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NS CARD READER

PROGRAMMING MANUAL

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PREFACE

This manual provides the programming information for the 02-268 NS Card Reader.

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CHAPTER 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The 02-268 NS Card Reader Interface is designed to operate with either the M46-230/231 (400 Cards Per Minute) (CPM) Card Readers or the M46-236/237 (1000 CPM) Card Readers. Refer to Instruction Manual 29-383. When the M46-234 Code Conversion feature is specified, the 02-268 NS Card Reader Interface includes a hardware Hollerith to ASCII code converter which may be selected or bypassed under program control.

1.2 OPERATING PROCEDURES

In the sections which follow, the M46-230/231 Low Speed (400 CPM) Card Readers and the M46-236/237 High Speed (1000 CPM) Card Readers are covered separately since they are supplied by different vendors.

1.2.1 Low Speed Card Readers

1.2.1.1 Controls and Indicators. The 400 CPM Low Speed Card Readers are shown in Figure 1-1. Refer to Table 1-1 for the descriptions of the operating controls and indicators.

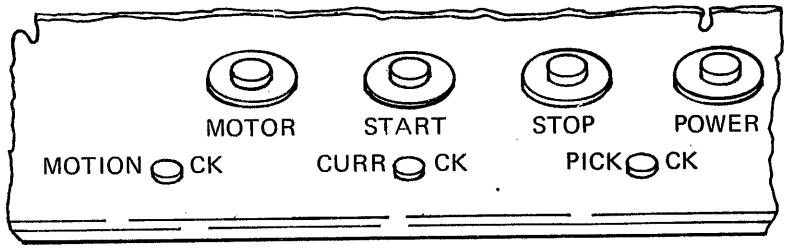


Figure 1-1 Control Panel for M46-230/231 Card Readers

1.2.1.2 Loading Procedure. After applying power to the card reader, allow a few minutes warm-up time. Place the cards face down in the hopper with the 12 edge (top edge) toward the operator. Additional cards may be added to the hopper without interfering with the operation.

1.2.1.3 Card Motion Error. If the interval between the time the selected card enters the read station and the time the card leaves does not correspond to 85 ± 1/3 columns (the total card width), the card motion indicator lights.

1.2.1.4 Light Current Error. When all photo-read-cells do not conduct whenever a card is not in the read station, the current indicator lights.

1.2.1.5 Dark Current Error. If all photo-read-cells do not go dark for some instants between the beginning of the card and Column 1, or between Column 80 and the end of the card, the current indicator lights.

TABLE 1-1 M46-230/231 OPERATOR CONTROLS AND INDICATORS

POWER (alternate switch/indicator)	Applies operating power to the DC power supply. Lights green in "power on" condition. Sets logic to initial conditions.
MOTOR (momentary switch/indicator)	Clears any trouble indications; starts drive motor, provided the conditions which caused the trouble indicated have been corrected. Lights green when motor starts.
START (momentary switch/indicator)	Conditions the logic to a Ready state, enabled to accept a Read command, provided the motor is on and no trouble exists. Lights green in "start" condition. If a Read command is present, or if the Interface connector has been removed for testing, card processing begins when this switch is actuated.
STOP (momentary switch/indicator)	Stops card processing, and inhibits the ready signal to the external equipment. Lights amber in "stop" condition. Reading of a card in process is completed before the stop.
PICK (indicator)	Lights red to indicate that a card did not reach the read station after a pick function. Stops reader motor.
MOTION (indicator)	Lights red to indicate an error sensed in the motion of a card through the read station. Stops reader motor.

TABLE 1-1 M46-230/231 OPERATOR CONTROLS AND INDICATORS
(Continued)

CURRENT CHECK (indicator)	Lights red to indicate malfunction of the read station due to the following conditions: Light Check - All photo transistor circuits are checked for performance, before card reading. Dark Check - Card entrance or departure, to and from the read station was improper.

1.2.2 High Speed Card Readers (M46-236/237)

1.2.2.1 Controls and Indicators. The 1000 CPM High Speed Card Readers are shown in Figure 1-2 and described in Table 1-2.

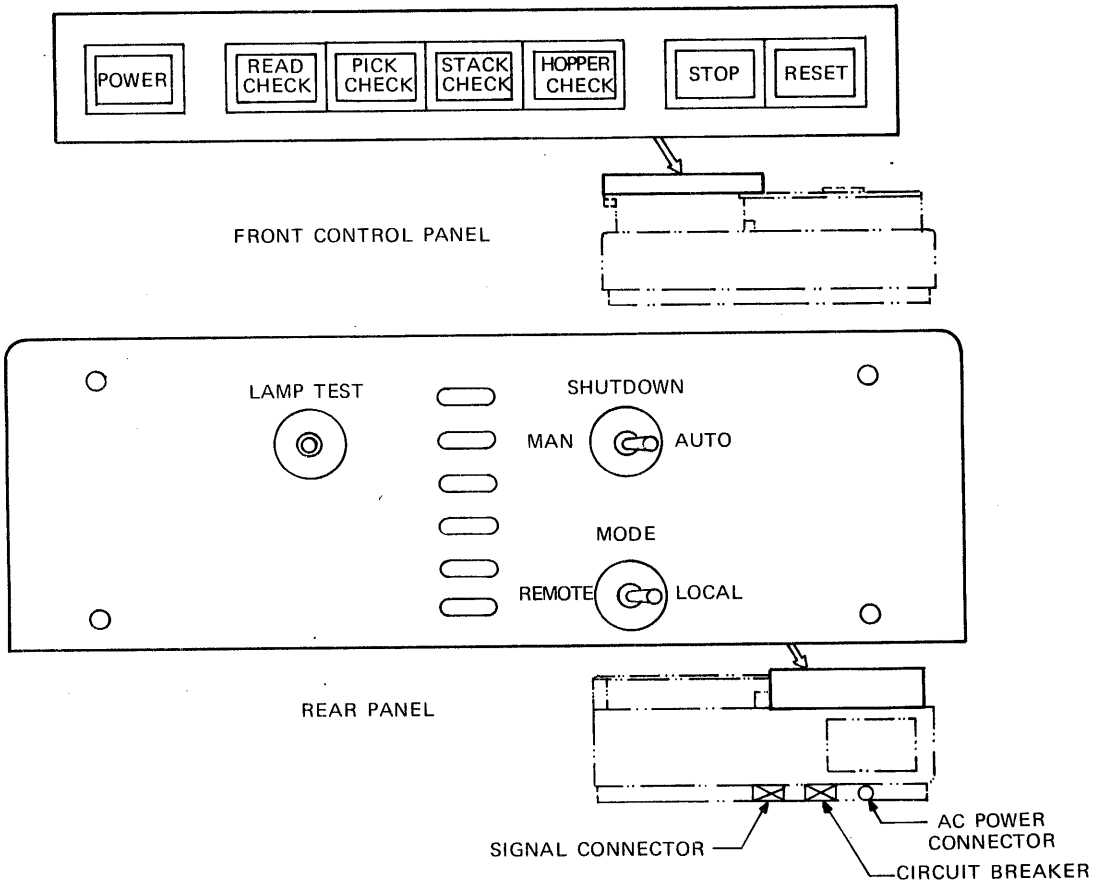


Figure 1-2 Switch and Indicator Location for M46-236 and 237 Card Readers

TABLE 1-2 M46-236/237 OPERATOR CONTROLS AND INDICATORS

FRONT CONTROL PANEL	
POWER (alternate switch/indicator)	Applies AC power to the reader. Lights white during the "power on" condition.
STOP (momentary switch/indicator)	Terminates reader operation at the end of a read cycle. Lights red when a "stop" condition is established.
RESET (momentary switch/indicator)	Clears error indicators and establishes "ready" condition. Lights green when "ready".
READ CHECK (indicator)	Lights orange when a "stop" condition is established due to any of the following: 1. Failure of leading or trailing edge dark check. 2. Failure of trailing edge dark check. 3. Card slippage. 4. Control logic failure.
PICK CHECK (indicator)	Lights orange when card fails to reach the read station after a "pick" command has been given to the reader.
STACK CHECK (indicator)	Lights orange when the previously read card fails to reach the output stacker (bin).
HOPPER CHECK (indicator)	Lights orange when either the input hopper (bin) is empty or the output stacker (bin) is full.

TABLE 1-2 M46-236/237 OPERATOR CONTROLS AND INDICATORS
(Continued)

REAR CONTROLS	
SHUTDOWN - MAN/AUTO (toggle switch)	Controls the power shut-down of the driver motor and vacuum/blower. In the MAN position, they run continuously when AC power is applied. When the AUTO position is selected, all motors turn off after the last card is read.
MODE - REMOTE/LOCAL (toggle switch)	Transfers reader control from the remote controller to the operator control panel.
LAMP TEST (momentary switch)	Powers all front panel lamps to test for lamp failure.

1.2.2.2 Operational Procedures. The following procedures explain both the operational sequence and some of the theory associated with the controls and indicators.

1. Place the AC power circuit breaker in the ON position to allow power ON/OFF control from the front panel.

2. Select the mode of operation, MAN or AUTO. When the MAN mode is selected, the drive and motor and vacuum/blower runs continuously when AC power is applied. When the AUTO mode of operation is selected, all motors turn off after the last card is read.

3. The second mode switch is used to select either REMOTE or LOCAL operations. When LOCAL operation is selected, card reader operations are controlled from the operator's control panel. In normal operation the card reader is connected to the appropriate interface logic and the switches are in the AUTO and REMOTE positions.

4. With the LOCAL mode of operation established, depress the POWER switch on the front panel to apply primary power to the reader. If the drive motor and vacuum/blower does not come on at this time, it is due to the input hopper being empty with AUTO shutdown selected.

5. Depress the LAMP TEST switch to check that all front panel indicators light.

6. Load the input hopper and depress the RESET switch. The RESET switch is a momentary action pushbutton indicator used to clear any error conditions and establish the card reader "ready" condition. When the "ready" condition is established, the RESET indicator lights green. All motors start and riffling action begins on the first half inch of cards.

7. As the cards are being read, the PICK CHECK indicator lights if a card has failed to reach the read head after a pick command has been given. Inspect the cards in the input hopper for excessive leading edge damage, interlocked webs, and cards stapled together. If no apparent card damage is present, check for excessive card warpage due to improper environmental control.

8. The READ CHECK indicator lights and the "stop" condition is established when any of the following conditions are detected.

    1. Failure of leading or trailing edge dark check.
    2. Failure of trailing edge light check.
    3. Card slippage.
    4. Control logic failure.

9. The STACK CHECK indicator lights if the previous card read has not reached the output stacker. Check the card track to make sure it is clear and check the output stacker for incorrectly stacked cards.

10. The HOPPER CHECK indicator lights when the input hopper is empty or when the output stacker is full. This is normal operation.

11. The STOP switch is a momentary action pushbutton switch indicator used to terminate card reader operation at the end of a read cycle. The STOP indicator lights red when the "stop" condition is established.

1.3 DATA FORMAT

Twelve bit binary in Normal mode, handled in two bytes. See Section 1-5.

Single eight bit ASCII byte in the Convert mode. Refer to Appendix D for the Hollerith to ASCII conversion table used with the Code Converter option.

1.4 PROGRAMMING INSTRUCTIONS

The following information applies to both the Low Speed and the High Speed Card Readers as presently supplied. Earlier models of the M46-230/231 Card Readers had a different status byte. This information is provided in Appendix E for reference purposes.

1.4.1 Status and Command Bytes

Status and command bytes for the 02-268 NS Card Reader Interface are shown in Table 1-3.

TABLE 1-3 STATUS AND COMMAND DEFINITIONS

BIT	0	1	2	3	4	5	6	7
STATUS	EOV	TBL	HCK	NMTN	BSY	EX	EOM	DU
COMMAND	DISABLE	ENABLE	FEED	CONVERT	CLEAR			

DISARM

STATUS:

EOV — Overflow. EOV is set in the Normal mode when the two data bytes are not taken before the next column of data arrives from the card reader. When the Hollerith to ASCII conversion hardware is enabled (Convert mode), EOV is set when the single data byte is not taken before the next column of data arrives from the card reader. It is possible, when EOV sets, that the last data byte read is meaningless. The EOV bit is reset by a FEED command, a System Initialize (at the Processor level) or by a CLEAR command.

TBL — Trouble. TBL is set when the card reader fails to "pick" a card following a FEED command, an illegally punched code is read in Convert Mode, or any time during the read cycle when an error condition is sensed within the card reader.

The error condition could be

1. Card Motion Error (card jammed)
2. Light Current Error
3. Dark Current Error

HCK — Hopper Check. HCK is set when there are no cards in the input hopper or the output stacker is full. The next FEED command cannot be executed and NMTN remains set. This is not set while the card is still in the read station.

NMTN — No Motion. NMTN is set at all times except for the interval of time between a FEED command and the time it takes the card to pass through the read station. If TBL, DU, EOM, or HCK occurs, NMTN remains reset until the trouble is manually corrected.

TABLE 1-3 STATUS AND COMMAND DEFINITIONS (Continued)

BSY	Busy. BSY is set while the Interface is waiting for data from the card reader. It resets when data is ready to be transferred. In the case where the Hollerith to ASCII conversion hardware is enabled (Convert mode), BSY is set after the single data byte is read. BSY is set by a FEED command, a System Initialize, or by a CLEAR command.
EX	Examine. EX is set when any of Bits 0, 1, 2, or 3 is set. EX is reset when all of Bits 0, 1, 2, and 3 are reset.
EOM	End of Medium. EOM is set when either NMTN is set or when HCK is set.
DU	Device Unavailable. DU is identical to TBL.
COMMANDS	
DISABLE	This command prevents the Interface from generating an interrupt. However, interrupts may be queued.
ENABLE	This command permits the Interface to interrupt.
DISARM	This command prevents interrupts from being generated; it resets any interrupts that may be queued, and prevents subsequent interrupts from being queued.
FEED	This command causes the card reader to pick a new card and read it. The FEED command sets the BSY bit and resets the EOV bit. If the card reader device is manually stopped (i.e., the Stop button depressed) the Interface queues the next FEED command; when manually restarted (i.e., the Start button depressed) a card will feed. This allows the card reader to be stopped and restarted without causing DU. Note that no action results if a FEED command is issued when TBL, HCK, or DU is set or if NMTN is reset. A FEED command will not be queued while a card is in the read station.
CONVERT	This command enables the Hollerith to ASCII conversion hardware. When running in the Covert mode, one data byte is read in for each transition of BSY. When running in the Normal mode, two data bytes are read in for each transition of BSY. The Interface is forced to the Normal mode on System Initialize, or any command when the CONVERT bit is not set or CLEAR command.
CLEAR	This command resets EOV and places the reader Interface in the Normal mode. This command sets NMTN and clears the Feed flip-flop. This command does not affect disable/enable disarm or BSY.

1.4.2 Instructions

Output Command (OC or OCR)	This instruction is used to send a command byte to the Card Reader Interface.
Sense Status (SS or SSR)	This instruction reads the status byte of the Card Reader Interface.
Read Data (RD or RDR)	This instruction is used to input a data byte from the Card Reader Interface.
Acknowledge Interrupt (AI or AIR)	This instruction allows the user to examine the device address and status byte when the Interface generates an interrupt. This instruction is valid on 16-bit Processors only.
Read Halfword (RH or RHR) and Read Block (RB or RBR)	These instructions can also be used with the Card Reader Interface to input data bytes.
Write Data (WD or WDR), Write Halfword (WH or WHR), and Write Block (WB or WBR)	These instructions are ignored by the Card Reader Interface.

1.5 PROGRAMMING SEQUENCES

The Card Reader can be programmed either by using a Sense Status loop or under Interrupt Control. Note that it cannot be programmed on 16-bit Processors using Auto Driver Channel. On 32-bit Processors, it can be programmed using Auto Driver Channel only if the interface has the Hollerith to ASCII translation PROM. This allows the data to be read on a byte basis, required feature of the Auto Driver Channel. A sample program using Auto Driver Channel is included in this specification.

1.5.1 Normal Mode

A card FEED command causes the card to move over the photo-read-cells, column by column, starting with column one. Every column read (blank columns are read as all bits zero) generates a data strobe for that column and initiates a data transfer cycle. The first Read Data instruction from the Processor reads the top six rows of the column; the second Read Data instruction reads the bottom six rows of that column. Bit numbers 0 and 1 are forced to zero. See Table 1-4.

TABLE 1-4 DATA BYTE FORMAT (NORMAL MODE)

BIT NUMBER	0	1	2	3	4	5	6	7	
ROW NUMBER			12	11	0	1	2	3	FIRST DATA BYTE
ROW N NUMBER			4	5	6	7	8	9	SECOND DATA BYTE

The Card Reader Interface may be given an Output command followed by a Sense Status to test for error conditions.

NOTE

If an error condition occurs (Bits 4:7 are high) in which the high order bits (Bits 0:3) are to be interrogated, a second Sense Status instruction should be given before testing the high order bits. This is to compensate for the difference in the time delay between status bit paths back to the Processor.

```
CKSTAT    SSR     DEV, STATUS
          BFC     8, NONBSY        Go Read Character
          BFC     4, CKSTAT        LOOP EX=0
          SSR     DEV, STATUS      EX=1, Extra Status Check
          THI     STATUS, X'E0'    Check Status Bits 0-2
          BNZ     TRBLE
```

If no errors are detected, each time Busy goes low, two Read Data instructions or a Read Halfword instruction must be given to read a column. If an attempt is made to give the Interface a Write command, it is ignored.

1.5.2 Convert Mode

This mode is the same as the Normal mode with the exception that only one Read Data instruction should be given to read an entire column. A non-standard character gives X'FF' in 7-bit ASCII code whereas a SPACE gives X'20' (See Appendix D, ASCII Card Code Conversion Table.) On 32-bit Processors, the Card Reader Interface with Hollerith to ASCII Conversion can be programmed using Auto Driver Channel. If the Interface is not equipped with the Code Converter option and an output Convert command is issued, the character X'FF' is read. This is treated as a non-printing RUBOUT on a TTY, Carriage Return on the M46-204/205 Line Printer and printed as an "Underline" on the M46-207/208/209/210 Line Printers.

NOTE

You can read in the Normal Mode by setting the command bits 3:4=01.

1.6 INTERRUPTS

When running under interrupt control, an Output command is given to enable interrupts and pick a card. The FEED command sets the Busy bit and after a column is available for reading, the Busy bit is reset and an interrupt is generated. Upon receipt of the interrupt, an Acknowledge Interrupt instruction is given if using a 16-bit Processor or 32-bit Processor in the Halfword mode, and a test for error conditions is made by checking the condition code. If no errors are present, a Read Data instruction may be given to read the column.

When enabled, an interrupt is generated when:

- The Busy bit changes from one to zero.
- The Examine bit changes from zero to one.

When disabled, interrupts are queued, Command Bits (0:1) = 10

When disarmed, interrupts are not generated or queued, Command Bits (0:1) = 11

If an Acknowledge Interrupt instruction is executed when no interrupt is pending, a device address of X'00' and a status of X'04' is returned (16-Bit Processor only).

Since interrupts are handled differently in the Fullword mode (32-bit Processor), a pointer is set up to direct program control to a service routine. The address of the pointer is given by: 2X Device Address + X'D0'. When the interrupt occurs, device status can be checked at R3 (register set 0). Return to the main program is via an LPSWR instruction where R0, R1 contain the old PSW.

1.7 INITIALIZATION

When the Processor is initialized, the Card Reader Interface is placed in the Normal mode, the No Motion, Busy, Examine and End of Medium bits are set, the Overflow bit is reset (Status = 00X111X), and interrupts are disarmed.

1.8 DEVICE NUMBER

The Card Reader Interface is normally assigned address X'04'. The Interface is strapped for this address at the factory. To change the address, refer to Sheet 2 of Functional Schematic 02-268D08.

1.9 SAMPLE PROGRAMS

Appendix B provides sample programs and flow charts for 16-Bit Processors (Model 4, 70, 7/16 etc.) using programmed status loops and interrupt control.

Appendix C provides sample programs and flow charts for 32-Bit Processors (Model 7/32 etc.) using program status loops, interrupt control, and Auto Driver Channel interrupt control.

1.10 HARDWARE CONVERSION OPTION

The M46-234 Code Conversion Kit performs the hardware Hollerith to ASCII conversion as established in Appendix D. Information for installing the kit is contained in the Card Reader Code Conversion Installation and Maintenance Manual, Publication Number 29-383.

APPENDIX A
SUMMARY INFORMATION
FOR STATUS AND COMMAND BYTES

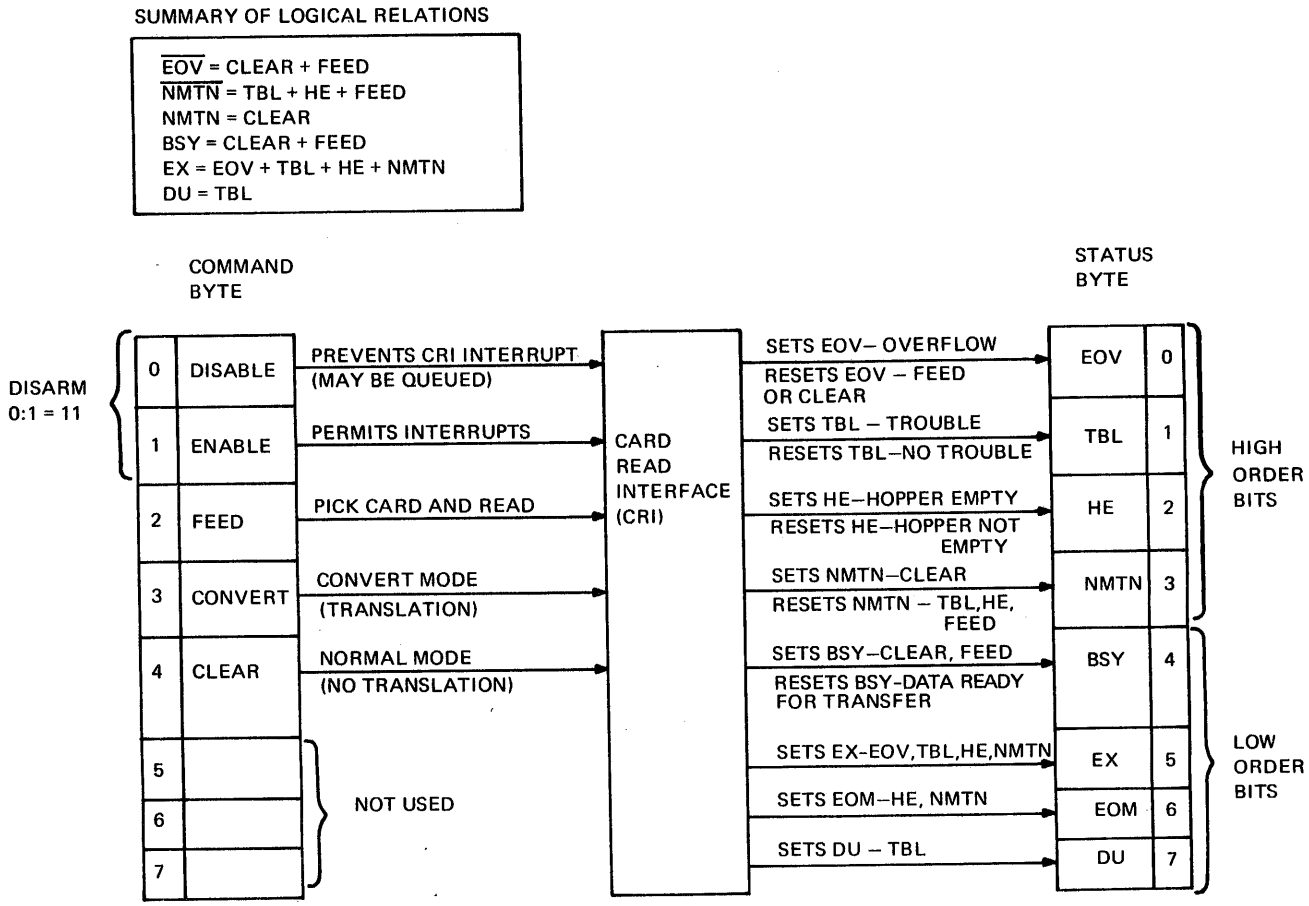
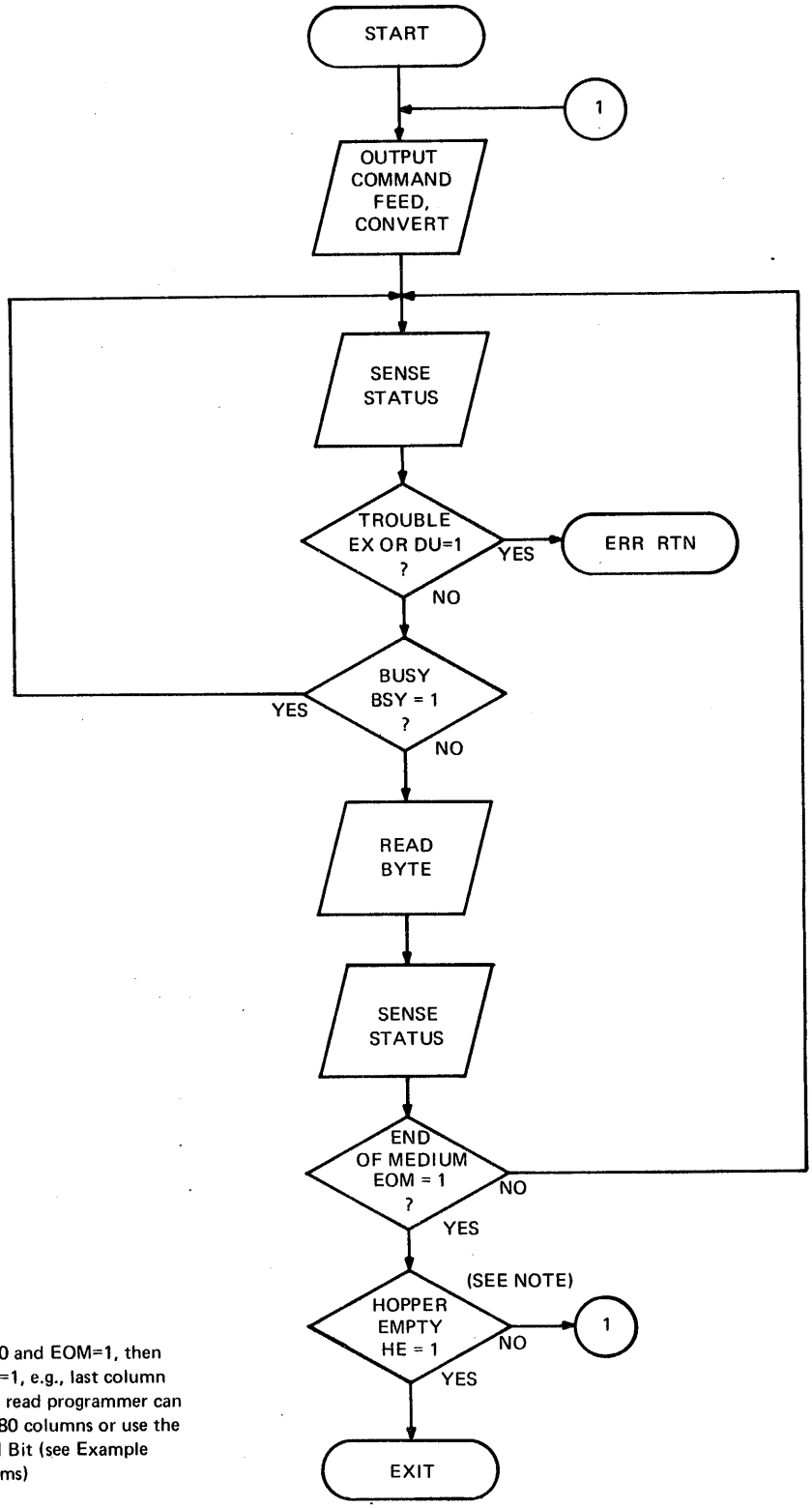


Figure A-1 Summary of Status and Command Byte Information

APPENDIX B
EXAMPLE PROGRAM LOGIC USING STATUS LOOPS

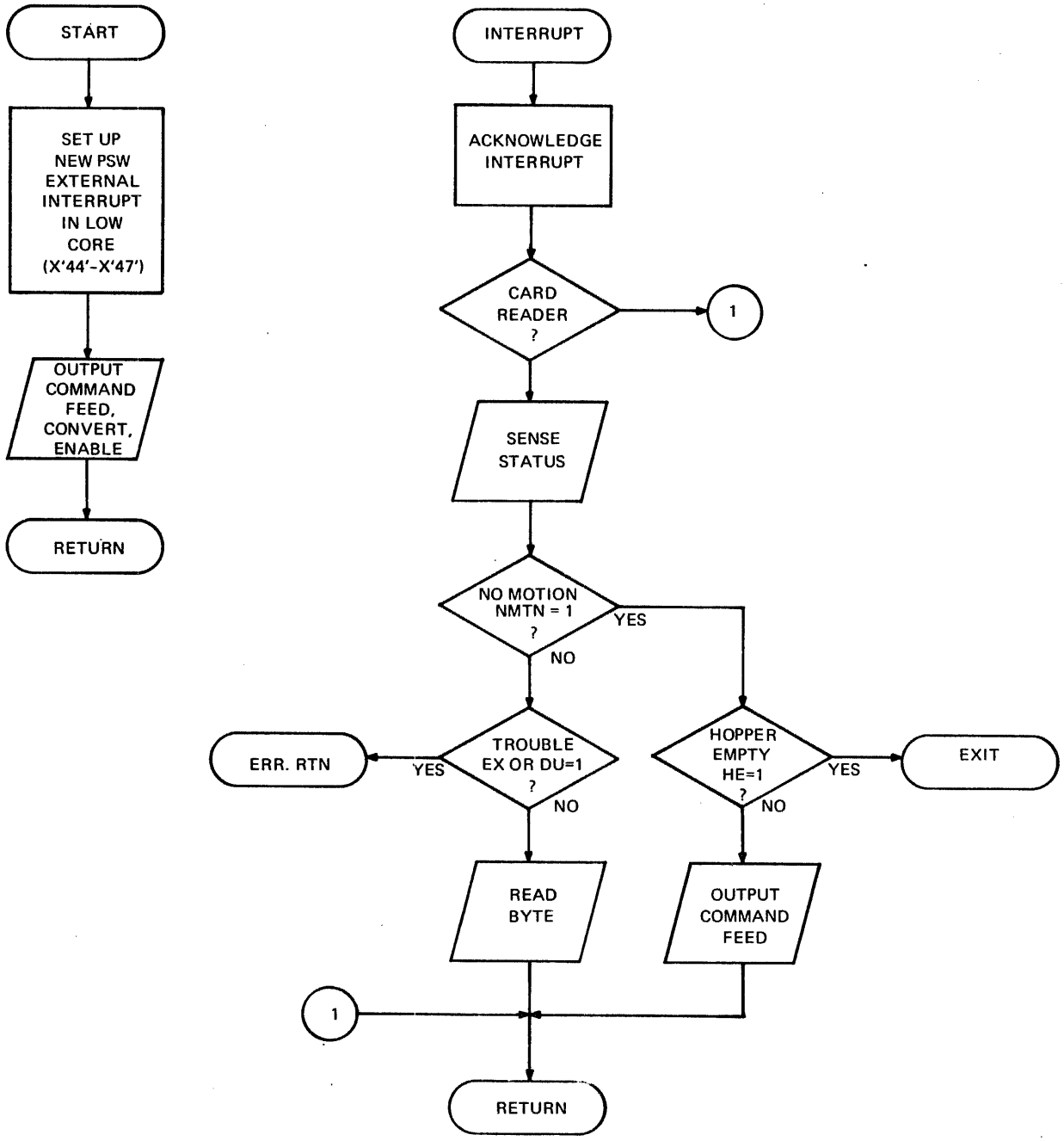


NOTE: If HE=0 and EOM=1, then NMTN=1, e.g., last column of card read programmer can count 80 columns or use the NMTN Bit (see Example Programs)

```
                    STATUS LOOPS, CONVERT MODE, 16-BIT PROCESSOR          16:18:49  05/15/80

PROG= CCRE          ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

                                    1           SCRAT                                                    SMPL0010
                                    2           WIDTH 120                                                SMPL0020
                                    3           TARGT 16                                                 SMPL0030
                                    4           CROSS                                                    SMPL0040
                                    5  CCRE     PROG  APPENDIX 2 STATUS LOOPS, CONVERT MODE, 16-BIT PROCESSOR  SMPL0050
                                    6  *                                                                SMPL0060
                                    7  * SAMPLE PROGRAM USING THE NS CARD READER INTERFACE              SMPL0070
                                    8  * THE CONVERT MODE, USING PROGRAMMED STATUS LOOPS.               SMPL0080
                                    9  *                                                                SMPL0090
            0000 0000              10  COUNT    EQU   0                                                  SMPL0100
            0000 0001              11  ONE      EQU   1                                                  SMPL0110
            0000 0001              12  DU       EQU   1                                                  SMPL0120
            0000 0002              13  COLUMN   EQU   2                                                  SMPL0130
            0000 0002              14  EOM      EQU   2                                                  SMPL0140
            0000 0003              15  INDEX    EQU   3                                                  SMPL0150
            0000 0004              16  DEVADR   EQU   4                                                  SMPL0160
            0000 0004              17  EX       EQU   4                                                  SMPL0170
            0000 0005              18  OUTCMD   EQU   5                                                  SMPL0180
            0000 0006              19  STATUS   EQU   6                                                  SMPL0190
            0000 0008              20  BUSY     EQU   8                                                  SMPL0200
0000R       0004                   21  CRADR    DC    X'04'          CARD READER ADDRESS                 SMPL0210
0002R       0733                   22  START    XHR   INDEX,INDEX    ZERO INDEX REGISTER                 SMPL0220
0004R       2411                   23           LIS   ONE,1          SET INCREMENT VALUES                SMPL0230
0006R       C820 004F              24           LHI   COLUMN,79      SET BXLE LIMIT                      SMPL0240
000AR       4840 0000R             25           LH    DEVADR,CRADR   SET DEVICE ADDRESS                  SMPL0250
000ER       C850 00F0              26           LHI   OUTCMD,X'F0'   SET OUTPUT COMMAND                  SMPL0260
0012R       0700                   27  NEXT     XHR   COUNT,COUNT    ZERO BXLE REGISTERS                 SMPL0270
0014R       9E45                   28           OCR   DEVADR,OUTCMD   GIVE OUTPUT COMMAND                SMPL0280
0016R       9D46                   29  SENSE    SSR   DEVADR,STATUS   GET DEVICE STATUS                   SMPL0290
0018R       4250 0040R             30           BTC   EX+DU,TROUBLE  EX OR DU STOP                       SMPL0300
001CR       4280 0016R             31           BTC   BUSY,SENSE     WAIT FOR BUSY = 0                   SMPL0310
0020R       DB43 0048R             32           RD    DEVADR,BUF(INDEX)  READ FIRST SIX ROWS              SMPL0320
0024R       DB43 0049R             33           RD    DEVADR,BUF+1(INDEX)                                 SMPL0330
0028R       2632                   34           AIS   INDEX,2        INCREMENT INDEX                     SMPL0340
002AR       C100 0016R             35           BXLE  COUNT,SENSE    HAVE 80 COLUMNS BEEN RFA            SMPL0350
002ER       9D46                   36  WAIT     SSR   DEVADR,STATUS   GET DEVICE STATUS                   SMPL0360
0030R       4320 002ER             37           BFC   EOM,WAIT       IS EOM=1? NO, CHECK STATUS AGAIN    SMPL0370
0034R       C360 0002              38           THI   STATUS,EOM     YES, IS HE=1                        SMPL0380
0038R       4330 0012R             39           BZ    NEXT           NO, PICK A CARD                     SMPL0390
003CR       C200 0044R             40           LPSW  STOP           YES,HALT                            SMPL0400
0040R       C200 0044R             41  TROUBLE  LPSW  STOP                                               SMPL0410
0044R       8000                   42  STOP     DC    X'8000',START                                       SMPL0420
0046R       0002R
            0000 0048R             43  BUF      EQU   *                                                   SMPL0430
0048R                              44           END                                                       SMPL0440
```

```
                STATUS LOOPS, CONVERT MODE, 16-BIT PROCESSOR          16:18:49  05/15/80

ASSEMBLED BY CAL 03-066RU7-00   (32-BIT)

START OPTIONS:  T=16,ERLST

   NO CAL ERRORS
   NO CAL WARNINGS
    2 PASSES

 ABSTOP     0000 0000
 ADC        0000 0002
 BUF        0000 0048R      32      33      43*
 BUSY       0000 0008       20*     31
 COLUMN     0000 0002       13*     24
 COUNT      0000 0000       10*     27      27      35
 CRADR      0000 0000R      21*     25
 DEVADR     0000 0004       16*     25      28      29      32      33      36
 DU         0000 0001       12*     30
 EOM        0000 0002       14*     37      38
 EX         0000 0004       17*     30
 IMPTOP     0000 0048R
 INDEX      0000 0003       15*     22      22      32      33      34
 LADC       0000 0001
 NEXT       0000 0012R      27*     39
 ONE        0000 0001       11*     23
 OUTCMD     0000 0005       18*     26      28
 PURETOP    0000 0000R
 SENSE      0000 0016R      29*     31      35
 START      0000 0002R      22*     42
 STATUS     0000 0006       19*     29      36      38
 STOP       0000 0044R      40      41      42*
 TROUBLE    0000 0040R      30      41*
 WAIT       0000 002ER      36*     37
```

EXAMPLE PROGRAM LOGIC USING STATUS LOOPS



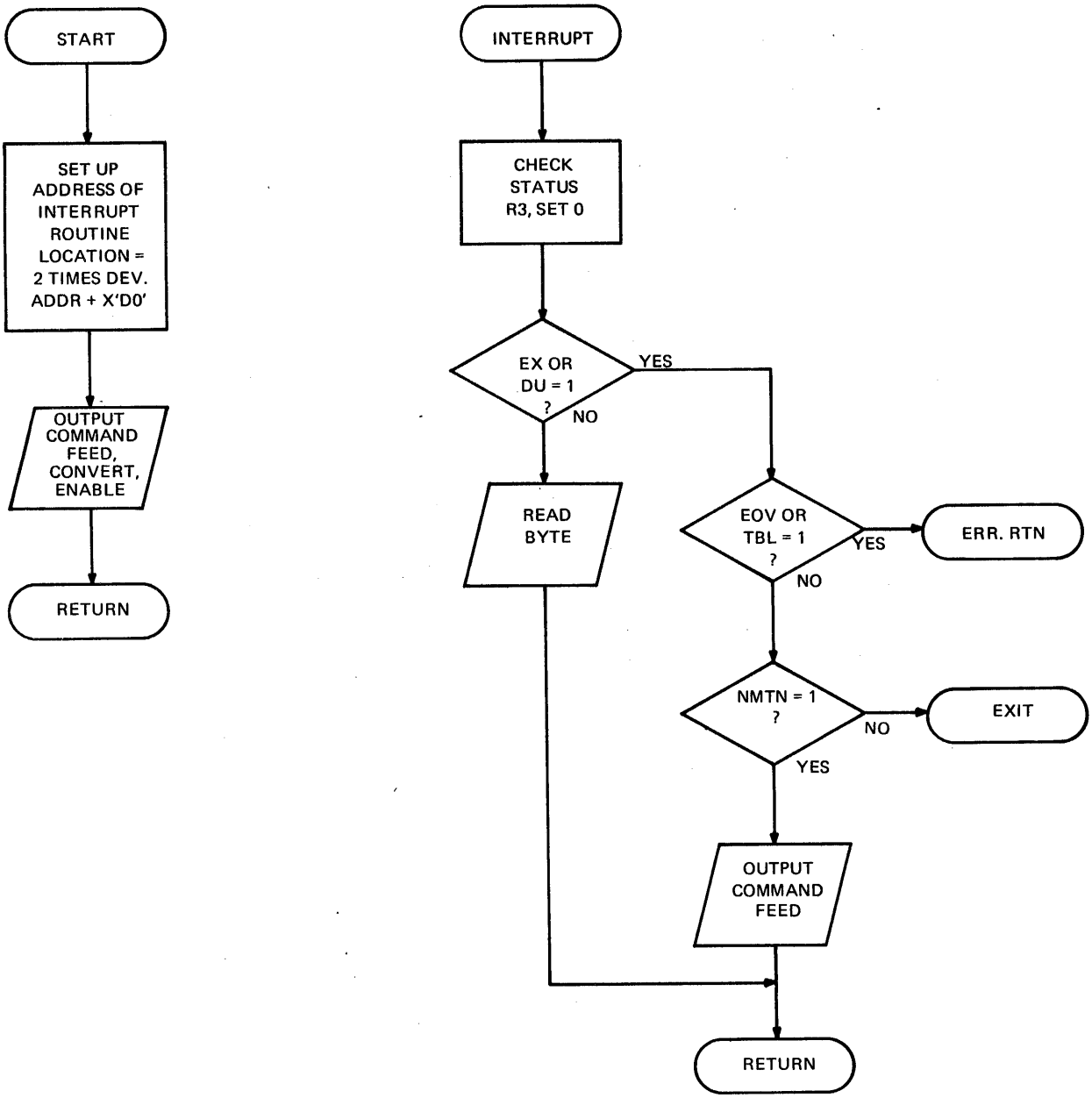
```
                    IMMED. INTERRUPTS, 16-BIT PROCESSOR                    16:18:55  05/15/80

PROG= CCRE          ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

                                    1           SCRAT                                                    SMPL0010
                                    2           WIDTH 120                                                SMPL0020
                                    3           TARGT 16                                                 SMPL0030
                                    4  CCRE     PROG  APPENDIX 2 IMMED. INTERRUPTS, 16-BIT PROCESSOR     SMPL0040
                                    5  *                                                                 SMPL0050
                                    6  * SAMPLE PROGRAM USING THE NS CARD READER INTERFACE               SMPL0060
                                    7  * THE NORMAL MODE, USING INTERRUPT CONTROL.                       SMPL0070
                                    8  *                                                                 SMPL0080
          0000 0000                 9  COUNT    EQU   0                                                  SMPL0090
          0000 0001                10  DU       EQU   1                                                  SMPL0100
          0000 0001                11  ONE      EQU   1                                                  SMPL0110
          0000 0002                12  EOM      EQU   2                                                  SMPL0120
          0000 0002                13  TWO      EQU   2                                                  SMPL0130
          0000 0003                14  INDEX    EQU   3                                                  SMPL0140
          0000 0004                15  EX       EQU   4                                                  SMPL0150
          0000 0004                16  DEVADR   EQU   4                                                  SMPL0160
          0000 0005                17  OUTCMD   EQU   5                                                  SMPL0170
          0000 0006                18  STATUS   EQU   6                                                  SMPL0180
          0000 0007                19  STORE    EQU   7                                                  SMPL0190
          0000 0008                20  BUSY     EQU   8                                                  SMPL0200
          0000 0020                21  HE       EQU   X'20'                                              SMPL0210
0000R     0004                     22  CRADR    DC    X'04'          CARD READER ADDRESS                 SMPL0220
0002R     0733                     23  START    XHR   INDEX,INDEX    ZERO INDEX REGISTER                 SMPL0230
0004R     0700                     24           XHR   COUNT,COUNT    ZERO COUNTER                        SMPL0240
0006R     2411                     25           LIS   ONE,1          SET INCREMENT VALUES                SMPL0250
0008R     2422                     26           LIS   TWO,2                                               SMPL0260
000AR     4840 0000R               27           LH    DEVADR,CRADR   SET DEVICE ADDRESS                 SMPL0270
000ER     C850 0060                28           LHI   OUTCMD,X'60'    SET OUTPUT COMMAND                  SMPL0280
0012R     9E45                     29           OCR   DEVADR,OUTCMD   ISSUE OUTPUT COMMAND                SMPL0290
0014R     C200 0052R               30           LPSW  WAIT           LOAD PSW AND WAIT FOR INTERRUPT     SMPL0300
0018R     9F76                     31  INT      AIR   STORE,STATUS   CLEAR INTERRUPT                     SMPL0310
001AR     0574                     32           CLHR  STORE,DEVADR   DID CARD READER INTERRUPT            SMPL0320
001CR     4230 0034R               33           BNE   RETURN         NO, RETURN                          SMPL0330
0020R     C500 0050                34           CLHI  COUNT,80       HAVE 80 COLUMNS BEEN READ?          SMPL0340
0024R     4230 0038R               35           BNE   RETURN+4       NO, CHECK FOR TROUBLE               SMPL0350
0028R     C360 0020                36           THI   STATUS,HE      IS HOPPER EMPTY?                    SMPL0360
002CR     4230 004ER               37           BNE   TROBLE         YES,HALT                            SMPL0370
0030R     0700                     38           XHR   COUNT,COUNT    NO,ZERO COUNT                       SMPL0380
0032R     9E45                     39           OCR   DEVADR,OUTCMD   ISSUUE OUTPUT COMMAND              SMPL0390
0034R     C200 0052R               40  RETURN   LPSW  WAIT           ENABLE EXTERNAL INTERRUPT           SMPL0400
0038R     9D46                     41           SSR   DEVADR,STATUS   GET DEVICE STATUS                   SMPL0410
003AR     4270 004ER               42           BTC   EX+DU+EOM,TROBLE  IF EX, EOM OR DU=1, HALT         SMPL0420
003ER     DB43 005AR               43           RD    DEVADR,BUF(INDEX)  READ FIRST SIX ROWS             SMPL0430
0042R     DB40 005BR               44           RD    DEVADR,BUF+1   (INDEX)                             SMPL0440
0046R     0A32                     45           AHR   INDEX,TWO      INCREMENT INDEX                     SMPL0450
0048R     0A01                     46           AHR   COUNT,ONE      INCREMENT COUNT                     SMPL0460
004AR     C200 0052R               47           LPSW  WAIT           ENABLE EXTERNAL INTERRUPTS          SMPL0470
004ER     C200 0056R               48  TROBLE   LPSW  STOP                                              SMPL0480
0052R     C000                     49  WAIT     DC    X'C000',INT                                        SMPL0490
0054R     0018R
0056R     8000                     50  STOP     DC    X'8000',START                                      SMPL0500
0058R     0002R
005AR     0000                     51  BUF      DC    0                                                  SMPL0510
005CR                              52           END                                                      SMPL0520
```

```
                IMMED. INTERRUPTS, 16-BIT PROCESSOR                16:18:55  05/15/80

ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

START OPTIONS:  T=16,ERLST

   NO CAL ERRORS
   NO CAL WARNINGS
    2 PASSES

 ABSTOP     0000 0000
 ADC        0000 0002
 BUF        0000 005AR
 BUSY       0000 0008
 COUNT      0000 0000
 CRADR      0000 0000R
 DEVADR     0000 0004
 DU         0000 0001
 EOM        0000 0002
 EX         0000 0004
 HE         0000 0020
 IMPTOP     0000 005CR
 INDEX      0000 0003
 INT        0000 0018R
 LADC       0000 0001
 ONE        0000 0001
 OUTCMD     0000 0005
 PURETOP    0000 0000R
 RETURN     0000 0034R
 START      0000 0002R
 STATUS     0000 0006
 STOP       0000 0056R
 STORE      0000 0007
 TROBLE     0000 004ER
 TWO        0000 0002
 WAIT       0000 0052R
```

```
                    : STATUS LOOP,32 BIT PROCESSORS                    16:16:25  05/15/80

PROG= CCRE          ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

                                        1           SCRAT                                                    SMPL0010
                                        2           TARGT 32                                                 SMPL0020
                                        3           WIDTH 120                                                SMPL0030
                                        4           NORX3                                                    SMPL0040
                                        5           CROSS                                                    SMPL0050
                                        6   CCRE    PROG  APPENDIX 3 : STATUS LOOP,32 BIT PROCESSORS         SMPL0060
                                        7   *                                                                SMPL0070
                                        8   * SAMPLE PROGRAM USING THE NS CARD READER INTERFACE              SMPL0080
                                        9   * THE CONVERT MODE, USING PROGRAMMED STATUS LOOPS.               SMPL0090
                                       10   *                                                                SMPL0100
                                       11   INDEX   EQU   3                                                  SMPL0110
          0000 0003                    12   DEVADR  EQU   4                                                  SMPL0120
          0000 0004                    13   OUTCMD  EQU   5                                                  SMPL0130
          0000 0005                    14   STATUS  EQU   6                                                  SMPL0140
          0000 0006                    15   CRADR   DC    X'04'       CARD READER ADDRESS                   SMPL0150
000000I   0004                         16   DU      EQU   1           DEVICE UNAVAILABLE                    SMPL0160
          0000 0001                    17   EOM     EQU   2           END OF MEDIAN                         SMPL0170
          0000 0002                    18   EX      EQU   4           EXAMINE                               SMPL0180
          0000 0004                    19   BUSY    EQU   8           BUSY                                  SMPL0190
          0000 0008                    20   HE      EQU   X'20'       HOPPER EMPTY                          SMPL0200
          0000 0020                    21   START   XR    INDEX,INDEX ZERO INDEX REGISTER                   SMPL0210
000002I   0733                         22           LH    DEVADR,CRADR SET DEVICE ADDRESS                   SMPL0220
000004I   4840 FFF8 =000000I           23           LHI   OUTCMD,X'F0' SET OUTPUT COMMAND: DISABLE FEED CONV SMPL0230
000008I   C850 00F0                    24   NEXT    OCR   DEVADR,OUTCMD ISSUE OUTPUT COMMAND                SMPL0240
00000CI   9E45                         25   SENSE   SSR   DEVADR,STATUS GET DEVICE STATUS                   SMPL0250
00000EI   9D46                         26           BTC   EOM,TROUBLE  IS EOM=0? YES,CHECK HOPPER          SMPL0260
000010I   4220 801E =000032I           27           BTC   EX+DU,TROUBLE EX OR DU=1? STOP                    SMPL0270
000014I   4250 801A =000032I           28           BTC   BUSY,SENSE   WAIT FOR BUSY = 0                    SMPL0280
000018I   4280 FFF2 =00000EI           29           RH    DEVADR,BUF(INDEX) READ FIRST SIX ROWS             SMPL0290
00001CI   D943 8020 =000040I           30           RH    DEVADR,BUF+1(INDEX)                               SMPL0300
000020I   D943 801D =000041I           31           AIS   INDEX,2     INCREMENT INDEX                       SMPL0310
000024I   2632                         32           B     SENSE                                             SMPL0320
000026I   4300 FFE4 =00000EI           33           THI   STATUS,HE   YES,IS HE=1? (HOPPER EMPTY))          SMPL0330
00002AI   C360 0020                    34           BZ    NEXT        NO,PICK A CARD                        SMPL0340
00002EI   4330 FFDA =00000CI           35   TROUBLE LPSW  STOP                                              SMPL0350
000032I   C200 8002 =000038I           36           ALIGN 8                                                 SMPL0360
000038I                                37   STOP    DC    Y'80F0',START                                     SMPL0370
000038I   0000 80F0
00003CI   0000 0002I                                                                                        SMPL0380
          0000 0040I                   38   BUF     EQU   *                                                 SMPL0390
000040I                                39           END
```

```
                : STATUS LOOP,32 BIT PROCESSORS                    16:16:25  05/15/80
ASSEMBLED BY CAL 03-066R07-00    (32-BIT)

START OPTIONS:  T=32,ERLST

   NO CAL ERRORS
   NO CAL WARNINGS
    2 PASSES

ABSTOP     0000 0000
ADC        0000 0004
BUF        0000 0040I      29      30      38*
BUSY       0000 0008       19*     28
CRADR      0000 0000I      15*     22
DEVADR     0000 0004       12*     22      24      25      29      30
DU         0000 0001       16*     27
EOM        0000 0002       17*     26
EX         0000 0004       18*     27
HE         0000 0020       20*     33
IMPTOP     0000 0040I      39
INDEX      0000 0003       11*     21      21      29      30      31
LADC       0000 0002
NEXT       0000 000CI      24*     34
OUTCMD     0000 0005       13*     23      24
PURETOP    0000 0000P      39
SENSE      0000 000EI      25*     28      32
START      0000 0002I      21*     37
STATUS     0000 0006       14*     25      33
STOP       0000 0038I      35      37*
TROUBLE    0000 0032I      26      27      35*
```

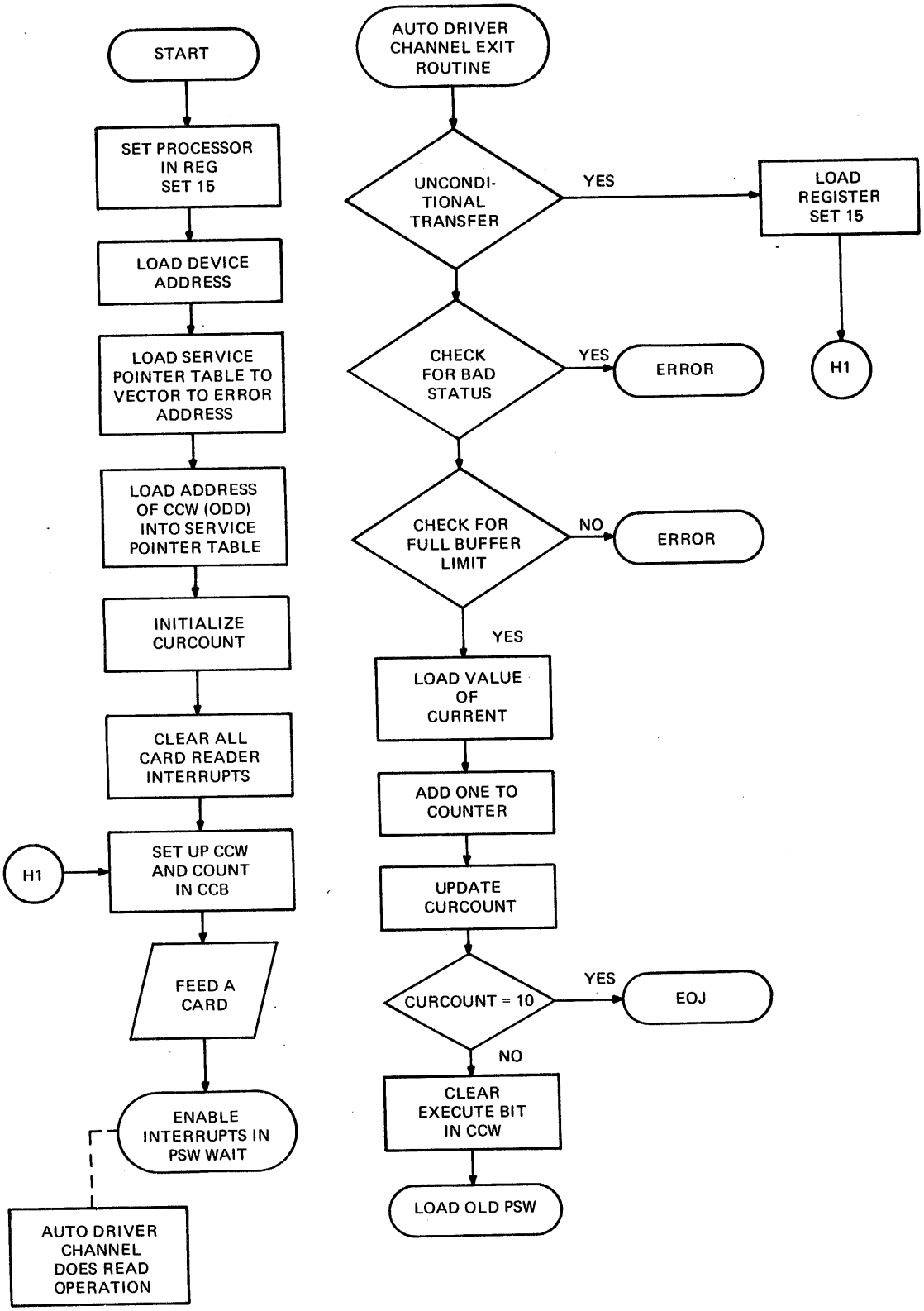
APPENDIX C
EXAMPLE PROGRAM LOGIC USING INTERRUPT CONTROL 32 BIT PROCESSOR



```
                    : IMMED. INTERRUPT, 32-BIT PROCESSOR                    09:43:39  05/16/80

PROG= CCRE      ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

                                    1           SCRAT                                                   SMPL0010
                                    2           WIDTH 120                                               SMPL0020
                                    3           TARGT 32                                                SMPL0030
                                    4           NORX3                                                   SMPL0040
                                    5           CROSS                                                   SMPL0050
                                    6   CCRE    PROG                : IMMED. INTERRUPT, 32-BIT PROCESSOR SMPL0060
                                    7   *                                                               SMPL0070
                                    8   * SAMPLE PROGRAM USING THE NS CARD READER INTERFACE             SMPL0080
                                    9   * THE NORMAL MODE, USING INTERRUPT CONTROL.                     SMPL0090
                                   10   *                                                               SMPL0100
          0000 0000                11   R0      EQU   0                                                 SMPL0110
          0000 0001                12   R1      EQU   1                                                 SMPL0120
          0000 0002                13   R2      EQU   2                                                 SMPL0130
          0000 0003                14   R3      EQU   3                                                 SMPL0140
          0000 0008                15   R8      EQU   8                                                 SMPL0150
          0000 0009                16   R9      EQU   9                                                 SMPL0160
          0000 0006                17   TWO     EQU   6                                                 SMPL0170
          0000 0007                18   INDEX   EQU   7                                                 SMPL0180
          0000 0004                19   DEVADR  EQU   4                                                 SMPL0190
          0000 0005                20   OUTCMD  EQU   5                                                 SMPL0200
          0000 0004                21   CRADR   EQU   X'04'          CARD READER ADDRESS                SMPL0210
          0000 0001                22   DU      EQU   1              DEVICE UNAVAILABLE                 SMPL0220
          0000 0004                23   EX      EQU   4              EXAMINE                            SMPL0230
          0000 0010                24   NMTN    EQU   X'10'                                             SMPL0240
          0000 0040                25   TBL     EQU   X'40'          TROUBLE                            SMPL0250
          0000 0080                26   EOV     EQU   X'80'          END OF VOLUME                      SMPL0260
0000001I  C200 8054 =0000581       27           LPSW  RSET0                                             SMPL0270
0000041   4880 0004                28   START   LH    R8,CRADR       LOAD CARD READER ADDRESS IN R8     SMPL0280
0000081   E690 8016 =0000221       29           LA    R9,CRDINT      LOAD INTERRUPT ADDRESS IN REG 9    SMPL0290
00000C1   4098 4800 00D0           30           STH   R9,X'D0'(R8,R8)                                   SMPL0300
0000121   0777                     31           XR    INDEX,INDEX    ZERO INDEX REGISTER                SMPL0310
0000141   4840 0004                32           LH    DEVADR,CRADR   SET DEVICE ADDRESS                 SMPL0320
0000181   C850 0060                33           LHI   OUTCMD,X'60'   SET OUTPUT COMMAND                 SMPL0330
00001C1   9E45                     34           OCR   DEVADR,OUTCMD  ISSUE OUTPUT COMMAND               SMPL0340
00001E1   C200 803E =0000601       35           LPSW  WAIT           LOAD PSW AND WAIT FOR INTERRUPT    SMPL0350
0000221   C330 0005                36   CRDINT  THI   R3,EX+DU      EX OR DU=1?                        SMPL0360
0000261   4230 800C =0000361       37           BNZ   OVFLO          YES,CHECK EOV BIT.                 SMPL0370
00002A1   D947 8044 =0000721       38           RH    DEVADR,BUF(INDEX)  READ FIRST SIX ROWS           SMPL0380
00002E1   D947 8041 =0000731       39           RH    DEVADR,BUF+1(INDEX)                               SMPL0390
0000321   2672                     40           AIS   INDEX,2        INCREMENT INDEX                    SMPL0400
0000341   1800                     41           LPSWR R0             ENABLE EXTERNAL INTERRUPTS         SMPL0410
0000361   C330 00C0                42   OVFLO   THI   R3,EOV+TBL    EOV OR TBL=1?                      SMPL0420
00003A1   4230 8012 =0000501       43           BNZ   TROBLE         YES, HALT                          SMPL0430
00003E1   C330 0010                44           THI   R3,NMTN        NMTN=1?                            SMPL0440
0000421   4230 8004 =00004A1       45           BNZ   FEED          YES, PICK A CARD                   SMPL0450
0000461   4300 8006 =0000501       46           B     TROBLE         NO, HOPPER EMPTY                   SMPL0460
00004A1   DE20 8023 =0000711       47   FEED    OC    R2,OUT+1       ISSUE OUTPUT COMMAND               SMPL0470
00004E1   1800                     48           LPSWR R0             ENABLE EXTERNAL INTERRUPT          SMPL0480
0000501   C200 8014 =0000681       49   TROBLE  LPSW  STOP                                              SMPL0490
0000581                            50           ALIGN 8                                                 SMPL0500
0000581   0000 4000                51   RSET0   DC    Y'4000',START                                     SMPL0510
00005C1   0000 0004I
0000601   0000 C000                52   WAIT    DC    Y'C000',START                                     SMPL0520
```

```
                  : IMMED. INTERRUPT, 32-BIT PROCESSOR                  09:43:39  05/16/80

000064I  0000 0004I                                                               SMPL0530
000068I  0000 80F0            53  STOP    DC    Y'80F0',START
00006CI  0000 0004I                                                               SMPL0540
000070I  0060                 54  OUT     DC    X'60'                             SMPL0550
000072I  0000 0000            55  BUF     DC    0                                 SMPL0560
000076I                       56          END
```

EXAMPLE PROGRAM LOGIC USING AUTO DRIVER CHANNEL (32 BIT PROCESSOR)



```
                    : AUTO DRIVER CHANNEL, 32-BIT PROCESSORS                    10:20:00  05/16/80

PROG= CCRE          ASSEMBLED BY CAL 03-066R07-00   (32-BIT)

                                                    1           SCRAT                                                   SMPL0010
                                                    2           CROSS                                                   SMPL0020
                                                    3           TARGT 32                                                SMPL0030
                                                    4           WIDTH 120                                               SMPL0040
                                                    5           NORX3                                                   SMPL0050
                                                    6   CCRE    PROG            : AUTO DRIVER CHANNEL, 32-BIT PROCESSORS SMPL0060
                                                    7   *                                                               SMPL0070
                                                    8   * THIS PROGRAM IS AN EXAMPLE OF THE NS CARD READER            SMPL0080
                                                    9   * USING THE AUTO DRIVER CHANNEL TO READ 10 CARDS.             SMPL0090
                                                   10   *                                                               SMPL0100
                                                   11   * NOTE: 32-BIT PROCESSORS ONLY                                 SMPL0110
                                                   12   *                                                               SMPL0120
                                                   13   *                                                               SMPL0130
                                                   14   * SET UP REGISTERS                                            SMPL0140
                                                   15   *                                                               SMPL0150
                0000 0000                          16   R0      EQU   0                                                 SMPL0160
                0000 0001                          17   R1      EQU   1                                                 SMPL0170
                0000 0003                          18   DEVADR  EQU   3                                                 SMPL0180
                0000 0004                          19   CCB     EQU   4                                                 SMPL0190
                0000 0005                          20   R5      EQU   5                                                 SMPL0200
                0000 0006                          21   R6      EQU   6                                                 SMPL0210
                0000 0007                          22   R7      EQU   7                                                 SMPL0220
                0000 0008                          23   R8      EQU   8                                                 SMPL0230
                0000 0009                          24   R9      EQU   9                                                 SMPL0240
                0000 000A                          25   R10     EQU   10                                                SMPL0250
                0000 000F                          26   R15     EQU   15                                                SMPL0260
0000001I  F870  0000 00F0                          27   START   LI    R7,Y'00F0'                                        SMPL0270
0000061I  9567                                     28           EPSR  R6,R7             ACTIVATE REGISTER SET 15        SMPL0280
0000081I  4830  808A =000096I                      29           LH    DEVADR,CRADR      LOAD CARD READER ADDRESS        SMPL0290
                                                   30   *                                                               SMPL0300
                                                   31   * SET UP INTERRUPT SERVICE POINTER TABLE                       SMPL0310
                                                   32   *                                                               SMPL0320
00000CI   0799                                     33           XR    R9,R9             ZERO OUT R9                     SMPL0330
00000EI   C880  0088I                              34           LHI   R8,ERROR          LOAD ERROR ROUTINE ADDRESS      SMPL0340
0000121   4089  00D0                               35   LDAGAIN STH   R8,X'D0'(R9)      STOR ERROR RTN ADR IN TOP TABLE SMPL0350
0000161   2692                                     36           AIS   R9,2              INCREMENT COUNTER               SMPL0360
0000181   C590  02D0                               37           CLHI  R9,X'2D0'         TEST FOR FULL TABLE             SMPL0370
00001CI   4280  FFF2 =000012I                      38           BL    LDAGAIN           NO,LOAD ANOTHER                 SMPL0380
0000201   C800  00A1I                              39           LHI   R0,CCW+1          LOAD ODD CHAN.                  SMPL0390
0000241   4870  806E =000096I                      40           LH    R7,CRADR          LOAD CARD READER ADDRESS        SMPL0400
0000281   1171                                     41           SLLS  R7,1              MULTIPLY BY 2                   SMPL0410
00002AI   4007  00D0                               42           STH   R0,X'D0'(R7)      STORE IN ISP TABLE              SMPL0420
00002EI   07AA                                     43           XR    R10,R10           ZERO OUT R10                    SMPL0430
0000301   40A0  8060 =000094I                      44           STH   R10,CURCOUNT      INITIALIZE CURCOUNT             SMPL0440
0000341   DE30  8062 =00009AI                      45           OC    DEVADR,CLEAR      CLEAR INTERRUPTS                SMPL0450
                                                   46   *                                                               SMPL0460
                                                   47   * SET UP CHANNEL COMMAND BLOCK                                 SMPL0470
                                                   48   *                                                               SMPL0480
0000381I  C870  F781                               49   REPEAT  LHI   R7,X'F781'        SET STATUS MASK, NO CRC,READ    SMPL0490
00003CI   4070  8060 =0000A0I                      50           STH   R7,CCW            STORE IN CCW                    SMPL0500
0000401I  C870  FFB1                               51           LHI   R7,-79            SET NEGATIVE BYTE COUNT         SMPL0510
0000441I  4070  805A =0000A2I                      52           STH   R7,BUFCOUNT       STOR IN BUFCOUNT                SMPL0520
0000481I  F870  0000 C0F0                          53           LI    R7,Y'C0F0'        ENABLE INTERRUPTS, REGISTER SET 15 SMPL0530
```

```
                : AUTO DRIVER CHANNEL, 32-BIT PROCESSORS                10:20:00  05/16/80

00004EI  DE30 8046 =000098I      54            OC    DEVADR,FEED       FEED A CARD                                  SMPL0540
000052I  9567                    55            EPSR  R6,R7             ACTIVATE Y'C0F0'                             SMPL0550
                                 56  *                                                                              SMPL0560
                                 57  * AUTO DRIVER CHANNEL EXIT ROUTINE                                            SMPL0570
                                 58  *                                                                              SMPL0580
000054I  4230 800C =000064I      59  FINISH    BNZ   STCHK             CHECK FOR UNCONDITIONAL TRANSFER             SMPL0590
000058I  F870 0000 00F0          60            LI    R7,Y'00F0'        GET REGISTER SET 15                          SMPL0600
00005EI  9567                    61            EPSR  R6,R7             ACTIVATE Y'00F0'                             SMPL0610
000060I  4300 FFD4 =000038I      62            B     REPEAT                                                         SMPL0620
000064I  42D0 8020 =000088I      63  STCHK     BTC   13,ERROR          IF BAD STATUS GO TO ERROR                    SMPL0630
000068I  4320 801C =000088I      64            BFC   2,ERROR           IF BUF LIMIT NO GOOD, GO TO ERR              SMPL0640
00006CI  48A0 8024 =000094I      65            LH    R10,CURCOUNT      SET R10 WITH CURCOUNT                        SMPL0650
000070I  26A1                    66            AIS   R10,1             INCREMENT R10                                SMPL0660
000072I  40A0 801E =000094I      67            STH   R10,CURCOUNT      UPDATE CURCOUNT                              SMPL0670
000076I  C5A0 000A               68            CLHI  R10,R10           ARE 10 LINES OUTPUT YET?                     SMPL0680
00007AI  4330 8012 =000090I      69            BE    EOJ               YES, END JOB                                 SMPL0690
00007EI  C870 0000               70            LHI   R7,X'0000'        NO,LOAD R7 WITH ZEROS                        SMPL0700
000082I  4070 801A =0000A0I      71            STH   R7,CCW            SET EXECUTE BIT IN CCW OFF                   SMPL0710
000086I  1800                    72            LPSWR R0                LOAD OLD PSW                                 SMPL0720
                                 73  *                                                                              SMPL0730
                                 74  * IF ERROR ROUTINE IS CALLED, PROCESSOR HALTS                                  SMPL0740
                                 75  *                                                                              SMPL0750
000088I  F870 0000 8000          76  ERROR     LI    R7,Y'8000'        LOAD WAIT STATE FOR PROCESSOR                SMPL0760
00008EI  9567                    77            EPSR  R6,R7             HANG                                         SMPL0770
000090I  C200 8024 =0000B8I      78  EOJ       LPSW  HALT              FINISH ROUTINE                               SMPL0780
000094I  0000                    79  CURCOUNT  DC    X'0'                                                           SMPL0790
000096I  0004                    80  CRADR     DC    X'04'             CARD READER ADDRESS                          SMPL0800
000098I  7000                    81  FEED      DC    X'7000'                                                        SMPL0810
00009AI  0800                    82  CLEAR     DC    X'0800'                                                        SMPL0820
00009CI  0000 0050               83  BUFFER    DC    80                                                             SMPL0830
0000A0I                          84            ALIGN 8                                                              SMPL0840
                                 85  *                                                                              SMPL0850
                                 86  * STORAGE AND SET UP OF CHANNEL COMMAND BLOCK                                  SMPL0860
                                 87  *                                                                              SMPL0870
0000A0I  0000                    88  CCW       DC    H'0'              *  CHANNEL COMMAND WORD                      SMPL0880
0000A2I  0000                    89  BUFCOUNT  DC    H'0'              *  BUFFER COUNT                              SMPL0890
0000A4I  0000 00EBI              90  BUFEND    DC    A(BUFFER+79)      *  END ADDRESS OF BUFFER                     SMPL0900
0000A8I  0000                    91            DC    H'0'              *  CHECK                                     SMPL0910
0000AAI  0000                    92            DC    H'0'              *  BUFFER ONE COUNT                          SMPL0920
0000ACI  0000 0000               93            DC    F'0'              *  BUFFER ONE END ADDRESS                    SMPL0930
0000B0I  0000 0000               94            DC    F'0'              *  TABLE                                     SMPL0940
0000B4I  0054I                   95  SUBADR    DC    Z(FINISH)         *  SUBROUTINE ADDRESS                        SMPL0950
0000B8I  0000 8000               96  HALT      DCF   Y'8000'                                                        SMPL0960
0000BCI  0000 0090I              97            DC    A(EOJ)                                                         SMPL0970
0000C0I                          98            END                                                                  SMPL0980
```

: AUTO DRIVER CHANNEL, 32-BIT PROCESSORS 10:20:00 05/16/80

ASSEMBLED BY CAL 03-066R07-00 (32-BIT)

START OPTIONS: T=32,ERLST

NO CAL ERRORS
NO CAL WARNINGS
2 PASSES

ABSTOP	0000 0000												
ADC	0000 0004												
BUFCOUNT	0000 00A2I	52	89*										
BUFEND	0000 00A4I	90*											
BUFFER	0000 009CI	83*	90										
CCB	0000 0004	19*											
CCW	0000 00A0I	39	50	71	88*								
CLEAR	0000 009AI	45	82*										
CRADR	0000 0096I	29	40	80*									
CURCOUNT	0000 0094I	44	65	67	79*								
DEVADR	0000 0003	18*	29	45	54								
EOJ	0000 0090I	69	78*	97									
ERROR	0000 0088I	34	63	64	76*								
FEED	0000 0098I	54	81*										
FINISH	0000 0054I	59*	95										
HALT	0000 00B8I	78	96*										
IMPTOP	0000 00C0I	98											
LADC	0000 0002												
LDAGAIN	0000 0012I	35*	38										
PURETOP	0000 0000P	98											
R0	0000 0000	16*	39	42	72								
R1	0000 0001	17*											
R10	0000 000A	25*	43	43	44	65	66	67	68	68			
R15	0000 000F	26*											
R5	0000 0005	20*											
R6	0000 0006	21*	28	55	61	77							
R7	0000 0007	22*	27	28	40	41	42	49	50	51	52	53	55 60
		61	70	71	76	77							
R8	0000 0008	23*	34	35									
R9	0000 0009	24*	33	33	35	36	37						
REPEAT	0000 0038I	49*	62										
START	0000 0000I	27*											
STCHK	0000 0064I	59	63*										
SUBADR	0000 00B4I	95*											

APPENDIX D

ASCII TO HOLLERITH TRANSLATION TABLE

1302

GRAPHIC	8-BIT ASCII CODE	CARD CODE
NULL	00	12-0-9-8-1
SCH	01	12-9-1
STX	02	12-9-2
ETX	03	12-9-3
EOT	04	9-7
ENG	05	0-9-8-5
ACK	06	0-9-8-6
BEL	07	0-9-8-7
BS	08	11-9-6-3
HT	09	12-9-5
IF	0A	0-9-5
VT	0B	12-9-8-3
FF	0C	12-9-8-4
CR	0D	12-9-8-5
SO	0E	12-9-8-6
S1	0F	12-9-8-7
DEL	10	12-11-9-8-1
DC1	11	11-9-1
DC2	12	11-9-2
DC3	13	9-8-3
DC4	14	9-8-4
NAK	15	9-8-5
SYN	16	9-2
ETB	17	0-9-6
CAN	18	11-9-8
EM	19	11-9-8-1
SUB	1A	9-8-7
ESC	1B	0-9-7
FS	1C	11-9-8-4
GS	1D	11-9-8-5
RS	1E	11-9-8-6
US	1F	11-9-8-7

GRAPHIC	8-BIT ASCII CODE	CARD CODE
SPACE	20	BLANK
!	21	12-8-7
!	21**	11-8-2
"	22	8-7
"	22*	0-8-5
#	23	8-3
#	23*	0-8-7
$	24	11-8-3
%	25	0-8-4
%	25*	11-8-7
&	26	12
&	26*	12-8-7
'	27	8-5
'	27*	4-8
(	28	12-8-5
(	28*	0-4-8
)	29	11-8-5
)	29*	12-4-8
*	2A	11-8-4
+	2B	12-8-6
+	2B*	12
,	2C	0-8-3
-	2D	11
.	2E	12-8-3
/	2F	0-1
0	30	0
1	31	1
2	32	2
3	33	3
4	34	4
5	35	5
6	36	6
7	37	7

1302

GRAPHIC	8-BIT ASCII CODE	CARD CODE
8	38	8
9	39	9
:	3A	8-2
;	3B	11-8-6
<	3C	12-8-4
<	3C*	12-6-8
=	3D	8-6
=	3D*	3-8
>	3E	0-8-6
>	3E*	6-8
?	3F	0-8-7
?	3F*	12-2-8
@	40	8-4
@	40*	0-2-8
A	41	12-1
B	42	12-2
C	43	12-3
D	44	12-4
E	45	12-5
F	46	12-6
G	47	12-7
H	48	12-8
I	49	12-9
J	4A	11-1
K	4B	11-2
L	4C	11-3
M	4D	11-4
N	4E	11-5
O	4F	11-6
P	50	11-7
Q	51	11-8
R	52	11-9
S	53	0-2
T	54	0-3
U	55	0-4
V	56	0-5
W	57	0-6

GRAPHIC	8-BIT ASCII CODE	CARD CODE
X	58	0-7
Y	59	0-8
Z	5A	0-9
[	5B	12-8-2
[	5B*	12-5-8
\	5C	0-8-2
]	5D	11-8-2
]	5D*	12-8-7
	5E	11-8-7
	5E*	7-8
<-	5F	0-8-5
`	60	8-1
a	61	12-0-1
b	62	12-0-2
c	63	12-0-3
d	64	12-0-4
e	65	12-0-5
f	66	12-0-6
g	67	12-0-7
h	68	12-0-8
i	69	12-0-9
j	6A	12-11-1
k	6B	12-11-2
l	6C	12-11-3
m	6D	12-11-4
n	6E	12-11-5
o	6F	12-11-6
p	70	12-11-7
q	71	12-11-8
r	72	12-11-9
s	73	11-0-2
t	74	11-0-3
u	75	11-0-4
v	76	11-0-5
w	77	11-0-6
x	78	11-0-7
y	79	11-0-8
z	7A	11-0-9
	7B	12-0
	7C	12-11
	7D	11-0
	7E	11-0-1
	7F	12-9-7

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GRAPHIC	8-BIT ASCII CODE	CARD CODE
	80	11-0-9-8-1
	81	0-9-1
	82	0-9-2
	83	0-9-3
	84	0-9-4
	85	11-9-5
	86	12-9-6
	87	11-9-7
	88	0-9-8
	89	0-9-8-1
	8A	0-9-8-2
	8B	0-9-8-3
	8C	0-9-8-4
	8D	12-9-8-1
	8E	12-9-8-2
	8F	12-9-8-3
	90	12-11-0-9-8-1
	91	9-1
	92	11-9-8-2
	93	9-3
	94	9-4
	95	9-5
	96	9-6
	97	12-9-8
	98	9-8
	99	9-8-1
	9A	9-8-2
	9B	9-8-3
	9C	12-9-4
	9D	11-9-4
	9E	9-8-6
	9F	11-0-9-1

GRAPHIC	8-BIT ASCII CODE	CARD CODE
	A0	12-0-9-1
	A1	12-0-9-2
	A2	12-0-9-3
	A3	12-0-9-4
	A4	12-0-9-5
	A5	12-0-9-6
	A6	12-0-9-7
	A7	12-0-9-8
	A8	12-8-1
	A9	12-11-9-1
	AA	12-11-9-2
	AB	12-11-9-3
	AC	12-11-9-4
	AD	12-11-9-5
	AE	12-11-9-6
	AF	12-11-9-7
	B0	12-11-9-8
	B1	11-8-1
	B2	11-0-9-2
	B3	11-0-9-3
	B4	11-0-9-4
	B5	11-0-9-5
	B6	11-0-9-6
	B7	11-0-9-7
	B8	11-0-9-8
	B9	0-8-1
	BA	12-11-0
	BB	12-11-0-9-1
	BC	12-11-0-9-2
	BD	12-11-0-9-3
	BE	12-11-0-9-4
	BF	12-11-0-9-5

1302

GRAPHIC	8-BIT ASCII CODE	CARD CODE
	C0	12-11-0-9-6
	C1	12-11-0-9-7
	C2	12-11-0-9-8
	C3	12-0-8-1
	C4	12-0-8-2
	C5	12-0-8-3
	C6	12-0-8-4
	C7	12-0-8-5
	C8	12-0-8-6
	C9	12-0-8-7
	CA	12-11-8-1
	CB	12-11-8-2
	CC	12-11-8-3
	CD	12-11-8-4
	CE	12-11-8-5
	CF	12-11-8-6
	D0	12-11-8-7
	D1	11-0-8-1
	D2	11-0-8-2
	D3	11-0-8-3
	D4	11-0-8-4
	D5	11-0-8-5
	D6	11-0-8-6
	D7	11-0-8-7
	D8	12-11-0-8-1
	D9	12-11-0-1
	DA	12-11-0-2
	DB	12-11-0-3
	DC	12-11-0-4
	DD	12-11-0-5
	DE	12-11-0-6
	DF	12-1-0-7

GRAPHIC	8-BIT ASCII CODE	CARD CODE
	E0	12-11-0-8
	E1	12-11-0-9
	E2	12-11-0-8-2
	E3	12-11-0-8-3
	E4	12-11-0-8-4
	E5	12-11-0-8-5
	E6	12-11-0-8-6
	E7	12-11-0-8-7
	E8	12-0-9-8-2
	E9	12-0-9-8-3
	EA	12-0-9-8-4
	EB	12-0-9-8-5
	EC	12-0-9-8-6
	ED	12-0-9-8-7
	EE	12-11-9-8-2
	EF	12-11-9-8-3
	F0	12-11-9-8-4
	F1	12-11-9-8-5
	F2	12-11-9-8-6
	F3	12-11-9-8-7
	F4	11-0-9-8-2
	F5	11-0-9-8-3
	F6	11-0-9-8-4
	F7	11-0-9-8-5
	F8	11-0-9-8-6
	F9	11-0-9-8-7
	FA	12-11-0-9-8-2
	FB	12-11-0-9-8-3
	FC	12-11-0-9-8-4
	FD	12-11-0-9-8-5
	FE	12-11-0-9-8-6
	FF	12-11-0-9-8-7

NOTES

All other punch combinations are translated to X'FF' a nonprinting character.

* Optional adjustments for 026 punch codes.

** Adjust ASCII 3.26 for exclamation point (!).

APPENDIX E
REFERENCE DATA FOR EARLY CARD READERS

1. This information is provided for users with earlier M46-230 and 231 Low Speed Card Readers equipped with the 17-277 exterior cable.

2. The status byte differs from the present product in that the Hopper Empty and Stacker Full conditions are on separate lines. The Stacker Full signal becomes part of the TBL and DU status bits.

3. Operator controls, indicators, and procedures are described in Section 1.2.1. The status and command definitions are in Table E-1.

TABLE E-1 STATUS COMMAND DEFINTIONS

BIT	0	1	2	3	4	5	6	7
STATUS	EOV	TBL	HE	NMTN	BSY	EX	EOM	DU
COMMAND	DISABLE	ENABLE	FEED	CONVERT	CLEAR			

DISARM

STATUS:

EOV — Overflow. EOV is set in the Normal mode when the two data bytes are not taken before the next column of data arrives from the card reader. When the Hollerith to ASCII conversion hardware is enabled (Convert mode), EOV is set when the signal data byte is not taken before the next column of data arrives from the card reader. It is possible, when EOV sets, that the last data byte read is meaningless. The EOV bit is reset by a FEED command, a System Initialize, or by a CLEAR command.

TABLE E-1 STATUS COMMAND DEFINITIONS (Continued)

TBL — Trouble. TBL is set when the card reader fails to "pick" a card following a FEED command or when an error condition is sensed.

The error condition could be

1. Card Motion Error
2. Light Current Error
3. Dark Current Error
4. Stacker Full. Any error condition or a "pick failure" causes the card reader to stop until the condition is cleared manually by the operator.
5. Illegal Card Code

HE — Hopper Empty. HE is set when there are no cards in the input hopper.

NMTN — No Motion. NMTN is set at all times except for the interval of time between a FEED command and the time it takes that card to pass through the read station. If TBL, DU, EOM, and HE occurs, the NMTN remains reset until the trouble is manually corrected.

BSY — Busy. BSY is set while the Interface is waiting for data from the card reader. It resets when data is ready to be transferred. In the case where the Hollerith to ASCII conversion hardware is not enabled (Convert Mode), BSY is set after the single data byte is read. BSY is set by a FEED command, a System Initialize, or by a CLEAR command.

EX — Examine. EX is set when any of Bits 0, 1, 2, or 3 is set. EX is reset when all of Bits 0, 1, 2, and 3 are reset.

EOM — End of Medium. EOM is set when either NMTN or HE is set.

DU — Device Unavailable. DU is identical to TBL.

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