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# H8/300L Super Low Power Series

## Conversion from 2-Byte Hexadecimal to 5-Digit Decimal Number (HEX)

### Introduction

The software HEX converts a 2-byte hexadecimal number, which is placed in a general-purpose register, to a 5-digit BCD (binary-coded decimal) number and places the result in general-purpose registers.

### Target Device

H8/38024

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### 1. Arguments

Description	Memory area	Data length (bytes)	
Input	2-byte hexadecimal number	R0	2
Output	5-digit BCD number (upper 1 digit)	R2L	1
	5-digit BCD number (lower 4 digits)	R3	2

### 2. Changes to Internal Registers and Flags

R0	R1	R2H	R2L	R3	R4	R5	R6	R7
×	—	×	○	○	—	—	—	—
I	U	H	U	N	Z	V	C	
—	—	×	—	×	×	×	×	×

#### Legend

- : No change
- ×: Undefined
- : Result

### 3. Specifications

Program memory (bytes)	30
Data memory (bytes)	0
Stack (bytes)	0
Clock cycle count	368
Reentrant	Possible
Relocation	Possible
Interrupt	Possible

### 4. Description

#### 4.1 Details of functions

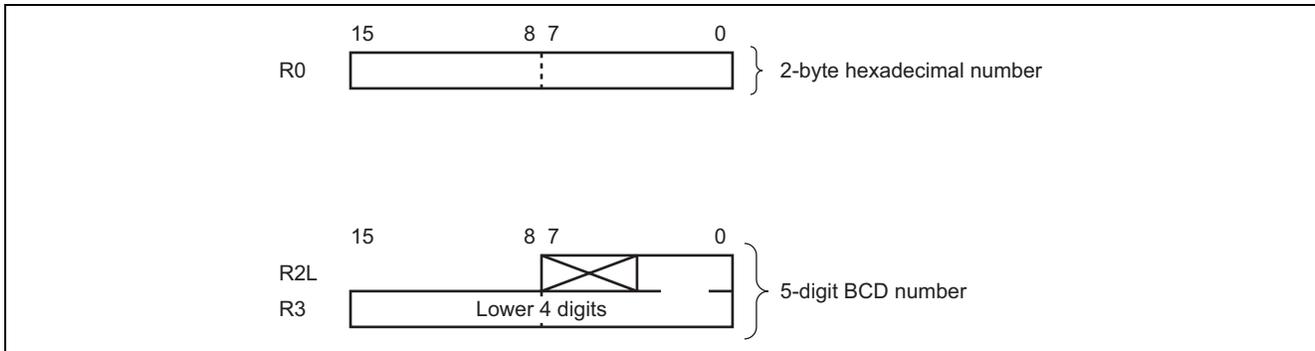
1. The following arguments are used with the software HEX:

R0: Sets a 2-byte hexadecimal number as an input argument.

R2L: The upper 1 digit (1 byte) of the 5-digit BCD number is placed here as an output argument.

R3: The lower 4 digits (2 bytes) of the 5-digit BCD number are placed here as an output argument.

Figure 1 shows the formats of the input and output arguments.



**Figure 1 Formats of Input and Output Arguments**

2. The following figure illustrates the execution of the software HEX. When the input argument is set as shown in (1), the 5-digit BCD number is placed in R2L and R3 as shown in (2).



**Figure 2 Example of Software HEX Execution**



### 4.5 Operation

1. A 4-bit binary number "B<sub>3</sub>B<sub>2</sub>B<sub>1</sub>B<sub>0</sub>" is represented by equations 1 and 2 below:

$$\begin{aligned}
 B_3 B_2 B_1 B_0 &= B_3 \times 2^3 + B_2 \times 2^2 + B_1 \times 2^1 + B_0 \times 2^0 \quad \text{----- (equation 1)} \\
 &= ((B_3 \times 2 + B_2) \times 2 + B_1) \times 2 + B_0 \quad \text{----- (equation 2)}
 \end{aligned}$$

**Figure 4 4-bit Binary Number "B<sub>3</sub>B<sub>2</sub>B<sub>1</sub>B<sub>0</sub>"**

2. First, equation 2 is used to compute  $\alpha = B_3 \times 2 + B_2$  (see figure 4) by executing an add instruction (ADD.B) and decimal adjust instruction (DAA). Next, a series of operations,  $\beta = \alpha \times 2 + B_1$ ,  $\gamma = \beta \times 2 + B_0$ , etc. are performed to produce a 5-digit BCD number as the result.
3. The software HEX uses R0 and R2L and R3 to compute  $\alpha = B_3 \times 2 + B_2$ .
  - a. R2H is used as the counter that counts the number of bit shifts on R0, which contains the input argument. D'16 is set in R2H for a total of 16 shifts.
  - b. R0 containing the 2-byte hexadecimal number is shifted 1 bit to left, and the most significant bit is thus loaded to the C bit.
  - c. R2L and R3 containing the 5-digit BCD number are processed in lowest byte-to-highest byte order, as follows:
    - R3L + R3L + C → R3L; R3L is then decimal-adjusted.
    - R3H + R3H + C → R3H; R3H is then decimal-adjusted.
    - R2L + R2L + C → R2L; R2L is then decimal-adjusted.
 Thus,  $\alpha = B_3 \times 2 + B_2$  is computed.
  - d. In the software HEX, R2H is decremented each time steps b and c are performed. This processing is repeated until R2H reaches "0".



## 6. Program List

```

*** H8/300 ASSEMBLER VER 1.0B ** 08/18/92 10:24:23
PROGRAM NAME =
1          ;*****
2          ;*
3          ;*      00 - NAME                      :CHANGE 2 BYTE HEXADECIMAL
4          ;*                                          TO BCD (HEX)
5          ;*
6          ;*****
7          ;*
8          ;*      ENTRY                          :R0 (HEXADECIMAL)
9          ;*
10         ;*      RETURNS :R2L (UPPER 1 CHARACTER (BY BCD))
11         ;*                                          R3 (LOWER 4 CHARACTER (BY BCD))
12         ;*
13         ;*****
14         ;
15  HEX_code C    0000          .SECTION          HEX_code, CODE, ALIGN=2
16          .EXPORT  HEX
17         ;
18  HEX_code C    00000000  HEX  .EQU $          ;Entry point
19  HEX_code C    0000 79020000  MOV.W    #H'0000,R2  ;Clear R2
20  HEX_code C    0004 0D23      MOV.W    R2,R3      ;Clear R3
21  HEX_code C    0006 F210      MOV.B    #D'16,R2H  ;Set bit counter
22  HEX_code C    0008          LOOP
23  HEX_code C    0008 1008      SHLL.B   R0L        ;Shift hexadecimal 1 bit left
24  HEX_code C    000A 1200      ROTXL.B  R0H
25         ;
26  HEX_code C    000C 0EBB      ADDX.B   R3L,R3L    ;R3L + R3L -> R3L
27  HEX_code C    000E 0F0B      DAA     R3L        ;Decimal adjust R3L
28  HEX_code C    0010 0E33      ADDX.B   R3H,R3H    ;R3H + R3H + C -> R3H
29  HEX_code C    0012 0F03      DAA     R3H        ;Decimal adjust R3H
30  HEX_code C    0014 0EAA      ADDX.B   R2L,R2L    ;R2L + R2L + C -> R2L
31  HEX_code C    0016 0F0A      DAA     R2L        ;Decimal adjust R2L
32         ;
33  HEX_code C    0018 1A02      DEC.B    R2H        ;Decrement R2H
34  HEX_code C    001A 46EC      BNE     LOOP       ;Branch Z=0
35  HEX_code C    001C 5470      RTS
36         ;
37         .END
*****TOTAL ERRORS 0
*****TOTAL WARNINGS 0

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