

# Static Serial Bootloader for MC56F800x/801x/802x/803x

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## 1 Introduction

Freescale offers serial bootloaders for digital signal controllers. Because MC56F800x/801x/802x/803x devices have critical flash resources, these serial bootloaders are designed to load application code only once, so as to allow applications to use the full flash memory space. However, some customers require the serial bootloader to stay in flash forever. This serial bootloader is a so-called static bootloader. This document describes the static serial bootloader and its requirements when used in applications.

This document is based on the Freescale serial bootloader designed under CW8.x with Processor Expert. About 2 KB in size, it is located in program flash from address 0x7B00 to 0x7FFF on the MC56F802x/3x and 0x1B00 to 0x1FFF on the MC56F800x/1x.

It is a reusable static bootloader. That is, after a reset occurs, the bootloader starts to run. If a boot delays in seconds without receiving the application s-record, it

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## Static Serial Bootloader Process

will jump to the programmed application code. If it receives the application s-record, it will program the application code to the on-chip flash.

The page erasing method is used by the static bootloader. The bootloader section cannot be overwritten by the application code.

## 2 Static Serial Bootloader Process

[Figure 1](#) shows the main process of the static serial bootloader.

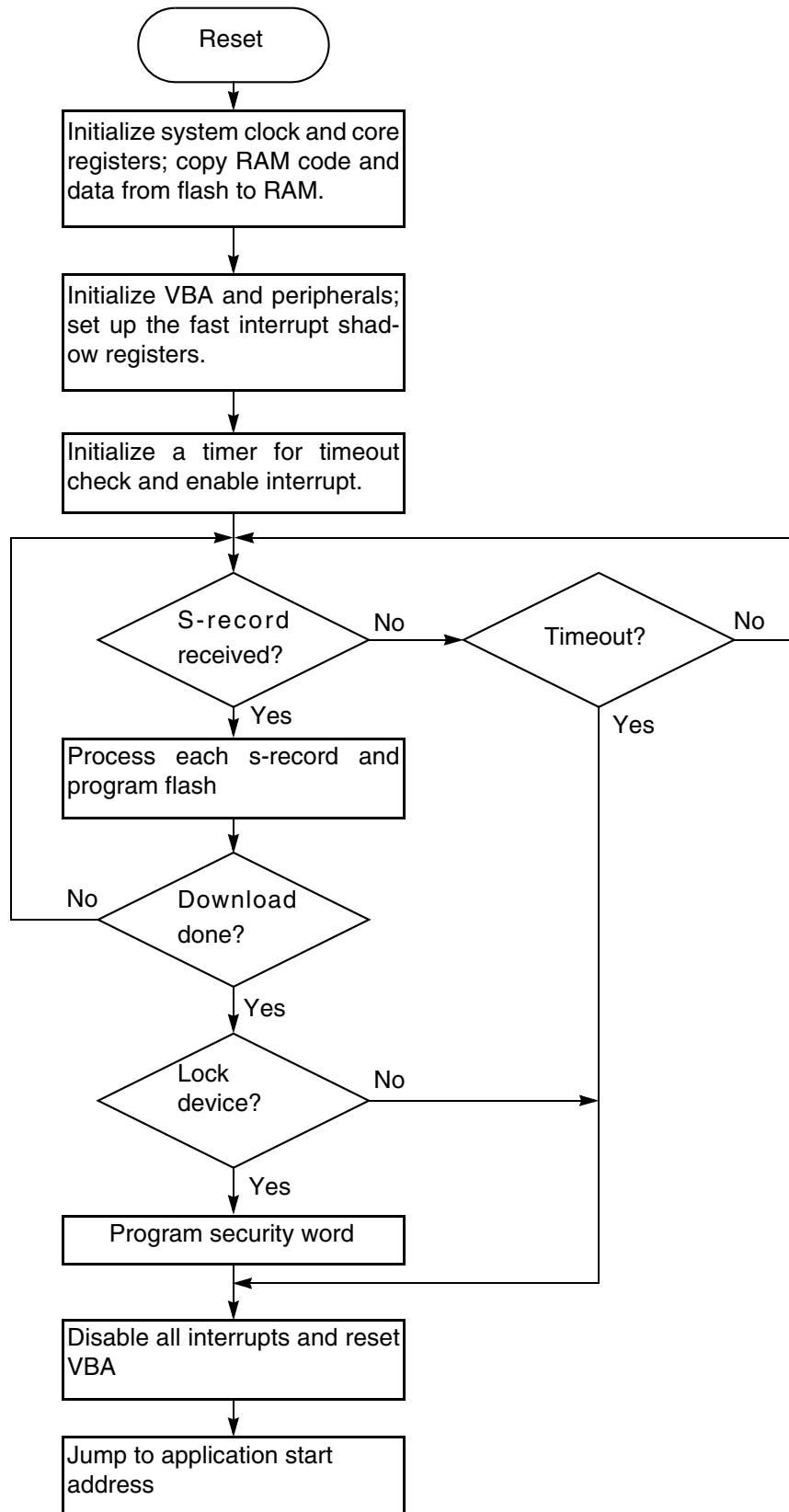
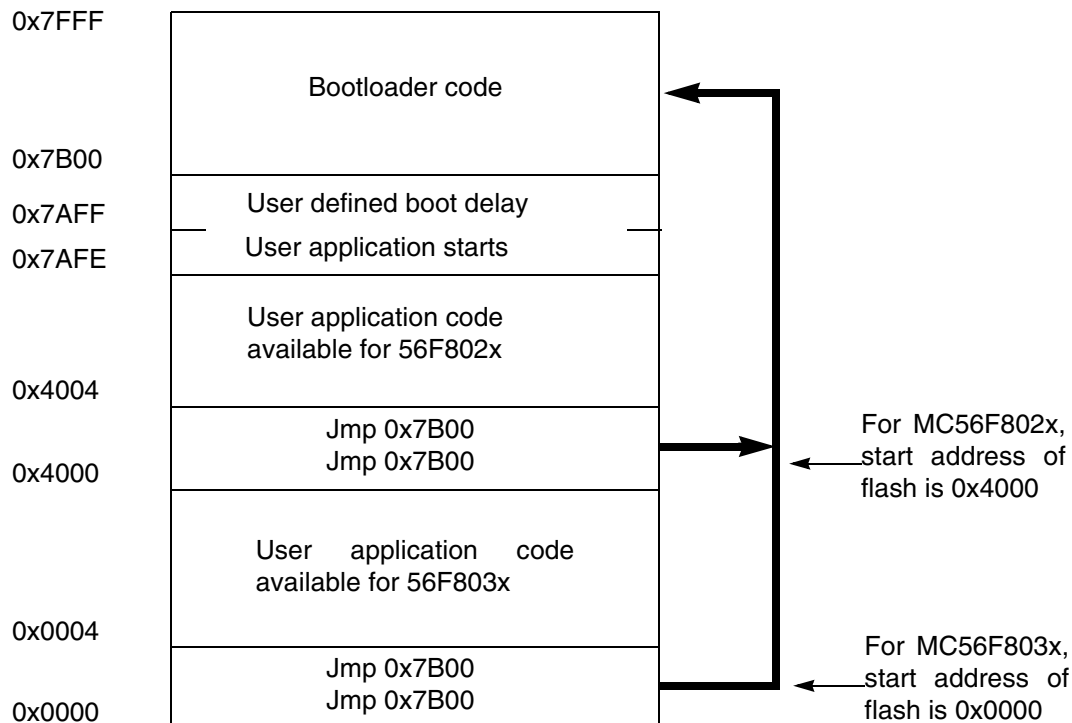


Figure 1. Bootloader Process

### 3 Program Flash Usage

The flash usage is shown in [Figure 2](#) and [Figure 3](#). Please pay attention NOT to overwrite the memory range from 0x7B00 to 0x7FFF for MC56F802x/3x, or from 0x1B00 to 0x1FFF for MC56F800x/1x, because it is used by the bootloader.



**Figure 2. Program Flash Usage for MC56F802x/3x Static Serial Bootloader**

#### NOTE

For the MC56F802x, the lower memory area from 0x0000 to 0x3FFF is reserved. Both hardware reset and COP reset vectors are located at 0x4000 to 0x4003. Therefore, two “jump to bootloader” instructions must be placed at these locations. However, for the MC56F803x these locations can be used for user application code, because both reset vectors are located at 0x0000 to 0x0003.

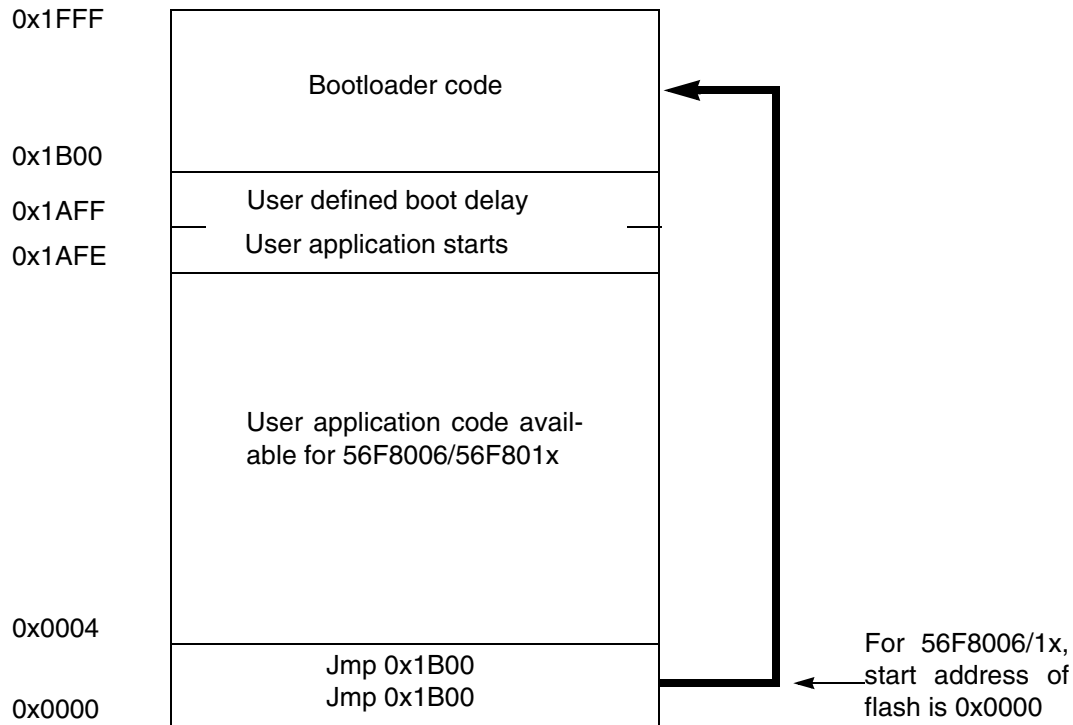


Figure 3. Program Flash Usage for 56F8006/1x Static Serial Bootloader

## 4 How to Make a Processor Expert Application Downloadable with Serial Bootloader

The loaded application should meet these requirements:

1. If it is necessary for the bootloader to start immediately after reset, a jump to address 0x7B00 for MC56F802x/3x or to 0x1B00 for MC56F800x/1x must be written into the reset and COP vector. Otherwise, there should be a jump to bootloader upon user event by calling this instruction:

```
asm{
    jmp BOOTLOADER_ADDR
}
```

The BOOTLOADER\_ADDR is defined as 0x1B00 for MC56F800x/1x or 0x7B00 for MC56F802x/3x. Please follow the steps below to do the modification.

- a) After the application code is generated, open the CPU bean and set the “Generate linker file” option to “no.” Thus the linker command file will not be regenerated and the changes can be saved in it.



- b) Open the linker command file and modify it:  
 Comment lines involve the *interrupt\_vectorsboot* section, thus the code will not be generated there:

```

#Serial bootloader configuration section
.xBootCfg (RWX) : ORIGIN = 0x00007BFF, LENGTH = 0x1

}

#KEEP_SECTION { interrupt_vectorsboot.text } # comment this line
KEEP_SECTION { interrupt_vectors.text }

SECTIONS {

.interrupt_vectorsboot :
{
F_vector_addr = .;
#interrupt vectors boot area
# *(interrupt_vectorsboot.text) # comment this line
} > _p_interruptsboot

.interrupt_vectors :
{

```

- c) Write the jump-to-bootloader code into reset and COP vector by either of the following actions:  
 – Open the vector.c file and modify the first two lines in *interrupt\_vector* section to have a jump to bootloader code:

```

#pragma define_section interrupt_vectors "interrupt_vectors.text" RX
#pragma section interrupt_vectors begin
static asm void _vect(void) {

```

```

JMP BOOTLOADER_ADDR // _EntryPoint          /* Interrupt no. 0 (Used) - ivINT_Reset */
JMP BOOTLOADER_ADDR // _EntryPoint          /* Interrupt no. 1 (Used)-ivINT_COPReset */
JSR Cpu_Interrupt                          /* Interrupt no.2 (Unused) - ivINT_Illegal_Instruction */
JSR Cpu_Interrupt                          /* Interrupt no.3 (Unused) - ivINT_SW3 */
JSR Cpu_Interrupt                          /* Interrupt no.4 (Unused) - ivINT_HWStackOverflow */
JSR Cpu_Interrupt                          /* Interrupt no.5 (Unused)-ivINT_MisalignedLongWordAccess */

```

– Or, comment these two lines in vector.c:

```

J
#pragma section interrupt_vectorsboot end

#pragma define_section interrupt_vectors "interrupt_vectors.text" RX
#pragma section interrupt_vectors begin
static asm void _vect(void) {
// JMP _EntryPoint          /* Interrupt no. 0 (Used) - ivINT_Reset */
// JMP _EntryPoint          /* Interrupt no. 1 (Used) - ivINT_COPReset */
JSR Cpu_Interrupt          /* Interrupt no. 2 (Unused) - ivINT_Illegal_Instruction */
JSR Cpu_Interrupt          /* Interrupt no. 3 (Unused) - ivINT_SW3 */
JSR Cpu_Interrupt          /* Interrupt no. 4 (Unused) - ivINT_HWStackOverflow */
}

```

Also modify the linker command file to put two “JMP to 0x7B00” instructions (for MC56F802x/3x) or “JMP to 0x1B00” instructions (for MC56F800x/1x) in .p\_Interrupts section as shown below:

```

# KEEP_SECTION { interrupt_vectorsboot.text }
KEEP_SECTION { interrupt_vectors.text }

SECTIONS {

    .interrupt_vectors :
    {
        # interrupt vectors
        F_vba = .;
        WRITEH(0xE154);          # opcode to jump to 0x7B00 in H/W reset vector
        WRITEH(0x7B00);          # 0x7B00 for 56F802x/3x; 0x1B00 for 56F800x/1x
        WRITEH(0xE154);          # opcode to jump to 0x7B00 in COP reset vector
        WRITEH(0x7B00);          # 0x7B00 for 56F802x/3x; 0x1B00 for 56F800x/1x
        *(interrupt_vectors.text)
    } > .p_Interrupts

```

### NOTE

Be sure that the Processor Expert does not overwrite the vector.c file in the subsequent code generation. Otherwise, modify it as described earlier.

- Write the application entry point at address 0x7AFE (MC56F802x/3x) or 0x1AFE (MC56F800x/1x) in program flash. Write the bootloader delay value at address 0x7AFF (MC56F802x/3x) or 0x1AFF (MC56F800x/1x) in the program flash.

Define a new segment .xBootCfg and a new section .ApplicationConfiguration in the linker command file:

```
.xBootCfg (RWX) : ORIGIN = 0x00001AFE, LENGTH = 0x2 # for 56F800x/1x
```

## Serial Communication Speed

```
# .xBootCfg (RWX) : ORIGIN = 0x00007AFE, LENGTH = 0x2 # for 56F802x/3x

.ApplicationConfiguration :
{
    # Store the application entry point
    WRITEH(F_EntryPoint);

    #Bootloader start delay in seconds
    WRITEH(10);

} > .xBootCfg
```

3. The VBA register must be set correctly before the application enables any interrupts.

If interrupts are used in the application, the VBA register has to be restored to the proper value so that the chip can jump to the correct vector when an interrupt occurs. Check it in the application code. In the application's main routine, the following sequence must be added before calling `PE_low_level_init()` for MC56F802x/3x:

```
extern unsigned int _vba;
INTC_VBA = (int)&_vba >>7; // restore VBA register to point to user defined vector table
```

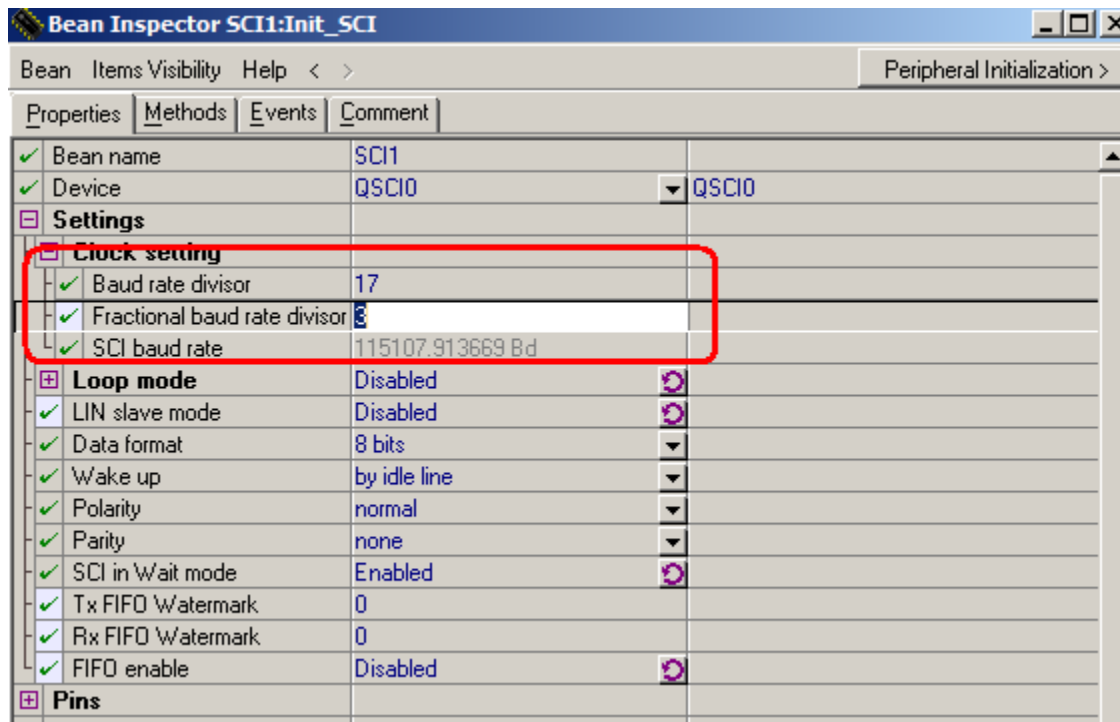
vba is defined in the linker command file as below:

```
.interrupt_vectors :
{
    # interrupt vectors
    F_vba = .;
    * (interrupt_vectors.text)
} > .p_Interrupts
```

## 5 Serial Communication Speed

The baud rate of the serial communication port is set to 9600 bps by default. Users can change it in the clock setting of SCI1 properties to 115200 bps, as shown below, and then regenerate the code:





## 6 Serial Communication Protocol

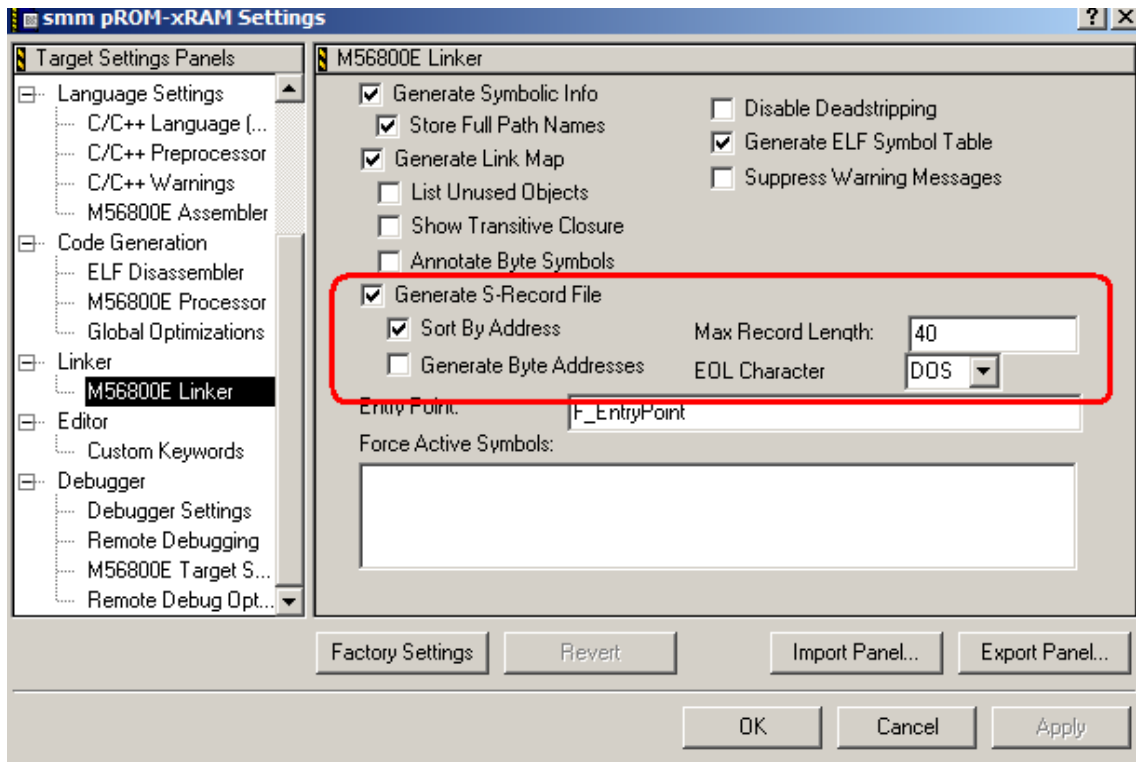
Use XON/XOFF protocol.

## 7 How to Generate an S-Record File

1. Configure the M56800E linker as follows. Do not check “Generate Byte Addresses.” The recommended Max Record Length is 40. EOL character must be DOS.
2. After the configuration, click the OK button and then select “Project” menu. Then click “Make” to rebuild the project.

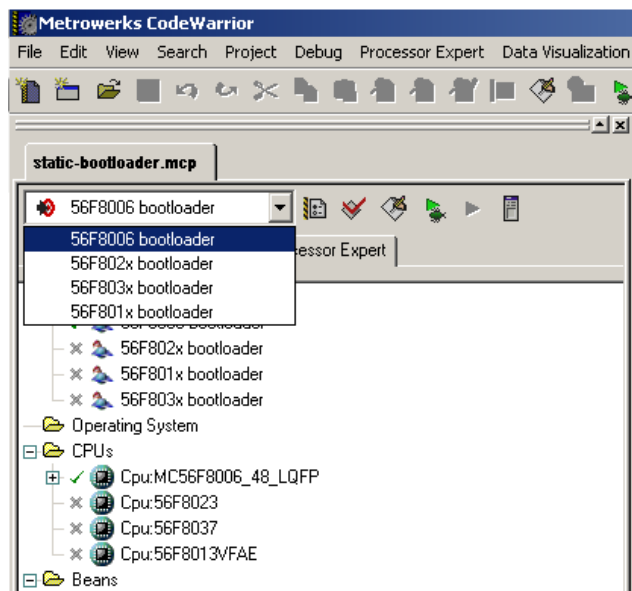
The generated s-record file to be used by the bootloader is the combined p and x s-record file without “.p” or “.x” in the extension name (.s).

## How to Choose the Target



## 8 How to Choose the Target

There are four targets in the static serial bootloader project. The selection is done with the help of the Target pulldown menu of the Project window.

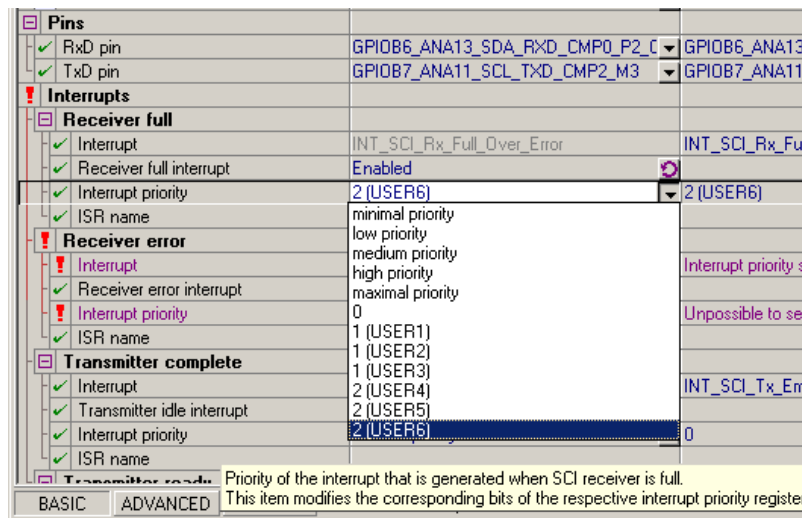


The Processor Expert is frozen in the project by default. It is necessary to un-freeze it and then select the desired target. If the project remains frozen, the Processor Expert will not rebuild the code and will keep the generated MC56F8006 code.

When changing from the MC56F8006 target to the MC56F801x/2x/3x target, and vice versa, it is necessary to modify the SCI bean with respect to the interrupt priority. Otherwise the Processor Expert code generation fails. The modification is done like this:

## 8.1 MC56F8006 Bootloader

Select “2 (USER6)” value for the interrupt priority items of the “Receiver full” and “Receiver error” interrupts.

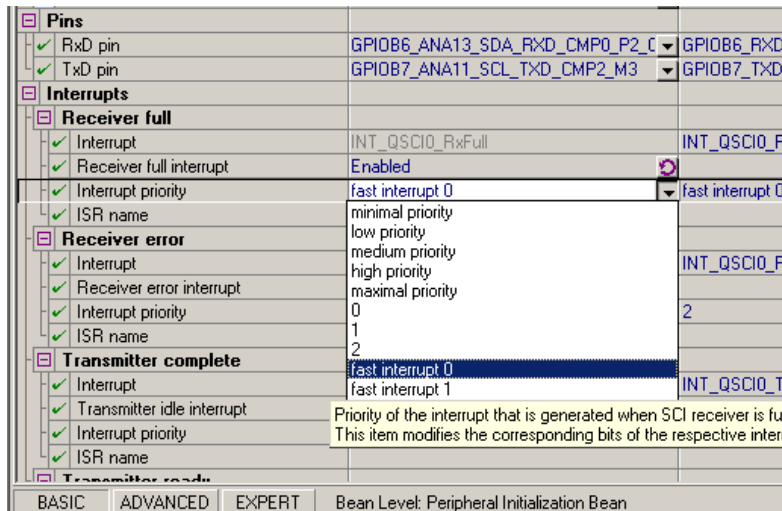


## 8.2 MC56F801x/2x/3x Bootloaders

Select “fast interrupt 0” value for the interrupt priority item of the “Receiver full” interrupt and choose one of these options:

- Disable the “Receiver error” interrupt and delete the ISR name for this interrupt.
- Set “fast interrupt 1” for the “Receiver error” interrupt. You may leave the same ISR name for “Receiver error” interrupt, but the PE generates a warning.

Both modifications work, and in either case the SCI error flags are checked within the ISR routine.

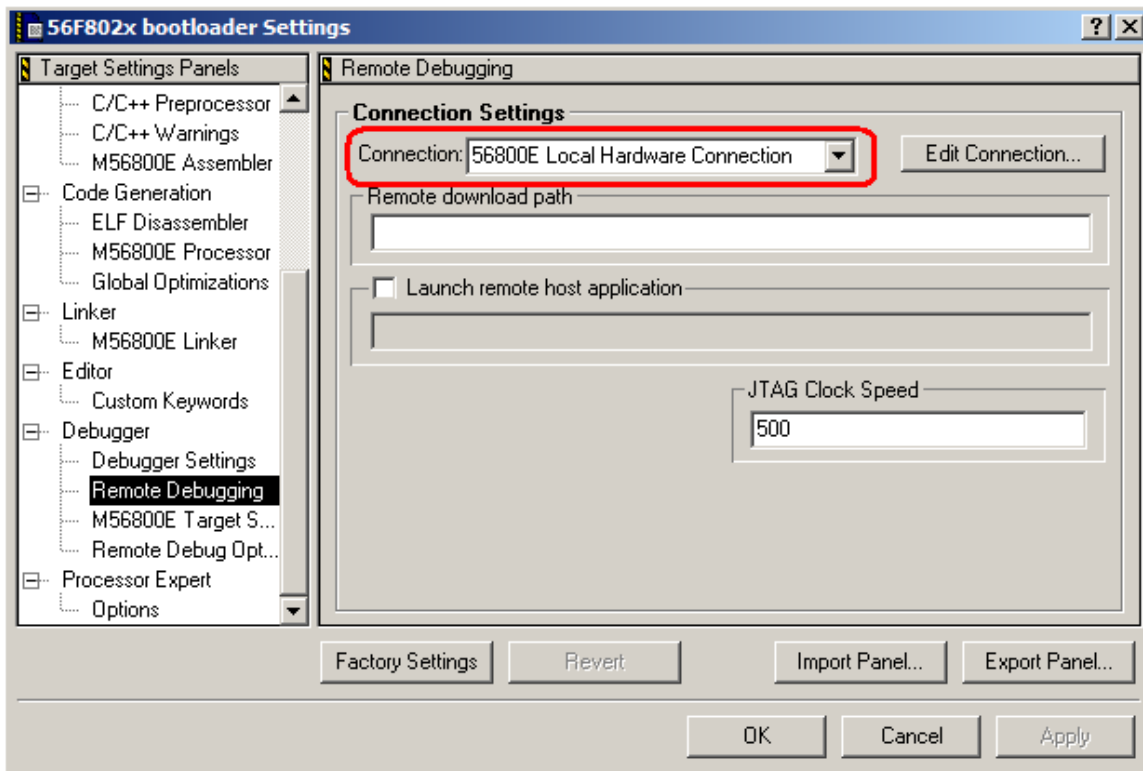


## 9 How to Download the Bootloader Code

There are two connection options:

- 56800E Local Hardware Connection: Requires a parallel interface to the PC.
- 56800E Local USBTAP Connection: Requires a USB interface to the PC.

The default setting for the bootloader is “56800E Local USBTAP Connection.” Please follow the picture below to select the one suitable to your development environment and then click the OK button. After that, select “Project” menu, followed by clicking “Debug,” to download the code.



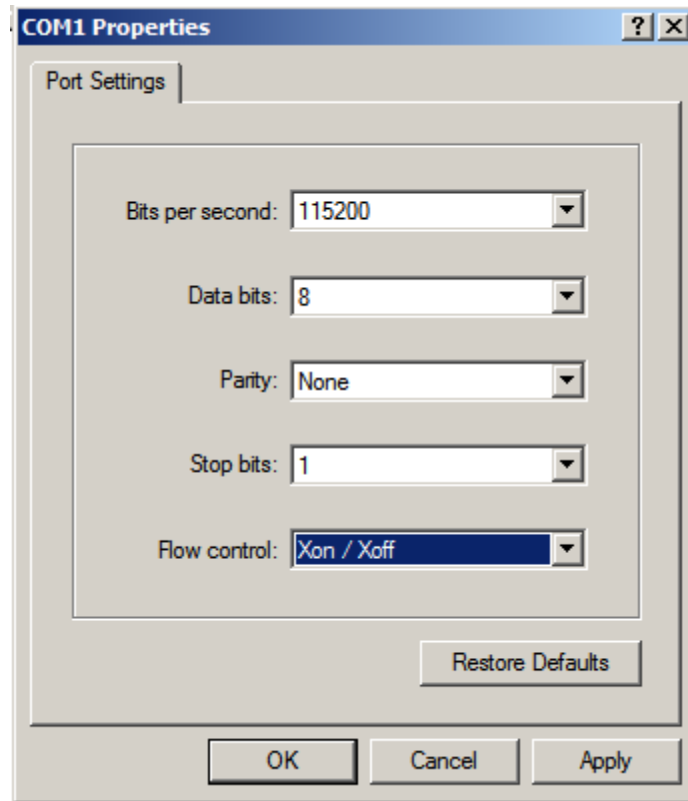
## 10 How to Download the Application Code

Most serial terminal programs can be used to download an s-record file from a host to an MC56F800x/1x/2x/3x device via the serial bootloader. For example, HyperTerminal can be used in a Windows platform.

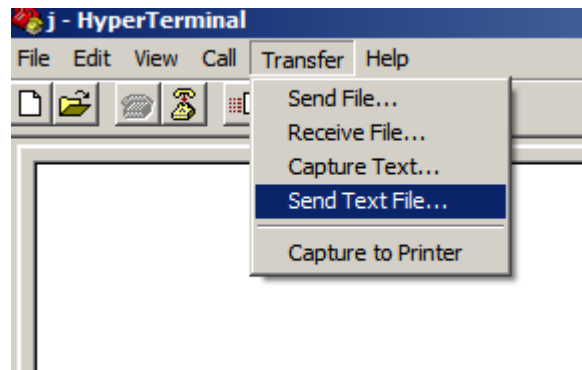
1. Click Windows Start menu. Select “Programs” followed by “Accessories,” and then select “HyperTerminal” under “Communication” menu item to open the HyperTerminal.
2. Enter a name for the connection. Click the “OK” button. The following dialog box pops up. A COM must be selected in the “Connect using” dropdown list.



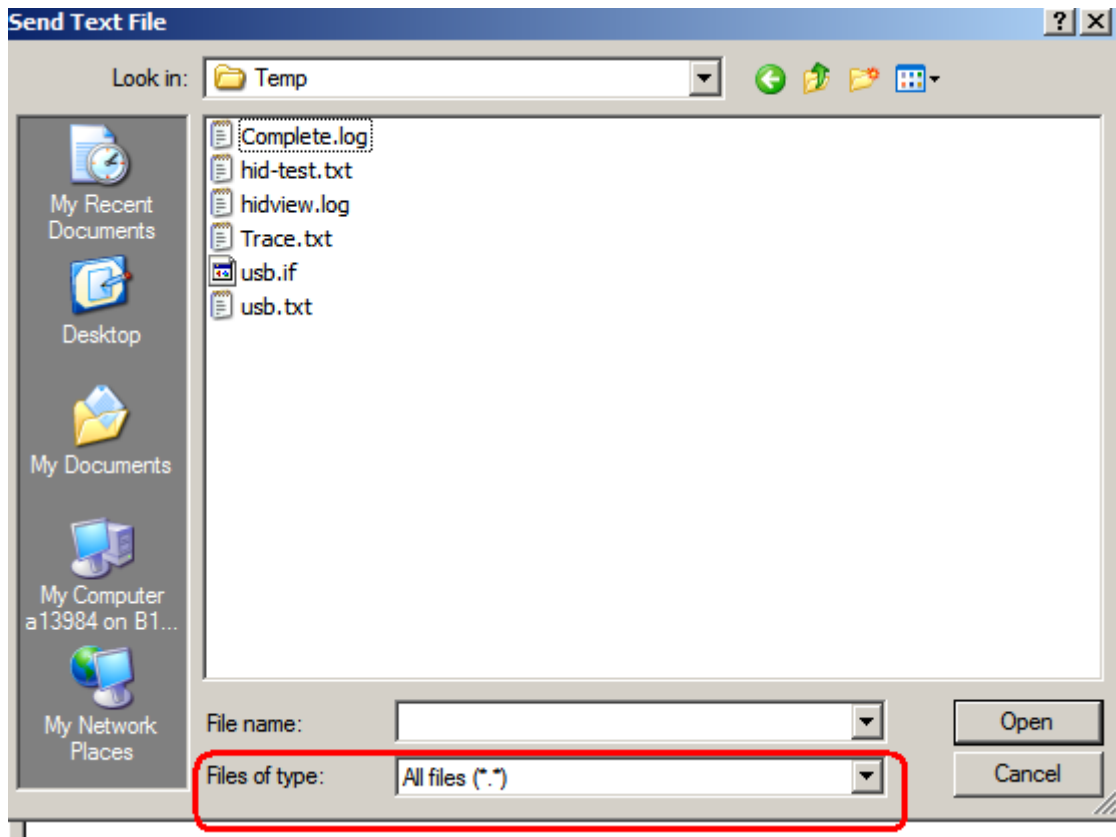
3. Configure the COM properties as follows:
  - Baud rate: 9600 bps
  - 8N1: 8 data bits, no parity, 1 stop bit character format
  - Flow control protocol: Xon/Xoff



4. Follow the following picture to select “Send Text File” when the bootloader startup banner appears:



Now select the application s-record file in the Send Text File dialog. Please note: change the file type to “All files(\*.\*)” as shown below:



## 11 Error Code

Error Codes	Meaning	Possible Reasons	What to do
xx01	S-record checksum error	S-record file format is incorrect or serial connection does not support XON/XOFF protocol.	Refer to <a href="#">Section 7, “How to Generate an S-Record File,”</a> and use the serial connection supporting XON/XOFF protocol.
xx02	S-record type error	S-record file format is incorrect or serial connection does not support XON/XOFF protocol.	Refer to <a href="#">Section 7, “How to Generate an S-Record File,”</a> and use the serial connection supporting XON/XOFF protocol.
xx10	Flash program error	May be caused by low voltage of the power supply to the chip.	Check the power supply to see if the voltage is below 2.7 V.
xx20	Wrong code/data start address	S-record file format is incorrect.	Refer to <a href="#">Section 7, “How to Generate an S-Record File.”</a>
xx40	SCI receiving error	The host transmits characters much faster than can be managed by the bootloader, which is normally caused by a breakpoint in the bootloader during debugging.	Remove all breakpoints during the bootloader debugging; lower the baud rate of the bootloader and host terminal.

**Note:** “x” means don’t care.

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Abbreviations:

- GMT: Greenwich Mean Time
- CT: Central Time
- CET: Central European Time
- HKG: Hong Kong Time
- TKY: Tokyo Time
- W: Winter
- S: Summer (Daylight Saving Time)



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