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2010年4月1日
瑞萨电子公司

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H8/300L Super Low Power 系列

5 位 BCD 转换为 2 个字节 16 进制数

要点

将设定在通用寄存器中的 5 位 BCD（2 进制编码 10 进制数）（3 个字节）转换为 2 个字节的 16 进制数，并将转换结果设定到通用寄存器。

动作确认器件

H8/38024

目录

1. 参数

内容		保存位置	数据长度（字节）
输入	5 位 BCD（高 1 位）	R0L	1
	5 位 BCD（低 4 位）	R1	2
输出	2 个字节 16 进制数	R2	2

2. 内部寄存器变化和标志变化

R0		R1	
×	•	•	
R2		R3	
○		×	
R4		R5	
•		•	×
R6		R7	
×		•	

I	U	H	U
•	•	×	•
N	Z	V	C
×	×	×	×

•：不变，×：不定，○：结果

3. 程序设计

程序存储器（字节）
64
数据存储器（字节）
0
堆栈（字节）
2
时钟周期数
210
重入
可
再定位
可
中途中断
可

4. 说明

4.1 功能

(1) 参数的详细内容如下：

R0L：输入参数，设定 5 位 BCD 的高 1 位（1 个字节）。

R1：输入参数，设定 5 位 BCD 的低 4 位（2 个字节）。

R2：输出参数，设定 2 个字节的 16 进制数。

输入参数，输出参数的格式如图 33-1 所示。

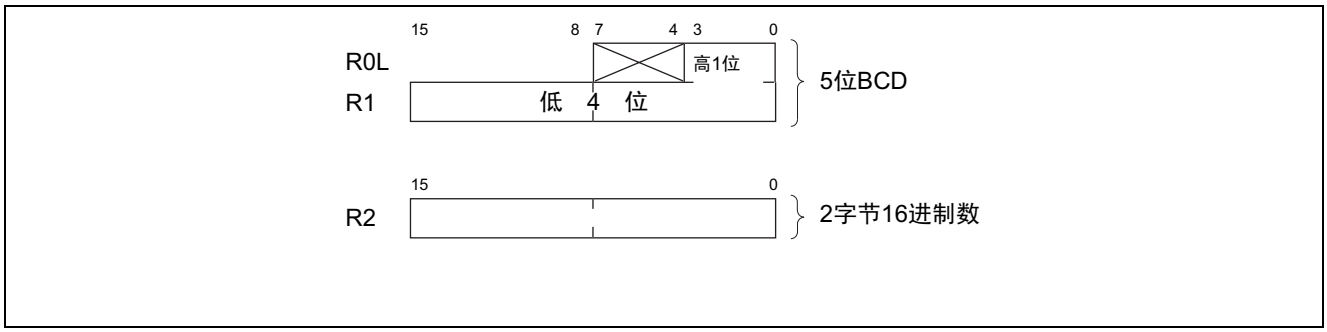


图 33-1 输入参数、输出参数

(2) 软件 BCD 的执行例子如图 33-2 所示。

一旦如①设定输入参数，就如②将 2 个字节的 16 进制数设定到 R2。

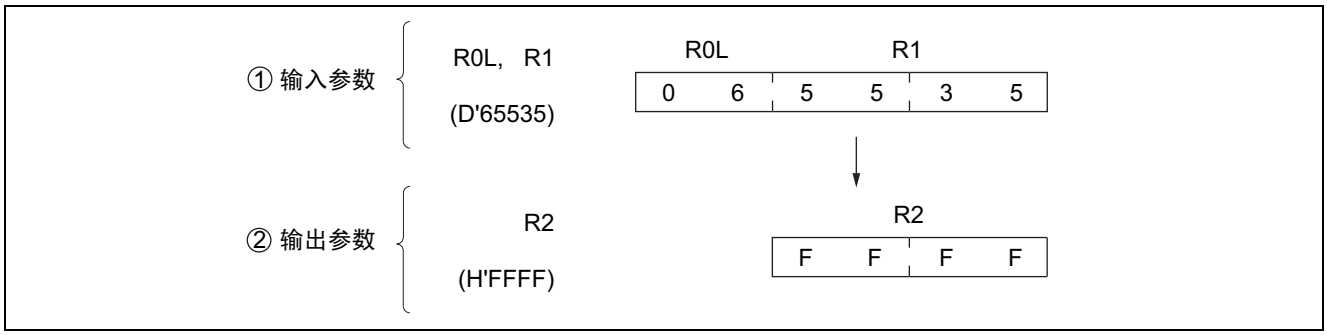


图 33-2 软件 BCD 的执行例子

4.2 使用时的注意

(1) 设定 5 位 BCD 高 1 位的 R0L 的位 4～7 的值不转换而在执行软件 BCD 后清 “0”。

(2) 作为 5 位 BCD，能设定的最大值为 D’65535。

(3) 如果不使用高位，就必须将不使用的位置“0”。如果不置“0”，因为计算含有被设定在高位的不定数据，所以就得不到正确的运算结果。

4.3 数据存储器的说明

软件 BCD 不使用数据存储器。

4.4 使用例

设定 5 位 BCD 为输入参数，子程序调用软件 BCD。

```
WORK1    . RES. B    3          …… 确保用户程序设定5位BCD（3字节）的
                                    数据存储区。
WORK2    . RES. B    2          …… 确保用户程序设定2字节16进制数的
                                    数据存储区。
         MOV. B  @WORK1,   R0L
         MOV. B  @WORK1+1, R1H   …… 将用户程序设定的5位BCD
         MOV. B  @WORK1+2, R1L      设定到输入参数。
         JSR     @BCD            …… 子程序调用软件BCD。
         MOV. B  @WORK2,   R2H
         MOV. B  @WORK2+1, R2L   …… 将设定在输出参数中的2字节16进制数
                                    设定到用户程序的数据存储器。
```

4.5 工作原理

(1) 软件 BCD 由 2 个处理构成。
   (a) 逐位取出 5 位 BCD 的处理
   (b) 取出的数据以 4 位为单位转换为 16 进制数的处理
(2) 使用图 33-3 说明 1 位数（4 位）的处理。

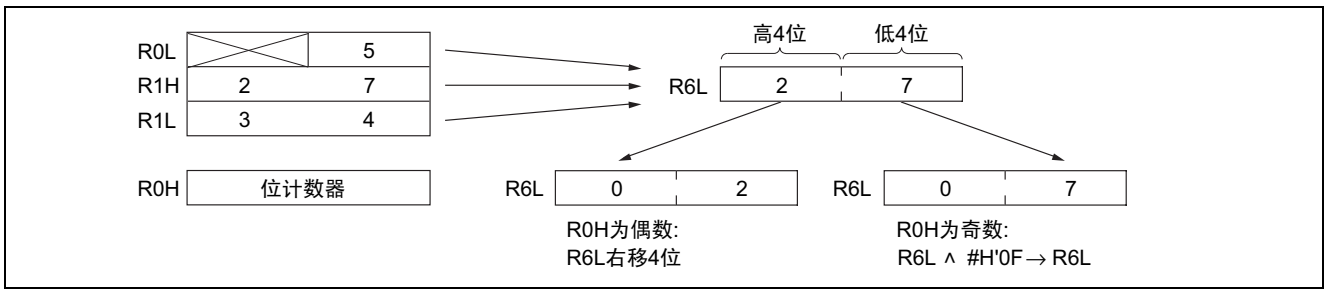


图 33-3 将通用寄存器中的 1 个字节数据分为 2 部分的方法

(a) 为了处理 5 位，给 R0H 设定 H’04。
(b) 从 5 位 BCD（R0L、R1H、R1L）的最高位开始依次传送到 R6L，选择高 4 位或者低 4 位。
(c) 每执行(b)处理时 R0H 递减。
(d) 执行(c)处理时，判断计数器是偶数还是奇数，
   R0H 为奇数时，取 R6L 和 H’0F 逻辑与（AND），然后取低 4 位。
   R0H 为偶数时，R6L 右移 4 位，然后取高 4 位。

(3) 将 BCD 转换为 16 进制数的处理如下：

(a) 假设 4 位 BCD 为 $D_3\ D_2\ D_1\ D_0$，$D_3\ D_2\ D_1\ D_0$ 可由图中的（式 1）、（式 2）表示。

$$D_3\ D_2\ D_1\ D_0 = D_3 \times 10^3 + D_2 \times 10^2 + D_1 \times 10^1 + D_0 \times 10^0 \cdots\cdots \text{（式1）}$$

$$= ((D_3 \times 10 + D_2) \times 10 + D_1) \times 10 + D_0 \cdots\cdots \text{（式2）}$$

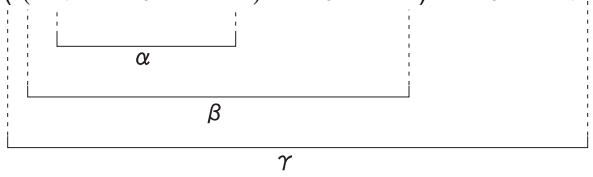


图 33-4　4 位 BCD 为 $D_3\ D_2\ D_1\ D_0$ 的想法

(b) 如（式 2），先求出 $\alpha = D_3 \times 10 + D_2$，然后求出 $\beta = \alpha \times 10 + D_1$、$\gamma = \beta \times 10 + D_0$。通过重复以上运算，能将 4 位 BCD 转换为 16 进制数。

(c) $D_3 \times 10$ 的运算方法如（式 3）、（式 4）所示：

$$D_3 \times 10 = D_3 \times (2 + 8) \cdots\cdots \text{（式3）}$$

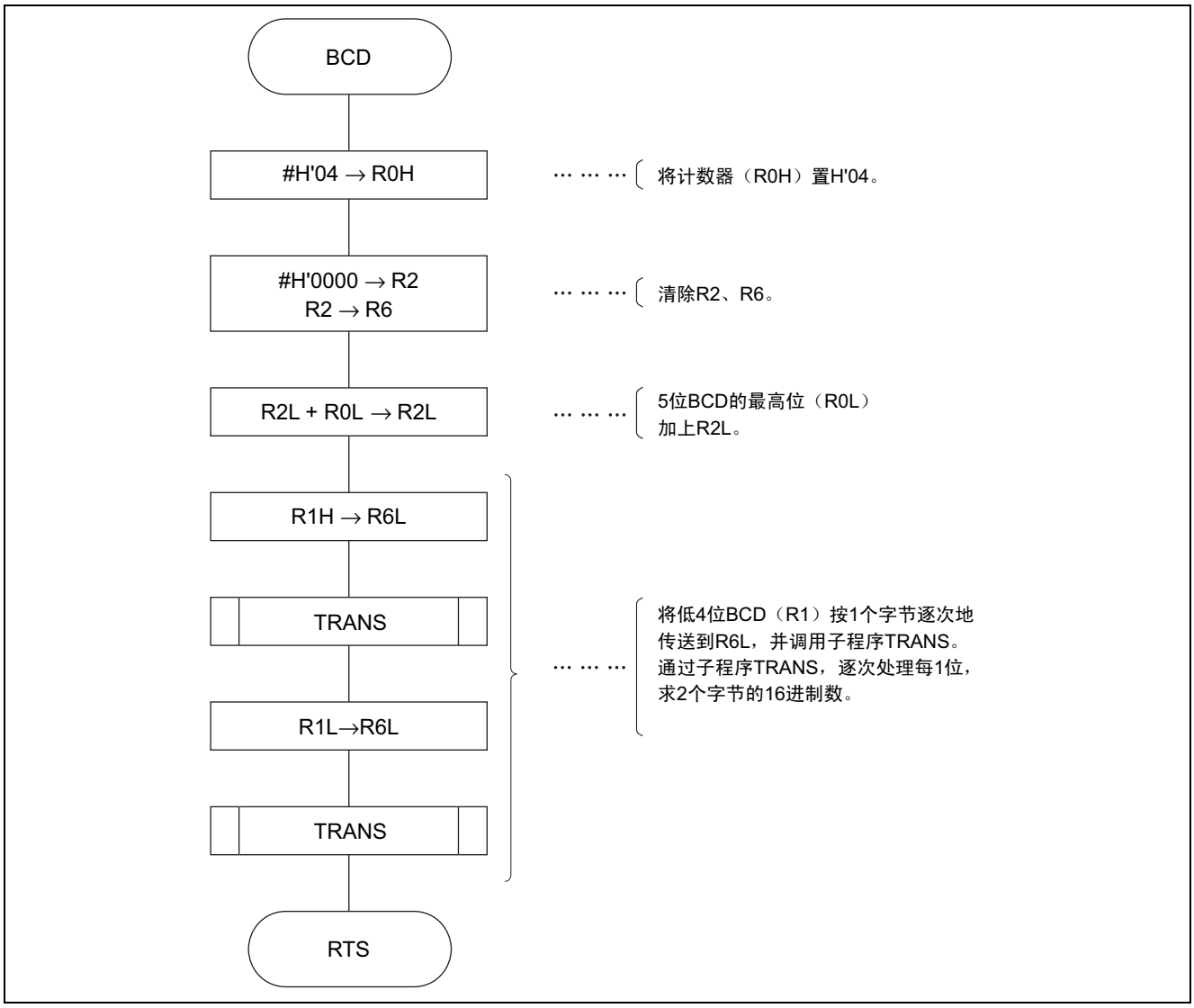
$$= D_3 \times 2 \times (1 + 2^2) \cdots\cdots \text{（式4）}$$

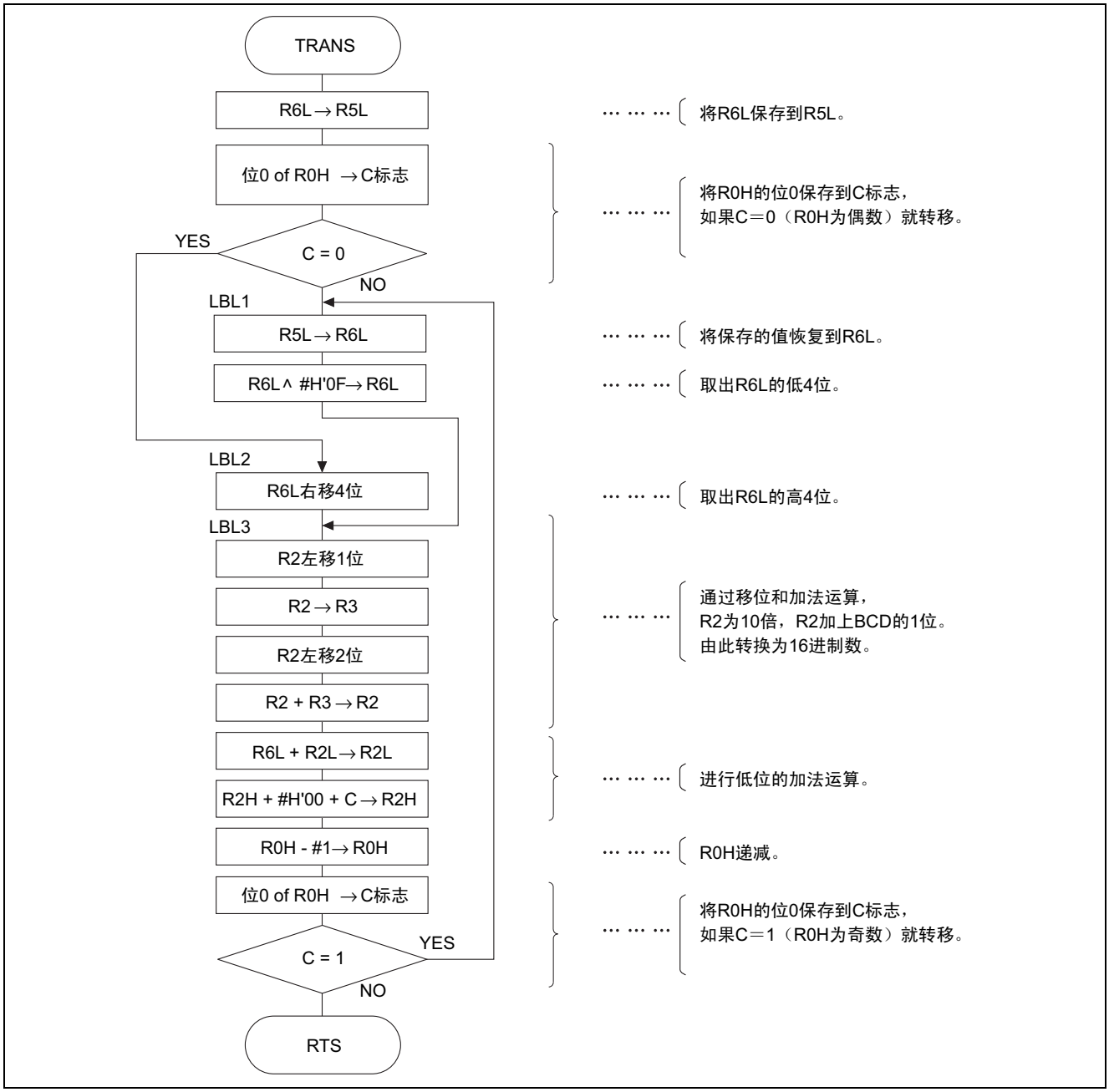
(d) 为了运算（式 4），软件 BCD 使用 R2 和 R3，按以下步骤进行：

1. 将 D_3 设定到 R2，并左移 1 位。
2. 将 R2 传送到 R3，并左移 2 位。
3. R2 加上 R3。

(4) 通过重复处理(2)、(3) 5 次，能求出 BCD 的 2 个字节 16 进制数。

5. 流程图


BCD
#H'04 → R0H
将计数器（R0H）置H'04。
#H'0000 → R2
R2 → R6
清除R2、R6。
R2L + R0L → R2L
5位BCD的最高位（R0L）
加上R2L。
R1H → R6L
TRANS
R1L→R6L
TRANS
将低4位BCD（R1）按1个字节逐次地
传送到R6L，并调用子程序TRANS。
通过子程序TRANS，逐次处理每1位，
求2个字节的16进制数。
RTS


TRANS
R6L → R5L
位0 of R0H → C标志
C = 0
YES
NO
LBL1
R5L → R6L
R6L ∧ #H'0F → R6L
LBL2
R6L右移4位
LBL3
R2左移1位
R2 → R3
R2左移2位
R2 + R3 → R2
R6L + R2L → R2L
R2H + #H'00 + C → R2H
R0H - #1 → R0H
位0 of R0H → C标志
C = 1
YES
NO
RTS
将R6L保存到R5L。
将R0H的位0保存到C标志，
如果C＝0（R0H为偶数）就转移。
将保存的值恢复到R6L。
取出R6L的低4位。
取出R6L的高4位。
通过移位和加法运算，
R2为10倍，R2加上BCD的1位。
由此转换为16进制数。
进行低位的加法运算。
R0H递减。
将R0H的位0保存到C标志，
如果C＝1（R0H为奇数）就转移。

6. 程序清单

```
*** H8/300 ASSEMBLER    VER 1.0B **  08/22/92 11:09:49
PROGRAM NAME =
1                           ;*********************************************************************
2                           ;*
3                           ;*    00 - NAME                  :CHANGE 5 CHARACTER
4                           ;*                                TO 2 BYTE HEXADECIMAL (BCD)
5                           ;*
6                           ;*********************************************************************
7                           ;*
8                           ;*    ENTRY              :R0L     (UPPER 1 CHAR (BY BCD))
9                           ;*                        R1      (LOWER 4 CHAR (BY BCD))
10                          ;*
11                          ;*    RETURN             :R2      (2 BYTE HEXADECIMAL)
12                          ;*
13                          ;*********************************************************************
14                          ;
15 BCD_code C 0000                .SECTION            BCD_code,CODE,ALIGN=2
16                                .EXPORT             BCD
17                          ;
18 BCD_code C      00000000 BCD   .EQU     $                  ;Entry point
19 BCD_code C 0000 F004             MOV.B   #H'04,R0H          ;Set bit counter
20 BCD_code C 0002 79020000         MOV.W   #H'0000,R2         ;Clear R2
21 BCD_code C 0006 0D26             MOV.W   R2,R6              ;Clear R6
22                          ;
23 BCD_code C 0008 088A             ADD.B   R0L,R2L            ;R2L + R0L -> R2L
24 BCD_code C 000A 0C1E             MOV.B   R1H,R6L            ;R1H -> R6L
25 BCD_code C 000C 5506             BSR     TRANS
26 BCD_code C 000E 0C9E             MOV.B   R1L,R6L            ;R1L -> R6L
27 BCD_code C 0010 5502             BSR     TRANS
28 BCD_code C 0012 5470             RTS
29                          ;
30                          ;---------------------------------------------------------------
31                          ;
32 BCD_code C 0014          TRANS                              ;Change BCD to hexadecimal
33 BCD_code C 0014 0CED             MOV.B   R6L,R5L            ;R6L -> R5L
34 BCD_code C 0016 7700             BLD     #0,R0H             ;load bit 0 of R0H
35 BCD_code C 0018 4406             BCC     LBL2               ;Branch if C=0
36 BCD_code C 001A          LBL1
37 BCD_code C 001A 0CDE             MOV.B   R5L,R6L            ;R5l -> R6L
38 BCD_code C 001C EE0F             AND.B   #H'0F,R6L          ;Clear bit 7-4 of R6L
39 BCD_code C 001E 4008             BRA     LBL3               ;Branch always
40 BCD_code C 0020          LBL2
41 BCD_code C 0020 110E             SHLR.B  R6L                ;Shift R6L 4 bit left
42 BCD_code C 0022 110E             SHLR.B  R6L
43 BCD_code C 0024 110E             SHLR.B  R6L
44 BCD_code C 0026 110E             SHLR.B  R6L
45 BCD_code C 0028          LBL3
46 BCD_code C 0028 100A             SHLL.B  R2L                ;Shift Hexadecimal 1 bit left
47 BCD_code C 002A 1202             ROTXL.B R2H
48 BCD_code C 002C 0D23             MOV.W   R2,R3              ;R2 -> R3
49 BCD_code C 002E 100A             SHLL.B  R2L                ;Shift Hexadecimal 2 bit left
50 BCD_code C 0030 1202             ROTXL.B R2H
51 BCD_code C 0032 100A             SHLL.B  R2L
52 BCD_code C 0034 1202             ROTXL.B R2H
53 BCD_code C 0036 0932             ADD.W   R3,R2              ;R3 + R2 -> R2
```

```
54 BCD_code C 0038 08EA           ADD.B    R6L,R2L
55 BCD_code C 003A 9200           ADDX.B   #0,R2H
56 BCD_code C 003C 1A00           DEC.B    R0H              ;Decrement bit counter
57 BCD_code C 003E 7700           BLD      #0,R0H           ;load bit 0 of R0H
58 BCD_code C 0040 45D8           BCS      LBL1             ;Branch if C=!
59 BCD_code C 0042 5470           RTS
60                          ;
61                                .END
*****TOTAL ERRORS      0
*****TOTAL WARNINGS    0
```

修订记录

Rev.	发行日	修订内容	
		页	修订要点
1.00	2005.07.29	—	初版发行

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