

P5 Verification Test Plan

Release No: 091010021

Product Model	DSS-5300
Description	Intel ATOM Digital Signage System
Test Configuration	<input checked="" type="checkbox"/> New product <input checked="" type="checkbox"/> System : DSS-5300 A0.1 <input checked="" type="checkbox"/> PCB : EMB-9459T A1.0 <input checked="" type="checkbox"/> BIOS : DSS-5300 BIOS 0.3(06/16/2009) <input checked="" type="checkbox"/> Inverter : N/A <input checked="" type="checkbox"/> LCD : N/A <input checked="" type="checkbox"/> Touch Panel : N/A <input checked="" type="checkbox"/> M/B Chipset : <input checked="" type="checkbox"/> North Bridge : Intel 945GSE <input checked="" type="checkbox"/> South Bridge : Intel NH82801GBM(ICH7M) <input checked="" type="checkbox"/> VGA Chipset : Intel 945GSE integrated <input checked="" type="checkbox"/> Audio Chipset : VIA HD VT1708B <input checked="" type="checkbox"/> Ethernet Chipset : Realtek RTL8111C 10/100/1000 MHz <input checked="" type="checkbox"/> I/O Chipset : ITE 8712 <input checked="" type="checkbox"/> TV Chipset : Intel 945GSE integrated <input checked="" type="checkbox"/> Remark : QE NPDP P5 Report for DSS-5300 A0.1
Test Result Summary	
<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Pass with Deviation Comment: _____ _____	

2009/11/27	Wenyuan Yang	Leo Liu
Issue date	Manager	Test Engineer

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There are 3 test results in this document; they are described as follows:

Pass: Function worked perfectly

Fail: Function failed and must be modified in the next version

N/A: Outside of specification or no test equipment

Platform Information:

Item	Device Information
PCB Model / Version	EMB-9459T A1.0
System	DSS-5300 A0.1
Carrier Board	N/A
BIOS / Version	DSS-5300 BIOS 0.3(06/16/2009)
CPU Type	Intel(R) Atom(TM) CPU N270 1.6GHz
Memory Type	Kingston DDR2 800 1GB(KVR800D2N6)
SATA HDD	FUJITSU MHZ2080BH 2.5" 80GB
SATA DVD	N/A
Primary IDE Master	N/A
Primary IDE Slave	N/A
CRT	VIEWSONIC E70 17"
LCD	N/A
Compact Flash	N/A
Riser Card	N/A
Backplane	N/A
Operating System	<input type="checkbox"/> Linux-RedHat 9.0 or <input checked="" type="checkbox"/> Fedora Core 9.0
	Windows Vista™ Ultimate English Version
	Windows XP Professional English Version V2002 Service Pack 3
Power Adapter	FSP060-DBAB1

Test Result for Certification

1. I/O Peripheral Function Test

I/O Peripheral Function Test –I/O Function	Result		
	Pass	Fail	N/A
Floppy Connector / Driver A:			X
Primary IDE Master			X
Primary IDE Slave			X
Secondary IDE Master			X
Secondary IDE Slave			X
Third IDE Master			X
Third IDE Slave			X
RAID 0 Function Test			X
RAID 1 Function Test			X
SATA1 / Serial ATA Connector 1	X		
SATA2 / Serial ATA Connector 2	X		
SATA3 / Serial ATA Connector 3			X
SATA4 / Serial ATA Connector 4			X
Compact Flash – Type I			X
Compact Flash – Type II			X
DOC (Disk On Chip)			X
DOM (Disk On Module) – 40 Pin			X
DOM (Disk On Module) – 44 Pin			X
COM 1-232	X		
COM 2-232	X		
COM 2-422	X		
COM 2-485	X		
COM 2-Ring /+5V /+12V	X		
COM 3-232			X
COM 4-232			X
COM 5-232			X
COM 6-232			X
PS/2 Mouse & Keyboard (Internal)			X
PS/2 Mouse & Keyboard (External)	X		
Audio Connector	X		
Audio 7.1 Channel / S/P DIF			X
LPT 1	X		
LPT 2			X
SIR / 115.2 Kbps			X
FIR / 4M bps			X
USB 1/2 Ports	X		
USB 3/4 Ports	X		
USB 5/6 Ports			X
USB 7/8 Ports			X
USB 2.0 1/2 Ports	X		
USB 2.0 3/4 Ports	X		

USB 2.0 5/6 Ports			X
USB 2.0 7/8 Ports			X
DIO Connector			X
Card Bus			X
PC/104			X
PC/104-Plus			X
PCI-104			X
CD-In Connector			X
TFT TTL LCD			X
TFT LVDS LCD			X
CRT	X		
TV-out / S Terminal			X
TV-out / AV Terminal			X
DVI	X		
HDMI			X
Component Video : Y/ Pb /Pr			X
Touch Screen – 4 Wire			X
Touch Screen – 5 Wire			X
Touch Screen – 8 Wire			X
DIMM Slots			X
Watchdog IRQ n			X
Watchdog Software Control	X		
CPU FAN Connector			X
System FAN Connector			X
Front Panel	Result		
	Pass	Fail	N/A
Power On Button	X		
IDE LED	X		
External Buzzer			X
On Board Buzzer	X		
Power LED	X		
Reset Switch			X
Keyboard Lock			X
Jumpers Function	Result		
	Pass	Fail	N/A
ATX simulates AT	X		
Audio Out Selection (W/O & W/ Amplifier)			X
LCD Power Select			X
COM1-Ring/5V/12V Selection	X		
COM2-Ring/5V/12V Selection	X		
COM2 RS-232/422/485 Selection (Depends on BIOS)			X
COM3-Ring/5V/12V Selection			X
COM4-Ring/5V/12V Selection			X
Clear CMOS	X		
Touch Screen Operating Mode Selection			X
Clock Shift of TFT LCD			X

Power Connector & Function		Result		
		Pass	Fail	N/A
5V only Power for Big 4P				X
ATX Power Connector				X
ATX Power_12V Connector		X		
AT Power Connector				X
Big 4P Power Connector				X
Mini 4P Power Connector		X		
External Power Connector(-12/-5V)				X
Option ATX Power Connector (PS-ON / +5VSB)				X
LAN Connector & Function		Result		
		Pass	Fail	N/A
LAN Link / Speed LED	LAN1	X		
	LAN2	X		
LAN Active LED	LAN1	X		
	LAN2	X		
LAN 10/100 Ethernet		X		
LAN 1G Ethernet		X		
PCI Connector & Function		Result		
		Pass	Fail	N/A
Mini PCI Slots				X
PCI Slots				X
PCI Express				X
Mini PCI Express card				X
Express card				X

2. Timer Accuracy Test

System Clock & RTC Clock Test				
Test Method	Margin for error	Result		
		Pass	Fail	N/A
RTC Clock in Power On Mode	±3 second during 24 hours	X		
RTC Clock in Power Off Mode	±3 second during 24 hours	X		
Watchdog Timer Test		Result		
		Pass	Fail	N/A
Time-out Interval	10 sec	X		
	60 sec	X		
	255 sec	X		

3. Network HUB / LAN Connection Test

Location	LED Type	Result		
		Pass	Fail	N/A
LAN1 LED	Link / Speed LED	X		
	Active LED	X		

LAN2 LED		Link / Speed LED				X		
		Active LED				X		
Location	Speed	HUB Type	Cable Length	HUB Speed	Onboard LAN Speed	Result		
						Pass	Fail	N/A
Onboard LAN1	10/100/1000 Mbps	HP J4095A 24 Ports	100M	1GBps	999	X		
		D-Link DGS-1008T	100M	100 MBps	999	X		
		SVEC FD916H (10 Mbps HUB)	100M	10 MBps	999	X		
Onboard LAN2	10/100/1000 Mbps	HP J4095A 24 Ports	100M	1GBps	999	X		
		D-Link DGS-1008T	100M	100 MBps	999	X		
		SVEC FD916H (10 Mbps HUB)	100M	10 MBps	999	X		

4. Hardware Compatibility

CPU Compatible Test							
CPU Type		FSB	Prime95 Version		Result		
					Pass	Fail	N/A
Intel(R) Atom(TM) CPU N270 1.6GHz		533MHz	V.256		X		
Memory Compatibility Test							
Memory Brand	Memory Chipset	Frequency	Size	MemTest86 Version	Result		
					Pass	Fail	N/A
Kingston	HYB18T512800BF3S	DDR2-533	512MB	2.01	X		
DSL	ELPIDA E5108AGBG-6E-E	DDR2-533	1GB	2.01	X		
Audio Basic Function Test					Result		
					Pass	Fail	N/A
System Sound					X		
CD_In							X
CD_In Sound Recorder							X
Play Sound Recorder					X		
Line Out					X		
Line In							X
Line In Sound Record							X
MIC Speaker				Dynamic	X		
				Condenser	X		
MIC Sound Recorder				Dynamic	X		
				Condenser	X		
Audio 5.1 Channel with S/P DIF Function Test					Result		
					Pass	Fail	N/A

2-channel mode for stereo speaker output		X			
4-channel mode for 4 speaker output				X	
6-channel mode for 5.1 speaker output				X	
8-channel mode for 7.1 speaker output				X	
S/P DIF function Test	Input			X	
	Output			X	
On Board TV Function Test		Result			
		Pass	Fail	N/A	
NTSC	AV Terminal			X	
PAL				X	
NTSC	S Terminal			X	
PAL				X	
On Board LCD Function Test					
TFT LCD	Type	Voltage	Result		
			Pass	Fail	N/A
LVDS	AUO G065VN01 V.0 / 6.5" / 640x480 / 18bit (4:3)	3.3V			X
	AUO G065VN01 V.0 / 6.5" / 640x480 / 24bit (4:3)	3.3V			X
	Data Image 7" / 800*480 / 18bit (16:9)	3.3V			X
	AU G084SN05 V.3 / 8.4" / 800*600 / 18bit (4:3)	3.3V			X
	AU G150XG01 V.0 / 15" / 1024*768 / 18bit (4:3)	3.3V			X
	AU M150XN07 V.2 / 15" / 1024x768 / 24bit (4:3)	3.3V			X
	Toshiba /12.1"/1280 x 768 x 18bit (16:9)	3.3V			X
	AU M170EG01 / 17" / 1280*1024 / 48bit (4:3)	5V			X
	AU M170XW01 V.1 / 17" / 1280x768 / 24bit (16:9)	5V			X
	AUO T260XW02 / 26" / 1366x768 / 24bit	5V			X
	AU M201UN02 V.5 / 20.1" / 1600x1200x48bit	5V			X
	AUO T370HW01 / 37" / 1920x1080 / 48bit	5V			X
	AUO M190PW01 V0 / 19" / 1440X900/48 bit	5V			X
TTL	Toshiba LTM10C209A / 10.4" / 640*480 / 18bit (4:3)	5V			X
	NEC NL8060AC31-12 / 12.1" / 800*600 / 18bit (4:3)	3.3/5V			X
	Sharp LQ121S1DG11 / 12.1" / 800*600 / 18bit (4:3)	3.3V			X
	LG LM151X2-C2TH / 15.1" / 1024x768 / 18bit (4:3)	3.3V			X
	Fujitsu FLC38XGC6V-06 / 15" / 1024*768 / 36bit (4:3)	5V			X
PCI Slot Function (PCI Adapter Card) Test					
Model	Type	Result			
		Pass	Fail	N/A	
CHANTECH NVIDIA GeForce4 MX440-8X	VGA Card			X	
Creative Sound BLASTER Live5.1	Sound Card			X	
Takram DC-395U V1.02	SCSI Card			X	
ADAPTEC Ultra160 SCSI ASC-29160	SCSI Card			X	
I-VIEW CP-1400AS (with Age STD-477FAI CCD)	Capture Card			X	
Intel GD82559 10/100 Mbps Fast Ethernet Adapter	LAN Card			X	
3Com 3C905C-TXM ETHERLINK 10/100 PCI	LAN Card			X	
D-Link DWL-520+ Wireless LAN	LAN Card			X	
ADAPTEC 1420SA RoHS 4-Port SATA II RAID	RAID Card			X	

LEMEL MD V1456VQH-P2 PCI MODEM Card	Modem Card			X
D-Link DU-520 USB 2.0	USB Hub Card			X
Tekram TR-822 Serial ATA 150 [SA-001] + SATA HDD Seagate ST3120026AS 120GB	SATA Card			X
ISA Slot Function Test		Result		
		Pass	Fail	N/A
NE2000 Compatible LAN Card (RTL8019AS)				X
Adaptec AHA-1510/20/22B SCSI Card				X
PCI-Express Function Test				
Model		Result		
		Pass	Fail	N/A
SUNIX SATA1414 VER 1.1 PCI-Express x1 SATA Card				X
SksKonnnect SK-9E21D 10/100/1000 Base-T Adapter PCI-Express x1 LAN Card				X
Adaptec AAR-1430SA SATAII HostRAID Controllers PCI-Express x4 RAID Card				X
ASUS EAX1600PRO/TD/256M/A (ATI Chipset) PCI-Express x16 VGA Card				X
WinFast PX6200 TC TDH PCI-Express x16 VGA Card				X
HDD Compatibility Test				
Model		Result		
		Pass	Fail	N/A
Seagate / ST3160815A / 160GB /PATA-100				X
Fujitsu MHY2080BH 80GB 2.5" HDD / ATA-133 / SATA				X
Western Digital/WD8800AAJS / 80GB / SATA II				X
HITACHI HDP725025GLA380 / 250GB / SATA 3.0Gb/s				X
IDE Cable Function test				
IDE Model		Result		
		Pass	Fail	N/A
40 Pin Cable ATA100				X
44 Pin Cable ATA33				X
80 Pin Cable ATA100				X
USB Function Test				
USB Basic Function Test		Result		
		Pass	Fail	N/A
USB Controller		X		
USB 2.0 Controller		X		
USB Keyboard Support		X		
USB Mouse Support		X		
USB 1.1 Compatible Test		Result		
		Pass	Fail	N/A
USB 1.1 Compatible Test		X		
USB 2.0 Compatible Test		Result		
		Pass	Fail	N/A
USB 2.0 Compatible Test		X		

USB 2.0 Function Test		Result			
		Pass	Fail	N/A	
Install Windows XP Professional from HighSpeed Device: USB2.0 DRW-1604P-D/WHT/G/ASUS		X			
USB Device Full Loading Test		Result			
Model		Pass	Fail	N/A	
BENQ 4824WI-ON2				X	
Mitsumi FLL3.5 D353GUE/FUE		X			
USB HDD 20GB		X			
USB Card Reader				X	
USB Mouse		X			
USB Flash drive Transcend 2GB				X	
Floppy Disk Controller Function Test		Result			
		Pass	Fail	N/A	
Copy and compare file between C: and A / B:				X	
Change Floppy to None value				X	
Swap FDD				X	
Peripheral Compatibility-Storage Device					
Model	Interface	Result			
		Pass	Fail	N/A	
FUJITSU MCB3064SS	SCSI			X	
IOMega ZIP 100 parallel port	Parallel			X	
IOMega ZIP100MB Internal ATAPI Drive	IDE			X	
DOC				X	
Type-I CF	Fix / PIO Mode			X	
Type-I CF	Fix / UDMA Mode			X	
Digital I/O Connector Test		Result			
		Pass	Fail	N/A	
Input Address:				X	
Output Address:				X	
VCC: Position :				X	
DIO-1 Function Test				X	
DIO-2 Function Test				X	
Adapter Compatibility- Industry Control Card PC/104, PC/104+, PCI-104 Modules					
Interface	Model	Type	Result		
			Pass	Fail	N/A
PC/104	AAEON PCM-5600	Modem Module			X
	AAEON PCM-3115B	PCMCIA Module			X
PC/104+	AAEON PCM-3430	SCSI Module			X
PCI-104	AAEON PCM-FA00	Mini-PCI Converter			X
	AAEON PCM-3794	SCSI Module			X
	AAEON PCM-3730	Intel 82559 LAN Module			X
PCI/104 Express	AAEON PER-123			X	

On-Board SCSI Function Test				
Model	Interface	Result		
		Pass	Fail	N/A
RICOH MP7060S	SCSI-CDROM 24X			X
Fujitsu MCB3064SS	SCSI-MO Device			X
Seagate 32155W	SCSI-HDD 2.15GB			X
IBM DNES-309170	SCSI-HDD 9GB			X
Seagate ST39205LW/P	9GB / Ultra160 / LVD			X
On-Board RAID Function Test				
Model	Interface	Result		
		Pass	Fail	N/A
Set SATA HDDs as RAID 0	SATA			X
Set SATA HDDs as RAID 1	SATA			X
Set SATA HDDs as RAID 10	SATA			X
Set SATA HDDs as RAID 5	SATA			X
COM Function Test		Result		
		Pass	Fail	N/A
COM Port Burn In Test overnight		X		
Disk On Module [DOM] Compatibility Test				
Model	Interface	Result		
		Pass	Fail	N/A
Transcend / TS512MDOM40V / 512MB	IDE 40 Pin			X
Transcend / TS512MDOM44V / 512MB	IDE 44 Pin			X
Mini PCI Card Compatibility Test				
Model	Interface	Result		
		Pass	Fail	N/A
PCI 10/100 LAN Mini PCI Card (Model:PER-C10L)	LAN			X
GM-101 WLAN 11b/g 54Mbps Mini PCI Card (Model: VNT6655AM)	WLAN			X
COM/LPT Ports & RS-232/422/485 Function Test		Result		
		Pass	Fail	N/A
RS-422 for COM2		X		
RS-485 for COM2		X		
COM1		X		
COM2		X		
COM3				X
COM4				X
COM5				X
COM6				X
LPT1				X
LPT2				X

Card Bus(PCMCIA) Compatibility Function Test			
Model	Result		
	Pass	Fail	N/A
Intel PRO/Wireless 2011B LAN PC Card (WPC2011BWW)			X
PQI 16MB Compact Flash Adapter (64MB PQI CF Card inserting)			X
Kingston datapack DP-PCM2 / 2GB (PC Card TypeII HDD)			X
PCi GW-NS54SG Cardbus Adapter Wireless LAN Type-II			X

5. O.S. Compatibility Test

Installation Operation System Compatibility Test			Result		
			Pass	Fail	N/A
[<input type="checkbox"/>] Linux-Red Hat 9.0 or [<input checked="" type="checkbox"/>] Fedora Core 9			X		
Windows Vista TM Ultimate English Version			X		
Windows Vista TM Ultimate x64 Edition English Version					X
Windows XP Professional English Version V2002 Service Pack 3			X		
Windows XP Professional English Version /Standard x64 Edition					X
Windows 2000 Professional English Version V5.00.2195 Service Pack4					X
Windows 2000 Professional Simplified-Chinese Version V5.00.2195 Service Pack4					X
Windows 2000 Professional Japanese Version V5.00.2195 Service Pack4					X
Windows Server 2000 English Version					X
Windows Server 2003 English Version / Standard Edition 5.2.3790					X
Windows Server 2003 English Version /Standard x64 Edition					X
Windows 98SE English Version V4.10.2222A					X
DOS 6.22 English Version					X
Utility and Driver Test					
OS	Drivers Version		Result		
			Pass	Fail	N/A
Linux-Fedora 9 / Kernel- 2.6.25-14.FC9	Chipset Software	Default Driver	X		
	Graphics Media	Default Driver	X		
	LAN Driver	Default Driver	X		
	Audio Driver	Default Driver	X		
Windows Vista TM Ultimate English Version	Chipset Software	INTEL Chipset Device Software Ver.9.0.0.1008 Date:5/1/2008	X		
	Graphics Media	INTEL 945 Express Chipset Ver.7.14.10.1504 Date:6/18/2008	X		
	LAN Driver	Realtek RTL8168C(P)/811C(P) PCI-E GBE Ver.6.216.12009 Date:01/20/2009	X		
	Audio Driver	VIA High Defition Audio Ver.6.0.1.1550 Date:10/22/2008	X		
Windows Vista TM Ultimate x64 Edition English Version	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X

Windows XP Professional English Version V2002 Service Pack 3	Chipset Software	Intel(R) Chipset Device Software 9.0.0.1008	X		
	Graphics Media	Mobile Intel(R) 945 Express Chipset Family 6.14.10.4926(2/28/2008)	X		
	LAN Driver	Realtek RTL8168C(P)/8111C(P) PCI-E Gigabit Ethernet NIC 5.698.701.2008(7/1/2008)	X		
	Audio Driver	VIA High Definition Audio Ver.6.0.1.1550 Date:10/22/2008	X		
Windows XP Professional x64 Edition English Version Service Pack 2 V2002	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows 2000 Professional English Version V5.00.2195 Service Pack 4	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows 2000 Professional Simplified-Chinese Version V5.00.2195 Service Pack4	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows 2000 Professional Japanese Version V5.00.2195 Service Pack4	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows Server 2000 English Version	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows Server 2003 English Version Standard Edition 5.2.3790	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows Server 2003 English Version Standard x64 Edition	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X
Windows 98SE English Version V4.10.2222A	Chipset Software				X
	Graphics Media				X
	LAN Driver				X
	Audio Driver				X

6. BIOS Function Test

Test Item	Result		
	Pass	Fail	N/A
Memory Beep Test	X		
Standard CMOS Setup Test	X		

Boot Sequence Test	X		
Power Management Test			
APM Power Management Test			X
ACPI Power Management Test	X		
Power On Function Test	X		
Wake Up Event Test	X		
Power On after Power Failure Test	X		
CMOS Backup / Clear CMOS Test	X		
Boot ROM Test (RPL/PXE)	X		
Supervisor / User Password Test			X
CRT / LCD / DVI / HDMI //TV Function Test	X		
TV Standard Function Test			X
Init Display First Function Test			X
On-Chip Serial ATA Function Test			X
SATA Mode-IDE/RAID Function Test			X
PC Health Status			
Voltage Monitor Test	X		
FAN Speed Monitor Test			X
Temperature Monitor Test	X		
Swap Floppy Drive & Boot up Floppy Seek Function Test			X
USB Onboard Device Function Test	X		
COM Address / IRQ Test	X		
LPT Address / IRQ Test			X
BIOS AWDFLASH Program Test	X		

7. Performance Test

Platform Information

CPU Board	EMB-9459T A1.0
System	DSS-5300 A0.1
Carrier Board	N/A
BIOS	DSS-5300 0.3(06/16/2009)
Operating System	Windows XP Professional V2002 Service Pack 3
CPU	Intel(R) Atom(TM) CPU N270 1.6GHz
Memory	Kingston DDR2 800 1GB(KVR800D2N6)
SATA HDD	FUJITSU MHZ2080BH 2.5" 80GB
Primary IDE Master	N/A
Primary IDE Slave	N/A
CRT	ViewSonic E70 17"
LCD	N/A
Compact Flash	N/A
Expansion Board	N/A
	N/A
Chipset Software	Intel(R) Chipset Device Software 9.0.0.1008
Graphics Media	Mobile Intel(R) 945 Express Chipset Family 6.14.10.4926(2/28/2008)
LAN Driver	Realtek RTL8168C(P)/8111C(P) PCI-E Gigabit Ethernet NIC

	5.698.701.2008(7/1/2008)
Audio Driver	VIA High Definition Audio Ver.6.0.1.1550 Date:10/22/2008
Touchscreen Driver	N/A
Power Supply or Adapter	FSP FSP060-DBAB1 12V/5.0A 60W MAX

Test result:

Testing Software	Result	Unit
PCMark2002		
CPU	2664	
Memory	6290	
HDD	1377	
Final Reality V1.01—BenchMark Test		
2D image	19.72	
3D	4.09	
Bus transfer	37.82	
Overall	13.84	Reality marks
3Dmark2001		
3DMark2001SE Build 330_Benchmark mode	N/A	

Test Result:

Testing Software	Result	Unit
PCMark05		
PCMark	1556	PCMarks
CPU	N/A	
Memory	N/A	
Graphics	N/A	
HDD	N/A	
3Dmark2003 v360		
3Dmark Score	721	

Remark: Please uses below two performance software to test main board if the chipset is new enough.
(ex. Intel Core 2 Duo CPU)