Freescale Semiconductor
Application Note

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CAN Bus Bootloader for DSC 56F83xx Family

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1 Overview

This document describes how to use a Freescale DSC 56F83xx family bootloader to perform an in-circuit re-program of flash memory in a target board. This is done by a CAN bus, a high-speed reliable operation in automotive and industrial control networks.

You will learn how to configure a DSC 56F8345EVM as a PC-CAN card to convert an S-record from the PC to the target board. A laboratory-constructed firmware is also described.

This document is written for users familiar with the DSC 56F83xx family, Metrowerks CodeWarrior for DSP, and CAN protocol, specification, and application. It also provides reference codes that can be modified to specific applications.

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2 Introduction

A PC-CAN card is a useful tool for debugging and/or upgrading firmware via the CAN bus, which is built on the target board for communication with its application, thereby not creating additional hardware cost in the system.

The DSC 56F83xx family offers a dedicated flash block (boot flash block) for bootloader, which commonly uses asynchronous communication protocol such as SCI, SPI, and CAN bus to reduce hardware wires. This document guides you in configuring the 56F8346 FlexCAN module for CAN bus communication. The firmware permanently resides in the boot flash block of target board as a CAN bootloader. The bootloader code can be kept even if the power supply is interrupted while programming the 56F8346 internal flash block; however, this performance depends on your hardware.

The application's firmware is divided into two parts: the PC-CAN card and the target board CAN bootloader. The PC-CAN card firmware also consists of two parts: PC to PC-CAN card communication using RS232, which can be done using the serial bootloader for DSC, and the PC-CAN card to the target board communication via the CAN bus. PC terminal emulator freeware such as Tera Term implements the interface between the PC and PC-CAN card with Xon/Xoff protocol.

The bootloader of the target board configures the FlexCAN module in communication with PC-CAN card through the CAN bus. The bootloader polls the CAN port for messages. After a message is received, the bootloader attempts to decode the incoming commands for flash programming. After the internal flash has successfully downloaded the S-record, the bootloader jumps to the starting address of the new S-record. Figure 1 shows the simple configuration of hardware.

3 Hardware Requirements

The hardware required for configuration includes:

- Power supply
- CAN bus
- 56F8346EVB as target board
- 56F8346EVB as PC-CAN card.
- Terminal firmware for data transfer via RS232
  - Bits/sec: 115200
  - No parity: none
  - Stop bit: 1
  - Flow control: Xon/Xoff

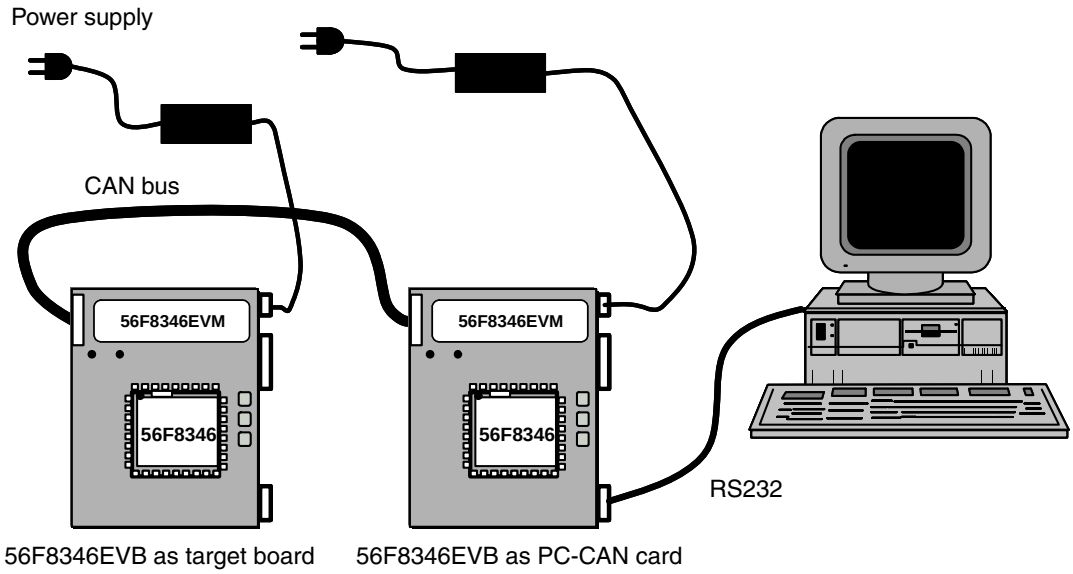

Figure 1. Hardware Configuration

4 FlexCAN

The FlexCAN (FC) module is a communication controller implementing the controller area network (CAN) protocol, an asynchronous communications protocol used in automotive and industrial control systems. It is a high-speed (1 Mbit/sec), short distance, priority-based protocol able to communicate using a variety of media. The FlexCAN module supports both the standard and extended identifier (ID) message formats specified in the CAN Protocol Revision 2.0 Specification, Part B. The CAN protocol was designed as a vehicle serial data bus, meeting the specific requirements of this field: real-time processing, reliable operation in the EMI environment of a vehicle, cost-effective, and required bandwidth. Knowledge of the CAN protocol, revision 2.0 is assumed. For details, refer to the CAN Protocol Revision 2.0 Specification. Figure 2 shows the FlexCAN module system block diagram.

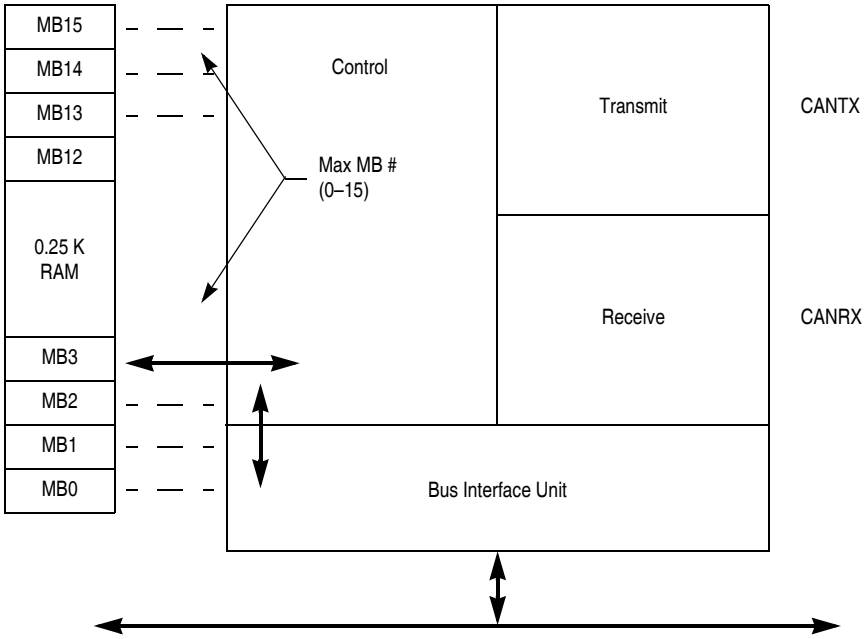

Figure 2. FlexCAN System Block Diagram

5 FlexCAN Module Configuration

Before configuring the FlexCAN module, evaluate your system specifications such as system propagation delay (wire length and transceiver delay), crystal tolerance, and re-synchronization jump width. To initialize the FlexCAN registers in CAN communication, you must define parameters such as baud rate, propagation segment (PS), time segment 1 (TS1) and time segment 2 (TS2). Unlike the MSCAN module, the FlexCAN module allows you to define the message buffer (MB) as either receive or transmit by changing the control bit in the corresponding FCMBx_Control register.

```
FCMB0_Control |= 0x0040;      // initialize MB0 for reception
FCMB0_Control |= 0x00C8;      // initialize MB0 for transmission with 8 bytes in data frame
```

The basic initialization for the registers:

```
void CanModInit(void)
{
    INT16U timer;

    SIM_PCE = SIM_PCE | 0x1000;          // enable peripheral clock

    FCMCR |= 0x0200;                     // software reset
    //initialize all operation modes
    FCCTL0 |= 0x0001;                    // PROPSEG = 2TQ
    FCCTL1 = 0x18FF;
    FCCTL0 &=~ 0x0010;                   // lowest ID is transmitted first
    FCMAXMB = 0x0001;                    // 2 MBs for use

    //initialize message buffer0
    FCMB0_Control = 0040;                // init MB0 for reception
    FCMB0_ID_HIGH = 0x2800;              // rec standard frame
    FCMB0_ID_LOW = 0x0000;
    FCMB0_DATA0 = 0;
    FCMB0_DATA1 = 0;
    FCMB0_DATA2 = 0;
    FCMB0_DATA3 = 0;

    //Initialize message buffer1
    FCMB1_Control = 0;
    FCMB1_ID_HIGH = 0;
    FCMB1_ID_LOW = 0;
    FCMB1_DATA0 = 0;
    FCMB1_DATA1 = 0;
    FCMB1_DATA2 = 0;
    FCMB1_DATA3 = 0;

    //clear HALF bit in FC_MCR
    FCMCR = 0x0;

    //initialize MASK registers
    FCRXGMASK_H = 0x0000;
    FCRXGMASK_L = 0x0000;
    cantx_IDH = 0x1800;

    timer = FCTIMER;                     // Read free running timer to unlock MB
}
```

6 PC-CAN Card Firmware

The PC-CAN card firmware is divided into two parts: PC to PC-CAN card communication using RS232 (serial communication) and PC-CAN card to target board communication via the CAN bus (PC-CAN Card to target board communication firmware). Figure 3 shows the system block diagram.

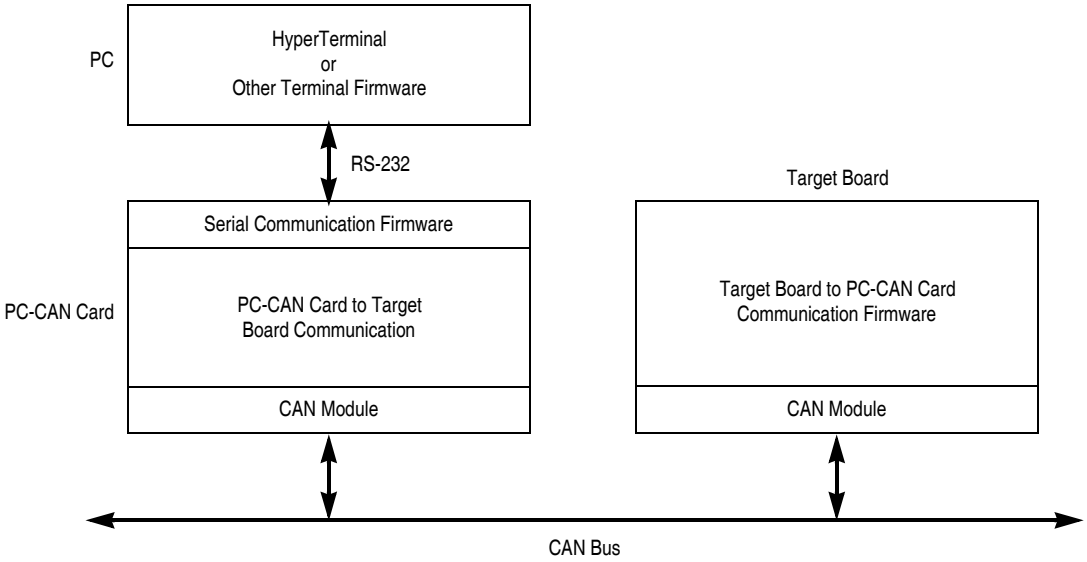

Figure 3. PC-CAN System Block Diagram

6.1 Serial Communication Firmware

The serial communication interface module allows asynchronous serial communication with peripheral devices and other CPUs. It also communicates with PC's RS232 interface. It requires the RS232 transceiver to connect with DSC 56F8346 TXD0 and TXD1 pins. DSC56F8346EVM is connected to the RS232 transceiver with a 9-pin socket (DTE). It uses a 9-pin serial cable to connect the PC and DSC56F8346EVM. The communication protocol is configured as 115200 bits/sec, with no parity, and one stop bit with Xon/Xoff protocol. The SCI communication was done from serial bootloader (83xx_bootloader.pdf), which helps receive S-records from the PC and stores them in the RAM buffer so they can be transmitted to the target board via the CAN bus. The serial bootloader firmware communicates with the PC through Xon/Xoff protocol and receives the S-record content from PC to DSC56F8346EVM internal buffer array, which is retrieved by "bootMemoryWrite" subroutine for target board.

This firmware also detects whether the internal flash block of the target board is blank. It protects the target board flash, which will not be erased accidentally. Figure 4 shows the flowchart for the firmware starts.

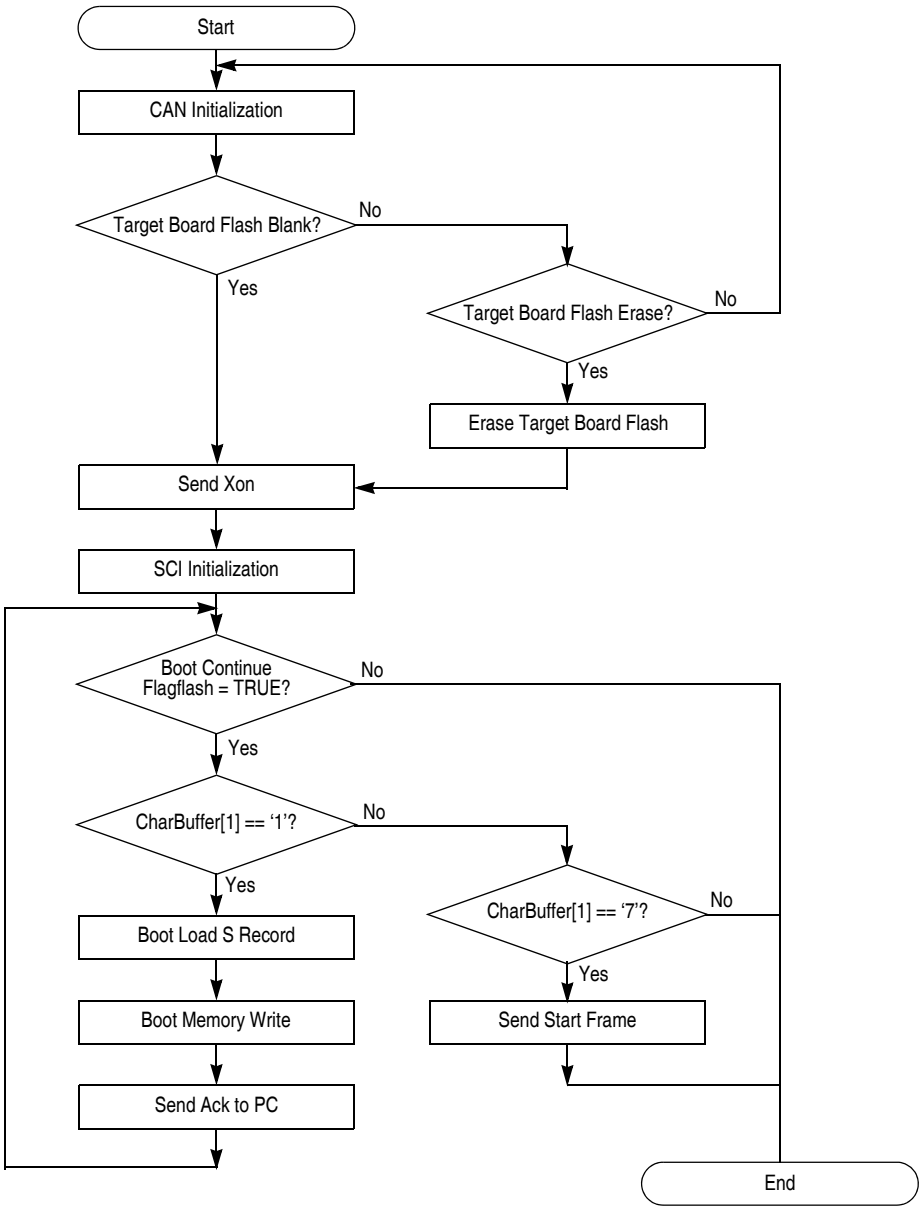

Figure 4. Serial Communication Firmware Starts

6.2 Target Board to PC-CAN Card Communication Firmware

The FlexCAN communication interface module allows an asynchronous communication protocol to and from CAN bus. The target board firmware is located next to the boot flash block. It will be invoked after reset if the state of the hardware pin (Port E bit 7) is set to high. The target board runs its application code if the state of the hardware pin is set to low.

In the target board, the bootloader is held in the DSC for future use. In this application, the bootloader code is running at the boot flash block to receive the data from PC-CAN card firmware through the CAN bus.

Figure 5 shows the flowchart for the firmware starts.

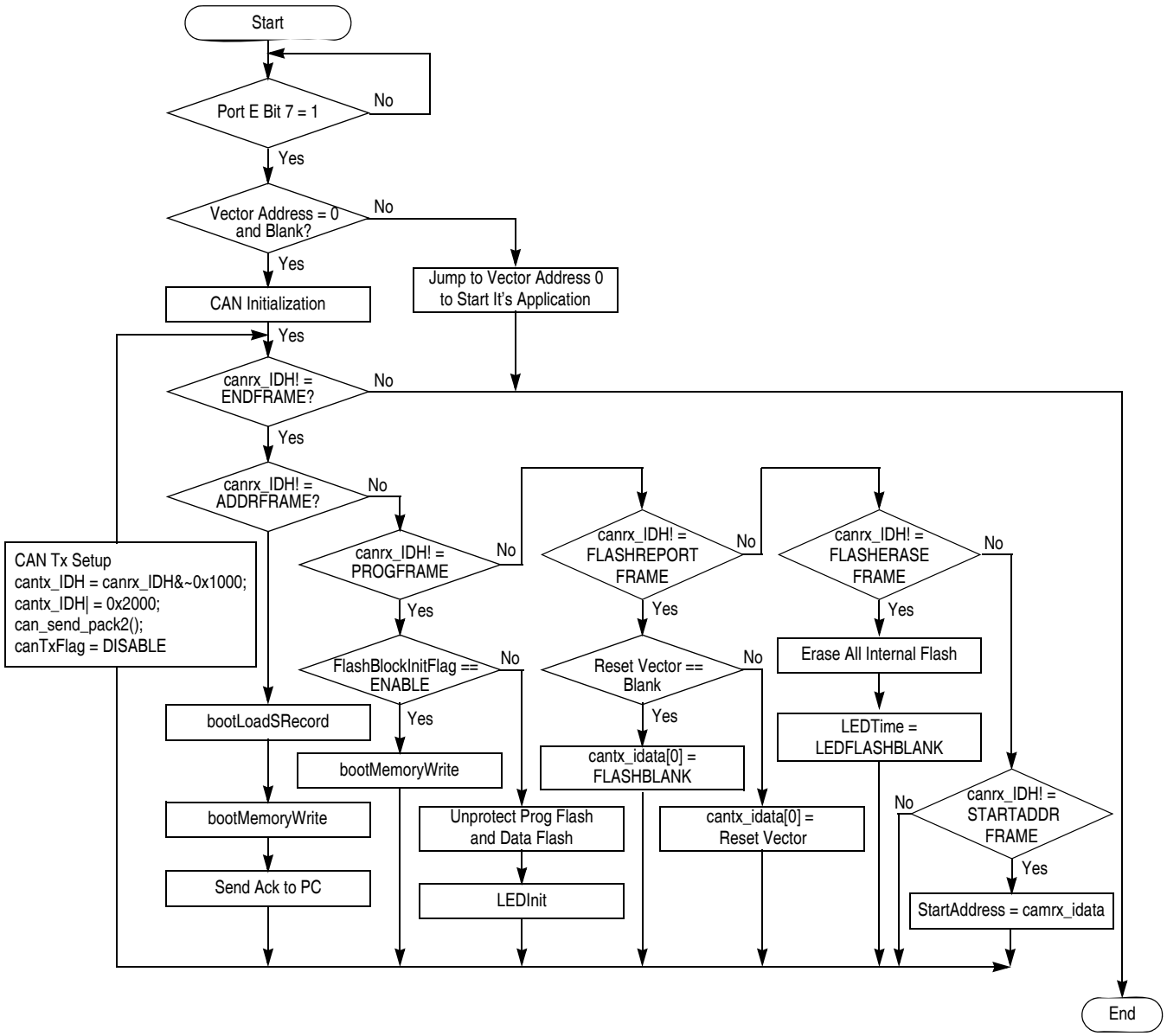

Figure 5. Target Board to PC-CAN Card Firmware Starts

6.3 Firmware Downloading Procedures

1. Download the PC-CAN card firmware.
   a) Connect 56F8346EVB as PC-CAN card.

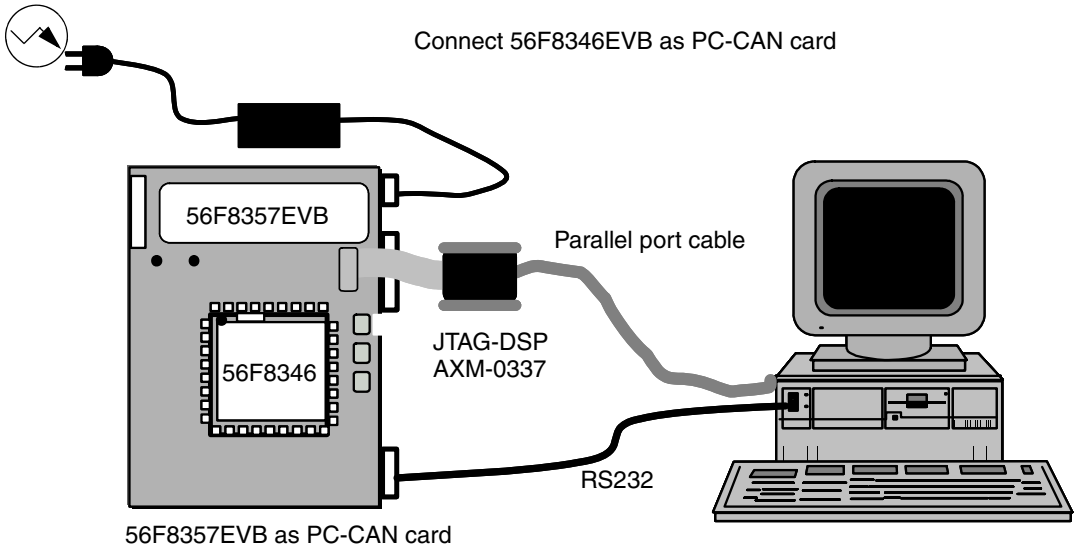

Figure 6. Hardware Configuration—Step 1a

   b) Select 56F8346 PC-CAN card as the target project.
   c) Click the debug icon to download the code to PC-CAN.

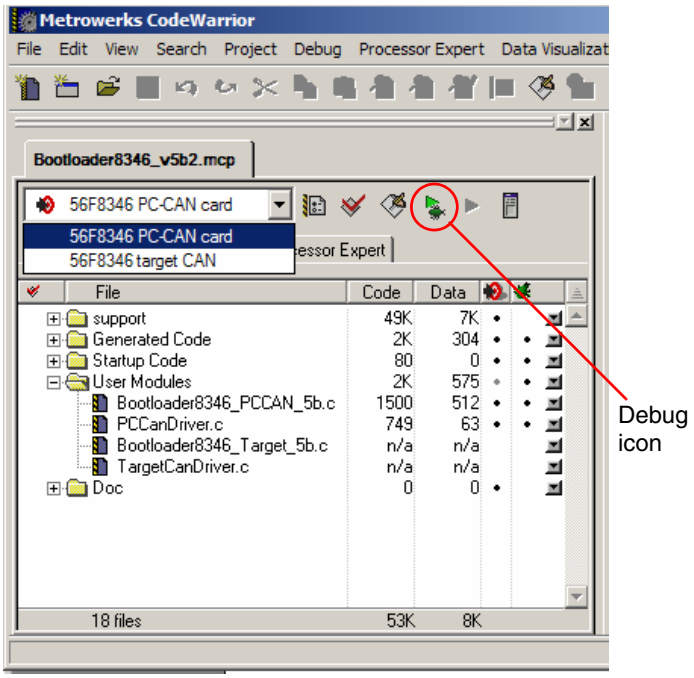

Figure 7. Metrowerks CodeWarrior—Steps 1b and 1c

2. Download the target board firmware.
   a) Connect 56F8346EVB as the target board.

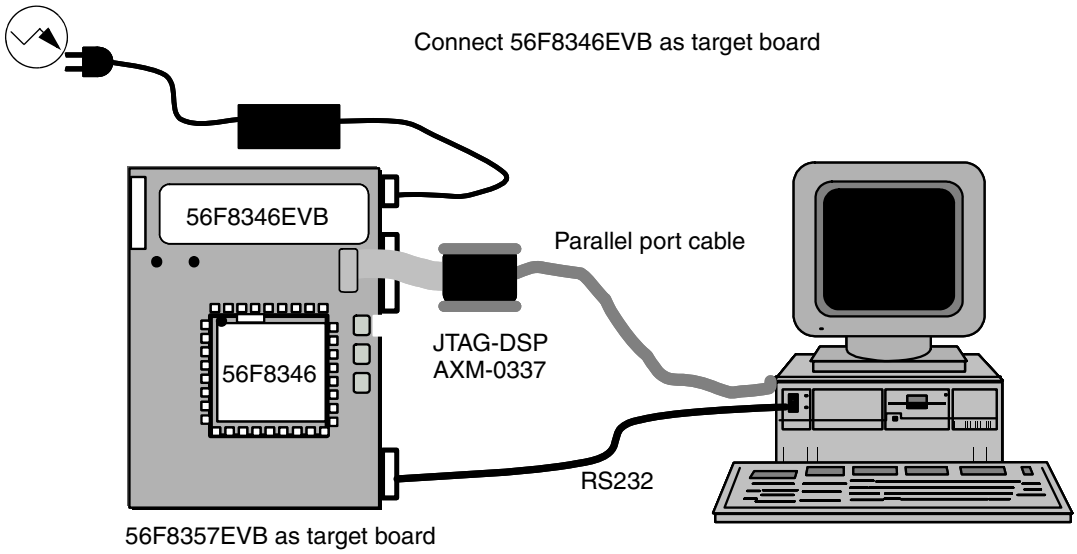

Figure 8. 56F8346EVB as the Target Board

   b) Select 56F83456 target CAN.
   c) Click the debug icon to download the code to the target board.

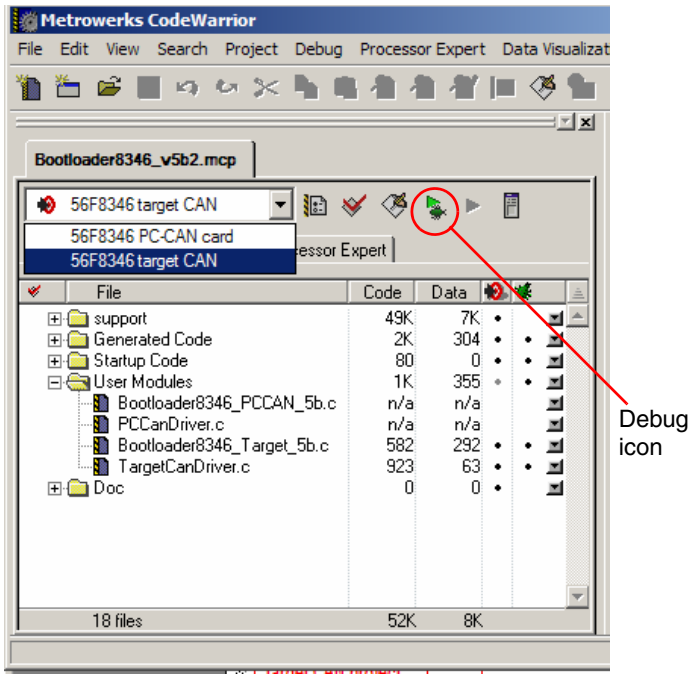

Figure 9. Metrowerks CodeWarrior—Steps 2a and 2b

3. Configure hardware.

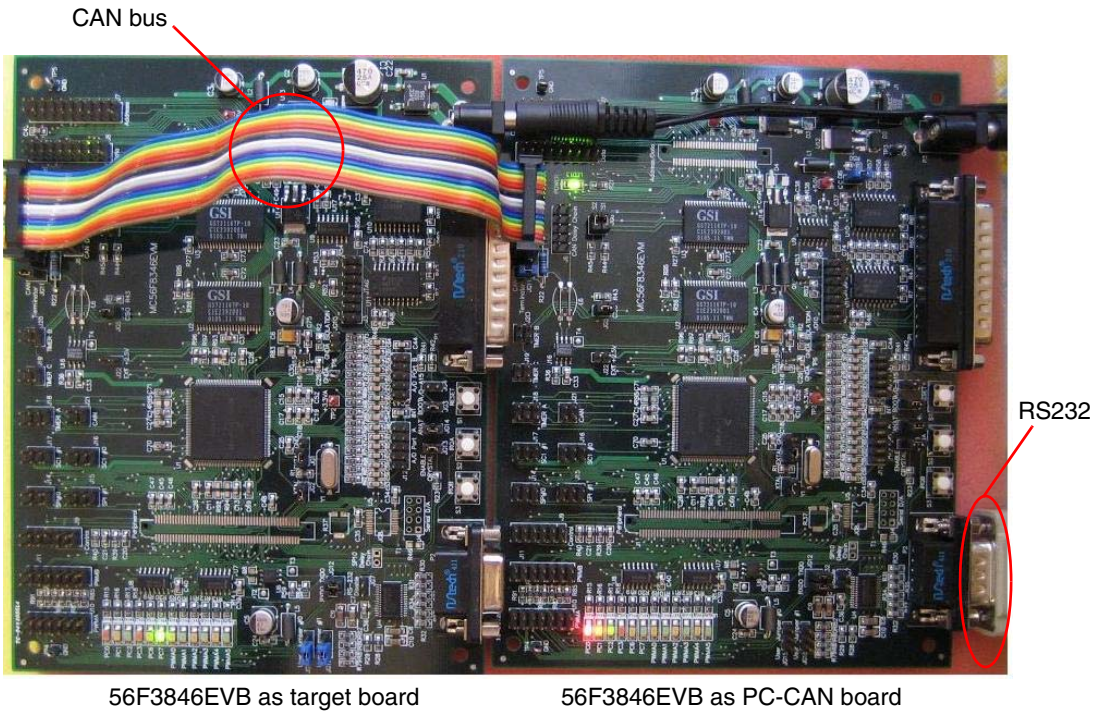

Figure 10. Hardware Configuration Photo

a) Connect 56F8346EVB (PC-CAN card) to 56F8346EVB (target board).

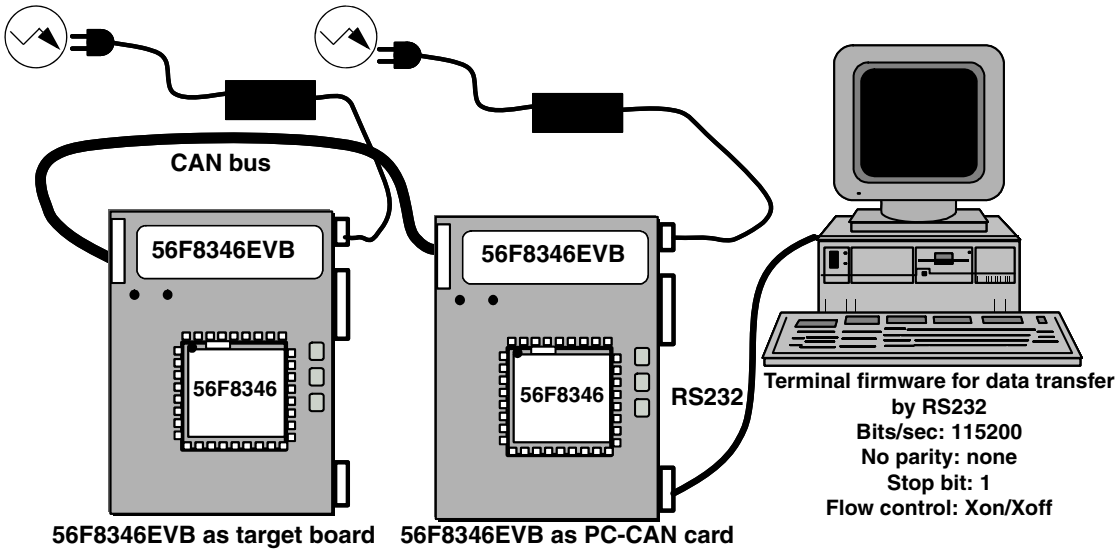

Figure 11. Hardware Configuration—PC-CAN to Target Board

6.4 S Record Downloading via PC-CAN Card Procedures

1. Invoke Tera Term.
   a) Select Serial port.

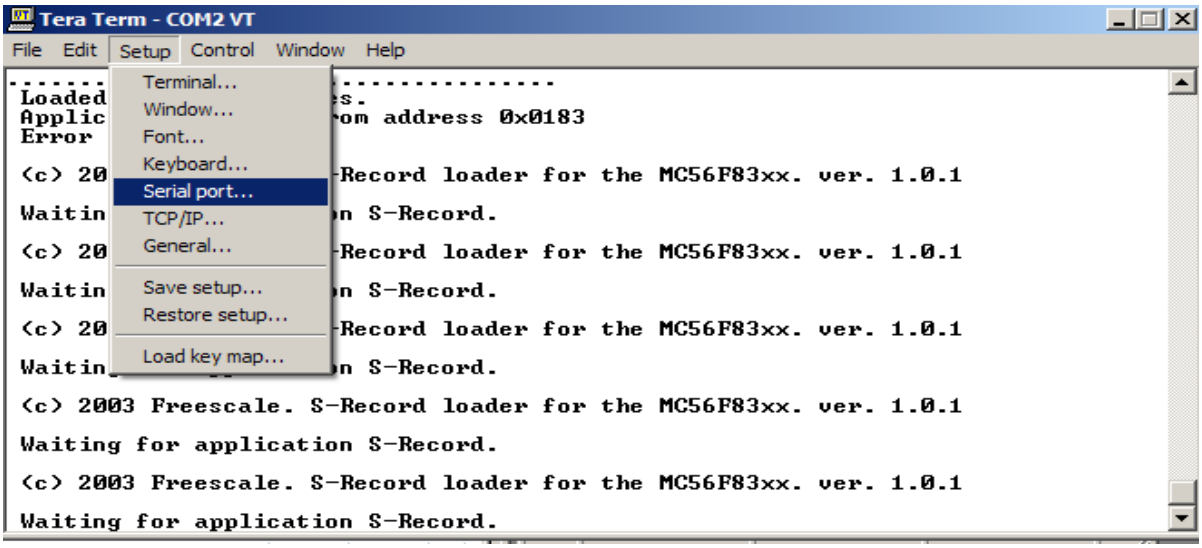

Figure 12. Tera Term—Step 1a

2. Configure Tera Term.
   a) Select COM port and the corresponding parameters.

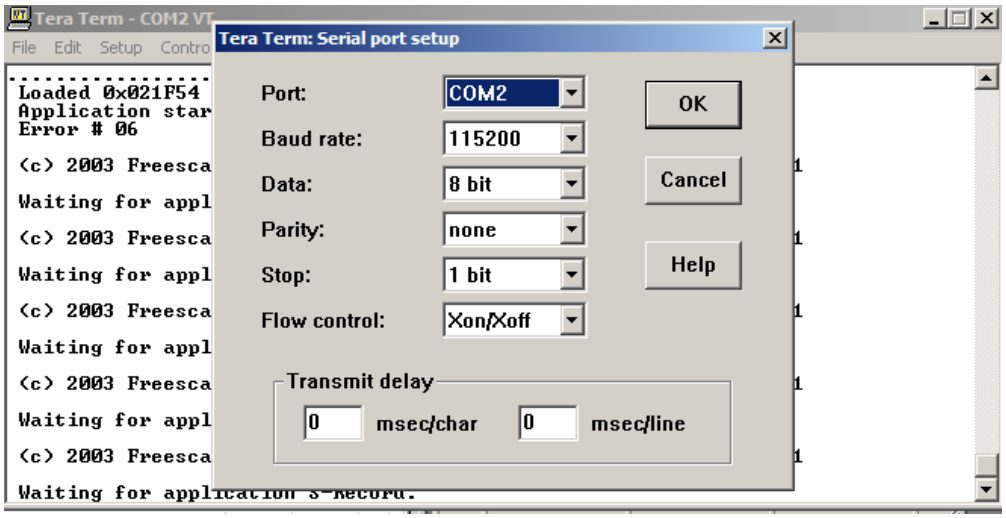

Figure 13. Tera Term—Step 2a

3. Send S-record through Tera Term.
   a) Under the File pull-down menu, select Send file.

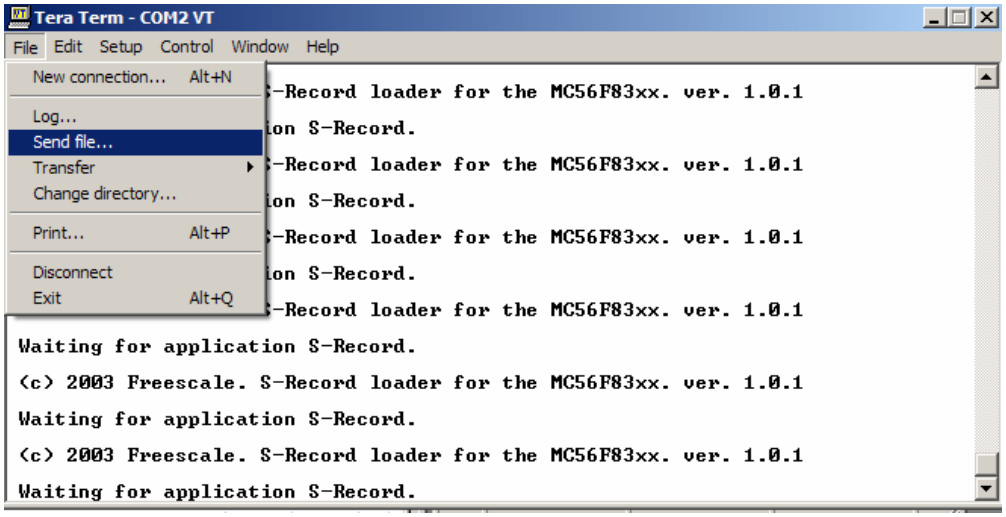

Figure 14. Tera Term—Step 3a

   b) Use CheckFlash_v2.mcp project to monitor the internal flash data integrity. Select CheckFlash_v2\Debug\56F834x_flash.elf.s and click Open to send the S-record.

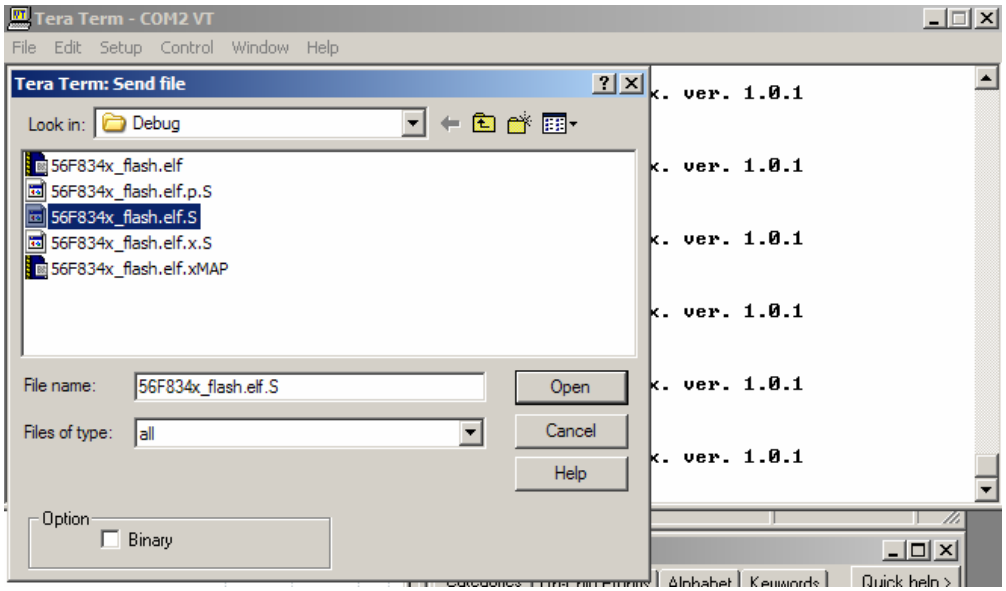

Figure 15. Tera Term—Step 3b

4. S-Record is downloaded through Tera Term.

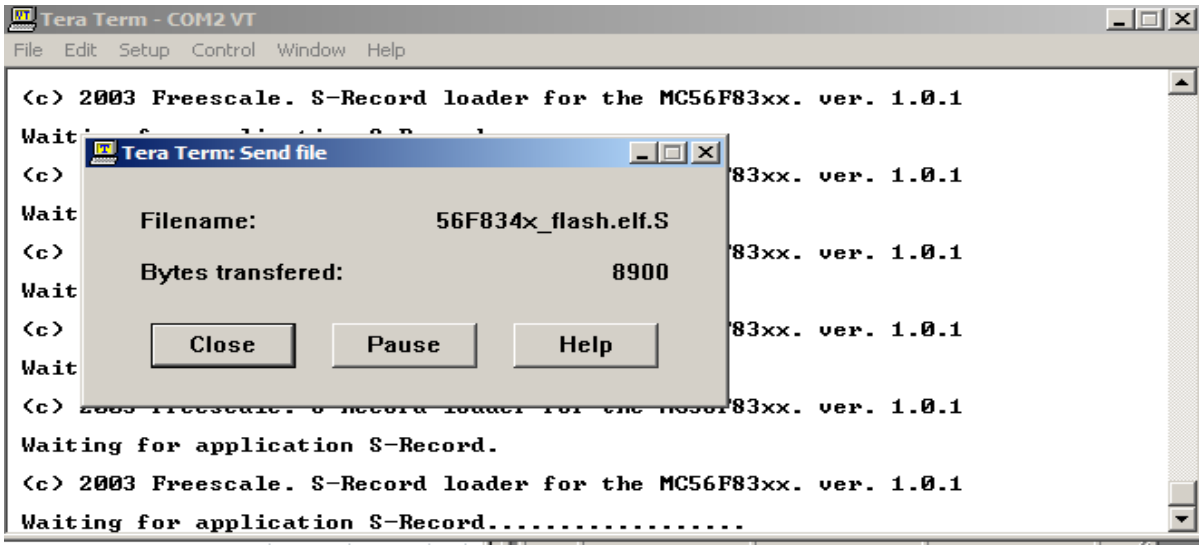

Figure 16. Tera Term—Step 4

5. S-record downloading is complete.

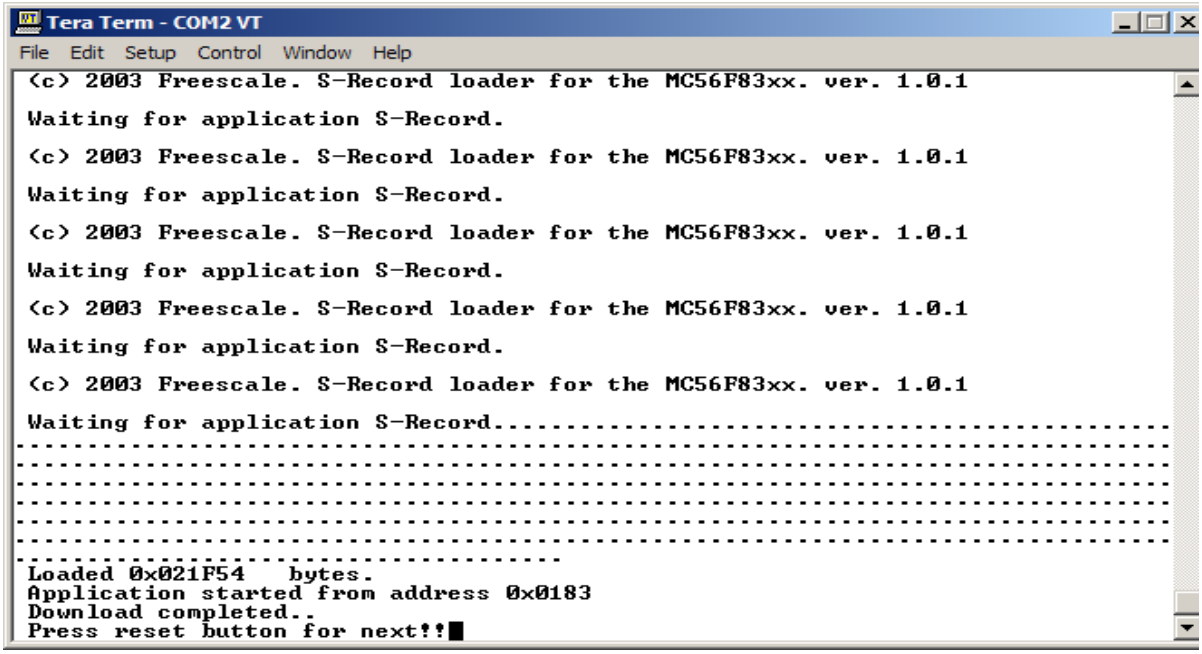

Figure 17. Tera Term—Step 5

a) When the target program is running, the LED (PEC2) blinks to indicate the flash board was verified.

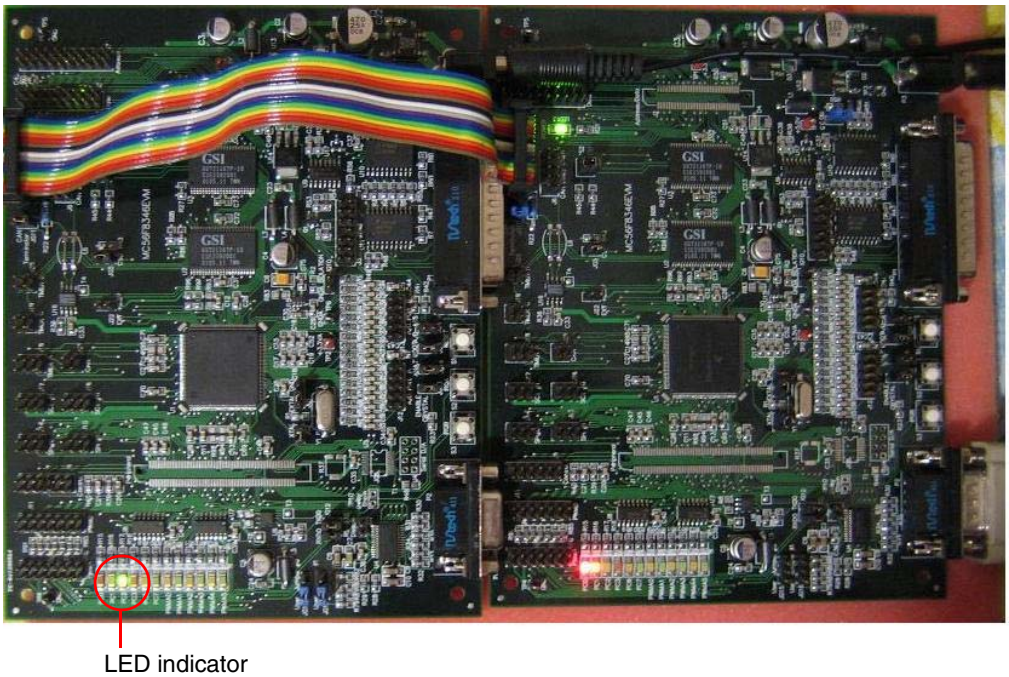

Figure 18. LED Indicator—Step 5a

6. During reset, select bootloader in target board.
   a) Use JG16 (PE7) to select the target board, running internal program flash or internal boot flash. Select JG16 (1-2) for internal program flash. Select JG16 (2-3) for internal boot flash.

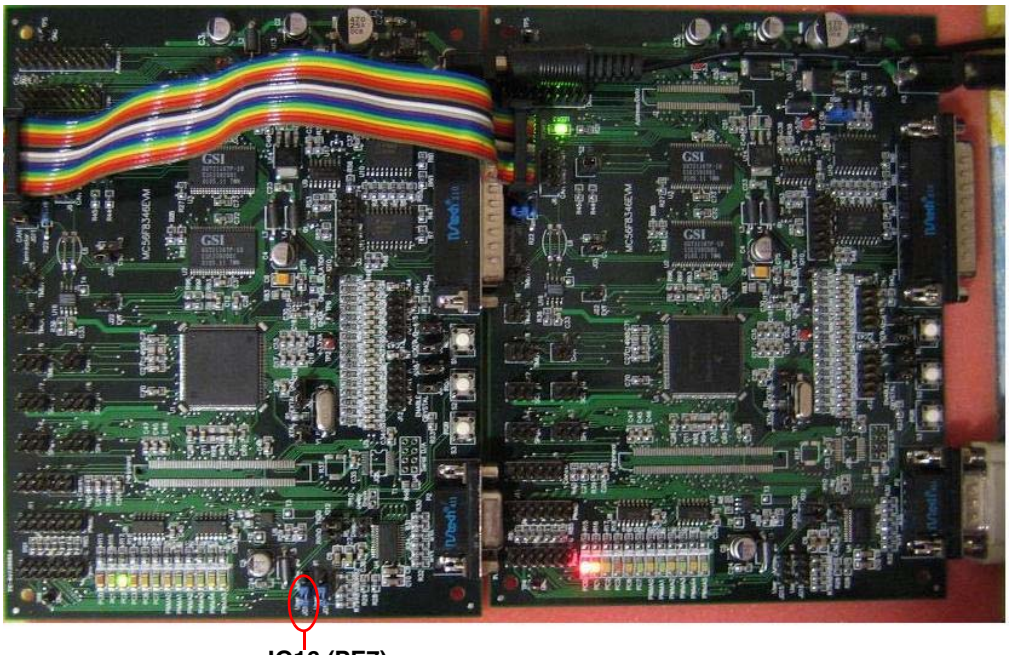

Figure 19. Hardware Configuration—Step 6a

7. Use PC-CAN card to erase the target board internal flash.
   a) Press the reset button of the PC-CAN card to restart PC-CAN card firmware. The symbol ">" indicates the PC-CAN card will search the target device because the target device is running on its own application code.
   b) On the target board, select JG16 (2–3) and press the reset button of the target board to select internal boot flash.
   c) The PC-CAN card will stop and display "Target Flash is not blank!! Would you like to erase (Y/N)"

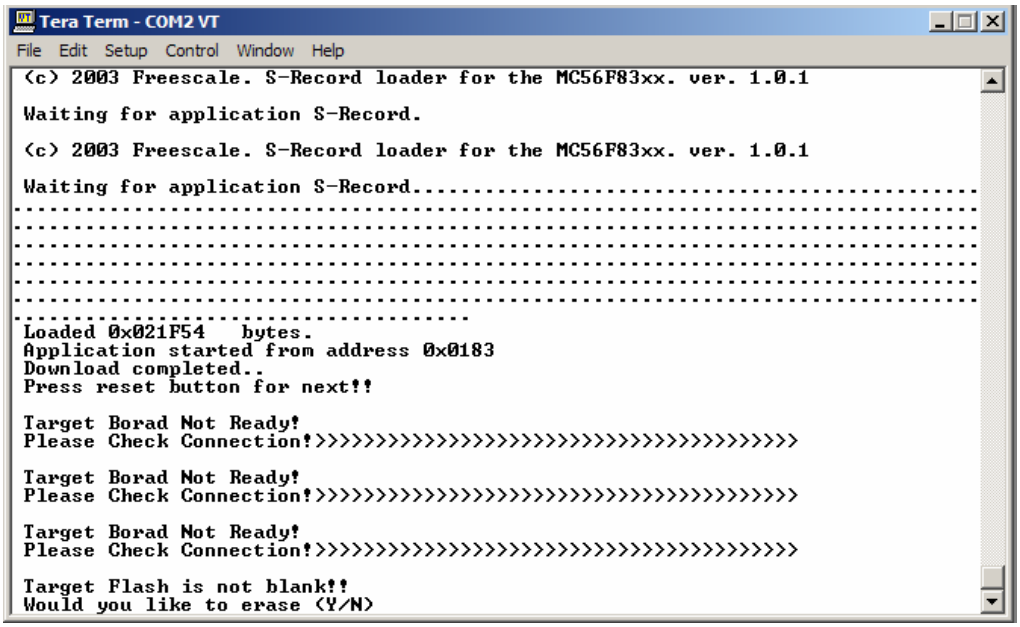

Figure 20. Tera Term—Steps 7a and 7c

8. The PC-CAN card sends the next S-record to the target board.
   a) Type “y” to erase the internal flash and download again.
   b) The PC-CAN can repeat the process to download the S-record to other target devices.

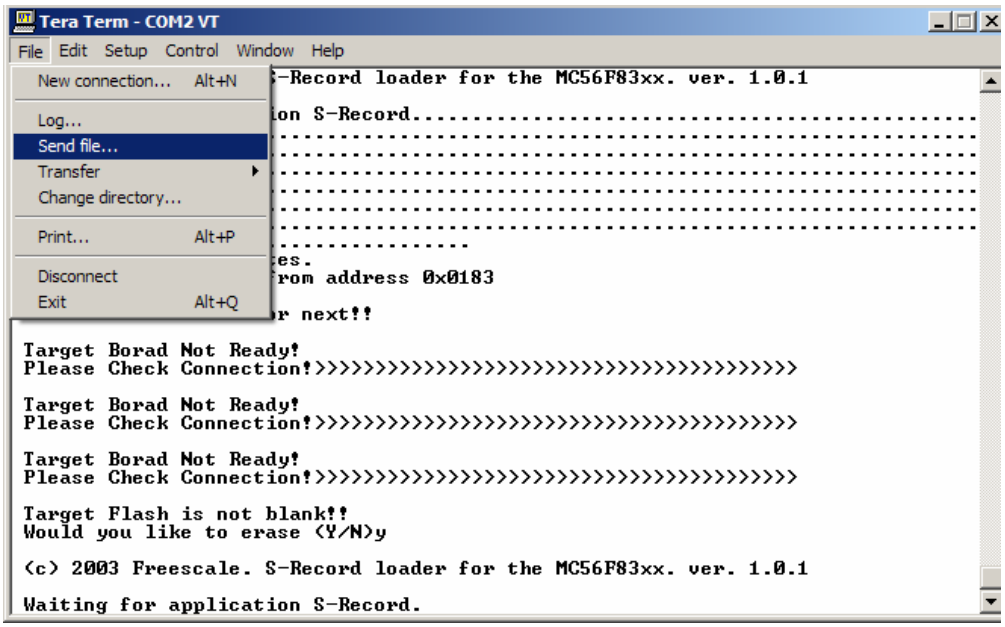

Figure 21. Tera Term—Step 8a

The application software, AN3312SW, may be downloaded from the Freescale Web site.

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