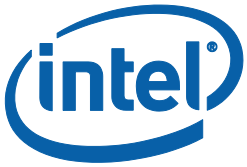

Intel® Integrated Sensor Solution Utility

User Guide

November 2020

Revision 1.4

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Document Number: XXXXXX

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Revision History

Document Number	Revision Number	Description	Revision Date
XXXXXX	0.8	Review and return	July 2016
XXXXXX	0.9	Added Yocto Linux support	December 2016
XXXXXX	1.0	Added I2C calibrate command and EFI support	February 2017
XXXXXX	1.1	Added SensorList function	June 2017
XXXXXX	1.2	Added EClite BIST function	July 2018
XXXXXX	1.3	Added NVM file related function	August 2018
XXXXXX	1.4	Added some test notes of BIST tests.	November 2020

1 Introduction

1.1 Overview

This document will describe the Intel® Integrated Sensor Solution Utility tool which is a stand-alone tool for use by OEMs and ODMs. The tool encompasses several different sensor tests and functionalities into a single tool.

The Intel® Integrated Sensors Solution Utility (or ISSU) will be provided as part of the Intel® ISS kit and will be located in:

- SW\ISSU

This folder includes the following:

- Windows* folder (for win32)
- Windows* 64 folder (for win64)
- Linux folder (for Yocto Linux 64bit)
- EFI64 folder (for UEFI 64bit)
- Intel(R) Integrated Sensor Solution Utility User Guide.pdf

The tool provides several different sets of functionality:

1. Information gathering about Intel® ISS
2. BIST sensor and ECLITE functionality
3. Updating and retrieving the Intel® ISS PDT file
4. Calibrating I2C bus functionality
5. Retrieving and parse NVM file functionality

1.2 Operating System Support

OS	Support Y/N
EFI Shell 64 bit	Y
Windows PE 64bit & 32bit	Y
Windows 10 DT 64bit & 32bit	Y
Windows 10 PE 64bit & 32bit	Y
Yocto Linux (GLIBCXX_3.4.21, Kernel 4.1.27) 64bit	Y

1.3 Error Return

Intel® ISS Utility will return 0 for success and a value of 1 to indicate an error. A detailed error code is displayed on the screen.

2 Intel® Integrated Sensor Solution Utility

2.1 Purpose

The Intel® Integrated Sensor Solution Utility (or Intel® ISSU) performs a number of useful functions that work with the Intel® Integrated Sensor Solution. These include conducting sensor self-tests, retrieving information about the Intel® Integrated Sensor Solution status and components, and getting or setting the Intel® ISS PDT configuration file.

2.2 System Requirements

Intel® ISSU runs on the OSs described in section" Operating System Support". The tool will execute only on systems that have the Intel® ISS enabled and running.

2.3 Required Files and Installation:

The Intel® ISS utility main executable is **ISSU.exe for windows version, ISSU for Linux version, ISSU.efi for EFI version**.

For windows version, the following files must be in the same directory as **ISSU.exe**:

- For win32: Idrvdll.dll, Pmxdll.dll
- For win64: Idrvdll32e.dll, Pmxdll32e.dll

For windows version, the installation of the following driver is required for Intel® ISSU to run:

- Intel® Integrated Sensor Solution
- ISS Dynamic Bus Enumerator
- HID PCI Minidriver for ISS

For Linux version, the installation of the following driver is required for Intel® ISSU to run:

- intel_ishtp
- intel_ish_ipc
- intel_ishtp_hid
- intel_ishtp_clients

For all the examples/images described in this document, it would use windows version as reference. Linux/EFI version of the tool should have similar behavior except special notes declared in detailed sections.

2.4 Intel® ISS Utility Usage

The tool is divided into several commands. Each command has its own functionality and specific arguments.

In addition to arguments that are specific per commend, there are also Options. Options are arguments that are available for all commands.

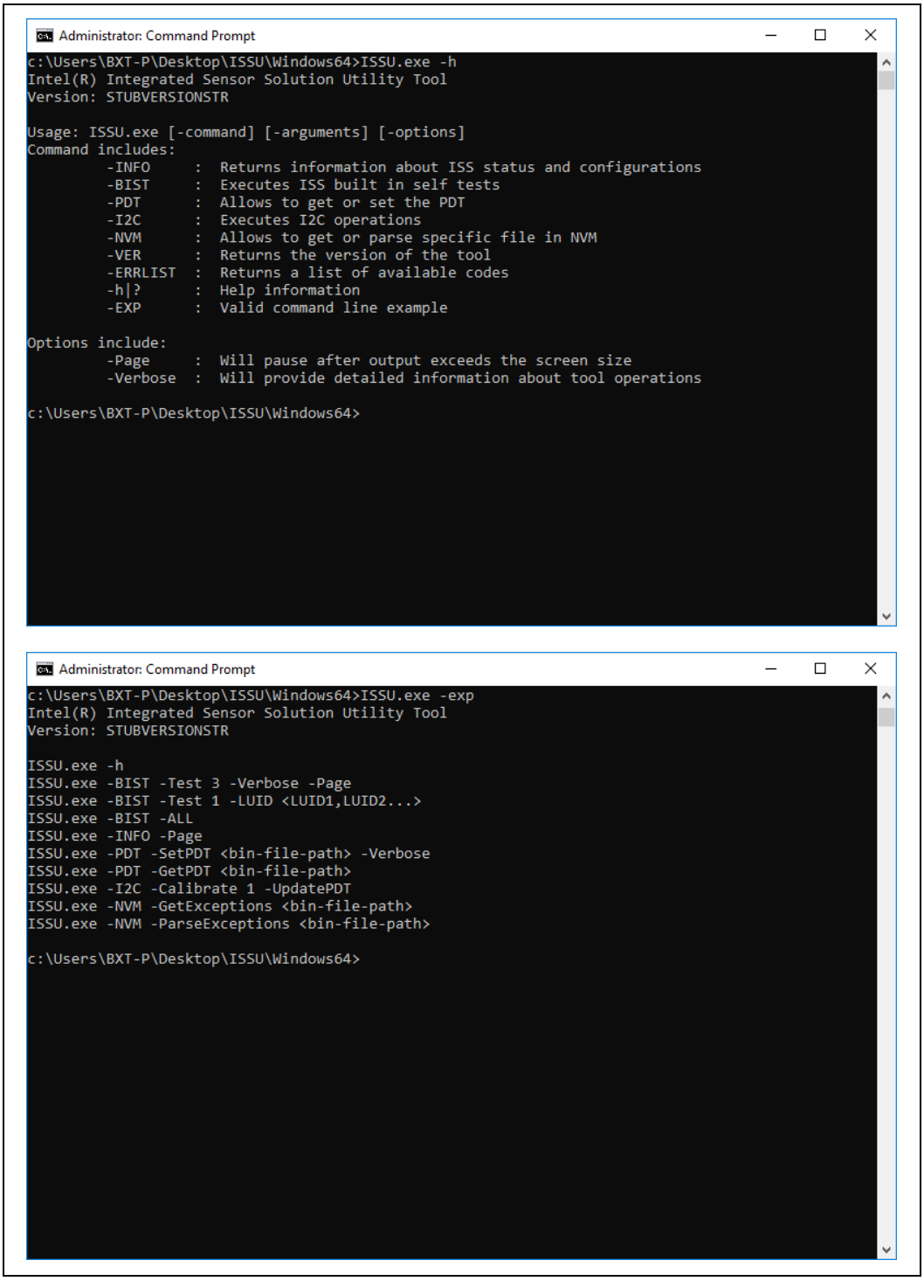
The tool command line is structured as below:

- ISSU [-command] [-arguments] [-options]

Table 2-1. Commands Specification

Option	Description
No option	Displays the help screen
-BIST	Executes ISS built-in self-tests; Retrieves ECLite BIST results if eligible.
-INFO	Returns information about ISS status and configurations
-PDT	Allows to get or set the PDT
-I2C	Allows to calibrate specific I2C bus
-NVM	Allows to get or parse specific file in NVM
-EXP	Shows examples of how to use the tool. Each command (BIST/PDT/Info) has the -exp command available and will show specific command examples for the functionality
-H or -?*	Displays the usage screen. Each command (BIST/PDT/Info) has the -h command available and will show specific help menu for the functionality *Note: "-?" is not supported in EFI version
-VER	Shows the version of the tool
-ERRLIST	Return a list of available codes

Figure 2-1. ISSU Command Usage and Examples



2.5 Options Specification

Options are generic for the tool and are available for all commands i.e.:

- Usage
- ISSU <<COMMAND: -BIST|-INFO|-PDT|-I2C>> <<COMMAND SPECIFIC ARGUMENTS>> [-Verbose] [-Page]

Option	Description
Verbose	Displays the maximum information available for operations the tool is performing.
Page	When the output exceeds screen size the output will pause and wait for any key press to proceed.

2.5.1 Examples:

- ISSU -BIST -TEST 3 -Verbose -Page
- ISSU -INFO -Page
- ISSU -PDT –SetPDT file.bin –Verbose
- ISSU -I2C –Calibrate 1 -UpdatePDT

2.6 ISSU -BIST Functionality

The BIST functionality will perform several levels of integrated self-tests. The test level desired can be specified as part of the arguments.

Note: Do not run Intel SensorViewer tool during BIST tests.

Note: Some tests may be implemented by the sensor vendor. These tests are not mandatory.

Running the -BIST functionality with no arguments will result in running the default BIST level for all sensors and retrieve ECLite BIST results if eligible. The default BIST level is test level 3.

Note: Up to BIST level 3, each BIST level also executes the levels below it.

For example:

- BIST level 3 will execute BIST level 3, 2, 1, 0 and ECLite if eligible.
- BIST level 2 will execute BIST level 2, 1, 0 and ECLite if eligible.
- BIST level 1 will execute BIST level 1, 0 and ECLite if eligible.

Table 2-2. -BIST [-arguments]

Option	Description
No option	Run default BIST level **for all sensors on system**
-h|-?*	Returns the help screen for ISSU –BIST *Note "-?" is not supported in EFI version
-EXP	Shows detailed examples of how to use the BIST command
-TEST <level>	Executes test level indicated. Single test level is possible per command line and will be executed for all sensors on system unless the -LUID argument is specified
-ALL	Runs all available BISTs (may be higher level than default level) for all sensors on system unless the -LUID argument is specified, and retrieve ECLITE test results if enabled.
-LUID <luid1,luid2…>	Specifies which sensors to run the BIST on. More than one LUID may be specified as an argument (separated with ",").
-ECLITE	Retrieve ECLITE test results individually.

2.6.1 Examples:

- ISSU -BIST
- ISSU -BIST -ALL
- ISSU -BIST -test 3
- ISSU -BIST -test 2 -LUID 0073000100010002
- ISSU -BIST -test 2 -LUID 0073000100010002,020F000100080042
- ISSU -BIST -ALL -Verbose –Page
- ISSU -BIST -ALL -LUID 0073000100010002

2.7 BIST Levels Specifications

Level	BIST Level 0: Configuration
Test Specifics	BIST level 0 checks: 1. FW is alive and responding 2. The virtual sensors configured have all required reporters that are needed as input. Virtual sensors rely on other sensors as inputs. This test will verify each virtual sensor has all its required reporters. The test also checks the optional reporters. These reporters are not mandatory but may be added for increased accuracy. If an optional reporter is missing the test will not fail but a notification/warning will be shown to the user.
Test Indication to user	Pass: FW is alive and all virtual sensors have all their defined inputters configured correctly Fail: 1. ISH FW not alive/responding, Please verify CSE/ISS compatibility, debug may be needed 2. Missing mandatory reporter: a. Error: Check in PDT the virtual sensor mandatory reporters. b. Warning: User may want to add the optional reporter for better accuracy.

Figure 2-2. Example of "BIST Level 0" Functionality

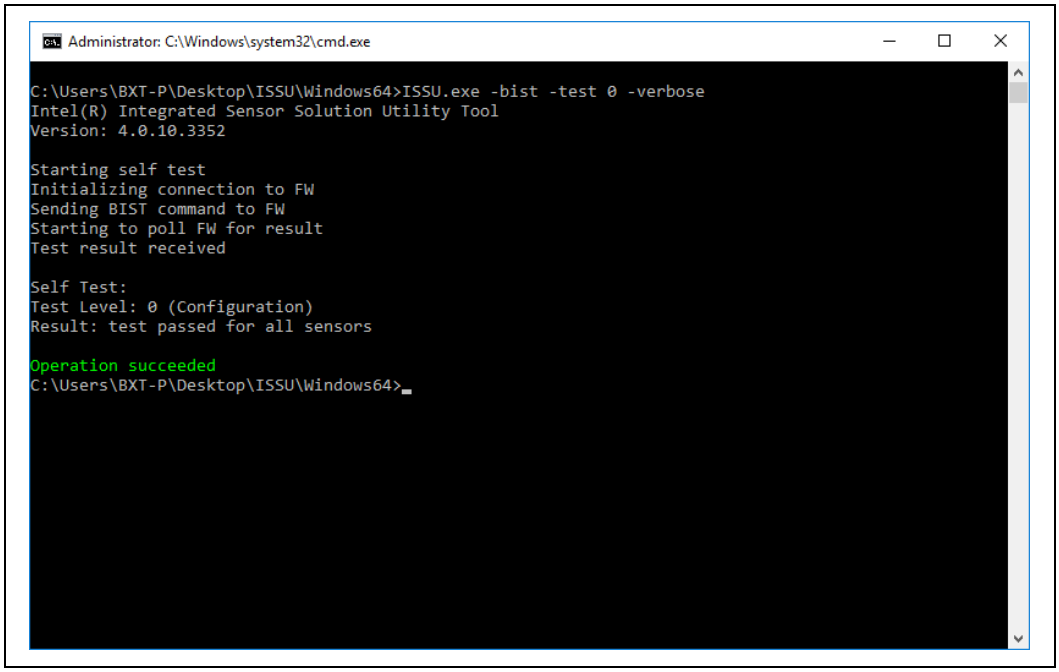


Table 2-3. BIST Level 1 Connectivity

Level	BIST Level 1: Connectivity
Test Specifics	BIST level 1 tests connectivity test to each sensor and the GPIO configuration. Checks that FW can reach each physical sensor: • A register is ready from each sensor and its value tested against the expected value. Checks GPIO configuration: • BIOS GPIO table matches PDT configuration.
Test Indication to user	Pass: GPIO and sensors are configured correctly, Soldering/BUS lines are working properly. Fail: • ISS could not reach all the sensors: Sensor is not reachable/configured correctly - check soldering or check the settings in PDT are correct. • uDriver could not generate a GPIO interrupt for that sensor - check with Intel/Vendor GPIO configuration. • BIOS config failure: GPIO that is configured in PDT for this sensor is not assigned in BIOS for ISH - Check BIOS config table.

Figure 2-3. Example of "BIST Level 1" Functionality

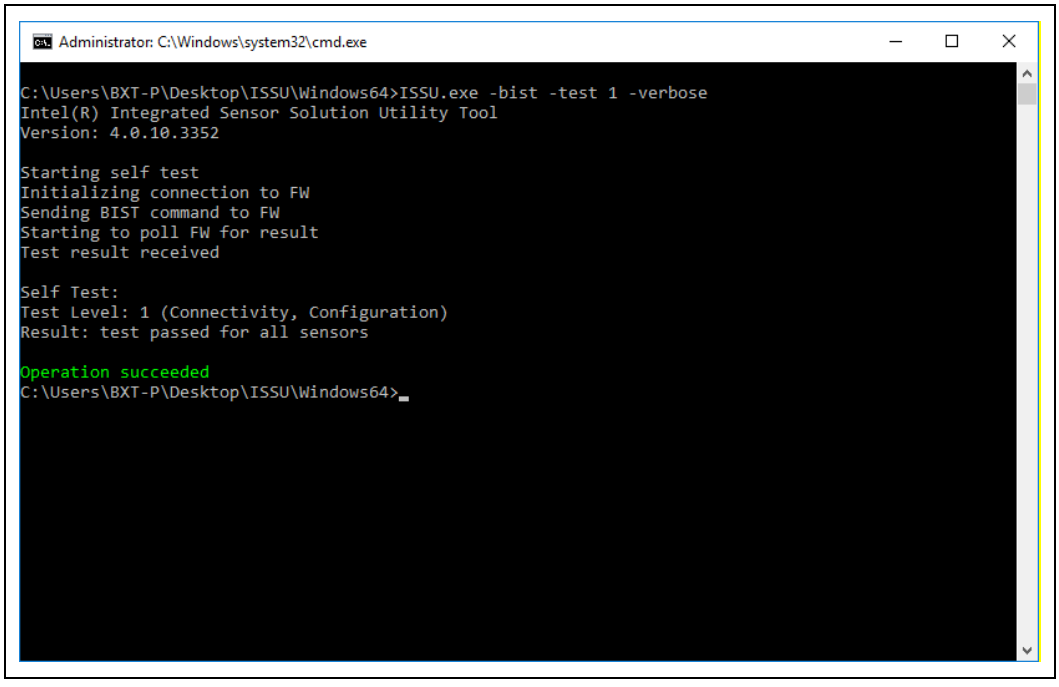


Table 2-4. BIST Level 2 Calibration

Level	BIST Level 2: Calibration
Test Specifics	BIST level 2 checks required calibration data exists for sensors and is in the correct format. If calibration is not required for a sensor, success is returned.
Test Indication to user	Pass: Calibration configured correctly - note this does not mean calibration values are correct, just that they are present and in the correct format. Fail: Check PDT for missing calibration or for wrong calibration format.

Figure 2-4. Example of "BIST Level 2" Functionality

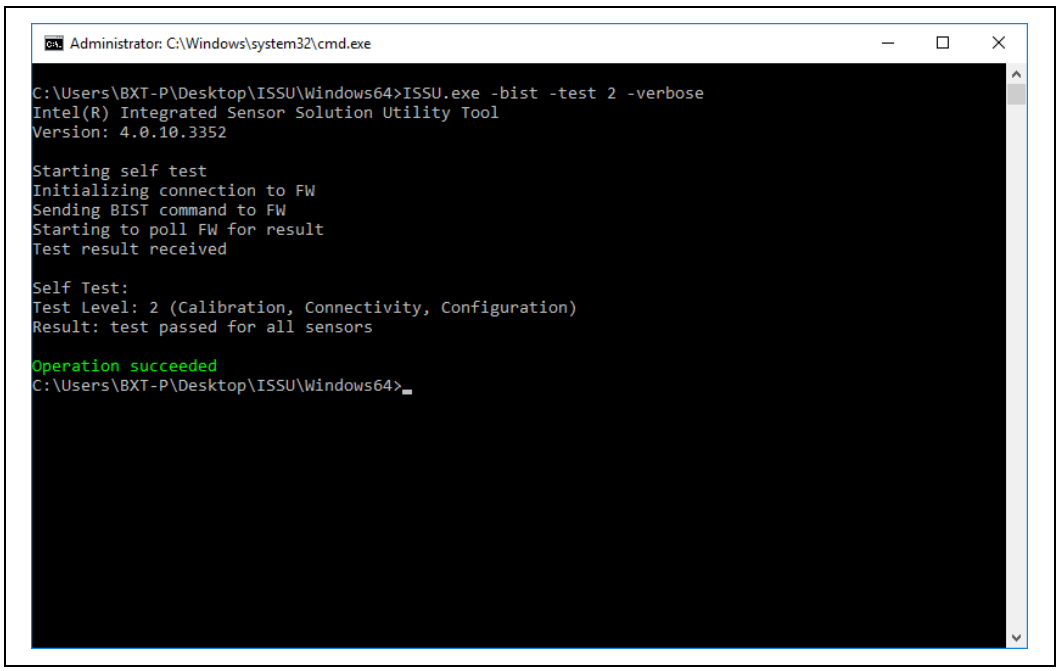
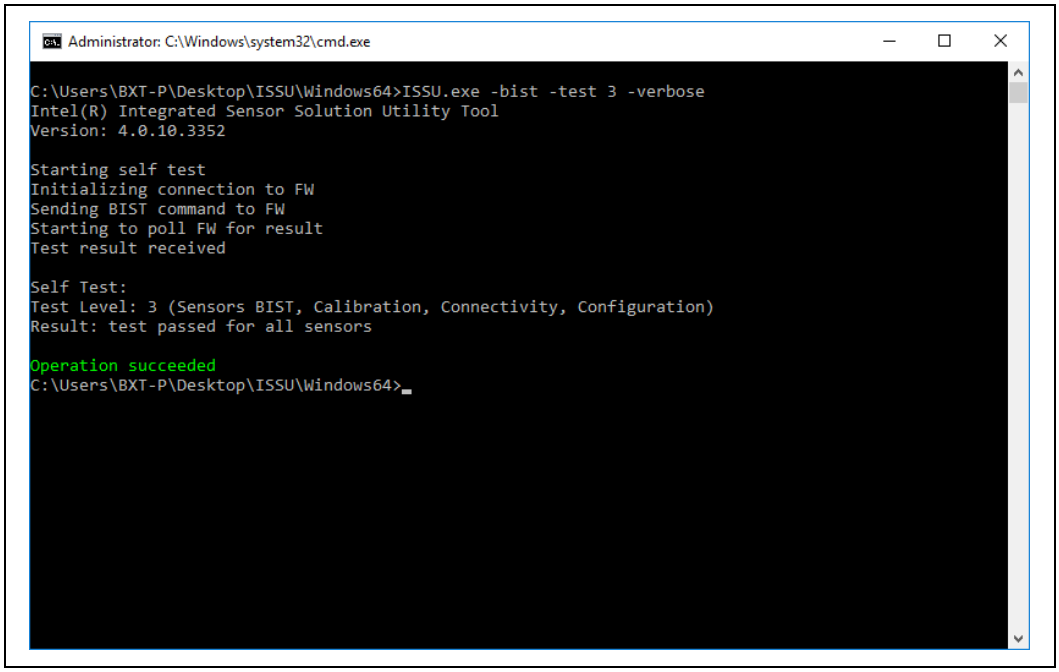
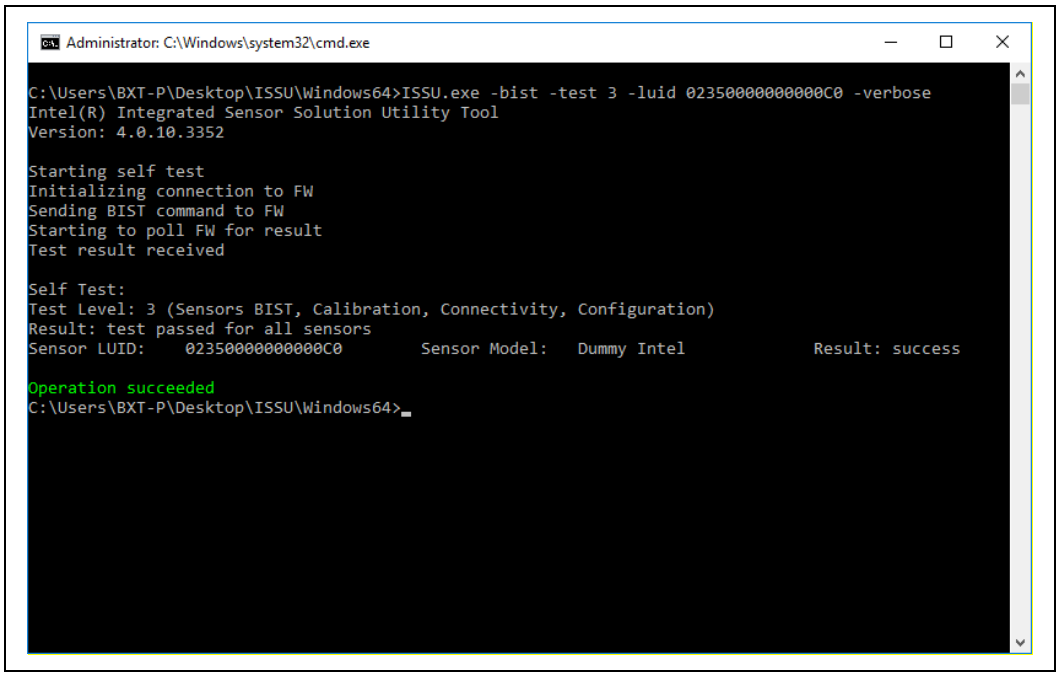


Table 2-5. BIST Level 3 Sensors BIST

Level	BIST Level 3: Sensors BIST
Test Specifics	BIST level 3 runs vendor defined sensor BIST. This test is not a mandatory test, some sensors may not have BIST level 3 available.
Test Indication to user	Pass: Test completed successfully. Fail: Need to contact Intel/Vendor. Each test is sensor specific and failure may mean different things for different sensors.

Figure 2-5. Example of "BIST Level 3" Functionality





2.8 ISSU -INFO Functionality

The -INFO functionality retrieves various information about Intel® ISS.

It can be used for triage and for gathering information for triage.

Table 2-6. -INFO [-arguments]

Option	Description
No option	Reports information for all components listed in table below
-h|-?*	Returns the help screen for ISSU –INFO *Note: "-?" is not supported in EFI version
-EXP	Shows detailed examples of how to use the INFO command
-BOM	Retrieves sensor LIUD and sensor model for all physical sensors on the system in order to get a clear BOM on the current system
-SensorList <bin-file-path>	Retrieves sensor related information from uncompressed ISS binary file and save to local file

Examples:

- ISSU -INFO -Page
- ISSU -INFO -BOM

The -INFO command will return information as specified in the table below:

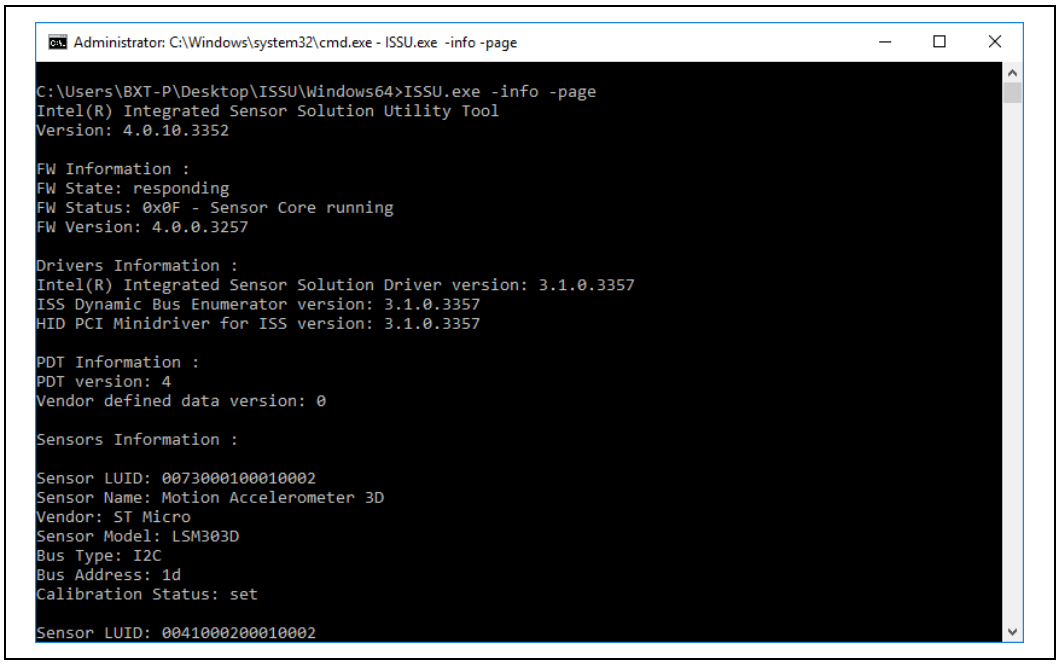
Table 2-7. -INFO Command Returns

Feature Name	Field Value
Integrated Sensor Solution FW state	Responding / Not Responding
Integrated Sensor Solution FW status	FW is Running / Sensor Core loaded / PDT loaded / Sensor Core running
Integrated Sensor Solution FW version	Version string
Intel® Integrated Sensor Solution Driver version *	Version string
ISS Dynamic Bus Enumerator version *	Version string
HID PCI Minidriver for ISS version *	Version string
PDT version	Version string
Vendor defined data version	Version string

Feature Name	Field Value
Sensors Information	Information on the various Sensors configured on the platform. For each sensor (physical and virtual): • Sensor LUID • Sensor name • Vendor • Sensor model • Bus type • Bus address • Calibration status (set/not set)

*Note: Linux and EFI version won't show such information

Figure 2-6. Example of -INFO Output



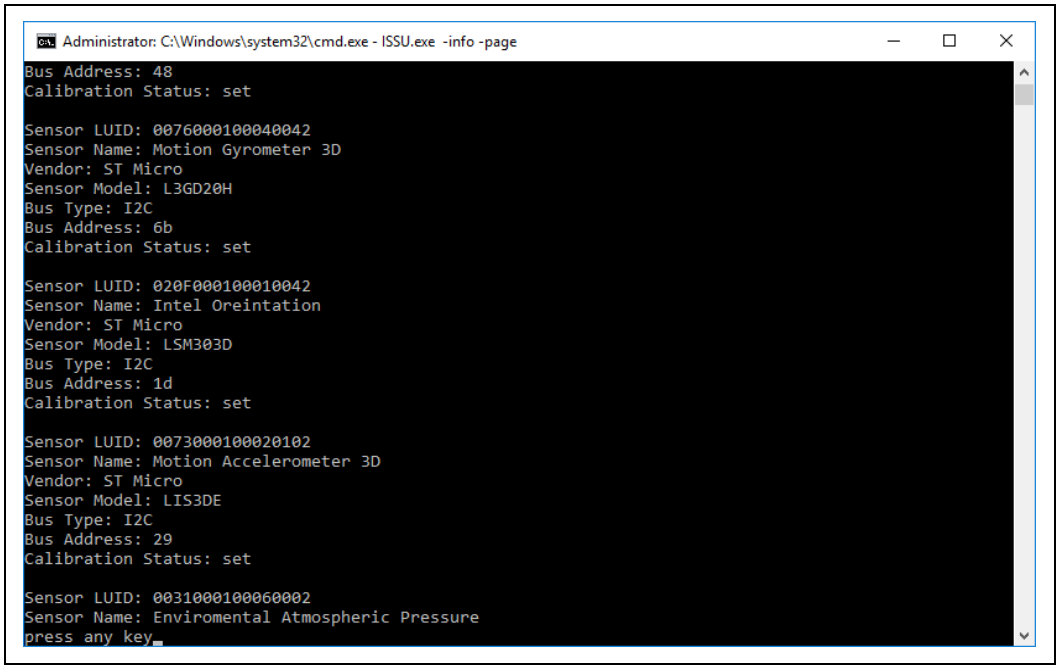


Figure 2-7. Example of -BOM Output

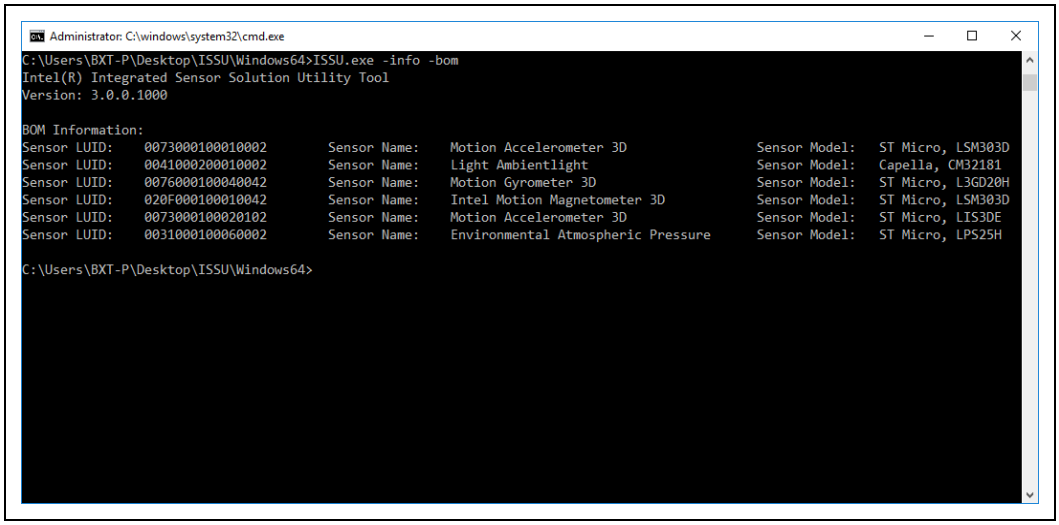
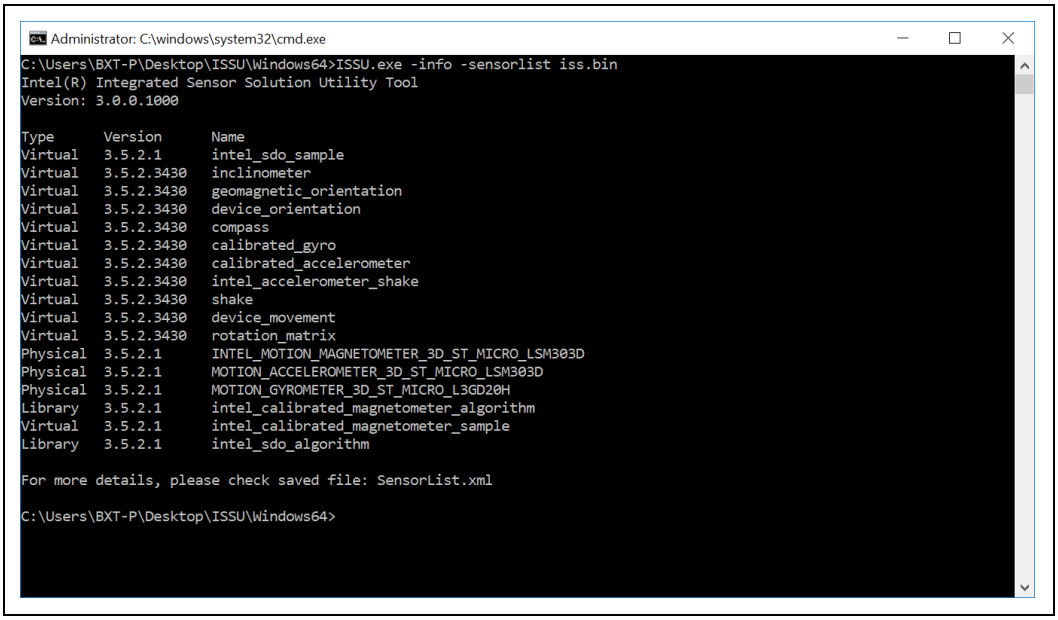


Figure 2-8. Example of -SensorList Output



Note: The input binary file ISS.bin should be decompressed ISS binary instead of the compressed one. For details of how to get decompressed ISS binary, please refer to appendix B.

2.9 ISSU –PDT Functionality

Intel® ISS uses a configuration file called PDT. This file contains all the system topology and configuration and also the calibration parameters that are used by Intel® ISS. The PDT command allows you to get or set the PDT on the SPI flash.

Sample PDT files can be found in kit release\FW\bin\PDT\Bare_PDTs, and it's needed to add ".bin" extension when set the PDT binary.

In order to get the current PDT that is stored on the flash use:

Table 2-8. –PDT [-arguments]

Option	Description
No option	Returns the help screen for ISSU –PDT
-H|-?*	Returns the help screen for ISSU –PDT *Note: "-?" is not supported in EFI version
-EXP	Shows detailed examples of how to use the PDT command
-SetPDT <bin-file-path>	Writes the PDT from bin-path-file to ISH
-GetPDT <bin-file-path>	Reads the PDT file currently on the NVM and exports it to bin-file-path

Examples:

- ISSU –PDT –SetPDT <bin-file-path>
- ISSU –PDT –SetPDT <bin-file-path> -Verbose
- ISSU –PDT –GetPDT <bin-file-path>

Figure 2-9. Example of "GetPDT" Functionality

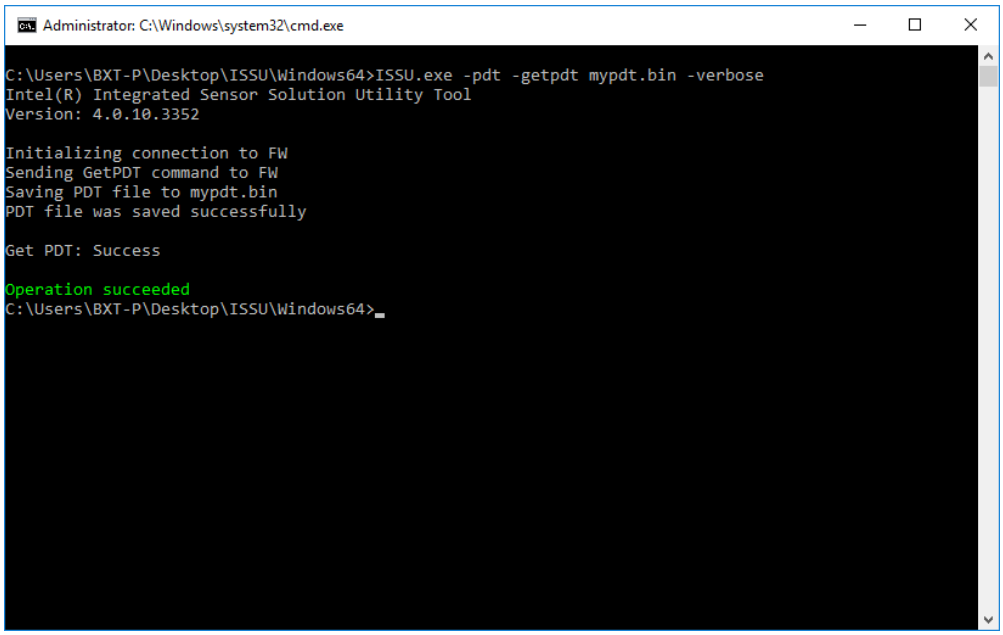
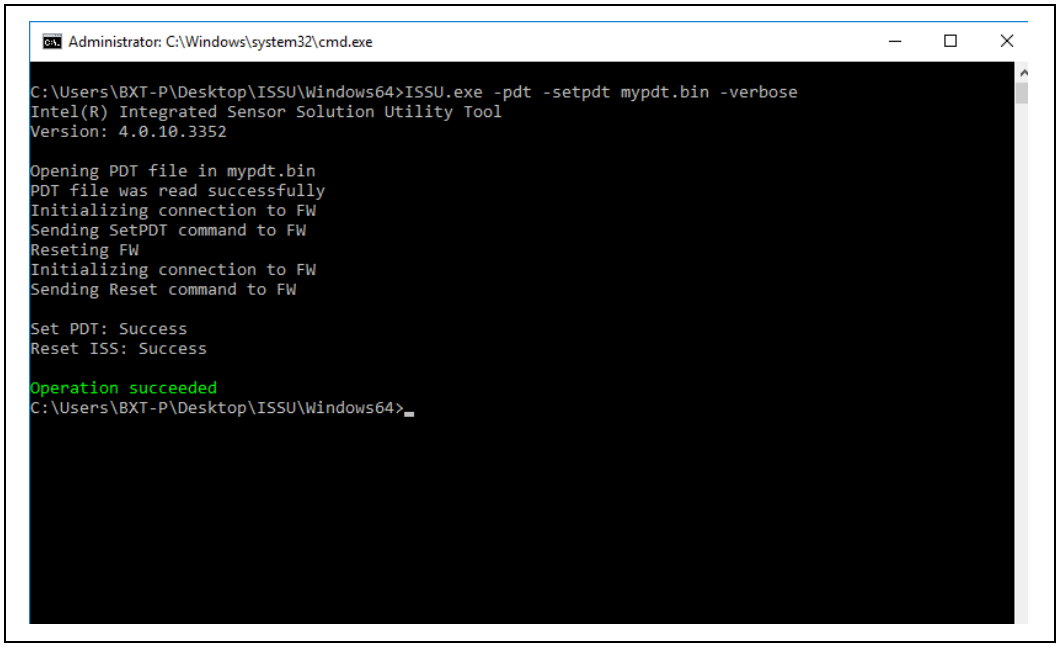


Figure 2-10. Example of "SetPDT" Functionality



Note: In Windows and Linux, the tool support relative path for <bin-file-path>. E.g. if user specify only the file name "pdt.bin", it should be in current folder where you run the command. While in EFI, it only support absolute path for <bin-file-path>. E.g. if user specify only the file name "pdt.bin", it would in the root folder \pdt.bin. To put the binary file info specified folder, \<path_to_folder>\pdt.bin should be used as <bin-file-path> argument to the tool.

2.10 ISSU –I2C Functionality

Intel® ISS uses several I2C buses to communicate with sensors or output debug information. ISS provided functions to calibrate I2C bus speed. The tool would send specific I2C bus calibrating request to ISS and parse the result.

Table 2-9. –I2C [-arguments]

Option	Description
No option	Returns the help screen for ISSU –I2C
-H|-?	Returns the help screen for ISSU –I2C *Note: "-?" is not supported in EFI version
-EXP	Shows detailed examples of how to use the I2C command
-Calibrate <busId>	Request to calibrate specific I2C bus and show the results
-UpdatePDT	Save I2C calibration results in PDT and reset ISS

Examples:

- ISSU –I2C –Calibrate <busid>
- ISSU –I2C –Calibrate <busid> -UpdatePDT

Figure 2-11. Example of "I2C Calibrate" Functionality

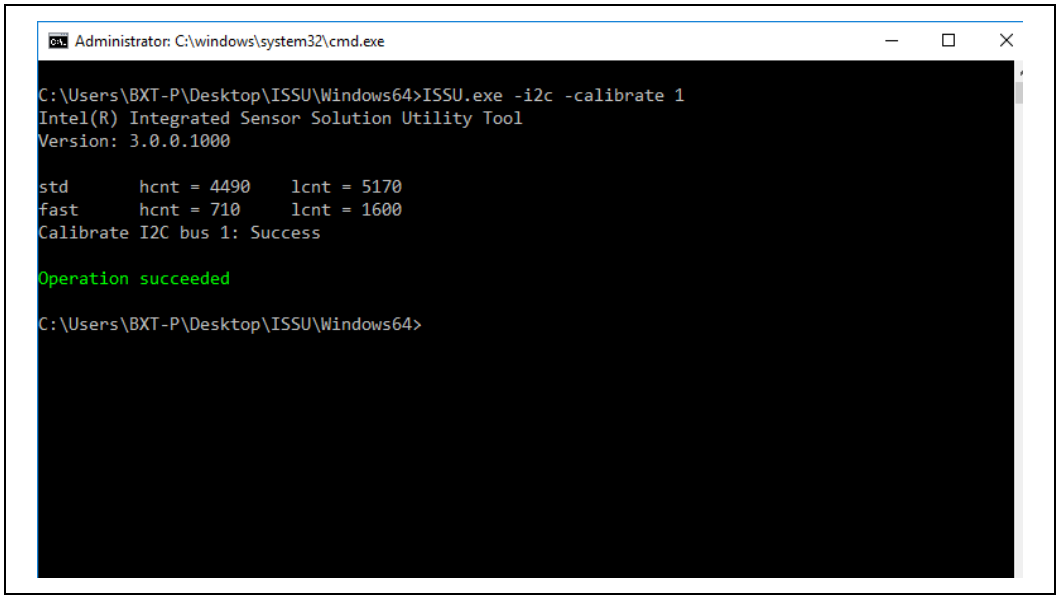
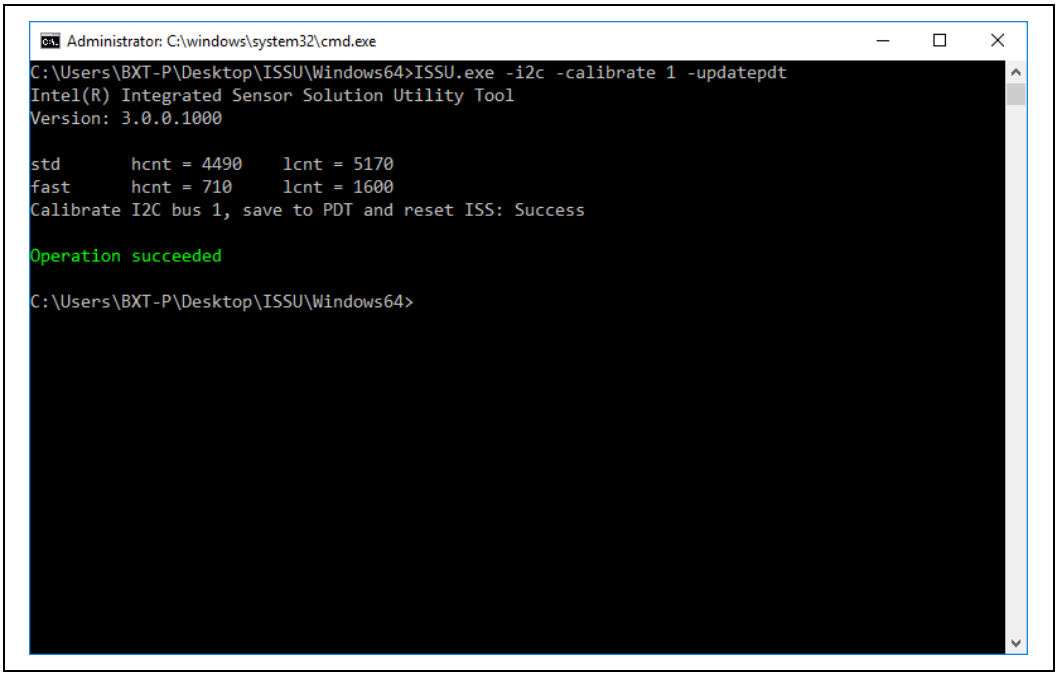


Figure 2-12. Example of "I2C calibrate and update PDT" Functionality



2.11 ISSU –NVM Functionality

Intel® ISS can store last 3 exceptions, 2 error log files and 2 user data files into NVM. The NVM command allows you to retrieve these files from the SPI flash and save to binary file, together with parsing exceptions to readable string.

In order to get/parse the files that are stored in NVM use:

Table 2-10. –NVM [-arguments]

Option	Description
No option	Returns the help screen for ISSU –NVM
-H|-?*	Returns the help screen for ISSU –NVM *Note: "-?" is not supported in EFI version
-EXP	Shows detailed examples of how to use the NVM command
-GetErrorLog0 <bin-file-path>	Reads error log file 0 currently on the NVM and exports it to bin-file-path
-GetErrorLog1 <bin-file-path>	Reads error log file 1 currently on the NVM and exports it to bin-file-path
-GetUserData0 <bin-file-path>	Reads user data file 0 currently on the NVM and exports it to bin-file-path
-GetUserData1 <bin-file-path>	Reads user data file 1 currently on the NVM and exports it to bin-file-path

Option	Description
-GetExceptions <bin-file-path>	Reads the exceptions log file currently on the NVM and exports it to bin-file-path
-ParseExceptions <bin-file-path>	Parse the exceptions information in bin-file-path to readable string

Examples:

- ISSU –NVM -GetErrorLog0 <bin-file-path>
- ISSU –NVM -GetExceptions <bin-file-path>
- ISSU –NVM -ParseExceptions <bin-file-path>

Figure 2-13. Example of "GetExceptions"/"GetErrorLog0"/"GetUserData1" Functionality

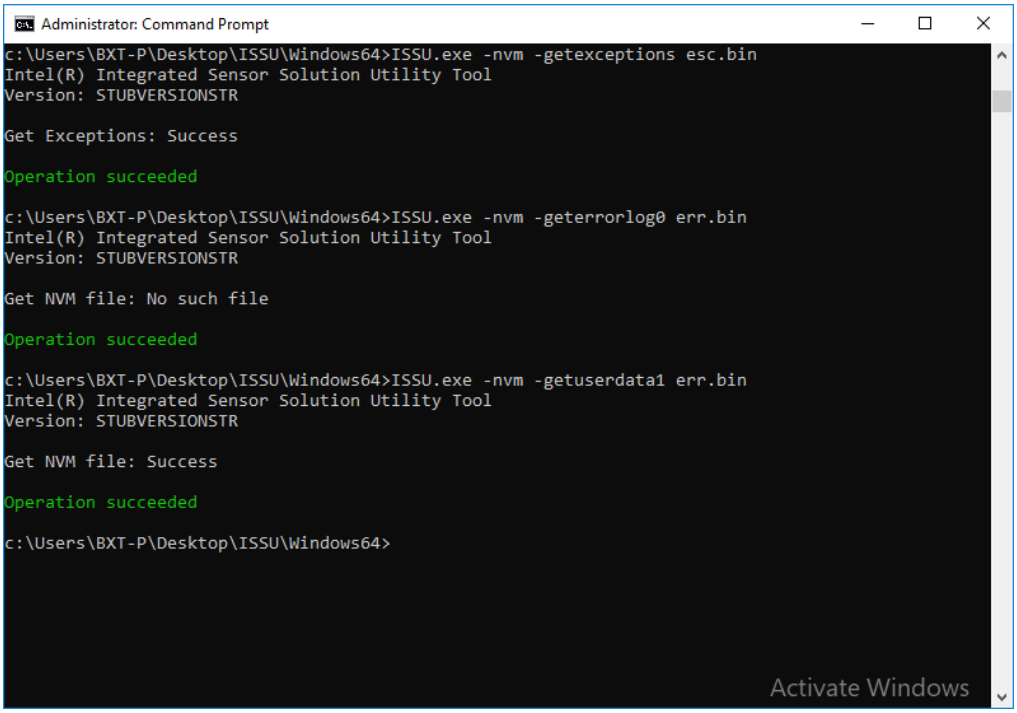
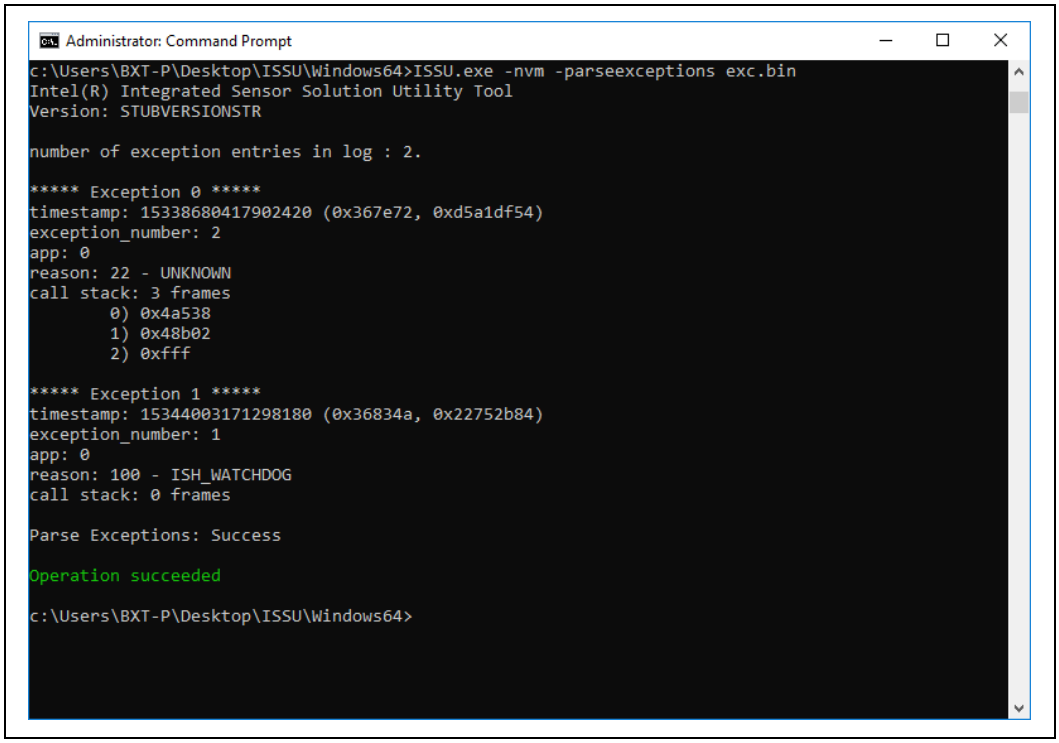


Figure 2-14. Example of "ParseExceptions" Functionality



Note: In Windows and Linux, the tool support relative path for <bin-file-path>. E.g. if user specify only the file name "exc.bin", it should be in current folder where you run the command. While in EFI, it only support absolute path for <bin-file-path>. E.g. if user specify only the file name "exc.bin", it would in the root folder \exc.bin. To put the binary file info specified folder, \<path_to_folder>\exc.bin should be used as <bin-file-path> argument to the tool.

3 Appendix A: Error List

Here is the error list returned by the tool for BIST:

Error	Test Level *	Explanation	Possible Reason	Note
0: Test passed	any	Sensor self-test passed		
1: Test failed	any	Sensor self-test general failure		
2: Test unsupported	any	Sensor does not support the particular test		
3: Sensor not active	any	Sensor is not initialized or not ready	1. One of the LUID parts is not supported on platform 2. There is a problem in PDT that causes sensor to fail in initialization	
6: Missing calibration	2	Sensor has no appropriate calibration data	1. Sensor doesn't have calibration data configured 2. Sensor's calibration data has wrong format	For physical AGM/ALS sensors only
7: Connectivity failure	1	Sensor connectivity test failed		Returned only on CHT and SKL, Following generations use errors 9-11
9: GPIO BIOS configuration failure	1	Sensor GPIO BIOS configuration error	The sensor GPIO ID is not allocated for ISS in the BIOS	Replacing error 7 starting APL,KBL
10: GPIO connectivity failure	1	Sensor connectivity test failed for GPIO	Sensor supports GPIO configuration but fails to configure GPIO for receiving interrupt (GPIO ID that is not connected \ configured to the sensor)	Replacing error 7 starting APL,KBL

11: I2C connectivity failure	1	Sensor connectivity test failed on I2C	Sensor is disabled in switch	Replacing error 7 starting APL,KBL

* Note that errors appearing in test level x will also appear in test levels greater than x since up to test level 3, the lower test levels are also called. I.e. test level 2 also calls tests 1 and 0 therefore an error that is relevant for test level 1 might appear when calling test level 2 or test level 3.

Here is the general error list returned by the tool:

0 : Success

1 : Command is currently not supported

2 : SMHI command failed

3 : Please wait, Working in progress

4 : SMHI error: Invalid parameter

8192 : General error

8193 : Cannot locate Intel® Integrated Sensor Solution driver

8194 : Memory access failure, please contact Intel support

8195 : Write register failure

8196 : Memory allocation failure, please contact Intel support

8197 : Circular buffer overflow

8198 : Not enough memory in circular buffer

8199 : Transmission error to Intel® Integrated Sensor Solution

8200 : Unsupported TXE bus message protocol version

8201 : Unexpected interrupt reason

8202 : Intel® Integrated Sensor Solution timeout occurred

8203 : Unexpected result in Intel® Integrated Sensor Solution response, please contact Intel support

8204 : Unsupported message type

8205 : Cannot find host client

8206 : Cannot find Intel® Integrated Sensor Solution client

8207 : Client already connected

8208 : No free connection available

8209 : Illegal parameter

8210 : Flow control error

8211 : No message

8212 : Requesting Intel® Integrated Sensor Solution receive buffer size is too large

8213 : Requesting Intel® Integrated Sensor Solution receive buffer size is too small

8214 : Circular buffer not empty

8215 : Cannot access Intel® Integrated Sensor Solution device

8216 : Invalid command-line arguments

8217 : Failed to read or write file

8218 : Invalid PDT file length

8219 : Invalid PDT file extension, PDT format is xxx.bin

8220 : Failed to get driver version

8221 : Unsupported OS

8222 : No required privileges, run as Administrator

8223 : Invalid sensor luid format

8224 : Failed to get device address

8225 : Failed to load driver (PCI access for windows)

8226 : Bist failed

8227 : Could not execute BIST: no sensors configured on the device. Please check the PDT configuration

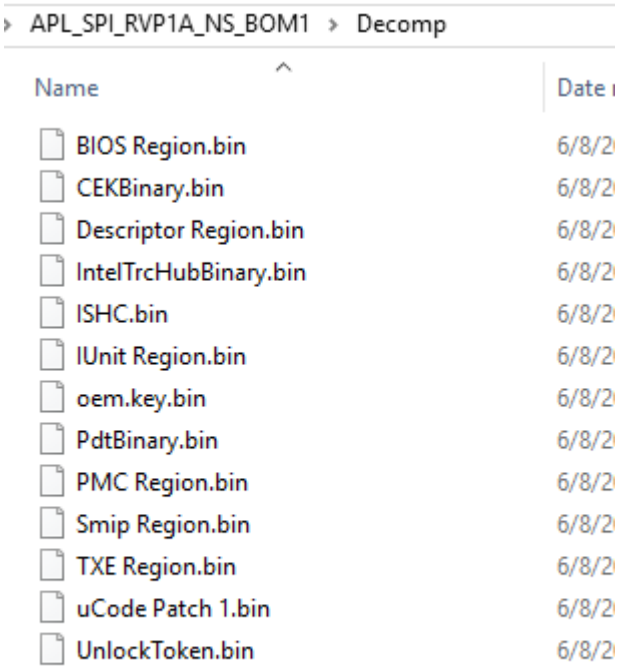
8228 : Unknown response from SMHI

4 Appendix B: Get Decompressed ISS Binary File

Use FIT tool to get compressed ISS binary from IFWI:

> fit.exe –f InputIFWI_xxx.bin –save Decompose.xml

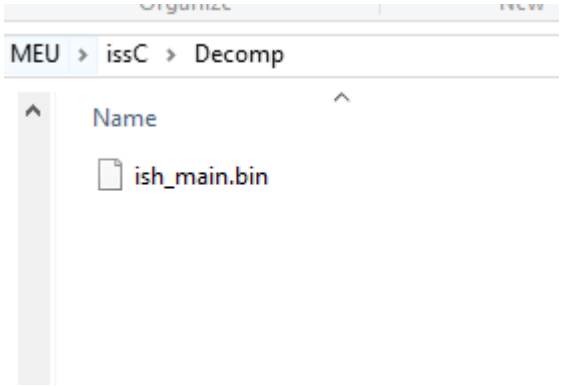
Find ISHC.bin in Decomp folder:



Use MEU tool to get decompressed ISS binary:

> meu -decomp CodePartition -f ISHC.bin -save iss.xml

The get the ish_main.bin which is uncompressed ISS binary:



Specify Lzma binary path "LzmaToolPath" in meu_config.xml, to tell meu.exe how to decompose ISHC.bin.

An example of meu_config.xml:

```
    <?xml version="1.0" encoding="utf-8"?>

<MeuConfig version="2.10" >

   <PathVars label="Path Variables">

      <WorkingDir value="./" label="$WorkingDir" help_text="Path for environment variable $WorkingDir" />

      <SourceDir value="./" label="$SourceDir" help_text="Path for environment variable $SourceDir" />

      <DestDir value="./" label="$DestDir" help_text="Path for environment variable $DestDir" />

      <UserVar1 value="./" label="$UserVar1" help_text="Path for environment variable $UserVar1" />

      <UserVar2 value="./" label="$UserVar2" help_text="Path for environment variable $UserVar2" />

      <UserVar3 value="./" label="$UserVar3" help_text="Path for environment variable $UserVar3" />

   </PathVars>

   <SigningConfig label="Signing Configuration">

      <SigningTool value="OpenSSL"
value_list="Disabled,,OpenSSL,,MobileSigningUtil" label="Signing Tool"
help_text="Select tool to be used for signing, or disable signing." />

      <SigningToolPath value="$SourceDir\..\openssl\openssl.exe" label="Signing Tool Path" help_text="Path to signing tool executable." />
```

```
    <SigningToolXmlPath value="" label="Signing Tool Config XML Path"
help_text="Configuration XML template for MobileSigningUtil. Leave blank if not using
MSU." />

    <SigningToolExecPath value="" label="Signing Tool Execution Path"
help_text="Specify a directory from which the signing tool should be executed. This
can be useful if relative paths are used in the Signing Tool Config XML. If no path is
provided, the signing tool will be executed from the same directory as this tool was
executed. Leave blank if not using MSU." />

  </SigningConfig>

  <CompressionConfig label="Compression Configuration">

    <LzmaToolPath value="$SourceDir\..\lzma\lzma.exe" label="LZMA Tool Path"
help_text="Path to lzma tool executable." />

  </CompressionConfig>

</MeuConfig>
```

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