RENESAS Tool News

MAEC TOOL NEWS: MAECT-M3T-NC308WA-030301D

A Note on Using C Compilers M3T-NC308WA and M3T-NC30WA

Please take note of the following problem in using C compilers (with an assembler and integrated development environment) M3T-NC308WA and M3T-NC30WA:

- On placing auto variables

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1. **Products and Versions Concerned**

for the M32C/80 and M16C/80 series
M3T-NC308WA V.5.00 Release 1
for the M16C/60, M16C/30, M16C/20, and M16C/10 series
M3T-NC30WA V.5.00 Release 1 and Release 2

2. **Description**

Auto variables contained in a function may be placed at incorrect addresses.

2.1 Conditions

This problem may occur if the following eight conditions are satisfied:
Even if, however, all these conditions are met, the problem might not happen depending on other variables or optimized results.

(1) A function contains auto variables with none of the following extending functions being declared:

#pragma INTERRUPT, #pragma INTF, #pragma HANDLER, #pragma INTHANDLER, #pragma CYCHANDLER, and #pragma ALMHANDLER

In the M3T-NC30WA, this function calls another function or inline function in addition to the above condition.

(2) One or more auto variables of even bytes in width and those of odd bytes are both declared in the function in (1).

(3) An argument is passed to the function in (1) via the stack.

(4) The argument in (3) above is not of type pointer and is not involved in any operation using address operator "&".

(5) Either of the following auto variables exists in the function:

a) When an argument not qualified as volatile exists in the function, the auto variable is even bytes in width and its size is equal to or greater than the size of the argument.
For example, when the argument is of type int, the auto variable is of type int, long, and so on.

b) The auto variable is not qualified as volatile and is of odd bytes, and its size is equal to or less than the size of the argument. For example, when the argument is of type int, the auto variable is of type char.

(6) The auto variable described in (5)-a) or (5)-b) meets all of the following conditions.

a) It is not used until the argument in (3) is passed to a function.

b) It is not involved in any operation using address operator "&".

c) It is not used as an argument to an asm function.

d) It is not of type pointer.

(7) The arguments and auto variables in (1)--(6) above are referenced at least once in the function and not assigned to any register.

(8) Any one or more of the optimizing options -O, -O[1-5], -OR, and -OS are selected. In the M3T-NC30WA, the -OSFA (-Ostack_frame_align) option is used in addition.
Note that the -OSFA option is not available in the M3T-NC308WA.

2.2 Example

[C-language source file]
An example in structure variables is explained below.

```
------------------------------------------------------------------------
int     ia, idmy;
char    cb;

typedef struct { int i; }   s2;     /* 2-byte structure type */
typedef struct { char c; }  s1;     /* 1-byte structure type */

void sub(void);

void func(s2 a)     /* First use of auto variable "a";
                              Conditions (1), (3), and (4) */
```

```
{
   s2   dmy;      /* Even-byte auto variable "dmy" declared;
                                  Condition (2)       */
   s1   b;       /* Odd-byte auto variable "b" declared;
                   Conditions (2), (5)-b), (6)-c), and (6)-d) */
   dmy.i = idmy;

   ia = a.i;      /* Last use of auto variable "a"      */

   b.c = cb;      /* First use of auto variable "b";
                Conditions (6)-a), (6)-b), (6)-c), and (6)-d) */
   b.c++;
   cb = b.c;      /* Last use of auto variable "b"      */

   dmy.i++;       /*                          Condition (7) */
   idmy = dmy.i;

   sub();         /*                         Condition (1) */
}
-------------------------------------------------------------------------

[Assembly language source file generated by NC308]
-------------------------------------------------------------------------
  ;## #   FUNCTION func
  ;## #   FRAME   AUTO    (     dmy)     size  2,       offset -2
  ;## #   FRAME   AUTO    (      b)     size  1,       offset 3
  ;## #   FRAME   ARG (      a)  size   2,    offset 8
  ;## #   ARG Size(2)     Auto Size(2)    Context Size(8)

        .glb    _func
  _func:
        enter   #02H
        mov.w   _idmy:16,-2[FB] ;  dmy.i = idmy;
        mov.w   8[FB],_ia:16    ;  ia = a.i;
        mov.b   _cb:16,3[FB]    ;  b.c = cb;  <-- *
        add.b   #01H,3[FB]      ;  b.c++;
        mov.b   3[FB],_cb:16    ;  cb = b.c;
        add.w   #0001H,-2[FB]   ;  dmy.i++;
        mov.w   -2[FB],_idmy:16 ;  idmy = dmy;
        jsr     _sub
        exitd
-------------------------------------------------------------------------
```

Note *:
"3[FB]", the operand of "mov.b _cb:16,3[FB]" that is the result of compiling "b.c = cb;", is the area where the value of the FB register before calling the function concerned is saved by an "enter" instruction. Then, it indicates that auto variable "b" has been placed at incorrect address in this example.

3. Workaround

This problem can be circumvented in either of the following ways:

(1) Place a dummy asm function immediately after the declaration of an auto variable, and as the argument of the asm function, use auto variable "b" that would be placed at incorrect address.
If auto variable "b" is of type structure, use its beginning member as the argument.

(2) Don't use the "-OSFA" option in the M3T-NC30WA.

[Example of circumvention by using the above way (1)]

```
------------------------------------------------------------------------
void func(s2 a)
{
   str2   dmy;
   str1   b;

  asm(";$@", b.c);  /* Place a dummy asm function that takes
                       the member of a structure as an argument */
                    /* The operand which corresponds
                       to auto variable "b" is outputted
                       as a comment into assembly code */
   dmy.i = idmy;

   /* Omitted */
}
------------------------------------------------------------------------
```

4. Schedule of Fixing the Problem

We plan to fix this problem in our next release of the products.
