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______________________________

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April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

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H8SX Family

RTS/L Return from Subroutine with Data Restoration

Introduction
Shows an example of C compiler use of the RTS/L instruction.

Target Device
H8SX/1688 EVA     Maximum mode

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1. Specifications

- The H8SX family microcomputer RTS/L instruction performs the following processing.
  - Restores the saved data from the stack to the registers specified by the register list.
  - Restores the PC from the stack, and performs processing from the address indicated by the restored PC.
- In this sample task, a subroutine is called from the main routine, and the assembly language code generated by the C compiler is shown.

2. Functions Used

This sample task shows an example of use of the RTS/L instruction by the C compiler.

3. Principles of Operation

Table 1 shows an example of the assembly language code generated by the C compiler when a subroutine is called.

<table>
<thead>
<tr>
<th>Sample C Program</th>
<th>Sample Assembly Language Code Generated by the C compiler</th>
</tr>
</thead>
<tbody>
<tr>
<td>void main(void)</td>
<td>_main:</td>
</tr>
<tr>
<td></td>
<td>{</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>sub_pgm() /* Subroutine call */ BSR _sub_pgm:8 ; Subroutine call</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>}</td>
</tr>
<tr>
<td>void sub_pgm(void)</td>
<td>_sub_pgm:</td>
</tr>
<tr>
<td></td>
<td>{</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>RTS/L ER3 ; End of subroutine</td>
</tr>
<tr>
<td></td>
<td>} /* End of subroutine */</td>
</tr>
<tr>
<td></td>
<td>.END</td>
</tr>
</tbody>
</table>
4. Development Environment

4.1 Development Support Tool Versions

The development support tools of this sample task is shown in table 2.

Table 2 Development Support Tool Versions

<table>
<thead>
<tr>
<th>Software Name</th>
<th>Version Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH38.EXE</td>
<td>C compiler (H8S, H8/300 series C/C++ compiler)</td>
</tr>
<tr>
<td></td>
<td>Ver. 6.0.00.005</td>
</tr>
<tr>
<td>ASM38.EXE</td>
<td>Assembler (H8S, H8/300 series cross assembler)</td>
</tr>
<tr>
<td></td>
<td>Ver. 6.0.01.005</td>
</tr>
<tr>
<td>OPTLNK.EXE</td>
<td>Linkage editor (optimizing linkage editor)</td>
</tr>
<tr>
<td></td>
<td>Ver. 8.0.00.020</td>
</tr>
<tr>
<td>LBG38.EXE</td>
<td>Library configuration tool (H8S, H8/300 series C/C++ standard library generator)</td>
</tr>
<tr>
<td></td>
<td>Ver. 2.0.00.000</td>
</tr>
</tbody>
</table>

4.2 C compiler Option Settings

C compiler option settings for this sample task are shown in table 3.

Table 3 C compiler Option Settings

<table>
<thead>
<tr>
<th>Option</th>
<th>Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>H8SX:24:MD</td>
</tr>
<tr>
<td>Code</td>
<td>Machinecode</td>
</tr>
<tr>
<td>OPTimize</td>
<td>1</td>
</tr>
<tr>
<td>REGParam</td>
<td>3</td>
</tr>
<tr>
<td>SPEed</td>
<td>Register, Shift, Struct, Expression</td>
</tr>
</tbody>
</table>
5. Description of Software

5.1 Modules

Modules used by this sample task are shown in table 4.

Table 4 Modules

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>main</td>
<td>Main routine</td>
</tr>
<tr>
<td></td>
<td>Calls rtsltst function.</td>
</tr>
<tr>
<td>rtsltst</td>
<td>RTS/L test program</td>
</tr>
<tr>
<td></td>
<td>Writes data to RAM as dummy processing.</td>
</tr>
</tbody>
</table>

5.2 Arguments

No arguments are used by this sample task.

5.3 Internal Registers Used

No internal registers are used by this sample task.

5.4 RAM Usage

Table 5 describes RAM usage in this sample task.

Table 5 RAM Usage

<table>
<thead>
<tr>
<th>Label</th>
<th>Size</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmy1[16]</td>
<td>16 bytes</td>
<td>For dummy processing</td>
</tr>
</tbody>
</table>
6. Flowcharts

6.1 Main Routine

main
CCR = H'80
Disable interrupts
rtsltst()
RTS/L test program execution

6.2 RTS/L Test Program

rtsltst
i = 0

i < 16?
Yes
No
dmy2 [ i ] = i
i ++

i = 0

i < 16?
Yes
No
dmy1 [ i ] = dmy2 [ i ]
i ++

End

6.3 Link Address Specifications

<table>
<thead>
<tr>
<th>Section Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV1</td>
<td>H'000000</td>
</tr>
<tr>
<td>P</td>
<td>H'001000</td>
</tr>
<tr>
<td>B</td>
<td>H'FEC000</td>
</tr>
</tbody>
</table>
7. Program Listing

7.1 C Program

/*******************************************************/
/*                                                 */
/*  H8SX Family                                    */
/*  Application Note                                */
/*                                                 */
/*  'RTS/L Test Program'                            */
/*                                                 */
/*  Function                                        */
/*  : RTS/L                                           */
/*                                                 */
/*                                                 */
/*******************************************************/
#include <machine.h>

/*******************************************************/
/*  Function define                                  */
/*******************************************************/
void main ( void );
void rtsltst ( void );

/*******************************************************/
/*  RAM define                                       */
/*******************************************************/
long dmy1[16];

/*******************************************************/
/*  Vector Address                                   */
/*******************************************************/
#pragma section     V1                         /* VECTOR SECTOIN SET               */
void (*const VEC_TBL1[])(void) = {
  main                                       /* 00 Reset                         */
};
#pragma entry main(sp=0xFFC000)
#pragma section                                /* P                                */
/*******************************************************/
/*  Main Routine                                    */
/*******************************************************/
void main ( void )
{
  set_ccr(0x80);                             /* Initialize CCR/Interrupt Disable */
  rtsltst();                                 /* RTS/L Test Program               */
  while(1);
}
/********************************************/
/* RTS/L Test Program                      */
/********************************************/
void rtsltst ( void )
{
    unsigned char i;
    unsigned long dmy2[16];

    for ( i=0; i<16; i++)
        dmy2[i] = i;

    for ( i=0; i<16; i++)
        dmy1[i] = dmy2[i];
}
7.2 Assembly Language Code Generated by the C compiler

```
P
;*** File main.c , Line 42
00000000          _main:          ; function: main
00000000 7A0700FFC000  MOV.L       #16760832,SP
00000006 F880            MOV.B       #128:8,R0L
00000008 0308            LDC.B       R0L,CCR
0000000A 5500            BSR         _rtsltst:8
0000000C L33:          ;*** File main.c , Line 54
0000000C 4000            BRA         L33:8

;*** File main.c , Line 54
0000000E          _rtsltst:          ; function: rtsltst
0000000E 01006DF3          PUSH.L      ER3
00000012 7A3F0040          SUB.L       #64:16,SP
00000016 18AA          L36:          ;*** File main.c , Line 54
00000018 0CAB          MOV.B       R2L,R3L
0000001A 1763          L36:          ;*** File main.c , Line 54
0000001C 0CA9          MOV.B       R2L,R1L
0000001E 01CC5041          MULXU.B     #4:4,R1
00000020 01CC5041          MULXU.B     #4:4,R1
00000022 0D10          L36:          ;*** File main.c , Line 54
00000024 1770          L36:          ;*** File main.c , Line 54
00000026 0A0A          INC.B       R2L
00000028 AA10          CMP.B       #16:8,R2L
0000002A 4500          CMP.B       #16:8,R2L
0000002C 010800DA00000000          MOV.L     @ER0,8(_dmy1:32,R2L.B)
0000002E 0A0A          INC.B       R2L
00000030 4500          BLO         L38:8
00000032 18AA          L38:          ;*** File main.c , Line 54
00000034 0CA9          MOV.B       R2L,R1L
00000036 01CC5041          MULXU.B     #4:4,R1
00000038 01CC5041          MULXU.B     #4:4,R1
0000003A 0D10          MULXU.B     #4:4,R1
0000003C 1770          MULXU.B     #4:4,R1
0000003E 0A0A          ADD.L       SP,ER0
00000040 010800DA00000000          MOV.L     @ER0,8(_dmy1:32,R2L.B)
00000042 0A0A          ADD.L       SP,ER0
00000044 7A1F0040          RTS.L       ER3
00000046 5403          RTS/L       ER3

B
00000000          _dmy1:          ; static: dmy1
00000000 00000000          .RES.L      16
CV1
00000000          _VEC_TBL1:          ; static: VEC_TBL1
00000000 00000000          .DATA.L    _main
```
### Revision Record

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Page</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Sep.15.04</td>
<td>—</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
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