HY-MCU
Compiler User Manual

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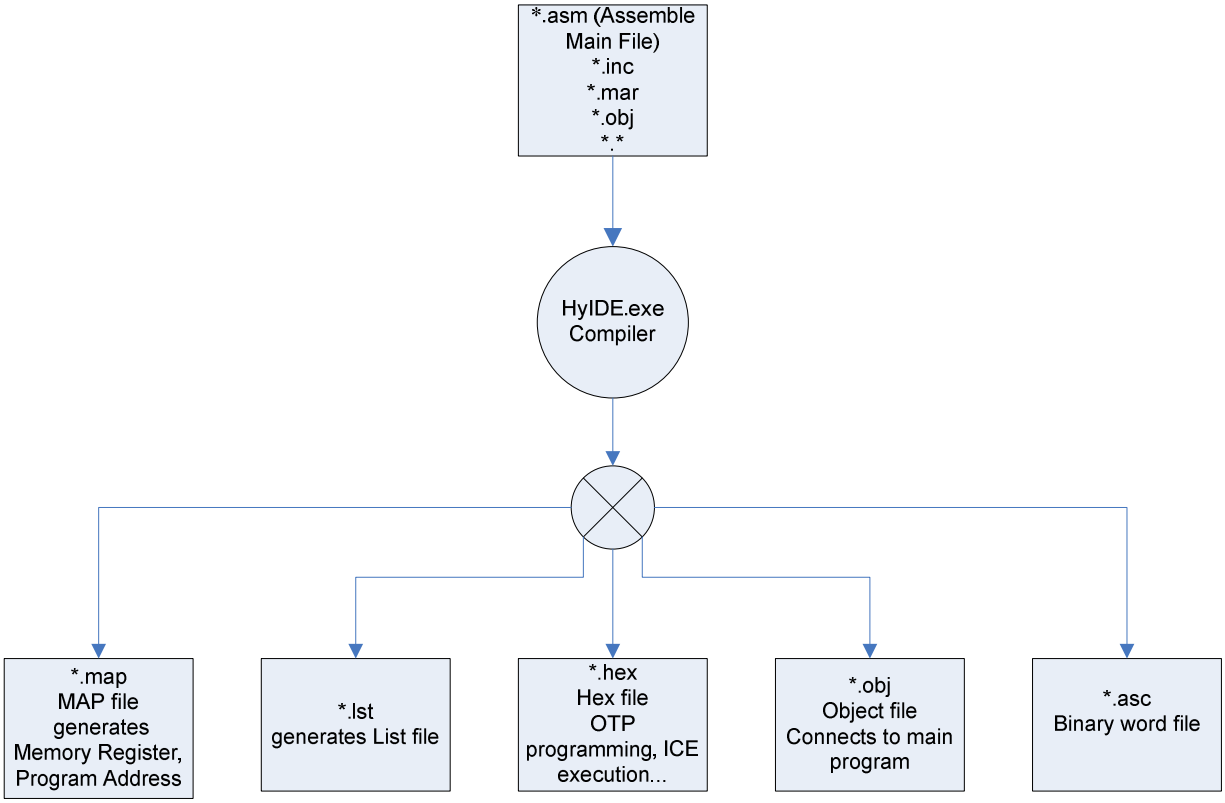
1. Compiler

File generated flow:



1.1 Compiler Main File

Program executes main file to compile main filename. Compiler can accept all kinds of filename extension excluding obj, hex, asc, lst, map, msk, pro, err and ifo.

1.2 Object File

Object connected file, the filename extension is*.obj that offers main program quoted function.

1.3 MAP File

Argument generated file, filename extension is *.map. Arguments include all EQU, DS defines Memory or Register Address, Label Address of Object file.

1.4 List File

Generates data after compiling, program lines, Address, machine code, main program.

1.5 Hex File

Generates Hex file, for ICE procedure emulation, OTP programming.

1.6 Asc File

Generating machine code binary word file.

2. Compiler Document File Restriction

1. Maximum document file is 128k byte. If maximum restriction is exceeded, Compiler will not send out a warning. Documents may be damaged. Users must pay extra attention to document size.
2. If the document exceeds 128k, users must utilize Include way to separate the file. Users must take notice of the documents size that are 128k byte respectively.
3. No matter the text is uppercase or lowercase, if word set is the same, it will be recognized as the same word set.
4. Filename length cannot exceed 128 byte, including Path.
   Ex:
   C:\Example\ASM\example.asm ← this string length cannot exceed 128 byte.
5. Word length constrain is 160 byte of every line in editing program.
   Ex:
   MVF TEMPABLE, F, BANK ← This string length cannot exceed 160 byte (space included).
6. Maximum Label, Memory and Register definition word length is 32 byte.
   Ex:
   Label1: ← This string length cannot exceed 32 byte
   ECK equ 80h ← 'ECK' cannot exceed 32 byte
7. Label, Memory and Register can include at most 8192 definition (Total).
8. Macro Maximum number is 4096.
9. Macro defines maximum argument as 32.
   Ex:
   Exm Macro A,B,C…… ← A,B,C argument cannot exceed 32
10. If Macro refers to another Macro, maximum levels cannot exceed 32.
    Ex:

```
ANB     Macro     CC
        Exm
ENDM
ANB1    Macro     CC
        ANB
ENDM
ANB2    Macro     CC
        ANB1
ENDM
…….
ANBn    Macro     CC
        ANBn-1          ←  Cannot exceed 32 levels.
ENDM
```

3. Pseudo

Pseudo instructions are used when defining program, memory or special register address. These instructions do not occupy memory or program space (except pseudo instructions, 'DB' and 'DW' for defining program).

Compiler's pseudo instructions are listed in below:

INCLUDE	Open another document
ORG	Define program address
END	End Program
MACRO	Definition module
ENDM	End Module definition
EQU	Define constant
DB	Define 1 Byte program
DW	Define 1 Word program
MEMAR	SRAM Address declaration
DS	SRAM length declaration
EXTENR	External argument reference
GLOBAL	Provide arguments for external program usage.
SET	Reserved
LOCAL	Reserved
UP	Label or address / 0x10000
HIGH	Label or address / 0x100
LOW	Label or address mod 0x100
DEFINE	Offer value to IF event arguments
IF	Conditions statement. Judge whether to compile statements before ENDIF
ELSE	Else, match up with IF wording
ENDIF	End IF

1. INCLUD

Open files of main program, including Marco file, object file, Definition file and Assemble file.

If Object or Assemble file is included, Compiler will arrange the instructions in sequence in ROM Address.

Ex:

SYSINI.asm content:

```
CLRF    080h
CLRF    081h
```

```
.....

MAIN.asm content:
ORG     0000h
RJ      START
INCLUDE   SYSINI.asm
ORG     0100h
START:
....

After Compiling MAIN.asm
Address         Program
0000h           RJ      100h
0001h           CLRF    080h
0002h           CLRF    081h
.....
0100h
....
```

Neither Marco nor definition file will be arranged in ROM Address, unless Marco is called in the program. At this time, Marco programs will be arranged in corresponding ROM Address.

Ex:

```
Def.mar content:
            W       EQU     0
            F       EQU     1
            ACCE    EQU     0
            BANK    EQU     1
ADDWORD     MARCO   A, B
            LBSR    B
            MVF     B, W, BANK
            LBSR    A
            ADDF    A, F, BANK
            LBSR    B
            MVF     B, W, BANK
            LBSR    A
            ADDC    A, F, BANK
ENDM

MAIN.asm content:
INCLUDE     Def.mar
BUFA    EQU     080h
BUFB    EQU     102h
ORG     0000h
GOTO    START
....
ORG     0100h
START:
MVL     012h
MVF     BUFA, F, ACCE
MVL     034h
MVF     BUFA+1, F, ACCE
MVL     056h
LBSR    BUFB
MVF     BUFB, F, BANK
MVL     078h
```

```
MVF         BUFB+1, F, ACCE
ADDWORD     A, B
….
```

After Compiling MAIN.asm

```
Address         Program
0000h           GOTO    START
…..
0100h           MVL     12h
0101h           MVF     80h, 1, 0
0102h           MVL     34h
0103h           MVF     081h, 1, 0
0104h           MVL     56h
0105h           LBSR    1
0106h           MVF     02h, 1, 0
0107h           MVL     78h
0108h           MVF     03h, 1, 0
0109h           LBSR    1
010Ah           MVF     02h, 0, 1
010Bh           LBSR    0
010Ch           ADDF    80h, 1, 1
010Dh           LBSR    1
010Eh           MVF     03h, 0, 1
010Fh           LBSR    0
0110h           ADDC    81h, 1, 1
  ….
```

2. ORG

Appoint program memory address.

Ex:

```
        ORG     0000h
        RJ      Begin
        ….
        ORG     0100h
    Begin:
          MVL       10h
        ….
```

After Compiling

```
0000h       RJ      101h
….
0100h       MVL     10h
```

3. END

End Program

When pseudo instruction, END exists in the program, Compiler will stop to assemble END below programs.

4. MACRO

Macro instruction

Instructions can be gathered into Macro to provide convenience to program reference.

Ex:

```
MOVFW     MACRO     A, B
```

```
MVF          A, 0, B
ENDM

MOVWF    MACRO    A, B
MVF          A, 1, B
ENDM
ORG      0000h
MOVFW    80h, 0
MOVWF    10h, 1
```

After Compiling

```
0000h       MVF    80h, 0, 0
0001h       MVF    10h, 1, 1
```

5. ENDM

End Macro instruction

After MACRO declaration, ENDM is necessary to end the instruction.

6. EQU

Define constant

EQU can be used to declare SRAM address

Ex:

```
COUNT    EQU    80h
```

COUNT address is 80h

7. DB

Define 1 Byte program

DB requires argument in even numbers. If it is singular number, 00h must be added ahead to compose a WORD.

Ex:

```
ORG    100h
DB       012h
DB       053h, 046h
```

After Compiling

```
0100h      0012h
0101h      05346h
```

8. DW

Define 1 WORD program

Ex:

```
ORG    100h
DW       01234h
```

After Compiling

```
0100h      01234h
```

9. MEMAR

Declare SRAM Address

SRAM initial address is defined by compiler through the arguments that followed MEMAR.

10. DS

Declare SRAM length

Ex:

```
MEMAR    080h          ← SRAM is arranged from 080h
TEMP     DS    16      ← Define TEMP as16 byte (from 080h to 08Fh)
COUNT    DS    2       ← Define COUNT as 2 Byte, address: 090h, 091h
BUF      DS    1       ← Define BUF as 1 Byte, address: 092h
```

11. EXTERN

Refer to external argument

When establishing Object Code, EXTERN declaration helps to define the external program arguments.

Ex:

```
    EXTERN    TEMP1, TEMP2
    GLOBAL    ADDBLK

        LEN    EQU    3
ADDBLK:
        MVF    TEMP2, 0, 0
        ADDF   TEMP1, 1, 0
        .......
```

12. GLOBAL

Provide arguments for external program usage.

When establishing Object Code, program arguments or subprograms can be released to provide reference to external program.

13. UP

Numeric highest bit → Numeric / 0x10000

Ex:

```
MVL    UP    Label1    →    UP    Label1 = 0x1000 / 0x10000 = 0x00
....
ORG    01000h
Label1:
```

14. HIGH

Numeric highest bit → Numeric / 0x100

Ex:

```
MVL    HIGH    Label1    →    HIGH    Label1 = 0x1000 / 0x100 = 0x10
....
ORG    01000h
Label1:
```

15. LOW

Numeric lowest bit → Numeric MOD 0x100

Ex:

```
MVL    LOW    Label1    →    LOW    Label1 = 0x10F2 MOD 0x100 =
0xF2
....
ORG    010F2h
Label1:
```

16. DEFINE 、IF、ELSE and ENDIF

DEFINE: Provide numeric for IF event arguments.

Condition statement, IF

Usage:

```
IF Event
    Content1
ELSE
    Content 2
ENDIF
```

Description:

- DEFINE variables and EQU defined variable name can be the same (they are irrelevant)
- When event is established, content 1 will be executed; otherwise content 2 will be implemented instead.
- When event is established, it can be “TRUE” or “1”.
- Event can be the variable of DEFINE
- Can be used in MACRO

Restriction：Not allow IF NEST

Ex:

```
        Define      FSR0 = 0
        Define      FSR1 = 1
        Define      H08B = 0

MOVLF   MACRO   RAMLabel, FSR
        MVL     RAMLabel
    IF   FSR = 0
        MVF     FSR0L, F, ACCE
    ELSE
        MVF     FSR1L, F, ACCE
    ENDIF
ENDM

            ORG     0
            JMP     BEGIN
    ……
    ……
BEGIN:
            MOVLF   TEMP, FSR0
    ……
    ……
    FSR0L       EQU     010h
    FSR0H       EQU     012h
    W           EQU     0
    F           EQU     1
    ACCE        EQU     0
    BANK        EQU     1
    TEMP        EQU     080h
    TEMP1       EQU     081h
```

After assembly:

```
            ORG     0
            JMP     BEGIN
    ……
```

```
.....
BEGIN:
        MVL     TEMP
        MVF     FSR0L, F, ACCE
.....
.....
```

4. Object Code

- Program code is saved as binary format.
- Using pseudo instruction, Global to generate function for main program quotation.
- Using pseudo instruction, Extern to quote external argument or program.
- Main program uses Include way to contain Object Code.
- Using MAP file to determine what functions can be quoted.

```
================================================================================

Memory, Register and Const

================================================================================

Name        Location      Address

                    ----        --------      -------

                   INDF0        Const          0x0000

                  POINC0        Const          0x0001

                  PODEC0        Const          0x0002

================================================================================

Local     Program     Address

================================================================================

Name        Location      Address

                    ----        --------      -------

                  RESET        Program         0x0000

               MAINLOOP        Program         0x000C

          MAINLOOP_DATA        Program         0x0025

               MAINLOOPAA        Program         0x0100

                   TEST        Program         0x0265

================================================================================

Extern     Program     Address

================================================================================

Name        Location      Address

                    ----        --------      -------

                  CLEAR        Program         0x0102

               MULTIPLY        Program         0x0106

              DIVIDE45        Program         0x0128

                 DIVIDE        Program         0x0145
```

HTOB Program 0x0186

BTOH Program 0x01B9

SQRT Program 0x01F0

TT1 Program 0x025F

TEMM Program 0x025C

5. Differences of Assembling and Assembling && debugging

Assembling

1. If there is a declaration of external argument (EXTERN), and it has been referred to, assembling is successful.
2. Assembling cannot judge whether RAM or Program has exceeded IC specification range. Thus, every IC can be assembled.

Assembling && debugging

1. Assembling cannot be implemented if external argument (EXTERN) is referred in the program. Error message will be displayed at this time.
2. Assembling will check whether RAM or Program has exceeded IC specification range. If Program Size or the reference RAM does not exist, error message will be displayed.

6. Error Message

1. ERROR[Code 0] : Unknown error
   Instruction name error
   Instruction name error or the name has not been defined in Macro
2. ERROR[Code 1]: Couldn't open source file
   Can not find the Source file
3. ERROR[Code 2]: cannot open file
   Include file name error or file name missing
4. ERROR[Code 3]: Temp file creation error
   Temporary file open error.
   Repeat opening file
5. ERROR[Code 4]: Duplicate label or redefining symbol
   Repeat definition, Symbol or Label
6. ERROR[Code 5]: Undefined Symbol
   Undefined Symbol or Label
7. ERROR[Code 6]: Out of memory...
   Register, Memory or Label definition exceeds 8192, or Macro exceeds 4096…
8. ERROR[Code 8]: Illegal Symbol
   Register, Memory or Label define name and instruction name is the same
9. ERROR[Code 9]: Illegal argument

LBSR argument greater than 16

10. ERROR[Code 10]: Overwriting previous address contents
    Reduplicated Address
    Ex:

```
ORG     0
Nop
Nop
Nop
Nop
JMP     Start
ORG     0004H
```

11. ERROR[Code 11]: Addresses above ….
    Program exceeds ROM Size
12. ERROR[Code 13]: Missing argument...
    Insufficient arguments behind the instruction
    Ex:

```
MVF   080h
```

13. ERROR[Code 14]: Too many arguments...
    Too many arguments behind the instruction
    Ex:

```
CLRF   080h, 1, 0
```

14. ERROR[Code 15]: Undeclared variable
    Undeclared variable
15. ERROR[Code 16]: Illegal Macro...
    Illegal Macro
16. ERROR[Code 19]: Macro nested too deep...
    Macro referenced Marco nest is more than 32 layers
17. ERROR[Code 20]: Circular file reference...
    Repeat quoted file, or there is no filename after INCLUDE
18. ERROR[Code 21]: Circular macro reference...
    Repeat definition, Macro
19. ERROR[Code 23]: Over Range
    Exceeding RJ or RCALL range
20. ERROR[Code 24]: Illegally Memory or Register
    Defining the non-existing register or memory
21. ERROR[Code 25]: Illegally Bit
    Defining the non-existing bit
    Ex:

```
INTF1    -    ADCIF   -    -    TMAIF   WDTIF   E1IF     E0IF
BSF      INTF1, 7, 0
```

22. ERROR[Code 26]: Memory Over
    Definition exceeds memory range