Graphics Cards Cheatsheet

A comprehensive guide to understanding graphics cards, their components, specifications, and technologies. Perfect for gamers, developers, and anyone interested in computer hardware.

GPU Architecture Basics

Core Components

GPU (Graphics Processing Unit)	The main processor responsible for rendering images, videos, and graphics.
CUDA Cores/Stream Processors	Parallel processing units that perform calculations for rendering. More cores generally mean better performance.
Memory (VRAM)	Video RAM, used to store textures, frame buffers, and other graphical data. Larger VRAM allows for higher resolutions and more complex scenes.
Memory Interface	The connection between the GPU and VRAM, measured in bits (e.g., 128-bit, 256-bit, 384-bit). Wider interfaces allow for faster data transfer.
Clock Speed	The speed at which the GPU operates, measured in MHz or GHz. Higher clock speeds generally improve performance.
ROPs (Render Output Units)	Responsible for merging processed pixel data and outputting the final image. More ROPs can improve performance at higher resolutions.
TMUs (Texture Mapping Units)	Apply textures to 3D models. More TMUs allow for more detailed textures and improved visual quality.

Key Architectures

Different GPU manufacturers use different architectures:

- **NVIDIA:** Turing, Ampere, Ada Lovelace
- **AMD:** RDNA, RDNA2, RDNA3
- **Intel:** Xe

Specifications and Performance Metrics

Important Specifications

VRAM Capacity	The amount of video memory (e.g., 8GB, 12GB, 24GB). Higher capacity is better for high-resolution gaming and complex textures.
Memory Type	GDDR6, GDDR6X, HBM2e. GDDR6X offers higher bandwidth than GDDR6. HBM2e is even faster but more expensive.
Memory Bandwidth	The rate at which data can be transferred between the GPU and VRAM, measured in GB/s. Higher bandwidth improves performance.
Boost Clock	The maximum clock speed the GPU can reach under load. Higher boost clocks can improve performance in demanding tasks.
TDP (Thermal Design Power)	The amount of power the GPU is expected to consume, measured in watts. Higher TDP GPUs require more robust cooling solutions.
Output Ports	DisplayPort, HDMI. Check for compatibility with your monitor and VR headset.

Performance Metrics

Frame Rate (FPS)	Frames per second, a measure of how smoothly a game runs. Higher FPS is better. Target 60+ FPS for smooth gameplay.
Resolution	The number of pixels displayed on the screen (e.g., 1920x1080, 2560x1440, 3840x2160). Higher resolutions require more powerful GPUs.
Latency	The delay between input and the corresponding action on screen. Lower latency is better for competitive gaming.
Power Consumption	The amount of power the GPU uses during operation. Measured in Watts (W).

Advanced Technologies

Ray Tracing

Definition	A rendering technique that simulates the physical behavior of light, creating more realistic reflections, shadows, and lighting effects.
NVIDIA	RTX series cards feature dedicated RT Cores for accelerating ray tracing calculations.
AMD	RX 6000 and 7000 series cards include Ray Accelerators for ray tracing.

Upscaling Technologies

NVIDIA DLSS (Deep Learning Super Sampling)	Uses AI to upscale lower-resolution images to higher resolutions, improving performance without sacrificing visual quality. Requires Tensor Cores.
AMD FSR (FidelityFX Super Resolution)	An open-source upscaling technology that works on a wide range of GPUs. Offers various quality presets.
Intel XeSS (Xe Super Sampling)	Upscaling technology by Intel. Improves performance without sacrificing visual quality.

Other Technologies

Adaptive Sync	Technologies like NVIDIA G-Sync and AMD FreeSync synchronize the monitor's refresh rate with the GPU's frame rate to reduce screen tearing and stuttering.
Resizable BAR/SAM (Smart Access Memory)	Allows the CPU to access the entire GPU memory, potentially improving performance in some games. Requires compatible CPU, motherboard, and GPU.

Troubleshooting & Maintenance

Common Issues

- **Driver Issues:** Update to the latest drivers or roll back to older versions if experiencing problems.
- **Overheating:** Ensure adequate cooling and clean dust from the GPU heatsink and fans.
- **Artifacting:** Visual distortions on the screen, often caused by overheating, driver issues, or hardware failure.
- **Crashing:** Can be caused by driver issues, overheating, or insufficient power supply.

Maintenance Tips

- **Regular Cleaning:** Use compressed air to remove dust from the GPU and case.
- **Monitor Temperatures:** Use monitoring software to check GPU temperatures and ensure they are within safe limits.
- **Cable Management:** Ensure proper cable management to promote airflow.
- **Proper Ventilation:** Ensure the PC case has adequate airflow to dissipate heat.

Tools for Monitoring

MSI Afterburner	Popular tool for overclocking, monitoring temperatures, and adjusting fan speeds.
GPU-Z	Provides detailed information about the GPU specifications and real-time monitoring of clocks, temperatures, and voltages.
HWMonitor	Monitors various hardware components, including GPU temperatures, voltages, and power consumption.