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2010年4月1日
瑞萨电子公司

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740 族

C-ASM 混合编程

1. 要点

下文描述的是如何在 ICC740 的编译环境下进行 C 和汇编的混合编程。

2. 说明

函数间的接口。

- 参数传递规则
- 返回值传递规则
- 接口关键字

从 C 程序中调用汇编程序。

根据实际的 C-ASM 混合程序描述参数和返回值在内存中的分配。

3. 内容

3.1 函数间的接口

汇编语言子程序是可以从 C 语言程序中调用的，这部分主要来描述 ICC740 中函数间的接口。

3.1.1 函数参数传递规则

ICC740 根据参数数据类型的不同在不同的地方存储参数。

下表 1 显示了参数是如何传递给一个函数的。

表 1　参数传递表

参数类型	传递载体
字符类型	累加器 A（注 1）
其他数据类型	C_ARGN 或 C_ARGZ（注 2）

【注】 1. 仅用来传递函数的第一个参数。
2. C_ARGN：在 N 页中存储函数的局部变量和参数。
C_ARGZ：在零页中存储函数的局部变量和参数。

3.1.2 函数返回值传递规则

ICC740 根据返回值数据类型的不同在不同的地方存储返回值。

下表 2 显示了返回值是如何传递给一个函数的。

表 2　返回值传递表

参数类型	传递载体
字符类型	累加器 A
其他数据类型	EXPR_STACK（注 1）

【注】 1. EXPR_STACK：表达式堆栈，其大小在 link740.xcl 中设置，数据放置的地址由寄存器 X 决定。

3.1.3 接口关键字

为了宣称从 C 语言程序中被调用的汇编语言程序函数，需要使用汇编器接口关键字“DEFFN”。对于在汇编语言程序中的函数，你需要用“PUBLIC”去声明这些函数的名字。然后，在 C 语言程序中，图 1 显示了如何使用编译器接口关键字“DEFFN”。参数“a”，“b”可以由用户的汇编语言子程序来决定。而参数“x”，“y”是由 C 语言程序的参数类型决定的。

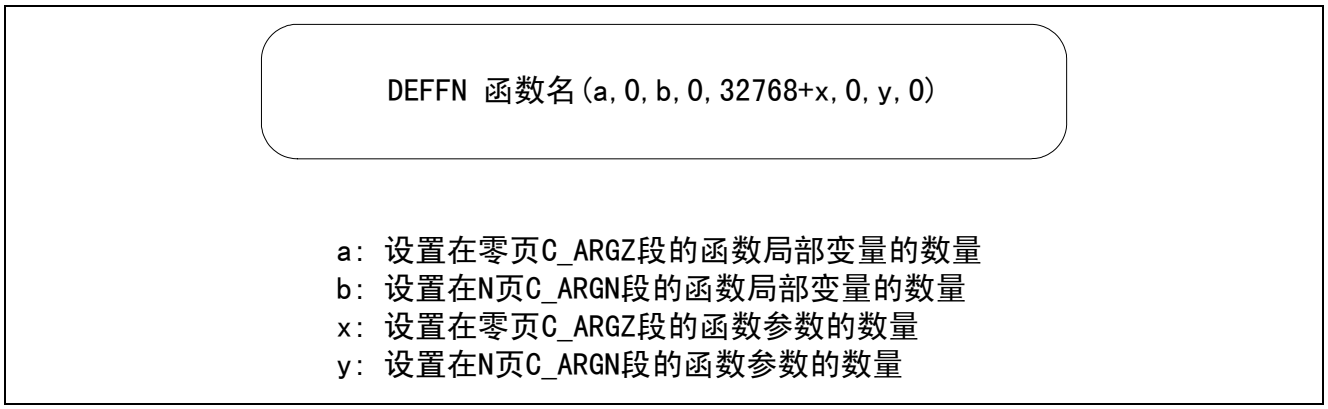


图 1 接口关键字 DEFFN 的设置

图 2 是一个如何在 C-ASM 混合编程程序中设置“DEFFN”的例子。

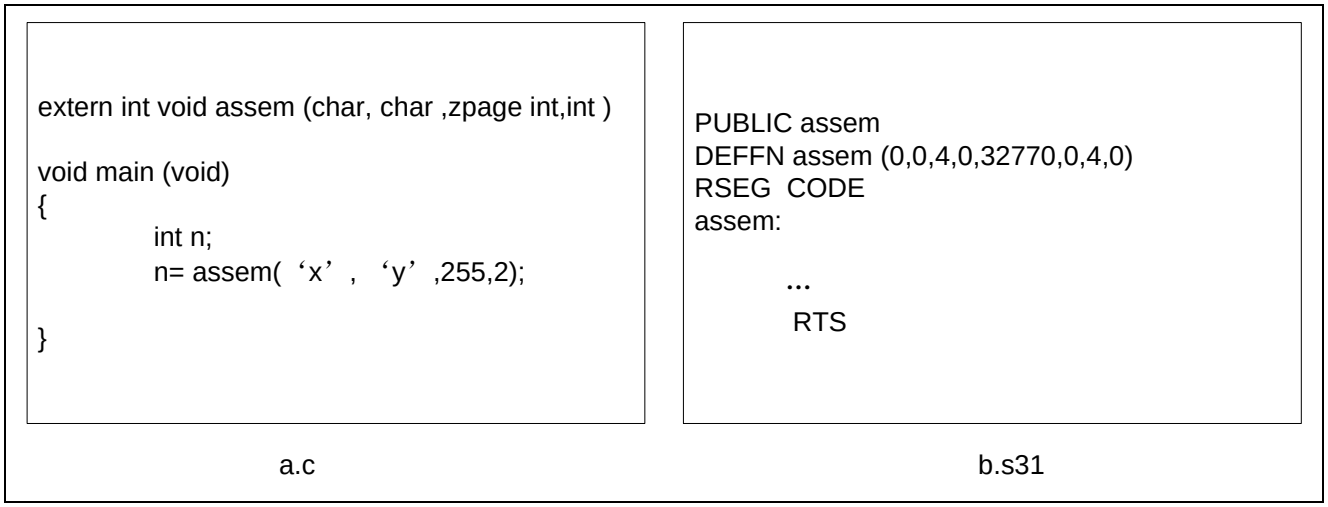


图 2 设置 DEFFN 的例程

在 C 程序中，子程序“assem”在零页中有一个整数型参数。因此在（37546+x）中的 x 值为 2 个字节。其他所有的参数全部在 N 页中，数量为 4 个字节，因此“DEFFN”中的 y 值为 4。在“assem”汇编语言程序中用户在 N 页内需要 4 个字节的局部变量，因此 b 的值为 4。

3.2 调用汇编语言子程序

为了 C 语言程序中调用汇编语言子程序，请遵从以下几个应用规则：

- 在一个与 C 程序独立的文件中写汇编子程序。
- 汇编子程序的名字请遵循符号变换法则。
- 在调用汇编子程序的 C 语言程序中，请声明汇编子程序的原形，这时使用的是存储器类型标示符“extern”。
- 在汇编子程序中，通常不要改变 X 寄存器的值以及由 ICC740 专用的标志符。如果 X 寄存器的值和标志符需要改变，那么在函数的入口处把这些值存储到堆栈中去，并且在函数结束前恢复这些值。

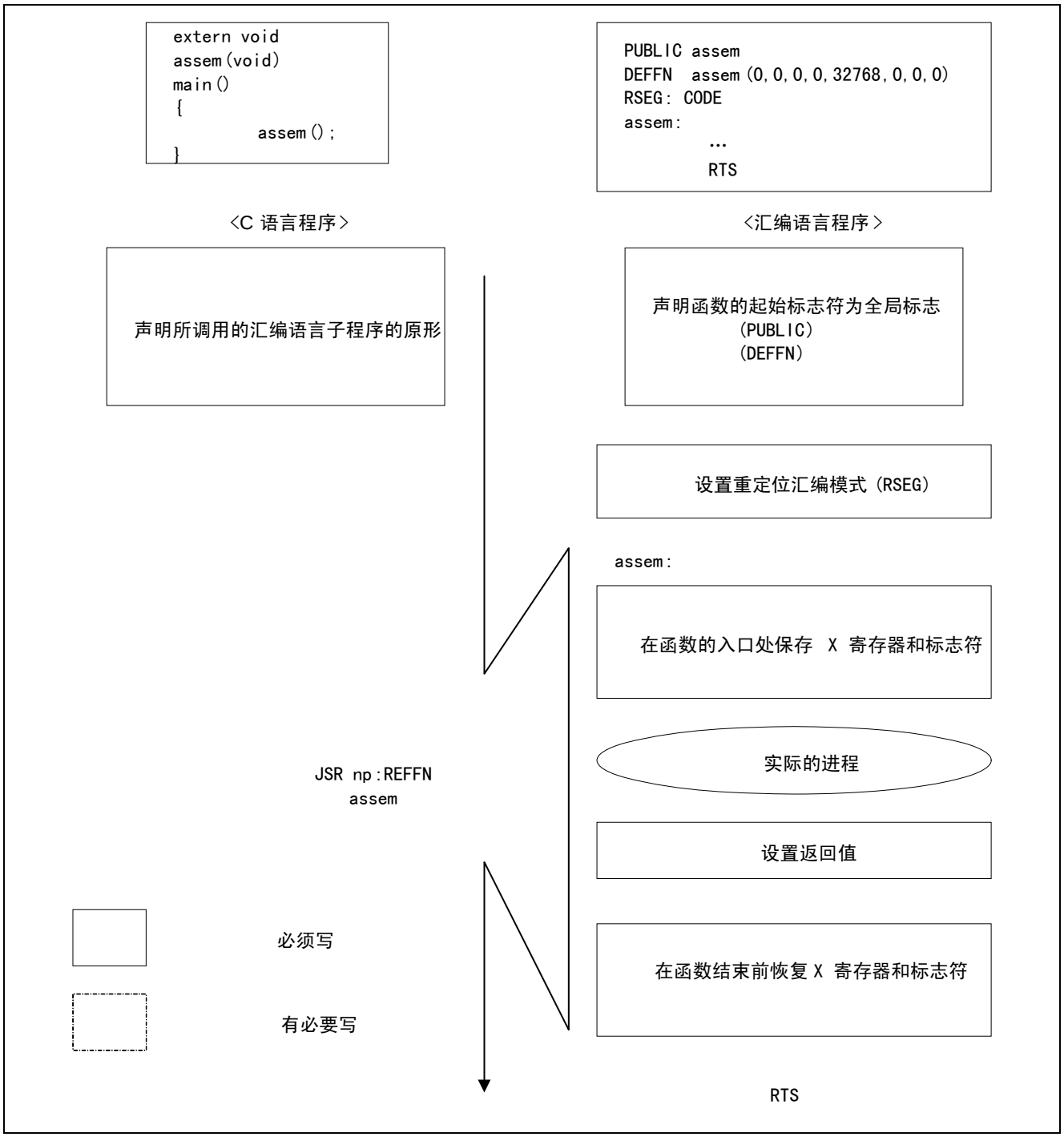


图 3 调用汇编语言子程序

3.3 参数传递与内存分配

这个部分将表述在实际的 C-ASM 混合程序中，不同类型的参数和返回值在函数间是如何传递的，以及如何进行内存分配。图 4 和图 5 将显示字符类型的参数及返回值传递。为了正确地传递参数，知道这些参数在 C 程序和汇编程序中分别放置在哪里是非常重要的。

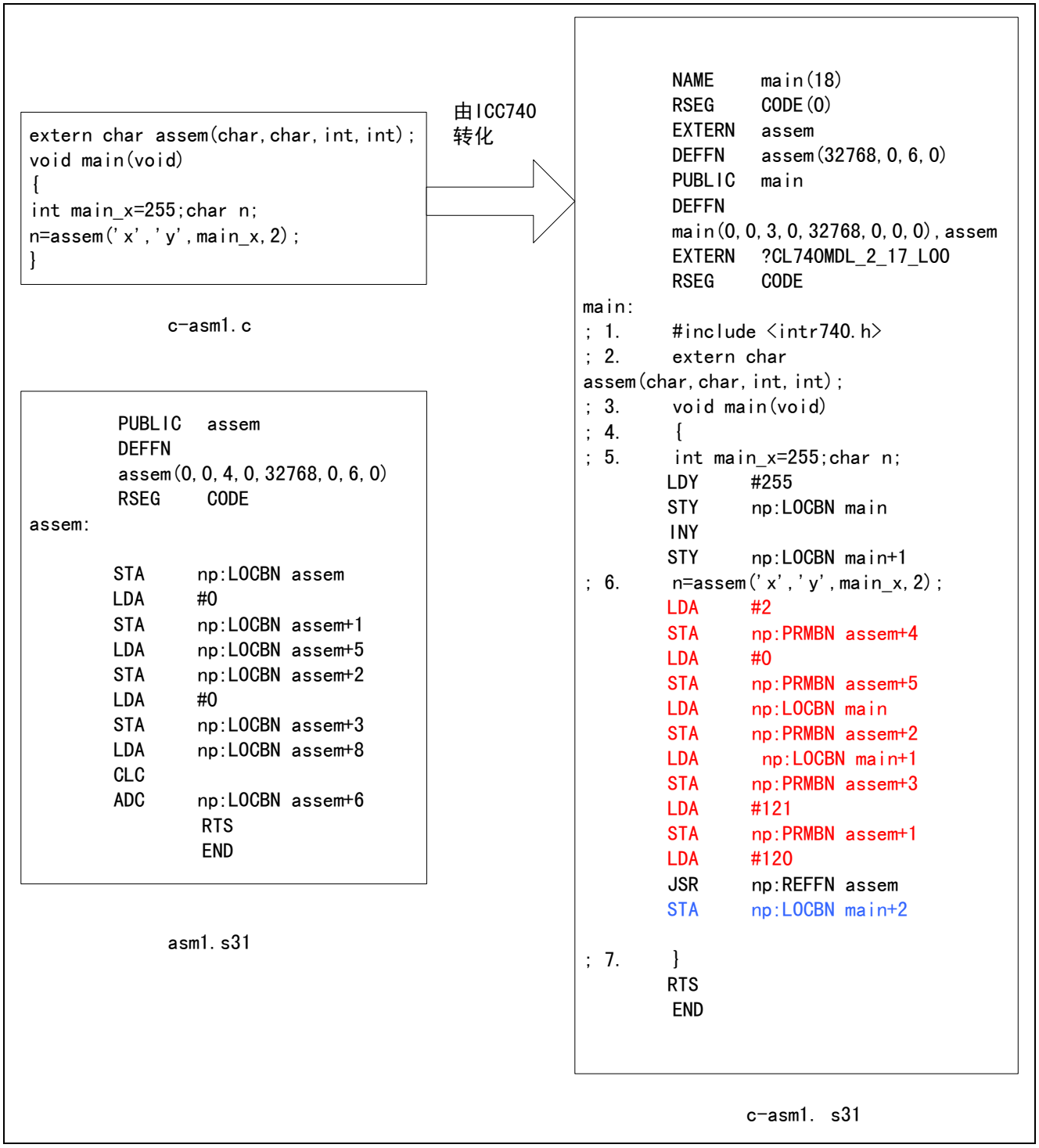
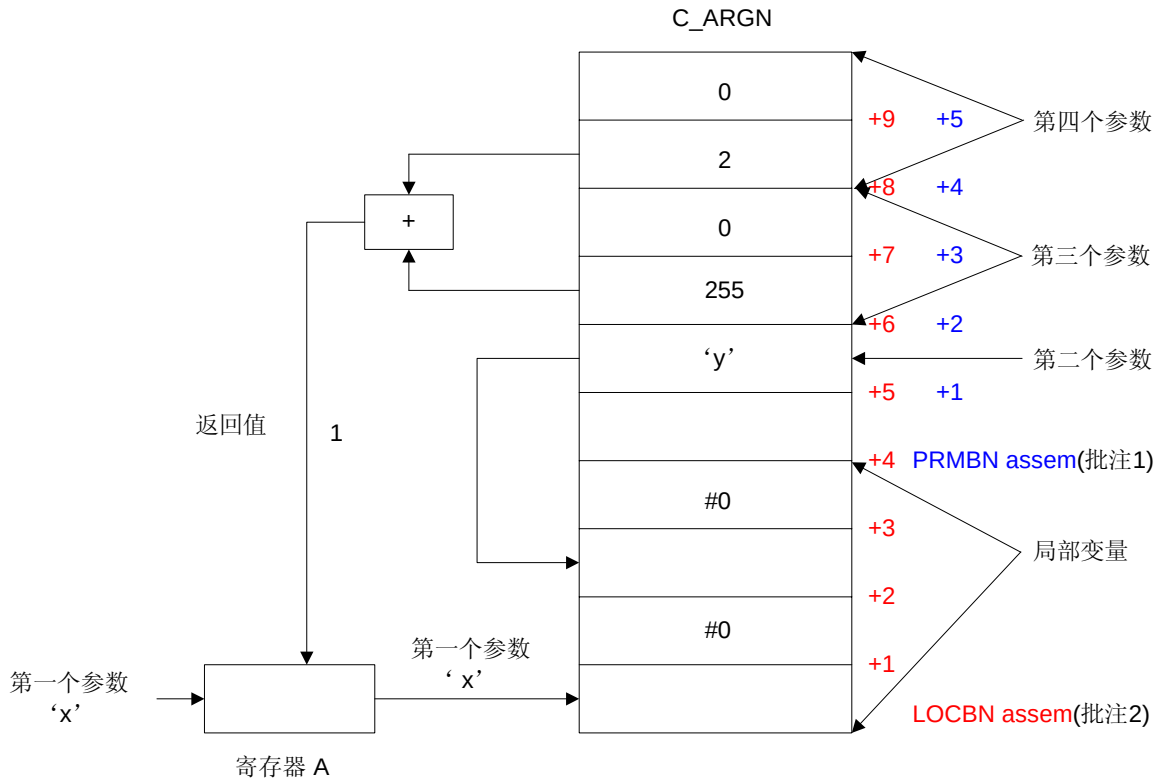


图 4 C 程序和汇编程序(1)

程序 c-asm1.s31 是由 ICC740 中包含的汇编器所产生的汇编程序。从 c-asm1.s31 我们可以知道，编译器是如何处理参数和返回值的。在 c-asm1.s31 中的红色部分是在调用汇编子程序前的参数处理。c-asm1.s31 中的蓝色部分是从汇编子程序返回后的返回值处理。因为子程序 assem 的第一个参数是字符型，因此字符‘x’将放置到寄存器 A 中。并且返回值也是字符型，因此返回值也同样被放置到寄存器 A 中。内存分配如图 5 所示。



【注】 1. 这是函数在 N 页中的参数块的首地址
2. 这是函数在 N 页中的本地变量存储块的首地址，其包含参数和局部变量（局部变量紧接着参数排列）

图 5 内存分配(1)

从图 5，我们可以知道地址(PRMBN assem)，(PRMBN assem+1)…(PRMBN assem+5)，是用来存储参数的。虽然第一个参数被放到寄存器 A 中，但在 C_ARGN 段中仍然为第一个参数保留了空间。汇编程序中局部变量紧随参数存储地址存储。

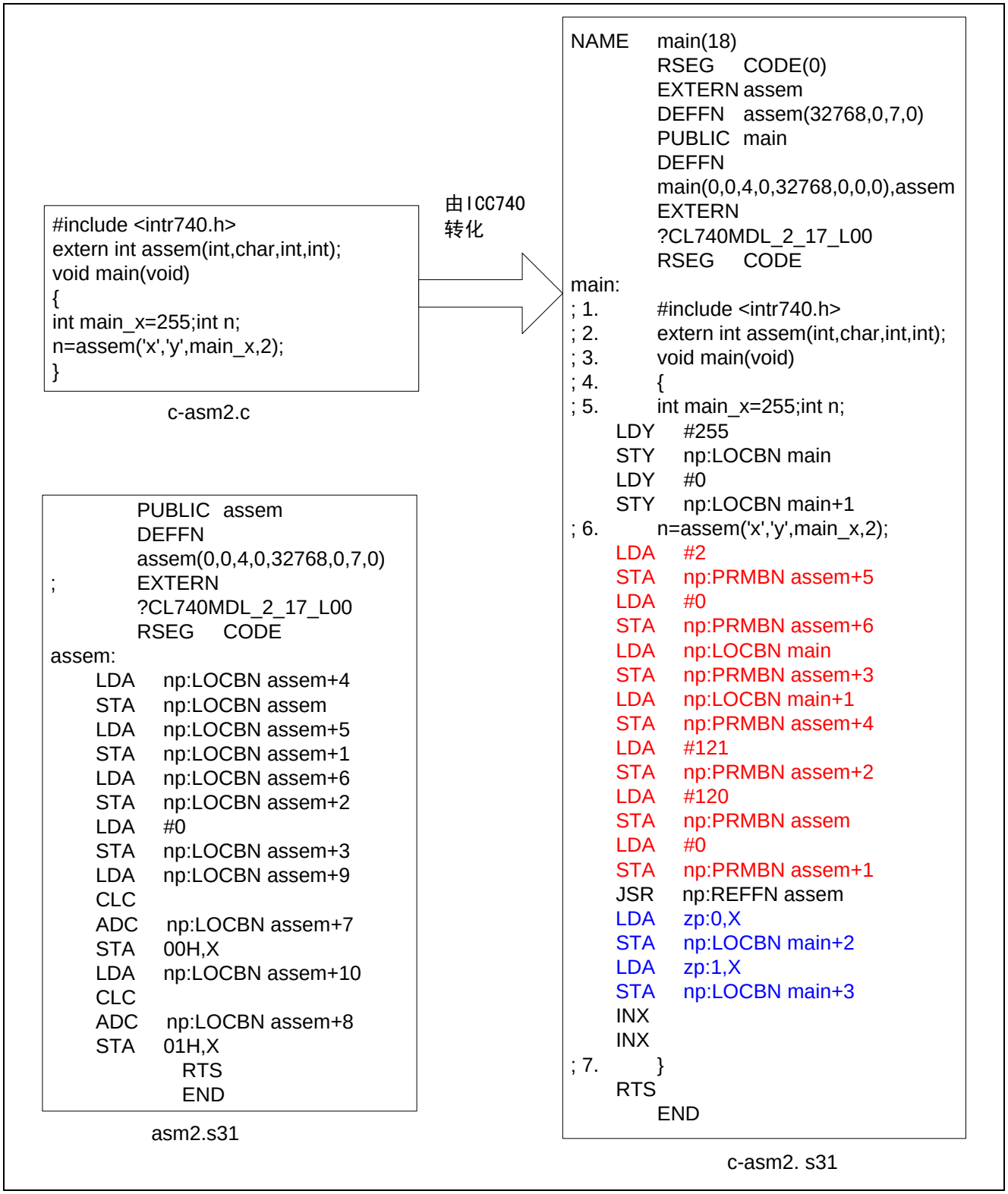
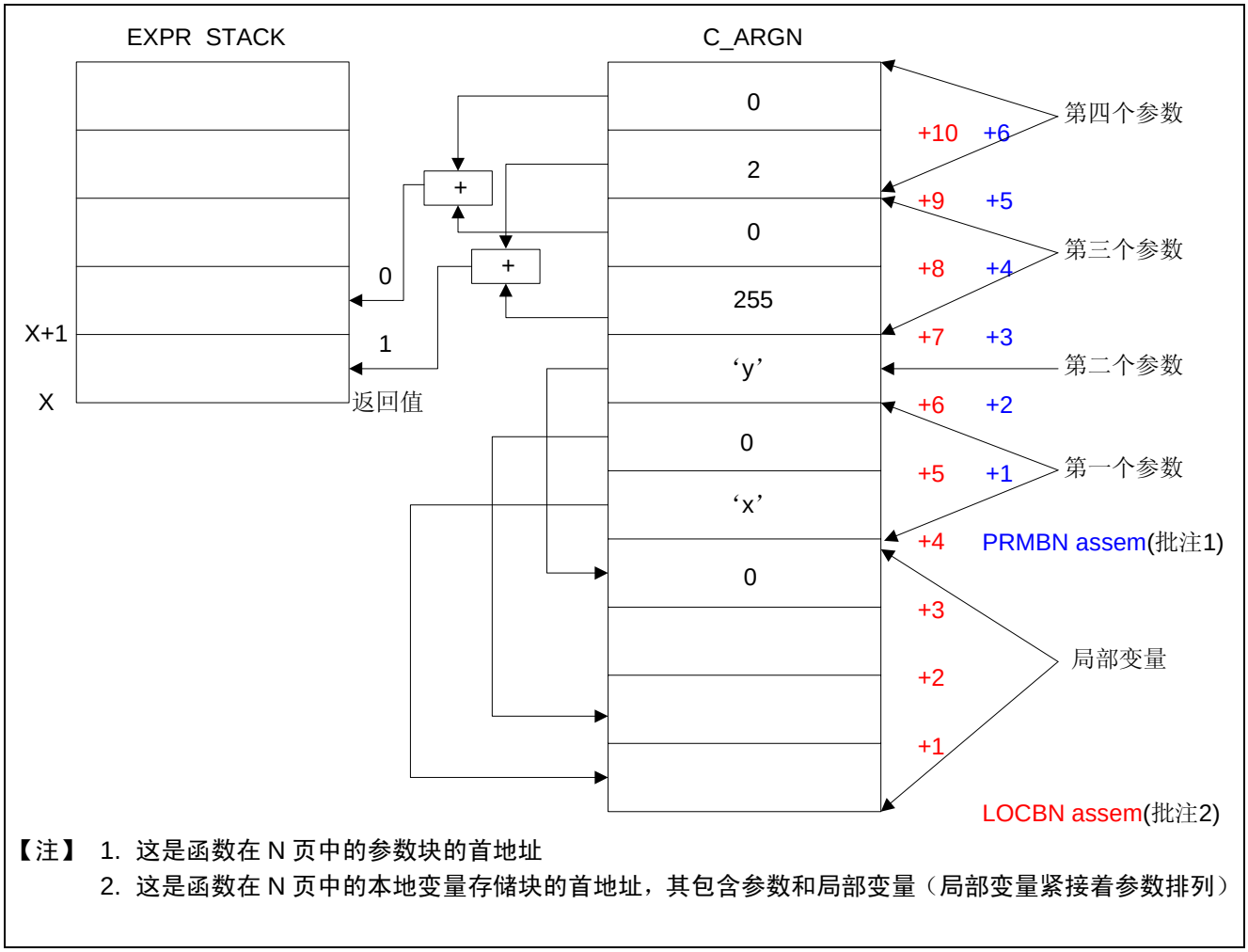


图 6 C 程序与汇编程序(2)

由于 assem 的第一个参数是整数，因此整型字符‘a’将被放到 C_ARGN 段中。并且返回值也是整型，因此返回值应被放置在 EXPR_STACK 中。内存设置如图 7 所示。



【注】 1. 这是函数在 N 页中的参数块的首地址
2. 这是函数在 N 页中的本地变量存储块的首地址，其包含参数和局部变量（局部变量紧接着参数排列）

图 7 内存分配(2)

4. 参考程序

```
/*****************************************************************************
*  File Name    : main.c                                                      *
*  Contents     : Demo program for C-ASM mixture                              *
*  Copyright (C) 2006, Renesas Technology Corp. All right reserved.           *
*  Version      : 1.00  ( 2005-12-28 ) Initial                               *
*                                                                             *
*****************************************************************************/
#include <intr740.h>
extern int assem(int,char,int,int)      ;Declare assem as “EXTERN”
void main(void)
{
      int main_x=255
      int n;
      n=assem('x','y',main_x,2)         ;Calling assembly subroutine and
                                         return integer value
}

/*****************************************************************************
*  File Name : asm.s31                                                        *
*  Contents     : Demo program for C-ASM mixture                              *
*  Copyright : Renesas Technology Corp.,                                      *
*  Version      : 1.00  ( 2005-12-28) Initial                                 *
*                                                                             *
*****************************************************************************/
PUBLIC   assem
DEFFN    assem(0,0,4,0,32768,0,7,0)     ;Declare the initial label symbol of
                                         the function as global
RSEG     CODE                           ;Set relocatable assembly mode
assem:
      LDA    np:LOCBN assem+4
      STA    np:LOCBN assem
      LDA    np:LOCBN assem+5
      STA    np:LOCBN assem+1           ;Move the value in memory
      LDA    np:LOCBN assem+6
      STA    np:LOCBN assem+2
      LDA    #0
      STA    np:LOCBN assem+3           ;Move the value in memory
      LDA    np:LOCBN assem+9
      CLC
      ADC    np:LOCBN assem+7
      STA    00H,X
      LDA    np:LOCBN assem+10
      CLC
      ADC    np:LOCBN assem+8
      STA    01H,X                      ;take the integer sum to EXPR stack
      RTS
      END
```

5. 参考文献

软件手册

740 族 编程指南<C 语言篇>

740 族 C 编译器用户手册

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Rev.	发行日	修订内容	
		页	要点
1.00	2006.01.18	—	初版发行
1.01	2008.03.17	9	增加咨询邮箱地址，修改软件手册名称，删去版本号
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9. 在使用本资料所记载的产品时，对于最大额定值、工作电源电压的范围、放热特性、安装条件及其他条件请在本公司规定的保证范围内使用。如果超出了本公司规定的保证范围使用时，对于由此而造成的故障和出现的事故，本公司将不承担任何责任。
10. 本公司一直致力于提高产品的质量和可靠性，但一般来说，半导体产品总会以一定的概率发生故障、或者由于使用条件不同而出现错误运行等。为了避免因本公司的产品发生故障或者错误运行而导致人身事故和火灾或造成社会性的损失，希望客户能自行负责进行冗余设计、采取延烧对策及进行防止错误运行等的安全设计（包括硬件和软件两方面的设计）以及老化处理等，这是作为机器和系统的出厂保证。特别是单片机的软件，由于单独进行验证很困难，所以要求在顾客制造的最终的机器及系统上进行安全检验工作。
11. 如果把本资料所记载的产品从其载体设备上卸下，有可能造成婴儿误吞的危险。顾客在将本公司产品安装到顾客的设备上时，请顾客自行负责将本公司产品设置为不容易剥落的安全设计。如果从顾客的设备上剥落而造成事故时，本公司将不承担任何责任。
12. 在未得到本公司的事先书面认可时，不可将本资料的一部分或者全部转载或者复制。
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