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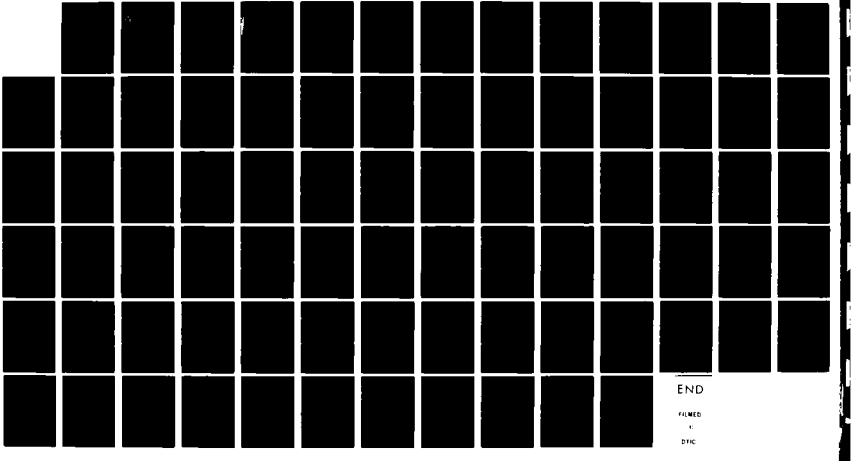

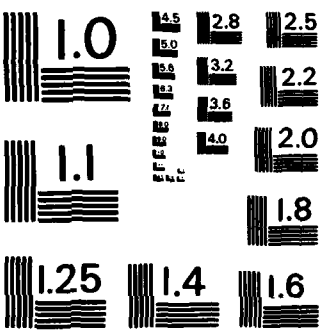

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NCS TIB 82-3

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TECHNICAL INFORMATION BULLETIN 82-3

MICROPROCESSOR IMPLEMENTATION OF OPTIONAL FUNCTIONS OF SYNCHRONOUS BIT-ORIENTED DATA LINK CONTROL PROCEDURES

MAY 1982

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This report contains a block diagram, flow charts, and computer programming for the following optional functions in Federal Standard 1003 (Synchronous Bit Oriented Data Link Control Procedures): Address Extention Function for all three classes of procedures (Unbalanced Normal, Balanced Asynchronous, and Unbalanced Asynchronous); Reset Function for the Balanced Aysnchronous class of procedure only; Delete Command I Frame Function for all three classes of procedures; Delete Response I Frame Function for all three classes of procedures; unnumbered Polling Function for all three

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classes of procedures.

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MICROPROCESSOR IMPLEMENTATION OF OPTIONAL FUNCTIONS OF SYNCHRONOUS BIT-ORIENTED DATA LINK CONTROL PROCEDURES

May 1982

PREPARED BY:

DELTA INFORMATION SYSTEMS, INC.
310 Cottman Street
Jenkintown, Pennsylvania 19046

APPROVED FOR PUBLICATION:

Marshall L Cain

MARSHALL L. CAIN
Assistant Manager
Office of NCS Technology
and Standards

FOREWORD

Among the responsibilities assigned to the Office of the Manager, National Communications System, is the management of the Federal Telecommunication Standards Program. Under this program, the NCS, with the assistance of the Federal Telecommunication Standards Committee identifies, develops, and coordinates proposed Federal Standards which either contribute to the interoperability of functionally similar Federal telecommunication systems or to the achievement of a compatible and efficient interface between computer and telecommunication systems. In developing and coordinating these standards a considerable amount of effort is expended in initiating and pursuing joint standards development efforts with appropriate technical committees of the Electronic Industries Association, the American National Standards institute, the International Organization for Standardization, and the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union. This Technical Information Bulletin presents an overview of an effort which is contributing to the development of compatible Federal, national, and international standards in the area of data link control procedures. It has been prepared to inform interested Federal activities of the progress of these efforts. Any comments, inputs or statements of requirements which could assist in the advancement of this work, are welcome and should be addressed to:

Office of the Manager
National Communications System
ATTN: NCS-TS (Frank McClelland)
Washington, D.C. 20305
(202) 692-2124

MICROPROCESSOR IMPLEMENTATION OF OPTIONAL FUNCTION OF SYNCHRONOUS BIT-ORIENTED DATA LINK CONTROL PROCEDURES

Final Report

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310 Cottman Street

Jenkintown, Pennsylvania 19046

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1.0 INTRODUCTION

This document summarizes the work performed by Delta Information Systems, Inc. for the Office of Technology and Standards of the National Communications System, an organization of the U.S. Government, under Purchase Order DCA100-81-C-0025. The Office of Technology and Standards, headed by National Communications System Assistant Manager Marshall L. Cain, is responsible for the management of the Federal Telecommunications Standards Program, which develops telecommunication standards whose use is mandatory by all Federal agencies. The objective of this program is to develop a block diagram, flow charts, and computer programming for the following tasks in accordance with Federal Standard 1003.

Address Extention Function for all three classes of procedures (Unbalanced Normal, Balanced Asynchronous, and Unbalanced Asynchronous).

- Reset Function for the Balanced Aysnchronous class of procedure only.
- Delete Command I Frame Function for all three classes of procedures.
- Delete Response I Frame Function for all three classes of procedures.
- Unnumbered Polling Function for all three classes of procedures.

- Initialization Function for all three classes of procedures.
- Unnumbered Information Function for all three classes of procedures.

The purpose of this effort is to determine the feasibility of using the M6800 or similar microprocessor to implement this type of protocol, and to obtain an estimate of memory and processor resources that would be required. The Office of Technology and Standards will use the information to advise other Federal agencies who implement the standard and, when merged with the results of other studies, to evaluate the operational and economic impact of incorporating various options in Federal Standard 1003.

The effort necessarily has focussed on the software required to implement the protocol itself, and is by no means a total hardward/software system design that would be required to develop a complete system. Complete system development is, of course, beyond the scope of this program.

Section 2 of this report contains a discussion of the method of implementation for the seven listed options and a list of state variables and parameters. Sections 3 through 8 include flow charts, code and a discussion of memory requirements and throughput for each of the options. The code was assembled on a 6800 cross-assembler and tested on a 6800 microcomputer supplied by Delta Information Systems.

2.0 SYSTEM DESIGN CONSIDERATIONS

The block diagram in Figure 2-1 shows a link with one primary/combined and one secondary/combined station communicating with each other by sending information in both directions. That is, either station may be a source or sink of data or both. Two-way simultaneous transmission is assumed. Although many secondary stations may communicate with one primary station, the objectives of this program can be met with no loss of generality, by assuming the existence of only one secondary station.

Each station, primary, secondary, or combined is made up of a microcomputer, an LSI interface to the link, and a user which supplies and uses the data to be communicated. The primary and secondary stations are physcially very similar; operationally, of course, the primary must supervise and control a number of secondary stations, and thus it requires a larger data structure and somewhat more complicated code.

For the purpose of this program, the microcomputer can be assumed to be very basic-microprocessor, memory (RAM and ROM), interface chips, clock, etc. A discussion of the interface chips, operating system considerations and general design features may be found in a previous report.[1]

The objective of this effort is to determine the incremental change in the number of instructions and processor time required for each of seven optional functions listed above, implemented on a Motorola 6800 microprocessor. These

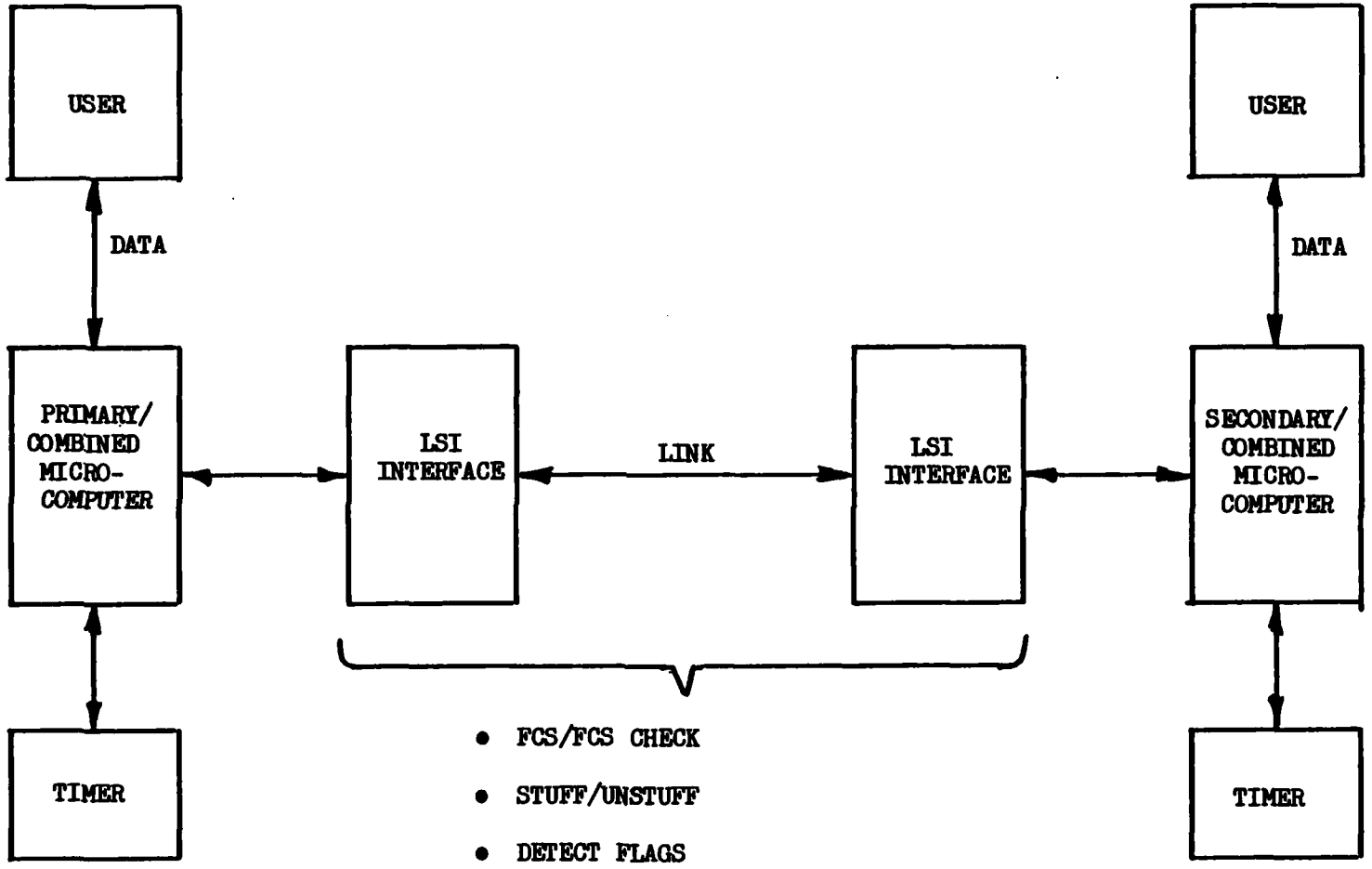

Figure 2-1 System Block Diagram

optional functions are achieved by the addition, or deletion, of commands and responses with respect to those present in one of the three basic classes of procedures.

No attempt has been made to produce a single basic design to accomodate all of the options one at a time or in combinations; in other words, each option is implemented starting from the same previously designed baseline so that the effect on memory requirements and throughput can be evaluated for each option.

Detailed flow charts and code for each option are compared with those of the baseline system to obtain the difference in memory requirements and throughput.

Those state variables and other parameters that are used by more than one routine and included in the code in the following sections are defined in Figure 2-2. A discussion of these may be found in Reference 1. Two of the flow charts in this previous report required some minor changes. These are included in Figures 2-3 and 2-4.

```
ERR LINE  ADDR  B1 B2 B3 B4        ADCCP MAIN                                                    PAGE    1

       1                                TITLE   'ADCCP MAIN'
       2                                LIST    X
       3                                XREF    I,RR,RNR,REJ,SREJ,SNRM,UA,DISC,DM,FRMR,RSET
       4                                XREF    SABM,SABM,UP,SIM,RIM,UI
       5                            *
       6                            *** DEFINE 6856 PROTOCOL CHIP ADDRESSES
       7                            *
       8  EC25                      MCR     EQU     $EC25       MODE CONTROL REGISTER
       9  EC24                      SAR     EQU     $EC24       SECONDARY ADDRESS REGISTER
      10  EC23                      TCR     EQU     $EC23       TRANSMITTER CONTROL
      11  EC22                      TDR     EQU     $EC22       TRANSMITTER DATA BUFFER
      12  EC27                      RCR     EQU     $EC27       RECEIVER CONTROL REGISTER
      13  EC26                      TSR     EQU     $EC26       TRANSMITTER STATUS REGISTER
      14  EC21                      RSR     EQU     $EC21       RECEIVER STATUS REGISTER
      15  EC20                      RDR     EQU     $EC20       RECEIVED DATA BUFFER
      16                            *

      18                            **
      19                            **    RAM VARIABLE STORAGE
      20                            **
      21                            *
      22                            *   BASE SECTION TABLES
      23                            *
      24                                  BSCT
      25  0000  02 04 06 09        ADDR    FCB     2,4,6,9     UNIQUE STATION ADDRESS
      26  0004                              RMB     8           SPACE FOR 2 ADDRESSES
      27                            *
      28                            ** JUMP TABLE FOR RECEIVED CONN/RESP
      29                            *
      30  000C  00 00          E   JMPTAB  FDB     I
      31  000E  00 00          E           FDB     RR
      32  0010  00 00          E           FDB     RNR
      33  0012  00 00          E           FDB     REJ
      34  0014  00 00          E           FDB     SREJ
      35  0016  00 00          E           FDB     SNRM
      36  0018  00 00          E           FDB     UA
      37  001A  00 00          E           FDB     DISC
      38  001C  00 00          E           FDB     DM
      39  001E  00 00          E           FDB     FRMR
      40  0020  00 00          E           FDB     RSET
      41  0022  00 00          E           FDB     SARM
      42  0024  00 00          E           FDB     SABM
      43  0026  00 00          E           FDB     UP
      44  0028  00 00          E           FDB     SIM
      45  002A  00 00          E           FDB     RIM
      46  002C  00 00          E           FDB     UI
```

Figure 2-2. Variables and Parameters

```
                        *
                        **   STATES/MODES
                        *
 002E                   STAT    RMB   1     STATION TYPE AND MODE:
                        *                      BIT 8 - UN/PRI
                        *                      BIT 7 - UN/SEC
                        *                      BIT 6 - UA/PRI
                        *                      BIT 5 - UA/SEC
                        *                      BIT 4 - BA
 002F                   OPSTAT  RMB   1     OPERATIONAL STATE:
                        *                      -2=FRMR
                        *                      -1=IS
                        *                       0=LOS
                        *                       1=ITS
 0030                   ITSMOD  RMB   1     ITS MODE:
                        *                       0=NRM
                        *                       1=ARM
                        *                       2=ABM
 0031                   ISMOD   RMB   1     IS MODE
                        *
 0032                   LOSMOD  RMB   1     LOS MODE:
                        *                       0=NDM
                        *                       1=ADM
 0033                   REMBUS  RMB   1     REMOTE BUSY
                        *                       1=TRUE
                        *                       0=FALSE
 0034                   STABUS  RMB   1     STATION BUSY
                        *                       1=TRUE
                        *                       0=FALSE
                        *
                        *** OTHER VARIABLES
                        *
 0035                   LENGMX  RMB   1     MAX LENGTH OF I-FRAME MESS (BYTES)
 0036                   PBIT    RMB   1     POLL BIT
 0037                   FBIT    RMB   1     FINAL BIT
 0038                   S       RMB   1     SEND VARIABLE
 0039                   R       RMB   1     RECEIVE VARIABLE
 003A                   NS      RMB   1     SEND SEQUENCE NUMBER
 003B                   NR      RMB   1     RECEIVE SEQUENCE NUMBER
 003C                   RDAFLG  RMB   1     RECEIVE DATA AVAILABLE FLAG
 003D                   RDBUFF  RMB   1     RECEIVE DATA BUFFER
 003E                   CNTFLD  RMB   1     CONTROL FIELD RECEIVED
 003F                   FTYPE   RMB   1     FRAME TYPE
 0040                   POLLP   RMB   1     PROVISIONAL POLL BIT
 0041                   NRP     RMB   1          *      RECEIVED SEQUENCE NUMBER
 0042                   NSP     RMB   1          *      SEND          *        *
 0043                   CFIELD  RMB   1     OUTPUT CONTROL BYTE
 0044                   UPFLAG  RMB   1     UP RECEIVED
                        *                       1=TRUE
                        *                       0=FALSE
 0045                   DAVAIL  RMB   1     DATA AVAILABLE FLAG
                        *                       1=TRUE
                        *                       0=FALSE
```

Figure 2-2. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        ADCCP MAIN                                    PAGE    3

     101  0046                   LFRM     RMB    1       LAST FRAME
     102                         *                          1=TRUE
     103                         *                          0=FALSE
     104  0047                   GBFLG    RMB    1       RECEIVED BYTE VALIDITY
     105                         *                         -2=EOM/FCS ERROR
     106                         *                         -1=EOM/ABORT
     107                         *                          0=NORMAL
     108                         *                          1=EOM
     109  0048                   FRMBIF   RMB    3       FRMR BASIC INFORMATION FIELD
     110  0048                        END

 ASSEMBLER ERRORS =     0
```

Figure 2-2. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE	
ADDR	B	0000	-25	
CFIELD	B	0043	-94	
CNTFLD	B	003E	-89	
DAVAIL	B	0045	-98	
DISC	E	0007	3	37
DM	E	0008	3	38
FBIT	B	0037	-82	
FRMBIF	B	0048	-109	
FRMR	E	0009	3	39
FTYPE	B	003F	-90	
GDFLG	B	0047	-104	
I	E	0000	3	30
ISNOD	B	0031	-66	
ITSNOD	B	0030	-62	
JMPTAB	B	000C	-30	
LDSNOD	B	0032	-68	
LENGMX	B	0035	-80	
LFRM	B	0046	-101	
MCR		EC25	-8	
MEMORY	M	0000	0	
MARG		0000	0	
MR	B	003B	-86	
MRP	B	0041	-92	
MS	B	003A	-85	
MSP	B	0042	-93	
OPSTAT	B	002F	-57	
PBIT	B	0036	-81	
POLLP	B	0040	-91	
R	B	0039	-84	
RCR		EC27	-12	
RDAFLG	B	003C	-87	
RDB		EC20	-15	
RDBUFF	B	003D	-88	
REJ	E	0003	3	33
REMBUS	B	0033	-71	
RIN	E	000F	4	45
RNR	E	0002	3	32
RR	E	0001	3	31
RSET	E	000A	3	40
RSR		EC21	-14	
S	B	0038	-83	
SABM	E	000C	4	42
SAR		EC24	-9	
SARM	E	000B	4	41
SIN	E	000E	4	44
SNRM	E	0005	3	35
SREJ	E	0004	3	34
STABUS	B	0034	-74	
STACK	S	0000	0	

Figure 2-2. Variables and Parameters

```
STAT     B 002E          -51
TCR        EC23          -10
TDB        EC22          -11
TSR        EC26          -13
UA       E 0006            3    36
UI       E 0010            4    46
UP       E 000D            4    43
UPFLAG   B 0044          -95
```

Figure 2-2. Cont.

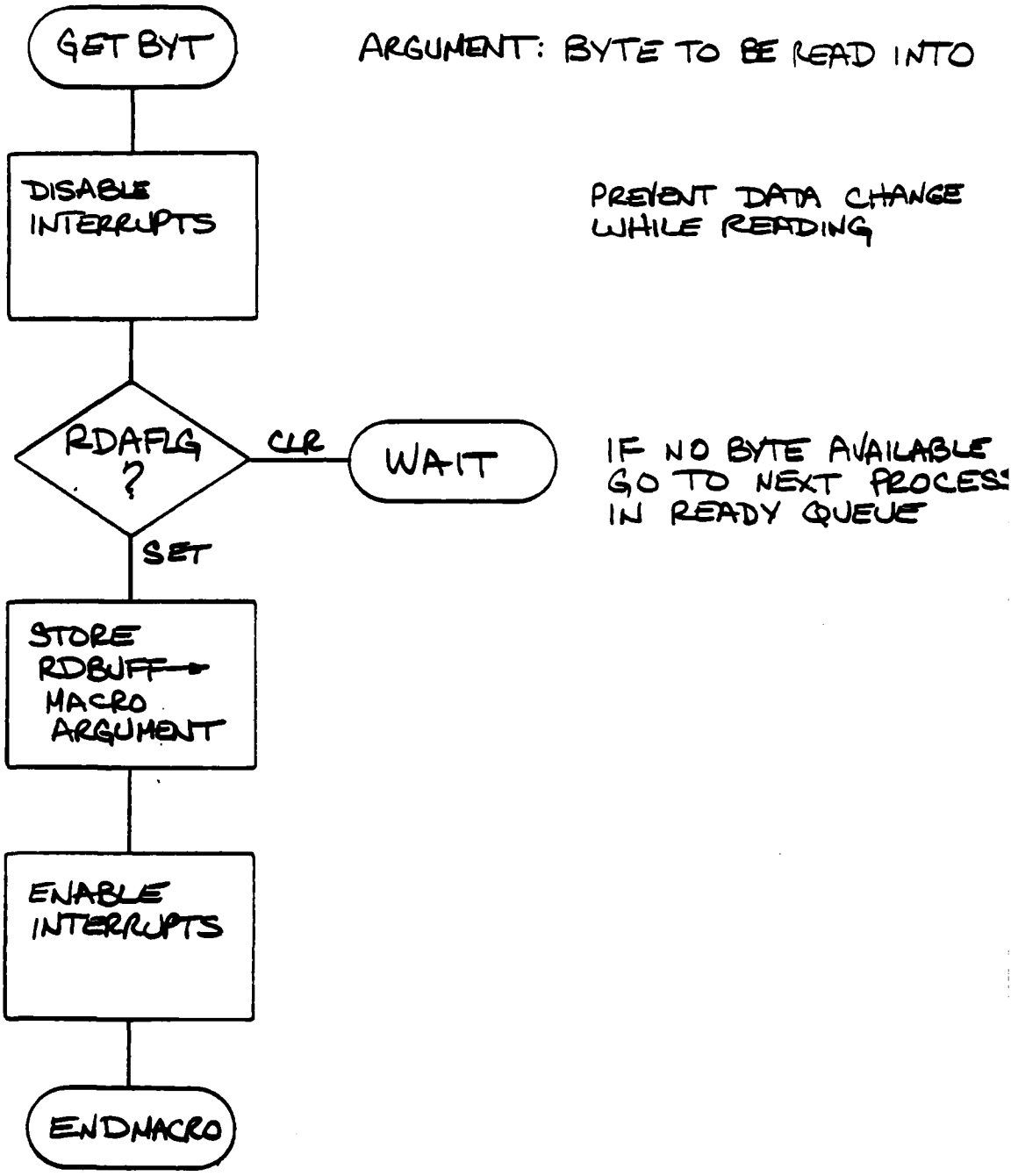

Figure 2-3. Read Data Byte Macro.

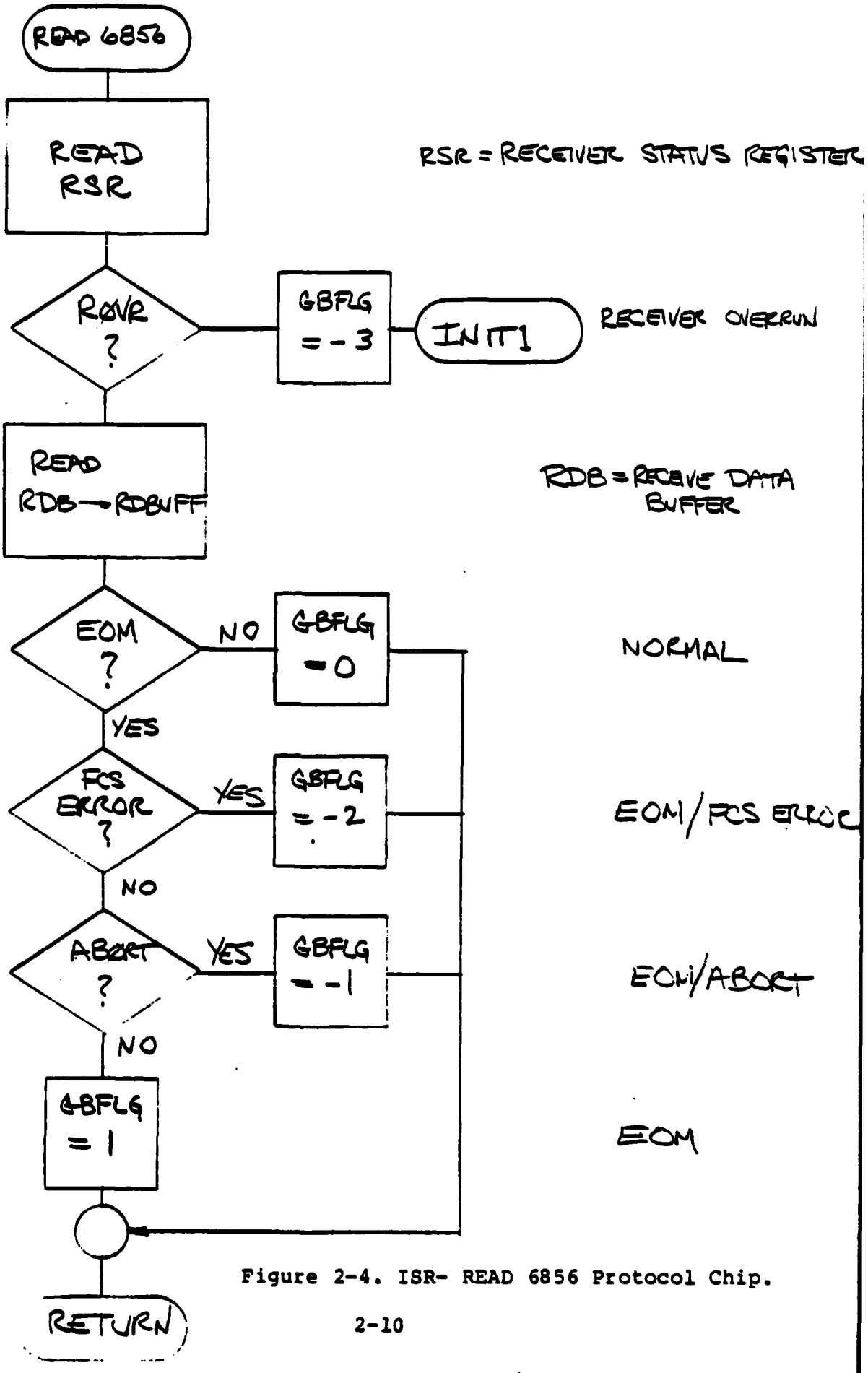

Figure 2-4. ISR- READ 6856 Protocol Chip.

3.0 ADDRESS EXTENSION FUNCTION

This option provides for greater than single octet addressing by means of the Extended Address Format. The extended format provides an address field which is made up of a sequence of octets, each having a "0" (Zero) as the first bit of the octet except for the last octet which has a "1" in the first bit position.

Processing of the received address is accomplished in the Receive Process (RCV). The flow chart for the RCV process is shown in Figure 3-1. A major subroutine called by RCV, the RCNTRL subroutine which processes the control field, is given in Figure 3-2. An expanded flow chart of the extended address handler is given in Figure 3-3. The 6800 assembly language code for the RCV process and the RCNTRL subroutine is presented in Figures 3-4 and 3-5 respectively.

The number of instructions required to perform the extended address can be estimated by examining Figure 3-4. The code for address processing is included in lines 52 through 132. Examination of this code shows that few (less than ten) additional instructions are required to perform the extended addressing function as opposed to single octet addressing. The extra processing time required to handle the extended address is negligible; however, there is a minor effect on throughput due to the increase in message length. The effect is very small for I/UI frames and somewhat larger for supervisory and other unnumbered frames.

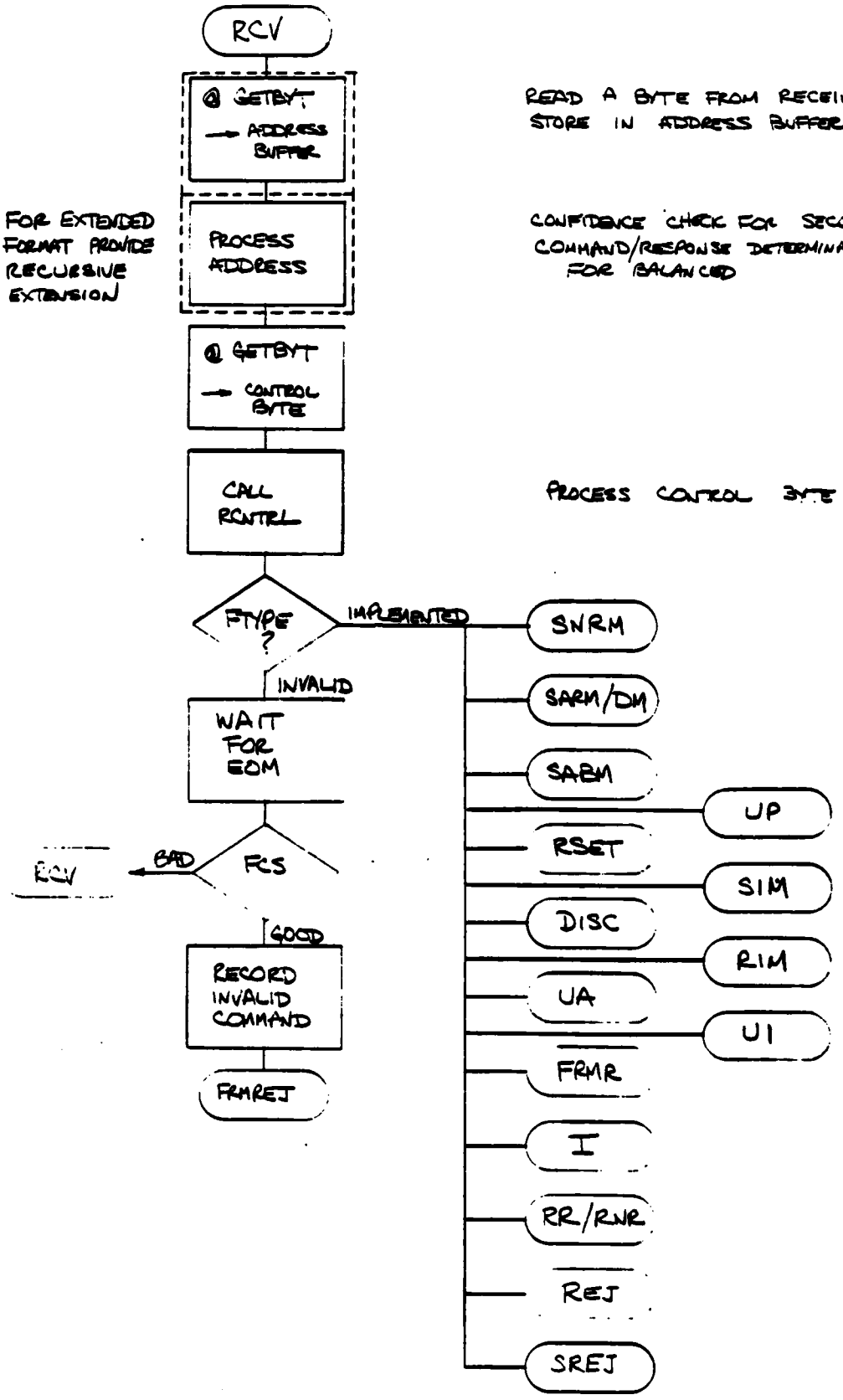

Figure 3-1 RCV Process

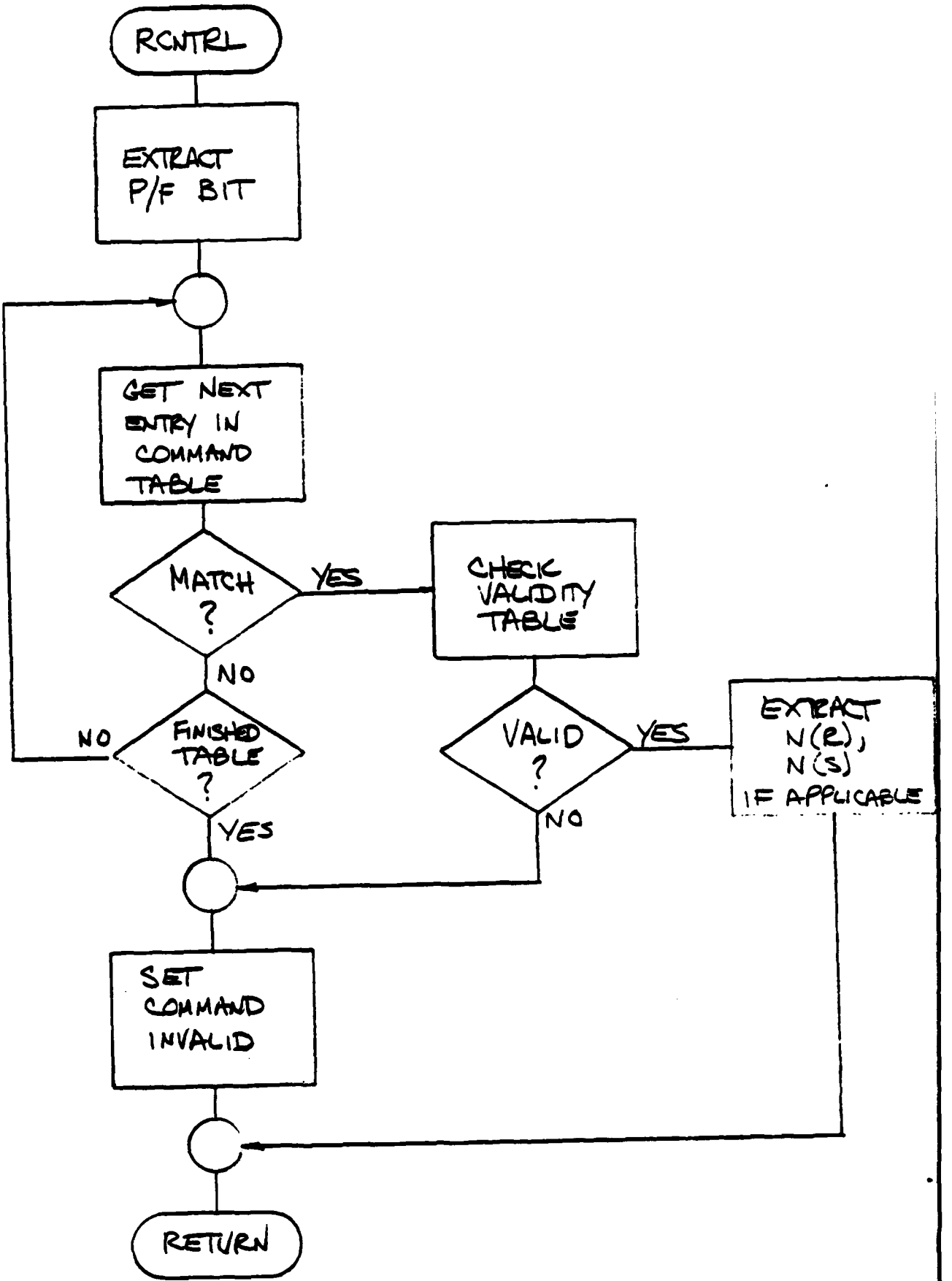

Figure 3-2 RCNTRL Subroutine

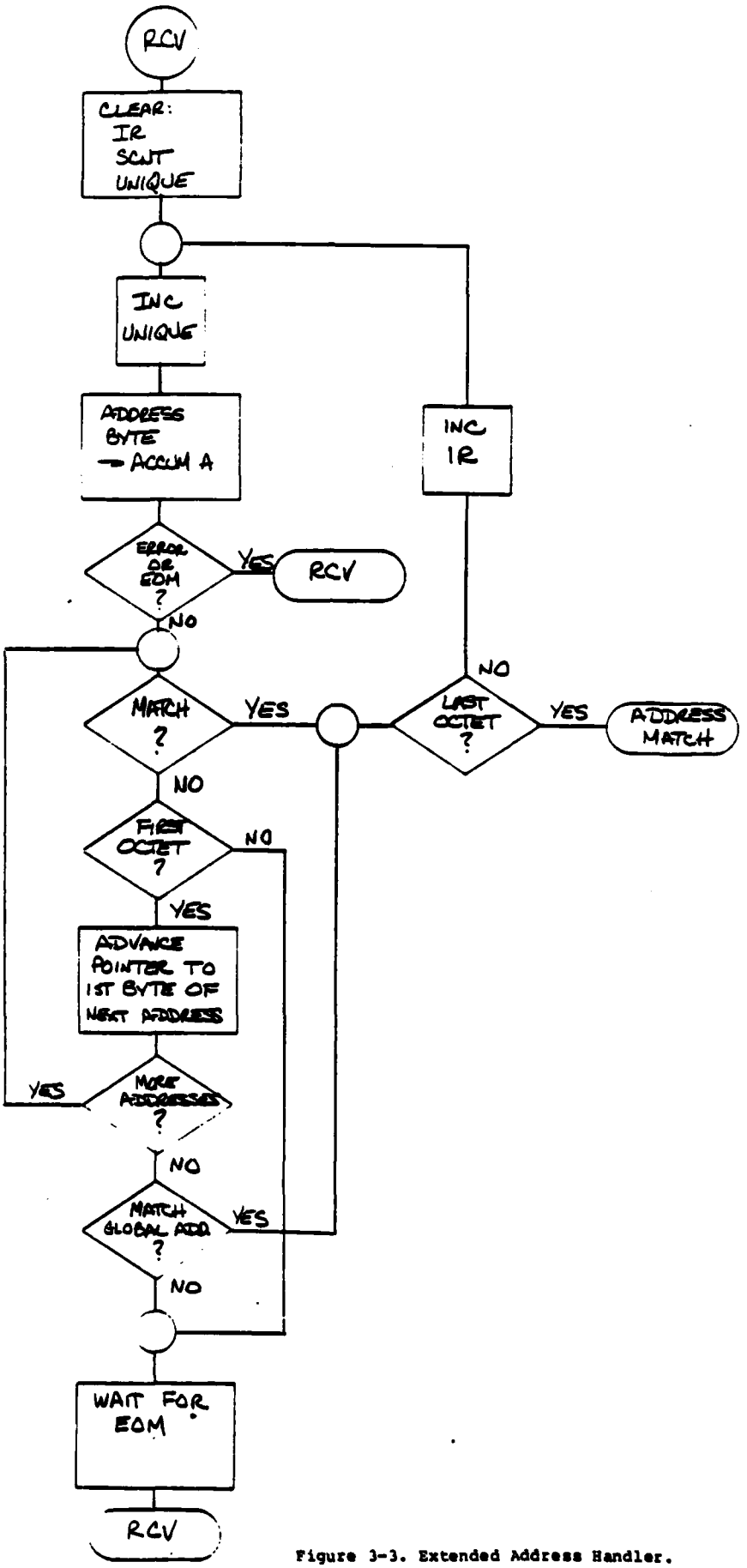

Figure 3-3. Extended Address Handler.

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE PROCESS (RCV)                                  PAGE    1

       1                                TITLE   'RECEIVE PROCESS (RCV)'
       2                                LIST    X
       3                                NAME    RCV
       4                          *
       5                          *** RECEIVE PROCESS
       6                          *
       7                          *   REFERENCES:  ADDR
       8                          *                RDBUFF
       9                          *                GBFLG
      10                          *                FTYPE
      11                          *                JMPTAB
      12                          *   MODIFIES:    RDAFLG
      13                          *                CNTFLD
      14                          *                FRMBIF
      15                          *   CALLS:       RCNTRL
      16                          *                FRMREJ
      17                          *
      18                          *   RECEIVES AND PROCESSES ADDRESS AND CONTROL BYTES OF THE
      19                          *   RECEIVED FRAME AND JUMPS TO THE APPROPRIATE ROUTINE VIA
      20                          *   A JUMP TABLE.

      22                               XDEF    RCV
      23                               XREFB   ADDR,RDAFLG,RDBUFF
      24                               XREFB   CNTFLD,FTYPE,JMPTAB,FRMBIF,GBFLG
      25                               XREF    RCNTRL,FRMREJ
      26  0002                    SCNTMX  EQU     2
      27                               DSCT
      28  0000                    UNIQUE  RMB     1
      29  0001                    SCNT    RMB     1
      30  0002                    ADDBUF  RMB     1
      31                          *
      32                          *** GETBYT MACRO DEFINITION
      33                          *
      34                          GETBYT  MACRO   ONEBYT
      35                                  LOCAL   SETOK
      36                                  SEI             PREVENT DATA CHANGE WHILE READING
      37                          *
      38                          * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      39                          *
      40                                  LDAA    RDAFLG
      41                                  BNE     SETOK
      42                          *         *
      43                          *   SAVE PLACE AND JUMP TO WAIT PROCESS
      44                          *         *
      45                          *
      46                          SETOK   LDAA    RDBUFF  STORE RDBUFF IN MACRO ARG
      47                                  STAA    ONEBYT
      48                                  CLR     RDAFLG
      49                                  CLI
      50                                  ENDM
```

Figure 3-4. Receive Process Code

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE PROCESS (RCV)                                  PAGE    2

      52                                PSCT
      53                          *
      54                          *   PROCESS ADDRESS
      55                          *
      56  0000  CE 00 00          RCV     LDX     #0
      57  0003  4F                        CLRA
      58  0004  97 01          B         STAA    SCNT
      59  0006  97 00          B         STAA    UNIQUE
      60  0008  7C 00 00        B   STADD   INC     UNIQUE
      61  000B                          GETBYT  ADDBUF
      62  000B  0F                    +     SEI             PREVENT DATA CHANGE WHILE READING
      63                              +*
      64                              +* TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      65                              +*
      66  000C  96 00           E     +     LDAA    RDAFLG
      67  000E  26 00                 +     BNE     .00000
      68                              +*      *
      69                              +*   SAVE PLACE AND JUMP TO WAIT PROCESS
      70                              +*      *
      71                              +*
      72  0010  96 00           E     +.00000   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      73  0012  97 02           B     +     STAA    ADDBUF
      74  0014  7F 00 00        E     +     CLR     RDAFLG
      75  0017  0E                    +     CLI
      76  0018  7D 00 00        E           TST     GBFLG
      77  001B  2D E3                       BLT     RCV       ERROR
      78  001D  2E E1                       BGT     RCV       EOM
      79  001F  E6 00           E   STADD1  LDAB    ADDR,X    MATCH STATION ADDRESS?
      80  0021  11                          CBA
      81  0022  27 2A                       BEQ     AMATCH
      82  0024  D6 00           B           LDAB    UNIQUE    NO MATCH: CHECK FOR FIRST OCTET
      83  0026  5A                          DECB
      84  0027  26 11                       BNE     UEOM      NOT FIRST OCTET
      85  0029  08                          INX
      86  002A  08                          INX
      87  002B  08                          INX
      88  002C  08                          INX
      89  002D  D6 01           B           LDAB    SCNT
      90  002F  5C                          INCB
      91  0030  D7 01           B           STAB    SCNT
      92  0032  D1 03                       CMPB    SCNTMX+1
      93  0034  2F E9                       BLE     STADD1
      94  0036  81 FF                       CMPA    #$FF      NOT A VALID ADDRESS
      95  0038  27 1F                       BEQ     LOCTET    MATCHES GLOBAL ADDRESS
      96                          *
      97                          *   NULL ADDRESS OR NO MATCH
      98                          *

     100  003A                    UEOM    GETBYT  ADDBUF    NO MATCH  WAIT FOR EOM
     101  003A  0F                    +     SEI             PREVENT DATA CHANGE WHILE READING
     102                              +*
     103                              +* TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
```

Figure 3-4. Cont.

```
 104                                 **
 105  0038  96 00          E        *       LDAA    RDAFLG
 106  0030  26 00                   *       BNE     .00001
 107                                 **       *
 108                                 **   SAVE PLACE AND JUMP TO WAIT PROCESS
 109                                 **       *
 110                                 **
 111  003F  96 00          E        *.00001  LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
 112  0041  97 02          E        *       STAA    ADDBUF
 113  0043  7F 00 00       E        *       CLR     RDAFLG
 114  0046  0E                      *       CLI
 115  0047  7D 00 00       E                TST     GDFLG
 116  004A  27 EE                            BEQ     WEOM
 117  004C  20 02                            BRA     RCV

 119  004E  46                      AWATCH   RORA                LOOK AT LEAST SIG BIT
 120  004F  25 08                            BCS     LOCTET      HAVE LAST OCTET OF ADDRESS
 121  0051  08                              INX
 122  0052  8C 00 09                         CPX     #SCNTMX+4+5     SAFETY CHECK
 123  0055  2C A9                            BGE     RCV
 124  0057  20 AF                            BRA     STADD

 126  0059                          LOCTET
 127                                 *       *
 128                                 *   CHECK ADDRESS FOR CONSISTENCY WITH CONFIGURATION
 129                                 *
 130                                 *   SECONDARY - SCNT=0 OR SCNTMX+1
 131                                 *   PRIMARY   - 0<SCNT<SCNTMX+1
 132                                 *       *
 133                                 *
 134                                 *   PROCESS CONTROL BYTE
 135                                 *
 136  0059                                   GETBYT  CNTFLD
 137  0059  0F                      *        SEI                 PREVENT DATA CHANGE WHILE READING
 138                                 **
 139                                 ** TEST RECEIVE [illegible] AVAILABLE EVENT VARIABLE
 140                                 **
 141  005A  96 00          E        *       LDAA    [illegible]
 142  005C  26 00                   *       BNE     .00[illegible]
 143                                 **       *
 144                                 **   SAVE PLACE [illegible] JUMP TO WAIT PROCESS
 145                                 **       *
 146                                 **
 147  005E  96 00          E        *.00002  LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
 148  0060  97 00          E        *       STAA    CNTFLD
 149  0062  7F 00 00       E        *       CLR     RDAFLG
 150  0065  0E                      *       CLI
 151  0066  7D 00 00       E                TST     GDFLG
 152  0069  2D 95                            BLT     RCV         ERROR
 153  0068  2E 93                            BGT     RCV         EOM
 154  006D  BD 00 00       E                JSR     RCNTRL
 155  0070  7D 00 00       E                TST     FTYPE       FRAME VALID?
```

Figure 3-4. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE PROCESS (RCV)                                    PAGE    4

     156  0073  2D 06                      BLT     WEON1     NO
     157  0075  DE 00          E           LDX     FTYPE     YES  PROCESS APPROPRIATE CONN/RESP
     158  0077  EE FE          E           LDX     JMPTAB-2,X
     159  0079  6E 00                      JMP     0,X
     160                                 *
     161                                 *   FRAME INVALID
     162                                 *
     163  0078                          WEON1   GETBYT  ADDBUF    WAIT FOR EOM
     164  0078  0F                    +         SEI               PREVENT DATA CHANGE WHILE READING
     165                              +*
     166                              +* TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
     167                              +*
     168  007C  96 00          E     +         LDAA    RDAFLG
     169  007E  26 00                +         BNE     .00003
     170                              +*        *
     171                              +*   SAVE PLACE AND JUMP TO WAIT PROCESS
     172                              +*        *
     173                              +*
     174  0080  96 00          E     +.00003   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
     175  0082  97 02          B     +         STAA    ADDBUF
     176  0084  7F 00 00       E     +         CLR     RDAFLG
     177  0087  0E                    +         CLI
     178  0088  7D 00 00       E               TST     GBFLG
     179  008B  27 EE                         BEQ     WEON1
     180  008D  2E 03                         BGT     EOM
     181  008F  7E 00 00       P               JMP     RCV       ERROR
     182                                 *
     183                                 *   EOM
     184                                 *
     185  0092  96 00          E     EOM       LDAA    CNTFLD    RECORD INVALID COMMAND
     186  0094  97 00          E               STAA    FRMDIF
     187  0096  7E 00 00       E               JMP     FRMREJ
     188  0099                            END

ASSEMBLER ERRORS =    0
```

Figure 3-4. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE							
ADDBUF	B	0002	-38	73	112	178				
ADDR	E	0000	23	79						
ANATCH	P	004E	81	-119						
CNTFLD	E	0003	24	148	185					
EOM	P	0092	180	-185						
FRMDIF	E	0006	24	186						
FRMREJ	E	0009	25	187						
FTYPE	E	0004	24	155	157					
GDFLG	E	0007	24	76	115	151	178			
JMPTAB	E	0005	24	158						
LOCTET	P	0039	93	120	-126					
MEMORY	M	0000	0							
MARG		0000	0							
RCNTRL	E	0000	23	134						
RCV	P	0000	-56	77	78	117	123	152	153	181
RDAFLG	E	0001	23	66	74	108	113	141	149	160
			176							
RDBUFF	E	0002	23	72	111	147	174			
SCNT	B	0001	-29	50	89	91				
SCNTMX		0002	-26	92	122					
STACK	S	0000	0							
STADD	P	0000	-60	124						
STADD1	P	001F	-79	93						
UNIQUE	B	0000	-28	59	60	82				
UEOM	P	003A	84	-180	116					
UEOM1	P	0078	156	-163	179					

Figure 3-4. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        RCNTRL SUBROUTINE                                    PAGE    1

       1                                TITLE   'RCNTRL SUBROUTINE'
       2                                LIST    M
       3                                NAME    RCNTRL
       4                          *
       5                          *** RCNTRL SUBROUTINE
       6                          *
       7                          *   REFERENCES:  CNTFLD
       8                          *                CONTAB
       9                          *                VALTAB
      10                          *                FRTAB
      11                          *                STAT
      12                          *   MODIFIES:    POLLP
      13                          *                NRP
      14                          *                NSP
      15                          *                FTYPE
      16                          *
      17                          *   EXTRACTS PROVISIONAL P/F BIT, N(R), N(S) IF APPLICABLE.
      18                          *   DETERMINES FRAME TYPE.   CHECKS COMMAND/RESPONSE FOR
      19                          *   VALIDITY AGAINST MODE, STATION TYPE.

      21                               XDEF    RCNTRL
      22                               XREFB   CNTFLD,POLLP,NRP,NSP,FTYPE,STAT
      23                               PSCT
      24  0000  96 00          E  RCNTRL LDAA    CNTFLD
      25  0002  16                       TAB
      26  0003  C4 10                    ANDB    #10
      27  0005  D7 00           E        STAB    POLLP          EXTRACT PROVISIONAL POLL BIT

      29  0007  CE 00 56        P        LDX     #CONTAB
      30  000A  16                       TAB
      31  000B  C4 01                    ANDB    #01            TEST FOR I-FRAME FIRST
      32  000D  E1 00                    CMPB    0,X
      33  000F  27 20                    BEQ     MATCH
      34  0011  08                       INX                    NOT AN I-FRAME

      36  0012  16                       TAB
      37  0013  C4 0F                    ANDB    #0F            TEST FOR SUPERVISORY FRAMES
      38  0015  E1 00               TEST1 CMPB    0,X
      39  0017  27 10                    BEQ     MATCH
      40  0019  08                       INX
      41  001A  8C 00 58        P        CPX     #CONTAB+5
      42  001D  26 F6                    BNE     TEST1

      44  001F  16                       TAB                    NOT A SUPERVISORY FRAME
      45  0020  C4 EF                    ANDB    #EF            TEST FOR UNNUMBERED FRAMES
      46  0022  E1 00               TEST2 CMPB    0,X
      47  0024  27 0B                    BEQ     MATCH
      48  0026  08                       INX
      49  0027  8C 00 63        P        CPX     #CONTAB+13
      50  002A  26 F6                    BNE     TEST2
```

Figure 3-5. RCNTL Code

```
ERR LINE  ADDR  B1 B2 B3 B4        RCNTRL SUBROUTINE                                    PAGE    2

      51  002C  C6 FF             INVLD   LDAB    #-1         INVALID FRAME TYPE
      52  002E  D7 00          E          STAB    FTYPE
      53  0030  39                       RTS

      55  0031  D6 00          E  MATCH   LDAB    STAT        GET STATION TYPE AND MODE
      56  0033  E4 11                     ANDB    VALTAB-CONTAB,X     TEST AGAINST FRAME TYPE
      57  0035  27 F5                     BEQ     INVLD
      58  0037  E6 22                     LDAB    FRTAB-CONTAB,X
      59  0039  D7 00          E          STAB    FTYPE

      61  003B  C1 0A                     CMPB    #10
      62  003D  2E 16                     BGT     DONE        UNNUMBERED FRAME
      63  003F  16                        TAB
      64  0040  C4 E0                     ANDB    #$E0        GET N(R) PORTION
      65  0042  54                        LSRB
      66  0043  54                        LSRB
      67  0044  54                        LSRB
      68  0045  54                        LSRB
      69  0046  54                        LSRB
      70  0047  D7 00          E          STAB    NRP         STORE PROVISIONAL N(R)
      71  0049  D6 00          E          LDAB    FTYPE
      72  004B  C1 02                     CMPB    #2
      73  004D  26 06                     BNE     DONE        SUPERVISORY FRAME
      74  004F  16                        TAB
      75  0050  C4 0E                     ANDB    #$0E
      76  0052  54                        LSRB
      77  0053  D7 00          E          STAB    NSP         STORE PROVISIONAL N(S)
      78  0055  39              DONE      RTS

      80  0056  00              CONTAB    FCB     %00000000 INFORMATION
      81  0057  01                        FCB     %00000010 RECEIVE READY
      82  0058  05                        FCB     %00001010 RECEIVE NOT READY
      83  0059  09                        FCB     %00010010 REJECT
      84  005A  0D                        FCB     %00011010 SELECTIVE REJECT
      85  005B  83                        FCB     %10000011 SET NORMAL RESPONSE MODE
      86  005C  63                        FCB     %01100011 UNNUMBERED ACKNOWLEDGEMENT
      87  005D  43                        FCB     %01000011 DISCONNECT
      88  005E  0F                        FCB     %00001111 DISCONNECTED MODE
      89  005F  87                        FCB     %10000111 FRAME REJECT
      90  0060  8F                        FCB     %10001111 RESET
      91  0061  0F                        FCB     %00001111 SET ASYNC RESPONSE MODE
      92  0062  2F                        FCB     %00101111 SET ASYNC BAL MODE
      93  0063  23                        FCB     %00100011 UNNUMBERED POLLING
      94  0064  87                        FCB     %10000111 SET INITIALIZATION MODE
      95  0065  87                        FCB     %10000111 REQUEST INITIALIZATION MODE
      96  0066  03                        FCB     %00000011 UNNUMBERED INFORMATION

      98  0067  F0              VALTAB    FCB     %11110000 I
      99  0068  F0                        FCB     %11110000 RR
     100  0069  F0                        FCB     %11110000 RNR
```

Figure 3-5. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        RCNTRL SUBROUTINE                                    PAGE    3

     101  006A  F8                        FCB     11111000B REJ
     102  006B  F8                        FCB     11111000B SREJ
     103  006C  40                        FCB     01000000B SNRM
     104  006D  A8                        FCB     10101000B UA
     105  006E  50                        FCB     01011000B DISC
     106  006F  B8                        FCB     10111000B DM
     107  0070  A8                        FCB     10101000B FRMR
     108  0071  08                        FCB     00001000B RSET
     109  0072  B8                        FCB     10111000B SARM
     110  0073  08                        FCB     00001000B SABM
     111  0074  58                        FCB     01011000B UP
     112  0075  58                        FCB     01011000B UI
     113  0076  A8                        FCB     10101000B RIM
     114  0077  F8                        FCB     11111000B UI

     116  0078  02 04 06 08       FRTAB   FCB     2,4,6,8,10,12,14,16,18,20,22,24,26
     117  007C  0A 0C 0E 10
     118  0080  12 14 16 18
     119  0084  1A
     120  0085  1C 1E 20 22                FCB     28,30,32,34
     121  0089                             END

  ASSEMBLER ERRORS =    0
```

Figure 3-5. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE					
CNTFLD	E	0000	22	24				
CONTAB	P	0056	29	41	49	56	58	-88
DONE	P	0055	62	73	-78			
FRTAB	P	0070	58	-116				
FTYPE	E	0004	22	52	59	71		
INVLD	P	002C	-51	57				
MATCH	P	0031	33	39	47	-55		
MEMORY	M	0000	0					
MARG		0000	0					
NRP	E	0002	22	70				
NSP	E	0003	22	77				
POLLP	E	0001	22	27				
RCNTRL	P	0000	-24					
STACK	S	0000	0					
STAT	E	0005	22	55				
TEST1	P	0018	-28	42				
TEST2	P	0022	-46	58				
VALTAB	P	0067	56	-98				

Figure 3-5. Cont.

4.0 DELETE RESET FUNCTION

This option removes the ability to reset the Send and Receive variables associated with only one direction of information flow by the deletion of the RSET command. This applies to the Balanced, Asynchronous class of procedures only.

Processing of the Reset function (RSET) is accomplished in the two routines RSET and TR-RSET used respectively for receive and transmit. Flow charts for these two routines are presented in Figures 4-1 and 4-2. Assembly language code for the receive RSET function is shown in Figure 4-3. If the RESET function is deleted, neither the receive nor transmit routines are required, resulting in a reduction of approximately 32 instructions (64 bytes) for receive and about 40 instructions for transmit. Since the transmission of the RSET command by a combined may be used to report an invalid N(R), some minor changes in the use of the FRMREJ subroutine may be implied. Effects on throughput are difficult to estimate at this level of implementation.

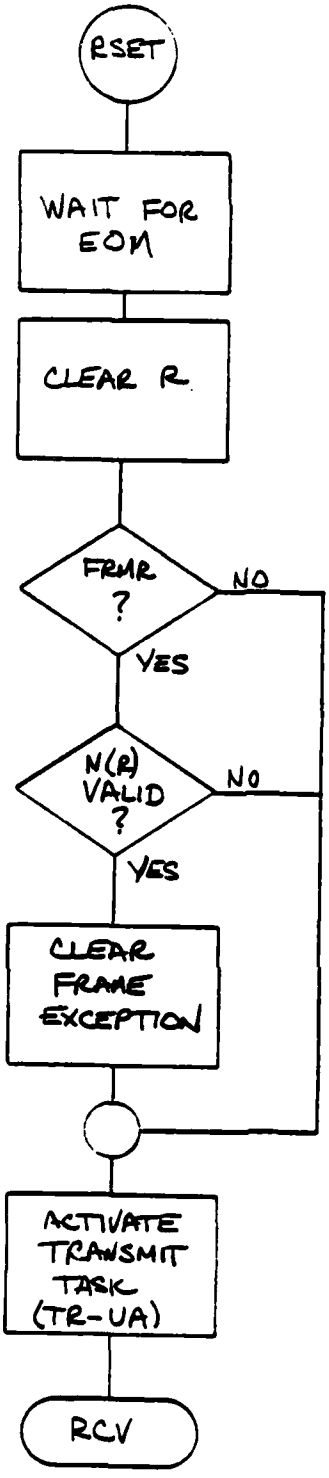

Figure 4-1. Receive RSET Command

TURN ON TRANSMITTER AND SEND RSET

Figure 4-2. Transmit RSET

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE RSET COMMAND (RSET)                                  PAGE    1

       1                                TITLE   'RECEIVE RSET COMMAND (RSET)'
       2                                LIST    X
       3                                NAME    RSET
       4                           *
       5                           *** RECEIVE RSET COMMAND
       6                           *
       7                           *   REFERENCES:  GBFLG
       8                           *                FRNBIF
       9                           *   MODIFIES:    R
      10                           *                OPSTAT
      11                           *
      12                           *   CLEARS RECEIVE STATE VARIABLE (R) AND APPLICABLE FRNR
      13                           *   CONDITIONS IN ADDRESSED COMBINED STATION.  CONFIRMS
      14                           *   ACCEPTANCE OF RSET BY TRANSMITTING UA.

      16                                XDEF    RSET
      17                                XREFB   GBFLG,R,OPSTAT,FRNBIF
      18                                XREFB   RDAFLG,RDBUFF
      19                                XREF    RCV
      20                                BSCT
      21  0000                      ADDBUF  RMB     1
      22                           *
      23                           *** GETBYT MACRO DEFINITION
      24                           *
      25                           GETBYT  MACRO   ONEBYT
      26                                   LOCAL   SETOK
      27                                   SEI             PREVENT DATA CHANGE WHILE READING
      28                           *
      29                           * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      30                           *
      31                                   LDAA    RDAFLG
      32                                   BNE     SETOK
      33                           *        *
      34                           *   SAVE PLACE AND JUMP TO WAIT PROCESS
      35                           *        *
      36                           *
      37                           SETOK   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      38                                   STAA    ONEBYT
      39                                   CLR     RDAFLG
      40                                   CLI
      41                                   ENDM
      42                                   PSCT
      43                           *
      44                           *   WAIT FOR EOM
      45                           *
      46  0000                     RSET    GETBYT  ADDBUF
      47  0000  0F                +        SEI             PREVENT DATA CHANGE WHILE READING
      48                           ++
      49                           ++ TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      50                           ++
      51  0001  96 00          E   +        LDAA    RDAFLG
      52  0003  26 00              +        BNE     .00000
      53                           ++       *
```

Figure 4-3. Receive RSET Command Code

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE RSET COMMAND (RSET)                    PAGE    2

      54                          **   SAVE PLACE AND JUMP TO WAIT PROCESS
      55                          **        *
      56                          **
      57  0005  96 00         E  *.00000   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      58  0007  97 00         B  *         STAA    ADDBUF
      59  0009  7F 00 00       E  *         CLR     RDAFLG
      60  000C  0E              *         CLI
      61  000D  7D 00 00       E           TST     GDFLG
      62  0010  2E 03                      BGT     EOM       HAVE EOM
      63  0012  7E 00 00       E           JMP     RCV       ERROR
      64  0015  7F 00 00       E  EOM      CLR     R
      65  0018  96 00          E           LDAA    SPSTAT    FRMR?
      66  001A  8B 02                      ADDA    02
      67  001C  26 09                      BNE     NOTVAL    NOT FRMR
      68  001E  96 02          E           LDAA    FRMDIF+2
      69  0020  84 08                      ANDA    #08
      70  0022  26 03                      BNE     NOTVAL    N(R) NOT VALID
      71  0024  7F 00 00       E           CLR     SPSTAT
      72  0027                        NOTVAL
      73                          *        *
      74                          *   ACTIVATE TRANSMIT TASK
      75                          *        *
      76  0027  7E 00 00       E           JMP     RCV
      77  002A                            END

  ASSEMBLER ERRORS =     0
```

Figure 4-3. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE		
ADDBUF	B	0000	-21	50	
EOM	P	0015	62	-64	
FRMBIF	E	0003	17	60	
GOFLG	E	0000	17	61	
MEMORY	N	0000	0		
NARG		0000	0		
NOTVAL	P	0027	67	70	-72
OPSTAT	E	0002	17	65	71
R	E	0001	17	64	
RCV	E	0006	19	63	76
RDAFLG	E	0004	18	51	59
RDBUFF	E	0005	18	57	
RSET	P	0000	-46		
STACK	S	0000	0		

Figure 4-3. Cont.

5.0 DELETE COMMAND OR RESPONSE I-FRAME

These two options limit the procedure to allow I frames to be commands only, or responses only, by deleting the I response and the I command respectively. This technique limits information frames to one direction for primary and secondary stations.

These options are treated together in this section, because the main effect of each is the same: one station loses the ability to transmit I-frames and the other loses the ability to receive them.

The SENDI process is used to transmit I-frames (Refer to Figure 5-1) both as commands and responses. The code for this process is presented in Figure 5-2. If I-frame transmission is deleted, the SENDI process is as shown in Figure 5-3. The 6800 code corresponding to the flow chart of Figure 5-3 is shown in Figure 5-4. The difference in number of instructions between these two routines is approximately 100 instructions. In addition to this reduction the CHICPNT routine can be deleted together with references to it in RR and RNR, removing an additional 60 instructions for a total of 160 instructions. Throughput can nearly be doubled if information transmission is limited to one direction based on the fact that the processor need manage half the number of buffers and pointers.

The flow chart for receiving I-frames is shown in Figure 5-5, and the corresponding code in Figure 5-6. If

I-frames are not to be received, this routine can be removed completely, saving approximately 75 instructions.

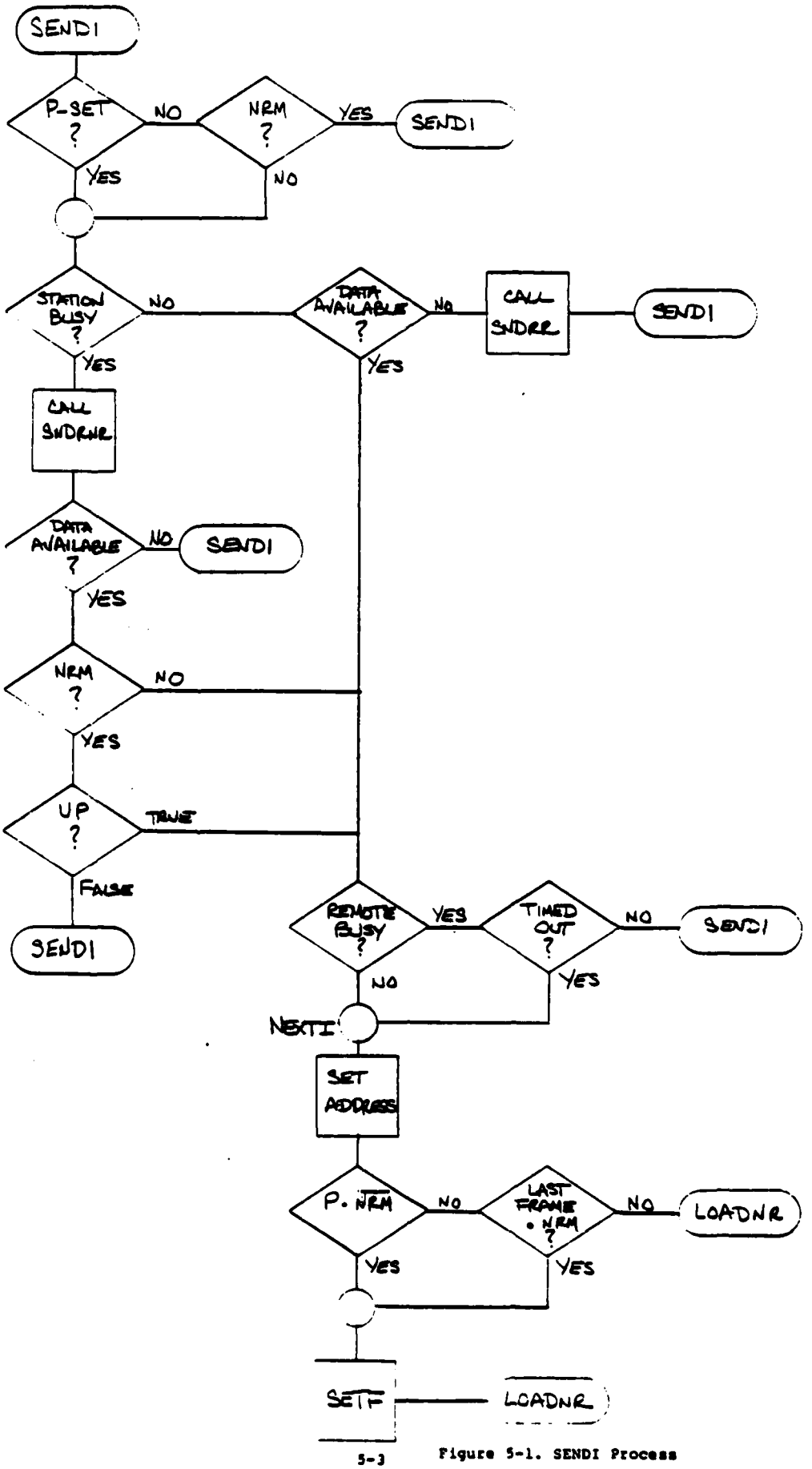

Figure 5-1. SENDI Process

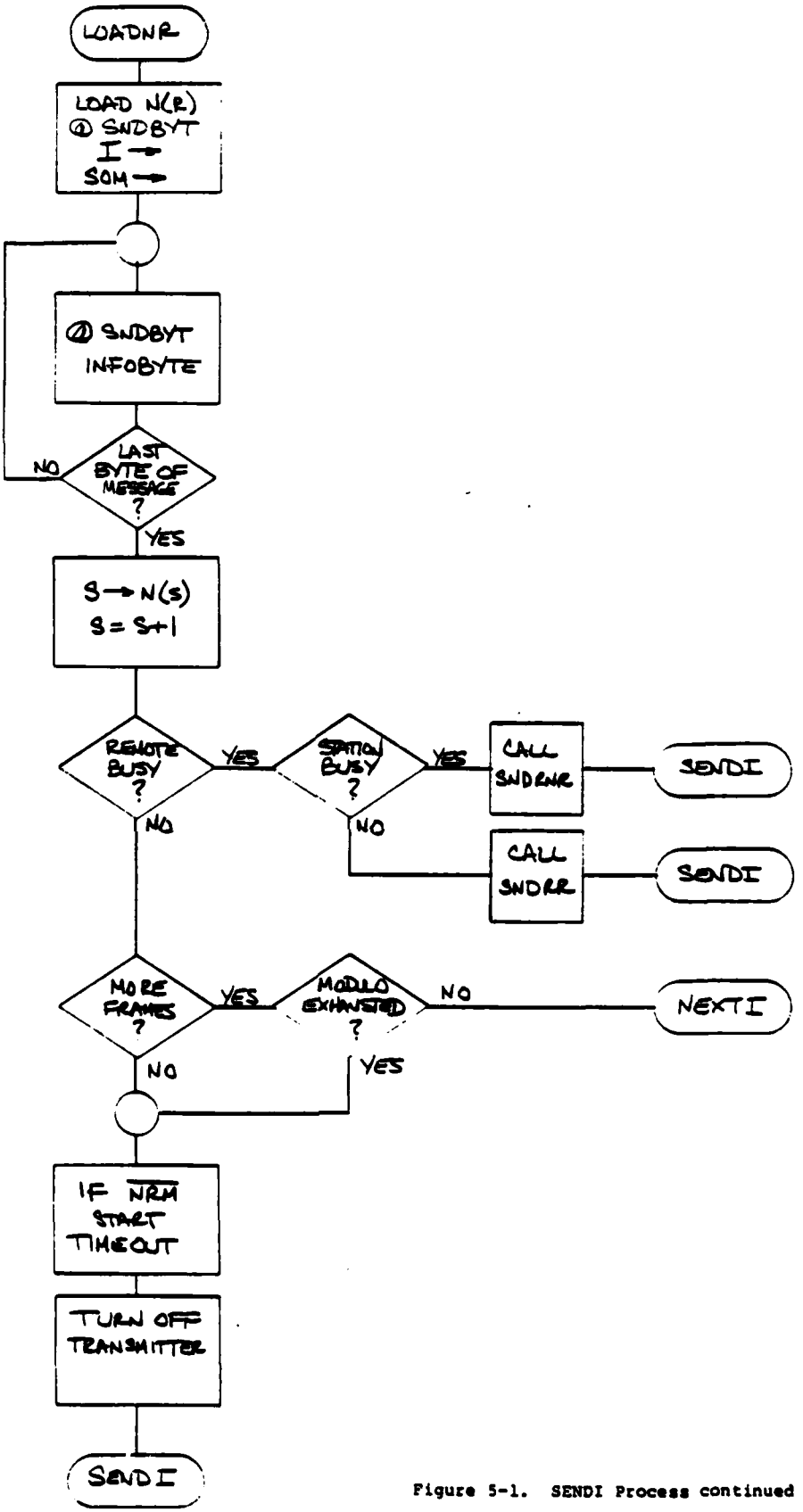

Figure 5-1. SENDI Process continued

```
ERR LINE  ADDR  B1 B2 B3 B4        SEND INFORMATION PROCESS (SENDI)                    PAGE    1

    1                                       TITLE   'SEND INFORMATION PROCESS (SENDI)'
    2                                       LIST    X
    3                                       NAME    SENDI
    4                                *
    5                                *** SENDI PROCESS
    6                                *
    7                                *   REFERENCES: FBIT,ITSMOD,STABUS,DAVAIL,RENBUS,LFRM,TSR
    8                                *   MODIFIES:   CFIELD,FBIT,TCR,TDB,S,NS
    9                                *
   10                                *   CALLS:      SNDRR
   11                                *               SNDRNR
   12                                *   EXIT:       NONE
   13                                *
   14                                *   TRANSMITS I-FRAMES AND SUPERVISORY FRAMES AS REQUIRED.  IF DATA
   15                                *   IS AVAILABLE FOR TRANSMISSION AND THE REMOTE STATION IS NOT
   16                                *   BUSY, THE LOOP FOR TRANSMITTING I-FRAMES IS ENTERED AT NEXT I.
   17                                *   THE COMPLETE I FRAME IS TRANSMITTED BYTE BY BYTE AND THE SEND
   18                                *   VARIABLE (S) IS INCREMENTED.   IF THE REMOTE STATION IS FOUND
   19                                *   TO BE BUSY, RR OR RNR IS TRANSMITTED AS APPROPRIATE.   IF MORE
   20                                *   FRAMES ARE AVAILABLE FOR TRANSMISSION, THE LOOP IS REPEATED
   21                                *   FROM NEXTI.   IF NOT, THE PROCESS IS REPEATED FROM SENDI.
   22                                *

   24                                       XDEF    SENDI
   25                                       XREFB   CFIELD,FBIT,ITSMOD,STABUS,DAVAIL,RENBUS,LFRM
   26                                       XREFB   FBIT,TSR,TDB,TCR,S,NS
   27                                       XREF    SNDRR,SNDRNR

   29                               *** SNDBYT MACRO DEFINITION
   30                               *
   31                               SNDBYT  MACRO   ONEBYT,TRFLG
   32                                       LOCAL   SETOK,SETOK1
   33                                       SEI             PREVENT DATA CHANGE WHILE WRITING
   34                               *
   35                               *   TEST TRANSMITTER BUFFER EMPTY EVENT VARIABLE
   36                               *
   37                                       LDAA    TSR
   38                                       ANDA    #$20    MASK OFF TBMT
   39                                       BNE     SETOK
   40                               *        *
   41                               *       SAVE PLACE AND JUMP TO WAIT PROCESS
   42                               *        *
   43                               SETOK   LDAA    ONEBYT
   44                                       STAA    TDB
   45                                       LDAA    #TRFLG
   46                                       BEQ     SETOK1
   47                                       STAA    TCR
   48                               SETOK1  CLI
   49                                       ENDM
```

Figure 5-2. SENDI Process Code

```
ERR LINE  ADDR  B1 B2 B3 B4        SEND INFORMATION PROCESS (SENDI)                PAGE    2

      51                                    PSCT
      52  0000                        SENDI
      53                              *
      54                              *** BEGIN PROGRAM
      55                              *
      56  0000  7F 00 00       E             CLR     CFIELD
      57  0003  96 00           E            LDAA    PBIT      P-SET?
      58  0005  26 04                       BNE     CHKBUS
      59  0007  96 00           E            LDAA    ITSMOD    NRM?
      60  0009  27 F5                       BEQ     SENDI
      61  000B  96 00           E   CHKBUS   LDAA    STABUS    STATION BUSY?
      62  000D  27 11                       BEQ     DVAL      NO
      63  000F  8D 00 00        E            JSR     SNDRNR    YES
      64  0012  96 00           E            LDAA    DAVAIL    DATA AVAILABLE?
      65  0014  27 EA                       BEQ     SENDI     NO
      66  0016  96 00           E            LDAA    ITSMOD    NRM?
      67  0018  26 E6                       BNE     SENDI     YES
      68  001A  96 00           E   CKRBUS   LDAA    REMBUS    REMOTE BUSY?
      69  001C  27 00                       BEQ     NEXTI     NO
      70                              *       *
      71                              *       IF TIMEOUT, NEXTI: IF NOT, SENDI
      72                              *       *
      73  001E  20 09                       BRA     NEXTI
      74  0020  96 00           E   DVAL     LDAA    DAVAIL    DATA AVAILABLE?
      75  0022  26 F6                       BNE     CKRBUS    YES
      76  0024  8D 00 00        E            JSR     SNDRR     NO
      77  0027  20 D7                       BRA     SENDI

      79                              *
      80                              *** SEND AN I-FRAME
      81                              *
      82  0029                        NEXTI
      83                              *       *
      84                              *       SET ADDRESS
      85                              *       *
      86  0029  96 00           E            LDAA    ITSMOD    NRM?
      87  002B  26 04                       BNE     CHKP      NO
      88  002D  96 00           E            LDAA    LFRM      YES: LAST FRAME?
      89  002F  27 0C                       BEQ     LOADNR    NO
      90  0031  96 00           E   CHKP     LDAA    PBIT      POLL BIT SET?
      91  0033  27 00                       BEQ     LOADNR    NO
      92  0035  97 00           E            STAA    FBIT      YES
      93  0037  96 00           E            LDAA    CFIELD
      94  0039  8A 10                       ORAA    #$10
      95  003B  97 00           E            STAA    CFIELD
      96  003D                        LOADNR
      97                              *       *
      98                              *       LOAD N(R), N(S) INTO CONTROL FIELD
      99                              *       *
     100  003D                               SNDBYT  CFIELD,#80
     101  003D  0F                      +      SEI             PREVENT DATA CHANGE WHILE WRITING
     102                              ++
```

Figure 5-2. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        SEND INFORMATION PROCESS (SEND1)                    PAGE    3

     103                          **   TEST TRANSMITTER BUFFER EMPTY EVENT VARIABLE
     104                          **
     105  003E  96 00          E  *         LDAA    TSR
     106  0040  84 20             *         ANDA    #$20      MASK OFF TBMT
     107  0042  26 00             *         BNE     .00000
     108                          **         *
     109                          **        SAVE PLACE AND JUMP TO WAIT PROCESS
     110                          **         *
     111  0044  96 00          E  *.00000   LDAA    CFIELD
     112  0046  97 00          E  *         STAA    TDB
     113  0048  86 00             *         LDAA    #$00
     114  004A  27 02             *         BEQ     .00001
     115  004C  97 00          E  *         STAA    TCR
     116  004E  0E                *.00001   CLI
     117                           *         *
     118                           *        SEND INFO BYTES
     119                           *         *
     120  004F  96 00          E             LDAA    S
     121  0051  97 00          E             STAA    NS
     122  0053  4C                           INCA
     123  0054  97 00          E             STAA    S
     124  0056  96 00          E             LDAA    RENBUS    REMOTE BUSY?
     125  0058  27 0E                        BEQ     NORECK    NO
     126  005A  96 00          E             LDAA    STABUS    YES: STATION BUSY?
     127  005C  27 05                        BEQ     SNDR      NO
     128  005E  BD 00 00       E             JSR     SNDRNR    YES
     129  0061  20 90                        BRA     SEND1
     130  0063  BD 00 00       E  SNDR      JSR     SNDRR
     131  0066  20 98                        BRA     SEND1
     132  0068                   NORECK
     133                           *         *
     134                           *        IF MORE FRAMES, NEXT1:
     135                           *        OTHERWISE TIMEOUT, TURN OFF TRANSMITTER AND SEND1
     136                           *         *
     137  0068                          END

ASSEMBLER ERRORS =    0
```

Figure 5-2. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE						
CFIELD	E	0000	25	36	93	95	111		
CHKBUS	P	0000	50	-61					
CHKP	P	0031	87	-90					
CKRBUS	P	001A	-60	78					
DAVAIL	E	0004	25	64	74				
DVAL	P	0020	62	-74					
FBIT	E	0007	26	92					
ITSNOD	E	0002	25	59	66	86			
LFRM	E	0006	25	88					
LOADNR	P	0030	89	91	-96				
MEMORY	M	0000	0						
NORECK	P	0060	125	-132					
NARG		0000	0						
NEXTI	P	0029	69	73	-82				
NS	E	000C	26	121					
PBIT	E	0001	25	87	90				
RENBUS	E	0005	25	60	124				
S	E	0000	26	120	123				
SENDI	P	0000	-52	60	65	67	77	129	131
SNDR	P	0063	127	-130					
SNDRNR	E	000E	27	63	120				
SNDRR	E	0000	27	76	130				
STABUS	E	0003	25	61	126				
STACK	S	0000	0						
TCR	E	000A	26	115					
TSB	E	0009	26	112					
TSR	E	0000	26	105					

Figure 5-2. Cont.

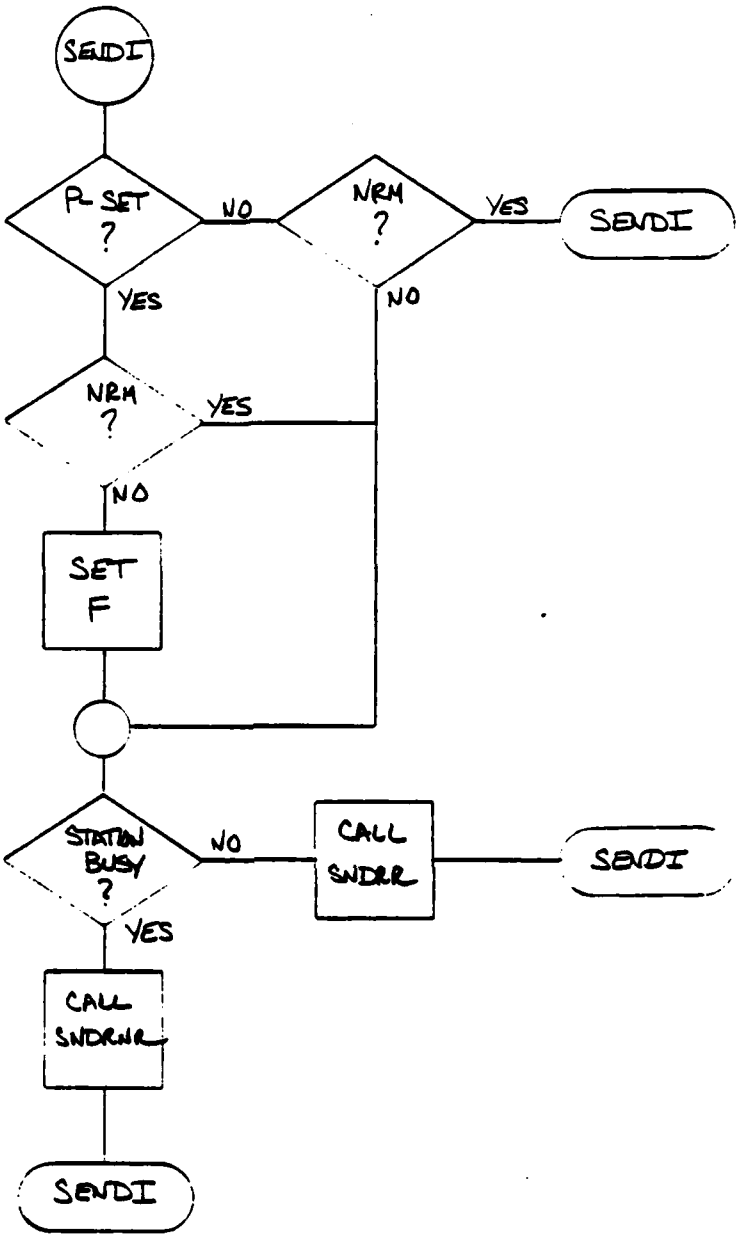

Figure 5-3. Delete I-Frame Transmission

```
ERR LINE  ADDR  B1 B2 B3 B4        DELETE RESPONSE I-FRAME TRANS (SENDI)                    PAGE    1

       1                                TITLE   'DELETE RESPONSE I-FRAME TRANS (SENDI)'
       2                                LIST    X
       3                                NAME    SENDI
       4                           *
       5                           *** SENDI PROCESS .
       6                           *
       7                           *   REFERENCES: FBIT,ITSNOD,STABUS
       8                           *   MODIFIES:   FBIT
       9                           *
      10                           *   CALLS:      SNDRR
      11                           *               SNDRNR
      12                           *   EXIT:       NONE
      13                           *
      14                           *   TRANSMITS SUPERVISORY FRAMES AS REQUIRED.
      15                           *

      17                               XDEF    SENDI
      18                               XREF    SNDRR,SNDRNR
      19                               XREFB   FBIT,ITSNOD,FBIT,STABUS

      21                               PSCT
      22  0000                     SENDI
      23                           *
      24                           *** BEGIN PROGRAM
      25                           *
      26  0000  96 00          E          LDAA    FBIT      F-SET?
      27  0002  27 08                     BEQ     CHKNRM    NO
      28  0004  96 00          E          LDAB    ITSNOD    YES: NRM?
      29  0006  26 00                     BNE     CHKBUS    YES
      30  0008  97 00          E          STAA    FBIT      NO: SET FINAL BIT
      31  000A  20 04                     BRA     CHKBUS
      32  000C  96 00          E  CHKNRM  LDAB    ITSNOD    NRM?
      33  000E  26 F0                     BNE     SENDI     YES
      34  0010  96 00          E  CHKBUS  LDAA    STABUS    STATION BUSY?
      35  0012  26 05                     BNE     SNDNR     YES
      36  0014  BD 00 00        E          JSR     SNDRR     NO
      37  0017  20 E7                     BRA     SENDI
      38  0019  BD 00 00        E  SNDNR   JSR     SNDRNR
      39  001C  20 E2                     BRA     SENDI
      40  001E                         END

ASSEMBLER ERRORS =    0
```

Figure 5-4. Delete Response I Transmission Code

CROSS REFERENCE

LABEL		VALUE	REFERENCE			
CHKBUS	P	0010	29	31	-34	
CHKMRM	P	000C	27	-32		
FBIT	E	0004	19	30		
ITSMSG	E	0003	19	28	32	
MEMORY	M	0000	0			
MARG		0000	0			
PBIT	E	0002	19	26		
SENDI	P	0000	-22	33	37	39
SNDMR	P	0019	35	-38		
SNDRMR	E	0001	18	38		
SNDRR	E	0000	18	36		
STABUS	E	0005	19	34		
STACK	S	0000	0			

Figure 5-4. Cont.

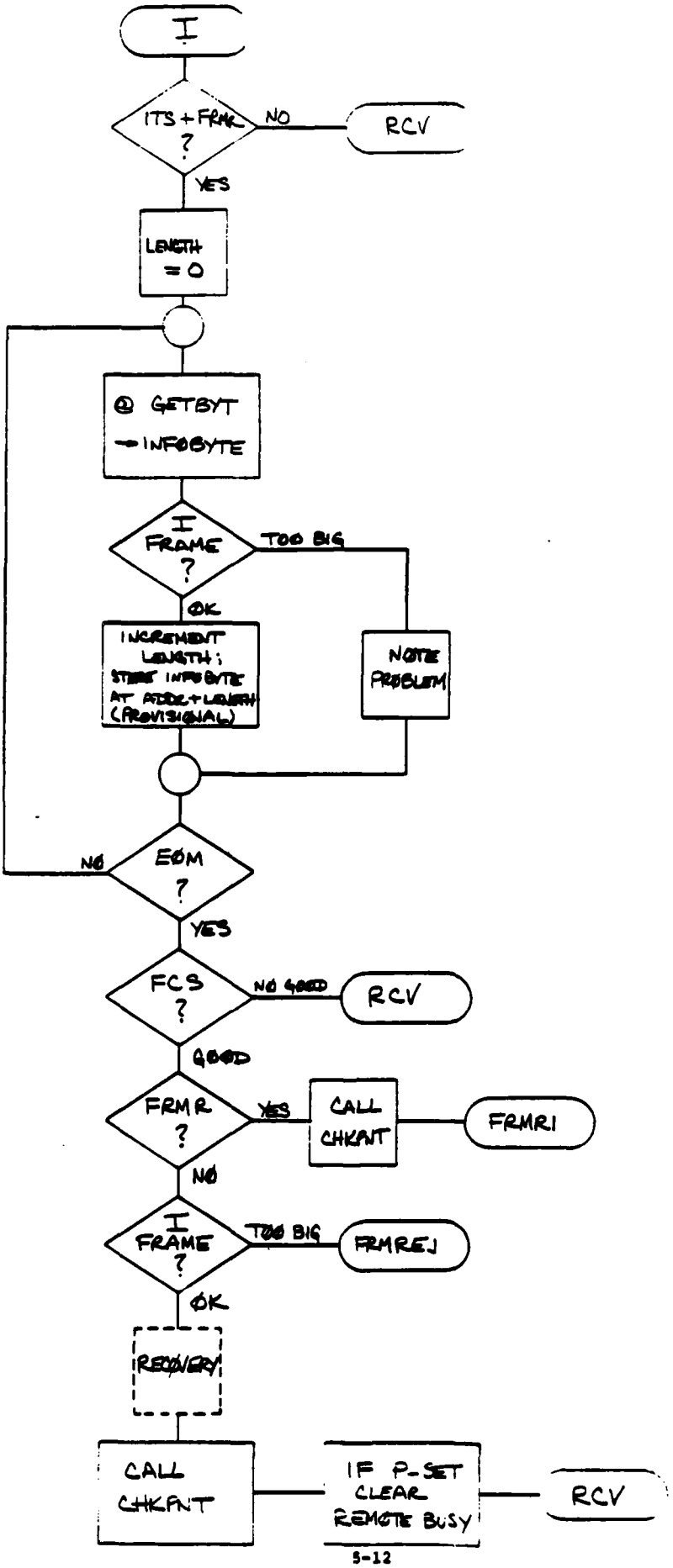

Figure 5-5.

Receive I Subroutine

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE INFORMATION FRAME (I)                    PAGE    1

       1                                TITLE   'RECEIVE INFORMATION FRAME (I)'
       2                                LIST    X
       3                                NAME    I
       4                          *
       5                          *** RECEIVE I COMMAND-RESPONSE
       6                          *
       7                          *   REFERENCES:  GDFLG
       8                          *                GPSTAT
       9                          *                PBIT
      10                          *                RDAFLG
      11                          *                RDBUFF
      12                          *                LENGMX
      13                          *   MODIFIES:    FBIT
      14                          *                INFBYT
      15                          *                RENBUS
      16                          *   CALLS:       RCV
      17                          *                CHKPNT
      18                          *                FRMREJ
      19                          *                FRMRI
      20                          *
      21                          *   MAKES THE APPROPRIATE CHECKS ON THE I-FRAME CONTROL FIELD
      22                          *   AND READS THE INFORMATION FIELD BYTE-BY-BYTE.

      24                               XDEF    I
      25                               XREF    RCV,CHKPNT,FRMREJ,FRMRI
      26                               XREFB   GPSTAT,PBIT,FBIT,RDAFLG,RDBUFF,GDFLG
      27                               XREFB   LENGMX,RENBUS
      28                               BSCT
      29  0000                    LENGTH   RMB     1
      30  0001                    LENGFL   RMB     1
      31  0002                    INFBYT   RMB     1
      32                          *
      33                          *** GETBYT MACRO DEFINITION
      34                          *
      35                          GETBYT   MACRO   ONEBYT
      36                                   LOCAL   GETOK
      37                                   SEI             PREVENT DATA CHANGE WHILE READING
      38                          *
      39                          * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      40                          *
      41                                   LDAA    RDAFLG
      42                                   BNE     GETOK
      43                          *         *
      44                          *   SAVE PLACE AND JUMP TO WAIT PROCESS
      45                          *         *
      46                          *
      47                          GETOK    LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      48                                   STAA    ONEBYT
      49                                   CLR     RDAFLG
      50                                   CLI
      51                                   ENDM
```

Figure 5-6. Receive I Frame Code

```
                                        PSCT
                                    *
                                    *** BEGIN PROGRAM
                                    *
                                    1
0000                                
0000 96 00          E               LDAA    OPSTAT      CHECK OPERATIONAL STATE
0002 2E 10                          BGT     CONT        ITS
0004 8B 02                          ADDA    #2
0006 27 0C                          BEQ     CONT        FRMR
0008 96 00          E               LDAA    PBIT        POLL BIT SET?
000A 26 03                          BNE     PTU0        YES
000C 7E 00 00       E               JMP     RCV
000F 97 00          E   PTU0        STAA    FBIT
                                    *       *
                                    *       ACTIVATE TRANSMIT TASK TR-ON
                                    *       *
0011 7E 00 00       E               JMP     RCV
0014 4F                 CONT        CLRA
0015 97 00          B               STAA    LENGTH
0017 97 01          B               STAA    LENGFL
                                    *
                                    *** RECEIVE MESSAGE LOOP
                                    *
0019                                LOOP    GETBYT  INFBYT
0019 0F                             *       SEI                 PREVENT DATA CHANGE WHILE READING
                                    **
                                    ** TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
                                    **
001A 96 00          E               *       LDAA    RDAFLG
001C 26 00                          *       BNE     .+$0000
                                    *       *
                                    **      SAVE PLACE AND JUMP TO WAIT PROCESS
                                    **      *
                                    **
001E 96 00          E               *.+$0000  LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
0020 97 02          B               *       STAA    INFBYT
0022 7F 00 00       E               *       CLR     RDAFLG
0025 0E                             *       CLI
0026 7D 00 00       E               *       TST     GBFLG
0029 2C 03                          BGE     PTU01       NORMAL OR EOM
002B 7E 00 00       E               JMP     RCV         ERROR/EOM
002E 2E 10              PTU01       BGT     CKFRMR      EOM/GOOD FRAME
0030 D6 00          B               LDAB    LENGTH
0032 D0 00          E               SUBB    LENGMX
0034 2E 05                          BGT     TOOBIG
0036 7C 00 00       B               INC     LENGTH
                                    *       *
                                    *       STORE INFBYT AT BASE ADDRESS+LENGTH
                                    *       *
0039 20 DE                          BRA     LOOP
003B 7C 00 01       B   TOOBIG      INC     LENGFL
003E 20 D9                          BRA     LOOP
0040 96 00          E   CKFRMR      LDAA    OPSTAT
```

Figure 5-6. Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE INFORMATION FRAME (I)

     106  0042  88 02                    ADDA    #2
     107  0044  26 06                    BNE     CIFRM       NOT FRNR
     108  0046  BD 00 00          E       JSR     CHKPNT
     109  0049  7E 00 00          E       JMP     FRNR1
     110  004C  7D 00 01          E CIFRM TST     LENGFL      I-FRAME TOO BIG?
     111  004F  27 03                    BEQ     PERREC      NO
     112  0051  7E 00 00          E       JMP     FRNREJ      YES
     113  0054                    PERREC
     114                            *        *
     115                            *        PERFORM RECOVERY
     116                            *        *
     117  0054  BD 00 00          E       JSR     CHKPNT
     118  0057  7D 00 00          E       TST     PBIT
     119  005A  26 03                    BNE     CLRBUS
     120  005C  7E 00 00          E       JMP     RCV
     121  005F  7F 00 00          E CLRBUS CLR    RENBUS
     122  0062  7E 00 00          E       JMP     RCV
     123  0065                        END

  ASSEMBLER ERRORS =     0
```

Figure 5-6. Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE					
CHKPNT	E	0001	25	100	117			
CIFRM	P	004C	107	-110				
CKFRMR	P	0040	94	-105				
CLRBUS	P	005F	119	-121				
CONT	P	0014	59	61	-70			
FBIT	E	0006	26	65				
FRMR1	E	0003	25	109				
FRMREJ	E	0002	25	112				
GDFLG	E	0009	26	91				
I	P	0000	-57					
INFBYT	B	0002	-31	88				
LENGFL	B	0001	-30	72	103	110		
LENGMX	E	000A	27	96				
LENGTH	B	0000	-29	71	95	98		
LOOP	P	0019	-76	102	104			
MEMORY	M	0000	0					
MARG		0000	0					
OPSTAT	E	0004	26	58	105			
PBIT	E	0005	26	62	110			
PERREC	P	0054	111	-113				
PTMG	P	000F	63	-65				
PTMG1	P	002E	92	-94				
RCV	E	0000	25	64	69	93	120	122
RDAFLG	E	0007	26	81	89			
RDBUFF	E	0000	26	87				
REMBUS	E	0008	27	121				
STACK	S	0000	0					
TOOBIG	P	003B	97	-103				

Figure 5-6. Cont.

6.0 UNNUMBERED POLLING FUNCTION

Option 6 provides for the ability to perform unnumbered group polling as well as unnumbered individual polling by the addition of the UP command. The UP command is used to solicit a response frame from a single station, or from a group of stations, by establishing a logical operational condition that exists at each addressed station for one respond opportunity.

The flow chart for the reception of the unnumbered polling command and the corresponding 6800 assembly language code are presented in Figures 6-1 and 6-2 respectively. Approximately 20 instructions are required for this routine. The receive UP function also requires some minor modification to the SENDI process and the processes for sending Receive Ready/Receive Not Ready. These modifications are shown in the flow charts of Figures 6-3 and 6-4. Effects on throughput are difficult ot judge at this level of implementation.

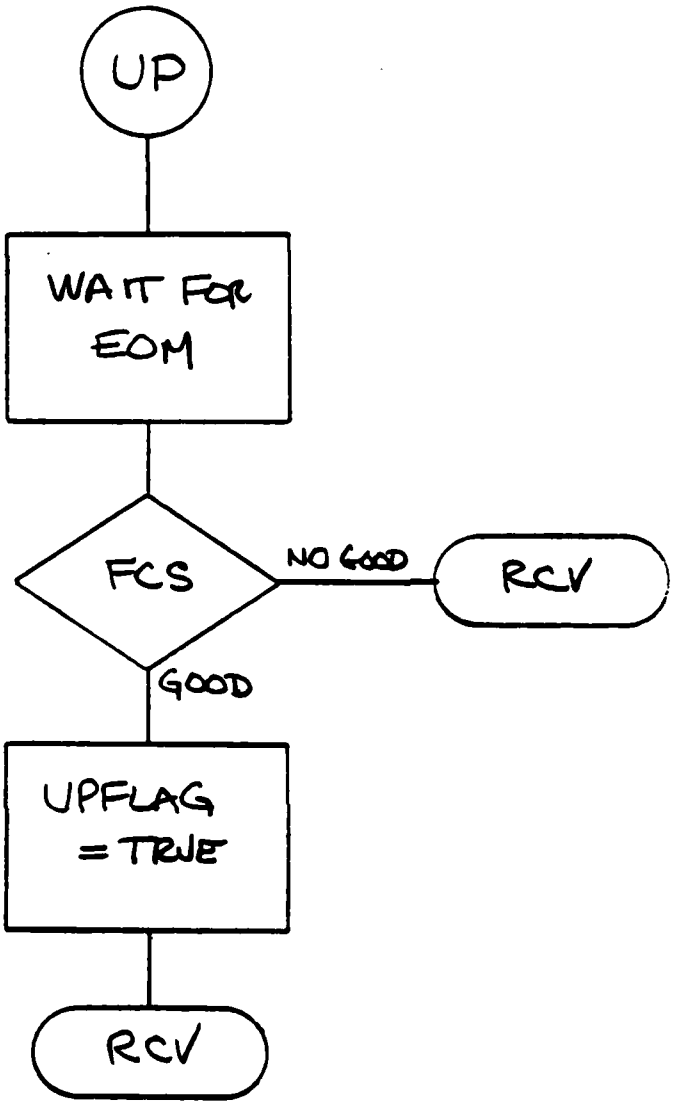

Figure 6-1. Receive UP Command

```
ERR LINE  ADDR  B1 B2 B3 B4      RECEIVE UNNUMBERED POLLING COMMAND (UP)                    PAGE    1

       1                                TITLE   'RECEIVE UNNUMBERED POLLING COMMAND (UP)'
       2                                LIST    X
       3                                NAME    UP
       4                        *
       5                        *** RECEIVE UP COMMAND
       6                        *
       7                        *   REFERENCES:  GBFLG
       8                        *                RDAFLG
       9                        *                RDBUFF
      10                        *   MODIFIES:    UPFLAG
      11                        *
      12                        *   THIS ROUTINE SETS THE UPFLAG, INDICATING THAT A UP COMMAND
      13                        *   HAS BEEN RECEIVED.

      15                               XDEF    UP
      16                               XREF    RCV
      17                               XREFB   RDAFLG,RDBUFF,GBFLG,UPFLAG
      18                               DSCT
      19  0000                 ADDBUF  RMB     1
      20                        *
      21                        *** GETBYT MACRO DEFINITION
      22                        *
      23                        GETBYT  MACRO   ONEBYT
      24                               LOCAL   SETOK
      25                               SEI                 PREVENT DATA CHANGE WHILE READING
      26                        *
      27                        * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      28                        *
      29                               LDAA    RDAFLG
      30                               BNE     SETOK
      31                        *       *
      32                        *   SAVE PLACE AND JUMP TO WAIT PROCESS
      33                        *       *
      34                        *
      35                        SETOK   LDAA    RDBUFF      STORE RDBUFF IN MACRO ARG
      36                               STAA    ONEBYT
      37                               CLR     RDAFLG
      38                               CLI
      39                               ENDM
```

Figure 6-2. Receive UP Command Code

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE UNNUMBERED POLLING COMMAND (UP)                    PAGE    2

      41                                    PSCT
      42                               *
      43                               *   WAIT FOR EOM
      44                               *
      45  0000                         UP       CETBYT  ADDBUF
      46  0000  0F                    *        SEI              PREVENT DATA CHANGE WHILE READING
      47                               **
      48                               ** TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      49                               **
      50  0001  96 00              E   *        LDAA    RDAFLG
      51  0003  26 00              E   *        BNE     .00000
      52                               **       *
      53                               **   SAVE PLACE AND JUMP TO WAIT PROCESS
      54                               **       *
      55                               **
      56  0005  96 00              E   *.00000   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      57  0007  97 00              E   *        STAA    ADDBUF
      58  0009  7F 00 00           E   *        CLR     RDAFLG
      59  000C  0E                      *        CLI
      60  000D  7D 00 00           E            TST     GBFLG
      61  0010  2E 03                           BGT     EOM       HAVE EOM
      62  0012  7E 00 00           E            JMP     RCV       ERROR
      63  0015  7F 00 00           E   EOM      CLR     UPFLAG
      64  0018  7C 00 00           E            INC     UPFLAG
      65  001B  7E 00 00           E            JMP     RCV
      66  001E                                END

ASSEMBLER ERRORS =    0
```

Figure 6-2 Cont.

CROSS REFERENCE

LABEL	VALUE	REFERENCE		
ADDBUF	B 0000	-19	97	
EOM	P 0015	61	-63	
GOFLG	E 0003	17	60	
MEMORY	M 0000	0		
MARG	0000	0		
RCV	E 0000	16	62	65
RDAFLG	E 0001	17	90	98
RDBUFF	E 0002	17	56	
STACK	B 0000	0		
UP	P 0000	-43		
UPFLAG	E 0004	17	63	64

Figure 6-2. Cont.

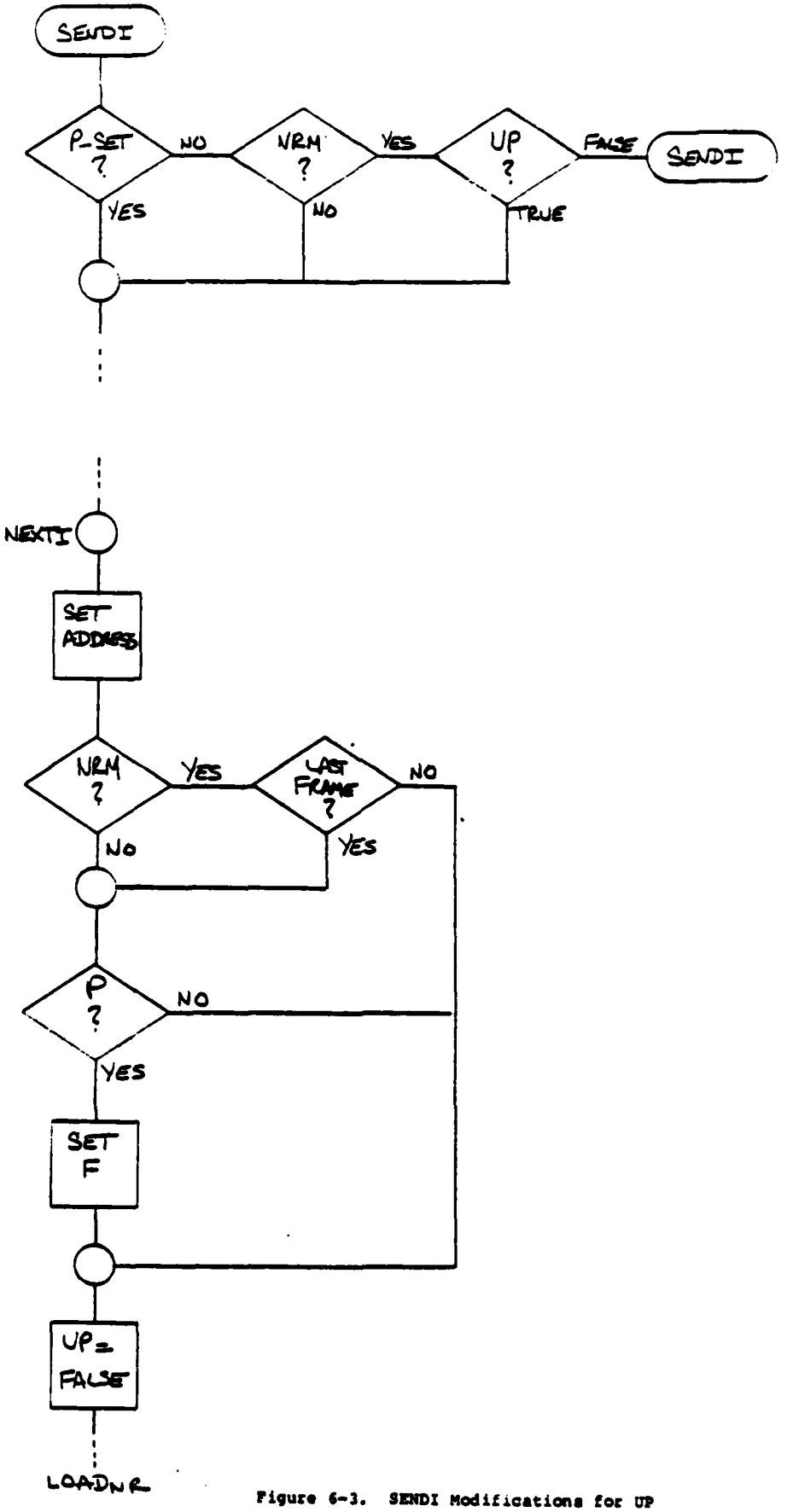

Figure 6-3. SENDI Modifications for UP

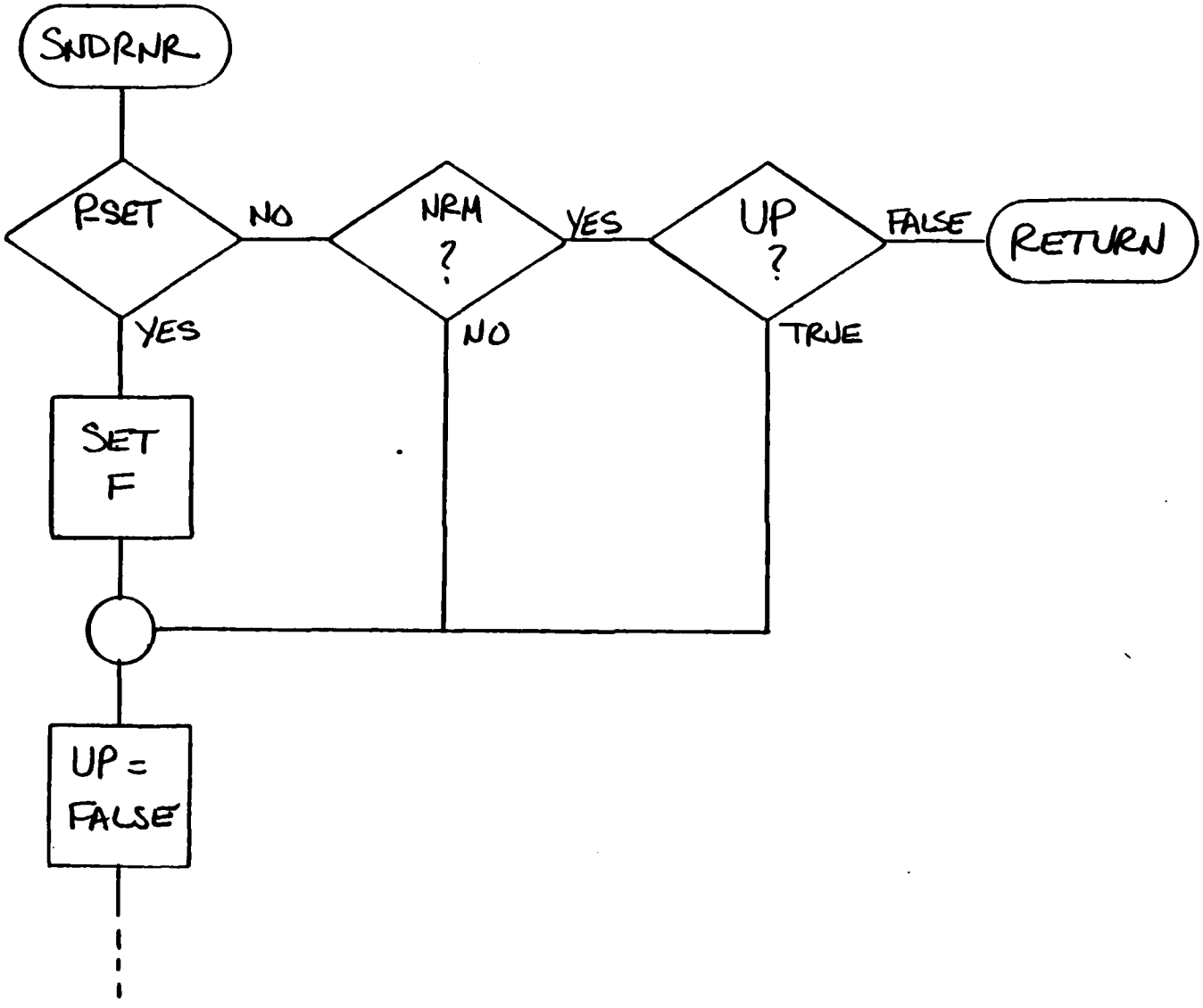

Figure 6-4. SNDRNR Modifications for UP

7.0 INITIALIZATION FUNCTION

This option provides the ability to initialize remote stations and the ability to request initialization. The SIM command and the RIM response are added. The SIM command is used to request a remote station to initiate a station-specified procedure to initialize its link-level control function. The RIM response is used by the Secondary/ combined station to request the SIM command.

The flow chart for the reception of the SIM command and the corresponding 6800 code are given in Figures 7-1 and 7-2. The flow chart for the transmission of the RIM response and corresponding code are given in Figures 7-3 and 7-4. Some modification to the module that determines the operational state is required to accommodate the initialization state and the RIM condition. This module is used at the beginning of the received command handlers for example, it appears in the received I-frame. The modifications to this routine are shown in Figure 7-5.

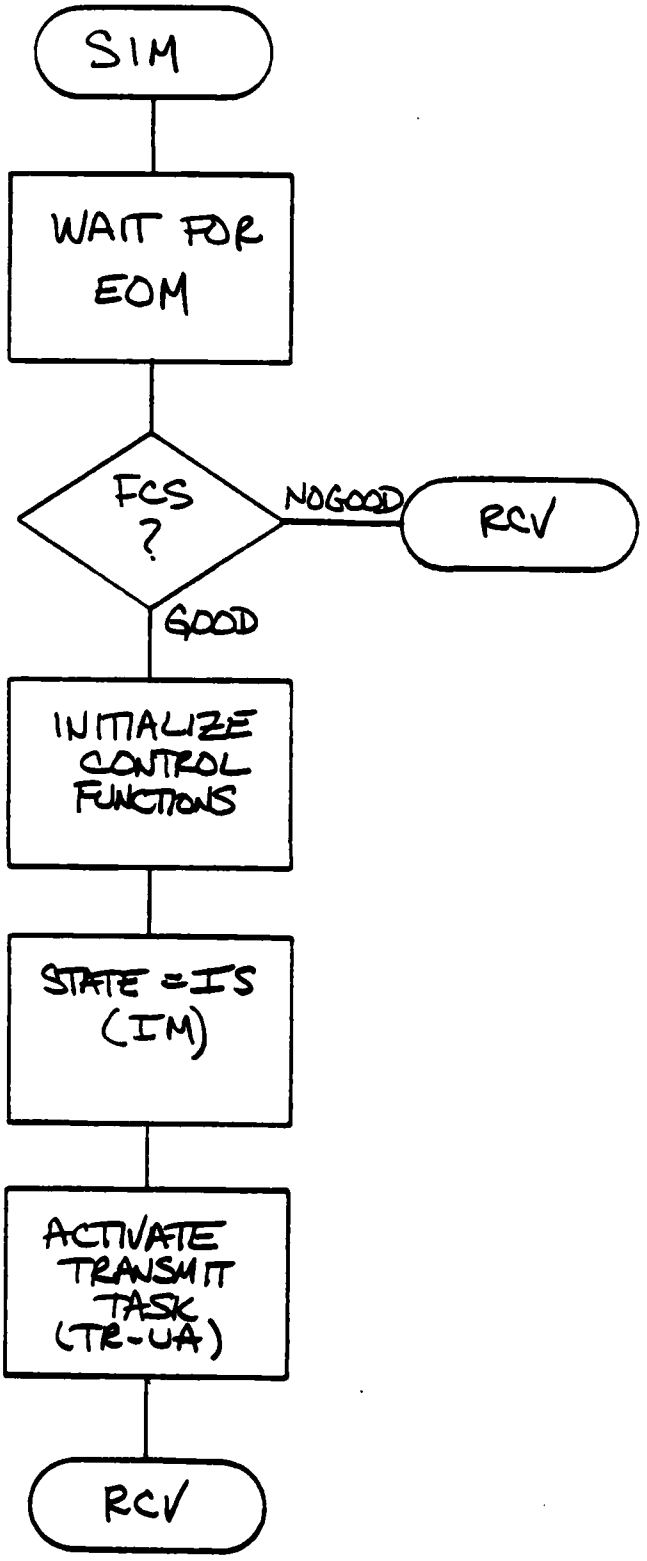

Figure 7-1. Receive SIM Command

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE SET INITIALIZATION MODE COMMAND (SIM)              PAGE    1

       1                                TITLE   'RECEIVE SET INITIALIZATION MODE COMMAND (SIM)'
       2                                LIST    X
       3                                NAME    SIM
       4                              *
       5                              *** RECEIVE SIM COMMAND
       6                              *
       7                              *   REFERENCES:  GOFLG
       8                              *                RDAFLG
       9                              *                RDBUFF
      10                              *   MODIFIES:    OPSTAT
      11                              *
      12                              *   THIS ROUTINE INITIALIZES CONTROL FUNCTIONS, SETS OPERATIONAL
      13                              *   STATE TO IS, AND SENDS OA.

      15                                   XDEF    SIM
      16                                   XREF    RCV
      17                                   XREFB   RDAFLG,RDBUFF,GOFLG,OPSTAT
      18                                   BSCT
      19  0000                         ADDBUF  RMB     1
      20                              *
      21                              *** GETBYT MACRO DEFINITION
      22                              *
      23                              GETBYT  MACRO   ONEBYT
      24                                      LOCAL   SETOK
      25                                      SEI                 PREVENT DATA CHANGE WHILE READING
      26                              *
      27                              * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      28                              *
      29                                      LDAA    RDAFLG
      30                                      BNE     SETOK
      31                              *        *
      32                              *   SAVE PLACE AND JUMP TO WAIT PROCESS
      33                              *        *
      34                              *
      35                              SETOK   LDAA    RDBUFF      STORE RDBUFF IN MACRO ARG
      36                                      STAA    ONEBYT
      37                                      CLR     RDAFLG
      38                                      CLI
      39                                      ENDM
```

Figure 7-2. Receive SIM Command Code

```
ERR LINE  ADDR  01 02 03 04        RECEIVE SET INITIALIZATION MODE COMMAND (SIM)              PAGE    2

      41                                    PSCT
      42                               *
      43                               *   WAIT FOR EOM
      44                               *
      45  0000                         SIM     GETBYT  ADDBUF
      46  0000  0F                   +         SEI                PREVENT DATA CHANGE WHILE READING
      47                              +*
      48                              +* TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
      49                              +*
      50  0001  96 00          E     +         LDAA    RDAFLG
      51  0003  26 00                +         BNE     .00000
      52                              +*        *
      53                              +*   SAVE PLACE AND JUMP TO WAIT PROCESS
      54                              +*        *
      55                              +*
      56  0005  96 00          E     +.00000   LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
      57  0007  97 00          E     +         STAA    ADDBUF
      58  0009  7F 00 00        E    +         CLR     RDAFLG
      59  000C  0E                   +         CLI
      60  000D  7D 00 00        E              TST     COFLG
      61  0010  2E 03                          BGT     EOM       HAVE EOM
      62  0012  7E 00 00        E              JMP     RCV       ERROR
      63  0015                       EOM
      64                               *        *
      65                               *        INITIALIZE CONTROL FUNCTIONS
      66                               *        *
      67  0015  86 FF                          LDAA    #-1
      68  0017  97 00           E              STAA    OPSTAT
      69                               *        *
      70                               *        ACTIVATE TRANSMIT TASK (TR-UA)
      71                               *        *
      72  0019  7E 00 00        E              JMP     RCV
      73  001C                           END

  ASSEMBLER ERRORS =    0
```

Figure 7-2 Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE		
ADDBUF	B	0000	-19	37	
EOM	P	0015	61	-63	
SBFLG	E	0003	17	60	
MEMORY	M	0000	0		
NARB		0000	0		
OPSTAT	E	0004	17	60	
RCV	E	0000	16	62	72
RDAFLG	E	0001	17	58	58
RDBUFF	E	0002	17	56	
SIN	P	0000	-45		
STACK	S	0000	0		

Figure 7-2 Cont.

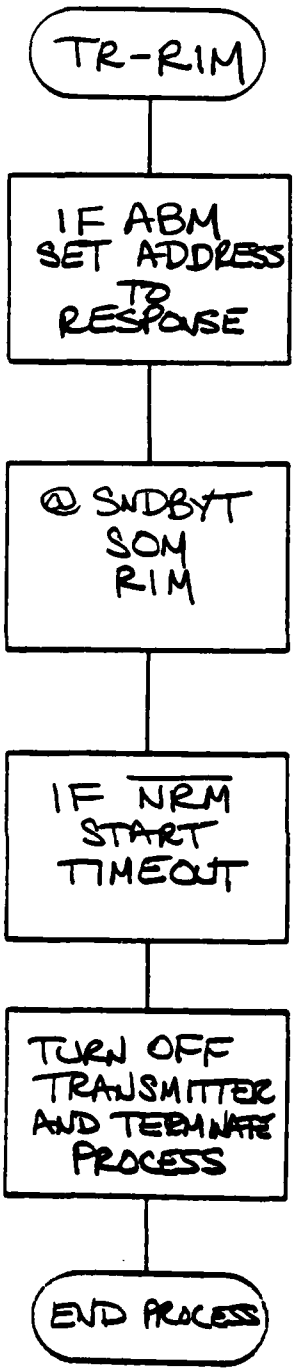

Figure 7-3. Transmit RIM Response

```
ERR LINE  ADDR  B1 B2 B3 B4        TRANSMIT REQUEST INITIALIZATION MODE RESPONSE (RIN          PAGE    1

                                          TITLE   'TRANSMIT REQUEST INITIALIZATION MODE RESPONSE (RIN)'
                                          LIST    X
                                          NAME    RIN
                                  *
                                  *** TRANSMIT RIN RESPONSE
                                  *
                                  *   REFERENCES: TSR
                                  *   MODIFIES:   CFIELD
                                  *               TDB
                                  *               TCR
                                  *

                                          XDEF    RIN
                                          XREFB   TSR.CFIELD.TDB.TCR

                                  *** SNDBYT MACRO DEFINITION
                                  *
                                  SNDBYT  MACRO   SNEBYT.TRFLG
                                          LOCAL   SETOK.SETOK1
                                          SEI                 PREVENT DATA CHANGE WHILE WRITING
                                  *
                                  *   TEST TRANSMITTER BUFFER EMPTY EVENT VARIABLE
                                  *
                                          LDAA    TSR
                                          ANDA    #$20        MASK OFF TBMT
                                          BNE     SETOK
                                  *        *
                                  *       SAVE PLACE AND JUMP TO WAIT PROCESS
                                  *        *
                                  SETOK   LDAA    SNEBYT
                                          STAA    TDB
                                          LDAA    STRFLG
                                          BEQ     SETOK1
                                          STAA    TCR
                                  SETOK1  CLI
                                          ENDM
```

Figure 7-4. Transmit RIM Command Code

```
ERR LINE  ADDR  B1 B2 B3 B4        TRANSMIT REQUEST INITIALIZATION MODE RESPONSE (RIN          PAGE    2

      38                                    PSCT
      39  0000                        RIN
      40                              *
      41                              *** BEGIN PROGRAM
      42                              *
      43                              *       *
      44                              *       IF ABN, SET ADDRESS TO RESPONSE
      45                              *       *
      46  0000  96 00          E             LDAA    CFIELD
      47  0002  84 10                        ANDA    #$10
      48  0004  8A 07                        ORAA    #$07
      49  0006  97 00          E             STAA    CFIELD
      50  0008                              SNDBYT  CFIELD,#$00
      51  0008  0F                    *       SEI             PREVENT DATA CHANGE WHILE WRITING
      52                              **
      53                              **   TEST TRANSMITTER BUFFER EMPTY EVENT VARIABLE
      54                              **
      55  0009  96 00          E     *       LDAA    TSR
      56  000B  84 20                *       ANDA    #$20        MASK OFF TBMT
      57  000D  26 00                *       BNE     .00000
      58                              **      *
      59                              **      SAVE PLACE AND JUMP TO WAIT PROCESS
      60                              **      *
      61  000F  96 00          E     *.00000   LDAA    CFIELD
      62  0011  97 00          E     *       STAA    TDR
      63  0013  86 00                *       LDAA    #$00
      64  0015  27 02                *       BEQ     .00001
      65  0017  97 00          E     *       STAA    TCR
      66  0019  0E                    *.00001 CLI
      67                              *       *
      68                              *       IF NOT NRM, START TIMEOUT
      69                              *       TURN OFF TRANSMITTER & TERMINATE PROCESS
      70                              *       *
      71  001A                              END

ASSEMBLER ERRORS =    0
```

Figure 7-4 Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE			
CFIELD	E	0001	14	46	49	61
MEMORY	M	0000	0			
MARG		0000	0			
RIN	P	0000	-39			
STACK	S	0000	0			
TCR	E	0003	14	65		
TDB	E	0002	14	62		
TSR	E	0000	14	55		

Figure 7-4 Cont.

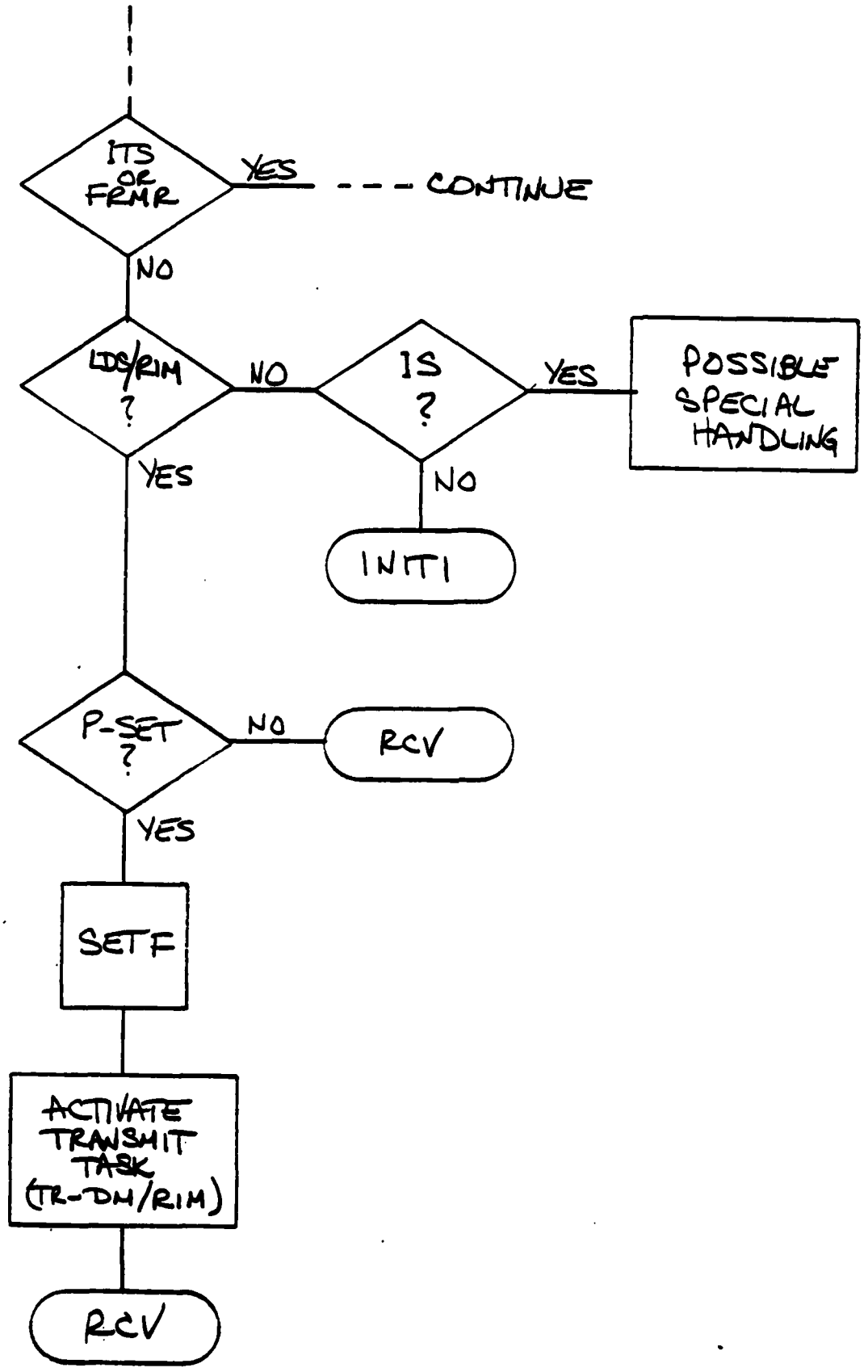

Figure 7-5. Modification for SIM/RIM

8.0 UNNUMBERED INFORMATION FUNCTION

This option provides the ability to exchange information fields without impacting the send and receive variables, and provides for the addition of the UI command and the UI response. Since the frame is not sequence number verified, the frame may be lost or duplicated if a link exception condition occurs.

The UI function is very similar to the transmit I function, assuming that a message is a number of bytes. The UI function requires no error recovery based on send and receive variables nor buffering and pointers for multiple frames. A flow chart for receiving UI and the corresponding 6800 code are given in Figures 8-1 and 8-2. Comparing Figure 8-2 with Figure 5-6 reveals the difference in code required to send a UI frame instead of an I frame. Of course, a UI frame may be sent in addition to an I frame.

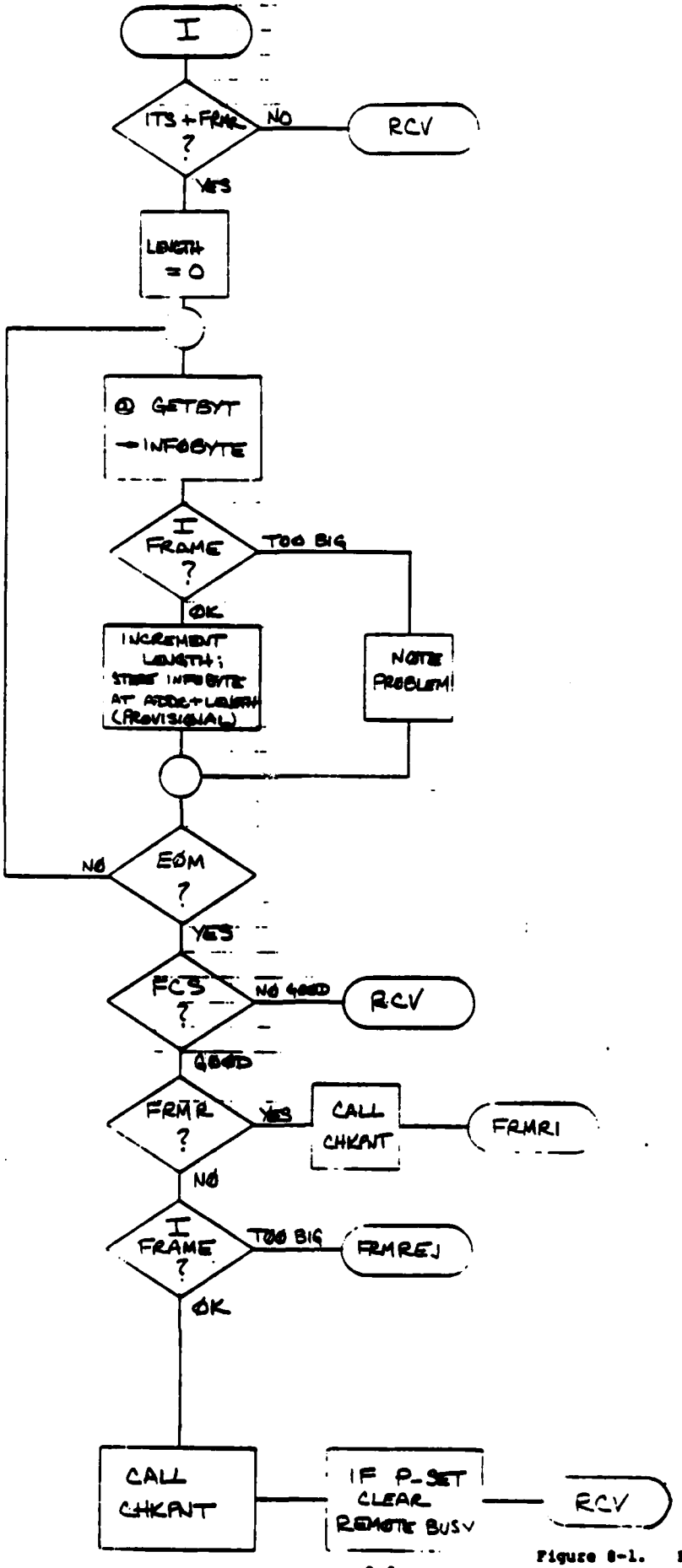

Figure 8-1. Receive UI Subroutine

```
ERR LINE  ADDR  01 02 03 04        RECEIVE UNNUMBERED INFORMATION FRAME (UI)                PAGE    1

        1                                TITLE   'RECEIVE UNNUMBERED INFORMATION FRAME (UI)'
        2                                LIST    X
        3                                NAME    UI
        4                        *
        5                        *** RECEIVE UI COMMAND-RESPONSE
        6                        *
        7                        *   REFERENCES:  GBFLG
        8                        *                GPSTAT
        9                        *                PBIT
       10                        *                RDAFLG
       11                        *                RDBUFF
       12                        *                LENGNX
       13                        *   MODIFIES:    FBIT
       14                        *                INFBYT
       15                        *                RENBUS
       16                        *   CALLS:       RCV
       17                        *                CHKPNT
       18                        *                FRMREJ
       19                        *                FRMRI
       20                        *
       21                        *   READS THE INFORMATION FIELD BYTE-BY-BYTE.

       23                               XDEF    UI
       24                               XDEF    RCV,CHKPNT,FRMREJ,FRMRI
       25                               XREFB   GPSTAT,PBIT,FBIT,RDAFLG,RDBUFF,GBFLG
       26                               XREFB   LENGNX,RENBUS
       27                               BSCT
       28  0000                 LENGTH  RMB     1
       29  0001                 LENGFL  RMB     1
       30  0002                 INFBYT  RMB     1
       31                       *
       32                       *** GETBYT MACRO DEFINITION
       33                       *
       34                       GETBYT  MACRO   ONEBYT
       35                               LOCAL   SETOK
       36                               SEI             PREVENT DATA CHANGE WHILE READING
       37                       *
       38                       * TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
       39                       *
       40                               LDAA    RDAFLG
       41                               BNE     SETOK
       42                       *        *
       43                       *   SAVE PLACE AND JUMP TO WAIT PROCESS
       44                       *        *
       45                       *
       46                       SETOK   LDAA    RDBUFF      STORE RDBUFF IN MACRO ARG
       47                               STAA    ONEBYT
       48                               CLR     RDAFLG
       49                               CLI
       50                               ENDM
```

Figure 8-2 Receive UI Frame Code

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE UNNUMBERED INFORMATION FRAME (UI)                PAGE    2

      92                                PAGE
      93                          *
      94                          *** BEGIN PROGRAM
      95                          *
      96  0000                    UI
      97  0000  96 00          E         LDAA    OPSTAT    CHECK OPERATIONAL STATE
      98  0002  2E 10                    BGT     CONT      ITS
      99  0004  8B 02                    ADDA    #2
     100  0006  27 0C                    BEQ     CONT      FRMR
     101  0008  96 00          E         LDAA    PBIT      POLL BIT SET?
     102  000A  26 03                    BNE     PTU0      YES
     103  000C  7E 00 00        E         JMP     RCV
     104  000F  97 00           E   PTU0  STAA    PBIT
     105                          *       *
     106                          *       ACTIVATE TRANSMIT TASK TX-ON
     107                          *       *
     108  0011  7E 00 00        E         JMP     RCV
     109  0014  4F                  CONT  CLRA
     110  0015  97 00           B         STAA    LENGTH
     111  0017  97 01           B         STAA    LENGFL
     112                          *
     113                          *** RECEIVE MESSAGE LOOP
     114                          *
     115  0019                    LOOP  GETBYT  INFBYT
     116  0019  0F                +       SEI               PREVENT DATA CHANGE WHILE READING
     117                          +*
     118                          +* TEST RECEIVE DATA AVAILABLE EVENT VARIABLE
     119                          +*
     120  001A  96 00           E +       LDAA    RDAFLG
     121  001C  26 00             +       BNE     .00000
     122                          +*       *
     123                          +*   SAVE PLACE AND JUMP TO WAIT PROCESS
     124                          +*       *
     125                          +*
     126  001E  96 00           E +.00000  LDAA    RDBUFF    STORE RDBUFF IN MACRO ARG
     127  0020  97 02           B +       STAA    INFBYT
     128  0022  7F 00 00        E +       CLR     RDAFLG
     129  0025  0E                +       CLI
     130  0026  7D 00 00        E         TST     EOFLG
     131  0029  2C 03                    BGE     PTU01     NORMAL OR EOM
     132  002B  7E 00 00        E         JMP     RCV       ERROR/EOM
     133  002E  2E 10           B   PTU01 BGT     CKFRMR    EOM/GOOD FRAME
     134  0030  96 00           B         LDAB    LENGTH
     135  0032  00 00           E         SUBB    LENGHH
     136  0034  2E 05                    BGT     TOOBIG
     137  0036  7C 00 00        B         INC     LENGTH
     138                          *       *
     139                          *       STORE INFBYT AT BASE ADDRESS+LENGTH
     140                          *       *
     141  0039  20 0E                    BRA     LOOP
     142  003B  7C 00 01        B   TOOBIG INC     LENGFL
     143  003E  20 09                    BRA     LOOP
     144  0040  96 00           E   CKFRMR LDAA    OPSTAT
```

Figure 8-2 Cont.

```
ERR LINE  ADDR  B1 B2 B3 B4        RECEIVE UNNUMBERED INFORMATION FRAME (UI)          PAGE    3

    105  0042  8B 02                      ADDA    02
    106  0044  26 06                      BNE     CIFRM     NOT FRMR
    107  0046  BD 00 00      E            JSR     CHKPNT
    108  0049  7E 00 00      E            JMP     FRMRI
    109  004C  7D 00 01      0   CIFRM    TST     LENGFL    I-FRAME TOO BIG?
    110  004F  27 03                      BEQ     PERREC    NO
    111  0051  7E 00 00      E            JMP     FRMREJ    YES
    112  0054                    PERREC
    113  0054  BD 00 00      E            JSR     CHKPNT
    114  0057  7D 00 00      E            TST     PBIT
    115  005A  26 03                      BNE     CLRBUS
    116  005C  7E 00 00      E            JMP     RCV
    117  005F  7F 00 00      E   CLRBUS   CLR     RENBUS
    118  0062  7E 00 00      E            JMP     RCV
    119  0065                        END

ASSEMBLER ERRORS =     0
```

Figure B-2 Cont.

CROSS REFERENCE

LABEL		VALUE	REFERENCE					
CHKPNT	E	0001	24	107	113			
CIFRM	P	004C	106	-109				
CKFRMR	P	0040	93	-104				
CLRBUS	P	005F	115	-117				
CONT	P	0014	58	60	-69			
FBIT	E	0006	25	64				
FRMRI	E	0003	24	100				
FRMREJ	E	0002	24	111				
GDFLG	E	0009	25	90				
INFBYT	B	0002	-30	87				
LENGFL	B	0001	-29	71	102	109		
LENGMX	E	000A	26	95				
LENGTH	B	0000	-28	70	94	97		
LOOP	P	0019	-75	101	103			
MEMORY	A	0000	0					
MARG		0000	0					
OPSTAT	E	0004	25	57	104			
PBIT	E	0005	25	61	114			
PERREC	P	0054	110	-112				
PTWO	P	000F	62	-64				
PTWOI	P	002E	91	-93				
RCV	E	0000	24	63	68	92	116	118
RDAFLG	E	0007	25	80	88			
RDBUFF	E	0008	25	86				
REMBUS	E	0000	26	117				
STACK	S	0000	0					
TOGBIG	P	0038	96	-102				
UI	P	0000	-86					

Figure 8-2 Cont.

9.0 REFERENCES

1. "Use of a Microprocessor to Implement an ADCCP Protocol with Reject and Selective Reject" (Federal Standard 1003) "Delta Information Systems, Inc. August 1981.
2. "Use of a Microprocessor To Implement an ADCCP Protocal (Federal Standard 1003)" Delta Information Systems, Inc. July 1980.
3. Malcon Easton, "Batch Throughput Efficiency of ADCCP/HDLC/SDLC Selective Reject Protocols" Data Communications pp 187-195, February 1980.