Chapter 2 Assemblers

-- 2.3 Machine-Independent Assembler Features

Outline

- Literals
- Symbol Defining Statement
- Expressions
- Program Blocks
- Control Sections and Program Linking

Literals

- Consider the following example

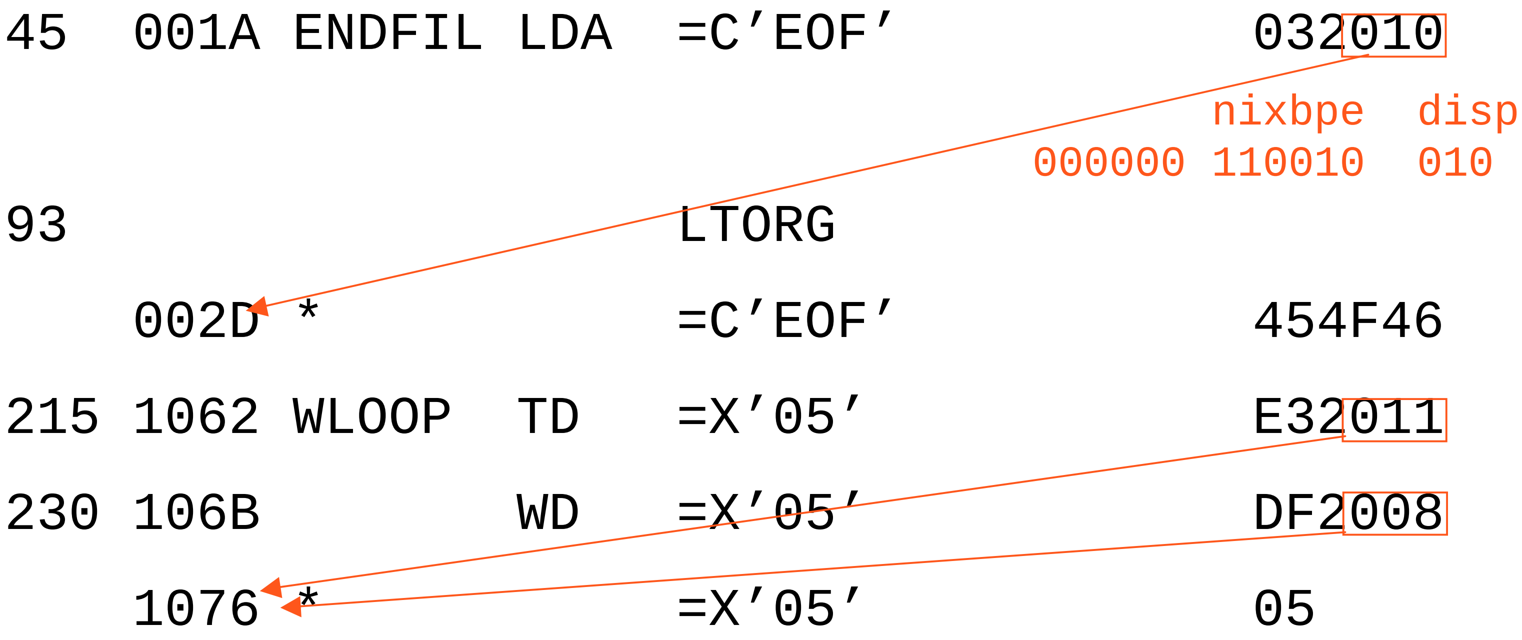
```
                   :
                  LDA          FIVE
                   :
      FIVE        WORD         5
                   :
```

- It is convenient to write the value of a constant operand as a part of instruction

```
                   :
      ⇨          LDA     =X’05’
                   :
```

Literals

- A literal is identified with the prefix =, followed by a specification of the literal value
- Examples: (Figure 2.10, pp.68)



```
45   001A ENDFIL LDA   =C’EOF’                032010
                                           nixbpe   disp
                                    000000 110010   010

93                     LTORG

     002D *            =C’EOF’                454F46

215  1062 WLOOP   TD   =X’05’                 E32011

230  106B         WD   =X’05’                 DF2008

     1076 *            =X’05’                 05
```

Literals vs. Immediate Operands

- Literals
  - The assembler generates the specified value as a constant at some other memory location

```
45     001A   ENDFIL LDA   =C’EOF’       032010
```

- Immediate Operands
  - The operand value is assembled as part of the machine instruction

```
55     0020                      LDA    #3      010003
```

- Examples: (Figure 2.10, pp.68)

Literal Pools

- Normally literals are placed into a pool at the end of the program
  - see Fig. 2.10 (after the END statement)
- In some cases, it is desirable to place literals into a pool at some other location in the object program
  - Assembler directive LTORG
    - When the assembler encounters a LTORG statement, it generates a literal pool (containing all literal operands used since previous LTORG)
  - Reason: keep the literal operand close to the instruction

Duplicate literals

- The same literal used more than once in the program
  - Only one copy of the specified value needs to be stored
  - For example, =X’05’ in Figure 2.10 (pp. 68)
- How to recognize the duplicate literals
  - Compare the character strings defining them
    - Easier to implement, but has potential problem (see next)
    - e.g. =X’05’
  - Compare the generated data value
    - Better, but will increase the complexity of the assembler
    - e.g. =C’EOF’ and =X’454F46’

Problem of duplicate-literal recognition

- ‘*’ denotes a literal refer to the current value of program counter
- There may be some literals that have the same name, but different values

```
    BASE      *
    LDB     =*
```

  - The literal =* repeatedly used in the program has the same name, but different values
- If a literal value represents an “address” in the program, the assembler must laso generate the appropriate the “Modification records”.

Literal table

- LITTAB
  - Content
    - Literal name
    - Operand value and length
    - Address
  - LITTAB is often organized as a hash table, using the literal name or value as the key

Implementation of Literal

- Pass 1
  - Build LITTAB with literal name, operand value and length, leaving the address unassigned
  - When LTORG or END statement is encountered, assign an address to each literal not yet assigned an address
    - The location counter is updated to reflect the number of bytes occupied by each literal
- Pass 2
  - Search LITTAB for each literal operand encountered
  - Generate data values using BYTE or WORD statements
  - Generate Modification record for literals that represent an address in the program

Symbol-Defining Statements

- Assembler directive **EQU**
  - Allows the programmer to define symbols and specify their values

    Syntax: `symbol EQU value`

    ```
    Syntax:    symbol         EQU            value
    ```
  - To improve the program *readability*, avoid using magic numbers, make it easier to find and change constant values
  - Replace

    ```
                              +LDT   #4096
    ```
  - with

    ```
              MAXLEN          EQU    4096
                              +LDT   #MAXLEN
    ```
  - Define mnemonic names for registers
    - `A   EQU   0          RMO A,X`
    - `X   EQU   1`
  - Expression
    - `MAXLEN      EQU    BUFEND-BUFFER`

Assembler directive ORG

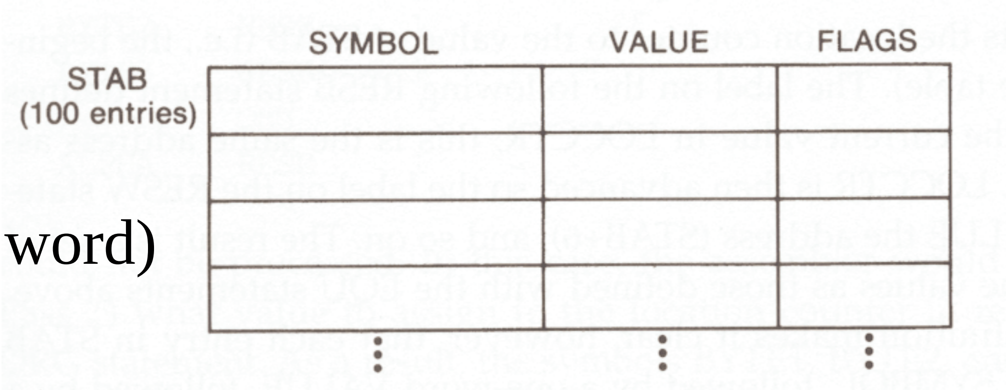
- Assembler directive **ORG**
  - Allow the assembler to reset the PC to values

    Syntax: `ORG value`
  - When ORG is encountered, the assembler resets its LOCCTR to the specified value
  - ORG will affect the values of all labels defined until the next ORG
  - If the previous value of LOCCTR can be automatically remembered, we can return to the normal use of LOCCTR by simply write

    ```
    ORG
    ```

Example: using ORG

- In the data structure
  - SYMBOL: 6 bytes
  - VALUE: 3 bytes (one word)
  - FLAGS: 2 bytes



- We want to refer to every field of each entry
- If EQU statements are used

```
STAB        RESB 1100
SYMBOL      EQU  STAB
VALUE       EQU  STAB+6
FLAG        EQU  STAB+9
```

Offset from STAB

Example: using ORG

- If ORG statements are used

```
STAB        RESB  1100
            ORG   STAB        ← Set LOCCTR to STAB
SYMBOL      RESB  6
VALUE       RESW  1           ← Size of each field
FLAGS       RESB  2
            ORG   STAB+1100   ← Restore LOCCTR
```

- We can fetch the VALUE field by

```
          LDA     VALUE,X
```

  - X = 0, 11, 22, … for each entry

Forward-Reference Problem

- Forward reference is not allowed for both EQU and ORG.
  - All terms in the value field must have been defined previously in the program.
  - The reason is that all symbols must have been defined during Pass 1 in a two-pass assembler.
    - Allowed:

      ```
      ALPHA        RESW        1
      BETA         EQU         ALPHA
      ```

    - Not allowed:

      ```
      BETA         EQU         ALPHA
      ALPHA        RESW        1
      ```

Expression

- The assemblers allow “the use of expressions as operand”
  - The assembler calculates the expressions and products a single operand address or value
  - Expressions consist of
    - Operator
      - +,-,*,/ (division is usually defined to produce an integer result)
    - Individual terms
      - Constants
      - User-defined symbols
      - Special terms, e.g., *, the current value of LOCCTR
  - Examples
    - `MAXLEN      EQU    BUFEND-BUFFER`
    - `STAB        RESB   (6+3+2)*MAXENTRIES`

Relocation Problem in Expressions

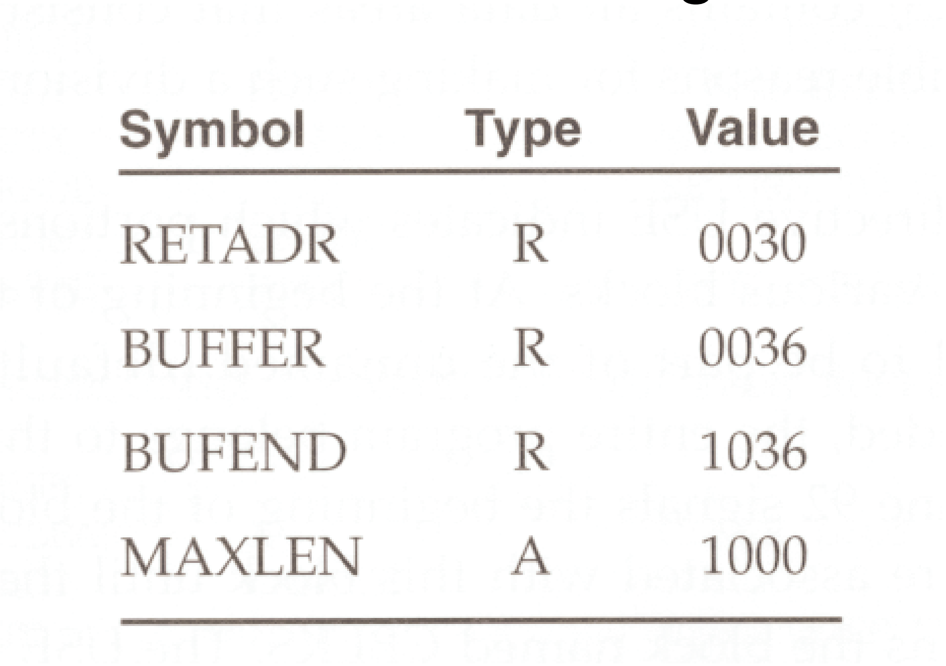
- Values of terms can be
  - Absolute (independent of program location)
    - constants
  - Relative (to the beginning of the program)
    - Address labels
    - * (value of LOCCTR)
- Expressions can be
  - Absolute
    - Only absolute terms
    - Relative terms in pairs with opposite signs for each pair
  - Relative
    - All the relative terms except one can be paired as described in “absolute”. The remaining unpaired relative term must have a positive sign.

Restriction of Relative Expressions

- No relative terms may enter into a multiplication or division operation
- Expressions that do not meet the conditions of either “absolute” or “relative” should be flagged as errors.

Handling Relative Symbols in SYMTAB

- To determine the type of an expression, we must keep track of the types of all symbols defined in the program.
- We need a “flag” in the SYMTAB for indication.



Symbol	Type	Value
RETADR	R	0030
BUFFER	R	0036
BUFEND	R	1036
MAXLEN	A	1000

- Absolute value

```
BUFEND - BUFFER
```

- Illegal

```
BUFEND + BUFFER
100 - BUFFER
3 * BUFFER
```

Example: (pp. 67, Figure 2.9) SYMTAB & LITTAB

SYMTAB

Name	Value
COPY	0
FIRST	0
CLOOP	6
ENDFIL	1A
RETADR	30
LENGTH	33
BUFFER	36
BUFEND	1036
MAXLEN	1000
RDREC	1036
RLOOP	1040
EXIT	1056
INPUT	105C
WREC	105D
WLOOP	1062

LITTAB

C'EOF'	454F46	3	002D
X'05'	05	1	1076

Program Blocks

- Allow the generated machine instructions and data to appear in the object program in a different order
  - Gather all code segments, data segments and stack segments
- Program blocks v.s. Control sections
  - Program blocks
    - Segments of code that are rearranged within a single object program unit
  - Control sections
    - Segments of code that are translated into independent object program units

Program Blocks

- Assembler directive: **USE**
  - `USE    [blockname]`
  - At the beginning, statements are assumed to be part of the unnamed (default) block
  - If no USE statements are included, the entire program belongs to this single block
  - Each program block may actually contain several separate segments of the source program
  - Example: pp. 79, Figure 2.11

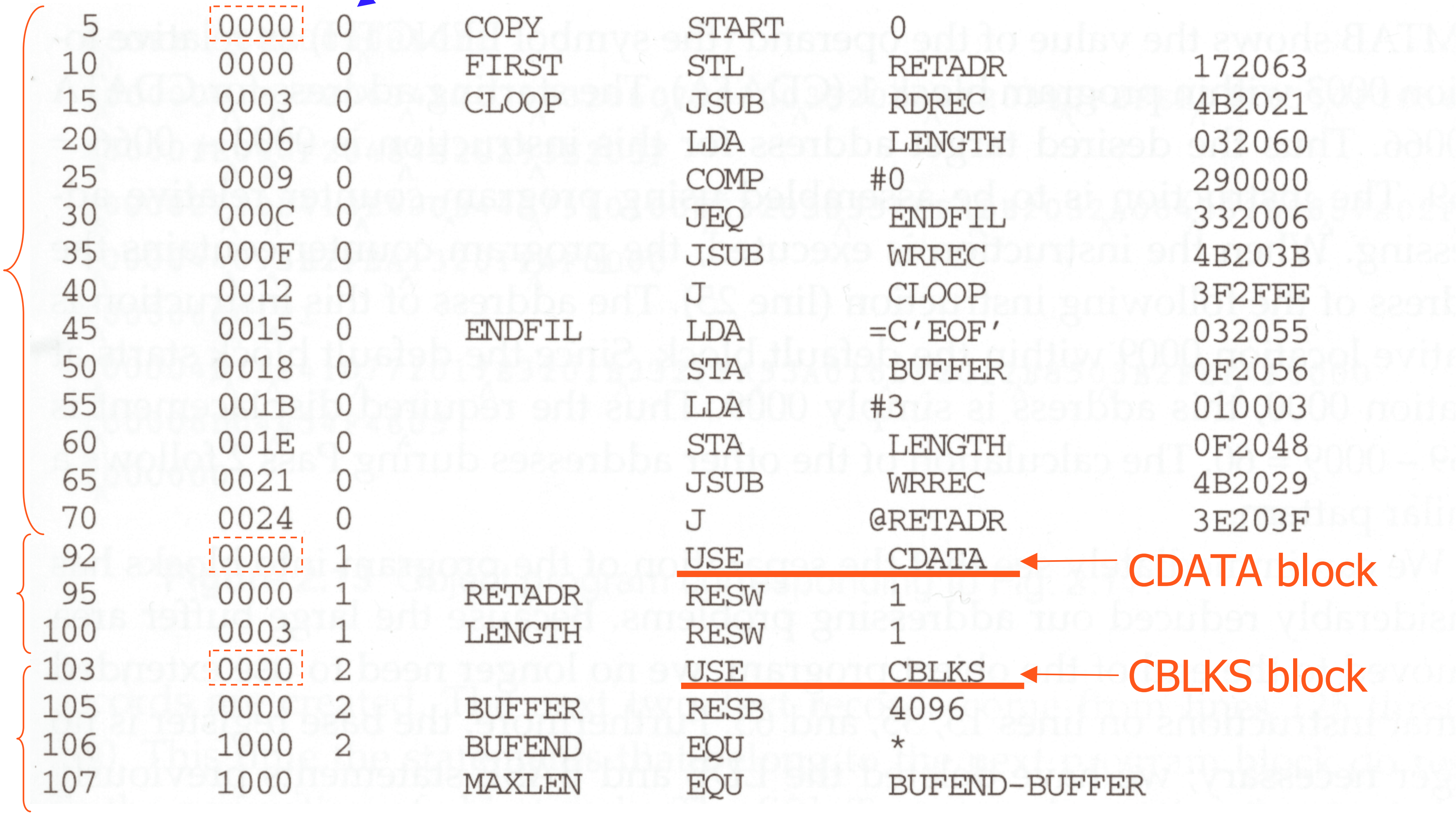
Program Blocks

- Assembler rearrange these segments to gather together the pieces of each block and assign address
  - Separate the program into blocks in a particular order
  - Large buffer area is moved to the end of the object program
  - Program readability is better if data areas are placed in the source program close to the statements that reference them.
- Example: pp, 81, Figure 2.12
  - Three blocks are used
    - `default: executable instructions`
    - `CDATA: all data areas that are less in length`
    - `CBLKS: all data areas that consists of larger blocks of memory`

Example: pp. 81, Figure 2.12

(default) block

Block number

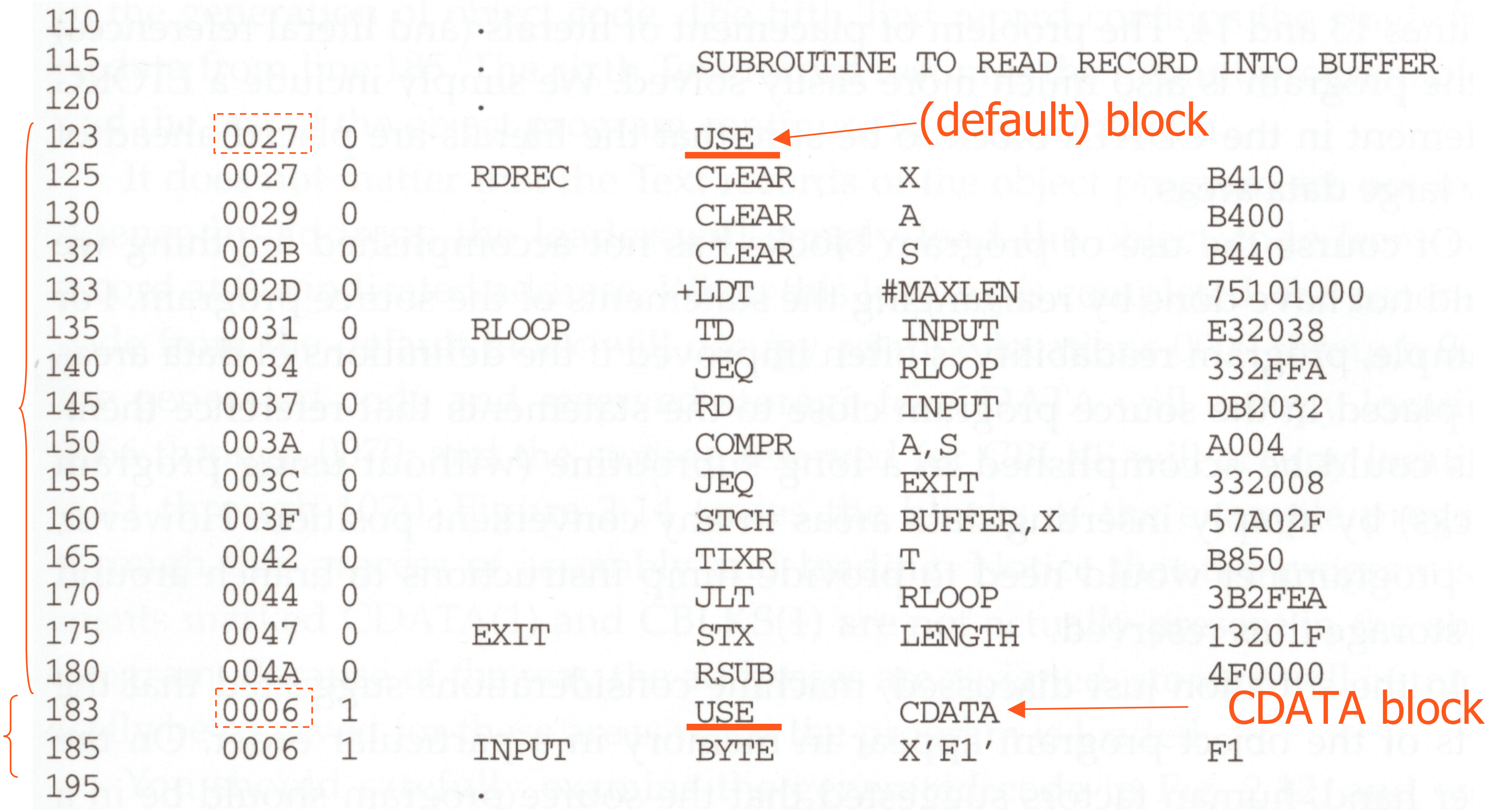


```
  5    0000  0   COPY      START    0
 10    0000  0   FIRST     STL      RETADR          172063
 15    0003  0   CLOOP     JSUB     RDREC           4B2021
 20    0006  0             LDA      LENGTH          032060
 25    0009  0             COMP    #0               290000
 30    000C  0             JEQ      ENDFIL          332006
 35    000F  0             JSUB     WRREC           4B203B
 40    0012  0             J        CLOOP           3F2FEE
 45    0015  0   ENDFIL    LDA     =C'EOF'          032055
 50    0018  0             STA      BUFFER          0F2056
 55    001B  0             LDA     #3               010003
 60    001E  0             STA      LENGTH          0F2048
 65    0021  0             JSUB     WRREC           4B2029
 70    0024  0             J       @RETADR          3E203F
 92    0000  1             USE      CDATA
 95    0000  1   RETADR    RESW     1
100    0003  1   LENGTH    RESW     1
103    0000  2             USE      CBLKS
105    0000  2   BUFFER    RESB     4096
106    1000  2   BUFEND    EQU      *
107    1000      MAXLEN    EQU      BUFEND-BUFFER
```

CDATA block

CBLKS block

Example: pp. 81, Figure 2.12

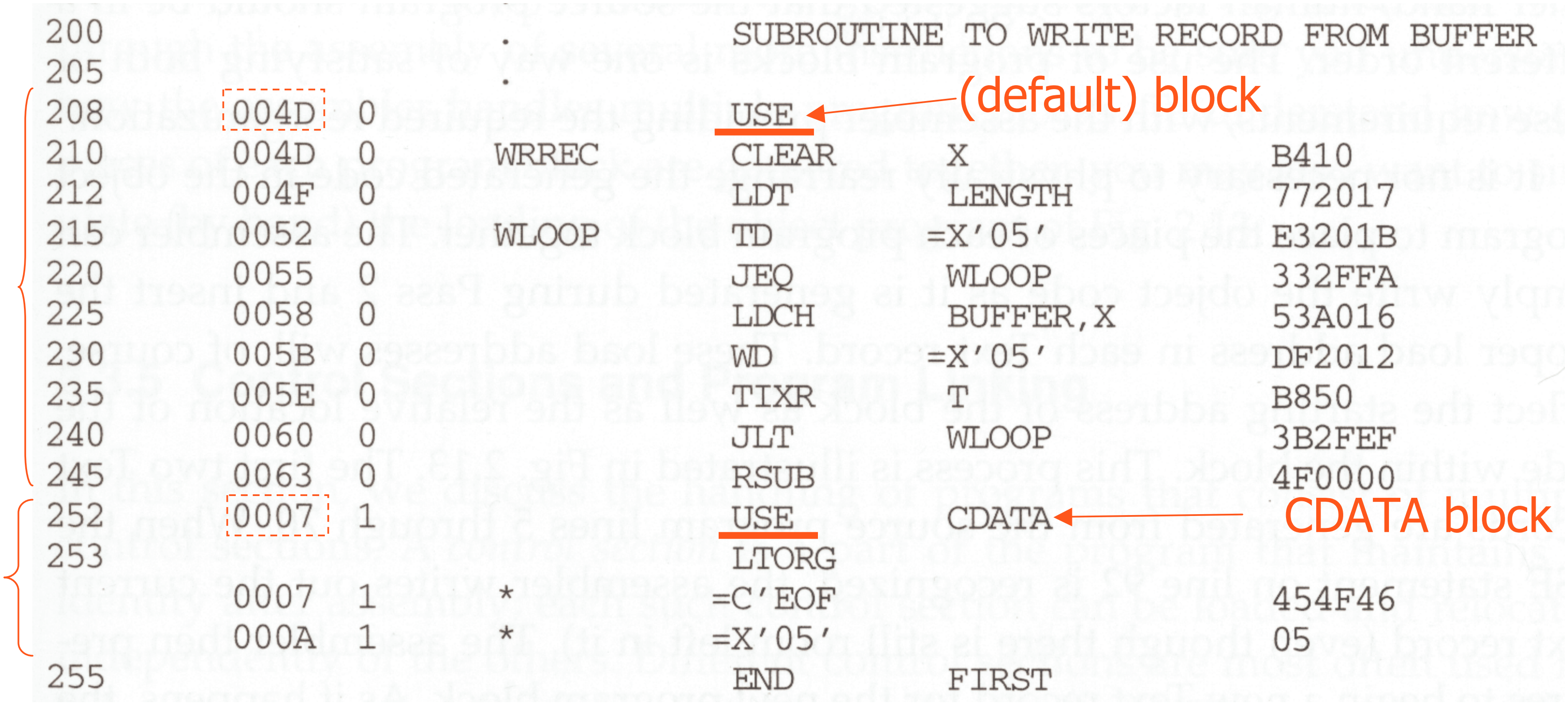


```
110                        .
115                        .       SUBROUTINE TO READ RECORD INTO BUFFER
120                        .
123    0027   0                    USE
125    0027   0      RDREC         CLEAR     X                  B410
130    0029   0                    CLEAR     A                  B400
132    002B   0                    CLEAR     S                  B440
133    002D   0                   +LDT      #MAXLEN             75101000
135    0031   0      RLOOP         TD        INPUT              E32038
140    0034   0                    JEQ       RLOOP              332FFA
145    0037   0                    RD        INPUT              DB2032
150    003A   0                    COMPR     A,S                A004
155    003C   0                    JEQ       EXIT               332008
160    003F   0                    STCH      BUFFER,X           57A02F
165    0042   0                    TIXR      T                  B850
170    0044   0                    JLT       RLOOP              3B2FEA
175    0047   0      EXIT          STX       LENGTH             13201F
180    004A   0                    RSUB                         4F0000
183    0006   1                    USE       CDATA
185    0006   1      INPUT         BYTE      X'F1'              F1
195                        .
```

(default) block

CDATA block

Example: pp. 81, Figure 2.12



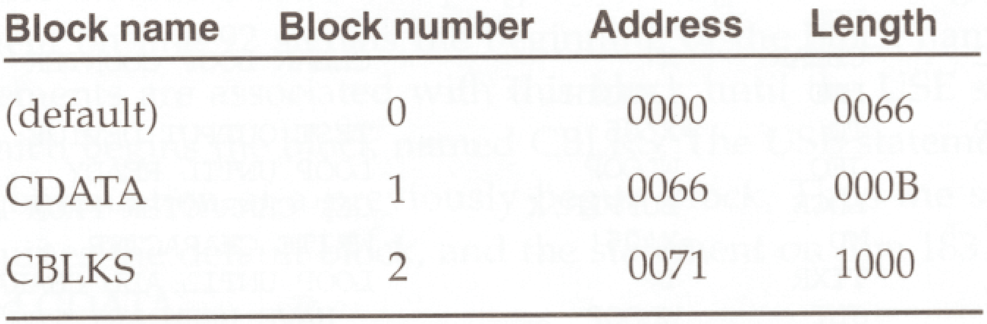
```
200                    .       SUBROUTINE TO WRITE RECORD FROM BUFFER
205                    .
208    004D   0                USE
210    004D   0    WRREC       CLEAR     X              B410
212    004F   0                LDT       LENGTH         772017
215    0052   0    WLOOP       TD        =X'05'         E3201B
220    0055   0                JEQ       WLOOP          332FFA
225    0058   0                LDCH      BUFFER,X       53A016
230    005B   0                WD        =X'05'         DF2012
235    005E   0                TIXR      T              B850
240    0060   0                JLT       WLOOP          3B2FEF
245    0063   0                RSUB                     4F0000
252    0007   1                USE       CDATA
253                            LTORG
       0007   1    *          =C'EOF                    454F46
       000A   1    *          =X'05'                    05
255                            END       FIRST
```

(default) block

CDATA block

Rearrange Codes into Program Blocks

- Pass 1
  - A separate location counter for each program block
    - Save and restore LOCCTR when switch between blocks
    - At the beginning of a block, LOCCTR is set to 0.
  - Assign each label an address relative to the start of the block
  - Store the block name or number in the SYMTAB along with the assigned relative address of the label
  - Indicate the block length as the latest value of LOCCTR for each block at the end of Pass1
  - Assign to each block a starting address in the object program by concatenating the program blocks in a particular order



Block name	Block number	Address	Length
(default)	0	0000	0066
CDATA	1	0066	000B
CBLKS	2	0071	1000

Rearrange Codes into Program Blocks

- Pass 2
  - Calculate the address for each symbol relative to the start of the object program by adding
    - The location of the symbol relative to the start of its block
    - The starting address of this block

Example of Address Calculation

```
20 0006 0     LDA    LENGTH     032060
```

- The value of the operand (LENGTH)
  - Address 0003 relative to Block 1 (CDATA)
  - Address 0003+0066=0069 relative to program
  - When this instruction is executed
    - PC = 0000 (starting addr. Of default block) + 0009
  - disp = 0069 – 0009 = 0060

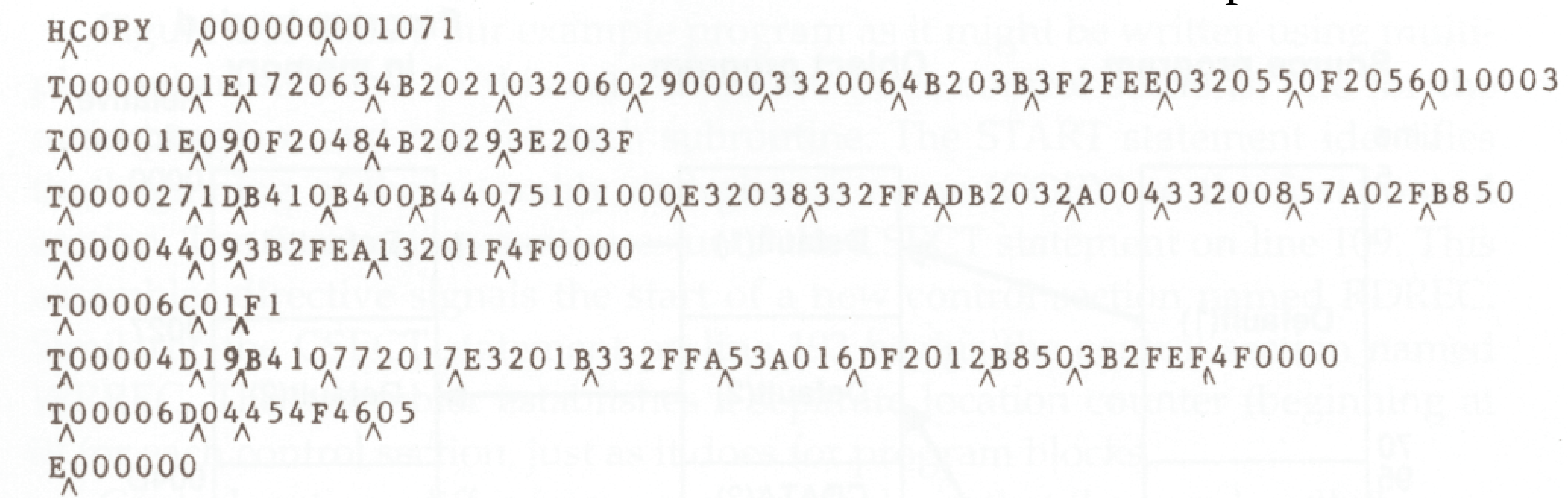
  -
    ```
       op       nixbpe      disp
    000000      110010       060    => 032060
    ```

SYMTAB

label name	block num	addr.	Flag
LENGTH	1	0003	
….	….	….	….

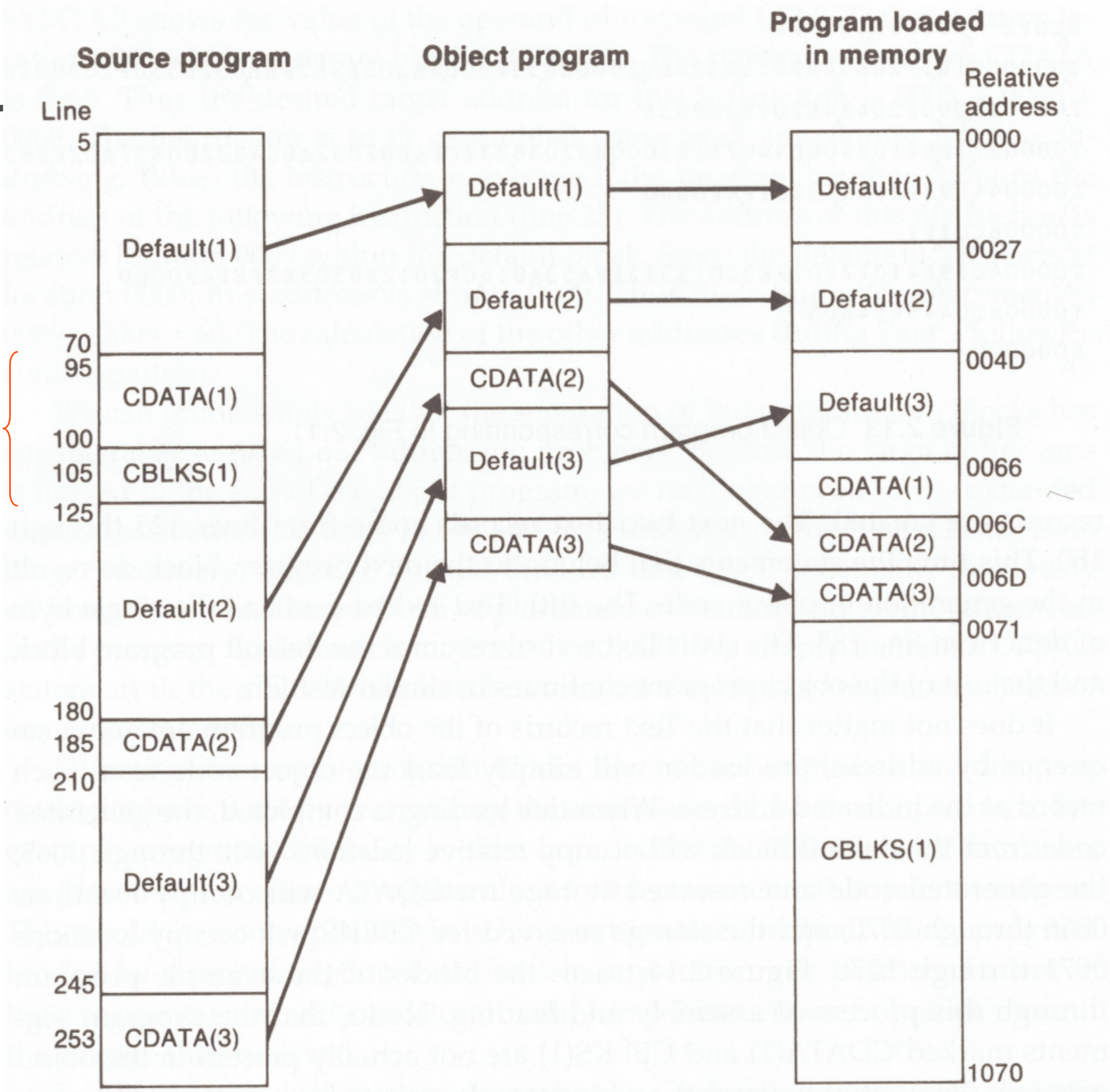
Object Program

- It is not necessary to physically rearrange the generated code in the object program
  - The assembler just simply insert the proper load address in each Text record.
  - The loader will load these codes into correct place



```
H^COPY  ^000000^001071
T^000000^1E^172063^4B2021^032060^290000^332006^4B203B^3F2FEE^032055^0F2056^010003
T^00001E^09^0F2048^4B2029^3E203F
T^000027^1D^B410^B400^B44075^101000^E32038^332FFA^DB2032^A004^332008^57A02F^B850
T^000044^09^3B2FEA^13201F^4F0000
T^00006C^01^F1
T^00004D^19^B410^772017^E3201B^332FFA^53A016^DF2012^B850^3B2FEF^4F0000
T^00006D^04^454F46^05
E^000000
```

Program Blocks Loaded in Memory



Not present
in object program

Control Sections and Program Linking

- Control sections
  - can be loaded and relocated independently of the other control sections
  - are most often used for subroutines or other logical subdivisions of a program
  - the programmer can assemble, load, and manipulate each of these control sections separately
  - because of this, there should be some means for linking control sections together
  - assembler directive: **CSECT**

    ```
    secname     CSECT
    ```
  - separate location counter for each control section

Control Sections and Program Linking

- External definition and reference
  - instruction in one control section may need to refer to instructions or data located in another section
  - External definition

    ```
    EXTDEF  name [, name]
    ```

    - `EXTDEF names symbols that are defined in this control section and may be used by other sections`
    - `Ex: EXTDEF   BUFFER, BUFEND, LENGTH`
  - External reference

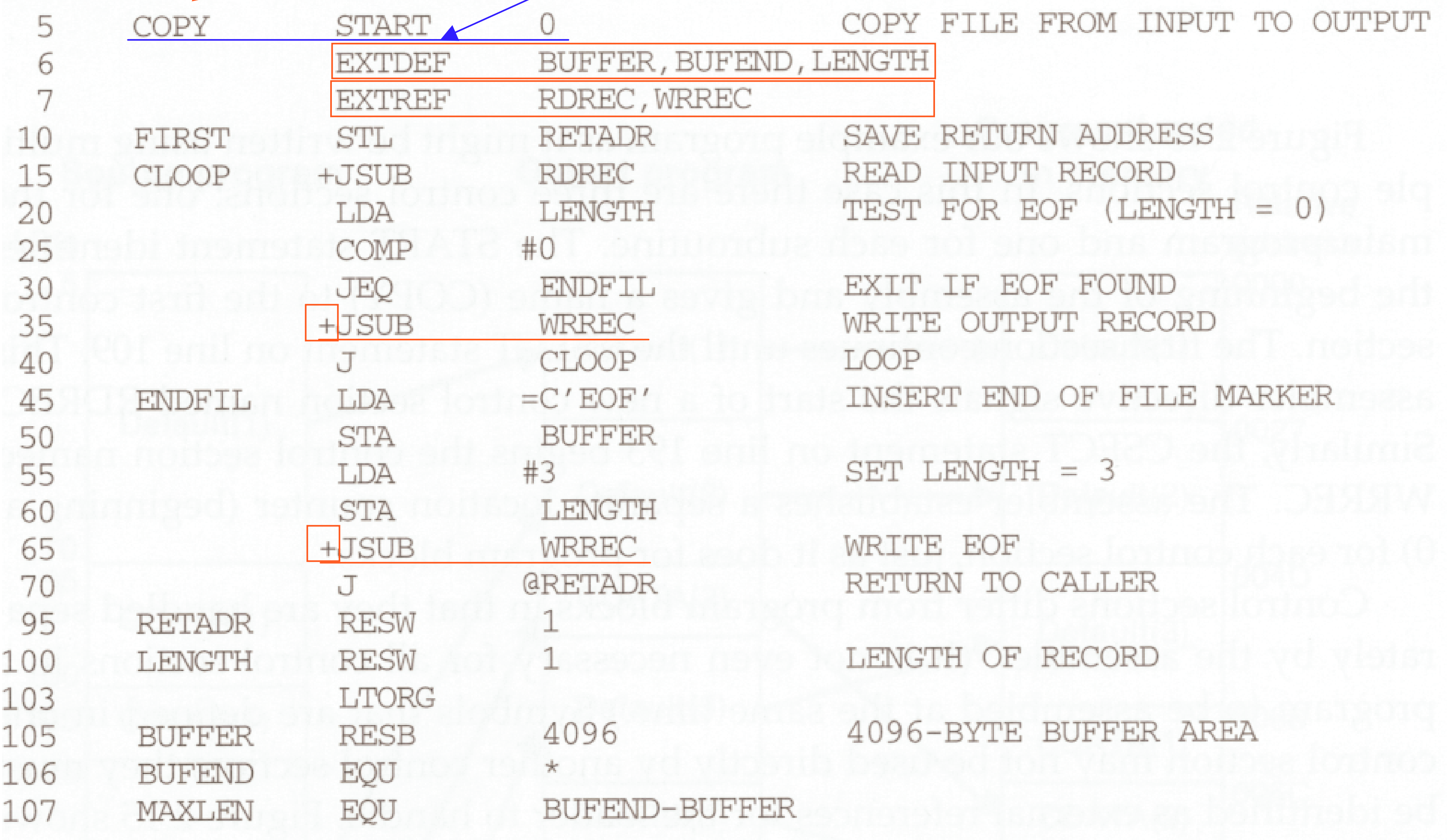
    ```
    EXTREF  name [,name]
    ```

    - `EXTREF names symbols that are used in this control section and are defined elsewhere`
    - `Ex: EXTREF   RDREC, WRREC`
  - To reference a external symbol, extended format instruction is needed (why?)

Example: pp. 86, Figure 2.15

Implicitly defined as an external symbol

first control section

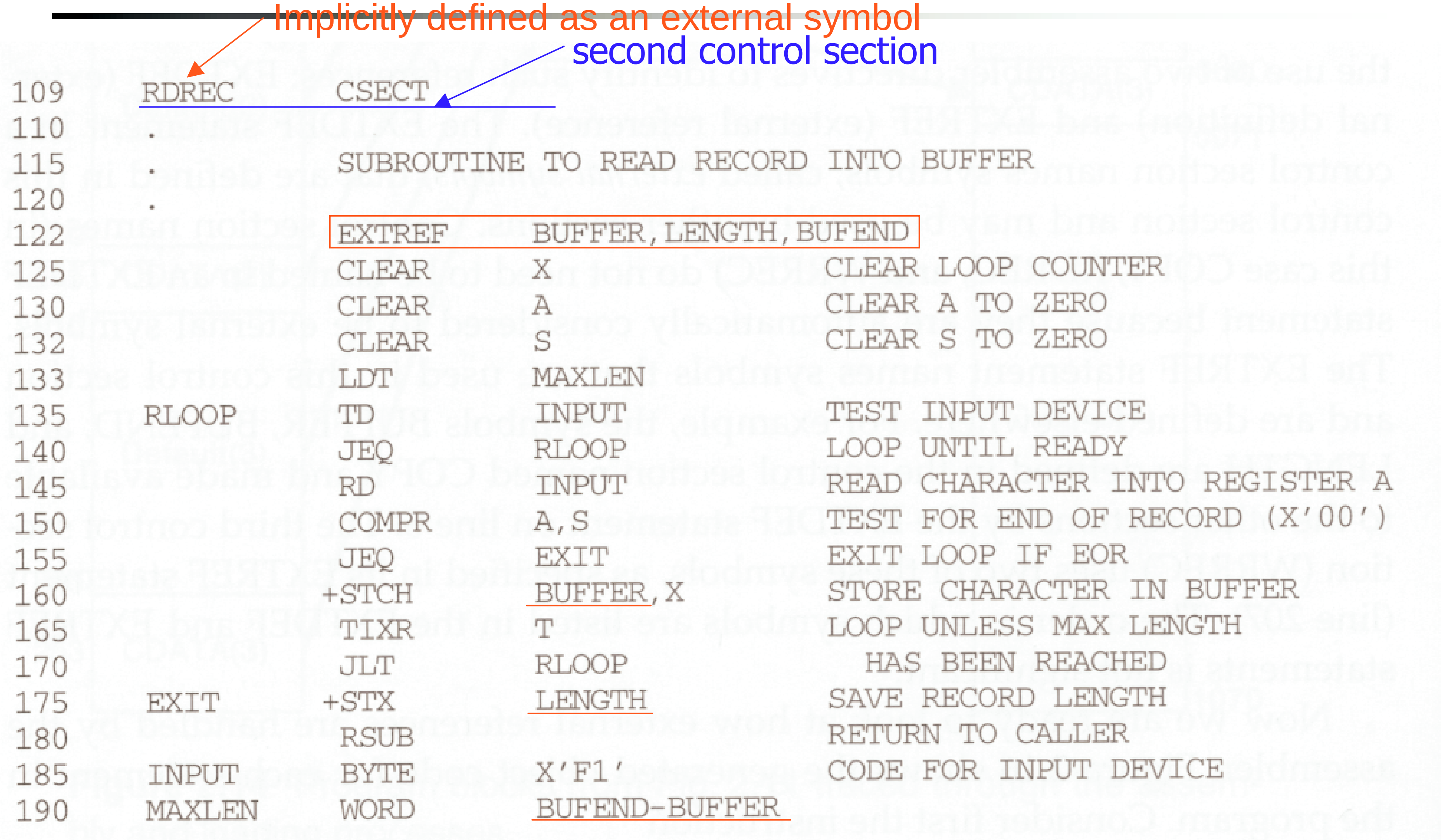


```
  5     COPY      START     0             COPY FILE FROM INPUT TO OUTPUT
  6               EXTDEF    BUFFER,BUFEND,LENGTH
  7               EXTREF    RDREC,WRREC
 10     FIRST     STL       RETADR        SAVE RETURN ADDRESS
 15     CLOOP    +JSUB      RDREC         READ INPUT RECORD
 20               LDA       LENGTH        TEST FOR EOF (LENGTH = 0)
 25               COMP     #0
 30               JEQ       ENDFIL        EXIT IF EOF FOUND
 35              +JSUB      WRREC         WRITE OUTPUT RECORD
 40               J         CLOOP         LOOP
 45     ENDFIL    LDA      =C'EOF'        INSERT END OF FILE MARKER
 50               STA       BUFFER
 55               LDA      #3             SET LENGTH = 3
 60               STA       LENGTH
 65              +JSUB      WRREC         WRITE EOF
 70               J        @RETADR        RETURN TO CALLER
 95     RETADR    RESW      1
100     LENGTH    RESW      1             LENGTH OF RECORD
103               LTORG
105     BUFFER    RESB      4096          4096-BYTE BUFFER AREA
106     BUFEND    EQU       *
107     MAXLEN    EQU       BUFEND-BUFFER
```

Example: pp. 86, Figure 2.15

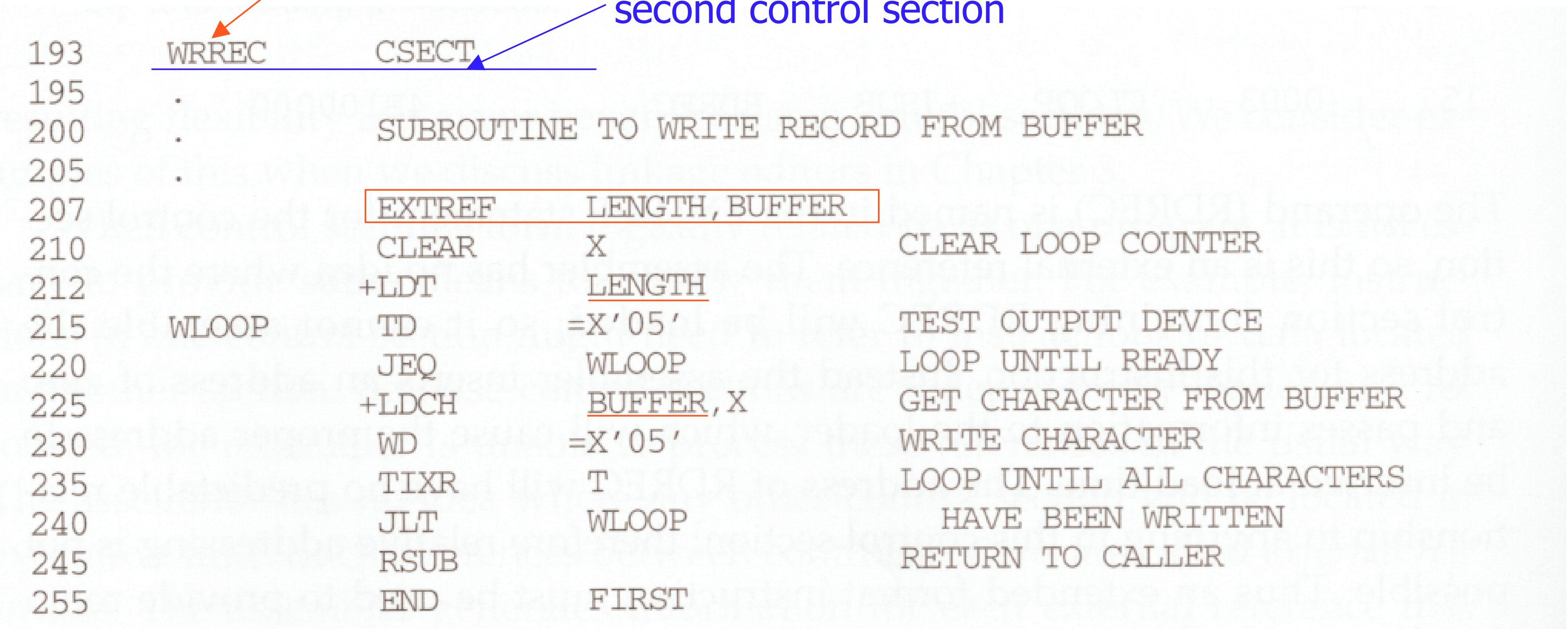
Implicitly defined as an external symbol

second control section



```
109    RDREC     CSECT
110    .
115    .         SUBROUTINE TO READ RECORD INTO BUFFER
120    .
122              EXTREF    BUFFER,LENGTH,BUFEND
125              CLEAR     X                CLEAR LOOP COUNTER
130              CLEAR     A                CLEAR A TO ZERO
132              CLEAR     S                CLEAR S TO ZERO
133              LDT       MAXLEN
135    RLOOP     TD        INPUT            TEST INPUT DEVICE
140              JEQ       RLOOP            LOOP UNTIL READY
145              RD        INPUT            READ CHARACTER INTO REGISTER A
150              COMPR     A,S              TEST FOR END OF RECORD (X'00')
155              JEQ       EXIT             EXIT LOOP IF EOR
160             +STCH      BUFFER,X         STORE CHARACTER IN BUFFER
165              TIXR      T                LOOP UNLESS MAX LENGTH
170              JLT       RLOOP              HAS BEEN REACHED
175    EXIT     +STX       LENGTH           SAVE RECORD LENGTH
180              RSUB                       RETURN TO CALLER
185    INPUT     BYTE      X'F1'            CODE FOR INPUT DEVICE
190    MAXLEN    WORD      BUFEND-BUFFER
```

Example: pp. 86, Figure 2.15



Implicitly defined as an external symbol

second control section

```
WRREC    CSECT
.
.        SUBROUTINE TO WRITE RECORD FROM BUFFER
.
         EXTREF   LENGTH,BUFFER
         CLEAR    X               CLEAR LOOP COUNTER
        +LDT      LENGTH
WLOOP    TD      =X'05'           TEST OUTPUT DEVICE
         JEQ      WLOOP           LOOP UNTIL READY
        +LDCH     BUFFER,X        GET CHARACTER FROM BUFFER
         WD      =X'05'           WRITE CHARACTER
         TIXR     T               LOOP UNTIL ALL CHARACTERS
         JLT      WLOOP             HAVE BEEN WRITTEN
         RSUB                     RETURN TO CALLER
         END      FIRST
```

Assembler Handle External Reference

- Case 1 (P.87)

```
15     0003     CLOOP     +JSUB   RDREC      4B100000
```

  - The operand RDREC is an external reference.
  - The assembler
    - has no idea where RDREC is
    - inserts an address of zero
    - can only use extended format to provide enough room (that is, relative addressing for external reference is invalid)
    - passes information to the loader

Assembler Handle External Reference

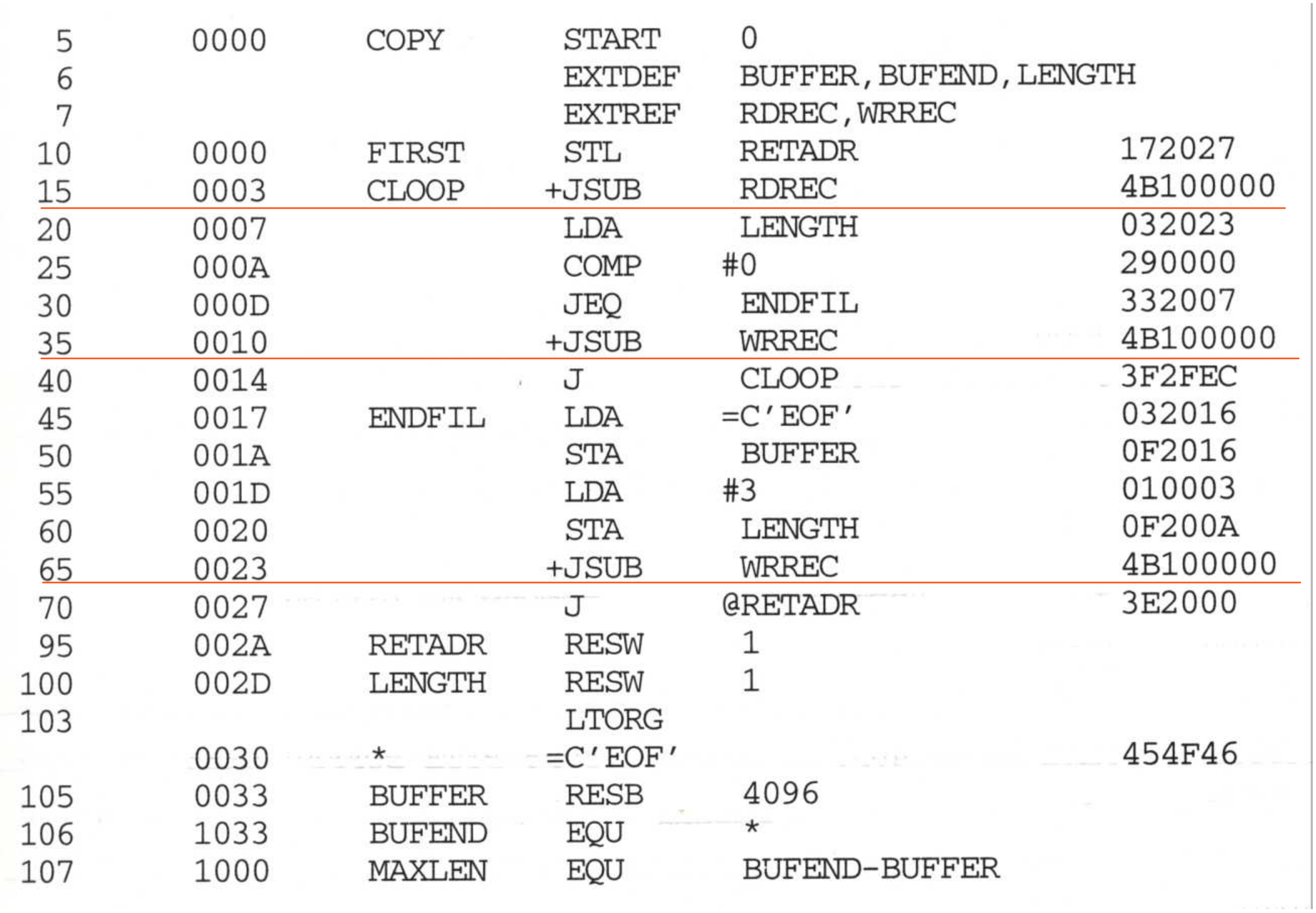
- Case 2

```
190 0028   MAXLEN     WORD     BUFEND-BUFFER    000000
```

  - There are two external references in the expression, BUFEND and BUFFER.
  - The assembler
    - inserts a value of zero
    - passes information to the loader
      - Add to this data area the address of BUFEND
      - Subtract from this data area the address of BUFFER
- Case 3
  - On line 107, BUFEND and BUFFER are defined in the same control section and the expression can be calculated immediately.

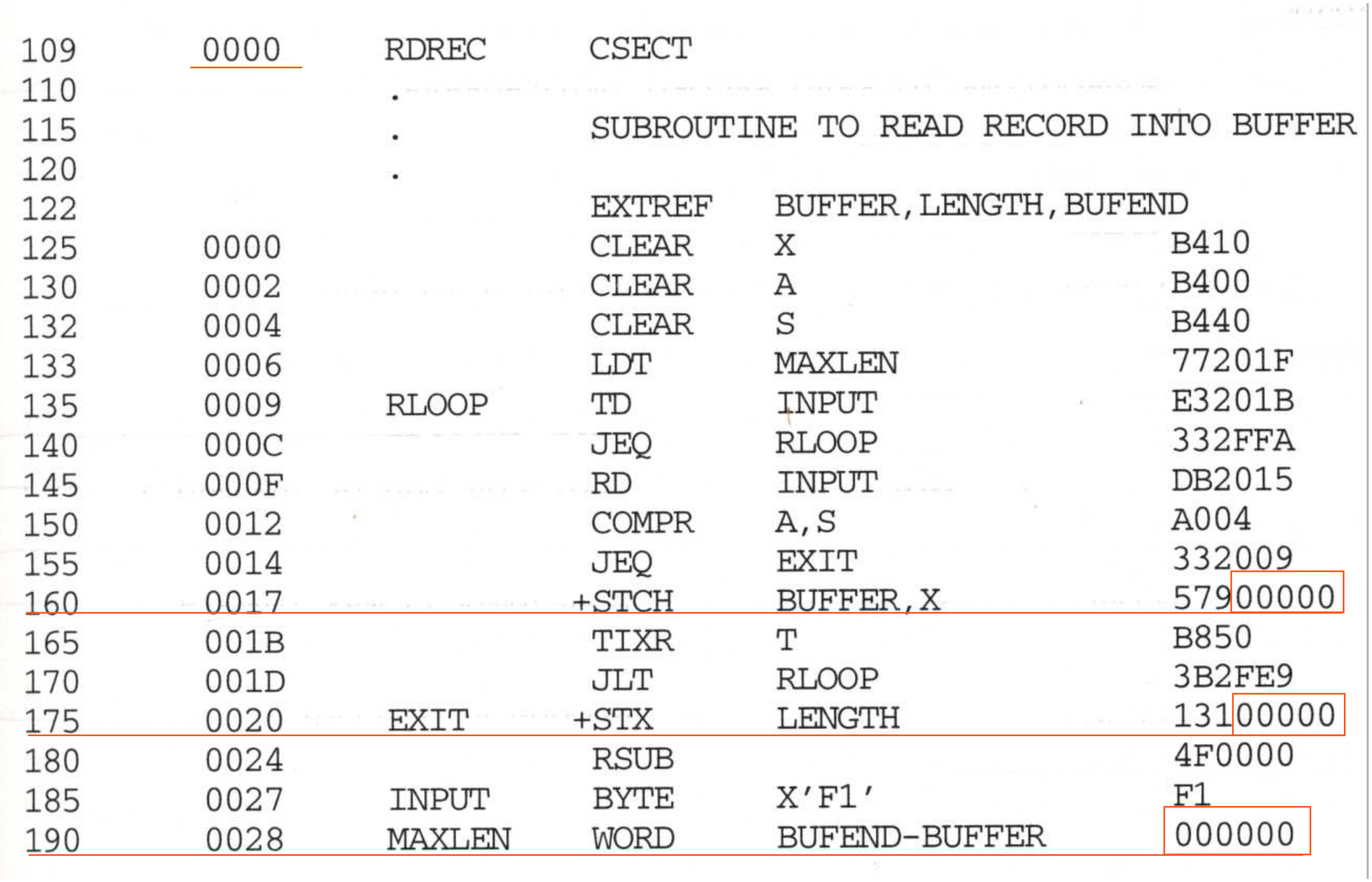
```
107     1000     MAXLEN     EQU     BUFEND-BUFFER
```

Object Code of Figure 2.15



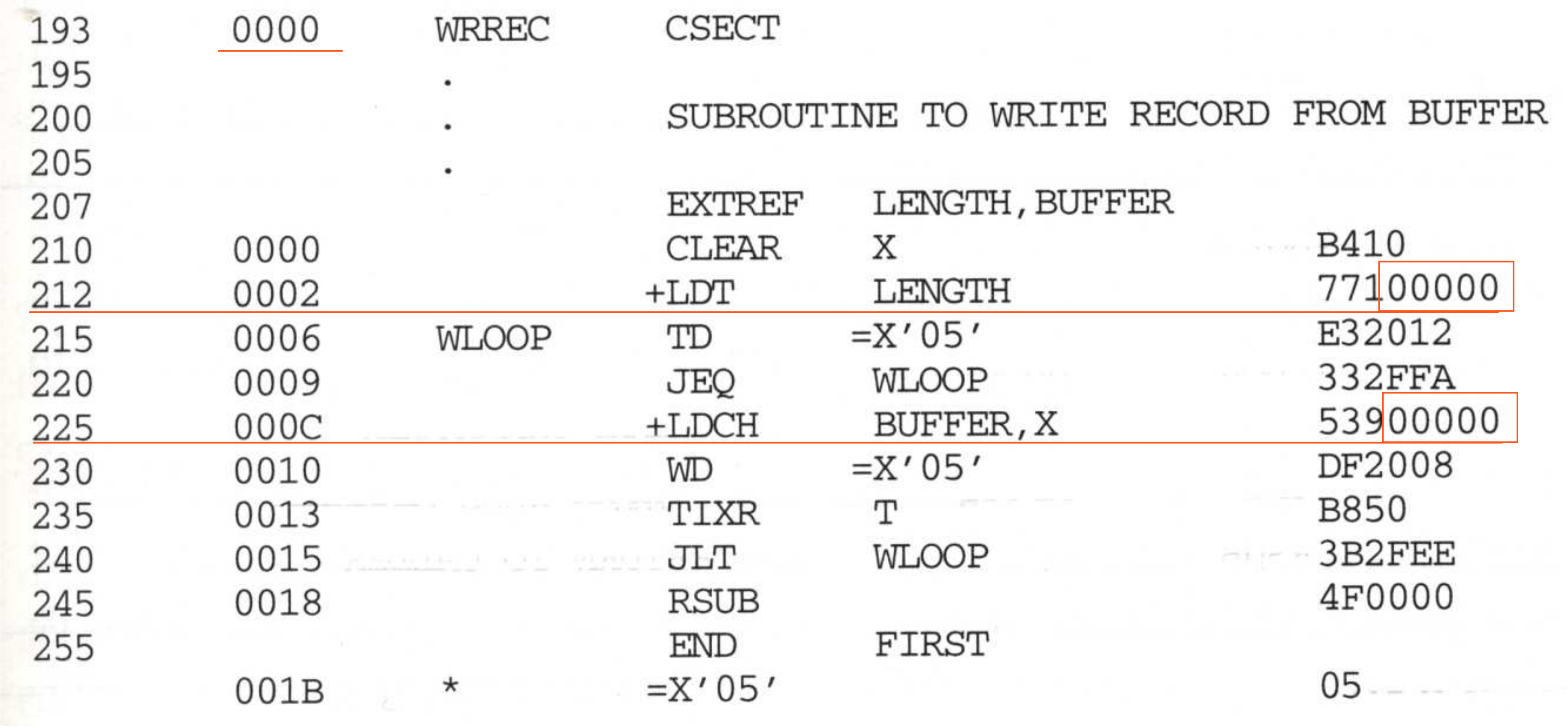
```
5      0000   COPY     START    0
6                      EXTDEF   BUFFER,BUFEND,LENGTH
7                      EXTREF   RDREC,WRREC
10     0000   FIRST    STL      RETADR             172027
15     0003   CLOOP   +JSUB     RDREC              4B100000
20     0007            LDA      LENGTH             032023
25     000A            COMP    #0                  290000
30     000D            JEQ      ENDFIL             332007
35     0010           +JSUB     WRREC              4B100000
40     0014            J        CLOOP              3F2FEC
45     0017   ENDFIL   LDA     =C'EOF'             032016
50     001A            STA      BUFFER             0F2016
55     001D            LDA     #3                  010003
60     0020            STA      LENGTH             0F200A
65     0023           +JSUB     WRREC              4B100000
70     0027            J       @RETADR             3E2000
95     002A   RETADR   RESW     1
100    002D   LENGTH   RESW     1
103                    LTORG
       0030   *       =C'EOF'                      454F46
105    0033   BUFFER   RESB     4096
106    1033   BUFEND   EQU      *
107    1000   MAXLEN   EQU      BUFEND-BUFFER
```

Object Code of Figure 2.15



```
109    0000    RDREC    CSECT
110                .
115                .       SUBROUTINE TO READ RECORD INTO BUFFER
120                .
122                        EXTREF    BUFFER,LENGTH,BUFEND
125    0000                CLEAR     X                         B410
130    0002                CLEAR     A                         B400
132    0004                CLEAR     S                         B440
133    0006                LDT       MAXLEN                    77201F
135    0009    RLOOP       TD        INPUT                     E3201B
140    000C                JEQ       RLOOP                     332FFA
145    000F                RD        INPUT                     DB2015
150    0012                COMPR     A,S                       A004
155    0014                JEQ       EXIT                      332009
160    0017               +STCH      BUFFER,X                  57900000
165    001B                TIXR      T                         B850
170    001D                JLT       RLOOP                     3B2FE9
175    0020    EXIT       +STX       LENGTH                    13100000
180    0024                RSUB                                4F0000
185    0027    INPUT       BYTE      X'F1'                     F1
190    0028    MAXLEN      WORD      BUFEND-BUFFER             000000
```

Object Code of Figure 2.15



```
193     0000    WRREC    CSECT
195                 .
200                 .    SUBROUTINE TO WRITE RECORD FROM BUFFER
205                 .
207                      EXTREF    LENGTH,BUFFER
210     0000             CLEAR     X                   B410
212     0002            +LDT       LENGTH              77100000
215     0006    WLOOP    TD       =X'05'               E32012
220     0009             JEQ       WLOOP               332FFA
225     000C            +LDCH      BUFFER,X            53900000
230     0010             WD       =X'05'               DF2008
235     0013             TIXR      T                   B850
240     0015             JLT       WLOOP               3B2FEE
245     0018             RSUB                          4F0000
255                      END       FIRST
        001B    *       =X'05'                         05
```

Records for Object Program

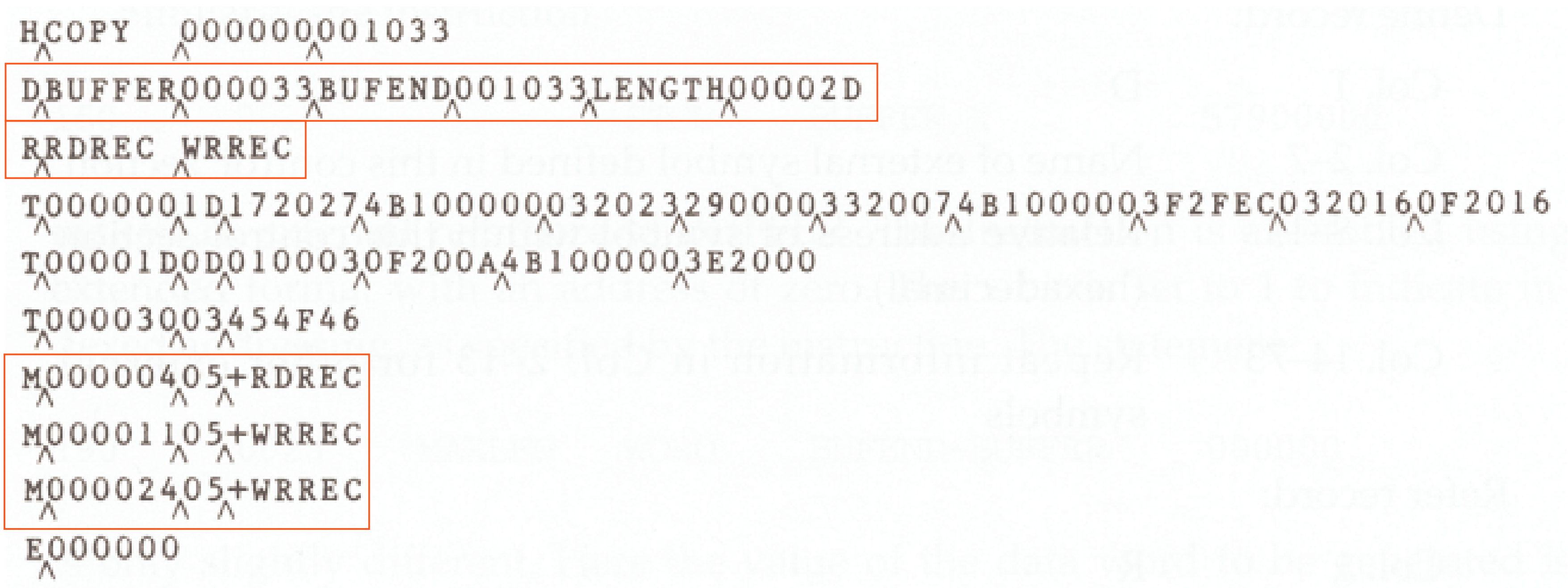
- The assembler must include information in the object program that will cause the loader to insert proper values where they are required
- Define record
  - Col. 1 D
  - Col. 2-7 Name of external symbol defined in this control section
  - Col. 8-13 Relative address within this control section (hexadeccimal)
  - Col.14-73 Repeat information in Col. 2-13 for other external symbols
- Refer record
  - Col. 1 R
  - Col. 2-7 Name of external symbol referred to in this control section
  - Col. 8-73 Name of other external reference symbols

Records for Object Program

- Modification record
  - Col. 1 M
  - Col. 2-7 Starting address of the field to be modified (hexiadecimal)
  - Col. 8-9 Length of the field to be modified, in half-bytes (hexadeccimal)
  - Col.11-16 External symbol whose value is to be added to or subtracted from the indicated field
  - Control section name is automatically an external symbol, i.e. it is available for use in Modification records.

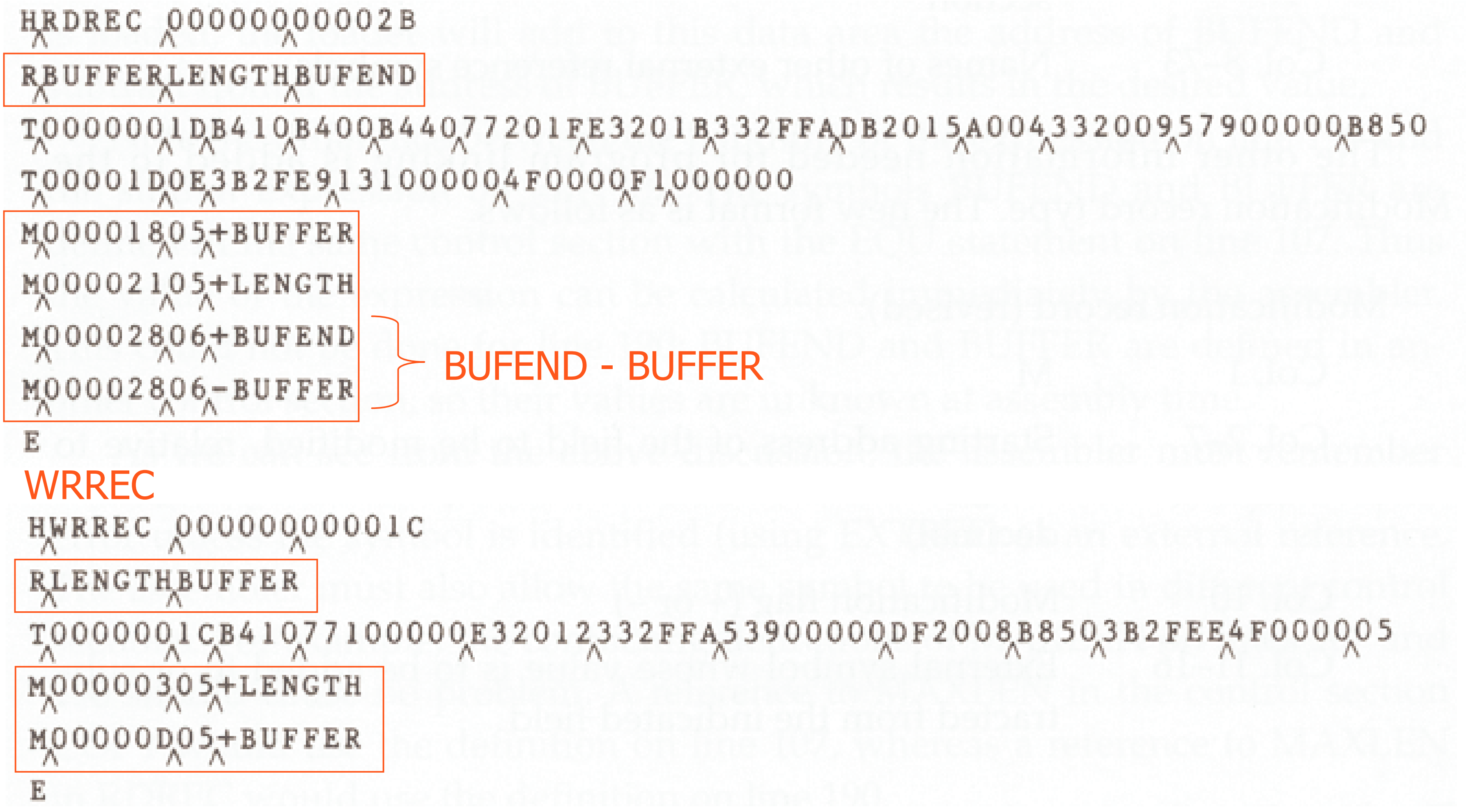
Object Program of Figure 2.15

COPY



```
H^COPY  ^000000^001033
D^BUFFER^000033^BUFEND^001033^LENGTH^00002D
R^RDREC ^WRREC
T^000000^1D^172027^4B100000^032023^290000^332007^4B100000^3F2FEC^032016^0F2016
T^00001D^0D^010003^0F200A^4B100000^3E2000
T^000030^03^454F46
M^000004^05^+RDREC
M^000011^05^+WRREC
M^000024^05^+WRREC
E^000000
```

Object Program of Figure 2.15



RDREC

```
H^RDREC ^000000^00002B
R^BUFFER^LENGTH^BUFEND
T^000000^1D^B410^B400^B440^77201F^E3201B^332FFA^DB2015^A004^332009^57900000^B850
T^00001D^0E^3B2FE9^13100000^4F0000^F1^000000
M^000018^05^+BUFFER
M^000021^05^+LENGTH
M^000028^06^+BUFEND
M^000028^06^-BUFFER
E
```

BUFEND - BUFFER

WRREC

```
H^WRREC ^000000^00001C
R^LENGTH^BUFFER
T^000000^1C^B410^77100000^E32012^332FFA^53900000^DF2008^B850^3B2FEE^4F000005
M^000003^05^+LENGTH
M^00000D^05^+BUFFER
E
```

Expressions in Multiple Control Sections

- Extended restriction
  - Both terms in each pair of an expression must be within the same control section
    - `Legal:   BUFEND-BUFFER`
    - `Illegal: RDREC-COPY`
- How to enforce this restriction
  - When an expression involves external references, the assembler cannot determine whether or not the expression is legal.
  - The assembler evaluates all of the terms it can, combines these to form an initial expression value, and generates Modification records.
  - The loader checks the expression for errors and finishes the evaluation.