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TECHNICAL MEMORANDUM (NASA) 77

BI-DIRECTIONAL COMMUNICATION INTERFACE
FOR MICROPROCESSOR-TO-SYSTEM/370

Described is a hardware and software interface to allow two-way communication between a microprocessor system and the IBM System/370

(NASA-CR-163940) BI-DIRECTIONAL COMMUNICATION INTERFACE FOR MICROPROCESSOR-TO-SYSTEM/370 (Ohio Univ.)
24 p HC 02/MF A01

by
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1. INTRODUCTION

This paper documents the design and operation of a bi-directional communication interface between a microcomputer and the IBM System/370. The hardware unit interconnects a modem to interface to the S/370, the microcomputer with an EIA I/O port, and a terminal for sending and receiving data from either the microcomputer or the S/370. Also described is the software necessary for the two-way interface. This interface has been designed so that no modifications need to be made to the terminal, modem, or microcomputer. This unit is designed to upgrade an uni-directional interface already in use [1].

II. INTERFACE DESCRIPTION: HARDWARE

Figure 1 shows the paths of signals between the microcomputer, the modem, and the terminal. The hardware interface consists of a four-pole, three-position switch and cables and plugs to connect the switch box to the other devices. All signals are assumed to be RS-232C (EIA standard).

In switch position 1, the microcomputer is connected directly to the terminal; all communications are between these two only. The modem is isolated in this position and it is not necessary to have it connected if no communication to the S/370 is desired. In position 2, the serial out from the keyboard is routed to the modem for communicating to the S/370. The serial out from the modem goes to the terminal and the serial in of the microcomputer. In this position, it is possible to send commands and receive responses from the S/370, while the microcomputer reads the data sent by the S/370. Thus it is possible to load a program into the microcomputer by displaying the object file on terminal. It is necessary to switch to position 1 and issue the microcomputer load command prior to typing the file. Position 3 on the switch box connects the serial out from the modem to the terminal and to the serial in on the microcomputer. In addition, the serial out from the microcomputer is sent to the modem. Here, the microcomputer communicates directly with the S/370, the terminal always displays the response sent by the S/370. With proper positioning of the half-duplex/full-duplex switches on the terminal and modem, the responses from the microcomputer may also be displayed. Note that the serial-out from the terminal is isolated, thus it may be necessary to start a program on the microcomputer by pressing the NMI (non-maskable interrupt) switch on the switch box.

Table 1 lists the connection used on the terminal and modem. Connections for RS-232C are made through 25-pin D-connectors. Data terminal equipment (DTE) devices are supplied with a male (DB-25P) connector while data communication equipment (DCE) devices are supplied with a female (DB-25S) connector. Figure 2 shows the detailed routing of connections from the connectors on the terminal and modem through the switch box.
Figure 1. Signal Routing For Bi-Directional Interface.

Note: Switches Shown in Position 1.
<table>
<thead>
<tr>
<th></th>
<th>DTE</th>
<th>DCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P GND</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S OUT</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>S IN</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>RTS</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>CTS</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>DSR</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>S GND</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>RLSD</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>DTR</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Protective Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Serial Output</td>
</tr>
<tr>
<td></td>
<td>Serial Input</td>
</tr>
<tr>
<td></td>
<td>Request to Send</td>
</tr>
<tr>
<td></td>
<td>Clear To Send</td>
</tr>
<tr>
<td></td>
<td>Data Set Ready</td>
</tr>
<tr>
<td></td>
<td>Signal Ground</td>
</tr>
<tr>
<td></td>
<td>Received Line Signal Detect</td>
</tr>
<tr>
<td></td>
<td>Data Terminal Ready</td>
</tr>
</tbody>
</table>

Table 1. RS-232C Connections.
Microcomputer
5-pin Amphenol

Blue
Wht/Blue
Wht/Org

NMI
Reset

Terminal
DB-25S

Black
Red
Org
Blue

Modem
DB-25P

Black
Red
Org
Blue

Figure 2. Interface Wiring Diagram.
III. INTERFACE DESCRIPTION: SOFTWARE

Full utilization of the bi-directional interface requires a set of programs to be run simultaneously on the microcomputer and the S/370. Figure 3 shows a block diagram of how the programs would operate for a typical application. Some points to be considered in writing the interface software are:

a. Most microcomputers store character data internally as ASCII.

b. Serial communications between devices are generally in ASCII format.

c. The I/O routines for the S/370 expect to receive ASCII which is then converted to EBCDIC, which the S/370 uses for internal storage of character data.

d. The Conversational Monitor System (CMS) portion of the VM/370 operating system is line-oriented, i.e., no system action is taken until a carriage return (hex OD) is received.

e. The S/370 issues a prompt when ready for another line.

A typical application for which this interface has been used is transmitting data collected by the microcomputer on a cassette tape to the S/370, where it is stored on a disk file for further processing. The sequence of events is as follows: the data to be transmitted is stored in a buffer in the microcomputer's memory. Generally, 80 characters comprise one line. Note that one byte consists of two four-bit hexadecimal numbers, each of which is converted to ASCII. Thus if 80 characters are to be sent, the buffer is 40 bytes long. After 80 characters are sent, a carriage return (hex OD) is sent. The S/370 does the ASCII-to-EBCDIC conversion and places the EBCDIC characters in a user buffer in the S/370 memory. When the S/370 is ready to receive another line, it sends a series of control characters. The microcomputer reads and recognizes these control characters as the prompt signal to send another line. The sequence of control characters currently sent by S/370 is shown in Figure 4.

Appendix A gives a listing of a MOS Technology 6502 microcomputer program (intended to be run using the 'Super-Jolt' micro unit) for reading 40 bytes of data from a Memodyne digital cassette tape unit and sending these to the S/370. The data to be sent are packed BCD numbers; i.e., one BCD digit occupies four bits, two BCD numbers are contained in one byte. Each BCD digit is sent as ASCII by the 'output byte' routine in the microcomputer monitor program (at address 72B1 (hex) in the Super-Jolt (TM) monitor). A carriage return is sent at the end of the line with a call to the WRT routine at address 72C6 (hex).
Figure 3. Control Program Flow Charts.

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Figure 4. Control Characters Sent by S/370 After Receiving Carriage Return.
Program lines 1 to 78 are initialization steps used for the Memodyne interface hardware and to position the tape properly. Lines 79 to 91 constitute the main part of the program which builds up the 40-byte buffer then sends the buffer to the S/370. This part loops continuously whether or not any data is received. The operator should monitor the operation to stop the program when all the data has been transmitted. Subroutine READ is called to read a byte from the tape unit. Subroutine W370 sends the 40-character buffer to the S/370, sends a carriage return, then looks for a period (hex 2E) followed by a DC-1 (hex 11). If this sequence is not done, the S/370 issues a read-error message. When these two characters are received, control is passed back to the main program sequence.

Subroutine RDT is a modification of the RDT routine at address 72E9 in the Jolt monitor. Most serial-read routines on microcomputers are full-duplex; as each bit is received, it is echoed back out to the sending device. However, the S/370 can receive half-duplex only. Thus it is necessary to change the interface method through the modem or to re-write the read routine so that the received bits are not echoed by the microcomputer. This is the purpose of having a separate read routine. If this is not done, read-errors result. The program presented here is shown to illustrate one application of the bi-directional interface. Other uses on other microcomputers would still use the same basic philosophy.

The companion program that is run on the S/370 is shown in Appendix B. This program is written in IBM 360/370 assembler language using standard CMS I/O routines. Again this program illustrates the application of sending data to the S/370 for storage on a disk file.

The data is read 80-bytes at a time, each BCD character in its ASCII format. Each character read is stripped of the upper four-digit mask and is repacked. This is done by the translate instruction at line 88 and the PACK instruction at line 90. Since one record produces only 40 packed BCD digits, two lines are read before one 80-byte record is written to the file. A blank line or an incomplete line is filled to the end with zeros. Each time a record is written, a counter is incremented which is printed at the end of program execution.

IV. INTERFACE OPERATION

The example of transmitting data from the microcomputer to the S/370 will be continued here to show how the interface may be operated. After the interface is properly connected, power should be applied to all units. At this point it is usually necessary to load the microcomputer with a program stored on a disk file. Thus the switch box should be set to position 2 and the appropriate CMS LOGON procedure performed. When the microprocessor object code is ready for transmittal (through editing, assembling, simulating, etc,) the switch box should be set to position 1, the microcomputer reset button pushed, and a carriage return or other appropriate
key to reset the microcomputer typed. Then issue the proper command to set the microcomputer for loading hexadecimal data over its serial lines. The switch box is then set back to position 2 and the appropriate command is issued to the S/370 to load the microcomputer with the object file. Next, the unit is switched back to position 1 to verify correct loading, initialize any memory locations and set up the NMI vector address to the start of the program. Now the switch box is placed in position 2 and the program to receive the data is started and then the unit is set to position 3 and the NMI button pressed.

As operation commences, the prompting period and any other responses from the S/370 will be displayed on the terminal. Depending on the setting of the half-duplex/full-duplex switches on the terminal and modem, data sent by the microcomputer will also be displayed on the terminal.

When the operation is finished, the unit may be set to position 2 to stop the S/370 program then position 1 to stop the microcomputer program.

V. SUMMARY

A discussion was presented here of an interface unit and software procedures to allow two-way communication between a microcomputer and a central computer. This can be used for two-way data transmission, control and other applications where bi-directional communications are necessary. As an aid to setting up the software for other computer systems, ASCII [3] and EBCDIC [4] tables are given in Tables 2 and 3.
### Table 2. ASCII Table

<table>
<thead>
<tr>
<th>ASCII Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 NULL</td>
<td>Null Idle</td>
</tr>
<tr>
<td>0001 SOM</td>
<td>Start of message</td>
</tr>
<tr>
<td>0010 EOA</td>
<td>End of address</td>
</tr>
<tr>
<td>0100 EOT</td>
<td>End of transmission</td>
</tr>
<tr>
<td>0101 ERR</td>
<td>Error</td>
</tr>
<tr>
<td>0110 RU</td>
<td>&quot;Who are you?&quot;</td>
</tr>
<tr>
<td>0111 BELL</td>
<td>Audible signal</td>
</tr>
<tr>
<td>1000 FE</td>
<td>Format effect</td>
</tr>
<tr>
<td>1001 HT</td>
<td>Horizontal tabulation</td>
</tr>
<tr>
<td>1010 LF</td>
<td>Line feed</td>
</tr>
<tr>
<td>1011 V/TAB</td>
<td>Vertical tabulation</td>
</tr>
<tr>
<td>1100 FF</td>
<td>Form feed</td>
</tr>
<tr>
<td>1101 CR</td>
<td>Carriage return</td>
</tr>
<tr>
<td>1110 SO</td>
<td>Shift out</td>
</tr>
<tr>
<td>1111 SI</td>
<td>Shift in</td>
</tr>
</tbody>
</table>

**Example:**

<table>
<thead>
<tr>
<th>ASCII Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 0001</td>
<td>A</td>
</tr>
</tbody>
</table>

The abbreviations used in the figure mean:

- **NULL** Null Idle
- **SOM** Start of message
- **EOA** End of address
- **EOC** End of message
- **EOT** End of transmission
- **ERR** Error
- **RU** "Who are you?"
- **BEL** Audible signal
- **FE** Format effect
- **HT** Horizontal tabulation
- **SK** Skip (punched card)
- **LF** Line feed
- **V/TAB** Vertical tabulation
- **FF** Form feed
- **ACK** Acknowledge
- **ESC** Escape
- **DEL** Delete Idle

The abbreviations used in the figure mean:

- **EOT** End of transmission
- **DC0** Device control
- **DC1** Device control
- **DC2** Device control
- **DC3** Device control
- **CR** Carriage return
- **SO** Shift out
- **SI** Shift in
- **ACK** Acknowledge
- **ESC** Escape
- **DEL** Delete Idle
- **LS** Logical end of media
- **LS** Logical end of media
Table 3. EBCDIC Table.
VI. REFERENCES


VII. APPENDICES

A. Program Listing for Microcomputer Control Program.
THIS PROGRAM IS DESIGNED FOR RUNNING ON THE JOLT/MEMODYNE SYSTEM FOR RECOVERING DATA STORED ON THE DIGITAL TAPE.
THE DATA IS READ IN 40 BYTES AT A TIME AND STORED IN A BUFFER, THEN THE BUFFER IS SENT TO THE S/370 OVER THE JOLT'S SERIAL LINES. WITH ASCII CONVERSION, 80 BYTES ARE ACTUALLY SENT OVER THE SERIAL LINES.

J.P. FISCHER 08/1980

PIAA EQU $4000 ADDRESS OF PIA SIDE A
PIAB EQU $4002 ADDRESS OF PIA SIDE B
WRT EQU $72C6 JOLT WRITE DATA TO SERIAL OUT LINE
WROB EQU $72B1
MPB EQU $6E02 PIA B FOR SERIAL I/O WORK
MCLK1T EQU $6E04 PIA TIMER
MCLKRD EQU $6E04 SAME AS ABOVE
MCLK1F EQU $6E05 SOME MORE TIMER STUFF
MAJCRT EQU $EA UPPER 8 BITS OF BAUD RATE
MAJCRT EQU $BB LOWER 8 BITS OF BAUD RATE
TAPESY EQU %00000010 PATTERN FOR TAPE SYNC CHECK
BOT EQU %00000100 PATTERN FOR BOT/EOT CHECK
LF EQU %00010000 PATTERN FOR LOAD FOWARD FUNCTION
REW2 EQU %00100000 PATTERN FOR REWIND OPERATION
START EQU %10000000 PATTERN FOR INITIATING START

ORG 0
XTEMP BSS 1 TEMPORARY FOR X
YTEMP BSS 1 TEMPORARY FOR Y
BUFFER BSS 40

ORG $200
JSR INTT SET UP PIA FOR MEMODYNE
LDA PIAB PREPARE TO CHECK BOT
AND =BOT SEE IF ON LEADER
BNE NOTBOT IF NOT, THEN OK
LDA PIAB GET SIDE B
EOR =LF CLEAR LOAD FOWARD BIT
ORA =START SET START BIT HIGH
STA PIAB AND STORE TO LOAD FOWARD
ETLOOP LDA PIAB GET STATUS
AND =BOT SEE IF STILL ON LEADER
BNE ETLOOP CONTINUE TESTING UNTIL OFF
LDA PIAB
ORA =LF SET LOAD FOWARD HIGH
STA PIAB AND REPLACE
IDLOOP LDA PIAB
AND =BOT NOW LOOP UNTIL AT READY POINT
BNE IDLOOP KEEP GOING UNTIL ON ROLE
LDA PIAB

- 14 -

ORIGINAL PAGE 12
OF POOR QUALITY
FILE: UNLOAD

S6502

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EOR =LF
STA PIAB
SET LOAD FORWARD LOW TO MOVE
OFF OF HOLE

TLOOP
LDA PIAB
AND =BOT
BEQ TLOOP
LDX =$30
TIMER ROUTINE

TIMXT
DEX
BNE TIMXT
KEEP LOOPING UNTIL OUT
ORA =LF
NOW RETURN LOAD FORWARD
STA PIAB
HIGH, SHOULD BE OFF OF HOLE

NBTBOT
LDA =0
CLEAR ACCUM. AND SET

* *
* NOW INITIALIZE THE 370 AND START
* SENDING DATA.
* *
LFLDS
LDX =0
READ 40 CHARACTERS FROM TAPE

L80
JSR READ
GET A BYTE FROM RECORDER
STA BUFFER,X
SAVE IN OUTPUT BUFFER
INX
DO ANOTHER ONE
CPX =40
DONE 40 BYTES YET?
BNE L80
IF NOT, DO AGAIN
LDY =40
SEND THESE 40
JSR W370
SEND TO SYSTEM
JMP LFLDS

* *
* INITIALIZATION FOR PIA
* *
INIT
LDX =0
STX PIAA+1
STX PIAB+1
STX PIAA
LDA =$88
STA PIAB
LDA =$FF
STA PIAA+1
STA PIAB+1
LDA =0
ORA =LF
ORA =PEW2
STA PIAB
RTS

* *
- 15 -
THIS IS THE READING PORTION OF THE PROGRAM TO RECOVER DATA FROM THE RECORDER AND PLACE IN THE MICROCOMPUTER'S MEMORY.

READ
LDA PIAB
ORA =START SET START HIGH
STA PIAB
RDLP
LDA PIAB
AND =TAPESY WAIT UNTIL SYNC IS HIGH
BEQ RDLP
LDA PIAB
EOR =START SET START LOW AGAIN
STA PIAB
INLP1
LDA PIAB
AND =TAPESY WAIT UNTIL SYNC IS LOW
BNE INLP1
LDA PIAB
GET THE DATA FROM RECORDER
RTS


W370
LDX =0 POINT TO FIRST CHARACTER
STX XTEMP ZERO X-TEMP SPACE
STY YTEMP SAVE LENGTH
WLOOP
LDX XTEMP GET POINTER
LDA BUFFER,X GET A CHARACTER
JSR WROB SEND IT
INC XTEMP X+1
DEC YTEMP LESS ONE CHARACTER
BNE WLOOP GO AGAIN IF NOT DONE
LDA =$D CARRIAGE RETURN
JSR WRT TELL 370 THIS IS END-OF-LINE
SCANP
JSR RDT READ JUNK FROM SYSTEM
CMP =$2E PERIOD
BNE SCANP
JSR RDT LOOK FOR
CMP =$11 DC1
BNE SCANP
RTS RETURN TO CALLER

* ************
* HIGH SPEED REWIND.
* ************

JSR INIT
LDA =$B8
STA PIAB
LDA =$7F
STA PIAB
ORA =REW2
STA PIAB
BRK

* MODIFIED JOLT READ ROUTINE.
* THIS ROUTINE IS IDENTICAL TO THE ORIGINAL 'RDT' ROUTINE
* AT ADDRESS $72E9, BUT THIS ROUTINE OPERATES IN HALF-
* DUPLEX RATHER THAN FULL-DUPLEX MODE.

RDT LDX =$8
RDT1 LDA MPB WAIT FOR START BIT
LSR A
BCC RDT1
JSR DLY1
RDT2 JSR DLY2
LDA MPB CY = NEXT BIT
LSR A
PHP SAVE BIT
TYA Y CONTAINS CHAR BEING FORMED.
LSR A
PLP RECALL BIT
BCC RDT4
ORA =$80 ADD IN NEXT BIT

RDT4 TAY
DEX
BNE RDT2 LOOP FOR 8 BITS
EOR =$FF COMPLEMENT DATA
AND =$7F CLEAR PARITY
JSR DLY2
CLC
FILE: UNLOAD  S6502   A  

OHIO UNIVERSITY AVIONICS ENGINEERING CENTER

DLY2  JSR DLY1  
*  
DLY1  PHA  SAVE FLAGS AND A  
PHA  
TXA  
PHA  SAVE X  
LDX MAJCRT  
LDA MINCRT  
*  
STA MCLK1T  
DL3  LDA MCLK1F  
BPL DL3  
DEX  
LDA MCLKRD  RESET TIMER INT FLAG  
PLP  
BPL DL3  
*  
PLA  
TAX  
PLP  
PLA  
RTS  
*  
*  
ORG $FFFA  
HEX 00,02  
*  
END
B. Program Listing for S/370 Control Program.
FILE: UNLOAD$ ASSEMBLE A

OHIO UNIVERSITY AVIONICS ENGINEERING CENTER

TITLE 'UNLOAD$: READS RECORDS FROM 'MEMODYNE/MICROCOMPUTER INTERFACE AND STORES ON DISK.'

PRINT NOSAVE

SPACE

**************************************************************************************************

* THIS PROGRAM IS DESIGNED TO BE RUN ON THE S/370 IN CONJUNCTION WITH THE MICRO 'UNLOAD' PROGRAM AND THE MEMODYNE/MICROCOMPUTER HARDWARE INTERFACE. RECORDS READ FROM TAPE ARE SENT TO THE 370 IN ASCII, CP THEN TRANSLATES THESE TO EBCDIC WHICH MUST BE TRANSLATED BACK TO HEX BY THIS PROGRAM. 80 BYTES ARE SENT AT A TIME (40 EQUIVALENT HEX CHARACTERS) AND 80 HEX CHARACTERS ARE STORED ON THE DISK FILE.

* J. P. FISCHER 08/1980

**************************************************************************************************

SPACE

UNLOAD$ START X'8000'

USING UNLOAD$, 12

MVI FLAGS, 0 CLEAR ALL FLAG BITS

LA 1, B(1) POINT TO FILE NAME FIELD

LR 2, 1 SAVE PLIST ADDRESS

CLI 0(1), X'FF' BLANK?

BE NOID IF SO, ERROR

LA 1, B(1) POINT TO FILE NAME

CLI 0(1), X'FF' NO FILETYPE?

BE NOID IF NOT, ERROR

MVC FILEID+8(16), 0(2) MOVE PARTIAL ID

LA 1, B(1)

CLI 0(1), X'FF' NO FILEMODE

BE NOMODE IF NOT, SUBSTITUTE #

MVC FILEID+24(2), 16(2) MOVE IN NEW MODE

B CHECK CONTINUE

NOMODE MVI FILEID+24, C'A' MOVE IN 'A'

MVI FILEID+25, C' ' SPACE

CHECK LA 1, B(1) MOVE POINTER IF SOME MORE

CLI 0(1), X'FF' SEE IF ANYTHING THERE

BE CHECK1 IF NOT, CONTINUE

CLI 0(1), C'( ' SEE IF OPTION

BNE PARMERR IF NOT, BAD PARM

LA 1, B(1) NEXT FIELD

CLI 0(1), X'FF' SEE IF BLANK

BE CHECK1

CLC 0(8, 1), OPTREP SEE IF REPLACE OPTION

BNE BADOPT IF NOT, CONTINUE

O1 FLAGS, 1 SET REPLACE BIT

SPACE

CHECK1 TM FLAGS, 1 SEE IF REPLACE IN EFFECT

BZ OPENF IF NOT, GO ON

FSERASE PSC3=FILEID

OPENF FSOPEN PSC3=FILEID OPEN FOR WRITING

CL 15, F3b SEE IF INVALID DISK

- 20 -
FILE: UNLOAD\$S
ASSEMBLE A

BE
INVDISK
SPACE 2

*******************************************************************************

* THIS PART OF THE PROGRAM CAUSES A TERMINAL
* READ TO GET THE ASCII CHARACTERS, THEN TRANSLATES
* THEM TO HEX AND STORES ON DISK.
*
*******************************************************************************

SPACE
SLR 4,4
SLR 7,7
LA 2,WBUF
LA 4,8
L 5,IBUF80
RDLOOP
LA 3,IBUF
RDTERM IBUF
LTR 0,0
BZ DONE
WAIT
TR IBUF(80),THTBL
STRIPZ
MVC TEMP(8),0(3)
PACK TEMP1(5),TEMP(9)
MVC 0(4,2),TEMP1
LA 2,4(2)
BXLE 3,4, STRIPZ
SPACE
RDTERM IBUF
LTR 0,0
BZ DONE
WAIT
LA 3,IBUF
TR IBUF(80),THTBL
Z1
MVC TEMP(8),0(3)
PACK TEMP1(5),TEMP(9)
MVC 0(4,2),TEMP1
LA 2,4(2)
BXLE 3,4,1
LA 2,WBUF
FSWRITE FSCB=FILEID
LTR 15,15
BNZ WRTERR
LA 7,1(7)
B RDLOOP
DONE
MVI WBUF+40,0
MVC WBUF+41(39),WBUF+40
FSWRITE FSCB=FILEID
LTR 15,15
BNZ WRTERR
LA 7,1(7)

*******************************************************************************

* NOW CLOSE THE FILE.

- 21 -
* U100111J

************ ******************** ********************

SPACE

DONE FS.CLOSE FSCB=FILEID CLOSE THE FILE
LINEDIT TEXT='----- RECORDS WRITTEN TO "FILE".
SUB=(DEC, (7)), DOT=NO, RENT=NO
SL 15,15 CLEAR RETURN CODE
BR 14 GO TO CMS
EJECT

NOID LINEDIT TEXT='DSMSUL0056 INCOMPLETE FILEID SPECIFIED.'
   DISP=R:RMSG, DOT=NO, RENT=NO
LA 15,24 RETURN CODE
BR 14 BACK TO CMS
SPACE

INVDISK LR 2,15 SAVE RETURN CODE
LINEDIT TEXT='DSMSUL0069 DISK '....' NOT ACCESSSED.'
   SUB=(CHARA, FILEID+24), DISP=ERRMSG, DOT=NO, RENT=NO
LR 15,2 GET RETURN CODE
BR 14 BACK TO CMS
SPACE

WRERR LR 2,15 SAVE RETURN CODE
LINEDIT TEXT='DSMSUL0105 ERROR '....' WRITING FILE '....
       ....... ' ON DISK', SUB=(DEC, (2), CHARA, FILEID+8, CHARA+UNL0033)
   A, FILEID+16, CHARA, FILEID+24), DISP=ERRMSG,
   DOT=NO, RENT=NO
LA 15,100 RETURN CODE
BR 14 BACK TO CMS
SPACE

PARMERR LR 2,1 SAVE PARM ADDRESS
LINEDIT TEXT='DSMSUL0070 INVALID PARAMETER '....
   SUB=(CHARA, (2)), DISP=ERRMSG, DOT=NO, RENT=NO
LA 15,24 RETURN CODE
BR 14 BACK TO CMS
SPACE

BADOPR LR 2,1 SAVE OPTION ADDRESS
LINEDIT TEXT='DSMSUL0032 INVALID OPTION '....
   SUB=(CHARA, (2))., DISP=ERRMSG, DOT=NO, RENT=NO
LA 15,24 RETURN CODE
BR 14 BACK TO CMS
EJECT

DS 0D
DC 'F36'
IBUF80 DC AL4(IBUF+79)
OPTREP DC CL8'REP'
FILEID FSCB '...' 'BUFFER=WBUF, BSIZE=80
TEMP DS XL8
DC 'C1'
TEMP1 DS XL5
FLAGS DS XL1
WBUF DS XL32
IBUF DS XL132
TBL DC 'X00'
ORG TBL+3*16
DC XL1'00FAFBPCDFEEFFFOFOFOPOFOPOPOFOPOPOPO'
ORG TBL+11*16
FILE: UNLOADS ASSEMBLER A

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DC XL16'F0F1F2F3F4F5F6F7F8F9F0F0F0F0' UNLOADS

TRTBL EQU TBL-X'40' UNL0166J
END UNLOADS UNL0167J

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