

BSP for Microsoft Windows* 7 (WIN7, WES7 & POSReady 7) 32 & 64 bit for Intel® Atom™ Processor E3800 Product Family/ Intel® Celeron® Processor N2807/N2930/J1900

User Guide

May 2014

Revision 3.0

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Revision History

Revision Number	Description	Revision Date
3.0	Added Windows Embedded POSReady 7	May 2014
2.0	Update USB3 BKM and known issues for Gold 2 release	Mar 2014
1.0	Update release for Windows 7 Gold 1.0 release	Jan 2014



1 Introduction

1.1 Scope of document

This document provides release information about Intel developed GPIO, I²C, SPI and HS-UART and USB3.0 driver for the Windows* 7, Windows Embedded Standard 7 and Windows Embedded POSReady 7. It covers the Driver Interfaces, Errata and Known Issues, and Best Known Methods. This document is intended for OEMs and ODMs that are enabling Win7 and WES7 drivers with Intel[®] Atom E3800 processor, Intel[®] Celeron[®] Processor N2XXX and Intel[®] Celeron[®] Processor J1XXX.

This document also include information of Window* 7 Inbox drivers that have been validated on Intel[®] Atom™ E3800 processor, Intel[®] Celeron[®] Processor N2XXX and Intel[®] Celeron[®] Processor J1XXX.

Note: To update the GPIO, I²C and SPI drivers on structure definition in public driver header file from beta driver to gold driver, recompile your applications with the latest public driver header.

1.2 System Requirements

The following Operating Systems are supported:

- Windows* 7 Operating System (both 32-bit and 64-bit versions)
- Windows* Embedded Standard 7 Operating System (both 32-bit and 64-bit versions)
- Windows* Embedded POSReady 7 Operating System (32-bit and 64-bit versions)

1.3 Acronyms and Terminology

Term	Description
BSOD	Blue Screen of Death (Stop Error)
GPIO	General Purpose Input/output
I ² C	Inter-Integrated Circuit
HS-UART	High Speed Universal Asynchronous Receiver/Transmitter
SPI	Serial Peripheral Interface
SUT	System Under Test



2 Release Summary

2.1 Release Details

Driver Version: 1.1.5.1021

2.2 Release Contents

The contents of this release include:

- Intel® Processor Win7 IO Drivers 32Bit and 64Bit Driver Installer
Both “Intel Processor Win7 IO Drivers 32Bit.msi” and “Intel Processor Win7 IO Drivers 64Bit.msi” installer will install the following drivers on your system:
 - Intel® Atom™/Celeron®/Pentium® Processor UART Host Controller
 - Intel® Atom™/Celeron®/Pentium® Processor I²C Controller
 - Intel® Atom™/Celeron®/Pentium® Processor SPI Controller
 - Intel® Atom™/Celeron®/Pentium® Processor GPIO Controller
 - Intel® Atom™/Celeron®/Pentium® Processor Lower Power Subsystem DMA Device
- Intel® Processor Win7 IO Drivers – Software Developer Guide
 - Headers Files for GPIO, I²C, and SPI
 - Software Developers Manual for Windows 7 IO Drivers
- Intel® Processor Win7 IO Drivers - Release Notes
- Intel® Processor Win7 IO Drivers – User’s Guide
- Intel® Software License Agreement



3 Best Known Configurations

Hardware Configuration

Category	Description	Rev/Type/ Source
CRB	Bayley Bay	FAB 3 REV03
	Bakersport	FAB B
SOC	Intel® Atom™ E3800	B3-I : W8XF
	Intel® Celeron® Processor N2XXX	B3-D : W6XF
	Intel® Celeron® Processor J1XXX	B3-M : W7XJ
Display	VGA	
Memory	Bayley Bay: 4 GB DDR3 (2x2GB)	
	Bakersport: 2 GB DDR3 (1x2GB with ECC)	

Firmware Configuration

CRB BIOS	BYTICRB_IA32_R_SPI_0080_11_SeC_Enable	Refer to BIOS release
KSC	v03.12	Integrated in BIOS



Driver/OS Configuration

Operating System	Windows* 7 SP1	MSDN
	Windows Embedded Standard 7 SP1	
	Windows Embedded POSReady 7 SP1	
Graphics Driver	PC 15_0_1073	EMGD
GPIO Driver	1.1.5.1021	Intel
I ² C Driver	1.1.5.1021	
SPI Driver	1.1.5.1021	
HS-UART Driver	1.1.5.1021	
Chipset INF	10.0.13	
USB 3.0 Driver	3.0.0.19 (32bit and 64bit)	VIP# 59303



4 The Ready Feature

Area	Feature	Source	Ready*
SIO	General SIO feature	Win7 inbox driver	Yes
USB	General USB 2.0 feature	Win7 inbox driver	Yes
	General USB 3.0 feature	Intel USB 3.0	Yes
	USB2.0 Boot	Win7 Inbox driver	Yes
SATA	General SATA feature	Win7 Inbox driver	Yes
PCIe	General PCIe feature	Win7 Inbox driver	Yes
EMGD gfx driver	General graphics feature	Intel	Yes
High Definition Audio	General HD Audio feature	Win7 Inbox driver	Yes
	HDMI Audio	Integrated in EMGD driver	Yes
Power Management	Power Mgmt S0 and S5	N/A	Yes
	Power Mgmt Sleep S3	Intel	Yes
	Power Mgmt Hibernate S4	Intel	Yes
GPIO Driver*	Direction Setting	Intel	Yes
	Multiplexing Setting		Yes
	Level Value Setting		Yes
	Pin Setting Query		Yes



I²C Driver*	Standard Mode (100Kbps)	Intel	Yes
	Fast Mode (400Kbps)		Yes
SPI Driver*	SPI Mode 0,1,2,3	Intel	Yes
	Transfer rate from 100Kbps up to 15 Mbps		Yes
HS-UART Driver*	Baud rate support up to 4000000	Intel	Yes
	Data size 5, 6, 7, 8-bit		Yes
	Odd, even, none parity		Yes
	1, 1.5, and 2 stop bits		Yes
	Hardware & No flow control & Software flow control		Yes
DMA Feature* (I²C, SPI, HS-UART)	DMA support for I ² C, SPI and HS-UART	Intel	Yes

Note: Refer to the next section for the limitations of the GPIO/I²C/SPI/HS-UART/DMA feature.



5 Interface of IO Drivers

5.1 GPIO Driver Interface

GPIO Driver interface is exposed by a series of IOCTLs. A separated C header file provides the definition of the IOCTLs and a separated programming guide provides how to program with the IOCTLs.

5.2 I²C Driver Interface

I²C Driver interface is exposed by a series of IOCTLs. A separated C header file provides the definition of the IOCTLs and a separated programming guide provides how to program with the IOCTLs.

Max single transfer length is limited to 64K Bytes.

There are total eight I²C controllers on Intel[®] Atom™ E3000 Processor, Intel[®] Celeron[®] Processor N2XXX and Intel[®] Celeron[®] Processor J1XXX which share same one DMA engine. The big data in single transferring will cause one I²C controller occupy DMA engine for a long duration.

Application can use multiple single transfers or IOCTL_I2C_EXECUTE_SEQUENCE interface to transfer big data.

By default, I²C driver uses DMA to copy data between peripheral and system memory, but can set windows registry to disable DMA feature and copy data by PIO mode. Refer to BKM section to about how set the registry.

5.3 SPI Driver Interface

SPI Driver interface is exposed by a series of IOCTLs. A separated C header file provides the definition of the IOCTLs and a separated programming guide provides how to program with the IOCTLs



5.4 HS-UART Driver Interface

HS-UART Driver interface is exposed by standard Windows Serial Communication interface. Refer to Serial Communications in Win32 in MSDN to understand the details.

<http://msdn.microsoft.com/en-us/library/ms810467.aspx>

Following APIs of serial communication in Win32 are not supported in driver 1.1.5.1021. Future releases may support these features.

- [SetCommMask](#)
- [WaitCommEvent](#)
- [GetCommMask](#)

Intel has no plan to support following APIs of serial communication in Win32:

- [SetupComm](#)
- [SetCommBreak](#)
- [ClearCommBreak](#)
- [EscapeCommFunction](#) (don't support parameter set to SETBREAK and CLRBREAK)

HS-UART driver doesn't support DMA transfer with software flow control, when application uses the software flow control, the HS-UART will use PIO mode to copy data between peripheral and system memory.

Software flow control only support maximum baud rate up to 115200.

HS-UART driver supports following standard baud rates by default:

- 300,600,1200,1800,2400,3600,4800,7200,9600,19200,38400,57600,115200,153600,184320,230400,307200,460800,921600,3686400
- Refer to BKM to know how to set nonstandard baud rate.
- Max nonstandard baud rate is 4000000.

5.5 LPSS DMA Driver Interface

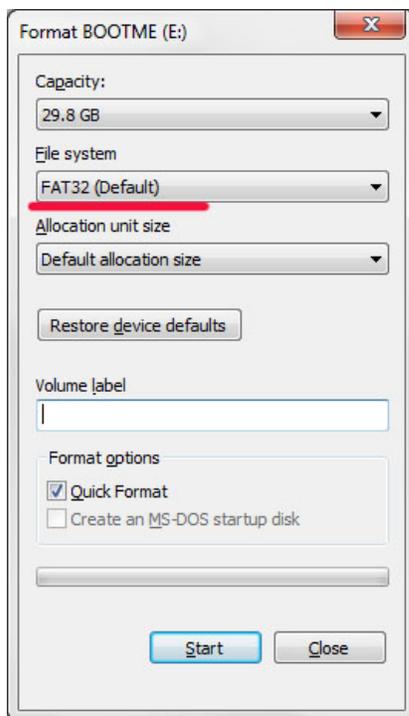
LPSS DMA Driver is not exposed publicly and only I²C, SPI, HS-UART driver are able to access the DMA driver interface.



6 Building Windows BSP

The content of this section covers Windows 7, Windows Embedded Standard 7 and Windows Embedded POSReady 7.

1. Prepare the installation media
 - a. Get a thumb drive which the capacity is between 8GB - 32GB, and format it with FAT32.



- b. Extract all files from ISO image of WIN7/WES7/POSReady 7 to thumb drive.

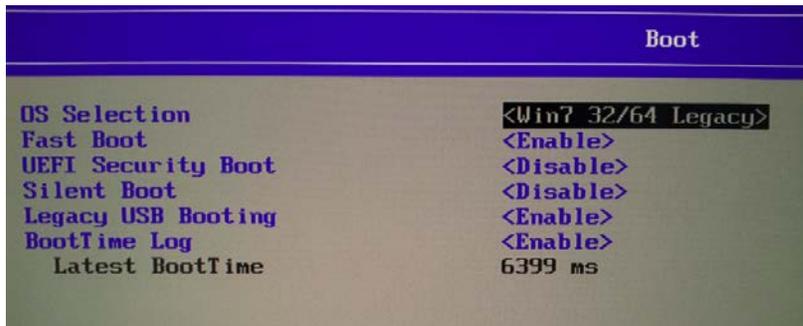


2. BIOS Setup for installation

a. In BIOS setting, enter into "Device Manager -> System Setup -> Boot, and follow with below setting:

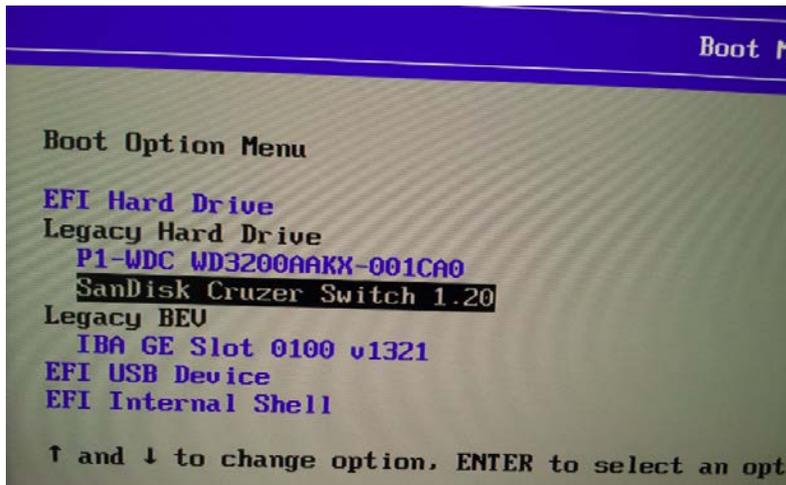
- OS Selection: Win7 32/64 Legacy
- Legacy USB Booting: Enable

Then press "F4" and commit changes and Exit.



b. Enter into "Boot Manager" -> then SELECT the option to boot from the drive or device which contains OS image and ENTER.

Note: Please DO NOT use EFI USB boot since Win 7 is using legacy mode.





3. OS Installation
 - a. Install OS with Windows OS default installation steps.
4. Intel IO drivers installation:
 - a. Execute Intel Processor Win7 IO Drivers 32Bit.msi or Intel Processor Win7 IO Drivers 64Bit.msi.
Note: Run as administrator.
 - b. Check the checkbox "Always trust software from Intel Technology Sdn.Bhd" and click **Install**.
5. Chipset INF installation
 - a. Execute the SetupChipset_10.0.13.exe installation package.



7 Errata & Known Issues

7.1 Errata

The following issues will not be fixed.

Issue #	Description	Impact	Recommendation
4634746	SPI driver failed to read and write on <51Kbps	Low speed transfer	Use SPI with speed >100Kbps
4634789	IOTG BIOS does not support USB Legacy boot in xHCI mode.	OS Boot in xHCI mode.	Perform OS Boot with USB in EHCI mode.
4634818	System re-enumeration and disconnect on HSIC device due to silicon issue.	File transfer fail on HSCI device when any plug/unplug on USB2.0 bottom port.	Do not plug/unplug on USB2.0 bottom port during file transfer on HSIC device.



7.2 Known Issues

Issue #	Description	Impact	Recommendation
4634724	UART driver has no support for IOCTL_SERIAL_SET_WAIT_MASK and IOCTL_SERIAL_WAIT_ON_MASK	User unable to use their own application / 3 rd party tools (Teraterm) that uses wait mask feature	Use Putty tool. IO driver will support this in the next release.
4634792	One bit is occasionally wrong in SPI	1 bit out of 1000 bits is corrupted on Bayley Bay platform.	Use Bakersport platform. This issue is under investigation.
4634842	Intermittent first byte lost when perform I ² C read on B3-M and B3-D	1 st byte is corrupted in I ² C read on BYT-M and BYT-D. Issue is not reproducible in PIO mode.	Disable DMA transfer for I ² C on BYT=M and BYT-D. See BKM 10.5 IO driver will fix issue in the next release.
4634844	High CPU usage when transferring data with high speed	Increase of CPU usage (15%~20%) when transferring data >1MB with high baud rate on HS-UART bus	No workaround for now. IO driver will fix issue in the next release.
4634938	HSUART data transfer is incomplete when timeout occurs	Slave device does not receive data transmitted through hardware flow control on UART. System unable to go into S3 and S4 power mode.	No workaround for now. This issue is under investigation.
4634938	HS-UART COM number increases after uninstallation and reinstallation of UART driver.	Applications using HS-UART COM ports need to change COM number	User to enable the change of COM number in their application. This issue is under investigation.



8 Platform BKMs

The following are recommended platform rework to enable the supported Windows 7 IO drivers on Intel customer reference boards. This is not an exhaustive list of platform rework.

8.1 How to rework BakerSport Fab B USB3.0 Port

By default, Bakersport Fab B has an issue with USB3.0 port. This port fails to read several types of USB3.0 thumb drive and couldn't achieve USB3.0 performance.

Remark: Patriot Memory 64GB and EDGE DiskGo 32GB Thumb Drive are not recommended to be used in EHCI mode.

Affected Platform	Bakersport boards (PBA# G72250-200 Rev 02) (Fab B)
Rework Steps	1) Un-stuff choke on L8A2 2) Stuff R8A4 and R8A3 (0 ohms)

8.2 How to rework Bakersport Fab B I²C Port 6

By default, Bakersport Fab B has an issue with I²C port 6. This port fail to read and write due to incorrect resistor connection.

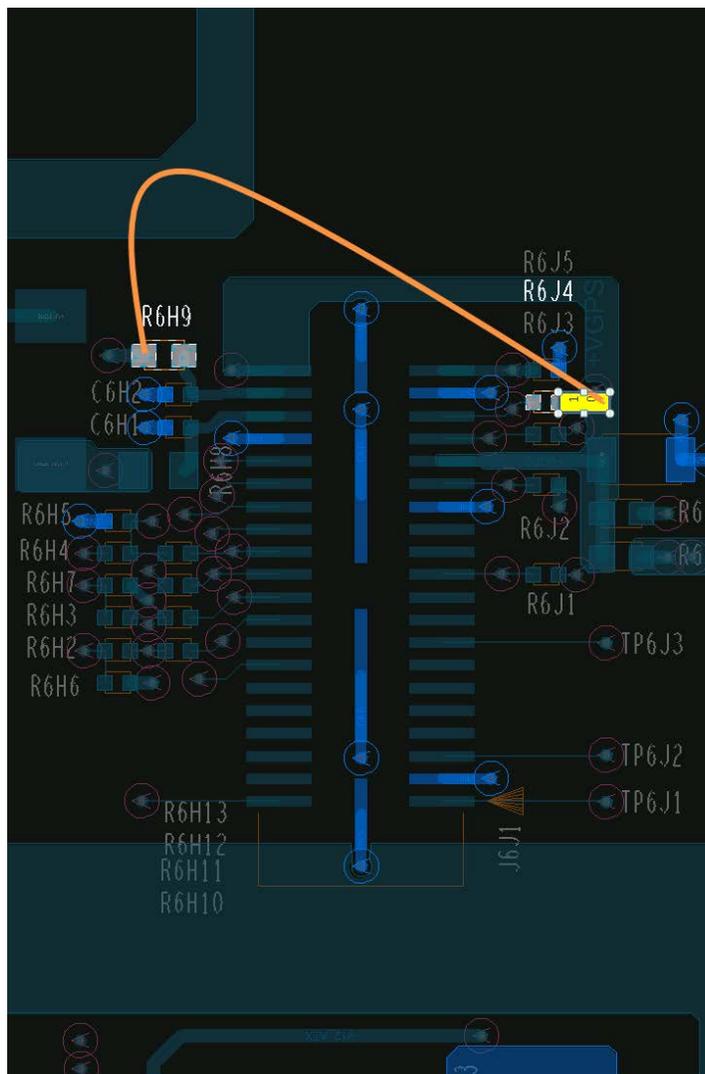
Affected Platform	Bakersport boards (PBA# G72250-200 Rev 02) (Fab B)
Rework Steps	1) UnStuff R5H9, R5H12, R5H8, R5H10 2) Stuff R5H4 (22 ohms) 3) Stuff R5H3 (22 ohms)



8.3 How to rework UART in Bakersport and Bayley Bay

By default, Bakersport Fab B has an issue with I²C port 6. This port fail to read and write due to incorrect resistor connection.

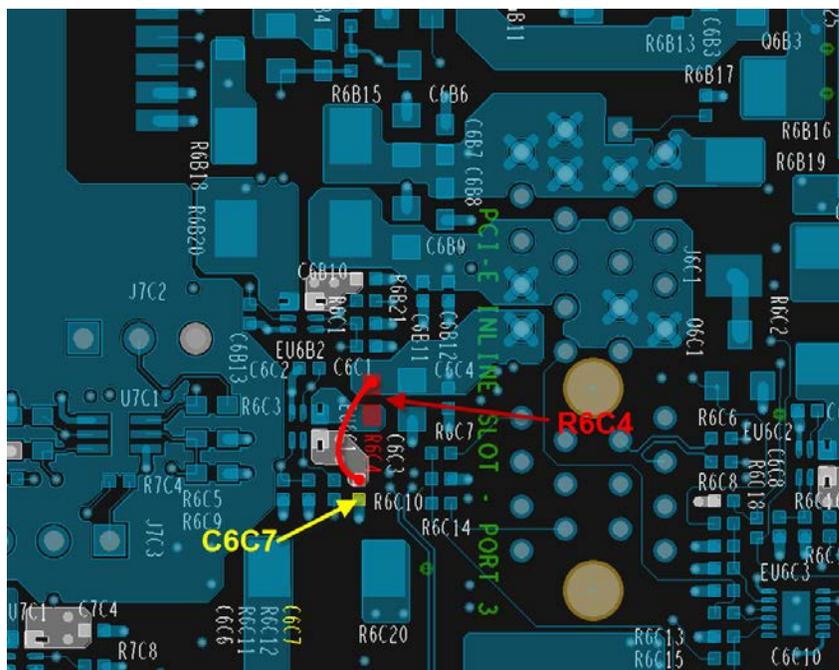
<p>Rework Steps</p>	<p>1) Place a 10K resistor followed by a 28 AWG wire from R6J4 to R6H9</p> <p>See below rework layout, yellow box is the 10K PU resistor followed by orange wire to R6H9</p>
<p>Affected Platform</p>	<p>Bakersport boards (PBA# G72250-200 Rev 02) (Fab B)</p> <p>Bayley Bay boards Fab 3 (IOTG configured) platforms only</p>



8.4 How to Rework Bayley Bay Fab 3 PCI-E INLI Slot-Port 3

By default, Bayley Bay Fab 03 has an issue with PCI-E Slot 3. This PCIe slot fail to detect network card after shutdown follow by power up (without switching off the main power).

Affected Platform	Bayley Bay boards Fab 3 (IOTG configured) platforms only
Rework Steps	1. Remove R6C4 2. Add jumper wire from C6C7 to R6C4 as shown below.
Reasons for the rework:	NIC cards don't get recognized in Windows while the jumper block (J7C2) is configured to Desktop mode, pins [1-2]. Failure mode occurs in PCIE Slot3



8.5 How to use Serial Port in Bayley Bay

The common serial port on Bayley Bay board does not work. The actual serial port is the Micro USB port near the COM port on CRB board. You will need to use the USB cable to connect the Micro USB port in the CRB board to the USB port in the host machine (Your laptop or desktop).

You need install a driver in host machine from this link <http://www.ftdichip.com/FTDrivers.htm> .

Then you will have a virtual COM port in host machine to communicate with Bayley Bay board.



9 Software Driver BKM

9.1 How to Resolve Yellow Bang Caused by SD/eMMC Card

You may observe yellow bangs in windows device manager when you plug in your SD/eMMC card as Windows 7 Inbox driver currently does not run on Intel® Atom™ E3800 platform. To hide the SD and eMMC devices, go to Device manager-> System setup-> South Cluster Configuration -> LPSS & SCC Configuration -> DISABLE the SD/eMMC Boot Controller.

LPSS & SCC Devices Mode	<PCI Mode>
SCC Configuration	
SCC eMMC Boot Controller	<Disable>
eMMC Secure Erase	<Disable>
SCC eMMC45 Support	<Enable>
DDR50 Capability Support	<Enable>
HS200 Capability Support	<Enable>
Re Tune Timer Value	<8>
SCC SDIO Support	<Disable>
SCC SD Card Support	<Disable>
SCC SD Card for Windows	<Disable>
SDR25 Capability Support for SDCard	<Disable>
DDR50 Capability Support for SDCard	<Disable>

9.2 How to Enable Hibernation in WES7

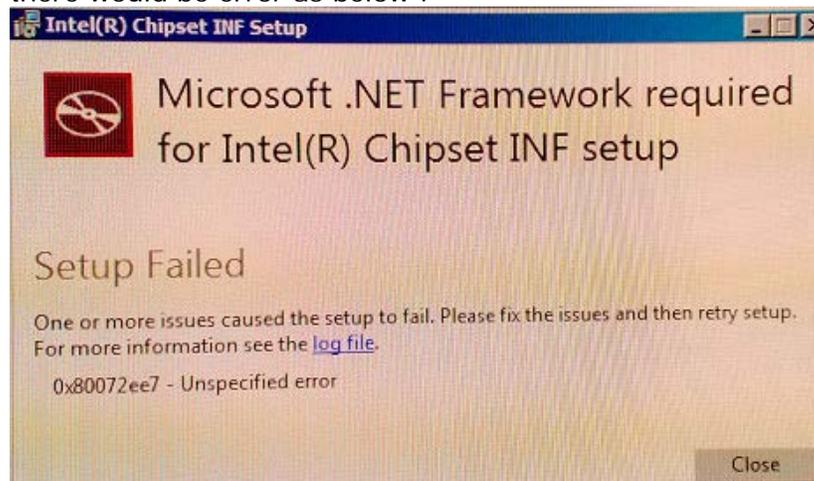
By default, the hibernation is disabled in WES7. To enable it, start the Windows Command Prompt and type "powercfg /h on" to enable the hibernation.



9.3 How to Create OS Boot from USB Device for WES 7

The following are generic steps for enabling OS boot on Windows. You may refer to Microsoft website for more instructions.

1. Prepare the setup environment: Connect USB Flash Device which you wish to deploy the WES 7 image to the USB port and connect the storage device which contain WES 7 image.
2. Power up the system and boot into WES 7 image.
3. Select **Build an Image**. Accept the license terms and conditions. Followed by select do not use a template, choose a language, and then click Next.
4. In the select the packages window to include in your image page, click "**Feature Packages**" to expand the branch, then click "**Embedded Enabling Features**", and then select "**Bootable Windows USB Stack**".
5. Add any other additional drivers/packages that you may need.
 - To install chipset INF, .NET is requested when installing the WES , else there would be error as below :



6. Click on **Resolve Dependencies** and try to resolve all the dependency issues.

Note: If you are asked to choose between **Standard Windows USB Stack** and **Bootable Windows USB Stack**, make sure only leave **Bootable Windows USB Stack** checked.

7. On the drive-selection screen, select the partition you wish to install to.
8. Click next and wait installation to complete.



9.4 How to Disable the DMA Feature for I²C

There are 7 I²C controllers in the Intel[®] Atom™ E3800 processor and these controllers use the windows registry to control the DMA feature.

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\iaioi2c\Parameters]
"ForceDma"="0,0,0,0,0,0,0"
```

ForceDma is a string type and there are 7 value mapped to the 7 I²C controllers which are device IDs are from 0F41 to 0F47h.

Value 0, will force DMA to disable, and I²C data will be read/write in PIO mode.

Value other than 0, if data length is more than the specified value, I²C data will be read/write in DMA mode; if data length is less than the specified value, I²C data will read/write in PIO mode.

By default, without any registry settings, I²C will use PIO mode.



9.5 How to Set the Baud Rates of HS-UART

1. The baud rate is calculated based on the following method:

$$\text{Baud rate} = (\text{SourceClockFrequency}) / (16 * \text{divisor})$$
$$\text{Source Clock Frequency} = 50000000 * \text{PrescalerMValue} / \text{PrescalerNValue} * 2$$

For example, to set baud rate to 1M:

Set PrescalerMValue = 64

Set PrescalerNValue = 100

SourceClockFrequency = 64,000,000

You can customize the value of SourceClockFrequency, PrescalerMValue and PrescalerNValue from windows registry. You will need to reboot the system after setting these values.

2. To support baud rate between 230,400 and 3,686,400, create and change the following registry setting:

```
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\iaiouart\Parameters]
;High speed source clock, M and N prescalers
"HSUartSourceClockFrequency"=dword:01c1f8f8
"HSUartPrescalerMValue"=dword:00003fff
"HSUartPrescalerNValue"=dword:00006c80
```

3. To support baud rate between 300 and 115200, change the following registry setting

For Low speed source clock, M and N prescalers:

"UartSourceClockFrequency"=dword:001c2000

"UartPrescalerMValue"=dword:0000025a

"UartPrescalerNValue"=dword:00007fff

See Section 27.2.3 Baud Rate Generator in the "Bay Trail-I SoC External Design Specification" document for details.



9.6 How to Install I/O Driver Unattended in Windows 7

All operations mentioned below require **administrator privileges** in Windows 7 and Windows Embedded Standard 7 (WES7). You will need to write a windows batch file to complete these steps.

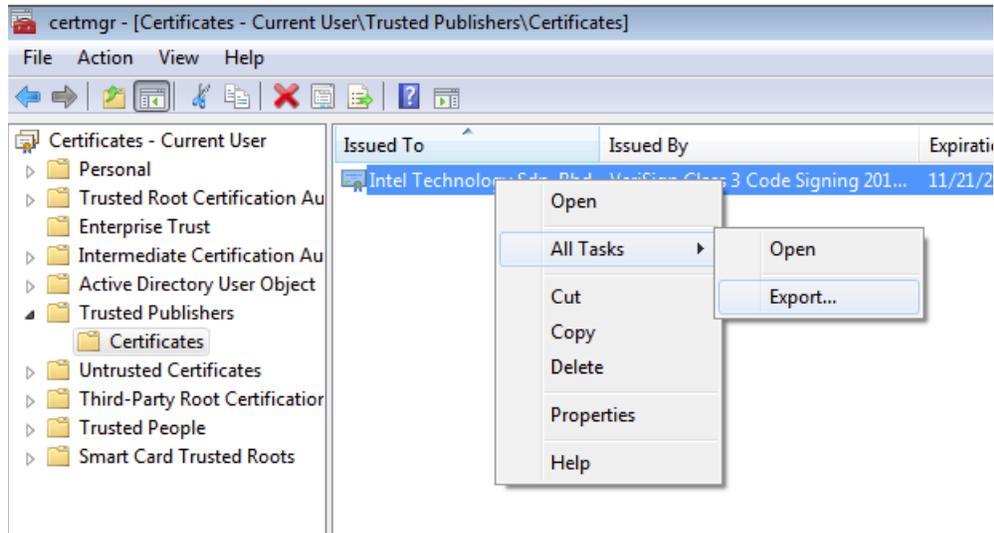
Suppress the Windows Security prompt

1. This prompt will pop up every time during driver installation until user clicks the "Always trust software from..." click box.



To suppress this prompt, you need to first add the "Intel Technology Sdn. Bhd." as a trusted publisher.

- a) Manually install Intel IO driver on Windows 7 and select the "Always trust software from Intel Technology Sdn. Bhd." click box.
- b) After installation, run Windows tool **certmgr.msc** and navigate to **Trusted Publishers** then **Certificates**.
- c) Export the certificate with the name "Intel Technology Sdn. Bhd." to your local disk with DER encoded binary X.509(.CER) format. For example, "Intel.cer"



- d) On your other Windows platform where you intend to install the driver unattended, add the exported certificate to the Windows Trusted Publisher. Run the following command with administrator privileges:
- `certmgr.exe -add intel.cer -c -s -r localMachine TrustedPublisher`
 - User can obtain `certmgr.exe` from Windows SDK. Refer to MSDN [Certificate Manager Tool](#)

Suppress the Windows Installer prompt

Intel IO driver package is in Windows Installer (MSI) format so you can use the `msiexec.exe` to install it in unattended mode. For example, run this command in administrator privileges:

```
msiexec /i "Intel Atom E3800 Win7 IO Drivers 32Bit.msi" /passive
```

To uninstall it:

```
msiexec /x "Intel Atom E3800 Win7 IO Drivers 32Bit.msi" /passive
```

Unattended uninstallation when .msi file is not present.

Create a bat file with following command. Run the bat file as administrator.

```
wmic product where name="xxxxxx" call uninstall
```

Note: "xxxxxx" refers to the application name. For example: Intel Atom E3800 Win7 IO Drivers 32bit



9.7 How to Install I/O Driver Using INF or SYS File

By default, you can run the Intel driver .msi installer package to install the I/O drivers. Alternatively, you can also install by retrieving the raw driver package (the inf and sys file) in following folder after driver installation and install the driver using PnPUtil or Windows DP Installer.

For 64 bit driver: [Program Files]\Intel\Intel Atom E3800 Win7 IO Drivers 64bit.

For 32 bit driver: [Program Files]\Intel\Intel Atom E3800 Win7 IO Drivers 32bit.

Then the user also can custom their own installation directly based on driver package files, for example:

- Use PnPUtil tool to install driver by inf file [http://msdn.microsoft.com/en-us/library/windows/hardware/ff550423\(v=vs.85\).aspx](http://msdn.microsoft.com/en-us/library/windows/hardware/ff550423(v=vs.85).aspx)
- Use Driver Package Installer (DPIInst) [http://msdn.microsoft.com/en-us/library/windows/hardware/ff544842\(v=vs.85\).aspx](http://msdn.microsoft.com/en-us/library/windows/hardware/ff544842(v=vs.85).aspx)

9.8 How to Install USB3.0 Driver into System

Note: For more details of the USB 3.0, Please refer to the USB 3.0 "Bring up Guide.pdf" which is available for download in VIP.

1. Connect PS2 keyboard and mouse onto your system

Note: Without the USB3.0 driver installed on your system, all USB ports are by default not functioning when XHCI controller is enabled.

2. Boot into Windows 7 with the below BIOS configuration:

Go to "Device Manager" -> System Setup -> Boot -> set OS selection to "Win7 32/64 Legacy" -> commit changes and exit

Go to "Device Manager" -> System Setup -> South Cluster Configuration -> USB Configuration -> disable EHCI and enable XHCI as below then commit change and exit



```
XHCI Controller <Enable>
  HSIC #0 <Enable>
XHCI Mode <Enable>
USB2 Link Power Management <Enable>

USB OTG Support <Disable>
USB VBUS <ON>

EHCI Controller <Disable>
USB RMH Mode <Enable>
USB EHCI debug <Disable>
USB Per-Port Control <Enable>
USB Port #0 <Enable>
```

3. Boot system into windows and install the USB3.0 driver.
4. After installation is completed, go to **Device Manager** to ensure that the below two USB3.0 devices are shown under Universal Serial Bus Controllers. Observe that the device should not have a yellow bang.
 - Intel® USB 3.0 eXtensible Host Controller
 - Intel® USB 3.0 Root Hub