



HCTL-IP RAID0x8 Demo Instruction

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HCTL-IP RAID0x8 Demo Instruction

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This document describes the instruction to run 8-ch RAID0 by using SATA HCTL-IP on FPGA development board and AB09-FMCRAID board. The demo is designed to write/verify data with eight SATA-III devices. User controls test operation through Serial console.

1 Environment Setup

To run the demo on FPGA development board, please prepare following hardware.

- 1) Supported FPGA Development board: ZCU102, KCU105
- 2) PC with Xilinx programmer software (Vivado) and Serial console software such as HyperTerminal
- 3) AB09-FMCRAID board, provided by Design Gateway
- 4) Power supply connecting to power connector on FMCRAID board to be SATA device power
- 5) Eight SATA-III devices connecting at CN0-CN7 of FMCRAID board
- 6) Xilinx Power adapter for Xilinx board
- 7) Two micro USB cables for programming FPGA and Serial console connecting between FPGA Development board and PC

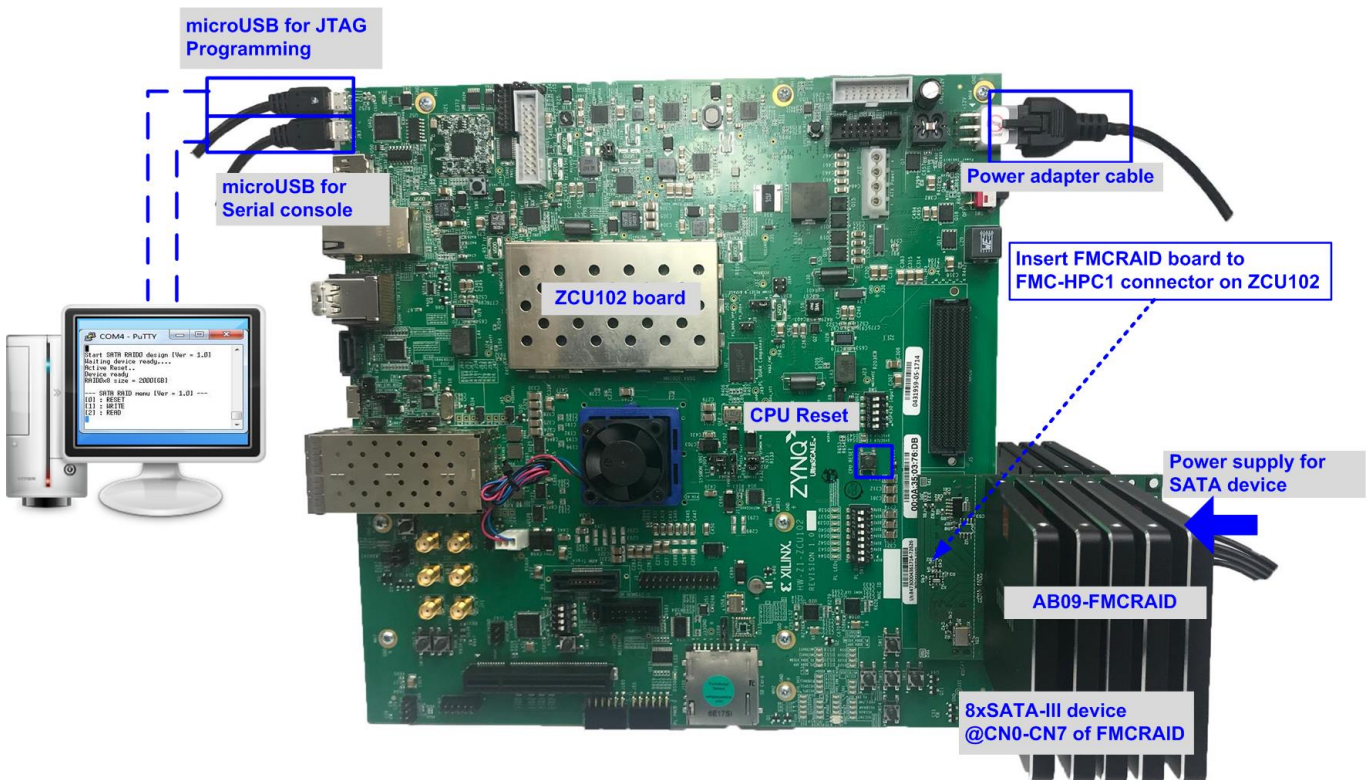


Figure 1-1 HCTL-IP RAID0 demo setup on ZCU102

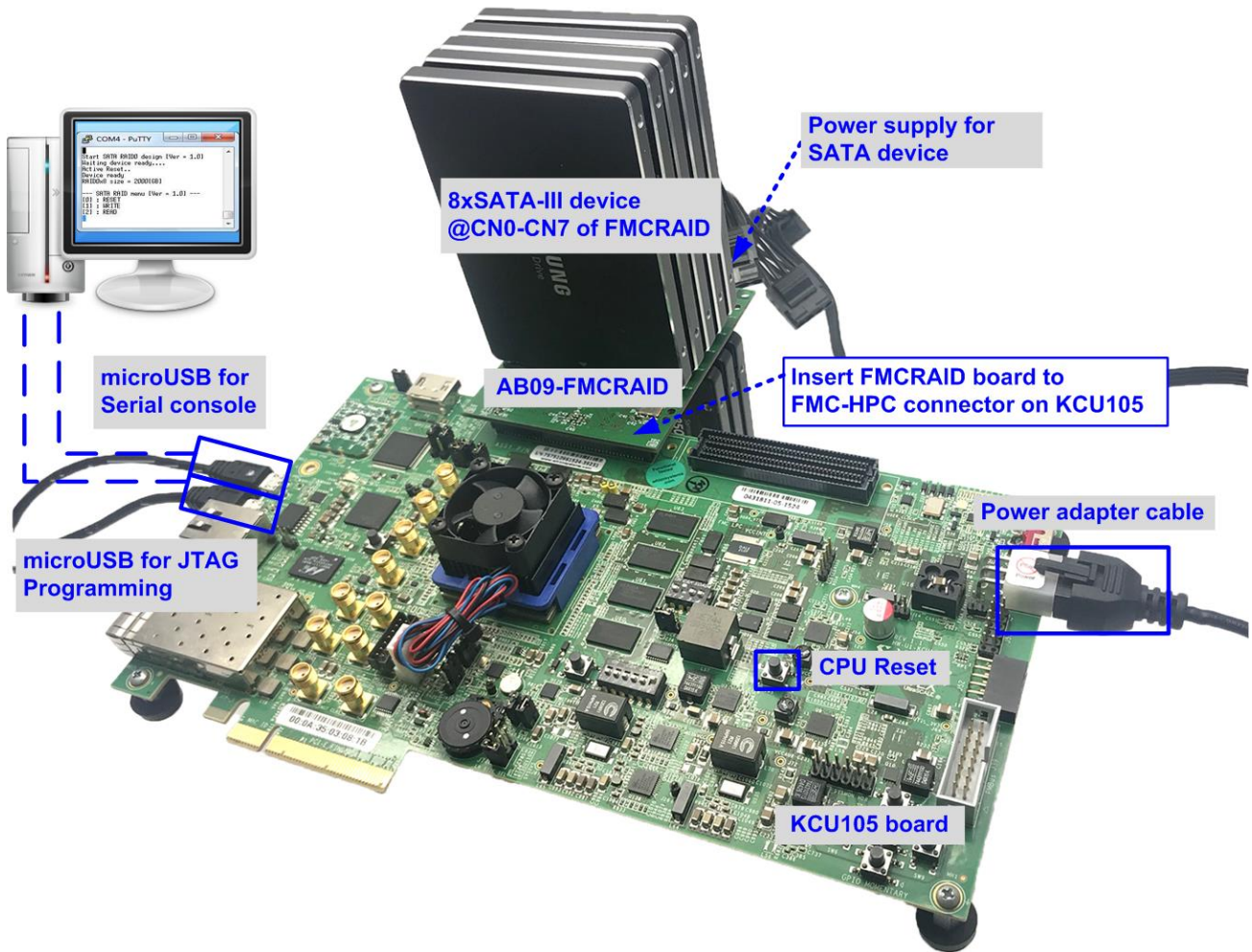


Figure 1-2 HCTL-IP RAID0 demo setup on KCU105

2 Demo setup

- 1) Power off system.
- 2) For ZCU102 board, set SW6="0000" (SW = ON) to configure PS from JTAG, as shown in Figure 2-1.



Figure 2-1 SW6 setting to configure PS from JTAG on ZCU102

- 3) Connect AB09-FMCRAID board to FMC-HPC(1) connector on FPGA development board.
- 4) Connect eight SATA-III devices to CN0-CN7 on FMCRAID board.
- 5) Connect power to power connector on FMCRAID board.

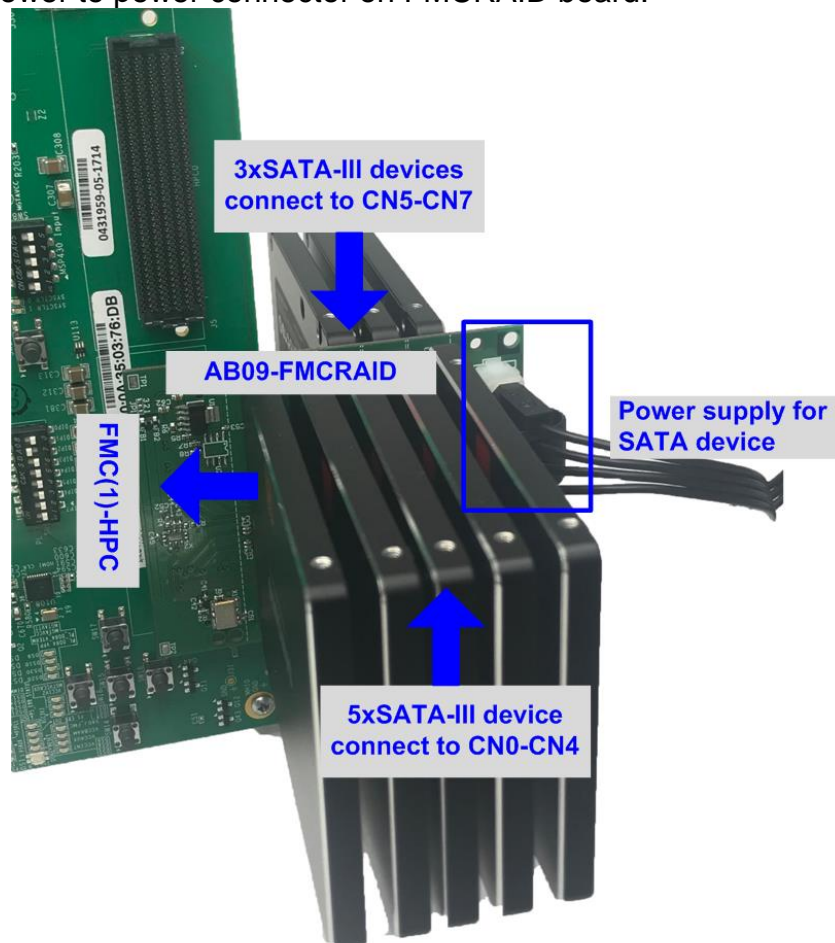


Figure 2-2 AB09-FMCRAID connection

- 6) Connect two micro USB cables from Xilinx development board to PC for JTAG programming and Serial console.

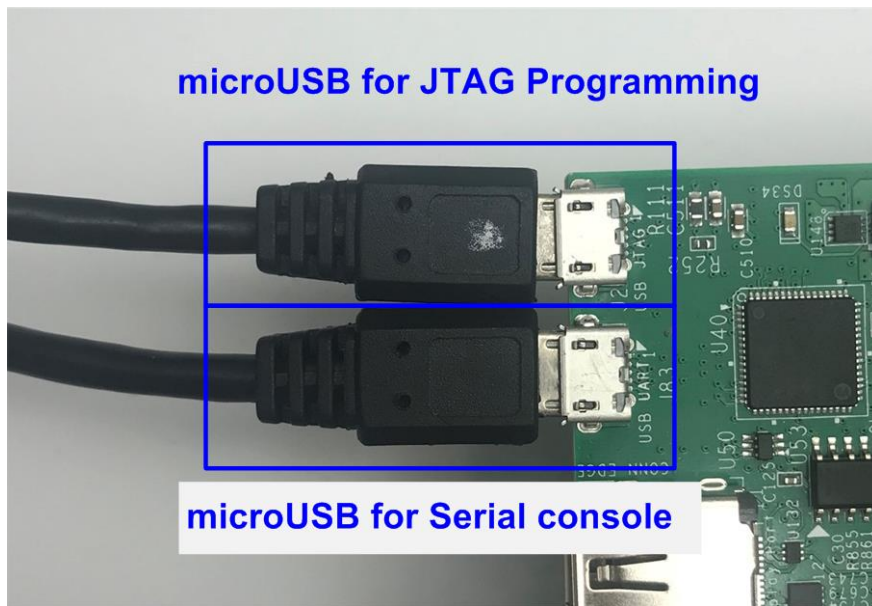


Figure 2-3 USB cable connection

- 7) Power on FPGA development board and power supply for SATA device.
- 8) Open Serial console such as TeraTerm, HyperTerminal and set Baud rate=115,200 Data=8 bit Non-Parity Stop=1.
- 9) Download configuration file and CPU firmware to FPGA
 - a) For ZCU102 board, open Vivado TCL shell and change current directory to ready_for_download. Then, run xxx_HSATARaid0x8.bat as shown in Figure 2-4. For example, type zcu102_HSATARaid0x8.bat.
 - b) For KCU105 board, program the configuration file which includes CPU firmware by using Vivado tool, as shown in Figure 2-5

```
C:\ Vivado 2017.4 Tcl Shell - C:\Xilinx\Vivado\2017.4\bin\vivado.bat -mode tcl
Vivado% cd D:/SATA/sataRaid8/HSATARaid0x8 ZCU102 FMCb/ready_for_download
Vivado% zcu102_HSataRaid0x8.bat
```

Go to ready_for_download directory

Run script file to download bit and elf file

Figure 2-4 Command script for download demo file to ZCU102 by Vivado tool

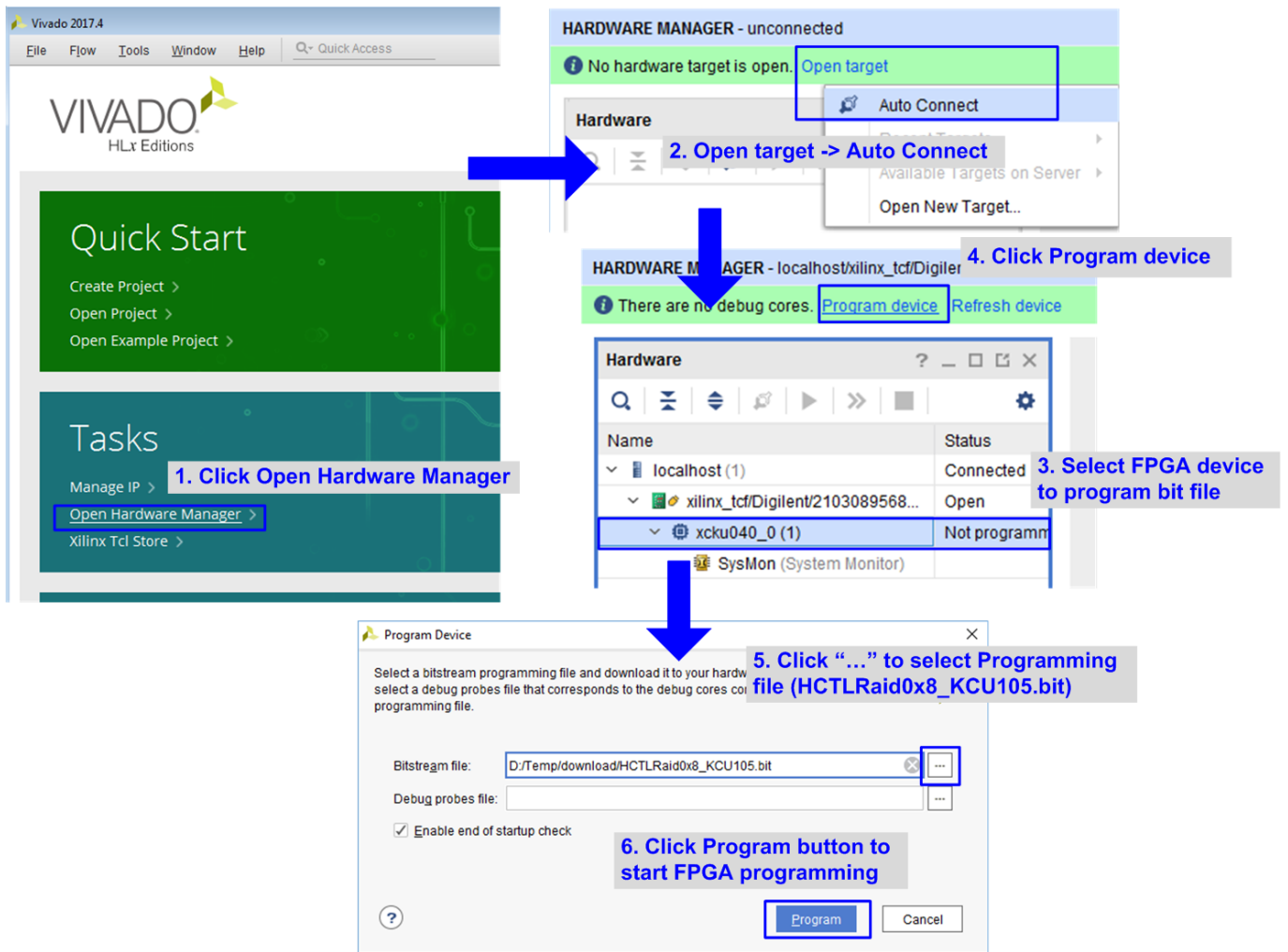


Figure 2-5 Program the configuration file to KCU105 by Vivado tool

10) Check LED status on Xilinx development board. The description of LED is shown in Table 2-1.

Table 2-1 LED Definition

GPIO LED	ON	OFF
0	Normal operation	System is in reset condition
1	System is busy	Idle status
2	Error detect	Normal operation
3	Data verification fail	Normal operation

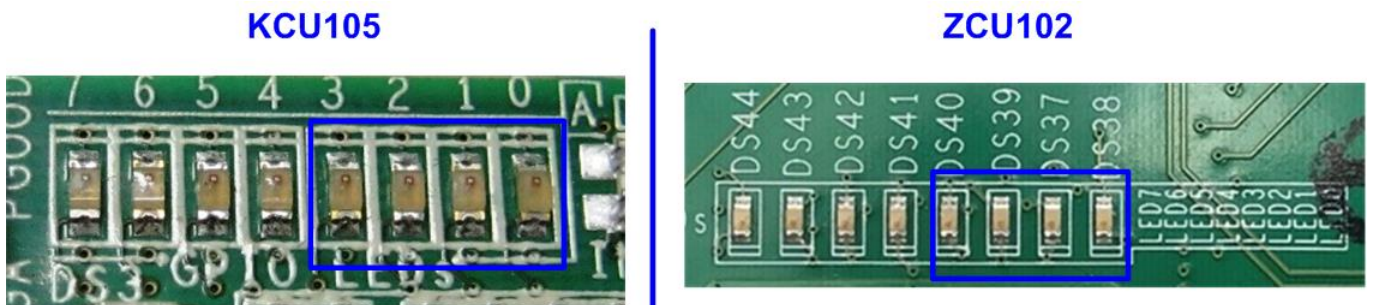


Figure 2-6 4-bit LED Status for user output

11) After programming completely, LED[0] and LED[1] are ON during RAID0 initialization process. Then, LED[1] changes to OFF to show that RAID0 completes initialization process and system is ready to receive command from user. After that, main menu is displayed as shown in Figure 2-8.

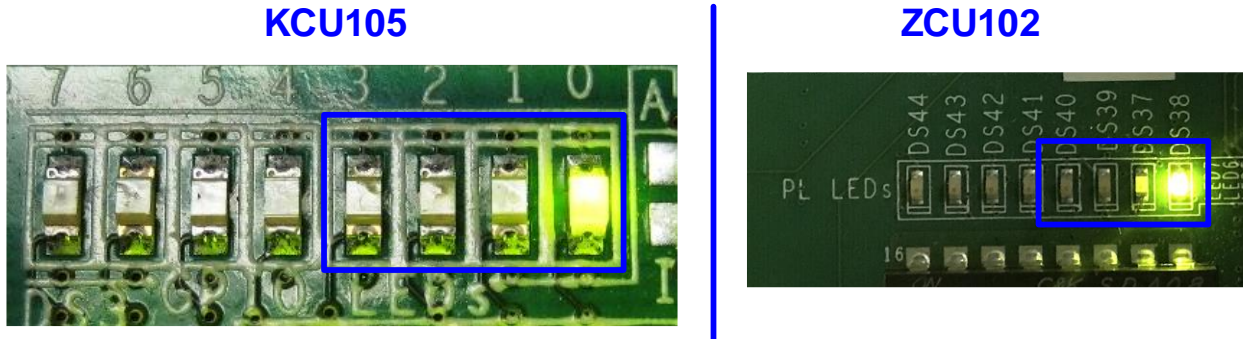


Figure 2-7 LED status after program configuration file and RAID0 initialization complete

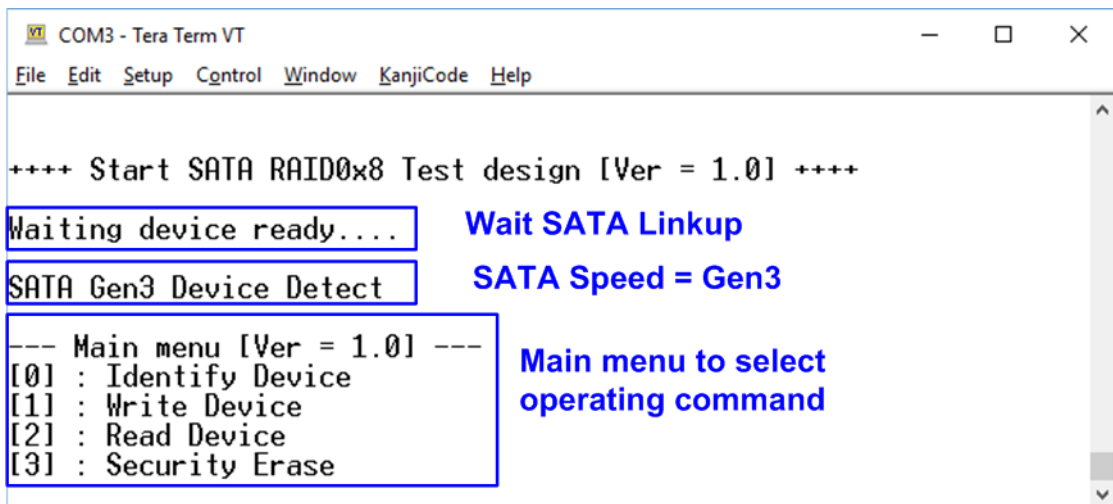


Figure 2-8 Main menu after program configuration file and RAID0 initialization complete

12) If some SATA devices are not detected, “CH[0-7] Not Detect” will be displayed as shown in Figure 2-9. CH[0]-[7] is referred to SATA channel which has found the error. Please check SATA device in error channel.

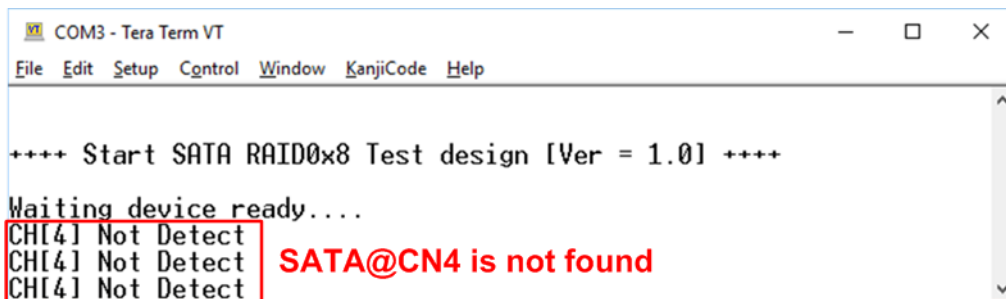


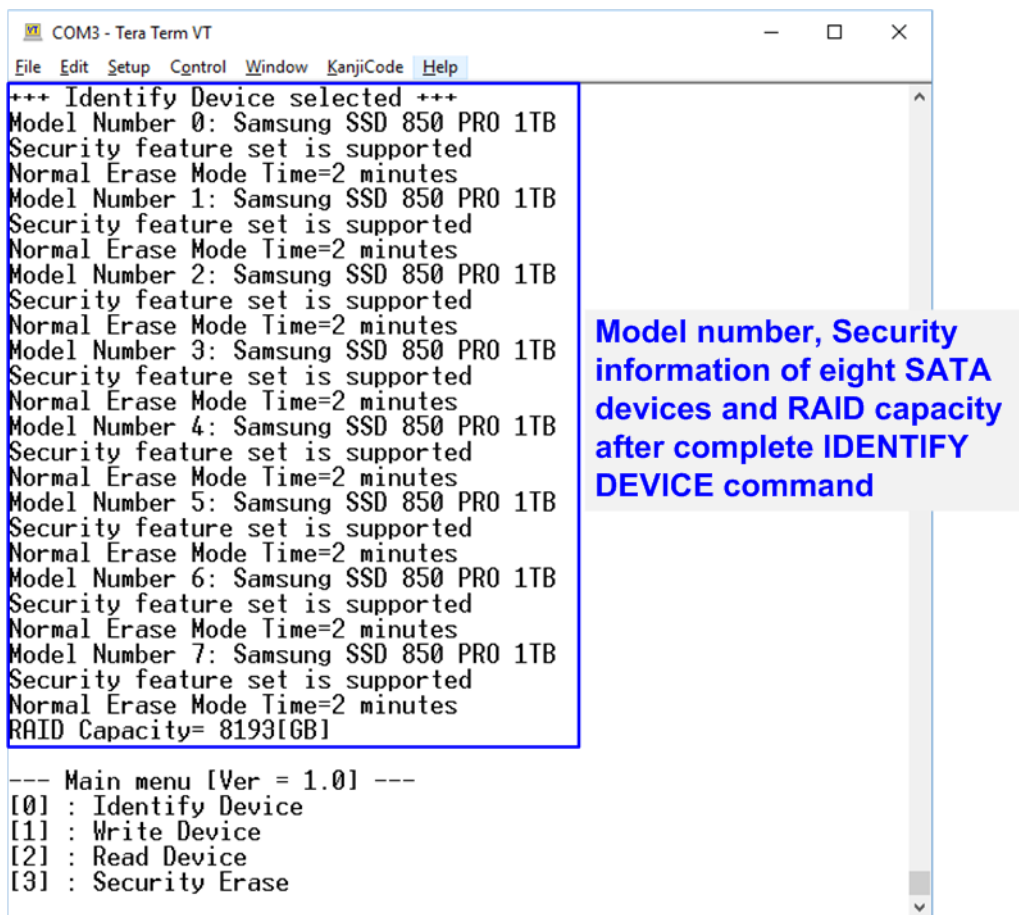
Figure 2-9 Error message when some devices are not detected

3 Test Menu

3.1 Identify Device

Select '0' to send Identify device command to RAID0. When operation is completed, all information is displayed on the console, i.e.

- 1) SSD model number
- 2) Security feature set is supported or not. If some devices are not supported, user must not run menu 3 to test Security erase command.
- 3) Normal Erase Mode Time: This is estimation time to complete Security erase command. Minimum valid value is 2 minutes. This information is displayed when the device supports Security feature set.
- 4) SSD capacity which is output value from RAID0 block. The value is equal to eight times of SATA CH#0 capacity.



```

COM3 - Tera Term VT
File Edit Setup Control Window KanjiCode Help
+++ Identify Device selected +++
Model Number 0: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 1: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 2: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 3: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 4: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 5: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 6: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
Model Number 7: Samsung SSD 850 PRO 1TB
Security feature set is supported
Normal Erase Mode Time=2 minutes
RAID Capacity= 8193[GB]

--- Main menu [Ver = 1.0] ---
[0] : Identify Device
[1] : Write Device
[2] : Read Device
[3] : Security Erase

```

Figure 3-1 Result from Identify Device menu

3.2 Write Device

- Select '1' to send Write command to RAID0. Three inputs are required for this menu.
- 1) Start LBA: Input start address of RAID0 in sector unit. The input is decimal unit when input only digit number. User can add "0x" to be prefix when input is hexadecimal unit.
 - 2) Sector Count: Input total transfer size in sector unit. The input is decimal unit when input only digit number. User can add "0x" to be prefix when input is hexadecimal unit.
 - 3) Test pattern: Select test pattern of test data for writing to RAID0. Five types can be selected, i.e. 32-bit increment, 32-bit decrement, all 0, all 1, and 32-bit LFSR counter.

As shown in Figure 3-2, if all inputs are valid, the operation will be started. During writing data, current transfer size is displayed to the console to show that system still be alive. Finally, test performance, total size, and total time usage are displayed on the console as test result.

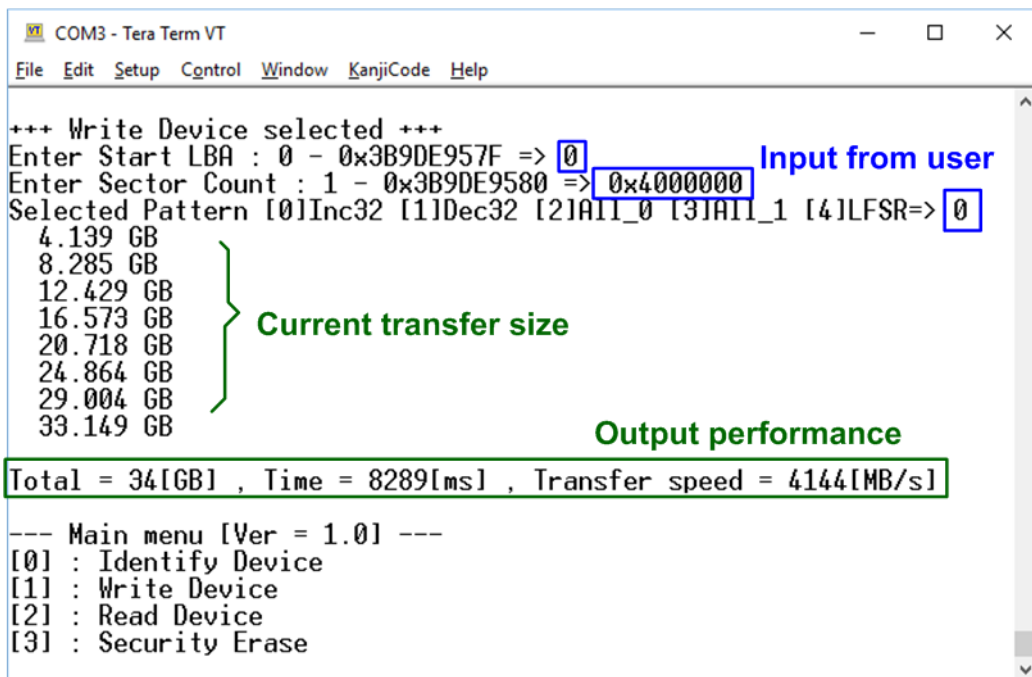


Figure 3-2 Input and result of Write Device menu

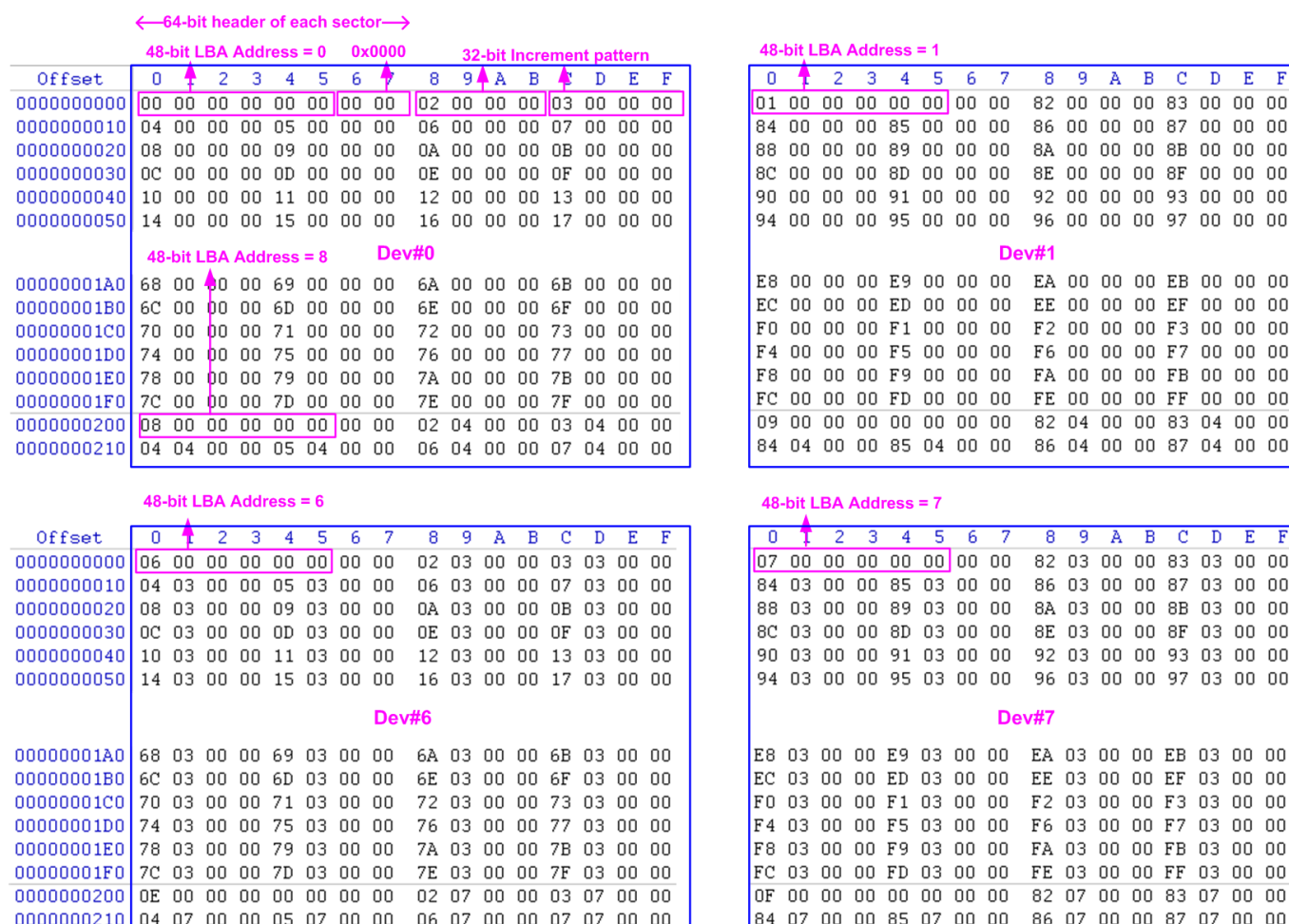


Figure 3-3 Example Test data in sector#0/#1 of Dev#0/#1/#6/#7 by increment pattern

Test data of each sector has different 64-bit header which consists of 48-bit LBA address and 16-bit all 0 value. 48-bit LBA address is unique value for each sector. After that, the test pattern is filled following user selection such as 32-bit increment pattern (as shown in Figure 3-3).

Stripe size in 8-ch RAID0 demo is 1 sector (512-byte). So, LBA address in the header of 1st sector in Disk#0 - Disk#7 are equal to 0 - 7 sequentially. The address in the header of the next sector for Disk#0 is 8.

Figure 3-4 – Figure 3-6 show error message when user input is invalid. “Invalid input” is displayed on the console. Then, it returns to main menu to receive new command.

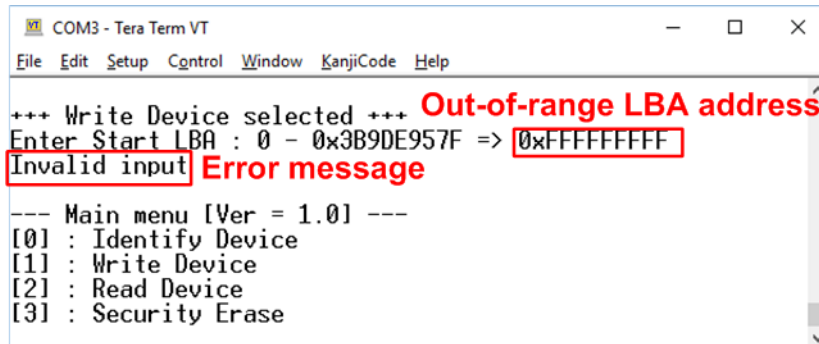


Figure 3-4 Invalid Start LBA input

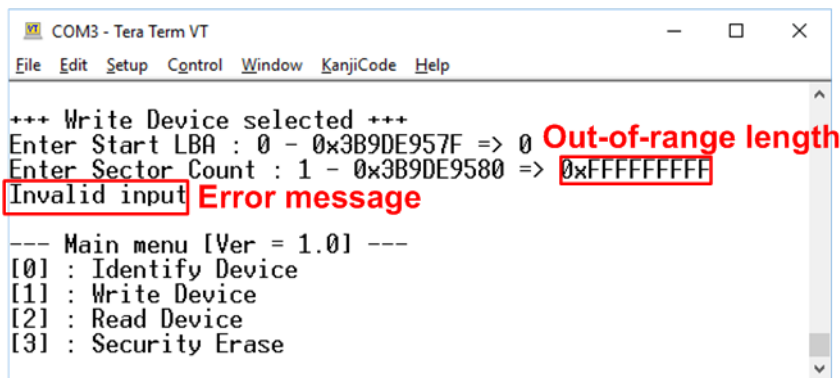


Figure 3-5 Invalid Sector count input

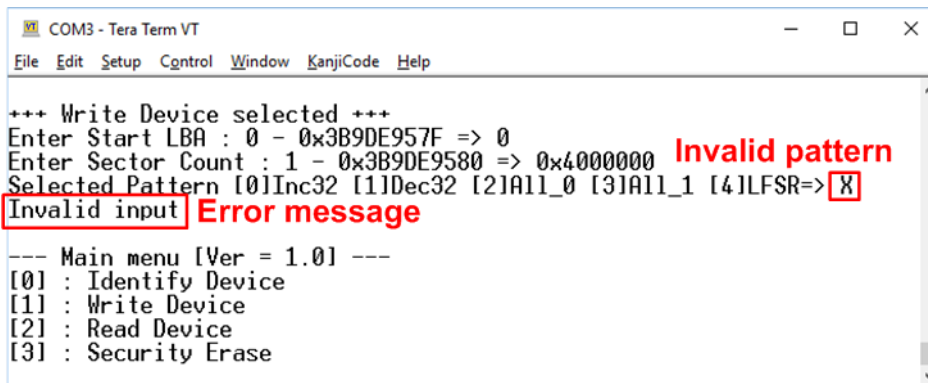


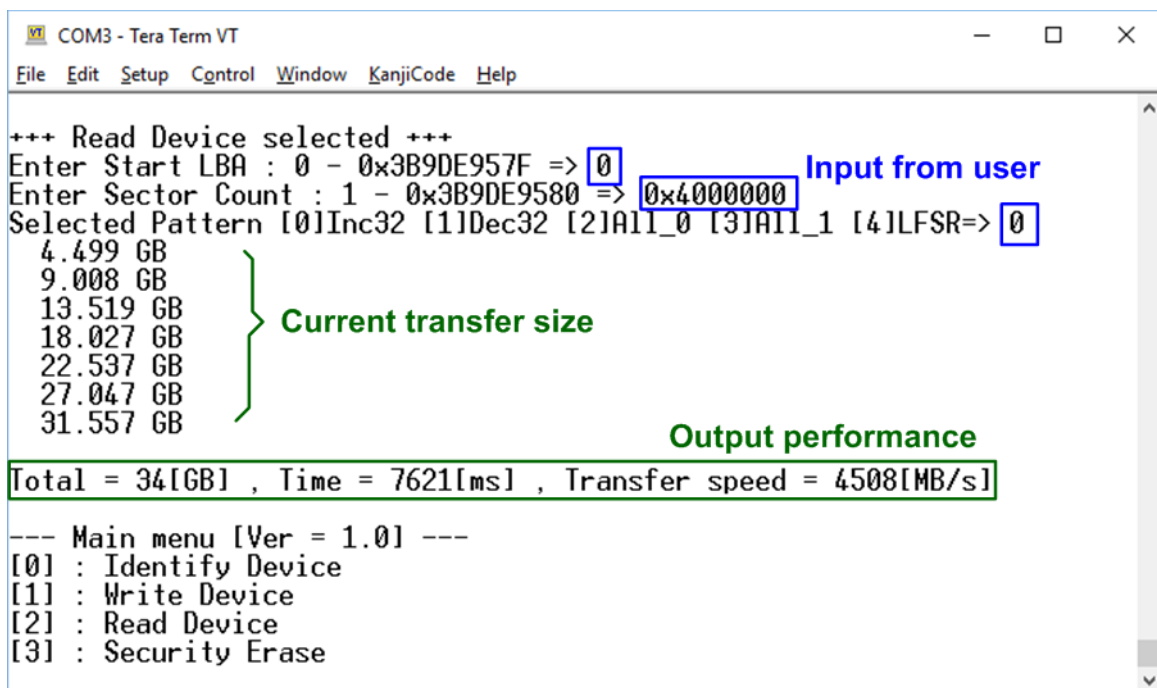
Figure 3-6 Invalid Test pattern input

3.3 Read Device

Select '2' to send Read command to RAID0. Three inputs are required for this menu.

- 1) Start LBA: Input start address of RAID0 in sector unit. The input is decimal unit when input only digit number. User can add "0x" to be prefix when input is hexadecimal unit.
- 2) Sector Count: Input total transfer size in sector unit. The input is decimal unit when input only digit number. User can add "0x" to be prefix when input is hexadecimal unit.
- 3) Test pattern: Select test pattern to verify data from RAID0. Test pattern must be matched with the test pattern which is used during write test. Five types can be selected, i.e. 32-bit increment, 32-bit decrement, all 0, all 1, and 32-bit LFSR counter.

Similar to write test if all inputs are valid, test system will read data from RAID0. Test performance, total size, and total time usage are displayed after end of transfer. "Invalid input" will be displayed if some inputs are out-of-range.



```

COM3 - Tera Term VT
File Edit Setup Control Window KanjiCode Help

+++ Read Device selected +++
Enter Start LBA : 0 - 0x3B9DE957F => 0
Enter Sector Count : 1 - 0x3B9DE9580 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 0
4.499 GB
9.008 GB
13.519 GB
18.027 GB
22.537 GB
27.047 GB
31.557 GB
Total = 34[GB] , Time = 7621[ms] , Transfer speed = 4508[MB/s]

--- Main menu [Ver = 1.0] ---
[0] : Identify Device
[1] : Write Device
[2] : Read Device
[3] : Security Erase
    
```

Figure 3-7 Input and result of Read Device menu

Figure 3-8 and Figure 3-9 show the error message when data verification is failed. “Verify fail” is displayed with error address, expected data, and read data. User can press any key to cancel read operation or wait until all read process complete. If read process is completed, output performance from read process will be displayed.

In case of cancel operation, the previous command does not complete in good sequence. It is recommended to power-off/on all SATA devices and press “RESET” button to restart system.

```

COM3 - Tera Term VT
File Edit Setup Control Window KanjiCode Help

+++ Read Device selected +++
Enter Start LBA : 0 - 0x3B9DE957F => 0
Enter Sector Count : 1 - 0x3B9DE9580 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 4
Wrong pattern

Verify fail
1st Error at Byte Addr = 0x00000000
Expect Data[255:128] = 0x0007FFFF_FFF80004_0003FFFF_FFFC0002
Expect Data[127:0] = 0x0001FFFF_FFFE0001_00000000_00000000
Read Data[255:128] = 0x00000007_00000006_00000005_00000004
Read Data[127:0] = 0x00000003_00000002_00000000_00000000
Verification fail message

Press any key to cancel operation
4.498 GB
9.006 GB
13.515 GB
18.024 GB
22.533 GB
27.040 GB
31.548 GB
Verify fail without cancel operation

Total = 34[GB] , Time = 7623[ms] , Transfer speed = 4507[MB/s]
Output performance

--- Main menu [Ver = 1.0] ---
[0] : Identify Device
[1] : Write Device
[2] : Read Device
[3] : Security Erase
  
```

Figure 3-8 Data verification is failed but wait until read complete

```

COM3 - Tera Term VT
File Edit Setup Control Window KanjiCode Help

+++ Read Device selected +++
Enter Start LBA : 0 - 0x3B9DE957F => 0
Enter Sector Count : 1 - 0x3B9DE9580 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 4

Verify fail
1st Error at Byte Addr = 0x00000000
Expect Data[255:128] = 0x0007FFFF_FFF80004_0003FFFF_FFFC0002
Expect Data[127:0] = 0x0001FFFF_FFFE0001_00000000_00000000
Read Data[255:128] = 0x00000007_00000006_00000005_00000004
Read Data[127:0] = 0x00000003_00000002_00000000_00000000
Verification fail message

Press any key to cancel operation
Operation is cancelled
Please reset system before start new test
Verify fail with cancel operation

--- Main menu [Ver = 1.0] ---
[0] : Identify Device
[1] : Write Device
[2] : Read Device
[3] : Security Erase
  
```

Figure 3-9 Data verification is failed and press any key to cancel operation

3.4 Security Erase

Select '3' to send Security Erase command to RAID0. Please confirm that all SATA devices support Security Erase feature by using Identify device menu. The estimation of operation time to run security erase is also displayed in Identify device menu.

After selecting the menu, warning message is displayed on the console. User input 'y' or 'Y' to continue security erase operation or input other keys to cancel operation.

Number 0-9 is displayed on the console every second to show that system still be alive. Finally, total time usage is displayed as shown in Figure 3-10.

Figure 3-11 shows the example when user inputs other keys to cancel the command.

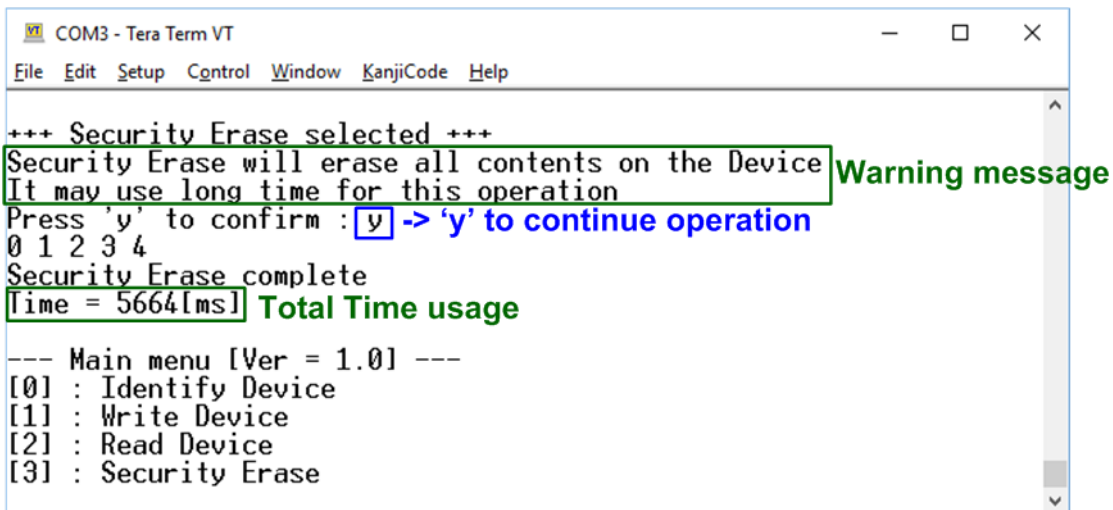


Figure 3-10 Result from Security Erase command

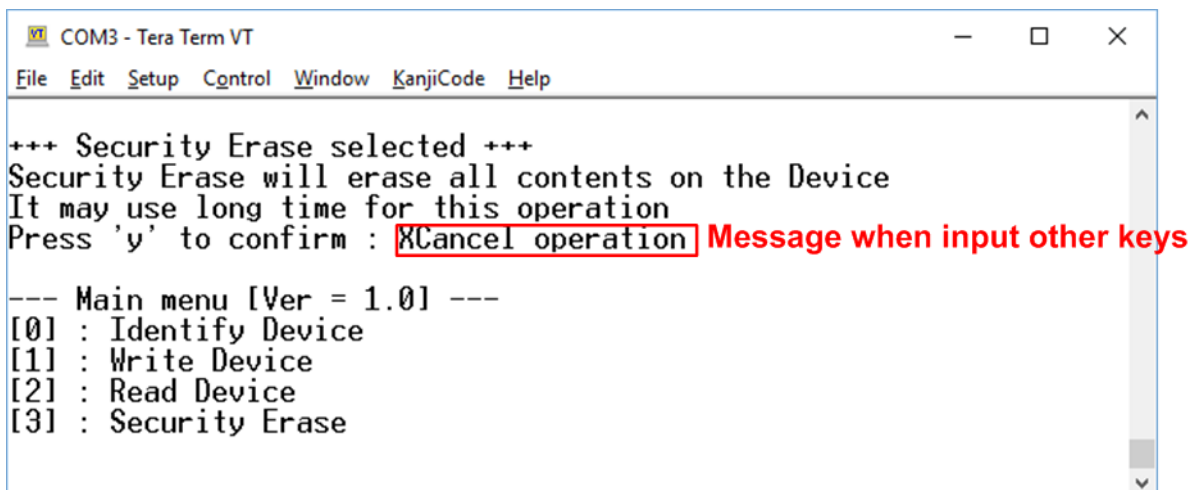


Figure 3-11 Cancel Security Erase command

4 Revision History

Revision	Date	Description
1.0	8-Mar-18	Initial version release