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M16C/62P Group

Serial Flash Boot Loader via Xmodem Data Transfer

1. Abstract

This documents describes how to rewrite the flash memory via Xmodem data transfer using EW0 mode in the M16C/62P Group.

2. Introduction

The application example described in this document is applied to the following MCU and parameter(s):

- MCU: M16C/62P Group (M30626FHPFP, M30626FHPGP)
- Oscillation frequency: 6 MHz
- Operating frequency: 24 MHz
- Memory capacity: 384 Kbytes + 4 Kbytes for ROM, 31 Kbytes for RAM

This program can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the M16C/62P Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Description on Serial Flash Boot Loader Via Xmodem Data Transfer

3.1 Program Operation Description

This program uses UART0 with 115200 bps, data transfer 8 bits, no parity check, and stop bit 1. The target board integrating the MCU and the host PC are connected with the RS-232C cable. The hyper terminal should be activated on the host PC beforehand. When the MCU receives serial data within 3 seconds after reset is deasserted, it enters rewrite mode and the following screen will be displayed in the hyper terminal. When the MCU does not receive serial data within 3 seconds, a jump will occur from address A0020h in the user area (user program area) to the read address. See Figure 3.2.

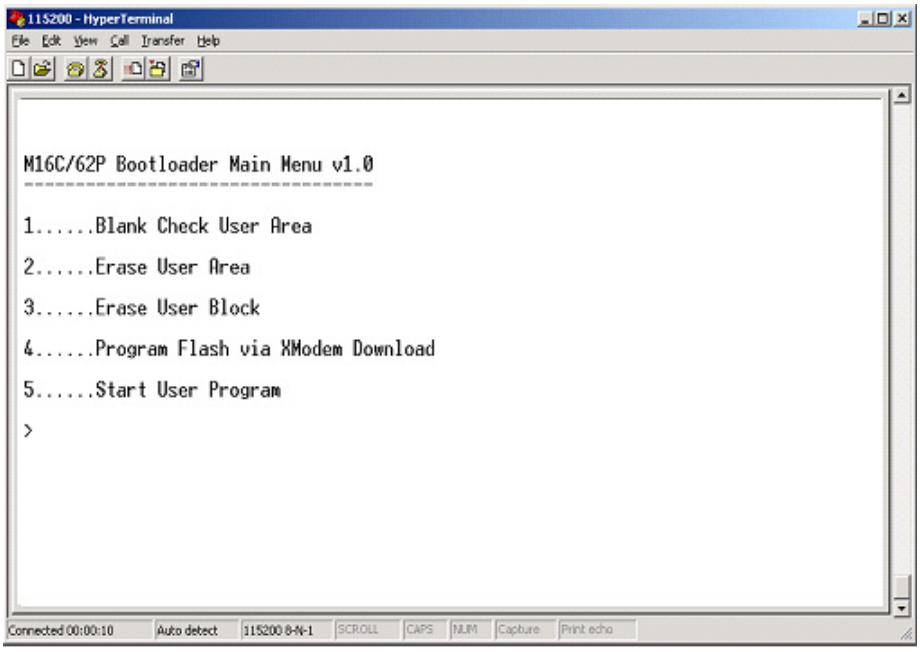

Figure 3.1 Boot Loader Menu Display

Command 1: Blank Check User area

Command 2: Erase User Area

Command 3: Erase User Block

Command 4: Write to User Area

Command 5: Execute User Program

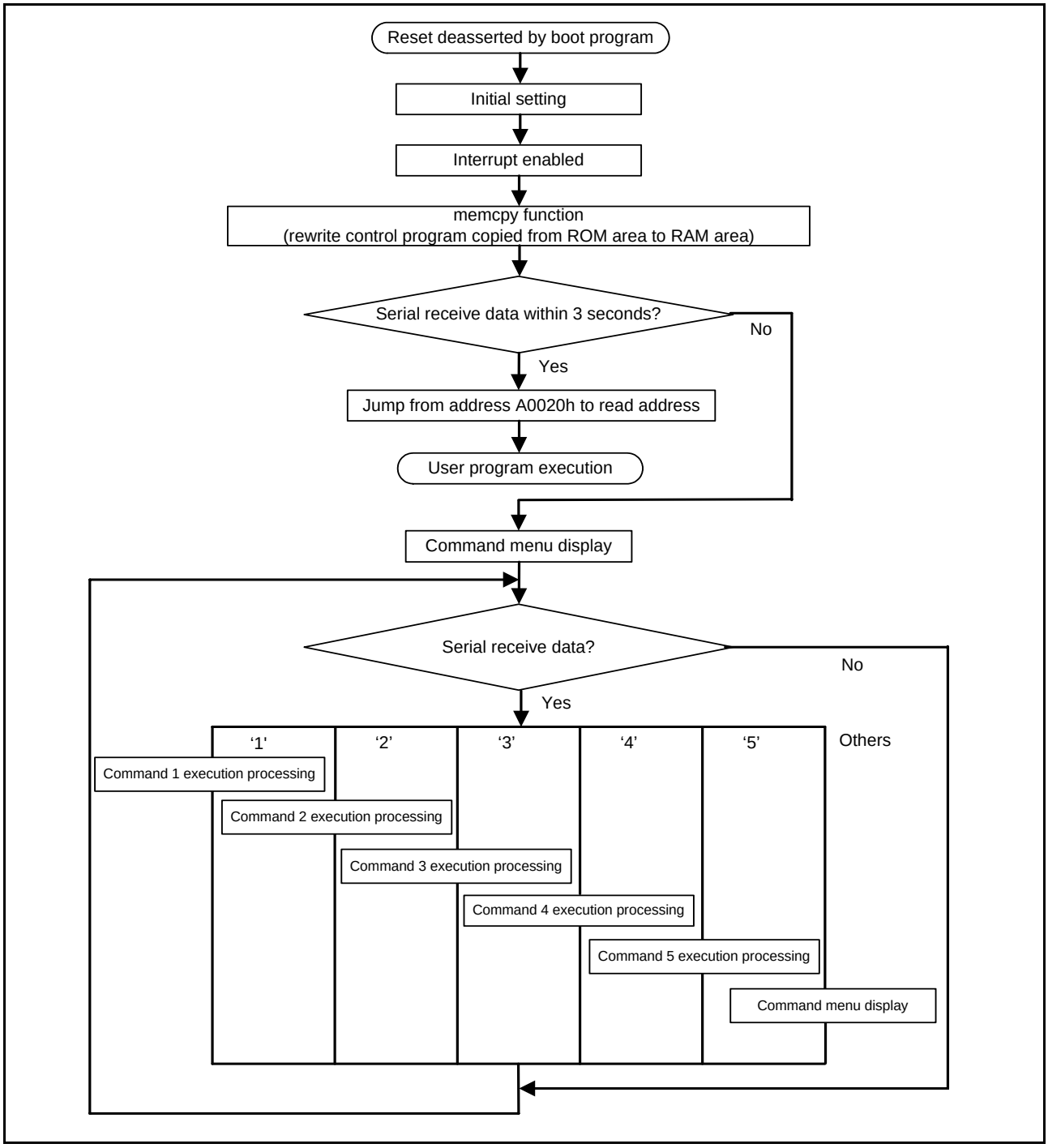

Figure 3.2 Flowchart of Program Operation Overview

3.2 Memory Allocation

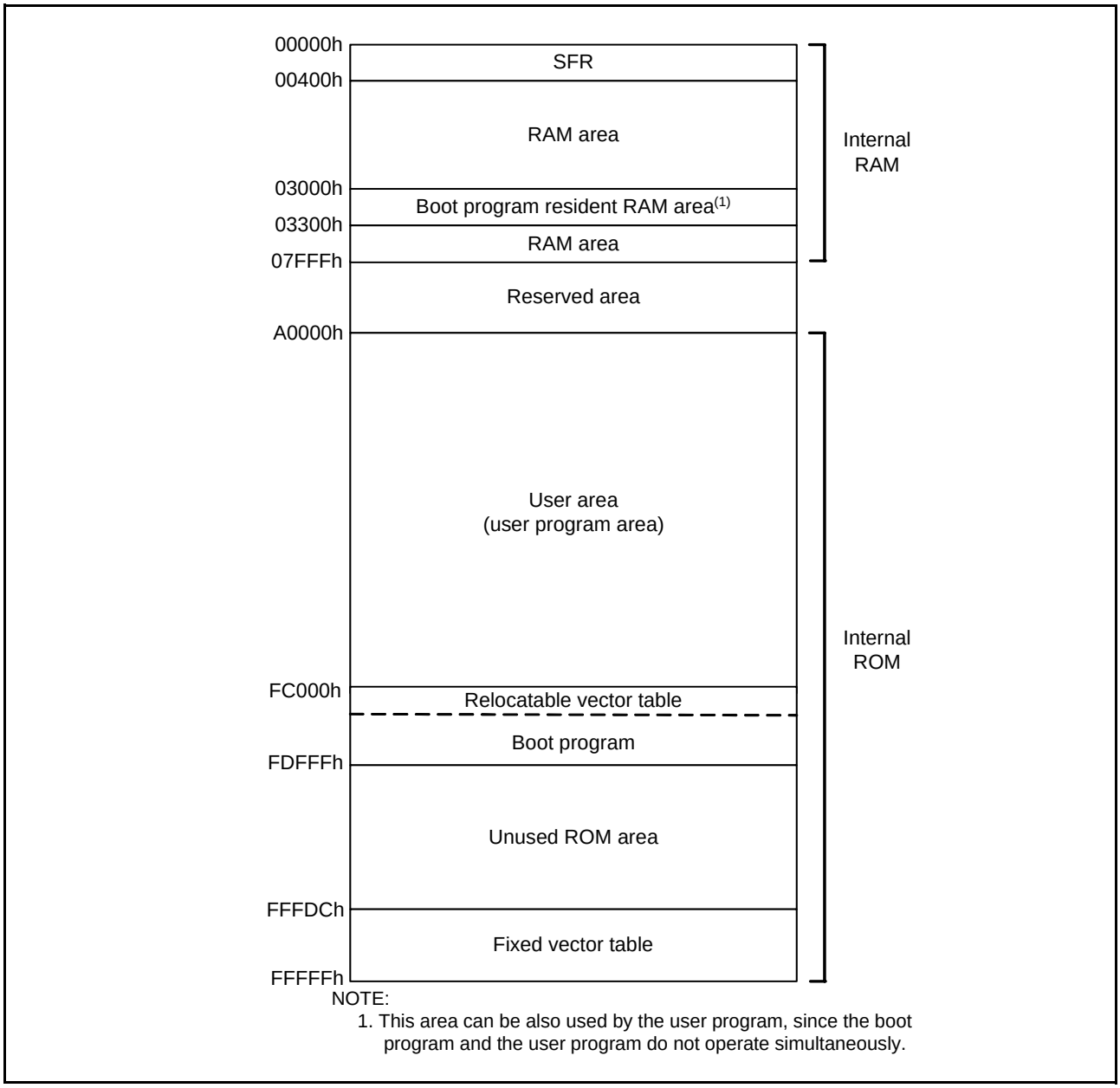

Figure 3.3 Memory Allocation

As shown in Figure 3.3, the boot program allocated from address 03000h to 03300h is used as the rewrite control program for reprogramming and erasing data in the user area. This rewrite control program rewrites the user area using EW0 mode (CPU rewrite mode 0). When EW0 mode is used, the rewrite control program should be executed in the internal RAM, or in an available external area while the PW13 bit is set to 1. Refer to the M16C/62P Group Hardware Manual for details. This boot program can rewrite the user area only. The unused ROM area can not be rewritten.

3.3 Description on Boot Program Contents

3.3.1 File Configuration

The file configuration of the boot program is as follows:

Table 3.1 File Configuration Table

File Name	Outline	Remark
flash.c	EW0 mode setting and exit processing, 128 bytes write processing, block erase processing, address ROM table in the user area	Transferred to the RAM area for execution
command.c	Command menu display, processing for commands 1 to 5	
delay_timer.c	Processing of timeout error by timer A0 interrupt	
lowlevelinit.c	MCU initial setting	
main.c	Copy processing of the write control program from the ROM area to the RAM area, program switching processing via serial receive data within 3 seconds	
serial.c	Serial data transmit/receive processing	
xmodem.c	Write processing via Xmodem data transfer	Write specification via Xmodem data transfer
flash_header.h	128-byte write function, prototype statement for the block erasure function, 128-byte write status, macro definition for the block erase status	
command.h	Prototype statement for commands 1 to 5, macro definition for the start/end addresses in the user area	
delay_time.h	Prototype statement for the timeout error function	
lowlevelinit.h	Prototype statement for the MCU initial setting function	
serial.h	Prototype statement for the serial data transmit/receive functions, macro definition for the serial communication status	
xmodem.h	Prototype statement for the write function via Xmodem transfer, macro definition for the write status via Xmodem transfer	

3.3.2 Resource List

Table 3.2 shows the Resource List of the boot program.

Table 3.2 Resource List

Resource	Usage
UART0	Serial communication for Xmodem data transfer
Timer A0	Timeout error processing for serial communication

3.3.3 Program to Operate in RAM Area

This program uses the function to copy the memcpy (memory operation) function - the NC30 standard library function - to copy the write control program (address ROM table in the user area, EW0 mode setting and exit function, 128-byte write function, and block erasure function) from the ROM area to the RAM area. It also divides sections by the #pragma SECTION statement to specify the allocation position for the write control program using the linker option.

(1) Copying the program from the ROM area to the RAM area

This section describes how to copy the rewrite control program from the ROM area to the RAM area.
This program uses the memcpy (memory operation) function.

```
void InitCommandHandler (void)
{
    InitSci();
    InitDelayTimer();

    // copy all RAM based code to RAM
    memcpy( (void *) INT_RAM_BASE_ADDRESS, (void *) RAM_BASED_ROM_ADDRESS, SIZE_OF_RAM_BASED_ROM );


}
```

Figure 3.4 Example of Using memcpy Function

Arguments: INT_RAM_BASED_ADDRESS (pointer to the memory area of the copy destination) 03000h

RAM_BASED_ROM_ADDRESS (pointer to the memory are of the copy source) FD800h

SIZE_OF_RAM_BASED_ROM (number of bytes to be copied) 00300h

Using the memcpy function copies an area of 00300h bytes from FD800h (copy source) to 03000h (copy destination).

(2) Specifying the storage position and execution position for the rewrite control program

The storage area (Flash ROM area) and execution area (RAM area) for the rewrite control program should be specified using the linker to allocate them separately.

• Specifying the start address in the ROM area

```
-LOC        ram_based_rom_FE = 0FD800, ram_based_prg = 0FD860
```

Figure 3.5 Example of Specifying Start Address in ROM area

This program uses "-LOC" to specify the storage address of the address ROM table (ram_based_rom_FE) in the user area to address 0FD800h, and the storage address of EW0 mode setting and exit function, write function, and erase function (ram_based_prg) to address 0FD860h.

• Specifying the start address in the RAM area

```
-ORDER      ram_based_rom_FE = 03000, ram_based_prg = 03060
```

Figure 3.6 Example of Specifying Start Address in RAM Area

This program uses "-ORDER" to specify the start address of the address ROM table (ram_based_rom_FE) in the user area to address 03000h, and the start address of EW0 mode setting and exit function, write function, and, erase function (ram_based_prg) to address 03060h.

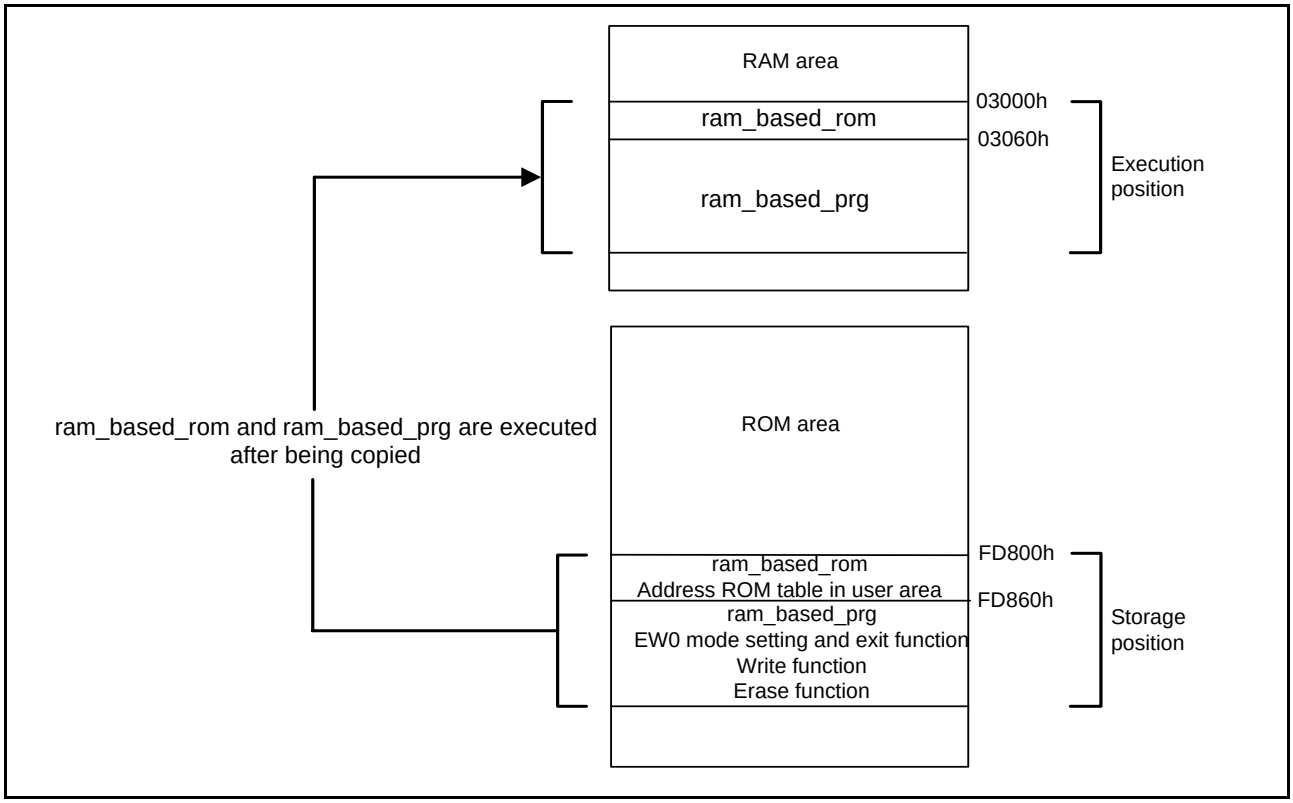

Figure 3.7 Example of Section Allocation

3.4 Command 1 to Command 5 Description

3.4.1 Command 1 (Blank Check User Area) Description

When command 1 is selected, the user area is blank checked. Figure 3.8 shows the Output when No Data is Present in User Area. Figure 3.9 shows the Output when Data is Present in User Area.

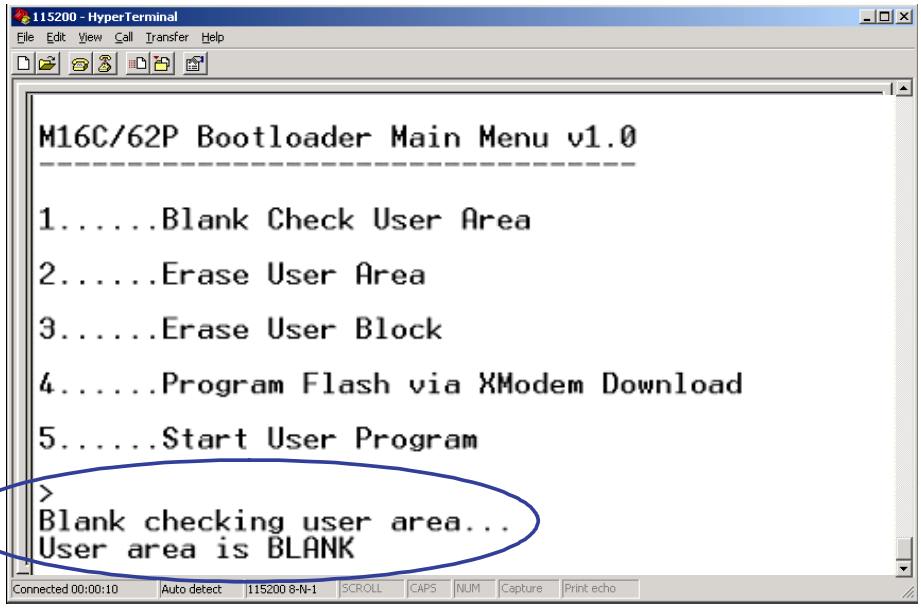

Figure 3.8 Output when No Data is Present in User Area

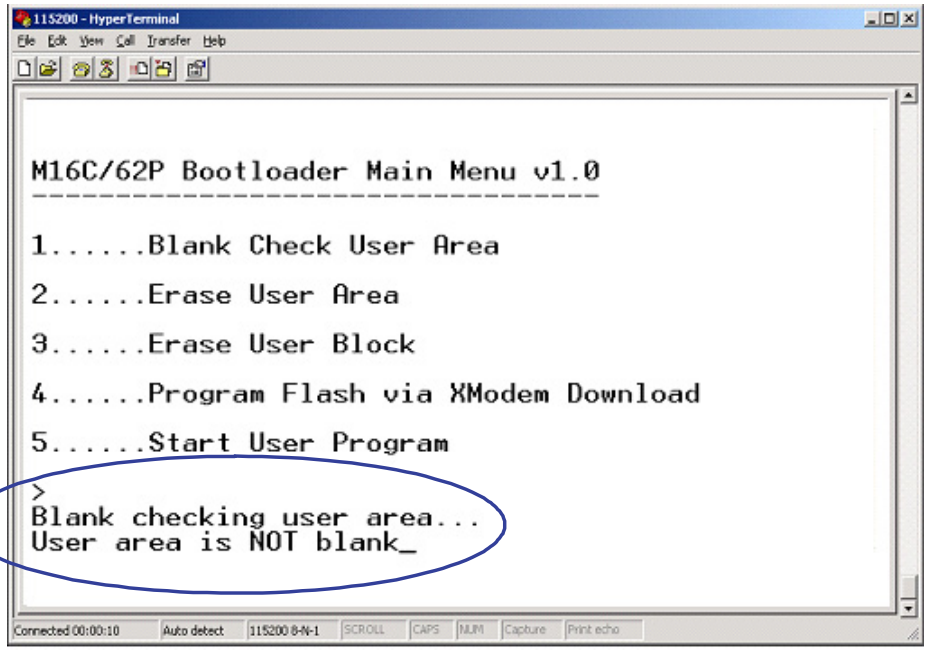

Figure 3.9 Output when Data is Present in User Area

3.4.2 Command 2 (Erase User Area) Description

When command 2 is selected, the user area (blocks 3 to 10) is erased. Figure 3.10 shows the Output when User Area is Erased.

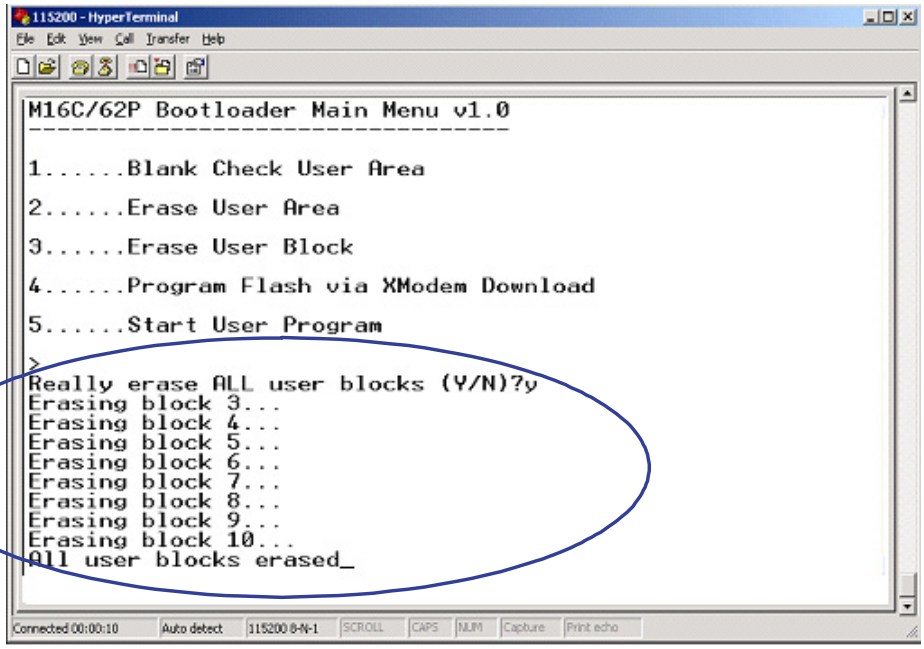

Figure 3.10 Output when User Area is Erased

3.4.3 Command 3 (Erase User Block) Description

When command 3 is selected, the user area (blocks 3 to 10) is erased in a block unit. As an example, Figure 3.11 shows the Output when the User Area Block are Erased if block 10 is specified.

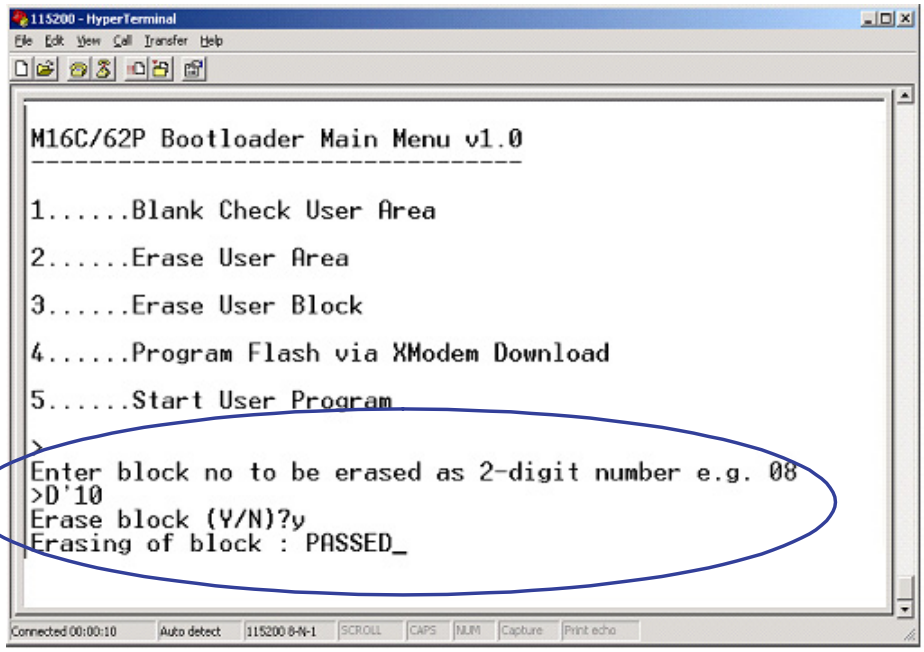

Figure 3.11 Output when the User Area Block are Erased

3.4.4 Command 4 (Write to User Area) Description

When command 4 is selected, data is written to the user area via Xmodem data transfer. Figure 3.12 shows the Write via Xmodem Data Transfer from address A0000h (user area). Data can be also written from addresses other than address A0000h, as long as they are within the range of the user area. However, data cannot be written if a specified address is not an even address.

- Write specification via Xmodem data transfer

This specification defines 128 bytes should be always written when writing data to the user area.
For example, when writing 62 bytes of data, 01xA should be written to the remaining 66 bytes.

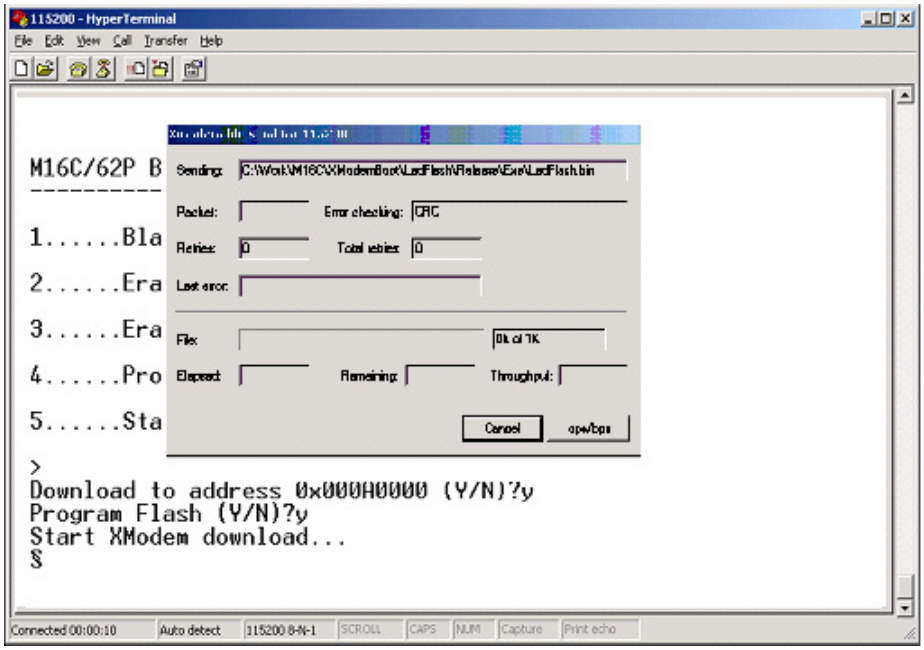

Figure 3.12 Write via Xmodem Data Transfer

3.4.5 Command 5 (Execute User Program) Description

When command 5 is selected, the user program is executed. Figure 3.13 shows the Output when User Program is Executed.

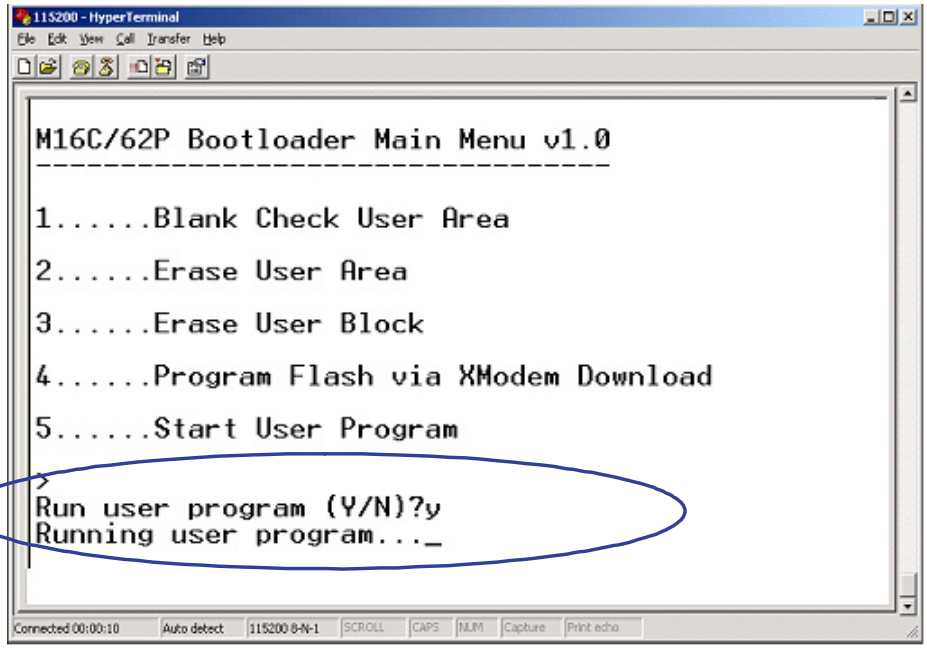

Figure 3.13 Output when User Program is Executed

4. Creating User Program

To use this boot program, the user program should be created using the following method.

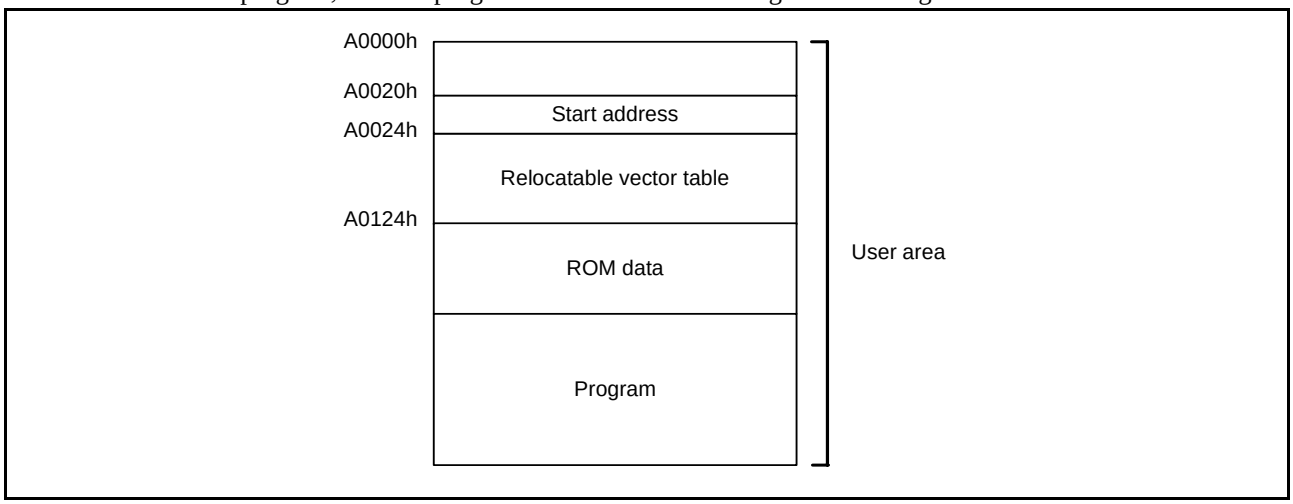

Figure 4.1 Memory Allocation

(1) Specifying the start address of the user program

Using vector.h (C startup file header automatically generated by HEW) easily sets the start address of the user program.
Changing the value of Fvectaddr (macro definition) in vector. h to A0000h allocates the start address to address A0020h.

(2) Section Allocation

With the linker option "-ORDER", the following method can be used to change the allocated sections of the relocatable vector table (vect), data (rom_FE), and the program (program) as shown in Figure 4.2.

```
-ORDER        vect=0A0024, rom_FE=0A0124, rom_FO, program
```

Figure 4.2 Specifying Section Allocation

(3) Converting the S-Record file in binary format

The boot program needs to write the binary file downloaded via Xmodem data transfer. Thus, the S-record file created by the M16C compiler (NC30) needs to be converted into binary format. There are many utilities available for this conversion. The following shows a usage example of the GNU GCC utility 'objcopy':

```
m32c-elf-objcopy.exe    -I    srec    xxxx.mot    -0    binary    yyyy.bin
```

Figure 4.3 Using 'objcopy' ('m32c-elf-objcopy.exe')

As a part of the GNU GCC tool chain, 'm32c-elf-objcopy.exe. in 'objcopy' can be downloaded from the following site:
http://www.kpitgnutools.com

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REVISION HISTORY	M16C/62P Group Serial Flash Boot Loader via Xmodem Data Transfer

Rev.	Date	Description	
		Page	Summary
1.00	Dec 15, 2006	–	First Edition issued

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