—		
Add	A	C1	1, 6, 11[2]	7	QR210	0000 ?001 (not Chained); 0000 ?000 (BAR Chained); 0000 ?010 (AAR and BAR Chained)	R-reg (GPR 6)	GPR 7	(None)
Subtract	S	E2	1, 6, 11[2]	B	210				
Zero and Add	?	C0	1, 6, 11[2]	5	250				
Zero and Subtract	!	D0	1, 6, 11[2]	9	250				
Multiply	@	BC	1, 6, 11[2]	2	300				
Divide	%	AC	1, 6, 11[2]	0	335				
Compare	C	C3	1, 6, 11[2]	4	510				
Set Wordmark	,	AB	1, 6, 11[2]	3	375				
Clear Wordmark	¤	8C	1, 6, 11[2]	1	375				
Clear Storage/Clear Storage and Branch	/	E1	1, 6, 11[2]	D	361				
Edit	E	C6	1, 6, 11[2]	6	180				
Zero Suppress	Z	E9	1, 6, 11[2]	8	180				
Branch if Character Equal	B	C2	1, 6, 12[2]	3	QR545	0001 ?001 (not Chained); 0001 ?000 (BAR and d-mod Chained); 0001 ?010 (AAR, BAR, and d-mod Chained)	R-reg (GPR 6)	GPR 7	L-reg 0-7 (GPR 4 0-7)
Branch if Bit Equal	W	E6	1, 6, 12[2]	B	555				
Branch if WM and/or Zone Equal	V	E5	1, 6, 12[2]	9	565				
Branch on C-bit	‡	E0	1, 6, 12[2]	F	560				
Table Lookup	T	E3	1, 6, 12[2]	7	510				
Move Data	D	C4	1, 6, 12[2]	5	610				
Test and Branch	J	D1	1, 7[2]	D	QR573	1100 ?000 (Chained J Op); 1101 ?100 (G Op); 1101 ?000 (Any Other Op)	R-reg (GPR 6)	(None)	M-reg 0-7 (GPR 4 0-7)
Branch on Channel 1 Status	R	D9	7[2]	8	593				
Branch on Channel 2 Status	X	E7	7[2]	A	593				
Branch on Channel 3 Status	3	F3	7[2]	C	593				
Priority Test and Branch	Y	E8	1, 7	6	582				
Store Address Register	G	C7	7	4	385				
Store or Restore Status	$	9B	1, 7	2	405				
Halt/Halt and Branch	.	8B	1, 6	1	—	1xxx xxx1	R-reg (GPR 6)	(None)	(None)
Read or Write without Wordmark	M	D4	10	1	QR800	0111 ?001	L-reg 8-31 (X Ctl Field)	GPR 7	M-reg 0-7 (GPR 4 0-7)
Read or Write with Wordmark	L	D3	10	0	800				
Unit Control	U	E4	5	—	800	0111 0101		(None)	
Stacker Select and Feed	K	D2	2	—	850	0000 0000	(None)		
Carriage Control	F	C6	2	—	850	0100 0000			

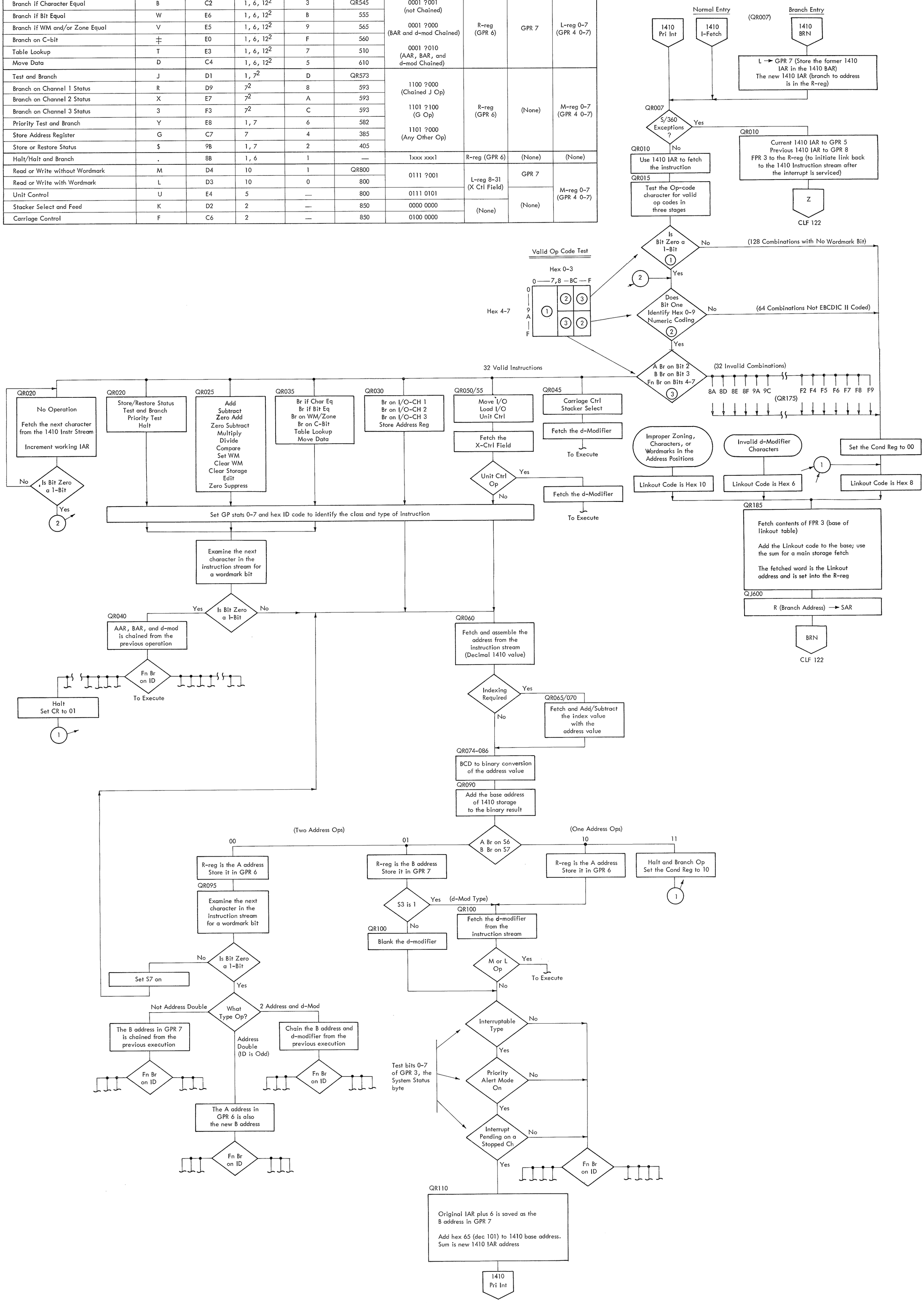


FIGURE CLF 900. 1410 I-FETCH

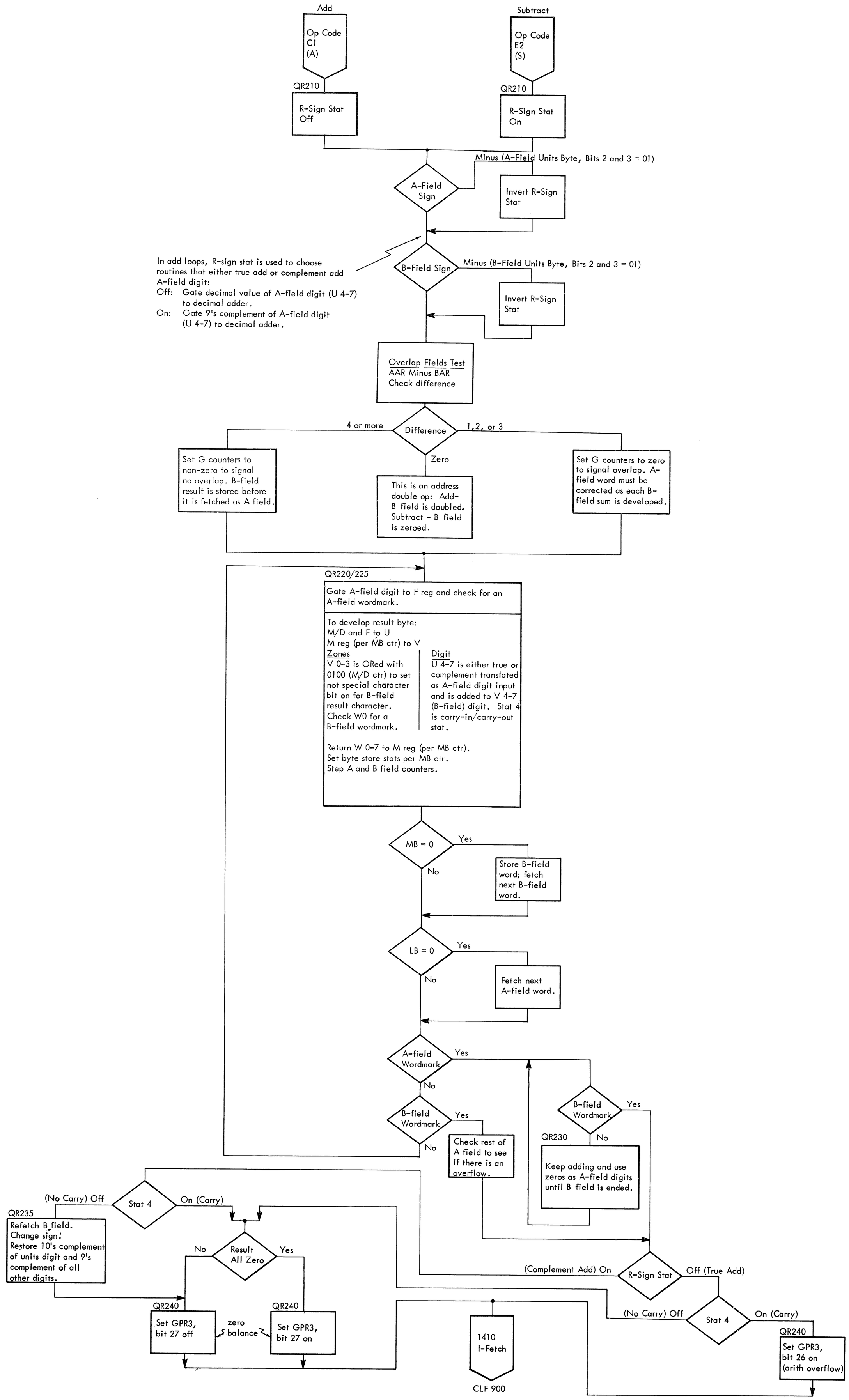


FIGURE CLF 901. ADD/SUBTRACT

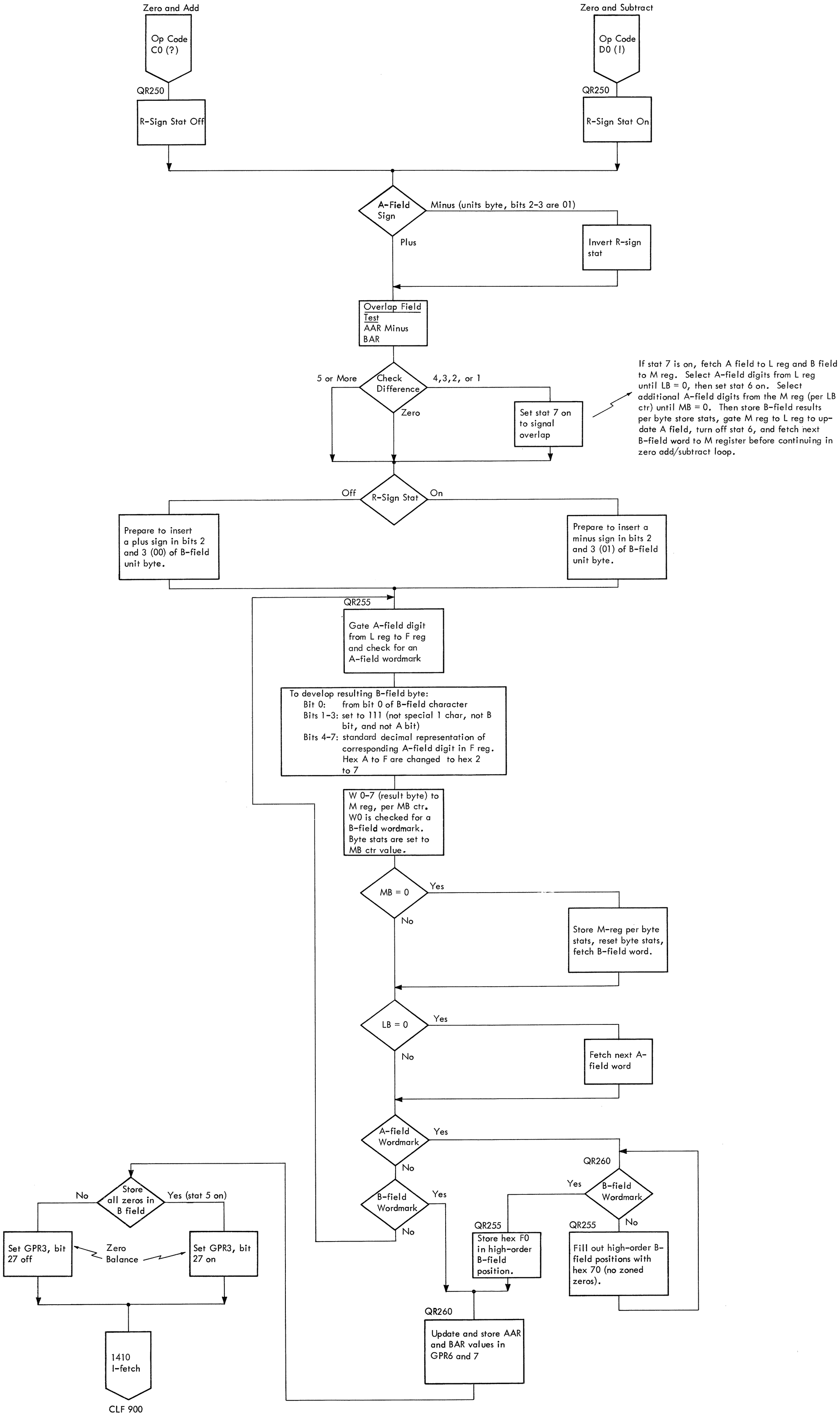
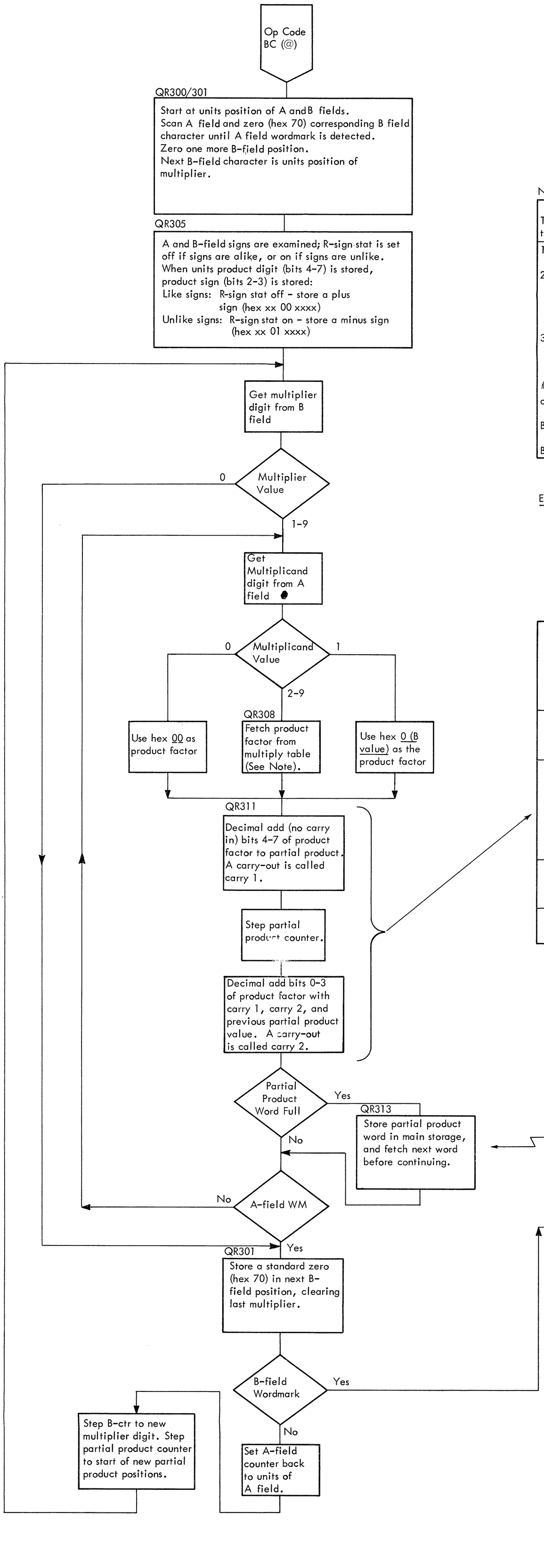


FIGURE CLF 902. ZERO AND ADD/ZERO AND SUBTRACT



Note:

To fetch product of B and A-field factors from multiply table.	Example: B factor is 7, A factor is 5
1. Emit from ROS → Y (Base Address of multiply table)	2100
2. Take B-field digit (not 0) Shift left four Shift right one Add to #1 result	0000 0111 0111 0000 0011 1000 → 0038 (binary add) 2138
3. Take 8 bit off A-field digit (not 0 or 1) Add to #2 result	0101 → 0005 (binary add) 213D
#3 sum is byte address of product byte of A and B-field factors. Bits 4-7 are units digit of product. Bits 0-3 are tens digit of product.	byte at 213D is hex 35

Example:

A field		v 623
B field (before)		v 65A0F5
B field (after clearing)		v 650000
Initial partial product		0000

	B Factor	A Factor	Product Factor	
With first B factor, and with all A factors, fetch product factors, and decimal add them to partial product.	5	3	15	00, 15, 015
	5	2	10	(decimal add) 10, 011
	5	v 6	30	30, 31
Step to next B-field position and clear it.				v 603115
Step again for next B factor Use it with all A factors to fetch another series of product factors; add them to partial product, properly aligned.	v 6	3	18	11, 18, 329
	v 6	2	12	(decimal add) 12, 044
	v 6	v 6	36	36, 40
Step to next B-field position and clear it.				v 0 ↑
B and A-field wordmarks end multiply execution.				v (final B field) 040495

FIGURE CLF 903. MULTIPLY

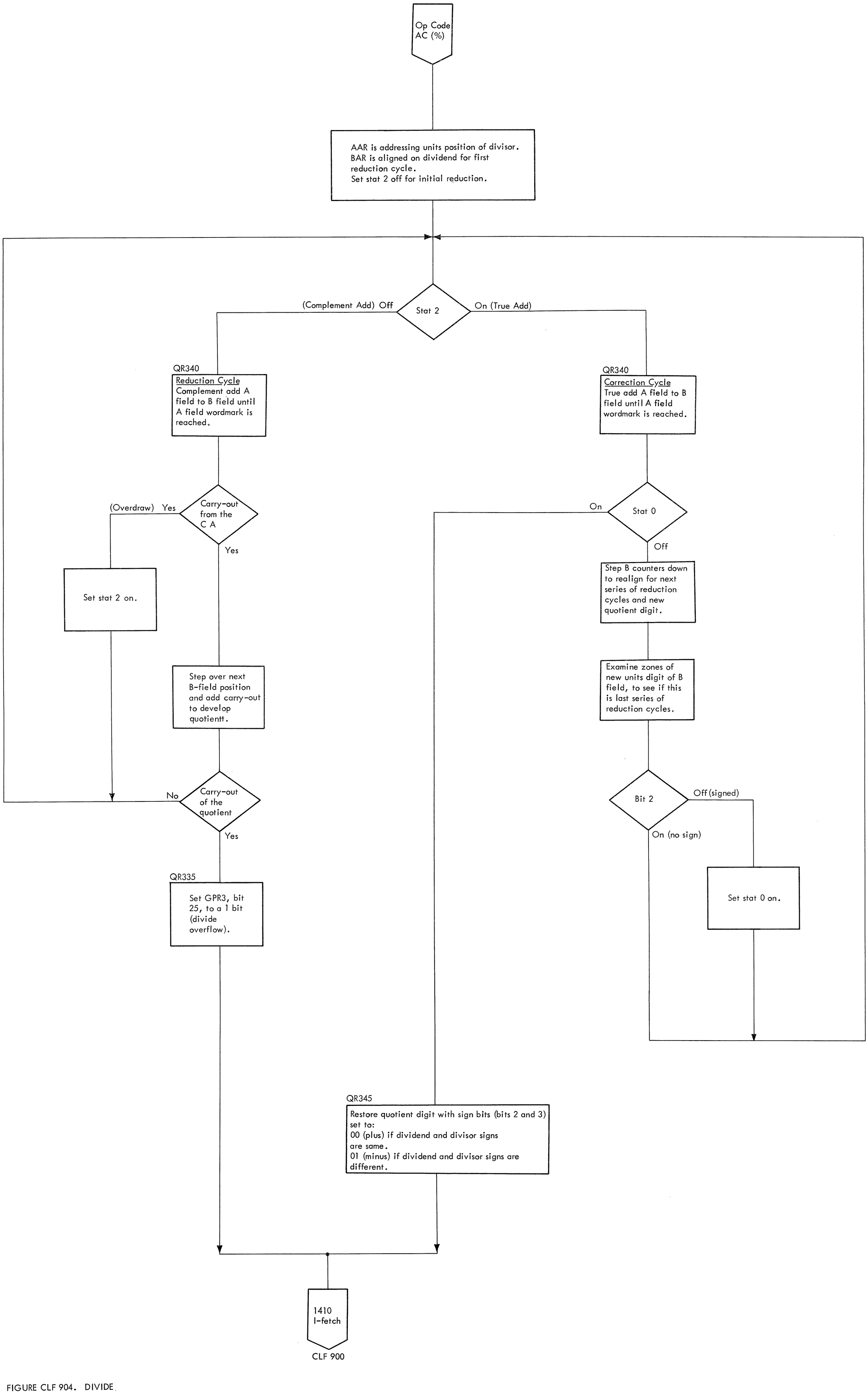


FIGURE CLF 904. DIVIDE

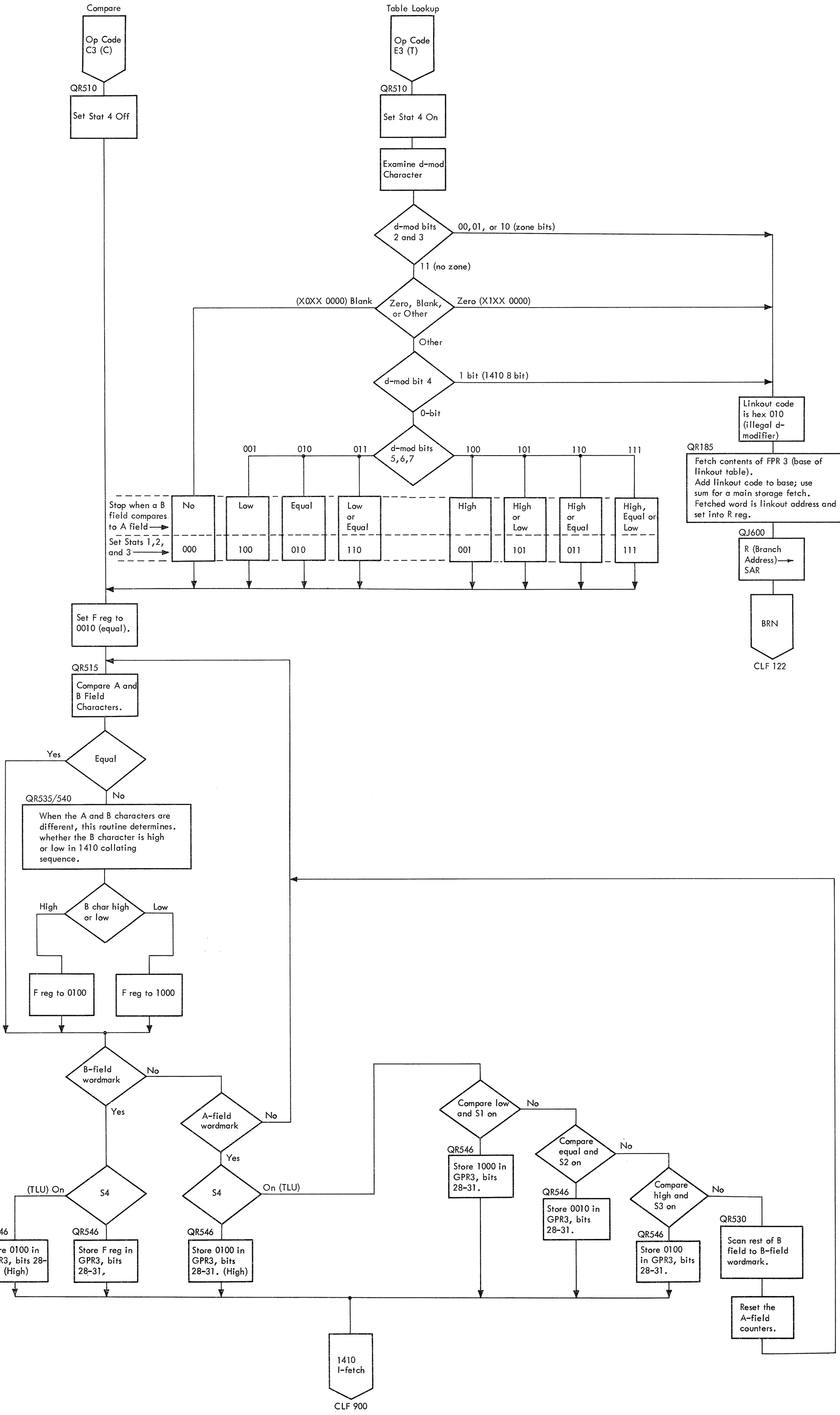


FIGURE CLF 905. COMPARE/TABLE LOOKUP

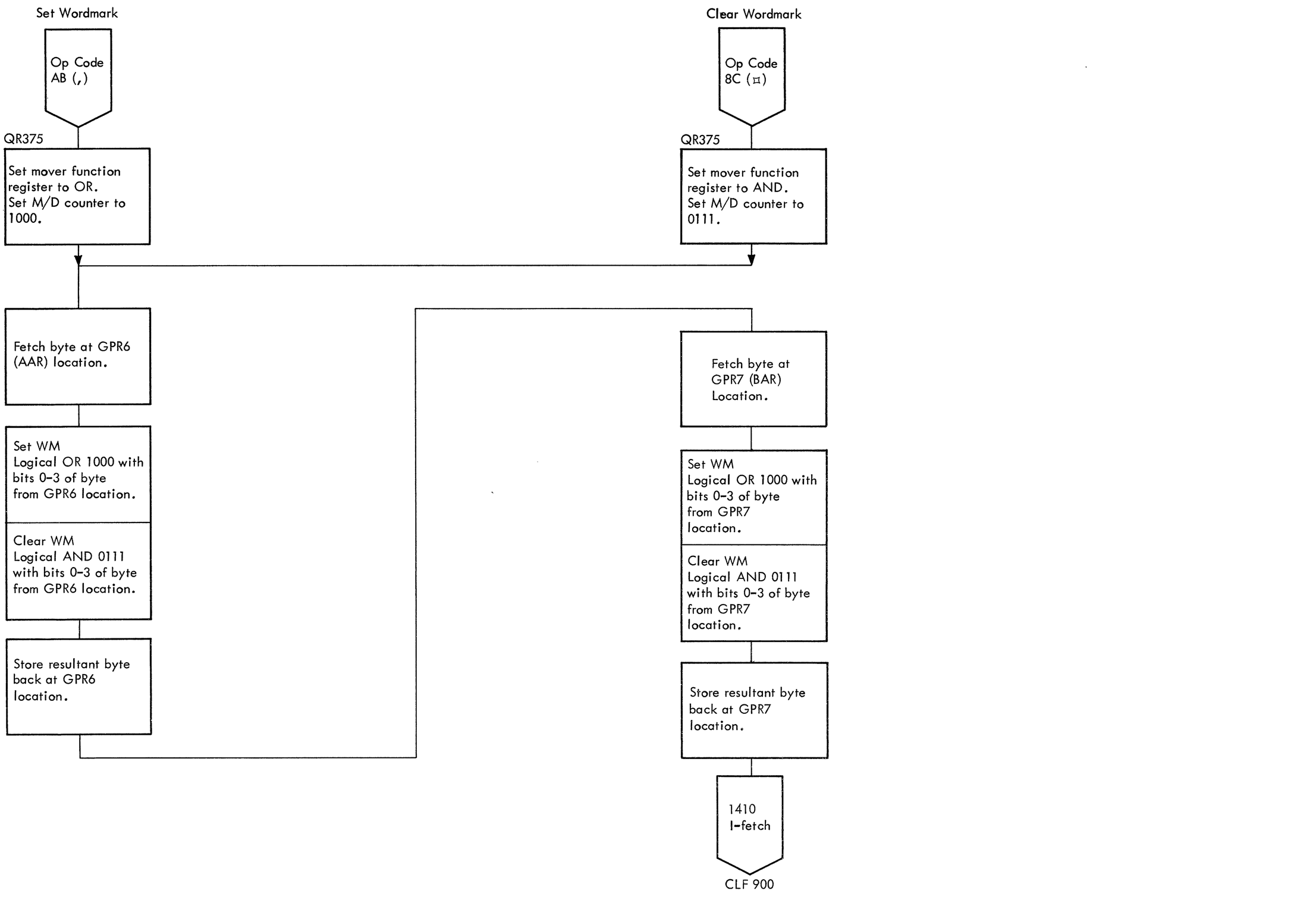


FIGURE CLF 906. SET WORDMARK/CLEAR WORDMARK

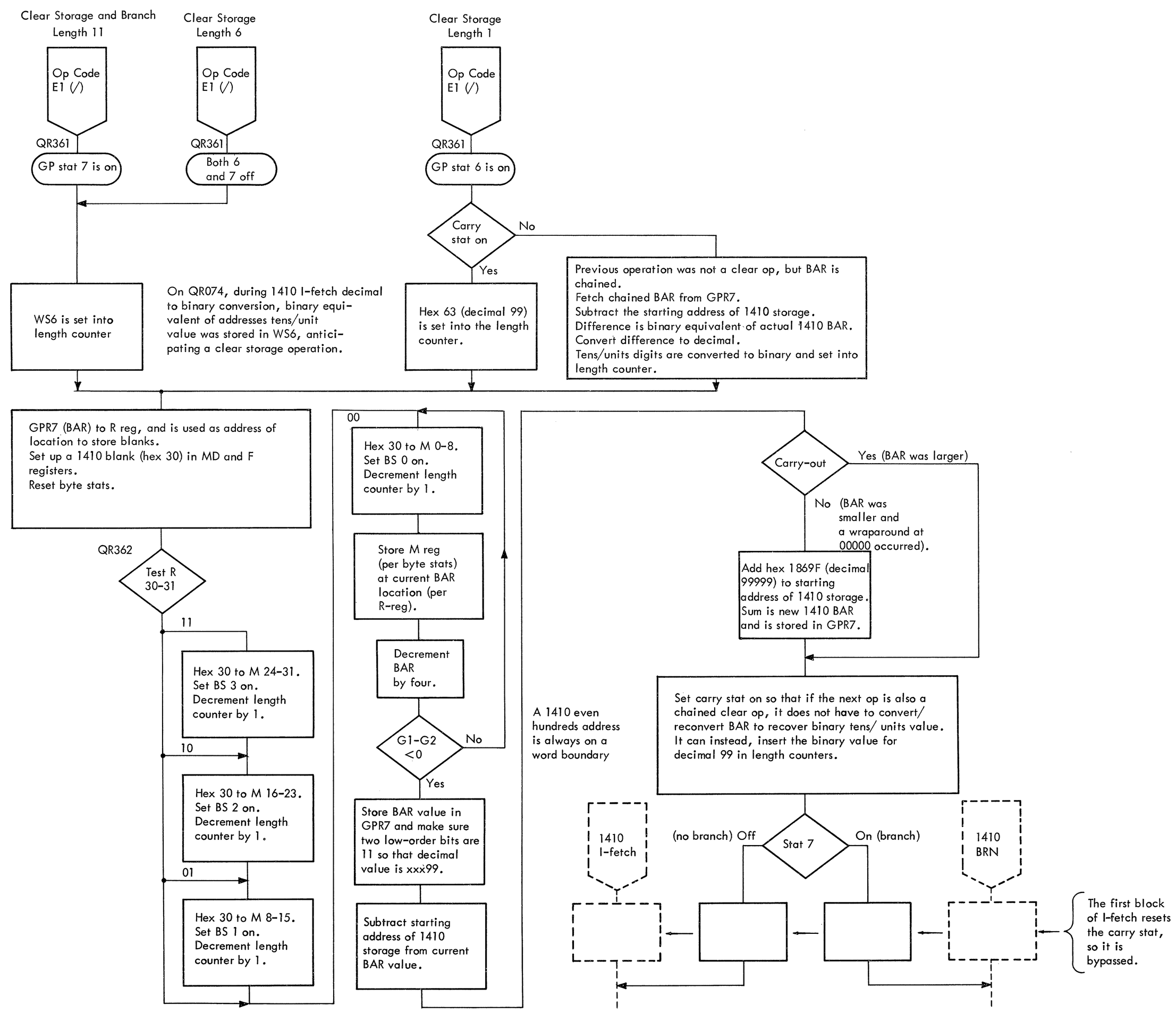


FIGURE CLF 907. CLEAR STORAGE/CLEAR STORAGE AND BRANCH

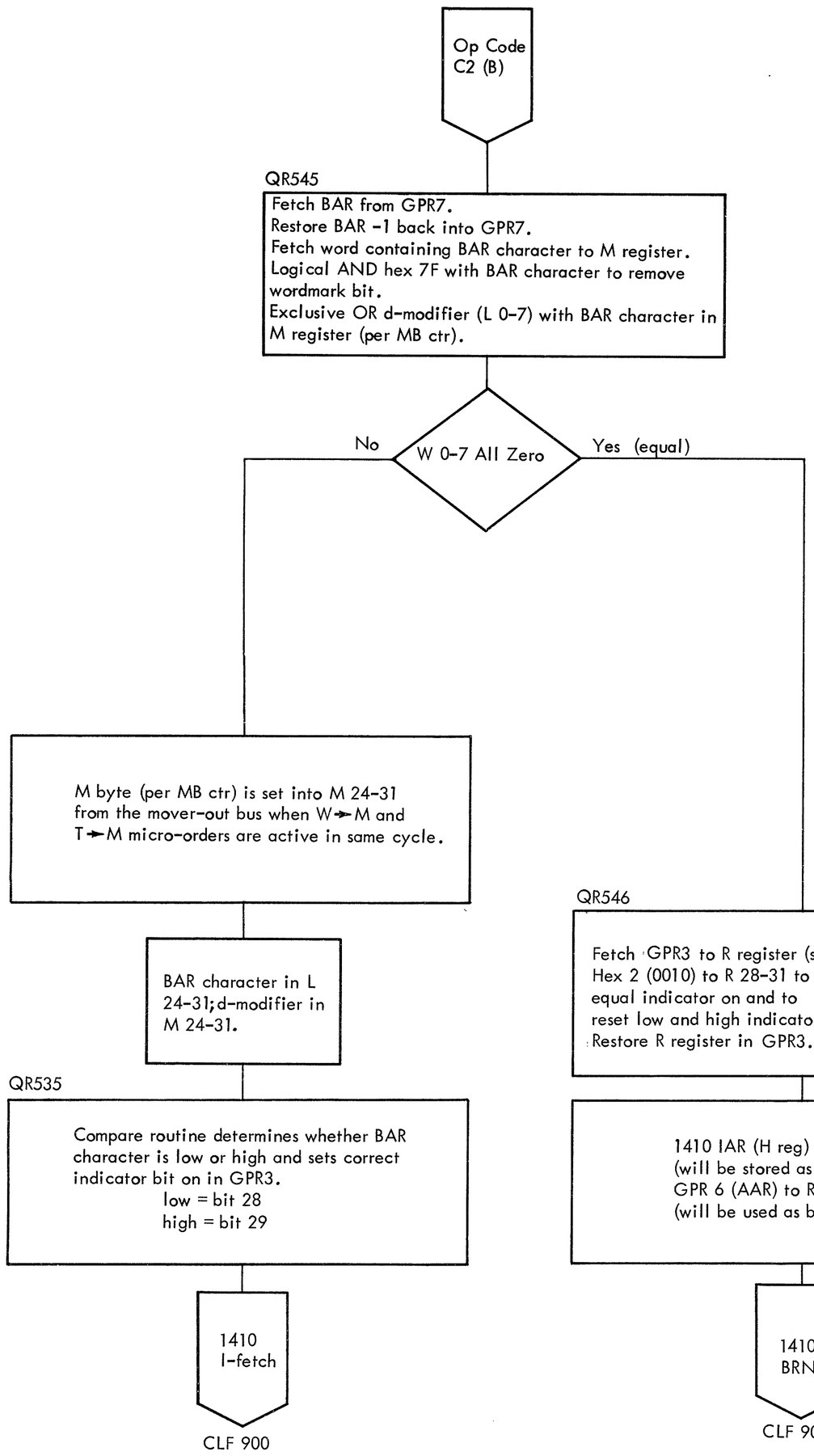


FIGURE CLF 908. BRANCH IF CHARACTER EQUAL

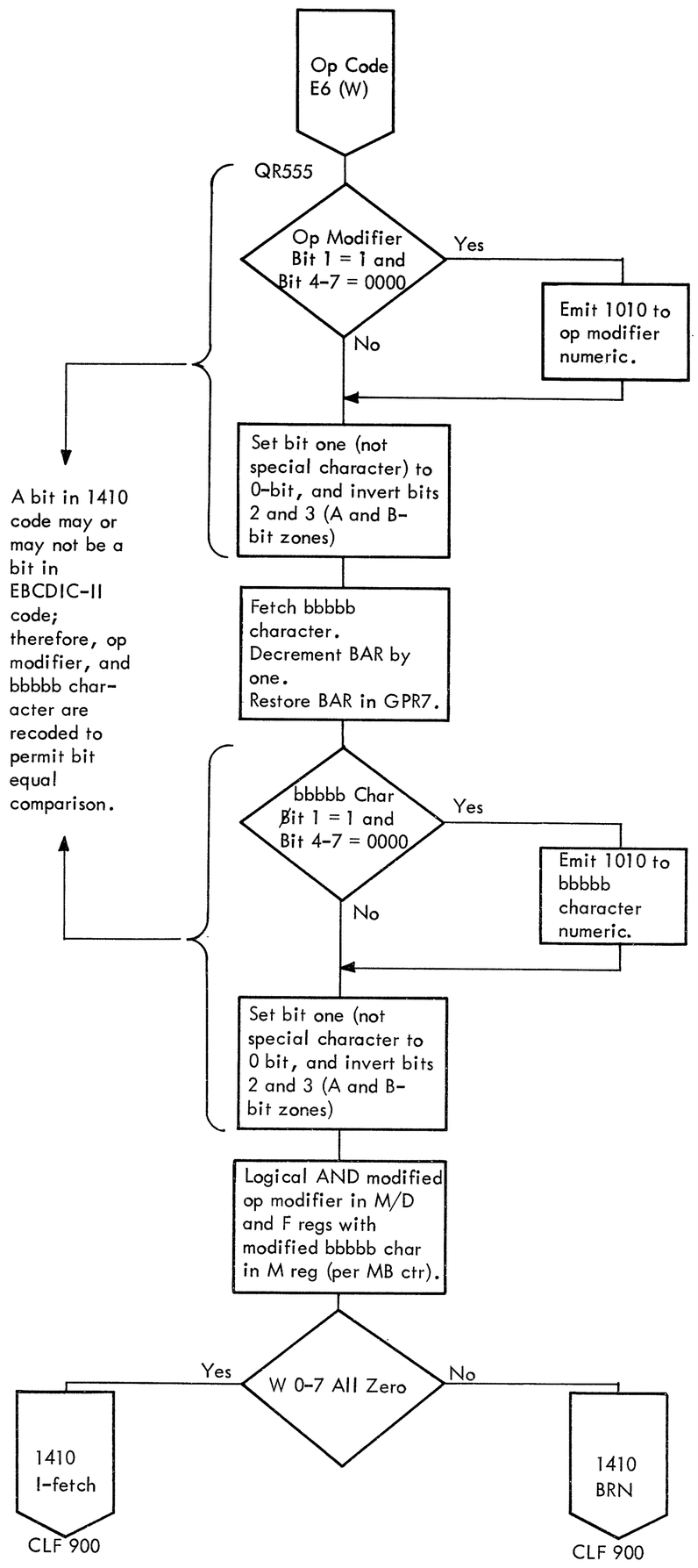


FIGURE CLF 909. BRANCH IF BIT EQUAL

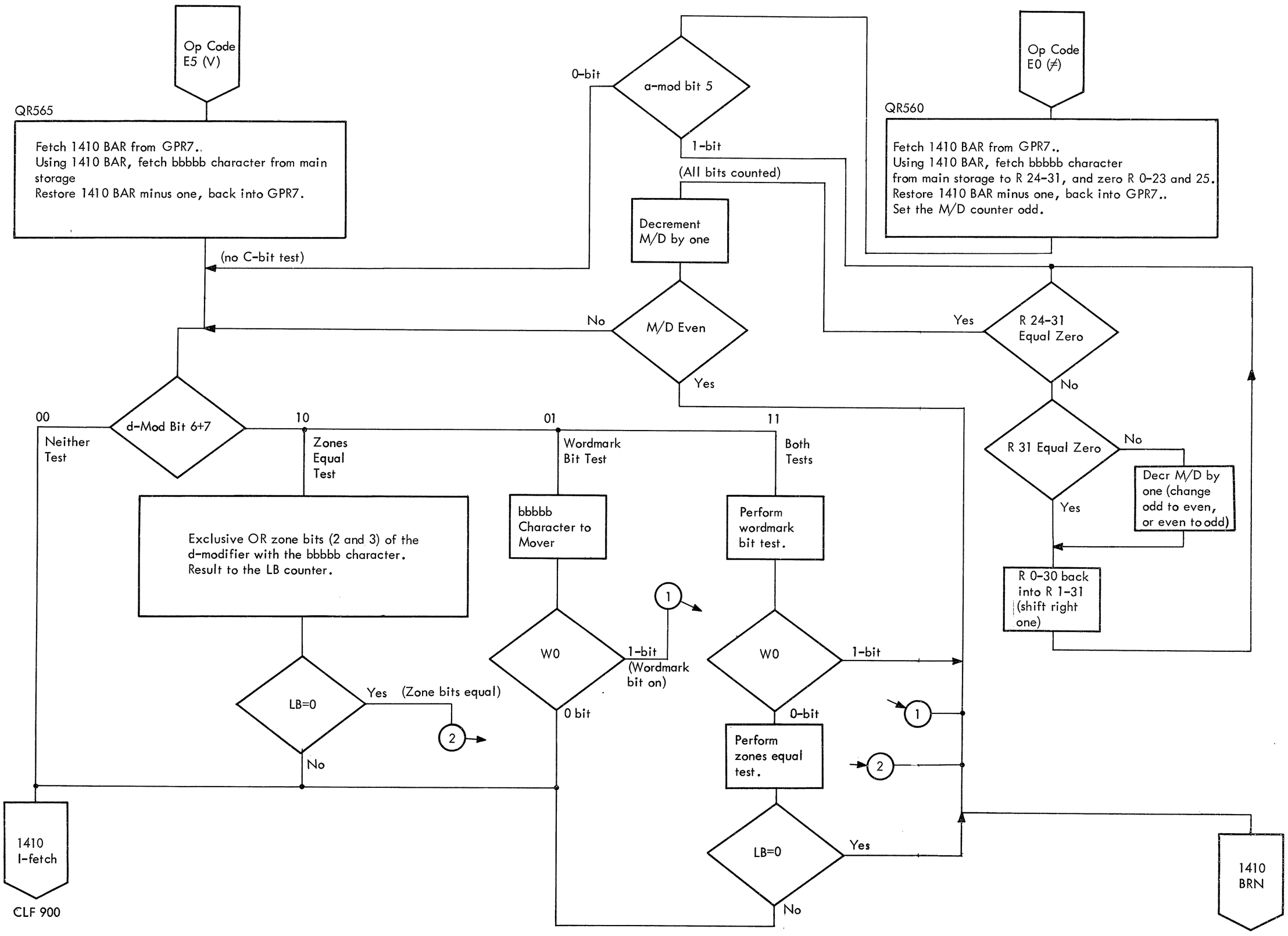
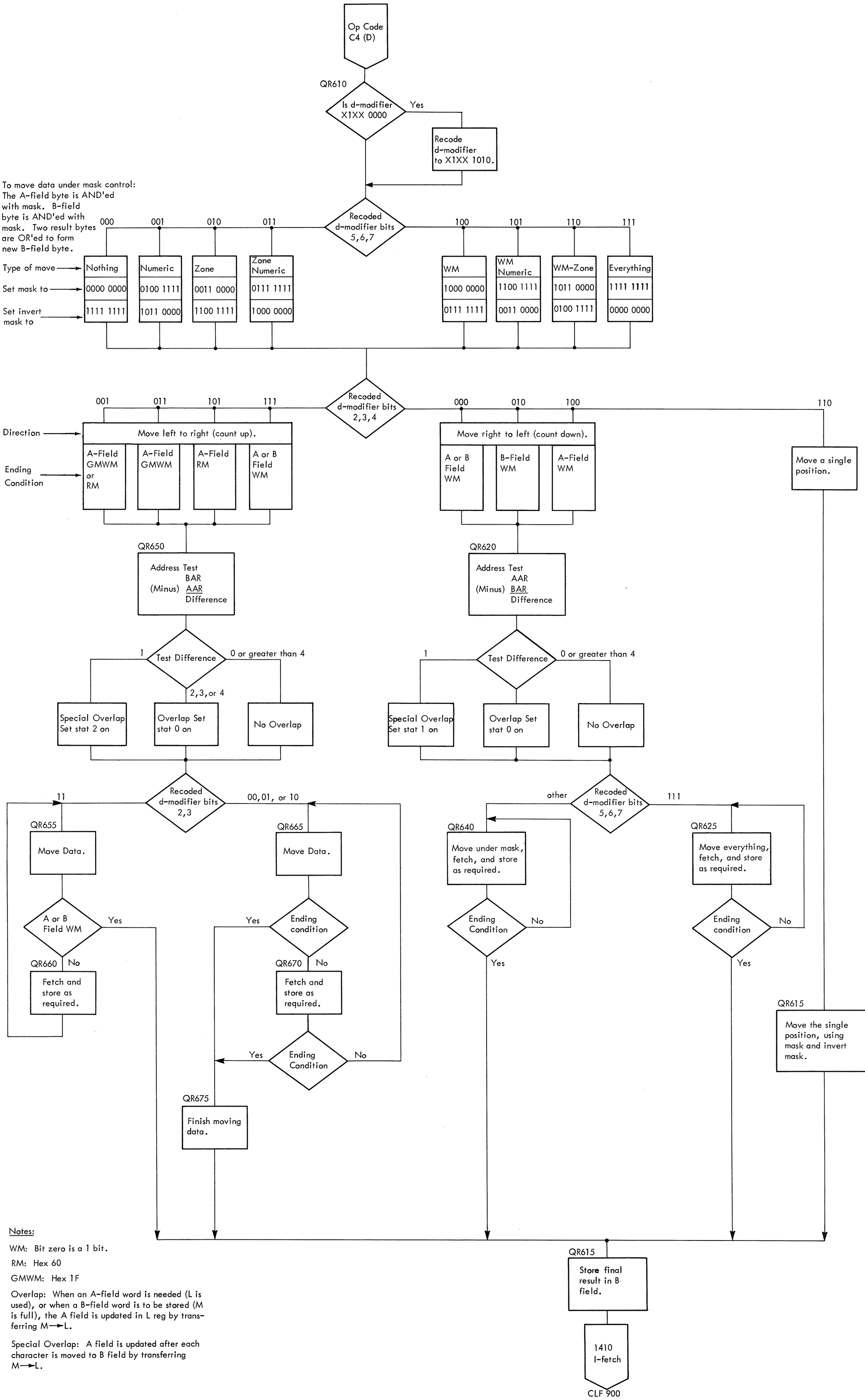


FIGURE CLF 910. BRANCH ON ZONES EQUAL/WORDMARK/C BIT



Notes:

WM: Bit zero is a 1 bit.

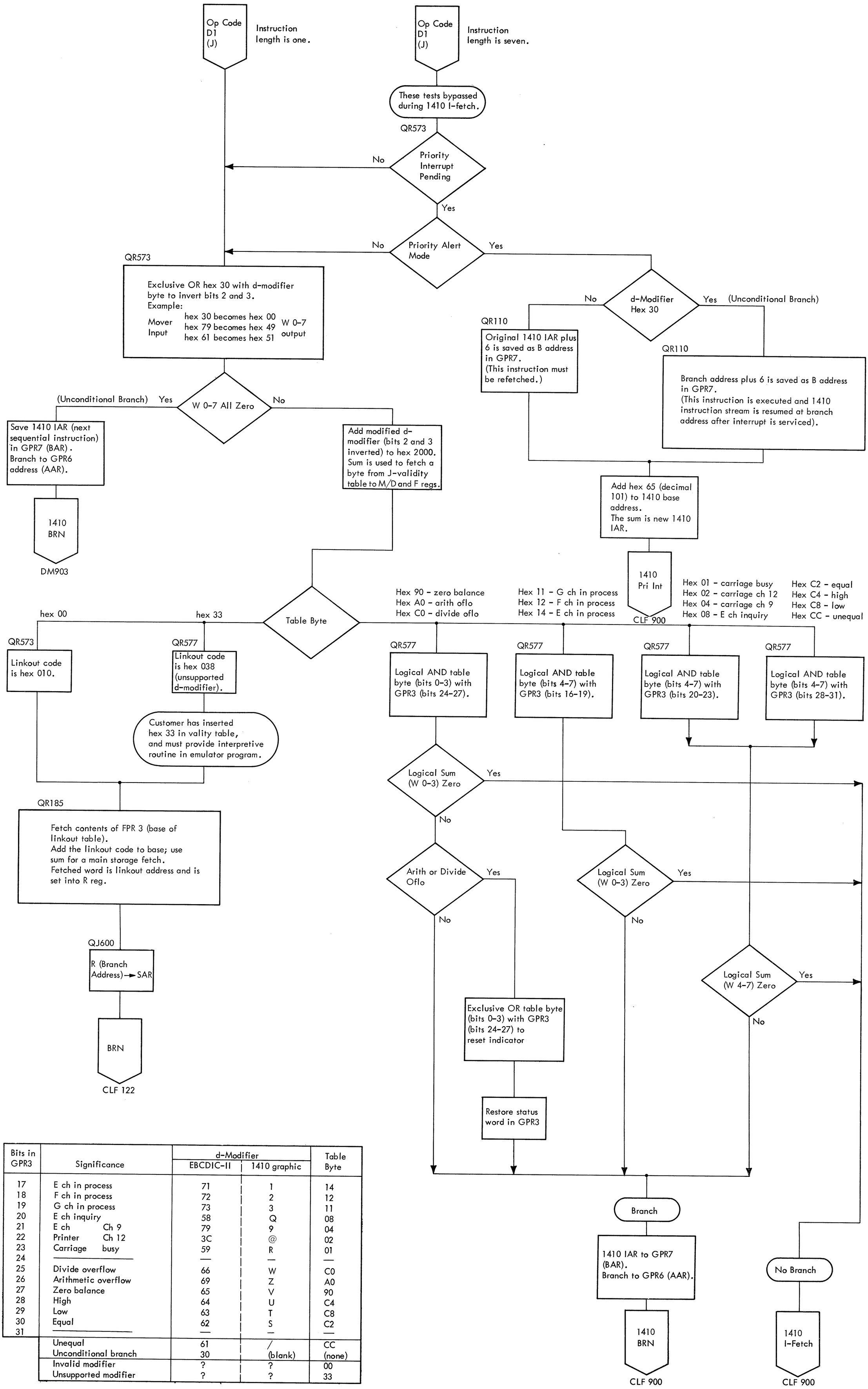
RM: Hex 60

GMWM: Hex 1F

Overlap: When an A-field word is needed (L is used), or when a B-field word is to be stored (M is full), the A field is updated in L reg by transferring M→L.

Special Overlap: A field is updated after each character is moved to B field by transferring M→L.

FIGURE CLF 911. MOVE DATA



Bits in GPR3	Significance	d-Modifier EBCDIC-II	d-Modifier 1410 graphic	Table Byte
17	E ch in process	71	1	14
18	F ch in process	72	2	12
19	G ch in process	73	3	11
20	E ch inquiry	58	Q	08
21	E ch Ch 9	79	9	04
22	Printer Ch 12	3C	@	02
23	Carriage busy	59	R	01
24		—	—	—
25	Divide overflow	66	W	C0
26	Arithmetic overflow	69	Z	A0
27	Zero balance	65	V	90
28	High	64	U	C4
29	Low	63	T	C8
30	Equal	62	S	C2
31		—	—	—
	Unequal	61	/	CC
	Unconditional branch	30	(blank)	(none)
	Invalid modifier	?	?	00
	Unsupported modifier	?	?	33

FIGURE CLF 912. TEST AND BRANCH

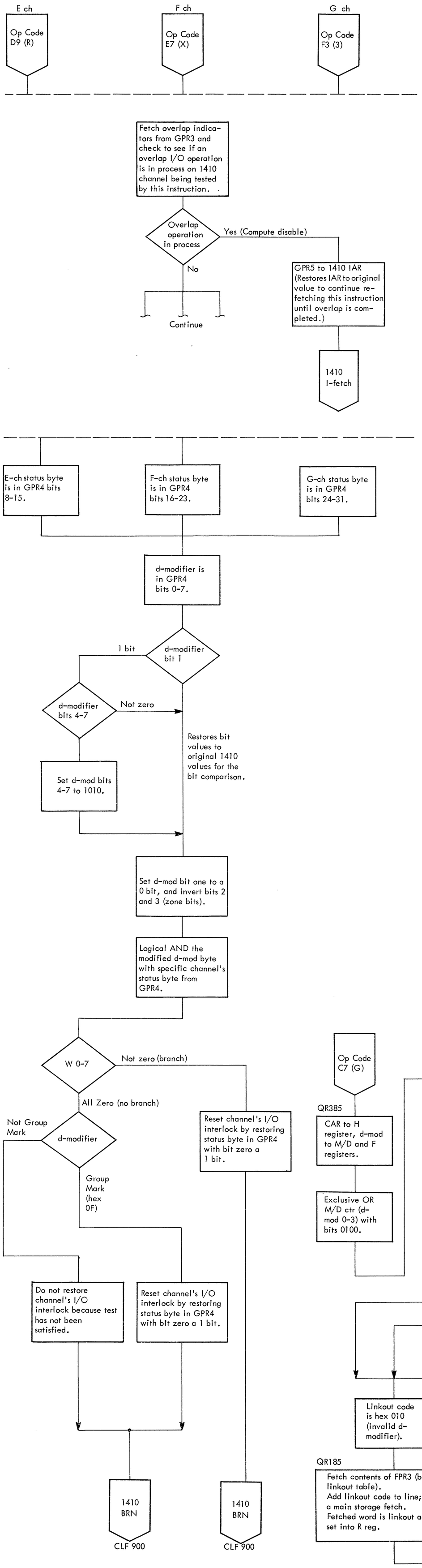
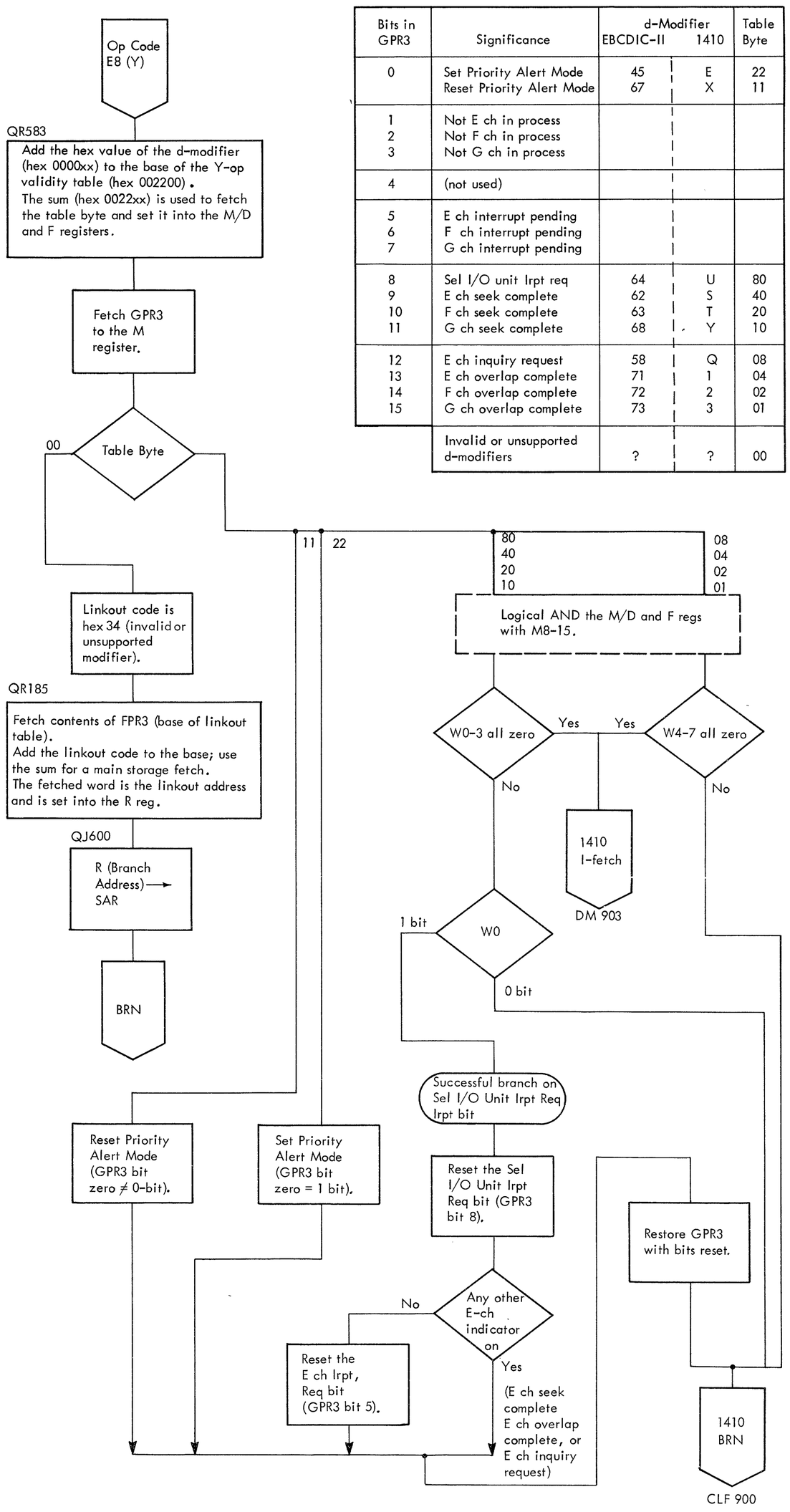
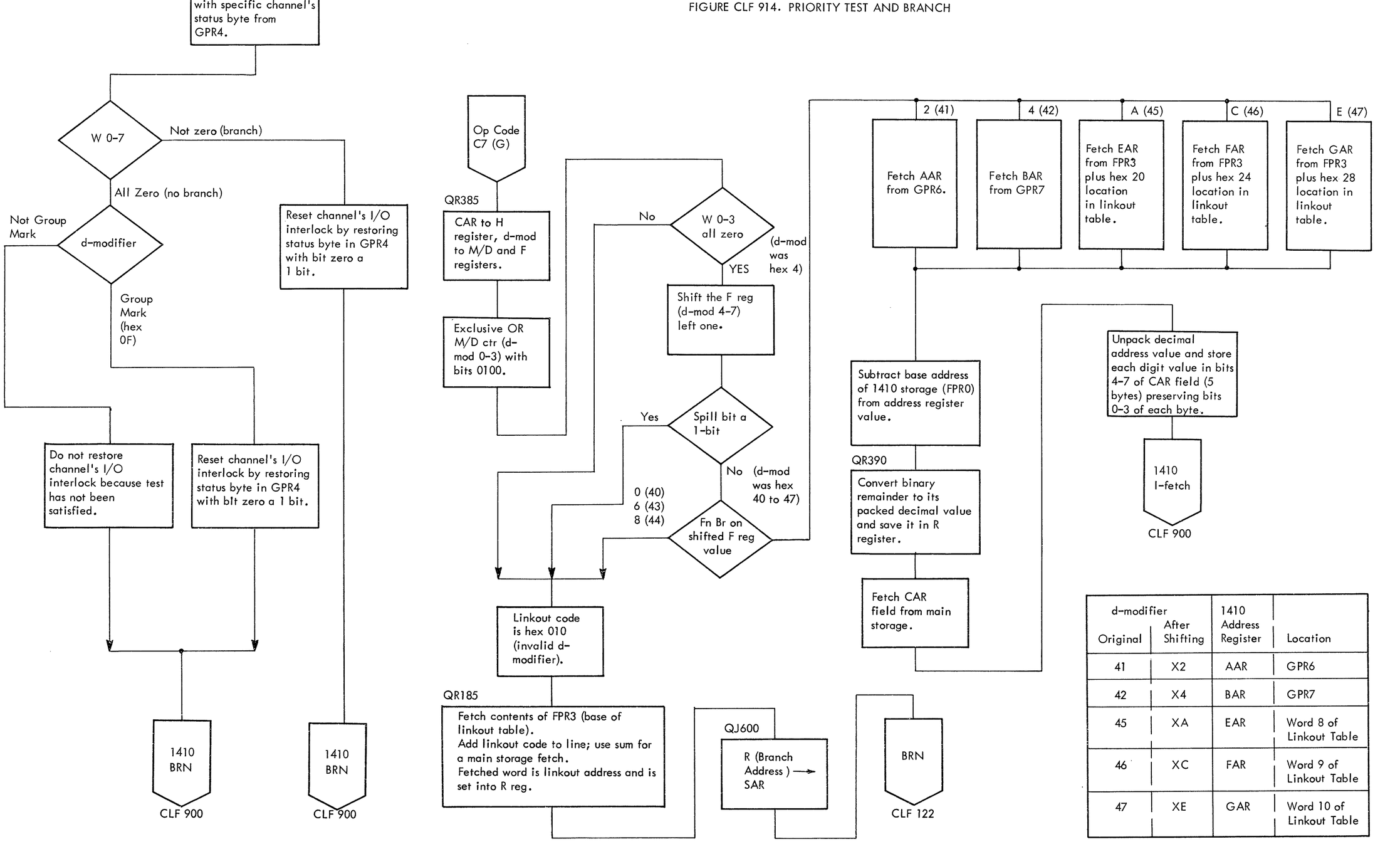


FIGURE CLF 913. BRANCH ON E/F/ OR G CHANNEL STATUS



Bits in GPR3	Significance	d-Modifier EBCDIC-II	d-Modifier 1410	Table Byte
0	Set Priority Alert Mode Reset Priority Alert Mode	45 67	E X	22 11
1 2 3	Not E ch in process Not F ch in process Not G ch in process			
4	(not used)			
5 6 7	E ch interrupt pending F ch interrupt pending G ch interrupt pending			
8 9 10 11	Sel I/O unit Irpt req E ch seek complete F ch seek complete G ch seek complete	64 62 63 68	U S T Y	80 40 20 10
12 13 14 15	E ch inquiry request E ch overlap complete F ch overlap complete G ch overlap complete	58 71 72 73	Q 1 2 3	08 04 02 01
	Invalid or unsupported d-modifiers	?	?	00

FIGURE CLF 914. PRIORITY TEST AND BRANCH



d-modifier Original	d-modifier After Shifting	1410 Address Register	Location
41	X2	AAR	GPR6
42	X4	BAR	GPR7
45	XA	EAR	Word 8 of Linkout Table
46	XC	FAR	Word 9 of Linkout Table
47	XE	GAR	Word 10 of Linkout Table

FIGURE CLF 915. STORE ADDRESS REGISTER

EBCDIC-II d-modifier	Function
62 59	Store CPU status Restore CPU status
45 46 47	Store E channel status Store F channel status Store G channel status
71 72 73	Restore E channel status Restore F channel status Restore G channel status

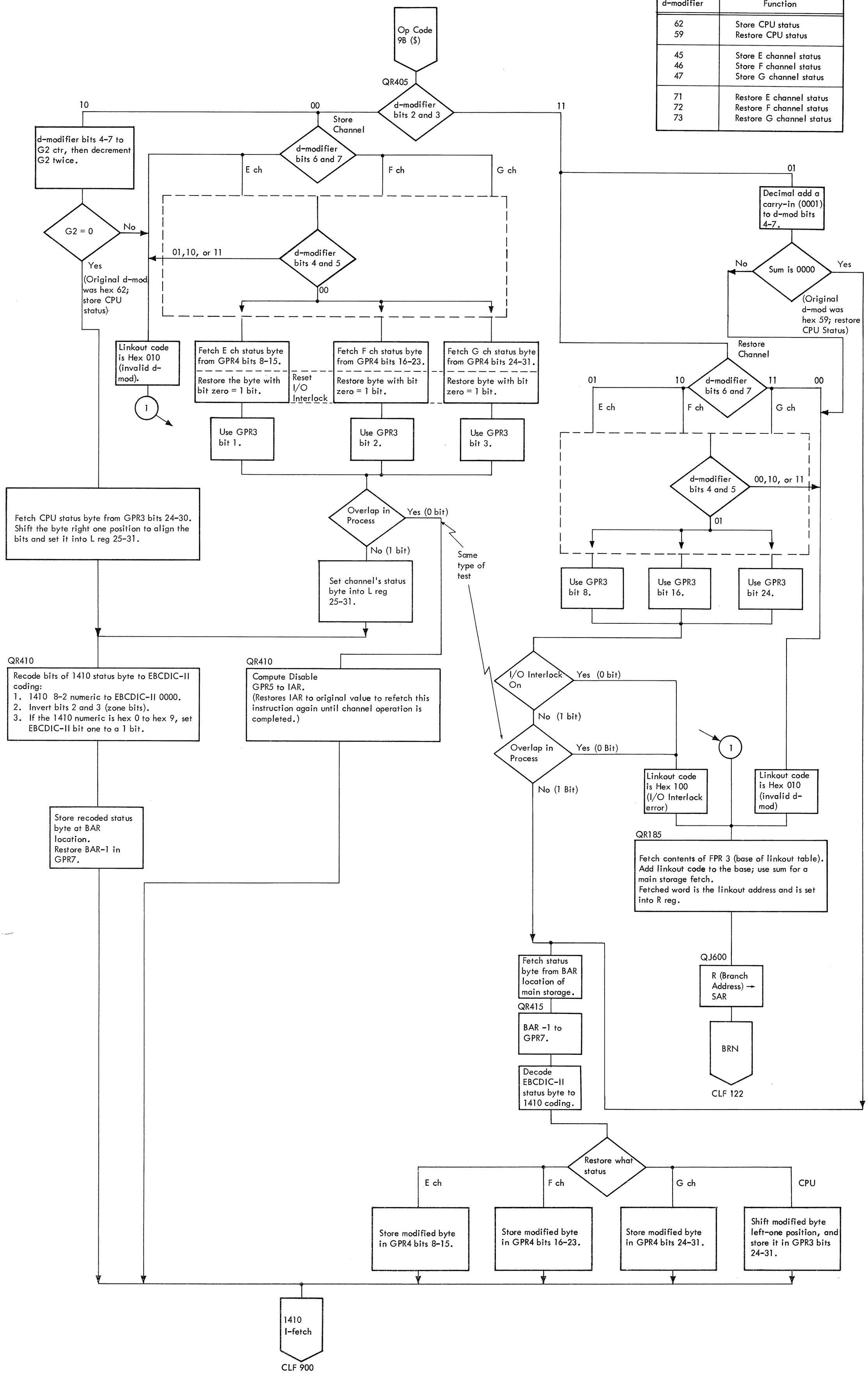


FIGURE CLF 916. STORE OR RESTORE STATUS

Form Z22-2833-4
Page Added 8/1/66
by FES Z22-6600-1

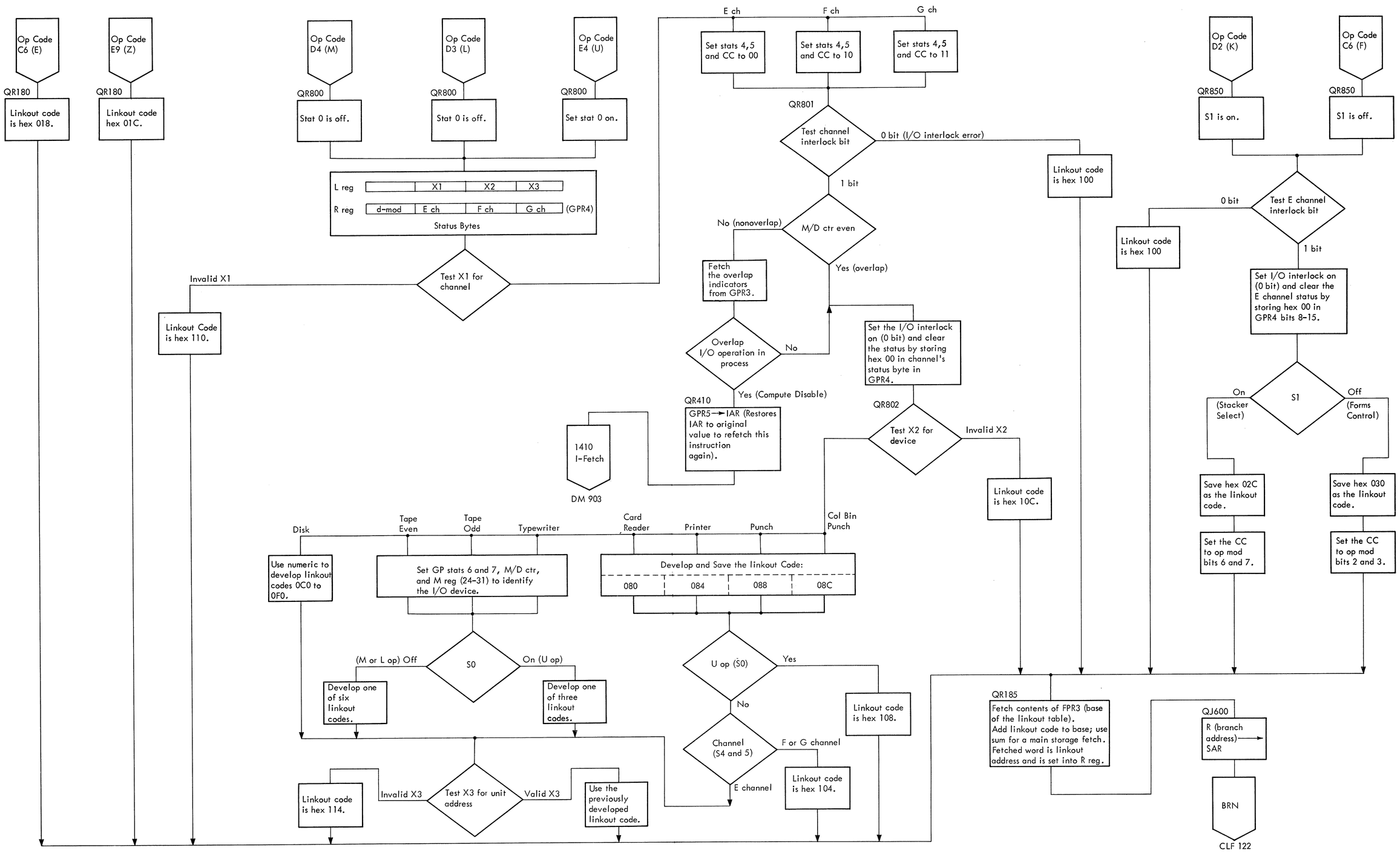


FIGURE CLF 917. EDIT/ZERO SUPPRESS/I/O INSTRUCTIONS

Linkback (8300 0AB1)
This routine is the program linkage from the emulator program back to the 1410 instruction stream.

QR181

Set PSW 0-31 from FPR6, bits 0-31.
Update the system word in GPR3 as follows:

Priority alert mode	bit 0
E, F, and G-ch in process	bits 1,2, and 3
1410 interrupt pending	bits 5,6, and 7
Y-branch indicators	bits 8-15
J-branch indicators (I/O)	bits 16-23
J-branch indicators (CPU)	bits 24-31

Set 1410 instruction address from GPR5 to 2050 IAR.

CLF 900

1410 I-Fetch

QR007

S/360 Exception

Bypass the System/360 exception test and resume 1410 instruction stream on QR010.

Special Scan (83x0 0A36)
This routine scans the 1410 I/O data field and counts the number of bytes anticipated by the 1410 I/O instruction. The resulting count is used in the System/360 CCW count field.

QR900

The odd-addressed GPR of the pair specified by GPR x contains the search address.

Valid Search Address
No
Yes

Interrupt code 5 to the F reg (invalid address)

Prog

CLF 122

Fetch byte from search address location.

Compare byte with GPR2, bits 0-7. A 1410 group mark-wordmark is coded hex 1F.

Equal
No
Yes

Any other ending condition
No
Yes

Increment search address.
Increment byte count.

Store byte count in GPR x

Set condition code to indicate stop conditions:
0 Stop character is at the starting address, or stop address is same as start address.
1 Stop character was not found and stop address terminated the search
2 No stop character was found before the stop address but count is valid.
3 Stop character was found at stop address.

Model 50 I-fetch

CLF 001

CCW Generate (83x0 0AB5)
This routine generates a string of CCWs for the disk emulation programs. Generated CCWs are stored in main storage, each one separated by two double words (room to insert two CCWs between the generated CCWs).

- Number of CCWx to be generated (00 = 256)
- Starting CCW address (double-word address)
- Command inserted into bits 0-7 of each CCW that is generated
- Starting data address for first CCW
- Flag-bits inserted into bits 32-39 of each CCW generated
- Starting count table address (half-word address)
- Total byte count of the 1410 data area

NC	CA	OP	DA	Flags	CTA	BC
GPR x		GPR x+1		GPR x+2		GPR x+3

QR910

GPR x bits 8-31 indicate the current CCW.
GPR x+1 bits 0-7 to bits 0-7 of current CCW.
GPR x+1 bits 8-31 to bits 8-31 of current CCW.
GPR x+2 bits 0-7 to bits 32-39 of current CCW.
Use GPR x+2 bits 8-31 to fetch two bytes from count table to put in bits 48-63 of current CCW.

GPR x bits 0-7 value decremented by one (NC).
GPR x+2 bits 8-31 value is incremented by ten (location of the next count value in the count table).
The GPR x+3 total byte count is decremented by the count value used in the generation of the last CCW (BC).

NC Value
Zero
Not Zero

BC Value
Zero or Minus
Plus

Increment GPR x bits 8-24 bytes.
Increment GPR x+1 bits 8-24 by count value used in last CCW.

Set CC = 3

Residual CCW count to GPR x+1 (the number of CCWs that were not generated)

BC Value
Minus
Zero
Plus

Set CC = 2

Set CC = 1

Set CC = 0

Data address of last CCW to GPR x +1

Model 50 I-fetch

CLF 001

GPR x contains address of last CCW generated.
GPR x+2 contains an address that is ten higher than the address of the last count table entry used.
GPR x+3 contains residual 1410 byte count.
If CC is 2 or 3, count may be in 2's complement form (negative) and indicates that the count of the CCWs is larger than the original GPR x+3 value.

FIGURE CLF 918. DIAGNOSE KERNELS (SHEET 1 OF 2)

Form 222-2833-4
Page Added 8/1/66
by FES 222-6600-1

Form Z22-2833-4
Page Added 8/1/66
by FES Z22-6600-1

Start I/O (83x0 0AB8)
This routine initiates a System/360 I/O operation on a selector channel that is simulating a 1410 tape or file operation. It permits special control bits in CAW 4-7 and CCW 37-39 to modify the selector channel operation.

QR920

Load CPU registers with this data:

L reg	Unit Address 0—7		Ch Addr 8—20 21-23 / Unit Address 24—31	B1-D1 Sum
R reg	SP Key 0—3	1410E Tsltr 4—7	Command Address 8—31	CAW
M reg	Command 0—7		Data Address 8—31	CCW-1

Fn Br on CAW 4-7 (hex)

0 1 2 3 8 9 A B D F 4 5 6 7 C E

Set the 1410E Tsltr Control latches to:

- Even Move Tape
- Even Move File
- Even Load Tape
- Even Load File
- Odd Move Tape
- Odd Load Tape

Issue foul on start I/O to common channel.

Issue start I/O to common channel.

(1)

To CLF 225 on QK 701 to wait in the 153 countdown loop for the reply.

Device Table Search (83x0 0AD5)
This routine searches through a table for the matching channel address; then, within the channel address portion of the table, the search continues for the matching unit address.

QR930

Starting search address is FPR1, bits 8-31. Zero the subtable counter.

Fetch the word at the search address and compare byte 2 (bits 8-15) with byte 58 of main storage (old I/O PSW channel address).

Equal? — No → Compare subtable counter with FPR1, bits 0-7.

Equal? — No → Increment subtable counter by one. Increment search address by hex 050 (binary equivalent of 20 words) to jump to next subtable.

Equal? — Yes → Set Condition Code to 3. → Model 50 I-fetch → CLF 001

Equal? — Yes (matching table entry word is found) → Load address of matching table entry into GPR x. Set condition code to 0.

Bit Zero of Table Entry — 1 bit (Device Busy) → Fetch next word in subtable, and check channel address (byte 2) to see if it is the same.

Compare — Same → Fetch the word at the search address and compare byte 2 (bits 8-15) with byte 58 of main storage (old I/O PSW channel address).

Compare — Different → Set Condition Code to 1.

Bit Zero of Table Entry — 0 bit (Device Not Busy) → From FPR1, bits 8-31, subtract the branch code (bits 0-7 of matching table entry); then subtract hex 004. Difference is the branch address; it is set into the R register and SAR.

BRN

CLF 122

FIGURE CLF 918. DIAGNOSE KERNELS (SHEET 2 OF 2)

IBM FE Supplement

System/Unit System/360 Model 50

Re: Form No. Z22-2833-4

This Supplement No. Z22-6600-1

Date August 1, 1966

Previous Supplement Nos. None

FIELD ENGINEERING DIAGRAM MANUAL, IBM SYSTEM/360
MODEL 50--2050 PROCESSING UNIT, FORM Z22-2833-4

This supplement to the subject manual provides diagrams for the 7070/7074 Compatibility Feature, the 1410/7010 Compatibility Feature, system reset (CLF 126), and IPL (CLF 127). The system data flow diagram (SDF 000) has been updated to show new form numbers, and the 1052 Adapter diagrams (IOP 301-306) have been updated.

Changed or new figures are indicated by a vertical line in the table of contents and changed figures are indicated by the symbol (•) to the left of the figure title.

Substitute the attached table of contents, SDF pages, and revised IOP pages for respective pages in the manual. Insert CLF 126 and CLF 127 in the proper place, and add diagrams for the compatibility features at the back of the manual.

File this page at the back of the manual. It will provide a reference to changes, a method of determining that all amendments have been received, and a check that the publication contains the proper pages.

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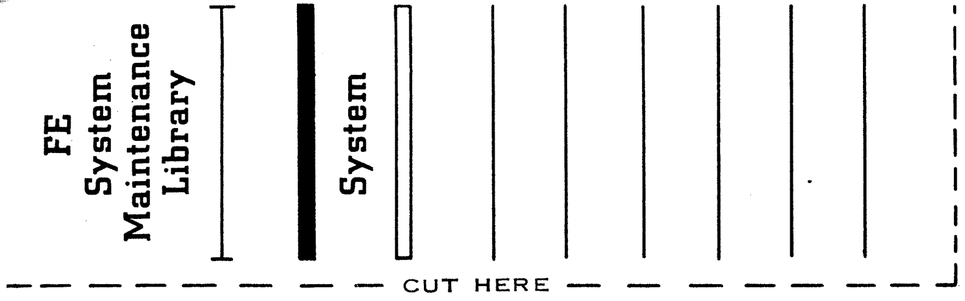

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