

Nvidia Graphics Card Installation

I hit upon the idea of upscaling my old video tapes made by video cameras (Sharp & Sony Hi-8) already digitized and old DVDs to 1920 x 1080 FHD (Full High Definition) MP4 video files. I had discarded old VHS tapes after digitizing and archiving the contents to DVDs (AVCHD).

The upscaling application software (Topaz Video Enhance AI) requires high performance graphics system installed powerful GPU (Graphics Processing Unit) along with high speed CPU (Central Processing Unit) with large capacity of main memory (32GB SDRAM (Synchronous Dynamic Random Access Memory)).

I chose **Nvidia GeForce RTX 2080 SUPER** replacing **Nvidia GeForce GT620** graphics card installed on ASUS i7-4770 3.4GHz standard size desktop PC (10 years old PC) bought just after Windows 8 debuts. The main purpose of the PC was to utilize USB 3.0 newly supported by Windows 8.

Windows 8 sucks! The development leader was fired immediately in 2 weeks and the CEO left in one year.

I predicted that Microsoft goes to hell down just after I started using Windows 8 although Microsoft resurrected after supplying free Windows 10. The USB 3.0 interface was also problematic for a long time.

Transition of Display Resolution

Notation	Resolution	Aspect Ratio
(VCD)	352 x 240	4.4 : 3
SD (DVD)	640 x 480	4 : 3
SD (DVD)	720 x 480	4.5 : 3
HD	1280 x 720	16 : 9
FHD (1K)	1920 x 1080	16 : 9
UHD (4K)	3840 x 2160	16 : 9

VCD (Video Compact Disc), DVD (Digital Video Disc)

SD (Standard Definition), HD (High Definition), FHD (Full High Definition), UHD (Ultra High Definition)

(A) Comparison of Nvidia RTX Series Graphics Cards

		RTX 40 Series	RTX 30 Series	RTX 20 Series
NVIDIA Architecture	Architecture Name	Ada Lovelace	Ampere	Turing
	Streaming Multiprocessors	2x FP32		1x FP32
	Ray Tracing Cores	Gen 3	Gen 2	Gen 1
	Tensor Cores (AI)	Gen 4	Gen 3	Gen 2
Platform	NVIDIA DLSS	DLSS 3 (Super Resolution + Frame Generation)	DLSS 2 (Super Resolution)	
	NVIDIA Reflex	Yes		
	NVIDIA Broadcast			
	NVIDIA GeForce Experience			
	Game Ready Drivers			
	NVIDIA Studio Drivers			
	NVIDIA ShadowPlay			
	NVIDIA Highlights			
	NVIDIA Ansel			
	NVIDIA Freestyle			
	VR Ready			
	NVIDIA Omniverse			
Additional Features	PCIe	Gen 4		Gen 3
	NVIDIA Encoder (NVENC)	Gen 8	Gen 7	
	NVIDIA Decoder (NVDEC)	Gen 5		Gen 4
	AV1 Encode	Yes	-	-
	AV1 Decode	Yes		-
	CUDA Capability	8.9	8.6	7.5
	DirectX12 Ultimate	Yes		

(B) Specification of Nvidia GeForce RTX Series Graphics Cards

RTX 20 Series

	RTX 2080 Ti	RTX 2080 SUPER	RTX 2080	RTX 2070 SUPER	RTX 2060 SUPER
GPU Engine Specs					
NVIDIA CUDA® Cores	4352	3072	2944	2560	2304
Boost Clock (GHz)	1.64	1.82	1.8	1.77	1.71
Base Clock (GHz)	1.35	1.65	1.52	1.61	1.41
Memory Specs					
Standard Memory Config	11GB GDDR6	8GB GDDR6			
Memory Interface Width	352-bit	256-bit			
Power Specs					
Graphics Card (W)	225	215	185	175	185/160
System Card (W)	650		550		550/500
Power Connection	3x PCIe cable	2x PCIe cable			

RTX 30 Series

	RTX 3090 Ti	RTX 3090	RTX 3080 Ti	RTX 3080	RTX 3070 Ti
GPU Engine Specs					
NVIDIA CUDA® Cores	10752	10496	10240	8960/8704	6144
Boost Clock (GHz)	1.86	1.70	1.67	1.71	1.77
Base Clock (GHz)	1.56	1.40	1.37	1.26/1.44	1.58
Memory Specs					
Standard Memory Config	24GB GDDR6X	12GB GDDR6X	12GB/10GB GDDR6X	8GB GDDR6X	
Memory Interface Width	384-bit	384-bit	384-bit	384/320-bit	256-bit
Power Specs					
Graphics Card (W)	450	350		350/320	290
System Card (W)	850	750			
Power Connection	3x PCIe cable	2x PCIe cable			

RTX 40 Series

	RTX 4090	RTX 4080	RTX 4070 Ti	RTX 4070	RTX 4060 Ti
GPU Engine Specs					
NVIDIA CUDA® Cores	16384	9728	7680	5888	4352
Boost Clock (GHz)	2.52	2.51	2.61	2.48	2.54
Base Clock (GHz)	2.23	2.21	2.31	1.92	2.31
Memory Specs					
Standard Memory Config	24GB GDDR6X	16GB GDDR6X	12GB GDDR6X	12GB GDDR6X	16GB/8GB GDDR6X
Memory Interface Width	384-bit	256-bit	192-bit	192-bit	128-bit
Power Specs					
Graphics Card (W)	450	320	285	200	165 or 160
System Card (W)	850	750	700	650	550
Power Connection	3x PCIe cable	3x PCIe cable	2x PCIe cable	2x PCIe cable	1x PCIe cable

(C) Result of 3DMark Graphics Benchmark

Rank	Score	Model		
1	36197	NVIDIA	GeForce RTX	4090
2	29978	AMD	Radeon RX	7900 XTX
3	28127	NVIDIA	GeForce RTX	4080
4	26165	AMD	Radeon RX	7900 XT
5	22745	NVIDIA	GeForce RTX	4070 Ti
6	21748			3090 Ti
7	21667			4090 (notebook)
8	21624	AMD	Radeon RX	6950 XT
9	21092			6900 XT
10	19793	NVIDIA	GeForce RTX	3090
11	19573			3080 Ti
12	19540	AMD	Radeon RX	6800 XT
13	18885	NVIDIA	GeForce RTX	4080 (notebook)
14	18597			3080 12GB
15	17858			4070
16	17568			3080
17	17545			3080 LHR
18	16480	AMD	Radeon RX	6800
19	14878	NVIDIA	GeForce RTX	Titan RTX
20	14833			3070 Ti
21	14651			2080 Ti
22	13578	AMD	Radeon RX	6750 XT
23	13511	NVIDIA	GeForce RTX	3070 LHR
24	13492			3070
25	13489	Intel	Arc	A770
26	13449	NVIDIA	GeForce RTX	4060 Ti 8 GB
27	13040			3080 Ti (notebook)
28	12868			A4500
29	12842	AMD	Radeon RX	6700 XT
30	12581	Intel	Arc	A750
31	12208	NVIDIA	GeForce RTX	3060 Ti GDDR6X
32	12079			4070 (notebook)
33	12026			3080 (notebook)
34	11592			2080 SUPER
35	11575			3060 Ti
36	11510	AMD	Radeon RX	6800M
37	11462	NVIDIA	GeForce RTX	3060 Ti LHR
38	11371			3070 Ti (notebook)
39	11229	AMD	Radeon RX	6700
40	11118	NVIDIA	GeForce RTX	A4000
41	10996			2080
42	10860	AMD	Radeon RX	7600
43	10691	NVIDIA	GeForce RTX	2080 SUPER (Notebook)
44	10437			3070 (notebook)
45	10435			4060 (notebook)
46	10149			Titan Xp Collector's Edition
47	10125			2070 SUPER

Rank	Score	Model		
48	10124			Titan Xp
49	10068			2080 (Notebook)
50	9999	AMD	Radeon RX	6650 XT
51	9873	NVIDIA	GeForce GTX	1080 Ti
52	9662	AMD	Radeon RX	6600 XT
53	9598	NVIDIA	GeForce RTX	Titan X (Pascal)
54	9563	AMD	Radeon RX	5700 XT
55	9481			6700M
56	9259			VII
57	8962			6800S
58	8926	NVIDIA	GeForce RTX	2070
59	8882			3060 GA104
60	8697			3060
61	8656			2060 SUPER
62	8565			2080 SUPER Max-Q
63	8536	AMD	Radeon RX	5700
64	8369	NVIDIA	GeForce RTX	3060 (notebook)
65	8360			2070 SUPER (Notebook)
66	8329			4050 (notebook)
67	8148	AMD	Radeon RX	6600
68	8028			6600M
69	8016	NVIDIA	GeForce RTX	2060 12GB
70	7982			2080 Max-Q
71	7857		Quadro RTX	4000
72	7845	AMD	Radeon RX	6700S
73	7756			5600 XT
74	7723	NVIDIA	GeForce RTX	2070 (Notebook refresh)
75	7578			2070 SUPER Max-Q
76	7544	AMD	Radeon RX	Vega 64
77	7544	NVIDIA	GeForce RTX	2070 (Notebook)
78	7543		GeForce GTX	1080
79	7498	NVIDIA	GeForce RTX	2060
80	7331			3060 8 GB
81	7108		GeForce GTX	1080 (Notebook)
82	6902		AMD	Radeon RX
83	6899	NVIDIA	GeForce RTX	2070 Max-Q
84	6804		GeForce GTX	1070 Ti
85	6755		GeForce RTX	2070 Max-Q (refresh)
86	6265		GeForce GTX	1660 Ti
87	6264		GeForce RTX	2060 (Notebook refresh)
88	6192			3050
89	6153	AMD	Radeon RX	5600M
90	6050	NVIDIA	GeForce GTX	1070
91	6011		Quadro	P5000
92	5988		GeForce GTX	1660 SUPER
93	5940		GeForce RTX	2060 (Notebook)
94	5915			A2000
95	5780		GeForce GTX	980 Ti
96	5594		GeForce RTX	2060 Max-Q

Rank	Score	Model		
97	5578		GeForce GTX	1660 Ti (Notebook)
98	5538			1070 (Notebook)
99	5415			1660
100	5361		GeForce RTX	3050 Ti (notebook)
101	5313		GeForce GTX	TITAN X
102	4973			1070 Max-Q
103	4969	AMD	Radeon RX	6500 XT
104	4937	NVIDIA	GeForce GTX	1660 Ti Max-Q
105	4862		GeForce RTX	3050 (notebook)
106	4856	AMD	Radeon RX	5500 XT
107	4782		Radeon R9	Fury
108	4765		Radeon RX	590
109	4688	NVIDIA	GeForce GTX	1650 SUPER
110	4633	AMD	Radeon R9	Nano
111	4437	AMD	Radeon RX	590 GME
112	4382	Intel	Arc	A380
113	4358	AMD	Radeon RX	580
114	4341	NVIDIA	GeForce GTX	980
115	4232	AMD	Radeon R9	390X
116	4179	NVIDIA	GeForce GTX	1060-6GB
117	4155	AMD	Radeon RX	480
118	4040	NVIDIA		P106-100
119	3994	AMD	Radeon R9	290X
120	3961			390
121	3889	NVIDIA	GeForce GTX	1060-5GB
122	3866	AMD	Radeon RX	570
123	3829	NVIDIA	GeForce GTX	1060-3GB
124	3818	AMD	Radeon RX	580 2048SP
125	3710		Radeon R9	290
126	3697		Radeon RX	470
127	3682	NVIDIA	GeForce GTX	1650 Ti (Notebook)
128	3648			1060 (Notebook)
129	3636			970
130	3597	AMD	Radeon RX	6400
131	3594	NVIDIA	GeForce GTX	1650
132	3524		GeForce RTX	2050 (notebook)
133	3447		Quadro	P3000
134	3445		GeForce GTX	1650 (Notebook)
135	3362			780 Ti
136	3310			1060 Max-Q
137	3163			1650 Ti Max-Q
138	3040	AMD	Radeon R9	380X
139	2945	NVIDIA	GeForce GTX	1650 Max-Q
140	2936			980M
141	2795			780
142	2791	AMD	Radeon R9	380
143	2367			680M
144	2351			280X
145	2341			NVIDIA

Rank	Score	Model		
146	2338			1050 Ti
147	2284			970M
148	2281			960
149	2281	AMD	Radeon HD	7970
150	2154		GeForce	MX450 30.5W 10Gbps
151	2138	NVIDIA	GeForce GTX	770
152	2091			1050 (Notebook)
153	2009	AMD	Radeon R9	280
154	2004	NVIDIA	GeForce GTX	680
155	1917	AMD	Radeon HD	7950
156	1876	NVIDIA	GeForce GTX	950
157	1826			670
158	1805	AMD	Radeon RX	560
159	1774		Radeon R9	270X
160	1757		Radeon RX	460
161	1738	NVIDIA	GeForce GTX	1050
162	1673			760
163	1652	AMD	Radeon HD	7870
164	1635	NVIDIA	GeForce GTX	660 Ti
165	1496	Intel	Iris Xe	Graphics
166	1480	AMD	Radeon R7	260X
167	1416		Radeon Vega 8	(Cezanne)
168	1351		Radeon Vega 7	(Cezanne)
169	1314		Radeon HD	7850
170	1308	NVIDIA	GeForce GTX	660
171	1306	Intel	Iris Xe	Graphics G7 96EU
172	1269	NVIDIA	GeForce GTX	750 Ti
173	1247	AMD	Radeon Vega 7	(Renoir)
174	1232	NVIDIA	GeForce	MX350
175	1229		GeForce GTX	960M
176	1213	Intel	Iris Xe	(12th gen notebook)
177	1207	AMD	Radeon RX	Vega 11 Mobile
178	1193			550
179	1149	NVIDIA	GeForce GTX	860M
180	1098		GeForce	MX250 (25W)
181	1082		GeForce GTX	1030
182	1081	AMD	Radeon RX	Vega 7 (Ryzen 4000 Mobile)
183	1069		Radeon Vega 7	Mobile (Cezanne)
184	1037		GeForce GTX	750
185	1002	NVIDIA	GeForce	MX150
186	981			950M
187	952	AMD	Radeon Vega 6	Mobile
188	897		Radeon Vega 5	(Ryzen 4000 Mobile)
189	870		Radeon Vega 6	
190	815	Intel	UHD Graphics	770 (13th gen 1500 MHz)
191	752			770 (12th gen desktop)
192	717	AMD	Radeon	Graphics (Raphael)
193	605	Intel	UHD Graphics	730 (12th gen desktop)
194	583	NVIDIA	GeForce	940MX

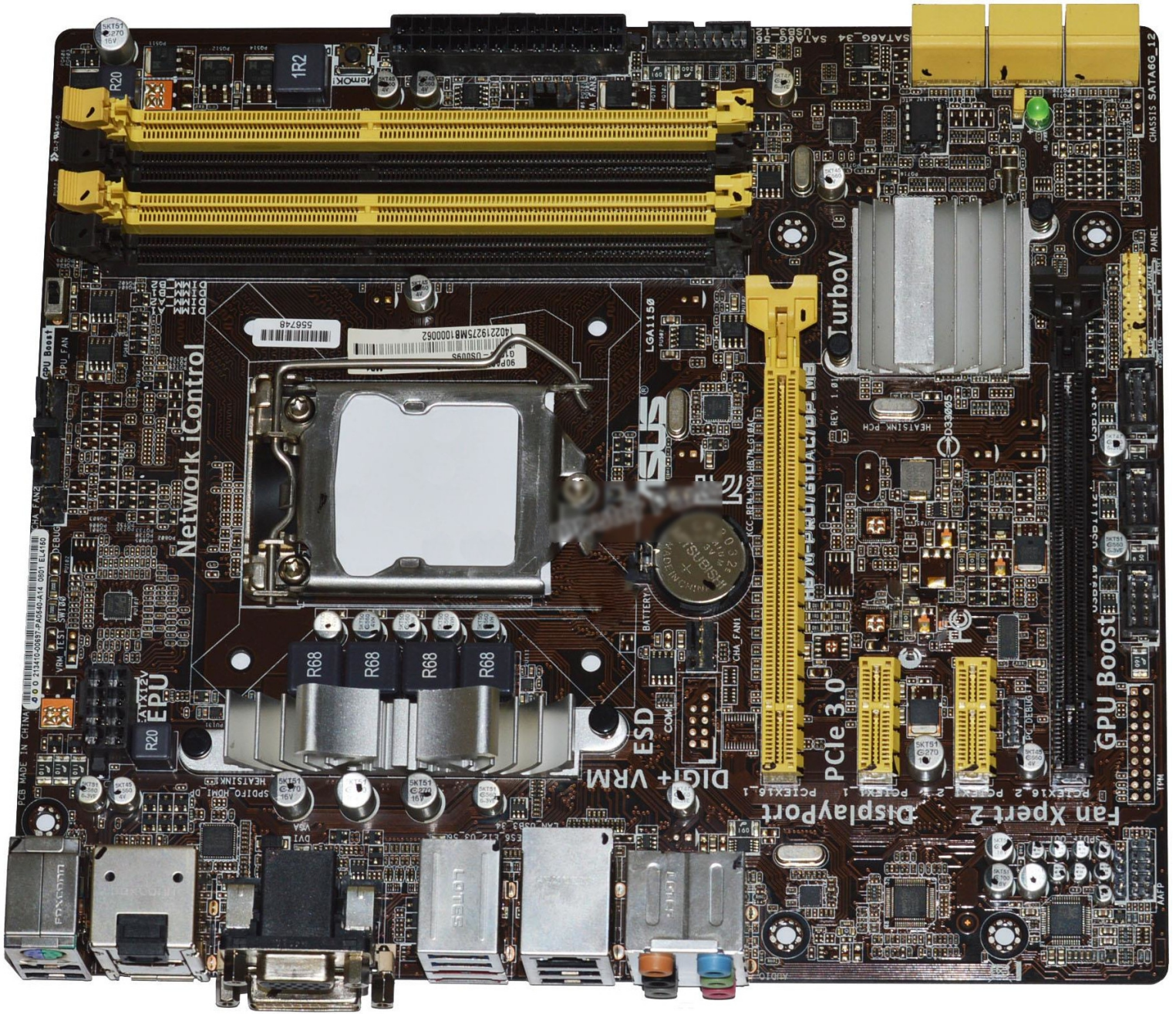
Rank	Score	Model		
195	425	Intel	UHD Graphics	630
196	385			10th Gen Mobile
197	365			620
198	361		HD Graphics	530
199	305	NVIDIA	GeForce GT	730
200	192			710
--	--			620



ASUS desktop PC

before installing

- Nvidia GeForce RX 2080 SUPER (Nvidia GeForce GT 620 occupies 16 bit PCI-E 3.0 slot now)
- Additional two 8GB memory cards to be installed in beige 240 pin UDIMM slots (16GB installed now)
- Continuous 700W power supply which provides two PCI-E power connectors to replace 350W power supply



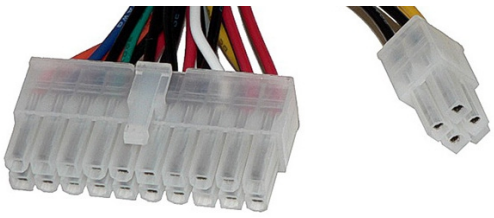
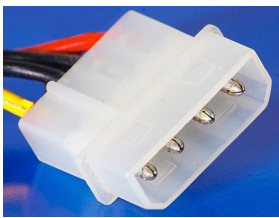
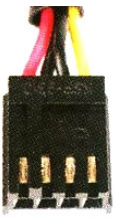
Motherboard

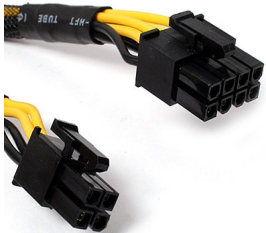
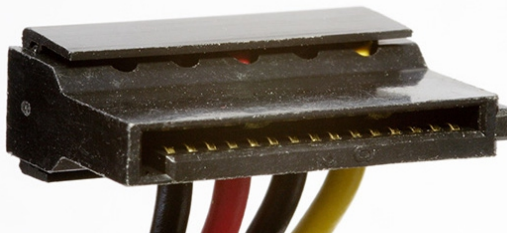

4x 8GB 240 pin UDIMM slots, 2x 16 bit PCI-E slots, 2x 1 bit PCI-E slots, x6 SATA sockets

Comparison of 350W power supply originally installed & 700W power supply newly installed

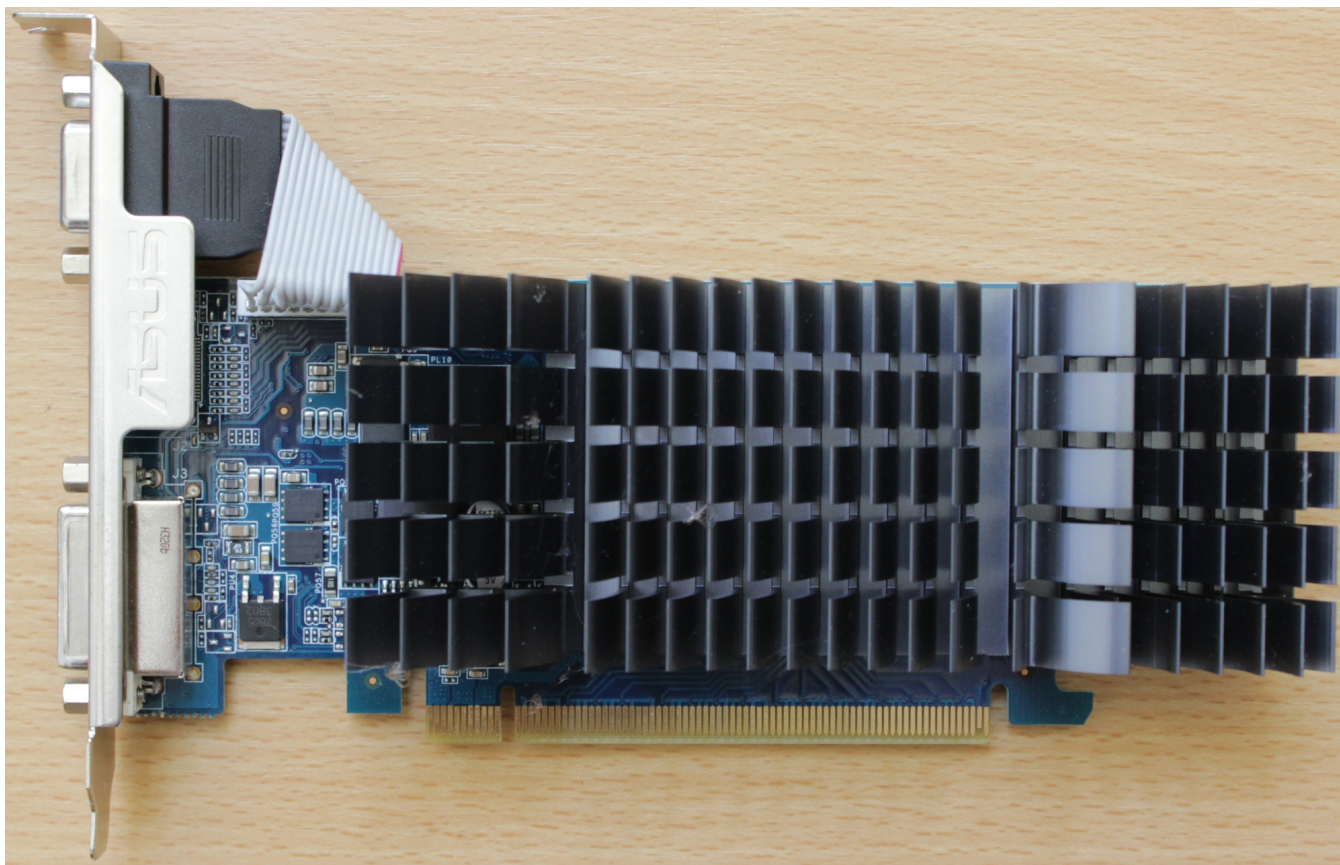
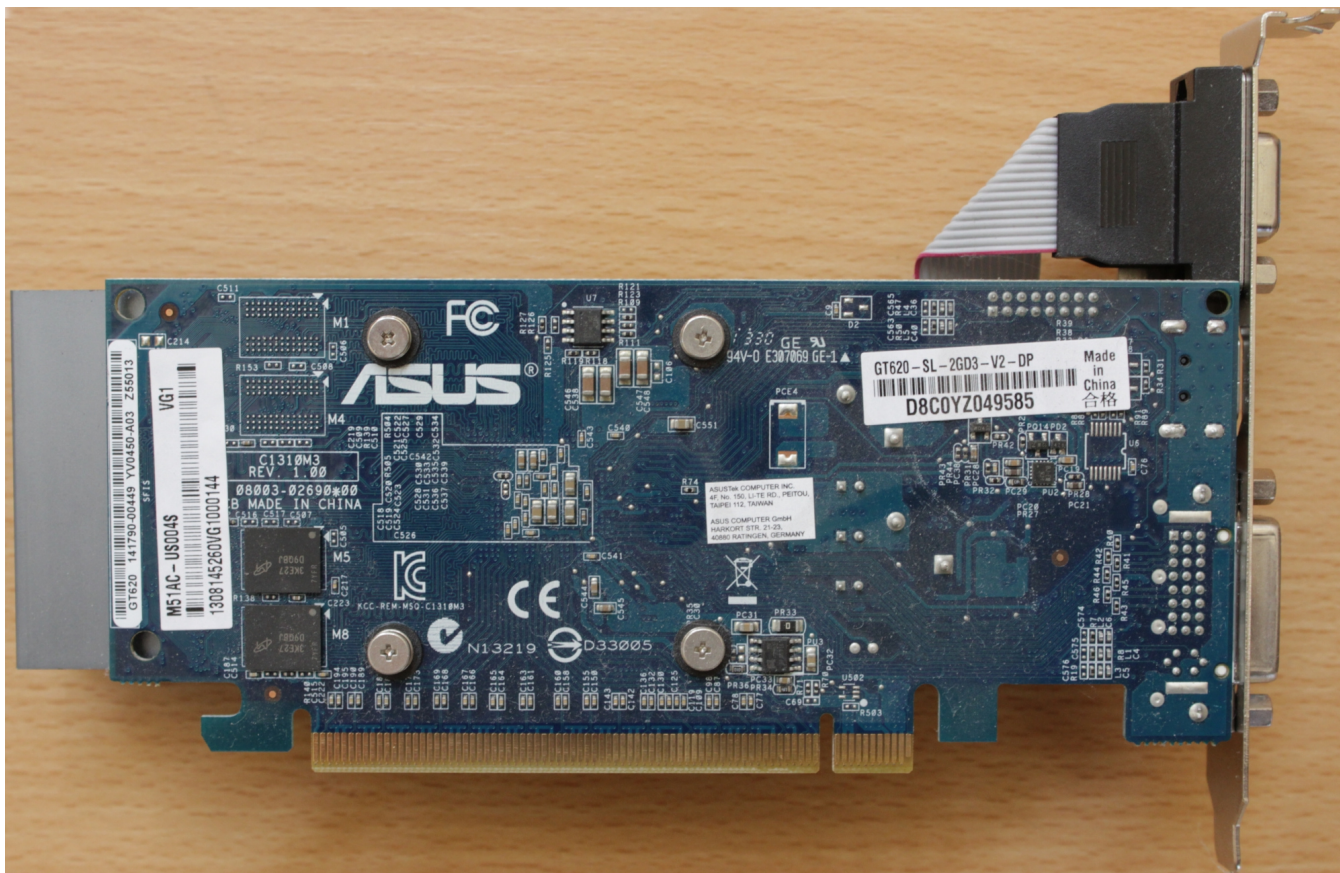
350W	Output voltage	+3.3V	+5V	+12V	-12V	+5VSB
	Max current	10A	10A	26A	0.3A	2A
	Max power	83W		216W	3.6W	10W
	Continuous power	287W				
700W	Output voltage	+3.3V	+5V	+12V	-12V	+5VSB
	Max current	19A	17A	54A	0.3A	2.5A
	Max power	110W		648W	3.6W	12.5W
	Continuous power	700W				

Connectors provided by 700W power supply

		
24pin main power connector (x1)	4 pin peripheral 12V+5V (x5)	4 pin FDD 12V+5V (x1)
Mother board	(Not in use)	(Not in use)

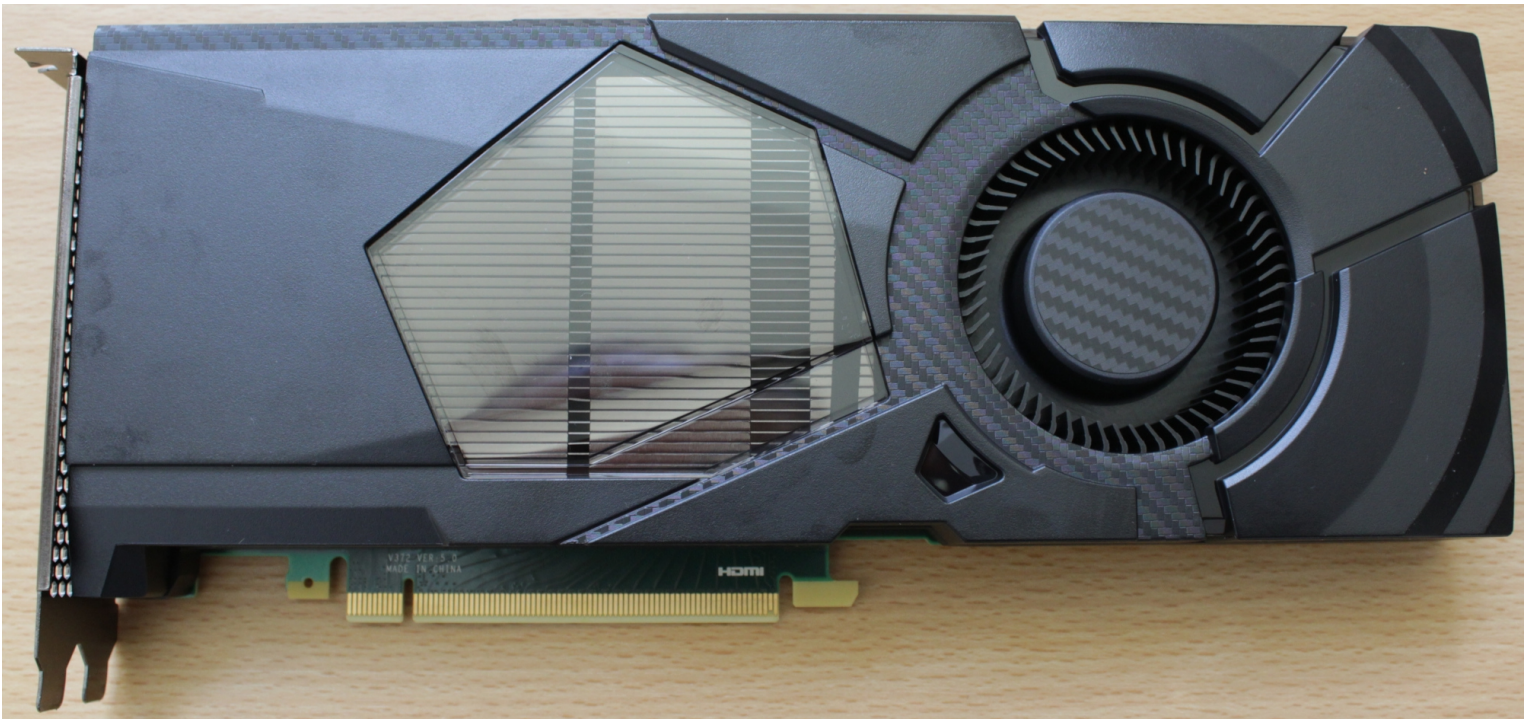
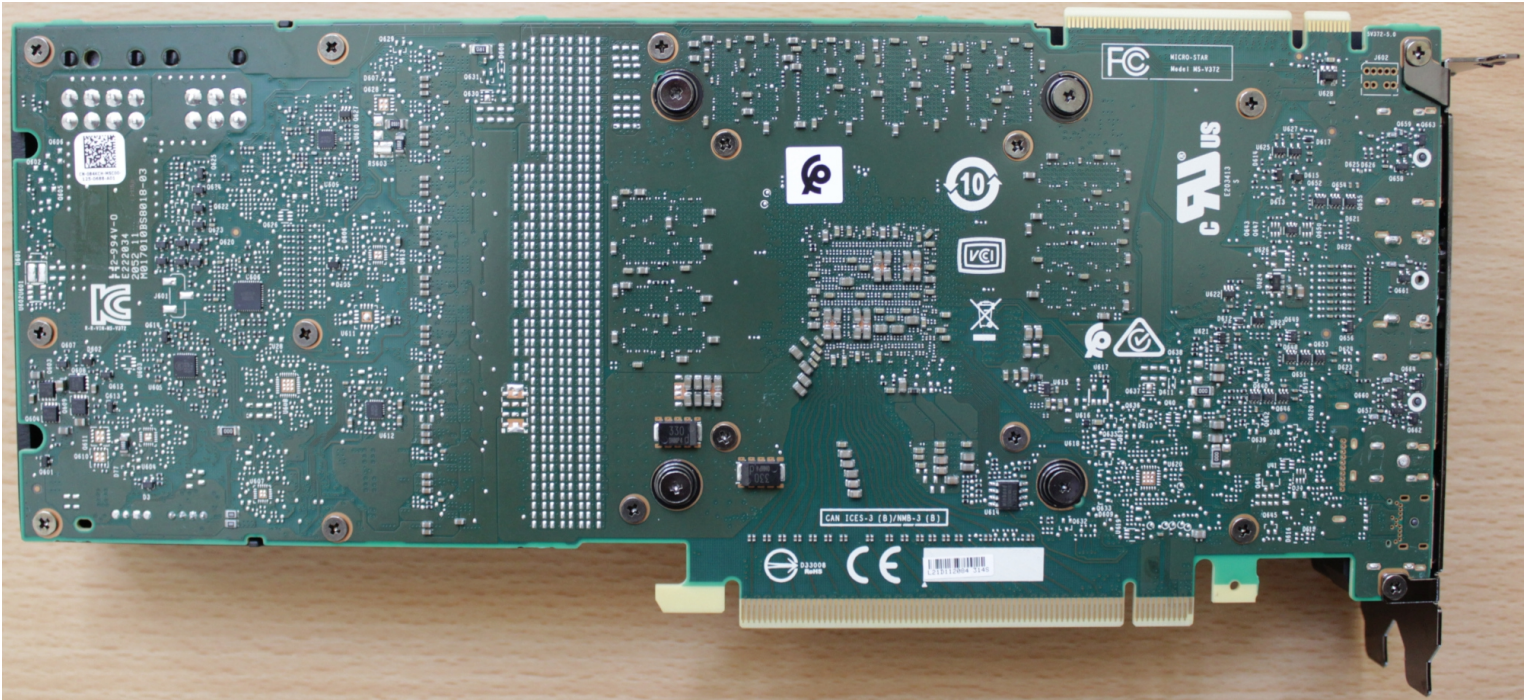
		
4+4 pin ATX 12V connector (x1)	5 pin SATA 12V+5V connector (x6)	6+2 pin PCI-E 12V connector (x 2)
Motherboard	Blu-ray drive SSD (Solid State Drive) HDD (Hard Disk Drive) x2	Graphics card (Nvidia GeForce RX 2080 SUPER)

Nvidia GeForce GT 620 (Previously installed graphics card)

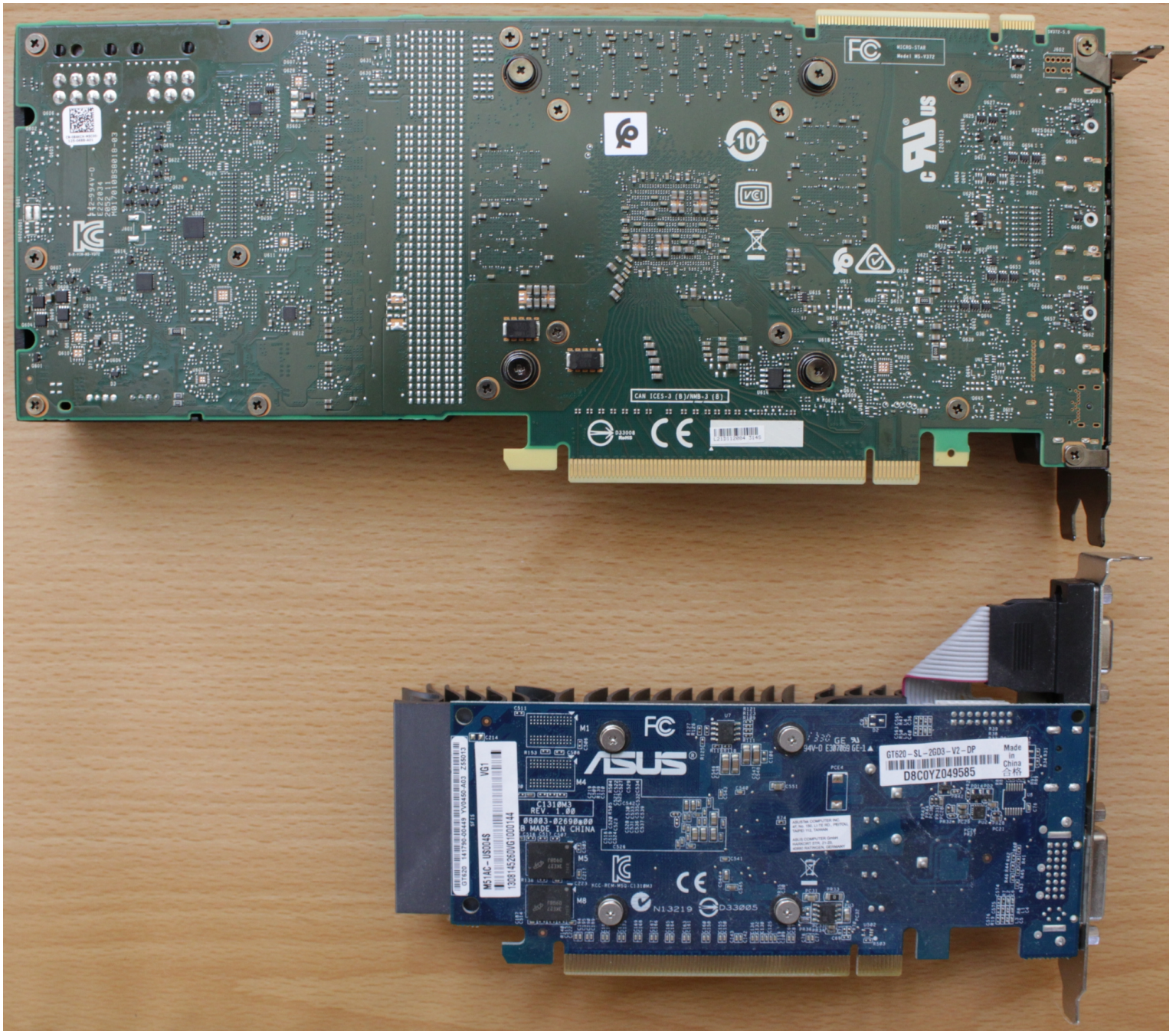


DVI, HDMI, VGA

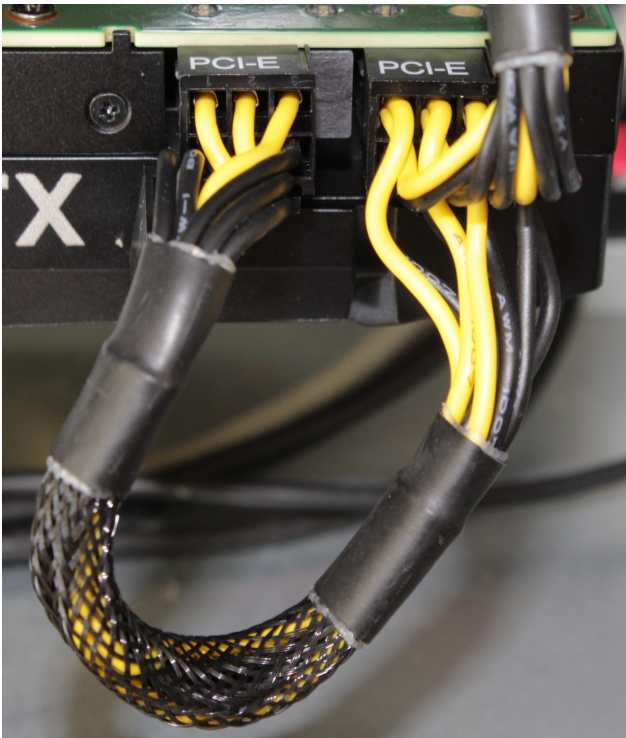
Nvidia GeForce RX 2080 SUPER (newly installed graphics card)



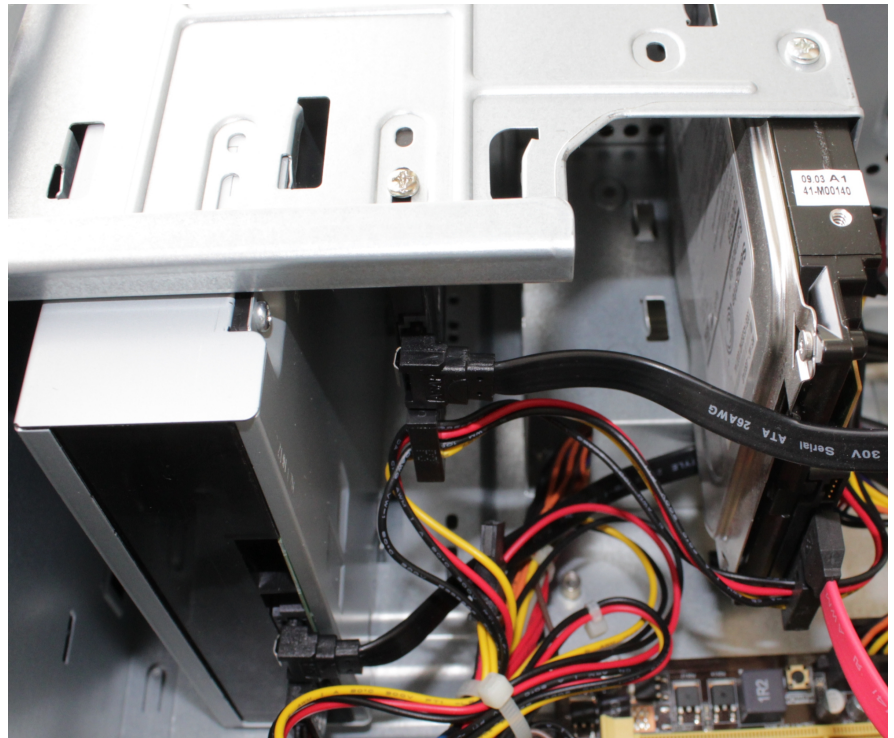
DisplayPort 1, HDMI, DisplayPort 2, DisplayPort 3



Nvidia GeForce RX 2080 SUPER (up) & Nvidia GeForce GT 620 (down)

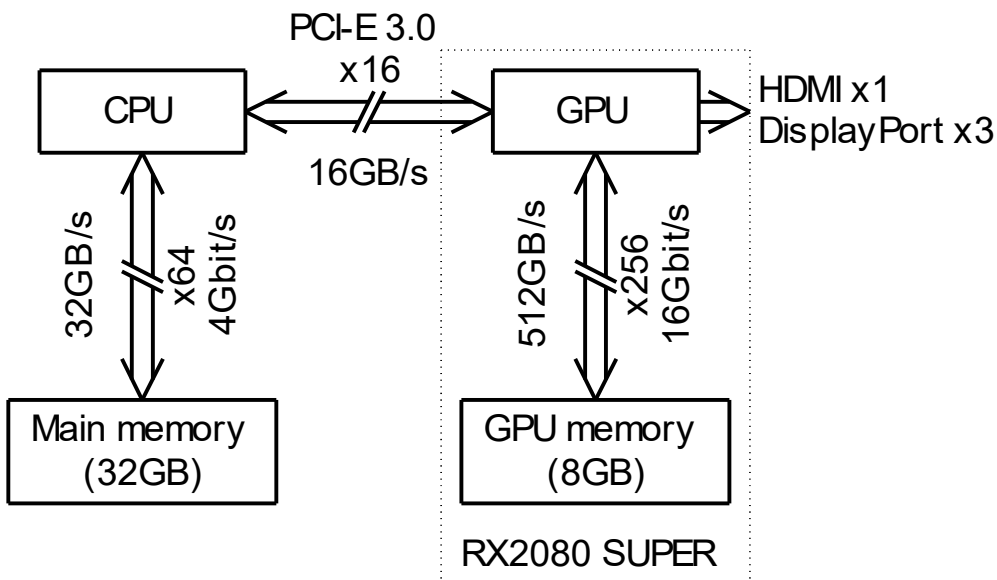


PCI-E 12V cable connection



SATA cable (up) and SATA power cable (down) connection

PCI-E Version	Throughput (GB/s)				
	x1	x2	x4	x8	x16
1.0 (2003)	0.250	0.500	1.000	2.000	4.000
2.0 (2007)	0.500	1.000	2.000	4.000	8.000
3.0 (2010)	0.985	1.969	3.938	7.877	15.754
4.0 (2017)	1.969	3.938	7.877	15.754	31.508
5.0 (2019)	3.938	7.877	15.754	31.508	63.015
6.0 (2022)	7.563	15.125	30.250	60.500	121.000



CUDA core	3072	Cores
Tensor core	384	
RT core	48	
FP32 core	1	Core
FP16 (half)	22.3	TeraFLOPS
FP32 (float)	11.15	
FP64 (double)	348.5	GigaFLOPS

GPU can access own 8GB GPU memory through wide 256 bit data bus which speed is 512GB/sec!
By handling own memory in freehand, remarkable performance is achieved as old NEC μ PD7220/72120.



Done

700W power supply (upper left), additional 16GB SDRAM (middle), Nvidia GeForce RX 2080 SUPER (down)

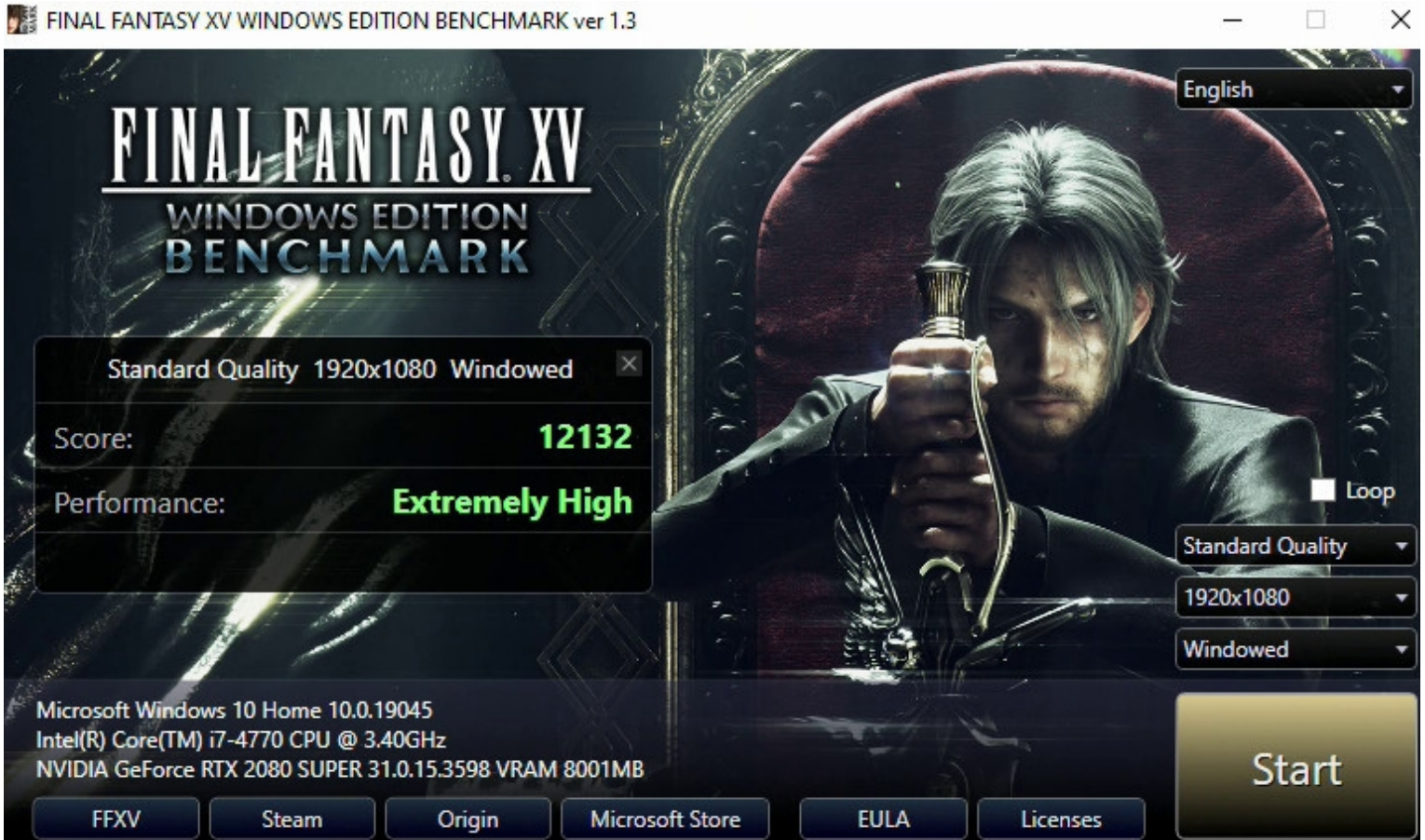
Benchmark Results

(1) Heaven UNIGINE

Watch an amazing [Heaven UNIGINE benchmark Result video](#).

Nvidia GeForce RX 2080 SUPER achieved 210 ~ 270 FPS (Frames Per Second) although Nvidia GeForce GT 620 achieved only 2 FPS in this benchmark.

(2) Final Fantasy



Result Screen of Final Fantasy Benchmark (Score = 12132, Performance = Extremely High)
Nvidia GeForce RTX 2080 SUPER

Score		Evaluation
12000	~	Run exceedingly well. A high frame rate is possible. Richer graphical settings usable.
9000	~ 11999	Run very comfortably. A high frame rate is possible. Higher quality graphical settings usable.
6000	~ 8999	Run comfortably. Run smoothly even at higher graphics settings.
4500	~ 5999	Standard level. Adjustments to the graphics settings recommended.
3000	~ 4499	Standard level.
2500	~ 2999	May experience processing glitch. Adjustments to the graphics settings recommended.
2000	~ 2499	Sluggish actions overall.
0	~ 1999	Does not meet minimum requirements.

Watch an amazing [Final Fantasy benchmark result video](#).