



# CUDA DRIVER API

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**API Reference Manual**



# TABLE OF CONTENTS

<b>Chapter 1. API synchronization behavior</b> .....	<b>1</b>
<b>Chapter 2. Modules</b> .....	<b>3</b>
2.1. Data types used by CUDA driver.....	4
CUDA_ARRAY3D_DESCRIPTOR.....	4
CUDA_ARRAY_DESCRIPTOR.....	4
CUDA_MEMCPY2D.....	4
CUDA_MEMCPY3D.....	4
CUDA_MEMCPY3D_PEER.....	4
CUDA_POINTER_ATTRIBUTE_P2P_TOKENS.....	4
CUDA_RESOURCE_DESC.....	4
CUDA_RESOURCE_VIEW_DESC.....	4
CUDA_TEXTURE_DESC.....	4
CUdevprop.....	4
CUipcEventHandle.....	4
CUipcMemHandle.....	4
CUaddress_mode.....	4
CUarray_cubemap_face.....	5
CUarray_format.....	5
CUcomputemode.....	6
CUctx_flags.....	6
CUdevice_attribute.....	7
CUevent_flags.....	11
CUfilter_mode.....	11
CUfunc_cache.....	11
CUfunction_attribute.....	12
CUgraphicsMapResourceFlags.....	13
CUgraphicsRegisterFlags.....	13
CUipcMem_flags.....	13
CUjit_cacheMode.....	13
CUjit_fallback.....	14
CUjit_option.....	14
CUjit_target.....	15
CUjitInputType.....	16
CUlimit.....	16
CUmemorytype.....	17
CUpointer_attribute.....	17
CUresourcetype.....	17
CUresourceViewFormat.....	18
CUresult.....	19
CUsharedconfig.....	23

CUstream_flags.....	23
CUarray.....	24
CUcontext.....	24
CUdevice.....	24
CUdeviceptr.....	24
CUevent.....	24
CUfunction.....	24
CUgraphicsResource.....	24
CUmipmappedArray.....	24
CUmodule.....	24
CUstream.....	25
CUstreamCallback.....	25
CUsurfObject.....	25
CUsurfref.....	25
CUtexObject.....	25
CUtexref.....	25
CU_IPC_HANDLE_SIZE.....	25
CU_LAUNCH_PARAM_BUFFER_POINTER.....	25
CU_LAUNCH_PARAM_BUFFER_SIZE.....	25
CU_LAUNCH_PARAM_END.....	26
CU_MEMHOSTALLOC_DEVICEMAP.....	26
CU_MEMHOSTALLOC_PORTABLE.....	26
CU_MEMHOSTALLOC_WRITECOMBINED.....	26
CU_MEMHOSTREGISTER_DEVICEMAP.....	26
CU_MEMHOSTREGISTER_PORTABLE.....	26
CU_PARAM_TR_DEFAULT.....	26
CU_TRSA_OVERRIDE_FORMAT.....	26
CU_TRSF_NORMALIZED_COORDINATES.....	27
CU_TRSF_READ_AS_INTEGER.....	27
CU_TRSF_SRGB.....	27
CUDA_ARRAY3D_2DARRAY.....	27
CUDA_ARRAY3D_CUBEMAP.....	27
CUDA_ARRAY3D_LAYERED.....	27
CUDA_ARRAY3D_SURFACE_LDST.....	27
CUDA_ARRAY3D_TEXTURE_GATHER.....	27
CUDA_VERSION.....	27
2.2. Initialization.....	28
culnit.....	28
2.3. Version Management.....	28
cuDriverGetVersion.....	28
2.4. Device Management.....	29
cuDeviceGet.....	29
cuDeviceGetAttribute.....	30

cuDeviceGetCount.....	34
cuDeviceGetName.....	35
cuDeviceTotalMem.....	36
2.5. Device Management [DEPRECATED].....	36
cuDeviceComputeCapability.....	36
cuDeviceGetProperties.....	37
2.6. Context Management.....	39
cuCtxCreate.....	39
cuCtxDestroy.....	41
cuCtxGetApiVersion.....	41
cuCtxGetCacheConfig.....	42
cuCtxGetCurrent.....	43
cuCtxGetDevice.....	44
cuCtxGetLimit.....	44
cuCtxGetSharedMemConfig.....	45
cuCtxGetStreamPriorityRange.....	46
cuCtxPopCurrent.....	47
cuCtxPushCurrent.....	48
cuCtxSetCacheConfig.....	48
cuCtxSetCurrent.....	50
cuCtxSetLimit.....	50
cuCtxSetSharedMemConfig.....	52
cuCtxSynchronize.....	53
2.7. Context Management [DEPRECATED].....	54
cuCtxAttach.....	54
cuCtxDetach.....	55
2.8. Module Management.....	56
cuLinkAddData.....	56
cuLinkAddFile.....	57
cuLinkComplete.....	58
cuLinkCreate.....	58
cuLinkDestroy.....	59
cuModuleGetFunction.....	60
cuModuleGetGlobal.....	61
cuModuleGetSurfRef.....	62
cuModuleGetTexRef.....	62
cuModuleLoad.....	63
cuModuleLoadData.....	64
cuModuleLoadDataEx.....	65
cuModuleLoadFatBinary.....	66
cuModuleUnload.....	67
2.9. Memory Management.....	67
cuArray3DCreate.....	68

cuArray3DGetDescriptor.....	71
cuArrayCreate.....	72
cuArrayDestroy.....	74
cuArrayGetDescriptor.....	75
cuDeviceGetByPCIBusId.....	76
cuDeviceGetPCIBusId.....	77
culpcCloseMemHandle.....	77
culpcGetEventHandle.....	78
culpcGetMemHandle.....	79
culpcOpenEventHandle.....	80
culpcOpenMemHandle.....	81
cuMemAlloc.....	82
cuMemAllocHost.....	83
cuMemAllocPitch.....	84
cuMemcpy.....	85
cuMemcpy2D.....	86
cuMemcpy2DAsync.....	89
cuMemcpy2DUnaligned.....	92
cuMemcpy3D.....	95
cuMemcpy3DAsync.....	98
cuMemcpy3DPeer.....	101
cuMemcpy3DPeerAsync.....	101
cuMemcpyAsync.....	102
cuMemcpyAtoA.....	103
cuMemcpyAtoD.....	104
cuMemcpyAtoH.....	105
cuMemcpyAtoHAsync.....	106
cuMemcpyDtoA.....	108
cuMemcpyDtoD.....	109
cuMemcpyDtoDAsync.....	110
cuMemcpyDtoH.....	111
cuMemcpyDtoHAsync.....	112
cuMemcpyHtoA.....	113
cuMemcpyHtoAAsync.....	114
cuMemcpyHtoD.....	115
cuMemcpyHtoDAsync.....	116
cuMemcpyPeer.....	117
cuMemcpyPeerAsync.....	118
cuMemFree.....	119
cuMemFreeHost.....	120
cuMemGetAddressRange.....	121
cuMemGetInfo.....	122
cuMemHostAlloc.....	123

cuMemHostGetDevicePointer.....	125
cuMemHostGetFlags.....	126
cuMemHostRegister.....	126
cuMemHostUnregister.....	128
cuMemsetD16.....	128
cuMemsetD16Async.....	129
cuMemsetD2D16.....	131
cuMemsetD2D16Async.....	132
cuMemsetD2D32.....	133
cuMemsetD2D32Async.....	134
cuMemsetD2D8.....	136
cuMemsetD2D8Async.....	137
cuMemsetD32.....	138
cuMemsetD32Async.....	139
cuMemsetD8.....	140
cuMemsetD8Async.....	141
cuMipmappedArrayCreate.....	142
cuMipmappedArrayDestroy.....	145
cuMipmappedArrayGetLevel.....	146
2.10. Unified Addressing.....	146
cuPointerGetAttribute.....	148
2.11. Stream Management.....	150
cuStreamAddCallback.....	150
cuStreamCreate.....	152
cuStreamCreateWithPriority.....	152
cuStreamDestroy.....	154
cuStreamGetFlags.....	154
cuStreamGetPriority.....	155
cuStreamQuery.....	156
cuStreamSynchronize.....	156
cuStreamWaitEvent.....	157
2.12. Event Management.....	158
cuEventCreate.....	158
cuEventDestroy.....	159
cuEventElapsedTime.....	160
cuEventQuery.....	161
cuEventRecord.....	162
cuEventSynchronize.....	163
2.13. Execution Control.....	163
cuFuncGetAttribute.....	164
cuFuncSetCacheConfig.....	165
cuFuncSetSharedMemConfig.....	166
cuLaunchKernel.....	167

2.14. Execution Control [DEPRECATED].....	170
cuFuncSetBlockShape.....	170
cuFuncSetSharedSize.....	171
cuLaunch.....	171
cuLaunchGrid.....	172
cuLaunchGridAsync.....	173
cuParamSetf.....	174
cuParamSeti.....	175
cuParamSetSize.....	176
cuParamSetTexRef.....	177
cuParamSetv.....	177
2.15. Texture Reference Management.....	178
cuTexRefGetAddress.....	178
cuTexRefGetAddressMode.....	179
cuTexRefGetArray.....	180
cuTexRefGetFilterMode.....	180
cuTexRefGetFlags.....	181
cuTexRefGetFormat.....	182
cuTexRefGetMaxAnisotropy.....	182
cuTexRefGetMipmapFilterMode.....	183
cuTexRefGetMipmapLevelBias.....	184
cuTexRefGetMipmapLevelClamp.....	184
cuTexRefGetMipmappedArray.....	185
cuTexRefSetAddress.....	186
cuTexRefSetAddress2D.....	187
cuTexRefSetAddressMode.....	188
cuTexRefSetArray.....	189
cuTexRefSetFilterMode.....	190
cuTexRefSetFlags.....	191
cuTexRefSetFormat.....	192
cuTexRefSetMaxAnisotropy.....	192
cuTexRefSetMipmapFilterMode.....	193
cuTexRefSetMipmapLevelBias.....	194
cuTexRefSetMipmapLevelClamp.....	195
cuTexRefSetMipmappedArray.....	196
2.16. Texture Reference Management [DEPRECATED].....	196
cuTexRefCreate.....	197
cuTexRefDestroy.....	197
2.17. Surface Reference Management.....	198
cuSurfRefGetArray.....	198
cuSurfRefSetArray.....	199
2.18. Texture Object Management.....	199
cuTexObjectCreate.....	199

cuTexObjectDestroy.....	204
cuTexObjectGetResourceDesc.....	205
cuTexObjectGetResourceViewDesc.....	205
cuTexObjectGetTextureDesc.....	206
2.19. Surface Object Management.....	207
cuSurfObjectCreate.....	207
cuSurfObjectDestroy.....	207
cuSurfObjectGetResourceDesc.....	208
2.20. Peer Context Memory Access.....	208
cuCtxDisablePeerAccess.....	209
cuCtxEnablePeerAccess.....	209
cuDeviceCanAccessPeer.....	211
2.21. Graphics Interoperability.....	211
cuGraphicsMapResources.....	212
cuGraphicsResourceGetMappedMipmappedArray.....	213
cuGraphicsResourceGetMappedPointer.....	214
cuGraphicsResourceSetMapFlags.....	215
cuGraphicsSubResourceGetMappedArray.....	216
cuGraphicsUnmapResources.....	217
cuGraphicsUnregisterResource.....	218
2.22. Profiler Control.....	218
cuProfilerInitialize.....	219
cuProfilerStart.....	220
cuProfilerStop.....	220
2.23. OpenGL Interoperability.....	221
OpenGL Interoperability [DEPRECATED].....	221
CUGLDeviceList.....	221
cuGLGetDevices.....	221
cuGraphicsGLRegisterBuffer.....	222
cuGraphicsGLRegisterImage.....	223
cuWGLGetDevice.....	225
2.23.1. OpenGL Interoperability [DEPRECATED].....	225
CUGLmap_flags.....	226
cuGLCtxCreate.....	226
cuGLInit.....	227
cuGLMapBufferObject.....	227
cuGLMapBufferObjectAsync.....	228
cuGLRegisterBufferObject.....	229
cuGLSetBufferObjectMapFlags.....	230
cuGLUnmapBufferObject.....	231
cuGLUnmapBufferObjectAsync.....	232
cuGLUnregisterBufferObject.....	232
2.24. Direct3D 9 Interoperability.....	233



Direct3D 9 Interoperability [DEPRECATED].....	233
CUd3d9DeviceList.....	233
cuD3D9CtxCreate.....	234
cuD3D9CtxCreateOnDevice.....	235
cuD3D9GetDevice.....	236
cuD3D9GetDevices.....	237
cuD3D9GetDirect3DDevice.....	238
cuGraphicsD3D9RegisterResource.....	238
2.24.1. Direct3D 9 Interoperability [DEPRECATED].....	240
CUd3d9map_flags.....	240
CUd3d9register_flags.....	240
cuD3D9MapResources.....	241
cuD3D9RegisterResource.....	242
cuD3D9ResourceGetMappedArray.....	244
cuD3D9ResourceGetMappedPitch.....	245
cuD3D9ResourceGetMappedPointer.....	246
cuD3D9ResourceGetMappedSize.....	247
cuD3D9ResourceGetSurfaceDimensions.....	248
cuD3D9ResourceSetMapFlags.....	250
cuD3D9UnmapResources.....	251
cuD3D9UnregisterResource.....	252
2.25. Direct3D 10 Interoperability.....	252
Direct3D 10 Interoperability [DEPRECATED].....	252
CUd3d10DeviceList.....	252
cuD3D10GetDevice.....	253
cuD3D10GetDevices.....	253
cuGraphicsD3D10RegisterResource.....	255
2.25.1. Direct3D 10 Interoperability [DEPRECATED].....	256
CUD3D10map_flags.....	256
CUD3D10register_flags.....	256
cuD3D10CtxCreate.....	257
cuD3D10CtxCreateOnDevice.....	258
cuD3D10GetDirect3DDevice.....	259
cuD3D10MapResources.....	259
cuD3D10RegisterResource.....	260
cuD3D10ResourceGetMappedArray.....	262
cuD3D10ResourceGetMappedPitch.....	263
cuD3D10ResourceGetMappedPointer.....	264
cuD3D10ResourceGetMappedSize.....	265
cuD3D10ResourceGetSurfaceDimensions.....	266
cuD3D10ResourceSetMapFlags.....	267
cuD3D10UnmapResources.....	268
cuD3D10UnregisterResource.....	269

2.26. Direct3D 11 Interoperability.....	270
Direct3D 11 Interoperability [DEPRECATED].....	270
CUd3d11DeviceList.....	270
cuD3D11GetDevice.....	271
cuD3D11GetDevices.....	271
cuGraphicsD3D11RegisterResource.....	273
2.26.1. Direct3D 11 Interoperability [DEPRECATED].....	274
cuD3D11CtxCreate.....	274
cuD3D11CtxCreateOnDevice.....	275
cuD3D11GetDirect3DDevice.....	276
2.27. VDDPAU Interoperability.....	277
cuGraphicsVDDPAURegisterOutputSurface.....	277
cuGraphicsVDDPAURegisterVideoSurface.....	278
cuVDDPAUCtxCreate.....	280
cuVDDPAUGetDevice.....	281
<b>Chapter 3. Data Structures.....</b>	<b>282</b>
CUDA_ARRAY3D_DESCRIPTOR.....	282
Depth.....	282
Flags.....	283
Format.....	283
Height.....	283
NumChannels.....	283
Width.....	283
CUDA_ARRAY_DESCRIPTOR.....	283
Format.....	283
Height.....	284
NumChannels.....	284
Width.....	284
CUDA_MEMCPY2D.....	284
dstArray.....	284
dstDevice.....	284
dstHost.....	284
dstMemoryType.....	285
dstPitch.....	285
dstXInBytes.....	285
dstY.....	285
Height.....	285
srcArray.....	285
srcDevice.....	285
srcHost.....	286
srcMemoryType.....	286
srcPitch.....	286
srcXInBytes.....	286

srcY.....	286
WidthInBytes.....	286
CUDA_MEMCPY3D.....	286
Depth.....	287
dstArray.....	287
dstDevice.....	287
dstHeight.....	287
dstHost.....	287
dstLOD.....	287
dstMemoryType.....	287
dstPitch.....	288
dstXInBytes.....	288
dstY.....	288
dstZ.....	288
Height.....	288
reserved0.....	288
reserved1.....	288
srcArray.....	289
srcDevice.....	289
srcHeight.....	289
srcHost.....	289
srcLOD.....	289
srcMemoryType.....	289
srcPitch.....	289
srcXInBytes.....	290
srcY.....	290
srcZ.....	290
WidthInBytes.....	290
CUDA_MEMCPY3D_PEER.....	290
Depth.....	290
dstArray.....	290
dstContext.....	291
dstDevice.....	291
dstHeight.....	291
dstHost.....	291
dstLOD.....	291
dstMemoryType.....	291
dstPitch.....	291
dstXInBytes.....	292
dstY.....	292
dstZ.....	292
Height.....	292
srcArray.....	292

srcContext.....	292
srcDevice.....	292
srcHeight.....	293
srcHost.....	293
srcLOD.....	293
srcMemoryType.....	293
srcPitch.....	293
srcXInBytes.....	293
srcY.....	293
srcZ.....	294
WidthInBytes.....	294
CUDA_POINTER_ATTRIBUTE_P2P_TOKENS.....	294
CUDA_RESOURCE_DESC.....	294
devPtr.....	294
flags.....	294
format.....	294
hArray.....	295
height.....	295
hMipmappedArray.....	295
numChannels.....	295
pitchInBytes.....	295
resType.....	295
sizeInBytes.....	295
width.....	296
CUDA_RESOURCE_VIEW_DESC.....	296
depth.....	296
firstLayer.....	296
firstMipmapLevel.....	296
format.....	296
height.....	296
lastLayer.....	297
lastMipmapLevel.....	297
width.....	297
CUDA_TEXTURE_DESC.....	297
addressMode.....	297
filterMode.....	297
flags.....	297
maxAnisotropy.....	298
maxMipmapLevelClamp.....	298
minMipmapLevelClamp.....	298
mipmapFilterMode.....	298
mipmapLevelBias.....	298
CUdevprop.....	298

clockRate.....	298
maxGridSize.....	299
maxThreadsDim.....	299
maxThreadsPerBlock.....	299
memPitch.....	299
regsPerBlock.....	299
sharedMemPerBlock.....	299
SIMDWidth.....	299
textureAlign.....	300
totalConstantMemory.....	300
CUipcEventHandle.....	300
CUipcMemHandle.....	300
<b>Chapter 4. Data Fields.....</b>	<b>301</b>
<b>Chapter 5. Deprecated List.....</b>	<b>307</b>



# Chapter 1.

## API SYNCHRONIZATION BEHAVIOR

The API provides memcpy/memset functions in both synchronous and asynchronous forms, the latter having an "Async" suffix. This is a misnomer as each function may exhibit synchronous or asynchronous behavior depending on the arguments passed to the function. In the reference documentation, each memcpy function is categorized as synchronous or asynchronous, corresponding to the definitions below.

### **Memcpy**

The API provides memcpy/memset functions in both synchronous and asynchronous forms, the latter having an "Async" suffix. This is a misnomer as each function may exhibit synchronous or asynchronous behavior depending on the arguments passed to the function. In the reference documentation, each memcpy function is categorized as synchronous or asynchronous, corresponding to the definitions below.

### **Synchronous**

1. For transfers from pageable host memory to device memory, a stream sync is performed before the copy is initiated. The function will return once the pageable buffer has been copied to the staging memory for DMA transfer to device memory, but the DMA to final destination may not have completed.
2. For transfers from pinned host memory to device memory, the function is synchronous with respect to the host.
3. For transfers from device to either pageable or pinned host memory, the function returns only once the copy has completed.
4. For transfers from device memory to device memory, no host-side synchronization is performed.
5. For transfers from any host memory to any host memory, the function is fully synchronous with respect to the host.

### **Asynchronous**

1. For transfers from pageable host memory to device memory, host memory is copied to a staging buffer immediately (no device synchronization is performed). The function will return once the pageable buffer has been copied to the staging memory. The DMA transfer to final destination may not have completed.
2. For transfers between pinned host memory and device memory, the function is fully asynchronous.
3. For transfers from device memory to pageable host memory, the function will return only once the copy has completed.
4. For all other transfers, the function is fully asynchronous. If pageable memory must first be staged to pinned memory, this will be handled asynchronously with a worker thread.
5. For transfers from any host memory to any host memory, the function is fully synchronous with respect to the host.

### **Memset**

The `cudaMemset` functions are asynchronous with respect to the host except when the target memory is pinned host memory. The Async versions are always asynchronous with respect to the host.

### **Kernel Launches**

Kernel launches are asynchronous with respect to the host. Details of concurrent kernel execution and data transfers can be found in the *CUDA Programmers Guide*.



# Chapter 2.

## MODULES

Here is a list of all modules:

- ▶ Data types used by CUDA driver
- ▶ Initialization
- ▶ Version Management
- ▶ Device Management
- ▶ Device Management [DEPRECATED]
- ▶ Context Management
- ▶ Context Management [DEPRECATED]
- ▶ Module Management
- ▶ Memory Management
- ▶ Unified Addressing
- ▶ Stream Management
- ▶ Event Management
- ▶ Execution Control
- ▶ Execution Control [DEPRECATED]
- ▶ Texture Reference Management
- ▶ Texture Reference Management [DEPRECATED]
- ▶ Surface Reference Management
- ▶ Texture Object Management
- ▶ Surface Object Management
- ▶ Peer Context Memory Access
- ▶ Graphics Interoperability
- ▶ Profiler Control
- ▶ OpenGL Interoperability
  - ▶ OpenGL Interoperability [DEPRECATED]
- ▶ Direct3D 9 Interoperability
  - ▶ Direct3D 9 Interoperability [DEPRECATED]

- ▶ Direct3D 10 Interoperability
  - ▶ Direct3D 10 Interoperability [DEPRECATED]
- ▶ Direct3D 11 Interoperability
  - ▶ Direct3D 11 Interoperability [DEPRECATED]
- ▶ VDPAU Interoperability

## 2.1. Data types used by CUDA driver

struct CUDA\_ARRAY3D\_DESCRIPTOR

struct CUDA\_ARRAY\_DESCRIPTOR

struct CUDA\_MEMCPY2D

struct CUDA\_MEMCPY3D

struct CUDA\_MEMCPY3D\_PEER

struct CUDA\_POINTER\_ATTRIBUTE\_P2P\_TOKENS

struct CUDA\_RESOURCE\_DESC

struct CUDA\_RESOURCE\_VIEW\_DESC

struct CUDA\_TEXTURE\_DESC

struct CUdevprop

struct CUipcEventHandle

struct CUipcMemHandle

enum CUaddress\_mode

Texture reference addressing modes

**Values**

**CU\_TR\_ADDRESS\_MODE\_WRAP = 0**  
Wrapping address mode

**CU\_TR\_ADDRESS\_MODE\_CLAMP = 1**  
Clamp to edge address mode

**CU\_TR\_ADDRESS\_MODE\_MIRROR = 2**  
Mirror address mode

**CU\_TR\_ADDRESS\_MODE\_BORDER = 3**  
Border address mode

**enum CUarray\_cubemap\_face**

Array indices for cube faces

**Values**

**CU\_CUBEMAP\_FACE\_POSITIVE\_X = 0x00**  
Positive X face of cubemap

**CU\_CUBEMAP\_FACE\_NEGATIVE\_X = 0x01**  
Negative X face of cubemap

**CU\_CUBEMAP\_FACE\_POSITIVE\_Y = 0x02**  
Positive Y face of cubemap

**CU\_CUBEMAP\_FACE\_NEGATIVE\_Y = 0x03**  
Negative Y face of cubemap

**CU\_CUBEMAP\_FACE\_POSITIVE\_Z = 0x04**  
Positive Z face of cubemap

**CU\_CUBEMAP\_FACE\_NEGATIVE\_Z = 0x05**  
Negative Z face of cubemap

**enum CUarray\_format**

Array formats

**Values**

**CU\_AD\_FORMAT\_UNSIGNED\_INT8 = 0x01**  
Unsigned 8-bit integers

**CU\_AD\_FORMAT\_UNSIGNED\_INT16 = 0x02**  
Unsigned 16-bit integers

**CU\_AD\_FORMAT\_UNSIGNED\_INT32 = 0x03**  
Unsigned 32-bit integers

**CU\_AD\_FORMAT\_SIGNED\_INT8 = 0x08**  
Signed 8-bit integers

**CU\_AD\_FORMAT\_SIGNED\_INT16 = 0x09**  
Signed 16-bit integers

**CU\_AD\_FORMAT\_SIGNED\_INT32 = 0x0a**

Signed 32-bit integers

**CU\_AD\_FORMAT\_HALF = 0x10**

16-bit floating point

**CU\_AD\_FORMAT\_FLOAT = 0x20**

32-bit floating point

## enum CUcomputemode

Compute Modes

### Values

**CU\_COMPUTEMODE\_DEFAULT = 0**

Default compute mode (Multiple contexts allowed per device)

**CU\_COMPUTEMODE\_EXCLUSIVE = 1**

Compute-exclusive-thread mode (Only one context used by a single thread can be present on this device at a time)

**CU\_COMPUTEMODE\_PROHIBITED = 2**

Compute-prohibited mode (No contexts can be created on this device at this time)

**CU\_COMPUTEMODE\_EXCLUSIVE\_PROCESS = 3**

Compute-exclusive-process mode (Only one context used by a single process can be present on this device at a time)

## enum CUctx\_flags

Context creation flags

### Values

**CU\_CTX\_SCHED\_AUTO = 0x00**

Automatic scheduling

**CU\_CTX\_SCHED\_SPIN = 0x01**

Set spin as default scheduling

**CU\_CTX\_SCHED\_YIELD = 0x02**

Set yield as default scheduling

**CU\_CTX\_SCHED\_BLOCKING\_SYNC = 0x04**

Set blocking synchronization as default scheduling

**CU\_CTX\_BLOCKING\_SYNC = 0x04**

Set blocking synchronization as default scheduling [Deprecated](#)

This flag was deprecated as of CUDA 4.0 and was replaced with

[CU\\_CTX\\_SCHED\\_BLOCKING\\_SYNC](#).

**CU\_CTX\_SCHED\_MASK = 0x07**

**CU\_CTX\_MAP\_HOST = 0x08**

Support mapped pinned allocations

**CU\_CTX\_LMEM\_RESIZE\_TO\_MAX = 0x10**

Keep local memory allocation after launch

**CU\_CTX\_FLAGS\_MASK = 0x1f**

## enum CUdevice\_attribute

Device properties

### Values

**CU\_DEVICE\_ATTRIBUTE\_MAX\_THREADS\_PER\_BLOCK = 1**

Maximum number of threads per block

**CU\_DEVICE\_ATTRIBUTE\_MAX\_BLOCK\_DIM\_X = 2**

Maximum block dimension X

**CU\_DEVICE\_ATTRIBUTE\_MAX\_BLOCK\_DIM\_Y = 3**

Maximum block dimension Y

**CU\_DEVICE\_ATTRIBUTE\_MAX\_BLOCK\_DIM\_Z = 4**

Maximum block dimension Z

**CU\_DEVICE\_ATTRIBUTE\_MAX\_GRID\_DIM\_X = 5**

Maximum grid dimension X

**CU\_DEVICE\_ATTRIBUTE\_MAX\_GRID\_DIM\_Y = 6**

Maximum grid dimension Y

**CU\_DEVICE\_ATTRIBUTE\_MAX\_GRID\_DIM\_Z = 7**

Maximum grid dimension Z

**CU\_DEVICE\_ATTRIBUTE\_MAX\_SHARED\_MEMORY\_PER\_BLOCK = 8**

Maximum shared memory available per block in bytes

**CU\_DEVICE\_ATTRIBUTE\_SHARED\_MEMORY\_PER\_BLOCK = 8**

Deprecated, use

**CU\_DEVICE\_ATTRIBUTE\_MAX\_SHARED\_MEMORY\_PER\_BLOCK**

**CU\_DEVICE\_ATTRIBUTE\_TOTAL\_CONSTANT\_MEMORY = 9**

Memory available on device for `__constant__` variables in a CUDA C kernel in bytes

**CU\_DEVICE\_ATTRIBUTE\_WARP\_SIZE = 10**

Warp size in threads

**CU\_DEVICE\_ATTRIBUTE\_MAX\_PITCH = 11**

Maximum pitch in bytes allowed by memory copies

**CU\_DEVICE\_ATTRIBUTE\_MAX\_REGISTERS\_PER\_BLOCK = 12**

Maximum number of 32-bit registers available per block

**CU\_DEVICE\_ATTRIBUTE\_REGISTERS\_PER\_BLOCK = 12**

Deprecated, use **CU\_DEVICE\_ATTRIBUTE\_MAX\_REGISTERS\_PER\_BLOCK**

**CU\_DEVICE\_ATTRIBUTE\_CLOCK\_RATE = 13**

Typical clock frequency in kilohertz

**CU\_DEVICE\_ATTRIBUTE\_TEXTURE\_ALIGNMENT = 14**

Alignment requirement for textures

**CU\_DEVICE\_ATTRIBUTE\_GPU\_OVERLAP = 15**

Device can possibly copy memory and execute a kernel concurrently. Deprecated. Use instead `CU_DEVICE_ATTRIBUTE_ASYNC_ENGINE_COUNT`.

**CU\_DEVICE\_ATTRIBUTE\_MULTIPROCESSOR\_COUNT = 16**

Number of multiprocessors on device

**CU\_DEVICE\_ATTRIBUTE\_KERNEL\_EXEC\_TIMEOUT = 17**

Specifies whether there is a run time limit on kernels

**CU\_DEVICE\_ATTRIBUTE\_INTEGRATED = 18**

Device is integrated with host memory

**CU\_DEVICE\_ATTRIBUTE\_CAN\_MAP\_HOST\_MEMORY = 19**

Device can map host memory into CUDA address space

**CU\_DEVICE\_ATTRIBUTE\_COMPUTE\_MODE = 20**

Compute mode (See [CUcomputemode](#) for details)

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE1D\_WIDTH = 21**

Maximum 1D texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_WIDTH = 22**

Maximum 2D texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_HEIGHT = 23**

Maximum 2D texture height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_WIDTH = 24**

Maximum 3D texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_HEIGHT = 25**

Maximum 3D texture height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_DEPTH = 26**

Maximum 3D texture depth

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LAYERED\_WIDTH = 27**

Maximum 2D layered texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LAYERED\_HEIGHT = 28**

Maximum 2D layered texture height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LAYERED\_LAYERS = 29**

Maximum layers in a 2D layered texture

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_ARRAY\_WIDTH = 27**

Deprecated, use

`CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_WIDTH`

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_ARRAY\_HEIGHT = 28**

Deprecated, use

`CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_HEIGHT`

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_ARRAY\_NUMSLICES = 29**

Deprecated, use

`CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_LAYERS`

**CU\_DEVICE\_ATTRIBUTE\_SURFACE\_ALIGNMENT = 30**

Alignment requirement for surfaces

**CU\_DEVICE\_ATTRIBUTE\_CONCURRENT\_KERNELS = 31**

Device can possibly execute multiple kernels concurrently

**CU\_DEVICE\_ATTRIBUTE\_ECC\_ENABLED = 32**  
Device has ECC support enabled

**CU\_DEVICE\_ATTRIBUTE\_PCI\_BUS\_ID = 33**  
PCI bus ID of the device

**CU\_DEVICE\_ATTRIBUTE\_PCI\_DEVICE\_ID = 34**  
PCI device ID of the device

**CU\_DEVICE\_ATTRIBUTE\_TCC\_DRIVER = 35**  
Device is using TCC driver model

**CU\_DEVICE\_ATTRIBUTE\_MEMORY\_CLOCK\_RATE = 36**  
Peak memory clock frequency in kilohertz

**CU\_DEVICE\_ATTRIBUTE\_GLOBAL\_MEMORY\_BUS\_WIDTH = 37**  
Global memory bus width in bits

**CU\_DEVICE\_ATTRIBUTE\_L2\_CACHE\_SIZE = 38**  
Size of L2 cache in bytes

**CU\_DEVICE\_ATTRIBUTE\_MAX\_THREADS\_PER\_MULTIPROCESSOR = 39**  
Maximum resident threads per multiprocessor

**CU\_DEVICE\_ATTRIBUTE\_ASYNC\_ENGINE\_COUNT = 40**  
Number of asynchronous engines

**CU\_DEVICE\_ATTRIBUTE\_UNIFIED\_ADDRESSING = 41**  
Device shares a unified address space with the host

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE1D\_LAYERED\_WIDTH = 42**  
Maximum 1D layered texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE1D\_LAYERED\_LAYERS = 43**  
Maximum layers in a 1D layered texture

**CU\_DEVICE\_ATTRIBUTE\_CAN\_TEX2D\_GATHER = 44**  
Deprecated, do not use.

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_GATHER\_WIDTH = 45**  
Maximum 2D texture width if CUDA\_ARRAY3D\_TEXTURE\_GATHER is set

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_GATHER\_HEIGHT = 46**  
Maximum 2D texture height if CUDA\_ARRAY3D\_TEXTURE\_GATHER is set

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_WIDTH\_ALTERNATE = 47**  
Alternate maximum 3D texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_HEIGHT\_ALTERNATE = 48**  
Alternate maximum 3D texture height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE3D\_DEPTH\_ALTERNATE = 49**  
Alternate maximum 3D texture depth

**CU\_DEVICE\_ATTRIBUTE\_PCI\_DOMAIN\_ID = 50**  
PCI domain ID of the device

**CU\_DEVICE\_ATTRIBUTE\_TEXTURE\_PITCH\_ALIGNMENT = 51**  
Pitch alignment requirement for textures

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURECUBEMAP\_WIDTH = 52**  
Maximum cubemap texture width/height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURECUBEMAP\_LAYERED\_WIDTH = 53**

Maximum cubemap layered texture width/height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURECUBEMAP\_LAYERED\_LAYERS = 54**

Maximum layers in a cubemap layered texture

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE1D\_WIDTH = 55**

Maximum 1D surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE2D\_WIDTH = 56**

Maximum 2D surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE2D\_HEIGHT = 57**

Maximum 2D surface height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE3D\_WIDTH = 58**

Maximum 3D surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE3D\_HEIGHT = 59**

Maximum 3D surface height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE3D\_DEPTH = 60**

Maximum 3D surface depth

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE1D\_LAYERED\_WIDTH = 61**

Maximum 1D layered surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE1D\_LAYERED\_LAYERS = 62**

Maximum layers in a 1D layered surface

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE2D\_LAYERED\_WIDTH = 63**

Maximum 2D layered surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE2D\_LAYERED\_HEIGHT = 64**

Maximum 2D layered surface height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACE2D\_LAYERED\_LAYERS = 65**

Maximum layers in a 2D layered surface

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACECUBEMAP\_WIDTH = 66**

Maximum cubemap surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACECUBEMAP\_LAYERED\_WIDTH = 67**

Maximum cubemap layered surface width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACECUBEMAP\_LAYERED\_LAYERS = 68**

Maximum layers in a cubemap layered surface

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE1D\_LINEAR\_WIDTH = 69**

Maximum 1D linear texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LINEAR\_WIDTH = 70**

Maximum 2D linear texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LINEAR\_HEIGHT = 71**

Maximum 2D linear texture height

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_LINEAR\_PITCH = 72**



Maximum 2D linear texture pitch in bytes

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_MIPMAPPED\_WIDTH = 73**

Maximum mipmapped 2D texture width

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE2D\_MIPMAPPED\_HEIGHT = 74**

Maximum mipmapped 2D texture height

**CU\_DEVICE\_ATTRIBUTE\_COMPUTE\_CAPABILITY\_MAJOR = 75**

Major compute capability version number

**CU\_DEVICE\_ATTRIBUTE\_COMPUTE\_CAPABILITY\_MINOR = 76**

Minor compute capability version number

**CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_TEXTURE1D\_MIPMAPPED\_WIDTH = 77**

Maximum mipmapped 1D texture width

**CU\_DEVICE\_ATTRIBUTE\_STREAM\_PRIORITIES\_SUPPORTED = 78**

Device supports stream priorities

**CU\_DEVICE\_ATTRIBUTE\_MAX**

## enum CUevent\_flags

Event creation flags

### Values

**CU\_EVENT\_DEFAULT = 0x0**

Default event flag

**CU\_EVENT\_BLOCKING\_SYNC = 0x1**

Event uses blocking synchronization

**CU\_EVENT\_DISABLE\_TIMING = 0x2**

Event will not record timing data

**CU\_EVENT\_INTERPROCESS = 0x4**

Event is suitable for interprocess use. **CU\_EVENT\_DISABLE\_TIMING** must be set

## enum CUfilter\_mode

Texture reference filtering modes

### Values

**CU\_TR\_FILTER\_MODE\_POINT = 0**

Point filter mode

**CU\_TR\_FILTER\_MODE\_LINEAR = 1**

Linear filter mode

## enum CUfunc\_cache

Function cache configurations

**Values****CU\_FUNC\_CACHE\_PREFER\_NONE = 0x00**

no preference for shared memory or L1 (default)

**CU\_FUNC\_CACHE\_PREFER\_SHARED = 0x01**

prefer larger shared memory and smaller L1 cache

**CU\_FUNC\_CACHE\_PREFER\_L1 = 0x02**

prefer larger L1 cache and smaller shared memory

**CU\_FUNC\_CACHE\_PREFER\_EQUAL = 0x03**

prefer equal sized L1 cache and shared memory

**enum CUfunction\_attribute**

Function properties

**Values****CU\_FUNC\_ATTRIBUTE\_MAX\_THREADS\_PER\_BLOCK = 0**

The maximum number of threads per block, beyond which a launch of the function would fail. This number depends on both the function and the device on which the function is currently loaded.

**CU\_FUNC\_ATTRIBUTE\_SHARED\_SIZE\_BYTES = 1**

The size in bytes of statically-allocated shared memory required by this function.

This does not include dynamically-allocated shared memory requested by the user at runtime.

**CU\_FUNC\_ATTRIBUTE\_CONST\_SIZE\_BYTES = 2**

The size in bytes of user-allocated constant memory required by this function.

**CU\_FUNC\_ATTRIBUTE\_LOCAL\_SIZE\_BYTES = 3**

The size in bytes of local memory used by each thread of this function.

**CU\_FUNC\_ATTRIBUTE\_NUM\_REGS = 4**

The number of registers used by each thread of this function.

**CU\_FUNC\_ATTRIBUTE\_PTX\_VERSION = 5**

The PTX virtual architecture version for which the function was compiled. This value is the major PTX version \* 10 + the minor PTX version, so a PTX version 1.3 function would return the value 13. Note that this may return the undefined value of 0 for cubins compiled prior to CUDA 3.0.

**CU\_FUNC\_ATTRIBUTE\_BINARY\_VERSION = 6**

The binary architecture version for which the function was compiled. This value is the major binary version \* 10 + the minor binary version, so a binary version 1.3 function would return the value 13. Note that this will return a value of 10 for legacy cubins that do not have a properly-encoded binary architecture version.

**CU\_FUNC\_ATTRIBUTE\_MAX**

## enum CUgraphicsMapResourceFlags

Flags for mapping and unmapping interop resources

### Values

**CU\_GRAPHICS\_MAP\_RESOURCE\_FLAGS\_NONE = 0x00**  
**CU\_GRAPHICS\_MAP\_RESOURCE\_FLAGS\_READ\_ONLY = 0x01**  
**CU\_GRAPHICS\_MAP\_RESOURCE\_FLAGS\_WRITE\_DISCARD = 0x02**

## enum CUgraphicsRegisterFlags

Flags to register a graphics resource

### Values

**CU\_GRAPHICS\_REGISTER\_FLAGS\_NONE = 0x00**  
**CU\_GRAPHICS\_REGISTER\_FLAGS\_READ\_ONLY = 0x01**  
**CU\_GRAPHICS\_REGISTER\_FLAGS\_WRITE\_DISCARD = 0x02**  
**CU\_GRAPHICS\_REGISTER\_FLAGS\_SURFACE\_LDST = 0x04**  
**CU\_GRAPHICS\_REGISTER\_FLAGS\_TEXTURE\_GATHER = 0x08**

## enum CUipcMem\_flags

CUDA Ipc Mem Flags

### Values

**CU\_IPC\_MEM\_LAZY\_ENABLE\_PEER\_ACCESS = 0x1**  
 Automatically enable peer access between remote devices as needed

## enum CUjit\_cacheMode

Caching modes for dlcm

### Values

**CU\_JIT\_CACHE\_OPTION\_NONE = 0**  
 Compile with no -dlcm flag specified  
**CU\_JIT\_CACHE\_OPTION\_CG**  
 Compile with L1 cache disabled  
**CU\_JIT\_CACHE\_OPTION\_CA**  
 Compile with L1 cache enabled

## enum CUjit\_fallback

Cubin matching fallback strategies

### Values

**CU\_PREFER\_PTX = 0**

Prefer to compile ptx if exact binary match not found

**CU\_PREFER\_BINARY**

Prefer to fall back to compatible binary code if exact match not found

## enum CUjit\_option

Online compiler and linker options

### Values

**CU\_JIT\_MAX\_REGISTERS = 0**

Max number of registers that a thread may use. Option type: unsigned int Applies to: compiler only

**CU\_JIT\_THREADS\_PER\_BLOCK**

IN: Specifies minimum number of threads per block to target compilation for OUT: Returns the number of threads the compiler actually targeted. This restricts the resource utilization fo the compiler (e.g. max registers) such that a block with the given number of threads should be able to launch based on register limitations. Note, this option does not currently take into account any other resource limitations, such as shared memory utilization. Cannot be combined with [CU\\_JIT\\_TARGET](#). Option type: unsigned int Applies to: compiler only

**CU\_JIT\_WALL\_TIME**

Overwrites the option value with the total wall clock time, in milliseconds, spent in the compiler and linker Option type: float Applies to: compiler and linker

**CU\_JIT\_INFO\_LOG\_BUFFER**

Pointer to a buffer in which to print any log messages that are informational in nature (the buffer size is specified via option [CU\\_JIT\\_INFO\\_LOG\\_BUFFER\\_SIZE\\_BYTES](#))

Option type: char \* Applies to: compiler and linker

**CU\_JIT\_INFO\_LOG\_BUFFER\_SIZE\_BYTES**

IN: Log buffer size in bytes. Log messages will be capped at this size (including null terminator) OUT: Amount of log buffer filled with messages Option type: unsigned int Applies to: compiler and linker

**CU\_JIT\_ERROR\_LOG\_BUFFER**

Pointer to a buffer in which to print any log messages that reflect errors (the buffer size is specified via option [CU\\_JIT\\_ERROR\\_LOG\\_BUFFER\\_SIZE\\_BYTES](#)) Option

type: char \* Applies to: compiler and linker

**CU\_JIT\_ERROR\_LOG\_BUFFER\_SIZE\_BYTES**

IN: Log buffer size in bytes. Log messages will be capped at this size (including null terminator) OUT: Amount of log buffer filled with messages Option type: unsigned int Applies to: compiler and linker

#### **CU\_JIT\_OPTIMIZATION\_LEVEL**

Level of optimizations to apply to generated code (0 - 4), with 4 being the default and highest level of optimizations. Option type: unsigned int Applies to: compiler only

#### **CU\_JIT\_TARGET\_FROM\_CUCONTEXT**

No option value required. Determines the target based on the current attached context (default) Option type: No option value needed Applies to: compiler and linker

#### **CU\_JIT\_TARGET**

Target is chosen based on supplied `CUjit_target`. Cannot be combined with `CU_JIT_THREADS_PER_BLOCK`. Option type: unsigned int for enumerated type `CUjit_target` Applies to: compiler and linker

#### **CU\_JIT\_FALLBACK\_STRATEGY**

Specifies choice of fallback strategy if matching cubin is not found. Choice is based on supplied `CUjit_fallback`. Option type: unsigned int for enumerated type `CUjit_fallback` Applies to: compiler only

#### **CU\_JIT\_GENERATE\_DEBUG\_INFO**

Specifies whether to create debug information in output (-g) (0: false, default) Option type: int Applies to: compiler and linker

#### **CU\_JIT\_LOG\_VERBOSE**

Generate verbose log messages (0: false, default) Option type: int Applies to: compiler and linker

#### **CU\_JIT\_GENERATE\_LINE\_INFO**

Generate line number information (-lineinfo) (0: false, default) Option type: int Applies to: compiler only

#### **CU\_JIT\_CACHE\_MODE**

Specifies whether to enable caching explicitly (-dlcm) Choice is based on supplied `CUjit_cacheMode_enum`. Option type: unsigned int for enumerated type `CUjit_cacheMode_enum` Applies to: compiler only

#### **CU\_JIT\_NUM\_OPTIONS**

## enum `CUjit_target`

Online compilation targets

### Values

**CU\_TARGET\_COMPUTE\_10 = 0**

Compute device class 1.0

**CU\_TARGET\_COMPUTE\_11**

Compute device class 1.1

**CU\_TARGET\_COMPUTE\_12**

Compute device class 1.2  
**CU\_TARGET\_COMPUTE\_13**  
 Compute device class 1.3  
**CU\_TARGET\_COMPUTE\_20**  
 Compute device class 2.0  
**CU\_TARGET\_COMPUTE\_21**  
 Compute device class 2.1  
**CU\_TARGET\_COMPUTE\_30**  
 Compute device class 3.0  
**CU\_TARGET\_COMPUTE\_35**  
 Compute device class 3.5  
**CU\_MAX\_JIT\_TARGET**

## enum CUjitInputType

Device code formats

### Values

**CU\_JIT\_INPUT\_CUBIN = 0**  
 Compiled device-class-specific device code Applicable options: none  
**CU\_JIT\_INPUT\_PTX**  
 PTX source code Applicable options: PTX compiler options  
**CU\_JIT\_INPUT\_FATBINARY**  
 Bundle of multiple cubins and/or PTX of some device code Applicable options: PTX compiler options, [CU\\_JIT\\_FALLBACK\\_STRATEGY](#)  
**CU\_JIT\_INPUT\_OBJECT**  
 Host object with embedded device code Applicable options: PTX compiler options, [CU\\_JIT\\_FALLBACK\\_STRATEGY](#)  
**CU\_JIT\_INPUT\_LIBRARY**  
 Archive of host objects with embedded device code Applicable options: PTX compiler options, [CU\\_JIT\\_FALLBACK\\_STRATEGY](#)  
**CU\_JIT\_NUM\_INPUT\_TYPES**

## enum CUlimit

Limits

### Values

**CU\_LIMIT\_STACK\_SIZE = 0x00**  
 GPU thread stack size  
**CU\_LIMIT\_PRINTF\_FIFO\_SIZE = 0x01**  
 GPU printf FIFO size  
**CU\_LIMIT\_MALLOC\_HEAP\_SIZE = 0x02**

GPU malloc heap size  
**CU\_LIMIT\_DEV\_RUNTIME\_SYNC\_DEPTH = 0x03**  
 GPU device runtime launch synchronize depth  
**CU\_LIMIT\_DEV\_RUNTIME\_PENDING\_LAUNCH\_COUNT = 0x04**  
 GPU device runtime pending launch count  
**CU\_LIMIT\_MAX**

## enum CUmemorytype

Memory types

### Values

**CU\_MEMORYTYPE\_HOST = 0x01**  
 Host memory  
**CU\_MEMORYTYPE\_DEVICE = 0x02**  
 Device memory  
**CU\_MEMORYTYPE\_ARRAY = 0x03**  
 Array memory  
**CU\_MEMORYTYPE\_UNIFIED = 0x04**  
 Unified device or host memory

## enum CUpointer\_attribute

Pointer information

### Values

**CU\_POINTER\_ATTRIBUTE\_CONTEXT = 1**  
 The [CUcontext](#) on which a pointer was allocated or registered  
**CU\_POINTER\_ATTRIBUTE\_MEMORY\_TYPE = 2**  
 The [CUmemorytype](#) describing the physical location of a pointer  
**CU\_POINTER\_ATTRIBUTE\_DEVICE\_POINTER = 3**  
 The address at which a pointer's memory may be accessed on the device  
**CU\_POINTER\_ATTRIBUTE\_HOST\_POINTER = 4**  
 The address at which a pointer's memory may be accessed on the host  
**CU\_POINTER\_ATTRIBUTE\_P2P\_TOKENS = 5**  
 A pair of tokens for use with the nv-p2p.h Linux kernel interface

## enum CUresourcetype

Resource types

### Values

**CU\_RESOURCE\_TYPE\_ARRAY = 0x00**

Array resource  
**CU\_RESOURCE\_TYPE\_MIPMAPPED\_ARRAY = 0x01**  
 Mipmapped array resource  
**CU\_RESOURCE\_TYPE\_LINEAR = 0x02**  
 Linear resource  
**CU\_RESOURCE\_TYPE\_PITCH2D = 0x03**  
 Pitch 2D resource

## enum CUresourceViewFormat

Resource view format

### Values

**CU\_RES\_VIEW\_FORMAT\_NONE = 0x00**  
 No resource view format (use underlying resource format)  
**CU\_RES\_VIEW\_FORMAT\_UINT\_1X8 = 0x01**  
 1 channel unsigned 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_2X8 = 0x02**  
 2 channel unsigned 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_4X8 = 0x03**  
 4 channel unsigned 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_1X8 = 0x04**  
 1 channel signed 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_2X8 = 0x05**  
 2 channel signed 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_4X8 = 0x06**  
 4 channel signed 8-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_1X16 = 0x07**  
 1 channel unsigned 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_2X16 = 0x08**  
 2 channel unsigned 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_4X16 = 0x09**  
 4 channel unsigned 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_1X16 = 0x0a**  
 1 channel signed 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_2X16 = 0x0b**  
 2 channel signed 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_4X16 = 0x0c**  
 4 channel signed 16-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_1X32 = 0x0d**  
 1 channel unsigned 32-bit integers  
**CU\_RES\_VIEW\_FORMAT\_UINT\_2X32 = 0x0e**  
 2 channel unsigned 32-bit integers



**CU\_RES\_VIEW\_FORMAT\_UINT\_4X32 = 0x0f**  
 4 channel unsigned 32-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_1X32 = 0x10**  
 1 channel signed 32-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_2X32 = 0x11**  
 2 channel signed 32-bit integers  
**CU\_RES\_VIEW\_FORMAT\_SINT\_4X32 = 0x12**  
 4 channel signed 32-bit integers  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_1X16 = 0x13**  
 1 channel 16-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_2X16 = 0x14**  
 2 channel 16-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_4X16 = 0x15**  
 4 channel 16-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_1X32 = 0x16**  
 1 channel 32-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_2X32 = 0x17**  
 2 channel 32-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_FLOAT\_4X32 = 0x18**  
 4 channel 32-bit floating point  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC1 = 0x19**  
 Block compressed 1  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC2 = 0x1a**  
 Block compressed 2  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC3 = 0x1b**  
 Block compressed 3  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC4 = 0x1c**  
 Block compressed 4 unsigned  
**CU\_RES\_VIEW\_FORMAT\_SIGNED\_BC4 = 0x1d**  
 Block compressed 4 signed  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC5 = 0x1e**  
 Block compressed 5 unsigned  
**CU\_RES\_VIEW\_FORMAT\_SIGNED\_BC5 = 0x1f**  
 Block compressed 5 signed  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC6H = 0x20**  
 Block compressed 6 unsigned half-float  
**CU\_RES\_VIEW\_FORMAT\_SIGNED\_BC6H = 0x21**  
 Block compressed 6 signed half-float  
**CU\_RES\_VIEW\_FORMAT\_UNSIGNED\_BC7 = 0x22**  
 Block compressed 7

## enum CUresult

Error codes

## Values

### **CUDA\_SUCCESS = 0**

The API call returned with no errors. In the case of query calls, this can also mean that the operation being queried is complete (see [cuEventQuery\(\)](#) and [cuStreamQuery\(\)](#)).

### **CUDA\_ERROR\_INVALID\_VALUE = 1**

This indicates that one or more of the parameters passed to the API call is not within an acceptable range of values.

### **CUDA\_ERROR\_OUT\_OF\_MEMORY = 2**

The API call failed because it was unable to allocate enough memory to perform the requested operation.

### **CUDA\_ERROR\_NOT\_INITIALIZED = 3**

This indicates that the CUDA driver has not been initialized with [cuInit\(\)](#) or that initialization has failed.

### **CUDA\_ERROR\_DEINITIALIZED = 4**

This indicates that the CUDA driver is in the process of shutting down.

### **CUDA\_ERROR\_PROFILER\_DISABLED = 5**

This indicates profiler is not initialized for this run. This can happen when the application is running with external profiling tools like visual profiler.

### **CUDA\_ERROR\_PROFILER\_NOT\_INITIALIZED = 6**

**Deprecated** This error return is deprecated as of CUDA 5.0. It is no longer an error to attempt to enable/disable the profiling via [cuProfilerStart](#) or [cuProfilerStop](#) without initialization.

### **CUDA\_ERROR\_PROFILER\_ALREADY\_STARTED = 7**

**Deprecated** This error return is deprecated as of CUDA 5.0. It is no longer an error to call [cuProfilerStart\(\)](#) when profiling is already enabled.

### **CUDA\_ERROR\_PROFILER\_ALREADY\_STOPPED = 8**

**Deprecated** This error return is deprecated as of CUDA 5.0. It is no longer an error to call [cuProfilerStop\(\)](#) when profiling is already disabled.

### **CUDA\_ERROR\_NO\_DEVICE = 100**

This indicates that no CUDA-capable devices were detected by the installed CUDA driver.

### **CUDA\_ERROR\_INVALID\_DEVICE = 101**

This indicates that the device ordinal supplied by the user does not correspond to a valid CUDA device.

### **CUDA\_ERROR\_INVALID\_IMAGE = 200**

This indicates that the device kernel image is invalid. This can also indicate an invalid CUDA module.

### **CUDA\_ERROR\_INVALID\_CONTEXT = 201**

This most frequently indicates that there is no context bound to the current thread. This can also be returned if the context passed to an API call is not a valid handle (such as a context that has had [cuCtxDestroy\(\)](#) invoked on it). This can also be returned if a user mixes different API versions (i.e. 3010 context with 3020 API calls). See [cuCtxGetApiVersion\(\)](#) for more details.

**CUDA\_ERROR\_CONTEXT\_ALREADY\_CURRENT = 202**

This indicated that the context being supplied as a parameter to the API call was already the active context. **Deprecated** This error return is deprecated as of CUDA 3.2. It is no longer an error to attempt to push the active context via `cuCtxPushCurrent()`.

**CUDA\_ERROR\_MAP\_FAILED = 205**

This indicates that a map or register operation has failed.

**CUDA\_ERROR\_UNMAP\_FAILED = 206**

This indicates that an unmap or unregister operation has failed.

**CUDA\_ERROR\_ARRAY\_IS\_MAPPED = 207**

This indicates that the specified array is currently mapped and thus cannot be destroyed.

**CUDA\_ERROR\_ALREADY\_MAPPED = 208**

This indicates that the resource is already mapped.

**CUDA\_ERROR\_NO\_BINARY\_FOR\_GPU = 209**

This indicates that there is no kernel image available that is suitable for the device.

This can occur when a user specifies code generation options for a particular CUDA source file that do not include the corresponding device configuration.

**CUDA\_ERROR\_ALREADY\_ACQUIRED = 210**

This indicates that a resource has already been acquired.

**CUDA\_ERROR\_NOT\_MAPPED = 211**

This indicates that a resource is not mapped.

**CUDA\_ERROR\_NOT\_MAPPED\_AS\_ARRAY = 212**

This indicates that a mapped resource is not available for access as an array.

**CUDA\_ERROR\_NOT\_MAPPED\_AS\_POINTER = 213**

This indicates that a mapped resource is not available for access as a pointer.

**CUDA\_ERROR\_ECC\_UNCORRECTABLE = 214**

This indicates that an uncorrectable ECC error was detected during execution.

**CUDA\_ERROR\_UNSUPPORTED\_LIMIT = 215**

This indicates that the `CUlimit` passed to the API call is not supported by the active device.

**CUDA\_ERROR\_CONTEXT\_ALREADY\_IN\_USE = 216**

This indicates that the `CUcontext` passed to the API call can only be bound to a single CPU thread at a time but is already bound to a CPU thread.

**CUDA\_ERROR\_PEER\_ACCESS\_UNSUPPORTED = 217**

This indicates that peer access is not supported across the given devices.

**CUDA\_ERROR\_INVALID\_SOURCE = 300**

This indicates that the device kernel source is invalid.

**CUDA\_ERROR\_FILE\_NOT\_FOUND = 301**

This indicates that the file specified was not found.

**CUDA\_ERROR\_SHARED\_OBJECT\_SYMBOL\_NOT\_FOUND = 302**

This indicates that a link to a shared object failed to resolve.

**CUDA\_ERROR\_SHARED\_OBJECT\_INIT\_FAILED = 303**

This indicates that initialization of a shared object failed.

**CUDA\_ERROR\_OPERATING\_SYSTEM = 304**

This indicates that an OS call failed.

**CUDA\_ERROR\_INVALID\_HANDLE = 400**

This indicates that a resource handle passed to the API call was not valid. Resource handles are opaque types like [CUstream](#) and [CUevent](#).

**CUDA\_ERROR\_NOT\_FOUND = 500**

This indicates that a named symbol was not found. Examples of symbols are global/constant variable names, texture names, and surface names.

**CUDA\_ERROR\_NOT\_READY = 600**

This indicates that asynchronous operations issued previously have not completed yet. This result is not actually an error, but must be indicated differently than [CUDA\\_SUCCESS](#) (which indicates completion). Calls that may return this value include [cuEventQuery\(\)](#) and [cuStreamQuery\(\)](#).

**CUDA\_ERROR\_LAUNCH\_FAILED = 700**

An exception occurred on the device while executing a kernel. Common causes include dereferencing an invalid device pointer and accessing out of bounds shared memory. The context cannot be used, so it must be destroyed (and a new one should be created). All existing device memory allocations from this context are invalid and must be reconstructed if the program is to continue using CUDA.

**CUDA\_ERROR\_LAUNCH\_OUT\_OF\_RESOURCES = 701**

This indicates that a launch did not occur because it did not have appropriate resources. This error usually indicates that the user has attempted to pass too many arguments to the device kernel, or the kernel launch specifies too many threads for the kernel's register count. Passing arguments of the wrong size (i.e. a 64-bit pointer when a 32-bit int is expected) is equivalent to passing too many arguments and can also result in this error.

**CUDA\_ERROR\_LAUNCH\_TIMEOUT = 702**

This indicates that the device kernel took too long to execute. This can only occur if timeouts are enabled - see the device attribute [CU\\_DEVICE\\_ATTRIBUTE\\_KERNEL\\_EXEC\\_TIMEOUT](#) for more information. The context cannot be used (and must be destroyed similar to [CUDA\\_ERROR\\_LAUNCH\\_FAILED](#)). All existing device memory allocations from this context are invalid and must be reconstructed if the program is to continue using CUDA.

**CUDA\_ERROR\_LAUNCH\_INCOMPATIBLE\_TEXTURING = 703**

This error indicates a kernel launch that uses an incompatible texturing mode.

**CUDA\_ERROR\_PEER\_ACCESS\_ALREADY\_ENABLED = 704**

This error indicates that a call to [cuCtxEnablePeerAccess\(\)](#) is trying to re-enable peer access to a context which has already had peer access to it enabled.

**CUDA\_ERROR\_PEER\_ACCESS\_NOT\_ENABLED = 705**

This error indicates that [cuCtxDisablePeerAccess\(\)](#) is trying to disable peer access which has not been enabled yet via [cuCtxEnablePeerAccess\(\)](#).

**CUDA\_ERROR\_PRIMARY\_CONTEXT\_ACTIVE = 708**

This error indicates that the primary context for the specified device has already been initialized.

**CUDA\_ERROR\_CONTEXT\_IS\_DESTROYED = 709**

This error indicates that the context current to the calling thread has been destroyed using `cuCtxDestroy`, or is a primary context which has not yet been initialized.

**CUDA\_ERROR\_ASSERT = 710**

A device-side assert triggered during kernel execution. The context cannot be used anymore, and must be destroyed. All existing device memory allocations from this context are invalid and must be reconstructed if the program is to continue using CUDA.

**CUDA\_ERROR\_TOO\_MANY\_PEERS = 711**

This error indicates that the hardware resources required to enable peer access have been exhausted for one or more of the devices passed to `cuCtxEnablePeerAccess()`.

**CUDA\_ERROR\_HOST\_MEMORY\_ALREADY\_REGISTERED = 712**

This error indicates that the memory range passed to `cuMemHostRegister()` has already been registered.

**CUDA\_ERROR\_HOST\_MEMORY\_NOT\_REGISTERED = 713**

This error indicates that the pointer passed to `cuMemHostUnregister()` does not correspond to any currently registered memory region.

**CUDA\_ERROR\_NOT\_PERMITTED = 800**

This error indicates that the attempted operation is not permitted.

**CUDA\_ERROR\_NOT\_SUPPORTED = 801**

This error indicates that the attempted operation is not supported on the current system or device.

**CUDA\_ERROR\_UNKNOWN = 999**

This indicates that an unknown internal error has occurred.

## enum CUsharedconfig

Shared memory configurations

### Values

**CU\_SHARED\_MEM\_CONFIG\_DEFAULT\_BANK\_SIZE = 0x00**

set default shared memory bank size

**CU\_SHARED\_MEM\_CONFIG\_FOUR\_BYTE\_BANK\_SIZE = 0x01**

set shared memory bank width to four bytes

**CU\_SHARED\_MEM\_CONFIG\_EIGHT\_BYTE\_BANK\_SIZE = 0x02**

set shared memory bank width to eight bytes

## enum CUstream\_flags

Stream creation flags

**Values****CU\_STREAM\_DEFAULT = 0x0**

Default stream flag

**CU\_STREAM\_NON\_BLOCKING = 0x1**

Stream does not synchronize with stream 0 (the NULL stream)

**typedef struct CUarray\_st \*CUarray**

CUDA array

**typedef struct CUctx\_st \*CUcontext**

CUDA context

**typedef int CUdevice**

CUDA device

**typedef unsigned int CUdeviceptr**

CUDA device pointer

**typedef struct CUevent\_st \*CUevent**

CUDA event

**typedef struct CUfunc\_st \*CUfunction**

CUDA function

**typedef struct CUgraphicsResource\_st  
\*CUgraphicsResource**

CUDA graphics interop resource

**typedef struct CUmipmappedArray\_st  
\*CUmipmappedArray**

CUDA mipmapped array

**typedef struct CUmod\_st \*CUmodule**

CUDA module

```
typedef struct CUstream_st *CUstream
```

CUDA stream

```
typedef void (CUDA_CB *CUstreamCallback) (CUstream
hStream, CUresult status, void* userData)
```

CUDA stream callback

```
typedef unsigned long long CUsurfObject
```

CUDA surface object

```
typedef struct CUsurfref_st *CUsurfref
```

CUDA surface reference

```
typedef unsigned long long CUtexObject
```

CUDA texture object

```
typedef struct CUtexref_st *CUtexref
```

CUDA texture reference

```
#define CU_IPC_HANDLE_SIZE 64
```

CUDA IPC handle size

```
#define CU_LAUNCH_PARAM_BUFFER_POINTER
((void*)0x01)
```

Indicator that the next value in the `extra` parameter to `cuLaunchKernel` will be a pointer to a buffer containing all kernel parameters used for launching kernel `f`. This buffer needs to honor all alignment/padding requirements of the individual parameters. If `CU_LAUNCH_PARAM_BUFFER_SIZE` is not also specified in the `extra` array, then `CU_LAUNCH_PARAM_BUFFER_POINTER` will have no effect.

```
#define CU_LAUNCH_PARAM_BUFFER_SIZE ((void*)0x02)
```

Indicator that the next value in the `extra` parameter to `cuLaunchKernel` will be a pointer to a `size_t` which contains the size of the buffer specified with `CU_LAUNCH_PARAM_BUFFER_POINTER`. It is required that

`CU_LAUNCH_PARAM_BUFFER_POINTER` also be specified in the `extra` array if the value associated with `CU_LAUNCH_PARAM_BUFFER_SIZE` is not zero.

**#define CU\_LAUNCH\_PARAM\_END ((void\*)0x00)**

End of array terminator for the `extra` parameter to `cuLaunchKernel`

**#define CU\_MEMHOSTALLOC\_DEVICEMAP 0x02**

If set, host memory is mapped into CUDA address space and `cuMemHostGetDevicePointer()` may be called on the host pointer. Flag for `cuMemHostAlloc()`

**#define CU\_MEMHOSTALLOC\_PORTABLE 0x01**

If set, host memory is portable between CUDA contexts. Flag for `cuMemHostAlloc()`

**#define CU\_MEMHOSTALLOC\_WRITECOMBINED 0x04**

If set, host memory is allocated as write-combined - fast to write, faster to DMA, slow to read except via SSE4 streaming load instruction (MOVNTDQA). Flag for `cuMemHostAlloc()`

**#define CU\_MEMHOSTREGISTER\_DEVICEMAP 0x02**

If set, host memory is mapped into CUDA address space and `cuMemHostGetDevicePointer()` may be called on the host pointer. Flag for `cuMemHostRegister()`

**#define CU\_MEMHOSTREGISTER\_PORTABLE 0x01**

If set, host memory is portable between CUDA contexts. Flag for `cuMemHostRegister()`

**#define CU\_PARAM\_TR\_DEFAULT -1**

For texture references loaded into the module, use default texunit from texture reference.

**#define CU\_TRSA\_OVERRIDE\_FORMAT 0x01**

Override the texref format with a format inferred from the array. Flag for `cuTexRefSetArray()`



**#define CU\_TRSF\_NORMALIZED\_COORDINATES 0x02**

Use normalized texture coordinates in the range [0,1) instead of [0,dim). Flag for `cuTexRefSetFlags()`

**#define CU\_TRSF\_READ\_AS\_INTEGER 0x01**

Read the texture as integers rather than promoting the values to floats in the range [0,1]. Flag for `cuTexRefSetFlags()`

**#define CU\_TRSF\_SRGB 0x10**

Perform sRGB->linear conversion during texture read. Flag for `cuTexRefSetFlags()`

**#define CUDA\_ARRAY3D\_2DARRAY 0x01**

Deprecated, use `CUDA_ARRAY3D_LAYERED`

**#define CUDA\_ARRAY3D\_CUBEMAP 0x04**

If set, the CUDA array is a collection of six 2D arrays, representing faces of a cube. The width of such a CUDA array must be equal to its height, and Depth must be six. If `CUDA_ARRAY3D_LAYERED` flag is also set, then the CUDA array is a collection of cubemaps and Depth must be a multiple of six.

**#define CUDA\_ARRAY3D\_LAYERED 0x01**

If set, the CUDA array is a collection of layers, where each layer is either a 1D or a 2D array and the Depth member of `CUDA_ARRAY3D_DESCRIPTOR` specifies the number of layers, not the depth of a 3D array.

**#define CUDA\_ARRAY3D\_SURFACE\_LDST 0x02**

This flag must be set in order to bind a surface reference to the CUDA array

**#define CUDA\_ARRAY3D\_TEXTURE\_GATHER 0x08**

This flag must be set in order to perform texture gather operations on a CUDA array.

**#define CUDA\_VERSION 5050**

CUDA API version number

## 2.2. Initialization

This section describes the initialization functions of the low-level CUDA driver application programming interface.

### CUresult `cuInit` (unsigned int `Flags`)

Initialize the CUDA driver API.

#### Parameters

##### Flags

- Initialization flag for CUDA.

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_INVALID_DEVICE`

#### Description

Initializes the driver API and must be called before any other function from the driver API. Currently, the `Flags` parameter must be 0. If `cuInit()` has not been called, any function from the driver API will return `CUDA_ERROR_NOT_INITIALIZED`.



Note that this function may also return error codes from previous, asynchronous launches.

## 2.3. Version Management

This section describes the version management functions of the low-level CUDA driver application programming interface.

### CUresult `cuDriverGetVersion` (int `*driverVersion`)

Returns the CUDA driver version.

#### Parameters

##### `driverVersion`

- Returns the CUDA driver version

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns in `*driverVersion` the version number of the installed CUDA driver. This function automatically returns `CUDA_ERROR_INVALID_VALUE` if the `driverVersion` argument is `NULL`.



Note that this function may also return error codes from previous, asynchronous launches.

## 2.4. Device Management

This section describes the device management functions of the low-level CUDA driver application programming interface.

### CUresult cuDeviceGet (CUdevice \*device, int ordinal)

Returns a handle to a compute device.

**Parameters****device**

- Returned device handle

**ordinal**

- Device number to get handle for

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

**Description**

Returns in `*device` a device handle given an ordinal in the range `[0, cuDeviceGetCount()-1]`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuDeviceGetAttribute`, `cuDeviceGetCount`, `cuDeviceGetName`, `cuDeviceTotalMem`

## CUresult cuDeviceGetAttribute (int \*pi, CUdevice\_attribute attrib, CUdevice dev)

Returns information about the device.

**Parameters****pi**

- Returned device attribute value

**attrib**

- Device attribute to query

**dev**

- Device handle

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

**Description**

Returns in \*pi the integer value of the attribute attrib on device dev. The supported attributes are:

- ▶ `CU_DEVICE_ATTRIBUTE_MAX_THREADS_PER_BLOCK`: Maximum number of threads per block;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_BLOCK_DIM_X`: Maximum x-dimension of a block;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_BLOCK_DIM_Y`: Maximum y-dimension of a block;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_BLOCK_DIM_Z`: Maximum z-dimension of a block;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_GRID_DIM_X`: Maximum x-dimension of a grid;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_GRID_DIM_Y`: Maximum y-dimension of a grid;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_GRID_DIM_Z`: Maximum z-dimension of a grid;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_SHARED_MEMORY_PER_BLOCK`: Maximum amount of shared memory available to a thread block in bytes; this amount is shared by all thread blocks simultaneously resident on a multiprocessor;
- ▶ `CU_DEVICE_ATTRIBUTE_TOTAL_CONSTANT_MEMORY`: Memory available on device for `__constant__` variables in a CUDA C kernel in bytes;

- ▶ `CU_DEVICE_ATTRIBUTE_WARP_SIZE`: Warp size in threads;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_PITCH`: Maximum pitch in bytes allowed by the memory copy functions that involve memory regions allocated through `cuMemAllocPitch()`;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_WIDTH`: Maximum 1D texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_LINEAR_WIDTH`: Maximum width for a 1D texture bound to linear memory;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_MIPMAPPED_WIDTH`: Maximum mipmapped 1D texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_WIDTH`: Maximum 2D texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_HEIGHT`: Maximum 2D texture height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_WIDTH`: Maximum width for a 2D texture bound to linear memory;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_HEIGHT`: Maximum height for a 2D texture bound to linear memory;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_PITCH`: Maximum pitch in bytes for a 2D texture bound to linear memory;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_MIPMAPPED_WIDTH`: Maximum mipmapped 2D texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_MIPMAPPED_HEIGHT`: Maximum mipmapped 2D texture height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_WIDTH`: Maximum 3D texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_HEIGHT`: Maximum 3D texture height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_DEPTH`: Maximum 3D texture depth;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_WIDTH_ALTERNATE`: Alternate maximum 3D texture width, 0 if no alternate maximum 3D texture size is supported;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_HEIGHT_ALTERNATE`: Alternate maximum 3D texture height, 0 if no alternate maximum 3D texture size is supported;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE3D_DEPTH_ALTERNATE`: Alternate maximum 3D texture depth, 0 if no alternate maximum 3D texture size is supported;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURECUBEMAP_WIDTH`: Maximum cubemap texture width or height;

- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_LAYERED_WIDTH`: Maximum 1D layered texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_LAYERED_LAYERS`: Maximum layers in a 1D layered texture;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_WIDTH`: Maximum 2D layered texture width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_HEIGHT`: Maximum 2D layered texture height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LAYERED_LAYERS`: Maximum layers in a 2D layered texture;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURECUBEMAP_LAYERED_WIDTH`: Maximum cubemap layered texture width or height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURECUBEMAP_LAYERED_LAYERS`: Maximum layers in a cubemap layered texture;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE1D_WIDTH`: Maximum 1D surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE2D_WIDTH`: Maximum 2D surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE2D_HEIGHT`: Maximum 2D surface height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE3D_WIDTH`: Maximum 3D surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE3D_HEIGHT`: Maximum 3D surface height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE3D_DEPTH`: Maximum 3D surface depth;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE1D_LAYERED_WIDTH`: Maximum 1D layered surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE1D_LAYERED_LAYERS`: Maximum layers in a 1D layered surface;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE2D_LAYERED_WIDTH`: Maximum 2D layered surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE2D_LAYERED_HEIGHT`: Maximum 2D layered surface height;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACE2D_LAYERED_LAYERS`: Maximum layers in a 2D layered surface;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACECUBEMAP_WIDTH`: Maximum cubemap surface width;
- ▶ `CU_DEVICE_ATTRIBUTE_MAXIMUM_SURFACECUBEMAP_LAYERED_WIDTH`: Maximum cubemap layered surface width;

- ▶ **CU\_DEVICE\_ATTRIBUTE\_MAXIMUM\_SURFACECUBEMAP\_LAYERED\_LAYERS:** Maximum layers in a cubemap layered surface;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_MAX\_REGISTERS\_PER\_BLOCK:** Maximum number of 32-bit registers available to a thread block; this number is shared by all thread blocks simultaneously resident on a multiprocessor;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_CLOCK\_RATE:** The typical clock frequency in kilohertz;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_TEXTURE\_ALIGNMENT:** Alignment requirement; texture base addresses aligned to textureAlign bytes do not need an offset applied to texture fetches;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_TEXTURE\_PITCH\_ALIGNMENT:** Pitch alignment requirement for 2D texture references bound to pitched memory;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_GPU\_OVERLAP:** 1 if the device can concurrently copy memory between host and device while executing a kernel, or 0 if not;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_MULTIPROCESSOR\_COUNT:** Number of multiprocessors on the device;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_KERNEL\_EXEC\_TIMEOUT:** 1 if there is a run time limit for kernels executed on the device, or 0 if not;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_INTEGRATED:** 1 if the device is integrated with the memory subsystem, or 0 if not;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_CAN\_MAP\_HOST\_MEMORY:** 1 if the device can map host memory into the CUDA address space, or 0 if not;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_COMPUTE\_MODE:** Compute mode that device is currently in. Available modes are as follows:
  - ▶ **CU\_COMPUTEMODE\_DEFAULT:** Default mode - Device is not restricted and can have multiple CUDA contexts present at a single time.
  - ▶ **CU\_COMPUTEMODE\_EXCLUSIVE:** Compute-exclusive mode - Device can have only one CUDA context present on it at a time.
  - ▶ **CU\_COMPUTEMODE\_PROHIBITED:** Compute-prohibited mode - Device is prohibited from creating new CUDA contexts.
  - ▶ **CU\_COMPUTEMODE\_EXCLUSIVE\_PROCESS:** Compute-exclusive-process mode - Device can have only one context used by a single process at a time.
- ▶ **CU\_DEVICE\_ATTRIBUTE\_CONCURRENT\_KERNELS:** 1 if the device supports executing multiple kernels within the same context simultaneously, or 0 if not. It is not guaranteed that multiple kernels will be resident on the device concurrently so this feature should not be relied upon for correctness;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_ECC\_ENABLED:** 1 if error correction is enabled on the device, 0 if error correction is disabled or not supported by the device;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_PCI\_BUS\_ID:** PCI bus identifier of the device;
- ▶ **CU\_DEVICE\_ATTRIBUTE\_PCI\_DEVICE\_ID:** PCI device (also known as slot) identifier of the device;

- ▶ `CU_DEVICE_ATTRIBUTE_TCC_DRIVER`: 1 if the device is using a TCC driver. TCC is only available on Tesla hardware running Windows Vista or later;
- ▶ `CU_DEVICE_ATTRIBUTE_MEMORY_CLOCK_RATE`: Peak memory clock frequency in kilohertz;
- ▶ `CU_DEVICE_ATTRIBUTE_GLOBAL_MEMORY_BUS_WIDTH`: Global memory bus width in bits;
- ▶ `CU_DEVICE_ATTRIBUTE_L2_CACHE_SIZE`: Size of L2 cache in bytes. 0 if the device doesn't have L2 cache;
- ▶ `CU_DEVICE_ATTRIBUTE_MAX_THREADS_PER_MULTIPROCESSOR`: Maximum resident threads per multiprocessor;
- ▶ `CU_DEVICE_ATTRIBUTE_UNIFIED_ADDRESSING`: 1 if the device shares a unified address space with the host, or 0 if not;
- ▶ `CU_DEVICE_ATTRIBUTE_COMPUTE_CAPABILITY_MAJOR`: Major compute capability version number;
- ▶ `CU_DEVICE_ATTRIBUTE_COMPUTE_CAPABILITY_MINOR`: Minor compute capability version number;



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuDeviceGetCount`, `cuDeviceGetName`, `cuDeviceGet`, `cuDeviceTotalMem`

## CUresult cuDeviceGetCount (int \*count)

Returns the number of compute-capable devices.

#### Parameters

##### count

- Returned number of compute-capable devices

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

#### Description

Returns in \*count the number of devices with compute capability greater than or equal to 1.0 that are available for execution. If there is no such device, `cuDeviceGetCount()` returns 0.





Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuDeviceGetAttribute](#), [cuDeviceGetName](#), [cuDeviceGet](#), [cuDeviceTotalMem](#)

## CUresult cuDeviceGetName (char \*name, int len, CUdevice dev)

Returns an identifier string for the device.

**Parameters****name**

- Returned identifier string for the device

**len**

- Maximum length of string to store in name

**dev**

- Device to get identifier string for

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#), [CUDA\\_ERROR\\_INVALID\\_DEVICE](#)

**Description**

Returns an ASCII string identifying the device `dev` in the NULL-terminated string pointed to by `name`. `len` specifies the maximum length of the string that may be returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuDeviceGetAttribute](#), [cuDeviceGetCount](#), [cuDeviceGet](#), [cuDeviceTotalMem](#)

## CUresult cuDeviceTotalMem (size\_t \*bytes, CUdevice dev)

Returns the total amount of memory on the device.

### Parameters

#### bytes

- Returned memory available on device in bytes

#### dev

- Device handle

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

### Description

Returns in \*bytes the total amount of memory available on the device dev in bytes.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuDeviceGetAttribute](#), [cuDeviceGetCount](#), [cuDeviceGetName](#), [cuDeviceGet](#),

## 2.5. Device Management [DEPRECATED]

This section describes the device management functions of the low-level CUDA driver application programming interface.

### CUresult cuDeviceComputeCapability (int \*major, int \*minor, CUdevice dev)

Returns the compute capability of the device.

### Parameters

#### major

- Major revision number

**minor**

- Minor revision number

**dev**

- Device handle

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

**Description**

Deprecated

This function was deprecated as of CUDA 5.0 and its functionality superceded by `cuDeviceGetAttribute()`.

Returns in `*major` and `*minor` the major and minor revision numbers that define the compute capability of the device `dev`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuDeviceGetAttribute`, `cuDeviceGetCount`, `cuDeviceGetName`, `cuDeviceGet`,  
`cuDeviceTotalMem`

## CUresult cuDeviceGetProperties (CUdevprop \*prop, CUdevice dev)

Returns properties for a selected device.

**Parameters****prop**

- Returned properties of device

**dev**

- Device to get properties for

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

## Description

### Deprecated

This function was deprecated as of CUDA 5.0 and replaced by [cuDeviceGetAttribute\(\)](#).

Returns in `*prop` the properties of device `dev`. The `CUdevprop` structure is defined as:

```
↑ typedef struct CUdevprop_st {
    int maxThreadsPerBlock;
    int maxThreadsDim[3];
    int maxGridSize[3];
    int sharedMemPerBlock;
    int totalConstantMemory;
    int SIMDWidth;
    int memPitch;
    int regsPerBlock;
    int clockRate;
    int textureAlign
} CUdevprop;
```

where:

- ▶ `maxThreadsPerBlock` is the maximum number of threads per block;
- ▶ `maxThreadsDim[3]` is the maximum sizes of each dimension of a block;
- ▶ `maxGridSize[3]` is the maximum sizes of each dimension of a grid;
- ▶ `sharedMemPerBlock` is the total amount of shared memory available per block in bytes;
- ▶ `totalConstantMemory` is the total amount of constant memory available on the device in bytes;
- ▶ `SIMDWidth` is the warp size;
- ▶ `memPitch` is the maximum pitch allowed by the memory copy functions that involve memory regions allocated through [cuMemAllocPitch\(\)](#);
- ▶ `regsPerBlock` is the total number of registers available per block;
- ▶ `clockRate` is the clock frequency in kilohertz;
- ▶ `textureAlign` is the alignment requirement; texture base addresses that are aligned to `textureAlign` bytes do not need an offset applied to texture fetches.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuDeviceGetAttribute](#), [cuDeviceGetCount](#), [cuDeviceGetName](#), [cuDeviceGet](#), [cuDeviceTotalMem](#)

## 2.6. Context Management

This section describes the context management functions of the low-level CUDA driver application programming interface.

### CUresult cuCtxCreate (CUcontext \*pctx, unsigned int flags, CUdevice dev)

Create a CUDA context.

#### Parameters

##### pctx

- Returned context handle of the new context

##### flags

- Context creation flags

##### dev

- Device to create context on

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_DEVICE, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

#### Description

Creates a new CUDA context and associates it with the calling thread. The `flags` parameter is described below. The context is created with a usage count of 1 and the caller of `cuCtxCreate()` must call `cuCtxDestroy()` or when done using the context. If a context is already current to the thread, it is supplanted by the newly created context and may be restored by a subsequent call to `cuCtxPopCurrent()`.

The three LSBs of the `flags` parameter can be used to control how the OS thread, which owns the CUDA context at the time of an API call, interacts with the OS scheduler when waiting for results from the GPU. Only one of the scheduling flags can be set when creating a context.

- ▶ **CU\_CTX\_SCHED\_AUTO**: The default value if the `flags` parameter is zero, uses a heuristic based on the number of active CUDA contexts in the process `C` and the number of logical processors in the system `P`. If  $C > P$ , then CUDA will yield to other OS threads when waiting for the GPU, otherwise CUDA will not yield while waiting for results and actively spin on the processor.

- ▶ `CU_CTX_SCHED_SPIN`: Instruct CUDA to actively spin when waiting for results from the GPU. This can decrease latency when waiting for the GPU, but may lower the performance of CPU threads if they are performing work in parallel with the CUDA thread.
  - ▶ `CU_CTX_SCHED_YIELD`: Instruct CUDA to yield its thread when waiting for results from the GPU. This can increase latency when waiting for the GPU, but can increase the performance of CPU threads performing work in parallel with the GPU.
  - ▶ `CU_CTX_SCHED_BLOCKING_SYNC`: Instruct CUDA to block the CPU thread on a synchronization primitive when waiting for the GPU to finish work.
  - ▶ `CU_CTX_BLOCKING_SYNC`: Instruct CUDA to block the CPU thread on a synchronization primitive when waiting for the GPU to finish work.
- Deprecated:** This flag was deprecated as of CUDA 4.0 and was replaced with `CU_CTX_SCHED_BLOCKING_SYNC`.
- ▶ `CU_CTX_MAP_HOST`: Instruct CUDA to support mapped pinned allocations. This flag must be set in order to allocate pinned host memory that is accessible to the GPU.
  - ▶ `CU_CTX_LMEM_RESIZE_TO_MAX`: Instruct CUDA to not reduce local memory after resizing local memory for a kernel. This can prevent thrashing by local memory allocations when launching many kernels with high local memory usage at the cost of potentially increased memory usage.

Context creation will fail with `CUDA_ERROR_UNKNOWN` if the compute mode of the device is `CU_COMPUTEMODE_PROHIBITED`. Similarly, context creation will also fail with `CUDA_ERROR_UNKNOWN` if the compute mode for the device is set to `CU_COMPUTEMODE_EXCLUSIVE` and there is already an active context on the device. The function `cuDeviceGetAttribute()` can be used with `CU_DEVICE_ATTRIBUTE_COMPUTE_MODE` to determine the compute mode of the device. The `nvidia-smi` tool can be used to set the compute mode for devices. Documentation for `nvidia-smi` can be obtained by passing a `-h` option to it.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`, `cuCtxSetLimit`, `cuCtxSynchronize`

## CUresult cuCtxDestroy (CUcontext ctx)

Destroy a CUDA context.

### Parameters

**ctx**

- Context to destroy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Destroys the CUDA context specified by `ctx`. The context `ctx` will be destroyed regardless of how many threads it is current to. It is the caller's responsibility to ensure that no API call is issued to `ctx` while `cuCtxDestroy()` is executing.

If `ctx` is current to the calling thread then `ctx` will also be popped from the current thread's context stack (as though `cuCtxPopCurrent()` were called). If `ctx` is current to other threads, then `ctx` will remain current to those threads, and attempting to access `ctx` from those threads will result in the error `CUDA_ERROR_CONTEXT_IS_DESTROYED`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuCtxCreate`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`,  
`cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`,  
`cuCtxSetLimit`, `cuCtxSynchronize`

## CUresult cuCtxGetApiVersion (CUcontext ctx, unsigned int \*version)

Gets the context's API version.

### Parameters

**ctx**

- Context to check

**version**

- Pointer to version

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_UNKNOWN

**Description**

Returns the API version used to create `ctx` in `version`. If `ctx` is NULL, returns the API version used to create the currently bound context.

This will return the API version used to create a context (for example, 3010 or 3020), which library developers can use to direct callers to a specific API version. Note that this API version may not be the same as returned by `cuDriverGetVersion`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`,  
`cuCtxPushCurrent`, `cuCtxSetCacheConfig`, `cuCtxSetLimit`, `cuCtxSynchronize`

**CUresult cuCtxGetCacheConfig (CUfunc\_cache \*pconfig)**

Returns the preferred cache configuration for the current context.

**Parameters****pconfig**

- Returned cache configuration

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

On devices where the L1 cache and shared memory use the same hardware resources, this returns through `pconfig` the preferred cache configuration for the current context. This is only a preference. The driver will use the requested configuration if possible, but it is free to choose a different configuration if required to execute functions.



This will return a `pconfig` of `CU_FUNC_CACHE_PREFER_NONE` on devices where the size of the L1 cache and shared memory are fixed.

The supported cache configurations are:

- ▶ `CU_FUNC_CACHE_PREFER_NONE`: no preference for shared memory or L1 (default)
- ▶ `CU_FUNC_CACHE_PREFER_SHARED`: prefer larger shared memory and smaller L1 cache
- ▶ `CU_FUNC_CACHE_PREFER_L1`: prefer larger L1 cache and smaller shared memory
- ▶ `CU_FUNC_CACHE_PREFER_EQUAL`: prefer equal sized L1 cache and shared memory



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`, `cuCtxSetLimit`, `cuCtxSynchronize`, `cuFuncSetCacheConfig`

## CUresult cuCtxGetCurrent (CUcontext \*pctx)

Returns the CUDA context bound to the calling CPU thread.

#### Parameters

`pctx`

- Returned context handle

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`,

#### Description

Returns in `*pctx` the CUDA context bound to the calling CPU thread. If no context is bound to the calling CPU thread then `*pctx` is set to `NULL` and `CUDA_SUCCESS` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuCtxSetCurrent](#), [cuCtxCreate](#), [cuCtxDestroy](#)

## CUresult cuCtxGetDevice (CUdevice \*device)

Returns the device ID for the current context.

**Parameters**

**device**

- Returned device ID for the current context

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#),

**Description**

Returns in \*device the ordinal of the current context's device.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuCtxCreate](#), [cuCtxDestroy](#), [cuCtxGetApiVersion](#), [cuCtxGetCacheConfig](#),  
[cuCtxGetLimit](#), [cuCtxPopCurrent](#), [cuCtxPushCurrent](#), [cuCtxSetCacheConfig](#),  
[cuCtxSetLimit](#), [cuCtxSynchronize](#)

## CUresult cuCtxGetLimit (size\_t \*pvalue, CUlimit limit)

Returns resource limits.

**Parameters**

**pvalue**

- Returned size of limit

**limit**

- Limit to query

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_VALUE,  
CUDA\_ERROR\_UNSUPPORTED\_LIMIT

**Description**

Returns in `*pvalue` the current size of `limit`. The supported `CULimit` values are:

- ▶ `CU_LIMIT_STACK_SIZE`: stack size in bytes of each GPU thread.
- ▶ `CU_LIMIT_PRINTF_FIFO_SIZE`: size in bytes of the FIFO used by the `printf()` device system call.
- ▶ `CU_LIMIT_MALLOC_HEAP_SIZE`: size in bytes of the heap used by the `malloc()` and `free()` device system calls.
- ▶ `CU_LIMIT_DEV_RUNTIME_SYNC_DEPTH`: maximum grid depth at which a thread can issue the device runtime call `cudaDeviceSynchronize()` to wait on child grid launches to complete.
- ▶ `CU_LIMIT_DEV_RUNTIME_PENDING_LAUNCH_COUNT`: maximum number of outstanding device runtime launches that can be made from this context.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`,  
`cuCtxGetDevice`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`,  
`cuCtxSetLimit`, `cuCtxSynchronize`

## CUresult cuCtxGetSharedMemConfig (CUsharedconfig \*pConfig)

Returns the current shared memory configuration for the current context.

**Parameters****pConfig**

- returned shared memory configuration

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

## Description

This function will return in `pConfig` the current size of shared memory banks in the current context. On devices with configurable shared memory banks, `cuCtxSetSharedMemConfig` can be used to change this setting, so that all subsequent kernel launches will by default use the new bank size. When `cuCtxGetSharedMemConfig` is called on devices without configurable shared memory, it will return the fixed bank size of the hardware.

The returned bank configurations can be either:

- ▶ `CU_SHARED_MEM_CONFIG_FOUR_BYTE_BANK_SIZE`: shared memory bank width is four bytes.
- ▶ `CU_SHARED_MEM_CONFIG_EIGHT_BYTE_BANK_SIZE`: shared memory bank width will eight bytes.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetLimit`, `cuCtxSynchronize`, `cuCtxGetSharedMemConfig`, `cuFuncSetCacheConfig`,

## CUresult cuCtxGetStreamPriorityRange (int \*leastPriority, int \*greatestPriority)

Returns numerical values that correspond to the least and greatest stream priorities.

### Parameters

#### **leastPriority**

- Pointer to an int in which the numerical value for least stream priority is returned

#### **greatestPriority**

- Pointer to an int in which the numerical value for greatest stream priority is returned

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_VALUE`,

### Description

Returns in `*leastPriority` and `*greatestPriority` the numerical values that correspond to the least and greatest stream priorities respectively. Stream priorities

follow a convention where lower numbers imply greater priorities. The range of meaningful stream priorities is given by [`*greatestPriority`, `*leastPriority`]. If the user attempts to create a stream with a priority value that is outside the meaningful range as specified by this API, the priority is automatically clamped down or up to either `*leastPriority` or `*greatestPriority` respectively. See [cuStreamCreateWithPriority](#) for details on creating a priority stream. A NULL may be passed in for `*leastPriority` or `*greatestPriority` if the value is not desired.

This function will return '0' in both `*leastPriority` and `*greatestPriority` if the current context's device does not support stream priorities (see [cuDeviceGetAttribute](#)).



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuStreamCreateWithPriority](#), [cuStreamGetPriority](#), [cuCtxGetDevice](#), [cuCtxSetLimit](#), [cuCtxSynchronize](#)

## CUresult cuCtxPopCurrent (CUcontext \*pctx)

Pops the current CUDA context from the current CPU thread.

#### Parameters

##### pctx

- Returned new context handle

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#)

#### Description

Pops the current CUDA context from the CPU thread and passes back the old context handle in `*pctx`. That context may then be made current to a different CPU thread by calling [cuCtxPushCurrent\(\)](#).

If a context was current to the CPU thread before [cuCtxCreate\(\)](#) or [cuCtxPushCurrent\(\)](#) was called, this function makes that context current to the CPU thread again.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuCtxCreate](#), [cuCtxDestroy](#), [cuCtxGetApiVersion](#), [cuCtxGetCacheConfig](#),  
[cuCtxGetDevice](#), [cuCtxGetLimit](#), [cuCtxPushCurrent](#), [cuCtxSetCacheConfig](#),  
[cuCtxSetLimit](#), [cuCtxSynchronize](#)

## CUresult cuCtxPushCurrent (CUcontext ctx)

Pushes a context on the current CPU thread.

**Parameters**

**ctx**

- Context to push

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

**Description**

Pushes the given context `ctx` onto the CPU thread's stack of current contexts. The specified context becomes the CPU thread's current context, so all CUDA functions that operate on the current context are affected.

The previous current context may be made current again by calling [cuCtxDestroy\(\)](#) or [cuCtxPopCurrent\(\)](#).



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuCtxCreate](#), [cuCtxDestroy](#), [cuCtxGetApiVersion](#), [cuCtxGetCacheConfig](#),  
[cuCtxGetDevice](#), [cuCtxGetLimit](#), [cuCtxPopCurrent](#), [cuCtxSetCacheConfig](#),  
[cuCtxSetLimit](#), [cuCtxSynchronize](#)

## CUresult cuCtxSetCacheConfig (CUfunc\_cache config)

Sets the preferred cache configuration for the current context.

**Parameters**

**config**

- Requested cache configuration

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

On devices where the L1 cache and shared memory use the same hardware resources, this sets through `config` the preferred cache configuration for the current context. This is only a preference. The driver will use the requested configuration if possible, but it is free to choose a different configuration if required to execute the function. Any function preference set via `cuFuncSetCacheConfig()` will be preferred over this context-wide setting. Setting the context-wide cache configuration to `CU_FUNC_CACHE_PREFER_NONE` will cause subsequent kernel launches to prefer to not change the cache configuration unless required to launch the kernel.

This setting does nothing on devices where the size of the L1 cache and shared memory are fixed.

Launching a kernel with a different preference than the most recent preference setting may insert a device-side synchronization point.

The supported cache configurations are:

- ▶ `CU_FUNC_CACHE_PREFER_NONE`: no preference for shared memory or L1 (default)
- ▶ `CU_FUNC_CACHE_PREFER_SHARED`: prefer larger shared memory and smaller L1 cache
- ▶ `CU_FUNC_CACHE_PREFER_L1`: prefer larger L1 cache and smaller shared memory
- ▶ `CU_FUNC_CACHE_PREFER_EQUAL`: prefer equal sized L1 cache and shared memory



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`,  
`cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetLimit`,  
`cuCtxSynchronize`, `cuFuncSetCacheConfig`

## CUresult cuCtxSetCurrent (CUcontext ctx)

Binds the specified CUDA context to the calling CPU thread.

### Parameters

**ctx**

- Context to bind to the calling CPU thread

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT

### Description

Binds the specified CUDA context to the calling CPU thread. If `ctx` is NULL then the CUDA context previously bound to the calling CPU thread is unbound and `CUDA_SUCCESS` is returned.

If there exists a CUDA context stack on the calling CPU thread, this will replace the top of that stack with `ctx`. If `ctx` is NULL then this will be equivalent to popping the top of the calling CPU thread's CUDA context stack (or a no-op if the calling CPU thread's CUDA context stack is empty).



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuCtxGetCurrent](#), [cuCtxCreate](#), [cuCtxDestroy](#)

## CUresult cuCtxSetLimit (CUlimit limit, size\_t value)

Set resource limits.

### Parameters

**limit**

- Limit to set

**value**

- Size of limit



## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_UNSUPPORTED_LIMIT`, `CUDA_ERROR_OUT_OF_MEMORY`

## Description

Setting `limit` to `value` is a request by the application to update the current limit maintained by the context. The driver is free to modify the requested value to meet h/w requirements (this could be clamping to minimum or maximum values, rounding up to nearest element size, etc). The application can use `cuCtxGetLimit()` to find out exactly what the limit has been set to.

Setting each `CULimit` has its own specific restrictions, so each is discussed here.

- ▶ `CU_LIMIT_STACK_SIZE` controls the stack size in bytes of each GPU thread. This limit is only applicable to devices of compute capability 2.0 and higher. Attempting to set this limit on devices of compute capability less than 2.0 will result in the error `CUDA_ERROR_UNSUPPORTED_LIMIT` being returned.
- ▶ `CU_LIMIT_PRINTF_FIFO_SIZE` controls the size in bytes of the FIFO used by the `printf()` device system call. Setting `CU_LIMIT_PRINTF_FIFO_SIZE` must be performed before launching any kernel that uses the `printf()` device system call, otherwise `CUDA_ERROR_INVALID_VALUE` will be returned. This limit is only applicable to devices of compute capability 2.0 and higher. Attempting to set this limit on devices of compute capability less than 2.0 will result in the error `CUDA_ERROR_UNSUPPORTED_LIMIT` being returned.
- ▶ `CU_LIMIT_MALLOC_HEAP_SIZE` controls the size in bytes of the heap used by the `malloc()` and `free()` device system calls. Setting `CU_LIMIT_MALLOC_HEAP_SIZE` must be performed before launching any kernel that uses the `malloc()` or `free()` device system calls, otherwise `CUDA_ERROR_INVALID_VALUE` will be returned. This limit is only applicable to devices of compute capability 2.0 and higher. Attempting to set this limit on devices of compute capability less than 2.0 will result in the error `CUDA_ERROR_UNSUPPORTED_LIMIT` being returned.
- ▶ `CU_LIMIT_DEV_RUNTIME_SYNC_DEPTH` controls the maximum nesting depth of a grid at which a thread can safely call `cudaDeviceSynchronize()`. Setting this limit must be performed before any launch of a kernel that uses the device runtime and calls `cudaDeviceSynchronize()` above the default sync depth, two levels of grids. Calls to `cudaDeviceSynchronize()` will fail with error code `cudaErrorSyncDepthExceeded` if the limitation is violated. This limit can be set smaller than the default or up the maximum launch depth of 24. When setting this limit, keep in mind that additional levels of sync depth require the driver to reserve large amounts of device memory which can no longer be used for user allocations. If these reservations of device memory fail, `cuCtxSetLimit` will return `CUDA_ERROR_OUT_OF_MEMORY`, and the limit can be reset to a lower value.

This limit is only applicable to devices of compute capability 3.5 and higher. Attempting to set this limit on devices of compute capability less than 3.5 will result in the error `CUDA_ERROR_UNSUPPORTED_LIMIT` being returned.

- ▶ `CU_LIMIT_DEV_RUNTIME_PENDING_LAUNCH_COUNT` controls the maximum number of outstanding device runtime launches that can be made from the current context. A grid is outstanding from the point of launch up until the grid is known to have been completed. Device runtime launches which violate this limitation fail and return `cudaErrorLaunchPendingCountExceeded` when `cudaGetLastError()` is called after launch. If more pending launches than the default (2048 launches) are needed for a module using the device runtime, this limit can be increased. Keep in mind that being able to sustain additional pending launches will require the driver to reserve larger amounts of device memory upfront which can no longer be used for allocations. If these reservations fail, `cuCtxSetLimit` will return `CUDA_ERROR_OUT_OF_MEMORY`, and the limit can be reset to a lower value. This limit is only applicable to devices of compute capability 3.5 and higher. Attempting to set this limit on devices of compute capability less than 3.5 will result in the error `CUDA_ERROR_UNSUPPORTED_LIMIT` being returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`, `cuCtxSynchronize`

## CUresult cuCtxSetSharedMemConfig (CUsharedconfig config)

Sets the shared memory configuration for the current context.

#### Parameters

##### config

- requested shared memory configuration

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_VALUE`

## Description

On devices with configurable shared memory banks, this function will set the context's shared memory bank size which is used for subsequent kernel launches.

Changed the shared memory configuration between launches may insert a device side synchronization point between those launches.

Changing the shared memory bank size will not increase shared memory usage or affect occupancy of kernels, but may have major effects on performance. Larger bank sizes will allow for greater potential bandwidth to shared memory, but will change what kinds of accesses to shared memory will result in bank conflicts.

This function will do nothing on devices with fixed shared memory bank size.

The supported bank configurations are:

- ▶ `CU_SHARED_MEM_CONFIG_DEFAULT_BANK_SIZE`: set bank width to the default initial setting (currently, four bytes).
- ▶ `CU_SHARED_MEM_CONFIG_FOUR_BYTE_BANK_SIZE`: set shared memory bank width to be natively four bytes.
- ▶ `CU_SHARED_MEM_CONFIG_EIGHT_BYTE_BANK_SIZE`: set shared memory bank width to be natively eight bytes.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetLimit`, `cuCtxSynchronize`, `cuCtxGetSharedMemConfig`, `cuFuncSetCacheConfig`,

## CUresult cuCtxSynchronize (void)

Block for a context's tasks to complete.

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`

## Description

Blocks until the device has completed all preceding requested tasks. `cuCtxSynchronize()` returns an error if one of the preceding tasks failed. If the context was created with the

`CU_CTX_SCHED_BLOCKING_SYNC` flag, the CPU thread will block until the GPU context has finished its work.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxCreate`, `cuCtxDestroy`, `cuCtxGetApiVersion`, `cuCtxGetCacheConfig`, `cuCtxGetDevice`, `cuCtxGetLimit`, `cuCtxPopCurrent`, `cuCtxPushCurrent`, `cuCtxSetCacheConfig`, `cuCtxSetLimit`

## 2.7. Context Management [DEPRECATED]

This section describes the deprecated context management functions of the low-level CUDA driver application programming interface.

### CUresult cuCtxAttach (CUcontext \*pctx, unsigned int flags)

Increment a context's usage-count.

#### Parameters

##### `pctx`

- Returned context handle of the current context

##### `flags`

- Context attach flags (must be 0)

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

#### Description

##### Deprecated

Note that this function is deprecated and should not be used.

Increments the usage count of the context and passes back a context handle in `*pctx` that must be passed to `cuCtxDetach()` when the application is done with the context. `cuCtxAttach()` fails if there is no context current to the thread.

Currently, the `flags` parameter must be 0.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuCtxCreate](#), [cuCtxDestroy](#), [cuCtxDetach](#), [cuCtxGetApiVersion](#), [cuCtxGetCacheConfig](#), [cuCtxGetDevice](#), [cuCtxGetLimit](#), [cuCtxPopCurrent](#), [cuCtxPushCurrent](#), [cuCtxSetCacheConfig](#), [cuCtxSetLimit](#), [cuCtxSynchronize](#)

## CUresult cuCtxDetach (CUcontext ctx)

Decrement a context's usage-count.

#### Parameters

**ctx**

- Context to destroy

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#)

#### Description

Deprecated

Note that this function is deprecated and should not be used.

Decrements the usage count of the context `ctx`, and destroys the context if the usage count goes to 0. The context must be a handle that was passed back by [cuCtxCreate\(\)](#) or [cuCtxAttach\(\)](#), and must be current to the calling thread.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuCtxCreate](#), [cuCtxDestroy](#), [cuCtxGetApiVersion](#), [cuCtxGetCacheConfig](#), [cuCtxGetDevice](#), [cuCtxGetLimit](#), [cuCtxPopCurrent](#), [cuCtxPushCurrent](#), [cuCtxSetCacheConfig](#), [cuCtxSetLimit](#), [cuCtxSynchronize](#)

## 2.8. Module Management

This section describes the module management functions of the low-level CUDA driver application programming interface.

**CUresult cuLinkAddData (CUlinkState state, CUjitInputType type, void \*data, size\_t size, const char \*name, unsigned int numOptions, CUjit\_option \*options, void \*\*optionValues)**

Add an input to a pending linker invocation.

### Parameters

#### state

A pending linker action.

#### type

The type of the input data.

#### data

The input data. PTX must be NULL-terminated.

#### size

The length of the input data.

#### name

An optional name for this input in log messages.

#### numOptions

Size of options.

#### options

Options to be applied only for this input (overrides options from `cuLinkCreate`).

#### optionValues

Array of option values, each cast to void \*.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_IMAGE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_NO\_BINARY\_FOR\_GPU

### Description

Ownership of `data` is retained by the caller. No reference is retained to any inputs after this call returns.

This method accepts only compiler options, which are used if the data must be compiled from PTX, and does not accept any of `CU_JIT_WALL_TIME`,

`CU_JIT_INFO_LOG_BUFFER`, `CU_JIT_ERROR_LOG_BUFFER`,  
`CU_JIT_TARGET_FROM_CUCONTEXT`, or `CU_JIT_TARGET`.

**See also:**

`cuLinkCreate`, `cuLinkAddFile`, `cuLinkComplete`, `cuLinkDestroy`

## **CUresult cuLinkAddFile (CUlinkState state, CUjitInputType type, const char \*path, unsigned int numOptions, CUjit\_option \*options, void \*\*optionValues)**

Add a file input to a pending linker invocation.

### **Parameters**

**state**

A pending linker action

**type**

The type of the input data

**path**

Path to the input file

**numOptions**

Size of options

**options**

Options to be applied only for this input (overrides options from `cuLinkCreate`)

**optionValues**

Array of option values, each cast to void \*

### **Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_FILE_NOT_FOUND`  
`CUDA_ERROR_INVALID_HANDLE`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_INVALID_IMAGE`, `CUDA_ERROR_OUT_OF_MEMORY`,  
`CUDA_ERROR_NO_BINARY_FOR_GPU`

### **Description**

No reference is retained to any inputs after this call returns.

This method accepts only compiler options, which are used if the input must be compiled from PTX, and does not accept any of `CU_JIT_WALL_TIME`, `CU_JIT_INFO_LOG_BUFFER`, `CU_JIT_ERROR_LOG_BUFFER`, `CU_JIT_TARGET_FROM_CUCONTEXT`, or `CU_JIT_TARGET`.

This method is equivalent to invoking `cuLinkAddData` on the contents of the file.

**See also:**

[cuLinkCreate](#), [cuLinkAddData](#), [cuLinkComplete](#), [cuLinkDestroy](#)

## CUresult cuLinkComplete (CUlinkState state, void \*\*cubinOut, size\_t \*sizeOut)

Complete a pending linker invocation.

**Parameters****state**

A pending linker invocation

**cubinOut**

On success, this will point to the output image

**sizeOut**

Optional parameter to receive the size of the generated image

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_INVALID\\_HANDLE](#),  
[CUDA\\_ERROR\\_OUT\\_OF\\_MEMORY](#)

**Description**

Completes the pending linker action and returns the cubin image for the linked device code, which can be used with [cuModuleLoadData](#). The cubin is owned by `state`, so it should be loaded before `state` is destroyed via [cuLinkDestroy](#). This call does not destroy `state`.

**See also:**

[cuLinkCreate](#), [cuLinkAddData](#), [cuLinkAddFile](#), [cuLinkDestroy](#), [cuModuleLoadData](#)

## CUresult cuLinkCreate (unsigned int numOptions, CUjit\_option \*options, void \*\*optionValues, CUlinkState \*stateOut)

Creates a pending JIT linker invocation.

**Parameters****numOptions**

Size of options arrays

**options**

Array of linker and compiler options



**optionValues**

Array of option values, each cast to void \*

**stateOut**

On success, this will contain a CUlinkState to specify and complete this action

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

**Description**

If the call is successful, the caller owns the returned CUlinkState, which should eventually be destroyed with `cuLinkDestroy`. The device code machine size (32 or 64 bit) will match the calling application.

Both linker and compiler options may be specified. Compiler options will be applied to inputs to this linker action which must be compiled from PTX. The options `CU_JIT_WALL_TIME`, `CU_JIT_INFO_LOG_BUFFER_SIZE_BYTES`, and `CU_JIT_ERROR_LOG_BUFFER_SIZE_BYTES` will accumulate data until the CUlinkState is destroyed.

`optionValues` must remain valid for the life of the CUlinkState if output options are used. No other references to inputs are maintained after this call returns.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuLinkAddData`, `cuLinkAddFile`, `cuLinkComplete`, `cuLinkDestroy`

**CUresult cuLinkDestroy (CUlinkState state)**

Destroys state for a JIT linker invocation.

**Parameters****state**

State object for the linker invocation

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_HANDLE

## Description

### See also:

[cuLinkCreate](#)

## CUresult cuModuleGetFunction (CUfunction \*hfunc, CUmodule hmod, const char \*name)

Returns a function handle.

### Parameters

#### hfunc

- Returned function handle

#### hmod

- Module to retrieve function from

#### name

- Name of function to retrieve

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND

## Description

Returns in \*hfunc the handle of the function of name name located in module hmod. If no function of that name exists, cuModuleGetFunction() returns CUDA\_ERROR\_NOT\_FOUND.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuModuleGetGlobal](#), [cuModuleGetTexRef](#), [cuModuleLoad](#), [cuModuleLoadData](#), [cuModuleLoadDataEx](#), [cuModuleLoadFatBinary](#), [cuModuleUnload](#)

## CUresult cuModuleGetGlobal (CUdeviceptr \*dptr, size\_t \*bytes, CUmodule hmod, const char \*name)

Returns a global pointer from a module.

### Parameters

**dptr**

- Returned global device pointer

**bytes**

- Returned global size in bytes

**hmod**

- Module to retrieve global from

**name**

- Name of global to retrieve

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND

### Description

Returns in `*dptr` and `*bytes` the base pointer and size of the global of name `name` located in module `hmod`. If no variable of that name exists, `cuModuleGetGlobal()` returns `CUDA_ERROR_NOT_FOUND`. Both parameters `dptr` and `bytes` are optional. If one of them is `NULL`, it is ignored.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuModuleGetFunction`, `cuModuleGetTexRef`, `cuModuleLoad`, `cuModuleLoadData`,  
`cuModuleLoadDataEx`, `cuModuleLoadFatBinary`, `cuModuleUnload`

## CUresult cuModuleGetSurfRef (CUsurfref \*pSurfRef, CUmodule hmod, const char \*name)

Returns a handle to a surface reference.

### Parameters

#### pSurfRef

- Returned surface reference

#### hmod

- Module to retrieve surface reference from

#### name

- Name of surface reference to retrieve

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND

### Description

Returns in \*pSurfRef the handle of the surface reference of name name in the module hmod. If no surface reference of that name exists, cuModuleGetSurfRef() returns CUDA\_ERROR\_NOT\_FOUND.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuModuleGetFunction, cuModuleGetGlobal, cuModuleGetTexRef, cuModuleLoad, cuModuleLoadData, cuModuleLoadDataEx, cuModuleLoadFatBinary, cuModuleUnload

## CUresult cuModuleGetTexRef (CUtexref \*pTexRef, CUmodule hmod, const char \*name)

Returns a handle to a texture reference.

### Parameters

#### pTexRef

- Returned texture reference

**hmod**

- Module to retrieve texture reference from

**name**

- Name of texture reference to retrieve

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND

**Description**

Returns in `*pTexRef` the handle of the texture reference of name `name` in the module `hmod`. If no texture reference of that name exists, `cuModuleGetTexRef()` returns `CUDA_ERROR_NOT_FOUND`. This texture reference handle should not be destroyed, since it will be destroyed when the module is unloaded.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuModuleGetFunction`, `cuModuleGetGlobal`, `cuModuleGetSurfRef`, `cuModuleLoad`,  
`cuModuleLoadData`, `cuModuleLoadDataEx`, `cuModuleLoadFatBinary`,  
`cuModuleUnload`

## CUresult cuModuleLoad (CUmodule \*module, const char \*fname)

Loads a compute module.

**Parameters****module**

- Returned module

**fname**

- Filename of module to load

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_FILE\_NOT\_FOUND,

`CUDA_ERROR_SHARED_OBJECT_SYMBOL_NOT_FOUND`,  
`CUDA_ERROR_SHARED_OBJECT_INIT_FAILED`

### Description

Takes a filename `fname` and loads the corresponding module `module` into the current context. The CUDA driver API does not attempt to lazily allocate the resources needed by a module; if the memory for functions and data (constant and global) needed by the module cannot be allocated, `cuModuleLoad()` fails. The file should be a cubin file as output by `nvcc`, or a PTX file either as output by `nvcc` or handwritten, or a fatbin file as output by `nvcc` from toolchain 4.0 or later.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuModuleGetFunction`, `cuModuleGetGlobal`, `cuModuleGetTexRef`, `cuModuleLoadData`,  
`cuModuleLoadDataEx`, `cuModuleLoadFatBinary`, `cuModuleUnload`

## CUresult cuModuleLoadData (CUmodule \*module, const void \*image)

Load a module's data.

### Parameters

#### `module`

- Returned module

#### `image`

- Module data to load

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`,  
`CUDA_ERROR_SHARED_OBJECT_SYMBOL_NOT_FOUND`,  
`CUDA_ERROR_SHARED_OBJECT_INIT_FAILED`

### Description

Takes a pointer `image` and loads the corresponding module `module` into the current context. The pointer may be obtained by mapping a cubin or PTX or fatbin file, passing a cubin or PTX or fatbin file as a NULL-terminated text string, or incorporating a cubin

or fatbin object into the executable resources and using operating system calls such as Windows `FindResource()` to obtain the pointer.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuModuleGetFunction`, `cuModuleGetGlobal`, `cuModuleGetTexRef`, `cuModuleLoad`, `cuModuleLoadDataEx`, `cuModuleLoadFatBinary`, `cuModuleUnload`

## CUresult cuModuleLoadDataEx (CUmodule \*module, const void \*image, unsigned int numOptions, CUjit\_option \*options, void \*\*optionValues)

Load a module's data with options.

#### Parameters

##### **module**

- Returned module

##### **image**

- Module data to load

##### **numOptions**

- Number of options

##### **options**

- Options for JIT

##### **optionValues**

- Option values for JIT

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`,  
`CUDA_ERROR_NO_BINARY_FOR_GPU`,  
`CUDA_ERROR_SHARED_OBJECT_SYMBOL_NOT_FOUND`,  
`CUDA_ERROR_SHARED_OBJECT_INIT_FAILED`

#### Description

Takes a pointer `image` and loads the corresponding module `module` into the current context. The pointer may be obtained by mapping a cubin or PTX or fatbin file, passing a cubin or PTX or fatbin file as a NULL-terminated text string, or incorporating a cubin

or fatbin object into the executable resources and using operating system calls such as Windows `FindResource()` to obtain the pointer. Options are passed as an array via `options` and any corresponding parameters are passed in `optionValues`. The number of total options is supplied via `numOptions`. Any outputs will be returned via `optionValues`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuModuleGetFunction](#), [cuModuleGetGlobal](#), [cuModuleGetTexRef](#), [cuModuleLoad](#), [cuModuleLoadData](#), [cuModuleLoadFatBinary](#), [cuModuleUnload](#)

## CUresult cuModuleLoadFatBinary (CUmodule \*module, const void \*fatCubin)

Load a module's data.

#### Parameters

##### **module**

- Returned module

##### **fatCubin**

- Fat binary to load

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_NOT_FOUND`,  
`CUDA_ERROR_OUT_OF_MEMORY`, `CUDA_ERROR_NO_BINARY_FOR_GPU`,  
`CUDA_ERROR_SHARED_OBJECT_SYMBOL_NOT_FOUND`,  
`CUDA_ERROR_SHARED_OBJECT_INIT_FAILED`

#### Description

Takes a pointer `fatCubin` and loads the corresponding module `module` into the current context. The pointer represents a fat binary object, which is a collection of different cubin and/or PTX files, all representing the same device code, but compiled and optimized for different architectures.

Prior to CUDA 4.0, there was no documented API for constructing and using fat binary objects by programmers. Starting with CUDA 4.0, fat binary objects can be constructed



by providing the `-fatbin` option to `nvcc`. More information can be found in the `nvcc` document.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuModuleGetFunction](#), [cuModuleGetGlobal](#), [cuModuleGetTexRef](#), [cuModuleLoad](#), [cuModuleLoadData](#), [cuModuleLoadDataEx](#), [cuModuleUnload](#)

## CUresult cuModuleUnload (CUmodule hmod)

Unloads a module.

#### Parameters

##### **hmod**

- Module to unload

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

#### Description

Unloads a module `hmod` from the current context.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuModuleGetFunction](#), [cuModuleGetGlobal](#), [cuModuleGetTexRef](#), [cuModuleLoad](#), [cuModuleLoadData](#), [cuModuleLoadDataEx](#), [cuModuleLoadFatBinary](#)

## 2.9. Memory Management

This section describes the memory management functions of the low-level CUDA driver application programming interface.

## CUresult cuArray3DCreate (CUarray \*pHandle, const CUDA\_ARRAY3D\_DESCRIPTOR \*pAllocateArray)

Creates a 3D CUDA array.

### Parameters

#### pHandle

- Returned array

#### pAllocateArray

- 3D array descriptor

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY,  
 CUDA\_ERROR\_UNKNOWN

### Description

Creates a CUDA array according to the `CUDA_ARRAY3D_DESCRIPTOR` structure `pAllocateArray` and returns a handle to the new CUDA array in `*pHandle`. The `CUDA_ARRAY3D_DESCRIPTOR` is defined as:

```
↑ typedef struct {
    unsigned int Width;
    unsigned int Height;
    unsigned int Depth;
    CUarray_format Format;
    unsigned int NumChannels;
    unsigned int Flags;
} CUDA_ARRAY3D_DESCRIPTOR;
```

where:

- ▶ Width, Height, and Depth are the width, height, and depth of the CUDA array (in elements); the following types of CUDA arrays can be allocated:
  - ▶ A 1D array is allocated if Height and Depth extents are both zero.
  - ▶ A 2D array is allocated if only Depth extent is zero.
  - ▶ A 3D array is allocated if all three extents are non-zero.
  - ▶ A 1D layered CUDA array is allocated if only Height is zero and the `CUDA_ARRAY3D_LAYERED` flag is set. Each layer is a 1D array. The number of layers is determined by the depth extent.
  - ▶ A 2D layered CUDA array is allocated if all three extents are non-zero and the `CUDA_ARRAY3D_LAYERED` flag is set. Each layer is a 2D array. The number of layers is determined by the depth extent.

- ▶ A cubemap CUDA array is allocated if all three extents are non-zero and the `CUDA_ARRAY3D_CUBEMAP` flag is set. `Width` must be equal to `Height`, and `Depth` must be six. A cubemap is a special type of 2D layered CUDA array, where the six layers represent the six faces of a cube. The order of the six layers in memory is the same as that listed in `CUarray_cubemap_face`.
- ▶ A cubemap layered CUDA array is allocated if all three extents are non-zero, and both, `CUDA_ARRAY3D_CUBEMAP` and `CUDA_ARRAY3D_LAYERED` flags are set. `Width` must be equal to `Height`, and `Depth` must be a multiple of six. A cubemap layered CUDA array is a special type of 2D layered CUDA array that consists of a collection of cubemaps. The first six layers represent the first cubemap, the next six layers form the second cubemap, and so on.
- ▶ `Format` specifies the format of the elements; `CUarray_format` is defined as:

```
typedef enum CUarray_format_enum {
    CU_AD_FORMAT_UNSIGNED_INT8 = 0x01,
    CU_AD_FORMAT_UNSIGNED_INT16 = 0x02,
    CU_AD_FORMAT_UNSIGNED_INT32 = 0x03,
    CU_AD_FORMAT_SIGNED_INT8 = 0x08,
    CU_AD_FORMAT_SIGNED_INT16 = 0x09,
    CU_AD_FORMAT_SIGNED_INT32 = 0x0a,
    CU_AD_FORMAT_HALF = 0x10,
    CU_AD_FORMAT_FLOAT = 0x20
} CUarray_format;
```

- ▶ `NumChannels` specifies the number of packed components per CUDA array element; it may be 1, 2, or 4;
- ▶ Flags may be set to
  - ▶ `CUDA_ARRAY3D_LAYERED` to enable creation of layered CUDA arrays. If this flag is set, `Depth` specifies the number of layers, not the depth of a 3D array.
  - ▶ `CUDA_ARRAY3D_SURFACE_LDST` to enable surface references to be bound to the CUDA array. If this flag is not set, `cuSurfRefSetArray` will fail when attempting to bind the CUDA array to a surface reference.
  - ▶ `CUDA_ARRAY3D_CUBEMAP` to enable creation of cubemaps. If this flag is set, `Width` must be equal to `Height`, and `Depth` must be six. If the `CUDA_ARRAY3D_LAYERED` flag is also set, then `Depth` must be a multiple of six.
  - ▶ `CUDA_ARRAY3D_TEXTURE_GATHER` to indicate that the CUDA array will be used for texture gather. Texture gather can only be performed on 2D CUDA arrays.

`Width`, `Height` and `Depth` must meet certain size requirements as listed in the following table. All values are specified in elements. Note that for brevity's sake, the full name of the device attribute is not specified. For ex., `TEXTURE1D_WIDTH` refers to the device attribute `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_WIDTH`.

Note that 2D CUDA arrays have different size requirements if the `CUDA_ARRAY3D_TEXTURE_GATHER` flag is set. `Width` and `Height` must not be

greater than `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_GATHER_WIDTH` and `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_GATHER_HEIGHT` respectively, in that case.

CUDA array type	Valid extents that must always be met {(width range in elements), (height range), (depth range)}	Valid extents with <code>CUDA_ARRAY3D_SURFACE_LDST</code> set {(width range in elements), (height range), (depth range)}
1D	{ (1,TEXTURE1D_WIDTH), 0, 0 }	{ (1,SURFACE1D_WIDTH), 0, 0 }
2D	{ (1,TEXTURE2D_WIDTH), (1,TEXTURE2D_HEIGHT), 0 }	{ (1,SURFACE2D_WIDTH), (1,SURFACE2D_HEIGHT), 0 }
3D	{ (1,TEXTURE3D_WIDTH), (1,TEXTURE3D_HEIGHT), (1,TEXTURE3D_DEPTH) } OR { (1,TEXTURE3D_WIDTH_ALTERNATE), (1,TEXTURE3D_HEIGHT_ALTERNATE), (1,TEXTURE3D_DEPTH_ALTERNATE) }	{ (1,SURFACE3D_WIDTH), (1,SURFACE3D_HEIGHT), (1,SURFACE3D_DEPTH) }
1D Layered	{ (1,TEXTURE1D_LAYERED_WIDTH), 0, (1,TEXTURE1D_LAYERED_LAYERS) }	{ (1,SURFACE1D_LAYERED_WIDTH), 0, (1,SURFACE1D_LAYERED_LAYERS) }
2D Layered	{ (1,TEXTURE2D_LAYERED_WIDTH), (1,TEXTURE2D_LAYERED_HEIGHT), (1,TEXTURE2D_LAYERED_LAYERS) }	{ (1,SURFACE2D_LAYERED_WIDTH), (1,SURFACE2D_LAYERED_HEIGHT), (1,SURFACE2D_LAYERED_LAYERS) }
Cubemap	{ (1,TEXTURECUBEMAP_WIDTH), (1,TEXTURECUBEMAP_WIDTH), 6 }	{ (1,SURFACECUBEMAP_WIDTH), (1,SURFACECUBEMAP_WIDTH), 6 }
Cubemap Layered	{ (1,TEXTURECUBEMAP_LAYERED_WIDTH), (1,TEXTURECUBEMAP_LAYERED_WIDTH), (1,TEXTURECUBEMAP_LAYERED_LAYERS) }	{ (1,SURFACECUBEMAP_LAYERED_WIDTH), (1,SURFACECUBEMAP_LAYERED_WIDTH), (1,SURFACECUBEMAP_LAYERED_LAYERS) }

Here are examples of CUDA array descriptions:

Description for a CUDA array of 2048 floats:

```
↑   CUDA_ARRAY3D_DESCRIPTOR desc;
    desc.Format = CU_AD_FORMAT_FLOAT;
    desc.NumChannels = 1;
    desc.Width = 2048;
    desc.Height = 0;
    desc.Depth = 0;
```

Description for a 64 x 64 CUDA array of floats:

```
↑   CUDA_ARRAY3D_DESCRIPTOR desc;
    desc.Format = CU_AD_FORMAT_FLOAT;
    desc.NumChannels = 1;
    desc.Width = 64;
    desc.Height = 64;
    desc.Depth = 0;
```

Description for a width x height x depth CUDA array of 64-bit, 4x16-bit float16's:

```
↑
    CUDA_ARRAY3D_DESCRIPTOR desc;
        desc.FormatFlags = CU_AD_FORMAT_HALF;
        desc.NumChannels = 4;
        desc.Width = width;
        desc.Height = height;
        desc.Depth = depth;
```



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoDAsync](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D16](#), [cuMemsetD2D32](#), [cuMemsetD8](#), [cuMemsetD16](#), [cuMemsetD32](#)

## CUresult cuArray3DGetDescriptor (CUDA\_ARRAY3D\_DESCRIPTOR \*pArrayDescriptor, CUarray hArray)

Get a 3D CUDA array descriptor.

#### Parameters

##### **pArrayDescriptor**

- Returned 3D array descriptor

##### **hArray**

- 3D array to get descriptor of

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#), [CUDA\\_ERROR\\_INVALID\\_HANDLE](#)

#### Description

Returns in \*pArrayDescriptor a descriptor containing information on the format and dimensions of the CUDA array hArray. It is useful for subroutines that have been

passed a CUDA array, but need to know the CUDA array parameters for validation or other purposes.

This function may be called on 1D and 2D arrays, in which case the `Height` and/or `Depth` members of the descriptor struct will be set to 0.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuArrayCreate (CUarray \*pHandle, const CUDA\_ARRAY\_DESCRIPTOR \*pAllocateArray)

Creates a 1D or 2D CUDA array.

#### Parameters

##### **pHandle**

- Returned array

##### **pAllocateArray**

- Array descriptor

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`, `CUDA_ERROR_UNKNOWN`

## Description

Creates a CUDA array according to the `CUDA_ARRAY_DESCRIPTOR` structure `pAllocateArray` and returns a handle to the new CUDA array in `*pHandle`. The `CUDA_ARRAY_DESCRIPTOR` is defined as:

```
↑ typedef struct {
    unsigned int Width;
    unsigned int Height;
    CUarray_format Format;
    unsigned int NumChannels;
} CUDA_ARRAY_DESCRIPTOR;
```

where:

- ▶ `Width`, and `Height` are the width, and height of the CUDA array (in elements); the CUDA array is one-dimensional if height is 0, two-dimensional otherwise;
- ▶ `Format` specifies the format of the elements; `CUarray_format` is defined as:

```
↑ typedef enum CUarray_format_enum {
    CU_AD_FORMAT_UNSIGNED_INT8 = 0x01,
    CU_AD_FORMAT_UNSIGNED_INT16 = 0x02,
    CU_AD_FORMAT_UNSIGNED_INT32 = 0x03,
    CU_AD_FORMAT_SIGNED_INT8 = 0x08,
    CU_AD_FORMAT_SIGNED_INT16 = 0x09,
    CU_AD_FORMAT_SIGNED_INT32 = 0x0a,
    CU_AD_FORMAT_HALF = 0x10,
    CU_AD_FORMAT_FLOAT = 0x20
} CUarray_format;
```

- ▶ `NumChannels` specifies the number of packed components per CUDA array element; it may be 1, 2, or 4;

Here are examples of CUDA array descriptions:

Description for a CUDA array of 2048 floats:

```
↑ CUDA_ARRAY_DESCRIPTOR desc;
    desc.Format = CU_AD_FORMAT_FLOAT;
    desc.NumChannels = 1;
    desc.Width = 2048;
    desc.Height = 1;
```

Description for a 64 x 64 CUDA array of floats:

```
↑ CUDA_ARRAY_DESCRIPTOR desc;
    desc.Format = CU_AD_FORMAT_FLOAT;
    desc.NumChannels = 1;
    desc.Width = 64;
    desc.Height = 64;
```

Description for a width x height CUDA array of 64-bit, 4x16-bit float16's:

```
↑ CUDA_ARRAY_DESCRIPTOR desc;
    desc.FormatFlags = CU_AD_FORMAT_HALF;
    desc.NumChannels = 4;
    desc.Width = width;
    desc.Height = height;
```

Description for a width x height CUDA array of 16-bit elements, each of which is two 8-bit unsigned chars:

```
↑ CUDA_ARRAY_DESCRIPTOR arrayDesc;
    desc.FormatFlags = CU_AD_FORMAT_UNSIGNED_INT8;
    desc.NumChannels = 2;
```

```
desc.Width = width;
desc.Height = height;
```



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoDAsync](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D16](#), [cuMemsetD2D32](#), [cuMemsetD8](#), [cuMemsetD16](#), [cuMemsetD32](#)

## CUresult cuArrayDestroy (CUarray hArray)

Destroys a CUDA array.

#### Parameters

##### **hArray**

- Array to destroy

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_HANDLE](#), [CUDA\\_ERROR\\_ARRAY\\_IS\\_MAPPED](#)

#### Description

Destroys the CUDA array `hArray`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#),



cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuArrayGetDescriptor (CUDA\_ARRAY\_DESCRIPTOR \*pArrayDescriptor, CUarray hArray)

Get a 1D or 2D CUDA array descriptor.

### Parameters

#### **pArrayDescriptor**

- Returned array descriptor

#### **hArray**

- Array to get descriptor of

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE

### Description

Returns in \*pArrayDescriptor a descriptor containing information on the format and dimensions of the CUDA array hArray. It is useful for subroutines that have been passed a CUDA array, but need to know the CUDA array parameters for validation or other purposes.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync,

cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuDeviceGetByPCIBusId (CUdevice \*dev, char \*pciBusId)

Returns a handle to a compute device.

### Parameters

#### dev

- Returned device handle

#### pciBusId

- String in one of the following forms: [domain]:[bus]:[device].[function] [domain]:[bus]:[device] [bus]:[device].[function] where domain, bus, device, and function are all hexadecimal values

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_DEVICE

### Description

Returns in \*device a device handle given a PCI bus ID string.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuDeviceGet, cuDeviceGetAttribute, cuDeviceGetPCIBusId

## CUresult cuDeviceGetPCIBusId (char \*pciBusId, int len, CUdevice dev)

Returns a PCI Bus Id string for the device.

### Parameters

#### pciBusId

- Returned identifier string for the device in the following format [domain]:[bus]:[device].[function] where `domain`, `bus`, `device`, and `function` are all hexadecimal values. `pciBusId` should be large enough to store 13 characters including the NULL-terminator.

#### len

- Maximum length of string to store in name

#### dev

- Device to get identifier string for

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE,  
CUDA\_ERROR\_INVALID\_DEVICE

### Description

Returns an ASCII string identifying the device `dev` in the NULL-terminated string pointed to by `pciBusId`. `len` specifies the maximum length of the string that may be returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuDeviceGet](#), [cuDeviceGetAttribute](#), [cuDeviceGetByPCIBusId](#)

## CUresult culpcCloseMemHandle (CUdeviceptr dptr)

Close memory mapped with [cuIpcOpenMemHandle](#).

### Parameters

#### dptr

- Device pointer returned by [cuIpcOpenMemHandle](#)

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_MAP\_FAILED, CUDA\_ERROR\_INVALID\_HANDLE,

**Description**

Unmaps memory returned by `cuIpcOpenMemHandle`. The original allocation in the exporting process as well as imported mappings in other processes will be unaffected.

Any resources used to enable peer access will be freed if this is the last mapping using them.

IPC functionality is restricted to devices with support for unified addressing on Linux operating systems.

**See also:**

`cuMemAlloc`, `cuMemFree`, `cuIpcGetEventHandle`, `cuIpcOpenEventHandle`,  
`cuIpcGetMemHandle`, `cuIpcOpenMemHandle`,

## CUresult `culpcGetEventHandle` (CUipcEventHandle \*pHandle, CUevent event)

Gets an interprocess handle for a previously allocated event.

**Parameters****pHandle**

- Pointer to a user allocated `CUipcEventHandle` in which to return the opaque event handle

**event**

- Event allocated with `CU_EVENT_INTERPROCESS` and `CU_EVENT_DISABLE_TIMING` flags.

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_MAP\_FAILED

**Description**

Takes as input a previously allocated event. This event must have been created with the `CU_EVENT_INTERPROCESS` and `CU_EVENT_DISABLE_TIMING` flags set. This opaque handle may be copied into other processes and opened with `cuIpcOpenEventHandle` to allow efficient hardware synchronization between GPU work in different processes.

After the event has been opened in the importing process, [cuEventRecord](#), [cuEventSynchronize](#), [cuStreamWaitEvent](#) and [cuEventQuery](#) may be used in either process. Performing operations on the imported event after the exported event has been freed with [cuEventDestroy](#) will result in undefined behavior.

IPC functionality is restricted to devices with support for unified addressing on Linux operating systems.

**See also:**

[cuEventCreate](#), [cuEventDestroy](#), [cuEventSynchronize](#), [cuEventQuery](#), [cuStreamWaitEvent](#), [cuIpcOpenEventHandle](#), [cuIpcGetMemHandle](#), [cuIpcOpenMemHandle](#), [cuIpcCloseMemHandle](#)

## CUresult cuIpcGetMemHandle (CUipcMemHandle \*pHandle, CUdeviceptr dptr)

Gets an interprocess memory handle for an existing device memory allocation.

**Parameters**

**pHandle**

- Pointer to user allocated [CUipcMemHandle](#) to return the handle in.

**dptr**

- Base pointer to previously allocated device memory

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_INVALID\\_HANDLE](#), [CUDA\\_ERROR\\_OUT\\_OF\\_MEMORY](#), [CUDA\\_ERROR\\_MAP\\_FAILED](#),

**Description**

Takes a pointer to the base of an existing device memory allocation created with [cuMemAlloc](#) and exports it for use in another process. This is a lightweight operation and may be called multiple times on an allocation without adverse effects.

If a region of memory is freed with [cuMemFree](#) and a subsequent call to [cuMemAlloc](#) returns memory with the same device address, [cuIpcGetMemHandle](#) will return a unique handle for the new memory.

IPC functionality is restricted to devices with support for unified addressing on Linux operating systems.

**See also:**

[cuMemAlloc](#), [cuMemFree](#), [cuIpcGetEventHandle](#), [cuIpcOpenEventHandle](#),  
[cuIpcOpenMemHandle](#), [cuIpcCloseMemHandle](#)

## CUresult cuIpcOpenEventHandle (CUevent \*phEvent, CUipcEventHandle handle)

Opens an interprocess event handle for use in the current process.

### Parameters

#### phEvent

- Returns the imported event

#### handle

- Interprocess handle to open

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_MAP\\_FAILED](#), [CUDA\\_ERROR\\_PEER\\_ACCESS\\_UNSUPPORTED](#),  
[CUDA\\_ERROR\\_INVALID\\_HANDLE](#)

### Description

Opens an interprocess event handle exported from another process with [cuIpcGetEventHandle](#). This function returns a [CUevent](#) that behaves like a locally created event with the [CU\\_EVENT\\_DISABLE\\_TIMING](#) flag specified. This event must be freed with [cuEventDestroy](#).

Performing operations on the imported event after the exported event has been freed with [cuEventDestroy](#) will result in undefined behavior.

IPC functionality is restricted to devices with support for unified addressing on Linux operating systems.

### See also:

[cuEventCreate](#), [cuEventDestroy](#), [cuEventSynchronize](#), [cuEventQuery](#),  
[cuStreamWaitEvent](#), [cuIpcGetEventHandle](#), [cuIpcGetMemHandle](#),  
[cuIpcOpenMemHandle](#), [cuIpcCloseMemHandle](#)

## CUresult cuIpcOpenMemHandle (CUdeviceptr \*pdptr, CUipcMemHandle handle, unsigned int Flags)

Opens an interprocess memory handle exported from another process and returns a device pointer usable in the local process.

### Parameters

#### pdptr

- Returned device pointer

#### handle

- [CUipcMemHandle](#) to open

#### Flags

- Flags for this operation. Must be specified as [CU\\_IPC\\_MEM\\_LAZY\\_ENABLE\\_PEER\\_ACCESS](#)

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_MAP\\_FAILED](#), [CUDA\\_ERROR\\_INVALID\\_HANDLE](#),  
[CUDA\\_ERROR\\_TOO\\_MANY\\_PEERS](#)

### Description

Maps memory exported from another process with [cuIpcGetMemHandle](#) into the current device address space. For contexts on different devices [cuIpcOpenMemHandle](#) can attempt to enable peer access between the devices as if the user called [cuCtxEnablePeerAccess](#). This behavior is controlled by the [CU\\_IPC\\_MEM\\_LAZY\\_ENABLE\\_PEER\\_ACCESS](#) flag. [cuDeviceCanAccessPeer](#) can determine if a mapping is possible.

Contexts that may open [CUipcMemHandles](#) are restricted in the following way. [CUipcMemHandles](#) from each [CUdevice](#) in a given process may only be opened by one [CUcontext](#) per [CUdevice](#) per other process.

Memory returned from [cuIpcOpenMemHandle](#) must be freed with [cuIpcCloseMemHandle](#).

Calling [cuMemFree](#) on an exported memory region before calling [cuIpcCloseMemHandle](#) in the importing context will result in undefined behavior.

IPC functionality is restricted to devices with support for unified addressing on Linux operating systems.



No guarantees are made about the address returned in `*pdptr`. In particular, multiple processes may not receive the same address for the same `handle`.

#### See also:

`cuMemAlloc`, `cuMemFree`, `cuIpcGetEventHandle`, `cuIpcOpenEventHandle`,  
`cuIpcGetMemHandle`, `cuIpcCloseMemHandle`, `cuCtxEnablePeerAccess`,  
`cuDeviceCanAccessPeer`,

## CUresult cuMemAlloc (CUdeviceptr \*dptr, size\_t bytesize)

Allocates device memory.

#### Parameters

##### **dptr**

- Returned device pointer

##### **bytesize**

- Requested allocation size in bytes

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`

#### Description

Allocates `bytesize` bytes of linear memory on the device and returns in `*dptr` a pointer to the allocated memory. The allocated memory is suitably aligned for any kind of variable. The memory is not cleared. If `bytesize` is 0, `cuMemAlloc()` returns `CUDA_ERROR_INVALID_VALUE`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`,  
`cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`,  
`cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,



[cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D16](#), [cuMemsetD2D32](#), [cuMemsetD8](#), [cuMemsetD16](#), [cuMemsetD32](#)

## CUresult cuMemAllocHost (void \*\*pp, size\_t bytesize)

Allocates page-locked host memory.

### Parameters

- pp**  
- Returned host pointer to page-locked memory
- bytesize**  
- Requested allocation size in bytes

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#), [CUDA\\_ERROR\\_OUT\\_OF\\_MEMORY](#)

### Description

Allocates `bytesize` bytes of host memory that is page-locked and accessible to the device. The driver tracks the virtual memory ranges allocated with this function and automatically accelerates calls to functions such as [cuMemcpy\(\)](#). Since the memory can be accessed directly by the device, it can be read or written with much higher bandwidth than pageable memory obtained with functions such as `malloc()`. Allocating excessive amounts of memory with [cuMemAllocHost\(\)](#) may degrade system performance, since it reduces the amount of memory available to the system for paging. As a result, this function is best used sparingly to allocate staging areas for data exchange between host and device.

Note all host memory allocated using [cuMemHostAlloc\(\)](#) will automatically be immediately accessible to all contexts on all devices which support unified addressing (as may be queried using [CU\\_DEVICE\\_ATTRIBUTE\\_UNIFIED\\_ADDRESSING](#)). The device pointer that may be used to access this host memory from those contexts is always equal to the returned host pointer `*pp`. See [Unified Addressing](#) for additional details.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuMemAllocPitch (CUdeviceptr \*dptr, size\_t \*pPitch, size\_t WidthInBytes, size\_t Height, unsigned int ElementSizeBytes)

Allocates pitched device memory.

### Parameters

#### **dptr**

- Returned device pointer

#### **pPitch**

- Returned pitch of allocation in bytes

#### **WidthInBytes**

- Requested allocation width in bytes

#### **Height**

- Requested allocation height in rows

#### **ElementSizeBytes**

- Size of largest reads/writes for range

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

### Description

Allocates at least `WidthInBytes * Height` bytes of linear memory on the device and returns in `*dptr` a pointer to the allocated memory. The function may pad the allocation to ensure that corresponding pointers in any given row will continue to meet the alignment requirements for coalescing as the address is updated from row to row. `ElementSizeBytes` specifies the size of the largest reads and writes that will be performed on the memory range. `ElementSizeBytes` may be 4, 8 or 16 (since coalesced memory transactions are not possible on other data sizes). If `ElementSizeBytes` is smaller than the actual read/write size of a kernel, the kernel

will run correctly, but possibly at reduced speed. The pitch returned in `*pPitch` by `cuMemAllocPitch()` is the width in bytes of the allocation. The intended usage of pitch is as a separate parameter of the allocation, used to compute addresses within the 2D array. Given the row and column of an array element of type `T`, the address is computed as:

```
↑ T* pElement = (T*)((char*)BaseAddress + Row * Pitch) + Column;
```

The pitch returned by `cuMemAllocPitch()` is guaranteed to work with `cuMemcpy2D()` under all circumstances. For allocations of 2D arrays, it is recommended that programmers consider performing pitch allocations using `cuMemAllocPitch()`. Due to alignment restrictions in the hardware, this is especially true if the application will be performing 2D memory copies between different regions of device memory (whether linear memory or CUDA arrays).

The byte alignment of the pitch returned by `cuMemAllocPitch()` is guaranteed to match or exceed the alignment requirement for texture binding with `cuTexRefSetAddress2D()`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpy (CUdeviceptr dst, CUdeviceptr src, size\_t ByteCount)

Copies memory.

### Parameters

#### **dst**

- Destination unified virtual address space pointer

#### **src**

- Source unified virtual address space pointer

#### **ByteCount**

- Size of memory copy in bytes

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies data between two pointers. `dst` and `src` are base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function infers the type of the transfer (host to host, host to device, device to device, or device to host) from the pointer values. This function is only allowed in contexts which support unified addressing. Note that this function is synchronous.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`,  
`cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`,  
`cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`,  
`cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`,  
`cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

**CUresult cuMemcpy2D (const CUDA\_MEMCPY2D \*pCopy)**

Copies memory for 2D arrays.

**Parameters****pCopy**

- Parameters for the memory copy

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Perform a 2D memory copy according to the parameters specified in `pCopy`. The `CUDA_MEMCPY2D` structure is defined as:

```
↑ typedef struct CUDA_MEMCPY2D_st {
    unsigned int srcXInBytes, srcY;
    CUmemorytype srcMemoryType;
    const void *srcHost;
    CUdeviceptr srcDevice;
    CUarray srcArray;
    unsigned int srcPitch;

    unsigned int dstXInBytes, dstY;
    CUmemorytype dstMemoryType;
    void *dstHost;
    CUdeviceptr dstDevice;
    CUarray dstArray;
    unsigned int dstPitch;

    unsigned int WidthInBytes;
    unsigned int Height;
} CUDA_MEMCPY2D;
```

where:

- ▶ `srcMemoryType` and `dstMemoryType` specify the type of memory of the source and destination, respectively; `CUmemorytype_enum` is defined as:

```
↑ typedef enum CUmemorytype_enum {
    CU_MEMORYTYPE_HOST = 0x01,
    CU_MEMORYTYPE_DEVICE = 0x02,
    CU_MEMORYTYPE_ARRAY = 0x03,
    CU_MEMORYTYPE_UNIFIED = 0x04
} CUmemorytype;
```

If `srcMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `srcDevice` and `srcPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `srcArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `srcMemoryType` is `CU_MEMORYTYPE_HOST`, `srcHost` and `srcPitch` specify the (host) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_DEVICE`, `srcDevice` and `srcPitch` specify the (device) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`, `srcArray` specifies the handle of the source data. `srcHost`, `srcDevice` and `srcPitch` are ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_HOST`, `dstHost` and `dstPitch` specify the (host) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `dstDevice` and `dstPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `dstArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `dstMemoryType` is `CU_MEMORYTYPE_DEVICE`, `dstDevice` and `dstPitch` specify the (device) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_ARRAY`, `dstArray` specifies the handle of the destination data. `dstHost`, `dstDevice` and `dstPitch` are ignored.

- ▶ `srcXInBytes` and `srcY` specify the base address of the source data for the copy.

For host pointers, the starting address is

```
↑ void* Start = (void*)((char*)srcHost+srcY*srcPitch + srcXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr Start = srcDevice+srcY*srcPitch+srcXInBytes;
```

For CUDA arrays, `srcXInBytes` must be evenly divisible by the array element size.

- ▶ `dstXInBytes` and `dstY` specify the base address of the destination data for the copy.

For host pointers, the base address is

```
↑ void* dstStart = (void*)((char*)dstHost+dstY*dstPitch + dstXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr dstStart = dstDevice+dstY*dstPitch+dstXInBytes;
```

For CUDA arrays, `dstXInBytes` must be evenly divisible by the array element size.

- ▶ `WidthInBytes` and `Height` specify the width (in bytes) and height of the 2D copy being performed.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.

`cuMemcpy2D()` returns an error if any pitch is greater than the maximum allowed (`CU_DEVICE_ATTRIBUTE_MAX_PITCH`). `cuMemAllocPitch()` passes back pitches that always work with `cuMemcpy2D()`. On intra-device memory copies (device to device, CUDA array to device, CUDA array to CUDA array), `cuMemcpy2D()` may fail for pitches not computed by `cuMemAllocPitch()`. `cuMemcpy2DUnaligned()` does not have this restriction, but may run significantly slower in the cases where `cuMemcpy2D()` would have returned an error code.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuMemcpy2DAsync (const CUDA\_MEMCPY2D \*pCopy, CUstream hStream)

Copies memory for 2D arrays.

#### Parameters

##### pCopy

- Parameters for the memory copy

##### hStream

- Stream identifier

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

#### Description

Perform a 2D memory copy according to the parameters specified in pCopy. The CUDA\_MEMCPY2D structure is defined as:

```
↑ typedef struct CUDA_MEMCPY2D_st {
    unsigned int srcXInBytes, srcY;
    CUmemorytype srcMemoryType;
    const void *srcHost;
    CUdeviceptr srcDevice;
    CUarray srcArray;
    unsigned int srcPitch;
    unsigned int dstXInBytes, dstY;
    CUmemorytype dstMemoryType;
    void *dstHost;
    CUdeviceptr dstDevice;
    CUarray dstArray;
```

```

        unsigned int dstPitch;
        unsigned int WidthInBytes;
        unsigned int Height;
    } CUDA_MEMCPY2D;

```

where:

- ▶ `srcMemoryType` and `dstMemoryType` specify the type of memory of the source and destination, respectively; `CUmemorytype_enum` is defined as:

```

typedef enum CUmemorytype_enum {
    CU_MEMORYTYPE_HOST = 0x01,
    CU_MEMORYTYPE_DEVICE = 0x02,
    CU_MEMORYTYPE_ARRAY = 0x03,
    CU_MEMORYTYPE_UNIFIED = 0x04
} CUmemorytype;

```

If `srcMemoryType` is `CU_MEMORYTYPE_HOST`, `srcHost` and `srcPitch` specify the (host) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `srcDevice` and `srcPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `srcArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `srcMemoryType` is `CU_MEMORYTYPE_DEVICE`, `srcDevice` and `srcPitch` specify the (device) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`, `srcArray` specifies the handle of the source data. `srcHost`, `srcDevice` and `srcPitch` are ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `dstDevice` and `dstPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `dstArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `dstMemoryType` is `CU_MEMORYTYPE_HOST`, `dstHost` and `dstPitch` specify the (host) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_DEVICE`, `dstDevice` and `dstPitch` specify the (device) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_ARRAY`, `dstArray` specifies the handle of the destination data. `dstHost`, `dstDevice` and `dstPitch` are ignored.

- ▶ `srcXInBytes` and `srcY` specify the base address of the source data for the copy.



For host pointers, the starting address is

```
↑ void* Start = (void*)((char*)srcHost+srcY*srcPitch + srcXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr Start = srcDevice+srcY*srcPitch+srcXInBytes;
```

For CUDA arrays, `srcXInBytes` must be evenly divisible by the array element size.

- ▶ `dstXInBytes` and `dstY` specify the base address of the destination data for the copy.

For host pointers, the base address is

```
↑ void* dstStart = (void*)((char*)dstHost+dstY*dstPitch + dstXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr dstStart = dstDevice+dstY*dstPitch+dstXInBytes;
```

For CUDA arrays, `dstXInBytes` must be evenly divisible by the array element size.

- ▶ `WidthInBytes` and `Height` specify the width (in bytes) and height of the 2D copy being performed.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.
- ▶ If specified, `srcHeight` must be greater than or equal to `Height + srcY`, and `dstHeight` must be greater than or equal to `Height + dstY`.

`cuMemcpy2D()` returns an error if any pitch is greater than the maximum allowed (`CU_DEVICE_ATTRIBUTE_MAX_PITCH`). `cuMemAllocPitch()` passes back pitches that always work with `cuMemcpy2D()`. On intra-device memory copies (device to device, CUDA array to device, CUDA array to CUDA array), `cuMemcpy2D()` may fail for pitches not computed by `cuMemAllocPitch()`. `cuMemcpy2DUnaligned()` does not have this restriction, but may run significantly slower in the cases where `cuMemcpy2D()` would have returned an error code.

`cuMemcpy2DAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument. It only works on page-locked host memory and returns an error if a pointer to pageable memory is passed as input.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#),

cuMemcpy2D, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemcpy2DUnaligned (const CUDA\_MEMCPY2D \*pCopy)

Copies memory for 2D arrays.

### Parameters

#### pCopy

- Parameters for the memory copy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Perform a 2D memory copy according to the parameters specified in pCopy. The CUDA\_MEMCPY2D structure is defined as:

```
↑ typedef struct CUDA_MEMCPY2D_st {
    unsigned int srcXInBytes, srcY;
    CUmemorytype srcMemoryType;
    const void *srcHost;
    CUdeviceptr srcDevice;
    CUarray srcArray;
    unsigned int srcPitch;
    unsigned int dstXInBytes, dstY;
    CUmemorytype dstMemoryType;
    void *dstHost;
    CUdeviceptr dstDevice;
    CUarray dstArray;
    unsigned int dstPitch;
    unsigned int WidthInBytes;
    unsigned int Height;
} CUDA_MEMCPY2D;
```

where:

- ▶ `srcMemoryType` and `dstMemoryType` specify the type of memory of the source and destination, respectively; `CUmemorytype_enum` is defined as:

```
↑ typedef enum CUmemorytype_enum {
    CU_MEMORYTYPE_HOST = 0x01,
    CU_MEMORYTYPE_DEVICE = 0x02,
    CU_MEMORYTYPE_ARRAY = 0x03,
    CU_MEMORYTYPE_UNIFIED = 0x04
} CUmemorytype;
```

If `srcMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `srcDevice` and `srcPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `srcArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `srcMemoryType` is `CU_MEMORYTYPE_HOST`, `srcHost` and `srcPitch` specify the (host) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_DEVICE`, `srcDevice` and `srcPitch` specify the (device) base address of the source data and the bytes per row to apply. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`, `srcArray` specifies the handle of the source data. `srcHost`, `srcDevice` and `srcPitch` are ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `dstDevice` and `dstPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `dstArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `dstMemoryType` is `CU_MEMORYTYPE_HOST`, `dstHost` and `dstPitch` specify the (host) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_DEVICE`, `dstDevice` and `dstPitch` specify the (device) base address of the destination data and the bytes per row to apply. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_ARRAY`, `dstArray` specifies the handle of the destination data. `dstHost`, `dstDevice` and `dstPitch` are ignored.

- ▶ `srcXInBytes` and `srcY` specify the base address of the source data for the copy.

For host pointers, the starting address is

```
↑ void* Start = (void*)((char*)srcHost+srcY*srcPitch + srcXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr Start = srcDevice+srcY*srcPitch+srcXInBytes;
```

For CUDA arrays, `srcXInBytes` must be evenly divisible by the array element size.

- ▶ `dstXInBytes` and `dstY` specify the base address of the destination data for the copy.

For host pointers, the base address is

```
↑ void* dstStart = (void*)((char*)dstHost+dstY*dstPitch + dstXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr dstStart = dstDevice+dstY*dstPitch+dstXInBytes;
```

For CUDA arrays, `dstXInBytes` must be evenly divisible by the array element size.

- ▶ `WidthInBytes` and `Height` specify the width (in bytes) and height of the 2D copy being performed.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.

`cuMemcpy2D()` returns an error if any pitch is greater than the maximum allowed (`CU_DEVICE_ATTRIBUTE_MAX_PITCH`). `cuMemAllocPitch()` passes back pitches that always work with `cuMemcpy2D()`. On intra-device memory copies (device to device, CUDA array to device, CUDA array to CUDA array), `cuMemcpy2D()` may fail for pitches not computed by `cuMemAllocPitch()`. `cuMemcpy2DUnaligned()` does not have this restriction, but may run significantly slower in the cases where `cuMemcpy2D()` would have returned an error code.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy3D`, `cuMemcpy3DAsync`,  
`cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpy3D (const CUDA\_MEMCPY3D \*pCopy)

Copies memory for 3D arrays.

### Parameters

#### pCopy

- Parameters for the memory copy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

### Description

Perform a 3D memory copy according to the parameters specified in pCopy. The `CUDA_MEMCPY3D` structure is defined as:

```

typedef struct CUDA_MEMCPY3D_st {
    unsigned int srcXInBytes, srcY, srcZ;
    unsigned int srcLOD;
    CUmemorytype srcMemoryType;
    const void *srcHost;
    CUdeviceptr srcDevice;
    CUarray srcArray;
    unsigned int srcPitch; // ignored when src is array
    unsigned int srcHeight; // ignored when src is array; may
    be 0 if Depth==1

    unsigned int dstXInBytes, dstY, dstZ;
    unsigned int dstLOD;
    CUmemorytype dstMemoryType;
    void *dstHost;
    CUdeviceptr dstDevice;
    CUarray dstArray;
    unsigned int dstPitch; // ignored when dst is array
    unsigned int dstHeight; // ignored when dst is array; may
    be 0 if Depth==1

    unsigned int WidthInBytes;
    unsigned int Height;
    unsigned int Depth;
} CUDA_MEMCPY3D;
  
```

where:

- ▶ `srcMemoryType` and `dstMemoryType` specify the type of memory of the source and destination, respectively; `CUmemorytype_enum` is defined as:

```

typedef enum CUmemorytype_enum {
    CU_MEMORYTYPE_HOST = 0x01,
    CU_MEMORYTYPE_DEVICE = 0x02,
    CU_MEMORYTYPE_ARRAY = 0x03,
    CU_MEMORYTYPE_UNIFIED = 0x04
} CUmemorytype;
  
```

If `srcMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `srcDevice` and `srcPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `srcArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `srcMemoryType` is `CU_MEMORYTYPE_HOST`, `srcHost`, `srcPitch` and `srcHeight` specify the (host) base address of the source data, the bytes per row, and the height of each 2D slice of the 3D array. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_DEVICE`, `srcDevice`, `srcPitch` and `srcHeight` specify the (device) base address of the source data, the bytes per row, and the height of each 2D slice of the 3D array. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`, `srcArray` specifies the handle of the source data. `srcHost`, `srcDevice`, `srcPitch` and `srcHeight` are ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `dstDevice` and `dstPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `dstArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `dstMemoryType` is `CU_MEMORYTYPE_HOST`, `dstHost` and `dstPitch` specify the (host) base address of the destination data, the bytes per row, and the height of each 2D slice of the 3D array. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_DEVICE`, `dstDevice` and `dstPitch` specify the (device) base address of the destination data, the bytes per row, and the height of each 2D slice of the 3D array. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_ARRAY`, `dstArray` specifies the handle of the destination data. `dstHost`, `dstDevice`, `dstPitch` and `dstHeight` are ignored.

- ▶ `srcXInBytes`, `srcY` and `srcZ` specify the base address of the source data for the copy.

For host pointers, the starting address is

```
↑ void* Start = (void*)((char*)srcHost+(srcZ*srcHeight+srcY)*srcPitch +
srcXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr Start = srcDevice+(srcZ*srcHeight+srcY)*srcPitch+srcXInBytes;
```

For CUDA arrays, `srcXInBytes` must be evenly divisible by the array element size.

- ▶ `dstXInBytes`, `dstY` and `dstZ` specify the base address of the destination data for the copy.

For host pointers, the base address is

```
↑ void* dstStart = (void*)((char*)dstHost+(dstZ*dstHeight+dstY)*dstPitch +
dstXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr dstStart = dstDevice+(dstZ*dstHeight+dstY)*dstPitch+dstXInBytes;
```

For CUDA arrays, `dstXInBytes` must be evenly divisible by the array element size.

- ▶ `WidthInBytes`, `Height` and `Depth` specify the width (in bytes), height and depth of the 3D copy being performed.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.
- ▶ If specified, `srcHeight` must be greater than or equal to `Height + srcY`, and `dstHeight` must be greater than or equal to `Height + dstY`.

`cuMemcpy3D()` returns an error if any pitch is greater than the maximum allowed (`CU_DEVICE_ATTRIBUTE_MAX_PITCH`).

The `srcLOD` and `dstLOD` members of the `CUDA_MEMCPY3D` structure must be set to 0.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpy3DAsync (const CUDA\_MEMCPY3D \*pCopy, CUstream hStream)

Copies memory for 3D arrays.

### Parameters

#### pCopy

- Parameters for the memory copy

#### hStream

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Perform a 3D memory copy according to the parameters specified in pCopy. The CUDA\_MEMCPY3D structure is defined as:

```
↑ typedef struct CUDA_MEMCPY3D_st {
    unsigned int srcXInBytes, srcY, srcZ;
    unsigned int srcLOD;
    CUmemorytype srcMemoryType;
    const void *srcHost;
    CUdeviceptr srcDevice;
    CUarray srcArray;
    unsigned int srcPitch; // ignored when src is array
    unsigned int srcHeight; // ignored when src is array; may
    be 0 if Depth==1

    unsigned int dstXInBytes, dstY, dstZ;
    unsigned int dstLOD;
    CUmemorytype dstMemoryType;
    void *dstHost;
    CUdeviceptr dstDevice;
    CUarray dstArray;
    unsigned int dstPitch; // ignored when dst is array
    unsigned int dstHeight; // ignored when dst is array; may
    be 0 if Depth==1

    unsigned int WidthInBytes;
    unsigned int Height;
    unsigned int Depth;
} CUDA_MEMCPY3D;
```

where:

- ▶ srcMemoryType and dstMemoryType specify the type of memory of the source and destination, respectively; CUmemorytype\_enum is defined as:

```
↑ typedef enum CUmemorytype_enum {
    CU_MEMORYTYPE_HOST = 0x01,
```



```

    CU_MEMORYTYPE_DEVICE = 0x02,
    CU_MEMORYTYPE_ARRAY = 0x03,
    CU_MEMORYTYPE_UNIFIED = 0x04
} CUmemorytype;

```

If `srcMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `srcDevice` and `srcPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `srcArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `srcMemoryType` is `CU_MEMORYTYPE_HOST`, `srcHost`, `srcPitch` and `srcHeight` specify the (host) base address of the source data, the bytes per row, and the height of each 2D slice of the 3D array. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_DEVICE`, `srcDevice`, `srcPitch` and `srcHeight` specify the (device) base address of the source data, the bytes per row, and the height of each 2D slice of the 3D array. `srcArray` is ignored.

If `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`, `srcArray` specifies the handle of the source data. `srcHost`, `srcDevice`, `srcPitch` and `srcHeight` are ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_UNIFIED`, `dstDevice` and `dstPitch` specify the (unified virtual address space) base address of the source data and the bytes per row to apply. `dstArray` is ignored. This value may be used only if unified addressing is supported in the calling context.

If `dstMemoryType` is `CU_MEMORYTYPE_HOST`, `dstHost` and `dstPitch` specify the (host) base address of the destination data, the bytes per row, and the height of each 2D slice of the 3D array. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_DEVICE`, `dstDevice` and `dstPitch` specify the (device) base address of the destination data, the bytes per row, and the height of each 2D slice of the 3D array. `dstArray` is ignored.

If `dstMemoryType` is `CU_MEMORYTYPE_ARRAY`, `dstArray` specifies the handle of the destination data. `dstHost`, `dstDevice`, `dstPitch` and `dstHeight` are ignored.

- ▶ `srcXInBytes`, `srcY` and `srcZ` specify the base address of the source data for the copy.

For host pointers, the starting address is

```

↑ void* Start = (void*)((char*)srcHost+(srcZ*srcHeight+srcY)*srcPitch +
srcXInBytes);

```

For device pointers, the starting address is

```

↑ CUdeviceptr Start = srcDevice+(srcZ*srcHeight+srcY)*srcPitch+srcXInBytes;

```

For CUDA arrays, `srcXInBytes` must be evenly divisible by the array element size.

- ▶ `dstXInBytes`, `dstY` and `dstZ` specify the base address of the destination data for the copy.

For host pointers, the base address is

```
↑ void* dstStart = (void*)((char*)dstHost+(dstZ*dstHeight+dstY)*dstPitch +
dstXInBytes);
```

For device pointers, the starting address is

```
↑ CUdeviceptr dstStart = dstDevice+(dstZ*dstHeight+dstY)*dstPitch+dstXInBytes;
```

For CUDA arrays, `dstXInBytes` must be evenly divisible by the array element size.

- ▶ `WidthInBytes`, `Height` and `Depth` specify the width (in bytes), height and depth of the 3D copy being performed.
- ▶ If specified, `srcPitch` must be greater than or equal to `WidthInBytes + srcXInBytes`, and `dstPitch` must be greater than or equal to `WidthInBytes + dstXInBytes`.
- ▶ If specified, `srcHeight` must be greater than or equal to `Height + srcY`, and `dstHeight` must be greater than or equal to `Height + dstY`.

`cuMemcpy3D()` returns an error if any pitch is greater than the maximum allowed (`CU_DEVICE_ATTRIBUTE_MAX_PITCH`).

`cuMemcpy3DAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument. It only works on page-locked host memory and returns an error if a pointer to pageable memory is passed as input.

The `srcLOD` and `dstLOD` members of the `CUDA_MEMCPY3D` structure must be set to 0.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpy3DPeer (const CUDA\_MEMCPY3D\_PEER \*pCopy)

Copies memory between contexts.

### Parameters

#### pCopy

- Parameters for the memory copy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Perform a 3D memory copy according to the parameters specified in pCopy. See the definition of the CUDA\_MEMCPY3D\_PEER structure for documentation of its parameters.

Note that this function is synchronous with respect to the host only if the source or destination memory is of type CU\_MEMORYTYPE\_HOST. Note also that this copy is serialized with respect all pending and future asynchronous work in to the current context, the copy's source context, and the copy's destination context (use cuMemcpy3DPeerAsync to avoid this synchronization).



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuMemcpyDtoD, cuMemcpyPeer, cuMemcpyDtoDAsync, cuMemcpyPeerAsync, cuMemcpy3DPeerAsync

## CUresult cuMemcpy3DPeerAsync (const CUDA\_MEMCPY3D\_PEER \*pCopy, CUstream hStream)

Copies memory between contexts asynchronously.

### Parameters

#### pCopy

- Parameters for the memory copy

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Perform a 3D memory copy according to the parameters specified in `pCopy`. See the definition of the `CUDA_MEMCPY3D_PEER` structure for documentation of its parameters.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuMemcpyDtoD`, `cuMemcpyPeer`, `cuMemcpyDtoDAsync`, `cuMemcpyPeerAsync`,  
`cuMemcpy3DPeerAsync`

## CUresult cuMemcpyAsync (CUdeviceptr dst, CUdeviceptr src, size\_t ByteCount, CUstream hStream)

Copies memory asynchronously.

**Parameters****dst**

- Destination unified virtual address space pointer

**src**

- Source unified virtual address space pointer

**ByteCount**

- Size of memory copy in bytes

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Copies data between two pointers. `dst` and `src` are base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function infers the type of the transfer (host to host, host to device, device to device, or device to host) from the pointer values. This function is only allowed in contexts which support unified addressing. Note that this function is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpyAtoA (CUarray dstArray, size\_t dstOffset, CUarray srcArray, size\_t srcOffset, size\_t ByteCount)

Copies memory from Array to Array.

### Parameters

#### **dstArray**

- Destination array

#### **dstOffset**

- Offset in bytes of destination array

#### **srcArray**

- Source array

#### **srcOffset**

- Offset in bytes of source array

**ByteCount**

- Size of memory copy in bytes

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies from one 1D CUDA array to another. `dstArray` and `srcArray` specify the handles of the destination and source CUDA arrays for the copy, respectively. `dstOffset` and `srcOffset` specify the destination and source offsets in bytes into the CUDA arrays. `ByteCount` is the number of bytes to be copied. The size of the elements in the CUDA arrays need not be the same format, but the elements must be the same size; and count must be evenly divisible by that size.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyAtoD (CUdeviceptr dstDevice, CUarray srcArray, size\_t srcOffset, size\_t ByteCount)

Copies memory from Array to Device.

**Parameters****dstDevice**

- Destination device pointer

**srcArray**

- Source array

**srcOffset**

- Offset in bytes of source array

**ByteCount**

- Size of memory copy in bytes

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies from one 1D CUDA array to device memory. `dstDevice` specifies the base pointer of the destination and must be naturally aligned with the CUDA array elements. `srcArray` and `srcOffset` specify the CUDA array handle and the offset in bytes into the array where the copy is to begin. `ByteCount` specifies the number of bytes to copy and must be evenly divisible by the array element size.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyAtoH (void \*dstHost, CUarray srcArray, size\_t srcOffset, size\_t ByteCount)

Copies memory from Array to Host.

**Parameters****dstHost**

- Destination device pointer

**srcArray**

- Source array

**srcOffset**

- Offset in bytes of source array

**ByteCount**

- Size of memory copy in bytes

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies from one 1D CUDA array to host memory. `dstHost` specifies the base pointer of the destination. `srcArray` and `srcOffset` specify the CUDA array handle and starting offset in bytes of the source data. `ByteCount` specifies the number of bytes to copy.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoHAsync`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyAtoHAsync (void \*dstHost, CUarray srcArray, size\_t srcOffset, size\_t ByteCount, CUstream hStream)

Copies memory from Array to Host.

**Parameters****dstHost**

- Destination pointer



**srcArray**

- Source array

**srcOffset**

- Offset in bytes of source array

**ByteCount**

- Size of memory copy in bytes

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies from one 1D CUDA array to host memory. `dstHost` specifies the base pointer of the destination. `srcArray` and `srcOffset` specify the CUDA array handle and starting offset in bytes of the source data. `ByteCount` specifies the number of bytes to copy.

`cuMemcpyAtoHAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `stream` argument. It only works on page-locked host memory and returns an error if a pointer to pageable memory is passed as input.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`,  
`cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`,  
`cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpyDtoA (CUarray dstArray, size\_t dstOffset, CUdeviceptr srcDevice, size\_t ByteCount)

Copies memory from Device to Array.

### Parameters

#### **dstArray**

- Destination array

#### **dstOffset**

- Offset in bytes of destination array

#### **srcDevice**

- Source device pointer

#### **ByteCount**

- Size of memory copy in bytes

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from device memory to a 1D CUDA array. `dstArray` and `dstOffset` specify the CUDA array handle and starting index of the destination data. `srcDevice` specifies the base pointer of the source. `ByteCount` specifies the number of bytes to copy.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyDtoD (CUdeviceptr dstDevice, CUdeviceptr srcDevice, size\_t ByteCount)

Copies memory from Device to Device.

### Parameters

#### dstDevice

- Destination device pointer

#### srcDevice

- Source device pointer

#### ByteCount

- Size of memory copy in bytes

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from device memory to device memory. `dstDevice` and `srcDevice` are the base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function is asynchronous.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#),  
[cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#),  
[cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#),  
[cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#),  
[cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#),  
[cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#),  
[cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#),  
[cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D16](#),  
[cuMemsetD2D32](#), [cuMemsetD8](#), [cuMemsetD16](#), [cuMemsetD32](#)

## CUresult cuMemcpyDtoDAsync (CUdeviceptr dstDevice, CUdeviceptr srcDevice, size\_t ByteCount, CUstream hStream)

Copies memory from Device to Device.

### Parameters

#### dstDevice

- Destination device pointer

#### srcDevice

- Source device pointer

#### ByteCount

- Size of memory copy in bytes

#### hStream

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from device memory to device memory. `dstDevice` and `srcDevice` are the base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#),  
[cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#),  
[cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#),  
[cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#),  
[cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoH](#),  
[cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#),  
[cuMemcpyHtoDAsync](#), [cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#),  
[cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#),

`cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`,  
`cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`,  
`cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpyDtoH (void \*dstHost, CUdeviceptr srcDevice, size\_t ByteCount)

Copies memory from Device to Host.

### Parameters

#### dstHost

- Destination host pointer

#### srcDevice

- Source device pointer

#### ByteCount

- Size of memory copy in bytes

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Copies from device to host memory. `dstHost` and `srcDevice` specify the base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function is synchronous.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`,  
`cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyDtoHAsync (void \*dstHost, CUdeviceptr srcDevice, size\_t ByteCount, CUstream hStream)

Copies memory from Device to Host.

### Parameters

#### dstHost

- Destination host pointer

#### srcDevice

- Source device pointer

#### ByteCount

- Size of memory copy in bytes

#### hStream

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from device to host memory. `dstHost` and `srcDevice` specify the base pointers of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy.

`cuMemcpyDtoHAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument. It only works on page-locked memory and returns an error if a pointer to pageable memory is passed as input.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`,

cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemcpyHtoA (CUarray dstArray, size\_t dstOffset, const void \*srcHost, size\_t ByteCount)

Copies memory from Host to Array.

### Parameters

#### dstArray

- Destination array

#### dstOffset

- Offset in bytes of destination array

#### srcHost

- Source host pointer

#### ByteCount

- Size of memory copy in bytes

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from host memory to a 1D CUDA array. `dstArray` and `dstOffset` specify the CUDA array handle and starting offset in bytes of the destination data. `pSrc` specifies the base address of the source. `ByteCount` specifies the number of bytes to copy.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync,

`cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemcpyHtoAAsync (CUarray dstArray, size\_t dstOffset, const void \*srcHost, size\_t ByteCount, CUstream hStream)

Copies memory from Host to Array.

### Parameters

#### dstArray

- Destination array

#### dstOffset

- Offset in bytes of destination array

#### srcHost

- Source host pointer

#### ByteCount

- Size of memory copy in bytes

#### hStream

- Stream identifier

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_VALUE`

### Description

Copies from host memory to a 1D CUDA array. `dstArray` and `dstOffset` specify the CUDA array handle and starting offset in bytes of the destination data. `srcHost` specifies the base address of the source. `ByteCount` specifies the number of bytes to copy.

`cuMemcpyHtoAAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument. It only works on page-locked memory and returns an error if a pointer to pageable memory is passed as input.



Note that this function may also return error codes from previous, asynchronous launches.



**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`,  
`cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoD`,  
`cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`,  
`cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`,  
`cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`,  
`cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`,  
`cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpyHtoD (CUdeviceptr dstDevice, const void \*srcHost, size\_t ByteCount)

Copies memory from Host to Device.

**Parameters****dstDevice**

- Destination device pointer

**srcHost**

- Source host pointer

**ByteCount**

- Size of memory copy in bytes

**Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

**Description**

Copies from host memory to device memory. `dstDevice` and `srcHost` are the base addresses of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy. Note that this function is synchronous.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuMemcpyHtoDAsync (CUdeviceptr dstDevice, const void \*srcHost, size\_t ByteCount, CUstream hStream)

Copies memory from Host to Device.

### Parameters

#### dstDevice

- Destination device pointer

#### srcHost

- Source host pointer

#### ByteCount

- Size of memory copy in bytes

#### hStream

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Copies from host memory to device memory. `dstDevice` and `srcHost` are the base addresses of the destination and source, respectively. `ByteCount` specifies the number of bytes to copy.

`cuMemcpyHtoDAsync()` is asynchronous and can optionally be associated to a stream by passing a non-zero `hStream` argument. It only works on page-locked memory and returns an error if a pointer to pageable memory is passed as input.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`, `cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD2D32Async`, `cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`, `cuMemsetD32Async`

## CUresult cuMemcpyPeer (CUdeviceptr dstDevice, CUcontext dstContext, CUdeviceptr srcDevice, CUcontext srcContext, size\_t ByteCount)

Copies device memory between two contexts.

#### Parameters

##### **dstDevice**

- Destination device pointer

##### **dstContext**

- Destination context

##### **srcDevice**

- Source device pointer

##### **srcContext**

- Source context

##### **ByteCount**

- Size of memory copy in bytes

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_VALUE`

## Description

Copies from device memory in one context to device memory in another context. `dstDevice` is the base device pointer of the destination memory and `dstContext` is the destination context. `srcDevice` is the base device pointer of the source memory and `srcContext` is the source pointer. `ByteCount` specifies the number of bytes to copy.

Note that this function is asynchronous with respect to the host, but serialized with respect all pending and future asynchronous work in to the current context, `srcContext`, and `dstContext` (use `cuMemcpyPeerAsync` to avoid this synchronization).



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuMemcpyDtoD`, `cuMemcpy3DPeer`, `cuMemcpyDtoDAsync`, `cuMemcpyPeerAsync`, `cuMemcpy3DPeerAsync`

## `CUresult cuMemcpyPeerAsync (CUdeviceptr dstDevice, CUcontext dstContext, CUdeviceptr srcDevice, CUcontext srcContext, size_t ByteCount, CUstream hStream)`

Copies device memory between two contexts asynchronously.

### Parameters

#### **dstDevice**

- Destination device pointer

#### **dstContext**

- Destination context

#### **srcDevice**

- Source device pointer

#### **srcContext**

- Source context

#### **ByteCount**

- Size of memory copy in bytes

#### **hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Copies from device memory in one context to device memory in another context. `dstDevice` is the base device pointer of the destination memory and `dstContext` is the destination context. `srcDevice` is the base device pointer of the source memory and `srcContext` is the source pointer. `ByteCount` specifies the number of bytes to copy. Note that this function is asynchronous with respect to the host and all work in other streams in other devices.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuMemcpyDtoD`, `cuMemcpyPeer`, `cuMemcpy3DPeer`, `cuMemcpyDtoDAsync`,  
`cuMemcpy3DPeerAsync`

## CUresult cuMemFree (CUdeviceptr dptr)

Frees device memory.

**Parameters****dptr**

- Pointer to memory to free

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Frees the memory space pointed to by `dptr`, which must have been returned by a previous call to `cuMemAlloc()` or `cuMemAllocPitch()`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoDAsync](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D16](#), [cuMemsetD2D32](#), [cuMemsetD8](#), [cuMemsetD16](#), [cuMemsetD32](#)

## CUresult cuMemFreeHost (void \*p)

Frees page-locked host memory.

#### Parameters

**p**

- Pointer to memory to free

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

#### Description

Frees the memory space pointed to by *p*, which must have been returned by a previous call to [cuMemAllocHost\(\)](#).



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoDAsync](#),

cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD8, cuMemsetD16, cuMemsetD32

## CUresult cuMemGetAddressRange (CUdeviceptr \*pbase, size\_t \*psize, CUdeviceptr dptr)

Get information on memory allocations.

### Parameters

#### pbase

- Returned base address

#### psize

- Returned size of device memory allocation

#### dptr

- Device pointer to query

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Returns the base address in *pbase* and size in *psize* of the allocation by `cuMemAlloc()` or `cuMemAllocPitch()` that contains the input pointer *dptr*. Both parameters *pbase* and *psize* are optional. If one of them is NULL, it is ignored.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetInfo,

`cuMemHostAlloc`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`,  
`cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemGetInfo (size\_t \*free, size\_t \*total)

Gets free and total memory.

### Parameters

#### **free**

- Returned free memory in bytes

#### **total**

- Returned total memory in bytes

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Returns in `*free` and `*total` respectively, the free and total amount of memory available for allocation by the CUDA context, in bytes.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`,  
`cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`,  
`cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`,  
`cuMemGetAddressRange`, `cuMemHostAlloc`, `cuMemHostGetDevicePointer`,  
`cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`,  
`cuMemsetD32`



## CUresult cuMemHostAlloc (void \*\*pp, size\_t bytesize, unsigned int Flags)

Allocates page-locked host memory.

### Parameters

#### pp

- Returned host pointer to page-locked memory

#### bytesize

- Requested allocation size in bytes

#### Flags

- Flags for allocation request

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

### Description

Allocates `bytesize` bytes of host memory that is page-locked and accessible to the device. The driver tracks the virtual memory ranges allocated with this function and automatically accelerates calls to functions such as `cuMemcpyHtoD()`. Since the memory can be accessed directly by the device, it can be read or written with much higher bandwidth than pageable memory obtained with functions such as `malloc()`. Allocating excessive amounts of pinned memory may degrade system performance, since it reduces the amount of memory available to the system for paging. As a result, this function is best used sparingly to allocate staging areas for data exchange between host and device.

The `Flags` parameter enables different options to be specified that affect the allocation, as follows.

- ▶ **CU\_MEMHOSTALLOC\_PORTABLE**: The memory returned by this call will be considered as pinned memory by all CUDA contexts, not just the one that performed the allocation.
- ▶ **CU\_MEMHOSTALLOC\_DEVICEMAP**: Maps the allocation into the CUDA address space. The device pointer to the memory may be obtained by calling `cuMemHostGetDevicePointer()`. This feature is available only on GPUs with compute capability greater than or equal to 1.1.
- ▶ **CU\_MEMHOSTALLOC\_WRITECOMBINED**: Allocates the memory as write-combined (WC). WC memory can be transferred across the PCI Express bus more quickly on some system configurations, but cannot be read efficiently by most CPUs.

WC memory is a good option for buffers that will be written by the CPU and read by the GPU via mapped pinned memory or host->device transfers.

All of these flags are orthogonal to one another: a developer may allocate memory that is portable, mapped and/or write-combined with no restrictions.

The CUDA context must have been created with the `CU_CTX_MAP_HOST` flag in order for the `CU_MEMHOSTALLOC_MAPPED` flag to have any effect.

The `CU_MEMHOSTALLOC_MAPPED` flag may be specified on CUDA contexts for devices that do not support mapped pinned memory. The failure is deferred to `cuMemHostGetDevicePointer()` because the memory may be mapped into other CUDA contexts via the `CU_MEMHOSTALLOC_PORTABLE` flag.

The memory allocated by this function must be freed with `cuMemFreeHost()`.

Note all host memory allocated using `cuMemHostAlloc()` will automatically be immediately accessible to all contexts on all devices which support unified addressing (as may be queried using `CU_DEVICE_ATTRIBUTE_UNIFIED_ADDRESSING`). Unless the flag `CU_MEMHOSTALLOC_WRITECOMBINED` is specified, the device pointer that may be used to access this host memory from those contexts is always equal to the returned host pointer `*pp`. If the flag `CU_MEMHOSTALLOC_WRITECOMBINED` is specified, then the function `cuMemHostGetDevicePointer()` must be used to query the device pointer, even if the context supports unified addressing. See [Unified Addressing](#) for additional details.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`, `cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`, `cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemHostGetDevicePointer (CUdeviceptr \*pdptr, void \*p, unsigned int Flags)

Passes back device pointer of mapped pinned memory.

### Parameters

#### pdptr

- Returned device pointer

#### p

- Host pointer

#### Flags

- Options (must be 0)

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Passes back the device pointer `pdptr` corresponding to the mapped, pinned host buffer `p` allocated by `cuMemHostAlloc`.

`cuMemHostGetDevicePointer()` will fail if the `CU_MEMALLOCHOST_DEVICEMAP` flag was not specified at the time the memory was allocated, or if the function is called on a GPU that does not support mapped pinned memory.

`Flags` provides for future releases. For now, it must be set to 0.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`, `cuMemcpy3D`,  
`cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`, `cuMemcpyAtoH`,  
`cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`, `cuMemcpyDtoDAsync`,  
`cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`, `cuMemcpyHtoAAsync`,  
`cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`, `cuMemFreeHost`,  
`cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`, `cuMemsetD2D8`,  
`cuMemsetD2D16`, `cuMemsetD2D32`, `cuMemsetD8`, `cuMemsetD16`, `cuMemsetD32`

## CUresult cuMemHostGetFlags (unsigned int \*pFlags, void \*p)

Passes back flags that were used for a pinned allocation.

### Parameters

#### pFlags

- Returned flags word

#### p

- Host pointer

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Passes back the flags `pFlags` that were specified when allocating the pinned host buffer `p` allocated by `cuMemHostAlloc`.

`cuMemHostGetFlags()` will fail if the pointer does not reside in an allocation performed by `cuMemAllocHost()` or `cuMemHostAlloc()`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuMemAllocHost`, `cuMemHostAlloc`

## CUresult cuMemHostRegister (void \*p, size\_t bytesize, unsigned int Flags)

Registers an existing host memory range for use by CUDA.

### Parameters

#### p

- Host pointer to memory to page-lock

#### bytesize

- Size in bytes of the address range to page-lock

**Flags**

- Flags for allocation request

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

**Description**

Page-locks the memory range specified by `p` and `bytesize` and maps it for the device(s) as specified by `Flags`. This memory range also is added to the same tracking mechanism as `cuMemHostAlloc` to automatically accelerate calls to functions such as `cuMemcpyHtoD()`. Since the memory can be accessed directly by the device, it can be read or written with much higher bandwidth than pageable memory that has not been registered. Page-locking excessive amounts of memory may degrade system performance, since it reduces the amount of memory available to the system for paging. As a result, this function is best used sparingly to register staging areas for data exchange between host and device.

This function has limited support on Mac OS X. OS 10.7 or higher is required.

The `Flags` parameter enables different options to be specified that affect the allocation, as follows.

- ▶ **CU\_MEMHOSTREGISTER\_PORTABLE**: The memory returned by this call will be considered as pinned memory by all CUDA contexts, not just the one that performed the allocation.
- ▶ **CU\_MEMHOSTREGISTER\_DEVICEMAP**: Maps the allocation into the CUDA address space. The device pointer to the memory may be obtained by calling `cuMemHostGetDevicePointer()`. This feature is available only on GPUs with compute capability greater than or equal to 1.1.

All of these flags are orthogonal to one another: a developer may page-lock memory that is portable or mapped with no restrictions.

The CUDA context must have been created with the **CU\_CTX\_MAP\_HOST** flag in order for the **CU\_MEMHOSTREGISTER\_DEVICEMAP** flag to have any effect.

The **CU\_MEMHOSTREGISTER\_DEVICEMAP** flag may be specified on CUDA contexts for devices that do not support mapped pinned memory. The failure is deferred to `cuMemHostGetDevicePointer()` because the memory may be mapped into other CUDA contexts via the **CU\_MEMHOSTREGISTER\_PORTABLE** flag.

The memory page-locked by this function must be unregistered with `cuMemHostUnregister()`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuMemHostUnregister](#), [cuMemHostGetFlags](#), [cuMemHostGetDevicePointer](#)

## CUresult cuMemHostUnregister (void \*p)

Unregisters a memory range that was registered with [cuMemHostRegister](#).

**Parameters**

**p**

- Host pointer to memory to unregister

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

**Description**

Unmaps the memory range whose base address is specified by *p*, and makes it pageable again.

The base address must be the same one specified to [cuMemHostRegister\(\)](#).



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuMemHostRegister](#)

## CUresult cuMemsetD16 (CUdeviceptr dstDevice, unsigned short us, size\_t N)

Initializes device memory.

**Parameters**

**dstDevice**

- Destination device pointer

**us**

- Value to set

**N**

- Number of elements

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Sets the memory range of N 16-bit values to the specified value us. The dstDevice pointer must be two byte aligned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy,  
 cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch,  
 cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned,  
 cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD,  
 cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD,  
 cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA,  
 cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree,  
 cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc,  
 cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async,  
 cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async,  
 cuMemsetD8, cuMemsetD8Async, cuMemsetD16Async, cuMemsetD32,  
 cuMemsetD32Async

## CUresult cuMemsetD16Async (CUdeviceptr dstDevice, unsigned short us, size\_t N, CUstream hStream)

Sets device memory.

**Parameters****dstDevice**

- Destination device pointer

**us**

- Value to set

**N**

- Number of elements

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Sets the memory range of *N* 16-bit values to the specified value *us*. The *dstDevice* pointer must be two byte aligned.

`cuMemsetD16Async()` is asynchronous and can optionally be associated to a stream by passing a non-zero `stream` argument.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`,  
`cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`,  
`cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`,  
`cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`,  
`cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`,  
`cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`,  
`cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`,  
`cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD2D32Async`,  
`cuMemsetD8`, `cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD32`, `cuMemsetD32Async`



## CUresult cuMemsetD2D16 (CUdeviceptr dstDevice, size\_t dstPitch, unsigned short us, size\_t Width, size\_t Height)

Initializes device memory.

### Parameters

#### dstDevice

- Destination device pointer

#### dstPitch

- Pitch of destination device pointer

#### us

- Value to set

#### Width

- Width of row

#### Height

- Number of rows

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Sets the 2D memory range of `Width` 16-bit values to the specified value `us`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. The `dstDevice` pointer and `dstPitch` offset must be two byte aligned. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`,  
`cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`,  
`cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`,

cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemsetD2D16Async (CUdeviceptr dstDevice, size\_t dstPitch, unsigned short us, size\_t Width, size\_t Height, CUstream hStream)

Sets device memory.

### Parameters

#### dstDevice

- Destination device pointer

#### dstPitch

- Pitch of destination device pointer

#### us

- Value to set

#### Width

- Width of row

#### Height

- Number of rows

#### hStream

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

### Description

Sets the 2D memory range of `Width` 16-bit values to the specified value `us`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. The `dstDevice` pointer and `dstPitch` offset must be two byte aligned. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.

`cuMemsetD2D16Async()` is asynchronous and can optionally be associated to a stream by passing a non-zero `stream` argument.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemsetD2D32 (CUdeviceptr dstDevice, size\_t dstPitch, unsigned int ui, size\_t Width, size\_t Height)

Initializes device memory.

#### Parameters

##### dstDevice

- Destination device pointer

##### dstPitch

- Pitch of destination device pointer

##### ui

- Value to set

##### Width

- Width of row

##### Height

- Number of rows

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

## Description

Sets the 2D memory range of `Width` 32-bit values to the specified value `ui`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. The `dstDevice` pointer and `dstPitch` offset must be four byte aligned. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`,  
`cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`,  
`cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`,  
`cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`,  
`cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`,  
`cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`,  
`cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`,  
`cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32Async`, `cuMemsetD8`,  
`cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`,  
`cuMemsetD32Async`

## CUresult cuMemsetD2D32Async (CUdeviceptr dstDevice, size\_t dstPitch, unsigned int ui, size\_t Width, size\_t Height, CUstream hStream)

Sets device memory.

### Parameters

#### **dstDevice**

- Destination device pointer

#### **dstPitch**

- Pitch of destination device pointer

#### **ui**

- Value to set

#### **Width**

- Width of row

**Height**

- Number of rows

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Sets the 2D memory range of `width` 32-bit values to the specified value `ui`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. The `dstDevice` pointer and `dstPitch` offset must be four byte aligned. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.

`cuMemsetD2D32Async()` is asynchronous and can optionally be associated to a stream by passing a non-zero `stream` argument.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`,  
`cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`,  
`cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`,  
`cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`,  
`cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`,  
`cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`,  
`cuMemHostGetDevicePointer`, `cuMemsetD2D8`, `cuMemsetD2D8Async`,  
`cuMemsetD2D16`, `cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD8`,  
`cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`,  
`cuMemsetD32Async`

## CUresult cuMemsetD2D8 (CUdeviceptr dstDevice, size\_t dstPitch, unsigned char uc, size\_t Width, size\_t Height)

Initializes device memory.

### Parameters

#### dstDevice

- Destination device pointer

#### dstPitch

- Pitch of destination device pointer

#### uc

- Value to set

#### Width

- Width of row

#### Height

- Number of rows

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

### Description

Sets the 2D memory range of `Width` 8-bit values to the specified value `uc`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuArray3DCreate`, `cuArray3DGetDescriptor`, `cuArrayCreate`, `cuArrayDestroy`,  
`cuArrayGetDescriptor`, `cuMemAlloc`, `cuMemAllocHost`, `cuMemAllocPitch`,  
`cuMemcpy2D`, `cuMemcpy2DAsync`, `cuMemcpy2DUnaligned`,  
`cuMemcpy3D`, `cuMemcpy3DAsync`, `cuMemcpyAtoA`, `cuMemcpyAtoD`,  
`cuMemcpyAtoH`, `cuMemcpyAtoHAsync`, `cuMemcpyDtoA`, `cuMemcpyDtoD`,  
`cuMemcpyDtoDAsync`, `cuMemcpyDtoH`, `cuMemcpyDtoHAsync`, `cuMemcpyHtoA`,  
`cuMemcpyHtoAAsync`, `cuMemcpyHtoD`, `cuMemcpyHtoDAsync`, `cuMemFree`,  
`cuMemFreeHost`, `cuMemGetAddressRange`, `cuMemGetInfo`, `cuMemHostAlloc`,

`cuMemHostGetDevicePointer`, `cuMemsetD2D8Async`, `cuMemsetD2D16`,  
`cuMemsetD2D16Async`, `cuMemsetD2D32`, `cuMemsetD2D32Async`, `cuMemsetD8`,  
`cuMemsetD8Async`, `cuMemsetD16`, `cuMemsetD16Async`, `cuMemsetD32`,  
`cuMemsetD32Async`

## **CUresult cuMemsetD2D8Async (CUdeviceptr dstDevice, size\_t dstPitch, unsigned char uc, size\_t Width, size\_t Height, CUstream hStream)**

Sets device memory.

### **Parameters**

#### **dstDevice**

- Destination device pointer

#### **dstPitch**

- Pitch of destination device pointer

#### **uc**

- Value to set

#### **Width**

- Width of row

#### **Height**

- Number of rows

#### **hStream**

- Stream identifier

### **Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### **Description**

Sets the 2D memory range of `Width` 8-bit values to the specified value `uc`. `Height` specifies the number of rows to set, and `dstPitch` specifies the number of bytes between each row. This function performs fastest when the pitch is one that has been passed back by `cuMemAllocPitch()`.

`cuMemsetD2D8Async()` is asynchronous and can optionally be associated to a stream by passing a non-zero `stream` argument.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemsetD32 (CUdeviceptr dstDevice, unsigned int ui, size\_t N)

Initializes device memory.

**Parameters****dstDevice**

- Destination device pointer

**ui**

- Value to set

**N**

- Number of elements

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

**Description**

Sets the memory range of N 32-bit values to the specified value ui. The dstDevice pointer must be four byte aligned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**



[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#),  
[cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#),  
[cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#),  
[cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#),  
[cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#),  
[cuMemcpyDtoDAsync](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#),  
[cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFree](#),  
[cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#),  
[cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D8Async](#),  
[cuMemsetD2D16](#), [cuMemsetD2D16Async](#), [cuMemsetD2D32](#), [cuMemsetD2D32Async](#),  
[cuMemsetD8](#), [cuMemsetD8Async](#), [cuMemsetD16](#), [cuMemsetD16Async](#),  
[cuMemsetD32Async](#)

## CUresult cuMemsetD32Async (CUdeviceptr dstDevice, unsigned int ui, size\_t N, CUstream hStream)

Sets device memory.

### Parameters

#### dstDevice

- Destination device pointer

#### ui

- Value to set

#### N

- Number of elements

#### hStream

- Stream identifier

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

### Description

Sets the memory range of N 32-bit values to the specified value ui. The dstDevice pointer must be four byte aligned.

[cuMemsetD32Async\(\)](#) is asynchronous and can optionally be associated to a stream by passing a non-zero stream argument.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuArray3DCreate](#), [cuArray3DGetDescriptor](#), [cuArrayCreate](#), [cuArrayDestroy](#), [cuArrayGetDescriptor](#), [cuMemAlloc](#), [cuMemAllocHost](#), [cuMemAllocPitch](#), [cuMemcpy2D](#), [cuMemcpy2DAsync](#), [cuMemcpy2DUnaligned](#), [cuMemcpy3D](#), [cuMemcpy3DAsync](#), [cuMemcpyAtoA](#), [cuMemcpyAtoD](#), [cuMemcpyAtoH](#), [cuMemcpyAtoHAsync](#), [cuMemcpyDtoA](#), [cuMemcpyDtoD](#), [cuMemcpyDtoDAsync](#), [cuMemcpyDtoH](#), [cuMemcpyDtoHAsync](#), [cuMemcpyHtoA](#), [cuMemcpyHtoAAsync](#), [cuMemcpyHtoD](#), [cuMemcpyHtoDAsync](#), [cuMemFree](#), [cuMemFreeHost](#), [cuMemGetAddressRange](#), [cuMemGetInfo](#), [cuMemHostAlloc](#), [cuMemHostGetDevicePointer](#), [cuMemsetD2D8](#), [cuMemsetD2D8Async](#), [cuMemsetD2D16](#), [cuMemsetD2D16Async](#), [cuMemsetD2D32](#), [cuMemsetD2D32Async](#), [cuMemsetD8](#), [cuMemsetD8Async](#), [cuMemsetD16](#), [cuMemsetD16Async](#), [cuMemsetD32](#)

## CUresult cuMemsetD8 (CUdeviceptr dstDevice, unsigned char uc, size\_t N)

Initializes device memory.

#### Parameters

##### dstDevice

- Destination device pointer

##### uc

- Value to set

##### N

- Number of elements

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#), [CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#), [CUDA\\_ERROR\\_INVALID\\_VALUE](#)

#### Description

Sets the memory range of N 8-bit values to the specified value uc.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8Async, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMemsetD8Async (CUdeviceptr dstDevice, unsigned char uc, size\_t N, CUstream hStream)

Sets device memory.

**Parameters****dstDevice**

- Destination device pointer

**uc**

- Value to set

**N**

- Number of elements

**hStream**

- Stream identifier

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE

**Description**

Sets the memory range of N 8-bit values to the specified value uc.

cuMemsetD8Async() is asynchronous and can optionally be associated to a stream by passing a non-zero stream argument.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

cuArray3DCreate, cuArray3DGetDescriptor, cuArrayCreate, cuArrayDestroy, cuArrayGetDescriptor, cuMemAlloc, cuMemAllocHost, cuMemAllocPitch, cuMemcpy2D, cuMemcpy2DAsync, cuMemcpy2DUnaligned, cuMemcpy3D, cuMemcpy3DAsync, cuMemcpyAtoA, cuMemcpyAtoD, cuMemcpyAtoH, cuMemcpyAtoHAsync, cuMemcpyDtoA, cuMemcpyDtoD, cuMemcpyDtoDAsync, cuMemcpyDtoH, cuMemcpyDtoHAsync, cuMemcpyHtoA, cuMemcpyHtoAAsync, cuMemcpyHtoD, cuMemcpyHtoDAsync, cuMemFree, cuMemFreeHost, cuMemGetAddressRange, cuMemGetInfo, cuMemHostAlloc, cuMemHostGetDevicePointer, cuMemsetD2D8, cuMemsetD2D8Async, cuMemsetD2D16, cuMemsetD2D16Async, cuMemsetD2D32, cuMemsetD2D32Async, cuMemsetD8, cuMemsetD16, cuMemsetD16Async, cuMemsetD32, cuMemsetD32Async

## CUresult cuMipmappedArrayCreate (CUmipmappedArray \*pHandle, const CUDA\_ARRAY3D\_DESCRIPTOR \*pMipmappedArrayDesc, unsigned int numMipmapLevels)

Creates a CUDA mipmapped array.

#### Parameters

##### pHandle

- Returned mipmapped array

##### pMipmappedArrayDesc

- mipmapped array descriptor

##### numMipmapLevels

- Number of mipmap levels

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

#### Description

Creates a CUDA mipmapped array according to the `CUDA_ARRAY3D_DESCRIPTOR` structure `pMipmappedArrayDesc` and returns a handle to the new CUDA mipmapped array in `*pHandle`. `numMipmapLevels` specifies the number of mipmap levels to

be allocated. This value is clamped to the range  $[1, 1 + \text{floor}(\log_2(\max(\text{width}, \text{height}, \text{depth})))]$ .

The `CUDA_ARRAY3D_DESCRIPTOR` is defined as:

```
typedef struct {
    unsigned int Width;
    unsigned int Height;
    unsigned int Depth;
    CUarray_format Format;
    unsigned int NumChannels;
    unsigned int Flags;
} CUDA_ARRAY3D_DESCRIPTOR;
```

where:

- ▶ Width, Height, and Depth are the width, height, and depth of the CUDA array (in elements); the following types of CUDA arrays can be allocated:
  - ▶ A 1D mipmapped array is allocated if Height and Depth extents are both zero.
  - ▶ A 2D mipmapped array is allocated if only Depth extent is zero.
  - ▶ A 3D mipmapped array is allocated if all three extents are non-zero.
  - ▶ A 1D layered CUDA mipmapped array is allocated if only Height is zero and the `CUDA_ARRAY3D_LAYERED` flag is set. Each layer is a 1D array. The number of layers is determined by the depth extent.
  - ▶ A 2D layered CUDA mipmapped array is allocated if all three extents are non-zero and the `CUDA_ARRAY3D_LAYERED` flag is set. Each layer is a 2D array. The number of layers is determined by the depth extent.
  - ▶ A cubemap CUDA mipmapped array is allocated if all three extents are non-zero and the `CUDA_ARRAY3D_CUBEMAP` flag is set. Width must be equal to Height, and Depth must be six. A cubemap is a special type of 2D layered CUDA array, where the six layers represent the six faces of a cube. The order of the six layers in memory is the same as that listed in `CUarray_cubemap_face`.
  - ▶ A cubemap layered CUDA mipmapped array is allocated if all three extents are non-zero, and both, `CUDA_ARRAY3D_CUBEMAP` and `CUDA_ARRAY3D_LAYERED` flags are set. Width must be equal to Height, and Depth must be a multiple of six. A cubemap layered CUDA array is a special type of 2D layered CUDA array that consists of a collection of cubemaps. The first six layers represent the first cubemap, the next six layers form the second cubemap, and so on.
- ▶ Format specifies the format of the elements; `CUarray_format` is defined as:

```
typedef enum CUarray_format_enum {
    CU_AD_FORMAT_UNSIGNED_INT8 = 0x01,
    CU_AD_FORMAT_UNSIGNED_INT16 = 0x02,
    CU_AD_FORMAT_UNSIGNED_INT32 = 0x03,
    CU_AD_FORMAT_SIGNED_INT8 = 0x08,
    CU_AD_FORMAT_SIGNED_INT16 = 0x09,
    CU_AD_FORMAT_SIGNED_INT32 = 0x0a,
    CU_AD_FORMAT_HALF = 0x10,
    CU_AD_FORMAT_FLOAT = 0x20
} CUarray_format;
```

- ▶ NumChannels specifies the number of packed components per CUDA array element; it may be 1, 2, or 4;
- ▶ Flags may be set to
  - ▶ `CUDA_ARRAY3D_LAYERED` to enable creation of layered CUDA mipmapped arrays. If this flag is set, Depth specifies the number of layers, not the depth of a 3D array.
  - ▶ `CUDA_ARRAY3D_SURFACE_LDST` to enable surface references to be bound to individual mipmap levels of the CUDA mipmapped array. If this flag is not set, `cuSurfRefSetArray` will fail when attempting to bind a mipmap level of the CUDA mipmapped array to a surface reference.
  - ▶ `CUDA_ARRAY3D_CUBEMAP` to enable creation of mipmapped cubemaps. If this flag is set, Width must be equal to Height, and Depth must be six. If the `CUDA_ARRAY3D_LAYERED` flag is also set, then Depth must be a multiple of six.
  - ▶ `CUDA_ARRAY3D_TEXTURE_GATHER` to indicate that the CUDA mipmapped array will be used for texture gather. Texture gather can only be performed on 2D CUDA mipmapped arrays.

Width, Height and Depth must meet certain size requirements as listed in the following table. All values are specified in elements. Note that for brevity's sake, the full name of the device attribute is not specified. For ex., `TEXTURE1D_MIPMAPPED_WIDTH` refers to the device attribute `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_MIPMAPPED_WIDTH`.

CUDA array type	Valid extents that must always be met{(width range in elements), (height range), (depth range)}
1D	{ (1,TEXTURE1D_MIPMAPPED_WIDTH), 0, 0 }
2D	{ (1,TEXTURE2D_MIPMAPPED_WIDTH), (1,TEXTURE2D_MIPMAPPED_HEIGHT), 0 }
3D	{ (1,TEXTURE3D_WIDTH), (1,TEXTURE3D_HEIGHT), (1,TEXTURE3D_DEPTH) } OR { (1,TEXTURE3D_WIDTH_ALTERNATE), (1,TEXTURE3D_HEIGHT_ALTERNATE), (1,TEXTURE3D_DEPTH_ALTERNATE) }
1D Layered	{ (1,TEXTURE1D_LAYERED_WIDTH), 0, (1,TEXTURE1D_LAYERED_LAYERS) }
2D Layered	{ (1,TEXTURE2D_LAYERED_WIDTH), (1,TEXTURE2D_LAYERED_HEIGHT), (1,TEXTURE2D_LAYERED_LAYERS) }

CUDA array type	Valid extents that must always be met{(width range in elements), (height range), (depth range)}
Cubemap	{ (1,TEXTURECUBEMAP_WIDTH), (1,TEXTURECUBEMAP_WIDTH), 6 }
Cubemap Layered	{ (1,TEXTURECUBEMAP_LAYERED_WIDTH), (1,TEXTURECUBEMAP_LAYERED_WIDTH), (1,TEXTURECUBEMAP_LAYERED_LAYERS) }



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuMipmappedArrayDestroy](#), [cuMipmappedArrayGetLevel](#), [cuArrayCreate](#),

## CUresult cuMipmappedArrayDestroy (CUmipmappedArray hMipmappedArray)

Destroys a CUDA mipmapped array.

#### Parameters

##### **hMipmappedArray**

- Mipmapped array to destroy

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ARRAY\_IS\_MAPPED

#### Description

Destroys the CUDA mipmapped array hMipmappedArray.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuMipmappedArrayCreate](#), [cuMipmappedArrayGetLevel](#), [cuArrayCreate](#),

## CUresult cuMipmappedArrayGetLevel (CUarray \*pLevelArray, CUmipmappedArray hMipmappedArray, unsigned int level)

Gets a mipmap level of a CUDA mipmapped array.

### Parameters

#### pLevelArray

- Returned mipmap level CUDA array

#### hMipmappedArray

- CUDA mipmapped array

#### level

- Mipmap level

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE

### Description

Returns in \*pLevelArray a CUDA array that represents a single mipmap level of the CUDA mipmapped array hMipmappedArray.

If level is greater than the maximum number of levels in this mipmapped array, CUDA\_ERROR\_INVALID\_VALUE is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuMipmappedArrayCreate, cuMipmappedArrayDestroy, cuArrayCreate,

## 2.10. Unified Addressing

This section describes the unified addressing functions of the low-level CUDA driver application programming interface.

### Overview



CUDA devices can share a unified address space with the host. For these devices there is no distinction between a device pointer and a host pointer -- the same pointer value may be used to access memory from the host program and from a kernel running on the device (with exceptions enumerated below).

### Supported Platforms

Whether or not a device supports unified addressing may be queried by calling `cuDeviceGetAttribute()` with the device attribute `CU_DEVICE_ATTRIBUTE_UNIFIED_ADDRESSING`.

Unified addressing is automatically enabled in 64-bit processes on devices with compute capability greater than or equal to 2.0.

### Looking Up Information from Pointer Values

It is possible to look up information about the memory which backs a pointer value. For instance, one may want to know if a pointer points to host or device memory. As another example, in the case of device memory, one may want to know on which CUDA device the memory resides. These properties may be queried using the function `cuPointerGetAttribute()`

Because pointers are unique, it is not necessary to specify information about the pointers specified to the various copy functions in the CUDA API. The function `cuMemcpy()` may be used to perform a copy between two pointers, ignoring whether they point to host or device memory (making `cuMemcpyHtoD()`, `cuMemcpyDtoD()`, and `cuMemcpyDtoH()` unnecessary for devices supporting unified addressing). For multidimensional copies, the memory type `CU_MEMORYTYPE_UNIFIED` may be used to specify that the CUDA driver should infer the location of the pointer from its value.

### Automatic Mapping of Host Allocated Host Memory

All host memory allocated in all contexts using `cuMemAllocHost()` and `cuMemHostAlloc()` is always directly accessible from all contexts on all devices that support unified addressing. This is the case regardless of whether or not the flags `CU_MEMHOSTALLOC_PORTABLE` and `CU_MEMHOSTALLOC_DEVICEMAP` are specified.

The pointer value through which allocated host memory may be accessed in kernels on all devices that support unified addressing is the same as the pointer value through which that memory is accessed on the host, so it is not necessary to call `cuMemHostGetDevicePointer()` to get the device pointer for these allocations.

Note that this is not the case for memory allocated using the flag `CU_MEMHOSTALLOC_WRITECOMBINED`, as discussed below.

### Automatic Registration of Peer Memory

Upon enabling direct access from a context that supports unified addressing to another peer context that supports unified addressing using `cuCtxEnablePeerAccess()` all

memory allocated in the peer context using `cuMemAlloc()` and `cuMemAllocPitch()` will immediately be accessible by the current context. The device pointer value through which any peer memory may be accessed in the current context is the same pointer value through which that memory may be accessed in the peer context.

### Exceptions, Disjoint Addressing

Not all memory may be accessed on devices through the same pointer value through which they are accessed on the host. These exceptions are host memory registered using `cuMemHostRegister()` and host memory allocated using the flag `CU_MEMHOSTALLOC_WRITECOMBINED`. For these exceptions, there exists a distinct host and device address for the memory. The device address is guaranteed to not overlap any valid host pointer range and is guaranteed to have the same value across all contexts that support unified addressing.

This device address may be queried using `cuMemHostGetDevicePointer()` when a context using unified addressing is current. Either the host or the unified device pointer value may be used to refer to this memory through `cuMemcpy()` and similar functions using the `CU_MEMORYTYPE_UNIFIED` memory type.

## CUresult cuPointerGetAttribute (void \*data, CUpointer\_attribute attribute, CUdeviceptr ptr)

Returns information about a pointer.

### Parameters

#### data

- Returned pointer attribute value

#### attribute

- Pointer attribute to query

#### ptr

- Pointer

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_DEVICE`

### Description

The supported attributes are:

- ▶ `CU_POINTER_ATTRIBUTE_CONTEXT`:

Returns in `*data` the `CUcontext` in which `ptr` was allocated or registered. The type of `data` must be `CUcontext *`.

If `ptr` was not allocated by, mapped by, or registered with a `CUcontext` which uses unified virtual addressing then `CUDA_ERROR_INVALID_VALUE` is returned.

► `CU_POINTER_ATTRIBUTE_MEMORY_TYPE`:

Returns in `*data` the physical memory type of the memory that `ptr` addresses as a `CUmemorytype` enumerated value. The type of `data` must be unsigned int.

If `ptr` addresses device memory then `*data` is set to `CU_MEMORYTYPE_DEVICE`. The particular `CUdevice` on which the memory resides is the `CUdevice` of the `CUcontext` returned by the `CU_POINTER_ATTRIBUTE_CONTEXT` attribute of `ptr`.

If `ptr` addresses host memory then `*data` is set to `CU_MEMORYTYPE_HOST`.

If `ptr` was not allocated by, mapped by, or registered with a `CUcontext` which uses unified virtual addressing then `CUDA_ERROR_INVALID_VALUE` is returned.

If the current `CUcontext` does not support unified virtual addressing then `CUDA_ERROR_INVALID_CONTEXT` is returned.

► `CU_POINTER_ATTRIBUTE_DEVICE_POINTER`:

Returns in `*data` the device pointer value through which `ptr` may be accessed by kernels running in the current `CUcontext`. The type of `data` must be `CUdeviceptr *`.

If there exists no device pointer value through which kernels running in the current `CUcontext` may access `ptr` then `CUDA_ERROR_INVALID_VALUE` is returned.

If there is no current `CUcontext` then `CUDA_ERROR_INVALID_CONTEXT` is returned.

Except in the exceptional disjoint addressing cases discussed below, the value returned in `*data` will equal the input value `ptr`.

► `CU_POINTER_ATTRIBUTE_HOST_POINTER`:

Returns in `*data` the host pointer value through which `ptr` may be accessed by the host program. The type of `data` must be `void **`. If there exists no host pointer value through which the host program may directly access `ptr` then `CUDA_ERROR_INVALID_VALUE` is returned.

Except in the exceptional disjoint addressing cases discussed below, the value returned in `*data` will equal the input value `ptr`.

► `CU_POINTER_ATTRIBUTE_P2P_TOKENS`:

Returns in `*data` two tokens for use with the `nv-p2p.h` Linux kernel interface. `data` must be a struct of type `CUDA_POINTER_ATTRIBUTE_P2P_TOKENS`.

`ptr` must be a pointer to memory obtained from `:cuMemAlloc()`. Note that `p2pToken` and `vaSpaceToken` are only valid for the lifetime of the source allocation. A subsequent allocation at the same address may return completely different tokens.

Note that for most allocations in the unified virtual address space the host and device pointer for accessing the allocation will be the same. The exceptions to this are

- ▶ user memory registered using `cuMemHostRegister`
- ▶ host memory allocated using `cuMemHostAlloc` with the `CU_MEMHOSTALLOC_WRITECOMBINED` flag For these types of allocation there will exist separate, disjoint host and device addresses for accessing the allocation. In particular
  - ▶ The host address will correspond to an invalid unmapped device address (which will result in an exception if accessed from the device)
  - ▶ The device address will correspond to an invalid unmapped host address (which will result in an exception if accessed from the host). For these types of allocations, querying `CU_POINTER_ATTRIBUTE_HOST_POINTER` and `CU_POINTER_ATTRIBUTE_DEVICE_POINTER` may be used to retrieve the host and device addresses from either address.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuMemAlloc`, `cuMemFree`, `cuMemAllocHost`, `cuMemFreeHost`, `cuMemHostAlloc`, `cuMemHostRegister`, `cuMemHostUnregister`

## 2.11. Stream Management

This section describes the stream management functions of the low-level CUDA driver application programming interface.

### `CUresult cuStreamAddCallback (CUstream hStream, CUstreamCallback callback, void *userData, unsigned int flags)`

Add a callback to a compute stream.

#### Parameters

##### `hStream`

- Stream to add callback to

##### `callback`

- The function to call once preceding stream operations are complete

**userData**

- User specified data to be passed to the callback function

**flags**

- Reserved for future use, must be 0

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_NOT\_SUPPORTED

**Description**

Adds a callback to be called on the host after all currently enqueued items in the stream have completed. For each `cuStreamAddCallback` call, the callback will be executed exactly once. The callback will block later work in the stream until it is finished.

The callback may be passed `CUDA_SUCCESS` or an error code. In the event of a device error, all subsequently executed callbacks will receive an appropriate `CUresult`.

Callbacks must not make any CUDA API calls. Attempting to use a CUDA API will result in `CUDA_ERROR_NOT_PERMITTED`. Callbacks must not perform any synchronization that may depend on outstanding device work or other callbacks that are not mandated to run earlier. Callbacks without a mandated order (in independent streams) execute in undefined order and may be serialized.

This API requires compute capability 1.1 or greater. See `cuDeviceGetAttribute` or `cuDeviceGetProperties` to query compute capability. Attempting to use this API with earlier compute versions will return `CUDA_ERROR_NOT_SUPPORTED`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuStreamCreate`, `cuStreamQuery`, `cuStreamSynchronize`, `cuStreamWaitEvent`,  
`cuStreamDestroy`

## CUresult cuStreamCreate (CUstream \*phStream, unsigned int Flags)

Create a stream.

### Parameters

#### phStream

- Returned newly created stream

#### Flags

- Parameters for stream creation

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

### Description

Creates a stream and returns a handle in `phStream`. The `Flags` argument determines behaviors of the stream. Valid values for `Flags` are:

- ▶ `CU_STREAM_DEFAULT`: Default stream creation flag.
- ▶ `CU_STREAM_NON_BLOCKING`: Specifies that work running in the created stream may run concurrently with work in stream 0 (the NULL stream), and that the created stream should perform no implicit synchronization with stream 0.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuStreamDestroy](#), [cuStreamCreateWithPriority](#), [cuStreamGetPriority](#), [cuStreamGetFlags](#), [cuStreamWaitEvent](#), [cuStreamQuery](#), [cuStreamSynchronize](#), [cuStreamAddCallback](#)

## CUresult cuStreamCreateWithPriority (CUstream \*phStream, unsigned int flags, int priority)

Create a stream with the given priority.

### Parameters

#### phStream

- Returned newly created stream

**flags**

- Flags for stream creation. See [cuStreamCreate](#) for a list of valid flags

**priority**

- Stream priority. Lower numbers represent higher priorities. See [cuCtxGetStreamPriorityRange](#) for more information about meaningful stream priorities that can be passed.

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#), [CUDA\\_ERROR\\_OUT\\_OF\\_MEMORY](#)

**Description**

Creates a stream with the specified priority and returns a handle in `phStream`. This API alters the scheduler priority of work in the stream. Work in a higher priority stream may preempt work already executing in a low priority stream.

`priority` follows a convention where lower numbers represent higher priorities. '0' represents default priority. The range of meaningful numerical priorities can be queried using [cuCtxGetStreamPriorityRange](#). If the specified priority is outside the numerical range returned by [cuCtxGetStreamPriorityRange](#), it will automatically be clamped to the lowest or the highest number in the range.



- ▶ Note that this function may also return error codes from previous, asynchronous launches.
- ▶ Stream priorities are supported only on Quadro and Tesla GPUs with compute capability 3.5 or higher.
- ▶ In the current implementation, only compute kernels launched in priority streams are affected by the stream's priority. Stream priorities have no effect on host-to-device and device-to-host memory operations.

**See also:**

[cuStreamDestroy](#), [cuStreamCreate](#), [cuStreamGetPriority](#), [cuCtxGetStreamPriorityRange](#),  
[cuStreamGetFlags](#), [cuStreamWaitEvent](#), [cuStreamQuery](#), [cuStreamSynchronize](#),  
[cuStreamAddCallback](#)

## CUresult cuStreamDestroy (CUstream hStream)

Destroys a stream.

### Parameters

#### hStream

- Stream to destroy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Destroys the stream specified by `hStream`.

In the case that the device is still doing work in the stream `hStream` when `cuStreamDestroy()` is called, the function will return immediately and the resources associated with `hStream` will be released automatically once the device has completed all work in `hStream`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuStreamCreate`, `cuStreamWaitEvent`, `cuStreamQuery`, `cuStreamSynchronize`,  
`cuStreamAddCallback`

## CUresult cuStreamGetFlags (CUstream hStream, unsigned int \*flags)

Query the flags of a given stream.

### Parameters

#### hStream

- Handle to the stream to be queried

#### flags

- Pointer to an unsigned integer in which the stream's flags are returned. The value returned in `flags` is a logical 'OR' of all flags that were used while creating this stream. See `cuStreamCreate` for the list of valid flags



**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY

**Description**

Query the flags of a stream created using `cuStreamCreate` or `cuStreamCreateWithPriority` and return the flags in `flags`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuStreamDestroy`, `cuStreamCreate`, `cuStreamGetPriority`

## CUresult cuStreamGetPriority (CUstream hStream, int \*priority)

Query the priority of a given stream.

**Parameters****hStream**

- Handle to the stream to be queried

**priority**

- Pointer to a signed integer in which the stream's priority is returned

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY

**Description**

Query the priority of a stream created using `cuStreamCreate` or `cuStreamCreateWithPriority` and return the priority in `priority`. Note that if the stream was created with a priority outside the numerical range returned by `cuCtxGetStreamPriorityRange`, this function returns the clamped priority. See `cuStreamCreateWithPriority` for details about priority clamping.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuStreamDestroy](#), [cuStreamCreate](#), [cuStreamCreateWithPriority](#), [cuCtxGetStreamPriorityRange](#), [cuStreamGetFlags](#)

## CUresult cuStreamQuery (CUstream hStream)

Determine status of a compute stream.

**Parameters**

**hStream**

- Stream to query status of

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_HANDLE](#), [CUDA\\_ERROR\\_NOT\\_READY](#)

**Description**

Returns [CUDA\\_SUCCESS](#) if all operations in the stream specified by `hStream` have completed, or [CUDA\\_ERROR\\_NOT\\_READY](#) if not.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuStreamCreate](#), [cuStreamWaitEvent](#), [cuStreamDestroy](#), [cuStreamSynchronize](#),  
[cuStreamAddCallback](#)

## CUresult cuStreamSynchronize (CUstream hStream)

Wait until a stream's tasks are completed.

**Parameters**

**hStream**

- Stream to wait for

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE

**Description**

Waits until the device has completed all operations in the stream specified by `hStream`. If the context was created with the `CU_CTX_SCHED_BLOCKING_SYNC` flag, the CPU thread will block until the stream is finished with all of its tasks.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuStreamCreate`, `cuStreamDestroy`, `cuStreamWaitEvent`, `cuStreamQuery`,  
`cuStreamAddCallback`

## CUresult cuStreamWaitEvent (CUstream hStream, CUevent hEvent, unsigned int Flags)

Make a compute stream wait on an event.

**Parameters****hStream**

- Stream to wait

**hEvent**

- Event to wait on (may not be NULL)

**Flags**

- Parameters for the operation (must be 0)

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE,

**Description**

Makes all future work submitted to `hStream` wait until `hEvent` reports completion before beginning execution. This synchronization will be performed efficiently on the device. The event `hEvent` may be from a different context than `hStream`, in which case this function will perform cross-device synchronization.

The stream `hStream` will wait only for the completion of the most recent host call to `cuEventRecord()` on `hEvent`. Once this call has returned, any functions (including `cuEventRecord()` and `cuEventDestroy()`) may be called on `hEvent` again, and the subsequent calls will not have any effect on `hStream`.

If `hStream` is 0 (the NULL stream) any future work submitted in any stream will wait for `hEvent` to complete before beginning execution. This effectively creates a barrier for all future work submitted to the context.

If `cuEventRecord()` has not been called on `hEvent`, this call acts as if the record has already completed, and so is a functional no-op.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuStreamCreate`, `cuEventRecord`, `cuStreamQuery`, `cuStreamSynchronize`,  
`cuStreamAddCallback`, `cuStreamDestroy`

## 2.12. Event Management

This section describes the event management functions of the low-level CUDA driver application programming interface.

### CUresult cuEventCreate (CUevent \*phEvent, unsigned int Flags)

Creates an event.

#### Parameters

##### **phEvent**

- Returns newly created event

##### **Flags**

- Event creation flags

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`

## Description

Creates an event `*phEvent` with the flags specified via `Flags`. Valid flags include:

- ▶ `CU_EVENT_DEFAULT`: Default event creation flag.
- ▶ `CU_EVENT_BLOCKING_SYNC`: Specifies that the created event should use blocking synchronization. A CPU thread that uses `cuEventSynchronize()` to wait on an event created with this flag will block until the event has actually been recorded.
- ▶ `CU_EVENT_DISABLE_TIMING`: Specifies that the created event does not need to record timing data. Events created with this flag specified and the `CU_EVENT_BLOCKING_SYNC` flag not specified will provide the best performance when used with `cuStreamWaitEvent()` and `cuEventQuery()`.
- ▶ `CU_EVENT_INTERPROCESS`: Specifies that the created event may be used as an interprocess event by `cuIpcGetEventHandle()`. `CU_EVENT_INTERPROCESS` must be specified along with `CU_EVENT_DISABLE_TIMING`.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuEventRecord`, `cuEventQuery`, `cuEventSynchronize`, `cuEventDestroy`, `cuEventElapsedTime`

## CUresult cuEventDestroy (CUevent hEvent)

Destroys an event.

### Parameters

#### `hEvent`

- Event to destroy

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_HANDLE`

## Description

Destroys the event specified by `hEvent`.

In the case that `hEvent` has been recorded but has not yet been completed when `cuEventDestroy()` is called, the function will return immediately and the resources

associated with `hEvent` will be released automatically once the device has completed `hEvent`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuEventCreate](#), [cuEventRecord](#), [cuEventQuery](#), [cuEventSynchronize](#),  
[cuEventElapsedTime](#)

## CUresult cuEventElapsedTime (float \*pMilliseconds, CUevent hStart, CUevent hEnd)

Computes the elapsed time between two events.

#### Parameters

##### **pMilliseconds**

- Time between `hStart` and `hEnd` in ms

##### **hStart**

- Starting event

##### **hEnd**

- Ending event

#### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_HANDLE](#), [CUDA\\_ERROR\\_NOT\\_READY](#)

#### Description

Computes the elapsed time between two events (in milliseconds with a resolution of around 0.5 microseconds).

If either event was last recorded in a non-NULL stream, the resulting time may be greater than expected (even if both used the same stream handle). This happens because the [cuEventRecord\(\)](#) operation takes place asynchronously and there is no guarantee that the measured latency is actually just between the two events. Any number of other different stream operations could execute in between the two measured events, thus altering the timing in a significant way.

If [cuEventRecord\(\)](#) has not been called on either event then

[CUDA\\_ERROR\\_INVALID\\_HANDLE](#) is returned. If [cuEventRecord\(\)](#) has been

called on both events but one or both of them has not yet been completed (that is, `cuEventQuery()` would return `CUDA_ERROR_NOT_READY` on at least one of the events), `CUDA_ERROR_NOT_READY` is returned. If either event was created with the `CU_EVENT_DISABLE_TIMING` flag, then this function will return `CUDA_ERROR_INVALID_HANDLE`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuEventCreate](#), [cuEventRecord](#), [cuEventQuery](#), [cuEventSynchronize](#), [cuEventDestroy](#)

## CUresult cuEventQuery (CUevent hEvent)

Queries an event's status.

#### Parameters

##### hEvent

- Event to query

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_NOT_READY`

#### Description

Query the status of all device work preceding the most recent call to `cuEventRecord()` (in the appropriate compute streams, as specified by the arguments to `cuEventRecord()`).

If this work has successfully been completed by the device, or if `cuEventRecord()` has not been called on `hEvent`, then `CUDA_SUCCESS` is returned. If this work has not yet been completed by the device then `CUDA_ERROR_NOT_READY` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuEventCreate](#), [cuEventRecord](#), [cuEventSynchronize](#), [cuEventDestroy](#),  
[cuEventElapsedTime](#)

## CUresult cuEventRecord (CUevent hEvent, CUstream hStream)

Records an event.

### Parameters

#### hEvent

- Event to record

#### hStream

- Stream to record event for

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_INVALID\_VALUE

### Description

Records an event. If `hStream` is non-zero, the event is recorded after all preceding operations in `hStream` have been completed; otherwise, it is recorded after all preceding operations in the CUDA context have been completed. Since operation is asynchronous, `cuEventQuery` and/or `cuEventSynchronize()` must be used to determine when the event has actually been recorded.

If `cuEventRecord()` has previously been called on `hEvent`, then this call will overwrite any existing state in `hEvent`. Any subsequent calls which examine the status of `hEvent` will only examine the completion of this most recent call to `cuEventRecord()`.

It is necessary that `hEvent` and `hStream` be created on the same context.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuEventCreate`, `cuEventQuery`, `cuEventSynchronize`, `cuStreamWaitEvent`,  
`cuEventDestroy`, `cuEventElapsedTime`



## CUresult cuEventSynchronize (CUevent hEvent)

Waits for an event to complete.

### Parameters

#### hEvent

- Event to wait for

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE

### Description

Wait until the completion of all device work preceding the most recent call to `cuEventRecord()` (in the appropriate compute streams, as specified by the arguments to `cuEventRecord()`).

If `cuEventRecord()` has not been called on `hEvent`, `CUDA_SUCCESS` is returned immediately.

Waiting for an event that was created with the `CU_EVENT_BLOCKING_SYNC` flag will cause the calling CPU thread to block until the event has been completed by the device. If the `CU_EVENT_BLOCKING_SYNC` flag has not been set, then the CPU thread will busy-wait until the event has been completed by the device.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuEventCreate`, `cuEventRecord`, `cuEventQuery`, `cuEventDestroy`, `cuEventElapsedTime`

## 2.13. Execution Control

This section describes the execution control functions of the low-level CUDA driver application programming interface.

## CUresult cuFuncGetAttribute (int \*pi, CUfunction\_attribute attrib, CUfunction hfunc)

Returns information about a function.

### Parameters

**pi**

- Returned attribute value

**attrib**

- Attribute requested

**hfunc**

- Function to query attribute of

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_INVALID\_VALUE

### Description

Returns in \*pi the integer value of the attribute `attrib` on the kernel given by `hfunc`. The supported attributes are:

- ▶ **CU\_FUNC\_ATTRIBUTE\_MAX\_THREADS\_PER\_BLOCK**: The maximum number of threads per block, beyond which a launch of the function would fail. This number depends on both the function and the device on which the function is currently loaded.
- ▶ **CU\_FUNC\_ATTRIBUTE\_SHARED\_SIZE\_BYTES**: The size in bytes of statically-allocated shared memory per block required by this function. This does not include dynamically-allocated shared memory requested by the user at runtime.
- ▶ **CU\_FUNC\_ATTRIBUTE\_CONST\_SIZE\_BYTES**: The size in bytes of user-allocated constant memory required by this function.
- ▶ **CU\_FUNC\_ATTRIBUTE\_LOCAL\_SIZE\_BYTES**: The size in bytes of local memory used by each thread of this function.
- ▶ **CU\_FUNC\_ATTRIBUTE\_NUM\_REGS**: The number of registers used by each thread of this function.
- ▶ **CU\_FUNC\_ATTRIBUTE\_PTX\_VERSION**: The PTX virtual architecture version for which the function was compiled. This value is the major PTX version \* 10 + the minor PTX version, so a PTX version 1.3 function would return the value 13. Note that this may return the undefined value of 0 for cubins compiled prior to CUDA 3.0.
- ▶ **CU\_FUNC\_ATTRIBUTE\_BINARY\_VERSION**: The binary architecture version for which the function was compiled. This value is the major binary version \* 10 + the

minor binary version, so a binary version 1.3 function would return the value 13. Note that this will return a value of 10 for legacy cubins that do not have a properly-encoded binary architecture version.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuCtxGetCacheConfig](#), [cuCtxSetCacheConfig](#), [cuFuncSetCacheConfig](#), [cuLaunchKernel](#)

## CUresult cuFuncSetCacheConfig (CUfunction hfunc, CUfunc\_cache config)

Sets the preferred cache configuration for a device function.

### Parameters

#### **hfunc**

- Kernel to configure cache for

#### **config**

- Requested cache configuration

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_INVALID\\_VALUE](#),  
[CUDA\\_ERROR\\_DEINITIALIZED](#), [CUDA\\_ERROR\\_NOT\\_INITIALIZED](#),  
[CUDA\\_ERROR\\_INVALID\\_CONTEXT](#)

### Description

On devices where the L1 cache and shared memory use the same hardware resources, this sets through `config` the preferred cache configuration for the device function `hfunc`. This is only a preference. The driver will use the requested configuration if possible, but it is free to choose a different configuration if required to execute `hfunc`. Any context-wide preference set via [cuCtxSetCacheConfig\(\)](#) will be overridden by this per-function setting unless the per-function setting is [CU\\_FUNC\\_CACHE\\_PREFER\\_NONE](#). In that case, the current context-wide setting will be used.

This setting does nothing on devices where the size of the L1 cache and shared memory are fixed.

Launching a kernel with a different preference than the most recent preference setting may insert a device-side synchronization point.

The supported cache configurations are:

- ▶ `CU_FUNC_CACHE_PREFER_NONE`: no preference for shared memory or L1 (default)
- ▶ `CU_FUNC_CACHE_PREFER_SHARED`: prefer larger shared memory and smaller L1 cache
- ▶ `CU_FUNC_CACHE_PREFER_L1`: prefer larger L1 cache and smaller shared memory
- ▶ `CU_FUNC_CACHE_PREFER_EQUAL`: prefer equal sized L1 cache and shared memory



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuCtxGetCacheConfig`, `cuCtxSetCacheConfig`, `cuFuncGetAttribute`, `cuLaunchKernel`

## CUresult cuFuncSetSharedMemConfig (CUfunction hfunc, CUsharedconfig config)

Sets the shared memory configuration for a device function.

### Parameters

#### **hfunc**

- kernel to be given a shared memory config

#### **config**

- requested shared memory configuration

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`,  
`CUDA_ERROR_INVALID_CONTEXT`

### Description

On devices with configurable shared memory banks, this function will force all subsequent launches of the specified device function to have the given shared memory bank size configuration. On any given launch of the function, the shared memory configuration of the device will be temporarily changed if needed to suit the function's preferred configuration. Changes in shared memory configuration between subsequent launches of functions, may introduce a device side synchronization point.

Any per-function setting of shared memory bank size set via `cuFuncSetSharedMemConfig` will override the context wide setting set with `cuCtxSetSharedMemConfig`.

Changing the shared memory bank size will not increase shared memory usage or affect occupancy of kernels, but may have major effects on performance. Larger bank sizes will allow for greater potential bandwidth to shared memory, but will change what kinds of accesses to shared memory will result in bank conflicts.

This function will do nothing on devices with fixed shared memory bank size.

The supported bank configurations are:

- ▶ `CU_SHARED_MEM_CONFIG_DEFAULT_BANK_SIZE`: use the context's shared memory configuration when launching this function.
- ▶ `CU_SHARED_MEM_CONFIG_FOUR_BYTE_BANK_SIZE`: set shared memory bank width to be natively four bytes when launching this function.
- ▶ `CU_SHARED_MEM_CONFIG_EIGHT_BYTE_BANK_SIZE`: set shared memory bank width to be natively eight bytes when launching this function.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxGetCacheConfig`, `cuCtxSetCacheConfig`, `cuCtxGetSharedMemConfig`,  
`cuCtxSetSharedMemConfig`, `cuFuncGetAttribute`, `cuLaunchKernel`

**CUresult cuLaunchKernel** (CUfunction f, unsigned int gridDimX, unsigned int gridDimY, unsigned int gridDimZ, unsigned int blockDimX, unsigned int blockDimY, unsigned int blockDimZ, unsigned int sharedMemBytes, CUstream hStream, void \*\*kernelParams, void \*\*extra)

Launches a CUDA function.

#### Parameters

**f**

- Kernel to launch

**gridDimX**

- Width of grid in blocks

**gridDimY**

- Height of grid in blocks

**gridDimZ**

- Depth of grid in blocks

**blockDimX**

- X dimension of each thread block

**blockDimY**

- Y dimension of each thread block

**blockDimZ**

- Z dimension of each thread block

**sharedMemBytes**

- Dynamic shared-memory size per thread block in bytes

**hStream**

- Stream identifier

**kernelParams**

- Array of pointers to kernel parameters

**extra**

- Extra options

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_INVALID\_IMAGE,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_LAUNCH\_FAILED,  
 CUDA\_ERROR\_LAUNCH\_OUT\_OF\_RESOURCES,  
 CUDA\_ERROR\_LAUNCH\_TIMEOUT,  
 CUDA\_ERROR\_LAUNCH\_INCOMPATIBLE\_TEXTURING,  
 CUDA\_ERROR\_SHARED\_OBJECT\_INIT\_FAILED

**Description**

Invokes the kernel `f` on a `gridDimX` x `gridDimY` x `gridDimZ` grid of blocks. Each block contains `blockDimX` x `blockDimY` x `blockDimZ` threads.

`sharedMemBytes` sets the amount of dynamic shared memory that will be available to each thread block.

`cuLaunchKernel()` can optionally be associated to a stream by passing a non-zero `hStream` argument.

Kernel parameters to `f` can be specified in one of two ways:

1) Kernel parameters can be specified via `kernelParams`. If `f` has `N` parameters, then `kernelParams` needs to be an array of `N` pointers. Each of `kernelParams[0]` through `kernelParams[N-1]` must point to a region of memory from which the actual kernel parameter will be copied. The number of kernel parameters and their offsets and sizes do not need to be specified as that information is retrieved directly from the kernel's image.

2) Kernel parameters can also be packaged by the application into a single buffer that is passed in via the `extra` parameter. This places the burden on the application of knowing each kernel parameter's size and alignment/padding within the buffer. Here is an example of using the `extra` parameter in this manner:

```
↑
    size_t argBufferSize;
    char argBuffer[256];

    // populate argBuffer and argBufferSize

    void *config[] = {
        CU_LAUNCH_PARAM_BUFFER_POINTER, argBuffer,
        CU_LAUNCH_PARAM_BUFFER_SIZE,   &argBufferSize,
        CU_LAUNCH_PARAM_END
    };
    status = cuLaunchKernel(f, gx, gy, gz, bx, by, bz, sh, s, NULL,
config);
```

The `extra` parameter exists to allow `cuLaunchKernel` to take additional less commonly used arguments. `extra` specifies a list of names of extra settings and their corresponding values. Each extra setting name is immediately followed by the corresponding value. The list must be terminated with either `NULL` or `CU_LAUNCH_PARAM_END`.

- ▶ `CU_LAUNCH_PARAM_END`, which indicates the end of the `extra` array;
- ▶ `CU_LAUNCH_PARAM_BUFFER_POINTER`, which specifies that the next value in `extra` will be a pointer to a buffer containing all the kernel parameters for launching kernel `f`;
- ▶ `CU_LAUNCH_PARAM_BUFFER_SIZE`, which specifies that the next value in `extra` will be a pointer to a `size_t` containing the size of the buffer specified with `CU_LAUNCH_PARAM_BUFFER_POINTER`;

The error `CUDA_ERROR_INVALID_VALUE` will be returned if kernel parameters are specified with both `kernelParams` and `extra` (i.e. both `kernelParams` and `extra` are non-NULL).

Calling `cuLaunchKernel()` sets persistent function state that is the same as function state set through the following deprecated APIs: `cuFuncSetBlockShape()`, `cuFuncSetSharedSize()`, `cuParamSetSize()`, `cuParamSeti()`, `cuParamSetf()`, `cuParamSetv()`.

When the kernel `f` is launched via `cuLaunchKernel()`, the previous block shape, shared size and parameter info associated with `f` is overwritten.

Note that to use `cuLaunchKernel()`, the kernel `f` must either have been compiled with toolchain version 3.2 or later so that it will contain kernel parameter information, or have no kernel parameters. If either of these conditions is not met, then `cuLaunchKernel()` will return `CUDA_ERROR_INVALID_IMAGE`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuCtxGetCacheConfig](#), [cuCtxSetCacheConfig](#), [cuFuncSetCacheConfig](#),  
[cuFuncGetAttribute](#)

## 2.14. Execution Control [DEPRECATED]

This section describes the deprecated execution control functions of the low-level CUDA driver application programming interface.

### CUresult cuFuncSetBlockShape (CUfunction hfunc, int x, int y, int z)

Sets the block-dimensions for the function.

**Parameters****hfunc**

- Kernel to specify dimensions of

**x**

- X dimension

**y**

- Y dimension

**z**

- Z dimension

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_HANDLE](#), [CUDA\\_ERROR\\_INVALID\\_VALUE](#)

**Description**

Deprecated

Specifies the *x*, *y*, and *z* dimensions of the thread blocks that are created when the kernel given by *hfunc* is launched.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**



`cuFuncSetSharedSize`, `cuFuncSetCacheConfig`, `cuFuncGetAttribute`, `cuParamSetSize`, `cuParamSeti`, `cuParamSetf`, `cuParamSetv`, `cuLaunch`, `cuLaunchGrid`, `cuLaunchGridAsync`, `cuLaunchKernel`

## CUresult cuFuncSetSharedSize (CUfunction hfunc, unsigned int bytes)

Sets the dynamic shared-memory size for the function.

### Parameters

#### **hfunc**

- Kernel to specify dynamic shared-memory size for

#### **bytes**

- Dynamic shared-memory size per thread in bytes

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_HANDLE`, `CUDA_ERROR_INVALID_VALUE`

### Description

#### Deprecated

Sets through `bytes` the amount of dynamic shared memory that will be available to each thread block when the kernel given by `hfunc` is launched.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuFuncSetBlockShape`, `cuFuncSetCacheConfig`, `cuFuncGetAttribute`, `cuParamSetSize`, `cuParamSeti`, `cuParamSetf`, `cuParamSetv`, `cuLaunch`, `cuLaunchGrid`, `cuLaunchGridAsync`, `cuLaunchKernel`

## CUresult cuLaunch (CUfunction f)

Launches a CUDA function.

### Parameters

#### **f**

- Kernel to launch

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_LAUNCH\_FAILED,  
 CUDA\_ERROR\_LAUNCH\_OUT\_OF\_RESOURCES,  
 CUDA\_ERROR\_LAUNCH\_TIMEOUT,  
 CUDA\_ERROR\_LAUNCH\_INCOMPATIBLE\_TEXTURING,  
 CUDA\_ERROR\_SHARED\_OBJECT\_INIT\_FAILED

**Description**

Deprecated

Invokes the kernel  $f$  on a  $1 \times 1 \times 1$  grid of blocks. The block contains the number of threads specified by a previous call to `cuFuncSetBlockShape()`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuFuncSetBlockShape`, `cuFuncSetSharedSize`, `cuFuncGetAttribute`, `cuParamSetSize`,  
`cuParamSetf`, `cuParamSeti`, `cuParamSetv`, `cuLaunchGrid`, `cuLaunchGridAsync`,  
`cuLaunchKernel`

## CUresult cuLaunchGrid (CUfunction f, int grid\_width, int grid\_height)

Launches a CUDA function.

**Parameters**

**f**

- Kernel to launch

**grid\_width**

- Width of grid in blocks

**grid\_height**

- Height of grid in blocks

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_LAUNCH\_FAILED,  
 CUDA\_ERROR\_LAUNCH\_OUT\_OF\_RESOURCES,

CUDA\_ERROR\_LAUNCH\_TIMEOUT,  
 CUDA\_ERROR\_LAUNCH\_INCOMPATIBLE\_TEXTURING,  
 CUDA\_ERROR\_SHARED\_OBJECT\_INIT\_FAILED

## Description

Deprecated

Invokes the kernel `f` on a `grid_width` x `grid_height` grid of blocks. Each block contains the number of threads specified by a previous call to `cuFuncSetBlockShape()`.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuFuncSetBlockShape`, `cuFuncSetSharedSize`, `cuFuncGetAttribute`, `cuParamSetSize`,  
`cuParamSetf`, `cuParamSeti`, `cuParamSetv`, `cuLaunch`, `cuLaunchGridAsync`,  
`cuLaunchKernel`

## CUresult cuLaunchGridAsync (CUfunction f, int grid\_width, int grid\_height, CUstream hStream)

Launches a CUDA function.

### Parameters

**f**

- Kernel to launch

**grid\_width**

- Width of grid in blocks

**grid\_height**

- Height of grid in blocks

**hStream**

- Stream identifier

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_LAUNCH\_FAILED,  
 CUDA\_ERROR\_LAUNCH\_OUT\_OF\_RESOURCES,  
 CUDA\_ERROR\_LAUNCH\_TIMEOUT,

CUDA\_ERROR\_LAUNCH\_INCOMPATIBLE\_TEXTURING,  
 CUDA\_ERROR\_SHARED\_OBJECT\_INIT\_FAILED

## Description

Deprecated

Invokes the kernel `f` on a `grid_width` x `grid_height` grid of blocks. Each block contains the number of threads specified by a previous call to `cuFuncSetBlockShape()`.

`cuLaunchGridAsync()` can optionally be associated to a stream by passing a non-zero `hStream` argument.



- ▶ In certain cases where cubins are created with no ABI (i.e., using `ptxas --abi-compile no`), this function may serialize kernel launches. In order to force the CUDA driver to retain asynchronous behavior, set the `CU_CTX_LMEM_RESIZE_TO_MAX` flag during context creation (see `cuCtxCreate`).
- ▶ Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuFuncSetBlockShape`, `cuFuncSetSharedSize`, `cuFuncGetAttribute`, `cuParamSetSize`, `cuParamSetf`, `cuParamSeti`, `cuParamSetv`, `cuLaunch`, `cuLaunchGrid`, `cuLaunchKernel`

## CUresult cuParamSetf (CUfunction hfunc, int offset, float value)

Adds a floating-point parameter to the function's argument list.

### Parameters

#### **hfunc**

- Kernel to add parameter to

#### **offset**

- Offset to add parameter to argument list

#### **value**

- Value of parameter

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Deprecated

Sets a floating-point parameter that will be specified the next time the kernel corresponding to `hfunc` will be invoked. `offset` is a byte offset.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuFuncSetBlockShape`, `cuFuncSetSharedSize`, `cuFuncGetAttribute`, `cuParamSetSize`, `cuParamSeti`, `cuParamSetv`, `cuLaunch`, `cuLaunchGrid`, `cuLaunchGridAsync`, `cuLaunchKernel`

## CUresult cuParamSeti (CUfunction hfunc, int offset, unsigned int value)

Adds an integer parameter to the function's argument list.

## Parameters

### `hfunc`

- Kernel to add parameter to

### `offset`

- Offset to add parameter to argument list

### `value`

- Value of parameter

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

## Description

Deprecated

Sets an integer parameter that will be specified the next time the kernel corresponding to `hfunc` will be invoked. `offset` is a byte offset.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuFuncSetBlockShape](#), [cuFuncSetSharedSize](#), [cuFuncGetAttribute](#), [cuParamSetSize](#), [cuParamSetf](#), [cuParamSetv](#), [cuLaunch](#), [cuLaunchGrid](#), [cuLaunchGridAsync](#), [cuLaunchKernel](#)

## CUresult cuParamSetSize (CUfunction hfunc, unsigned int numbytes)

Sets the parameter size for the function.

**Parameters****hfunc**

- Kernel to set parameter size for

**numbytes**

- Size of parameter list in bytes

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

**Description**

Deprecated

Sets through `numbytes` the total size in bytes needed by the function parameters of the kernel corresponding to `hfunc`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuFuncSetBlockShape](#), [cuFuncSetSharedSize](#), [cuFuncGetAttribute](#), [cuParamSetf](#), [cuParamSeti](#), [cuParamSetv](#), [cuLaunch](#), [cuLaunchGrid](#), [cuLaunchGridAsync](#), [cuLaunchKernel](#)

## CUresult cuParamSetTexRef (CUfunction hfunc, int texunit, CUtexref hTexRef)

Adds a texture-reference to the function's argument list.

### Parameters

#### hfunc

- Kernel to add texture-reference to

#### texunit

- Texture unit (must be `CU_PARAM_TR_DEFAULT`)

#### hTexRef

- Texture-reference to add to argument list

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

#### Deprecated

Makes the CUDA array or linear memory bound to the texture reference `hTexRef` available to a device program as a texture. In this version of CUDA, the texture-reference must be obtained via `cuModuleGetTexRef()` and the `texunit` parameter must be set to `CU_PARAM_TR_DEFAULT`.



Note that this function may also return error codes from previous, asynchronous launches.

## CUresult cuParamSetv (CUfunction hfunc, int offset, void \*ptr, unsigned int numbytes)

Adds arbitrary data to the function's argument list.

### Parameters

#### hfunc

- Kernel to add data to

#### offset

- Offset to add data to argument list

**ptr**

- Pointer to arbitrary data

**numbytes**

- Size of data to copy in bytes

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Deprecated

Copies an arbitrary amount of data (specified in `numbytes`) from `ptr` into the parameter space of the kernel corresponding to `hfunc`. `offset` is a byte offset.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuFuncSetBlockShape`, `cuFuncSetSharedSize`, `cuFuncGetAttribute`, `cuParamSetSize`,  
`cuParamSetf`, `cuParamSeti`, `cuLaunch`, `cuLaunchGrid`, `cuLaunchGridAsync`,  
`cuLaunchKernel`

## 2.15. Texture Reference Management

This section describes the texture reference management functions of the low-level CUDA driver application programming interface.

### CUresult cuTexRefGetAddress (CUdeviceptr \*pdptr, CUtexref hTexRef)

Gets the address associated with a texture reference.

**Parameters****pdptr**

- Returned device address

**hTexRef**

- Texture reference



**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns in `*pdptr` the base address bound to the texture reference `hTexRef`, or returns `CUDA_ERROR_INVALID_VALUE` if the texture reference is not bound to any device memory range.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetAddressMode (CUaddress\_mode \*pam, CUtexref hTexRef, int dim)

Gets the addressing mode used by a texture reference.

**Parameters****pam**

- Returned addressing mode

**hTexRef**

- Texture reference

**dim**

- Dimension

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns in `*pam` the addressing mode corresponding to the dimension `dim` of the texture reference `hTexRef`. Currently, the only valid value for `dim` are 0 and 1.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`,  
`cuTexRefGetAddress`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`, `cuTexRefGetFlags`,  
`cuTexRefGetFormat`

## CUresult cuTexRefGetArray (CUarray \*phArray, CUtexref hTexRef)

Gets the array bound to a texture reference.

### Parameters

#### **phArray**

- Returned array

#### **hTexRef**

- Texture reference

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Returns in `*phArray` the CUDA array bound to the texture reference `hTexRef`, or returns `CUDA_ERROR_INVALID_VALUE` if the texture reference is not bound to any CUDA array.

### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`,  
`cuTexRefGetAddress`, `cuTexRefGetAddressMode`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetFilterMode (CUfilter\_mode \*pfm, CUtexref hTexRef)

Gets the filter-mode used by a texture reference.

### Parameters

#### **pfm**

- Returned filtering mode

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns in `*pfm` the filtering mode of the texture reference `hTexRef`.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`,  
`cuTexRefGetAddress`, `cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFlags`,  
`cuTexRefGetFormat`

## CUresult cuTexRefGetFlags (unsigned int \*pFlags, CUtexref hTexRef)

Gets the flags used by a texture reference.

**Parameters****pFlags**

- Returned flags

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns in `*pFlags` the flags of the texture reference `hTexRef`.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`,

[cuTexRefGetAddress](#), [cuTexRefGetAddressMode](#), [cuTexRefGetArray](#),  
[cuTexRefGetFilterMode](#), [cuTexRefGetFormat](#)

## CUresult cuTexRefGetFormat (CUarray\_format \*pFormat, int \*pNumChannels, CUtexref hTexRef)

Gets the format used by a texture reference.

### Parameters

#### **pFormat**

- Returned format

#### **pNumChannels**

- Returned number of components

#### **hTexRef**

- Texture reference

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

### Description

Returns in `*pFormat` and `*pNumChannels` the format and number of components of the CUDA array bound to the texture reference `hTexRef`. If `pFormat` or `pNumChannels` is NULL, it will be ignored.

### See also:

[cuTexRefSetAddress](#), [cuTexRefSetAddress2D](#), [cuTexRefSetAddressMode](#),  
[cuTexRefSetArray](#), [cuTexRefSetFilterMode](#), [cuTexRefSetFlags](#), [cuTexRefSetFormat](#),  
[cuTexRefGetAddress](#), [cuTexRefGetAddressMode](#), [cuTexRefGetArray](#),  
[cuTexRefGetFilterMode](#), [cuTexRefGetFlags](#)

## CUresult cuTexRefGetMaxAnisotropy (int \*pmaxAniso, CUtexref hTexRef)

Gets the maximum anisotropy for a texture reference.

### Parameters

#### **pmaxAniso**

- Returned maximum anisotropy

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the maximum anisotropy in `pmaxAniso` that's used when reading memory through the texture reference `hTexRef`.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetMipmapFilterMode (CUfilter\_mode \*pfm, CUtexref hTexRef)

Gets the mipmap filtering mode for a texture reference.

**Parameters****pfm**

- Returned mipmap filtering mode

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the mipmap filtering mode in `pfm` that's used when reading memory through the texture reference `hTexRef`.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetMipmapLevelBias (float \*pbias, CUtexref hTexRef)

Gets the mipmap level bias for a texture reference.

### Parameters

#### **pbias**

- Returned mipmap level bias

#### **hTexRef**

- Texture reference

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Returns the mipmap level bias in `pbias` that's added to the specified mipmap level when reading memory through the texture reference `hTexRef`.

### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetMipmapLevelClamp (float \*pminMipmapLevelClamp, float \*pmaxMipmapLevelClamp, CUtexref hTexRef)

Gets the min/max mipmap level clamps for a texture reference.

### Parameters

#### **pminMipmapLevelClamp**

- Returned mipmap min level clamp

**pmaxMipmapLevelClamp**

- Returned mipmap max level clamp

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the min/max mipmap level clamps in `pminMipmapLevelClamp` and `pmaxMipmapLevelClamp` that's used when reading memory through the texture reference `hTexRef`.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefGetMipmappedArray (CUmipmappedArray \*phMipmappedArray, CUtexref hTexRef)

Gets the mipmapped array bound to a texture reference.

**Parameters****phMipmappedArray**

- Returned mipmapped array

**hTexRef**

- Texture reference

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Returns in `*pMipmappedArray` the CUDA mipmapped array bound to the texture reference `hTexRef`, or returns `CUDA_ERROR_INVALID_VALUE` if the texture reference is not bound to any CUDA mipmapped array.

## See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`, `cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`, `cuTexRefGetAddressMode`, `cuTexRefGetFilterMode`, `cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetAddress (size\_t \*ByteOffset, CUtexref hTexRef, CUdeviceptr dptr, size\_t bytes)

Binds an address as a texture reference.

## Parameters

### ByteOffset

- Returned byte offset

### hTexRef

- Texture reference to bind

### dptr

- Device pointer to bind

### bytes

- Size of memory to bind in bytes

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`, `CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`, `CUDA_ERROR_INVALID_VALUE`

## Description

Binds a linear address range to the texture reference `hTexRef`. Any previous address or CUDA array state associated with the texture reference is superseded by this function. Any memory previously bound to `hTexRef` is unbound.

Since the hardware enforces an alignment requirement on texture base addresses, `cuTexRefSetAddress()` passes back a byte offset in `*ByteOffset` that must be applied to texture fetches in order to read from the desired memory. This offset must be divided by the texel size and passed to kernels that read from the texture so they can be applied to the `tex1Dfetch()` function.



If the device memory pointer was returned from `cuMemAlloc()`, the offset is guaranteed to be 0 and NULL may be passed as the `ByteOffset` parameter.

The total number of elements (or texels) in the linear address range cannot exceed `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_LINEAR_WIDTH`. The number of elements is computed as  $(\text{bytes} / \text{bytesPerElement})$ , where `bytesPerElement` is determined from the data format and number of components set using `cuTexRefSetFormat()`.

**See also:**

`cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`, `cuTexRefSetArray`,  
`cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetAddress2D (CUtexref hTexRef, const CUDA\_ARRAY\_DESCRIPTOR \*desc, CUdeviceptr dptr, size\_t Pitch)

Binds an address as a 2D texture reference.

**Parameters**

**hTexRef**

- Texture reference to bind

**desc**

- Descriptor of CUDA array

**dptr**

- Device pointer to bind

**Pitch**

- Line pitch in bytes

**Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

**Description**

Binds a linear address range to the texture reference `hTexRef`. Any previous address or CUDA array state associated with the texture reference is superseded by this function. Any memory previously bound to `hTexRef` is unbound.

Using a `tex2D()` function inside a kernel requires a call to either `cuTexRefSetArray()` to bind the corresponding texture reference to an array, or `cuTexRefSetAddress2D()` to bind the texture reference to linear memory.

Function calls to `cuTexRefSetFormat()` cannot follow calls to `cuTexRefSetAddress2D()` for the same texture reference.

It is required that `dptr` be aligned to the appropriate hardware-specific texture alignment. You can query this value using the device attribute `CU_DEVICE_ATTRIBUTE_TEXTURE_ALIGNMENT`. If an unaligned `dptr` is supplied, `CUDA_ERROR_INVALID_VALUE` is returned.

`Pitch` has to be aligned to the hardware-specific texture pitch alignment. This value can be queried using the device attribute `CU_DEVICE_ATTRIBUTE_TEXTURE_PITCH_ALIGNMENT`. If an unaligned `Pitch` is supplied, `CUDA_ERROR_INVALID_VALUE` is returned.

`Width` and `Height`, which are specified in elements (or texels), cannot exceed `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_WIDTH` and `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_HEIGHT` respectively. `Pitch`, which is specified in bytes, cannot exceed `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_PITCH`.

#### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddressMode`, `cuTexRefSetArray`,  
`cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetAddressMode (CUtexref hTexRef, int dim, CUaddress\_mode am)

Sets the addressing mode for a texture reference.

#### Parameters

##### **hTexRef**

- Texture reference

##### **dim**

- Dimension

##### **am**

- Addressing mode to set

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Specifies the addressing mode `am` for the given dimension `dim` of the texture reference `hTexRef`. If `dim` is zero, the addressing mode is applied to the first parameter of the functions used to fetch from the texture; if `dim` is 1, the second, and so on.

`CUaddress_mode` is defined as:

```
↑ typedef enum CUaddress_mode_enum {
    CU_TR_ADDRESS_MODE_WRAP = 0,
    CU_TR_ADDRESS_MODE_CLAMP = 1,
    CU_TR_ADDRESS_MODE_MIRROR = 2,
    CU_TR_ADDRESS_MODE_BORDER = 3
} CUaddress_mode;
```

Note that this call has no effect if `hTexRef` is bound to linear memory. Also, if the flag, `CU_TRSF_NORMALIZED_COORDINATES`, is not set, the only supported address mode is `CU_TR_ADDRESS_MODE_CLAMP`.

## See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetArray`,  
`cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetArray (CUtexref hTexRef, CUarray hArray, unsigned int Flags)

Binds an array as a texture reference.

### Parameters

#### **hTexRef**

- Texture reference to bind

#### **hArray**

- Array to bind

#### **Flags**

- Options (must be `CU_TRSA_OVERRIDE_FORMAT`)

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

## Description

Binds the CUDA array `hArray` to the texture reference `hTexRef`. Any previous address or CUDA array state associated with the texture reference is superseded by this function. `Flags` must be set to `CU_TRSA_OVERRIDE_FORMAT`. Any CUDA array previously bound to `hTexRef` is unbound.

## See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`, `cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`, `cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetFilterMode (CUtexref hTexRef, CUfilter\_mode fm)

Sets the filtering mode for a texture reference.

## Parameters

### `hTexRef`

- Texture reference

### `fm`

- Filtering mode to set

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

## Description

Specifies the filtering mode `fm` to be used when reading memory through the texture reference `hTexRef`. `CUfilter_mode_enum` is defined as:

```
↑ typedef enum CUfilter_mode_enum {
    CU_TR_FILTER_MODE_POINT = 0,
    CU_TR_FILTER_MODE_LINEAR = 1
} CUfilter_mode;
```

Note that this call has no effect if `hTexRef` is bound to linear memory.

## See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,

[cuTexRefGetAddressMode](#), [cuTexRefGetArray](#), [cuTexRefGetFilterMode](#),  
[cuTexRefGetFlags](#), [cuTexRefGetFormat](#)

## CUresult cuTexRefSetFlags (CUtexref hTexRef, unsigned int Flags)

Sets the flags for a texture reference.

### Parameters

#### hTexRef

- Texture reference

#### Flags

- Optional flags to set

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

### Description

Specifies optional flags via `Flags` to specify the behavior of data returned through the texture reference `hTexRef`. The valid flags are:

- ▶ [CU\\_TRSF\\_READ\\_AS\\_INTEGER](#), which suppresses the default behavior of having the texture promote integer data to floating point data in the range [0, 1]. Note that texture with 32-bit integer format would not be promoted, regardless of whether or not this flag is specified;
- ▶ [CU\\_TRSF\\_NORMALIZED\\_COORDINATES](#), which suppresses the default behavior of having the texture coordinates range from [0, Dim) where Dim is the width or height of the CUDA array. Instead, the texture coordinates [0, 1.0) reference the entire breadth of the array dimension;

### See also:

[cuTexRefSetAddress](#), [cuTexRefSetAddress2D](#), [cuTexRefSetAddressMode](#),  
[cuTexRefSetArray](#), [cuTexRefSetFilterMode](#), [cuTexRefSetFormat](#), [cuTexRefGetAddress](#),  
[cuTexRefGetAddressMode](#), [cuTexRefGetArray](#), [cuTexRefGetFilterMode](#),  
[cuTexRefGetFlags](#), [cuTexRefGetFormat](#)

## CUresult cuTexRefSetFormat (CUtexref hTexRef, CUarray\_format fmt, int NumPackedComponents)

Sets the format for a texture reference.

### Parameters

#### hTexRef

- Texture reference

#### fmt

- Format to set

#### NumPackedComponents

- Number of components per array element

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Specifies the format of the data to be read by the texture reference `hTexRef`. `fmt` and `NumPackedComponents` are exactly analogous to the `Format` and `NumChannels` members of the `CUDA_ARRAY_DESCRIPTOR` structure: They specify the format of each component and the number of components per array element.

### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetMaxAnisotropy (CUtexref hTexRef, unsigned int maxAniso)

Sets the maximum anisotropy for a texture reference.

### Parameters

#### hTexRef

- Texture reference

#### maxAniso

- Maximum anisotropy

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Specifies the maximum anisotropy `maxAniso` to be used when reading memory through the texture reference `hTexRef`.

Note that this call has no effect if `hTexRef` is bound to linear memory.

**See also:**

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetMipmapFilterMode (CUtexref hTexRef, CUfilter\_mode fm)

Sets the mipmap filtering mode for a texture reference.

**Parameters****hTexRef**

- Texture reference

**fm**

- Filtering mode to set

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Specifies the mipmap filtering mode `fm` to be used when reading memory through the texture reference `hTexRef`. `CUfilter_mode_enum` is defined as:

```
↑ typedef enum CUfilter_mode_enum {
    CU_TR_FILTER_MODE_POINT = 0,
    CU_TR_FILTER_MODE_LINEAR = 1
} CUfilter_mode;
```

Note that this call has no effect if `hTexRef` is not bound to a mipmapped array.

**See also:**

[cuTexRefSetAddress](#), [cuTexRefSetAddress2D](#), [cuTexRefSetAddressMode](#),  
[cuTexRefSetArray](#), [cuTexRefSetFlags](#), [cuTexRefSetFormat](#), [cuTexRefGetAddress](#),  
[cuTexRefGetAddressMode](#), [cuTexRefGetArray](#), [cuTexRefGetFilterMode](#),  
[cuTexRefGetFlags](#), [cuTexRefGetFormat](#)

## CUresult cuTexRefSetMipmapLevelBias (CUtexref hTexRef, float bias)

Sets the mipmap level bias for a texture reference.

**Parameters****hTexRef**

- Texture reference

**bias**

- Mipmap level bias

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

**Description**

Specifies the mipmap level bias `bias` to be added to the specified mipmap level when reading memory through the texture reference `hTexRef`.

Note that this call has no effect if `hTexRef` is not bound to a mipmapped array.

**See also:**

[cuTexRefSetAddress](#), [cuTexRefSetAddress2D](#), [cuTexRefSetAddressMode](#),  
[cuTexRefSetArray](#), [cuTexRefSetFlags](#), [cuTexRefSetFormat](#), [cuTexRefGetAddress](#),  
[cuTexRefGetAddressMode](#), [cuTexRefGetArray](#), [cuTexRefGetFilterMode](#),  
[cuTexRefGetFlags](#), [cuTexRefGetFormat](#)



## CUresult cuTexRefSetMipmapLevelClamp (CUtexref hTexRef, float minMipmapLevelClamp, float maxMipmapLevelClamp)

Sets the mipmap min/max mipmap level clamps for a texture reference.

### Parameters

#### **hTexRef**

- Texture reference

#### **minMipmapLevelClamp**

- Mipmap min level clamp

#### **maxMipmapLevelClamp**

- Mipmap max level clamp

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Specifies the min/max mipmap level clamps, `minMipmapLevelClamp` and `maxMipmapLevelClamp` respectively, to be used when reading memory through the texture reference `hTexRef`.

Note that this call has no effect if `hTexRef` is not bound to a mipmapped array.

### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetArray`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## CUresult cuTexRefSetMipmappedArray (CUtexref hTexRef, CUmipmappedArray hMipmappedArray, unsigned int Flags)

Binds a mipmapped array to a texture reference.

### Parameters

#### hTexRef

- Texture reference to bind

#### hMipmappedArray

- Mipmapped array to bind

#### Flags

- Options (must be `CU_TRSA_OVERRIDE_FORMAT`)

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Binds the CUDA mipmapped array `hMipmappedArray` to the texture reference `hTexRef`. Any previous address or CUDA array state associated with the texture reference is superseded by this function. `Flags` must be set to `CU_TRSA_OVERRIDE_FORMAT`. Any CUDA array previously bound to `hTexRef` is unbound.

### See also:

`cuTexRefSetAddress`, `cuTexRefSetAddress2D`, `cuTexRefSetAddressMode`,  
`cuTexRefSetFilterMode`, `cuTexRefSetFlags`, `cuTexRefSetFormat`, `cuTexRefGetAddress`,  
`cuTexRefGetAddressMode`, `cuTexRefGetArray`, `cuTexRefGetFilterMode`,  
`cuTexRefGetFlags`, `cuTexRefGetFormat`

## 2.16. Texture Reference Management [DEPRECATED]

This section describes the deprecated texture reference management functions of the low-level CUDA driver application programming interface.

## CUresult cuTexRefCreate (CUtexref \*pTexRef)

Creates a texture reference.

### Parameters

#### pTexRef

- Returned texture reference

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Deprecated

Creates a texture reference and returns its handle in \*pTexRef. Once created, the application must call `cuTexRefSetArray()` or `cuTexRefSetAddress()` to associate the reference with allocated memory. Other texture reference functions are used to specify the format and interpretation (addressing, filtering, etc.) to be used when the memory is read through this texture reference.

### See also:

[cuTexRefDestroy](#)

## CUresult cuTexRefDestroy (CUtexref hTexRef)

Destroys a texture reference.

### Parameters

#### hTexRef

- Texture reference to destroy

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Deprecated

Destroys the texture reference specified by hTexRef.

**See also:**[cuTexRefCreate](#)

## 2.17. Surface Reference Management

This section describes the surface reference management functions of the low-level CUDA driver application programming interface.

### **CUresult cuSurfRefGetArray (CUarray \*phArray, CUsurfref hSurfRef)**

Passes back the CUDA array bound to a surface reference.

**Parameters****phArray**

- Surface reference handle

**hSurfRef**

- Surface reference handle

**Returns**

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#)

**Description**

Returns in \*phArray the CUDA array bound to the surface reference hSurfRef, or returns [CUDA\\_ERROR\\_INVALID\\_VALUE](#) if the surface reference is not bound to any CUDA array.

**See also:**[cuModuleGetSurfRef](#), [cuSurfRefSetArray](#)

## CUresult cuSurfRefSetArray (CUsurfref hSurfRef, CUarray hArray, unsigned int Flags)

Sets the CUDA array for a surface reference.

### Parameters

#### hSurfRef

- Surface reference handle

#### hArray

- CUDA array handle

#### Flags

- set to 0

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Sets the CUDA array `hArray` to be read and written by the surface reference `hSurfRef`. Any previous CUDA array state associated with the surface reference is superseded by this function. `Flags` must be set to 0. The `CUDA_ARRAY3D_SURFACE_LDST` flag must have been set for the CUDA array. Any CUDA array previously bound to `hSurfRef` is unbound.

### See also:

`cuModuleGetSurfRef`, `cuSurfRefGetArray`

## 2.18. Texture Object Management

This section describes the texture object management functions of the low-level CUDA driver application programming interface. The texture object API is only supported on devices of compute capability 3.0 or higher.

### CUresult cuTexObjectCreate (CUtexObject \*pTexObject, const CUDA\_RESOURCE\_DESC \*pResDesc,

```
const CUDA_TEXTURE_DESC *pTexDesc, const
CUDA_RESOURCE_VIEW_DESC *pResViewDesc)
```

Creates a texture object.

### Parameters

#### **pTexObject**

- Texture object to create

#### **pResDesc**

- Resource descriptor

#### **pTexDesc**

- Texture descriptor

#### **pResViewDesc**

- Resource view descriptor

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Creates a texture object and returns it in `pTexObject`. `pResDesc` describes the data to texture from. `pTexDesc` describes how the data should be sampled. `pResViewDesc` is an optional argument that specifies an alternate format for the data described by `pResDesc`, and also describes the subresource region to restrict access to when texturing. `pResViewDesc` can only be specified if the type of resource is a CUDA array or a CUDA mipmapped array.

Texture objects are only supported on devices of compute capability 3.0 or higher.

The `CUDA_RESOURCE_DESC` structure is defined as:

```
↑ typedef struct CUDA_RESOURCE_DESC_st
    {
        CUresourcetype resType;

        union {
            struct {
                CUarray hArray;
            } array;
            struct {
                CUmipmappedArray hMipmappedArray;
            } mipmap;
            struct {
                CUdeviceptr devPtr;
                CUarray_format format;
                unsigned int numChannels;
                size_t sizeInBytes;
            } linear;
            struct {
                CUdeviceptr devPtr;
```

```

        CUarray_format format;
        unsigned int numChannels;
        size_t width;
        size_t height;
        size_t pitchInBytes;
    } pitch2D;
} res;

    unsigned int flags;
} CUDA_RESOURCE_DESC;

```

where:

- ▶ `CUDA_RESOURCE_DESC::resType` specifies the type of resource to texture from. `CUresourceType` is defined as:

```

typedef enum CUresourcetype_enum {
    CU_RESOURCE_TYPE_ARRAY           = 0x00,
    CU_RESOURCE_TYPE_MIPMAPPED_ARRAY = 0x01,
    CU_RESOURCE_TYPE_LINEAR          = 0x02,
    CU_RESOURCE_TYPE_PITCH2D        = 0x03
} CUresourcetype;

```

If `CUDA_RESOURCE_DESC::resType` is set to `CU_RESOURCE_TYPE_ARRAY`, `CUDA_RESOURCE_DESC::res::array::hArray` must be set to a valid CUDA array handle.

If `CUDA_RESOURCE_DESC::resType` is set to `CU_RESOURCE_TYPE_MIPMAPPED_ARRAY`, `CUDA_RESOURCE_DESC::res::mipmap::hMipmappedArray` must be set to a valid CUDA mipmapped array handle.

If `CUDA_RESOURCE_DESC::resType` is set to `CU_RESOURCE_TYPE_LINEAR`, `CUDA_RESOURCE_DESC::res::linear::devPtr` must be set to a valid device pointer, that is aligned to `CU_DEVICE_ATTRIBUTE_TEXTURE_ALIGNMENT`. `CUDA_RESOURCE_DESC::res::linear::format` and `CUDA_RESOURCE_DESC::res::linear::numChannels` describe the format of each component and the number of components per array element. `CUDA_RESOURCE_DESC::res::linear::sizeInBytes` specifies the size of the array in bytes. The total number of elements in the linear address range cannot exceed `CU_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE1D_LINEAR_WIDTH`. The number of elements is computed as  $(\text{sizeInBytes} / (\text{sizeof}(\text{format}) * \text{numChannels}))$ .

If `CUDA_RESOURCE_DESC::resType` is set to `CU_RESOURCE_TYPE_PITCH2D`, `CUDA_RESOURCE_DESC::res::pitch2D::devPtr` must be set to a valid device pointer, that is aligned to `CU_DEVICE_ATTRIBUTE_TEXTURE_ALIGNMENT`. `CUDA_RESOURCE_DESC::res::pitch2D::format` and `CUDA_RESOURCE_DESC::res::pitch2D::numChannels` describe the format of each component and the number of components per array element. `CUDA_RESOURCE_DESC::res::pitch2D::width` and `CUDA_RESOURCE_DESC::res::pitch2D::height` specify the width and height of the array in elements, and cannot exceed

`CUDA_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_WIDTH` and `CUDA_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_HEIGHT` respectively. `CUDA_RESOURCE_DESC::res::pitch2D::pitchInBytes` specifies the pitch between two rows in bytes and has to be aligned to `CUDA_DEVICE_ATTRIBUTE_TEXTURE_PITCH_ALIGNMENT`. Pitch cannot exceed `CUDA_DEVICE_ATTRIBUTE_MAXIMUM_TEXTURE2D_LINEAR_PITCH`.

- ▶ flags must be set to zero.

The `CUDA_TEXTURE_DESC` struct is defined as

```
typedef struct CUDA_TEXTURE_DESC_st {
    CUaddress_mode addressMode[3];
    CUfilter_mode filterMode;
    unsigned int flags;
    unsigned int maxAnisotropy;
    CUfilter_mode mipmapFilterMode;
    float mipmapLevelBias;
    float minMipmapLevelClamp;
    float maxMipmapLevelClamp;
} CUDA_TEXTURE_DESC;
```

where

- ▶ `CUDA_TEXTURE_DESC::addressMode` specifies the addressing mode for each dimension of the texture data. `CUaddress_mode` is defined as:

```
typedef enum CUaddress_mode_enum {
    CU_TR_ADDRESS_MODE_WRAP = 0,
    CU_TR_ADDRESS_MODE_CLAMP = 1,
    CU_TR_ADDRESS_MODE_MIRROR = 2,
    CU_TR_ADDRESS_MODE_BORDER = 3
} CUaddress_mode;
```

This is ignored if `CUDA_RESOURCE_DESC::resType` is `CU_RESOURCE_TYPE_LINEAR`. Also, if the flag, `CU_TRSF_NORMALIZED_COORDINATES` is not set, the only supported address mode is `CU_TR_ADDRESS_MODE_CLAMP`.

- ▶ `CUDA_TEXTURE_DESC::filterMode` specifies the filtering mode to be used when fetching from the texture. `CUfilter_mode` is defined as:

```
typedef enum CUfilter_mode_enum {
    CU_TR_FILTER_MODE_POINT = 0,
    CU_TR_FILTER_MODE_LINEAR = 1
} CUfilter_mode;
```

This is ignored if `CUDA_RESOURCE_DESC::resType` is `CU_RESOURCE_TYPE_LINEAR`.

- ▶ `CUDA_TEXTURE_DESC::flags` can be any combination of the following:
  - ▶ `CU_TRSF_READ_AS_INTEGER`, which suppresses the default behavior of having the texture promote integer data to floating point data in the range [0, 1]. Note that texture with 32-bit integer format would not be promoted, regardless of whether or not this flag is specified.



- ▶ `CU_TRSF_NORMALIZED_COORDINATES`, which suppresses the default behavior of having the texture coordinates range from  $[0, \text{Dim})$  where  $\text{Dim}$  is the width or height of the CUDA array. Instead, the texture coordinates  $[0, 1.0)$  reference the entire breadth of the array dimension; Note that for CUDA mipmapped arrays, this flag has to be set.
- ▶ `CUDA_TEXTURE_DESC::maxAnisotropy` specifies the maximum anisotropy ratio to be used when doing anisotropic filtering. This value will be clamped to the range  $[1, 16]$ .
- ▶ `CUDA_TEXTURE_DESC::mipmapFilterMode` specifies the filter mode when the calculated mipmap level lies between two defined mipmap levels.
- ▶ `CUDA_TEXTURE_DESC::mipmapLevelBias` specifies the offset to be applied to the calculated mipmap level.
- ▶ `CUDA_TEXTURE_DESC::minMipmapLevelClamp` specifies the lower end of the mipmap level range to clamp access to.
- ▶ `CUDA_TEXTURE_DESC::maxMipmapLevelClamp` specifies the upper end of the mipmap level range to clamp access to.

The `CUDA_RESOURCE_VIEW_DESC` struct is defined as

```
↑ typedef struct CUDA_RESOURCE_VIEW_DESC_st
    {
        CUresourceViewFormat format;
        size_t width;
        size_t height;
        size_t depth;
        unsigned int firstMipmapLevel;
        unsigned int lastMipmapLevel;
        unsigned int firstLayer;
        unsigned int lastLayer;
    } CUDA_RESOURCE_VIEW_DESC;
```

where:

- ▶ `CUDA_RESOURCE_VIEW_DESC::format` specifies how the data contained in the CUDA array or CUDA mipmapped array should be interpreted. Note that this can incur a change in size of the texture data. If the resource view format is a block compressed format, then the underlying CUDA array or CUDA mipmapped array has to have a base of format `CU_AD_FORMAT_UNSIGNED_INT32` with 2 or 4 channels, depending on the block compressed format. For ex., BC1 and BC4 require the underlying CUDA array to have a format of `CU_AD_FORMAT_UNSIGNED_INT32` with 2 channels. The other BC formats require the underlying resource to have the same base format but with 4 channels.
- ▶ `CUDA_RESOURCE_VIEW_DESC::width` specifies the new width of the texture data. If the resource view format is a block compressed format, this value has to be 4 times the original width of the resource. For non block compressed formats, this value has to be equal to that of the original resource.

- ▶ `CUDA_RESOURCE_VIEW_DESC::height` specifies the new height of the texture data. If the resource view format is a block compressed format, this value has to be 4 times the original height of the resource. For non block compressed formats, this value has to be equal to that of the original resource.
- ▶ `CUDA_RESOURCE_VIEW_DESC::depth` specifies the new depth of the texture data. This value has to be equal to that of the original resource.
- ▶ `CUDA_RESOURCE_VIEW_DESC::firstMipmapLevel` specifies the most detailed mipmap level. This will be the new mipmap level zero. For non-mipmapped resources, this value has to be zero. `CUDA_TEXTURE_DESC::minMipmapLevelClamp` and `CUDA_TEXTURE_DESC::maxMipmapLevelClamp` will be relative to this value. For ex., if the `firstMipmapLevel` is set to 2, and a `minMipmapLevelClamp` of 1.2 is specified, then the actual minimum mipmap level clamp will be 3.2.
- ▶ `CUDA_RESOURCE_VIEW_DESC::lastMipmapLevel` specifies the least detailed mipmap level. For non-mipmapped resources, this value has to be zero.
- ▶ `CUDA_RESOURCE_VIEW_DESC::firstLayer` specifies the first layer index for layered textures. This will be the new layer zero. For non-layered resources, this value has to be zero.
- ▶ `CUDA_RESOURCE_VIEW_DESC::lastLayer` specifies the last layer index for layered textures. For non-layered resources, this value has to be zero.

See also:

`cuTexObjectDestroy`

## CUresult cuTexObjectDestroy (CUtexObject texObject)

Destroys a texture object.

### Parameters

#### texObject

- Texture object to destroy

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

### Description

Destroys the texture object specified by `texObject`.

**See also:**[cuTexObjectCreate](#)

## CUresult cuTexObjectGetResourceDesc (CUDA\_RESOURCE\_DESC \*pResDesc, CUtexObject texObject)

Returns a texture object's resource descriptor.

**Parameters****pResDesc**

- Resource descriptor

**texObject**

- Texture object

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the resource descriptor for the texture object specified by `texObject`.

**See also:**[cuTexObjectCreate](#)

## CUresult cuTexObjectGetResourceViewDesc (CUDA\_RESOURCE\_VIEW\_DESC \*pResViewDesc, CUtexObject texObject)

Returns a texture object's resource view descriptor.

**Parameters****pResViewDesc**

- Resource view descriptor

**texObject**

- Texture object

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the resource view descriptor for the texture object specified by `texObject`.  
 If no resource view was set for `texObject`, the `CUDA_ERROR_INVALID_VALUE` is returned.

**See also:**

[cuTexObjectCreate](#)

## CUresult cuTexObjectGetTextureDesc (CUDA\_TEXTURE\_DESC \*pTexDesc, CUtexObject texObject)

Returns a texture object's texture descriptor.

**Parameters****pTexDesc**

- Texture descriptor

**texObject**

- Texture object

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the texture descriptor for the texture object specified by `texObject`.

**See also:**

[cuTexObjectCreate](#)

## 2.19. Surface Object Management

This section describes the surface object management functions of the low-level CUDA driver application programming interface. The surface object API is only supported on devices of compute capability 3.0 or higher.

### CUresult cuSurfObjectCreate (CUsurfObject \*pSurfObject, const CUDA\_RESOURCE\_DESC \*pResDesc)

Creates a surface object.

#### Parameters

##### pSurfObject

- Surface object to create

##### pResDesc

- Resource descriptor

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

#### Description

Creates a surface object and returns it in pSurfObject. pResDesc describes the data to perform surface load/stores on. CUDA\_RESOURCE\_DESC::resType must be CU\_RESOURCE\_TYPE\_ARRAY and CUDA\_RESOURCE\_DESC::res::array::hArray must be set to a valid CUDA array handle. CUDA\_RESOURCE\_DESC::flags must be set to zero.

Surface objects are only supported on devices of compute capability 3.0 or higher.

#### See also:

[cuSurfObjectDestroy](#)

### CUresult cuSurfObjectDestroy (CUsurfObject surfObject)

Destroys a surface object.

#### Parameters

##### surfObject

- Surface object to destroy

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Destroys the surface object specified by `surfObject`.

**See also:**

[cuSurfObjectCreate](#)

## CUresult cuSurfObjectGetResourceDesc (CUDA\_RESOURCE\_DESC \*pResDesc, CUsurfObject surfObject)

Returns a surface object's resource descriptor.

**Parameters****pResDesc**

- Resource descriptor

**surfObject**

- Surface object

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

Returns the resource descriptor for the surface object specified by `surfObject`.

**See also:**

[cuSurfObjectCreate](#)

## 2.20. Peer Context Memory Access

This section describes the direct peer context memory access functions of the low-level CUDA driver application programming interface.

## CUresult cuCtxDisablePeerAccess (CUcontext peerContext)

Disables direct access to memory allocations in a peer context and unregisters any registered allocations.

### Parameters

#### peerContext

- Peer context to disable direct access to

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED,  
 CUDA\_ERROR\_PEER\_ACCESS\_NOT\_ENABLED,  
 CUDA\_ERROR\_INVALID\_CONTEXT,

### Description

Returns `CUDA_ERROR_PEER_ACCESS_NOT_ENABLED` if direct peer access has not yet been enabled from `peerContext` to the current context.

Returns `CUDA_ERROR_INVALID_CONTEXT` if there is no current context, or if `peerContext` is not a valid context.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuDeviceCanAccessPeer`, `cuCtxEnablePeerAccess`

## CUresult cuCtxEnablePeerAccess (CUcontext peerContext, unsigned int Flags)

Enables direct access to memory allocations in a peer context.

### Parameters

#### peerContext

- Peer context to enable direct access to from the current context

#### Flags

- Reserved for future use and must be set to 0

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED,  
 CUDA\_ERROR\_PEER\_ACCESS\_ALREADY\_ENABLED,  
 CUDA\_ERROR\_TOO\_MANY\_PEERS, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_PEER\_ACCESS\_UNSUPPORTED, CUDA\_ERROR\_INVALID\_VALUE

## Description

If both the current context and `peerContext` are on devices which support unified addressing (as may be queried using [CU\\_DEVICE\\_ATTRIBUTE\\_UNIFIED\\_ADDRESSING](#)) and same major compute capability, then on success all allocations from `peerContext` will immediately be accessible by the current context. See [Unified Addressing](#) for additional details.

Note that access granted by this call is unidirectional and that in order to access memory from the current context in `peerContext`, a separate symmetric call to [cuCtxEnablePeerAccess\(\)](#) is required.

Returns [CUDA\\_ERROR\\_PEER\\_ACCESS\\_UNSUPPORTED](#) if [cuDeviceCanAccessPeer\(\)](#) indicates that the [CUdevice](#) of the current context cannot directly access memory from the [CUdevice](#) of `peerContext`.

Returns [CUDA\\_ERROR\\_PEER\\_ACCESS\\_ALREADY\\_ENABLED](#) if direct access of `peerContext` from the current context has already been enabled.

Returns [CUDA\\_ERROR\\_TOO\\_MANY\\_PEERS](#) if direct peer access is not possible because hardware resources required for peer access have been exhausted.

Returns [CUDA\\_ERROR\\_INVALID\\_CONTEXT](#) if there is no current context, `peerContext` is not a valid context, or if the current context is `peerContext`.

Returns [CUDA\\_ERROR\\_INVALID\\_VALUE](#) if `Flags` is not 0.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

[cuDeviceCanAccessPeer](#), [cuCtxDisablePeerAccess](#)



## CUresult cuDeviceCanAccessPeer (int \*canAccessPeer, CUdevice dev, CUdevice peerDev)

Queries if a device may directly access a peer device's memory.

### Parameters

#### canAccessPeer

- Returned access capability

#### dev

- Device from which allocations on `peerDev` are to be directly accessed.

#### peerDev

- Device on which the allocations to be directly accessed by `dev` reside.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_DEVICE

### Description

Returns in `*canAccessPeer` a value of 1 if contexts on `dev` are capable of directly accessing memory from contexts on `peerDev` and 0 otherwise. If direct access of `peerDev` from `dev` is possible, then access may be enabled on two specific contexts by calling `cuCtxEnablePeerAccess()`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuCtxEnablePeerAccess`, `cuCtxDisablePeerAccess`

## 2.21. Graphics Interoperability

This section describes the graphics interoperability functions of the low-level CUDA driver application programming interface.

## CUresult cuGraphicsMapResources (unsigned int count, CUgraphicsResource \*resources, CUstream hStream)

Map graphics resources for access by CUDA.

### Parameters

#### count

- Number of resources to map

#### resources

- Resources to map for CUDA usage

#### hStream

- Stream with which to synchronize

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED,  
 CUDA\_ERROR\_UNKNOWN

### Description

Maps the `count` graphics resources in `resources` for access by CUDA.

The resources in `resources` may be accessed by CUDA until they are unmapped. The graphics API from which `resources` were registered should not access any resources while they are mapped by CUDA. If an application does so, the results are undefined.

This function provides the synchronization guarantee that any graphics calls issued before `cuGraphicsMapResources()` will complete before any subsequent CUDA work issued in `stream` begins.

If `resources` includes any duplicate entries then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `resources` are presently mapped for access by CUDA then `CUDA_ERROR_ALREADY_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuGraphicsResourceGetMappedPointer`, `cuGraphicsSubResourceGetMappedArray`,  
`cuGraphicsUnmapResources`

## CUresult cuGraphicsResourceGetMappedMipmappedArray (CUmipmappedArray \*pMipmappedArray, CUgraphicsResource resource)

Get a mipmapped array through which to access a mapped graphics resource.

### Parameters

#### pMipmappedArray

- Returned mipmapped array through which `resource` may be accessed

#### resource

- Mapped resource to access

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_NOT\_MAPPED, CUDA\_ERROR\_NOT\_MAPPED\_AS\_ARRAY

### Description

Returns in `*pMipmappedArray` a mipmapped array through which the mapped graphics resource `resource`. The value set in `*pMipmappedArray` may change every time that `resource` is mapped.

If `resource` is not a texture then it cannot be accessed via a mipmapped array and `CUDA_ERROR_NOT_MAPPED_AS_ARRAY` is returned. If `resource` is not mapped then `CUDA_ERROR_NOT_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsResourceGetMappedPointer](#)

## CUresult cuGraphicsResourceGetMappedPointer (CUdeviceptr \*pDevPtr, size\_t \*pSize, CUgraphicsResource resource)

Get a device pointer through which to access a mapped graphics resource.

### Parameters

#### pDevPtr

- Returned pointer through which `resource` may be accessed

#### pSize

- Returned size of the buffer accessible starting at \*pPointer

#### resource

- Mapped resource to access

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_NOT\_MAPPED, CUDA\_ERROR\_NOT\_MAPPED\_AS\_POINTER

### Description

Returns in \*pDevPtr a pointer through which the mapped graphics resource `resource` may be accessed. Returns in pSize the size of the memory in bytes which may be accessed from that pointer. The value set in pPointer may change every time that `resource` is mapped.

If `resource` is not a buffer then it cannot be accessed via a pointer and `CUDA_ERROR_NOT_MAPPED_AS_POINTER` is returned. If `resource` is not mapped then `CUDA_ERROR_NOT_MAPPED` is returned. \*



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsMapResources](#), [cuGraphicsSubResourceGetMappedArray](#)

## CUresult cuGraphicsResourceSetMapFlags (CUgraphicsResource resource, unsigned int flags)

Set usage flags for mapping a graphics resource.

### Parameters

#### resource

- Registered resource to set flags for

#### flags

- Parameters for resource mapping

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_ALREADY\_MAPPED

### Description

Set flags for mapping the graphics resource `resource`.

Changes to `flags` will take effect the next time `resource` is mapped. The `flags` argument may be any of the following:

- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA kernels. This is the default value.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_READ_ONLY`: Specifies that CUDA kernels which access this resource will not write to this resource.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_WRITE_DISCARD`: Specifies that CUDA kernels which access this resource will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

If `resource` is presently mapped for access by CUDA then `CUDA_ERROR_ALREADY_MAPPED` is returned. If `flags` is not one of the above values then `CUDA_ERROR_INVALID_VALUE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuGraphicsMapResources

## CUresult cuGraphicsSubResourceGetMappedArray (CUarray \*pArray, CUgraphicsResource resource, unsigned int arrayIndex, unsigned int mipLevel)

Get an array through which to access a subresource of a mapped graphics resource.

### Parameters

#### pArray

- Returned array through which a subresource of `resource` may be accessed

#### resource

- Mapped resource to access

#### arrayIndex

- Array index for array textures or cubemap face index as defined by `CUarray_cubemap_face` for cubemap textures for the subresource to access

#### mipLevel

- Mipmap level for the subresource to access

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_NOT_MAPPED`, `CUDA_ERROR_NOT_MAPPED_AS_ARRAY`

### Description

Returns in `*pArray` an array through which the subresource of the mapped graphics resource `resource` which corresponds to array index `arrayIndex` and mipmap level `mipLevel` may be accessed. The value set in `*pArray` may change every time that `resource` is mapped.

If `resource` is not a texture then it cannot be accessed via an array and `CUDA_ERROR_NOT_MAPPED_AS_ARRAY` is returned. If `arrayIndex` is not a valid array index for `resource` then `CUDA_ERROR_INVALID_VALUE` is returned. If `mipLevel` is not a valid mipmap level for `resource` then `CUDA_ERROR_INVALID_VALUE` is returned. If `resource` is not mapped then `CUDA_ERROR_NOT_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsResourceGetMappedPointer](#)

## CUresult cuGraphicsUnmapResources (unsigned int count, CUgraphicsResource \*resources, CUstream hStream)

Unmap graphics resources.

**Parameters****count**

- Number of resources to unmap

**resources**

- Resources to unmap

**hStream**

- Stream with which to synchronize

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_NOT\_MAPPED, CUDA\_ERROR\_UNKNOWN

**Description**

Unmaps the `count` graphics resources in `resources`.

Once unmapped, the resources in `resources` may not be accessed by CUDA until they are mapped again.

This function provides the synchronization guarantee that any CUDA work issued in `stream` before `cuGraphicsUnmapResources()` will complete before any subsequently issued graphics work begins.

If `resources` includes any duplicate entries then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `resources` are not presently mapped for access by CUDA then `CUDA_ERROR_NOT_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsMapResources`

## CUresult cuGraphicsUnregisterResource (CUgraphicsResource resource)

Unregisters a graphics resource for access by CUDA.

### Parameters

#### **resource**

- Resource to unregister

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_HANDLE`, `CUDA_ERROR_UNKNOWN`

### Description

Unregisters the graphics resource `resource` so it is not accessible by CUDA unless registered again.

If `resource` is invalid then `CUDA_ERROR_INVALID_HANDLE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuGraphicsD3D9RegisterResource`, `cuGraphicsD3D10RegisterResource`,  
`cuGraphicsD3D11RegisterResource`, `cuGraphicsGLRegisterBuffer`,  
`cuGraphicsGLRegisterImage`

## 2.22. Profiler Control

This section describes the profiler control functions of the low-level CUDA driver application programming interface.



## CUresult cuProfilerInitialize (const char \*configFile, const char \*outputFile, CUoutput\_mode outputMode)

Initialize the profiling.

### Parameters

#### configFile

- Name of the config file that lists the counters/options for profiling.

#### outputFile

- Name of the outputFile where the profiling results will be stored.

#### outputMode

- outputMode, can be CU\_OUT\_KEY\_VALUE\_PAIR or CU\_OUT\_CSV.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_PROFILER\_DISABLED

### Description

Using this API user can initialize the CUDA profiler by specifying the configuration file, output file and output file format. This API is generally used to profile different set of counters by looping the kernel launch. The `configFile` parameter can be used to select profiling options including profiler counters. Refer to the "Compute Command Line Profiler User Guide" for supported profiler options and counters.

Limitation: The CUDA profiler cannot be initialized with this API if another profiling tool is already active, as indicated by the `CUDA_ERROR_PROFILER_DISABLED` return code.

Typical usage of the profiling APIs is as follows:

```
for each set of counters/options { cuProfilerInitialize(); //Initialize profiling, set
the counters or options in the config file ... cuProfilerStart(); // code to be profiled
cuProfilerStop(); ... cuProfilerStart(); // code to be profiled cuProfilerStop(); ... }
```



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuProfilerStart](#), [cuProfilerStop](#)

## CUresult cuProfilerStart (void)

Enable profiling.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_CONTEXT

### Description

Enables profile collection by the active profiling tool for the current context. If profiling is already enabled, then `cuProfilerStart()` has no effect.

`cuProfilerStart` and `cuProfilerStop` APIs are used to programmatically control the profiling granularity by allowing profiling to be done only on selective pieces of code.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuProfilerInitialize](#), [cuProfilerStop](#)

## CUresult cuProfilerStop (void)

Disable profiling.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_CONTEXT

### Description

Disables profile collection by the active profiling tool for the current context. If profiling is already disabled, then `cuProfilerStop()` has no effect.

`cuProfilerStart` and `cuProfilerStop` APIs are used to programmatically control the profiling granularity by allowing profiling to be done only on selective pieces of code.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuProfilerInitialize](#), [cuProfilerStart](#)

## 2.23. OpenGL Interoperability

This section describes the OpenGL interoperability functions of the low-level CUDA driver application programming interface. Note that mapping of OpenGL resources is performed with the graphics API agnostic, resource mapping interface described in [Graphics Interoperability](#).

### OpenGL Interoperability [DEPRECATED]

#### enum CUGLDeviceList

CUDA devices corresponding to an OpenGL device

##### Values

**CU\_GL\_DEVICE\_LIST\_ALL = 0x01**

The CUDA devices for all GPUs used by the current OpenGL context

**CU\_GL\_DEVICE\_LIST\_CURRENT\_FRAME = 0x02**

The CUDA devices for the GPUs used by the current OpenGL context in its currently rendering frame

**CU\_GL\_DEVICE\_LIST\_NEXT\_FRAME = 0x03**

The CUDA devices for the GPUs to be used by the current OpenGL context in the next frame

#### CUresult cuGLGetDevices (unsigned int \*pCudaDeviceCount, CUdevice \*pCudaDevices, unsigned int cudaDeviceCount, CUGLDeviceList deviceList)

Gets the CUDA devices associated with the current OpenGL context.

##### Parameters

###### pCudaDeviceCount

- Returned number of CUDA devices.

###### pCudaDevices

- Returned CUDA devices.

###### cudaDeviceCount

- The size of the output device array pCudaDevices.

###### deviceList

- The set of devices to return.

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_NO\_DEVICE, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_CONTEXT

**Description**

Returns in `*pCudaDeviceCount` the number of CUDA-compatible devices corresponding to the current OpenGL context. Also returns in `*pCudaDevices` at most `cudaDeviceCount` of the CUDA-compatible devices corresponding to the current OpenGL context. If any of the GPUs being used by the current OpenGL context are not CUDA capable then the call will return `CUDA_ERROR_NO_DEVICE`.

The `deviceList` argument may be any of the following:

- ▶ `CU_GL_DEVICE_LIST_ALL`: Query all devices used by the current OpenGL context.
- ▶ `CU_GL_DEVICE_LIST_CURRENT_FRAME`: Query the devices used by the current OpenGL context to render the current frame (in SLI).
- ▶ `CU_GL_DEVICE_LIST_NEXT_FRAME`: Query the devices used by the current OpenGL context to render the next frame (in SLI). Note that this is a prediction, it can't be guaranteed that this is correct in all cases.



- ▶ This function is not supported on Mac OS X.
- ▶ Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuWGLGetDevice](#)

## CUresult cuGraphicsGLRegisterBuffer (CUgraphicsResource \*pCudaResource, GLuint buffer, unsigned int Flags)

Registers an OpenGL buffer object.

**Parameters****pCudaResource**

- Pointer to the returned object handle

**buffer**

- name of buffer object to be registered

**Flags**

- Register flags

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_ALREADY_MAPPED`, `CUDA_ERROR_INVALID_CONTEXT`,

## Description

Registers the buffer object specified by `buffer` for access by CUDA. A handle to the registered object is returned as `pCudaResource`. The register flags `Flags` specify the intended usage, as follows:

- ▶ `CU_GRAPHICS_REGISTER_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA. This is the default value.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_READ_ONLY`: Specifies that CUDA will not write to this resource.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_WRITE_DISCARD`: Specifies that CUDA will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuGraphicsUnregisterResource`, `cuGraphicsMapResources`,  
`cuGraphicsResourceGetMappedPointer`

## CUresult cuGraphicsGLRegisterImage (CUgraphicsResource \*pCudaResource, GLuint image, GLenum target, unsigned int Flags)

Register an OpenGL texture or renderbuffer object.

### Parameters

#### **pCudaResource**

- Pointer to the returned object handle

#### **image**

- name of texture or renderbuffer object to be registered

#### **target**

- Identifies the type of object specified by `image`

#### **Flags**

- Register flags

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_ALREADY\_MAPPED, CUDA\_ERROR\_INVALID\_CONTEXT,

## Description

Registers the texture or renderbuffer object specified by `image` for access by CUDA. A handle to the registered object is returned as `pCudaResource`.

`target` must match the type of the object, and must be one of `GL_TEXTURE_2D`, `GL_TEXTURE_RECTANGLE`, `GL_TEXTURE_CUBE_MAP`, `GL_TEXTURE_3D`, `GL_TEXTURE_2D_ARRAY`, or `GL_RENDERBUFFER`.

The register flags `Flags` specify the intended usage, as follows:

- ▶ `CU_GRAPHICS_REGISTER_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA. This is the default value.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_READ_ONLY`: Specifies that CUDA will not write to this resource.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_WRITE_DISCARD`: Specifies that CUDA will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_SURFACE_LDST`: Specifies that CUDA will bind this resource to a surface reference.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_TEXTURE_GATHER`: Specifies that CUDA will perform texture gather operations on this resource.

The following image formats are supported. For brevity's sake, the list is abbreviated. For ex., `{GL_R, GL_RG} X {8, 16}` would expand to the following 4 formats `{GL_R8, GL_R16, GL_RG8, GL_RG16}` :

- ▶ `GL_RED, GL_RG, GL_RGBA, GL_LUMINANCE, GL_ALPHA, GL_LUMINANCE_ALPHA, GL_INTENSITY`
- ▶ `{GL_R, GL_RG, GL_RGBA} X {8, 16, 16F, 32F, 8UI, 16UI, 32UI, 8I, 16I, 32I}`
- ▶ `{GL_LUMINANCE, GL_ALPHA, GL_LUMINANCE_ALPHA, GL_INTENSITY} X {8, 16, 16F_ARB, 32F_ARB, 8UI_EXT, 16UI_EXT, 32UI_EXT, 8I_EXT, 16I_EXT, 32I_EXT}`

The following image classes are currently disallowed:

- ▶ Textures with borders
- ▶ Multisampled renderbuffers



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsUnregisterResource](#), [cuGraphicsMapResources](#),  
[cuGraphicsSubResourceGetMappedArray](#)

## CUresult cuWGLGetDevice (CUdevice \*pDevice, HGPUNV hGpu)

Gets the CUDA device associated with hGpu.

**Parameters**

**pDevice**

- Device associated with hGpu

**hGpu**

- Handle to a GPU, as queried via `WGL_NV_gpu_affinity()`

**Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

**Description**

Returns in \*pDevice the CUDA device associated with a hGpu, if applicable.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGLMapBufferObject](#), [cuGLRegisterBufferObject](#), [cuGLUnmapBufferObject](#),  
[cuGLUnregisterBufferObject](#), [cuGLUnmapBufferObjectAsync](#),  
[cuGLSetBufferObjectMapFlags](#)

### 2.23.1. OpenGL Interoperability [DEPRECATED]

#### OpenGL Interoperability

This section describes deprecated OpenGL interoperability functionality.

## enum CUGLmap\_flags

Flags to map or unmap a resource

### Values

`CU_GL_MAP_RESOURCE_FLAGS_NONE = 0x00`

`CU_GL_MAP_RESOURCE_FLAGS_READ_ONLY = 0x01`

`CU_GL_MAP_RESOURCE_FLAGS_WRITE_DISCARD = 0x02`

## CUresult cuGLCtxCreate (CUcontext \*pCtx, unsigned int Flags, CUdevice device)

Create a CUDA context for interoperability with OpenGL.

### Parameters

#### pCtx

- Returned CUDA context

#### Flags

- Options for CUDA context creation

#### device

- Device on which to create the context

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_OUT_OF_MEMORY`

### Description

**Deprecated** This function is deprecated as of Cuda 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with an OpenGL context in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuCtxCreate`, `cuGLInit`, `cuGLMapBufferObject`, `cuGLRegisterBufferObject`,  
`cuGLUnmapBufferObject`, `cuGLUnregisterBufferObject`, `cuGLMapBufferObjectAsync`,  
`cuGLUnmapBufferObjectAsync`, `cuGLSetBufferObjectMapFlags`, `cuWGLGetDevice`



## CUresult cuGLInit (void)

Initializes OpenGL interoperability.

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_UNKNOWN

### Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Initializes OpenGL interoperability. This function is deprecated and calling it is no longer required. It may fail if the needed OpenGL driver facilities are not available.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuGLMapBufferObject, cuGLRegisterBufferObject, cuGLUnmapBufferObject,  
 cuGLUnregisterBufferObject, cuGLMapBufferObjectAsync,  
 cuGLUnmapBufferObjectAsync, cuGLSetBufferObjectMapFlags, cuWGLGetDevice

## CUresult cuGLMapBufferObject (CUdeviceptr \*dptr, size\_t \*size, GLuint buffer)

Maps an OpenGL buffer object.

### Parameters

#### dptr

- Returned mapped base pointer

#### size

- Returned size of mapping

#### buffer

- The name of the buffer object to map

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_MAP\_FAILED

## Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Maps the buffer object specified by `buffer` into the address space of the current CUDA context and returns in `*dptr` and `*size` the base pointer and size of the resulting mapping.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same shareGroup, as the context that was bound when the buffer was registered.

All streams in the current CUDA context are synchronized with the current GL context.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

[cuGraphicsMapResources](#)

## CUresult cuGLMapBufferObjectAsync (CUdeviceptr \*dptr, size\_t \*size, GLuint buffer, CUstream hStream)

Maps an OpenGL buffer object.

## Parameters

### **dptr**

- Returned mapped base pointer

### **size**

- Returned size of mapping

### **buffer**

- The name of the buffer object to map

### **hStream**

- Stream to synchronize

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_MAP\_FAILED

## Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Maps the buffer object specified by `buffer` into the address space of the current CUDA context and returns in `*dptr` and `*size` the base pointer and size of the resulting mapping.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same `shareGroup`, as the context that was bound when the buffer was registered.

Stream `hStream` in the current CUDA context is synchronized with the current GL context.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuGraphicsMapResources](#)

## CUresult cuGLRegisterBufferObject (GLuint buffer)

Registers an OpenGL buffer object.

#### Parameters

##### **buffer**

- The name of the buffer object to register.

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_ALREADY_MAPPED`

#### Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Registers the buffer object specified by `buffer` for access by CUDA. This function must be called before CUDA can map the buffer object. There must be a valid OpenGL context bound to the current thread when this function is called, and the buffer name is resolved by that context.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsGLRegisterBuffer](#)

## CUresult cuGLSetBufferObjectMapFlags (GLuint buffer, unsigned int Flags)

Set the map flags for an OpenGL buffer object.

**Parameters****buffer**

- Buffer object to unmap

**Flags**

- Map flags

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_NOT\_INITIALIZED,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED,  
CUDA\_ERROR\_INVALID\_CONTEXT,

**Description**

**Deprecated** This function is deprecated as of Cuda 3.0.

Sets the map flags for the buffer object specified by `buffer`.

Changes to `Flags` will take effect the next time `buffer` is mapped. The `Flags` argument may be any of the following:

- ▶ `CU_GL_MAP_RESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA kernels. This is the default value.
- ▶ `CU_GL_MAP_RESOURCE_FLAGS_READ_ONLY`: Specifies that CUDA kernels which access this resource will not write to this resource.
- ▶ `CU_GL_MAP_RESOURCE_FLAGS_WRITE_DISCARD`: Specifies that CUDA kernels which access this resource will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

If `buffer` has not been registered for use with CUDA, then

`CUDA_ERROR_INVALID_HANDLE` is returned. If `buffer` is presently mapped for access by CUDA, then `CUDA_ERROR_ALREADY_MAPPED` is returned.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same `shareGroup`, as the context that was bound when the buffer was registered.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsResourceSetMapFlags](#)

## CUresult cuGLUnmapBufferObject (GLuint buffer)

Unmaps an OpenGL buffer object.

**Parameters**

**buffer**

- Buffer object to unmap

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

**Description**

**Deprecated** This function is deprecated as of Cuda 3.0.

Unmaps the buffer object specified by `buffer` for access by CUDA.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same shareGroup, as the context that was bound when the buffer was registered.

All streams in the current CUDA context are synchronized with the current GL context.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsUnmapResources](#)

## CUresult cuGLUnmapBufferObjectAsync (GLuint buffer, CUstream hStream)

Unmaps an OpenGL buffer object.

### Parameters

#### **buffer**

- Name of the buffer object to unmap

#### **hStream**

- Stream to synchronize

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE

### Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Unmaps the buffer object specified by `buffer` for access by CUDA.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same shareGroup, as the context that was bound when the buffer was registered.

Stream `hStream` in the current CUDA context is synchronized with the current GL context.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsUnmapResources](#)

## CUresult cuGLUnregisterBufferObject (GLuint buffer)

Unregister an OpenGL buffer object.

### Parameters

#### **buffer**

- Name of the buffer object to unregister

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`

## Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Unregisters the buffer object specified by `buffer`. This releases any resources associated with the registered buffer. After this call, the buffer may no longer be mapped for access by CUDA.

There must be a valid OpenGL context bound to the current thread when this function is called. This must be the same context, or a member of the same `shareGroup`, as the context that was bound when the buffer was registered.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuGraphicsUnregisterResource`

## 2.24. Direct3D 9 Interoperability

This section describes the Direct3D 9 interoperability functions of the low-level CUDA driver application programming interface. Note that mapping of Direct3D 9 resources is performed with the graphics API agnostic, resource mapping interface described in [Graphics Interoperability](#).

### Direct3D 9 Interoperability [DEPRECATED]

#### enum CUd3d9DeviceList

CUDA devices corresponding to a D3D9 device

#### Values

`CU_D3D9_DEVICE_LIST_ALL = 0x01`

The CUDA devices for all GPUs used by a D3D9 device

`CU_D3D9_DEVICE_LIST_CURRENT_FRAME = 0x02`

The CUDA devices for the GPUs used by a D3D9 device in its currently rendering frame

`CU_D3D9_DEVICE_LIST_NEXT_FRAME = 0x03`

The CUDA devices for the GPUs to be used by a D3D9 device in the next frame

## **CUresult cuD3D9CtxCreate (CUcontext \*pCtx, CUdevice \*pCudaDevice, unsigned int Flags, IDirect3DDevice9 \*pD3DDevice)**

Create a CUDA context for interoperability with Direct3D 9.

### **Parameters**

#### **pCtx**

- Returned newly created CUDA context

#### **pCudaDevice**

- Returned pointer to the device on which the context was created

#### **Flags**

- Context creation flags (see `cuCtxCreate()` for details)

#### **pD3DDevice**

- Direct3D device to create interoperability context with

### **Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_OUT_OF_MEMORY`, `CUDA_ERROR_UNKNOWN`

### **Description**

Creates a new CUDA context, enables interoperability for that context with the Direct3D device `pD3DDevice`, and associates the created CUDA context with the calling thread. The created `CUcontext` will be returned in `*pCtx`. Direct3D resources from this device may be registered and mapped through the lifetime of this CUDA context. If `pCudaDevice` is non-NULL then the `CUdevice` on which this CUDA context was created will be returned in `*pCudaDevice`.

On success, this call will increase the internal reference count on `pD3DDevice`. This reference count will be decremented upon destruction of this context through `cuCtxDestroy()`. This context will cease to function if `pD3DDevice` is destroyed or encounters an error.

Note that this function is never required for correct functionality. Use of this function will result in accelerated interoperability only when the operating system is Windows Vista or Windows 7, and the device `pD3DDevice` is not an `IDirect3DDevice9Ex`. In all other circumstances, this function is not necessary.





Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuD3D9GetDevice](#), [cuGraphicsD3D9RegisterResource](#)

## CUresult cuD3D9CtxCreateOnDevice (CUcontext \*pCtx, unsigned int flags, IDirect3DDevice9 \*pD3DDevice, CUdevice cudaDevice)

Create a CUDA context for interoperability with Direct3D 9.

### Parameters

#### pCtx

- Returned newly created CUDA context

#### flags

- Context creation flags (see [cuCtxCreate\(\)](#) for details)

#### pD3DDevice

- Direct3D device to create interoperability context with

#### cudaDevice

- The CUDA device on which to create the context. This device must be among the devices returned when querying CU\_D3D9\_DEVICES\_ALL from [cuD3D9GetDevices](#).

### Returns

CU\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

### Description

Creates a new CUDA context, enables interoperability for that context with the Direct3D device `pD3DDevice`, and associates the created CUDA context with the calling thread. The created `CUcontext` will be returned in `*pCtx`. Direct3D resources from this device may be registered and mapped through the lifetime of this CUDA context.

On success, this call will increase the internal reference count on `pD3DDevice`. This reference count will be decremented upon destruction of this context through [cuCtxDestroy\(\)](#). This context will cease to function if `pD3DDevice` is destroyed or encounters an error.

Note that this function is never required for correct functionality. Use of this function will result in accelerated interoperability only when the operating system is Windows

Vista or Windows 7, and the device `pD3DDdevice` is not an `IDirect3DDevice9Ex`. In all other circumstances, this function is not necessary.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuD3D9GetDevices](#), [cuGraphicsD3D9RegisterResource](#)

## CUresult cuD3D9GetDevice (CUdevice \*pCudaDevice, const char \*pszAdapterName)

Gets the CUDA device corresponding to a display adapter.

#### Parameters

##### **pCudaDevice**

- Returned CUDA device corresponding to `pszAdapterName`

##### **pszAdapterName**

- Adapter name to query for device

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_NOT_FOUND`, `CUDA_ERROR_UNKNOWN`

#### Description

Returns in `*pCudaDevice` the CUDA-compatible device corresponding to the adapter name `pszAdapterName` obtained from `EnumDisplayDevices()` or `IDirect3D9::GetAdapterIdentifier()`.

If no device on the adapter with name `pszAdapterName` is CUDA-compatible, then the call will fail.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuD3D9CtxCreate](#)

## CUresult cuD3D9GetDevices (unsigned int \*pCudaDeviceCount, CUdevice \*pCudaDevices, unsigned int cudaDeviceCount, IDirect3DDevice9 \*pD3D9Device, CUd3d9DeviceList deviceList)

Gets the CUDA devices corresponding to a Direct3D 9 device.

### Parameters

#### pCudaDeviceCount

- Returned number of CUDA devices corresponding to pD3D9Device

#### pCudaDevices

- Returned CUDA devices corresponding to pD3D9Device

#### cudaDeviceCount

- The size of the output device array pCudaDevices

#### pD3D9Device

- Direct3D 9 device to query for CUDA devices

#### deviceList

- The set of devices to return. This set may be [CU\\_D3D9\\_DEVICE\\_LIST\\_ALL](#) for all devices, [CU\\_D3D9\\_DEVICE\\_LIST\\_CURRENT\\_FRAME](#) for the devices used to render the current frame (in SLI), or [CU\\_D3D9\\_DEVICE\\_LIST\\_NEXT\\_FRAME](#) for the devices used to render the next frame (in SLI).

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_NO\\_DEVICE](#),  
[CUDA\\_ERROR\\_INVALID\\_VALUE](#), [CUDA\\_ERROR\\_NOT\\_FOUND](#),  
[CUDA\\_ERROR\\_UNKNOWN](#)

### Description

Returns in \*pCudaDeviceCount the number of CUDA-compatible device corresponding to the Direct3D 9 device pD3D9Device. Also returns in \*pCudaDevices at most cudaDeviceCount of the CUDA-compatible devices corresponding to the Direct3D 9 device pD3D9Device.

If any of the GPUs being used to render pDevice are not CUDA capable then the call will return [CUDA\\_ERROR\\_NO\\_DEVICE](#).



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**[cuD3D9CtxCreate](#)

## CUresult cuD3D9GetDirect3DDevice (IDirect3DDevice9 \*\*ppD3DDevice)

Get the Direct3D 9 device against which the current CUDA context was created.

**Parameters****ppD3DDevice**

- Returned Direct3D device corresponding to CUDA context

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT

**Description**

Returns in \*ppD3DDevice the Direct3D device against which this CUDA context was created in [cuD3D9CtxCreate\(\)](#).



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**[cuD3D9GetDevice](#)

## CUresult cuGraphicsD3D9RegisterResource (CUgraphicsResource \*pCudaResource, IDirect3DResource9 \*pD3DResource, unsigned int Flags)

Register a Direct3D 9 resource for access by CUDA.

**Parameters****pCudaResource**

- Returned graphics resource handle

**pD3DResource**

- Direct3D resource to register

**Flags**

- Parameters for resource registration

## Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

## Description

Registers the Direct3D 9 resource `pD3DResource` for access by CUDA and returns a CUDA handle to `pD3DResource` in `pCudaResource`. The handle returned in `pCudaResource` may be used to map and unmap this resource until it is unregistered. On success this call will increase the internal reference count on `pD3DResource`. This reference count will be decremented when this resource is unregistered through `cuGraphicsUnregisterResource()`.

This call is potentially high-overhead and should not be called every frame in interactive applications.

The type of `pD3DResource` must be one of the following.

- ▶ `IDirect3DVertexBuffer9`: may be accessed through a device pointer
- ▶ `IDirect3DIndexBuffer9`: may be accessed through a device pointer
- ▶ `IDirect3DSurface9`: may be accessed through an array. Only stand-alone objects of type `IDirect3DSurface9` may be explicitly shared. In particular, individual mipmap levels and faces of cube maps may not be registered directly. To access individual surfaces associated with a texture, one must register the base texture object.
- ▶ `IDirect3DBaseTexture9`: individual surfaces on this texture may be accessed through an array.

The `Flags` argument may be used to specify additional parameters at register time. The valid values for this parameter are

- ▶ `CU_GRAPHICS_REGISTER_FLAGS_NONE`: Specifies no hints about how this resource will be used.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_SURFACE_LDST`: Specifies that CUDA will bind this resource to a surface reference.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_TEXTURE_GATHER`: Specifies that CUDA will perform texture gather operations on this resource.

Not all Direct3D resources of the above types may be used for interoperability with CUDA. The following are some limitations.

- ▶ The primary rendertarget may not be registered with CUDA.
- ▶ Resources allocated as shared may not be registered with CUDA.
- ▶ Textures which are not of a format which is 1, 2, or 4 channels of 8, 16, or 32-bit integer or floating-point data cannot be shared.
- ▶ Surfaces of depth or stencil formats cannot be shared.

If Direct3D interoperability is not initialized for this context using `cuD3D9CtxCreate` then `CUDA_ERROR_INVALID_CONTEXT` is returned. If `pD3DResource` is of incorrect type or is already registered then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pD3DResource` cannot be registered then `CUDA_ERROR_UNKNOWN` is returned. If `Flags` is not one of the above specified value then `CUDA_ERROR_INVALID_VALUE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuD3D9CtxCreate`, `cuGraphicsUnregisterResource`, `cuGraphicsMapResources`, `cuGraphicsSubResourceGetMappedArray`, `cuGraphicsResourceGetMappedPointer`

## 2.24.1. Direct3D 9 Interoperability [DEPRECATED]

### Direct3D 9 Interoperability

This section describes deprecated Direct3D 9 interoperability functionality.

#### enum CUd3d9map\_flags

Flags to map or unmap a resource

##### Values

```
CU_D3D9_MAPRESOURCE_FLAGS_NONE = 0x00
CU_D3D9_MAPRESOURCE_FLAGS_READONLY = 0x01
CU_D3D9_MAPRESOURCE_FLAGS_WRITEDISCARD = 0x02
```

#### enum CUd3d9register\_flags

Flags to register a resource

##### Values

```
CU_D3D9_REGISTER_FLAGS_NONE = 0x00
CU_D3D9_REGISTER_FLAGS_ARRAY = 0x01
```

## CUresult cuD3D9MapResources (unsigned int count, IDirect3DResource9 \*\*ppResource)

Map Direct3D resources for access by CUDA.

### Parameters

#### count

- Number of resources in ppResource

#### ppResource

- Resources to map for CUDA usage

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED, CUDA\_ERROR\_UNKNOWN

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Maps the `count` Direct3D resources in `ppResource` for access by CUDA.

The resources in `ppResource` may be accessed in CUDA kernels until they are unmapped. Direct3D should not access any resources while they are mapped by CUDA. If an application does so the results are undefined.

This function provides the synchronization guarantee that any Direct3D calls issued before `cuD3D9MapResources()` will complete before any CUDA kernels issued after `cuD3D9MapResources()` begin.

If any of `ppResource` have not been registered for use with CUDA or if `ppResource` contains any duplicate entries, then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `ppResource` are presently mapped for access by CUDA, then `CUDA_ERROR_ALREADY_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsMapResources](#)

## CUresult cuD3D9RegisterResource (IDirect3DResource9 \*pResource, unsigned int Flags)

Register a Direct3D resource for access by CUDA.

### Parameters

#### pResource

- Resource to register for CUDA access

#### Flags

- Flags for resource registration

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Registers the Direct3D resource pResource for access by CUDA.

If this call is successful, then the application will be able to map and unmap this resource until it is unregistered through [cuD3D9UnregisterResource\(\)](#). Also on success, this call will increase the internal reference count on pResource. This reference count will be decremented when this resource is unregistered through [cuD3D9UnregisterResource\(\)](#).

This call is potentially high-overhead and should not be called every frame in interactive applications.

The type of pResource must be one of the following.

- ▶ IDirect3DVertexBuffer9: Cannot be used with Flags set to CU\_D3D9\_REGISTER\_FLAGS\_ARRAY.
- ▶ IDirect3DIndexBuffer9: Cannot be used with Flags set to CU\_D3D9\_REGISTER\_FLAGS\_ARRAY.
- ▶ IDirect3DSurface9: Only stand-alone objects of type IDirect3DSurface9 may be explicitly shared. In particular, individual mipmap levels and faces of cube maps may not be registered directly. To access individual surfaces associated with a texture, one must register the base texture object. For restrictions on the Flags parameter, see type IDirect3DBaseTexture9.
- ▶ IDirect3DBaseTexture9: When a texture is registered, all surfaces associated with the all mipmap levels of all faces of the texture will be accessible to CUDA.



The `Flags` argument specifies the mechanism through which CUDA will access the Direct3D resource. The following values are allowed.

- ▶ `CUDA_D3D9_REGISTER_FLAGS_NONE`: Specifies that CUDA will access this resource through a `CUDA_DEVICEPTR`. The pointer, size, and (for textures), pitch for each subresource of this allocation may be queried through `cuD3D9ResourceGetMappedPointer()`, `cuD3D9ResourceGetMappedSize()`, and `cuD3D9ResourceGetMappedPitch()` respectively. This option is valid for all resource types.
- ▶ `CUDA_D3D9_REGISTER_FLAGS_ARRAY`: Specifies that CUDA will access this resource through a `CUDA_ARRAY` queried on a sub-resource basis through `cuD3D9ResourceGetMappedArray()`. This option is only valid for resources of type `IDirect3DSurface9` and subtypes of `IDirect3DBaseTexture9`.

Not all Direct3D resources of the above types may be used for interoperability with CUDA. The following are some limitations.

- ▶ The primary rendertarget may not be registered with CUDA.
- ▶ Resources allocated as shared may not be registered with CUDA.
- ▶ Any resources allocated in `D3DPOOL_SYSTEMMEM` or `D3DPOOL_MANAGED` may not be registered with CUDA.
- ▶ Textures which are not of a format which is 1, 2, or 4 channels of 8, 16, or 32-bit integer or floating-point data cannot be shared.
- ▶ Surfaces of depth or stencil formats cannot be shared.

If Direct3D interoperability is not initialized on this context, then `CUDA_ERROR_INVALID_CONTEXT` is returned. If `pResource` is of incorrect type (e.g. is a non-stand-alone `IDirect3DSurface9`) or is already registered, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` cannot be registered then `CUDA_ERROR_UNKNOWN` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsD3D9RegisterResource](#)

## CUresult cuD3D9ResourceGetMappedArray (CUarray \*pArray, IDirect3DResource9 \*pResource, unsigned int Face, unsigned int Level)

Get an array through which to access a subresource of a Direct3D resource which has been mapped for access by CUDA.

### Parameters

#### pArray

- Returned array corresponding to subresource

#### pResource

- Mapped resource to access

#### Face

- Face of resource to access

#### Level

- Level of resource to access

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_NOT\_MAPPED

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in \*pArray an array through which the subresource of the mapped Direct3D resource pResource which corresponds to Face and Level may be accessed. The value set in pArray may change every time that pResource is mapped.

If pResource is not registered then CUDA\_ERROR\_INVALID\_HANDLE is returned. If pResource was not registered with usage flags CU\_D3D9\_REGISTER\_FLAGS\_ARRAY then CUDA\_ERROR\_INVALID\_HANDLE is returned. If pResource is not mapped then CUDA\_ERROR\_NOT\_MAPPED is returned.

For usage requirements of Face and Level parameters, see cuD3D9ResourceGetMappedPointer().



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuGraphicsSubResourceGetMappedArray`

**CUresult cuD3D9ResourceGetMappedPitch** (`size_t *pPitch`, `size_t *pPitchSlice`, `IDirect3DResource9 *pResource`, `unsigned int Face`, `unsigned int Level`)

Get the pitch of a subresource of a Direct3D resource which has been mapped for access by CUDA.

### Parameters

#### **pPitch**

- Returned pitch of subresource

#### **pPitchSlice**

- Returned Z-slice pitch of subresource

#### **pResource**

- Mapped resource to access

#### **Face**

- Face of resource to access

#### **Level**

- Level of resource to access

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_NOT_MAPPED`

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pPitch` and `*pPitchSlice` the pitch and Z-slice pitch of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `Face` and `Level`. The values set in `pPitch` and `pPitchSlice` may change every time that `pResource` is mapped.

The pitch and Z-slice pitch values may be used to compute the location of a sample on a surface as follows.

For a 2D surface, the byte offset of the sample at position `x`, `y` from the base pointer of the surface is:

$$y * \text{pitch} + (\text{bytes per pixel}) * x$$

For a 3D surface, the byte offset of the sample at position `x`, `y`, `z` from the base pointer of the surface is:

$z * \text{slicePitch} + y * \text{pitch} + (\text{bytes per pixel}) * x$

Both parameters `pPitch` and `pPitchSlice` are optional and may be set to `NULL`.

If `pResource` is not of type `IDirect3DBaseTexture9` or one of its subtypes or if `pResource` has not been registered for use with CUDA, then `cudaErrorInvalidResourceHandle` is returned. If `pResource` was not registered with usage flags `CU_D3D9_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped for access by CUDA then `CUDA_ERROR_NOT_MAPPED` is returned.

For usage requirements of `Face` and `Level` parameters, see `cuD3D9ResourceGetMappedPointer()`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsSubResourceGetMappedArray`

**CUresult cuD3D9ResourceGetMappedPointer (CUdeviceptr \*pDevPtr, IDirect3DResource9 \*pResource, unsigned int Face, unsigned int Level)**

Get the pointer through which to access a subresource of a Direct3D resource which has been mapped for access by CUDA.

#### Parameters

##### **pDevPtr**

- Returned pointer corresponding to subresource

##### **pResource**

- Mapped resource to access

##### **Face**

- Face of resource to access

##### **Level**

- Level of resource to access

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_NOT_MAPPED`

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pDevPtr` the base pointer of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `Face` and `Level`. The value set in `pDevPtr` may change every time that `pResource` is mapped.

If `pResource` is not registered, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` was not registered with usage flags `CU_D3D9_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped, then `CUDA_ERROR_NOT_MAPPED` is returned.

If `pResource` is of type `IDirect3DCubeTexture9`, then `Face` must be one of the values enumerated by type `D3DCUBEMAP_FACES`. For all other types `Face` must be 0. If `Face` is invalid, then `CUDA_ERROR_INVALID_VALUE` is returned.

If `pResource` is of type `IDirect3DBaseTexture9`, then `Level` must correspond to a valid mipmap level. At present only mipmap level 0 is supported. For all other types `Level` must be 0. If `Level` is invalid, then `CUDA_ERROR_INVALID_VALUE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

[cuGraphicsResourceGetMappedPointer](#)

## CUresult cuD3D9ResourceGetMappedSize (size\_t \*pSize, IDirect3DResource9 \*pResource, unsigned int Face, unsigned int Level)

Get the size of a subresource of a Direct3D resource which has been mapped for access by CUDA.

### Parameters

#### **pSize**

- Returned size of subresource

#### **pResource**

- Mapped resource to access

#### **Face**

- Face of resource to access

#### **Level**

- Level of resource to access

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_NOT\_MAPPED

**Description**

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pSize` the size of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `Face` and `Level`. The value set in `pSize` may change every time that `pResource` is mapped.

If `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` was not registered with usage flags `CU_D3D9_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped for access by CUDA, then `CUDA_ERROR_NOT_MAPPED` is returned.

For usage requirements of `Face` and `Level` parameters, see `cuD3D9ResourceGetMappedPointer`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsResourceGetMappedPointer`

**CUresult cuD3D9ResourceGetSurfaceDimensions** (`size_t *pWidth`, `size_t *pHeight`, `size_t *pDepth`, `IDirect3DResource9 *pResource`, `unsigned int Face`, `unsigned int Level`)

Get the dimensions of a registered surface.

**Parameters****pWidth**

- Returned width of surface

**pHeight**

- Returned height of surface

**pDepth**

- Returned depth of surface

**pResource**

- Registered resource to access

**Face**

- Face of resource to access

**Level**

- Level of resource to access

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE

**Description**

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pWidth`, `*pHeight`, and `*pDepth` the dimensions of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `Face` and `Level`.

Because anti-aliased surfaces may have multiple samples per pixel, it is possible that the dimensions of a resource will be an integer factor larger than the dimensions reported by the Direct3D runtime.

The parameters `pWidth`, `pHeight`, and `pDepth` are optional. For 2D surfaces, the value returned in `*pDepth` will be 0.

If `pResource` is not of type `IDirect3DBaseTexture9` or `IDirect3DSurface9` or if `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned.

For usage requirements of `Face` and `Level` parameters, see `cuD3D9ResourceGetMappedPointer()`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsSubResourceGetMappedArray`

## CUresult cuD3D9ResourceSetMapFlags (IDirect3DResource9 \*pResource, unsigned int Flags)

Set usage flags for mapping a Direct3D resource.

### Parameters

#### pResource

- Registered resource to set flags for

#### Flags

- Parameters for resource mapping

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED

### Description

**Deprecated** This function is deprecated as of Cuda 3.0.

Set `Flags` for mapping the Direct3D resource `pResource`.

Changes to `Flags` will take effect the next time `pResource` is mapped. The `Flags` argument may be any of the following:

- ▶ `CU_D3D9_MAPRESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA kernels. This is the default value.
- ▶ `CU_D3D9_MAPRESOURCE_FLAGS_READONLY`: Specifies that CUDA kernels which access this resource will not write to this resource.
- ▶ `CU_D3D9_MAPRESOURCE_FLAGS_WRITEDISCARD`: Specifies that CUDA kernels which access this resource will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

If `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is presently mapped for access by CUDA, then `CUDA_ERROR_ALREADY_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:



`cuGraphicsResourceSetMapFlags`

## `CUresult cuD3D9UnmapResources (unsigned int count, IDirect3DResource9 **ppResource)`

Unmaps Direct3D resources.

### Parameters

#### **count**

- Number of resources to unmap for CUDA

#### **ppResource**

- Resources to unmap for CUDA

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_HANDLE`, `CUDA_ERROR_NOT_MAPPED`,  
`CUDA_ERROR_UNKNOWN`

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Unmaps the `count` Direct3D resources in `ppResource`.

This function provides the synchronization guarantee that any CUDA kernels issued before `cuD3D9UnmapResources()` will complete before any Direct3D calls issued after `cuD3D9UnmapResources()` begin.

If any of `ppResource` have not been registered for use with CUDA or if `ppResource` contains any duplicate entries, then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `ppResource` are not presently mapped for access by CUDA, then `CUDA_ERROR_NOT_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuGraphicsUnmapResources`

## CUresult cuD3D9UnregisterResource (IDirect3DResource9 \*pResource)

Unregister a Direct3D resource.

### Parameters

#### pResource

- Resource to unregister

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED, CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT, CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_UNKNOWN

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Unregisters the Direct3D resource pResource so it is not accessible by CUDA unless registered again.

If pResource is not registered, then CUDA\_ERROR\_INVALID\_HANDLE is returned.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsUnregisterResource](#)

## 2.25. Direct3D 10 Interoperability

This section describes the Direct3D 10 interoperability functions of the low-level CUDA driver application programming interface. Note that mapping of Direct3D 10 resources is performed with the graphics API agnostic, resource mapping interface described in [Graphics Interoperability](#).

### Direct3D 10 Interoperability [DEPRECATED]

#### enum CUd3d10DeviceList

CUDA devices corresponding to a D3D10 device

**Values****CU\_D3D10\_DEVICE\_LIST\_ALL = 0x01**

The CUDA devices for all GPUs used by a D3D10 device

**CU\_D3D10\_DEVICE\_LIST\_CURRENT\_FRAME = 0x02**

The CUDA devices for the GPUs used by a D3D10 device in its currently rendering frame

**CU\_D3D10\_DEVICE\_LIST\_NEXT\_FRAME = 0x03**

The CUDA devices for the GPUs to be used by a D3D10 device in the next frame

**CUresult cuD3D10GetDevice (CUdevice \*pCudaDevice, IDXGIAdapter \*pAdapter)**

Gets the CUDA device corresponding to a display adapter.

**Parameters****pCudaDevice**

- Returned CUDA device corresponding to pAdapter

**pAdapter**

- Adapter to query for CUDA device

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_NOT\_FOUND, CUDA\_ERROR\_UNKNOWN

**Description**

Returns in \*pCudaDevice the CUDA-compatible device corresponding to the adapter pAdapter obtained from IDXGIFactory::EnumAdapters.

If no device on pAdapter is CUDA-compatible then the call will fail.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuD3D10GetDevices](#)

**CUresult cuD3D10GetDevices (unsigned int \*pCudaDeviceCount, CUdevice \*pCudaDevices, unsigned**

## int cudaDeviceCount, ID3D10Device \*pD3D10Device, CUd3d10DeviceList deviceList)

Gets the CUDA devices corresponding to a Direct3D 10 device.

### Parameters

#### pCudaDeviceCount

- Returned number of CUDA devices corresponding to pD3D10Device

#### pCudaDevices

- Returned CUDA devices corresponding to pD3D10Device

#### cudaDeviceCount

- The size of the output device array pCudaDevices

#### pD3D10Device

- Direct3D 10 device to query for CUDA devices

#### deviceList

- The set of devices to return. This set may be `CU_D3D10_DEVICE_LIST_ALL` for all devices, `CU_D3D10_DEVICE_LIST_CURRENT_FRAME` for the devices used to render the current frame (in SLI), or `CU_D3D10_DEVICE_LIST_NEXT_FRAME` for the devices used to render the next frame (in SLI).

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_NO_DEVICE`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_NOT_FOUND`,  
`CUDA_ERROR_UNKNOWN`

### Description

Returns in \*pCudaDeviceCount the number of CUDA-compatible device corresponding to the Direct3D 10 device pD3D10Device. Also returns in \*pCudaDevices at most cudaDeviceCount of the CUDA-compatible devices corresponding to the Direct3D 10 device pD3D10Device.

If any of the GPUs being used to render pDevice are not CUDA capable then the call will return `CUDA_ERROR_NO_DEVICE`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuD3D10GetDevice](#)

## CUresult cuGraphicsD3D10RegisterResource (CUgraphicsResource \*pCudaResource, ID3D10Resource \*pD3DResource, unsigned int Flags)

Register a Direct3D 10 resource for access by CUDA.

### Parameters

#### pCudaResource

- Returned graphics resource handle

#### pD3DResource

- Direct3D resource to register

#### Flags

- Parameters for resource registration

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

### Description

Registers the Direct3D 10 resource `pD3DResource` for access by CUDA and returns a CUDA handle to `pD3DResource` in `pCudaResource`. The handle returned in `pCudaResource` may be used to map and unmap this resource until it is unregistered. On success this call will increase the internal reference count on `pD3DResource`. This reference count will be decremented when this resource is unregistered through `cuGraphicsUnregisterResource()`.

This call is potentially high-overhead and should not be called every frame in interactive applications.

The type of `pD3DResource` must be one of the following.

- ▶ ID3D10Buffer: may be accessed through a device pointer.
- ▶ ID3D10Texture1D: individual subresources of the texture may be accessed via arrays
- ▶ ID3D10Texture2D: individual subresources of the texture may be accessed via arrays
- ▶ ID3D10Texture3D: individual subresources of the texture may be accessed via arrays

The `Flags` argument may be used to specify additional parameters at register time. The valid values for this parameter are

- ▶ CU\_GRAPHICS\_REGISTER\_FLAGS\_NONE: Specifies no hints about how this resource will be used.

- ▶ `CU_GRAPHICS_REGISTER_FLAGS_SURFACE_LDST`: Specifies that CUDA will bind this resource to a surface reference.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_TEXTURE_GATHER`: Specifies that CUDA will perform texture gather operations on this resource.

Not all Direct3D resources of the above types may be used for interoperability with CUDA. The following are some limitations.

- ▶ The primary rendertarget may not be registered with CUDA.
- ▶ Resources allocated as shared may not be registered with CUDA.
- ▶ Textures which are not of a format which is 1, 2, or 4 channels of 8, 16, or 32-bit integer or floating-point data cannot be shared.
- ▶ Surfaces of depth or stencil formats cannot be shared.

If `pD3DResource` is of incorrect type or is already registered then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pD3DResource` cannot be registered then `CUDA_ERROR_UNKNOWN` is returned. If `Flags` is not one of the above specified value then `CUDA_ERROR_INVALID_VALUE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuGraphicsUnregisterResource](#), [cuGraphicsMapResources](#),  
[cuGraphicsSubResourceGetMappedArray](#), [cuGraphicsResourceGetMappedPointer](#)

## 2.25.1. Direct3D 10 Interoperability [DEPRECATED]

### Direct3D 10 Interoperability

This section describes deprecated Direct3D 10 interoperability functionality.

#### enum `CUD3D10map_flags`

Flags to map or unmap a resource

#### Values

`CU_D3D10_MAPRESOURCE_FLAGS_NONE` = 0x00

`CU_D3D10_MAPRESOURCE_FLAGS_READONLY` = 0x01

`CU_D3D10_MAPRESOURCE_FLAGS_WRITEDISCARD` = 0x02

#### enum `CUD3D10register_flags`

Flags to register a resource

**Values**

`CU_D3D10_REGISTER_FLAGS_NONE = 0x00`

`CU_D3D10_REGISTER_FLAGS_ARRAY = 0x01`

**CUresult cuD3D10CtxCreate (CUcontext \*pCtx, CUdevice \*pCudaDevice, unsigned int Flags, ID3D10Device \*pD3DDevice)**

Create a CUDA context for interoperability with Direct3D 10.

**Parameters****pCtx**

- Returned newly created CUDA context

**pCudaDevice**

- Returned pointer to the device on which the context was created

**Flags**

- Context creation flags (see `cuCtxCreate()` for details)

**pD3DDevice**

- Direct3D device to create interoperability context with

**Returns**

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_VALUE`,  
`CUDA_ERROR_OUT_OF_MEMORY`, `CUDA_ERROR_UNKNOWN`

**Description**

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D10 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuD3D10GetDevice`, `cuGraphicsD3D10RegisterResource`

## CUresult cuD3D10CtxCreateOnDevice (CUcontext \*pCtx, unsigned int flags, ID3D10Device \*pD3DDevice, CUdevice cudaDevice)

Create a CUDA context for interoperability with Direct3D 10.

### Parameters

#### pCtx

- Returned newly created CUDA context

#### flags

- Context creation flags (see [cuCtxCreate\(\)](#) for details)

#### pD3DDevice

- Direct3D device to create interoperability context with

#### cudaDevice

- The CUDA device on which to create the context. This device must be among the devices returned when querying `CU_D3D10_DEVICES_ALL` from [cuD3D10GetDevices](#).

### Returns

[CUDA\\_SUCCESS](#), [CUDA\\_ERROR\\_DEINITIALIZED](#),  
[CUDA\\_ERROR\\_NOT\\_INITIALIZED](#), [CUDA\\_ERROR\\_INVALID\\_VALUE](#),  
[CUDA\\_ERROR\\_OUT\\_OF\\_MEMORY](#), [CUDA\\_ERROR\\_UNKNOWN](#)

### Description

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D10 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuD3D10GetDevices](#), [cuGraphicsD3D10RegisterResource](#)



**CUresult cuD3D10GetDirect3DDevice (ID3D10Device \*\*ppD3DDevice)**

Get the Direct3D 10 device against which the current CUDA context was created.

**Parameters****ppD3DDevice**

- Returned Direct3D device corresponding to CUDA context

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT

**Description**

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D10 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuD3D10GetDevice](#)

**CUresult cuD3D10MapResources (unsigned int count, ID3D10Resource \*\*ppResources)**

Map Direct3D resources for access by CUDA.

**Parameters****count**

- Number of resources to map for CUDA

**ppResources**

- Resources to map for CUDA

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED,  
CUDA\_ERROR\_UNKNOWN

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Maps the `count` Direct3D resources in `ppResources` for access by CUDA.

The resources in `ppResources` may be accessed in CUDA kernels until they are unmapped. Direct3D should not access any resources while they are mapped by CUDA. If an application does so, the results are undefined.

This function provides the synchronization guarantee that any Direct3D calls issued before `cuD3D10MapResources()` will complete before any CUDA kernels issued after `cuD3D10MapResources()` begin.

If any of `ppResources` have not been registered for use with CUDA or if `ppResources` contains any duplicate entries, then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `ppResources` are presently mapped for access by CUDA, then `CUDA_ERROR_ALREADY_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuGraphicsMapResources`

## CUresult cuD3D10RegisterResource (ID3D10Resource \*pResource, unsigned int Flags)

Register a Direct3D resource for access by CUDA.

## Parameters

### `pResource`

- Resource to register

### Flags

- Parameters for resource registration

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_OUT_OF_MEMORY`, `CUDA_ERROR_UNKNOWN`

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Registers the Direct3D resource `pResource` for access by CUDA.

If this call is successful, then the application will be able to map and unmap this resource until it is unregistered through `cuD3D10UnregisterResource()`. Also on success, this call will increase the internal reference count on `pResource`. This reference count will be decremented when this resource is unregistered through `cuD3D10UnregisterResource()`.

This call is potentially high-overhead and should not be called every frame in interactive applications.

The type of `pResource` must be one of the following.

- ▶ `ID3D10Buffer`: Cannot be used with `Flags` set to `CU_D3D10_REGISTER_FLAGS_ARRAY`.
- ▶ `ID3D10Texture1D`: No restrictions.
- ▶ `ID3D10Texture2D`: No restrictions.
- ▶ `ID3D10Texture3D`: No restrictions.

The `Flags` argument specifies the mechanism through which CUDA will access the Direct3D resource. The following values are allowed.

- ▶ `CU_D3D10_REGISTER_FLAGS_NONE`: Specifies that CUDA will access this resource through a `CUdeviceptr`. The pointer, size, and (for textures), pitch for each subresource of this allocation may be queried through `cuD3D10ResourceGetMappedPointer()`, `cuD3D10ResourceGetMappedSize()`, and `cuD3D10ResourceGetMappedPitch()` respectively. This option is valid for all resource types.
- ▶ `CU_D3D10_REGISTER_FLAGS_ARRAY`: Specifies that CUDA will access this resource through a `CUarray` queried on a sub-resource basis through `cuD3D10ResourceGetMappedArray()`. This option is only valid for resources of type `ID3D10Texture1D`, `ID3D10Texture2D`, and `ID3D10Texture3D`.

Not all Direct3D resources of the above types may be used for interoperability with CUDA. The following are some limitations.

- ▶ The primary rendertarget may not be registered with CUDA.
- ▶ Resources allocated as shared may not be registered with CUDA.
- ▶ Textures which are not of a format which is 1, 2, or 4 channels of 8, 16, or 32-bit integer or floating-point data cannot be shared.
- ▶ Surfaces of depth or stencil formats cannot be shared.

If Direct3D interoperability is not initialized on this context then `CUDA_ERROR_INVALID_CONTEXT` is returned. If `pResource` is of incorrect type or is already registered, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` cannot be registered, then `CUDA_ERROR_UNKNOWN` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuGraphicsD3D10RegisterResource](#)

### CUresult cuD3D10ResourceGetMappedArray (CUarray \*pArray, ID3D10Resource \*pResource, unsigned int SubResource)

Get an array through which to access a subresource of a Direct3D resource which has been mapped for access by CUDA.

#### Parameters

##### pArray

- Returned array corresponding to subresource

##### pResource

- Mapped resource to access

##### SubResource

- Subresource of pResource to access

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_NOT\_MAPPED

#### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in \*pArray an array through which the subresource of the mapped Direct3D resource pResource, which corresponds to SubResource may be accessed. The value set in pArray may change every time that pResource is mapped.

If pResource is not registered, then [CUDA\\_ERROR\\_INVALID\\_HANDLE](#) is returned. If pResource was not registered with usage flags [CU\\_D3D10\\_REGISTER\\_FLAGS\\_ARRAY](#), then [CUDA\\_ERROR\\_INVALID\\_HANDLE](#) is returned. If pResource is not mapped, then [CUDA\\_ERROR\\_NOT\\_MAPPED](#) is returned.

For usage requirements of the SubResource parameter, see [cuD3D10ResourceGetMappedPointer\(\)](#).



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuGraphicsSubResourceGetMappedArray](#)

## CUresult cuD3D10ResourceGetMappedPitch (size\_t \*pPitch, size\_t \*pPitchSlice, ID3D10Resource \*pResource, unsigned int SubResource)

Get the pitch of a subresource of a Direct3D resource which has been mapped for access by CUDA.

### Parameters

#### pPitch

- Returned pitch of subresource

#### pPitchSlice

- Returned Z-slice pitch of subresource

#### pResource

- Mapped resource to access

#### SubResource

- Subresource of pResource to access

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_NOT\_MAPPED

### Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in \*pPitch and \*pPitchSlice the pitch and Z-slice pitch of the subresource of the mapped Direct3D resource pResource, which corresponds to SubResource. The values set in pPitch and pPitchSlice may change every time that pResource is mapped.

The pitch and Z-slice pitch values may be used to compute the location of a sample on a surface as follows.

For a 2D surface, the byte offset of the sample at position **x**, **y** from the base pointer of the surface is:

$$y * \text{pitch} + (\text{bytes per pixel}) * x$$

For a 3D surface, the byte offset of the sample at position  $x$ ,  $y$ ,  $z$  from the base pointer of the surface is:

$$z * \text{slicePitch} + y * \text{pitch} + (\text{bytes per pixel}) * x$$

Both parameters `pPitch` and `pPitchSlice` are optional and may be set to `NULL`.

If `pResource` is not of type `IDirect3DBaseTexture10` or one of its sub-types or if `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` was not registered with usage flags `CU_D3D10_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped for access by CUDA, then `CUDA_ERROR_NOT_MAPPED` is returned.

For usage requirements of the `SubResource` parameter, see `cuD3D10ResourceGetMappedPointer()`.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuGraphicsSubResourceGetMappedArray`

### `CUresult cuD3D10ResourceGetMappedPointer (CUdeviceptr *pDevPtr, ID3D10Resource *pResource, unsigned int SubResource)`

Get a pointer through which to access a subresource of a Direct3D resource which has been mapped for access by CUDA.

#### Parameters

##### `pDevPtr`

- Returned pointer corresponding to subresource

##### `pResource`

- Mapped resource to access

##### `SubResource`

- Subresource of `pResource` to access

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_NOT_MAPPED`

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pDevPtr` the base pointer of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `SubResource`. The value set in `pDevPtr` may change every time that `pResource` is mapped.

If `pResource` is not registered, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` was not registered with usage flags `CU_D3D10_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped, then `CUDA_ERROR_NOT_MAPPED` is returned.

If `pResource` is of type `ID3D10Buffer`, then `SubResource` must be 0. If `pResource` is of any other type, then the value of `SubResource` must come from the subresource calculation in `D3D10CalcSubResource()`.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

[cuGraphicsResourceGetMappedPointer](#)

## `CUresult cuD3D10ResourceGetMappedSize (size_t *pSize, ID3D10Resource *pResource, unsigned int SubResource)`

Get the size of a subresource of a Direct3D resource which has been mapped for access by CUDA.

## Parameters

### `pSize`

- Returned size of subresource

### `pResource`

- Mapped resource to access

### `SubResource`

- Subresource of `pResource` to access

## Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_INVALID_CONTEXT`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_NOT_MAPPED`

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pSize` the size of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `SubResource`. The value set in `pSize` may change every time that `pResource` is mapped.

If `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` was not registered with usage flags `CU_D3D10_REGISTER_FLAGS_NONE`, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is not mapped for access by CUDA, then `CUDA_ERROR_NOT_MAPPED` is returned.

For usage requirements of the `SubResource` parameter, see `cuD3D10ResourceGetMappedPointer()`.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

`cuGraphicsResourceGetMappedPointer`

**CUresult cuD3D10ResourceGetSurfaceDimensions** (`size_t *pWidth`, `size_t *pHeight`, `size_t *pDepth`, `ID3D10Resource *pResource`, `unsigned int SubResource`)

Get the dimensions of a registered surface.

## Parameters

### **pWidth**

- Returned width of surface

### **pHeight**

- Returned height of surface

### **pDepth**

- Returned depth of surface

### **pResource**

- Registered resource to access

### **SubResource**

- Subresource of `pResource` to access



**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE

**Description**

**Deprecated** This function is deprecated as of CUDA 3.0.

Returns in `*pWidth`, `*pHeight`, and `*pDepth` the dimensions of the subresource of the mapped Direct3D resource `pResource`, which corresponds to `SubResource`.

Because anti-aliased surfaces may have multiple samples per pixel, it is possible that the dimensions of a resource will be an integer factor larger than the dimensions reported by the Direct3D runtime.

The parameters `pWidth`, `pHeight`, and `pDepth` are optional. For 2D surfaces, the value returned in `*pDepth` will be 0.

If `pResource` is not of type `IDirect3DBaseTexture10` or `IDirect3DSurface10` or if `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned.

For usage requirements of the `SubResource` parameter, see `cuD3D10ResourceGetMappedPointer()`.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsSubResourceGetMappedArray`

## CUresult cuD3D10ResourceSetMapFlags (ID3D10Resource \*pResource, unsigned int Flags)

Set usage flags for mapping a Direct3D resource.

**Parameters****pResource**

- Registered resource to set flags for

**Flags**

- Parameters for resource mapping

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_ALREADY\_MAPPED

**Description**

**Deprecated** This function is deprecated as of CUDA 3.0.

Set flags for mapping the Direct3D resource `pResource`.

Changes to flags will take effect the next time `pResource` is mapped. The `Flags` argument may be any of the following.

- ▶ `CU_D3D10_MAPRESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA kernels. This is the default value.
- ▶ `CU_D3D10_MAPRESOURCE_FLAGS_READONLY`: Specifies that CUDA kernels which access this resource will not write to this resource.
- ▶ `CU_D3D10_MAPRESOURCE_FLAGS_WRITEDISCARD`: Specifies that CUDA kernels which access this resource will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

If `pResource` has not been registered for use with CUDA, then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pResource` is presently mapped for access by CUDA then `CUDA_ERROR_ALREADY_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuGraphicsResourceSetMapFlags](#)

## CUresult cuD3D10UnmapResources (unsigned int count, ID3D10Resource \*\*ppResources)

Unmap Direct3D resources.

**Parameters****count**

- Number of resources to unmap for CUDA

**ppResources**

- Resources to unmap for CUDA

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
 CUDA\_ERROR\_NOT\_MAPPED, CUDA\_ERROR\_UNKNOWN

**Description**

**Deprecated** This function is deprecated as of CUDA 3.0.

Unmaps the `count` Direct3D resources in `ppResources`.

This function provides the synchronization guarantee that any CUDA kernels issued before `cuD3D10UnmapResources()` will complete before any Direct3D calls issued after `cuD3D10UnmapResources()` begin.

If any of `ppResources` have not been registered for use with CUDA or if `ppResources` contains any duplicate entries, then `CUDA_ERROR_INVALID_HANDLE` is returned. If any of `ppResources` are not presently mapped for access by CUDA, then `CUDA_ERROR_NOT_MAPPED` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

`cuGraphicsUnmapResources`

**CUresult cuD3D10UnregisterResource (ID3D10Resource \*pResource)**

Unregister a Direct3D resource.

**Parameters****pResource**

- Resources to unregister

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_UNKNOWN

## Description

**Deprecated** This function is deprecated as of CUDA 3.0.

Unregisters the Direct3D resource `pResource` so it is not accessible by CUDA unless registered again.

If `pResource` is not registered, then `CUDA_ERROR_INVALID_HANDLE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

## See also:

[cuGraphicsUnregisterResource](#)

## 2.26. Direct3D 11 Interoperability

This section describes the Direct3D 11 interoperability functions of the low-level CUDA driver application programming interface. Note that mapping of Direct3D 11 resources is performed with the graphics API agnostic, resource mapping interface described in [Graphics Interoperability](#).

### Direct3D 11 Interoperability [DEPRECATED]

#### enum CUd3d11DeviceList

CUDA devices corresponding to a D3D11 device

#### Values

**CU\_D3D11\_DEVICE\_LIST\_ALL = 0x01**

The CUDA devices for all GPUs used by a D3D11 device

**CU\_D3D11\_DEVICE\_LIST\_CURRENT\_FRAME = 0x02**

The CUDA devices for the GPUs used by a D3D11 device in its currently rendering frame

**CU\_D3D11\_DEVICE\_LIST\_NEXT\_FRAME = 0x03**

The CUDA devices for the GPUs to be used by a D3D11 device in the next frame

## CUresult cuD3D11GetDevice (CUdevice \*pCudaDevice, IDXGIAAdapter \*pAdapter)

Gets the CUDA device corresponding to a display adapter.

### Parameters

#### pCudaDevice

- Returned CUDA device corresponding to pAdapter

#### pAdapter

- Adapter to query for CUDA device

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_NO\_DEVICE,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_NOT\_FOUND,  
CUDA\_ERROR\_UNKNOWN

### Description

Returns in \*pCudaDevice the CUDA-compatible device corresponding to the adapter pAdapter obtained from IDXGIFactory::EnumAdapters.

If no device on pAdapter is CUDA-compatible the call will return CUDA\_ERROR\_NO\_DEVICE.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuD3D11GetDevices](#)

## CUresult cuD3D11GetDevices (unsigned int \*pCudaDeviceCount, CUdevice \*pCudaDevices, unsigned

## int cudaDeviceCount, ID3D11Device \*pD3D11Device, CUd3d11DeviceList deviceList)

Gets the CUDA devices corresponding to a Direct3D 11 device.

### Parameters

#### pCudaDeviceCount

- Returned number of CUDA devices corresponding to pD3D11Device

#### pCudaDevices

- Returned CUDA devices corresponding to pD3D11Device

#### cudaDeviceCount

- The size of the output device array pCudaDevices

#### pD3D11Device

- Direct3D 11 device to query for CUDA devices

#### deviceList

- The set of devices to return. This set may be `CU_D3D11_DEVICE_LIST_ALL` for all devices, `CU_D3D11_DEVICE_LIST_CURRENT_FRAME` for the devices used to render the current frame (in SLI), or `CU_D3D11_DEVICE_LIST_NEXT_FRAME` for the devices used to render the next frame (in SLI).

### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_DEINITIALIZED`,  
`CUDA_ERROR_NOT_INITIALIZED`, `CUDA_ERROR_NO_DEVICE`,  
`CUDA_ERROR_INVALID_VALUE`, `CUDA_ERROR_NOT_FOUND`,  
`CUDA_ERROR_UNKNOWN`

### Description

Returns in \*pCudaDeviceCount the number of CUDA-compatible device corresponding to the Direct3D 11 device pD3D11Device. Also returns in \*pCudaDevices at most cudaDeviceCount of the CUDA-compatible devices corresponding to the Direct3D 11 device pD3D11Device.

If any of the GPUs being used to render pDevice are not CUDA capable then the call will return `CUDA_ERROR_NO_DEVICE`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuD3D11GetDevice](#)

## CUresult cuGraphicsD3D11RegisterResource (CUgraphicsResource \*pCudaResource, ID3D11Resource \*pD3DResource, unsigned int Flags)

Register a Direct3D 11 resource for access by CUDA.

### Parameters

#### pCudaResource

- Returned graphics resource handle

#### pD3DResource

- Direct3D resource to register

#### Flags

- Parameters for resource registration

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_INVALID\_HANDLE,  
CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

### Description

Registers the Direct3D 11 resource `pD3DResource` for access by CUDA and returns a CUDA handle to `pD3DResource` in `pCudaResource`. The handle returned in `pCudaResource` may be used to map and unmap this resource until it is unregistered. On success this call will increase the internal reference count on `pD3DResource`. This reference count will be decremented when this resource is unregistered through `cuGraphicsUnregisterResource()`.

This call is potentially high-overhead and should not be called every frame in interactive applications.

The type of `pD3DResource` must be one of the following.

- ▶ ID3D11Buffer: may be accessed through a device pointer.
- ▶ ID3D11Texture1D: individual subresources of the texture may be accessed via arrays
- ▶ ID3D11Texture2D: individual subresources of the texture may be accessed via arrays
- ▶ ID3D11Texture3D: individual subresources of the texture may be accessed via arrays

The `Flags` argument may be used to specify additional parameters at register time. The valid values for this parameter are

- ▶ CU\_GRAPHICS\_REGISTER\_FLAGS\_NONE: Specifies no hints about how this resource will be used.

- ▶ `CU_GRAPHICS_REGISTER_FLAGS_SURFACE_LDST`: Specifies that CUDA will bind this resource to a surface reference.
- ▶ `CU_GRAPHICS_REGISTER_FLAGS_TEXTURE_GATHER`: Specifies that CUDA will perform texture gather operations on this resource.

Not all Direct3D resources of the above types may be used for interoperability with CUDA. The following are some limitations.

- ▶ The primary rendertarget may not be registered with CUDA.
- ▶ Resources allocated as shared may not be registered with CUDA.
- ▶ Textures which are not of a format which is 1, 2, or 4 channels of 8, 16, or 32-bit integer or floating-point data cannot be shared.
- ▶ Surfaces of depth or stencil formats cannot be shared.

If `pD3DResource` is of incorrect type or is already registered then `CUDA_ERROR_INVALID_HANDLE` is returned. If `pD3DResource` cannot be registered then `CUDA_ERROR_UNKNOWN` is returned. If `Flags` is not one of the above specified value then `CUDA_ERROR_INVALID_VALUE` is returned.



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

[cuGraphicsUnregisterResource](#), [cuGraphicsMapResources](#),  
[cuGraphicsSubResourceGetMappedArray](#), [cuGraphicsResourceGetMappedPointer](#)

## 2.26.1. Direct3D 11 Interoperability [DEPRECATED]

### Direct3D 11 Interoperability

This section describes deprecated Direct3D 11 interoperability functionality.

**CUresult cuD3D11CtxCreate (CUcontext \*pCtx, CUdevice \*pCudaDevice, unsigned int Flags, ID3D11Device \*pD3DDevice)**

Create a CUDA context for interoperability with Direct3D 11.

#### Parameters

##### **pCtx**

- Returned newly created CUDA context

##### **pCudaDevice**

- Returned pointer to the device on which the context was created

##### **Flags**

- Context creation flags (see [cuCtxCreate\(\)](#) for details)



**pD3DDevice**

- Direct3D device to create interoperability context with

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

**Description**

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D11 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuD3D11GetDevice](#), [cuGraphicsD3D11RegisterResource](#)

## CUresult cuD3D11CtxCreateOnDevice (CUcontext \*pCtx, unsigned int flags, ID3D11Device \*pD3DDevice, CUdevice cudaDevice)

Create a CUDA context for interoperability with Direct3D 11.

**Parameters****pCtx**

- Returned newly created CUDA context

**flags**

- Context creation flags (see [cuCtxCreate\(\)](#) for details)

**pD3DDevice**

- Direct3D device to create interoperability context with

**cudaDevice**

- The CUDA device on which to create the context. This device must be among the devices returned when querying CU\_D3D11\_DEVICES\_ALL from [cuD3D11GetDevices](#).

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_VALUE,  
 CUDA\_ERROR\_OUT\_OF\_MEMORY, CUDA\_ERROR\_UNKNOWN

**Description**

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D11 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuD3D11GetDevices](#), [cuGraphicsD3D11RegisterResource](#)

**CUresult cuD3D11GetDirect3DDevice (ID3D11Device \*\*ppD3DDevice)**

Get the Direct3D 11 device against which the current CUDA context was created.

**Parameters****ppD3DDevice**

- Returned Direct3D device corresponding to CUDA context

**Returns**

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT

**Description**

**Deprecated** This function is deprecated as of CUDA 5.0.

This function is deprecated and should no longer be used. It is no longer necessary to associate a CUDA context with a D3D11 device in order to achieve maximum interoperability performance.



Note that this function may also return error codes from previous, asynchronous launches.

**See also:**

[cuD3D11GetDevice](#)

## 2.27. VDPAU Interoperability

This section describes the VDPAU interoperability functions of the low-level CUDA driver application programming interface.

### CUresult cuGraphicsVDPAURegisterOutputSurface (CUgraphicsResource \*pCudaResource, VdpOutputSurface vdpSurface, unsigned int flags)

Registers a VDPAU VdpOutputSurface object.

#### Parameters

##### **pCudaResource**

- Pointer to the returned object handle

##### **vdpSurface**

- The VdpOutputSurface to be registered

##### **flags**

- Map flags

#### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_INVALID\_HANDLE, CUDA\_ERROR\_ALREADY\_MAPPED, CUDA\_ERROR\_INVALID\_CONTEXT,

#### Description

Registers the VdpOutputSurface specified by `vdpSurface` for access by CUDA. A handle to the registered object is returned as `pCudaResource`. The surface's intended usage is specified using `flags`, as follows:

- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA. This is the default value.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_READ_ONLY`: Specifies that CUDA will not write to this resource.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_WRITE_DISCARD`: Specifies that CUDA will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

The `VdpOutputSurface` is presented as an array of subresources that may be accessed using pointers returned by `cuGraphicsSubResourceGetMappedArray`. The exact number of valid `arrayIndex` values depends on the VDP AU surface format. The mapping is shown in the table below. `mipLevel` must be 0.

VdpRGBAFormat	arrayIndex	Size	Format	Content
VDP_RGBA_FORMAT_B8G8R8A8	0	w x h	ARGB8	Entire surface
VDP_RGBA_FORMAT_R10G10B10A2	0	w x h	A2BGR10	Entire surface



Note that this function may also return error codes from previous, asynchronous launches.

#### See also:

`cuCtxCreate`, `cuVDPAUCtxCreate`, `cuGraphicsVDPAURegisterVideoSurface`, `cuGraphicsUnregisterResource`, `cuGraphicsResourceSetMapFlags`, `cuGraphicsMapResources`, `cuGraphicsUnmapResources`, `cuGraphicsSubResourceGetMappedArray`, `cuVDPAUGetDevice`

## CUresult cuGraphicsVDPAURegisterVideoSurface (CUgraphicsResource \*pCudaResource, VdpVideoSurface vdpSurface, unsigned int flags)

Registers a VDP AU `VdpVideoSurface` object.

#### Parameters

##### **pCudaResource**

- Pointer to the returned object handle

##### **vdpSurface**

- The `VdpVideoSurface` to be registered

##### **flags**

- Map flags

#### Returns

`CUDA_SUCCESS`, `CUDA_ERROR_INVALID_HANDLE`,  
`CUDA_ERROR_ALREADY_MAPPED`, `CUDA_ERROR_INVALID_CONTEXT`,

## Description

Registers the `VdpVideoSurface` specified by `vdpSurface` for access by CUDA. A handle to the registered object is returned as `pCudaResource`. The surface's intended usage is specified using `flags`, as follows:

- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_NONE`: Specifies no hints about how this resource will be used. It is therefore assumed that this resource will be read from and written to by CUDA. This is the default value.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_READ_ONLY`: Specifies that CUDA will not write to this resource.
- ▶ `CU_GRAPHICS_MAP_RESOURCE_FLAGS_WRITE_DISCARD`: Specifies that CUDA will not read from this resource and will write over the entire contents of the resource, so none of the data previously stored in the resource will be preserved.

The `VdpVideoSurface` is presented as an array of subresources that may be accessed using pointers returned by `cuGraphicsSubResourceGetMappedArray`. The exact number of valid `arrayIndex` values depends on the VDP AU surface format. The mapping is shown in the table below. `mipLevel` must be 0.

VdpChromaType	arrayIndex	Size	Format	Content
VDP_CHROMA_TYPE_420	0	w x h/2	R8	Top-field luma
	1	w x h/2	R8	Bottom-field luma
	2	w/2 x h/4	R8G8	Top-field chroma
	3	w/2 x h/4	R8G8	Bottom-field chroma
VDP_CHROMA_TYPE_422	0	w x h/2	R8	Top-field luma
	1	w x h/2	R8	Bottom-field luma
	2	w/2 x h/2	R8G8	Top-field chroma
	3	w/2 x h/2	R8G8	Bottom-field chroma



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

[cuCtxCreate](#), [cuVDPAUCtxCreate](#), [cuGraphicsVDPAURegisterOutputSurface](#), [cuGraphicsUnregisterResource](#), [cuGraphicsResourceSetMapFlags](#), [cuGraphicsMapResources](#), [cuGraphicsUnmapResources](#), [cuGraphicsSubResourceGetMappedArray](#), [cuVDPAUGetDevice](#)

## CUresult cuVDPAUCtxCreate (CUcontext \*pCtx, unsigned int flags, CUdevice device, VdpDevice vdpDevice, VdpGetProcAddress \*vdpGetProcAddress)

Create a CUDA context for interoperability with VDPAU.

### Parameters

#### pCtx

- Returned CUDA context

#### flags

- Options for CUDA context creation

#### device

- Device on which to create the context

#### vdpDevice

- The VdpDevice to interop with

#### vdpGetProcAddress

- VDPAU's VdpGetProcAddress function pointer

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
 CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
 CUDA\_ERROR\_INVALID\_VALUE, CUDA\_ERROR\_OUT\_OF\_MEMORY

### Description

Creates a new CUDA context, initializes VDPAU interoperability, and associates the CUDA context with the calling thread. It must be called before performing any other VDPAU interoperability operations. It may fail if the needed VDPAU driver facilities are not available. For usage of the `flags` parameter, see `cuCtxCreate()`.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

`cuCtxCreate`, `cuGraphicsVDPAURegisterVideoSurface`,  
`cuGraphicsVDPAURegisterOutputSurface`, `cuGraphicsUnregisterResource`,  
`cuGraphicsResourceSetMapFlags`, `cuGraphicsMapResources`,  
`cuGraphicsUnmapResources`, `cuGraphicsSubResourceGetMappedArray`,  
`cuVDPAUGetDevice`

## CUresult cuVDPAUGetDevice (CUdevice \*pDevice, VdpDevice vdpDevice, VdpGetProcAddress \*vdpGetProcAddress)

Gets the CUDA device associated with a VDPAU device.

### Parameters

#### pDevice

- Device associated with vdpDevice

#### vdpDevice

- A VdpDevice handle

#### vdpGetProcAddress

- VDPAU's VdpGetProcAddress function pointer

### Returns

CUDA\_SUCCESS, CUDA\_ERROR\_DEINITIALIZED,  
CUDA\_ERROR\_NOT\_INITIALIZED, CUDA\_ERROR\_INVALID\_CONTEXT,  
CUDA\_ERROR\_INVALID\_VALUE

### Description

Returns in \*pDevice the CUDA device associated with a vdpDevice, if applicable.



Note that this function may also return error codes from previous, asynchronous launches.

### See also:

cuCtxCreate, cuVDPAUCtxCreate, cuGraphicsVDPAURegisterVideoSurface,  
cuGraphicsVDPAURegisterOutputSurface, cuGraphicsUnregisterResource,  
cuGraphicsResourceSetMapFlags, cuGraphicsMapResources,  
cuGraphicsUnmapResources, cuGraphicsSubResourceGetMappedArray

# Chapter 3.

## DATA STRUCTURES

Here are the data structures with brief descriptions:

`CUDA_ARRAY3D_DESCRIPTOR`  
`CUDA_ARRAY_DESCRIPTOR`  
`CUDA_MEMCPY2D`  
`CUDA_MEMCPY3D`  
`CUDA_MEMCPY3D_PEER`  
`CUDA_POINTER_ATTRIBUTE_P2P_TOKENS`  
`CUDA_RESOURCE_DESC`  
`CUDA_RESOURCE_VIEW_DESC`  
`CUDA_TEXTURE_DESC`  
`CUdevprop`  
`CUipcEventHandle`  
`CUipcMemHandle`

### 3.1. `CUDA_ARRAY3D_DESCRIPTOR` Struct Reference

3D array descriptor

`size_t CUDA_ARRAY3D_DESCRIPTOR::Depth`

#### **Description**

Depth of 3D array



`unsigned int CUDA_ARRAY3D_DESCRIPTOR::Flags`

**Description**

Flags

`CUarray_format CUDA_ARRAY3D_DESCRIPTOR::Format`

**Description**

Array format

`size_t CUDA_ARRAY3D_DESCRIPTOR::Height`

**Description**

Height of 3D array

`unsigned int CUDA_ARRAY3D_DESCRIPTOR::NumChannels`

**Description**

Channels per array element

`size_t CUDA_ARRAY3D_DESCRIPTOR::Width`

**Description**

Width of 3D array

## 3.2. CUDA\_ARRAY\_DESCRIPTOR Struct Reference

Array descriptor

`CUarray_format CUDA_ARRAY_DESCRIPTOR::Format`

**Description**

Array format

`size_t CUDA_ARRAY_DESCRIPTOR::Height`

**Description**

Height of array

`unsigned int CUDA_ARRAY_DESCRIPTOR::NumChannels`

**Description**

Channels per array element

`size_t CUDA_ARRAY_DESCRIPTOR::Width`

**Description**

Width of array

### 3.3. CUDA\_MEMCPY2D Struct Reference

2D memory copy parameters

`CUarray CUDA_MEMCPY2D::dstArray`

**Description**

Destination array reference

`CUdeviceptr CUDA_MEMCPY2D::dstDevice`

**Description**

Destination device pointer

`void *CUDA_MEMCPY2D::dstHost`

**Description**

Destination host pointer

## CUmemorytype CUDA\_MEMCPY2D::dstMemoryType

### Description

Destination memory type (host, device, array)

## size\_t CUDA\_MEMCPY2D::dstPitch

### Description

Destination pitch (ignored when dst is array)

## size\_t CUDA\_MEMCPY2D::dstXInBytes

### Description

Destination X in bytes

## size\_t CUDA\_MEMCPY2D::dstY

### Description

Destination Y

## size\_t CUDA\_MEMCPY2D::Height

### Description

Height of 2D memory copy

## CUarray CUDA\_MEMCPY2D::srcArray

### Description

Source array reference

## CUdeviceptr CUDA\_MEMCPY2D::srcDevice

### Description

Source device pointer

`const void *CUDA_MEMCPY2D::srcHost`

**Description**

Source host pointer

`CUmemorytype CUDA_MEMCPY2D::srcMemoryType`

**Description**

Source memory type (host, device, array)

`size_t CUDA_MEMCPY2D::srcPitch`

**Description**

Source pitch (ignored when src is array)

`size_t CUDA_MEMCPY2D::srcXInBytes`

**Description**

Source X in bytes

`size_t CUDA_MEMCPY2D::srcY`

**Description**

Source Y

`size_t CUDA_MEMCPY2D::WidthInBytes`

**Description**

Width of 2D memory copy in bytes

### 3.4. CUDA\_MEMCPY3D Struct Reference

3D memory copy parameters

## `size_t CUDA_MEMCPY3D::Depth`

### **Description**

Depth of 3D memory copy

## `CUarray CUDA_MEMCPY3D::dstArray`

### **Description**

Destination array reference

## `CUdeviceptr CUDA_MEMCPY3D::dstDevice`

### **Description**

Destination device pointer

## `size_t CUDA_MEMCPY3D::dstHeight`

### **Description**

Destination height (ignored when dst is array; may be 0 if Depth==1)

## `void *CUDA_MEMCPY3D::dstHost`

### **Description**

Destination host pointer

## `size_t CUDA_MEMCPY3D::dstLOD`

### **Description**

Destination LOD

## `CUmemorytype CUDA_MEMCPY3D::dstMemoryType`

### **Description**

Destination memory type (host, device, array)

## `size_t CUDA_MEMCPY3D::dstPitch`

### **Description**

Destination pitch (ignored when dst is array)

## `size_t CUDA_MEMCPY3D::dstXInBytes`

### **Description**

Destination X in bytes

## `size_t CUDA_MEMCPY3D::dstY`

### **Description**

Destination Y

## `size_t CUDA_MEMCPY3D::dstZ`

### **Description**

Destination Z

## `size_t CUDA_MEMCPY3D::Height`

### **Description**

Height of 3D memory copy

## `void *CUDA_MEMCPY3D::reserved0`

### **Description**

Must be NULL

## `void *CUDA_MEMCPY3D::reserved1`

### **Description**

Must be NULL

## CUarray CUDA\_MEMCPY3D::srcArray

### Description

Source array reference

## CUdeviceptr CUDA\_MEMCPY3D::srcDevice

### Description

Source device pointer

## size\_t CUDA\_MEMCPY3D::srcHeight

### Description

Source height (ignored when src is array; may be 0 if Depth==1)

## const void \*CUDA\_MEMCPY3D::srcHost

### Description

Source host pointer

## size\_t CUDA\_MEMCPY3D::srcLOD

### Description

Source LOD

## CUmemorytype CUDA\_MEMCPY3D::srcMemoryType

### Description

Source memory type (host, device, array)

## size\_t CUDA\_MEMCPY3D::srcPitch

### Description

Source pitch (ignored when src is array)

## size\_t CUDA\_MEMCPY3D::srcXInBytes

### Description

Source X in bytes

## size\_t CUDA\_MEMCPY3D::srcY

### Description

Source Y

## size\_t CUDA\_MEMCPY3D::srcZ

### Description

Source Z

## size\_t CUDA\_MEMCPY3D::WidthInBytes

### Description

Width of 3D memory copy in bytes

## 3.5. CUDA\_MEMCPY3D\_PEER Struct Reference

3D memory cross-context copy parameters

## size\_t CUDA\_MEMCPY3D\_PEER::Depth

### Description

Depth of 3D memory copy

## CUarray CUDA\_MEMCPY3D\_PEER::dstArray

### Description

Destination array reference



## CUcontext CUDA\_MEMCPY3D\_PEER::dstContext

### Description

Destination context (ignored with dstMemoryType is CU\_MEMORYTYPE\_ARRAY)

## CUdeviceptr CUDA\_MEMCPY3D\_PEER::dstDevice

### Description

Destination device pointer

## size\_t CUDA\_MEMCPY3D\_PEER::dstHeight

### Description

Destination height (ignored when dst is array; may be 0 if Depth==1)

## void \*CUDA\_MEMCPY3D\_PEER::dstHost

### Description

Destination host pointer

## size\_t CUDA\_MEMCPY3D\_PEER::dstLOD

### Description

Destination LOD

## CUmemorytype CUDA\_MEMCPY3D\_PEER::dstMemoryType

### Description

Destination memory type (host, device, array)

## size\_t CUDA\_MEMCPY3D\_PEER::dstPitch

### Description

Destination pitch (ignored when dst is array)

## `size_t CUDA_MEMCPY3D_PEER::dstXInBytes`

### Description

Destination X in bytes

## `size_t CUDA_MEMCPY3D_PEER::dstY`

### Description

Destination Y

## `size_t CUDA_MEMCPY3D_PEER::dstZ`

### Description

Destination Z

## `size_t CUDA_MEMCPY3D_PEER::Height`

### Description

Height of 3D memory copy

## `CUarray CUDA_MEMCPY3D_PEER::srcArray`

### Description

Source array reference

## `CUcontext CUDA_MEMCPY3D_PEER::srcContext`

### Description

Source context (ignored with `srcMemoryType` is `CU_MEMORYTYPE_ARRAY`)

## `CUdeviceptr CUDA_MEMCPY3D_PEER::srcDevice`

### Description

Source device pointer

`size_t CUDA_MEMCPY3D_PEER::srcHeight`

**Description**

Source height (ignored when src is array; may be 0 if Depth==1)

`const void *CUDA_MEMCPY3D_PEER::srcHost`

**Description**

Source host pointer

`size_t CUDA_MEMCPY3D_PEER::srcLOD`

**Description**

Source LOD

`CUmemorytype CUDA_MEMCPY3D_PEER::srcMemoryType`

**Description**

Source memory type (host, device, array)

`size_t CUDA_MEMCPY3D_PEER::srcPitch`

**Description**

Source pitch (ignored when src is array)

`size_t CUDA_MEMCPY3D_PEER::srcXInBytes`

**Description**

Source X in bytes

`size_t CUDA_MEMCPY3D_PEER::srcY`

**Description**

Source Y

`size_t CUDA_MEMCPY3D_PEER::srcZ`

**Description**

Source Z

`size_t CUDA_MEMCPY3D_PEER::WidthInBytes`

**Description**

Width of 3D memory copy in bytes

## 3.6. CUDA\_POINTER\_ATTRIBUTE\_P2P\_TOKENS Struct Reference

GPU Direct v3 tokens

## 3.7. CUDA\_RESOURCE\_DESC Struct Reference

CUDA Resource descriptor

`CUdeviceptr CUDA_RESOURCE_DESC::devPtr`

**Description**

Device pointer

`unsigned int CUDA_RESOURCE_DESC::flags`

**Description**

Flags (must be zero)

`CUarray_format CUDA_RESOURCE_DESC::format`

**Description**

Array format

## `CUarray CUDA_RESOURCE_DESC::hArray`

### **Description**

CUDA array

## `size_t CUDA_RESOURCE_DESC::height`

### **Description**

Height of the array in elements

## `CUmipmappedArray CUDA_RESOURCE_DESC::hMipmappedArray`

### **Description**

CUDA mipmapped array

## `unsigned int CUDA_RESOURCE_DESC::numChannels`

### **Description**

Channels per array element

## `size_t CUDA_RESOURCE_DESC::pitchInBytes`

### **Description**

Pitch between two rows in bytes

## `CUresourcetype CUDA_RESOURCE_DESC::resType`

### **Description**

Resource type

## `size_t CUDA_RESOURCE_DESC::sizeInBytes`

### **Description**

Size in bytes

`size_t CUDA_RESOURCE_DESC::width`

**Description**

Width of the array in elements

## 3.8. CUDA\_RESOURCE\_VIEW\_DESC Struct Reference

Resource view descriptor

`size_t CUDA_RESOURCE_VIEW_DESC::depth`

**Description**

Depth of the resource view

`unsigned int CUDA_RESOURCE_VIEW_DESC::firstLayer`

**Description**

First layer index

`unsigned int  
CUDA_RESOURCE_VIEW_DESC::firstMipmapLevel`

**Description**

First defined mipmap level

`CUresourceViewFormat  
CUDA_RESOURCE_VIEW_DESC::format`

**Description**

Resource view format

`size_t CUDA_RESOURCE_VIEW_DESC::height`

**Description**

Height of the resource view

`unsigned int CUDA_RESOURCE_VIEW_DESC::lastLayer`

**Description**

Last layer index

`unsigned int  
CUDA_RESOURCE_VIEW_DESC::lastMipmapLevel`

**Description**

Last defined mipmap level

`size_t CUDA_RESOURCE_VIEW_DESC::width`

**Description**

Width of the resource view

### 3.9. CUDA\_TEXTURE\_DESC Struct Reference

Texture descriptor

`CUaddress_mode CUDA_TEXTURE_DESC::addressMode`

**Description**

Address modes

`CUfilter_mode CUDA_TEXTURE_DESC::filterMode`

**Description**

Filter mode

`unsigned int CUDA_TEXTURE_DESC::flags`

**Description**

Flags

`unsigned int CUDA_TEXTURE_DESC::maxAnisotropy`

**Description**

Maximum anisotropy ratio

`float CUDA_TEXTURE_DESC::maxMipmapLevelClamp`

**Description**

Mipmap maximum level clamp

`float CUDA_TEXTURE_DESC::minMipmapLevelClamp`

**Description**

Mipmap minimum level clamp

`CUfilter_mode`

`CUDA_TEXTURE_DESC::mipmapFilterMode`

**Description**

Mipmap filter mode

`float CUDA_TEXTURE_DESC::mipmapLevelBias`

**Description**

Mipmap level bias

## 3.10. CUdevprop Struct Reference

Legacy device properties

`int CUdevprop::clockRate`

**Description**

Clock frequency in kilohertz



## int CUdevprop::maxGridSize

### Description

Maximum size of each dimension of a grid

## int CUdevprop::maxThreadsDim

### Description

Maximum size of each dimension of a block

## int CUdevprop::maxThreadsPerBlock

### Description

Maximum number of threads per block

## int CUdevprop::memPitch

### Description

Maximum pitch in bytes allowed by memory copies

## int CUdevprop::regsPerBlock

### Description

32-bit registers available per block

## int CUdevprop::sharedMemPerBlock

### Description

Shared memory available per block in bytes

## int CUdevprop::SIMDWidth

### Description

Warp size in threads

## int CUdevprop::textureAlign

### Description

Alignment requirement for textures

## int CUdevprop::totalConstantMemory

### Description

Constant memory available on device in bytes

## 3.11. CUipcEventHandle Struct Reference

CUDA IPC event handle

## 3.12. CUipcMemHandle Struct Reference

CUDA IPC mem handle

# Chapter 4.

## DATA FIELDS

Here is a list of all documented struct and union fields with links to the struct/union documentation for each field:

### A

#### **addressMode**

[CUDA\\_TEXTURE\\_DESC](#)

### C

#### **clockRate**

[CUdevprop](#)

### D

#### **Depth**

[CUDA\\_MEMCPY3D](#)

[CUDA\\_MEMCPY3D\\_PEER](#)

#### **depth**

[CUDA\\_RESOURCE\\_VIEW\\_DESC](#)

#### **Depth**

[CUDA\\_ARRAY3D\\_DESCRIPTOR](#)

#### **devPtr**

[CUDA\\_RESOURCE\\_DESC](#)

#### **dstArray**

[CUDA\\_MEMCPY3D\\_PEER](#)

[CUDA\\_MEMCPY2D](#)

[CUDA\\_MEMCPY3D](#)

#### **dstContext**

[CUDA\\_MEMCPY3D\\_PEER](#)

#### **dstDevice**

[CUDA\\_MEMCPY2D](#)

[CUDA\\_MEMCPY3D](#)

CUDA\_MEMCPY3D\_PEER

**dstHeight**

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

**dstHost**

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY2D

**dstLOD**

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

**dstMemoryType**

CUDA\_MEMCPY2D

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

**dstPitch**

CUDA\_MEMCPY2D

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

**dstXInBytes**

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY2D

**dstY**

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY3D

CUDA\_MEMCPY2D

**dstZ**

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY3D

**F**

**filterMode**

CUDA\_TEXTURE\_DESC

**firstLayer**

CUDA\_RESOURCE\_VIEW\_DESC

**firstMipmapLevel**

CUDA\_RESOURCE\_VIEW\_DESC

**Flags**

CUDA\_ARRAY3D\_DESCRIPTOR

**flags**

CUDA\_RESOURCE\_DESC

CUDA\_TEXTURE\_DESC

**Format**

CUDA\_ARRAY3D\_DESCRIPTOR

**format**

CUDA\_RESOURCE\_VIEW\_DESC

CUDA\_RESOURCE\_DESC

**Format**

CUDA\_ARRAY\_DESCRIPTOR

**H****hArray**

CUDA\_RESOURCE\_DESC

**height**

CUDA\_RESOURCE\_DESC

**Height**

CUDA\_MEMCPY2D

CUDA\_ARRAY\_DESCRIPTOR

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY3D

CUDA\_ARRAY3D\_DESCRIPTOR

**height**

CUDA\_RESOURCE\_VIEW\_DESC

**hMipmappedArray**

CUDA\_RESOURCE\_DESC

**L****lastLayer**

CUDA\_RESOURCE\_VIEW\_DESC

**lastMipmapLevel**

CUDA\_RESOURCE\_VIEW\_DESC

**M****maxAnisotropy**

CUDA\_TEXTURE\_DESC

**maxGridSize**

CUdevprop

**maxMipmapLevelClamp**

CUDA\_TEXTURE\_DESC

**maxThreadsDim**

CUdevprop

**maxThreadsPerBlock**

CUdevprop

**memPitch**

CUdevprop

**minMipmapLevelClamp**

CUDA\_TEXTURE\_DESC

**mipmapFilterMode**

CUDA\_TEXTURE\_DESC

**mipmapLevelBias**

CUDA\_TEXTURE\_DESC

## N

**NumChannels**

CUDA\_ARRAY\_DESCRIPTOR

**numChannels**

CUDA\_RESOURCE\_DESC

**NumChannels**

CUDA\_ARRAY3D\_DESCRIPTOR

## P

**pitchInBytes**

CUDA\_RESOURCE\_DESC

## R

**regsPerBlock**

CUdevprop

**reserved0**

CUDA\_MEMCPY3D

**reserved1**

CUDA\_MEMCPY3D

**resType**

CUDA\_RESOURCE\_DESC

## S

**sharedMemPerBlock**

CUdevprop

**SIMDWidth**

CUdevprop

**sizeInBytes**

CUDA\_RESOURCE\_DESC

**srcArray**

CUDA\_MEMCPY2D

CUDA\_MEMCPY3D

CUDA\_MEMCPY3D\_PEER

**srcContext**

CUDA\_MEMCPY3D\_PEER

**srcDevice**

CUDA\_MEMCPY2D  
 CUDA\_MEMCPY3D  
 CUDA\_MEMCPY3D\_PEER

**srcHeight**

CUDA\_MEMCPY3D  
 CUDA\_MEMCPY3D\_PEER

**srcHost**

CUDA\_MEMCPY2D  
 CUDA\_MEMCPY3D  
 CUDA\_MEMCPY3D\_PEER

**srcLOD**

CUDA\_MEMCPY3D  
 CUDA\_MEMCPY3D\_PEER

**srcMemoryType**

CUDA\_MEMCPY2D  
 CUDA\_MEMCPY3D\_PEER  
 CUDA\_MEMCPY3D

**srcPitch**

CUDA\_MEMCPY3D\_PEER  
 CUDA\_MEMCPY3D  
 CUDA\_MEMCPY2D

**srcXInBytes**

CUDA\_MEMCPY3D  
 CUDA\_MEMCPY2D  
 CUDA\_MEMCPY3D\_PEER

**srcY**

CUDA\_MEMCPY3D\_PEER  
 CUDA\_MEMCPY2D  
 CUDA\_MEMCPY3D

**srcZ**

CUDA\_MEMCPY3D\_PEER  
 CUDA\_MEMCPY3D

**T****textureAlign**

CUdevprop

**totalConstantMemory**

CUdevprop

**W****Width**

CUDA\_ARRAY\_DESCRIPTOR

CUDA\_ARRAY3D\_DESCRIPTOR

**width**

CUDA\_RESOURCE\_VIEW\_DESC

CUDA\_RESOURCE\_DESC

**WidthInBytes**

CUDA\_MEMCPY3D\_PEER

CUDA\_MEMCPY2D

CUDA\_MEMCPY3D



# Chapter 5.

## DEPRECATED LIST

### **Global CU\_CTX\_BLOCKING\_SYNC**

This flag was deprecated as of CUDA 4.0 and was replaced with CU\_CTX\_SCHED\_BLOCKING\_SYNC.

### **Global CUDA\_ERROR\_PROFILER\_NOT\_INITIALIZED**

This error return is deprecated as of CUDA 5.0. It is no longer an error to attempt to enable/disable the profiling via cuProfilerStart or cuProfilerStop without initialization.

### **Global CUDA\_ERROR\_PROFILER\_ALREADY\_STARTED**

This error return is deprecated as of CUDA 5.0. It is no longer an error to call cuProfilerStart() when profiling is already enabled.

### **Global CUDA\_ERROR\_PROFILER\_ALREADY\_STOPPED**

This error return is deprecated as of CUDA 5.0. It is no longer an error to call cuProfilerStop() when profiling is already disabled.

### **Global CUDA\_ERROR\_CONTEXT\_ALREADY\_CURRENT**

This error return is deprecated as of CUDA 3.2. It is no longer an error to attempt to push the active context via cuCtxPushCurrent().

### **Global cuDeviceComputeCapability**

**Global cuDeviceGetProperties**

**Global cuCtxAttach**

**Global cuCtxDetach**

**Global cuFuncSetBlockShape**

**Global cuFuncSetSharedSize**

**Global cuLaunch**

**Global cuLaunchGrid**

**Global cuLaunchGridAsync**

**Global cuParamSetf**

**Global cuParamSeti**

**Global cuParamSetSize**

**Global cuParamSetTexRef**

**Global cuParamSetv**

**Global cuTexRefCreate****Global cuTexRefDestroy****Global cuGLCtxCreate**

This function is deprecated as of Cuda 5.0.

**Global cuGLInit**

This function is deprecated as of Cuda 3.0.

**Global cuGLMapBufferObject**

This function is deprecated as of Cuda 3.0.

**Global cuGLMapBufferObjectAsync**

This function is deprecated as of Cuda 3.0.

**Global cuGLRegisterBufferObject**

This function is deprecated as of Cuda 3.0.

**Global cuGLSetBufferObjectMapFlags**

This function is deprecated as of Cuda 3.0.

**Global cuGLUnmapBufferObject**

This function is deprecated as of Cuda 3.0.

**Global cuGLUnmapBufferObjectAsync**

This function is deprecated as of Cuda 3.0.

**Global cuGLUnregisterBufferObject**

This function is deprecated as of Cuda 3.0.

**Global cuD3D9MapResources**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9RegisterResource**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceGetMappedArray**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceGetMappedPitch**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceGetMappedPointer**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceGetMappedSize**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceGetSurfaceDimensions**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9ResourceSetMapFlags**

This function is deprecated as of Cuda 3.0.

**Global cuD3D9UnmapResources**

This function is deprecated as of CUDA 3.0.

**Global cuD3D9UnregisterResource**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10CtxCreate**

This function is deprecated as of CUDA 5.0.

**Global cuD3D10CtxCreateOnDevice**

This function is deprecated as of CUDA 5.0.

**Global cuD3D10GetDirect3DDevice**

This function is deprecated as of CUDA 5.0.

**Global cuD3D10MapResources**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10RegisterResource**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceGetMappedArray**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceGetMappedPitch**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceGetMappedPointer**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceGetMappedSize**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceGetSurfaceDimensions**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10ResourceSetMapFlags**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10UnmapResources**

This function is deprecated as of CUDA 3.0.

**Global cuD3D10UnregisterResource**

This function is deprecated as of CUDA 3.0.

**Global cuD3D11CtxCreate**

This function is deprecated as of CUDA 5.0.

**Global cuD3D11CtxCreateOnDevice**

This function is deprecated as of CUDA 5.0.

**Global cuD3D11GetDirect3DDevice**

This function is deprecated as of CUDA 5.0.

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