
MCU machine code

It is sometimes desirable to determine the machine code loads onto the device or interpret code already on a device.

PIC Machine Code

Example program (Q1) to write 55h to LEDS on port c

Address	Instruction	Machine Code
0000	bsf STATUS, RP0	01 01bb bfff ffff 01 0110 1000 0011 1 6 8 3
0001	clrf TRISC	00 0001 1fff ffff 00 0001 1000 0111 0 1 8 7
0002	bcf STATUS, RP0	01 00bb bfff ffff 01 0010 1000 0011 1 2 8 3
0003	movlw 055h	11 00xx kkkk kkkk 11 0000 0101 0101 3 0 5 5
0004	movwf PORTC	00 0000 1fff ffff 00 0000 1000 0111 0 0 8 7
Repeat		
0005	goto Repeat	10 1kkk kkkk kkkk 10 1000 0000 0101 2 8 0 5

Microcontrollers

The following listing from the assembler verifies the "hand generated" machine code in the previous example program.

Q1.LST

```
00001 ; Light alternate leds
00002 ;
00003      #include <P16F877A.INC>
00004 LIST
00002 ; P16F877A.INC Standard Header File,
00398 LIST surpressed header file list
00004
2007 3FF2 00005 __FUSES _PWRTE_ON & _CP_OFF & _WDT_OFF & _HS_OSC
00006 ;
0000 00007 org      00h          ; reset vector.
0000 1683 00008 bsf     STATUS, RP0
0001 0187 00009 clrf    TRISC
0002 1283 00010 bcf     STATUS, RP0
00011
0003 3055 00012 movlw   055h
0004 0087 00013 movwf   PORTC
0005      00014 Repeat
0005 2805 00015 goto    Repeat
```

Microcontrollers

Q1.HEX in Intel hex format

```
:02 0000 04 0000 FA
:0C000000083168701831255308700052805
:02400E00F23F7F
:00000001FF
```

Ignore this record as it contains no code or useful data

```
:02          2 bytes of code in record
0000        Load address * 2
04          Record type (04=Linear address record)
0000        2 code bytes
FA          Checksum (02+05+28+D1) mod 256 = 0
```

Program code

```
:0C          12 bytes of code in record
0000        Load address * 2
00          Record type (0=Code)
8316
8701
8312
5530
8700
0528        12 code bytes (LSB at lower address)
05          Check Sum
           (0C+00+00+00+83+16+87+01+83+12+55+30+87+00+05+28+5)mod 256=0
```

Config word

```
:02          2 bytes of code in record
400E        Load Address * 2 so load address is 2007
00          Record type (0=Code)
F235        2 code bytes
7F          Check Sum
```

End record

```
:00          No code
0000        Ignored
01          Record type 01 = end record
FF          Check Sum
```

It is important to understand the code to this level because at the end of the day, this is the code that will be written to the device regardless of what the assembler and list files say. Remember, assemblers and linkers are programs so may contain bugs.